Resource Implications of an Expanded USA Silver Hake Fishery

by

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1. Stock Definition

The silver hake (*Merluccius bilinearis*) inhabiting the continental shelf waters off the northeast coast of the United States are presently grouped into three stocks. These are: (1) the Gulf of Maine (ICNAF Div. 5Y) stock, (2) the Georges Bank (ICNAF Subdiv. 5Ze) stock, and (3) the Southern New England-Middle Atlantic (ICNAF Subdiv. 5Zw and Stat. Area 6) stock (Figure 1). These delineations reflect, to some extent, scientific information concerning stock identification, but essentially resulted within ICNAF from a need to assess and manage based on the areas by which catch statistics were reported to ICNAF.

There is some evidence that silver hake in the area between the Gulf of Maine and Cape Hatteras consist of several discrete stocks. Conover et al. (1961) examined morphometric measurements and found no significant differences between fish from the inshore Gulf of Maine and the northern part of Georges Bank nor between fish from the Southern New England and the Middle Atlantic areas, but did find highly significant differences between fish from the Gulf of Maine-northern Georges Bank area and the Southern New England-Middle Atlantic area. Tagging studies were conducted in 1957-1958 in the Gulf of Maine-Georges Bank area and off New Jersey (Fritz 1959) resulting in only a 4.3% recapture rate (Fritz 1963). The recaptures occurred fairly close to the tagging site (the greatest distance traveled was 65 km) indicating the lack of any significant movement of silver hake from one area to another.

Nichy (1969) examined first-year growth patterns on otoliths from young silver hake and found a difference in otolith zonal formation and length at age between fish north and south of $41^{\circ}30'$N latitude. Recent calculation of growth parameters using age-length data from the Gulf of Maine, Georges Bank,

and Southern New England-Middle Atlantic areas (Almeida 1978) indicated that fish in the Gulf of Maine grow faster and attain greater lengths than those to the south.

Konstantinov and Noskov (1969) reported that serological analysis had distinguished one silver hake stock in the Georges Bank area and another in the Cape Cod-Cape Hatteras area, with an approximate division in the Nantucket Shoals area (Subdiv. 5Ze and 5Zw boundary area) and some mixing of the two groups during autumn and winter.

Examination of the seasonal distribution of silver hake catches during USA research vessel bottom trawl surveys (Anderson 1974) suggests that fish which summer in the inshore portions of the Gulf of Maine and along the northern part of Georges Bank appear to overwinter in the deep areas of the Gulf of Maine, and fish which occupy the southern part of Georges Bank in the warm months overwinter in deep water along the southern edge of the Bank. Fish in the Southern New England-Middle Atlantic area undergo a seasonal inshore-offshore migration. Survey catches indicate a generally continuous distribution of fish from the southeastern part of Georges Bank to the Middle Atlantic area and show no apparent division between a Georges Bank stock and a Southern New England-Middle Atlantic stock.

Examination and consideration of all available information suggests the possibility of a Gulf of Maine-northern Georges Bank stock and another stock (maybe two) extending from southern Georges Bank to the Middle Atlantic area. However, scientific evidence is presently not sufficient to define separate spawning stocks which are genetically distinct. Additional studies of considerable magnitude, such as tagging and morphometric-meristic analysis, must be conducted before further conclusions can be made. In the meantime, providing that traditional fishing areas and patterns do not change sub-

stantially, the present stock delineations are satisfactory for management of the resource.

An issue has been raised recently by industry claiming that silver hake fished during the summer in the inshore waters of the Gulf of Maine migrate from areas to the south (i.e., southern Georges Bank, Southern New England). Results from the limited tagging studies conducted during 1957-1958 tend to negate this argument. As stated above, additional studies are needed to resolve this question.

2. Current Status of the Stocks

2.1 Gulf of Maine

Total stock biomass (ages 1 and older) decreased from 219,400 tons in 1955 to a low of only 23,000 tons in 1971 (Figure 2) and then increased to 101,200 tons in 1977 (Anderson and Almeida 1978). Recruitment to this stock was very poor during the mid- and late 1960's (Figure 3), but has improved in the 1970's. The 1974 and 1976 year-classes are estimated to be the strongest observed since 1964 although they are still less than the 1954-1973 mean size. Projections indicate that the total stock biomass available at the beginning of 1978 was approximately the same as in 1977, but spawning stock biomass (ages 2 and older) increased over 15% from 1977 to 1978. A catch of about 9,000 tons in 1978 would maintain the 1979 spawning stock biomass at the 1978 level.

2.2 Georges Bank

Total stock biomass (ages 1 and older) increased from 109,300 tons in 1955 (Figure 4) to a high of nearly 800,000 tons in 1963 and then declined to 107,600 tons in 1970 (Anderson 1977). Total biomass increased to 420,000 tons in 1975 but then declined to an estimated 311,000 tons at the beginning

of 1977. As with the Gulf of Maine stock, recruitment was very poor during the mid- and late 1960's (Figure 5), but improved in the early 1970's. The 1975 and 1976 year classes are estimated to be poor. Projections indicate that the spawning stock biomass decreased from 268,000 tons in 1977 to 236,000 tons in 1978. The 1978 OY was set at 58,800 tons which corresponds approximately to fishing mortality at the $F_{0.1}$ level. Given a 1978 catch of about 60,000 tons, the resultant spawning stock biomass in 1979 will decline by about 25% from 1978 if the 1977 year class is equal in size to the poorest observed previously or will increase by about 13% if the 1977 year class is equal to the mean size observed.

2.3 Southern New England-Middle Atlantic

Total stock biomass (ages 1 and older) increased from an average of 76,000 tons during 1955-1959 to a high of 454,000 tons in 1965 (Figure 6) and decreased to 82,000 tons in 1970 (Anderson and Almeida 1977). Biomass increased to 210,000 tons in 1973, decreased to an average of 188,000 tons during 1974-1976, and then increased to an estimated 307,000 tons at the beginning of 1978. Recruitment in 3 of the last 4 years has been above average (Figure 7) with the 1976 year class estimated to be the strongest since 1964. Projections indicate that spawning stock biomass increased 44% from 1977 to 1978, with the 1978 level being the highest since 1966. The 1978 OY has been set at 33,200 tons which would result in an additional 14% increase in spawning biomass in 1979. Fishing at $F_{0.1}$ in 1978 would produce a catch of 54,000 tons and also achieve a 5% increase in spawning biomass in 1979. A 1978 catch of 65,600 tons would maintain the same spawning biomass in 1979 as in 1978.

3. Domestic and Foreign Fisheries

3.1 Gulf of Maine

Total catch during 1955-1964 varied between 21,500 and 37,000 tons and averaged 29,700 tons (Figure 2). Catches dropped from 31,700 tons in 1964 to 22,600 tons in 1965, and ranged from 24,700 to 11,400 tons during 1965-1970 while averaging 18,300 tons. Catches continued to drop and averaged only 8,100 tons during 1971-1977 while ranging between 5,213 (1974) and 9,760 (1976) tons; the 1977 catch was 8,727 tons.

This fishery has been conducted almost exclusively by the USA. In 1963 and 1971-1975, small catches were reported by the USSR, Poland, FRG, GDR, and Bulgaria, which averaged about 10% of the total annual catch in those years.

Total allowable catch (TAC) for this stock was set by ICNAF at 10,000 tons for 1973-1974, 15,000 tons for 1975, 10,000 tons for 1976, and 9,000 tons for 1977.

The bulk of the USA catches have traditionally been taken during May-December by small vessels fishing single-day trips in inshore areas, although catches have been made in all months since 1970. Prior to 1964, the most productive grounds were located in statistical area 514 (Figure 8) which includes Stellwagen Bank, local grounds adjacent to Gloucester, and Cape Cod Bay. During 1964-1973, statistical area 513 (Jeffreys Ledge to Casco Bay) provided the greatest catches. During 1974-1977, area 514 again was the most productive area. In 1977, 80% of the Div. 5Y silver hake catch came from area 514, and 10% each from areas 513 and 515. In earlier years catches were reported from area 512, as high as 750 tons in 1969, but have decreased to only a few tons per year in the last 5 years. In the last several years, the inshore fishery has essentially begun in April instead of May, and during 1976-1978 significant catches have been taken from area 515 (deep overwintering area) during the January-April period.

3.2 Georges Bank

Total catch increased from an average of 19,000 tons during 1955-1961 to nearly 239,000 tons in 1965 and declined rapidly to 18,400 tons in 1969 (Figure 4). Catches increased and stabilized at an average of about 68,000 tons during 1971-1975, but declined to 45,900 tons in 1976 and to 43,200 tons in 1977.

USA catches averaged 18,200 tons during 1955-1963, but declined to average only 3,600 tons during 1968-1977. The 1977 catch was 3,749 tons.

During 1973-1975, the TAC was 80,000 tons each year. The 1976 and 1977 TACs were 50,000 and 70,000 tons, respectively. The 1978 OY was set at 58,800 tons. USA allocations of the 1973-1977 TACs were 17,000, 11,056, 11,100, 8,500, and 15,000 tons, respectively, whereas actual USA catches during this period averaged only about one third of each year's allocation. The amount in 1978 designated as USA capacity was 26,000 tons.

Until 1969, statistical area 521 (Figure 8), which lies immediately east of Cape Cod, produced the bulk of the USA catches in Subdiv. 5Ze, with most of the fishery conducted during June-October. In 5 of the 8 years since 1969, area 522 on Georges Bank, which includes Cultivator Shoal, has out-produced area 521. USA fishermen have been catching silver hake from this area since 1955, primarily during June-September.

The foreign fishery for silver hake has been conducted primarily by the USSR. They have fished virtually all of Georges Bank for silver hake beginning in 1962, but have focused mainly along the southern part of the Bank in statistical areas 525, 526, and 524. The USSR has also fished area 522 during the same months as the USA. The seasonal pattern of the USSR fishery has varied from year to year but has primarily been conducted during

March-August. During 1962-1977, about 77% of the catch was taken during those months. During 1973-1976, March was the predominant month, averaging 30% per year of the total. In 1977, 84% of the USSR catch was during April-June, with June having the largest share (37%).

Beginning in 1970, various conservation areas were established by ICNAF (Figures 9-13) which closed parts of the area to the foreign hake fishery, in some cases for certain months and in other cases all the time. In 1976, the USSR stern trawler fleet for silver hake was excluded from most of Georges Bank by virtue of an ICNAF regulation banning the use of bottom trawls by vessels over 155 ft. in waters less than 40 fathoms (Figure 13). Consequently, the USSR fishery was confined to the southern slopes of the Bank. From 1 March to 30 June 1977, the foreign hake fishery in Subdiv. 5Ze was limited to a relatively narrow "window" extending between 67°W and 70°W longitude (Figure 14) along the edge of the continental shelf. The 1978 "window" is in the same place (Figure 15) as for 1977.

3.3 Southern New England-Middle Atlantic

Total catches averaged about 16,800 tons during 1955-1959, declined to 9,952 tons in 1960, and then improved steadily to 137,400 tons in 1966 (Figure 6). Catches dropped sharply to 50,900 tons in 1967 and have since fluctuated between 19,200 and 67,000 tons. Catches increased steadily from 19,200 tons in 1970 to 66,000 tons in 1973 and then declined to 24,700 tons in 1977.

USA commercial catches during 1955-1965 ranged between 8,151 and 25,008 tons and averaged about 14,800 tons per year. During this time an excellent industrial (reduction to meal and oil) market existed for silver hake. Catches during 1966-1977 were much lower as a result of the closing of a major reduction plant, ranging between 4,989 and 9,840 tons and averaging

about 7,600 tons or about 19% of the total catch per year. Estimated USA recreational catches during 1955-1976 ranged between 692 and 3,469 tons and averaged about 1,900 tons per year.

The TAC for this stock was 80,000 tons per year during 1973-1975, 43,000 tons in 1976, and 45,000 tons in 1977. The 1978 OY was set at 33,200 tons. USA allocations during 1973-1977 were 25,000, 18,864, 18,900, 9,000, and 12,500 (plus 2,000 for the USA recreational fishery) tons, respectively. During 1973-1975 USA catches averaged only 35% of the allocated amounts, whereas in 1976 the USA exceeded its allocation by 6%, and in 1977 the USA catch was about 75% of the allocation. The amount designated as USA capacity in 1978 was 20,600 tons.

The USA silver hake fishery in Subdiv. 5Zw is conducted throughout the entire year, although in most years the peak catches have been during May-July. Statistical area 539 has, in most years, contributed the largest share from Southern New England waters. The USA fishery in SA 6 is primarily in Div. 6A and is conducted mainly from November through May.

The foreign fishery on this stock, as with the Georges Bank stock, has been primarily by the USSR. They have fished in all areas of Subdiv. 5Zw and SA 6, with the largest share in most years (11 of 15) coming from 5Zw. Catches have been taken in all months, however, the bulk (average of 56% during 1963-1977) has generally come during February-April; during 1969-1972 the largest catches came during June-August. ICNAF conservation areas (Figures 9-13) restricted the foreign fishery both seasonally and areally. Additional restrictions were placed on the foreign fishery in SA 6 as a result of bilateral fisheries agreements. The 1977 foreign hake fishery

in Subdiv. 5Zw + SA 6 was restricted to a "window" extending from the 5Ze-5Zw boundary west into Div. 6A along the edge of the shelf which was open only through March. The 1978 foreign fishery was confined to essentially the same "window" in that fishing with bottom gear (which is needed to catch silver hake although some may be caught with pelagic gear) was limited to area 4 (Figure 15) during January-March.

4. Expansion of the USA Fishery - Potential and Problems

In an effort to relieve some of the excessive fishing pressure on cod, haddock, and yellowtail flounder, the USA fishing industry has been urged to catch and market alternate species. At the present time, the silver hake stocks in SA 5-6 constitute one of the most logical alternative resources to USA fishermen. The stocks, particularly the Georges Bank and Southern New England-Middle Atlantic stocks, are high in abundance, and current USA catches are considerably below the amounts reserved for USA fishermen. USA catches of silver hake were much higher 10-15 years ago than presently due to greater market demand (e.g. reduction, mink food, human food). Given a market demand and a fair, steady price, it is quite likely that catches would increase significantly. If the USA industry could harvest all of the estimated surplus stock available in 1978, it would increase its catch about six times over that in 1977.

Although the Gulf of Maine stock has been rebuilding since 1971, further growth is needed before it reaches the level it held in the 1950's and early 1960's. Consequently in 1978, there is not a potential for increasing catches from that stock beyond the 1975-1977 level (about 9,000 tons) if the management strategy is to continue rebuilding the stock.

The Georges Bank and Southern New England-Middle Atlantic stocks both offer substantial potential. However, in order to realize this potential, USA fishing practices would have to change. If a substantial USA fishery developed which supplied domestic and/or export markets, catches during all months of the year would be required. It is likely that the present inshore fishery could satisfy market demands during the warm months, but larger vessels than those currently used in the USA silver hake fishery which could operate during the winter and spring months along the edge of the continental shelf from southern Georges Bank to the Mid-Atlantic would be required.

Despite the potential represented by the silver hake resource, numerous problems are associated with the expansion of the USA fishery. Expanded effort in the areas along the continental shelf will result in direct conflict with USA lobster pots fished in many of the prime offshore hake grounds. This gear conflict problem existed with the foreign fishery.

USA vessels fishing offshore areas for hake would take various other species as by-catch such as mackerel, herring, squid, scup, flounder, etc. By-catch levels of these or other species could be excessive and conflict with the management of these species. This, of course, was a problem with the foreign fishery. The current inshore fishery has a certain amount of by-catch of species such as cod, haddock, flounder, etc., which would become a greater problem with an expanded fishery.

If an intensive USA winter-spring fishery for silver hake was developed in offshore waters where fish concentrate during overwintering and prior to the inshore spawning migrations, it is possible that heavy fishing on these concentrations may affect availability later for the inshore fishery. This may be particularly the case in the Southern New England-Middle Atlantic

stock. USA fishermen argued successfully in the late 1960's that the USSR fishery in fact caused such a problem which led to the establishment of the hake management area by ICNAF during 1970-1974 (Figures 9-11) which prohibited fishing for hake during January-March in 1970-1972 and during April in 1973-1974. At the present time, there is an important recreational fishery for silver hake in the New York Bight between October and June. It is important to this fishery that fish be highly available, and a sudden expansion in the USA commercial fishery in that area may reduce availability to the recreational fishery.

The current USA silver hake fishery does not have a minimum mesh size regulation although the foreign hake fishery has a 60-mm mesh regulation. If the USA fishery was expanded significantly and a minimum mesh size (e.g. 60 mm) not instituted, the potential would exist for heavy mortality on undersized silver hake and other species.

It is not likely that an expanded silver hake fishery will necessarily relieve pressure on the cod, haddock, and yellowtail stocks in all areas. The silver hake stock with the greatest potential for expansion is the Southern New England-Middle Atlantic stock. However, this area represents the southern extent of the range of cod and haddock, and consequently catches of these two species are less there than in the Georges Bank and Gulf of Maine areas. In the Gulf of Maine, where there is a need for alternate species to cod and haddock, the present potential for expanding the silver hake fishery does not exist, unless a management strategy is adopted which postpones further rebuilding of the silver hake stock and allows increased catches to relieve pressure on cod and haddock.

In Section 1, it was suggested that silver hake in the Gulf of Maine and on the northern part of Georges Bank may belong to the same stock. However, definite evidence is not available to either verify or disprove this possibility. Some may argue that the evidence for calling it a single stock is sufficient and that it should be managed accordingly. In the event of such action, it could potentially be disastrous for the inshore Gulf of Maine portion of the stock if the OY for the revised and enlarged stock were taken solely from inshore waters. Until such time as conclusive evidence would be available to determine whether the fish actually were all of one stock, traditional fishing areas and patterns should be maintained. This would imply that, for a Gulf of Maine-northern Georges Bank stock, any expansion of the fishery should be in the northern Georges Bank area.

5. References

Almeida, F. P. 1978. Determination of the von Bertalanffy growth equation for the Southern New England-Middle Atlantic, Georges Bank, and Gulf of Maine stocks of silver hake. NMFS, NEFC, Woods Hole Lab. Ref. No. 78-13 (mimeo).

Anderson, E. D. 1974. Comments on the delineation of red and silver hake stocks in ICNAF Subarea 5 and Statistical Area 6. Int. Comm. Northw. Atlant. Fish., Res. Doc. 74/100, Ser. No. 3336 (mimeo).

_____. 1977. Assessment of the Georges Bank silver hake stock. NMFS, NEFC, Woods Hole Lab. Ref. No. 77-21 (mimeo).

_____, and F. P. Almeida. 1977. Assessment of the Southern New England-Middle Atlantic silver hake stock. NMFS, NEFC, Woods Hole Lab. Ref. No. 77-30 (mimeo).

_____. 1978. Assessment of the Gulf of Maine silver hake stock. NMFS, NEFC, Woods Hole Lab. Ref. No. 78-10 (mimeo).

Conover, J. T., R. L. Fritz, and M. Viera. 1961. A morphometric study of silver hake. U.S. Fish Wildl. Serv., Spec. Sci. Rept. Fish. 368.

Fritz, R. L. 1959. Hake tagging in Europe and the U.S., 1931-1958. J. Cons. Int. Explor. Mer 24: 480-485.

_____. 1963. An analysis of silver hake tag returns. Int. Comm. Northw. Atlant. Fish., Spec. Publ. 4: 214-215.

Konstantinov, K. G., and A. S. Noskov. 1969. USSR research report 1968. Int. Comm. Northw. Atlant. Fish., Redbook 1969 (Part II): 99-117.

Nichy, F. E. 1969. Growth patterns on otoliths from young silver hake, Merluccius bilinearis (Mitch.). Int. Comm. Northw. Atlant. Fish., Res. Bull. 6: 107-117.

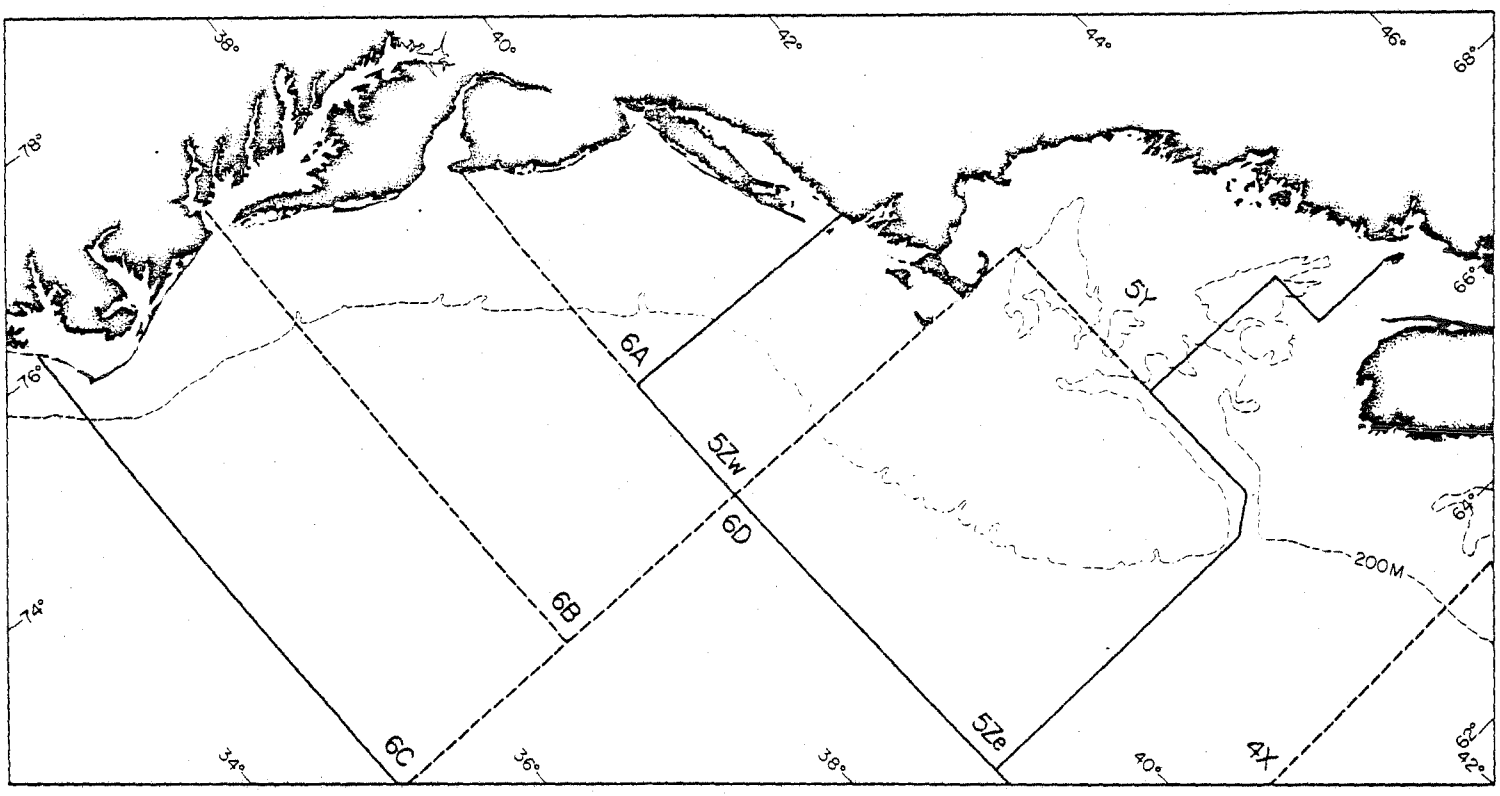

Figure 1. Divisions and subdivisions of ICNAF Subarea 5 and Statistical Area 6.

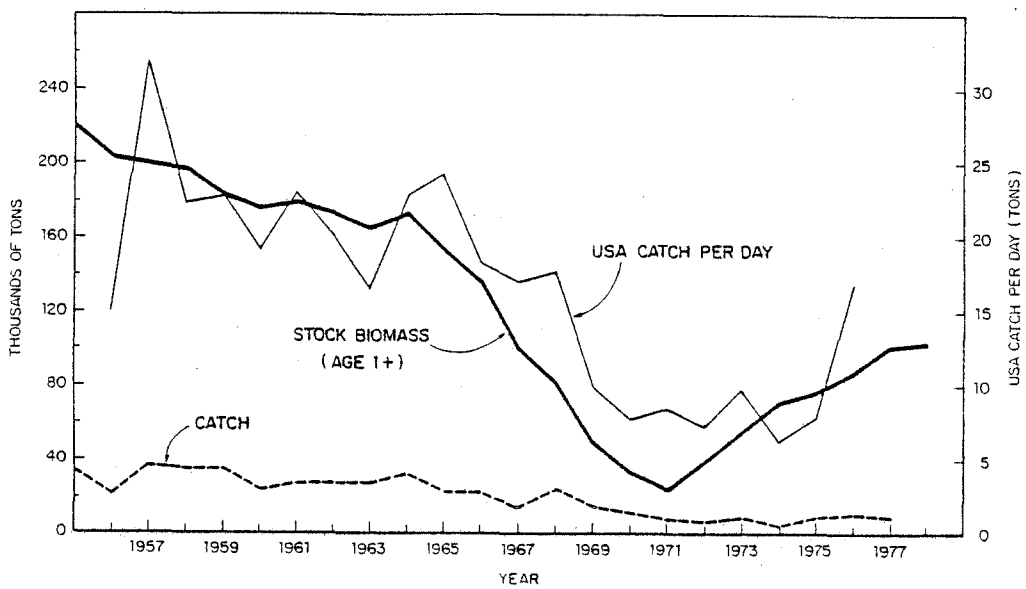

Figure 2. International catch, stock biomass (ages 1 and older) from virtual population analysis, and USA commercial catch per day from the Gulf of Maine silver hake stock.

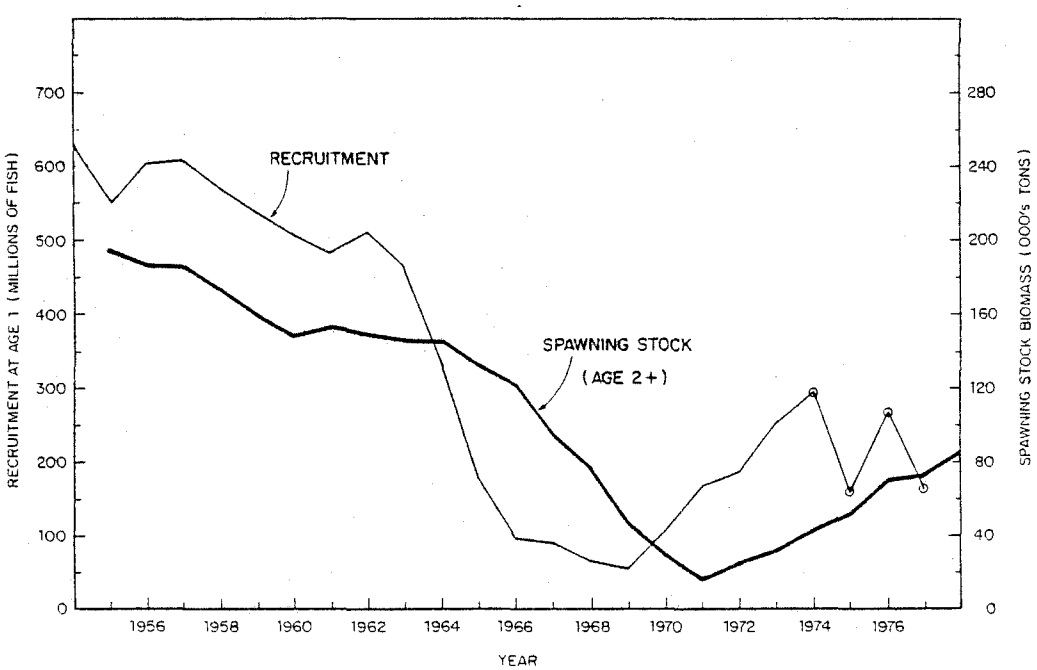

Figure 3. Gulf of Maine silver hake spawning stock biomass (ages 2 and older) in 1955-1978 and abundance at age 1 of the 1954-1977 year classes. Open circles indicate estimated year-class sizes.

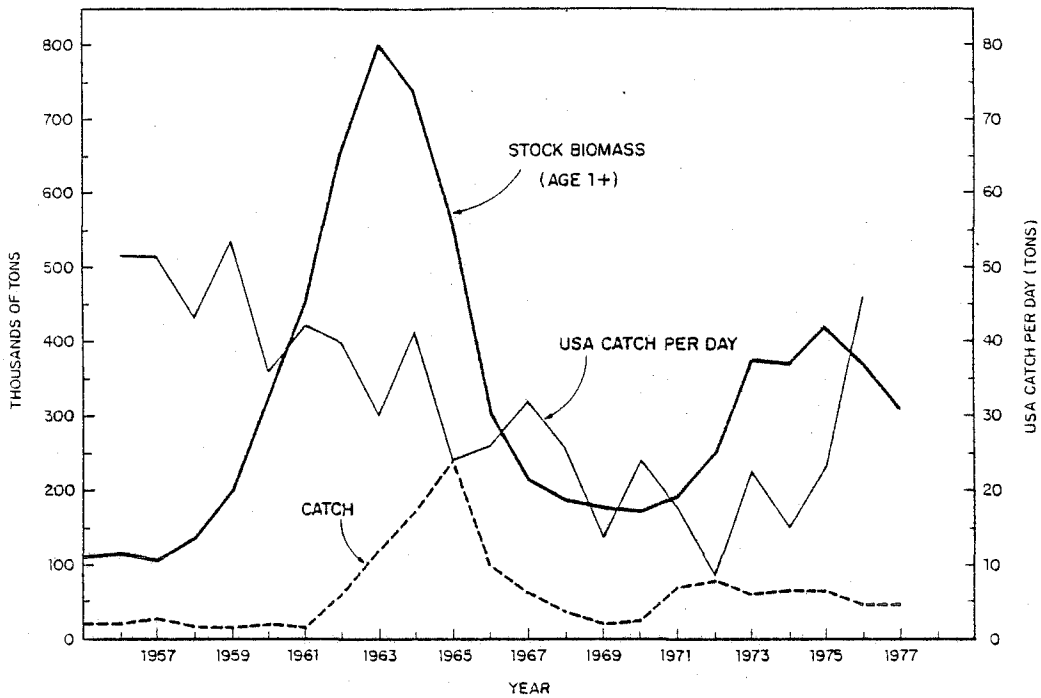

Figure 4. International catch, stock biomass (ages 1 and older) from virtual population analysis, and USA commercial catch per day from the Georges Bank silver hake stock.

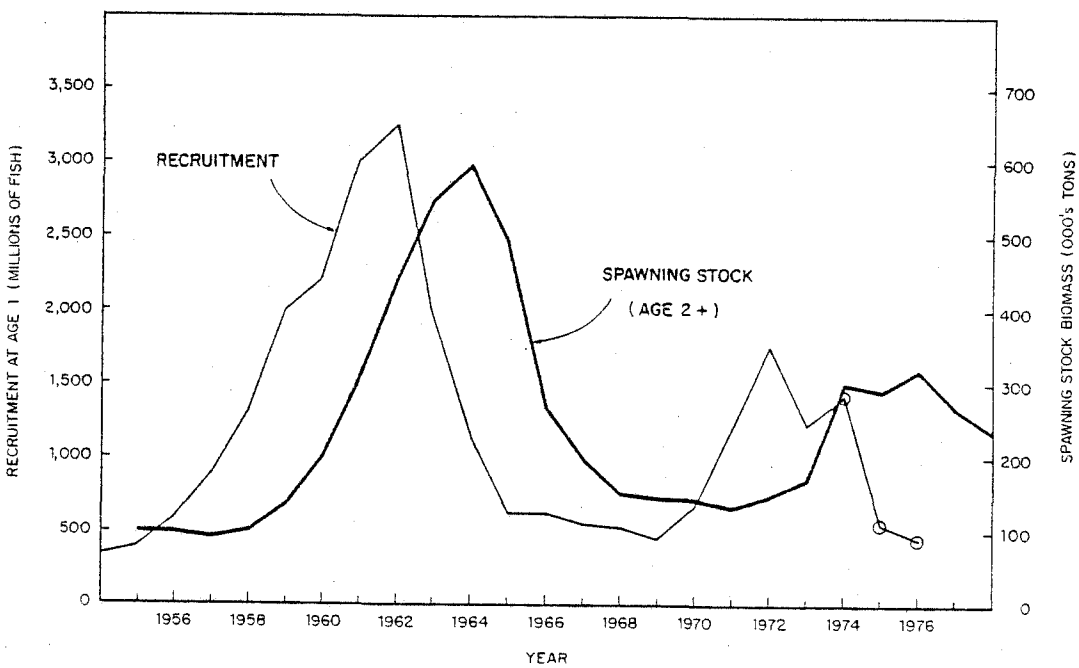

Figure 5. Georges Bank silver hake spawning stock biomass (ages 2 and older) in 1955-1978 and abundance at age 1 of the 1954-1976 year classes. Open circles indicate estimated year-class sizes.

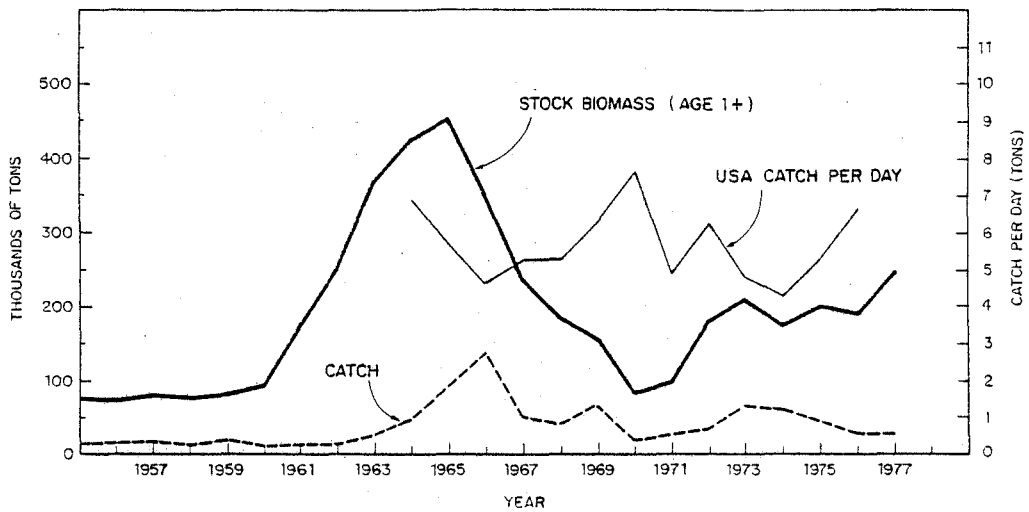

Figure 6. International catch, stock biomass (ages 1 and older) from virtual population analysis, and USA commercial catch per day from the Southern New England-Middle Atlantic silver hake stock.

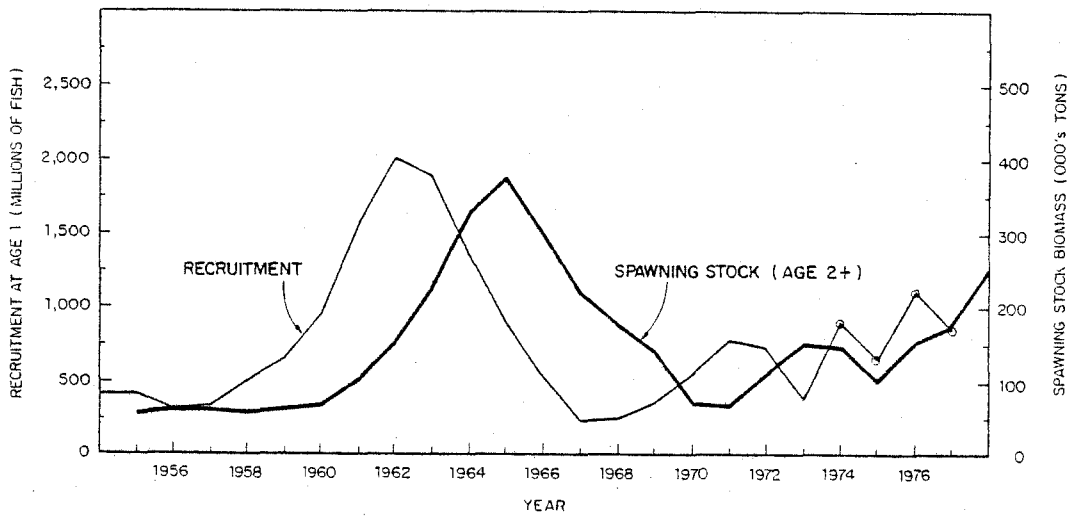

Figure 7. Southern New England-Middle Atlantic silver hake spawning stock biomass (ages 2 and older) in 1955-1978 and abundance at age 1 of the 1954-1977 year classes. Open circles indicate estimated year-class sizes.

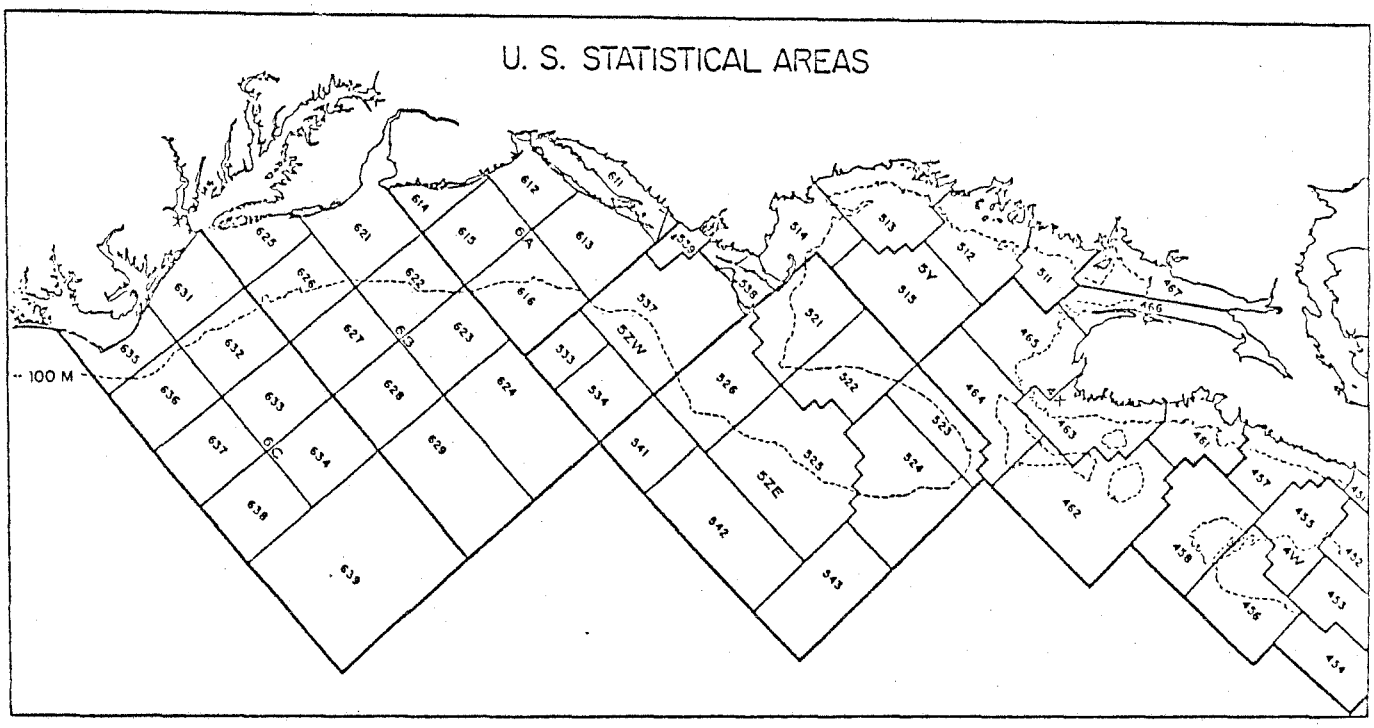

Figure 8. USA statistical areas for the reporting of commercial fishery statistics.

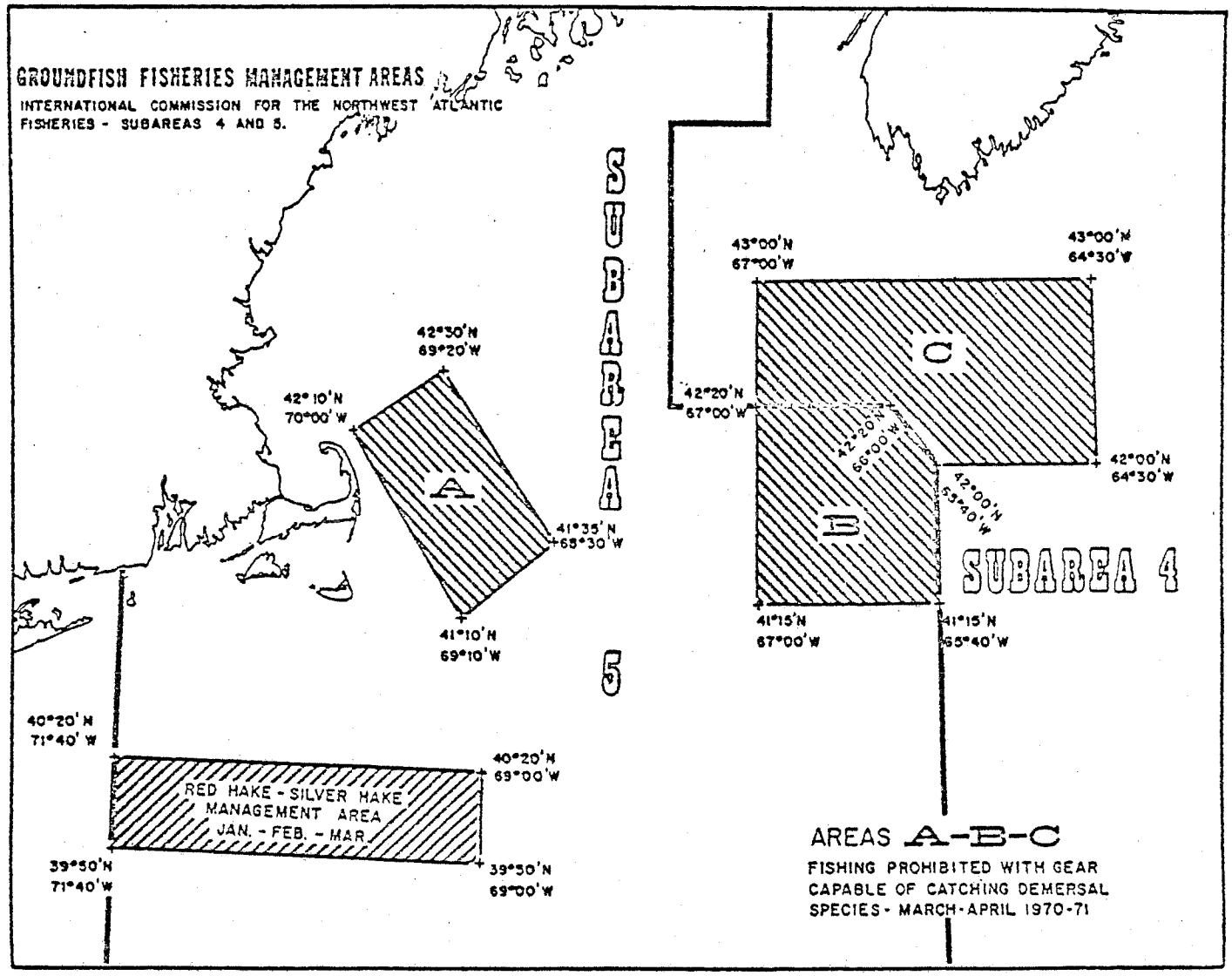

Figure 9. ICNAF conservation areas, 1970-1971.

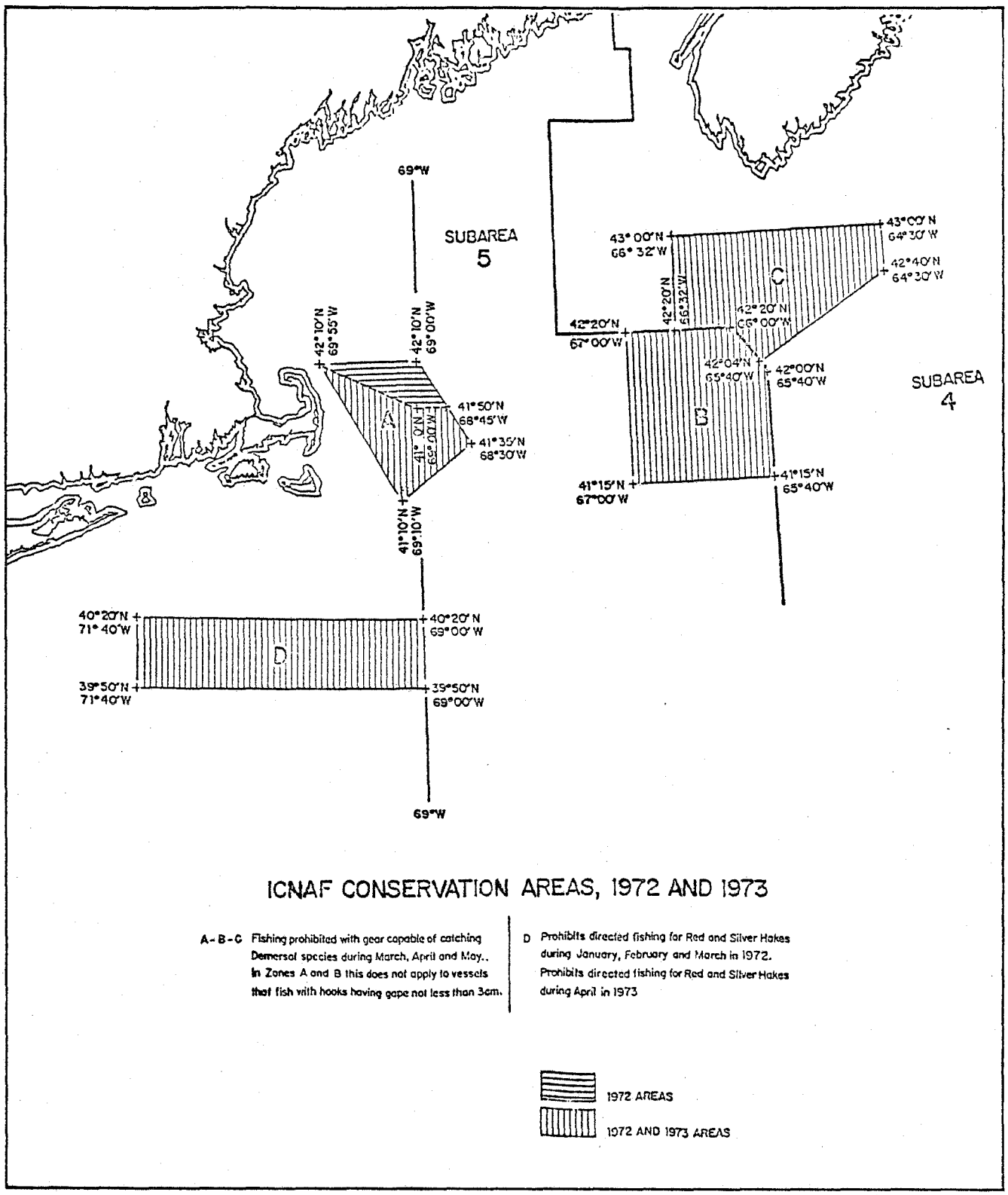

Figure 10. ICNAF conservation areas, 1972-1973.

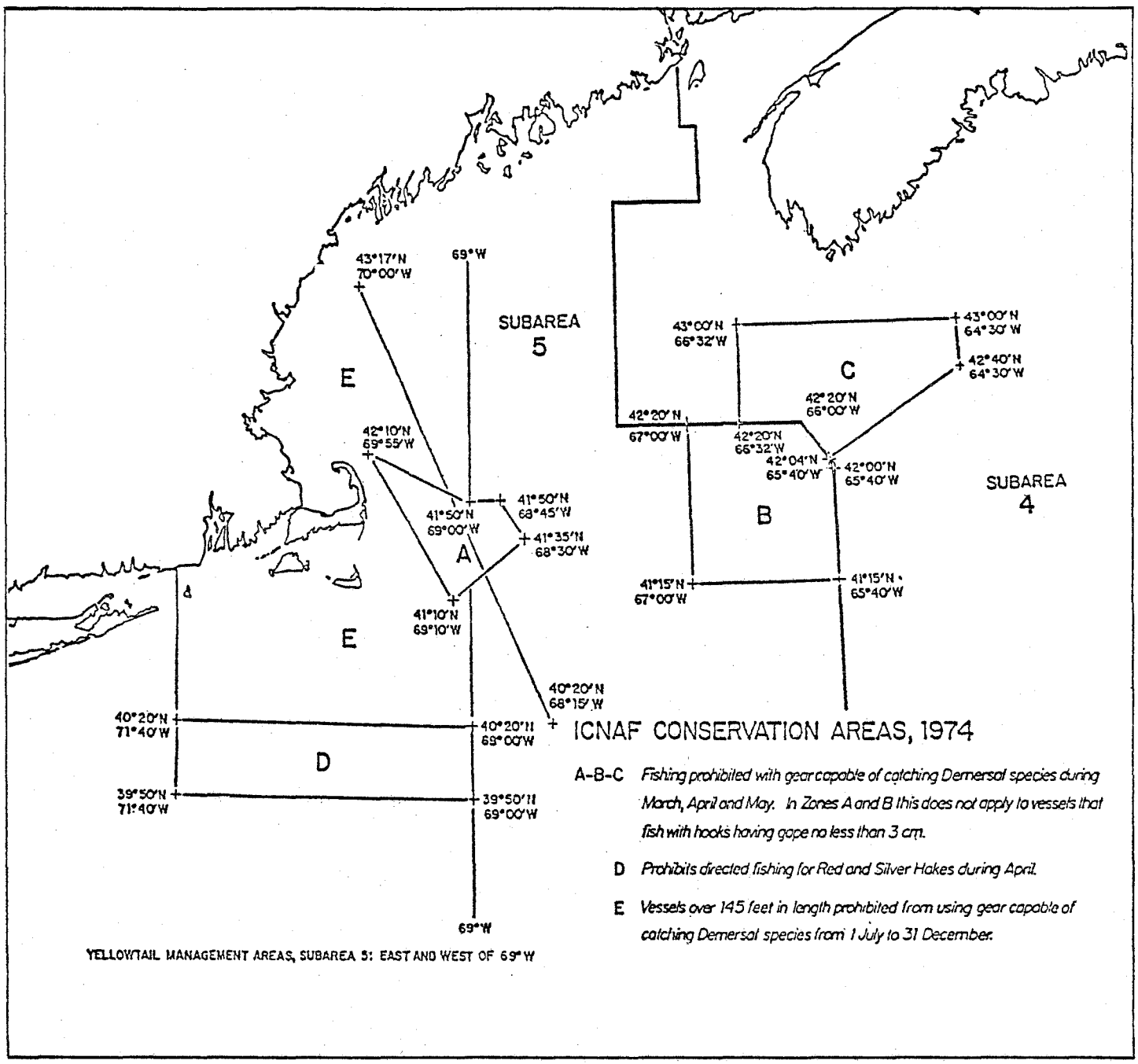

Figure 11. ICNAF conservation areas, 1974.

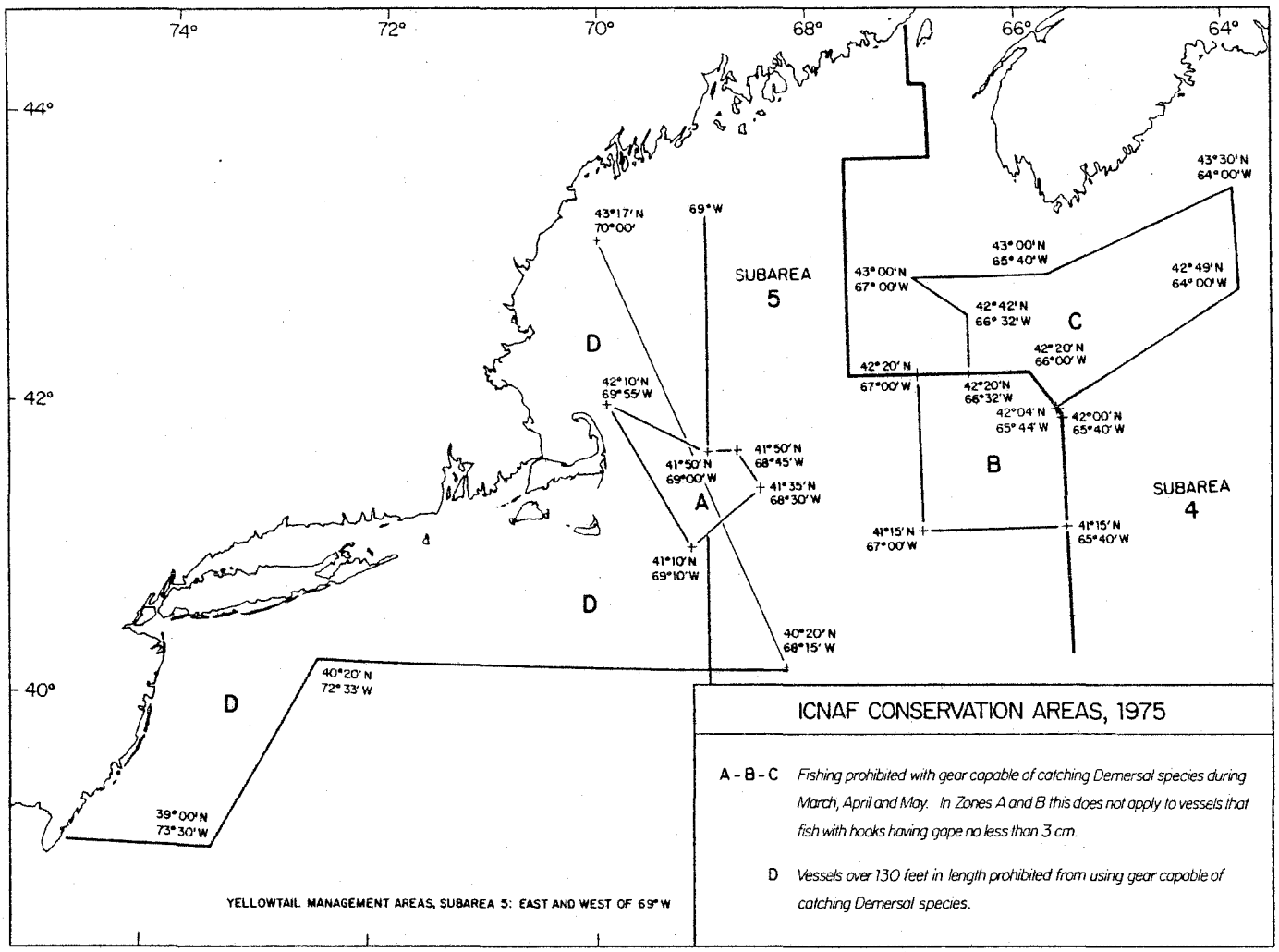

Figure 12. ICNAF conservation areas, 1975.

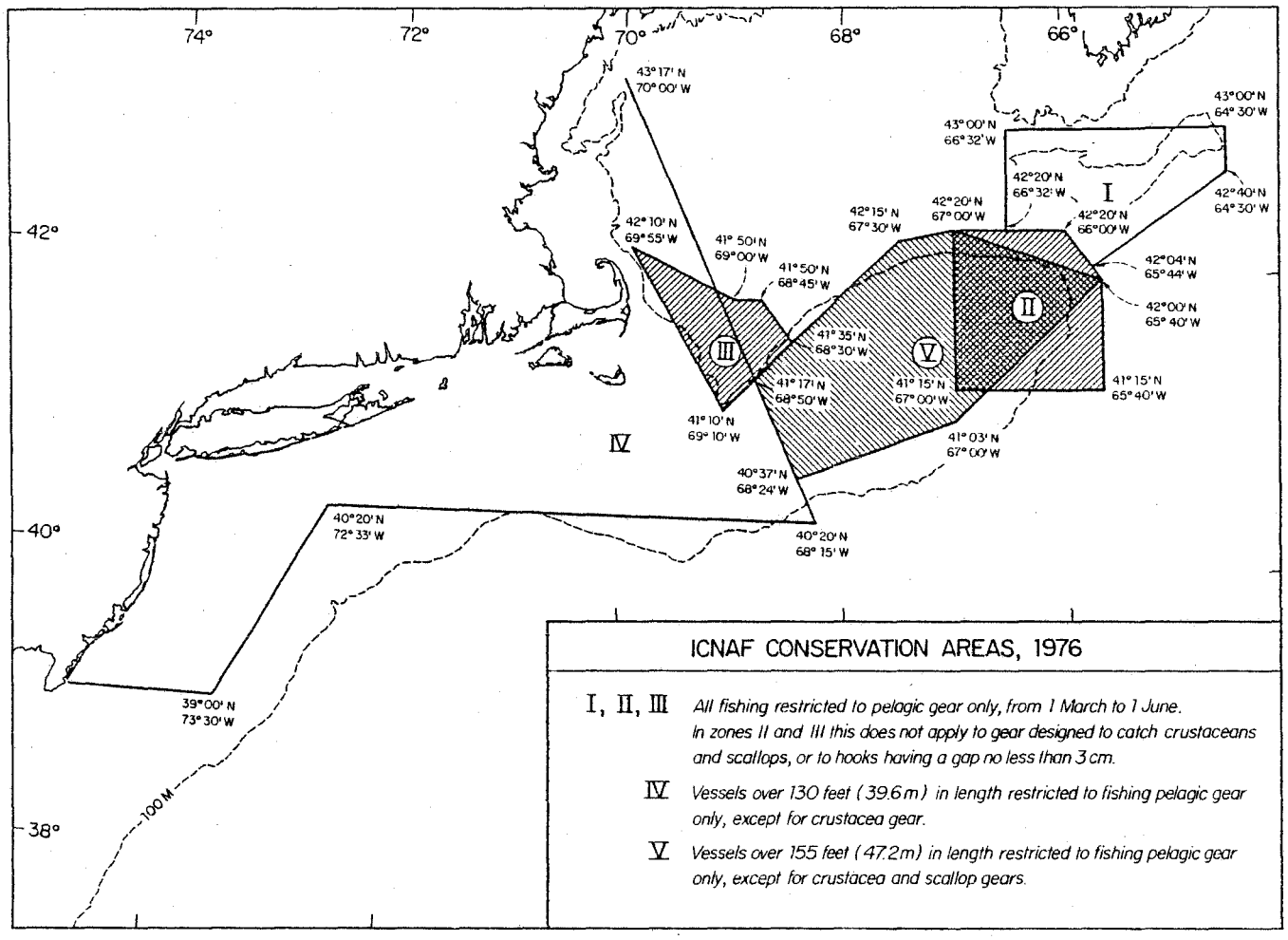

Figure 13. ICNAF conservation areas, 1976.

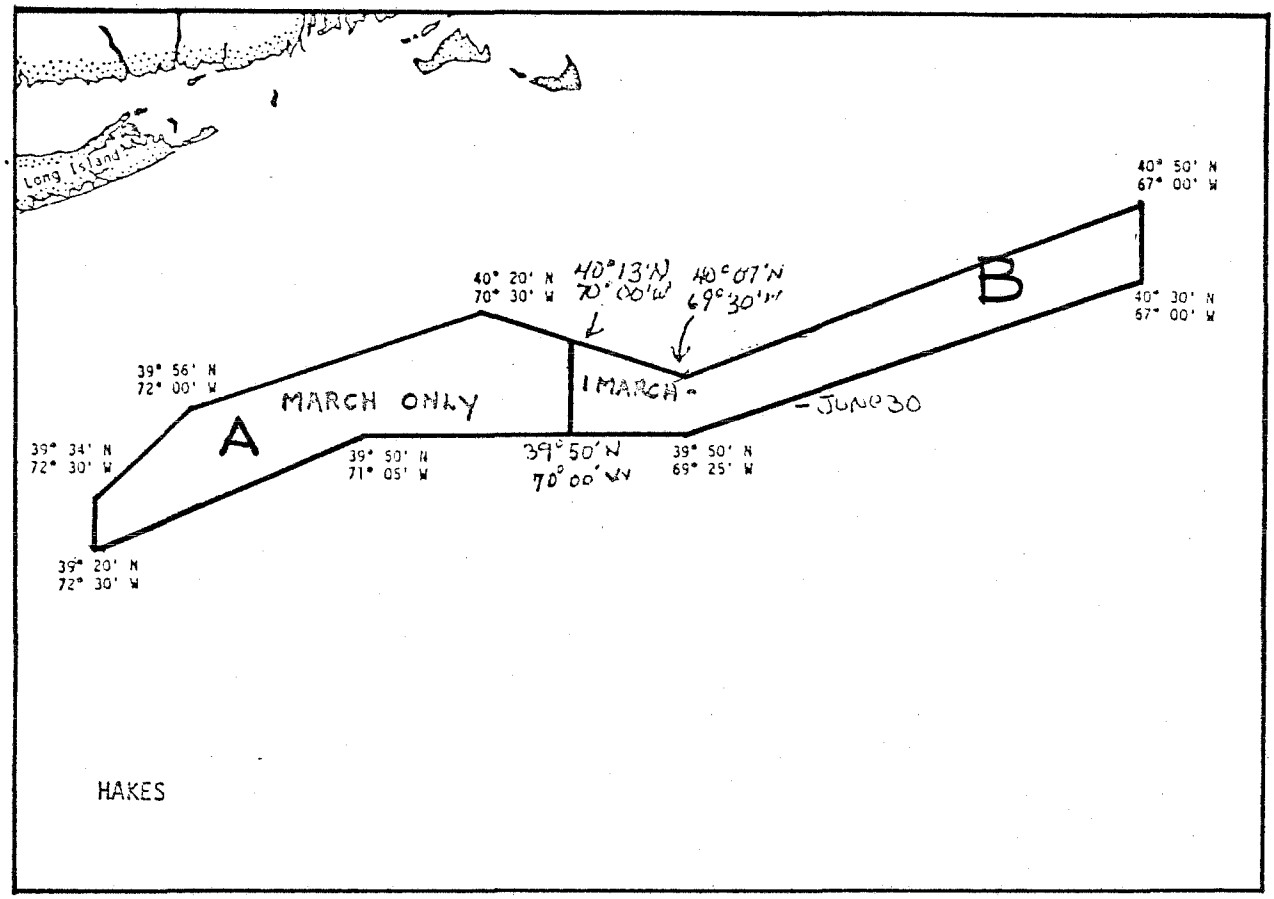

Figure 14. Foreign hake fishing areas and times for 1977.

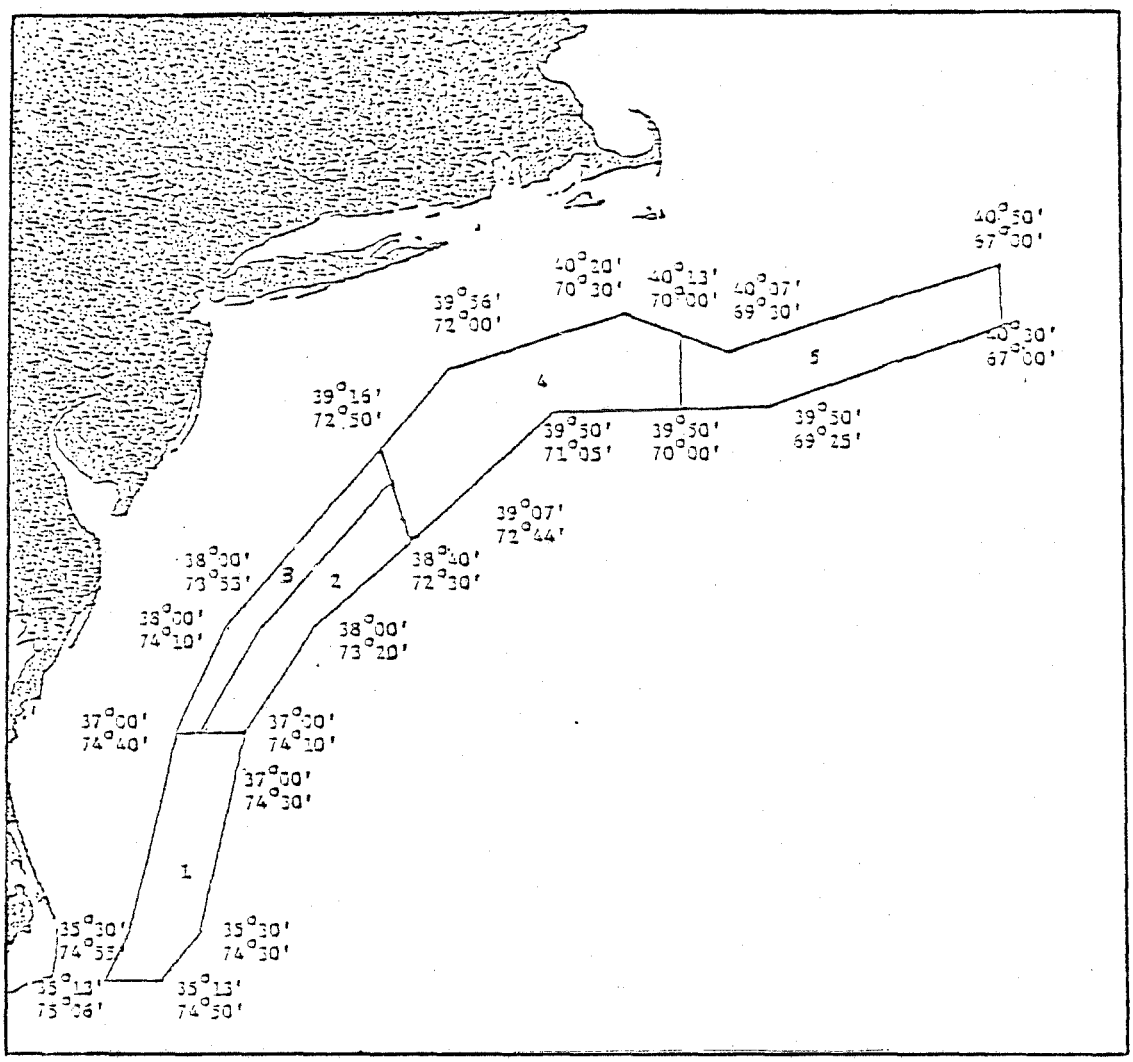

Figure 15. Foreign fishing areas for 1978.