

**Estimates of the Number of Vessels
and Quantity of Gear Deployed
in the Lobster and Gillnet Fisheries
in 1999 off the Northeast Coast
of the United States**

by

Kathryn D. Bisack

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ABSTRACT

This paper presents an estimate of the number of vessels and the quantity of gear deployed in the lobster and gillnet fisheries in 1999 off the northeast coast of the United States. The analyses presented here were developed to support the Environmental Assessment (EA) of the Atlantic Large Whale Take Reduction Plan (NMFS, 2000). Vessels actively fishing lobster gear were identified as well as vessels which held a fishing permit but had no recorded fishing activity in any database. In contrast, only vessels actively fishing gillnet gear were estimated. In both fisheries the total quantity of gear fished was estimated as the product of the number of vessels and the amount of gear fished per vessel. Vessel and gear estimates were stratified by management areas defined within the American Lobster Fishery Management Plan and the Atlantic Large Whale Take Reduction Plan. In 1999, there were 7,539 vessels potentially fishing lobster traps of which 79% fished in the northern inshore area (or state waters), 9% in northern nearshore, and 2% in the northern offshore area. The quantity of lobster gear deployed was expressed as the number of trawls, where a lobster trawl consists of several traps tied together with one line. A lower bound estimate was developed from recorded fishing trips, and an upper bound estimate was derived based on the maximum amount of gear a lobster vessel could legally fish. The lower and upper bound estimates of total lobster trawls fished in 1999 are 436,620 and 1,436,979, respectively. In 1999, 546 vessels actively fished gillnet gear. The quantity of gillnet gear deployed was expressed as the number of strings, where a string consists of several 300 foot nets tied together. Approximately 38% of the vessels operated in the northern nearshore area, 17% offshore, and 42% in the southern nearshore area. These vessels fished an estimated 3,254 strings of gillnet gear in 1999.

1.0 Introduction

Estimates were developed to establish a single source of information on the number of vessels and the quantity of gear in the lobster and gillnet fisheries off the northeast coast of the United States in 1999. The paper provides a methodological template for updating these estimates in the future.

The estimates were developed to support the Environmental Assessment (EA) of the Atlantic Large Whale Take Reduction Plan (NMFS, 2000) and to evaluate the economic impacts of gear modifications in the lobster and gillnet fisheries aimed at reducing right whale entanglements. Gillnets and lobster traps are the primary source of vertical lines that may entangle right whales and other marine mammals.

The lobster and gillnet fisheries off the northeast coast of the United States operate from Maine to Cape Hatteras. Traps are the principal fishing gear used to catch lobsters. A lobster trawl consists of one to forty lobster traps strung together, where the line between traps averages 120 feet in the inshore management area and 180 feet in the offshore management area (NMFS, *pers. comm.*). Lobster traps are set on the bottom of the ocean to soak for one or more days, hauled back and reset in the water.

Gillnet gear as deployed in the USA Atlantic region, consists of nets (typically monofilament mesh) suspended between a buoyed head rope and a weighted ground line. A gillnet vessel fishes four to seven strings per trip on average. A single gillnet string normally consists of five to twelve nets strung together, in which the standard net is about three hundred feet long and eleven feet high. Gear is set in the water to soak for 24 to 72 hours, after which the gear is hauled and reset. Target species include groundfish such as pollock, cod, flatfish, monkfish and dogfish. Both gillnet gear and lobster trawls are retrieved by hauling in one of the two buoy lines attached to the end of the lobster trawl or gillnet string.

This paper estimates the number of vessels that fished lobster gear in 1999 as well as those vessels who held a permit to fish lobster gear but for which no fishing activity was recorded in any database. In contrast, only vessels which actively fished gillnet gear in 1999 was estimated. In both fisheries, the total quantity of gear fished was calculated as the product of the number of vessels and the amount of gear fished per vessel. A lower bound estimate was developed from recorded fishing trips, and an upper bound estimate was derived based on the maximum amount of gear a lobster vessel could legally fish. In the gillnet fishery, a point estimate is presented for the number of vessels and quantity of gear. Vessel and gear estimates are stratified by management areas defined within the American Lobster Fishery Management Plan and the Atlantic Large Whale Take Reduction Plan. Data were provided by the National Marine Fisheries Service and the Department of Marine Resources from the states of Maine, New Hampshire, Massachusetts and Rhode Island. Several databases are used because none are comprehensive and each provides a different level of information.

2.0 Current Regulations

Fishery regulations have been imposed to protect the American lobster and commercially landed groundfish such as cod. Under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA), regulations have been implemented to protect marine mammals. Typical and common regulations used in fisheries include output controls (Total Allowable Catch, Individual Quota, Vessel Catch Limits), input controls (limited licenses, individual effort quota such as days at sea, gear and vessel restrictions), and technical measures (size and sex selectivity, time and area closures). Current regulations are presented and used in the process of estimating the number of vessels and the amount of gear fished.

Right Whale

Seasonal area closures have been implemented to protect right whales. In the 1997 and 2000 Atlantic Large Whale Take Reduction Team (ALWTRT) plan (NMFS, 1997), there are two areas closed to fishing. The Cape Cod Bay Critical Habitat (CCBCH) area is closed to vessels fishing lobster traps and gillnet gear from January 1 to May 15 (when the presence of right whales is highest). The Great South Channel Critical Habitat (GSCCH) is also closed to both gear types from April 1 to June 30.

Areas have been redefined between ALWTRT plans. Specifically, the 1997 right whale management areas were modified to comply with the American lobster fishery management plan (FMP) areas (NMFS, 1999) in 2000.

Lobster Fleet

New measures were implemented to the American lobster FMP on December 6, 1999, with the objective of ending over-fishing (NMFS, 1999). These new measures include: an extension of the current moratorium of new entrants into the EEZ fishery; designation of lobster management areas; nearshore and offshore area trap limits; a 5-inch maximum carapace size in the Gulf of Maine; trap size restrictions; a trap escape vent size increase; trap tag requirements; and an annual specification of additional management measures necessary to end over-fishing and rebuild the American lobster.

In 2000, federal and state permit holders in ME, NH, MA and RI were required under the American lobster FMP (NARA, 2000) to purchase one tag for each lobster trap. Tags were sold by one authorized vendor within each state. In addition, trap limits were imposed. The maximum number of lobster traps that can be fished depends on the management area. Vessels which fish exclusively in offshore waters (Management Area 3) can fish up to 1,800 lobster traps (Figure 1). Vessels fishing in other areas (or in management area combinations) can fish a maximum of 800 lobster traps.

Gillnet Fleet

Vessels fishing gillnet gear are affected by the New England multi-species FMP, Harbor Porpoise Take Reduction Team Plan (HBPTRP), Dogfish FMP, Cod FMP and the ALWTRT plan. Gillnet vessels are subject to days-at-sea limits, mesh size restrictions, seasonal and year-

round closures, minimum fish sizes and trip limits. Under the New England multi-species FMP, vessel trip report (VTR) logbooks are mandatory for the gillnet fleet.

3.0 Data

3.1 Data

Data from the following databases were used to estimate the number of vessels and the quantity of gear fished: 1) the Northeast Dealer Report Weighout (WO) data base; 2) the Northeast Vessel Trip (VTR) data base; 3) National Marine Fisheries Service Permit Data (NMFSPD); 4) State Tag data - lobster trap tag data provided by individual states (Maine, New Hampshire, Massachusetts, Rhode Island) and the NMFS Northeast Regional Office (Gloucester, MA)¹ and; 5) the Northeast Domestic Fisheries Observer Program (NDFOP) .

Commercial landings information by species are collected in the NEFSC WO and VTR data bases. In the VTR, ‘kept’ pounds are recorded and ‘landed’ pounds are recorded in the WO. It is assumed that the NEFSC WO data contains more complete records of total landings, and that the VTR data is a subset. In addition to species landed (in live pounds), records in the WO identify the vessel’s permit number with the date landed, information on the market category of each species, the type of gear fished, the port landed and the value of the catch, as well as other information. A shortcoming of the WO data is that it does not contain information on the location of fishing trips.

The NEFSC VTR data is a self-reporting commercial logbook system. VTR logbook data contains fishing trip information on area fished, kept and discarded portions of the catch, and effort information, which includes the hull number (and/or permit number) and the port landed. It is uncertain whether ‘kept’ weight in the VTR data was recorded in live or landed pounds; both types are likely contained in the VTR database. Live weight includes the head and guts of the catch. For details on the VTR and Dealer data see Wigley *et al.* (1998). VTR logbooks are mandatory for vessels registered under the multi-species FMP, and voluntary for those registered under the American lobster FMP.

The NMFSPD data identifies vessels that have acquired federal permits under the American lobster or multi-species FMP. Data elements include the name and address of the permit holder, vessel characteristics, and the types of gear used under each permit type. Under the American lobster FMP, permit holders must identify on the application the management areas they intend to fish (Figure 1). The selected management area then determines the maximum number of lobster traps a vessel can fish. Although an individual holds a permit to fish, this does not imply

¹ A “Memorandum of Understanding” exists between NMFS and the states of Maine, New Hampshire, Massachusetts, and Rhode Island to share fisheries data. Trap tag data were not available at the time of this analysis from the state of Massachusetts. However, Massachusetts did provide landings data by month and area for state permitted vessels. States south of Rhode Island were not participants in the lobster trap tag program.

the permit holder is actively fishing. Therefore, estimates on the number of vessels from this database represent the number of vessels “potentially” fishing.

State tag data were provided by three of the four states. Maine and New Hampshire’s trap tag data identified vessels by their state hull and/or federal permit number and included the number of lobster trap tags purchased. Massachusetts did not have trap tag data available at the time of this analysis. Instead, the state of Massachusetts provided monthly catch data. Each data record recorded a vessel’s monthly catch and included the state hull and/or federal permit number, the number of lobster traps fished, total pounds of lobster landed, total number of trips and the areas fished (Figure 2). Rhode Island trap tag data were available. However, RI data were limited to those applicants who included their state hull or federal permit number on their application, which was approximately 35% of the permit holders.² Similar to the NMFSPD, lobster trap tag data provided by ME, NH, and RI represent the number of vessels “potentially” fishing with traps. In contrast, catch data provided by MA represents vessels “actively” fishing.

Data provided by the NFDOP consists of biological and economic data collected by on-board observers on commercial fishing trips. These data are a sub-sample of total fishing effort. In addition to the on-board observer trip data, the NFDOP provided a list of the gillnet vessels sampled as well as those not sampled from Maine to North Carolina. Vessels on the list that were not sampled were identified with gillnet gear in their possession. The list of vessels included the hull number, the primary fishing port, however, fishing grounds were not identified. This list of gillnet vessels provided by the NFDOP also represents vessels “potentially” fishing.

Five databases are used in these analyses because none are comprehensive. To analyze the lobster fleet, all databases were used except the NFDOP. To estimate the number of gillnet vessels and the quantity of gear, data from NEFSC’s VTR , WO, and the NFDOP were used. Data on “active” gillnet vessels are more available than data for the lobster fleet, because the majority of vessels fishing gillnet gear fish under the multi-species FMP and therefore have mandatory reporting.

3.2 Stratification

Data from all databases were temporally and spatially stratified to incorporate the American lobster FMP and ALWTRT plan (NMFS, 2000). The temporal stratification identified time blocks in which areas were are open and closed to fishing. The spatial stratification was based on management areas defined within the American lobster FMP and the ALWTRT plan.

² On the application form to purchase tags, permit holders were not required to identify their vessel’s state hull or federal permit number. To fully utilize the Rhode Island data, a separate data file was needed (but not available) to match a vessel’s hull number to a person. As a result of not being able to cross the tag data to hull numbers, the estimate of vessels fishing commercial lobster traps in Rhode Island is considered “biased down”.

The spatial stratification consisted of two tiers. The first tier follows the American lobster FMP stratification (Figure 1), and the second tier incorporates the ALWTRT plan. Under the second tier, the northern nearshore areas (Lobster Management Areas 1 and 2 within the American lobster FMP) were subdivided into northern inshore (state waters) and northern nearshore waters for Maine, New Hampshire, Massachusetts and Rhode Island (Figure 3). The offshore area (Lobster Management Area 3) was subdivided into the GOM and Mid-Atlantic area. The southern nearshore area corresponds to Lobster Management Area 4 and 5 under the American lobster FMP. Areas closed to fishing include: 1) Stellwagen Bank and Jeffreys Ledge; 2) Cape Cod Bay Critical Habitat (CCBCH) and; 3) the Great South Channel Critical Habitat (GSCCH).

Minor changes are incorporated to the above spatial stratification for the gillnet fleet. Specifically, the northern inshore and nearshore areas as defined within the lobster fishery above, are aggregated into the northern nearshore area. “Other Northeast Waters” as shown in Figure 4 encompass the northern nearshore and northern offshore waters.³

4.0 Lobster Fleet

To determine the total impact a management regulation will have on a fishery, the number of active vessels is the most desirable number. However, vessels fishing under the American lobster FMP do not have mandatory reporting. Vessels referred to as “active” have recorded fishing activity. Vessels referred to as “potentially active” include vessels that hold permits, do not have any recorded fishing activity in any database, but may or may not be fishing. Both types of data are used. A lower and upper bound estimate of the number of vessels and quantity of gear fished in the lobster fleet are presented. Methods are in section 4.1 and the results are in section 4.2.

4.1 Methods

In section 4.1.1, first we evaluate the databases to determine the number of active vessels. We then proceed to estimate the number of “active” and “potentially active” vessels, which is considered a maximum number of vessels fishing in the lobster fleet. Section 4.1.2 presents the method to estimate a lower and upper bound estimate of total traps and total trawls fished by the lobster fleet. Estimates are spatially and temporally stratified as outlined above (Section 3.2).

4.1.1 Method to estimate the number of lobster vessels

The number of “active” vessels is determined by tracking a vessel’s hull number across NEFSC’s VTR, WO and the NMFSPD databases. Any vessel that has recorded fishing effort using lobster gear or holds an American lobster permit is included. The percent of active vessels recorded in the VTR and WO is compared to the number of vessels permitted. That is, a Venn diagram approach is used to measure the ratio between the number of active vessels and permitted vessels.

³ The same stratification was used on the gillnet fleet as on the lobster fleet above to estimate the economic impact on both the lobster and gillnet fishery in an area where right whales are present.

The total number of vessels “potentially active” and “actively” fishing with lobster traps is investigated next. There are two major steps. First, all vessel information within each database needs to be aggregated to one record per vessel. In the second step, databases are merged by vessel. Information from each database for each vessel is then used to estimate the total number of vessels and assign them to a stratum.

In the first step, three databases (VTR Logbook, NMFSPD, State Tag Data)⁴ are merged after some preliminary processing within each database. Processing of the VTR data involved totaling a vessel’s landings for each stratum (or management area) and then assigning the vessel to the stratum where the majority of landings occurred. This avoids assigning a vessel to more than one area, which eliminates over-counting issues. Preliminary processing of the NMFSPD involved collapsing all management areas a vessel planned to fish as identified on the permit application onto one data record. In the lobster trap tag data, a single record existed for each vessel showing the number of purchased lobster tags and their respective states. Therefore, once the VTR and NMFSPD databases were processed and collapsed into one record per vessel per database, all three databases were merged by the vessel’s hull number, resulting in documentation of a vessel’s activity according to all the databases on one record. This completes the first step.

In the second step, vessels were assigned to a stratum (fishing area), based on which databases a vessel was recorded in and the information contained within each database. VTR logbook data was considered the best source of fishing trip locations. If a vessel did not have a VTR logbook the following was assumed: 1) vessels with a federal permit only, fish in federal waters, and; 2) vessels with a state permit only, fish in state waters. Each state was processed separately. The detailed rules of assigning a vessel to a fishing area and the order of the assignment follows:

Rules of Assignment

1. All vessels with a VTR logbook are processed first, since this is considered the best and only source of data for determining where a vessel is actively fishing. These vessels are assigned to the management area where the majority of their fishing activity occurs. The following rules apply to the remaining vessels without a VTR logbook.
2. Vessels with a state permit only (and no VTR logbook data) are assigned only to state waters. In Massachusetts (MA) only, state waters are further divided into the CCBCH area and other MA state waters. Vessels in the Massachusetts’s state database are assigned to an area based on their monthly landings data. Vessels fishing MA areas 1 to 5 and MA area 9 to 14 are assigned to the northern inshore stratum, MA areas 6 to 8 are assigned to CCBCH stratum, vessels in MA area 15 to 18 are assigned to the northern nearshore stratum, vessels in MA area 19 to 20 are assigned to Jeffreys Ledge and Stellwagen Bank stratum, and MA areas greater than 21 are assigned to the offshore stratum (Figures 2 and 4). The following rules apply to all remaining vessels not identified in these two steps.

⁴ NEFSC’s dealer data is not used as a data source here since too few vessels reported.

3. Vessels with a federal permit only and vessels with both a federal and state permit are subdivided into vessels that chose one fishing area and vessels that chose multiple fishing areas within the American lobster FMP areas. Vessels which choose one fishing area are assigned to that area. Vessels with multiple areas are prorated according to the next rule (#4).

4. Vessels in this category chose multiple fishing areas, and must be assigned to one fishing area. Vessels in this step are processed by state and prorated to a management area according to the distribution of vessels in their state who have a VTR logbook (Step 1 above). That is, if 40% of vessels from Maine with VTR logbooks fish in offshore waters, then 40% of the Maine vessels which chose multiple fishing areas are assigned to the offshore waters.⁵

Once all vessels are assigned to a stratum based on these rules, vessels numbers are then summed across all strata to estimate the total number of vessels potentially fishing in the lobster fleet.

4.1.2 Method to estimate lobster gear

Total gear fished is the product of the number of vessels and the quantity of gear fished per vessel. In the lobster fishery, gear is counted by the number of individual lobster traps and lobster trawls, where a trawl consists of several lobster traps tied together on a single line. The lower and upper bound estimate of gear fished per vessel is based on recorded fishing activity, and the maximum amount of gear a vessel can legally fish, respectively. A point estimate of number of vessels fishing lobster traps by management area has been estimated as described in section 4.1.1. The lower and upper bound estimates of total gear fished is defined as the product of the point estimate of vessels and the lower and upper bound estimate of gear fished per vessel. Estimates in total and by strata are presented.

Two sources of data were available to calculate a lower and upper bound estimate of the number of traps fished per vessel.⁶ First, vessels fishing lobster gear report the number of traps they hauled on a trip in the VTR database. I assumed a vessel hauls all their traps within one fishing trip, and further assumed, the average number of traps hauled per trip is equivalent to the average number of traps fished per vessel. This estimate of “VTR traps per vessel” is acknowledged as being downwardly biased. The lower bound estimate of total traps fished is then the product of “traps fished per vessel” (as recorded in the VTR) and the maximum number of vessels potentially fishing lobster traps. Second, the American lobster FMP defines a maximum number of traps that can be legally fished per permit holder per management area. The upper bound is therefore an estimate of the “maximum” quantity of gear fished since it is the product of the

⁵ An upward bias may exist within this algorithm if more vessels fishing in offshore management areas (federal waters) turn in VTR logbooks compared to the number of vessels fishing in northern nearshore or inshore waters (state waters). Length of vessels could be added as an additional screening layer to this algorithm to sort out nearshore and offshore vessels. For example, typically vessels over 50 feet are capable of traveling to offshore areas and vessels of a smaller size are not capable of traveling long distances. The cutoff length between vessels traveling offshore and nearshore can be explored and used as an extension to this algorithm.

⁶ The number of traps fished per vessel varies by management area, and may vary by season. However, seasonal variation was not considered here and a constant average annual number of traps fished per vessel is used.

maximum number of vessels and the maximum amount of gear that can be legally fished per vessel.

The total number of trawls fished is equal to total traps fished divided by the number of traps per trawl. The number of “traps fished per vessel” and “traps per trawl” varies by management area. Following Wilson and Plantinga (1997), we assume 50% of the vessels in the northern inshore tie two lobster traps per trawl and 50% of the vessels tie fifteen traps per trawl. In offshore waters we assume vessels fish forty traps per trawl, and fifteen traps per trawl in all other areas.⁷ Number of traps fished per trawl could not be estimated from the 1999 VTR logbook or any other source of data at the time of this analysis. Similar to the estimates of number of traps fished, a lower and upper bound estimate of the number of trawls fished is also presented.⁸

4.2 Results

4.2.1 Vessel Estimation

The percent of vessels that reported fishing effort within the lobster fleet was evaluated first. Approximately 20% of the federal lobster permit holders show fishing activity in NEFSC’s 1999 VTR and Dealer data.⁹ Due to such a low percentage of vessels reporting their fishing activity with lobster traps, an estimate of “active” vessels was not pursued further. Presented next is an estimate of the number of “potentially active” and “active” vessels.

Results indicate the total number of vessels potentially fishing with lobster traps was 7,539 in 1999. Sixty four percent (or 4,792) of the vessels were in Maine, four percent (or 320) in New Hampshire, twenty percent (or 1,507) in Massachusetts, eight percent (or 628) in Rhode Island, and four percent (or 292) were in the Mid-Atlantic states (Table 1). Of the 7,539 vessels, eight percent (or 603) filed VTR logbooks, sixty six percent (or 4,996) were recorded in state databases only, eleven percent (or 816) had only a federal permit, and fifteen percent (or 1,124) of the vessels had both a state and federal permit.

The next step of the analysis was to assign vessels to a management stratum. Vessels with a VTR logbook were examined first and each state was processed separately. Vessels were assigned to the management area where the majority of their fishing occurred. In Maine, VTR logbooks show 74% of the vessels fishing in the northern inshore stratum, 18% in the northern nearshore and roughly 6% fishing offshore (Table 2). Similar results are available for other

⁷ Four members of the ALWTRT were asked what was the average number of traps per trawl fished in nearshore waters. They reported an average of 15 traps. The estimate of traps per trawls offshore is based on earlier work in the 1997 ALWTRT plan.(62 FR 39157, July 22, 1997).

⁸ Since we are concerned with reducing the entanglement of right whales, the number of buoy lines in the water becomes a focal point. On pair trawls there is one buoy line and for all other trawls there are two buoy lines.

⁹ Specifically, 15%, 22%, 22%, and 42% of lobster fishing activity is reported for Maine, New Hampshire, Massachusetts and Rhode Island, respectively.

states. Comparing states, 74%, 100%, 45% and 22% of the vessels in the 1999 VTR fished in northern inshore waters for ME, NH, MA and RI, respectively (Tables 2-5, second column).

Under the second rule of assignment, vessels with only a state permit were examined next. Sixty six percent of the total vessels ($0.66 = 4,996 / 7,539$) which purchased state lobster trap tags, did not hold a federal lobster permit or hand in a VTR logbook (Table 1). These vessels, with the exception of MA, were assigned to the northern inshore stratum, since they were licensed to fish in state waters only (Table 2-5, third column).¹⁰

The third rule of assignment applies to 816 vessels with only a federal lobster permit (Table 1). There were 67, 0, 200, and 14 vessels that chose one area of fishing in ME, NH, MA and RI, respectively, and were assigned accordingly. Vessels that chose more than one area were assigned next, according to the VTR distribution of vessels fishing in federal waters only.¹¹ For example, according to Maine's VTR data, 51 vessels ($51=35+11+1+4$ from Table 2, column 2) were fishing in federal waters only. Of these 51 vessels, 68% of these vessels ($0.68 = 35/51$) fished in the northern nearshore area (Table 2).

Now, fifty five ME vessels have a federal lobster permit and chose multiple management areas to fish, have no VTR logbook, and need to be assigned to a management area. Using the fourth rule, thirty seven vessels ($37=55*0.68$) were assigned to the northern nearshore area, and twelve to the offshore area ($12=55*(11/51)$) based on Maine's VTR logbooks (Table 2, column 4). This same method was applied to data from NH, MA and RI (Tables 3-5). Of the four states, Massachusetts had the most vessels (396) holding only a federal permit.

The third rule of assignment applies to the 1,124 vessels which hold both a federal and state permit (Table 1). There were 564, 8, and 43 vessels holding both permits that were from ME, NH and RI, respectively, that chose one area to fish and were assigned to that management area.¹² In cases where a vessel chose the nearshore area on the permit application, vessels were subdivided further into the northern inshore and northern nearshore areas according to the distribution of VTR vessels for those two areas (Section 4.1.1, Rule 4).

In the mid-Atlantic region, the estimated number of vessels is 292 (Table 1). These states do not participate in the lobster trap tag program. Thus, only vessels fishing in federal waters were

¹⁰ Although MA did not have trap tag data available, their supply of catch data to the NEFSC was richer in detail compared to the standard trap tag data, since fishing grounds were identified. Ninety six percent of MA vessels were identified in the VTR and MA catch data. For location information, MA catch data was chosen over VTR data (Table 4).

¹¹ In Massachusetts, the state landings data were combined with the VTR logbook data to estimate the spatial and temporal distribution of the other MA vessels which did not have fishing location information (Table 4).

¹² Since Massachusetts supplied state landings data by area, these vessels did not need to be prorated.

examined. Using the above rules of assignment, in the mid-Atlantic region 76% ($0.76=222/292$, as seen in Table 6) of fishing occurred in the nearshore area.

The allocation of vessels to a stratum is complete. Within each stratum, vessels were now aggregated across states.

In summary, of the 7,539 vessels fishing lobster traps during 1999, 79% fished primarily in the northern inshore area, 9% in the northern nearshore area, 2% in the northern offshore area, 2% in CCBCH when it was open to fishing, 3% in the Jeffrey's Ledge/Stellwagen Bank management area, 3% in the southern nearshore area and 1% in the southern offshore area (Table 7).

A possible bias was identified in the methods section in relation to the fourth rule. This is the case where vessels only have a federal permit or vessels have a federal and state permit, chose multiple fishing areas on their federal permit, and did not have a VTR logbook. Specifically, using the fourth rule to allocate these vessels to a stratum could result in an upward bias toward offshore vessels, if more vessels fishing offshore were turning in VTR logbooks compared to other areas. Approximately 10% ($0.097=729/7539$) of all vessels fell into this category and were assigned to a stratum using the fourth rule. If the bias exists, it is not considered to be major. By adding an additional screening layer such as vessel length, the potential bias could be minimized further.

Finally, suppose a limited entry program was established within the lobster fishery which was based on a vessel's historical participation. That is, vessels who show recorded fishing activity can remain in the fishery. When determining the total number of vessels, we could eliminate those vessels who have a federal permit but did not purchase trap tags and did not show any fishing activity in the VTR logbook database. There were 815 vessels which fell into this category (Table 1). Then the total number of participants that showed VTR activity and/or purchased trap tags was 6,724 vessels.¹³ Although a limited entry program based on historical participation is being pursued, no such regulation was in place when this paper was written. Therefore, the number of vessels "potentially active" and "actively" fishing with lobster traps remains at 7,539 vessels.

4.2.2 Gear Estimation

Estimates of the number of traps per vessel from the 1999 VTR data range from a minimum of 240 traps (northern inshore area) to a maximum of 854 traps (northern offshore area) (Table 8). A maximum of 1800 traps is allowed if the vessel registers to fish offshore exclusively and a maximum of 800 traps is allowed for other vessels, according to the American lobster FMP (Section 2).

Total lower and upper bound estimates of lobster trawls for the Gulf of Maine and Mid-Atlantic waters were 436,620 and 1,436,979, respectively (Table 8). In the northern nearshore area the lower and upper bound estimates of trawls is 12,002 ($12,022 \text{ trawls} = 677 \text{ vessels} * 266 \text{ traps per}$

¹³ However, the purchase of trap tags does not imply fishing activity (1,125 vessels in Table 1).

vessel/15 traps per trawl) and 36,097 trawls fished, respectively (Table 8). The majority of lobster trap fishing occurs in the northern inshore and northern nearshore area.

4.2.3 Comparison of other estimates

Total lobster traps estimated here were consistent at the aggregate level with those presented by NMFS (1997). Total lobster trap estimates for Maine and Massachusetts were compared with those presented by the Atlantic States Marine Fisheries Commission (ASMFC) Report of the American lobster (1998). Estimates of total traps in Maine by the ASMFC based on 1998 data were within the lower and upper bound of these 1999 estimates. Massachusetts trap estimates by the ASMFC were 12 % below the 1999 lower bound estimate. This difference may be due to the point estimate of vessels including the “potentially active” and “active” number of vessels fishing, where ASMFC reports “active” vessels.

Finally, the total number of trap tags purchased in Maine, New Hampshire, Massachusetts and Rhode Island were compared to the lower and upper bound estimate of total lobster traps in these states. Results show that the total lobster tags sold is between the lower and upper bound estimate (Table 9). For example in Maine, 1.75 million trap tags were sold in 2000. Maine’s lower and upper bound estimate is 1.2 and 3.87 million traps, respectively. For each state, the number of tags purchased is between the 1999 lower and upper bound estimate of total traps by state. If individuals purchase more tags than they fish, the lower bound estimate may be closer to the true estimate of the number of lobster traps fished.

5.0 Gillnet Fleet

The number of gillnet vessels and the quantity of gillnet gear deployed were estimated here. Since the majority of vessels fishing gillnet gear operate under the multi-species FMP for groundfish, the VTR logbook and dealer data are mandatory, and data on active gillnet vessels are considered reliable. Therefore, the number of vessels presented here represents the number of vessels actively fishing gillnet gear in 1999. A point estimate is presented for both the number of vessels and the amount of gillnet gear fished.

Section 5.1 presents the methods to estimate the total number of vessels and quantity of gillnet gear actively fished. Results are reported in Section 5.2.

5.1 Methods

Sections 5.1.1 and 5.1.2 presents the methods to estimate the number of vessels and quantity of gillnet gear actively fished, respectively. Estimates are spatially and temporally stratified as outlined in Section 3.2.

5.1.1 Method to estimate gillnet vessels

The number of active vessels in 1999 was determined by tracking a vessel’s hull number in the VTR logbook, Dealer and NFDOP database. If a vessel fished at least one trip with gillnet gear it

was included. Methods used are similar to those described within the lobster fishery (Section 4.1). There are two step in determining the number of vessels within each stratum.

First the number of “active” vessels is determined. A vessel’s records for the year are aggregated to one record within each database and then merged across three databases (VTR, Dealer, SS). In the VTR, a vessel is assigned to the stratum where the majority of its fishing occurred. Location of fishing trips are not recorded in the dealer data. However, the vessel’s port and state of landing are identified. A vessel in the Dealer data was assigned to the state where the majority of its fishing occurred. Once each database is processed separately, vessels from the VTR, NFDOP and Dealer data were merged by the vessel’s hull and permit number. Vessel hull numbers provided by the NFDOP are reported, however, they are not used to estimate the active number of gillnet vessels.¹⁴

In the second step, vessels are assigned to a stratum based on the databases in which a vessel was recorded and the information contained within the database. Each state was processed separately. Detailed rules of assignment to a stratum and the order of assignment follows:

Rules of Assignment

1. All vessels in the VTR logbook were processed first and assigned to the management area where the majority of their reported fishing occurred. The following rules apply to vessels without a VTR logbook.
2. Vessels in the Dealer database and not in the VTR logbook database were sorted and assigned to the state in which they landed the majority of their catch. Within each state, vessels were prorated to a stratum (or management area) based on the spatial distribution of vessels with a VTR logbook fishing within their state. For example, if 50% of ME vessels with a VTR logbook fished in northern nearshore waters, then 50% of the ME vessels without a VTR logbook were assigned to the northern nearshore waters. This assumes at the aggregate level, vessels in the VTR database are representative of vessels without a logbook. The states of Maine, New Hampshire, Massachusetts, and Rhode Island were processed individually. Vessels from the mid-Atlantic region (south of Rhode Island) were aggregated and processed as one group.

Vessels provided by the NFDOP that have no recorded fishing activity in the VTR or Dealer data, are not assigned to a stratum. These vessels are “potentially” fishing gillnet gear. Once all vessels are assigned to a stratum, vessels are summed across the strata to estimate the total number of active vessels in the fleet.

5.1.2 Method to estimate gillnet gear

“Total gear fished” is the product of the number of vessels and the quantity of gear fished per vessel. The quantity of gear fished per vessel is defined as the number of strings fished per trip

¹⁴ The list of vessels provided by the NFDOP were not based on observed gillnet trips The list represents a survey of vessels that may potentially (ie. not confirmed) be fishing gillnet gear.

and the total length of strings being fished on average. A string consists of several 300 foot nets tied together. Trip data collected by on-board observers from NFDOP were used to estimate the average net length, number of nets per string, and strings per trip by stratum. Given one net is typically 300 feet long, then one string with 10 nets would be 3,000 feet long. If a vessel fished 5 strings per trip, the total length is 15,000 feet of gillnet gear per vessel.

The estimate of total gear fished is potentially downwardly, since gillnet vessels may not pull all their strings in one trip. For example, if a vessel fishes every day and soaks the strings for 48 hours in the water, then the vessel may have twice as much gear fishing compared to the recorded gear on an observed trip. Soak time and vessel fishing frequency were not accounted for in this analysis. Vessels are not sampled on consecutive fishing trips and the recorded unit of effort contained in VTR logbooks are inconsistent, which prevents this type of analysis.

5.2 Gillnet Results

5.2.1 Vessel Estimation

Based on 1999 data from Maine to North Carolina, there were 953 unique gillnet vessels “potentially active” and “active” according to these three databases (Table 10). The 1999 vessel list provided by the NFDOP identified an additional 407 gillnet vessels not in the Dealer or VTR.¹⁵ There were 546 vessels “actively” fishing gillnet gear based on the VTR and Dealer databases, of which 250 gillnet vessels were identified in the Dealer data (without a VTR logbook), and an additional 296 gillnet vessels were identified in the VTR logbook.

Vessels with a VTR logbook were assigned to the stratum in which the majority of their fishing occurred (Table 11). Vessels without VTR logbooks were assigned to a stratum based on fishing distributional patterns of other vessels from their state of landing who did have a VTR logbook. For example, there were 27 vessels from Maine with a VTR logbook (Table 10), of which 48% fish primarily in the northern nearshore waters and 52% fish in the northern offshore waters (Table 11). The 11 vessels from Maine in the WO database without a VTR logbook (Table 10) were prorated to these two strata, resulting in 5 vessels being assigned to the northern nearshore area and 6 vessels to the northern offshore area (Table 12). This step was repeated by state for the remaining 239 vessels in the Dealer database (239=250-11) in New Hampshire, Massachusetts, Rhode Island and the Mid-Atlantic.

According to the 1999 Dealer and VTR logbooks, the total estimate of active gillnet vessels was 546. Approximately 57% of the fleet (312 vessels) fished in northern waters and 43% (234 vessels) fished in the Mid-Atlantic region (Table 12). The majority of fishing occurred in the northern nearshore (38.3%) and southern nearshore (41.9%) waters with a smaller percentage of the fleet fishing primarily offshore (17.3%).

¹⁵ Sixty four percent of these 407 vessels are from the state of North Carolina and twenty one percent from Virginia.

5.2.2 Gear Estimation

There were 947 observed gillnet trips in 1999 (Table 13). The average number of nets per string ranged between 5.2 (in the southern nearshore) to 18.4 nets (in the northern offshore). Net length is typically 300 feet. The number of strings fished per trip ranged between 3.9 (on the Stellwagen Bank/Jeffreys Ledge area) and 10.7 strings (in the northern offshore area). Gillnet vessels in the northern offshore area fished on average the most nets per string (18.4 nets) and strings per trip (10.7 strings).

Total number of strings fished by the gillnet fleet is 3,254 (Table 14). Total number of strings fished by the industry in the northern nearshore stratum is 1,003 strings (4.8 strings*209 vessels). The average length per string fished is 3,090 feet and total length of all strings fished per vessel on average is 14,832 feet in the northern nearshore stratum.

6.0 Recommendations

Several databases were accessed to develop these estimates versus individual estimates from each database. Key to improving our knowledge of the number of lobster vessels was the requirement that vessels had to purchase one tag for each lobster trap from Maine to Rhode Island in 2000, and that the transactions were recorded.¹⁶ The use of purchased tag data for lobster traps, however, still only informs us of the number of “potential” vessels fishing lobster traps. More effort data are needed on vessels fishing lobster gear in state and federal waters. Currently, the Massachusetts Division of Marine Fisheries has the most detailed and comprehensive data records. Massachusetts requires all vessels landing lobsters in their state to fill out a monthly landings report which includes total pounds of lobster landed, number of traps fished and trips by Massachusetts statistical area designations. Other states may want to adopt these procedures.

Commercial landings data collected on vessels fishing gillnet gear is considered superior to data on the lobster fleet. However, improvements could also be made to the gillnet data. For example, VTR logbook data needs to be more consistent across vessels. Specifically, data elements such as the number of strings, nets, and amount of soak time are recorded in different units, or not recorded at all. Landed catch is recorded, but it is not clear whether the amount represents catch in terms of live (i.e. with head and guts) or landed. As a result of these data issues, other databases are used for these data elements. If these data issues are corrected the VTR database has the potential of supplying more refined units of effort which could be used in the estimation process. For example, “average landings per string” is a more desirable unit of effort than “total landings per trip”.

Database quality typically improve over time as more analysts use them and provide feedback.

¹⁶ However, the state of Rhode Island did not require applicant’s purchasing trap tags to identify their hull number. Changing this requirement from voluntary to mandatory next year will improve Rhode Island’s lobster fleet data.

Inconsistencies in recording data elements can be decreased by providing fishers more examples on how to fill out the VTR reports, for example. In some cases, data needs to be collected before its quality can be improved.

Finally, the methods presented here may be improved. For example, the algorithm of allocating vessels to a management area may be improved by adding more data screening layers. Including the length of a vessel will allow the analyst to determine whether a vessel is more likely to fish inshore versus offshore.

7.0 References

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Table 1. Number of lobster vessels by state as recorded within each database (VTR, NMFSPD, State Tag Data). A one (1) in a database column indicates the vessels were recorded in that database, and zero (0) indicates the vessels were not recorded in that database. South is all states south of Rhode Island

Data Bases			State					Total Vessels	Vessels by Database
VTR	NMFSPD	State	ME	NH	MA	RI	South		
0	0	1	3,704	280	646	366		4,996	4,996
0	1	0	122	27	396	58	213	816	816
0	1	1	773	8	224	119		1,124	1,124
1	0	0	7	1	13	4	22	47	603
1	0	1	46	0	26	5		77	
1	1	0	7	3	29	25	57	121	
1	1	1	133	1	173	51		358	
Total vessels			4,792	320	1,507	628	292	7,539	7,539
Percent			64	4	20	8	4	100	100

Table 2. By stratum, number of lobster vessels from Maine with a VTR logbook (and percent), vessels with only a state permit, vessels with only a federal permit fishing in one area only (Fish 1) and fishing in more than one area (Fish > 1), and vessels with a federal and state permit (which fish one or more than one area).

Maine								
Stratum	VTR		State Vessels	Federal Only		Federal and State		Grand Total
	Vessels	Percent		Fish 1	Fish>1	Fish 1	Fish>1	
N.Inshore	142	0.736	3,704			452	154	4,452
N.Nearshore	35	0.181		67	37	111	38	288
Offshore	11	0.057			12	1	12	36
GSCCH						0	0	0
						0	0	0
CCBCH						0	1	3
						0	0	0
Jeff/Stel	4	0.021			5		4	13
Total	193	1.000	3,704	67	55	564	209	4,792

Table 3. By stratum, number of lobster vessels from New Hampshire with a VTR logbook (and percent), vessels with only a state permit, vessels with only a federal permit fishing in one area only (Fish 1) and fishing in more than one area (Fish > 1), and vessels with a federal and state permit (which fish one or more than one area).

New Hampshire									
Stratum	VTR		State Data		Federal Only		Federal and State		Grand Total
	Vessels	Percent	Vessels	Percent	Fish 1	Fish >1	Fish 1	Fish >1	
N.Inshore	5	1.00	267	0.95		14	0	0	286
N.Nearshore	0	0.00			12	0	8	0	20
Offshore	0	0.00	13	0.05		1	0	0	14
GSCCH Open									0
Close									0
CCBCH Open									0
Close									0
Total	5	1.00	280	1.00	12	15	8	0	320

Table 4. By stratum, number of lobster vessels from Massachusetts with a VTR logbook (and percent), vessels with only a state permit, vessels with only a federal permit fishing in one area only (Fish 1) and fishing in more than one area (Fish > 1), and vessels with a federal and state permit (which fish one or more than one area).

Massachusetts									
Stratum	VTR		MA State Data		State and VTR		Federal Only		Grand Total
	Vessels	Percent	Vessels	Percent	Vessels	Percent	Fish 1	Fish >1	
N.Inshore	19	0.45	824	0.77	843	0.76	0	0	843
N.Nearshore	8	0.19	31	0.03	39	0.04	97	72	208
Offshore	7	0.17	7	0.01	14	0.01	9	26	49
GSCCH Open	1	0.02		0.00	1	0.00	0	0	3
Close		0.00		0.00	0	0.00	0	0	0
CCBCH Open	3	0.07	154	0.14	157	0.14	0	0	157
Close	3	0.07	2	0.00	5	0.00	0	0	5
Jeff/Stell B.	1	0.02	51	0.05	52	0.05	94	96	242
Total	42	1.00	1,069	1.00	1,111	1.00	200	196	1,507

Table 5. By stratum, number of lobster vessels from Rhode Island with a VTR logbook (and percent), vessels with only a state permit, vessels with only a federal permit fishing in one area only (Fish 1) and fishing in more than one area (Fish > 1), and vessels with a federal and state permit (which fish one or more than one area).

Rhode Island								
Stratum	VTR		RI Instate Vessels	Federal Only		Federal & State		Grand Total
	Vessels	Percent		Fish 1	Fish > 1	Fish 1	Fish > 1	
N.Inshore	19	0.22	366			0	17	402
N.Nearshore	35	0.41		12	23	41	31	143
Offshore	27	0.32		2	18	2	24	73
GSCCH								
Open		0.00			0		0	0
Close		0.00			0		0	0
CCBCH								
Open		0.00			0		0	0
Close		0.00			0		0	0
Jeff/Stell B.		0.00			0		0	0
S. Inshore		0.00			0		0	0
S. Nearshore	4	0.05			3		4	10
Total	85	1	366	14	44	43	76	628

Table 6. By stratum, number of lobster vessels from the mid-Atlantic region with a VTR logbook (and percent), vessels with only a federal permit fishing in one area only (Fish 1) and fishing in more than one area (Fish > 1).

Mid-Atlantic Region					
Stratum	VTR		Federal Only		Grand Total
	Vessels	Percent	Fish 1	Fish > 1	
N.Nearshore	1	0.01	14	2	17
S. Nearshore	64	0.81	50	108	222
S. Offshore	14	0.18	15	24	53
	79		79	134	292

Table 7. Total number of “potentially active” and “active” vessels fishing lobster traps by state and stratum

Stratum	ME	NH	MA	RI	NY and South	Grand Total	Percent
N.Inshore	4,451	286	843	402		5,982	79
N.Nearshore	289	20	208	143	17	677	9
N.Offshore	36	14	49	73		172	2
GSCCH open	0		3	0		3	
close	0		0	0		0	
CCBCH open	3		157	0		160	2
close	0		5	0		5	
Jeff/Stell B.	13		242	0		255	3
S.Nearshore					222	222	3
S.Offshore				10	53	63	1
Total	4,792	320	1,507	628	292	7,539	
Percent	64	4	20	8	4		100

Table 8. Average depth fished, number of lobster vessels, lower bound (LB) and upper bound (UB) estimate of the number of traps fished per vessel, assumed number of traps per trawl, and LB and UB estimates of the total number of lobster trap trawls by area.

Stratum	Average Depth ¹	Vessels	Traps/Vessel		Traps per Trawl	Total Trap Trawls	
			LB	UB		LB	UB
N.Inshore	100	5,982	240	800	2 and 15 ²	406,776	1,355,920
N.Nearshore	177	677	266	800	15	12,002	36,097
N.Offshore	419	172	854	1,800	40	3,670	7,735
GSCCH open	306	3	854	1,800	40	61	128
close	179	0	854	1,800	40	0	0
CCBCH open	144	160	279	800	15	2,976	8,533
close	164	5	334	800	15	111	267
Jeff/Stell	241	255	392	800	15	6,675	13,623
S.Nearshore	56	222	254	800	15	3,759	11,840
S.Offshore	336	63	374	1,800	40	589	2,835
		7,539				436,620	1,436,979

¹ Average depth was estimated from NEFSC’s 1999 observer data.

² Following Wilson and Plantinga (1997), it is assumed that 50% of trap trawls are pairs and 50% are multiple trap trawls (15 traps)

Table 9. Total lobster trap tags sold by July 2000 compared to lower bound (LB) and upper bound (UB) estimates of the potential lobster traps fished by state

	Tags Sold	Estimate of Total Traps	
		LB	UB
ME	1,754,084	1,181,791	3,869,600
NH	141,367	85,916	270,000
MA	790,199	442,293	1,257,335
RI	261,165	200,600	585,400

Table 10. Total number of gillnet vessels from 1999 by state within each database (VTR, WO, NFDOP) and their intersection. A one (1) indicates the vessels were recorded in the database, and zero (0) indicates the vessels were not recorded in that database.

Database			State					Total	
VTR	WO	NFDOP	ME	NH	MA	RI	South	Vessels	
0	0	1					407	407	407
0	1	0	11	19	87	17	63	197	250
0	1	1			2		51	53	
1	0	0	7	4	22	2	16	51	
1	0	1			1		14	15	296
1	1	0	18	21	76	16	16	147	
1	1	1	2		7		74	83	
Total			38	44	195	33	641	953	953

Table 11. Total number of gillnet vessels in the VTR logbook database by stratum and the percent of vessels fishing in a stratum by state.

Stratum	No. of VTR Vessels	Percent of vessels by state within a stratum				
		ME	NH	MA	RI	South
N.Nearshore	116	0.48	0.58	0.70	0.89	
N.Offshore	52	0.52	0.38	0.23	0.11	
GSCCH open	2			0.02		
CCBCH open	2			0.02		
	0					
Jeff/Stell B. close	4		0.04	0.03		
S.Nearshore	117					0.98
S.Offshore	3					0.02
Total	296	1.00	1.00	1.00	1.00	1.00

Table 12. Total number of gillnet vessels in the VTR logbook database, the prorated WO vessels by state, and the grand total number of gillnet vessels by stratum.

Stratum	No. of VTR Vessels	Prorated WO vessels					Grand Total	Percent	
		ME	NH	MA	RI	Mid-Atlantic			
N.Nearshore	116	5	11	62	15		209	0.383	0.57
N.Offshore	52	6	7	20	2		87	0.159	
GSCCH open	2	0	0	2	0		4	0.007	
CCBCH open	2	0	0	2	0		4	0.007	
	0	0	0	0	0				
Jeff/Stell B. close	4	0	1	3	0		8	0.015	
S.Nearshore	117					112	229	0.419	0.43
S.Offshore	3					2	5	0.010	
Total	296	11	19	89	17	114	546	1.000	1.00

Table 13. For each stratum during 1999, the total number of gillnet vessels, the number of observed fishing trips, average number of nets per string, average net length (feet), average depth (feet) and average strings hauled per trip from the NDFOP.

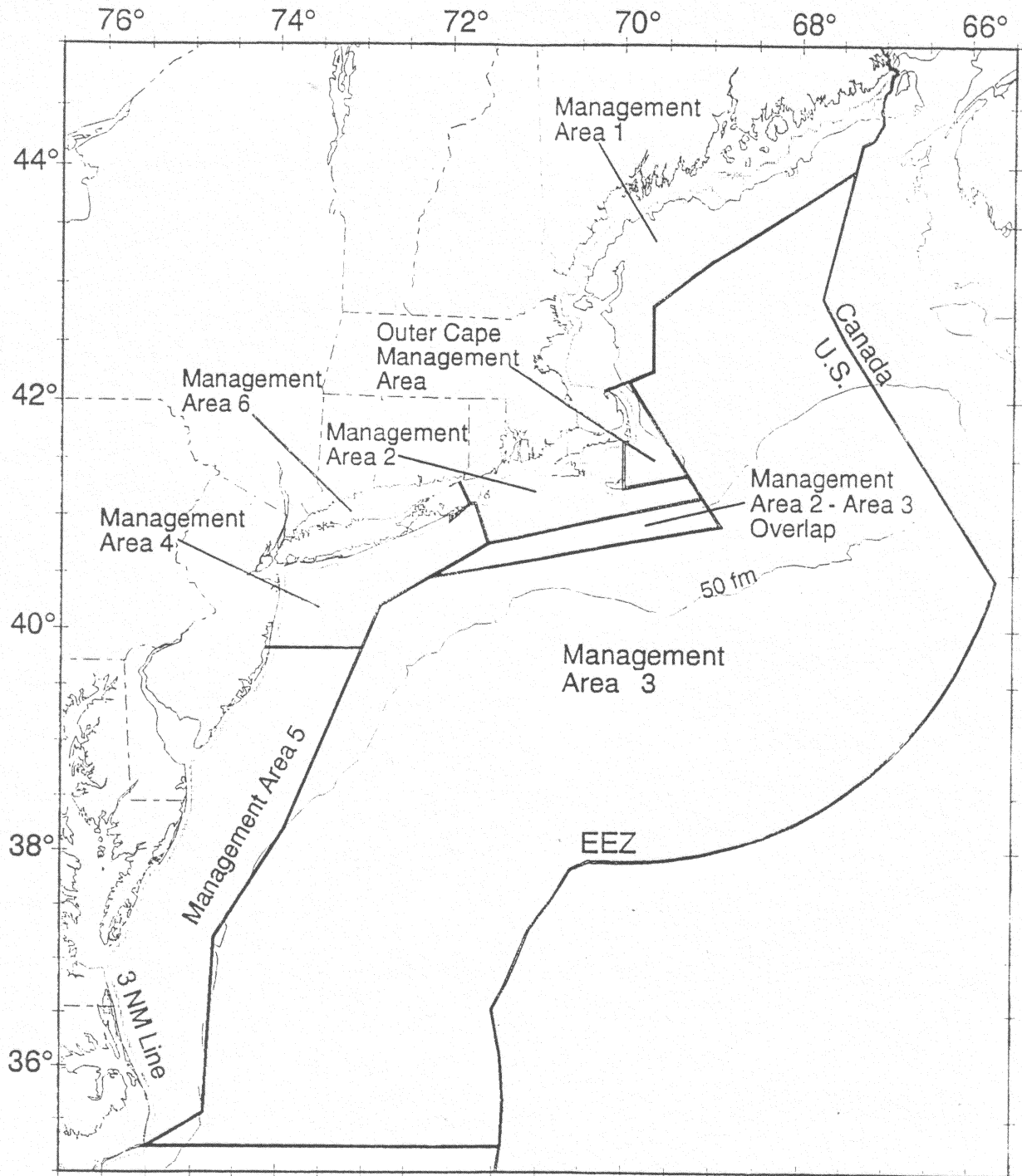
Stratum	Total No. of Vessels	NDFOP Data				
		Observer Trips	Average			
			Nets per String	Net Length	Depth	Strings per Trip
N.Nearshore	209	323	10.3	300	177	4.8
N.Offshore	87	45	18.4	300	419	10.7
GSCCH open	4	27	9.1	300	306	7.8
CCBCH open	4	50	10.8	354	144	4.6
Jeff/Stell B.	8	62	12.7	310	241	3.9
S. Nearshore	229	173	5.2	372	56	5.2
S. Offshore	5	265	9.7	300	336	9.7
Total	546	947				

Table 14. For each stratum during 1999, total number of gillnet vessels, total number of strings, average length per string (feet) and average length of all strings per vessel trip

Stratum	Total number of vessels	Total number strings	Average length per string (feet)	Average length of strings per vessel trip
N.Nearshore	209	1,003	3,090	14,832
N.Offshore	87	931	5,520	59,064
GSCCH open	4	31	2,730	21,294
CCBCH open	4	18	3,823	17,587
Jeff/Stell B.	8	31	3,937	15,354
S. Nearshore	229	1,191	1,934	10,059
N.Offshore	5	49	2,910	28,227
Total	546	3,254		

Figure 1

American lobster Management Areas established for the purpose of regional lobster management.



NOAA Fisheries
Northeast Regional Office
Gloucester, MA

Figure 2.

Massachusetts Division of Marine Fisheries Statistical Reporting Map – Inshore Areas
 Areas 1 – 14 Comprise the Territorial Waters of the Commonwealth

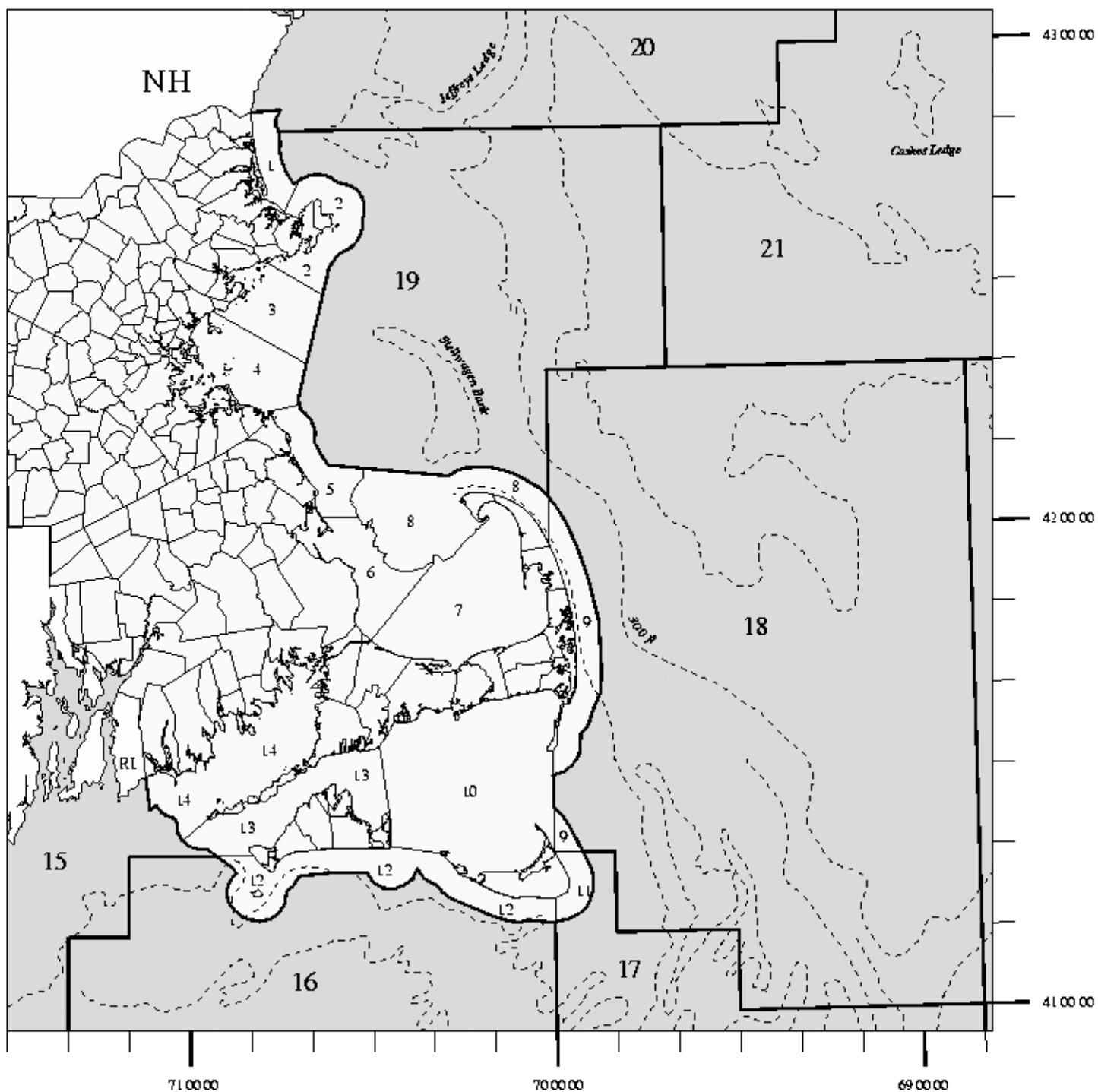
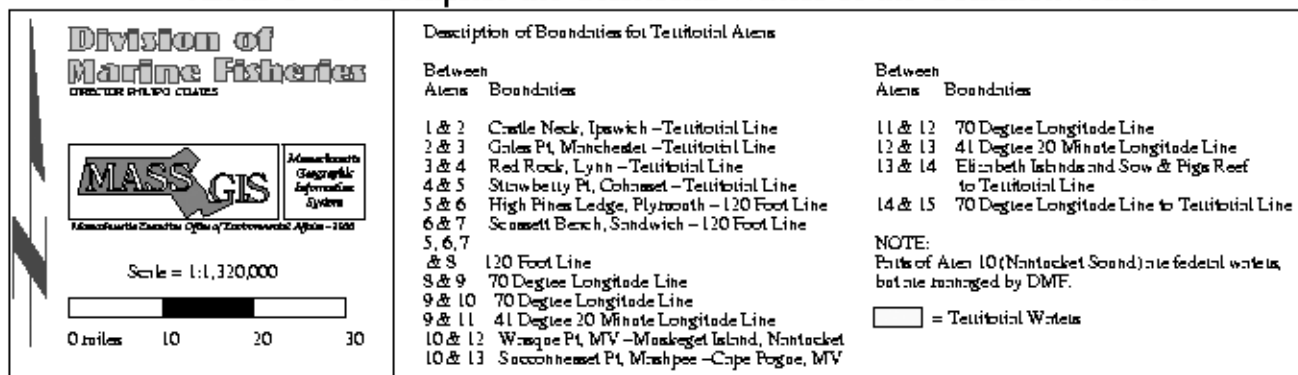


Figure 3.
Combined management areas under the ALWTRT plan
and the American lobster FMP

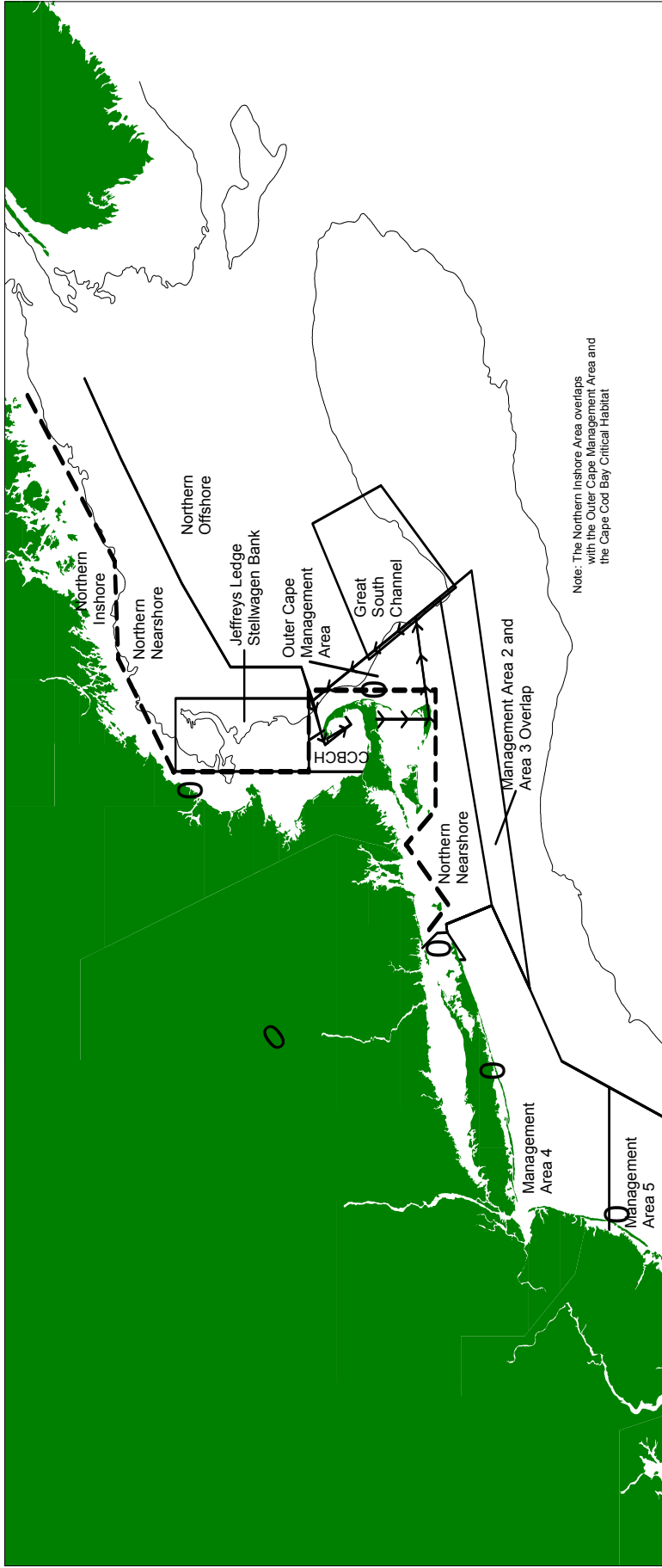
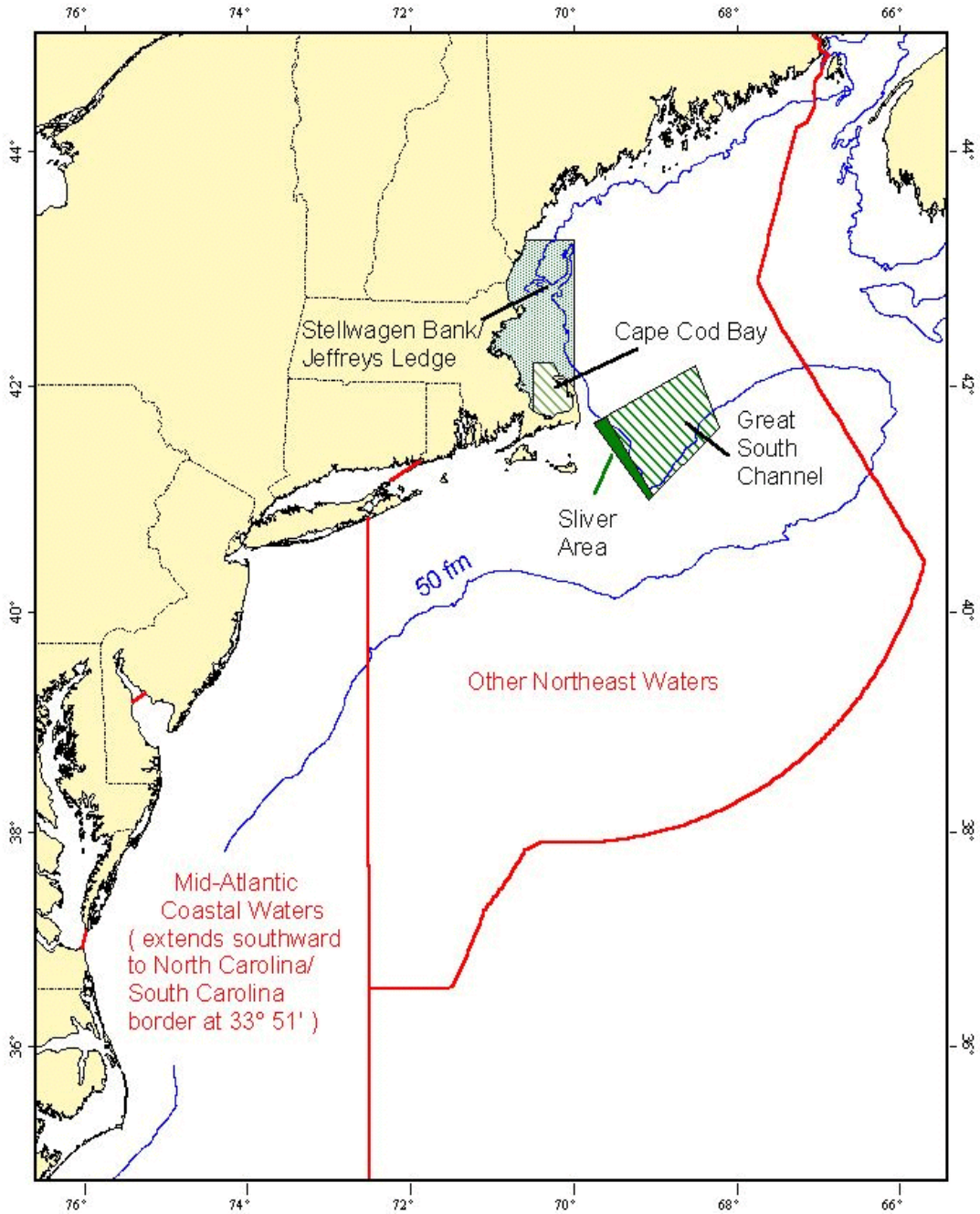


Figure 4.

ALWTRP Regulated Gillnet Waters



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