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"Management Regions, Statistical Areas, & Fishing Grounds: Criteria for Dividing up the Sea"

WORK IN PROGRESS

by

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Currently, fisheries management in the Northeast takes place using a variety of spatial divisions based variously on biological, social, political, and economic criteria. This paper examines some of these different spatial divisions, such as management region, statistical area, and fishing ground, and discusses some of the implications of these differing criteria as used by various stakeholders in searching for effective management.

Introduction

Fisheries are often cited as one of the most difficult resources to manage, due to their nature as both fugitive and as common pool (McCay & Acheson, 1987; Acheson, 1989; Libecap, 1989; Ostrom, 1990). Because "fish have tails", as fishermen[1] often say, only for certain sessile species does the idea of owning a piece of the sea even make sense -- unless the owned territory is large enough to encompass the total range of the species. This is an unreasonable option for a private individual in most nations, though large territorial areas have sometimes been granted to groups (e.g. Japanese community cooperatives). Even these are not based on species range (Matsuda & Kaneda, 1984).

In managing fisheries, nonetheless, one important starting point is the delimitation of areas which have sufficient characteristics in common to be managed as units. While the sea is in one sense without strict, intrinsic boundaries, there are differences in bottom type and topography, in the mix and distribution of species, in the size of boats and types of gears which fish those species, in the characteristics of the fisherfolk who use the boats and gears, and in the jurisdictional rules of those political entities (formal and informal) whose borders touch the sea.

Fisherfolk and scientists consistently divide up the territory of the sea for such purposes as indicating productive fishing spots and nursery grounds, delimitations of species ranges, faunal boundaries, and locations of important currents. Many management tools have explicitly or implicitly used assumptions about biological, political, social, and economic territories in creating gear and target species restricted areas, establishing regional management zones, and setting state quotas on landings. With each group possessing its own cognitive map, there may be dissension about the appropriateness of the delimited areas. In this paper I discuss some of the different criteria by which managers, scientists and fishermen divide up the sea, and potential implications for management.

Materials and Methods

Data for this paper have been gathered through ethnographic research as well as computer database searches and library research. The ethnographic portion was conducted as part of a series of visits to different ports. By state, these were: in Maine, Stonington, and Portland; in New Hampshire, Portsmouth, and Seabrook;

[1] There is a debate within social science circles over the appropriateness of a gender-specific term such as "fishermen". However, in the Northeast most fisherfolk are men and even those who are women tend to prefer the title "fisherman". Since This paper concentrates on the Northeast, I will frequently use the gender-specific term.

in Massachusetts, Boston, Gloucester, Chatham, and New Bedford; and in Rhode Island, Point Judith. The total ethnographic sample is small (N=21) and non-random (e.g., 5 fishermen are from Stonington), consisting of those fishermen available on the day I spent in each port as part of a "get acquainted" tour after beginning my job in Woods Hole. The number of fishermen available depended on the physical layout of the port and docks as well as the timing of landings and patterns of dock behavior common to each port. Thus, for instance, in Gloucester vessels landed at about the same time at scattered docks, a few to each, and left very soon after taking out (unloading). In Stonington, on the other hand, landings were sequential and fishermen more likely to stand around chatting for a time.

Fishermen were asked basic demographic data and were requested to create maps of where they fished by season and species, using tracing paper placed over NOAA nautical charts. The degree of specificity varied considerably. Some fishermen indicated areas which encompassed most of the Northeast coast and said they fished for whatever was out there (see Figure 1). Others drew numerous small areas, each of which was specific to a certain time of year and species mix (see Figure 2). Only one fisherman hesitated before drawing the map, and he indicated he would do so on the condition that I did not show the map to any other fishermen. No one refused to be interviewed.

The computer searches involved two NMFS databases, "weigh out" and "sea-sampling". The weigh out database is limited in its ability to track territoriality due to several factors: the element "home port" is no longer supported by NMFS and record sets containing latitude and longitude data are difficult to cross over record sets containing either home port or principal port (port where the plurality of value for a vessel was landed in a given month). Bisack (pers. com.) chose to use sea sampling instead to avoid these and other problems. Sea sampling suffers, however, from skewed samples, since vessels located in Scituate, MA near the sampling institution (Manomet Bird Observatory) are consistently re-sampled while more distant ports may not be sampled at all. I chose to use the weigh out database for its broader coverage, but limited my degree of specificity to NOAA/NMFS/NEFSC[2] statistical areas. In doing so, of course, I do precisely what I am questioning in this paper. I impose a scientific grid on fishermen's patterns[3].

Future work with these concepts will involve mapping tow locations for otter trawls using sea-sampling data, loading fishermen's maps into a GIS, and additional mapping and interviewing.

Differing Criteria

In this section, I explore the fishermen's conceptions of territory at sea, and compare them to those of scientists and managers. In many ways scientists and fishermen have the most similar cognitive maps. Yet in the course of scientists contributing to management, fishermen have come to believe scientists know very little about the ocean -- at least in ways that fishermen understand to be meaningful. The converse has also sometimes been true, with scientists believing fishermen are ignorant about the very medium on and from which they earn their livelihood and make their lives. Managers can be caught in the middle, trying to please both sides -- and the politicians -- and yet too often alienating them all.

Fisherfolk

A number of authors have discussed the question of territoriality among fisherfolk in recent years. True territoriality seems to be most commonly associated with the use of stationary gears such as pots, traps, and fixed nets, and is more likely to be found in small, community-based, inshore fisheries. In the U.S. Acheson has described the territories of Maine lobstermen (1987, 1979, 1975), while Overbey has examined similar self-regulation among stone crab and shrimp fishermen in the Gulf of Mexico. Stiles (1976) found that codfishermen in Newfoundland who use stationary gear also have established territories, and that even codfishermen using mobile gear observe informal spacing conventions. Cordell (1989) has surveyed inshore fishing territories worldwide. Davis (1984) has described a case in Nova Scotia where different portions of the sea, both inshore and offshore, are delegated to specific gear types. Pálsson (1982) and Durrenberger and Pálsson (1986), meanwhile, have examined the question of territoriality among offshore Icelandic fishermen.

Fishermen divide up the ocean by such categories as inshore versus offshore, hard bottom versus soft bottom, shoals versus deep water, named ledges, banks, shoals and canyons, known "snags" or "hangs" which can destroy gear, depth contours, and species-specific or species-group-specific sites. Furthermore, fishing grounds are often categorized by seasonal usage: winter, spring, summer, fall, year-round, or sometimes only

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[2] This is the National Oceanic and Atmospheric Administration/National Marine Fisheries Service/Northeast Fisheries Science Center.

[3] However, one of anthropology's areas of interest is precisely in mapping the intersection of the emic view (that of a member of the culture) and the etic view (that of an outside observer).

a specific month. Even the definition of "winter" or "year-round" can vary from individual to individual. The extent to which different locations are fished then depends on the size and horsepower of the boat, the current gear and obstacles to changing gear (time, expense, available space on deck), the particulars of this year's fishing, and the captain's personal experience, cultural norms, and individual preferences (cf. Murawski et al. 1991:251-252).

Some differences in fishing patterns can be discerned by port. For instance, Bisack (pers. com.) has found that in New England sink gillnet fishermen from adjacent ports of landing tend to have fished in the same area. By choosing the port where the plurality of landings have occurred for each vessel in her sample (defined as "principal port" in the weigh out), and glossing that as home port, she has distinguished 4-5 separate fisheries territories associated with groups of adjacent ports[4]. This agrees with fishermen's own descriptions. Said the owner-operator of a 40 foot gillnetter out of Portsmouth: "Inshore day gillnetters are almost as territorial as lobstermen." Said the owner of a 38 foot gillnet boat, commenting on some proposed regulations: "Area/time closures are crazy. Large areas would tie us up anyway. We don't have the range."

Murawski indicates that certain areas of Georges Bank off the northern New England coast continue to be fished -- especially by Gloucester fishermen -- even though other areas are currently more productive (pers. com.). Historical data (Goode & Collins, 1887) and port agents in Gloucester confirm that Georges is a favorite fishing area for Gloucester boats. In addition, Miller & Van Maanen (1981:36) note: "Many of the Gloucester boats have fished the same grounds for years and their charts reflect this fact for they are full of markings indicating safe lanes and alleys."

Weighout summary trip files show that percentage of trips to the NOAA/NMFS/NEFSC statistical areas encompassing Georges Bank by vessels by principal port for Gloucester show a significant rise in trips to Georges Bank statistical areas between 1972 and 1982, but no significant[5] movement between 1982 and 1992 -- when stocks were dropping (see Table 1). Gloucester port agents add, however, that the lower concentrations of fish in the past 12-15 years have meant that Gloucester boats are also found frequently on Jeffreys Ledge and Stellwagen Bank. New Bedford, by contrast, showed a significant increase of activity on Georges between 1972 and 1982, and a significant drop in activity between 1982 and 1992. Boston's and Portland's Georges activity have shown no statistically significant change in either period, with Boston maintaining a fairly strong interest and Portland a modest interest (appropriate to its greater distance from Georges Bank).

In a related vein, Gloucester and New Bedford boats are said by Portland fishermen to fish much more crowded together than Portland vessels. "Why do you think they're always building up the sides and bows?", a Portland dragger asked me. "They ram each other all the time, so they need to keep adding protection." Within Gloucester itself, "greaser" or recent immigrant boats are said by more established residents to "fish in packs" (Miller & Van Maanen, 1981:35)[6].

Many fishermen describe grounds which cross statistical areas, and management region boundaries. In addition, NMFS port agents note that with longer tows and fewer concentrations of fish, fishermen do cover much more territory and are frequently in multiple statistical areas in single trips. This does not show up in the NMFS weigh out files, however, because the weigh out form allows for only one statistical area of record. Thus when a trip covers more than one area, the port agent must choose the area where most of the fishing seems to have occurred.

Even with this limitation, though, we can begin to examine range by the number of NOAA/NMFS/NEFSC statistical areas recorded for a vessel over the course of a year. For example, 43% of the gillnet fleet fished in more than one statistical area in 1992. This is a substantial increase over 1982 when only 25% of gillnet vessels fished in more than one statistical area (Pollard, pers. com) -- although the overall pattern of statistical areas has not changed in a significant way at the alpha = 0.05 level. While scallopers have fished multiple areas over the whole decade (e.g., 73-74% fishing 5 or more areas), the number of vessels fishing in 7 or more areas has increased from 13% in 1982 to 34% in 1992. Otter trawls in general show little change in fishing patterns. Clammers have shown no statistically significant pattern changes, although tonnage class 2 clam vessels do seem to be fishing a single area more heavily today than in 1982 (See Tables 2,3,4).

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[4] Details of these data are currently being analyzed for use in regulatory decisions and therefore can not yet be discussed publically.

[5] Throughout this paper "significant" indicates statistical significance at alpha = 0.05.

[6] Increasing numbers of vessels overall has led many fishermen to complain of general crowding. Gatewood and McCay (1990:22) found that "crowding on the fishing ground" was a significant item of dissatisfaction for baymen, scallopers, draggers, and longliners in New Jersey. Crowding among lobstermen in Portland Harbor has led to violence several times in the summer of 1993.

Further, fishermen from New England may range into the Mid-Atlantic and fishermen from the Mid-Atlantic may range into New England -- in addition to fishermen from both regions occasionally fishing outside of the Northeast altogether. A fisherman based in Point Judith, RI, for instance, may "take out" (land his catch) anywhere from Stonington, ME to the Gulf of Mexico. In most cases where a vessel ranges far from its home port, it moves to the new area for the course of a season. In these instances we have migrant workers rather than commuters.

In addition, there is the question of those portions of Georges Bank and other traditional grounds which are now Canadian. The Northeast Peak, on the Canadian side of the Hague Line, is firmly embedded in many fishermen's conception of available fishing area. This international boundary, then, is a source of constant irritation. Despite its being in effect for nearly a decade, with no signs that it will ever be changed, fishermen constantly refer to the unfairness of its imposition and propose alterations. For example one fisherman (owner of a 65 foot Gloucester dragger) noted, "If there is a line, and a closure of 50 miles on one side[7], then there should be another closure for 50 miles on the other side, because the fish will just swim from the closed area on one side of the line to the open area on the other, & the Canadians benefit." Another fisherman (owner of an 86 foot Boston dragger) commented that what's frustrating to him is that he sees haddock just the other side of the line. "From the Hague line to Nova Scotia is a more productive area than from Boston to the Line. There's something about the bottom contour and maybe other factors. The fish don't cross the Hague Line... The Canadians are hitting the fish before they get here. You hear the Canadians talking [on the radio]... It would really help if the Hague Line could be extended from Grand Manaan down, 20 miles along the line (67 degrees). The Canadians don't fish there anyway."

While the area fished per trip and per year may be increasing, evaluating weigh out data shows the number of ports of landing per year is generally not on the rise. Scallopers, in fact, are landing in fewer ports in 1992 than in 1982, though the change is from 63% in a single port in 1982 to 73% in a single port in 1992 does not represent a statistically significant change in overall pattern. Clammers as a group are similar (43% in a single port in 1982 and 55% in a single port in 1992), though the impetus here is at least partly related to the introduction of ITQs and a subsequent decrease in the number of vessels. Further, disaggregating by size shows that the smallest and the largest clam vessels are landing in fewer ports due to their often being owned by processors. The smallest vessels were the most likely to disappear from the fleet. While these small vessels were always most likely to land in a single port throughout the year, they are now somewhat more likely to do so. Draggers continue to land about 60% of the time in a single port and 30% of the time in no more than 2 ports. Gillnetters, on the other hand, landed in more than port only 17% of the time in 1982 but 26% of the time in 1992 (Pollard, pers. com.). While this again is not statistically significant, when coupled with the change in number of statistical areas fished by gillnet boats, it seems to show a more mobile gillnet fleet (See Tables 5,6).

Fishing grounds, gear type, and targeted species are mutually influencing variables. Where you fish affects what gear you use and vice versa, not just due to species, but due to topographic conditions. Fishermen who frequent the hard bottom of the Gulf of Maine, for instance, rely heavily on rock hoppers to prevent torn nets. Rock hoppers are superfluous, though, for those who fish the soft bottom off Point Judith. Bottom type can also be combined with gear type in discussing territoriality. For instance, in hard bottom where only certain areas are towable, these areas are often considered to be off limits to gillnets and other non-trawl gear. Species ranges mean that the southern New England fishery allows for more targeting of whiting and other small mesh species than does the northern New England fishery. Further, some fishermen simply like or dislike certain species or gear types.

For example, the owner-operator of a 65 foot dragger out of Gloucester, MA says that in winter he fishes first for groundfish, in inshore waters from Cape Cod north along the Boston traffic lane and then out to Murray Basin. Then, if fishing is poor, he'll go further offshore -- around Wilkinson Basin -- and fish for flatfish. He prefers not to do that, though because "flatfish are boring." Referring to a gear rather than a species preference, a gillnetter from Seabrook, NH stated: "I tried dragging, but I liked gillnetting better. It's more selective." Said a gillnetter from Stonington, ME: "That's [gillnetting] why I bought the boat." He also goes scallop dragging and if that isn't going well switches to shrimping. He prefers scalloping to shrimping, but likes gillnetting best of all. Another Stonington gillnetter, with a 40 foot boat says he catches urchins in the winter and could live off urchining now, but doesn't want to -- too boring, and the divers are "big babies".

Small and rural ports, such as Stonington, ME, have a higher percentage of small boats (variously described as 60 foot and under or as 30 foot and under) than a large port such as New Bedford, MA. These small boats have traditionally fished within 20 miles of shore, though they will venture out further if fishing is poor (Peterson & Smith, 1981). A small boat is usually a "day boat", i.e., the skipper leaves in the wee hours

[7] He refers here to Area 2, a US region which is closed to fishing from February 1st to June 1st, in order to allow haddock to spawn unmolested. Amendment 5 to the Northeast Multispecies Plan is currently under consideration. It would enlarge Area 2 in time and space on the U.S. side, but not affect the Canadian side. Currently Canada also enforces a spawning closure.

of the morning and returns around sunset. Larger boats most frequently are "trip boats", leaving port either for 2-5, 7-10, or 10-15 days at a time and having much larger ranges[8]. These differences have implications for the social structure of the communities and the families of fishermen as well as for fishing effort.

Many fishermen have very strong feelings about the choice of day versus trip fishing, due to issues such as time spent with family and predictability of schedule (Binkley, 1990; Gatewood and McCay, 1990; Apostle, 1985; Pollnac & Poggie, 1988). Miller & Van Maanen (1981:30-31) note that in Gloucester the most important division among fishermen is between inshore and offshore draggermen. Day fishermen often have a strong commitment to day fishing in order to spend time with family and be active in the community. Nor is community a factor only for inshore vessels. In a survey of Nova Scotian offshore fishermen, Binkley (1990) found that community attachment was of "extreme importance" in measures of job satisfaction.

Furthermore, small boats often rely on gear switching, unlike large boats for whom such switching is often prohibitively expensive (Dewar, 1983:24) and who must therefore cover more area in search of their initial target species (what some have called a biosystem approach) rather than staying in a smaller zone and adjusting to what is there (an ecosystem approach). Ninety three percent of gillnet vessels in the Northeast, for instance, fish with other gear (usually otter trawls or shrimp trawls) for 20% of the year. Shrimp trawls have a 6 month off season in which they use otter trawls, gillnets, and lobster traps.

The owner of a 42 foot gillnetter out of Stonington: He gillnets for cod from May through October, and also brings in some pollock and hake. In the winter he scallops. The owner of a 40 foot gillnetter out of Stonington: He gillnets from the end of April to September or October. The rest of the year he goes urchining. A Stonington man who owns 4 boats in conjunction with 2 relatives: He's done gillnetting, clamming, lobstering, musseling, hauling bait. November 1st through April 15 their boats do Maine inshore scalloping, sometimes shrimping, groundfish. Two of the boats are going hag fishing. For the last 2-3 years he's been going longlining from the end of November to April.

By contrast, those who consider themselves otter trawlers do not do significant amounts of fishing with other gears (Pollard, pers. com.), though they may fish for different species. This sort of "annual round" is illustrated by the following examples:

The captain of a 59 foot dragger out of Point Judith: "We fish for whiting and squid mostly, mackerel for the last few trips". They fish anywhere from 30-50 miles offshore, though this winter (January to April, 1993) it's been more like 80 miles. Given the lack of fish lately, they'll probably continue to stay further offshore year round. If fishing is really bad, they may try for red crab or monkfish, from June onward, "if yellowtailing doesn't happen".

The owner-operator of a 60 foot boat out of Point Judith: In late summer, when the inshore fishery is in the doldrums, he may make 2-4 trips to below the dumping area, for whiting. In the fall, there are scup northwest of the closed area. In spring there are winter flounder off the Block Island, and in late spring whiting and flounder are in Block Island Sound. He also designated scattered other areas as "year round" for either, "flounder, squid, scup", "whiting, squid, flounder", "whiting, fluke, scup", or "whiting, flounder" -- indicating the relative prevalence of different species in each location.

Both limited ability to switch gear and preferences for specific gears influence inter-gear rivalries. Lobstermen complain that draggers tow through traps. "Draggers destroy the bottom", say many gillnetters. "Draggers clean the bottom, but nets are selective of sizes, always are set in a new spot." Draggers respond that, "Gillnetter block off whole areas for themselves" or "Gillnets block migration routes and disrupt the fish". Further, these gear conflicts may be influenced by other factors. A Maine small boat fisherman, for instance, says, "Small draggers aren't a problem. They're too small to get on our gear or tow through it. The big guys, though, think the high fliers are goal posts! They just drive right through." As different gears attempt to fish in the same area they may interfere with each other either intentionally or accidentally. This leads to claims of priority. While not territoriality in a strict sense because these may not be grounds permanently assigned to particular individuals or fleets (cf. Pálsson, 1982; Durrenberger & Pálsson, 1986), these disputes do show perceptions of delimited areas.

Scientists

One way of looking at scientific boundaries is to examine the statistical sampling areas used to collect and compile biological and other data. There are numerous levels of statistical sampling areas defined for the Northeast coast. At the most aggregate levels the areal boundaries are defined by North Atlantic Fisheries

[8] There is some division by age among the fishermen with respect to day versus trip boats as well, with younger men more likely to work on the long trip boats and older men, near retirement, more likely to work day boats. Said one fisherman in his mid thirties about his decision to leave a freezer boat for a boat which makes 2-4 day trips, "I'm not 25 anymore."

Association (NAFO) conventions. These internationally agreed to boundaries stem from efforts by the North American Council on Fishery Investigations (NACFI) beginning in 1921, and continued by the International Commission for the Northwest Atlantic Fisheries (ICNAF) until 1979, when it was superseded by NAFO. In 1979 these ICNAF boundaries were accepted unchanged as the NAFO Subarea, Division, and Subdivision boundaries (NAFO 1980).

Within the NAFO Convention Area there are Subareas 1-5 and subsumed Divisions, Subdivisions, and statistical reporting areas. There is also a sixth region, added in 1967 to coordinate with the boundaries of the International Council for the Exploration of the Sea (ICES) statistical area (ICNAF 1967). It is complementary in size and scope to the Subareas, but called Statistical Area 6. It too contains Divisions, Subdivisions, and statistical reporting areas (see Figure 3). Finally, each of the NAFO Divisions is separately segmented into NOAA/NMFS/NEFSC statistical areas (see Figure 4). A NAFO statistical reporting area is 30 minutes by 30 minutes[9] (ICNAF 1974), while a NOAA/NMFS/NEFSC statistical area varies in size from 2 degrees by 2 degrees (area 639) to an irregular shape approximately 1 degree by 30 minutes (area 539).

In theory, the NAFO demarcations correspond to general fish stock[10] boundaries, however they appear to correspond only to the stock structure of cod and haddock (Halliday & Pinhorn 1990:2,39-40), two of the most important groundfish or demersal species during the period when these lines were drawn. Currently, haddock stocks are very low and catches are minimal (10% of their historical highs). Cod is still an important species (though it too is depleted in some areas), but many other groundfish such as pollock, hake, and flounder have gained in importance. In addition, there are species still categorized as "underutilized", but gaining in popularity such as the pelagic species of spiny dogfish and skate. Finally, while groundfish comprise the bulk of landings in New England, in the Mid-Atlantic, in addition to the demersal silver hake, pelagic species such as butterfish and squid are common. Thus existing boundaries were not created with the majority of currently important commercial species in mind.

Rounsefell (1948) describes the NAFO system and the reasons for its adoption as to determine population trends and facilitate the calculation of maximum sustainable yield (MSY) for the various fish populations. "He then emphasized the need for a stratified sampling scheme requiring the delineation of areas homogenous with regard to fish density as the basic sampling units for the collection and analysis of fishery statistics" (Halliday & Pinhorn 1990:6; emphasis mine). "Hence homogeneity of fisheries, and particularly fisheries participation, [was] a key factor in the definition of Subareas." Côte (MS 1953), on the other hand, felt these subdivisions of Subareas should be considered only to the extent they helped to delimit areas homogenous with regard to stock composition (as opposed to fish density; emphasis mine). Both of these views, though, see the NAFO areas as primarily designed around biological and statistical considerations, not management per se. Yet it was administrative concerns which governed boundaries in the end (Halliday & Pinhorn 1990:7-9).

Another way of looking at scientific boundaries is to discuss fish assemblages and their spatial locations, ecosystems and niches, depth zones such as benthos and necton, environmental criteria which limit the movements of particular species, ocean bottom topography, the locations of and areas influenced by currents, and other regions defined solely by variables endogenous to the system under study. Since to cover even a fraction of such considerations is beyond the scope of this paper, I will limit my discussion to the brief listing above.

Managers

A basic delimitation is between U.S. waters and Canadian waters. The current boundary, the Hague Line, was set by the International Court of Justice (ICJ) in 1984, to settle disputes between the U.S. and Canada over the overlapping borders of their respective EEZ's (Exclusive Economic Zones, in the U.S an area from 3 miles offshore out to 200 miles)[11]. While both the U.S. and Canada argued that the setting of this border should take fishing practices into account, the Court categorically rejected that contention and based its decision almost solely on geographical features (Churchill 1993:53). Waters beyond 200 miles are governed by international treaty, if at all.

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[9] A finer scale of 10 minutes by 10 minutes rectangles of latitude and longitude, known as "unit areas" or "ten minute squares" is sometimes used for collecting other effort and fishing location data (Halliday & Pinhorn 1990:24,28) -- much of this gleaned from logbooks or research vessels (Halliday & Pinhorn 1990:44).

[10] A "stock" is "a self-sustaining population of a species". "Stock structure, therefore, is a description of the spatial and temporal separation of a species into relatively discrete reproductive units" (Halliday & Pinhorn 1990:2).

[11] It should be pointed out that an EEZ is not "territory" per se. The physical area is not claimed. However, capture and sale of resources within the area are limited to domestic vessels or foreign vessels which have received specific permission to fish in the zone.

Within U.S. waters (territorial[12] and EEZ[13]), there are eight fisheries management regions in the United States, each tied to a regional Fisheries Management Council (FMC). For every two Council regions there is a corresponding larger region associated with a NMFS Fisheries Science Center (FSC). The eastern seaboard of the U.S. is overseen by the New England, Mid-Atlantic, and South Atlantic FMC's. The New England and Mid-Atlantic are both within the purview of the NMFS Northeast FSC, while the South Atlantic (along with the Gulf of Mexico) is within the jurisdiction of the NMFS Southeast FSC. This paper deals primarily with New England and the Mid-Atlantic.

The New England coastal region consists of the states of Maine, New Hampshire, and Massachusetts. The Mid-Atlantic coast consists of the states of Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, and Virginia. The division between the two is at the Massachusetts/Rhode Island border. The division of Northeast from Southeast (Mid-Atlantic from South Atlantic) is at the Virginia/North Carolina border (see Figure 5).

In creating these regions, administrative concerns were again paramount, though political boundaries happened to correspond fairly closely to biologically important distinctions in this case. In the Northeast, there is a recognized faunal boundary at Cape Cod (42 degrees north) and another at Cape Hatteras (35 degrees north)[14]. The latter corresponds roughly to the division between Mid-Atlantic and South Atlantic[15]. The boundary between the New England and Mid-Atlantic regions lies at 71 degrees 45 minutes west, apparently in recognition of the southern boundary of the large scale commercial haddock fishery at Nantucket shoals south of Cape Cod (Rounsefell 1948). Thus biological and administrative criteria meshed to some degree in creating the management regions of the Northeast. But though roughly based on biological factors, the precise location of regional boundaries at state boundaries is designed to minimize political disputes over jurisdiction, and to facilitate data collection.

The regional Councils, however, have jurisdiction only over federal waters, that is, waters from 3 miles off the coast to 200 miles off the coast. Waters within 3 miles of shore are administered by state governments. There is an attempt, however, on the part of the federal government and state authorities to coordinate their efforts. In addition, there are coordination efforts among states through bodies such as the Atlantic States Marine Fisheries Commission (ASFMC).

Implications for Management of these Differing Criteria

In recent management plans the sea is more and more being divided, whether directly by designating behaviors within specific physical areas or indirectly by such mechanisms as the prospect of examining the effectiveness of Amendment 5 groundfish regulations using three sub-regions, or the state quotas in the summer flounder fishery. Thus our knowledge of both fish behavior and fishermen's behavior and beliefs with respect to range and preferences becomes more and more important.

TAC (total allowable catch) legislation in international treaties and national legislation has meant that the statistical regions became management regions as well. Divisions, the smallest across the board area used for statistical collection, were chosen as the management units for international TAC's. Data from these Divisions would allow both the calculation of TAC's and their monitoring for enforcement purposes (Halliday & Pinhorn 1990:18). Different combinations of Divisions, and of Divisions and time periods have been used for TAC's for stocks of different species (Halliday & Pinhorn 1990:18-19). More and more, TACs are being included in programs which have other primary governance mechanisms -- simply as a backstop.

Quotas, like TACs, demarcate the sea only indirectly -- through the use of either statistical areas or state or federal waters as zones within which certain amounts of fish may be taken. However, as we have seen with the summer flounder quotas in the U.S., failure to take into account fishermen's ranges and traditional fishing patterns can lead to dispute. Because fishermen often land in a state different from the one in which they live or in which their boat is registered, states began to complain that their quotas were being filled by non-residents. This has led to the recent decision to allow quota trading among states. While there are some economic rent issues exacerbated by such trading, the practice does recognize the actual behavior of fishermen and attempt to incorporate that into regulations.

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[12] U.S. territorial waters extend from shore to 12 miles.

[13] The U.S. has never ratified the most recent Law of the Sea Treaty.

[14] "Views on zoogeographic boundaries in the Northwest Atlantic have been fairly consistent from their first development in the mid-1800s (Hazel 1970)."

[15] The precise regional boundary lies at 36 degrees 33 minutes north, at the state line between Virginia and South Carolina. This"perhaps reflected compromise for convenience in collection of fishery statistics" (Halliday & Pinhorn 1990:29).

Turning to actual territory issues, most Northeast fishermen have accepted the 200 mile EEZ. This is because none of them fish that far out anyway, and because this regulation keeps out foreign boats which would otherwise compete with them for fish. Many are, however, fundamentally opposed to the Hague Line dividing U.S. and Canadian waters, because this boundary conflicts with their ethno-ecological model. Adjustment by fishermen here will to a large extent involve the passing of a generation which still remembers having personally fished the Northeast Peak and Browns.

Moving to smaller spatial delimitations, subdivisions of the NACFI regional grid were theoretically established in 1931 to coincide with "individual fishing banks or fishing grounds" (Halliday & Pinhorn 1990:6,24). Côte (MS 1953) noted that, "It may be that areas traditionally fished should also be considered without jeopardizing biologists' needs." Recent management documents also occasionally refer to confirmation of data or trends by fishermen, though this is as yet limited and unusual. The way in which these NACFI fishing grounds were determined is not explained, however comparison of the Subdivisions with fishermen-defined fishing grounds leads to the conclusion that fishermen's definitions were not the primary basis for these boundaries. Given that NOAA/NMFS/NEFSC statistical areas are subsets of NAFO areas, they too lack coherence with fishermen's "maps". The fact that scientists collect their data on non-commercial vessels and use different criteria from fishermen leads to assumptions of ignorance by both groups. Fishermen often do not understand why scientists always go back to the same stations, even when everyone knows that some of those areas do not have and never have had fish. This has in fact become a standard joke on the docks. This engenders skepticism about the scientists' figures, which in turn leads scientists to wonder why the fishermen so stubbornly reject what the scientists see as obvious conclusions. Yet, when the reasoning behind the sampling protocol is explained, fishermen readily grasp its significance.

Furthermore, there is the -- for fishermen -- artificial distinction between state waters and federal waters (though it has marginal relationship to fishermen's own inshore/offshore distinction[16]). Here the problem is both different criteria for choosing a tow location, and lack of communication about those criteria. The division between the New England and Mid-Atlantic regions, being based primarily on a faunal boundary, makes more sense to a fisherman. However, the boundary is seen only as marking a transition to a different species composition and not as any delimitation of available fishing areas.

Closed areas, like quotas, can disrupt the traditional annual round of fishermen by forcing a switch to different species or different gear, or to becoming a migrant worker. Many factors will be involved in which of these choices is made. Level of community attachment will figure into whether or not migrant labor is chosen, with day fishermen and fishermen from close-knit rural or ethnic communities being less willing to leave home for long periods of time. (In fact, many offshore fishermen would prefer to spend more, not less, time at home as it is.) Draggers will be less likely to choose different gear. Closed areas at least make sense to many fishermen, however, in a way that quotas do not. Fishermen have a very strong aversion to throwing overboard anything that has already come on deck -- especially if it is already dead. They do, however, generally recognize the need to protect spawning fish and juveniles. Further, to the extent that closed areas take into account the different patterns exhibited by small versus large vessels and by different gear types, they will be more readily accepted. Larger vessels and otter trawlers, for instance seem to fish larger, less differentiated areas. Smaller vessels and gillnetters operate more often in terms of microniches.

Areas of restriction by gear are another measure which is more in line with existing fisheries practices. Increased overall crowding on the grounds has led to the abandonment or conflict over many traditionally gear-specific areas, but there exists the possibility of building on and officially institutionalizing some of these spatial divisions.

Summary

The primary management regions and statistical areas are constructed on the basis of different types and scales of data than those used by fishermen, or in some cases even by scientists because managers are concerned with enforcement issues and therefore constrained by existing administrative boundaries. Fishermen and biologists are both concerned with the condition of the resource rather than its administration, but even here the variables are not identical. Fishermen like to point out that they are in the business of killing fish, and that they do so to feed their families and other people's families. Scientists main concern is with gathering knowledge and with conservation. Biologists sample by statistical area, and only use named ledges, banks, and shoals as reference points. They also use other meso-level designations such as "Gulf of Maine", which are not widely used by fishermen. These incompatibilities may be one reason (though others certainly abound) for the lack of communication and sense of isolation that fishermen feel with regard to managers and scientists. And yet,

[16] Fishermen's concept of the division between offshore and inshore is somewhat fluid, but can be approximated as occurring at about 20 miles offshore. Management is more likely to use an existing administrative division such as the 12 mile territorial sea. This could be seen in one option which was considered for Amendment 5 to the Northeast Multispecies FMP, where inshore night fishing was to be prohibited and inshore was in fact designated as within 12 miles of shore.

there are many potentially overlapping and complementary areas of knowledge between fishermen and scientists which could lead to mutual support rather than antagonism. Especially when creating seasonally closed areas or gear and species-specific measures, not only is fishermen's knowledge of ecosystem dynamics a valuable addition to existing data sets, but compliance should be easier if the boundaries of the area form a logical subset of the fishers' own cognitive maps of the sea (cf. Ostrom 1990). Recent attempts at co-management in Canada (Pinkerton 1987,1988,1989), Norway (Jentoft 1989, Jentoft & Kristofferson 1989), the U.S. (McCay & Creed 1989) and elsewhere offer some guidelines for future efforts to include local knowledge and ability in the formulation and implementation of effective management.

References

Acheson, James

1975 "The Lobster Fiefs: Economic and Ecological Effects of Territoriality in the Maine Lobster Industry" Human Ecology 3:183-207.

1979 "Variations in Traditional Inshore Fishing Rights in Maine Lobstering Communities" Raoul Andersen, ed. North Atlantic Maritime Cultures The Hague: Mouton.

1987 "The Lobster Fiefs Revisited: Economic and Ecological Effects of Territoriality n the Maine Lobster Fishery" Bonnie McCay & James Acheson, eds. The Question of then Commons: the Culture and Ecology of Communal Resources Tucson, AZ: University of Arizona Press.

1989 "Management of Common Property Resources" Economic Anthropology. Stuart Plattner, ed. Stanford,CA: Stanford Univ. Press.

Acheson, James, ed.

1981 Sociocultural Aspects of New England Fisheries, Vol. I. NSF Final Report.

Apostle, Richard

1985 "Work Satisfaction and Community Attachment among Fishermen in Southwest Nova Scotia" Canadian Journal of Fisheries and Aquatic Sciences 42:256-267.

Bennett, John & John Bowen, eds.

1988 Production and Autonomy: Anthropological Studies and Critiques of Development. Lanham, NY: University Press of America.

Binkley, Marian

1990 "Work Organization Among Nova Scotian Offshore Fishermen" Human Organization 49(4):395-405.

Bisack, Kathryn

1993 Operations Research Analyst, Marine Mammal Investigation, Northeast Fisheries Science Center, National Marine Fisheries Service.

Churchill, R.R.

1993 "Fisheries Issues in Maritime Boundary Delimitation" Marine Policy 17(1):44-57.

Cordell, John

1989 A Sea of Small Boats: Customary Law and Territoriality in the World of Inshore Fishing Report No. 62. Cambridge, MA: Cultural Survival.

Côte, J.

1953 "Subdivision of Subareas" ICNAF Meeting Document, No. 18, Serial No. 90 (2pp).

Davis, Anthony

1984 "Property Rights and Access Management in the Small Boat Fishery: A Case Study from Southwest Nova Scotia" Cynthia Lamson and Arthur Hanson, eds. Atlantic Fisheries and Coastal Communities: Fisheries Decision-Making Case Studies. Halifax, Nova Scotia: Dalhousie Ocean Studies Programme.

Dewar, Margaret

1983 Industry in Trouble: Economics and Politics of the New England Fisheries. Cambridge, MA: MIT Press.

Durrenberger, E. Paul & Gísli Pálsson

1986 "Finding Fish: the Tactics of Icelandic Skippers" American Ethnologist 13(2):213-229.

1987 "Ownership at Sea: Fishing Territories and Access to Sea Resources" American Ethnologist 14(3):508-522.

Gatewood, John & Bonnie McCay
1990 "Comparison of Job Satisfaction in Six New Jersey Fisheries: Implications for Management" Human Organization 49:14-25.

Goode, G.B & J.W. Collins
1887 "The George's Bank Cod Fishery" G.B. Goode, ed. The Fisheries and Fishing Industries of the United States. Washington, DC.

Halliday, R.G. & A.T. Pinhorn
1990 "The Delimitation of Fishing Areas in the Northwest Atlantic" Journal of Northwest Atlantic Fishery Science 10:1-51.

Hazel, J.E.
1970 "Atlantic Continental shelf and Slope of the United States: Ostrocod Zoogeography in the southern Nova Scotian and northern Virginian Faunal Provinces" U.S. Geological Survey Professional Paper 529-E:v + 29 pp.

ICNAF
1967 "Report of Standing Committee on Research and Statistics" ICNAF Redbook (79pp).
1974 "Standing Committee on Research and Statistics Proceedings ICNAF Redbook (154 pp).

Jentoft, Svein
1989 "Fisheries Co-Management: Delegating Government Responsibility to Fishermen's Organizations" J.S. Thomas, L. Maril, & E.P. Durrenberger, eds. Marine Resource Utilization: A Conference on Social Science Issues Mobile, AL: University of South Alabama.

Jentoft, Svein & Trond Kristofferson
1989 "Fishermen's Co-Management: the Case of the Norwegian Fishery" Human Organization 48(4):355-365.

Johnston, Douglas M., ed.
1976 Marine Policy and the Coastal Community. London: Croom-Helm.

Lamson, Cynthia and Arthur Hanson, eds.
1984 Atlantic Fisheries and Coastal Communities: Fisheries Decision-Making Case Studies. Halifax, Nova Scotia: Dalhousie Ocean Studies Programme.

Libecap, Gary D.
1989 Contracting for Property Rights. New York: Cambridge University Press.

Matsuda, Yoshiaki & Yoshiuki Taneda
1984 "The Seven Great Fisheries Incidents in Japan" K. Ruddle & T. Akimichi, eds. Maritime Institutions in the Western Pacific. Senri Ethnological Studies No. 17. Osaka, Japan: National Museum of Ethnology.

McCay, Bonnie J. & James Acheson,eds.
1987 The Question of the Commons: The Culture and Ecology of Communal Resources. Tucson: University od Arizona Press.

McCay, Bonnie & Carolyn Creed
1989 "Dividing Up the Commons: Co-Management of the U.S. Surf Clam Fishery" J.S. Thomas, L. Maril, & E.P. Durrenberger, eds. Marine Resource Utilization: A Conference on Social Science Issues Mobile, AL: University of South Alabama.

Miller, Marc & John Van Maanen
1981 "'Boats Don't Fish, People Do: Some Ethnographic Notes on the Federal Management of Fisheries in Gloucester" James Acheson, ed. Sociocultural Aspects of New England Fisheries, Vol. I. NSF Final Report.

Murawski, S.A., A.M. Lange, & J.S. Idoine
1991 "An Analysis of Technological Interactions Among Gulf of Maine Mixed-Species Fisheries" ICES mar. Sci. Symp. 193:237-252.

NAFO
1980 "Annual Report for the Year 1979" NAFO Annual Report 1. (86pp).

Ostrom, Elinor
1990 Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press.

Overbey, Margaret
1989 "Self-Regulation Among Fishermen of the Gulf of Mexico?" J.S. Thomas, L. Maril, & E.P. Durrenberger, eds. Marine Resource Utilization: A Conference on Social Science Issues Mobile, AL: University of South Alabama.

Peterson, Susan B. & Leah J. Smith
1981 Small-Scale Commercial Fishing in New England.Woods Hole Oceanographic Institute Technical Report No. 81-72. Woods Hole, MA: WHOI.

Pálsson, Gísli
1982 "Territoriality Among Icelandic Fishermen" Acta Sociologica 25 (suppl.):5-13.

Pinkerton, Evelyn
1987 "Intercepting the State: Dramatic Processes in the Assertion of Local Co-Management Rights" Bonnie McCay & James Acheson, eds. The Question of then Commons: the Culture and Ecology of Communal Resources Tucson, AZ: University of Arizona Press.

1988 "Cooperative Management of Local Fisheries: A Route to Development" John Bennett & John Bowen, eds. Production and Autonomy: Anthropological Studies and Critiques of Development. Lanham, NY: University Press of America.

Pinkerton, Evelyn, ed.
1989 Co-Operative Management of Local Fisheries: New Directions in Improved Management and Community Development. Vancouver, B.C.: University of British Columbia Press.

Pollard, Barbara
1993 Operations Research Analyst, Economics Investigation, Northeast Fisheries Science Center, National Marine Fisheries Service.

Pollnac, Richard & John Poggie, Jr.
1988 "The Structure of Job Satisfaction among New England Fishermen and Its Implications for Management" American Anthropologist 90:888-901.

Rounsefell, G.A.
1948 "Development of Fishery Statistics in the North Atlantic" U.S. Fish & Wildlife Service Special Science Report 47. (27pp.)

K. Ruddle & T. Akimichi, eds.
1984 Maritime Institutions in the Western Pacific. Senri Ethnological Studies No. 17. Osaka, Japan: National Museum of Ethnology.

Stiles, Geoffrey
1976 "The Small Maritime Community and its Resource Management Problems: A Newfoundland Example" Douglas M. Johnston, ed. Marine Policy and the Coastal Community. London: Croom-Helm.

Thomas, J.S.; L. Maril, & E.P. Durrenberger, eds.
1989 Marine Resource Utilization: A Conference on Social Science Issues Mobile, AL: University of South Alabama.

Table 1 Percentages of Total Trips Made to Statistical Areas Encompassing U.S. Portion of Georges Bank by Port

GLOUCESTER	1972	1982	1992
Georges Bank Trips	23	88	73
Total Trips	71	203	192
Georges Bank/Total	32%	44%	38%

NEW BEDFORD	1972	1982	1992
Georges Bank Trips	38	59	47
Total Trips	69	113	105
Georges Bank/Total	55%	52%	45%

BOSTON	1972	1982	1992
Georges Bank Trips	43	32	26
Total Trips	84	64	62
Georges Bank/Total	51%	50%	42%

PORTLAND	1972	1982	1992
Georges Bank Trips	1	11	13
Total Trips	40	70	65
Georges Bank/Total	3%	16%	20%

Table 2 Number of Statistical Areas Visited Vessel Per Year by Fleet

All OTTER	1	2	3	4	5	6	7	8	9	10	>10
1982 No. trips	302	177	107	95	70	64	52	18	3	2	2
% of total	34%	20%	12%	11%	8%	7%	6%	2%	<1%	<1%	<1%
1992 No. trips	216	143	89	93	87	78	50	28	10	6	2
% of total	27%	18%	11%	12%	11%	10%	6%	5%	1%	<1%	<1%
Otter TC3*											
1982 No. trips	56	56	64	67	53	50	37	8	0	2	1
% of total	14%	14%	16%	17%	14%	13%	9%	2%	N/A	<1%	<1%
1992 No. trips	30	49	51	71	65	60	36	16	7	5	1
% of total	8%	13%	13%	18%	17%	15%	9%	4%	<1%	<1%	<1%

TC = Tonnage Class. TC2 = 5-50 GRT. TC3 = 51-150 GRT. TC4 = 151-500 GRT.

Table 3 Number of Statistical Areas Visited Per Year by Fleet

Scallop	1	2	3	4	5	6	7	8	9	10	>10
1982 No. trips	15	14	19	16	12	20	8	4	2	0	0
% of total	14%	13%	17%	15%	11%	18%	7%	4%	2%	N/A	N/A
1992 No. trips	27	5	7	22	35	53	44	18	8	5	3
% of total	12%	2%	3%	10%	15%	23%	19%	8%	4%	2%	1%
Gillnet											
1982 No. trips	52	10	2	4	1	0					
% of total	75%	15%	3%	6%	2%	N/A					
1992 No. trips	70	29	16	5	3	1					
% of total	57%	23%	13%	4%	3%	1%					

Table 4 Number of Statistical Areas Visited Per Year by Fleet

All CLAM	1	2	3	4	5	6	7	8	9
1982 No. trips	39	38	25	11	10	4	0	4	1
% of total	30%	29%	19%	8%	8%	3%	N/A	3%	1%
1992 No. trips	36	29	15	15	11	5	0	0	0
% of total	32%	26%	14%	14%	10%	5%	N/A	N/A	N/A
CLAM TC2									
1982 No. trips	8	4	3	2	1				
% of total	44%	22%	17%	11%	6%				
1992 No. trips	26	5	0	0	0				
% of total	84%	16%	N/A	N/A	N/A				
CLAM TC4									
1982 No. trips	5	7	6	4	6	2	0	4	1
% of total	14%	20%	17%	11%	17%	6%	N/A	11%	3%
1992 No. trips	1	8	4	4	6	1	0	0	0
% of total	4%	33%	17%	17%	25%	4%	N/A	N/A	N/A

Table 5 Number of Ports of Landing per Year by Fleet

No. Ports	1	2	3	4	5	6	7
Otter							
1982 Port calls	525	266	75	21	3	2	
% of Total	59%	30%	8%	2%	>1%	>1%	
1992 Port calls	492	222	62	22	4	0	
% of Total	61%	28%	8%	3%	1%	N/A	
Gillnet							
1982 Port calls	57	11	1	0	0	0	0
% of Total	83%	16%	2%	N/A	N/A	N/A	N/A
1992 Port calls	91	22	8	2	0	0	1
% of Total	73%	18%	7%	2%	N/A	N/A	1%
Scallop							
1982 Port calls	69	21	11	7	1	1	
% of Total	63%	19%	10%	6%	1%	1%	
1992 Port calls	165	47	11	3	1	0	
% of Total	73%	21%	5%	1%	<1%	N/A	

Table 6 Number of Ports of Landing per Year by Fleet

No. Ports	1	2	3	4	5
Clam TC4					
1982 Port calls	13	7	8	3	4
% of Total	37%	20%	23%	9%	11%
1992 Port calls	14	4	5	1	0
% of Total	58%	17%	21%	4%	N/A
Clam TC3					
1982 Port calls	35	27	11	5	1
% of Total	44%	34%	14%	6%	1%
1992 Port calls	21	24	7	4	0
% of Total	38%	43%	13%	7%	N/A
Clam TC2					
1982 Port calls	9	6	3		
% of Total	50%	33%	17%		
1992 Port calls	26	5	0		
% of Total	84%	16%	N/A		

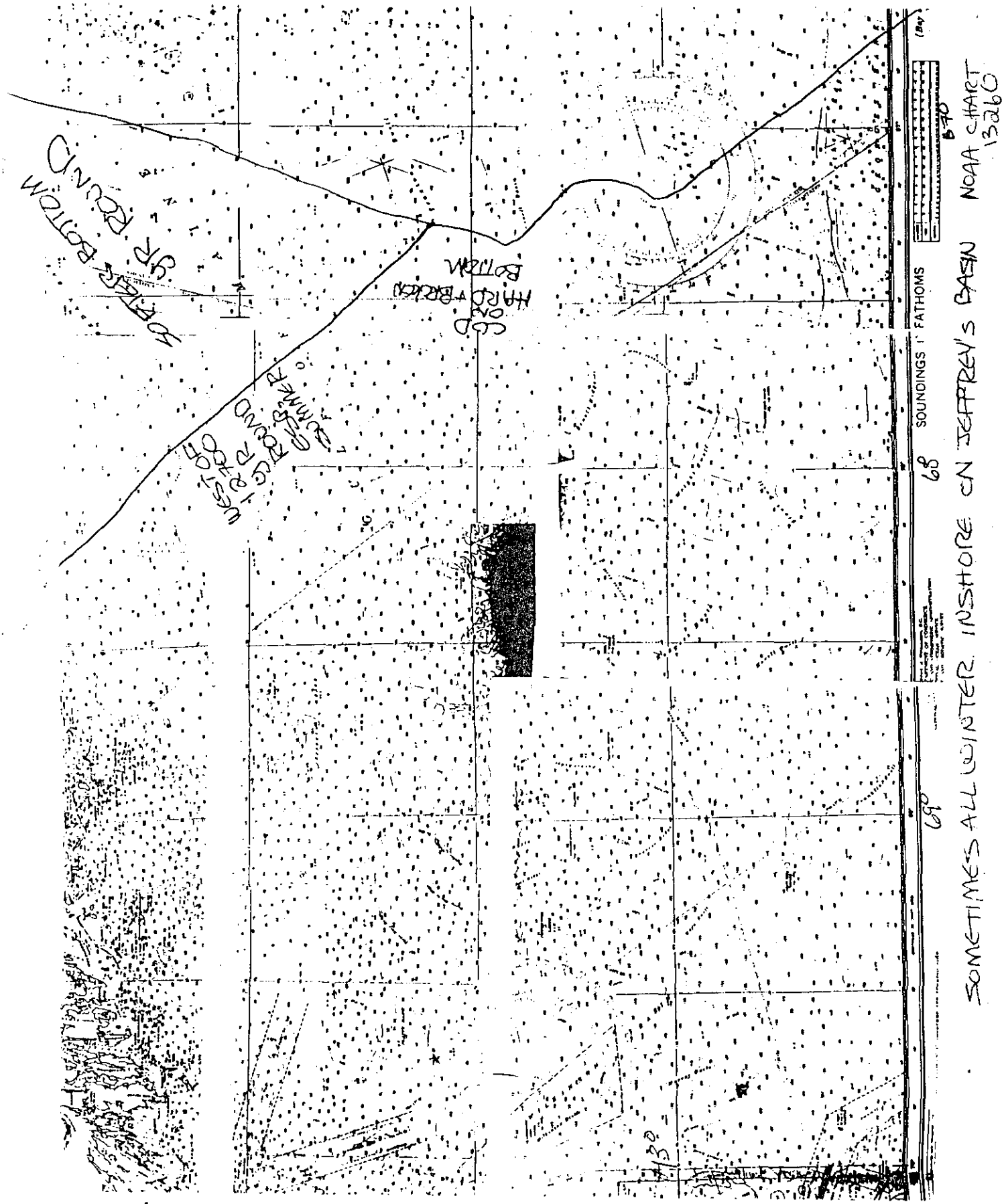

Figure 1 Example Fisherman's Map of Annual Round of Fishing

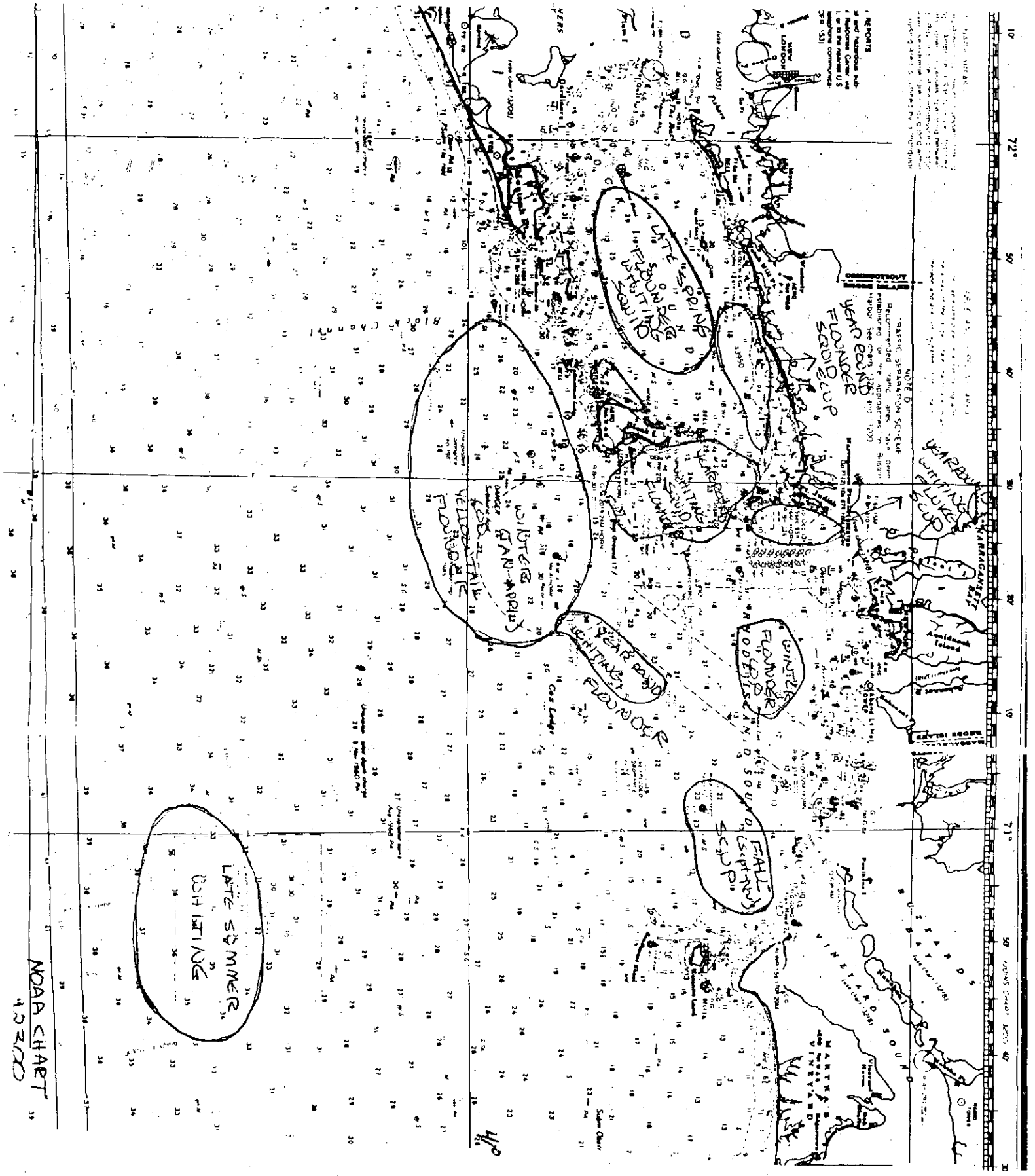

Figure 2 Example Fisherman's Map of Annual Round of Fishing

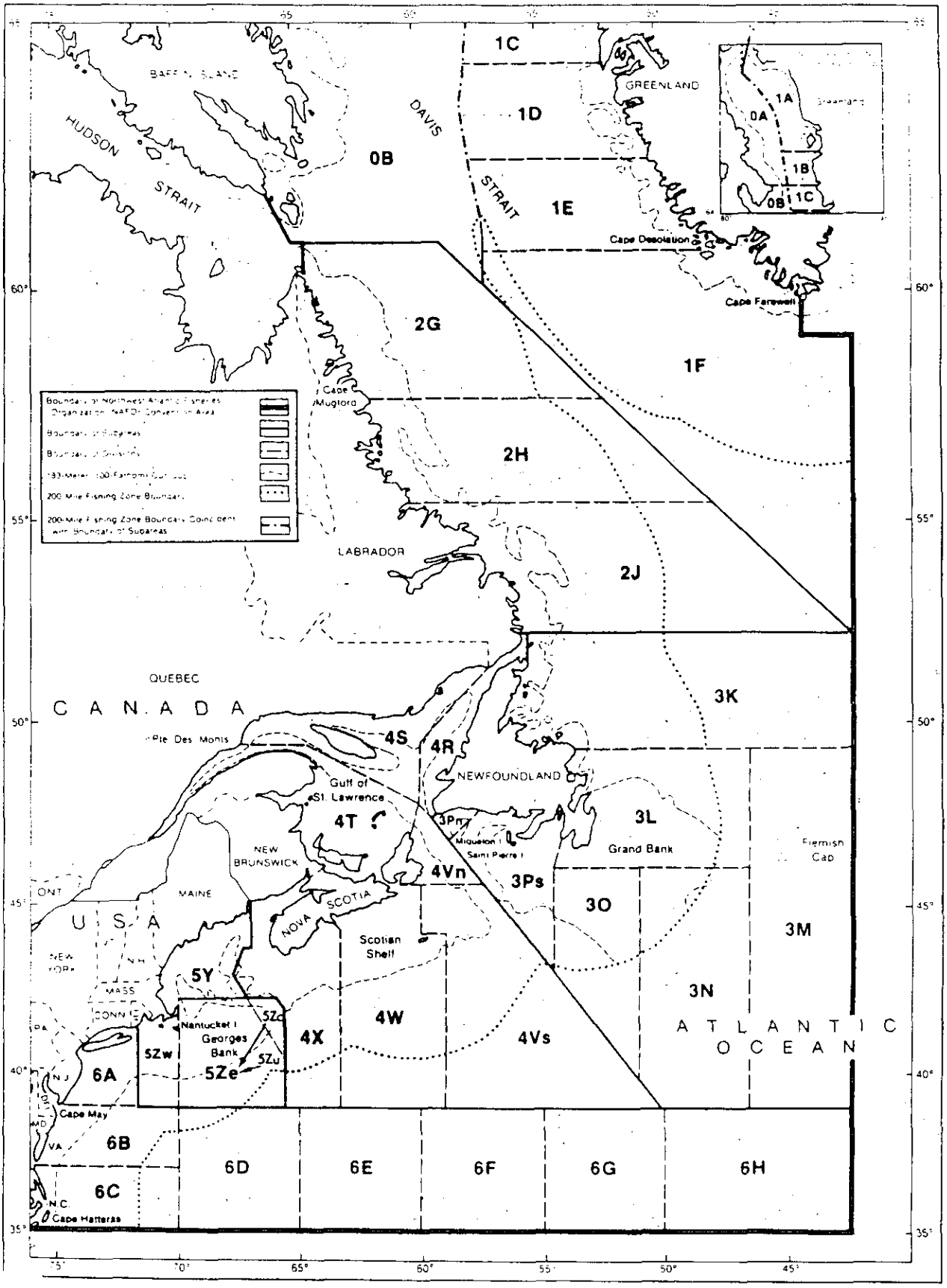

Figure 3 NAFO Subareas, Divisions, and Statistical Reporting Areas (from Halliday & Pinhorn, 1990:22)

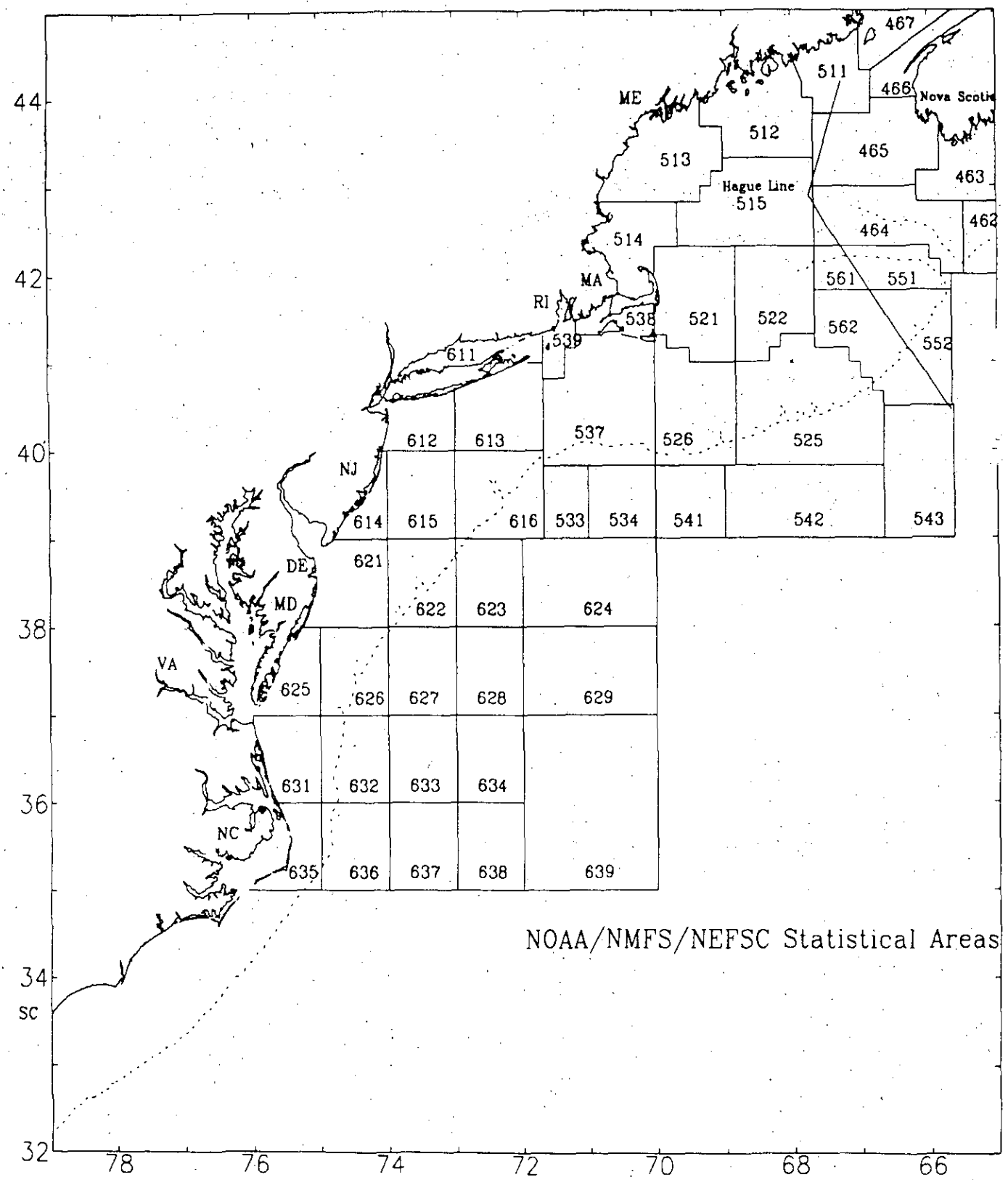

Figure 4 NOAA/NMFS/NEFSC Statistical Areas

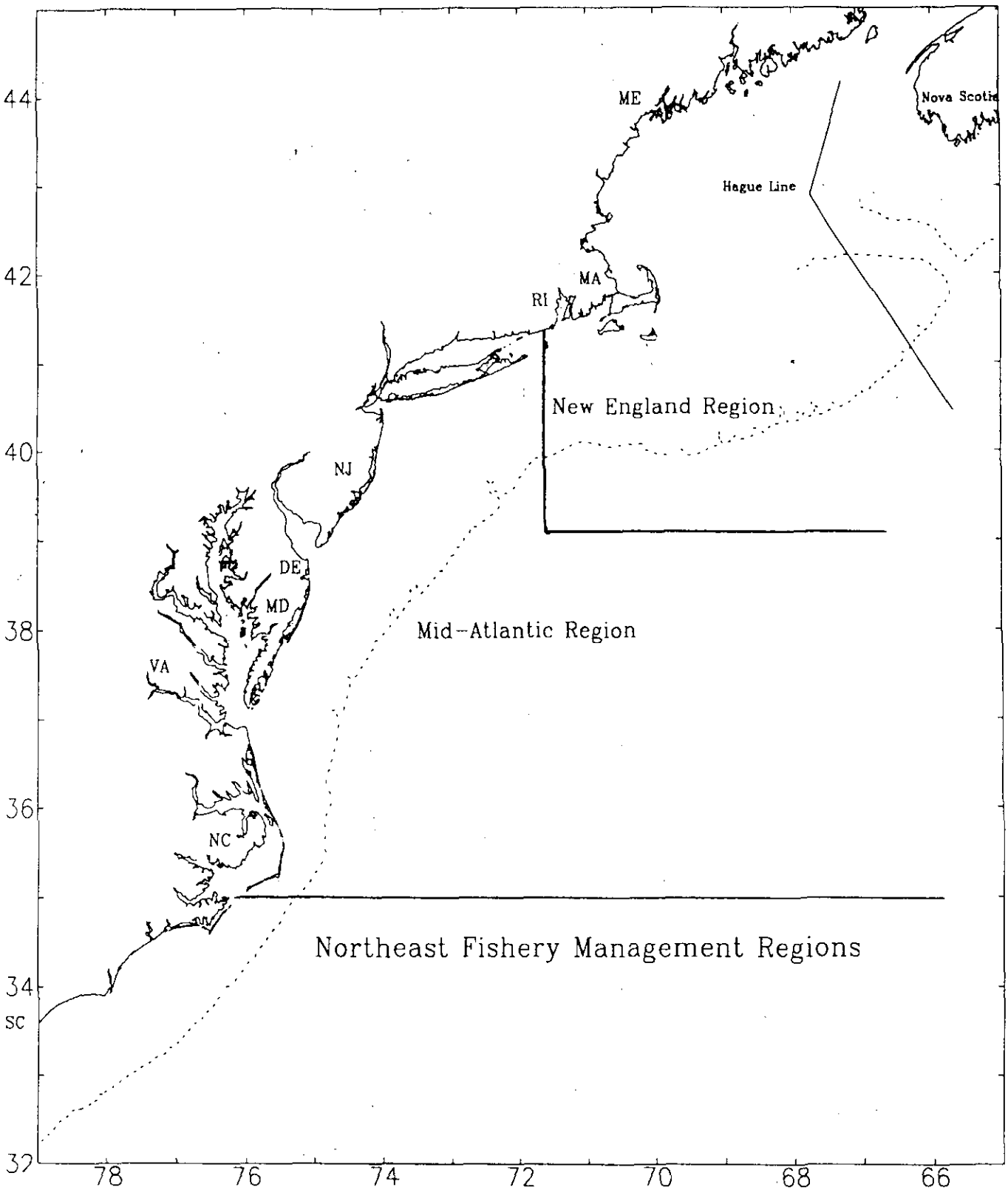

Figure 5 United States Fishery Management Regions in the Northeast