INTERNATIONAL PACIFIC HALIBUT COMMISSION

ESTABLISHED BY A CONVENTION BETWEEN
CANADA AND THE UNITED STATES OF AMERICA

Scientific Report No. 65

Abundance and Fishing Mortality of Pacific Halibut, Cohort Analysis, 1935-1976

by
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and
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SEATTLE, WASHINGTON
1978

The International Pacific Halibut Commission has three publications: Annual Reports, Scientific Reports, and Technical Reports. Until 1969, only one series was published. The numbering of the original series has been continued with the Scientific Reports.

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ABSTRACT

Previous assessments of halibut stocks have been based primarily on changes in catch per unit effort (CPUE) in the setline fishery. In this report catch and age data are used to independently estimate fishing mortality and abundance of halibut in the northeast Pacific since 1935. Estimates of abundance are in terms of numbers of fish whereas CPUE has been expressed as weight. The results show that the size of year classes has declined since the 1930's, which, in turn, led to reduced recruitment to the setline fishery and a decline in the abundance of older halibut. The decline in the number of halibut was greater than the decline in CPUE in the setline fishery. An increase in growth during the period apparently contributed to this difference. Setlines accounted for most of the fishing mortality on fish over 8 years of age. Mortality by trawls was relatively low but represented a high proportion of the total fishing mortality on younger ages during the 1960's and early 1970's. Historical trends in fishing mortality generally coincided with trends in fishing effort although discrepancies were noted. Several sources of error may affect the estimates, and the magnitude and direction of these potential errors were examined.

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INTRODUCTION

The International Pacific Halibut Commission (IPHC) has relied heavily on changes in the catch per unit effort (CPUE) of the North American setline fishery to assess the abundance of halibut (*Hippoglossus stenolepis*) and regulate the fishery (Southward 1968; Bell 1970; Skud 1973). In the early years of management, regulations were based on an empirical approach which related levels of catch to CPUE. Theoretical models as well as tagging and age composition data also have been used to assess stocks, but these usually depended at least partly on CPUE. IPHC generally has not used estimates of absolute stock size, although Chapman, Myhre, and Southward (1962) did express a relationship between CPUE and stock size. The relationship, however, was based on weight and not on numbers of fish. The lack of information on numbers of fish in the stock has been a basic problem in assessing changes in CPUE because the growth rate of halibut has increased substantially since the 1930's (Southward 1967). CPUE (by weight) can increase as a result of growth whereas the number of fish may not change or may decrease. In fact, Skud (1975a) considered that "this phenomenon may explain much of the apparent improvement of stock condition from 1930 to 1940 and beyond".

The criteria required to use CPUE as an index of abundance have been discussed by many authors, e.g., Ricker (1940 and 1958), Widrig (1954), Gulland (1955), and Beverton and Holt (1957). Garrod (1976) categorized the errors that may affect estimates of CPUE: (1) changes in fishing power of the effort unit, (2) changes in biological availability of the resource, and (3) changes in the relative distribution of fish and fishing. Murphy (1960) discussed specific problems related to estimating CPUE from longline catches. As in other fisheries, errors are present to some degree in the estimation of CPUE for the halibut fishery. Skud (1972 and 1975a) showed that hook-spacing and soak-time affect fishing power in the halibut fishery and that there are seasonal differences in availability. IPHC has attempted to standardize CPUE estimates, but factors affecting CPUE often are difficult to assess or are not practical to measure, some factors are constantly changing and others may be unknown.

CPUE data have been and will continue to be useful, but there are advantages to having stock assessments that are independent of CPUE. IPHC has tagged large numbers of halibut, and the results have provided estimates of migration and mortality. Past tagging experiments, however, cannot be used to indicate annual changes in halibut stocks over broad areas because tagging usually was limited to specific grounds and was not repeated periodically. On the other hand, halibut landings from the North American setline fishery have been sampled annually since 1935 to determine the age of fish in the catch. IPHC (1960) used age composition data along with CPUE to estimate mortality, and Hardman (MS) used catch and age data to indicate year class size. Several methods have been developed to estimate abundance and mortality from catch and age data without utilizing CPUE, e.g., Fry (1949), Murphy (1964), Jones (1964), Gulland (1965), and Pope (1972). Pope's method, called cohort analysis, is more direct than some of the earlier methods and provides estimates of abundance and fishing mortality at each age in a year class. The purpose of this paper is to use cohort analysis with catch and age data from the halibut fishery in the northeast Pacific Ocean. Abundance and fishing mortality are estimated at each age from 1935 to 1976 and related to changes in CPUE and fishing effort. Trends in year class strength are examined, and sources of error are discussed.

COHORT ANALYSIS

Description

Pope's (1972) method of estimating stock size and fishing mortality from catch and age data is similar to an earlier method described by Gulland (1965). The difficulty with Gulland's method was that the estimates had to be calculated by iteration. Pope suggested an approximation that provided an analytical solution to estimates of stock size and fishing mortality and made it easier to determine the effects of errors. Pope called the method "cohort analysis" whereas the similar method of Gulland has been termed "virtual population analysis".

Pope's approximation is:

$$N_i = C_i\, e^{M/2} + N_{i+1}\, e^{M} \qquad (1)$$

where: N_i = abundance (numbers of fish) of a year class at age i,

C_i = catch (numbers of fish) of a year class at age i,

M = natural mortality.

The stock size at each age is estimated sequentially by assuming M and a starting value of N_{i+1}. Generally, the number of fish alive at the oldest age in a year class (N_t) is used to start computations, and is estimated by:

$$N_t = \frac{C_t(F_t + M)}{F_t\ (1\text{-}e^{(F_t + M)})} \qquad (2)$$

where: C_t = catch for the oldest age in a year class,

F_t = fishing mortality for the oldest age in a year class — called terminal fishing mortality by Pope.

The subsequent N_i's are then estimated by working back through the year class using equation (1) where N_t from equation (2) become N_{i+1} in equaltion (1). The F_i's are then estimated from the calculated N_i's:

$$F_i = \ln\left(\frac{N_i}{N_{i+1}}\right) - M$$

Although cohort analysis has the advantage of being independent of errors associated with CPUE, it is subject to errors in estimates of F_t and M as well as errors in catch and age data. Migration of fish in or out of the area that is defined for the stock also can affect the results. These potential errors have been investigated by Pope (1972), Agger, Böetius, and Lassen (1973), and Ulltang (1977) and are discussed later in this report. Doubleday (1976) suggested a least squares approach to analyzing catch and age data that allows an examination of the reliability of the parameter values. Although Doubleday's method may be useful, it is more complex than cohort analysis, and Doubleday warns that it may have some serious imperfections. We attempted an iterative procedure where estimates of mortality from cohort analysis were regressed against fishing effort to improve estimates of natural mortality, but were not able to get estimates of natural mortality to converge at reasonable values. D. F. Gray (Bedford Institute of Oceanography, Canada, MS) has presented a similar approach but also was unable to obtain satisfactory estimates of natural mortality. Consequently, we concluded that Pope's (1972) method is the best available for analyzing catch and age data from the halibut fishery.

Application

Cohort analysis was applied separately to catch and age data from Area 2 (South of Cape Spencer, Alaska) and Area 3 (west and north of Cape Spencer). IPHC regulatory areas and geographic regions are shown in Figure 1. The catch in Area 1 (Columbia Region and south) is minor and was included as part of Area 2. Data from Area 4 (Bering Sea) were considered inadequate for cohort analysis because of the short time span of data. The catch in the Bering Sea was not significant until 1958, and the North American fishery has been relatively minor except for a short period in the early 1960's. Another concern was that most of the catch occurs as an incidental or by-catch in trawl fisheries by Japan and the U.S.S.R. Hoag and French (1976) estimated the annual incidental catch and examined the age composition of the catch. The estimates, however, were not precise, and age data were not available annually. As discussed later, the incidental catch in the Northeast Pacific Ocean was included in the analysis for Areas 2 and 3. This apparent inconsistency was justified on the basis that the incidental catch in Areas 2 and 3 was small relative to the setline catch and, therefore, any errors introduced also would be small.

Cohort analysis requires an estimate of natural mortality, and we assumed a value of 0.2 for all ages and year classes. Natural mortality has been estimated by earlier investigators, but the estimates vary considerably and are not available by age or year class. Estimates from age composition data generally range from 0.1 to 0.3 (IPHC 1960). J. E. Paloheimo (University of Toronto, MS) used age and CPUE data from the halibut fishery and estimated natural mortality between 0.10 and 0.21. Estimates from tagging data are higher than from age data and average between 0.3 and 0.4 (IPHC 1960; Myhre 1967). Estimates from tagging, however, are affected by losses such as tag shedding and non-reporting and, therefore, probably are too high. Natural mortality apparently is higher for males than females (Myhre, MS) and undoubtedly varies with age and year class. For these reasons, the 0.2, chosen for the cohort analysis, is not considered precise, and values ranging from 0.1 to 0.3 are possible.

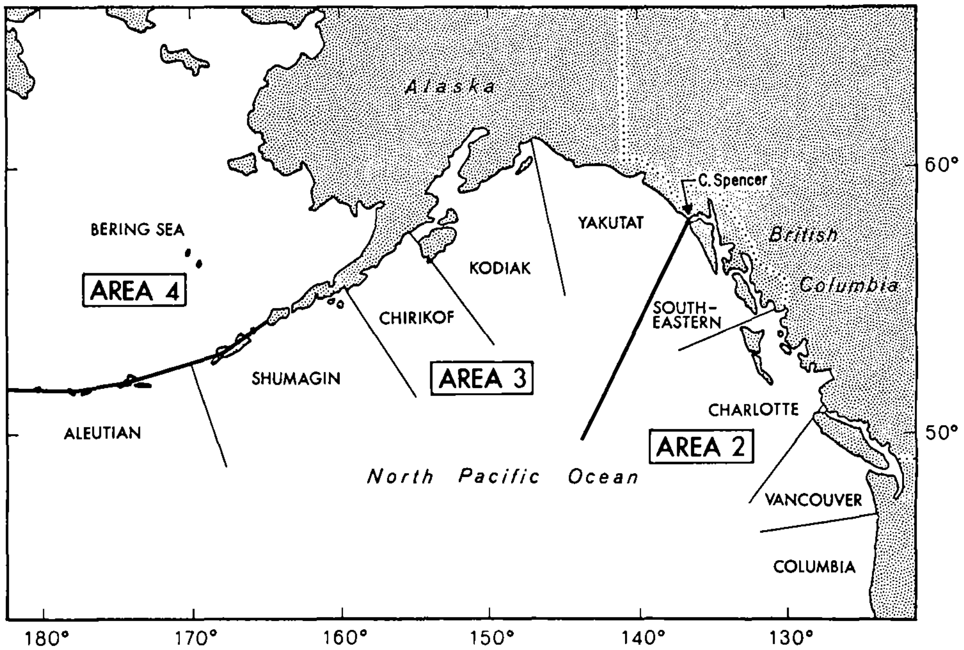

Figure 1. Regulatory Areas 2, 3, and 4 and regional divisions of the coast. Area 1 (Columbia Region and south) was combined with Area 2 in 1967.

An estimate of fishing mortality (F_t) at the oldest age of each year class also is required to begin computations. As with natural mortality, estimates of fishing mortality vary considerably, usually between 0.1 and 0.3. Previous estimates suggest that fishing mortality is higher in Area 2 than in Area 3 (IPHC 1960; Myhre 1967) although more recent estimates (unpublished) do not indicate this difference. Fishing mortality also varies with fish size and therefore with age (Myhre 1969). We assumed an F_t of 0.2 for all year classes where the oldest age was 8 years or older (above the age of entry in the setline fishery) and did not attempt to adjust F_t for changes in fishing effort or catchability. Cohort analysis was not performed when the oldest age in a year class was less than 8 years.

Halibut landings from the North American setline fishery have been sampled since 1935 to determine the age of fish in the catch. Southward (1976) described the sampling design and the inherent assumptions. Landings are sampled systematically, and Hardman (MS) has calculated the relative age composition (proportion at each age) and the average weight of fish for each region of the coast from 1935 to 1976. The total number of fish in the catch is calculated by dividing the catch (weight) for the region by the estimated average weight of fish in the catch. The number of fish caught at each age is then estimated by multiplying the total number of fish by the proportion of fish at each age. The catch by region was reported by Myhre et al. (1977). The catch at each age for regulatory areas was calculated by summing the catch at each age for the appropriate regions.

Age data were available in nearly all regions since 1960 and in the majority of regions since 1950. From 1935 to 1949, IPHC primarily sampled only two "indicator grounds": Goose Islands in the Charlotte (inside) Region, and Portlock-Albatross Banks in the Kodiak Region. Other regions were either not sampled or sampled sporadically during this period. To determine if samples from the indicator grounds could be used to represent other regions, we compared the relative age composition from the indicator grounds with that of other regions where samples were available; the average compositions for 1935 to 1949 are shown in Figure 2. Although data from the other regions were limited during the period, the results show that the age composition was similar among regions in Area 3, but varied in Area 2. The age composition in Southeastern Alaska (outside) more closely resembled the age composition in Area 3, whereas the halibut caught in Charlotte (inside) and Vancouver were younger. Samples were not available during the 1930's and 1940's from Charlotte (outside) and Southeastern Alaska (inside), but recent data suggests that the age composition in these regions also is closer to that in Area 3. On this basis, we applied the age composition from the Charlotte (inside) region to the catch from the Vancouver region when samples were not available, and applied the average age composition from Area 3 to the catch from all other regions where samples were not available. Samples also were lacking throughout Area 3 during 1944 to 1948 and, for these years, we averaged data from 1943 and 1949.

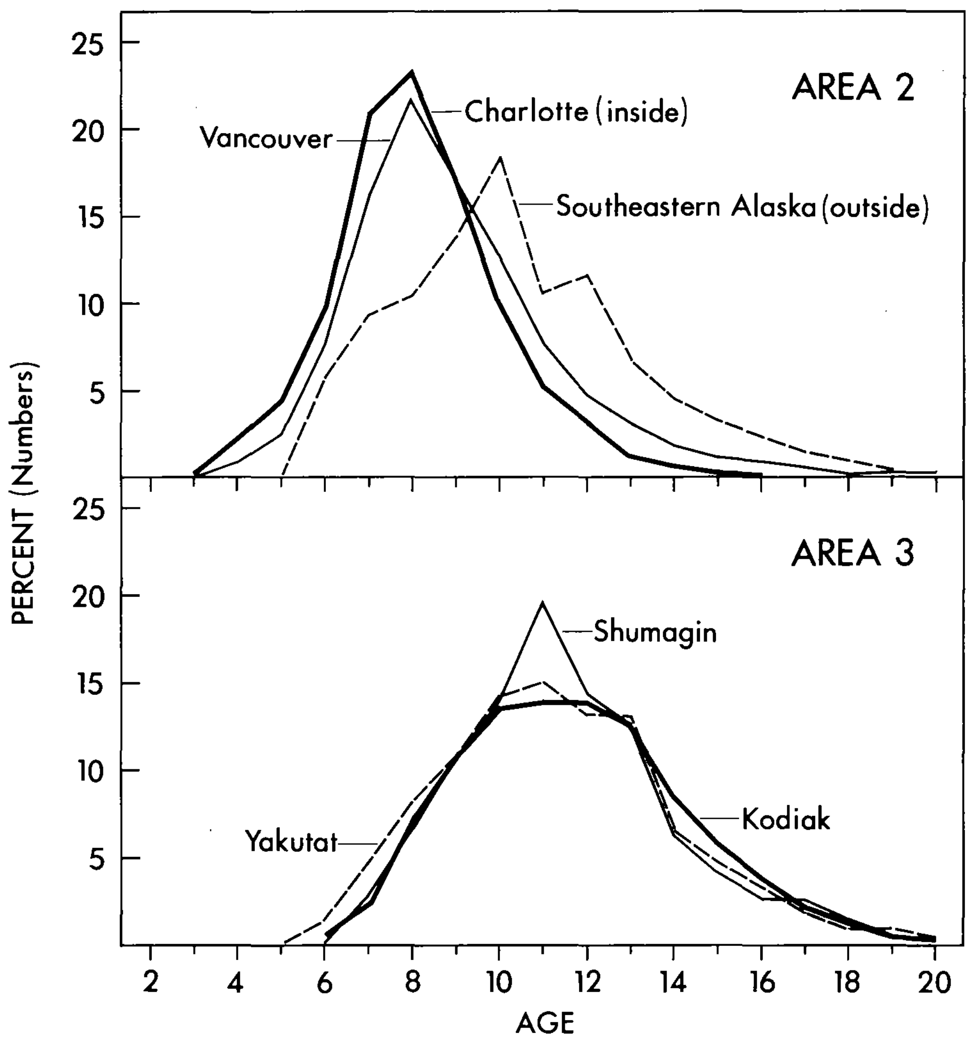

Figure 2. Average age composition by region and regulatory area, 1935-1949.

Nearly all of the halibut catch was by North American setline vessels before 1960. Since then, foreign and domestic fisheries for groundfish, shrimp, and crab have expanded. These fisheries primarily use trawls, and regulations prohibit the retention of trawl-caught halibut by domestic and Japanese fishermen. Halibut caught in trawls tend to be below the optimum harvesting size (Myhre 1969). However, halibut are caught incidentally, and those that are released still represent a loss because many die from injuries received during capture. The magnitude of the loss is not known precisely because the incidental catch is not reported directly. Hoag (1971) and Hoag and French (1976) estimated the incidental catch in the domestic and foreign trawl fisheries from data collected by observers who sampled the catch at sea. The results showed that the incidental catch accounted for about 15% of the total halibut catch (by weight) in the northeast Pacific during the early 1970's. An additional incidental catch occurs in the domestic shrimp and crab fisheries and in the foreign black cod fishery. There also is a relatively minor catch by the sport fishery (Skud 1975b).

Estimates of the incidental catch by the foreign and domestic trawl fisheries for groundfish were included in the analysis. Based on the estimated survival of released halibut (Hoag 1975), only 50% of the incidental catch by the domestic trawl fishery was used. No adjustment was made for the foreign catch as the mortality of released halibut is near 100% due to the large groundfish catch and the long sorting process. Data were insufficient to estimate the age composition of the incidental catch on an annual basis so we applied the average age composition from Hoag (1971) and Hoag and French (1976) to each year's catch. We did not include an estimate of the incidental catch by the domestic shrimp and crab fisheries, the foreign black cod fishery or the sport fishery. Data on the halibut catch in these fisheries are meager, but indicate that the catch is probably small relative to the catch in other fisheries.

The annual catch of halibut by the trawl and setline fisheries from 1935 to 1976 is shown by age and regulatory area in Appendix Table 1. Most of the halibut were 3 to 20 years old in the setline catch and 3 to 15 years old in the trawl catch; the data were truncated at these ages.

RESULTS

Estimates of abundance and fishing mortality are shown by age (3 to 20 years) and year (1935-1976) in Appendix Tables 2 and 3. Because estimates from recent year classes and years are less precise than other estimates, cohort analysis was not used on year classes after 1968, and estimates for all years after 1971 were excluded when examining historical trends.

Abundance

To examine trends in stock size and relate these to trends in the setline fishery, we grouped the estimated number of fish at each age into pre- and post-recruits. The pre-recruits provide an indication of future yield in the setline fishery whereas the post-recruits provide an estimate of the population available to the fishery. Generally, halibut first enter the setline fishery as 4- or 5-year-olds and recruitment is 50% completed at 7 to 10 years of age (Chapman, Myhre, and Southward 1962). Age of entry has varied with time and is related to factors such as growth, fishing mortality, and the legal minimum size limit. Halibut tend to enter the setline fishery at a younger age in parts of Area 2, i.e., the Charlotte and Vancouver regions. Precise information was not available on the age of entry each year, so we assumed "knife-edge" recruitment at 8 years of age for all years and examined trends in 3- to 7-year-olds (pre-recruits) and 8- to 20-year-olds (post-recruits). Small variations in the age of entry do not affect the overall trends.

The estimated abundance of pre- and post-recruits has declined sharply since the 1940's and 1950's (Table 1). As discussed later in the report, the migration of juvenile halibut from Area 3 to Area 2 may be substantial. If so, some of the pre-recruits that were estimated to be in Area 2 actually were in Area 3. Migration, however, should not affect the trends in pre-recruits or the total number for Areas 2 and 3 combined. In Area 2, the abundance of pre-recruits increased to about 40 million fish in the mid-1940's, but then declined to about 20 million in the early 1950's. Following a slight increase in the mid-1950's, abundance continued to decline and was less than 10 million fish in 1971. Similar trends occurred with about a 5 year lag in the abundance of post-recruits, which peaked at 13 million fish in the early 1950's and then declined to 5 million fish by 1971. Trends in Area 3 were similar to those described for Area 2 except that the increase noted for Area 2 during the 1930's and 1940's was not apparent in Area 3. Abundance of post-recruits in Area 3 was relatively stable from 1935 to 1949, but declined steadily thereafter with the exception of a slight increase during the 1950's and early 1960's.

The number of post-recruits was poorly correlated with changes in CPUE in the setline fishery (Table 1). The correlation coefficient (r) was 0.33 for Area 2 and 0.06 for Area 3. Because CPUE is expressed in terms of weight, it is affected by changes in growth as well as changes in abundance. Southward (1967) showed a pronounced increase in the growth of halibut since the 1930's that apparently accounts for a major part of the poor correlation between abundance and CPUE. In Area 2, the abundance of post-recruits increased 92% between 1935 and the peak in 1952 whereas CPUE peaked in 1954 and increased 127%. By 1971, abundance had declined by 62% but CPUE only declined 44%. The difference between CPUE and abundance was even greater in Area 3: abundance declined 26% between 1935 and 1960 while during the same time CPUE increased 61%. From 1960-1971, abundance declined by 52% but CPUE declined only 39%. Factors other than growth also affect CPUE and may account for part of the observed differences. For example, changes in availability may have caused the sharp peak in CPUE during the 1950's. Fishing techniques have changed and the CPUE in the early years may not be comparable with CPUE today.

The poor relationship between abundance in terms of numbers of fish and CPUE in weight does not imply that CPUE or biomass is an invalid measure of stock size. Biomass reflects changes in growth as well as abundance and, as such, may be the best single measure of stock size. We attempted to estimate the biomass of post-recruits by multiplying the abundance at each age by the average weight of fish at each age in the setline catch, but the estimates may be too high because setline gear is selective for larger fish (Myhre 1969). We concluded that further study is needed before estimates of biomass are published, but preliminary results suggest a biomass of about 200 millions pounds in Area 2 and 300 million pounds in Area 3 in the 1950's. By the early 1970's, the biomass was about 150 million pounds in each area. Trends in the biomass estimates generally coincided with trends in CPUE. We also calculated CPUE in terms of

Table 1. Abundance of pre- and post-recruits and CPUE in the setline fishery by regulatory area, 1935-1971.

	Area 2			Area 3		
	Abundance* (thousands of fish)		CPUE	Abundance* (thousands of fish)		CPUE
Year	Pre-recruits	Post-recruits	(lbs./skate)	Pre-recruits	Post-recruits	(lbs./skate)
1935	28,606	7,177	61.7	34,171	13,989	97.8
1936	28,290	6,894	54.7	32,870	13,368	96.3
1937	26,209	7,670	61.3	31,700	13,672	110.0
1938	27,214	7,920	69.9	31,516	14,046	114.8
1939	30,401	7,921	61.4	33,753	13,576	113.4
1940	33,946	7,827	62.5	34,687	13,698	117.1
1941	37,345	7,506	63.1	36,012	13,299	122.5
1942	40,377	7,134	65.7	35,933	12,837	133.0
1943	41,354	7,670	74.0	34,996	12,924	131.4
1944	41,813	8,905	87.9	32,934	13,588	150.6
1945	41,164	10,229	79.9	30,322	14,037	131.3
1946	39,713	11,566	83.8	28,139	14,445	125.2
1947	39,482	12,029	87.1	28,341	14,410	114.8
1948	34,839	12,502	89.4	25,875	14,246	113.6
1949	31,092	13,202	86.1	25,469	13,834	106.2
1950	26,482	13,525	87.8	23,493	12,868	104.1
1951	22,896	13,406	86.8	21,644	12,164	108.9
1952	19,917	13,638	92.5	19,853	12,384	128.8
1953	20,265	11,950	129.7	20,110	11,312	134.6
1954	23,171	10,887	139.8	23,093	11,147	127.1
1955	24,096	9,068	123.0	24,427	10,175	116.6
1956	24,535	7,979	133.0	25,112	9,477	126.7
1957	25,420	7,056	101.4	24,892	8,996	119.9
1958	25,317	6,749	102.1	26,988	8,841	139.8
1959	22,566	7,703	99.6	24,818	9,886	160.6
1960	21,760	7,754	107.3	24,861	9,963	157.7
1961	20,467	7,541	96.8	25,416	9,993	159.7
1962	18,465	7,399	84.7	24,000	9,755	138.5
1963	16,307	7,359	80.2	21,384	10,370	124.3
1964	17,436	6,805	77.8	22,919	9,693	120.0
1965	16,096	6,814	87.6	20,475	9,303	107.5
1966	15,531	6,476	83.3	17,248	8,858	113.0
1967	15,094	5,765	81.5	15,187	7,494	113.3
1968	14,002	5,176	86.6	13,182	6,334	113.0
1969	12,012	5,710	82.7	10,600	6,535	105.8
1970	10,170	5,260	76.9	9,339	5,701	104.5
1971	8,124	5,051	78.4	8,118	4,817	95.9

*Values may differ slightly from those in the Appendix due to rounding.

numbers of fish and compared this with the estimated number of post-recruits. CPUE in numbers was estimated from the annual catch of post-recruits (Appendix Table I) and the annual effort in the setline fishery (Myhre et al. 1977). The results show an improved relationship between estimates of abundance and CPUE: r was 0.80 in Area 2 and 0.71 in Area 3. This further supports the earlier conclusion that the increase in growth accounts for a major part of the difference in the trends in abundance (numbers) and CPUE (weight).

Results from cohort analysis indicate a long-term decline in year class size since the 1940's. The abundance of 3-year-olds was used to indicate year class size before entry into either the trawl or setline fisheries. Estimates for the 1932 to 1968 year classes are shown in Figure 3. After increasing during the 1930's, year class size peaked in the late 1930's at over 10 million fish in each regulatory area. Year classes declined sharply to about 5 million fish in the late 1940's. Several prominent year classes occurred during the 1950's and early 1960's, i.e. 1951, 1955, 1958, and 1961, but these year classes were generally smaller than those of the late 1930's and early 1940's. After 1961, year classes again declined sharply and were estimated to be less than 3 million fish in 1965-1968. Estimates of year classes in the 1960's, however, are less reliable than earlier ones. They have been sampled for fewer years and depend heavily on estimates of catch by the trawl fisheries. Data from IPHC surveys of juvenile halibut indicate that the decline in abundance continued until the early 1970's (Best 1977).

Estimates of the abundance of 3-year-olds show an overall decline of about 70% from the late 1930's to the late 1960's. The decline accounts for most of the reduction in abundance of post-recruits in later years and may explain the drop in CPUE and yield in the setline fishery. This should not be construed to mean that year class strength at 3 years of age is the only factor that determines the abundance of older fish and yield in the setline fishery. Obviously, natural mortality, growth, the incidental catch by other fisheries, and the catch by the setline fishery also have an effect. However, the results do indicate the importance of evaluating year class strength in the assessment of halibut stocks.

The cause of the reduced abundance of 3-year-olds is not known. The trawl fisheries were not intensive until the 1960's and their incidental catch consisted primarily of halibut over 3 years old (Hoag 1971; Hoag and French 1976). This indicates that trawling was not responsible for the decline at this age although it did contribute to the reduced abundance of 4- to 7-year-olds in the 1960's and 1970's (Hoag 1976). The production of young halibut apparently has declined. Trends in the abundance of 3-year-olds were similar in Areas 2 and 3 and the same year classes tended to be prominent in both areas, an indication that the factors affecting year class size are similar for Areas 2 and 3. Adverse environmental conditions or reduced spawning stocks could have contributed to the decline. The abundance of spawners, however, was relatively high until the mid-1960's, and we have no evidence of a long-term change in the environment. Until more is known about environmental factors and spawning stocks, the cause of the reduced abundance of 3-year-olds will remain in doubt.

Fishing Mortality

Estimates of fishing mortality were examined by age and gear type. Total fishing mortality at each age was divided into trawl (foreign and domestic) mortality and setline mortality based on the proportion of the catch taken by

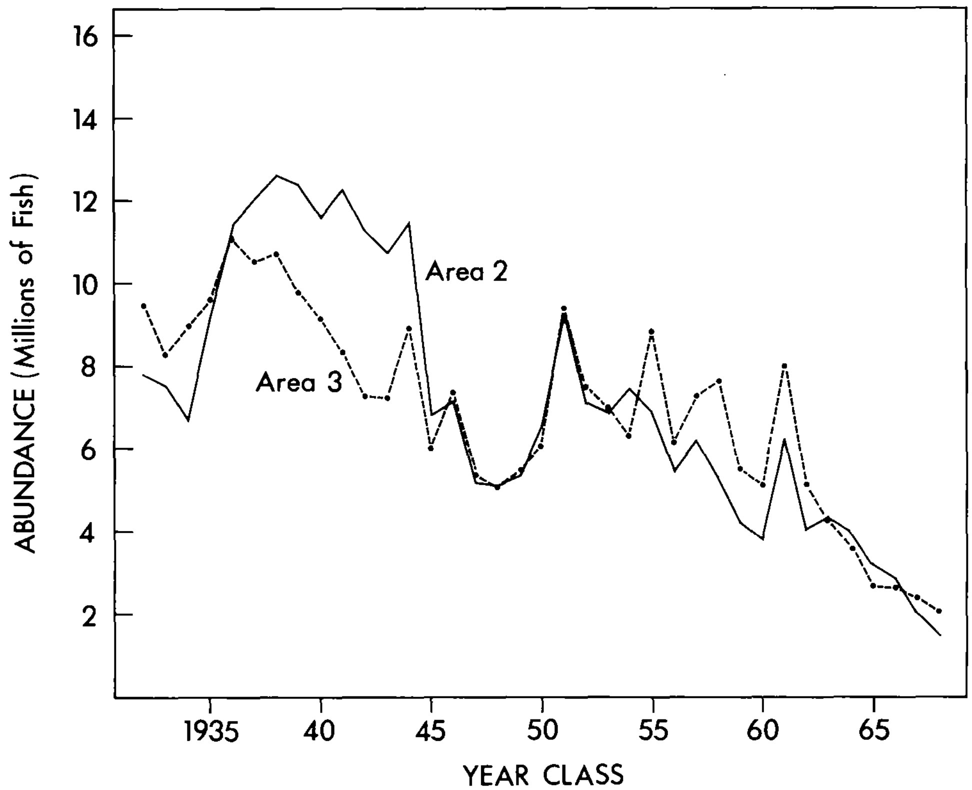

Figure 3. The abundance of 3-year-olds in Areas 2 and 3, 1932-1968 year classes.

each gear type. Values of mortality are shown for all ages and years in Appendix Table 3. We excluded estimates after 1971 and from fish over 15 years old when examining trends because cohort analysis requires an assumed value of fishing mortality at the oldest age of each year class to initiate computations and several years are required to reduce the effect of an incorrect initial value.

The results show that setlines accounted for most of the fishing mortality. Mortality by trawls was negligible before 1962 and even after 1962, was generally less than 0.05. A notable exception occurred in Area 3 where trawl mortality on 4-year-olds exceeded 0.1 from 1964 to 1970. Although trawl mortality was relatively low, it did represent a high proportion of the total fishing mortality on fish less than 8 years of age during the 1960's and early 1970's: about 30% in Area 2 and 80% in Area 3. For greater ages, trawl mortality usually represented less than 10% of the total fishing mortality.

Mortality by setlines generally increased with age although the relationship varied with area (Figure 4). In Area 2, the average setline mortality from 1935 to 1971 increased sharply from less than 0.01 at 4 years of age to 0.16 at age 10 and then continued to increase slowly to nearly 0.2 at age 15. Setline mortality in Area 3 was lower than in Area 2 for fish less than 12 years old, but increased more sharply and was higher for 13- to 15-year-olds. Selectivity of the gear apparently contributes to the increase in mortality with age but the reason for the difference between areas is not clear. Myhre (1969) used tagging data to estimate the selection curve for the setline fishery with respect to the length of fish. He showed that selectivity in Area 2 increased with length up to 87 cm (about 8 years of age), but declined after that. The results from cohort analysis also showed a decline in fishing mortality at older ages in Area 2 during some years even though this was not indicated in the long-term average. Myhre showed that selectivity in Area 3 continued to increase up to about 170 cm (over 20 years of age).

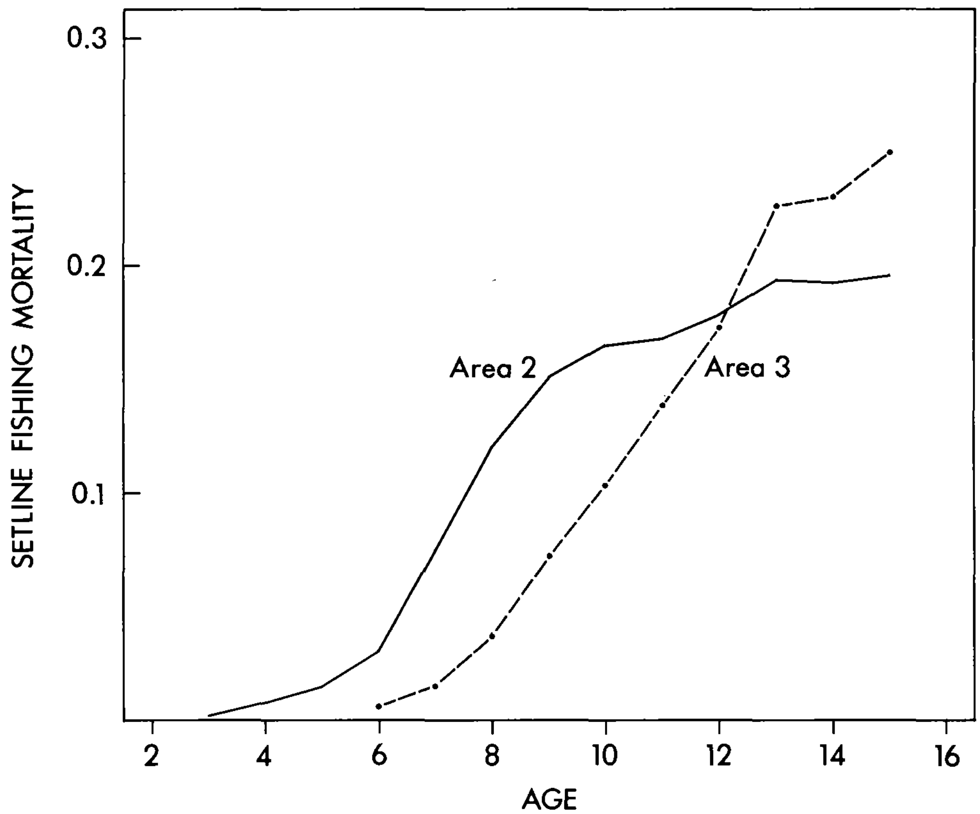

Figure 4. Average fishing mortality by setlines at each age in Areas 2 and 3, 1935-1971.

The increase in setline mortality with age requires that age be accounted for when comparing estimates from cohort analysis with those from earlier studies involving tagging and age composition data. Tagging provides an estimate of the average mortality for all fish over about 8 years of age, but estimates from age and CPUE data usually only include fish over 12 or 13 years old (fish fully vulnerable to setline gear). IPHC (1960) noted that age and CPUE data provided higher estimates of fishing mortality than tagging data, but did not reconcile the difference. Although several factors may be involved, the increase in mortality with age accounts for at least part of the difference. Results from cohort analysis show partial agreement with both, i.e., estimates for 10-year-olds are similar to those from tagging whereas estimates for 15-year-olds are similar to those from age and CPUE data.

Historical trends in setline mortality from 1935 to 1971 were examined for 8- to 15-year-olds, the dominant ages in the setline catch. The average mortality for these ages and the annual fishery effort by the setline fleet is shown in Figure 5. Setline mortality in Area 2 declined from over 0.2 in the late 1930's to less than 0.15 during 1948 to 1950. After an increase in the mid-1950's, mortality again declined to less than 0.15 during the 1960's. In Area 3, mortality declined from about 0.17 in 1935 to 1938 to about 0.12 in the 1950's and then increased to over 0.25 in 1969 to 1971.

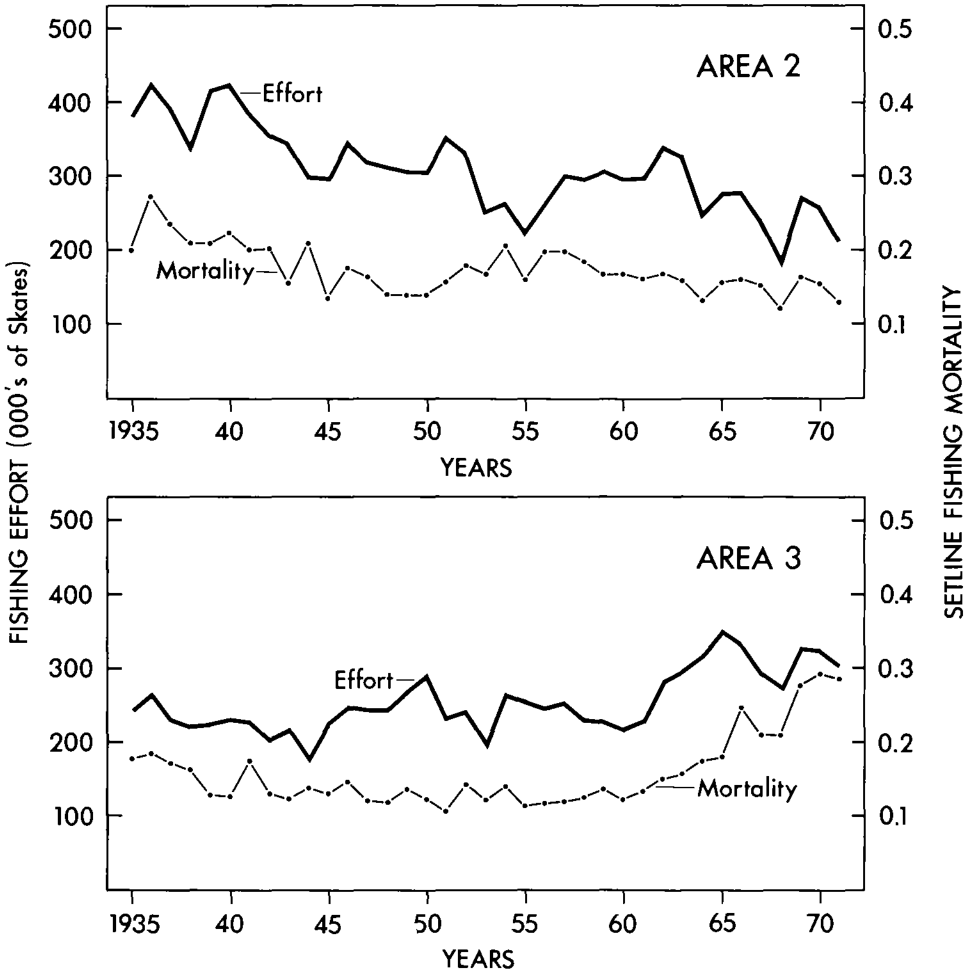

Figure 5. **Average setline mortality (8- to 15-year-olds) and effort in Areas 2 and 3, 1935-1971.**

The correlation coefficient between setline effort and setline mortality was 0.73 in Area 2 and 0.66 in Area 3, indicating that changes in mortality were related to changes in effort. Several discrepancies, however, were noted. Fishing effort in Area 2 declined during the mid 1950's while mortality increased. Conversely, effort increased during the late 1950's and early 1960's, whereas mortality declined. In Area 3, mortality and effort both increased during the 1960's, but mortality more than doubled while effort only increased about 50%. These discrepancies suggest that other factors such as gear efficiency and the availability of the fish also affect mortality.

Mortality estimates from cohort analysis show that young halibut have become increasingly vulnerable to the setline fishery since 1935. The change was most noticeable in Area 3 where setline mortality on fish less than 10 years old nearly doubled between the 1940's and the 1950's whereas mortality on fish over 12 years old did not change appreciably. In Area 2, mortality was about the same on young fish, but declined on old fish, indicating that a releative increase in mortality also occurred there. Assuming that catchability generally increases with size of fish, the greater mortality of young fish can be attributed to the improved growth since the 1930's. The increase in growth shifted the selection curve for setline gear about one year, i.e., 8-year-olds in the 1960's were about the same size and had the same relative mortality as 9-year-olds in the 1940's. A shift in the selection curve will alter the relationship between CPUE and stock size. Further study, however, is needed to evaluate the magnitude of the effect.

SOURCES OF ERROR

Cohort analysis is subject to errors from the assumed value of M and F_t as well as estimates of the catch at each age. The results also can be biased by the migration of fish in or out of the defined stock area. Pope (1972), Agger, Böetius, and Lassen (1973), and Ulltang (1977) examined the effects of these sources of error on the results from cohort analysis. The effect of these potential errors is summarized in Table 2. In general, abundance will be overestimated and fishing mortality underestimated if M is too high, if F_t is too low, or if immigration occurs. Abundance will be underestimated and fishing mortality overestimated if the opposite is true. Too high or too low a catch results respectively in an over- or underestimate of abundance and fishing mortality.

Because the parameters in the model are not known precisely, we varied the parameter values to test the effect of error on the estimates of abundance and fishing mortality. F_t and M were varied between 0.1 and 0.3, generally within the range of published values. The catch by setlines was assumed to be precise, but Hoag and French (1976) listed several factors that could bias the estimated incidental catch by trawlers. Although the precision of the estimated catch by trawlers is unknown, we examined the effect of error by varying the estimates by plus or minus 50%. The results indicate that errors in the parameters will not significantly affect trends in the estimates providing that the parameter values do not change over time. The parameter values do have a pronounced effect on the individual estimates, and the effect varies with age.

Table 2. Summary of the effects of error on estimates of fishing mortality and abundance.

	Effects of Error	
Error	Fishing Mortality	Abundance
M overestimated	Underestimated	Overestimated
M underestimated	Overestimated	Underestimated
F_t underestimated	Underestimated	Overestimated
F_t overestimated	Overestimated	Underestimated
Immigration	Underestimated	Overestimated
Emigration	Overestimated	Underestimated
Catch overestimated	Overestimated	Overestimated
Catch underestimated	Underestimated	Underestimated

The effect of an error in F_t will be greatest on older fish and on recent year classes that have not passed through the fishery. Cohort analysis proceeds by working backwards through each age in a year class, and errors become progressively smaller as cumulative fishing mortality increases. If F_t was really 0.3 or 0.1 rather than the assumed 0.2, the error in the estimates for year classes that have passed through the fishery would decline from about 50% at age 20 to 20% at age 15 and would drop to below 10% at ages less than 10. On the other hand, estimates for recent year classes could be subject to errors of 50% at younger ages. Trends in the estimates did not change appreciably when cohort analysis was recalculated with an F_t of 0.1 and 0.3. However, a trend in F_t over time could alter the results. For example, if F_t had declined markedly in the 1960's and the 1970's, abundance would have been underestimated and fishing mortality overestimated relative to that in earlier years.

The effect of an error in M becomes progressively larger at younger ages. If M was 0.1 or 0.3 rather than 0.2, errors in the estimates would increase from about 10% at age 20 to as much as 200% at age 3. An error in M is more critical to estimates of abundance than to estimates of fishing mortality because fishing mortality is relatively low at young ages. Estimates of year class size would be severely affected by an error in M. For example, the estimated abundance of 3-year-olds in the late 1930's would be about 3 million fish in each area with an M of 0.1, compared to about 8 million with an M of 0.2 and 25 million with an M of 0.3.

Although an error in M affects the magnitude of the estimates, conclusions regarding trends in abundance and fishing mortality will not change signifcantly unless there are long-term cycles in M. Natural mortality is higher for males than for females, and a change in the sex ratio over time would, therefore, alter the average M for the population. Schmitt and Skud (MS) suggest that the proportion of females in the setline catch increased from the 1950's to the 1960's and 1970's. However, the increase was small and could have resulted from a change in the fishery rather than in the population. We consider the likelihood of a major long-term change in M to be slight because estimates of fishing mortality from cohort analysis generally relate to fishing effort over the period whereas an unaccounted for change in M would alter this relationship. However, it is important to recognize that an increase in M since the 1940's could explain the apparent decline in year class size that was noted earlier. In other words, the relative abundance of 3-year-olds would be underestimated in recent years if M has been increasing. These results emphasize the need for precise estimates of M in explaining changes in stocks.

Increasing the incidental catch by trawlers by 50% raises the estimates of abundance and trawl mortality by as much as 20%. However, trawl mortality still is less than 0.05 for most ages, and long-term trends in abundance and year class strength remain essentially unchanged. The incidental catch by trawlers would have to be several times greater than estimated to account for the estimated decline in year class strength. Reducing the incidental catch by 50% lowers the estimates of abundance and trawl mortality, but again does not affect overall conclusions.

Ulltang (1977) notes that one of the largest sources of error in cohort analysis lies in the implicit assumption that fish caught in a given area were also in that area when they were younger. Halibut migrate from the Bering Sea to the northeast Pacific and between Areas 2 and 3. Although the direction of migration varies seasonally, most migrations tend to be eastward and counteract the westward drift of eggs and larvae (Dunlop et al. 1964; Skud 1977). Tagging studies indicate that the annual rate of migration is relatively low for adult halibut (over 8 years of age). Dunlop et al. (1964) estimated that 24% of the halibut tagged in the eastern Bering Sea migrated to the northeast Pacific over a 7-year period; this amounts to an annual instantaneous rate of 0.04. Migration rates from Area 3 to Area 2 have not been calculated but are probably low. For example, Thompson and Herrington (1930) reported that in tagging experiments in Area 3 only 5 percent of the recoveries were from Area 2. Seasonal movements may be more extensive (Skud 1977). However, the setline fishery only operates during the summer and seasonal movements should not affect the results from cohort analysis.

Skud (1977) showed that the migration of juvenile halibut from Area 3 to Area 2 is more extensive than the migration of adults. This indicates that the abundance of halibut less than about 8 years old was overestimated in Area 2 and underestimated in Area 3, i.e., some of the juveniles that were estimated to be in Area 2 actually were in Area 3. A movement of juveniles from the Bering Sea to the northeast Pacific Ocean would result in an overestimate of abundance in both Areas 2 and 3. Because rates of migration are largely unknown, no attempt was made to quantify the magnitude of this potential error. We did recalculate the results from the cohort analysis treating Areas 2 and 3 as a single area. This analysis showed that the estimates of abundance were essentially identical to the sum of the individual estimates for Areas 2 and 3; estimates of fishing mortality were intermediate. Overall conclusions regarding trends in abundance, year class size, and mortality were not altered.

SUMMARY

IPHC has relied heavily on CPUE data from the North American setline fishery to assess halibut stocks and regulate the fishery. CPUE was based on weight and not on numbers of fish. The lack of information on numbers of fish in the stock has been critical because the growth rate of halibut has increased. CPUE data have been and will continue to be useful, but there are distinct advantages to having stock assessments that are independent of CPUE. Pope (1972) developed a method, called cohort analysis, of estimating abundance (numbers of fish) and fishing mortality from catch and age data. We applied this method to halibut data in Areas 2 and 3 from 1935 to 1976, and estimated fishing mortality and abundance at each age for 3- to 20-year-olds. Total fishing mortality was divided into trawl and setline mortality based on the proportion of the catch by each gear.

The results show that the abundance of pre-recruits (3- to 7-year-olds) in each area declined from over 30 million fish in the 1930's and 1940's to less than 10 million fish in the early 1970's. Trends in the abundance of post-recruits (8- to 20-year-olds) generally followed trends in abundance of pre-recruits. The abundance of post-recruits in Area 2 declined from over 10 million fish during the late 1940's and early 1950's to about 5 million fish in the early 1970's. In Area 3, the abundance of post-recruits was relatively stable from 1935 to 1949, but then declined steadily from about 13 million fish to 5 million fish. The decline in the number of post-recruits was greater than the decline in CPUE (weight) in the setline fishery. An increase in growth during the period apparently contributed to this difference. Further study is needed before the estimates from cohort analysis

can be converted to biomass, but preliminary results indicate that trends in biomass generally coincide with trends in CPUE.

The abundance of 3-year-olds was used to indicate year class size before entering into either the trawl or setline fisheries. Year class size has fluctuated, but generally declined since the early 1940's. The decline in year class strength may account for much of the drop in CPUE and yield in the setline fishery although other factors such as the incidental catch by trawlers and the catch by the setline fishery also have played a role.

Setlines accounted for most of the estimated fishing mortality. Mortality by trawls was negligible before 1960 and even after 1960, was generally less than 0.05. Although relatively low, trawl mortality did represent a high percentage of the total fishing mortality on fish less than 8 years of age. Mortality by setlines generally increased with age although the relationship varied with area and time. Setline mortality on 8- to 15-year-olds, the dominant ages in the setline catch, declined in Area 2 from about 0.2 in the 1930's to less than 0.15 in the early 1970's. In Area 3, mortality averaged about 0.15 from 1935 to 1960, but then increased to about 0.25 by the early 1970's. Trends in setline mortality generally coincided with trends in setline effort. The vulnerability of young halibut to setlines, however, apparently has increased since the 1930's, probably due to an improvement in growth.

Several sources of error should be recognized. Cohort analysis requires knowing natural mortality at all ages and fishing mortality at the oldest age in each year class. Errors in these parameters have a pronounced effect on individual estimates, but will not significantly affect trends in the estimates unless the parameter values change over time. The results also depend on accurate catch and age data. We consider catch and age data from the setline fishery generally reliable although prior to 1960 estimates of age composition are based on meager samples in some regions. Data from the trawl fisheries are less precise. The method assumes unit stocks, and immigration or emigration can bias the results. The rate of adult migration apparently is relatively small but the migration of juvenile halibut from Area 3 to Area 2 may be substantial. Consequently, the abundance of juvenile halibut may be overestimated in Area 2 and underestimated in Area 3, however, the combined estimates from both areas probably are accurate.

ACKNOWLEDGMENTS

We thank Keith S. Ketchen, Loh-Lee Low, Jyri E. Paloheimo, Ralph P. Silliman and G. Morris Southward for reviewing the manuscript.

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APPENDIX

Table 1. Catch in numbers of fish by age, gear type and regulatory area, 1935-1976 25

Table 2. Stock size in thousands of fish by age and regulatory area, 1935-1976 33

Table 3. Fishing mortality by age, gear type, and regulatory area, 1935-1975 38

TABLE 1. ESTIMATED ANNUAL CATCH IN NUMBERS OF FISH BY AGE, GEAR AND REGULATORY AREA, 1935 - 1976.

	1935		1936		1937	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	10097	0	19320	0	4616	0
4	39653	547	33800	0	89856	0
5	43840	8093	30500	4045	75316	0
6	154330	35026	107547	23958	88984	0
7	354021	96663	354627	72689	329559	6751
8	289184	156337	272420	118016	497306	92598
9	333164	253661	210984	181345	249862	162616
10	256227	223822	249479	255913	150300	195866
11	110541	220461	190884	252803	149749	215637
12	66498	211209	110881	196678	125579	197763
13	31408	141353	72042	161721	60263	171387
14	25365	79595	41506	98640	28000	86494
15	15588	62494	25311	71471	25227	72950
16	10940	38237	16972	43619	11603	38757
17	4099	21917	11530	32197	5954	22420
18	3536	17266	11463	28598	4836	14687
19	1664	7550	3719	10204	4947	11381
20	1955	10424	3696	8232	1209	4302

	1938		1939		1940	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	3191	0	0	0	0	0
4	59197	0	41417	0	41862	0
5	129202	0	79139	0	238965	0
6	149795	4470	121954	296	216381	4753
7	336090	24740	229009	7194	281256	15316
8	437243	59749	356048	63364	285904	54716
9	375354	139671	280517	104755	315006	102039
10	125150	108158	240834	172258	286179	202281
11	88691	156322	95402	120226	176377	181368
12	82567	178926	88370	128800	77509	135736
13	64233	179958	66856	116088	45512	86405
14	45713	132671	48919	112342	41637	88519
15	24356	78818	24861	60607	34406	91052
16	14153	45213	19622	51737	13401	39506
17	7731	22999	8182	22665	9465	25245
18	4136	11068	5042	14683	5445	15738
19	3766	11681	2199	296	1306	3063
20	941	2877	2186	3449	1877	4331

	1941		1942		1943	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	0	0	1615	0	1783	0
4	40731	0	38591	0	12752	0
5	90065	4309	55970	0	65016	0
6	218521	20326	131355	25949	214067	7385
7	208029	41614	336160	91496	535204	62613
8	304379	67728	168225	121229	439026	171520
9	236471	119093	200577	130524	152122	123192
10	206127	202662	164741	164469	92041	138053
11	144251	277421	127559	170444	76671	139846
12	120598	232263	105648	183644	74595	127024
13	51808	176015	91740	128639	62796	151658
14	27326	100883	42327	80660	28749	73683
15	31582	87042	24271	48575	19816	53566
16	12966	86654	26006	46995	11405	44074
17	10296	43948	13114	23538	9135	22229
18	2557	19494	12801	14175	2188	12837
19	923	6737	5808	4256	1984	5871
20	761	4265	1093	1991	1193	6051

TABLE 1. (CONT.)

AGE	1944 AREA 2 SETLINE	1944 AREA 3 SETLINE	1945 AREA 2 SETLINE	1945 AREA 3 SETLINE	1946 AREA 2 SETLINE	1946 AREA 3 SETLINE
3	0	0	0	0	0	0
4	5087	0	3971	0	1487	0
5	19542	0	30282	0	14279	0
6	120926	24102	207249	8541	122669	8974
7	196258	28182	408841	46306	407433	48658
8	364199	68906	331031	81085	559540	85206
9	242503	109762	273667	95285	356712	100128
10	123750	112236	110009	122965	273786	129214
11	95361	119679	67439	131814	121603	138514
12	98958	140834	52592	128521	80816	135054
13	103667	170377	60642	174723	74273	183604
14	53627	117469	34847	85819	43838	90181
15	34193	69662	20789	56492	25280	59363
16	18926	42613	12041	36118	15619	37954
17	17045	31469	11452	32413	13176	34061
18	6849	12996	4156	12555	5507	13191
19	5013	17322	4216	11011	4251	11570
20	3105	3231	2500	6895	2827	7244

AGE	1947 AREA 2 SETLINE	1947 AREA 3 SETLINE	1948 AREA 2 SETLINE	1948 AREA 3 SETLINE	1949 AREA 2 SETLINE	1949 AREA 3 SETLINE
3	7008	0	1157	0	0	0
4	53063	0	17097	0	4889	0
5	29320	0	53796	0	19566	0
6	98778	8069	96679	8005	59000	4093
7	199844	43750	225830	43399	119765	13991
8	398375	76611	372733	75998	254716	65706
9	322422	90027	365047	89307	293582	100926
10	209446	116180	231127	115249	273039	167996
11	176324	124542	131661	123544	171148	158578
12	107908	121429	81314	120457	148325	150410
13	77159	165082	71251	163760	78789	216360
14	46245	81083	40538	80433	44642	108103
15	26898	53375	23490	52947	22019	65563
16	18087	34125	16773	33852	16729	38540
17	17747	30625	12993	30380	16526	38468
18	6978	11861	5177	11766	6880	18037
19	4703	10403	4491	10319	4097	14918
20	3212	6513	2490	6462	3731	14518

AGE	1950 AREA 2 SETLINE	1950 AREA 3 SETLINE	1951 AREA 2 SETLINE	1951 AREA 3 SETLINE	1952 AREA 2 SETLINE	1952 AREA 3 SETLINE
3	0	0	0	0	1205	0
4	682	0	1349	0	5491	0
5	3432	0	6417	0	27720	0
6	47511	2781	13446	1727	34080	686
7	122397	4238	124023	15404	62259	2327
8	302342	47297	225997	54821	327543	45469
9	437459	128275	321883	92856	370198	89621
10	281024	145675	308270	137014	322785	115878
11	175725	165118	195182	134987	269672	174540
12	129854	160150	136595	118019	165190	147799
13	75693	151582	118833	129584	125100	167339
14	62015	126999	76049	82713	80344	140536
15	23897	52335	56844	80614	57523	91952
16	15971	42317	31311	36062	36827	61573
17	7225	31299	21939	22276	22964	26236
18	4120	13226	15579	10119	7750	19333
19	2662	10130	5691	4675	5643	15513
20	2753	10198	2576	2678	6117	9865

TABLE 1. (CONT.)

AGE	1953 AREA 2 SETLINE	1953 AREA 3 SETLINE	1954 AREA 2 SETLINE	1954 AREA 3 SETLINE	1955 AREA 2 SETLINE	1955 AREA 3 SETLINE
3	1398	0	685	0	0	0
4	4871	0	36557	0	20241	369
5	15585	456	27657	0	83579	512
6	43771	584	49253	3642	113803	3366
7	107674	11828	128093	10971	168954	12387
8	167694	24678	269254	35292	211099	26049
9	331882	91447	266542	51421	230235	64233
10	276350	106011	411058	134204	185598	59419
11	236337	111616	228036	114200	230389	135068
12	179202	126529	178234	125544	135900	99991
13	112897	111272	123433	127955	83718	93676
14	70158	98704	85780	104702	50579	75767
15	48093	87850	59406	86107	36187	60423
16	39188	55767	44266	74170	22579	48676
17	21904	31533	27578	46702	20201	36967
18	19224	21741	15217	32561	8551	22368
19	5664	6364	8674	13867	5294	13415
20	5575	3783	4006	7215	2466	7515

AGE	1956 AREA 2 SETLINE	1956 AREA 3 SETLINE	1957 AREA 2 SETLINE	1957 AREA 3 SETLINE	1958 AREA 2 SETLINE	1958 AREA 3 SETLINE
3	950	0	2264	0	4598	0
4	6907	0	13838	431	165028	2670
5	55631	2349	35558	1236	79798	1424
6	151201	10777	122841	12573	68526	9012
7	208065	27632	215055	31481	222469	51628
8	204792	55673	223845	57349	200306	69435
9	163861	58218	194290	82886	167870	80115
10	208952	104407	103435	76917	130397	102425
11	129656	75873	138576	109392	88330	92503
12	176443	131831	97914	73118	77977	101104
13	116993	82577	122896	110342	56823	74917
14	83937	74558	70561	67800	75629	99273
15	51827	57172	50870	59576	51620	57084
16	34778	37681	34105	41441	29407	36344
17	26914	33051	27026	26939	26058	23138
18	20773	23647	16631	23978	20218	17143
19	13994	16250	11520	11597	12184	11764
20	7250	9070	12083	10064	6916	7203

AGE	1959 AREA 2 SETLINE	1959 AREA 3 SETLINE	1960 AREA 2 SETLINE	1960 AREA 3 SETLINE	1961 AREA 2 SETLINE	1961 AREA 3 SETLINE
3	544	0	4675	0	225	0
4	21754	119	14516	26	25676	39
5	207201	2272	57958	583	46279	1451
6	120120	8298	221446	2743	73007	4576
7	144447	30807	179185	17115	215513	18700
8	359163	142477	236268	43032	201597	53743
9	192591	132996	398291	130709	204618	83014
10	121972	131838	165066	110392	274570	169659
11	93585	112306	82264	103262	115606	112730
12	50853	76818	52764	78664	56122	96665
13	49143	97900	34918	68027	33444	73879
14	41275	57948	31358	59158	23695	53619
15	33158	64367	24409	49122	21809	46823
16	23084	36130	23791	39690	15625	36895
17	18354	25439	16763	25053	17681	26519
18	14093	12970	11478	17499	10595	15997
19	12713	12190	9074	10547	7823	9837
20	6912	5729	5924	8558	7235	5633

TABLE 1. (CONT.)

1962

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	1188	689	1877	0	14560	14560
4	14294	2480	16774	152	85280	85432
5	59381	10335	69716	2401	39520	41921
6	86161	15985	102146	8528	27040	35568
7	144759	19430	164189	33038	10400	43438
8	225138	20808	245946	57734	8320	66054
9	195617	18327	213944	105088	5200	110288
10	177918	15158	193076	135943	4160	140103
11	174702	7579	182281	204088	2080	206168
12	66355	5512	71867	86378	1664	88042
13	35286	3996	39282	77902	1248	79150
14	21291	2894	24185	54508	832	55340
15	20217	2205	22422	40366	416	40782
16	16123	0	16123	43918	0	43918
17	13464	0	13464	31601	0	31601
18	11936	0	11936	18544	0	18544
19	7645	0	7645	10192	0	10192
20	7158	0	7158	4680	0	4680

1963

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	154	630	784	19	33600	33619
4	13097	2269	15366	363	196800	197163
5	47047	9457	56504	2378	91200	93578
6	145259	14626	159885	15209	62400	77609
7	155989	17778	173767	34226	24000	58226
8	209506	19039	228545	111549	19200	130749
9	224369	16769	241138	128638	12000	140638
10	148313	13870	162183	154878	9600	164478
11	124920	6935	131855	156016	4800	160816
12	97645	5043	102688	197851	3840	201691
13	40002	3656	43658	83424	2880	86304
14	19511	2648	22159	48215	1920	50135
15	14447	2018	16465	28067	960	29027
16	12139	0	12139	27413	0	27413
17	12885	0	12885	23649	0	23649
18	9275	0	9275	21556	0	21556
19	9458	0	9458	10757	0	10757
20	7118	0	7118	6979	0	6979

1964

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	2438	648	3086	115	76860	76975
4	6593	2331	8924	633	450180	450813
5	22670	9715	32385	1503	208620	210123
6	48690	15026	63716	13407	142740	156147
7	122206	18264	140470	64948	54900	119848
8	118922	19560	138482	81694	43920	125614
9	152599	17227	169826	204003	27450	231453
10	120450	14249	134699	155514	21960	177474
11	89905	7124	97029	160315	10980	171295
12	67518	5181	72699	149350	8784	158134
13	59351	3756	63107	154653	6588	161241
14	20895	2720	23615	60426	4392	64818
15	13534	2073	15607	31609	2196	33805
16	10825	0	10825	22351	0	22351
17	9342	0	9342	17867	0	17867
18	5810	0	5810	14656	0	14656
19	6984	0	6984	11943	0	11943
20	6307	0	6307	9343	0	9343

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 1. (CONT.)

1965

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	161	840	1001	74	112980	113054
4	20822	3023	23845	332	661740	662072
5	24316	12598	36914	3437	306660	310097
6	46110	19486	65596	15626	209820	225446
7	97164	23685	120849	80058	80700	160758
8	179116	25365	204481	159807	64560	224367
9	129589	22341	151930	137625	40350	177975
10	167939	18478	186417	264363	32280	296643
11	114174	9239	123413	152579	16140	168719
12	71598	6719	78317	135898	12912	148810
13	58241	4871	63112	110333	9684	120017
14	45060	3528	48588	85897	6456	92353
15	16369	2688	19057	30672	3228	33900
16	13145	0	13145	14659	0	14659
17	9353	0	9353	11362	0	11362
18	8443	0	8443	8344	0	8344
19	5395	0	5395	7071	0	7071
20	4906	0	4906	4765	0	4765

1966

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	1299	1863	3162	0	83860	83860
4	4818	8919	13737	81	491180	491261
5	40895	15909	56804	2219	227620	229839
6	68187	22313	90500	16259	155740	171999
7	86346	25609	111955	42987	59900	102887
8	150141	27236	177377	115339	47920	163259
9	174320	23845	198165	205804	29950	235754
10	123362	19713	143075	155628	23960	179588
11	122766	9856	132622	244491	11980	256471
12	93275	7178	100453	141918	9584	151502
13	67420	5207	72627	125550	7188	132738
14	49096	3766	52862	107972	4792	112764
15	36818	2855	39673	74380	2396	76776
16	17392	0	17392	35988	0	35988
17	10949	0	10949	18733	0	18733
18	8016	0	8016	13139	0	13139
19	4634	0	4634	6957	0	6957
20	6491	0	6491	9197	0	9197

1967

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	4342	6088	10430	18	61950	61968
4	30750	33925	64675	18	362850	362868
5	26767	25964	52731	1439	168150	169589
6	105087	27703	132790	24151	115050	139201
7	106475	25464	131939	57596	44250	101846
8	110673	26241	136914	94158	35400	129558
9	153333	22335	175668	193861	22125	215986
10	134051	18421	152472	189042	17700	206742
11	80410	9211	89621	123496	8850	132346
12	80433	6754	87187	164682	7080	171762
13	46599	4912	51511	89318	5310	94628
14	26937	3531	30468	62917	3540	66457
15	23216	2611	25827	44461	1770	46231
16	15349	0	15349	35441	0	35441
17	6405	0	6405	15521	0	15521
18	4130	0	4130	10769	0	10769
19	3186	0	3186	6326	0	6326
20	3933	0	3933	5076	0	5076

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 1. (CONT.)

1968

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	1211	8606	9817	0	47390	47390
4	30578	48361	78939	0	277570	277570
5	43063	34491	77554	565	128630	129195
6	36713	35320	72033	10300	88010	98310
7	96006	31050	127056	82969	33850	116819
8	74236	31763	105999	93884	27080	120964
9	62453	26850	89303	114479	16925	131404
10	83100	22133	105233	188101	13540	201641
11	70079	11066	81145	139262	6770	146032
12	45607	8128	53735	89678	5416	95094
13	43550	5915	49465	111844	4062	115906
14	27830	4246	32076	56793	2708	59501
15	22245	3120	25365	39248	1354	40602
16	16736	0	16736	30334	0	30334
17	11370	0	11370	16358	0	16358
18	4985	0	4985	8443	0	8443
19	2456	0	2456	4076	0	4076
20	2492	0	2492	2445	0	2445

1969

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	2287	7368	9655	47	33810	33857
4	38172	40744	78916	0	198030	198030
5	75177	33119	108296	251	91770	92021
6	81612	36477	118089	9975	62790	72765
7	74379	7507	81886	43201	24150	67351
8	167704	35852	203556	170791	19320	190111
9	90028	30657	120685	108506	12075	120581
10	66310	25295	91605	116302	9660	125962
11	75355	12647	88002	197549	4830	202379
12	72148	9264	81412	144924	3864	148788
13	52695	6734	59429	92098	2898	94996
14	43634	4846	48480	92593	1932	94525
15	24548	3598	28146	43111	966	44077
16	20949	0	20949	32019	0	32019
17	20087	0	20087	22397	0	22397
18	8049	0	8049	12926	0	12926
19	6393	0	6393	5127	0	5127
20	3332	0	3332	3258	0	3258

1970

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	610	4688	5298	0	36610	36610
4	36837	25566	62403	168	214430	214598
5	64484	23017	87501	2213	99370	101583
6	73101	26588	99689	17025	67990	85015
7	76796	26377	103173	66670	26150	92820
8	68812	27503	96315	115981	20920	136901
9	109344	23661	133005	256420	13075	269495
10	62927	19532	82459	114206	10460	124666
11	52392	9766	62158	103548	5230	108778
12	56467	7143	63610	149163	4184	153347
13	48202	5189	53391	97632	3138	100770
14	38415	3739	42154	60892	2092	62984
15	32008	2791	34799	54265	1046	55311
16	21036	0	21036	24860	0	24860
17	13886	0	13886	15108	0	15108
18	10210	0	10210	10935	0	10935
19	7795	0	7795	7613	0	7613
20	4623	0	4623	3647	0	3647

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 1. (CONT.)

1971

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	156	4774	4930	0	28490	28490
4	18641	25716	44357	282	166870	167152
5	88311	25163	113474	1323	77330	78653
6	105393	30070	135463	11745	52910	64655
7	135495	30718	166213	44185	20350	64535
8	144164	32165	176329	89335	16280	105615
9	92839	27778	120617	108316	10175	118491
10	107559	22938	130497	185720	8140	193860
11	42341	11469	53810	78938	4070	83008
12	34219	8380	42599	70764	3256	74020
13	31020	6086	37106	83738	2442	86180
14	25264	4389	29653	57236	1628	58864
15	16774	3288	20062	49681	814	50495
16	15462	0	15462	26123	0	26123
17	10944	0	10944	13837	0	13837
18	6977	0	6977	8996	0	8996
19	4732	0	4732	5700	0	5700
20	3035	0	3035	2967	0	2967

1972

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	2846	9814	12660	29	48020	48049
4	11439	55555	66994	0	281260	281260
5	28282	37135	65417	1995	130340	132335
6	73456	36461	109917	15091	89180	104271
7	106841	30493	137334	52588	34300	86888
8	119560	30922	150482	84910	27440	112350
9	89932	25925	115857	104370	17150	121520
10	62730	21356	84086	99428	13720	113148
11	82838	10678	93516	145537	6860	152397
12	34161	7859	42020	53264	5488	58752
13	32080	5723	37803	56597	4116	60713
14	22225	4101	26326	44201	2744	46945
15	22252	2990	25242	27528	1372	28900
16	12895	0	12895	19669	0	19669
17	10766	0	10766	11679	0	11679
18	5237	0	5237	5300	0	5300
19	3765	0	3765	4546	0	4546
20	3566	0	3566	2497	0	2497

1973

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	146	10079	10225	0	46620	46620
4	1056	57457	58513	0	273060	273060
5	3355	35950	39305	0	126540	126540
6	14360	33645	48005	2587	86580	89167
7	32012	26421	58433	17816	33300	51116
8	54630	26480	81110	36400	26640	63040
9	56594	21952	78546	60273	16650	76923
10	58610	18065	76675	67765	13320	81085
11	41527	9033	50560	63248	6660	69908
12	45279	6667	51946	87817	5328	93145
13	20332	4860	25192	37111	3996	41107
14	18608	3473	22081	28189	2664	30853
15	18143	2506	20649	26544	1332	27876
16	12344	0	12344	15603	0	15603
17	8302	0	8302	6140	0	6140
18	8978	0	8978	5507	0	5507
19	4379	0	4379	1711	0	1711
20	4353	0	4353	1996	0	1996

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 1. (CONT.)

1974

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	0	8003	8003	0	51660	51660
4	171	45244	45415	0	302580	302580
5	1598	30612	32210	0	140220	140220
6	5442	30304	35746	953	95940	96893
7	16148	25602	41750	6176	36900	43076
8	31658	26008	57666	19227	29520	48747
9	41346	21843	63189	22716	18450	41166
10	41022	17996	59018	31699	14760	46459
11	37243	8998	46241	34634	7380	42014
12	27968	6620	34588	29766	5904	35670
13	36616	4820	41436	35575	4428	40003
14	12986	3455	16441	13042	2952	15994
15	13620	2523	16143	10999	1476	12475
16	13121	0	13121	11737	0	11737
17	8803	0	8803	5361	0	5361
18	5337	0	5337	2676	0	2676
19	3282	0	3282	2444	0	2444
20	2421	0	2421	742	0	742

1975

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	0	8003	8003	0	51660	51660
4	96	45244	45340	0	302580	302580
5	1740	30612	32352	0	140220	140220
6	5501	30304	35805	881	95940	96821
7	16462	25602	42064	12639	36900	49539
8	37876	26008	63884	31847	29520	61367
9	49660	21843	71503	41416	18450	59866
10	53981	17996	71977	41319	14760	56079
11	49522	8998	58520	39881	7380	47261
12	47798	6620	54418	39246	5904	45150
13	26699	4820	31519	25545	4428	29973
14	32758	3455	36213	33354	2952	36306
15	12214	2523	14737	10033	1476	11509
16	12878	0	12878	9792	0	9792
17	11761	0	11761	6482	0	6482
18	7495	0	7495	3547	0	3547
19	3612	0	3612	1548	0	1548
20	3924	0	3924	1387	0	1387

1976

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	0	8003	8003	0	51660	51660
4	34	45244	45278	0	302580	302580
5	1343	30612	31955	17	140220	140237
6	8238	30304	38542	1631	95940	97571
7	16985	25602	42587	9860	36900	46760
8	41276	26008	67284	39998	29520	69518
9	48961	21843	70804	54796	18450	73246
10	54957	17996	72953	45678	14760	60438
11	41004	8998	50002	36642	7380	44022
12	41052	6620	47672	36663	5904	42567
13	32871	4820	37691	27358	4428	31786
14	26901	3455	30356	23748	2952	26700
15	30415	2523	32938	21036	1476	22512
16	11620	0	11620	6642	0	6642
17	10069	0	10069	5558	0	5558
18	7881	0	7881	4255	0	4255
19	4961	0	4961	2293	0	2293
20	2649	0	2649	1203	0	1203

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 2. ESTIMATED STOCK SIZE IN THOUSANDS OF FISH BY AGE AND REGULATORY AREA, 1935 - 1976.

	1935			1936			1937		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	7765	9474	17239	7481	8285	15766	6687	8959	15646
4	6680	6974	13654	6349	7757	14106	6107	6784	12891
5	5903	7403	13306	5433	5709	11142	5167	6351	11518
6	5343	6225	11568	4793	6053	10846	4421	4671	9092
7	2915	4094	7009	4234	5065	9299	3827	4934	8761
8	2063	3327	5390	2067	3265	5332	3146	4081	7227
9	1926	3120	5046	1427	2582	4009	1445	2566	4011
10	1365	2747	4112	1275	2325	3600	977	1950	2927
11	785	1703	2488	886	2047	2933	818	1672	2490
12	414	1229	1643	543	1195	1738	553	1447	2000
13	228	678	906	279	815	1094	344	800	1144
14	129	426	555	158	427	585	163	521	684
15	95	260	355	82	277	359	92	260	352
16	73	180	253	64	156	220	45	162	207
17	39	114	153	50	113	163	37	88	125
18	20	72	92	28	73	101	30	63	93
19	29	70	99	13	43	56	12	34	46
20	12	64	76	23	50	73	7	26	33

	1938			1939			1940		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	9123	9603	18726	11326	11085	22411	11954	10535	22489
4	5471	7335	12806	7466	7862	15328	9273	9075	18348
5	4919	5554	10473	4425	6005	10430	6076	6437	12513
6	4162	5200	9362	3910	4547	8457	3552	4917	8469
7	3539	3824	7363	3272	4253	7525	3091	3723	6814
8	2835	4034	6869	2593	3109	5702	2472	3476	5948
9	2126	3258	5384	1925	3249	5174	1801	2488	4289
10	957	1954	2911	1401	2541	3942	1323	2565	3888
11	664	1419	2083	671	1502	2173	929	1924	2853
12	535	1174	1709	464	1021	1485	463	1121	1584
13	339	1006	1345	363	799	1162	300	719	1019
14	227	500	727	219	661	880	237	549	786
15	108	349	457	145	289	434	135	439	574
16	52	147	199	67	214	281	96	182	278
17	26	98	124	30	80	110	37	128	165
18	25	52	77	14	59	73	17	45	62
19	20	39	59	16	33	49	7	35	42
20	6	18	24	13	21	34	11	26	37

	1941			1942			1943		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	12534	10665	23199	12338	9763	22101	11529	9118	20647
4	9787	8625	18412	10262	8732	18994	10100	7994	18094
5	7554	7430	14984	7976	7062	15038	8367	7149	15516
6	4758	5270	10028	6104	6079	12183	6480	5782	12262
7	2712	4021	6733	3698	4297	7995	4878	4954	9832
8	2276	3034	5310	2032	3255	5287	2723	3435	6158
9	1765	2796	4561	1588	2423	4011	1512	2555	4067
10	1189	1944	3133	1231	2181	3412	1119	1865	2984
11	824	1917	2741	787	1409	2196	859	1637	2496
12	601	1411	2012	544	1318	1862	529	999	1528
13	309	795	1104	383	945	1328	350	913	1263
14	204	511	715	206	491	697	230	658	888
15	156	370	526	142	327	469	130	329	459
16	80	277	357	99	224	323	95	224	319
17	66	113	179	53	148	201	58	141	199
18	22	82	104	45	53	98	32	100	132
19	9	22	31	15	50	65	25	31	56
20	5	26	31	7	12	19	7	37	44

TABLE 2. (CONT.)

	1944			1945			1946		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	12215	8344	20559	11247	7251	18498	10692	7226	17918
4	9438	7465	16903	10001	6831	16832	9208	5936	15144
5	8258	6545	14803	7722	6112	13834	8184	5593	13777
6	6791	5853	12644	6743	5358	12101	6295	5004	11299
7	5111	4727	9838	5451	4770	10221	5333	4379	9712
8	3510	3999	7509	4007	3845	7852	4093	3864	7957
9	1832	2657	4489	2544	3212	5756	2981	3074	6055
10	1100	1980	3080	1281	2076	3357	1835	2544	4379
11	833	1402	2235	789	1520	2309	949	1589	2538
12	634	1214	1848	596	1040	1636	585	1125	1710
13	366	703	1069	429	866	1295	440	735	1175
14	230	611	841	206	421	627	297	551	848
15	163	472	635	139	394	533	137	267	404
16	89	221	310	102	323	425	95	271	366
17	67	143	210	56	143	199	73	232	305
18	39	95	134	40	89	129	35	87	122
19	24	70	94	26	66	92	29	61	90
20	19	20	39	15	42	57	17	44	61

	1947			1948			1949		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	11459	8896	20355	6813	6027	12840	7130	7355	14485
4	8754	5916	14670	9376	7283	16659	5577	4934	10511
5	7538	4860	12398	7119	4844	11963	7661	5963	13624
6	6688	4579	11267	6145	3979	10124	5780	3966	9746
7	5043	4089	9132	5386	3742	9128	4944	3251	8195
8	3998	3541	7539	3948	3308	7256	4205	3024	7229
9	2845	3086	5931	2913	2830	5743	2895	2640	5535
10	2118	2426	4544	2037	2445	4482	2054	2236	4290
11	1255	1966	3221	1545	1882	3427	1459	1898	3357
12	667	1175	1842	868	1497	2365	1146	1429	2575
13	406	799	1205	448	852	1300	637	1116	1753
14	293	436	729	262	505	767	303	550	853
15	203	370	573	198	283	481	178	340	518
16	89	165	254	142	254	396	141	184	325
17	64	188	252	57	104	161	101	178	279
18	48	159	207	36	126	162	35	58	93
19	24	60	84	33	120	153	25	92	117
20	20	40	60	15	39	54	23	89	112

	1950			1951			1952		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	5150	5306	10456	5091	5067	10158	5349	5405	10754
4	5837	6022	11859	4216	4344	8560	4168	4149	8317
5	4562	4040	8602	4779	4930	9709	3451	3556	7007
6	6254	4882	11136	3732	3308	7040	3907	4037	7944
7	4679	3243	7922	5078	3995	9073	3043	2706	5749
8	3939	2649	6588	3720	2652	6372	4045	3257	7302
9	3213	2417	5630	2952	2126	5078	2841	2121	4962
10	2105	2070	4175	2235	1862	4097	2125	1656	3781
11	1435	1679	3114	1469	1563	3032	1551	1401	2952
12	1039	1410	2449	1016	1225	2241	1026	1157	2183
13	804	1034	1838	734	1010	1744	708	896	1604
14	450	718	1168	590	709	1299	493	709	1202
15	207	352	559	312	473	785	414	506	920
16	126	219	345	148	241	389	204	314	518
17	100	116	216	89	141	230	93	165	258
18	68	111	179	76	67	143	53	96	149
19	22	31	53	52	79	131	48	45	93
20	17	62	79	16	16	32	37	60	97

TABLE 2. (CONT.)

AGE	1953 AREA 2	1953 AREA 3	1953 TOTAL	1954 AREA 2	1954 AREA 3	1954 TOTAL	1955 AREA 2	1955 AREA 3	1955 TOTAL
3	6512	6072	12584	9232	9335	18567	7073	7475	14548
4	4378	4425	8803	5330	4971	10301	7558	7643	15201
5	3408	3397	6805	3580	3623	7203	4331	4070	8401
6	2800	2912	5712	2776	2781	5557	2906	2966	5872
7	3168	3304	6472	2253	2383	4636	2228	2273	4501
8	2435	2214	4649	2496	2695	5191	1729	1941	3670
9	3015	2625	5640	1842	1790	3632	1800	2174	3974
10	1991	1656	3647	2169	2067	4236	1267	1419	2686
11	1448	1251	2699	1380	1260	2640	1404	1571	2975
12	1025	989	2014	972	924	1896	924	928	1852
13	691	814	1505	677	695	1372	634	643	1277
14	467	582	1049	463	566	1029	443	453	896
15	331	454	785	319	388	707	302	368	670
16	287	331	618	227	292	519	207	239	446
17	134	202	336	199	220	419	146	172	318
18	55	111	166	90	137	227	138	138	276
19	36	61	97	28	71	99	60	82	142
20	34	23	57	24	44	68	15	46	61

AGE	1956 AREA 2	1956 AREA 3	1956 TOTAL	1957 AREA 2	1957 AREA 3	1957 TOTAL	1958 AREA 2	1958 AREA 3	1958 TOTAL
3	6828	6978	13806	7390	6329	13719	6877	8847	15724
4	5791	6120	11911	5590	5713	11303	6048	5182	11230
5	6170	6257	12427	4735	5011	9746	4564	4677	9241
6	3470	3332	6802	5001	5121	10122	3844	4101	7945
7	2276	2426	4702	2704	2718	5422	3983	4181	8164
8	1671	1850	3521	1675	1961	3636	2019	2197	4216
9	1224	1566	2790	1183	1464	2647	1169	1554	2723
10	1265	1722	2987	854	1229	2083	793	1124	1917
11	869	1108	1977	847	1315	2162	606	937	1543
12	941	1164	2105	594	839	1433	568	978	1546
13	633	669	1302	610	833	1443	398	620	1018
14	444	441	885	413	473	886	389	582	971
15	317	303	620	287	294	581	274	326	600
16	214	247	461	213	196	409	189	187	376
17	149	152	301	144	168	312	143	123	266
18	101	107	208	98	94	192	93	113	206
19	105	93	198	64	66	130	65	56	121
20	44	55	99	74	61	135	42	44	86

AGE	1959 AREA 2	1959 AREA 3	1959 TOTAL	1960 AREA 2	1960 AREA 3	1960 TOTAL	1961 AREA 2	1961 AREA 3	1961 TOTAL
3	5387	6157	11544	6127	7293	13420	5289	7624	12913
4	5626	7243	12869	4410	5041	9451	5012	5971	10983
5	4803	4240	9043	4587	5930	10517	3598	4127	7725
6	3664	3828	7492	3745	3470	7215	3703	4855	8558
7	3085	3350	6435	2892	3126	6018	2865	2838	5703
8	3060	3376	6436	2395	2715	5110	2205	2544	4749
9	1472	1736	3208	2180	2636	4816	1747	2184	3931
10	805	1199	2004	1031	1301	2332	1425	2040	3465
11	531	827	1358	549	863	1412	695	965	1660
12	416	683	1099	350	576	926	375	613	988
13	394	709	1103	295	490	785	239	400	639
14	275	440	715	279	492	771	210	340	550
15	250	387	637	187	308	495	200	349	549
16	178	215	393	174	259	433	131	208	339
17	128	120	248	125	144	269	121	176	297
18	94	80	174	88	75	163	87	95	182
19	58	77	135	64	54	118	62	46	108
20	42	35	77	36	52	88	44	34	78

TABLE 2. (CONT.)

	1962			1963			1964		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	4185	5520	9705	3790	5146	8936	6166	8013	14179
4	4330	6242	10572	3425	4507	7932	3102	4183	7285
5	4080	4889	8969	3530	5033	8563	2790	3511	6301
6	2904	3378	6282	3278	3965	7243	2839	4036	6875
7	2966	3971	6937	2285	2733	5018	2539	3176	5715
8	2151	2307	4458	2280	3212	5492	1714	2185	3899
9	1623	2034	3657	1539	1829	3368	1660	2511	4171
10	1246	1713	2959	1135	1566	2701	1042	1370	2412
11	918	1516	2434	845	1275	2120	783	1133	1916
12	464	688	1152	587	1055	1642	573	899	1472
13	256	414	670	315	484	799	387	681	1068
14	165	261	426	174	268	442	218	318	536
15	150	230	380	114	164	278	123	174	297
16	144	244	388	103	151	254	78	108	186
17	93	137	230	103	160	263	73	99	172
18	83	120	203	64	83	147	73	109	182
19	61	63	124	57	81	138	44	49	93
20	44	29	73	43	43	86	38	57	95

	1965			1966			1967		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	3998	5120	9118	4324	4261	8585	3990	3582	7572
4	5045	6491	11536	3272	4089	7361	3537	3413	6950
5	2532	3017	5549	4109	4715	8824	2666	2903	5569
6	2255	2685	4940	2039	2189	4228	3313	3652	6965
7	2267	3163	5430	1787	1994	3781	1588	1637	3225
8	1951	2492	4443	1746	2445	4191	1362	1539	2901
9	1278	1675	2953	1413	1837	3250	1269	1854	3123
10	1205	1846	3051	909	1211	2120	977	1291	2268
11	731	961	1692	818	1243	2061	614	829	1443
12	553	773	1326	487	634	1121	550	786	1336
13	403	593	996	382	498	880	308	382	690
14	260	412	672	273	377	650	247	288	535
15	157	202	359	169	254	423	176	206	382
16	86	112	198	112	134	246	102	138	240
17	54	68	122	59	78	137	76	78	154
18	51	65	116	36	45	81	38	47	85
19	54	76	130	34	45	79	22	25	47
20	30	29	59	40	56	96	24	31	55

	1968			1969			1970		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	3180	2752	5932	2886	2653	5539	1998	2437	4435
4	3257	2876	6133	2595	2210	4805	2354	2141	4495
5	2837	2466	5303	2595	2104	4699	2053	1631	3684
6	2135	2224	4359	2253	1902	4155	2027	1639	3666
7	2592	2864	5456	1683	1732	3415	1738	1491	3229
8	1181	1248	2429	2007	2239	4246	1304	1357	2661
9	991	1143	2134	871	912	1783	1459	1662	3121
10	880	1322	2202	731	817	1548	604	638	1242
11	662	870	1532	626	900	1526	515	555	1070
12	422	559	981	469	580	1049	433	554	987
13	371	488	859	297	371	668	310	340	650
14	205	227	432	259	295	554	189	218	407
15	175	175	350	139	132	271	168	156	324
16	120	127	247	120	107	227	88	68	156
17	70	81	151	83	77	160	79	59	138
18	56	49	105	47	52	99	50	42	92
19	28	29	57	41	33	74	31	31	62
20	15	15	30	20	20	40	28	22	50

TABLE 2. (CONT.)

	1971			1972			1973		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	1451	2089	3540	+	+	+	+	+	+
4	1631	1962	3593	1184	1684	2868	+	+	+
5	1871	1559	3430	1295	1455	2750	909	1125	2034
6	1602	1243	2845	1429	1205	2634	1001	1072	2073
7	1569	1265	2834	1189	959	2148	1071	892	1963
8	1329	1137	2466	1134	977	2111	849	707	1556
9	980	987	1967	929	835	1764	793	699	1492
10	1074	1116	2190	694	701	1395	656	574	1230
11	420	409	829	762	739	1501	492	471	963
12	366	356	722	295	260	555	539	467	1006
13	297	315	612	261	224	485	203	160	363
14	206	187	393	209	180	389	179	129	308
15	117	122	239	141	100	241	147	105	252
16	106	77	183	77	54	131	93	56	149
17	53	34	87	73	40	113	52	26	78
18	52	34	86	34	15	49	50	22	72
19	32	25	57	37	20	57	23	7	30
20	19	18	37	22	15	37	27	12	39

	1974			1975			1976		
AGE	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL	AREA 2	AREA 3	TOTAL
3	+	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	+	+	+
5	+	+	+	+	+	+	+	+	+
6	708	806	1514	+	+	+	+	+	+
7	776	797	1573	548	572	1120	+	+	+
8	824	684	1508	598	613	1211	410	424	834
9	622	522	1144	622	516	1138	432	447	879
10	578	502	1080	452	390	842	445	368	813
11	467	396	863	420	369	789	305	268	573
12	357	323	680	341	287	628	291	260	551
13	394	298	692	261	232	493	230	194	424
14	144	94	238	285	208	493	185	163	348
15	127	78	205	103	62	165	201	137	338
16	102	60	162	89	52	141	71	40	111
17	65	32	97	72	39	111	61	34	95
18	35	16	51	45	21	66	48	26	74
19	33	13	46	24	11	35	30	14	44
20	15	5	20	24	8	32	16	7	23

\+ UNRELIABLE ESTIMATES.

TABLE 3. ESTIMATED INSTANTANEOUS FISHING MORTALITY BY AGE, GEAR AND REGULATORY AREA, 1935 - 1976.

	1935		1936		1937	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	.001	.000	.003	.000	.001	.000
4	.007	.000	.006	.000	.016	.000
5	.008	.001	.006	.001	.016	.000
6	.032	.006	.025	.004	.022	.000
7	.144	.026	.097	.016	.100	.002
8	.168	.053	.157	.041	.192	.025
9	.212	.094	.178	.081	.212	.073
10	.232	.094	.244	.130	.186	.118
11	.169	.154	.272	.147	.226	.154
12	.195	.211	.256	.201	.289	.164
13	.165	.262	.336	.247	.215	.270
14	.246	.231	.343	.295	.210	.203
15	.201	.309	.415	.336	.362	.371
16	.181	.267	.350	.369	.340	.307
17	.125	.240	.296	.378	.198	.329
18	.218	.308	.605	.566	.194	.296
19	.065	.128	.376	.302	.577	.462
20	.200	.200	.200	.200	.200	.200

	1938		1939		1940	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	.000	.000	.000	.000	.000	.000
4	.012	.000	.006	.000	.005	.000
5	.029	.000	.020	.000	.044	.000
6	.041	.001	.035	.000	.070	.001
7	.111	.007	.080	.002	.106	.005
8	.187	.017	.165	.023	.137	.018
9	.217	.049	.176	.036	.215	.046
10	.156	.063	.211	.078	.273	.091
11	.160	.130	.171	.093	.236	.110
12	.187	.184	.237	.150	.205	.144
13	.235	.220	.228	.175	.184	.142
14	.251	.347	.283	.208	.216	.196
15	.286	.288	.211	.263	.330	.260
16	.355	.415	.394	.311	.168	.274
17	.399	.301	.358	.378	.335	.245
18	.205	.268	.496	.321	.430	.494
19	.228	.407	.160	.010	.227	.101
20	.200	.200	.200	.200	.200	.200

	1941		1942		1943	
AGE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE	AREA 2 SETLINE	AREA 3 SETLINE
3	.000	.000	.000	.000	.000	.000
4	.005	.000	.004	.000	.001	.000
5	.013	.001	.008	.000	.009	.000
6	.052	.004	.024	.005	.037	.001
7	.089	.012	.106	.024	.129	.014
8	.160	.025	.096	.042	.196	.057
9	.160	.048	.150	.061	.118	.055
10	.213	.122	.160	.087	.095	.085
11	.215	.174	.197	.144	.104	.099
12	.251	.201	.242	.167	.169	.151
13	.205	.281	.308	.163	.221	.203
14	.160	.246	.258	.200	.148	.132
15	.253	.301	.209	.179	.184	.198
16	.198	.424	.342	.264	.143	.246
17	.188	.560	.316	.193	.192	.192
18	.141	.303	.377	.351	.079	.153
19	.118	.407	.544	.099	.091	.239
20	.200	.200	.200	.200	.200	.200

TABLE 3. (CONT.)

AGE	1944 AREA 2 SETLINE	1944 AREA 3 SETLINE	1945 AREA 2 SETLINE	1945 AREA 3 SETLINE	1946 AREA 2 SETLINE	1946 AREA 3 SETLINE
3	.000	.000	.000	.000	.000	.000
4	.001	.000	.000	.000	.000	.000
5	.003	.000	.004	.000	.002	.000
6	.020	.005	.035	.002	.022	.002
7	.043	.007	.087	.011	.088	.012
8	.122	.019	.096	.024	.164	.025
9	.158	.047	.127	.033	.142	.037
10	.133	.065	.100	.068	.180	.058
11	.135	.099	.099	.101	.153	.101
12	.189	.137	.103	.147	.166	.142
13	.376	.312	.170	.252	.206	.323
14	.299	.239	.207	.255	.178	.199
15	.264	.178	.180	.173	.228	.282
16	.269	.239	.139	.132	.200	.168
17	.329	.278	.259	.289	.223	.177
18	.216	.164	.123	.170	.191	.182
19	.261	.317	.200	.203	.179	.234
20	.200	.200	.200	.200	.200	.200

AGE	1947 AREA 2 SETLINE	1947 AREA 3 SETLINE	1948 AREA 2 SETLINE	1948 AREA 3 SETLINE	1949 AREA 2 SETLINE	1949 AREA 3 SETLINE
3	.001	.000	.000	.000	.000	.000
4	.007	.000	.002	.000	.001	.000
5	.004	.000	.008	.000	.003	.000
6	.016	.002	.018	.002	.011	.001
7	.045	.012	.047	.013	.027	.005
8	.117	.024	.110	.026	.069	.024
9	.134	.033	.149	.035	.119	.043
10	.116	.054	.134	.053	.159	.087
11	.169	.073	.099	.075	.139	.097
12	.197	.121	.109	.093	.154	.124
13	.236	.259	.193	.239	.147	.241
14	.192	.230	.187	.194	.178	.245
15	.158	.174	.140	.231	.147	.239
16	.254	.259	.140	.159	.141	.263
17	.366	.199	.292	.388	.199	.274
18	.176	.086	.172	.109	.248	.421
19	.247	.214	.164	.100	.200	.196
20	.200	.200	.200	.200	.200	.200

AGE	1950 AREA 2 SETLINE	1950 AREA 3 SETLINE	1951 AREA 2 SETLINE	1951 AREA 3 SETLINE	1952 AREA 2 SETLINE	1952 AREA 3 SETLINE
3	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.001	.000
5	.001	.000	.001	.000	.009	.000
6	.008	.001	.004	.001	.010	.000
7	.029	.001	.027	.004	.023	.001
8	.089	.020	.070	.023	.094	.016
9	.163	.060	.128	.049	.155	.048
10	.160	.081	.165	.085	.184	.080
11	.145	.115	.159	.100	.213	.148
12	.149	.134	.161	.113	.196	.152
13	.110	.177	.197	.153	.217	.231
14	.165	.217	.154	.138	.199	.247
15	.136	.179	.224	.209	.167	.224
16	.151	.240	.266	.181	.222	.244
17	.083	.355	.320	.191	.319	.194
18	.069	.142	.259	.184	.178	.253
19	.143	.446	.129	.068	.140	.475
20	.200	.200	.200	.200	.200	.200

TABLE 3. (CONT.)

AGE	1953 AREA 2 SETLINE	1953 AREA 3 SETLINE	1954 AREA 2 SETLINE	1954 AREA 3 SETLINE	1955 AREA 2 SETLINE	1955 AREA 3 SETLINE
3	.000	.000	.000	.000	.000	.000
4	.001	.000	.008	.000	.003	.000
5	.005	.000	.009	.000	.022	.000
6	.017	.000	.020	.001	.044	.001
7	.038	.004	.065	.005	.088	.006
8	.079	.012	.127	.015	.145	.015
9	.130	.039	.174	.032	.152	.033
10	.167	.073	.235	.074	.177	.047
11	.199	.104	.202	.106	.200	.100
12	.215	.152	.227	.163	.177	.127
13	.199	.164	.225	.227	.158	.176
14	.182	.207	.229	.229	.135	.204
15	.175	.241	.231	.282	.142	.200
16	.164	.206	.242	.330	.128	.255
17	.199	.190	.166	.267	.166	.271
18	.484	.244	.207	.306	.071	.197
19	.190	.123	.420	.242	.103	.198
20	.200	.200	.200	.200	.200	.200

AGE	1956 AREA 2 SETLINE	1956 AREA 3 SETLINE	1957 AREA 2 SETLINE	1957 AREA 3 SETLINE	1958 AREA 2 SETLINE	1958 AREA 3 SETLINE
3	.000	.000	.000	.000	.001	.000
4	.001	.000	.003	.000	.031	.001
5	.010	.000	.008	.000	.020	.000
6	.049	.004	.028	.003	.020	.002
7	.106	.013	.092	.013	.064	.014
8	.146	.034	.160	.033	.116	.036
9	.160	.042	.200	.065	.173	.059
10	.202	.069	.144	.072	.201	.106
11	.180	.079	.199	.096	.176	.116
12	.232	.134	.201	.101	.165	.121
13	.228	.147	.252	.158	.172	.143
14	.235	.207	.209	.172	.242	.209
15	.199	.234	.218	.254	.234	.215
16	.198	.185	.195	.266	.189	.242
17	.223	.275	.233	.195	.225	.233
18	.257	.279	.208	.329	.273	.183
19	.159	.215	.221	.214	.232	.266
20	.200	.200	.200	.200	.200	.200

AGE	1959 AREA 2 SETLINE	1959 AREA 3 SETLINE	1960 AREA 2 SETLINE	1960 AREA 3 SETLINE	1961 AREA 2 SETLINE	1961 AREA 3 SETLINE
3	.000	.000	.001	.000	.000	.000
4	.004	.000	.004	.000	.006	.000
5	.049	.001	.014	.000	.014	.000
6	.037	.002	.068	.001	.022	.001
7	.053	.010	.071	.006	.087	.007
8	.139	.048	.115	.018	.107	.024
9	.156	.088	.225	.056	.139	.043
10	.183	.130	.195	.098	.240	.096
11	.217	.163	.181	.142	.203	.138
12	.145	.133	.182	.164	.181	.192
13	.148	.166	.140	.167	.168	.228
14	.182	.157	.133	.143	.133	.192
15	.159	.203	.155	.194	.129	.160
16	.155	.205	.163	.186	.141	.219
17	.172	.267	.161	.214	.176	.182
18	.182	.198	.155	.297	.145	.206
19	.276	.192	.171	.245	.150	.272
20	.200	.200	.200	.200	.200	.200

TABLE 3. (CONT.)

1962

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.000	.000	.000	.000	.003	.003
4	.003	.000	.004	.000	.015	.015
5	.016	.003	.019	.000	.009	.010
6	.034	.006	.040	.003	.009	.012
7	.056	.007	.063	.009	.003	.012
8	.124	.011	.135	.028	.004	.032
9	.144	.013	.157	.059	.003	.062
10	.173	.015	.188	.092	.003	.095
11	.238	.010	.248	.161	.002	.163
12	.174	.014	.188	.149	.003	.152
13	.167	.019	.186	.233	.004	.237
14	.155	.021	.176	.263	.004	.267
15	.162	.018	.180	.217	.002	.219
16	.132	.000	.132	.222	.000	.222
17	.174	.000	.174	.295	.000	.295
18	.172	.000	.172	.187	.000	.187
19	.148	.000	.148	.196	.000	.196
20	.200	.000	.200	.200	.000	.200

1963

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.000	.000	.000	.000	.007	.007
4	.004	.000	.005	.000	.050	.050
5	.015	.003	.018	.000	.020	.021
6	.050	.005	.055	.004	.018	.022
7	.079	.009	.088	.014	.010	.024
8	.107	.010	.117	.039	.007	.046
9	.177	.013	.190	.081	.008	.089
10	.157	.015	.172	.116	.007	.123
11	.179	.010	.189	.146	.004	.150
12	.204	.011	.215	.232	.005	.237
13	.152	.014	.166	.213	.007	.220
14	.133	.018	.151	.223	.009	.232
15	.154	.021	.175	.211	.007	.218
16	.140	.000	.140	.224	.000	.224
17	.149	.000	.149	.179	.000	.179
18	.174	.000	.174	.337	.000	.337
19	.201	.000	.201	.158	.000	.158
20	.200	.000	.200	.200	.000	.200

1964

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.000	.000	.001	.000	.011	.011
4	.002	.000	.003	.000	.127	.127
5	.009	.004	.013	.000	.068	.068
6	.019	.006	.025	.004	.040	.044
7	.055	.008	.063	.023	.020	.043
8	.081	.013	.094	.043	.023	.066
9	.108	.012	.120	.094	.013	.107
10	.138	.016	.154	.136	.019	.155
11	.136	.011	.147	.171	.012	.183
12	.140	.011	.151	.204	.012	.216
13	.186	.012	.198	.291	.012	.303
14	.112	.015	.127	.238	.017	.255
15	.132	.020	.152	.226	.016	.242
16	.166	.000	.166	.261	.000	.261
17	.152	.000	.152	.223	.000	.223
18	.092	.000	.092	.160	.000	.160
19	.192	.000	.192	.316	.000	.316
20	.200	.000	.200	.200	.000	.200

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 3. (CONT.)

1965

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.000	.000	.000	.000	.025	.025
4	.004	.000	.005	.000	.120	.120
5	.011	.005	.016	.001	.120	.121
6	.023	.010	.033	.007	.090	.097
7	.049	.012	.061	.029	.029	.058
8	.108	.015	.123	.075	.030	.105
9	.120	.021	.141	.097	.028	.125
10	.168	.019	.187	.174	.021	.195
11	.192	.015	.207	.195	.021	.216
12	.155	.015	.170	.218	.021	.239
13	.175	.015	.190	.233	.020	.253
14	.214	.017	.231	.265	.020	.285
15	.124	.020	.144	.185	.020	.205
16	.184	.000	.184	.157	.000	.157
17	.212	.000	.212	.205	.000	.205
18	.201	.000	.201	.154	.000	.154
19	.116	.000	.116	.108	.000	.108
20	.200	.000	.200	.200	.000	.200

1966

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.000	.000	.001	.000	.022	.022
4	.002	.003	.005	.000	.142	.142
5	.011	.004	.015	.000	.054	.055
6	.038	.012	.050	.009	.082	.091
7	.056	.016	.072	.025	.034	.059
8	.101	.018	.119	.054	.023	.077
9	.148	.020	.168	.134	.019	.153
10	.165	.026	.191	.155	.024	.179
11	.182	.015	.197	.247	.012	.259
12	.240	.019	.259	.288	.019	.307
13	.219	.017	.236	.330	.019	.349
14	.224	.017	.241	.385	.017	.402
15	.278	.022	.300	.394	.013	.407
16	.189	.000	.189	.351	.000	.351
17	.231	.000	.231	.308	.000	.308
18	.284	.000	.284	.386	.000	.386
19	.161	.000	.161	.185	.000	.185
20	.200	.000	.200	.200	.000	.200

1967

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	.001	.002	.003	.000	.019	.019
4	.010	.010	.020	.000	.125	.125
5	.011	.011	.022	.000	.066	.067
6	.036	.009	.045	.007	.036	.043
7	.077	.019	.096	.040	.031	.071
8	.095	.023	.118	.071	.027	.098
9	.145	.021	.166	.124	.014	.138
10	.166	.023	.189	.178	.017	.195
11	.158	.018	.176	.181	.013	.194
12	.178	.015	.193	.265	.011	.276
13	.185	.020	.205	.302	.018	.320
14	.130	.017	.147	.279	.016	.295
15	.159	.018	.177	.273	.011	.284
16	.181	.000	.181	.333	.000	.333
17	.098	.000	.098	.250	.000	.250
18	.127	.000	.127	.292	.000	.292
19	.174	.000	.174	.325	.000	.325
20	.200	.000	.200	.200	.000	.200

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 3. (CONT.)

1968

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	.000	.003	.003	.000	.019	.019
4	.010	.017	.027	.000	.113	.113
5	.017	.014	.031	.000	.060	.060
6	.019	.019	.038	.005	.045	.050
7	.042	.014	.056	.033	.013	.046
8	.073	.031	.104	.088	.025	.113
9	.073	.032	.105	.118	.018	.136
10	.112	.030	.142	.173	.012	.185
11	.126	.020	.146	.195	.010	.205
12	.129	.023	.152	.196	.012	.208
13	.140	.019	.159	.293	.011	.304
14	.165	.025	.190	.326	.016	.342
15	.153	.022	.175	.286	.010	.296
16	.167	.000	.167	.306	.000	.306
17	.198	.000	.198	.252	.000	.252
18	.103	.000	.103	.209	.000	.209
19	.104	.000	.104	.170	.000	.170
20	.200	.000	.200	.200	.000	.200

1969

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	.000	.003	.004	.000	.014	.014
4	.016	.018	.034	.000	.104	.104
5	.033	.014	.047	.000	.050	.050
6	.041	.019	.060	.006	.037	.043
7	.050	.005	.055	.028	.016	.044
8	.098	.021	.119	.089	.010	.099
9	.124	.042	.166	.142	.016	.158
10	.108	.041	.149	.173	.014	.187
11	.145	.024	.169	.279	.007	.286
12	.189	.024	.213	.324	.009	.333
13	.222	.028	.250	.322	.010	.332
14	.209	.023	.232	.429	.009	.438
15	.221	.032	.253	.449	.010	.459
16	.214	.000	.214	.402	.000	.402
17	.309	.000	.309	.390	.000	.390
18	.210	.000	.210	.325	.000	.325
19	.187	.000	.187	.189	.000	.189
20	.200	.000	.200	.200	.000	.200

1970

	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	.000	.003	.003	.000	.017	.017
4	.018	.012	.030	.000	.117	.117
5	.035	.013	.048	.002	.069	.071
6	.041	.015	.056	.012	.047	.059
7	.051	.017	.068	.051	.020	.071
8	.061	.024	.085	.100	.018	.118
9	.087	.019	.106	.188	.010	.198
10	.125	.039	.164	.223	.020	.243
11	.121	.022	.143	.232	.012	.244
12	.157	.020	.177	.355	.010	.365
13	.190	.021	.211	.385	.012	.397
14	.258	.025	.283	.371	.013	.384
15	.238	.021	.259	.489	.009	.498
16	.305	.000	.305	.514	.000	.514
17	.215	.000	.215	.336	.000	.336
18	.255	.000	.255	.335	.000	.335
19	.323	.000	.323	.323	.000	.323
20	.200	.000	.200	.200	.000	.200

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

TABLE 3. (CONT.)

	1971					
	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	.000	.004	.004	.000	.015	.015
4	.013	.018	.031	.000	.099	.099
5	.054	.015	.069	.000	.056	.057
6	.076	.022	.098	.011	.048	.059
7	.102	.023	.125	.040	.018	.058
8	.130	.029	.159	.091	.017	.108
9	.112	.034	.146	.130	.012	.142
10	.119	.025	.144	.204	.009	.213
11	.120	.033	.153	.242	.012	.254
12	.111	.027	.138	.250	.011	.261
13	.125	.024	.149	.351	.010	.361
14	.148	.026	.174	.415	.012	.427
15	.176	.035	.211	.604	.010	.614
16	.175	.000	.175	.466	.000	.466
17	.257	.000	.257	.609	.000	.609
18	.159	.000	.159	.343	.000	.343
19	.180	.000	.180	.292	.000	.292
20	.200	.000	.200	.200	.000	.200

	1972					
	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	+	+	+	+	+	+
4	.011	.054	.065	.000	.204	.204
5	.025	.032	.057	.002	.104	.106
6	.059	.030	.089	.014	.086	.100
7	.107	.030	.137	.064	.041	.105
8	.126	.033	.159	.103	.033	.136
9	.115	.033	.148	.150	.025	.175
10	.107	.037	.144	.173	.024	.197
11	.129	.017	.146	.247	.012	.259
12	.139	.032	.171	.260	.027	.287
13	.149	.026	.175	.331	.024	.355
14	.127	.023	.150	.321	.020	.341
15	.194	.026	.220	.366	.018	.384
16	.203	.000	.203	.517	.000	.517
17	.178	.000	.178	.392	.000	.392
18	.188	.000	.188	.499	.000	.499
19	.121	.000	.121	.291	.000	.291
20	.200	.000	.200	.200	.000	.200

	1973					
	AREA 2			AREA 3		
AGE	SETLINE	TRAWL*	TOTAL	SETLINE	TRAWL*	TOTAL
3	+	+	+	+	+	+
4	+	+	+	+	+	+
5	.004	.045	.049	.000	.133	.133
6	.016	.038	.054	.003	.093	.096
7	.034	.028	.062	.023	.042	.065
8	.075	.037	.112	.060	.044	.104
9	.084	.032	.116	.102	.028	.130
10	.105	.033	.138	.142	.028	.170
11	.099	.022	.121	.162	.017	.179
12	.098	.015	.113	.235	.014	.249
13	.119	.028	.147	.302	.033	.335
14	.123	.023	.146	.280	.027	.307
15	.148	.020	.168	.332	.017	.349
16	.159	.000	.159	.370	.000	.370
17	.195	.000	.195	.298	.000	.298
18	.221	.000	.221	.324	.000	.324
19	.238	.000	.238	.294	.000	.294
20	.200	.000	.200	.200	.000	.200

* INCLUDES FOREIGN AND DOMESTIC TRAWL.

\+ UNRELIABLE ESTIMATES.

TABLE 3. (CONT.)

1974

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	+	+	+	+	+	+
4	+	+	+	+	+	+
5	+	+	+	+	+	+
6	.009	.048	.057	.001	.142	.143
7	.024	.037	.061	.009	.053	.062
8	.044	.037	.081	.032	.050	.082
9	.078	.041	.119	.050	.041	.091
10	.083	.037	.120	.074	.034	.108
11	.093	.023	.116	.103	.022	.125
12	.091	.022	.113	.108	.022	.130
13	.109	.014	.123	.143	.018	.161
14	.107	.028	.135	.170	.039	.209
15	.128	.024	.152	.173	.023	.196
16	.153	.000	.153	.242	.000	.242
17	.162	.000	.162	.208	.000	.208
18	.185	.000	.185	.205	.000	.205
19	.117	.000	.117	.232	.000	.232
20	.200	.000	.200	.200	.000	.200

1975

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	+	+	+	+	+	+
4	+	+	+	+	+	+
5	+	+	+	+	+	+
6	+	+	+	+	+	+
7	.035	.054	.089	.026	.075	.101
8	.075	.051	.126	.061	.056	.117
9	.094	.042	.136	.095	.042	.137
10	.145	.049	.194	.127	.046	.173
11	.141	.026	.167	.129	.024	.153
12	.170	.024	.194	.166	.025	.191
13	.121	.022	.143	.131	.023	.154
14	.137	.014	.151	.198	.017	.215
15	.143	.029	.172	.200	.029	.229
16	.174	.000	.174	.232	.000	.232
17	.200	.000	.200	.204	.000	.204
18	.202	.000	.202	.207	.000	.207
19	.184	.000	.184	.175	.000	.175
20	.200	.000	.200	.200	.000	.200

1976

AGE	AREA 2 SETLINE	AREA 2 TRAWL*	AREA 2 TOTAL	AREA 3 SETLINE	AREA 3 TRAWL*	AREA 3 TOTAL
3	+	+	+	+	+	+
4	+	+	+	+	+	+
5	+	+	+	+	+	+
6	+	+	+	+	+	+
7	+	+	+	+	+	+
8	.123	.077	.200	.115	.085	.200
9	.138	.062	.200	.150	.050	.200
10	.151	.049	.200	.151	.049	.200
11	.164	.036	.200	.166	.034	.200
12	.172	.028	.200	.172	.028	.200
13	.174	.026	.200	.172	.028	.200
14	.177	.023	.200	.178	.022	.200
15	.185	.015	.200	.187	.013	.200
16	.200	.000	.200	.200	.000	.200
17	.200	.000	.200	.200	.000	.200
18	.200	.000	.200	.200	.000	.200
19	.200	.000	.200	.200	.000	.200
20	.200	.000	.200	.200	.000	.200

* INCLUDES FOREIGN AND DOMESTIC TRAWL.
\+ UNRELIABLE ESTIMATES.