SOUTHERN NEW ENGLAND INDUSTRY-BASED YELLOWTAIL FLOUNDER SURVEY, 2003–2005

PILOT STUDY REPORT

Submitted to the National Marine Fisheries Service

by

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ABSTRACT

Yellowtail flounder stocks in the Southern New England/Mid-Atlantic area have experienced dramatic shifts in abundance and have been assessed by the National Marine Fisheries Service (NMFS) as overfished and the stock at low spawning stock biomass. In 2001, the Multispecies Monitoring Committee recommended that fishing mortality should be reduced to as close to zero as possible and widespread closures were identified as one measure to achieve rebuilding targets.

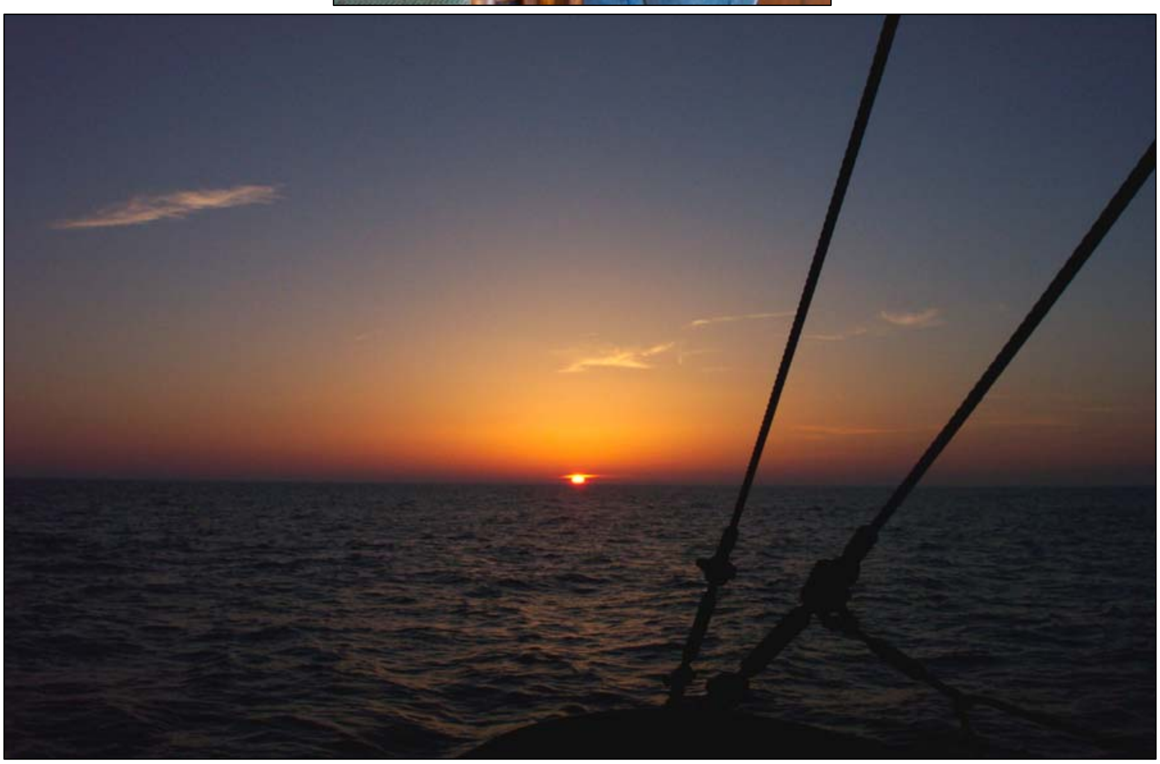
Historically, many fishermen have challenged the methodology and data used for assessment determinations, including research vessel protocol, gear deployed and areas sampled. Adversarial confrontations between fishermen, scientists and managers escalated as measures to reduce fishing mortality were ratcheted up through numerous groundfish amendments during the 1990s. Fishermen questioned the primary management measure adopted to protect aggregations of juvenile yellowtail flounders, closing the Nantucket Lightship Area in 1994 as being implemented too late and contend the measure has not provided any apparent benefit for Southern New England yellowtail flounder recovery. Conversely, Closed Areas I and II on Georges Bank—adopted at the same time—had shown significant increases in yellowtail flounder biomass.

The National Marine Fisheries Service and the New England Fishery Management Council identified the need for an industry-based commercial fishing initiative to conduct scientifically designed species-specific surveys on key stocks where data gaps existed, and established an Industry-Based Survey Committee to design a pilot project for New England groundfish species. The objective was to bridge the widening gap between science and industry. The IBS committee prioritized research on Southern New England yellowtail flounder distribution and Gulf of Maine cod distribution research for pilot studies to assess the health of groundfish fisheries in New England.

The Southern New England Yellowtail Flounder Industry-Based Survey is a partnership between the Rhode Island Department of Environmental Management's Division of Fish and Wildlife, National Oceanographic and Atmospheric Administration's (NOAA) National Marine Fisheries Service, and the fishing industry. The Rhode Island Division Fish and Wildlife implemented the project in 2003 through funds Congress allocated to NOAA fisheries for collaborative research on New England groundfish species. The survey partners the collective knowledge of fishermen, scientists, and fisheries managers to design, implement, and oversee research on yellowtail flounder stocks. Commercial vessels, fishing under a NMFS Letter of Acknowledgement, which exempt the vessels from specific groundfish regulations, serve as scientific research platforms to collect vital biological data on the status of the southern New England yellowtail flounder stock. The survey is designed to obtain high-resolution data on the distribution, abundance, recruitment, movement patterns, and size at age compositions of Southern New England yellowtail flounder. The Industry-Based Survey complements the expansive coastwide Northeast Fisheries Science Center (NEFSC) bottom trawl survey, utilizing a specially designed flatfish net designed to catch yellowtail flounder and is focused on species-specific objectives rather than the traditional multi-species, broad-based objectives. Detailed biological, environmental, and tow data were collected onboard the vessels by NEFSC scientists and trained observers.

IN MEMORIAM

This is a special dedication to Scott Westcott, owner and captain of the F/V *Mary Elena*, who passed away suddenly in May 2005 after successfully completing his 5th cruise. His dedication to the project was genuine and steadfast, one of the finest gentleman fisherman known to the port of Point Judith, Rhode Island, and along the East Coast.



ACKNOWLEDGEMENTS

The authors wish to thank the following people for their assistance in the implementation and completion of this pilot survey project.

The late Captain Scott Westcott, Captains Steven Follett, Kevin Jones, Barry Klapp, Patrick Knapp, and the crews of the F/V *Mary Elena* and F/V *Heather Lynn* as well as Industry-Based Survey partner Fred Mattera, all whom demonstrated incredible responsibility, commitment, and professionalism to the Southern New England Yellowtail Flounder Survey, as well as sharing their invaluable experiences with Southern New England ground fisheries.

The Scott Westcott family, wife Julie, daughters Jessica and Jennifer, and son Gregory, who all contributed to the survey, both at sea and on shore.

The RI Commercial Fishermen's Association, Trawlworks, Inc., Superior Trawl, and the URI Sea Grant Fisheries Center all consulted on the IBS design and survey. Commercial fishermen from multiple ports from New Bedford, MA to Cape May, NJ were consulted for expertise on historical yellowtail flounder fishery.

Ocean Marine Underwriters, Life Raft and Survival Equipment, Inc., Northeast Safety Training Co., and Point Judith Electronics provided reduced costs for the collaborative project.

The NEFSC staff for guidance in survey and sampling design as well as onboard support and NOAA's Northeast Regional Office for providing oversight. Special thanks to Dr. Steven Cadrin, Rob Johnston, and Jay Burnett.

The Industry-Based Survey Design & Implementation Committee for providing input and critique.

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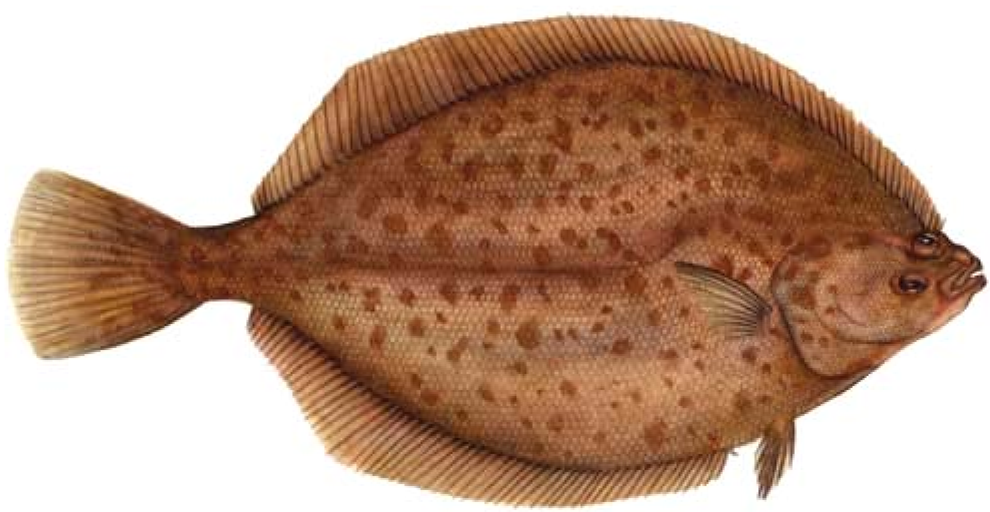
Senator Jack Reed, for his continued support to the fishing industry and commitment to collaborative research and to Congress for earmarking the funds to provide the momentum to bridge the gaps between the scientific community and commercial fishermen.

Jason McNamee, RIDFW biologist, and Della Grallert, AIS observer, measure yellowtail flounders.



Yellowtail Flounder

Limanda ferruginea

EXECUTIVE SUMMARY

This report summarizes a pilot industry-based survey for yellowtail flounder (*Limanda ferruginea*) conducted from 2003–2005 in the Southern New England (SNE) offshore waters. Funding for the collaborative research project was spearheaded by Congress in 2000 when the National Marine Fisheries Service (NMFS) was allocated $15 million as New England groundfish disaster relief funds to be used for cooperative research efforts. The New England Fisheries Management Council's Research Steering Committee and NMFS assessed the needs in the region and determined that the primary focus of the funds should be to establish an industry-based study fleet, a cod-tagging program, and gear modification research. Based upon these priorities, an Industry-Based Survey Committee was established and tasked with designing a pilot industry-based program for New England groundfish species. The long-term goal was established to determine the spatial and temporal distribution patterns of key resource species to aid in the design, implementation, and evaluation (pre/during/post) of management measures to protect these species in meeting fishery management goals.

In September of 2002, NMFS granted the Rhode Island Department of Environmental Management $839,189 to implement a cooperative research project, which included a Southern New England yellowtail flounder survey and a complementary tagging study. To expand industry participation geographically, the tagging component of the project, funded at $100,000, was diverted to the Massachusetts Division of Marine Fisheries.

The partnership was coordinated by the NMFS Cooperative Research Partners Initiative, with the objective of collecting data to improve the knowledge of yellowtail flounder populations and translate the data into an expanded information base for monitoring of existing regulations and exploring new fishery management strategies.

The Point Judith, RI vessels *Heather Lynn* and *Mary Elena* were selected to conduct the survey, based upon criteria developed by the IBS design committee. The survey was performed in the spring and fall during 2003, 2004, and 2005. Each vessel completed approximately 150 tows during each survey segment, resulting in over 1,800 completed tows for the six surveys. Detailed biological data were collected on over 64,000 individual yellowtail flounders, and bycatch species recorded. Scale samples collected onboard from the 2003 and 2004 cruises have been aged and utilized in the 2005 Groundfish Assessment Review Meeting report to fine-tune size and age structure. It is expected that all yellowtail flounder data will be utilized in the 2008 assessment. The current groundfish plan, Amendment 13, mandates a benchmark review and update of the assessments and reference points chosen and current mortality rates to evaluate the current rebuilding targets for groundfish species.

In the long term, data from these surveys will provide a valuable time series on geographical distribution of adults and juveniles and provide an indicator of recruitment throughout the SNE area, along with high-resolution data inside the Nantucket Lightship (NLS) closed area, all of which provide valuable tools for fisheries management decisions. The complementary yellowtail flounder tagging initiative throughout the survey area is providing crucial data on movement patterns within and outside of stock boundary areas and the NLS closed area.

TABLE OF CONTENTS

LIST OF FIGURES & TABLES

LIST OF ACRONYMS

CPUE	Catch Per Unit Effort
CRPI	Collaborative Research Partners Initiative
DAS	Days At Sea
F	Fishing Mortality
FMP	Fishery Management Plan
GARM	Groundfish Assessment Review Meeting
IBS	Industry-Based Survey
MPA	Marine Protected Area
NEFMC	New England Fisheries Management Council
NEFSC	Northeast Fisheries Science Center
NLS	Nantucket Lightship
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
RIDEM	Rhode Island Department of Environmental Management
RIDFW	Rhode Island Division of Fish and Wildlife
SSB	Spawning Stock Biomass
VPA	Virtual Population Analyses
VTR	Vessel Trip Report

1 PURPOSE

In 1994, the New England Fishery Management Council (NEFMC) voted to close three substantial areas on Georges Bank, the Nantucket Lightship (NLS) and Closed Areas I and II for groundfish protection. The NLS area was closed in response to industry reports of huge juvenile year-classes being discarded, which was verified through intensive sea sampling. Discards were from a large 1987 year-class recruiting into the fishery.

At the time of IBS Design Committee deliberations (2001), the area had been closed for seven years, and apparently has not provided any benefit in renewed recruitment of Southern New England (SNE) yellowtail flounder (*Limanda ferruginea*). The National Marine Fisheries Service's (NMFS) trawl survey data indicated an increase in average size and weight per tow; therefore the dominant increase in biomass was attributed to growth, rather than recruitment. Due to the design of the Northeast Fisheries Science Center (NEFSC) trawl net, few yellowtail flounders were caught throughout the stock range to provide reliable indices of abundance. Additionally, portside sampling had become inadequate to characterize the stock status, and therefore the Stock Assessment Review Committee (SARC) rejected recent Virtual Population Analysis (VPA) assessments. In addition to the NLS area, there had not been a comprehensive yellowtail flounder assessment since 1998 (NEFSC 2002).

Southern New England yellowtail flounder stocks have been identified as overfished and overfishing is occurring (NEFSC 2005). Yellowtail flounder are currently managed under the Northeast Multispecies Management Plan for groundfish species . The plan was in year 5 of the rebuilding process during the time the IBS Committee met, and significant improvements of some groundfish species had been achieved, however the stock remained overfished in the Southern New England area. Landings of SNE yellowtail flounder declined from 514 mt in 1993 to 271 mt in 1997 (NMFS, Fisheries Statistics Division, Silver Spring, MD, pers. comm.). In 2000, landings rebounded to 754 mt; however recruitment indices in the NMFS trawl survey remained low.

The population biomass of yellowtail flounder in 2000 was estimated at 7–11% of the target biomass of 61,500 mt. According to the assessment by the Multispecies Monitoring Committee (2001), stock status had not changed. Spawning stock biomass (SSB) of yellowtail flounder remained low, well below the Amendment 7 target and SSB was extremely low compared to historic biomass levels. The Committee recommended that fishing mortality (F) should be as close to zero as practicable for the foreseeable future. With F=0.0, it was estimated the fishery would be rebuilt by 2009. The NEFMC Plan Development Team (PDT) previously recommended that in order to rebuild SNE yellowtail flounder stocks, a 50–70% reduction in fishing mortality from the current level. Widespread closures were identified as one possible measure for achieving rebuilding targets. As such, the NEFMC Groundfish PDT identified three thirty-minute blocks (numbered 84, 85, and 86 in Figure 1) in SNE for potential year-round closure to all gear capable of catching groundfish in order to rebuild yellowtail flounder stocks. The blocks slated for closure are not based upon survey data, but on data collected from the Vessel Trip Reports (VTR). The landings reported in the VTR have been identified as somewhat unreliable for quantifying catch data due to the burdensome process requiring fishermen to fill out a separate report every time the vessel moves from one statistical area to another or when changes to cod-end mesh size are made.

Measures to rebuild SNE stocks were being developed by the New England Fisheries Management Council under Amendment 9. The measures under consideration in that amendment would use different rebuilding requirements and targets than Amendment 7. The targets and requirements were more restrictive, established under the Sustainable Fisheries Act. Alternatives identified in Framework 36 to address reductions in *F* on Gulf of Maine and Georges Bank cod would also apply to the SNE area. Measures proposed included reductions in days-at-sea (DAS), counting days-at-sea at a 2:1 ratio—requiring additional blocks out of the fishery—and a ban on night fishing. While the NEFMC had recently rejected the framework proposals, the same alternatives were going to be explored again in mandated deliberations by the Secretary of Commerce and future NEFMC deliberations.

Commercial landings of yellowtail flounder along the US East Coast decreased 3% from 5,507 mt in 2002 to 5,327 mt in 2003 (NMFS, pers. comm.). Research vessel survey indices suggest that the Georges Bank stock (Div. 5Z, E of 69E) is at a moderate to high biomass level, while the Southern New England/Mid-Atlantic stock (Div. 5Z W of 69E and Div. 6) remains at a historic low (Sosebee 2004).

While the NLS area had not provided any perceptible benefit to yellowtail flounder recruitment in the SNE area, Closed Areas I and II had shown significant increases in yellowtail flounder biomass. Besides obvious oceanographic differences favorable to larval transport, numerous questions remained about the current NLS closure to be addressed prior to implementation of additional closed areas for SNE yellowtail flounder. The Rhode Island Division of Fish and Wildlife (RIDFW) and commercial fishing industry proposed the area be re-evaluated for abundance, size, distribution, and predatory species that may have displaced yellowtail flounder stocks. They suggested the NLS area's original objective of protecting yellowtail flounders and yellowtail flounder habitat needed to be re-assessed. They also recommended that potential new closed areas should be intensively surveyed.

Anecdotal reports from the fishing industry indicate yellowtail flounders have become increasingly abundant in certain areas; they have noted observing varying year-classes and an increase in the female to male ratio. Since there was no longer adequate sea sampling coverage to corroborate these reports (sea sampling coverage is prioritized by species, gear type, and lawsuits), a large-scale study of the SNE/Mid-Atlantic (MA) area was needed prior to enacting further closures. Numerous variables were identified that could be investigated, including relative abundance before and after the NLS closure, environmental impacts such as long-term temperature indices, and trophic and predatory relationships. Congressional funding language included all multispecies affected by the groundfish crisis, and a paramount need was identified to update yellowtail flounder stock status, stock boundaries, and monitoring of closed areas. Industry members, scientists, and managers recognized the need for more data on critical stocks where significant gaps existed, and the pilot project intended to address all of the above was initiated.

2 GOALS AND OBJECTIVE

The goal of the industry-based survey is to assess the temporal and spatial abundance, distribution, and size composition of yellowtail flounder (and associated species) within the Nantucket Lightship closed area, proposed closed areas, and adjacent areas. The purpose of this program is for the fishing industry to assist in providing high-resolution data in SNE/MA areas to complement the NEFSC survey and cover grounds not sampled by the NEFSC vessel. The commercial fishing industry conducted intensive sampling using industry-designed flatfish trawls to collect data that could be used to derive reliable estimates of the abundance of Southern New England yellowtail flounder at age.

3 APPROACH

Industry and scientists collaborated on the specifics of the pilot survey design and timeframe, including stock assessment biologists from the NEFSC, RIDFW biologists, inshore and offshore commercial ground fishermen, net designers, and fisheries managers. As suggested by the IBS design committee, the bottom trawl survey would be conducted throughout the study area during the spring and fall months, corresponding to the current NMFS spring/fall bottom trawl survey timeframes. The spring and fall components of the survey would collect information on relative year-class strength, population abundance, distribution, and size structure. Additionally, the spring survey would collect information related to spawning.

The survey design agreed upon by the partners was 50% randomly generated stations and 50% industry-selected fixed stations. The locations of the stations selected by industry were based upon the historical distribution throughout the SNE stock range. Fishermen from New Bedford to Cape May were consulted to obtain both historical tow logs and information on wrecks and hangs. The historical information was gathered from multiple generations of fishermen with experience targeting yellowtail flounder and provided useful in navigating tows in unfamiliar areas, particularly the Nantucket Lightship closed area, which has been off limits to trawling for a decade. The IBS survey vessels were allowed access to the NLS operating under a letter of agreement (LOA) to conduct scientific research.

The initial allocation from Congress to NMFS for groundfish disaster relief was $15 million. Of that total, NMFS earmarked between $6–7 million for both the IBS study fleet and IBS surveys over 3 years (GOM report); however, funds for IBS were subsequently decreased. Initial expenses earmarked by the IBS survey committee included funding for calibration tows and depletion studies. After substantial discussions about the number of tows and the high cost to complete those studies, the consensus from the NEFSC stock assessment biologist, RIDFW, and industry was the current funding allocation was inadequate to include calibration tows and depletion studies. The number of tows needed to provide high-resolution data to cover the entire designated survey area would be reduced greatly; thereby minimizing biological sampling, and the group agreed that some trade-offs had to be made to achieve the goals and objectives of the survey.

With regard to calibration between boats, the vessel selection process paired two vessels neatly (see Vessel & Gear Specifications below). The vessels would be following identical towing protocol utilizing identical nets, covering the same area, and net mensuration equipment would log the gear characteristics on all tows. Therefore, calibration tows were not considered to be a critical issue in the initial pilot survey, and the group suggested additional funding should be requested in the future to conduct calibration and depletion studies if necessary. Side by side comparison tows were completed in close proximity to address the catchability by vessel and the initial net design, along with a twin trawl experiment to address size selectivity in the spring of 2004. (See Net Selectivity, Section 6.4). Additionally, this report provides catch-per-unit effort (CPUE) by vessel for each survey as well as on a tow-by-tow basis, along with catch at depth by vessel, and box plots which display catch rates.

Six surveys were conducted in 2003, 2004, and 2005, with a total of 1827 tows logged. Detailed biological data were collected on over 64,000 individual yellowtail flounders, and all species bycatch recorded. Scale samples collected onboard from the 2003 and 2004 cruises have been aged and utilized in the 2005 GARM report to fine tune size and age structure. In the long term, data from these surveys will provide a valuable time series on geographical distribution of adults and juveniles as well as an indicator of recruitment, all of which provide valuable tools for fisheries management decisions. The yellowtail flounder survey has been complemented with a yellowtail flounder tagging initiative throughout the survey area, which provides crucial data on movement patterns within and outside of stock boundary areas.

4 METHODOLOGY

4.1 Survey Design

Survey strata were chosen specifically for the Southern New England yellowtail flounder stock range, within the depth range for the species (approximately 10–45 fathoms). Stratum included 30-minute squares, or portions of 30-minute squares within the specified range, and included statistical areas 613, 616, 539, 537, and 526, including the Nantucket Lightship Closed Area. The survey area encompassed 49,671 square kilometers, with a total of 109 10-minute blocks. The survey area included essential fish habitat (EFH) identified by the NEFMC for SNE yellowtail flounder.

The random tow locations were determined by randomly selecting one location for every 100 square miles (9 tows for each 30-minute square). Fewer tows were allocated to strata that were depth limited (*i.e.*, 6 tows for each stratum with 2/3 of the area surveyed, such as strata 73 and 87, and 3 tows for each stratum with 1/3 of the area surveyed, such as strata 64–69 and 100–102). An equal number of industry-selected tows were plotted in each stratum. Captains and industry participants reviewed the tow selection prior to each survey. Tow allocations were adjusted for each survey to account for areas that could not be towed due to the bottom type.

Based upon consultation with the NEFSC and industry, it was determined 300 tows would be needed to adequately sample the entire stock area in the pilot survey. The survey design agreed upon by the partners was 50% randomly generated stations and 50% industry-selected fixed stations. The locations of the stations selected by industry were based upon the historical distribution throughout the SNE stock range. It is important to note that the pilot survey design and sampling protocol were specifically chosen to obtain fine-scale, high-resolution data on SNE yellowtail flounder. The survey area and sampling protocol was not designed to capture high-resolution data on other demersal or pelagic species, as the stock boundaries and depth parameters for all species varies widely. The pilot survey was designed to record bycatch data on all other species as they relate to the SNE yellowtail stock, either as predatory species or species of significant commercial importance.

Figure 1. Survey Boundaries

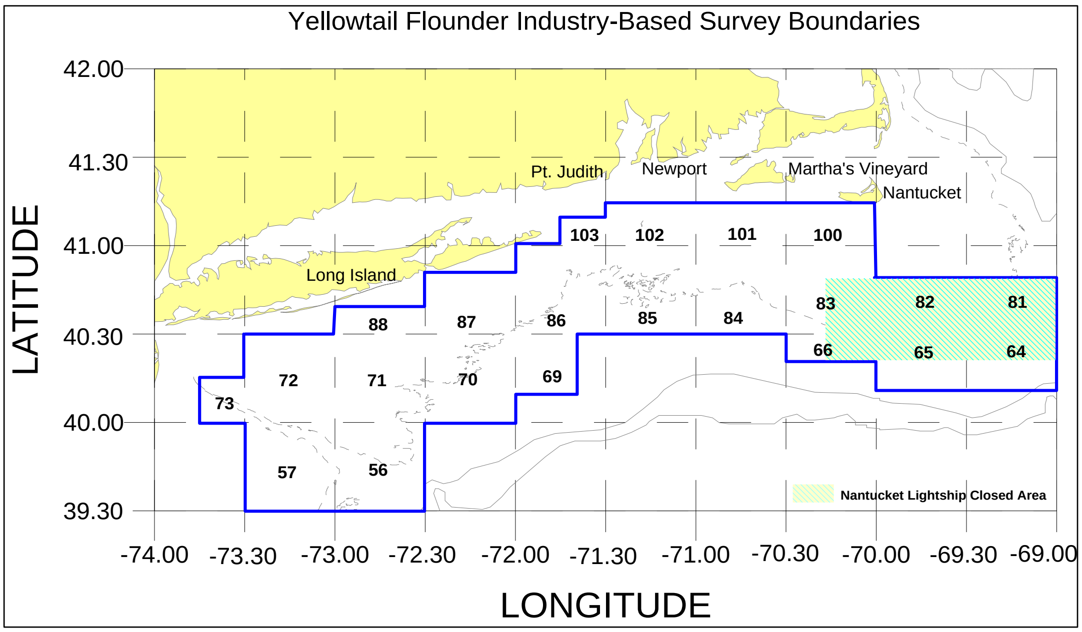
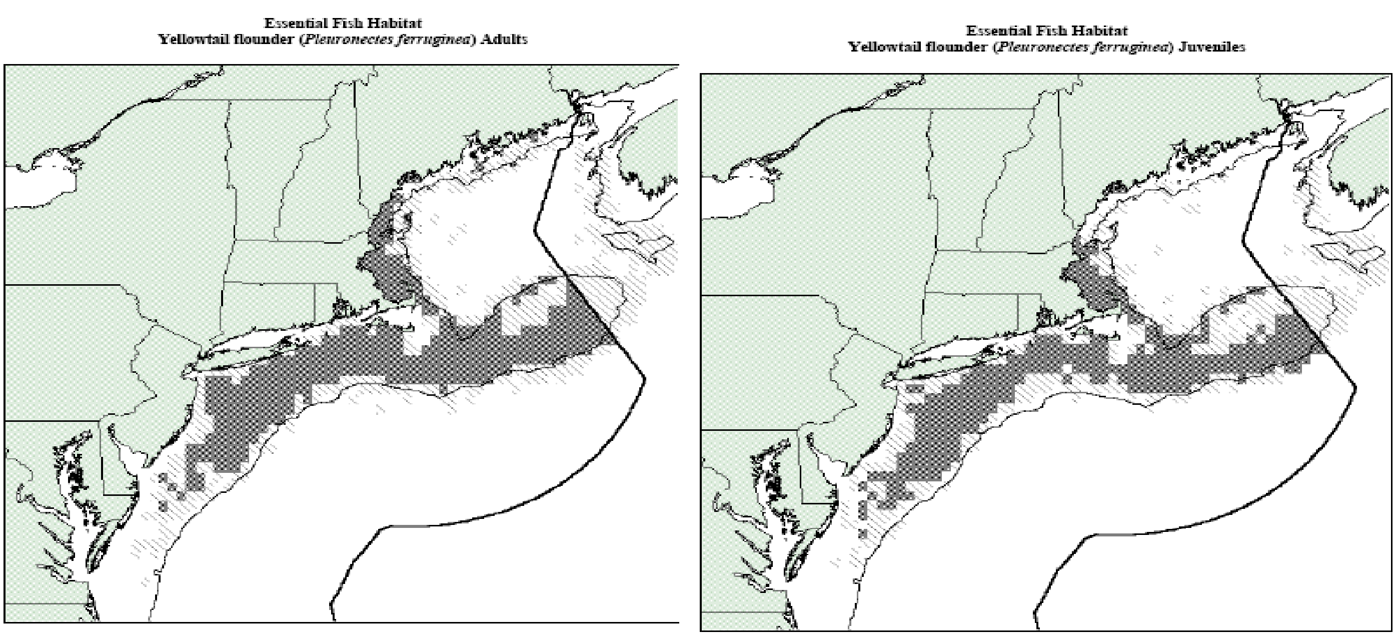


Figure 2. Essential Fish Habitat



4.2 Vessel Selection

Based upon the survey design, the IBS committee developed preliminary vessel criteria for contracted vessels. In order to accommodate observers, bunkroom for 8 persons was needed. Large deck space was needed for the vessels to operate as scientific support platforms, therefore the design committee decided vessels selected needed to be a minimum of 80'. Vessels needed net mensuration sensors and standardized gear for the initial survey. Only experienced captains with documented history in the SNE yellowtail flounder fishery were considered and vessels were required to make a commitment of approximately 30 days per year for the survey.

The SNE members developed these criteria in order to keep the costs of the surveys down, and canvassed local ports before making a decision. Based upon the criterion developed, the F/V *Heather Lynn*, and F/V *Mary Elena* were chosen. The F/V *Karen Elizabeth* was selected as a back-up vessel, should a vessel breakdown have occurred. These vessels all have identical engines and horsepower, with a reduction gear ration of 6:1, as well as identical propeller size. At the selected towing speed and equal rpms, the vessels exerted identical bollard pull.

The captains (also owners) of each vessel chosen were second-generation fishermen, with decades of fishing experience throughout the survey area, including the NLS area before it was closed. Vessel captains made a firm commitment to the IBS survey with their respective vessels and crews. Captains and crews were briefed on survey protocol prior to the commencement of each cruise. Communication between RIDFW and one or both of the vessels at sea occurred on a daily basis via satellite or cell phone to monitor progress and address problems encountered. Daily communication improved scheduling gear work and provided advance notice to procure observers for the following legs.

VESSELS AND GEAR SPECIFICATIONS
PROVIDED TO IBS DESIGN COMMITTEE 2002

	F/V *Heather Lynn*	**F/V *Mary Elena***
Type	Steel Stern Trawler	Steel Stern Trawler
Length	84’	90’
Main Engine	CAT 3508	CAT 3508
Horsepower	800	800
Crew Size	4 persons	4 persons
Berths	8	8
Sensor Doors	NETMIND (Wireless)	SIMRAD ITI (Wireless)
Headline	NETMIND	SIMRAD ITI
Net [1]	404 flat net	404 flat net
Sweep Length	135’	135’
Webbing	6” mesh	6” mesh
Codend	6” diameter (60 m x 75 m)	6” diameter (60 m x 75 m)
Liners	2.8” diameter (180 m x 250 m) or	2.8” diameter (180 m x 250 m) or
	3.25” diameter (160 m x 200 m)	3.25” diameter (160 m x 200 m)
Doors	NETS 4Meter	TYBORON 92”
Legs	20 fathoms	20 fathoms
Ground Cable	100 fathoms (2.75” cookie discs)	100 fathoms (2.75” cookie discs)
Ground Chain	5 fathom	5 fathom

Both vessels were inspected shore side by the US Coast Guard.

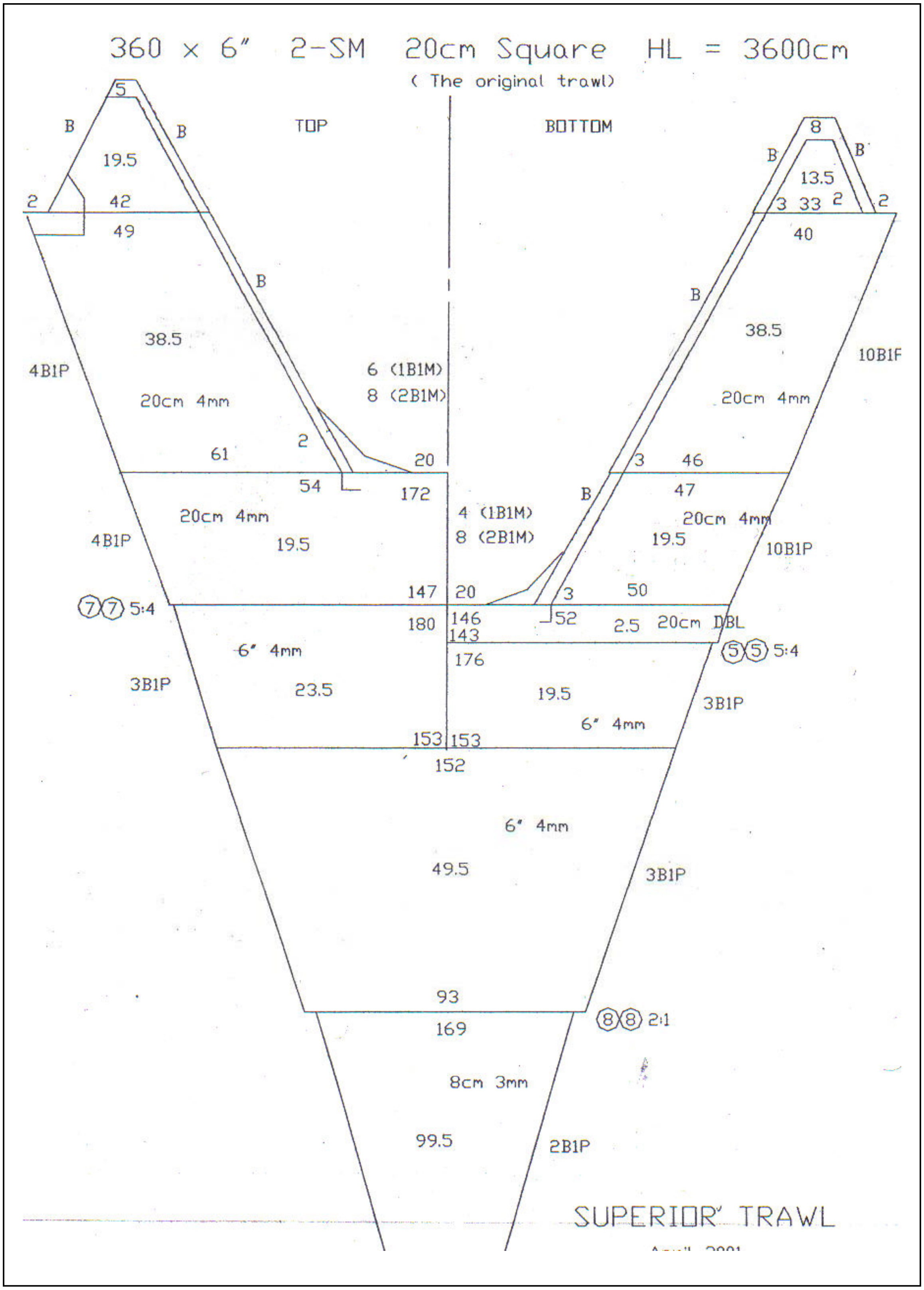
[1] The net listed is the gear currently used to fish for yellowtail flounders. Both vessels switched to a 360 flat net for the industry-based survey.

4.3 Net Design

Both Superior Trawl and Trawlworks, Inc., of Rhode Island worked with RIDFW and industry participants on the specifics of net design. A 360 x 6” two-seam trawl with a 3” straight cod-end was selected for targeting yellowtail flounders . Ground cables were equipped with 3” cookies**.** The participants reviewed the results of a previous yellowtail flounder mesh selectivity study to match cod-end size (Skrobe et al. 2003). The participants debated utilizing a smaller cod-end to retain all small fish, but decided utilizing anything less that 3” would result in unnecessarily excessive catches. For the initial survey, two new nets were constructed, with another new net initially supplied by the F/V *Mary Elena* as a back up. Two more nets were constructed as the surveys progressed, with each vessel having a spare net, spare codends, bellies and patch twine onboard. Each vessel was equipped with multiple net drums and was able to quickly switch over to the spare net when needed.

Hauling back, cod-end full of skates and dogfish

Design of Net for Industry-Based Survey



4.4 Survey Logs

For the initial survey, RIDFW staff biologists and NEFSC observers that were specifically trained to record data on the NMFS Fisheries Observer Program Trawl Logs served as observers (Appendix D). All lengths, weights, numbers, and sex of yellowtail flounder were recorded, length and weights on all winter flounder were recorded, and weights on all other species were recorded. The numbers of fish and crustaceans were not recorded in the initial survey. For compatibility with NEFSC SURVAN database, these logs were subsequently converted to the format of the NEFSC standard trawl survey logs (Appendix D).

For all subsequent surveys, the NEFSC standard trawl survey logs were used and the same yellowtail flounder data collected. The total weight of each tow's catch and the weight of major species caught on each tow were recorded. The total weight and number of yellowtail flounder caught in each tow was recorded. Estimates of total weights and numbers for species other than yellowtail flounder were derived from sub-sampling. Sub-sampling of the total catch in the fall of 2003 was considered minimal, due to high catch rates, poor weather, inadequate number of observers on some trips and seasickness. Enhanced training and observer experience from 2004 on resulted in higher levels of sub-sampling to enumerate bycatch.

4.5 Tows

The survey was composed of six segments: both a spring and fall component in 2003, 2004, and 2005. The initial survey was ambitiously designed, with a target of 10 tows per day—some days 11 or 12 tows were made. Due to the intense workload to collect all necessary yellowtail flounder data and increase sub-sampling to accurately expand bycatch estimates, the number of tows targeted per day was reduced to 8 per day during the second year of implementation. NEFSC was able to provide chief scientific staff onboard beginning with the 2004 survey and provided valuable guidance to improve sub-sampling techniques.

Summary of Survey Sampling

Survey Segment	Data Logs	Yellowtail Flounder Data	Other Detailed Species	Sub-Sampling
Spring 2003	Observer	Length, weight, sex, scales (1 per 5 cm), maturity, stomach contents	Winter flounder: lengths and weights; Lobsters: sexed, lengths and weights	All fish weighed, no sub-sampling
Fall 2003	NEFSC Survey	Same	Winter flounder: lengths and weights	3 baskets if tow > 800 pounds
Spring 2004	NEFSC Survey	Same		3 baskets if tow > 800 pounds
Fall 2004	NEFSC Survey	Same		9 baskets if tow > 1000
Spring 2005	NEFSC Survey	Same, except all > 40 cm scale sample		6–9 baskets depending on tow weight
Fall 2005	NEFSC Survey	Same, except all > 40 cm scale sample		6–9 baskets depending on tow weight

2005 Guidelines for SNE Industry Based Yellowtail Flounder Survey

Target Species: Yellowtail Flounder

Vessels: F/V *Mary Elena* 90' Stern Trawler

F/V *Heather Lynn* 86' Stern Trawler

Alternate Vessel: F/V *Karen Elizabeth* as back up, 90' stern trawler

Survey Area: 30-minute squares (or portions of) of statistical areas 613, 616, 539, 537,and 526 including the Nantucket Lightship closed area between 10–45 fathoms. Vessel captains will split random and industry selected tows by box to vary ground and depth strata covered by each vessel. Survey duration expected to last approximately 16 days, trip duration typically 3–5 days, weather dependent.

Towing: 150 trawl stations per vessel and per season

Fifty percent of the stations were designated as industry-selected fixed tows, based upon historically high-density areas, and the remaining 50% were randomly generated each survey to include low-density areas as well.

Tows loaded onto PCWindplot, tows with green flag are industry selected; tows with magenta flag are random selections (flag colors changed for each survey to distinguish tows from previous surveys on plotter . Hard copy and maps of tows located in captain's binder.

Effort: Target 8 tows per day (down from initial 10); chief scientist's discretion to change this based on volume of catch

Tow duration (approximately 30 minutes, from when winches are locked to time winches engaged for haulback) and speed (2.8–3.1 knots) are variable, will be logged on plotter. (note: review of all tow logs post survey indicate towing speed was routinely 2.9-3.0 knots to maintain consistent door spread, all recorded on logs). Critical component to log on plotter is distance covered over ground, towing distance is targeted for 1.9 nm**.** Data on door and wing spread from the Simrad ITI and Netmind sensors was recorded by captains to ensure nets were towing correctly. Door spread varies between 65-72 fathoms, to obtain optimum towing angle of 16 degrees. Scope of wire out varies dependant upon depth

Tow direction: variable, tows plotted are start points, captain's discretion as to which direction, based upon fixed gear, tide, current.

Non-towable bottom: If the location is not towable for any reason, relocate station as close as possible. Captain has the discretion to abort tows for hangs, fixed gear, or large schools of dogfish and re-locate as close as possible.

Logs: Standard NEFSC survey log sheets provided

1. Ship operations log for cruise and tow info and sub-sample information. Make sure the total weight of each tow is recorded, the captain will provide the total estimated weight, and then break down the major species caught by estimated weight per tow. Captain to record hail weight on captain's log and relay weight to chief scientists.
2. Detail logs for length frequency, weight, and sex of yellowtail flounder only.

All other haul information will be recorded in the wheelhouse on NMFS observer forms by the Captains. Bottom temperature automatically logged with VEMCO minilog probes sewn into headrope.

Sampling: All tows estimated to be < 1000 pounds will be sorted and sampled in entirety (weight and numbers of fish). Many of these tows will contain large numbers of skates and dogfish that can be sub-sampled. Again, catch processing will be at chief scientist's discretion. Complete detail log for all yellowtail flounders in tow.

Sub-Sampling: (See Appendix C for NEFSC Sub-sampling guidelines)

Prior to sorting the yellowtail flounder catch, a random sample of fish representative of the total catch will be taken from the trawl. For catches >= 1000 pounds a 9 basket sub-sample should be used. Samples greater than 9 baskets may not be possible due to staff and time constraints**,** however due to reduced number of tows per day a larger catch may be possible to process, but will be left to the chief scientist's discretion. Baskets will be filled going on the conveyor, 2–3 baskets as the catch starts to enter the conveyor, again about halfway through, and again towards the end of the catch coming onto the conveyor. The total weight for each basket will be recorded separately on log, and the total weight and number of each species in the sub-sample will be recorded. Expansion factors will be done post-processing.

All yellowtail flounder will be sorted from the sub-sample. Sex and individual lengths taken will be taken from all yellowtail flounder. Scale samples will be taken at the rate of 1 per 5cm interval for all yellowtail flounder < 40 cm (male and female). Scale samples for all yellowtail flounder > 40 cm will be taken. Individual weights of fish taken for scale samples will also be recorded.

When there is a small number (< 8) of very large fish (*i.e.*, barndoor skates, summer flounder, torpedo ray, striped bass) those individual fish can be picked from the pile and measured and recorded separately in a different column.

Dogfish: Counted not sexed

4.6 Yellowtail Flounder Sampling

All remaining yellowtail flounder will be sorted from the catch. Sex and individual lengths will be taken from all yellowtail flounder. Scale samples will be taken at the rate of 1 per 5 cm interval for all yellowtail flounder < 40 cm (male and female). Scale samples for all yellowtail flounder > 40 cm will be taken. Individual weights of fish taken for scale samples will also be recorded. Chief scientist will advise at sea, depending upon amount of fish. Scales taken at caudal peduncle of fish, length measured along lateral line of fish.

Treat male and female yellowtail flounder as separate species, using separate detail logs for male (1) and female (2). If the sex is unknown (0), it should be recorded in a separate column on the sheet. Record the total weight of each sex on bottom of log.

Scale Envelopes: Sample number is recorded on scale envelope from the detail log, and the location is recorded on the scale envelope as the tow number.

Maturity staging: Treat males and females separately; take samples on fish between 16–25cm for males and between 21–30cm. for females. NEFSC staff suggested restricting length ranges within those specified ranges as being representative of the critical sizes over which knife-edge maturation process occurs. NEFSC also suggested that maturity observations should be considered secondary to length and age samples. Chief scientist will develop intervals for sampling as time allows.

4.7 Data Processing

With the exception of the Spring 2003 Observer Logs, all survey data was post-processed and coded at RIDFW according to the NEFSC standards, then forwarded to NEFSC for QA/QC. Keypunching of data was contracted out to Unicor, and the final datasets reside in the NEFSC Oracle database. Summary survey data is also available at the Cooperative Partners Website.

4.8 Outreach

Press releases were prepared prior to each survey explaining survey timing and areas, along with a spreadsheet listing tow locations. This information was circulated to fixed gear fishermen, fisheries organizations and posted at the RIDEM website. Coverage of the SNE IBS yellowtail flounder survey was featured in several issues of *Commercial Fisheries News* and *The Fishermens Call*. Posters on the IBS surveys developed by RIDFW and NMFS Collaborative Research Partners Initiative (CRPI) were displayed at Fish Expo (2004) and Saltwater Anglers shows (2004, 2005).

5 2003-2005 SPRING AND FALL SURVEY SUMMARY DATA

Catch Rates

Catch rates of yellowtail flounder numerical density (number/ km^2). Numerical density was estimated by dividing the number of yellowtail flounder caught in each tow by the area swept (km^2). The density estimates were log-transformed as ln[density+1] for visual comparison on a uniform scale. The log-transformed estimates were summarized with box plots to compare the c

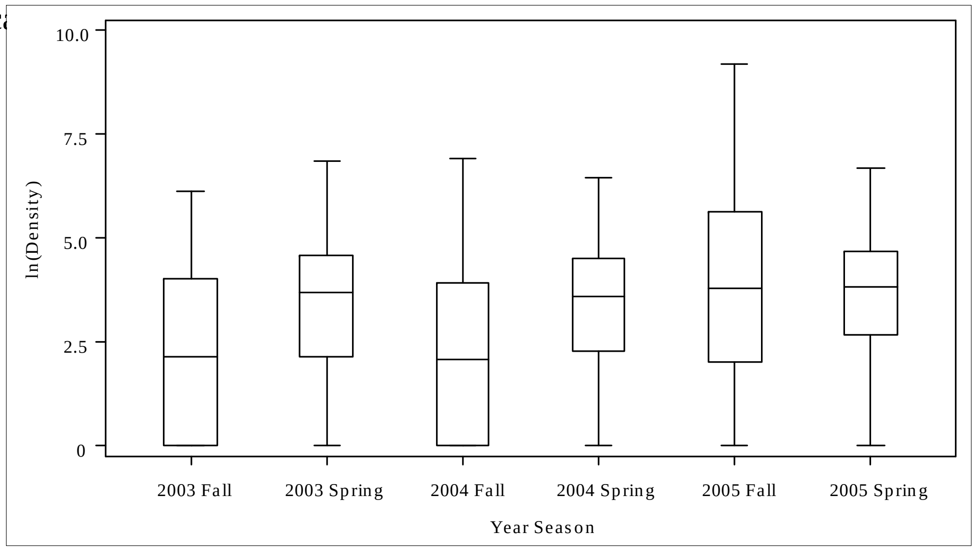


Figure 3. Box plots of log-transformed catch rates (number per km2) of yellowtail flounder

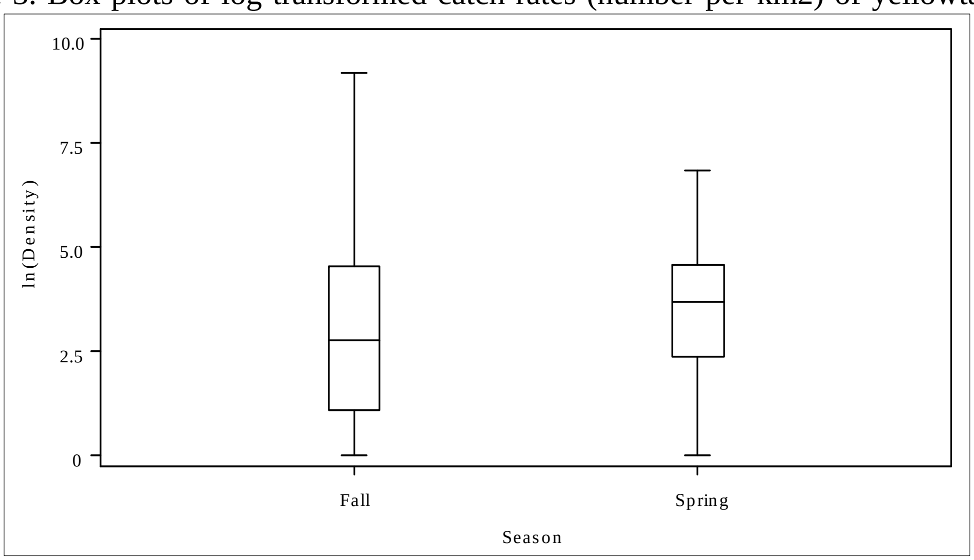


Figure 4. Box plots of log-transformed catch rates (number per km2) of yellowtail flounder observed in spring and fall seasons.

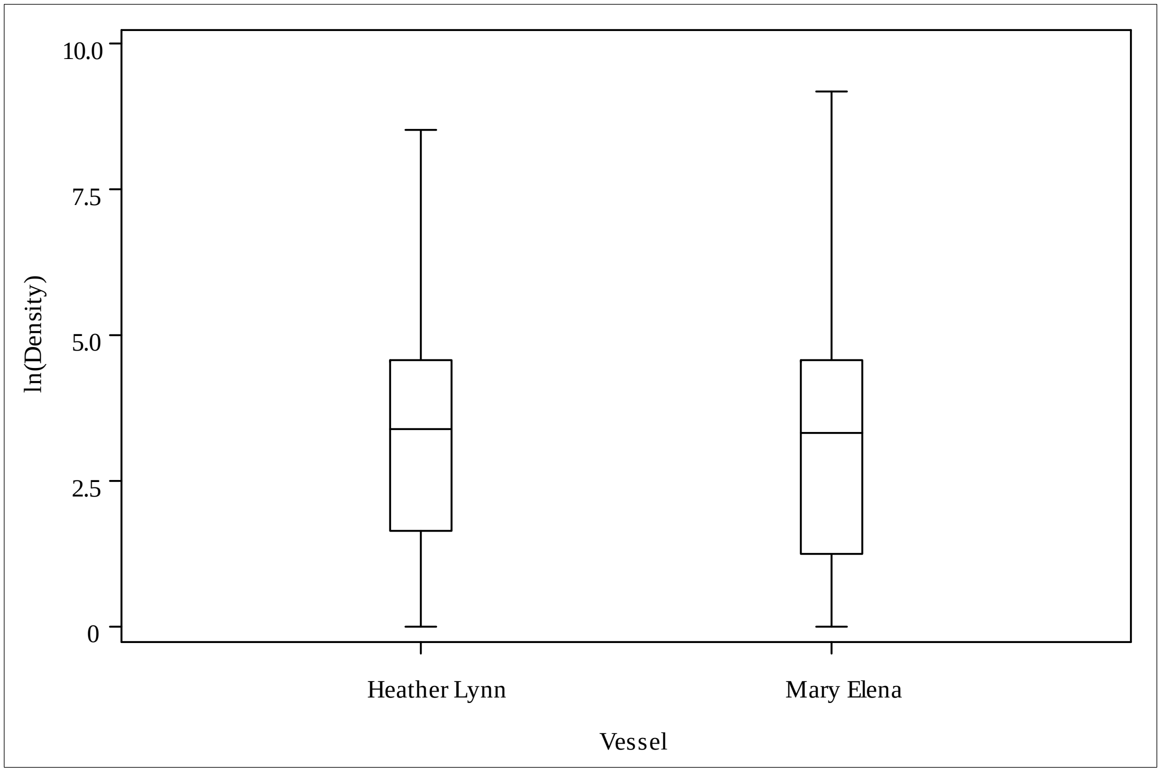


Figure 4. Box plots of log-transformed catch rates (number per km2) of yellowtail flounder observed in spring and fall seasons.

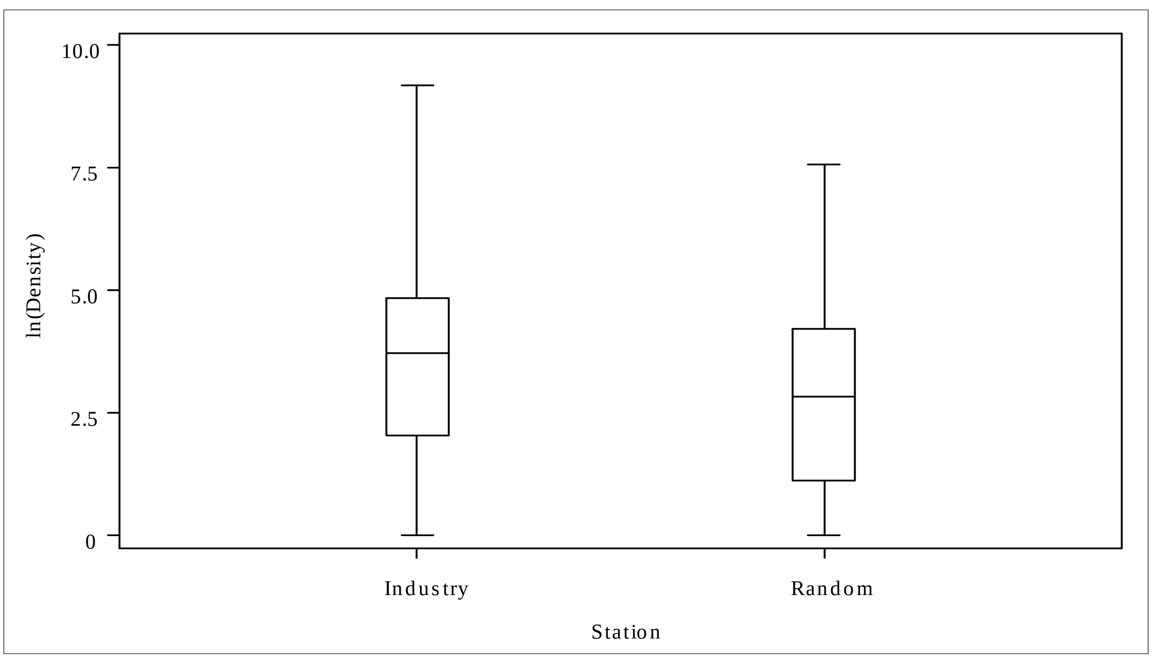


Figure 5. Box plots of log-transformed catch rates (number per km2) of yellowtail flounder for both random and industry-selected stations.

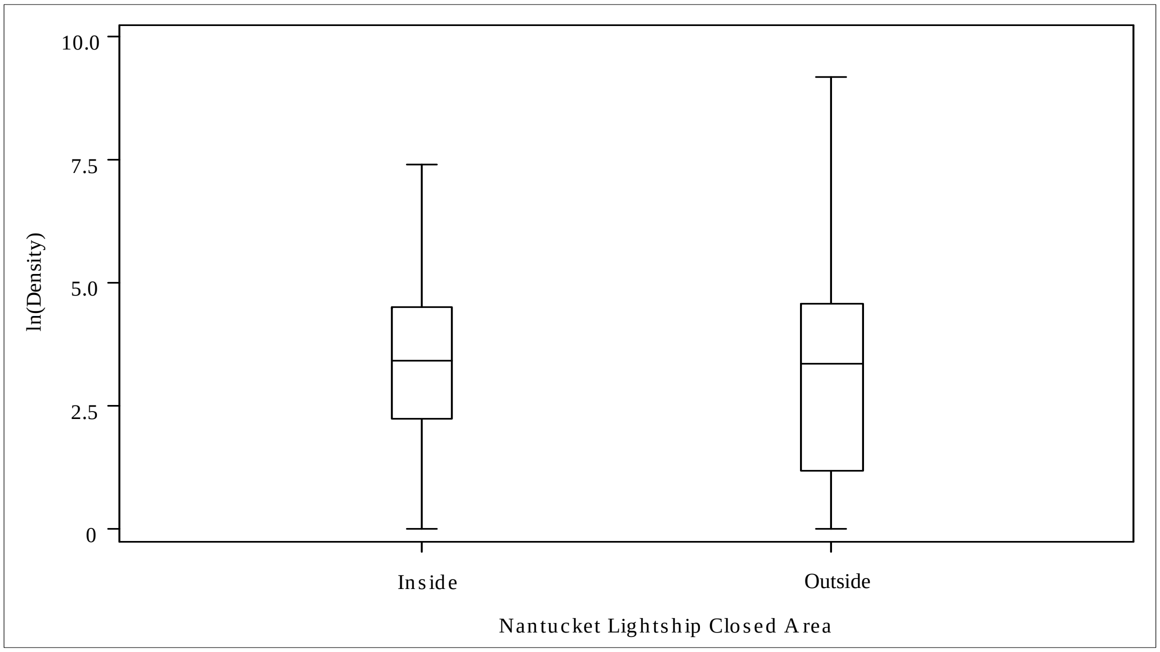


Figure 6. Box plots of log-transformed catch rates (number per km2) of yellowtail flounder for stations both inside and outside the Nantucket Lightship Closed Area.

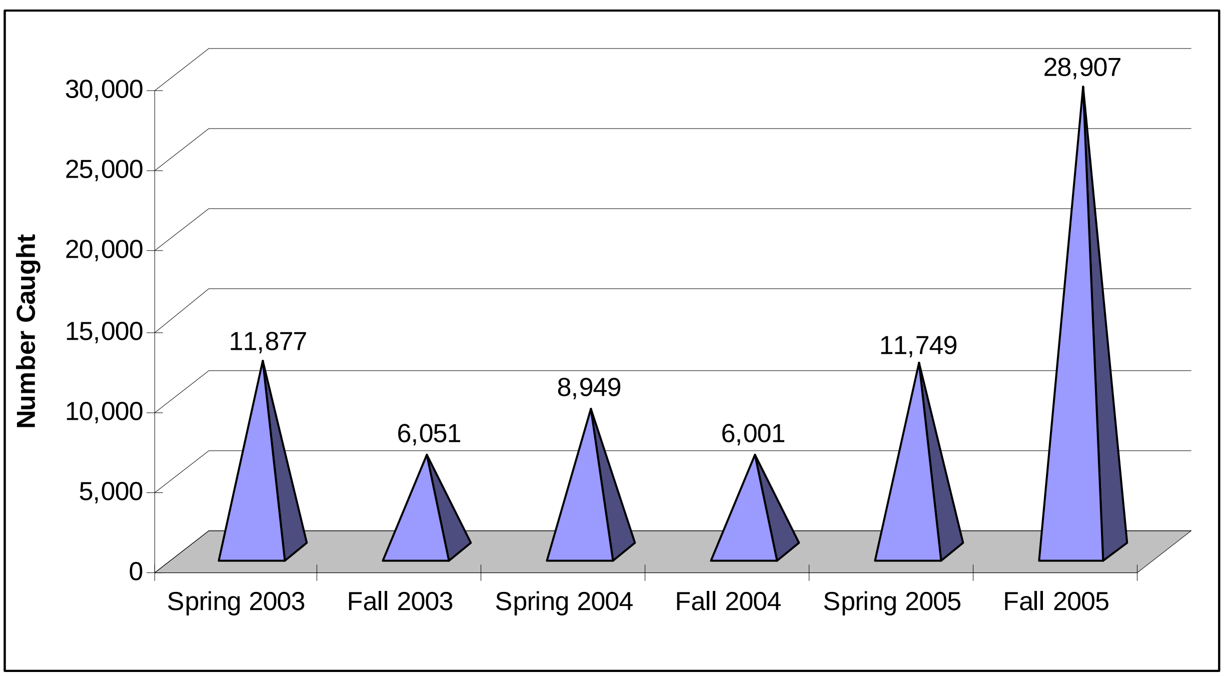


Figure 7. Total numbers of yellowtail flounder caught in each survey segment of the yellowtail flounder industry-based survey. Note that the fall 2005 value is an estimate expanded from sub-sampling.

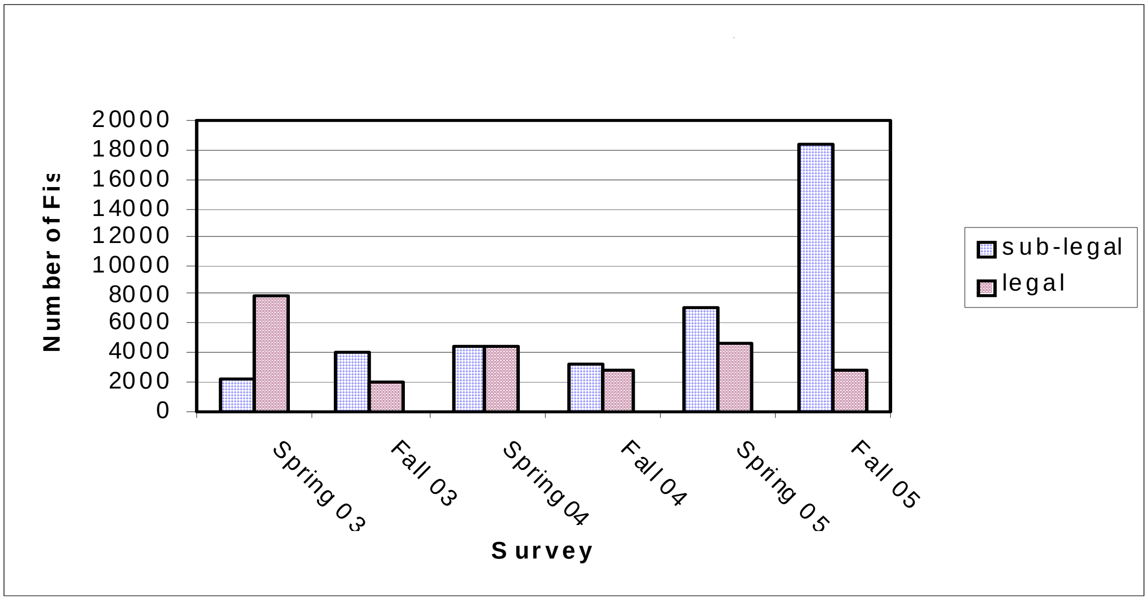


Figure 8. Number of yellowtail flounder sampled in each survey segment.

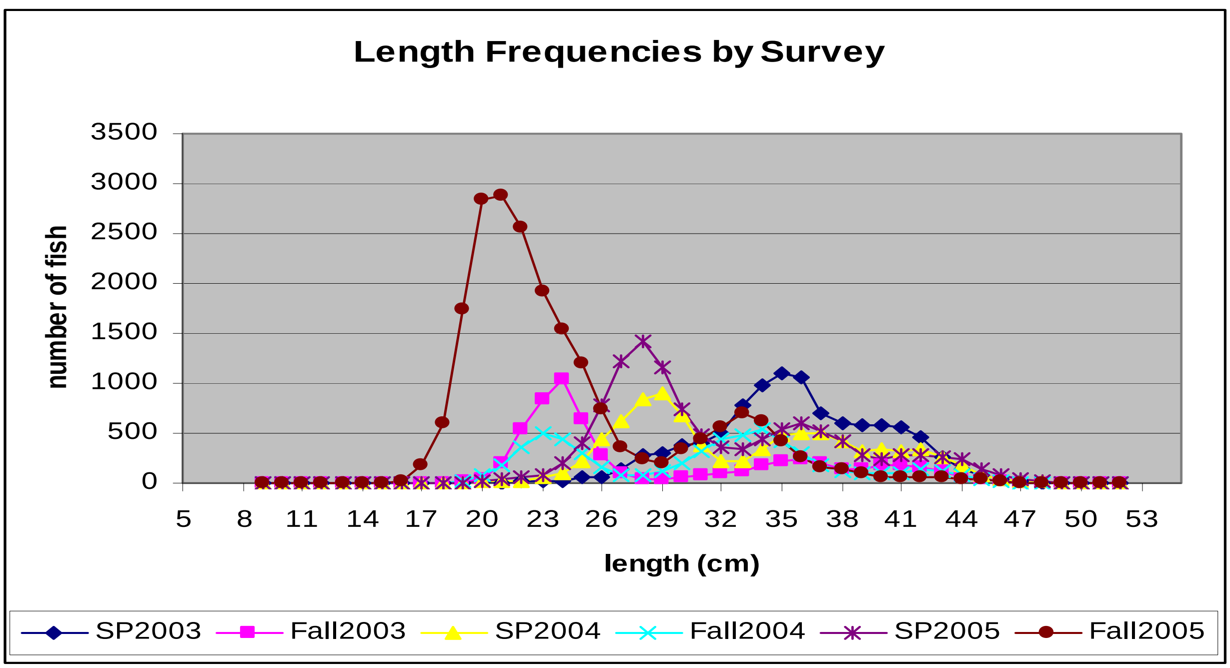


Figure 9. Number of yellowtail flounder observed at length for each survey segment.

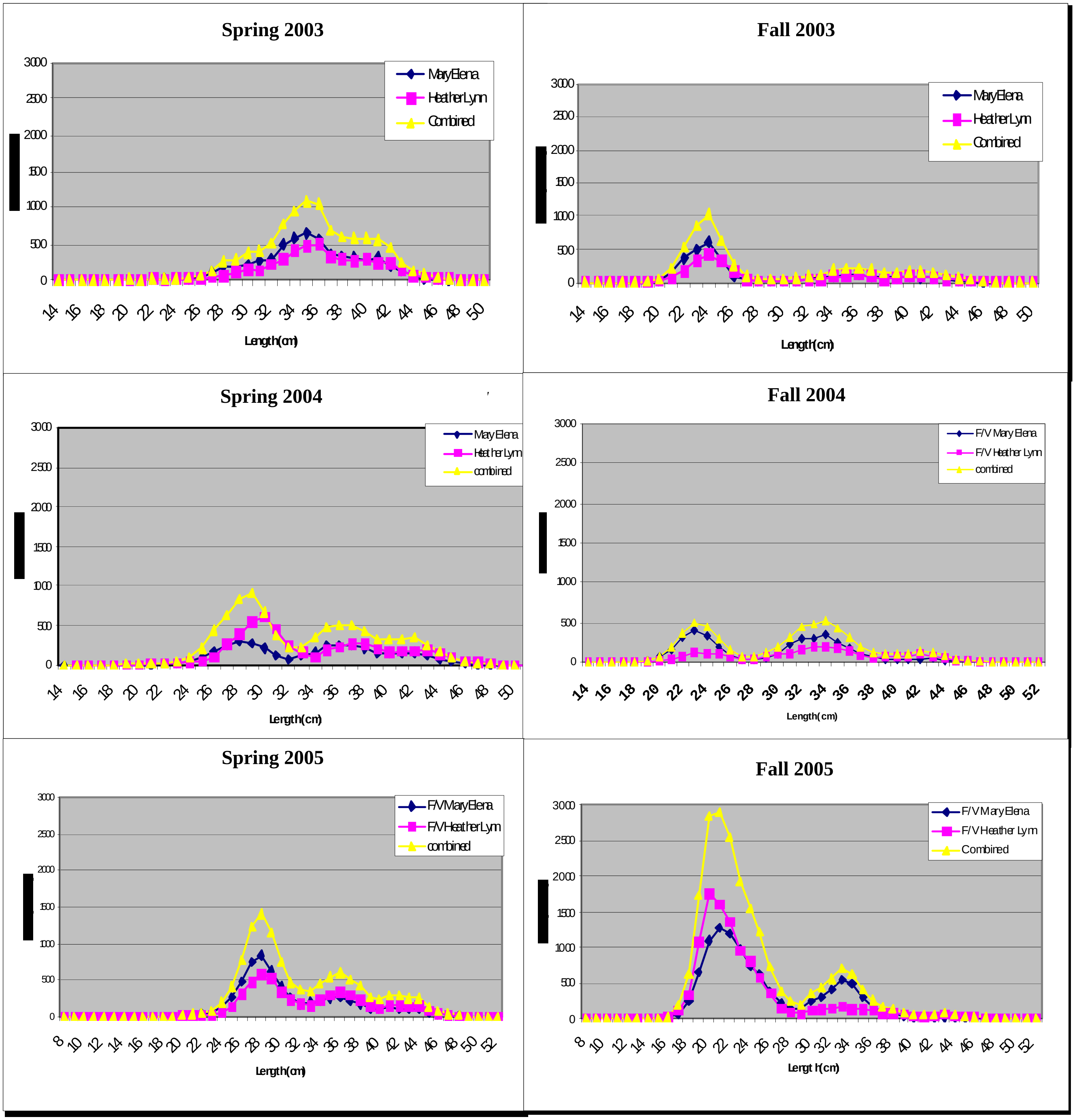


Figure 10. Length-frequency distributions of yellowtail flounder by vessel and combined, plotted individually for each survey segment.

Table 1. Yellowtail flounder catch in numbers and percentage caught by each vessel for each survey segment.

Segment	F/V *Mary Elena* Number Caught	F/V *Mary Elena* Percent of Total	F/V *Heather Lynn* Number Caught	F/V *Heather Lynn* Percent of Total	Total Number
2003 Spring	6,892	58%	4,985	42%	11,877
2003 Fall	3,351	55%	2,700	45%	6,051
2004 Spring	3,767	42%	5,182	58%	8,949
2004 Fall	3,753	63%	2,248	37%	6,001
2005 Spring	6,222	53%	5,527	47%	11,749
2005 Fall	13,859	48%	15,048	52%	28,907

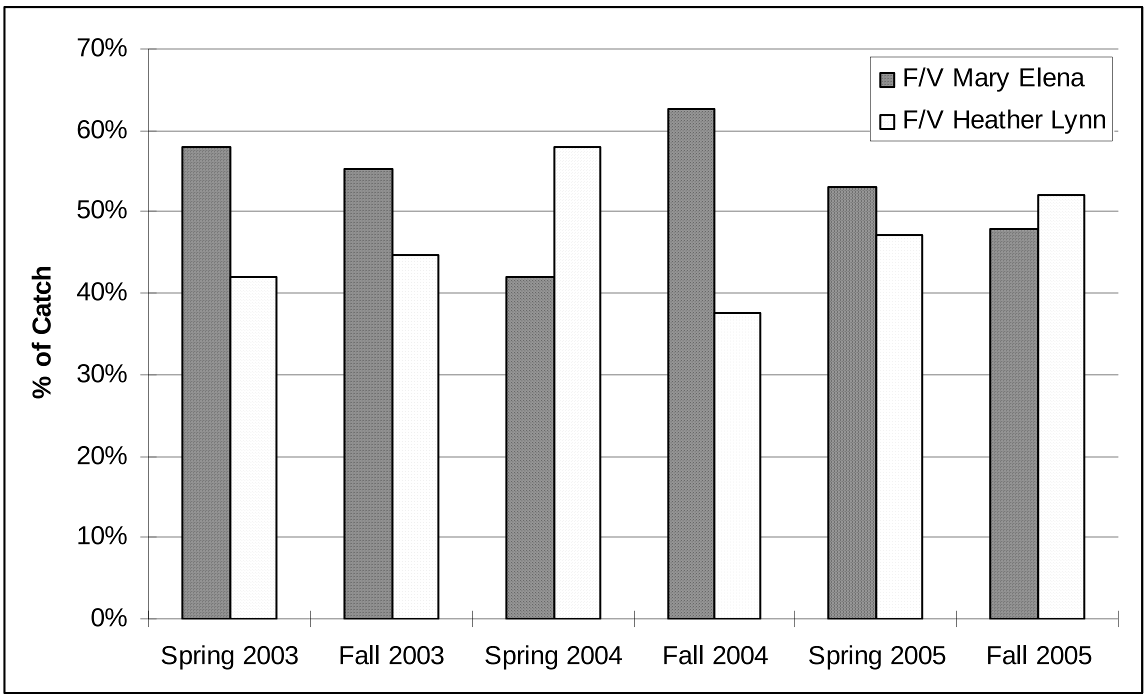


Figure 11. Percentage of total catch of yellowtail flounder caught by each vessel for each survey segment.

Catch by vessel varies primarily by depth & area fished. To minimize cruise expenses (# days, observer costs, and fuel costs) over the expansive survey area, the 2 boats split up each stratum, one would go East and the other West, or one take the Northern portion while the other would survey the Southern area. In some areas, the vessels ended up towing in close proximity.

Table 2. Yellowtail flounder catch in numbers and percentage caught at randomly selected and industry selected stations for each survey segment.

	Industry-Selected		Random		
Segment	**Number Caught**	**Percent of Total**	**Number Caught**	**Percent of Total**	**Total Number**
2003 Spring	7,135	60%	4,742	40%	11,877
2003 Fall	3,492	58%	2,559	42%	6,051
2004 Spring	5,601	63%	3,348	37%	8,949
2004 Fall	4,150	69%	1,851	31%	6,001
2005 Spring	7,664	65%	4,085	35%	11,749
2005 Fall	18,357	64%	10,550	36%	28,907

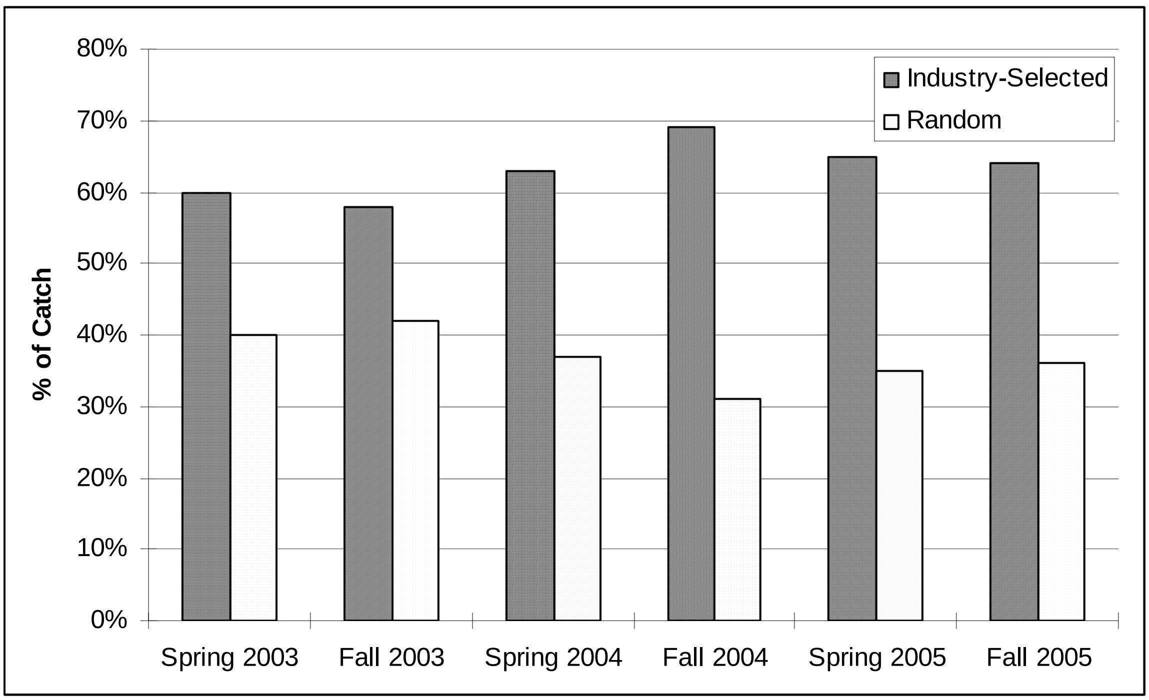


Figure 12. Percentage of total catch of yellowtail flounder caught by random and industry-selected tows for each survey segment.

Table 3. Comparison of the number of length measurements taken and age samples processed between samples collected from the industry-based survey and the NEFSC spring and fall surveys. (Catalyst for IBS data to complement NEFSC bottom trawl survey)

	IBS		NEFSC	
Segment	**Lengths**	**Aged Samples**	**Lengths**	**Aged Samples**
2003 Spring	11,877	346	28	23
2003 Fall	6,051	193	103	28
2004 Spring	8,949	450	35	29
2004 Fall	6,001	420	11	11
2005 Spring	11,749	[2]	41	38
2005 Fall	21,145 [3]	[2]	117	49
Total	65,772	1,409	335	178

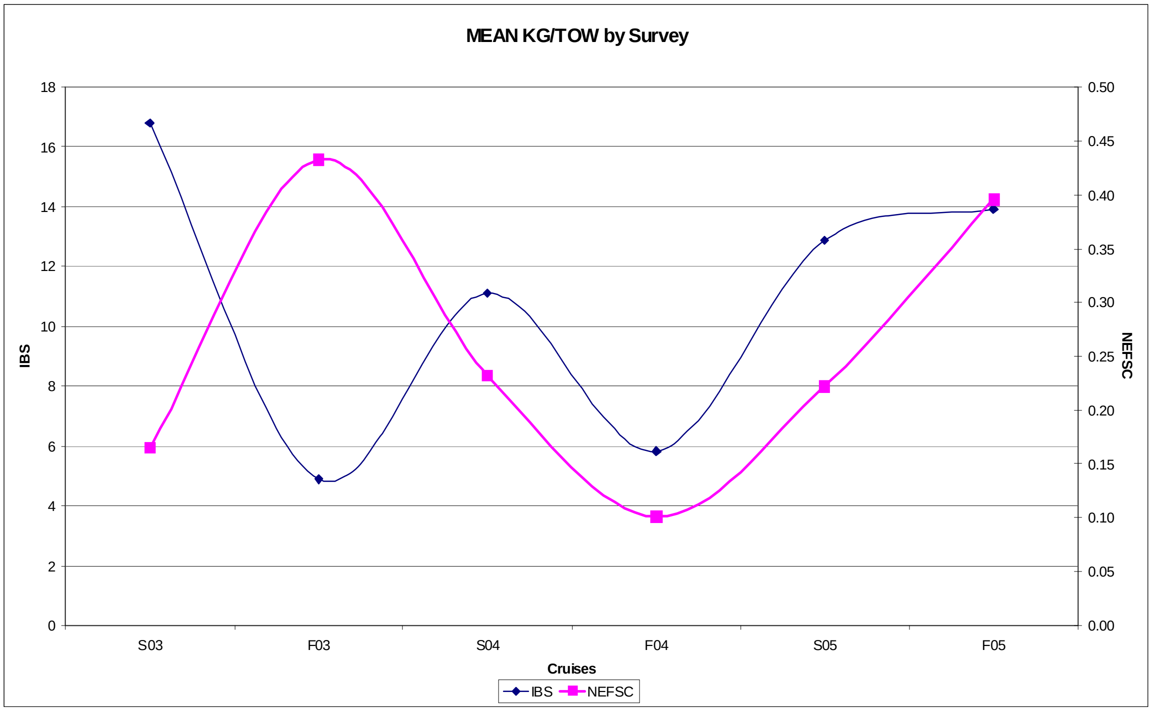


Figure 13. Comparison of relative biomass indices (average kg/tow) of yellowtail flounder between the NEFSC bottom trawl survey and the yellowtail flounder industry-based survey.

[2] Scales collected in the 2005 survey are currently being processed for ageing.
[3] Minimum estimate based on expansion of sub-sample due to large catch of yellowtail flounders.

Table 4. Estimated number of yellowtail flounder at age by sex for each survey segment.

Segment	Sex	Number at Age								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2003 Spring	Male	141	610	1,059	1,923	896	43	7	2	2
	Female	168	407	994	1,350	1,395	816	216	62	17
	Unknown	7	15	20	12	7	3	1	0	0
2003 Fall	Male	2,812	646	412	253	161	21	0	0	0
	Female	135	264	354	265	423	107	28	0	0
	Unknown	141	9	17	1	2	0	0	0	0
2004 Spring	Male	617	2,715	574	809	449	73	5	0	0
	Female	413	866	626	604	804	269	114	8	2
2004 Fall	Male	16	1,514	80	308	338	5	50	0	0
	Female	257	1,226	897	331	732	211	27	6	0
2005 Spring [4]	Male	968	2,412	613	1,048	542	86	10	0	0
	Female	1,257	1,996	777	582	755	422	211	49	19
2005 Fall [5]	Male	3,997	5,562	380	209	171	5	16	0	0
	Female	5,932	2,717	1,457	270	283	122	21	1	0

[4] Sex-specific age-length keys based on data from 2003 and 2004 spring segments were applied to 2005 spring length-frequencies to estimate the number caught at age

[5] Sex-specific age-length keys based on data from 2003 and 2004 fall segments were applied to 2005 fall length-frequencies to estimate the number caught at age

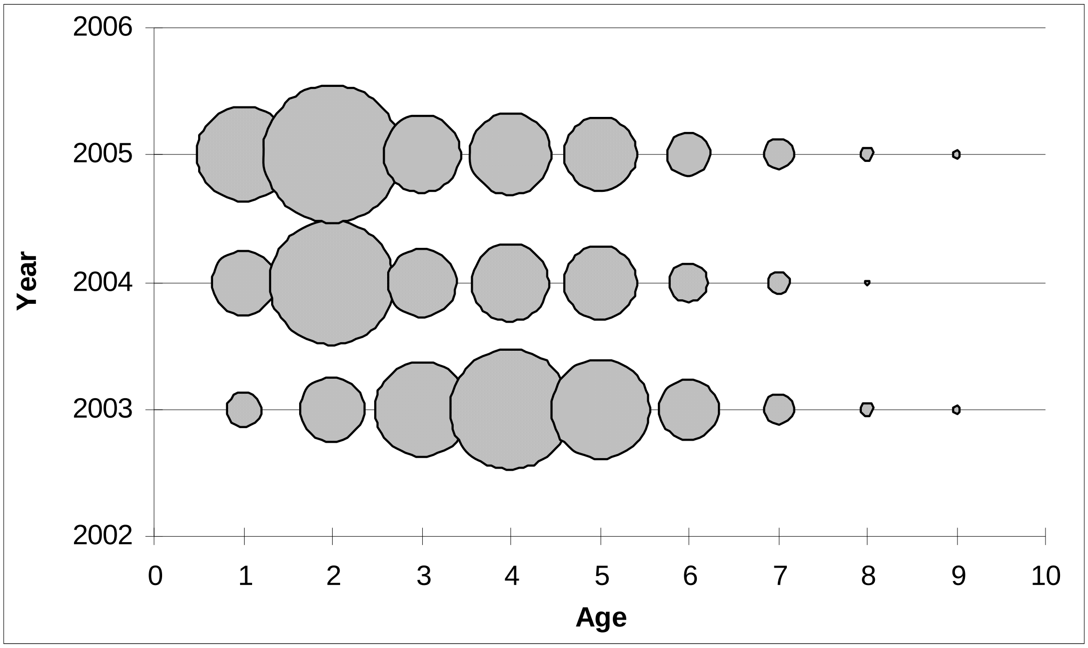


Figure 14. Estimated number per tow at age of yellowtail flounder observed in the spring segment of the industry-based survey, 2003–2005.

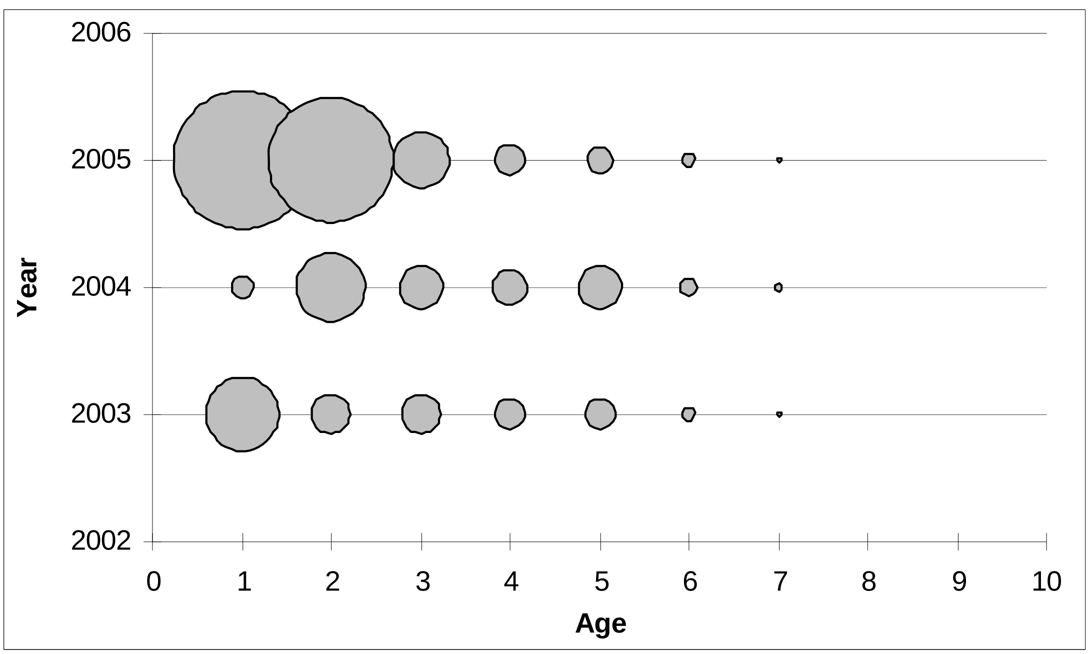


Figure 15. Estimated number per tow at age of yellowtail flounder observed in the fall segment of the industry-based survey, 2003–2005.

5.1 Spring 2003

The initial IBS pilot survey was conducted from April 21–May 7, 2003. A total of 307 tows were completed from the Great South Channel to Hudson Canyon by two commercial fishing vessels from Point Judith, RI—the F/V *Heather Lynn* and the F/V *Mary Elena*. Tows were both randomly generated and industry selected, based upon historical distribution. Onboard observers recorded all tow data, measured length frequencies on 11,877 yellowtail flounder, and collected 687 samples for ageing. Winter flounder length-frequency data and scale samples were also collected as time allotted, at the request of the RIDFW.

Two RIDFW biologists served onboard, and additional observers were contracted through AIS. Due to the volume of fish and data collected, 4 observers were needed onboard each vessel to complete the survey.

NMFS trained observers were deployed along with RIDFW staff. Data were collected on the NEFSC Fisheries Observer logs, rather than the standard NMFS trawl log. AIS observers were trained to collect data on these logs, which included (1) Vessel and Trip Information Log, (2) Trawl Gear Characteristics Log, (3) Trawl Haul Log, and (4) Length Frequency Log. Length frequency, weight and sex of all yellowtail flounders recorded, total catch sampled to capture bycatch. All other species were weighed, however not enumerated, as observer logs do not require collection of numbers. RIDFW entered survey data into Excel spreadsheets, and generated summary maps, tables and figures of the spring survey; all data was turned over to the NEFSC for processing and posting on the CRPI IBS website. The NEFSC subsequently identified incompatibility in data components and format between the observer logs and the NMFS trawl logs, which resulted in a delay in getting the spring 2003 survey into the NEFSC database.

This survey produced the largest number of yellowtail flounder above the minimum size of 33 cm in all surveys and the largest abundance inside the NLS closed area of all six surveys. Skates were the largest bycatch, followed by ocean pout and dogfish.

5.2 Fall 2003

The second survey of the pilot project was conducted from October 3–26 2003. A total of 304 tows were completed over 16 survey days. The F/V *Heather Lynn* and the F/V *Mary Elena* towed from the Great South Channel to Hudson Canyon. New random tows were generated for the survey and the previously industry selected tows remained as fixed stations. Onboard observers recorded all tow data, measured length frequencies on 6,051 yellowtail flounder, and collected 347 samples for ageing. Winter flounder length-frequency data and scale samples were also collected as time allotted at the request of the RIDFW. Additionally, several days were added on to tag yellowtail flounders, as part of the original tagging component of the project.

NEFSC personnel provided guidance on sub-sampling and entering data on the NEFSC logs. RIDFW provided some observer coverage; the remaining observers were contracted through PTSI, Inc. Logistics allowed for a brief training on entering data on the new logs for the observers, who were only familiar with the NMFS observer logs. RIDFW contracted a fisheries specialist/technician beginning January 2004 to assist on the yellowtail flounder survey. The technician entered the fall survey data into Excel spreadsheets, and generated summary maps, tables and figures. NEFSC provided the technician with training in the post processing of the survey logs, and beginning in 2004, RIDFW began working up all the logs. All data were turned over to the NEFSC for processing and posting on the CRPI IBS website.

The fall survey encountered rough weather delays, seasickness, equipment malfunctions, and large bags of dogfish and skates. Observers experienced problems either calibrating or the functionality on both the 6 kg and 30 kg Marel scales during portions of the survey, despite the scales having been serviced by the manufacturer prior to the fall cruise. While all pertinent yellowtail flounder data were collected, the breakdown of the small (6 kg) scale used for individual weights on both vessels preempted collecting individual weights on a number of tows (16% of all tows); however the number at length was recorded. For individual yellowtail flounders without weights, the NEFSC length at weight key was utilized to generate weights.

The target level of sampling on other species was not reached on many tows. The high number of tows per day (10–12) started to become problematic for the observers to keep up with the large volume of fish, notably dogfish. Therefore, for the fall 2003 survey, data presented on all species other than yellowtail flounder should be considered an estimate.

The total number of yellowtail flounders caught in the fall survey was 50% less than in the previous spring survey. The proportion of fish caught inside the NLS remained close to that of the spring survey, at 30%. The bycatch of dogfish increased substantially, with numerous tows catching between 1,000-7,000 dogfish. Individual captain's logs recorded tows of 10–20,000 pounds that they dumped rather than bringing onboard.

5.3 Spring 2004

The third survey of the pilot project started on April 2nd and went through April 27th, with a total of 15 days spent on the survey, and 304 tows completed. Biological data on 8,949 individual yellowtail flounders were collected throughout the stock range. Samples for ageing were collected on 1,302 yellowtail flounders.

To address sub-sampling errors encountered in the fall 2003 survey, a full day of training for the observers was conducted, including a shake down cruise onboard one vessel. NEFSC staff participated in the training of observers on data logs and sampling procedures. Due to increased sub-sampling, both weights and numbers are included in selected tables below.

Due to hang-ups and wear and tear on the survey nets, an additional spare net was constructed for the spring survey, and additional spare cod ends, bellies, and patch twine was purchased. Old nets were inspected and trawl warp measured prior to loading onboard this survey and all subsequent surveys.

5.4 Net Selectivity Study

An important element of the survey was to detect recruitment of yellowtail flounder in the SNE area, looking at different size structures and age classes of fish. During the 2003 pilot survey, it became apparent that small fish (< 19 cm) were not being captured in the basic survey net. The questions to be addressed on the lack of < 19 cm fish caught in the first survey year throughout the SNE stock range were:

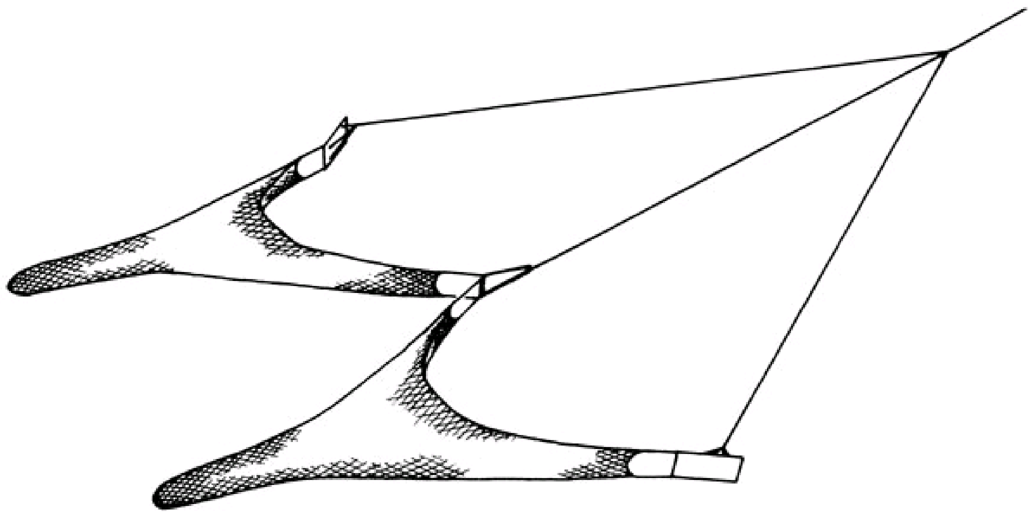
- Are behavioral differences in the smaller fish causing them to escape through the larger mesh size located at the mouth of the net or under the footrope?
- Are the 3” cod-end and 6” bellies too large?
- Is there no signal of recruitment at this time?

Consultation with industry suggested that small yellowtail flounders (and other flatfish species) often do not make it into the codend—upon encountering the twine, they respond by eluding the large mesh and escape, unlike the larger fish that tend to get herded into the net. It is plausible to assume a 6” fish is likely to escape a 6” mesh, whereas a 2” mesh is going to retain all juveniles. A study by Walsh (1992) found trawl vulnerability to be size dependent for yellowtail flounder. He determined the efficiency of a multispecies groundfish trawl to be 50%, but only on those fish greater than 24 cm.

To investigate this further, an additional 3 days were added on to the spring 2004 survey to perform gear selectivity experiments. RIDFW worked with net designers to modify the original survey net, which should catch smaller fish if they are present. Two of the 8” wing sections were reduced to 4 ½” and the first bottom belly was switched out from 6” to 3” mesh. The F/V *Mary Elena* towed the new (experimental) net, while the F/V *Heather Lynn* towed the standard (control) survey net in close proximity (< ¼ nm). Twenty side-by-side tows were conducted. The catch rates between the two vessels towing side by side was similar, however the length-frequency distribution indicates the experimental net picked up a small amount of yellowtail flounders < 19 cm, whereas the standard survey net did not.

To address catchability over the same area swept path, the F/V *Mary Elena* spent one day towing a twin trawl. The twin trawl uses special rigging that allows the experimental and control nets to be towed side by side at the same time from the same vessel. Twin trawling is a relatively novel concept in the Western North Atlantic fisheries, with few experienced captains. The captain of the F/V *Mary Elena* had previously worked with Massachusetts’s Division of Marine Fisheries conducting twin trawl experiments. For this study, five twin tows were completed.

Design of a standard twin trawl rig. (Source: FAO 2007)



The experimental net again picked up smaller fish in the exercise. Overall fish catches (all species combined) in the experimental net while twin towing were significantly higher than the standard net, suggesting that it would be difficult to use the modified net during a regular survey, with the likelihood of catches too high to process. More importantly, due to the small number of sublegal fish caught, RIDFW decided it would not be prudent to alter the existing survey design. The current nets have already produced a valuable database that needed to remain standardized. Therefore, the experimental net was modified back to the original survey net, and provided the second spare net for vessels in subsequent surveys.

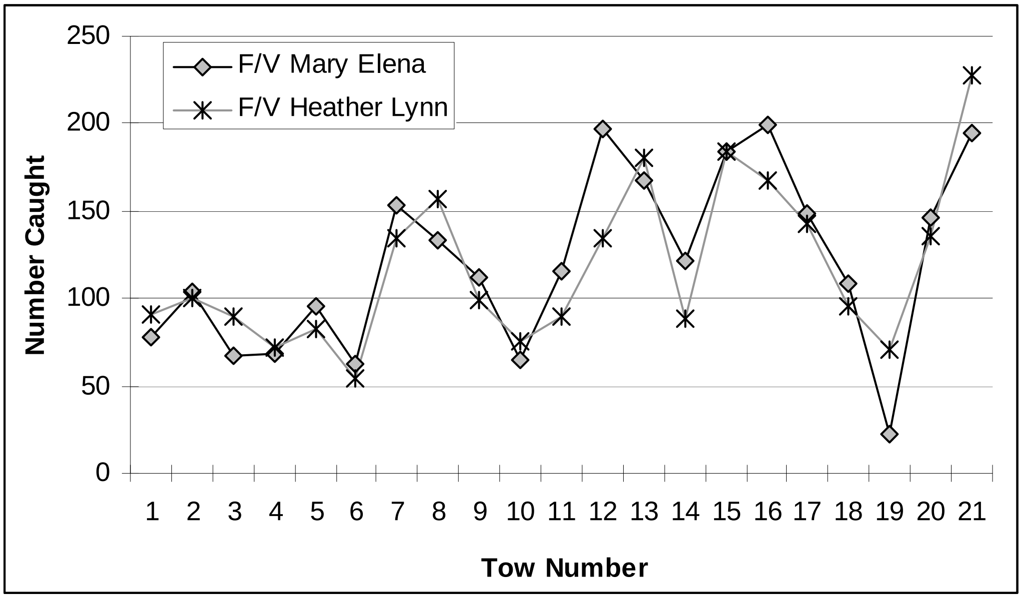


Figure 16. Comparison of the yellowtail flounder catch in numbers by tow between the experimental and control (standard) nets during the net selectivity study performed in spring 2004. The F/V *Mary Elena* towed the experimental net and the F/V *Heather Lynn* towed the standard net.

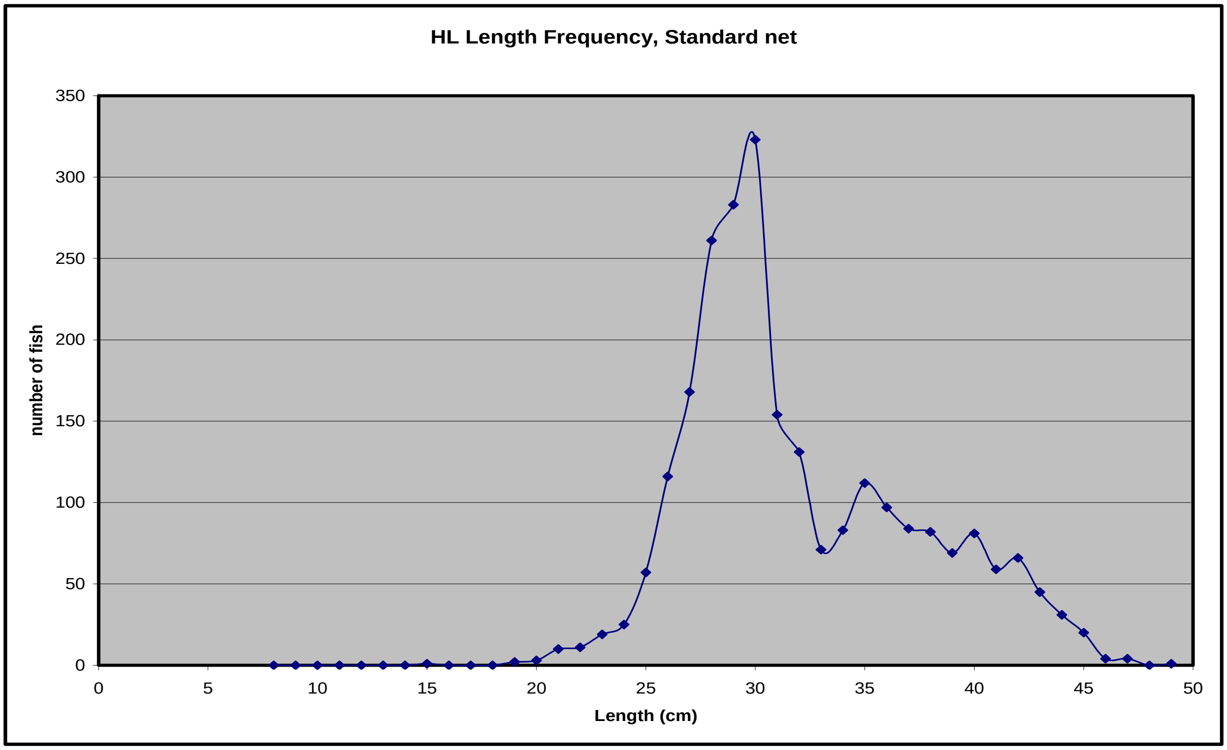


Figure 17. Length-frequency of yellowtail flounder caught in the standard (control) net towed by the F/V *Heather Lynn* (HL) during the net selectivity study performed in spring 2004.

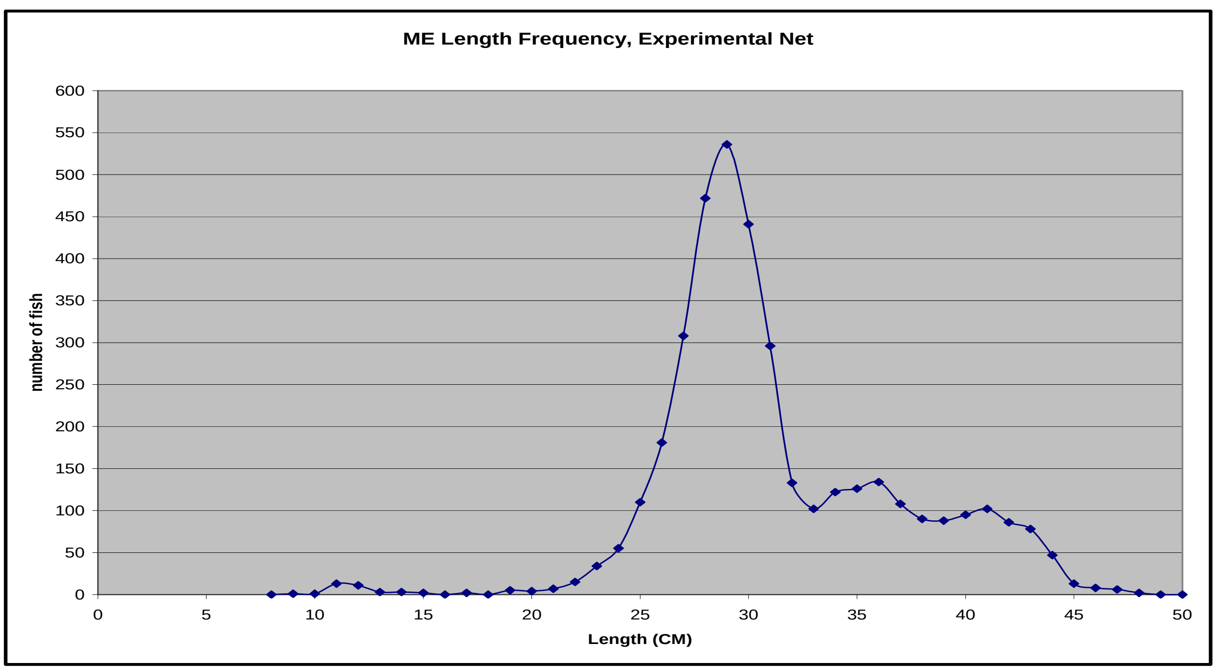


Figure 18. Length-frequency of yellowtail flounder caught in the experimental net towed by the F/V *Mary Elena* (ME) during the net selectivity study performed in spring 2004.

5.5 Fall 2004

In August of 2004, a workshop to review the yellowtail flounder and cod surveys was held in consultation with NERO, NEFSC, IBS implementation Committee, NEFMC, and industry. Presentations on survey results to date were given and recommendations were made on the following:

- To review the survey design (single-species versus multi-species, survey area, number of tows and sampling protocol)
- To form a IBS review sub-committee chaired by Dr. Steven Cadrin, NEFSC, to conduct the needed analyses
- To develop a safety training and guidelines manual consistent for collaborative survey work
- To review the budget and plan for future surveys

None of the above could be completed prior to the start of the fall cruise, which began on October 2, 2004; therefore the survey protocol remained status quo. Another day of training was scheduled for the observers, including a shake-down cruise onboard one vessel sorting and enumerating the catch on the NMFS trawl logs and reviewing sub-sampling protocol. Competing demands on the NEFSC continued, however they were available to supply limited support as chief scientists onboard, and provided more training to the RIDFW staff on log entry and post processing.

The survey lasted 16 days. Data on 6,001 individual yellowtail flounders were collected throughout the stock range and 1,558 samples taken for ageing. Contracted observers had a high level of experience with the Northeast Ground fishery, and along with the oversight of NEFSC Chief Scientists onboard, sub-sampling improved significantly.

5.6 Spring 2005

Survey methodology continued status quo for the spring 2005 cruise. The IBS design sub-committee continued to evaluate impacts on the reliability of population estimates with reduced sample sizes, however no changes were recommended for this survey.

The survey started April 4th, after a one-day orientation and USCG certified safety training session for the observers. The spring cruise brought back many experienced observers who had participated in previous yellowtail flounder cruises. Four legs were conducted with a total of 16 survey days. Biological data was collected on 11,749 yellowtail flounders, along with scale samples and individual weights collected on 2,684 fish for ageing. As in all previous surveys, the cruise data were entered shore side into Excel and surfer databases, and a series of maps, charts and tables describing yellowtail flounder distribution and length-frequencies created. RIDFW data technician continued to receive guidance from NEFSC in post-processing of survey logs and was able to turn over the completed logs quickly after the spring survey.

Consultation with NEFSC indicated the number of age samples collected in previous surveys was excessive, but to continue taking 1 fish per 5 cm interval and begin to take age samples on all fish > 40 cm, since larger fish derive the estimate of mortality rate. The IBS samples were expected to improve the catch at age estimates for the upcoming GARM estimate, and ageing became a priority for the RIDFW and IBS survey. The NEFSC recommended ageing be sub-sampled by area, and RIDFW selected 1 scale sample for all lengths under 40 cm per stratum, and all over 40 cm. Massachusetts DMF loaned a scale press to RIDFW, and the RIDFW data technician was trained by the NEFSC. All of the selected scale samples from 2003–2004 were pressed and aged with the assistance of NEFSC prior to the August 2005 GARM.

5.7 Fall 2005

Fall 2005 survey started after a one-day orientation and another USCG certified safety training session of observers conducted in Point Judith, RI. RIDFW was fortunate to have many observers return that were familiar with the survey protocol. Survey protocol remained status quo. The IBS design sub-committee results were presented in July 2005 at the IBS Technical Committee meeting where members organized to review goals and objectives, survey methodology, and review data and utility for management. Recommendations were made on future objectives relating to science and management needs and also on optimal survey design.

Based upon the sub-committee analysis, RIDFW recommended that beginning with the 2006 surveys (projected to be level funded for 2006 at the meeting) the number of stations could be reduced by 25% without impacting the reliability of population estimates. Technical Committee recommendations were forwarded to the NEFSC Director and NERO Regional Administrator to determine 2006 priorities. Pending a recommendation by NMFS otherwise, RIDFW determined that it would not be prudent to change survey design during the end of the three year time series of an intensive survey on SNE yellowtail flounder population and distribution.

The survey began on September 19th and ended on November 4th with a total of 7 legs and 25 survey days for vessels to complete all stations. Yellowtail flounders were tagged on one leg of the survey. The survey took longer (and cost more) than all previous surveys, as the number of tows targeted per day was decreased to 8, based upon concerns expressed over workload and safety by NEFSC chief scientists who had participated in earlier surveys. Additionally, one vessel had mechanical problems, which required an immediate haul-out and shaft replacement.

The fall survey picked up a large signal of recruitment of juvenile yellowtail flounders (15–26 cm), with 60% of all yellowtail flounders caught under the legal size (33 cm) throughout the survey area. Inside the Nantucket Lightship Closed Area, while densities were low, juvenile yellowtail flounders dominated the catch with 88% sublegal sized. The recruitment signal was identified as the 2004 cohort, and has been identified as the “most abundant year-class since 1988, and was produced from extremely low spawning biomass (Cadrin and Brown 2006).”

Biological data were collected on 21,145 individual yellowtail flounders, and scale samples and individual weights collected on 1,959 fish for ageing. The fall 2005 survey detected a very strong year-class of 0 and 1-year-old fish, with some tows so large that yellowtail flounders had to be sub-sampled. The number of yellowtail flounders was expanded from sub-sampling to 28,907 fish. Reports from fishermen following up on the fall survey confirmed they were catching a large number of sublegal fish (20–30 cm) with 6.5” mesh in the same areas identified with the IBS fall survey.

RIDFW fisheries specialist finished post processing of the survey logs and delivered to NEFSC in mid-December. In late December, NERO notified RIDFW that due to budget cuts, there would be no funding for future surveys going into 2006 and the contract would end on January 6, 2006. The contracted fisheries specialist was taken off the project and RIDFW has covered all salary costs to complete the necessary data entry and analyses and final report since the contract ended.

Results of the surveys are presented below. Comprehensive data on yellowtail flounder distribution, abundance, and size is presented below. Yellowtail flounder data are also broken down by area throughout the SNE stock range, with the Eastern Section is defined as the Nantucket Lightship Area between 70.30–69 degrees, the Central Section is defined as Southern New England between 70.30–72 degrees, and the Western Section is defined as the Mid-Atlantic between 72–74 degrees. A section on the Nantucket Lightship Closed Area and biomass estimations follows. Distribution plots on other species, chosen for their commercial interest or as predatory competitors for yellowtail flounder are presented in Appendix B.

Observers receive safety training from the Northeast Safety Training Company and the US Coast Guard in Point Judith, RI prior to the spring 2005 survey.

YELLOWTAIL FLOUNDER SUMMARY DATA, SPRING 2003

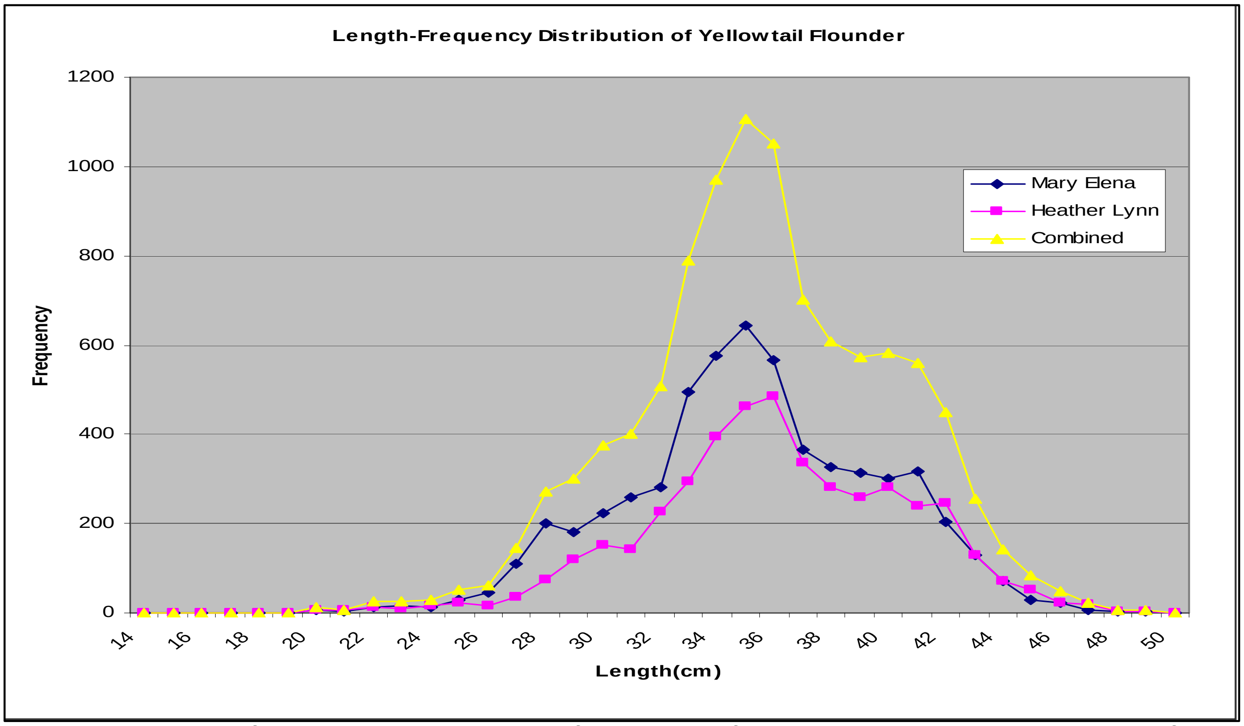


Figure 19. Length-frequency distributions of yellowtail flounder by vessel and combined for the spring 2003 survey.

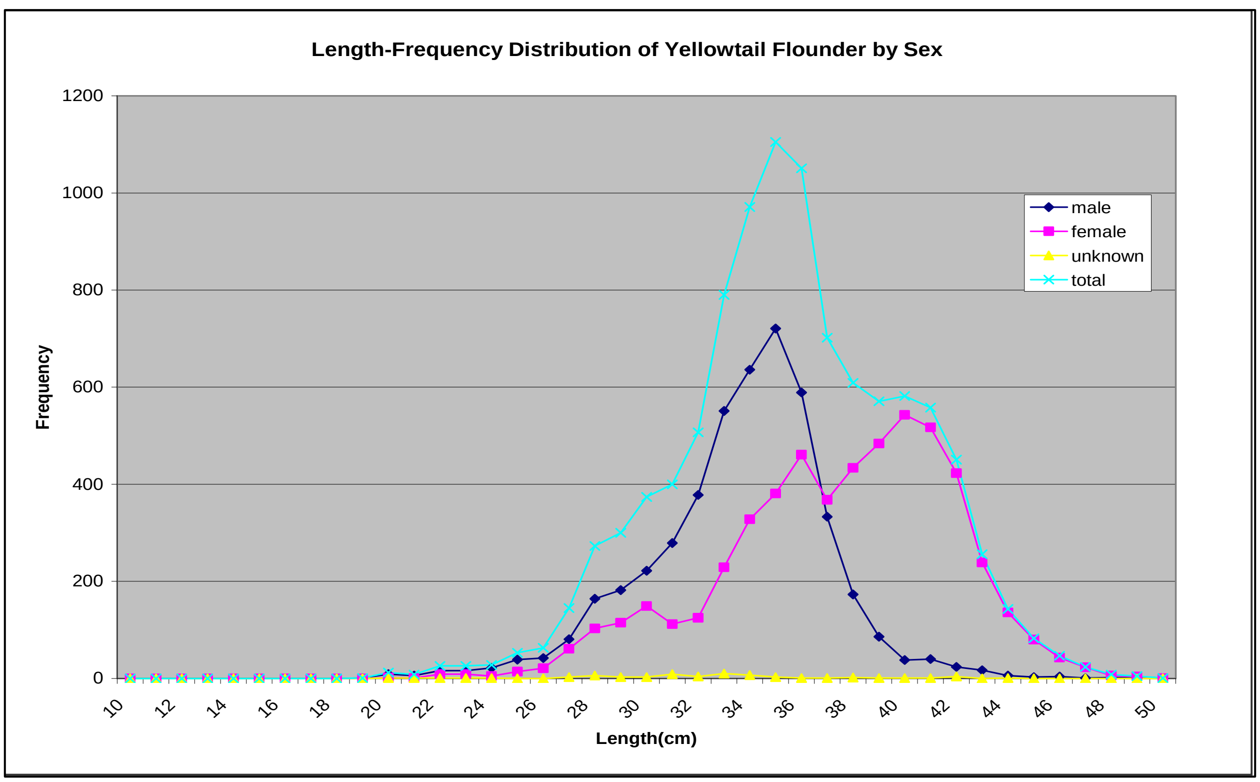
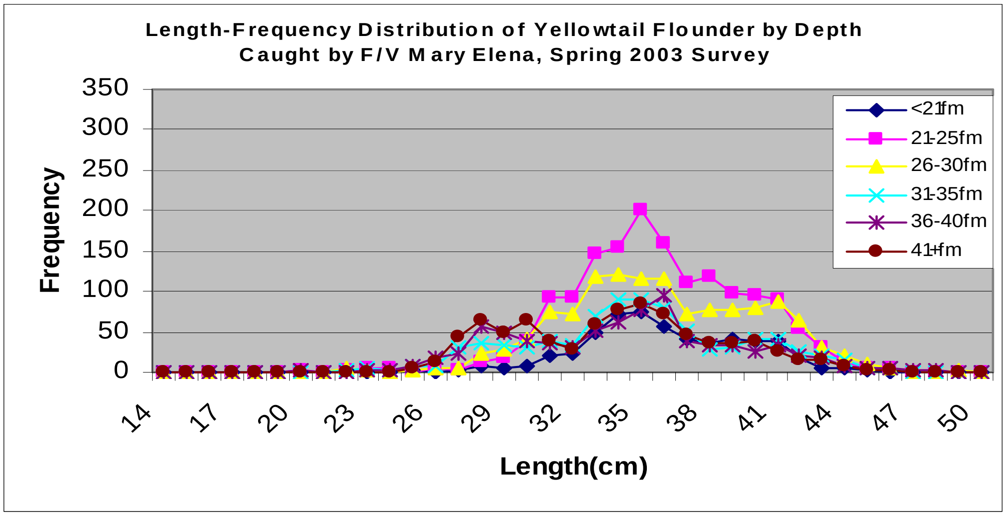
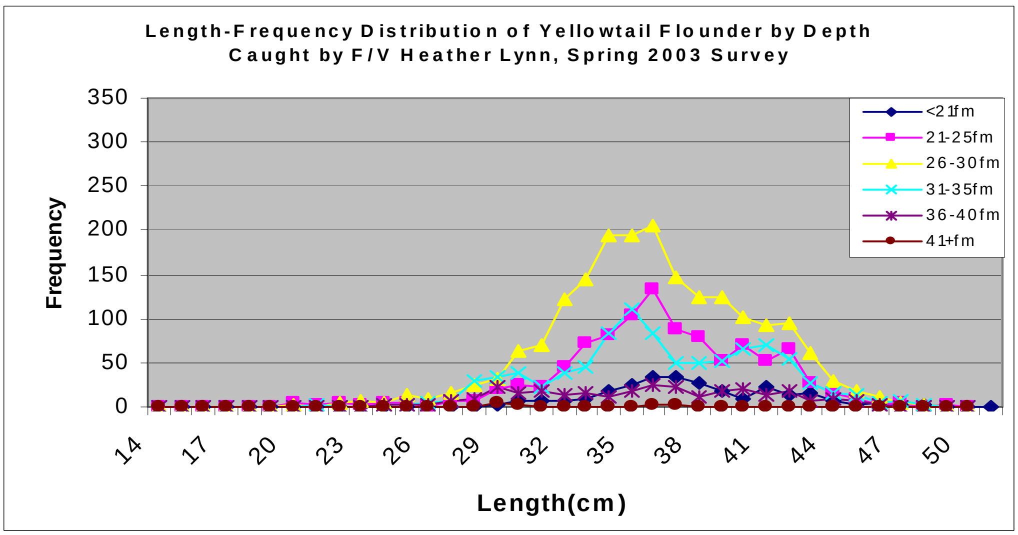


Figure 20. Length-frequency distributions of yellowtail flounder by sex for the spring 2003 survey.





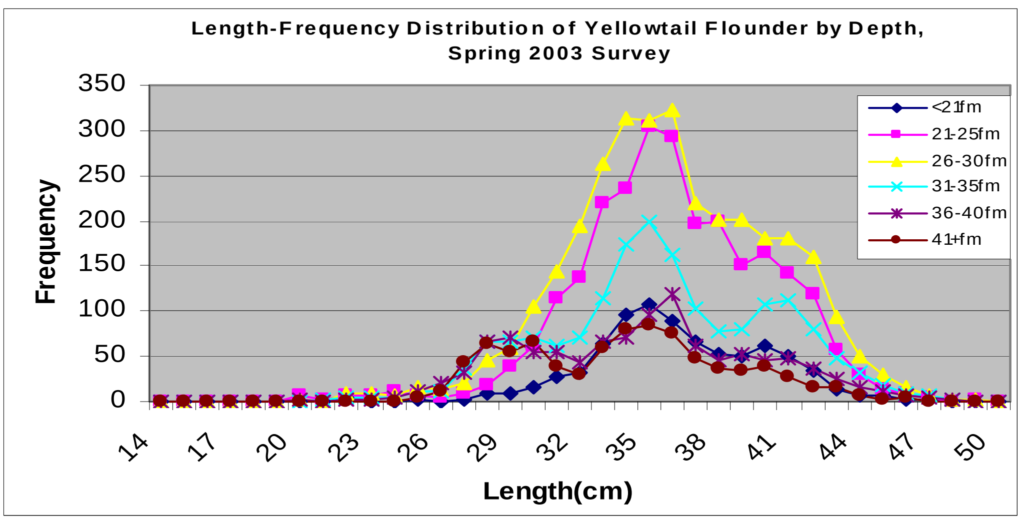


Figure 21. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the spring 2003 survey.

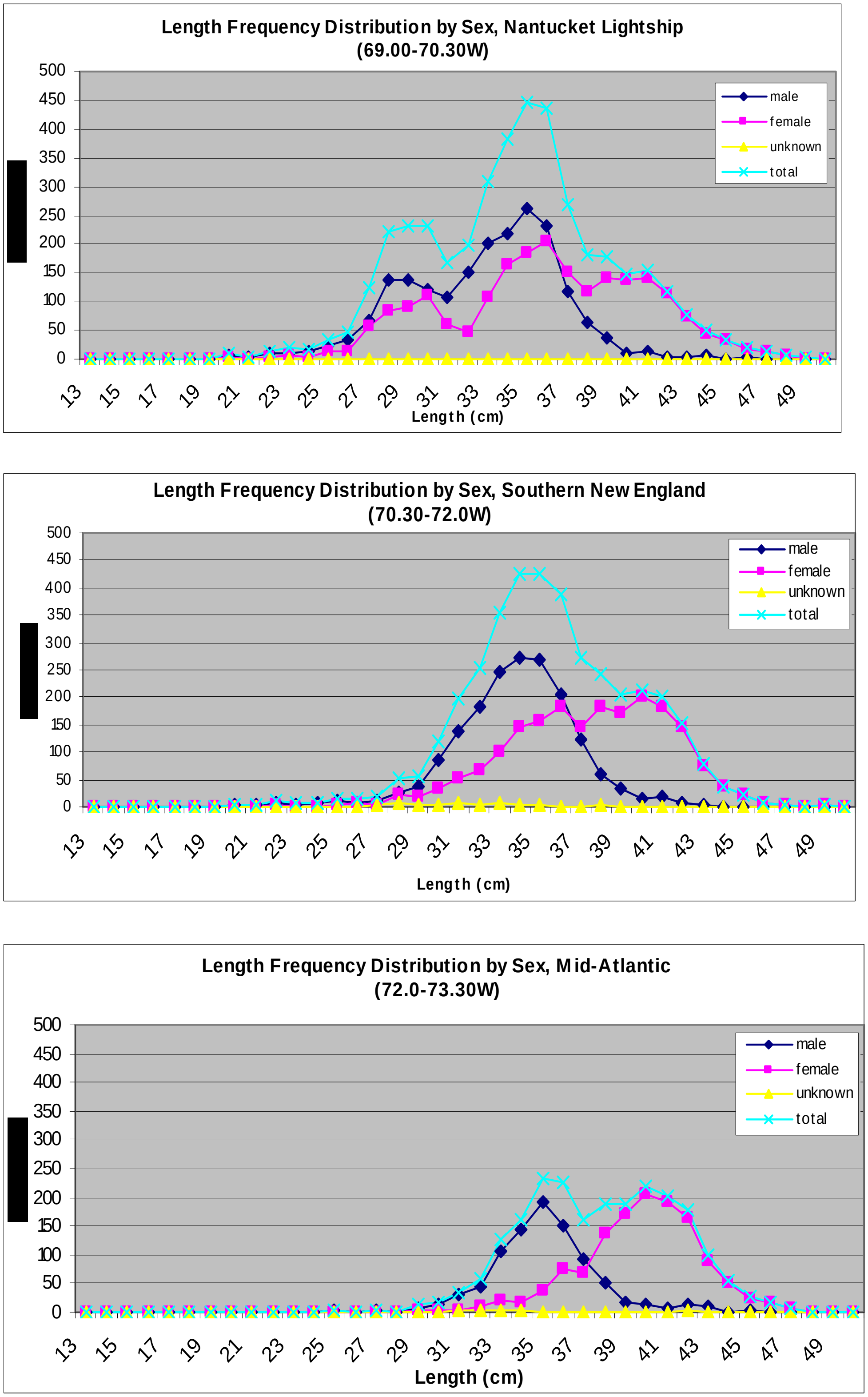


Figure 22. Length-frequency distributions of yellowtail flounder by sex for the Nantucket Lightship, Southern New England, and Mid-Atlantic sub-areas within the SNE range for the spring 2003 survey.

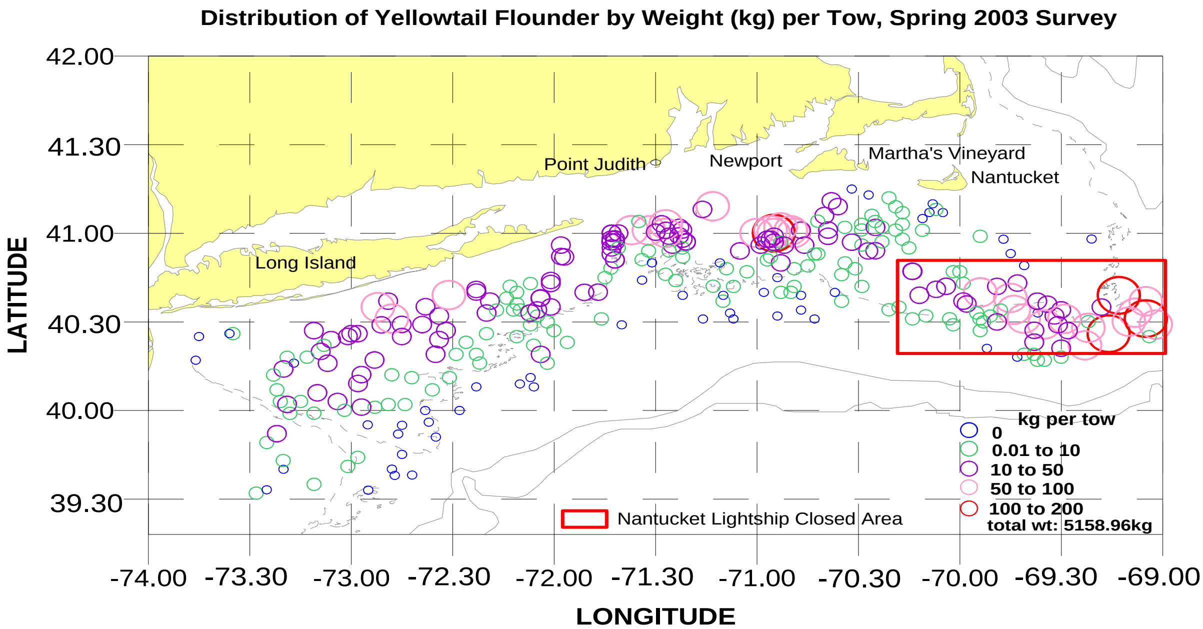


Figure 23. Map of weight per tow by station for the spring 2003 survey. Circles are proportional to the magnitude of the weight per tow. The NLS closed area is bounded by the rectangle.

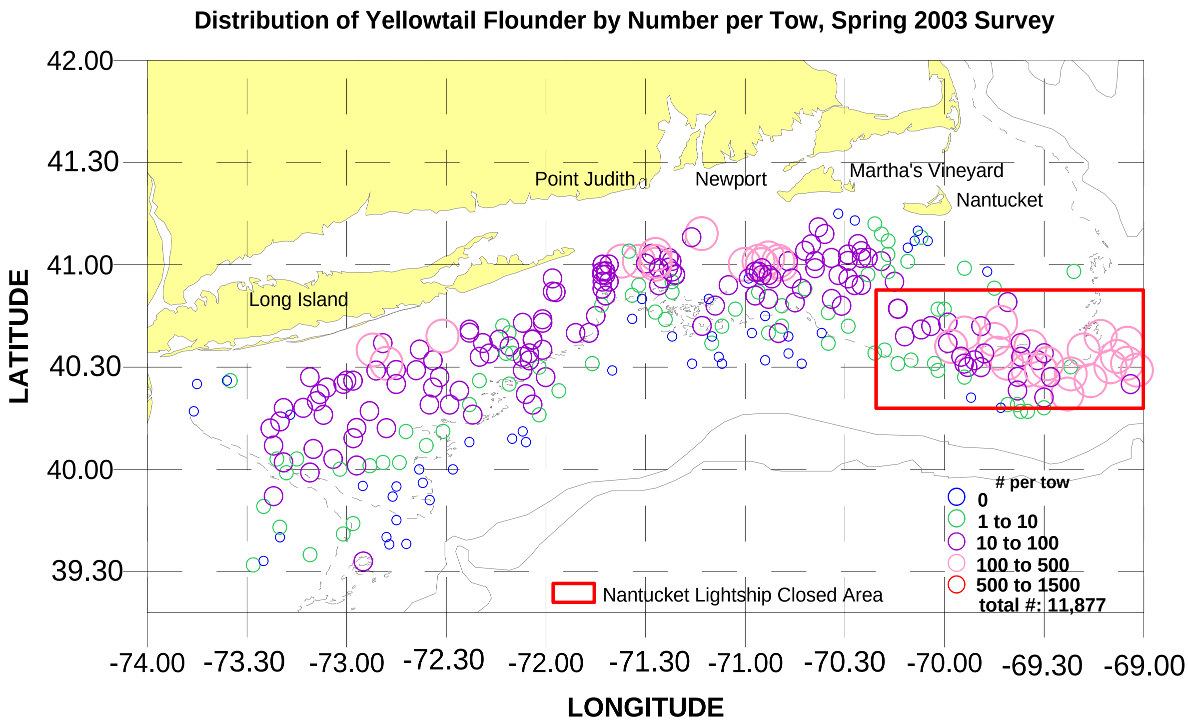


Figure 24. Map of number per tow by station for the spring 2003 survey. Circles are proportional to the magnitude of the number per tow.

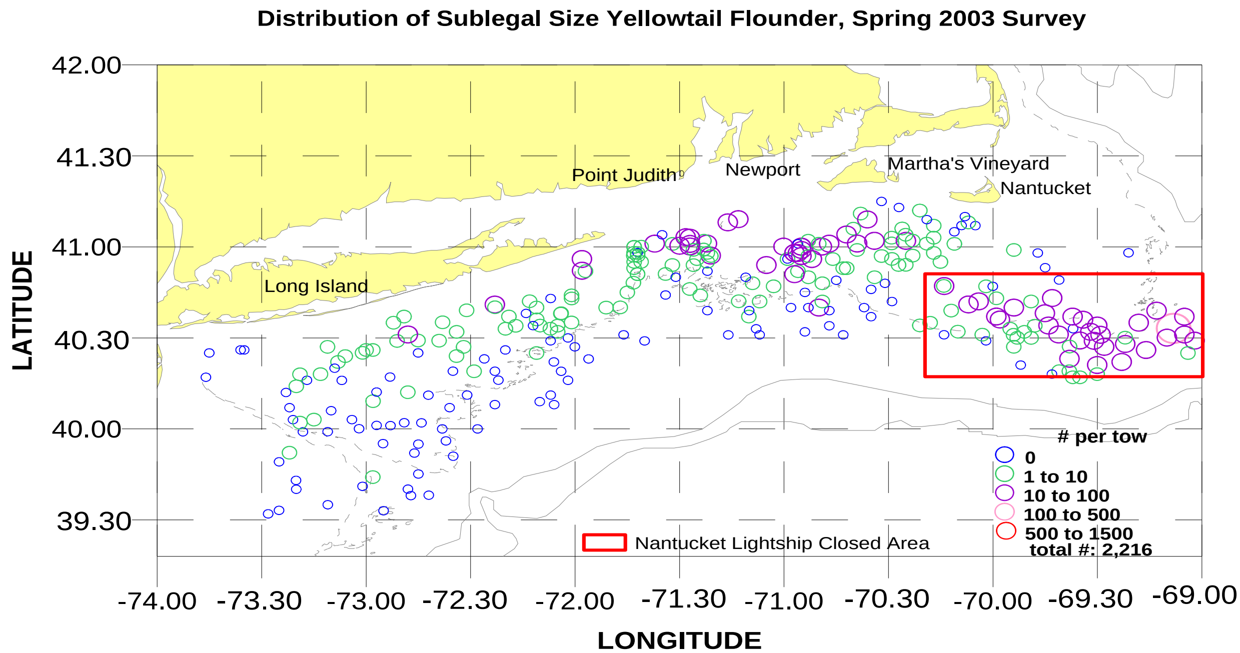


Figure 25. Map of the abundance of sublegal size yellowtail flounder caught at each station for the spring 2003 survey. Circles are proportional to the magnitude of the numbers observed.

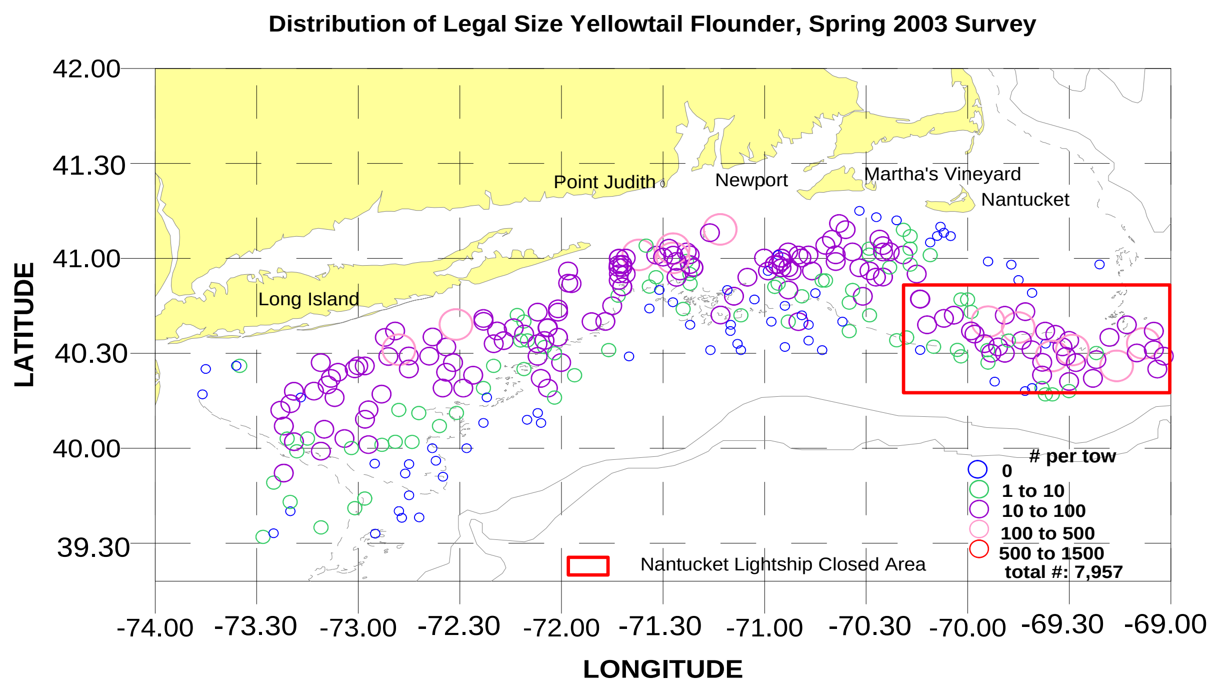


Figure 26. Map of the abundance of legal size yellowtail flounder caught at each station for the spring 2003 survey. Circles are proportional to the magnitude of the numbers observed.

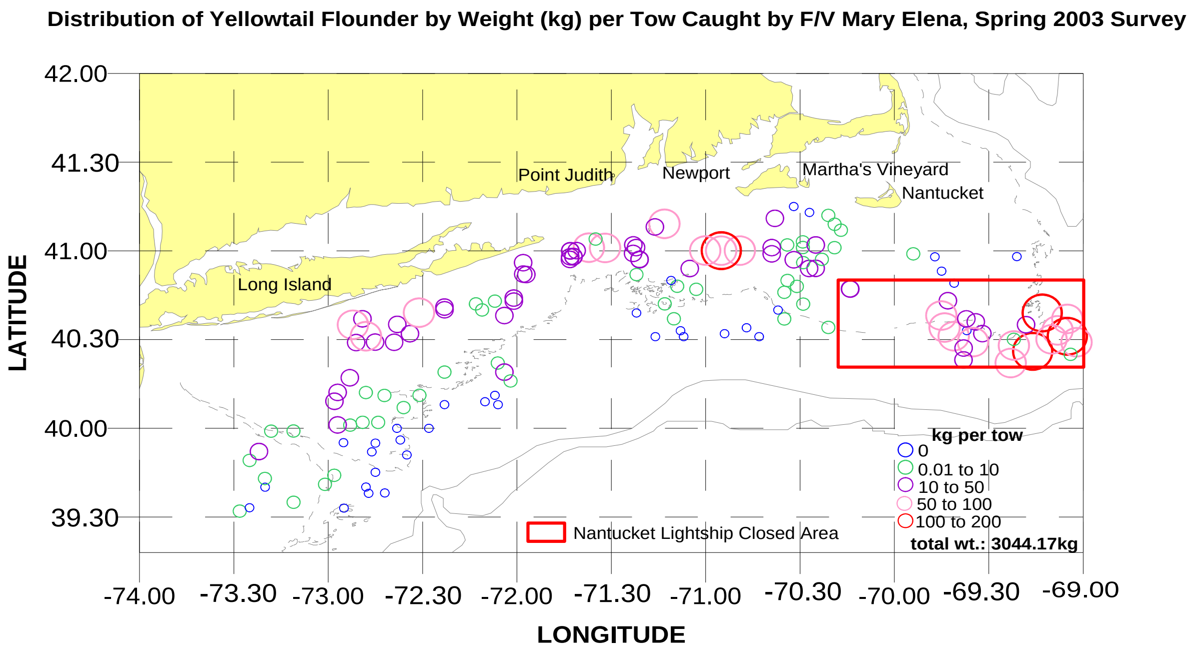


Figure 27. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the spring 2003 survey. Circles are proportional to the magnitude of the weight per tow.

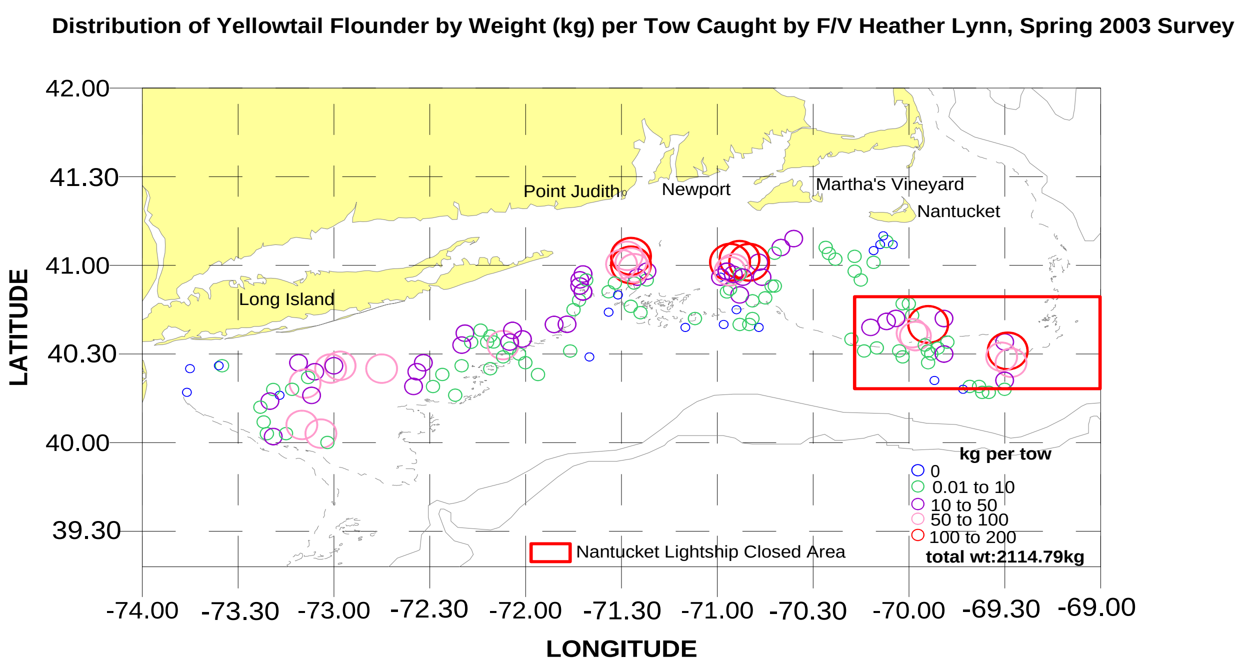


Figure 28. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the spring 2003 survey. Circles are proportional to the magnitude of the weight per tow.

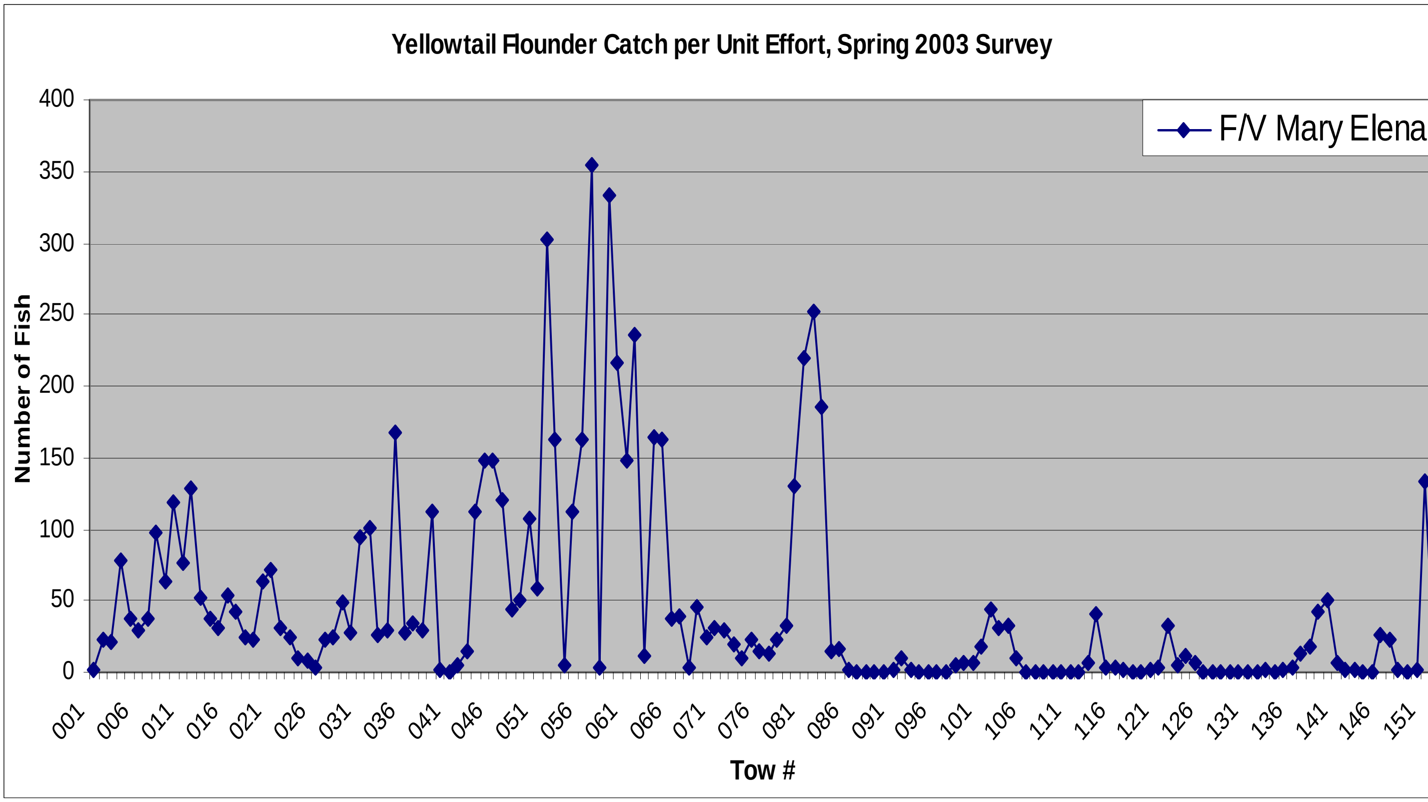


Figure 29. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the spring 2003 survey.

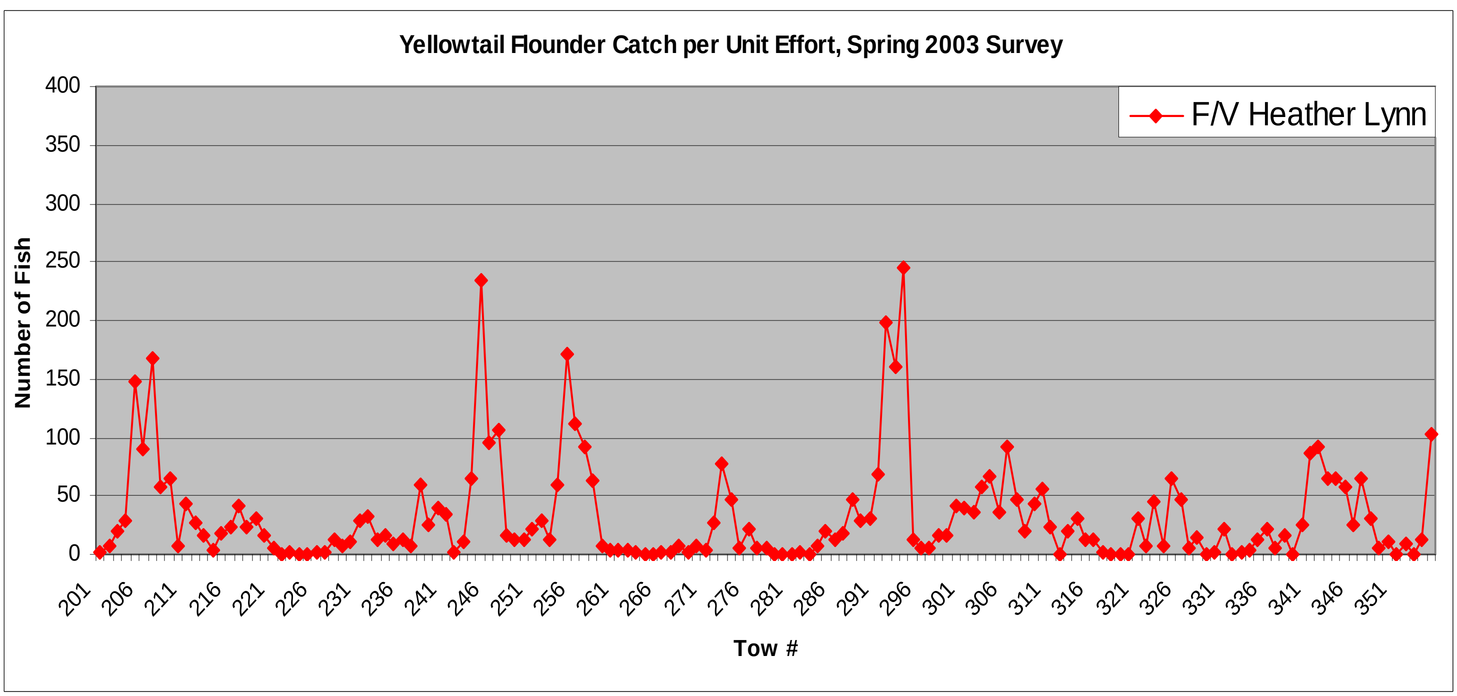


Figure 30. Number of yellowtail flounder caught by tow number based on observations from the F/V Heather Lynn for the spring 2003 survey.

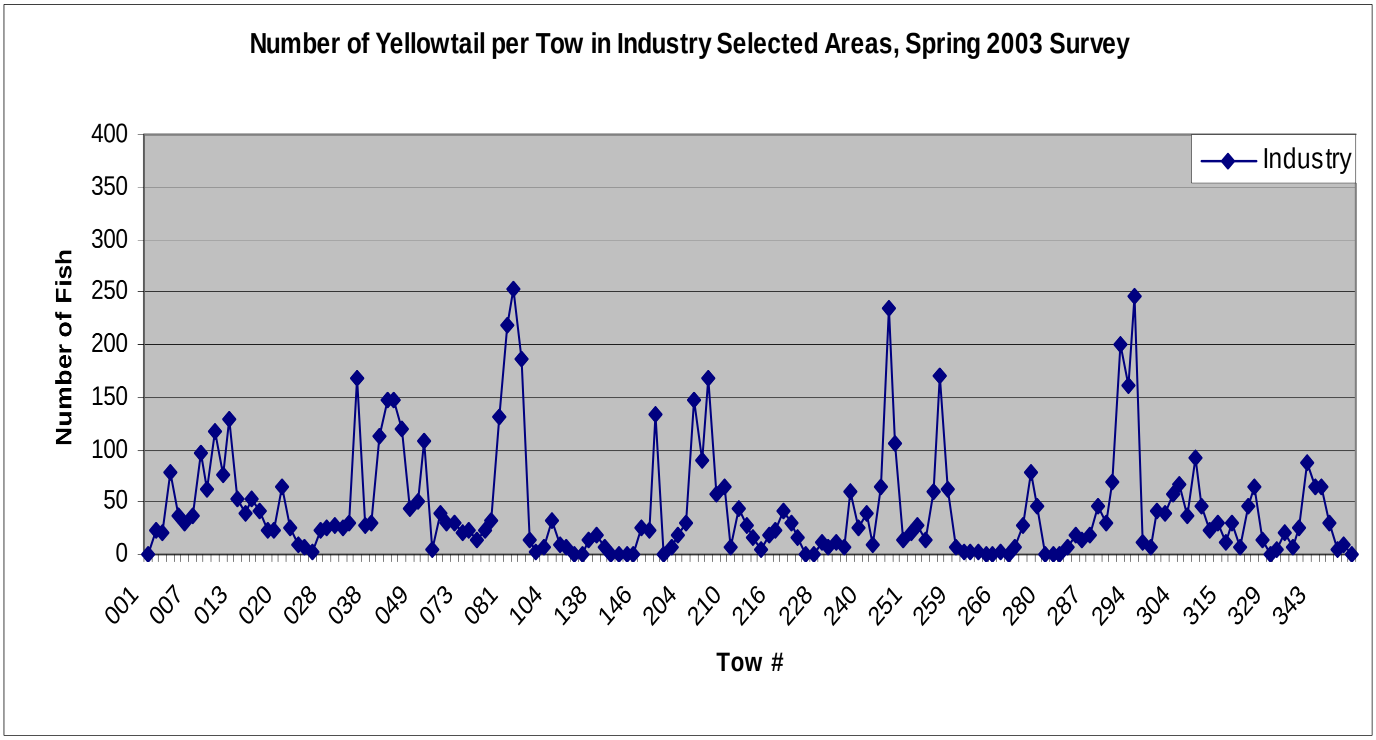


Figure 31. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the spring 2003 survey.

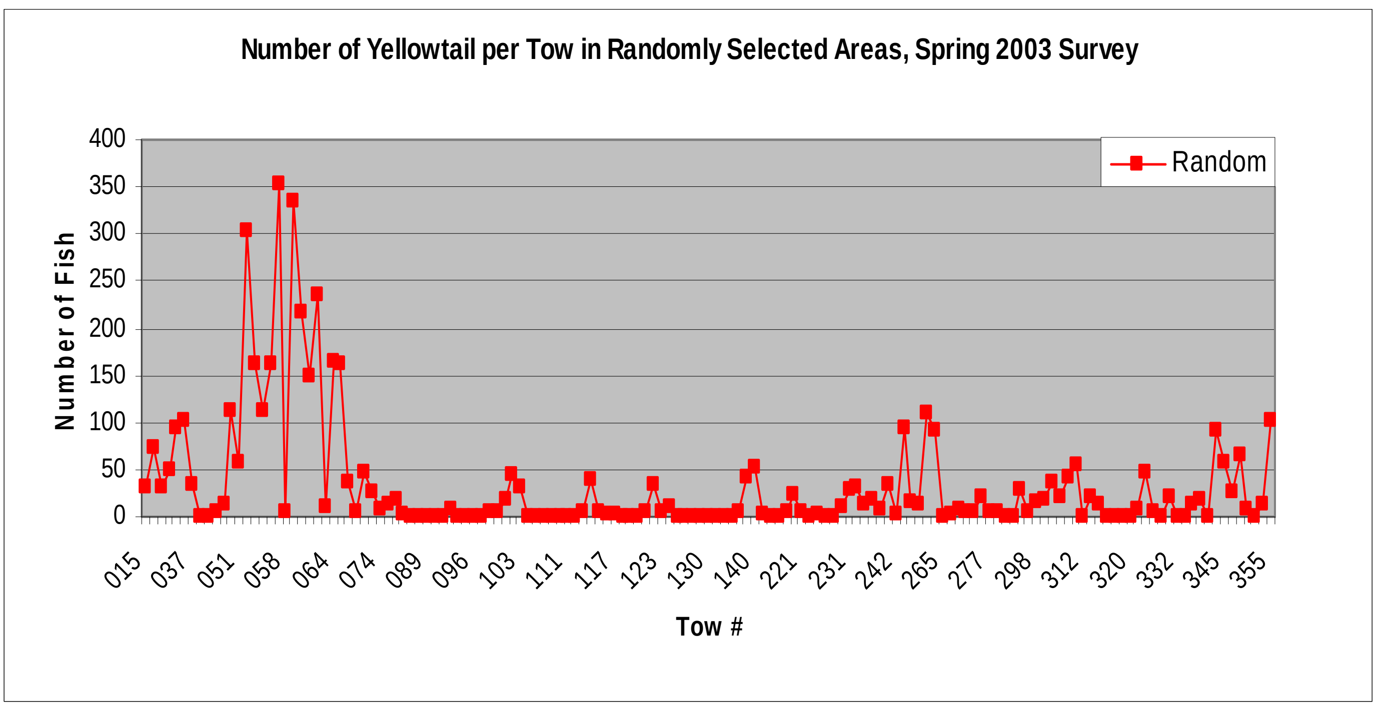


Figure 32. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the spring 2003 survey.

YELLOWTAIL FLOUNDER SUMMARY DATA, FALL 2003

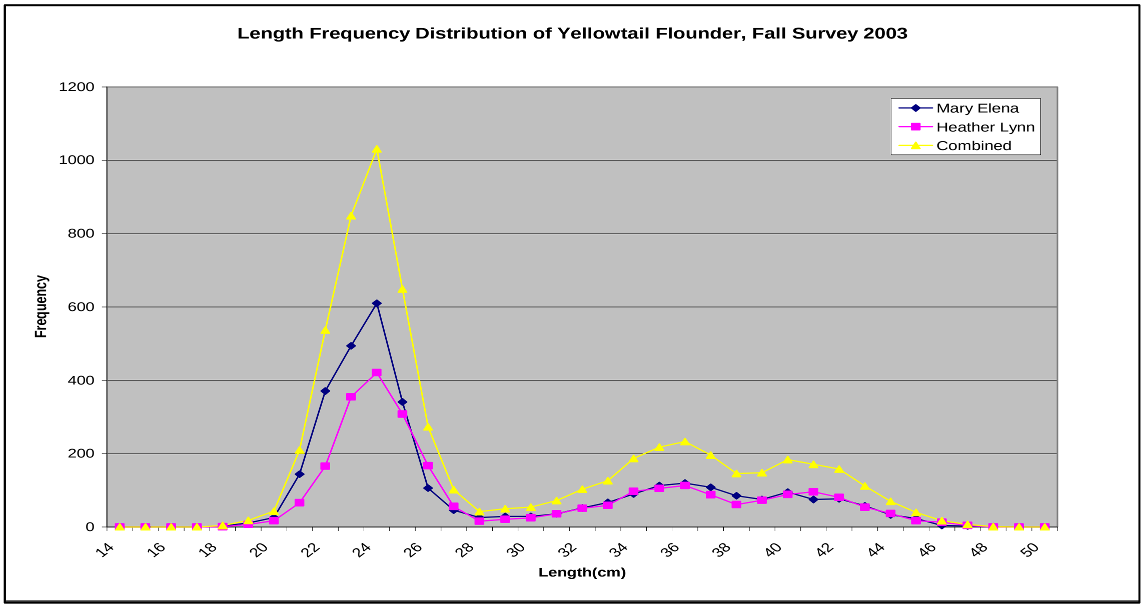


Figure 33. Length-frequency distributions of yellowtail flounder by vessel and combined for the fall 2003 survey.

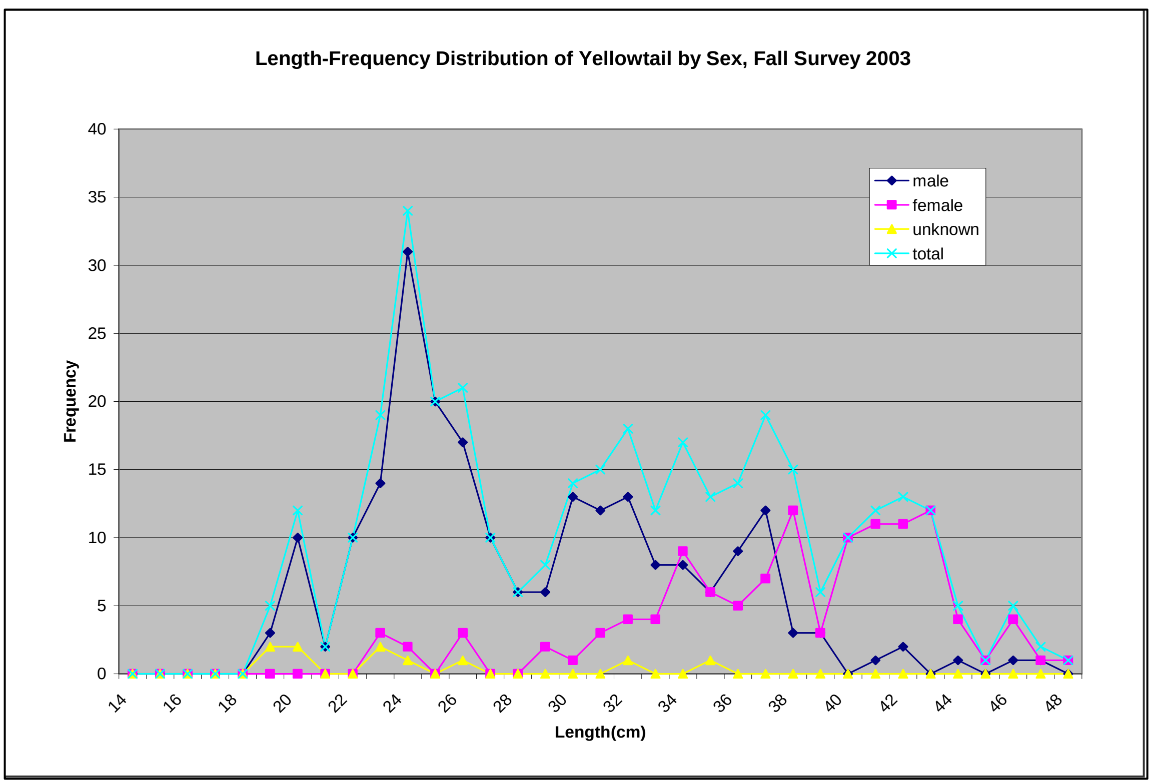
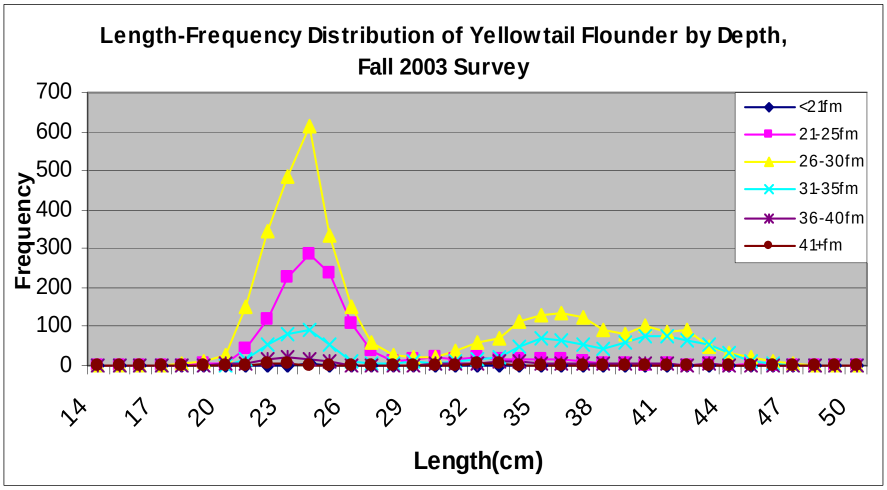
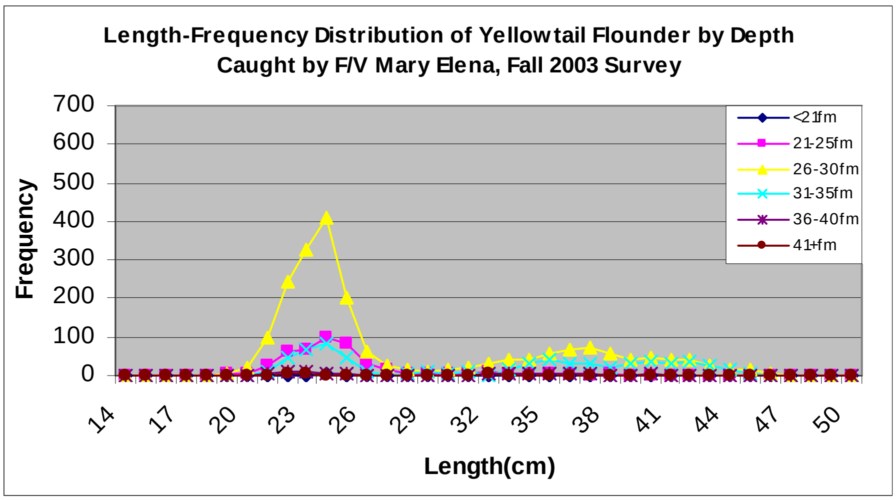


Figure 34. Length-frequency distributions of yellowtail flounder by sex for the fall 2003 survey.





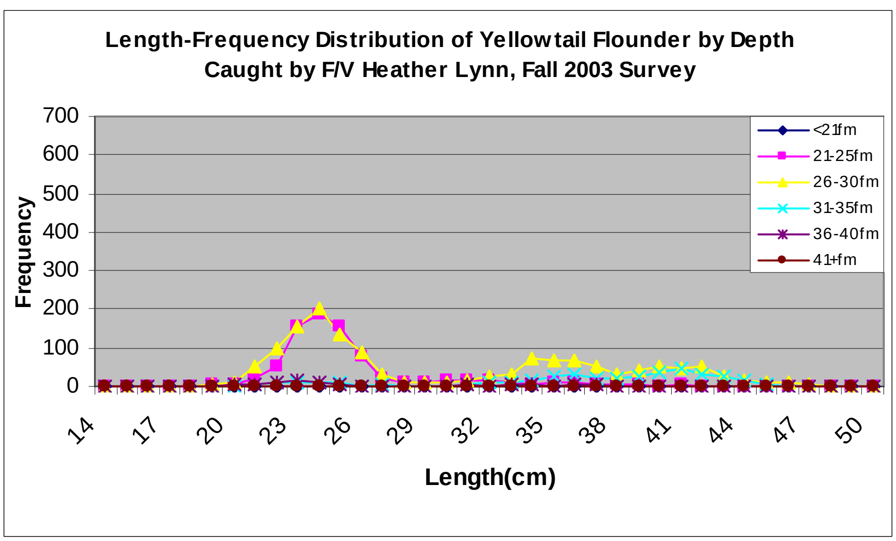
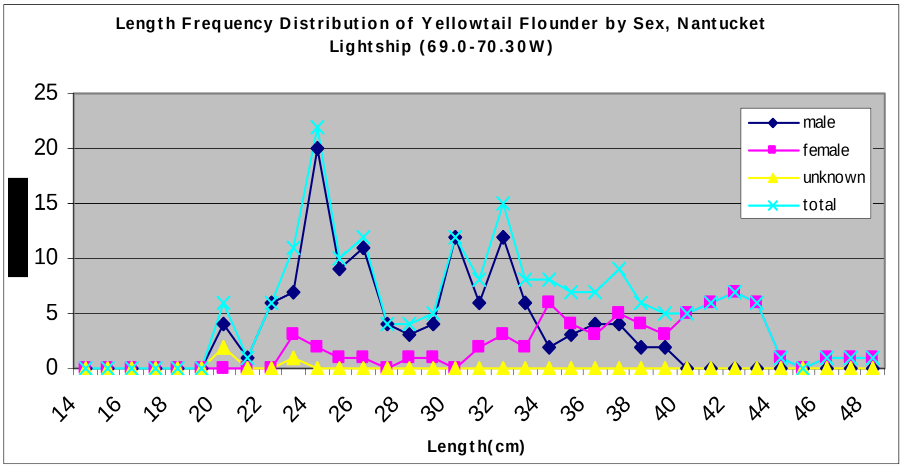
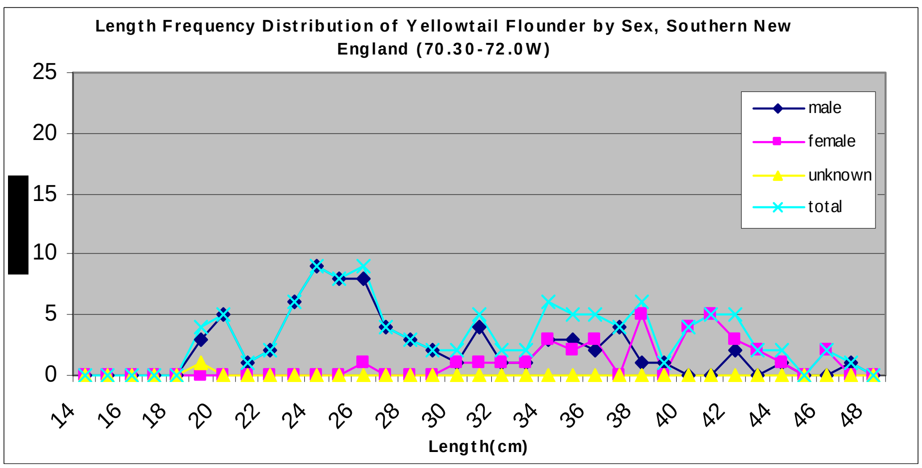


Figure 35. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the fall 2003 survey.





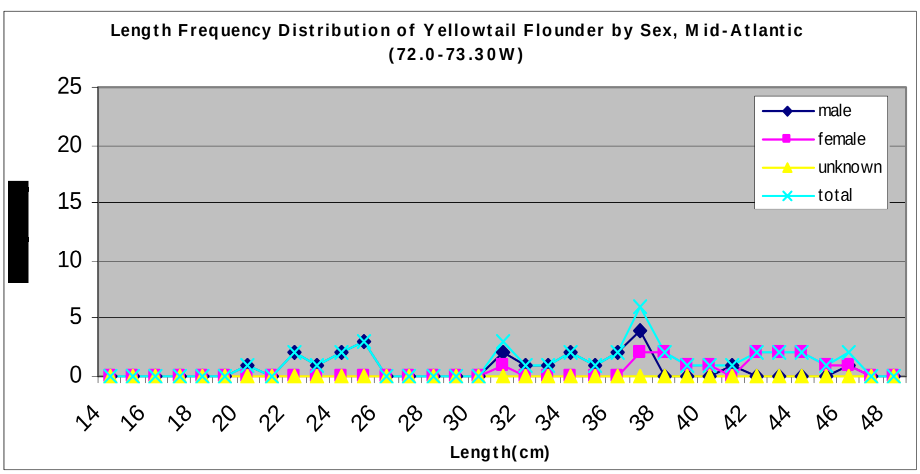


Figure 36. Length-frequency distributions of yellowtail flounder by sex for the Nantucket Lightship, Southern New England, and Mid-Atlantic sub-areas within the SNE range for the fall 2003 survey.

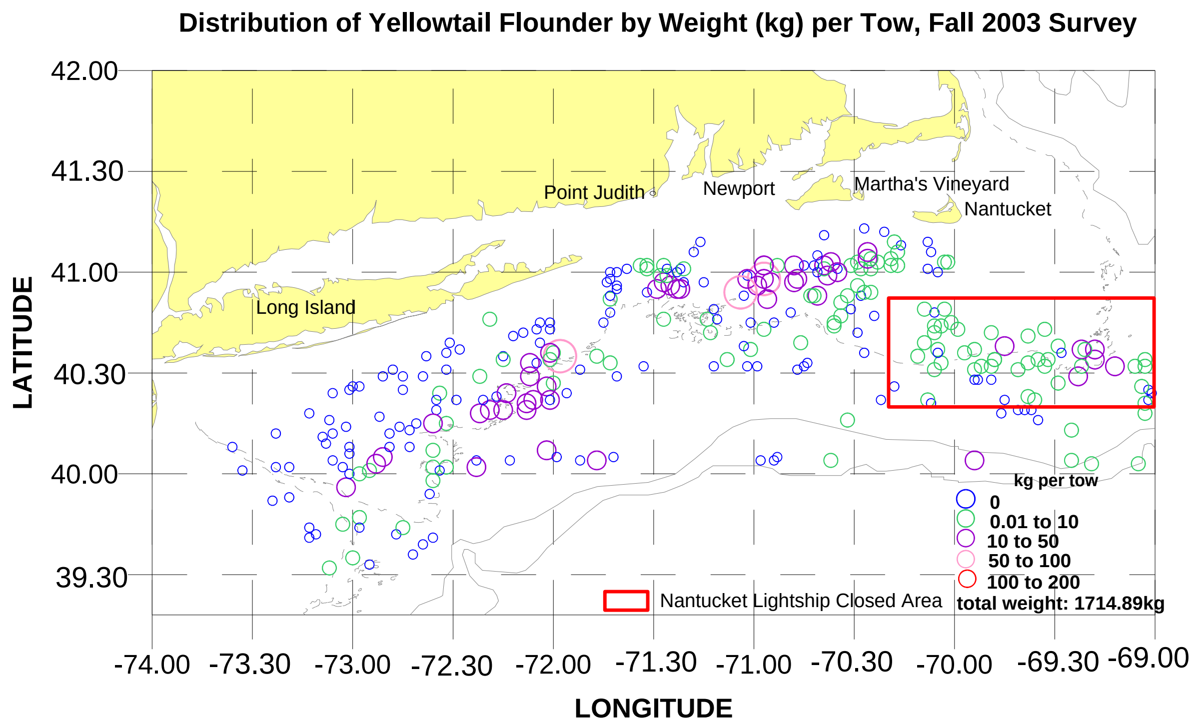


Figure 37. Map of weight per tow by station for the fall 2003 survey. Circles are proportional to the magnitude of the weight per tow.

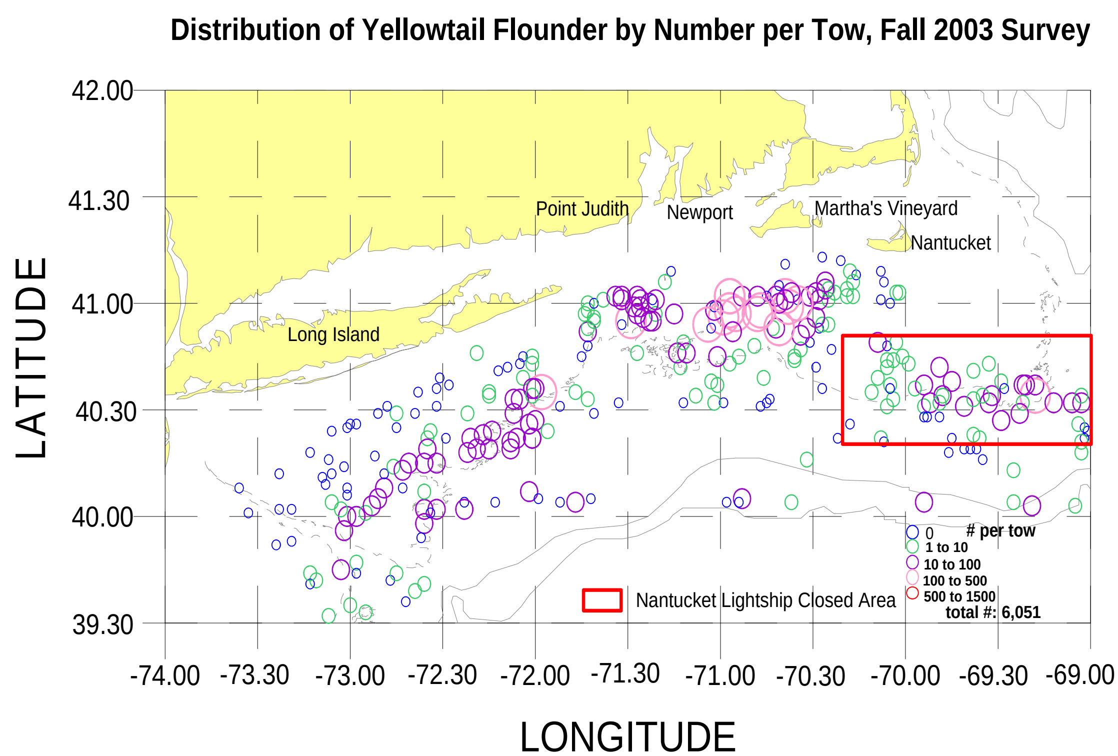


Figure 38. Map of number per tow by station for the fall 2003 survey. Circles are proportional to the magnitude of the number per tow.

Distribution of Sublegal Size Yellowtail Flounder by Number per Tow, Fall 2003 Survey

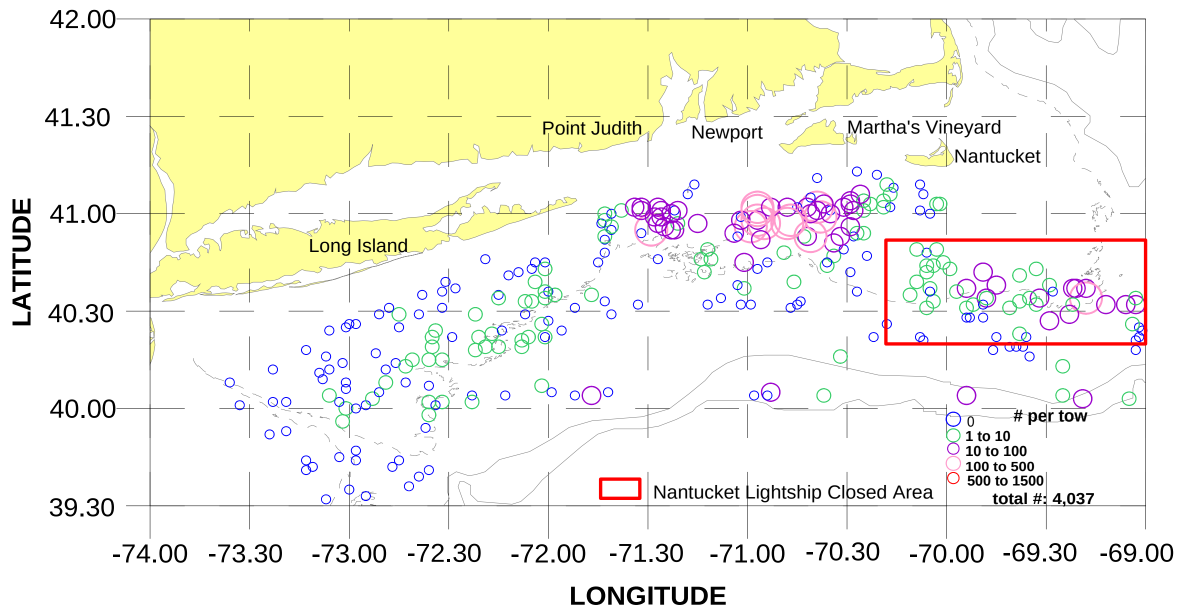


Figure 39. Map of the abundance of sublegal size yellowtail flounder caught at each station for the fall 2003 survey. Circles are proportional to the magnitude of the numbers observed.

Distribution of Legal Size Yellowtail Flounder by Number per Tow, Fall 2003 Survey

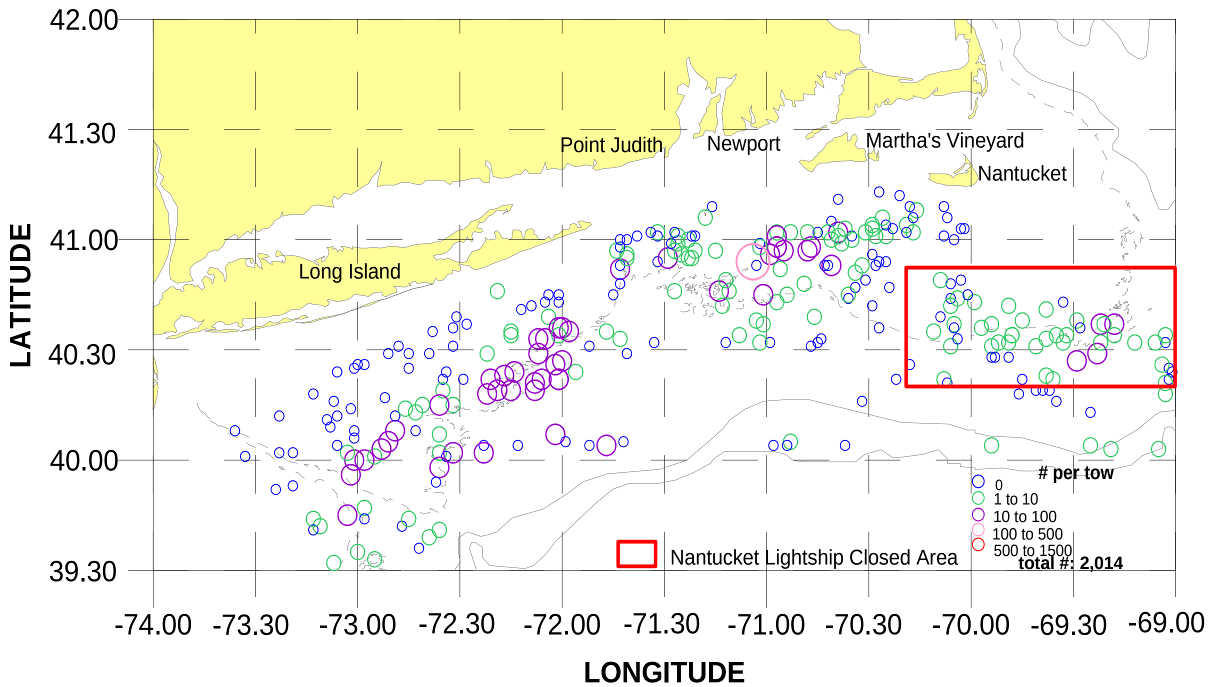


Figure 40. Map of the abundance of legal size yellowtail flounder caught at each station for the fall 2003 survey. Circles are proportional to the magnitude of the numbers observed.

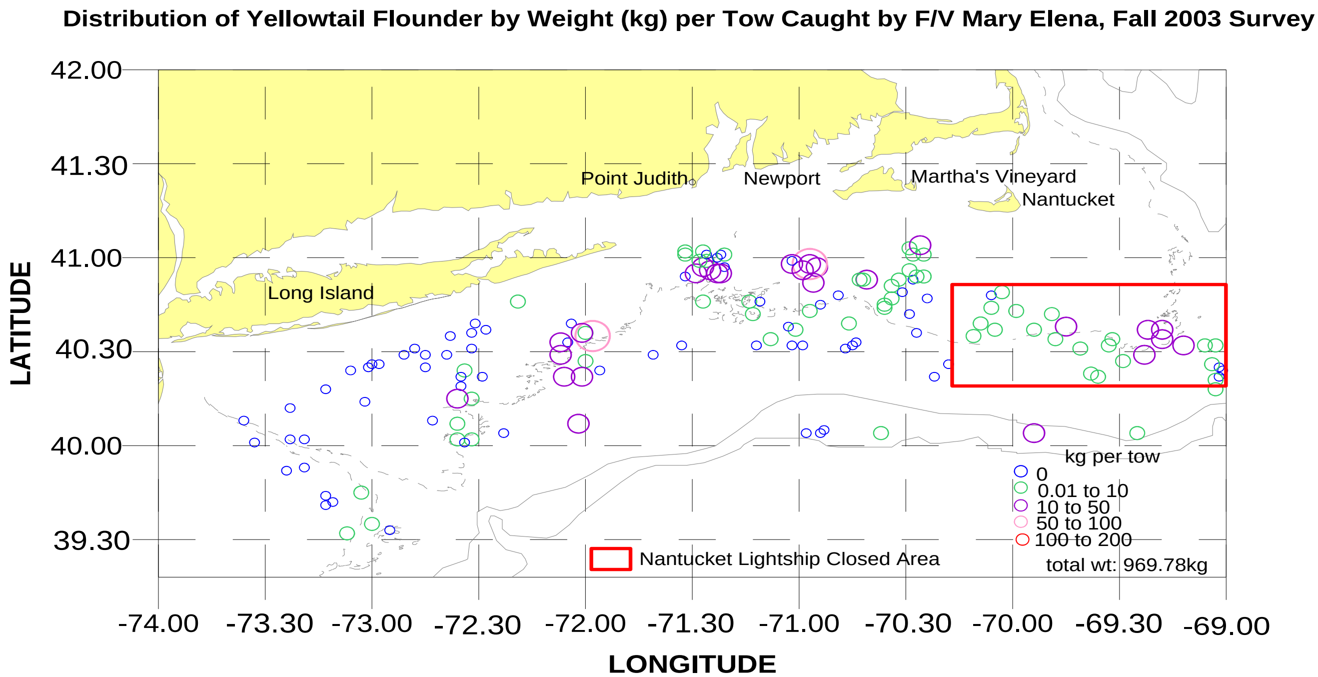


Figure 41. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the fall 2003 survey. Circles are proportional to the magnitude of the weight per tow.

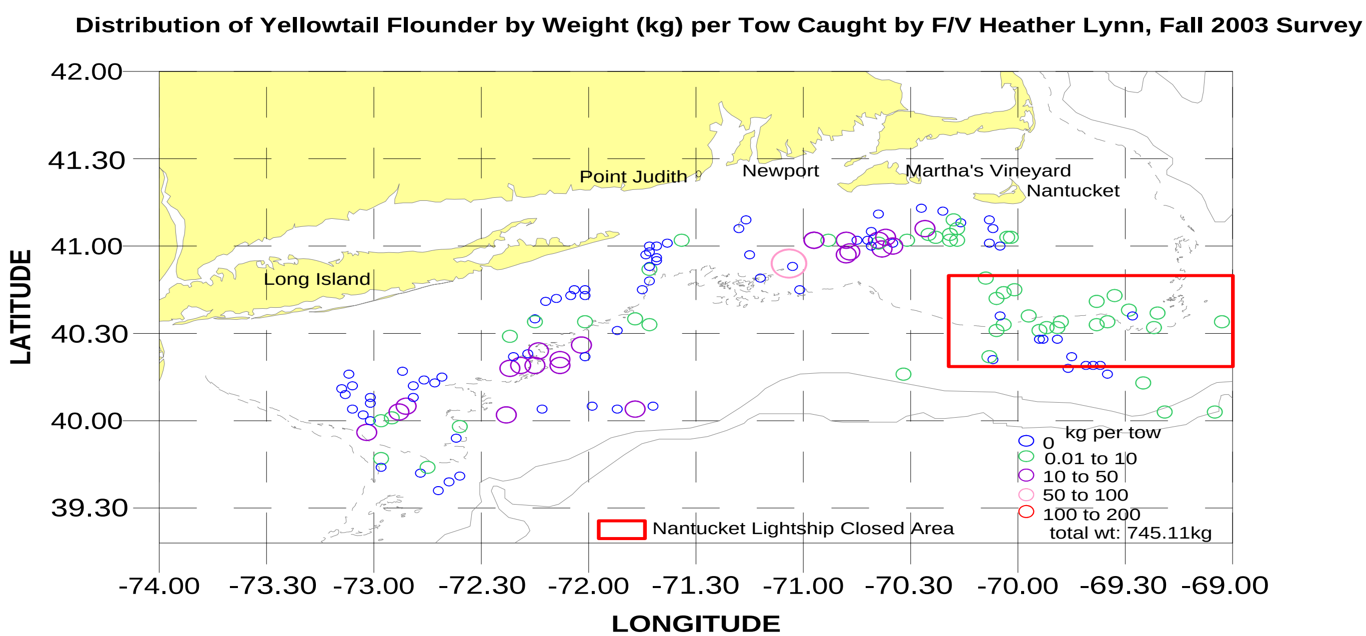


Figure 42. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the fall 2003 survey. Circles are proportional to the magnitude of the weight per tow.

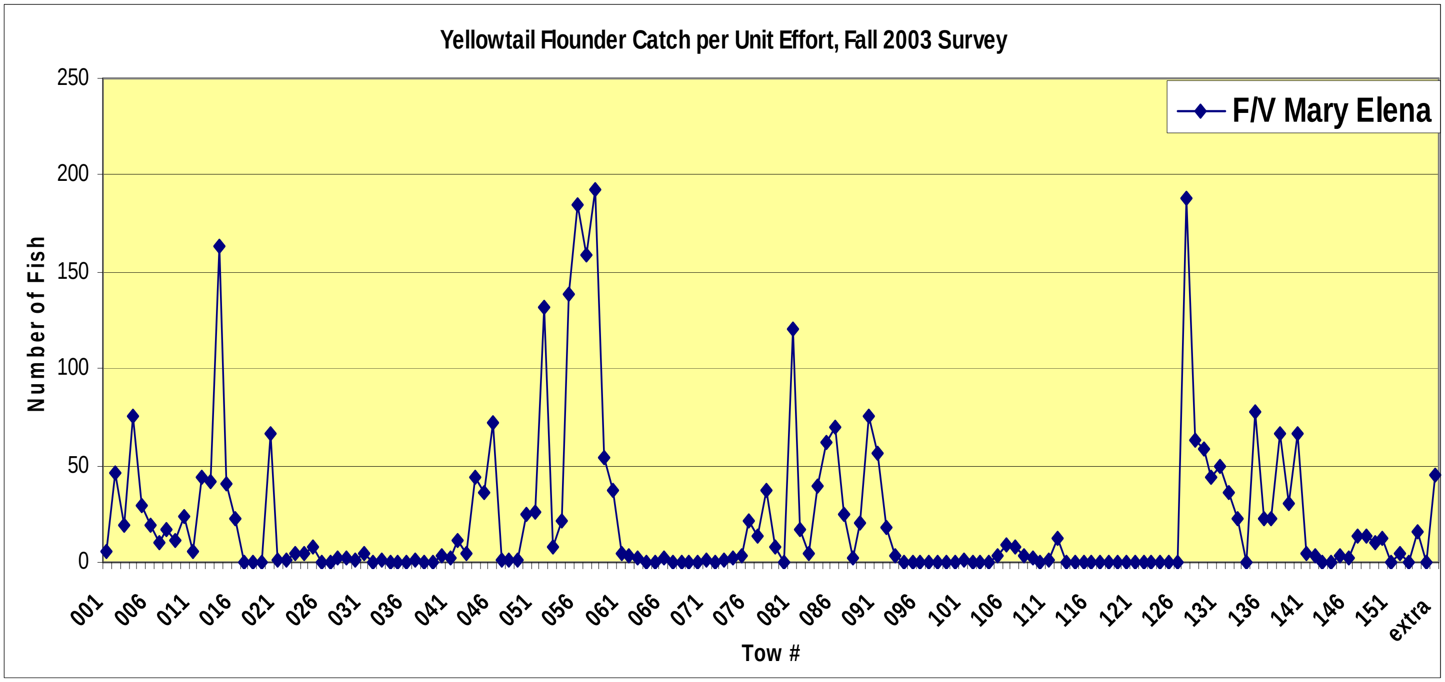


Figure 43. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the fall 2003 survey.

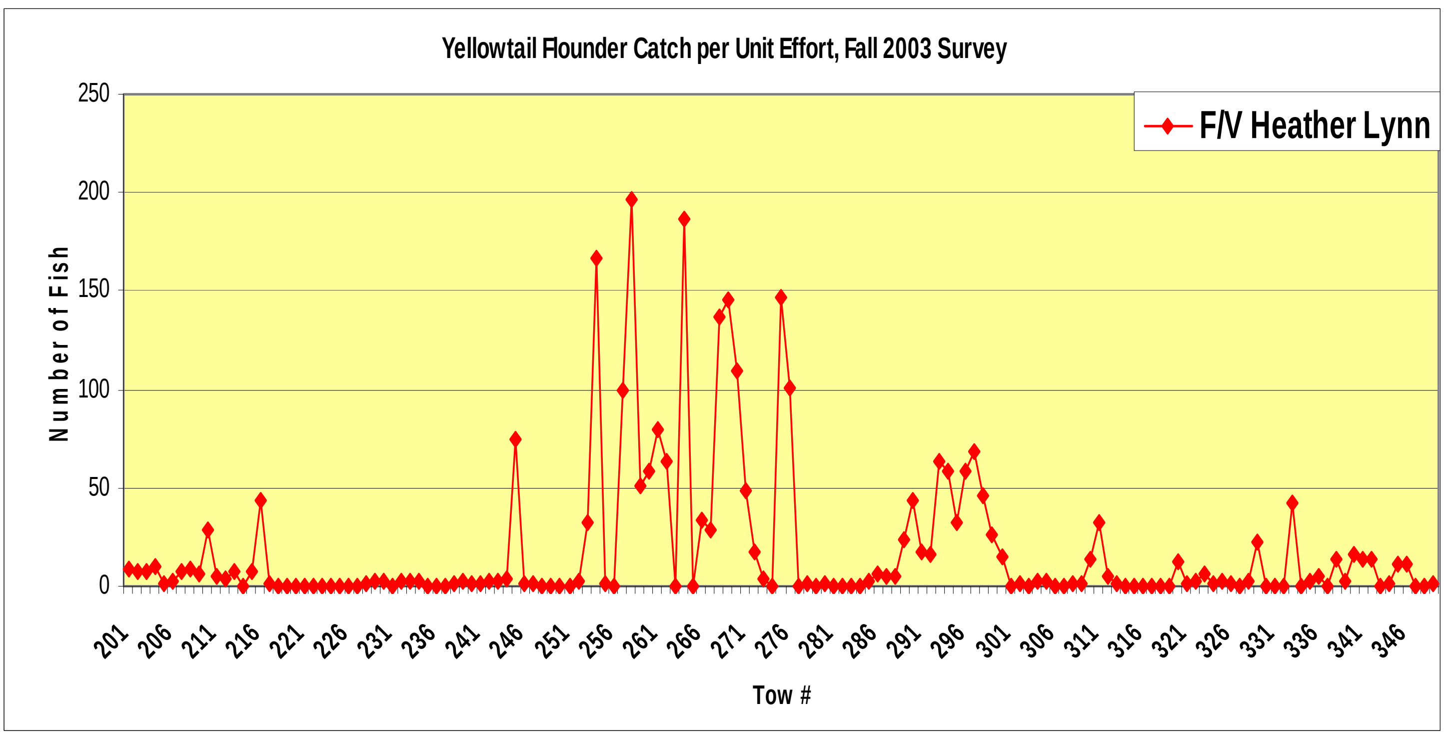


Figure 44. Number of yellowtail flounder caught by tow number based on observations from the F/V *Heather Lynn* for the fall 2003 survey.

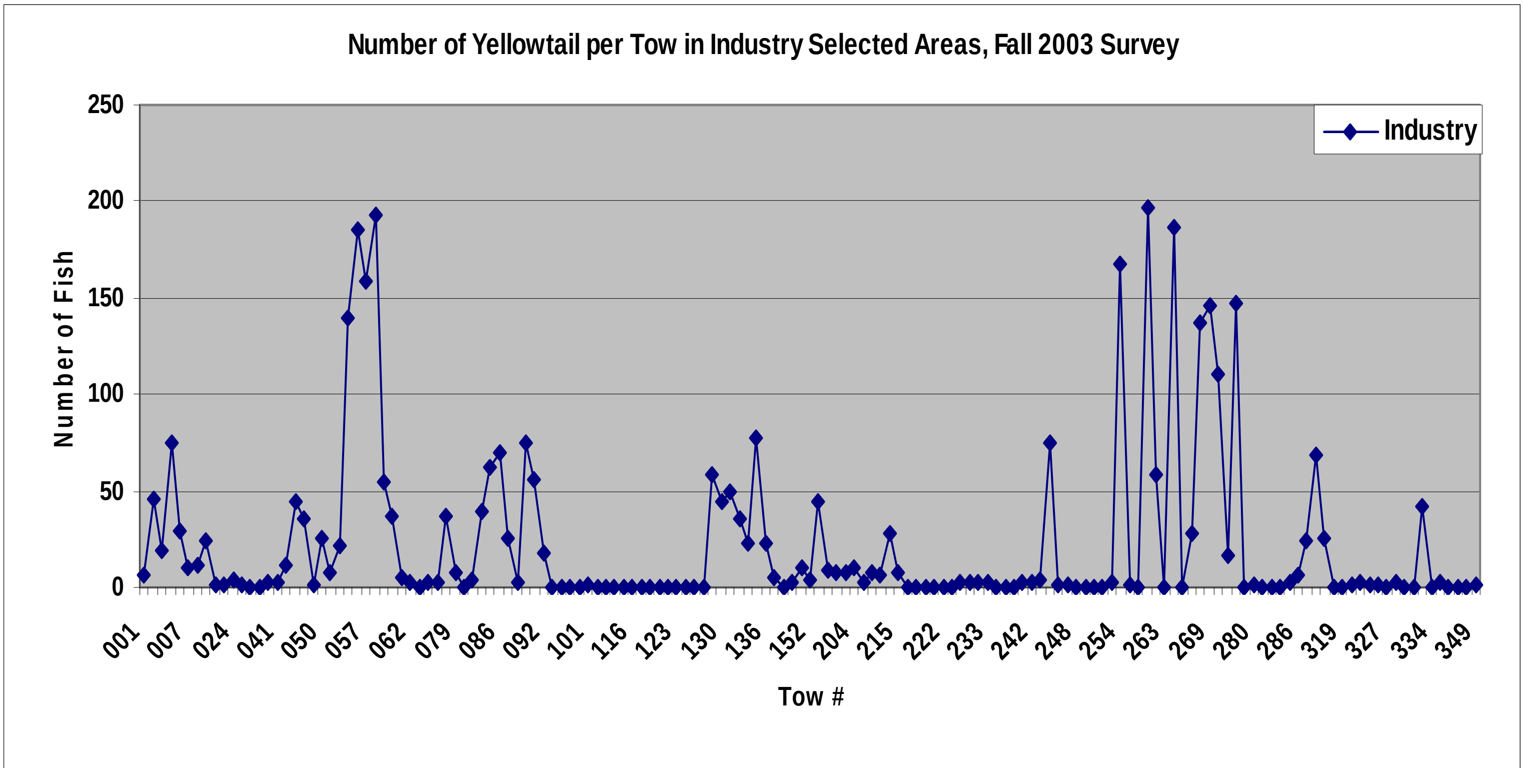


Figure 45. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the fall 2003 survey.

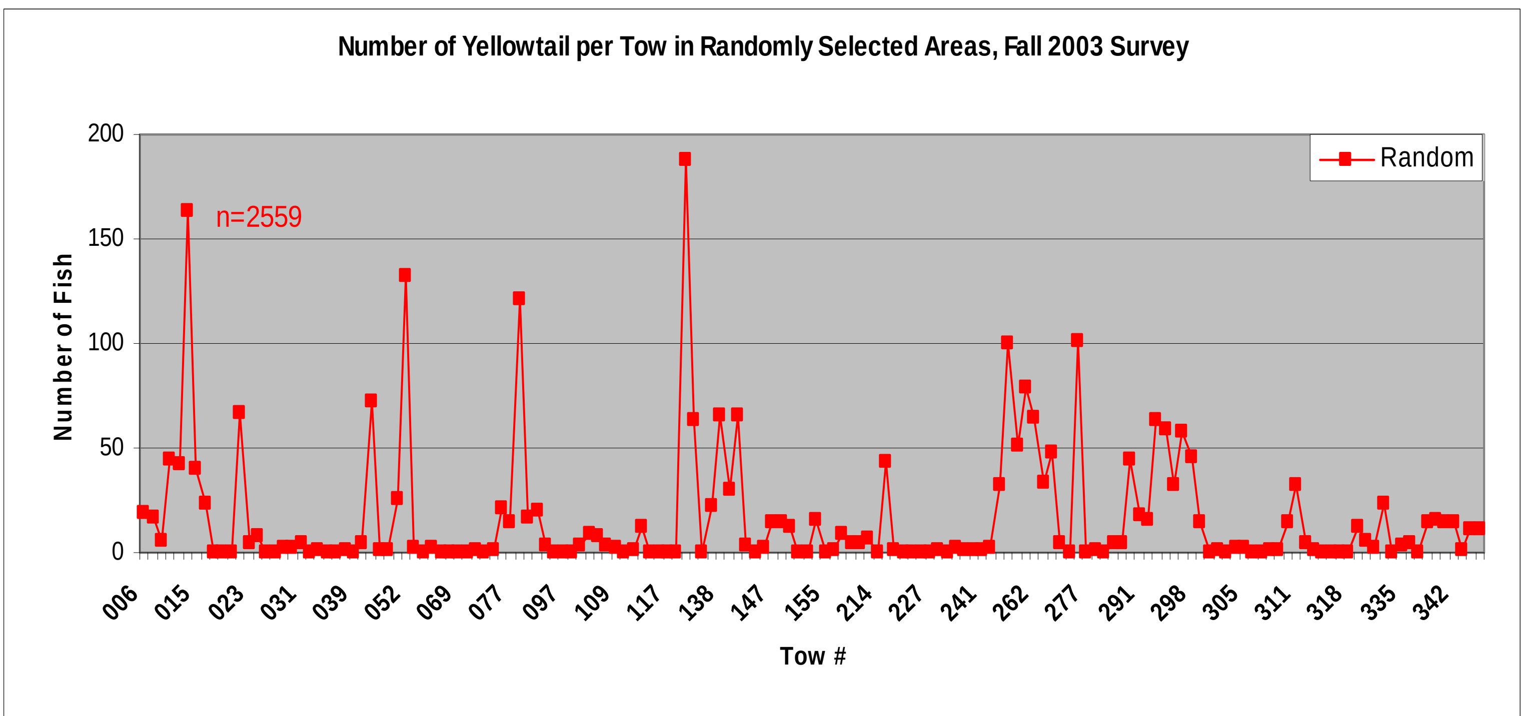


Figure 46. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the fall 2003 survey.

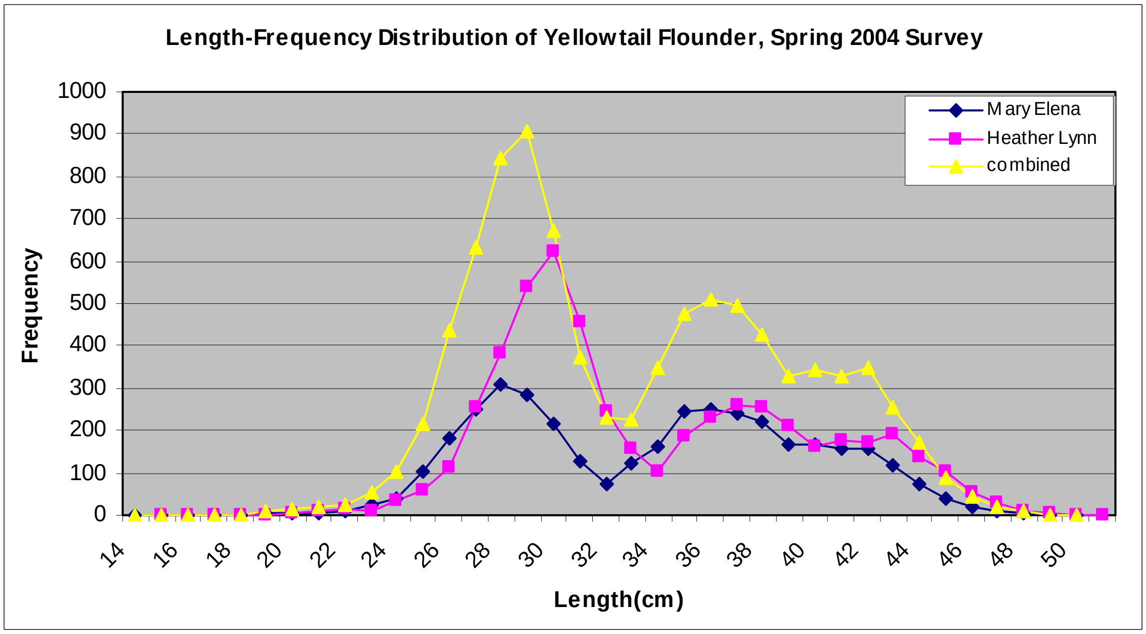


Figure 47. Length-frequency distributions of yellowtail flounder by vessel and combined for the spring 2004 survey.

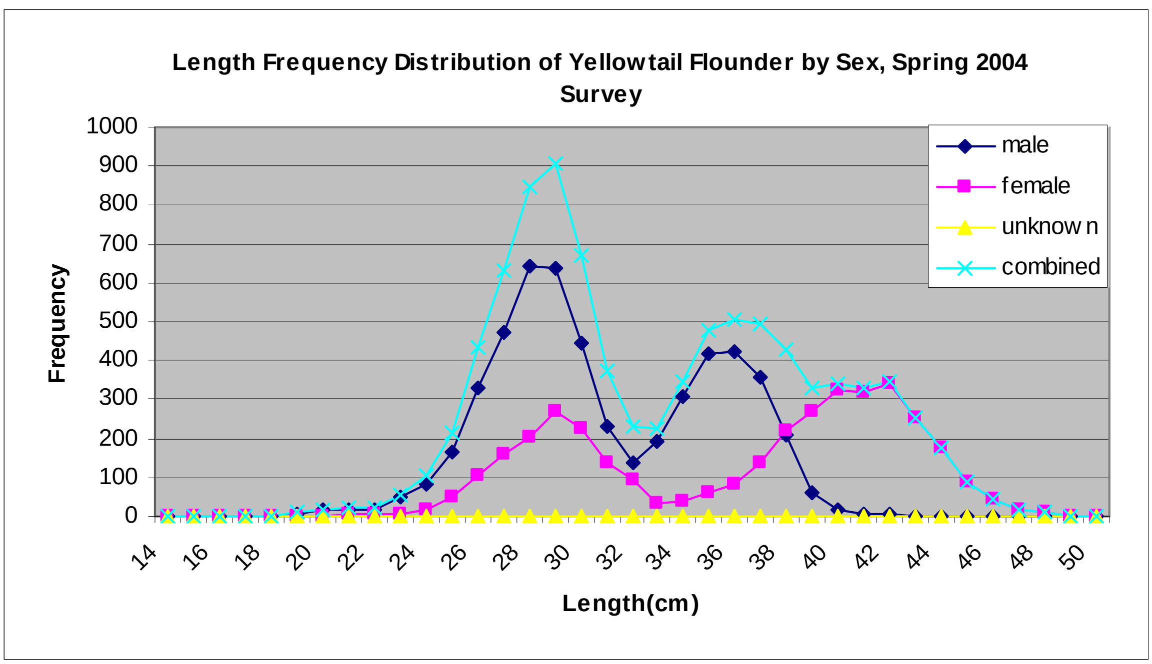


Figure 48. Length-frequency distributions of yellowtail flounder by sex for the spring 2004 survey.

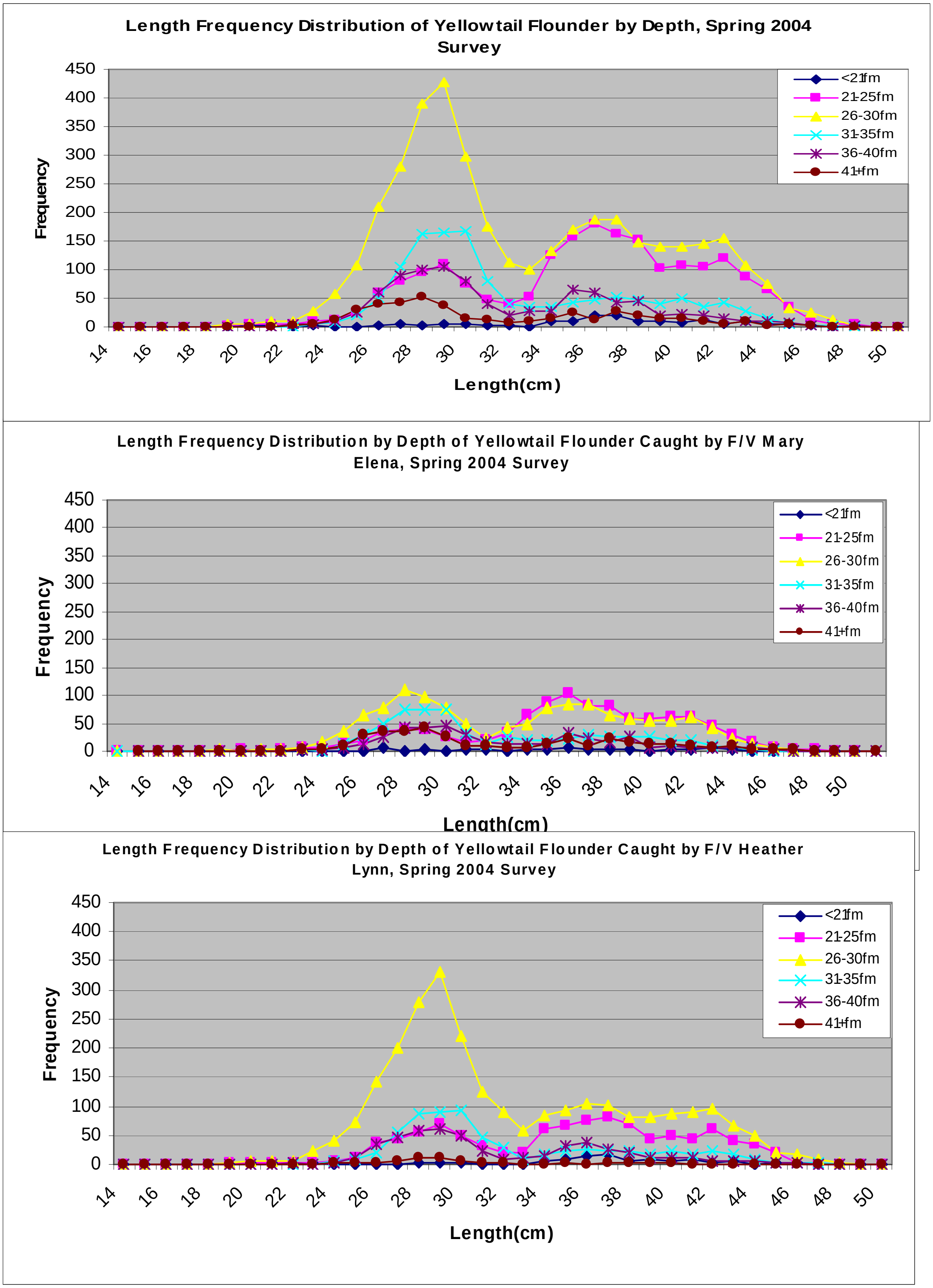
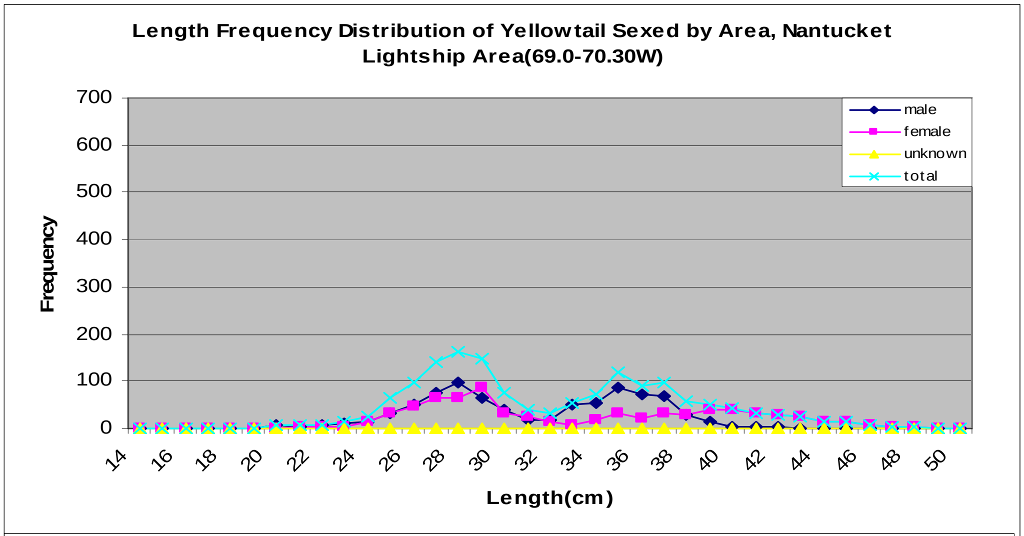
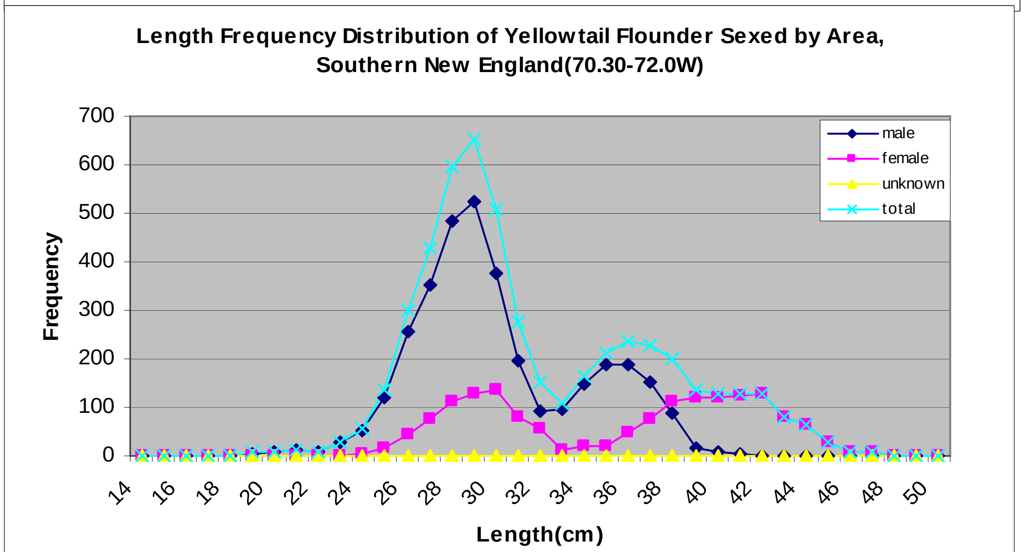


Figure 49. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the spring 2004 survey.





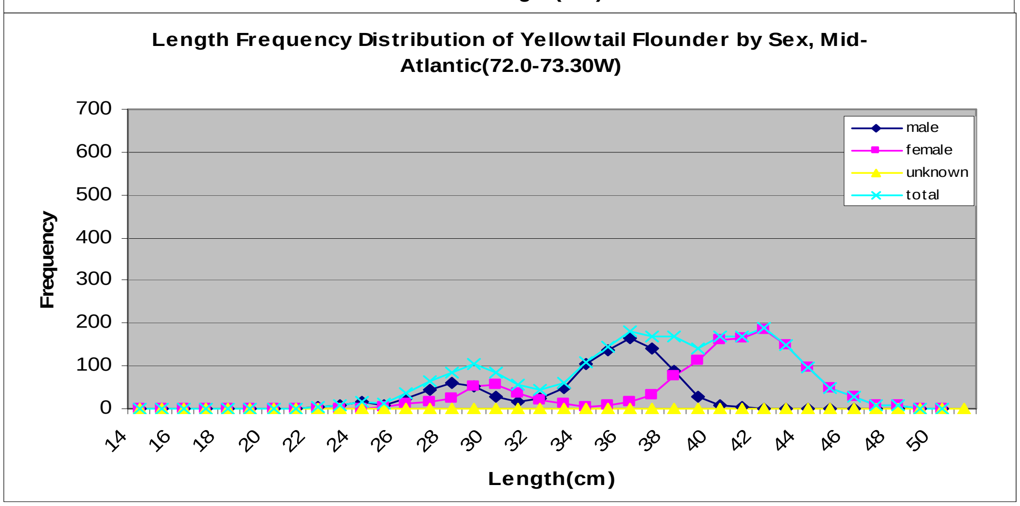


Figure 50. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the spring 2004 survey.

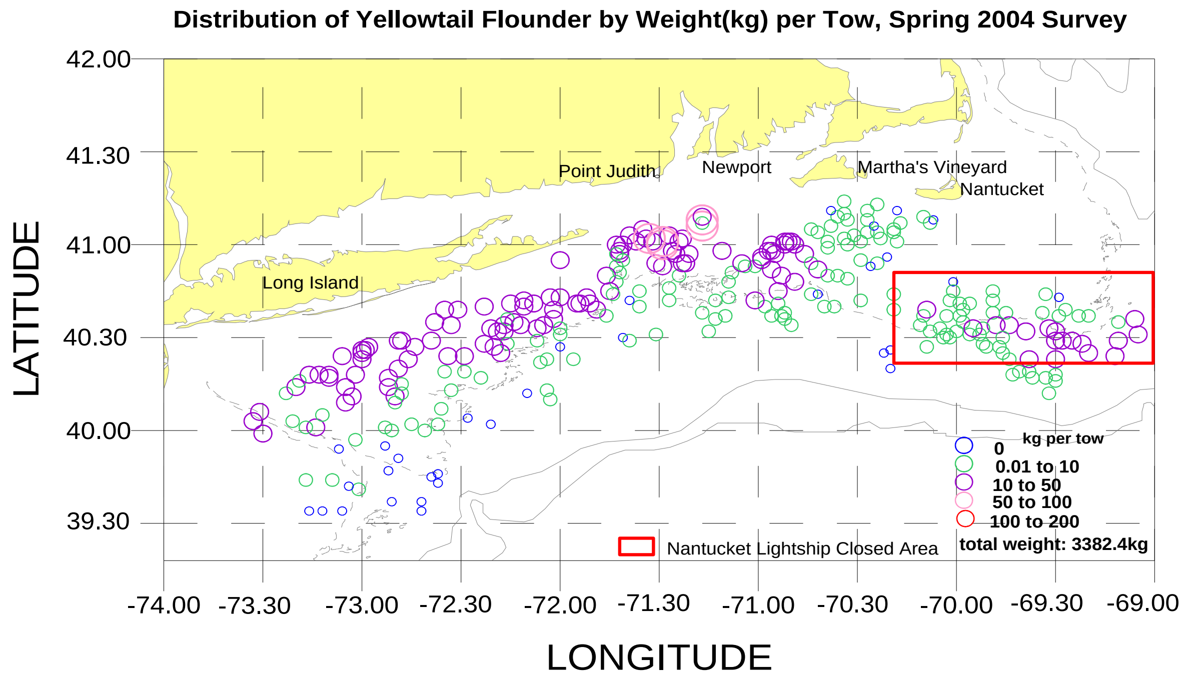


Figure 51. Map of weight per tow by station for the spring 2004 survey. Circles are proportional to the magnitude of the weight per tow.

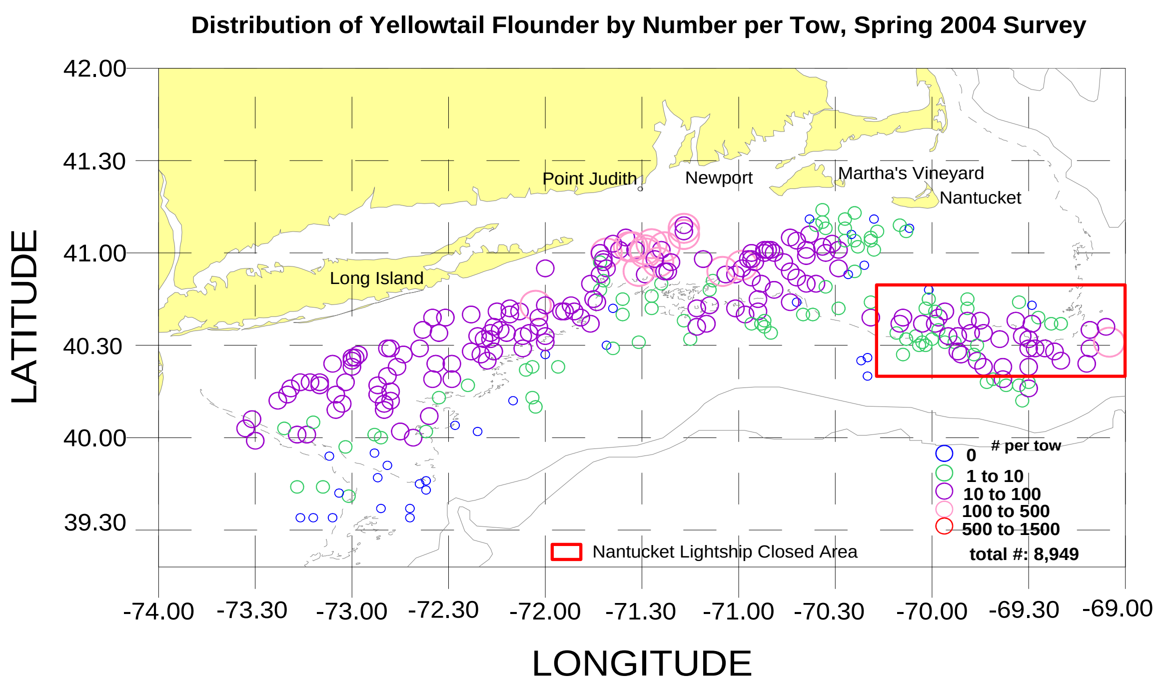


Figure 52. Map of number per tow by station for the spring 2004 survey. Circles are proportional to the magnitude of the number per tow.

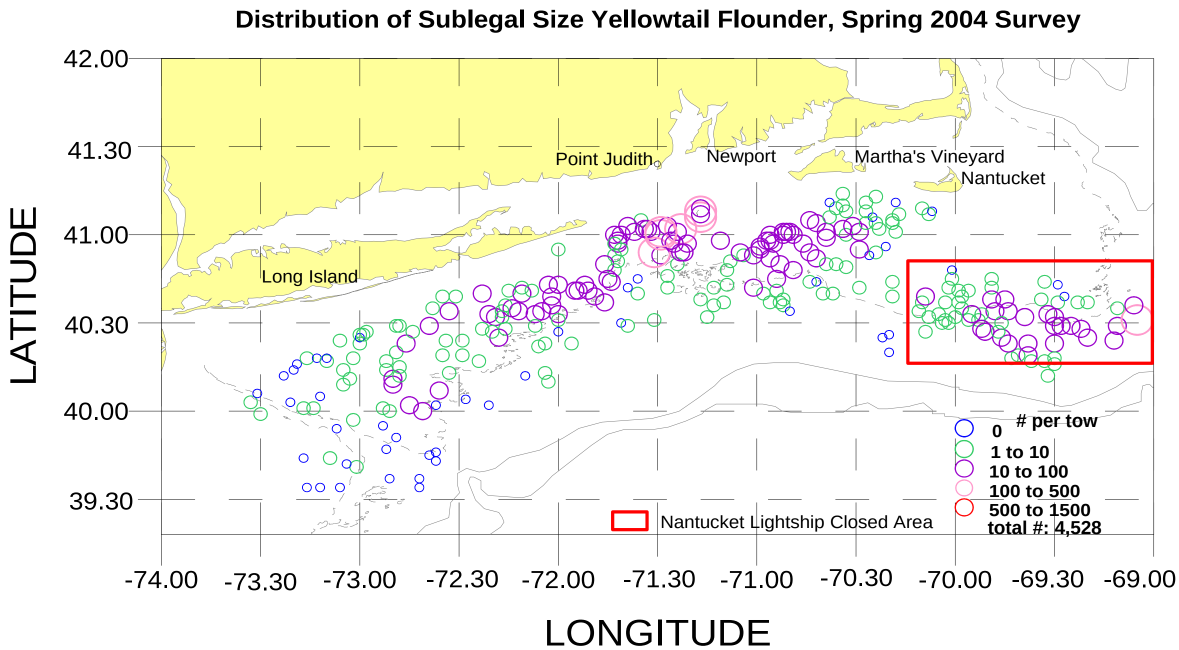


Figure 53 Map of the abundance of sublegal size yellowtail flounder caught at each station for the spring 2004 survey. Circles are proportional to the magnitude of the numbers observed.

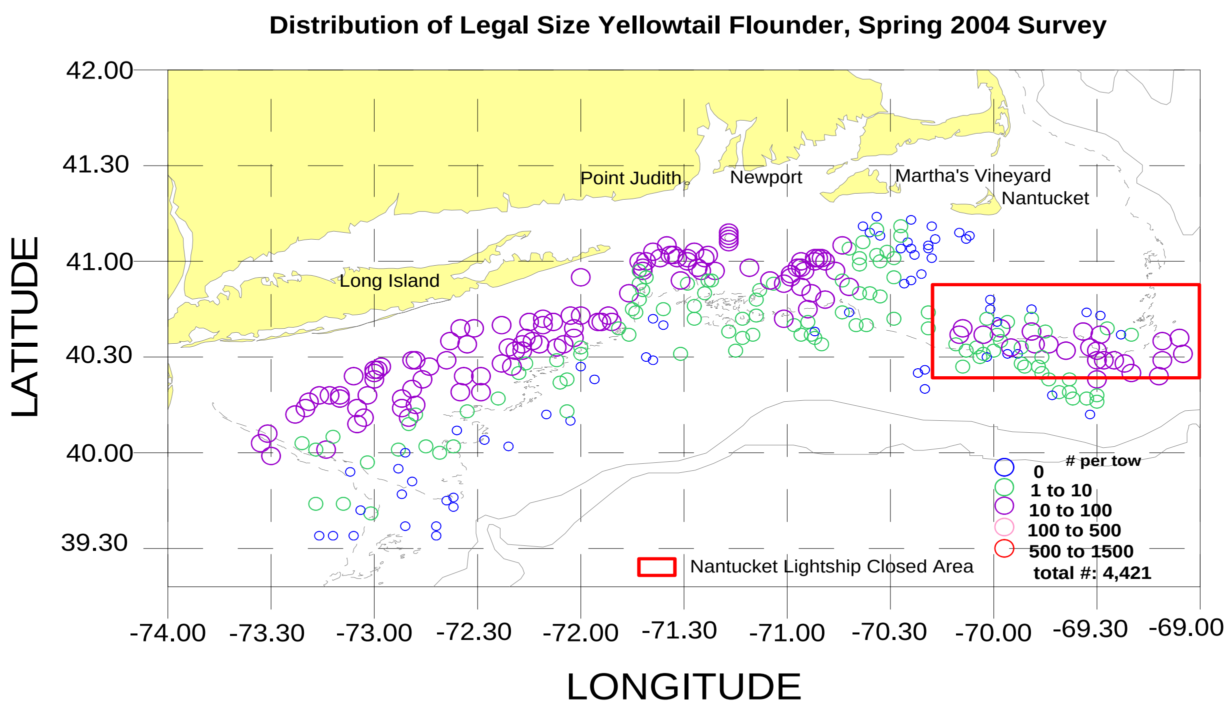


Figure 54. Map of the abundance of legal size yellowtail flounder caught at each station for the spring 2004 survey. Circles are proportional to the magnitude of the numbers observed.

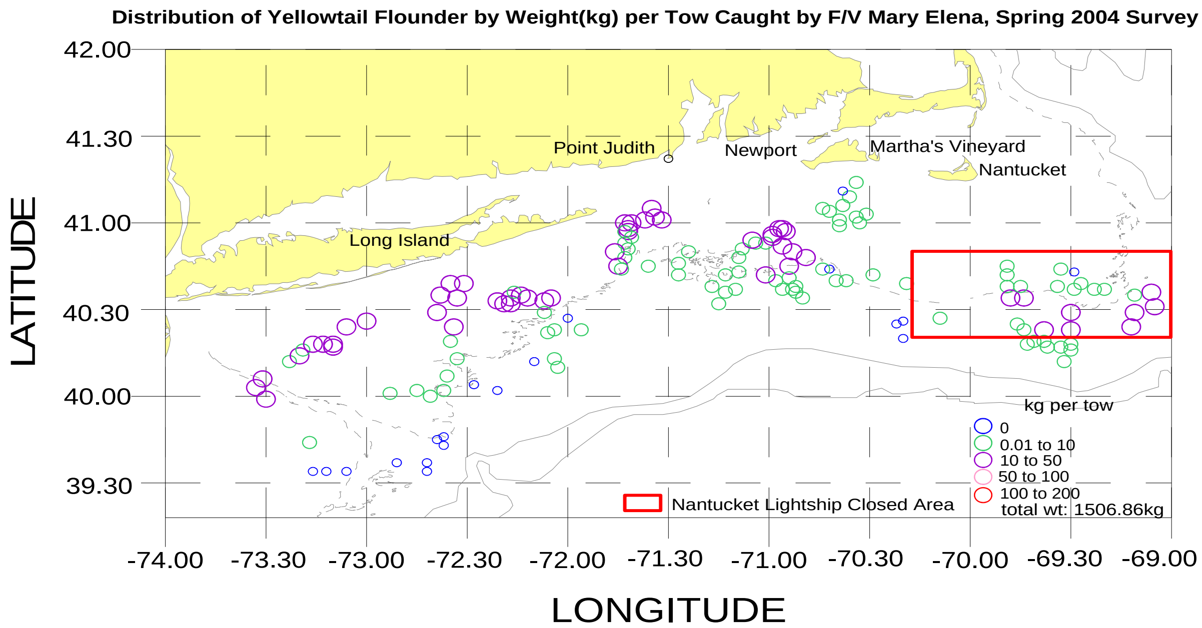


Figure 55. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the spring 2004 survey. Circles are proportional to the magnitude of the weight per tow.

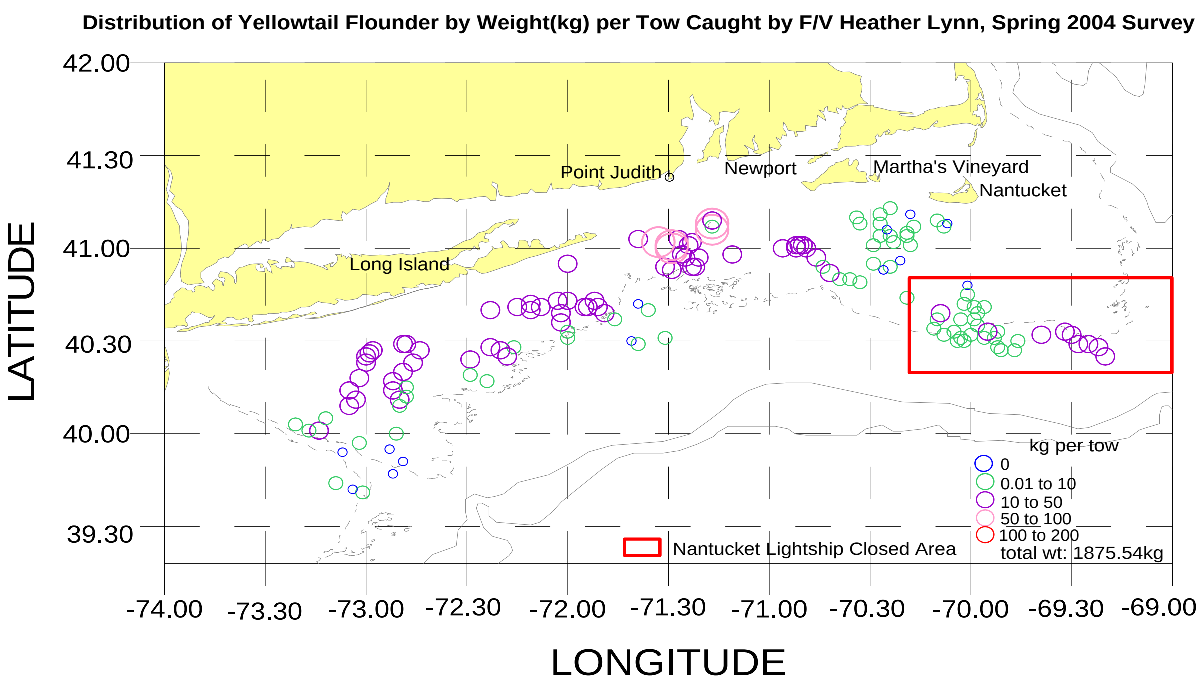


Figure 56. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the spring 2004 survey. Circles are proportional to the magnitude of the weight per tow.

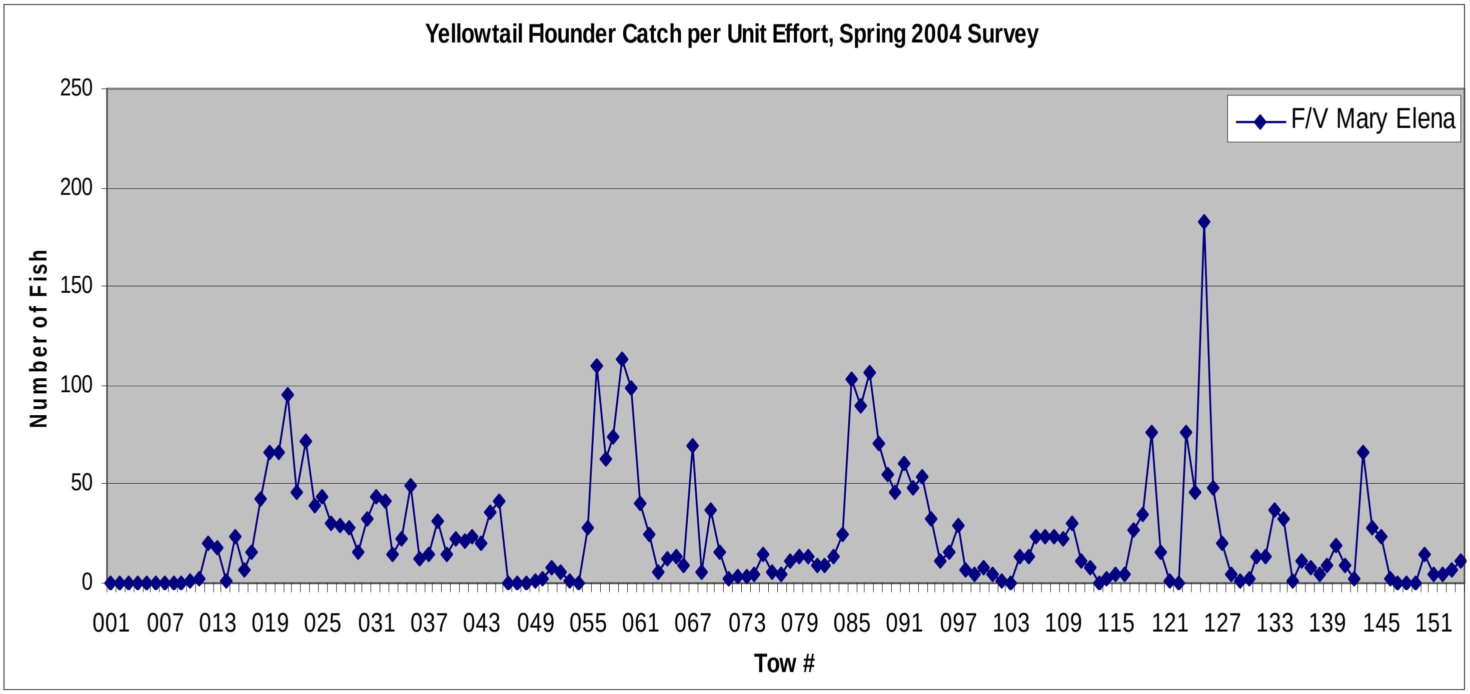


Figure 57. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the spring 2004 survey.

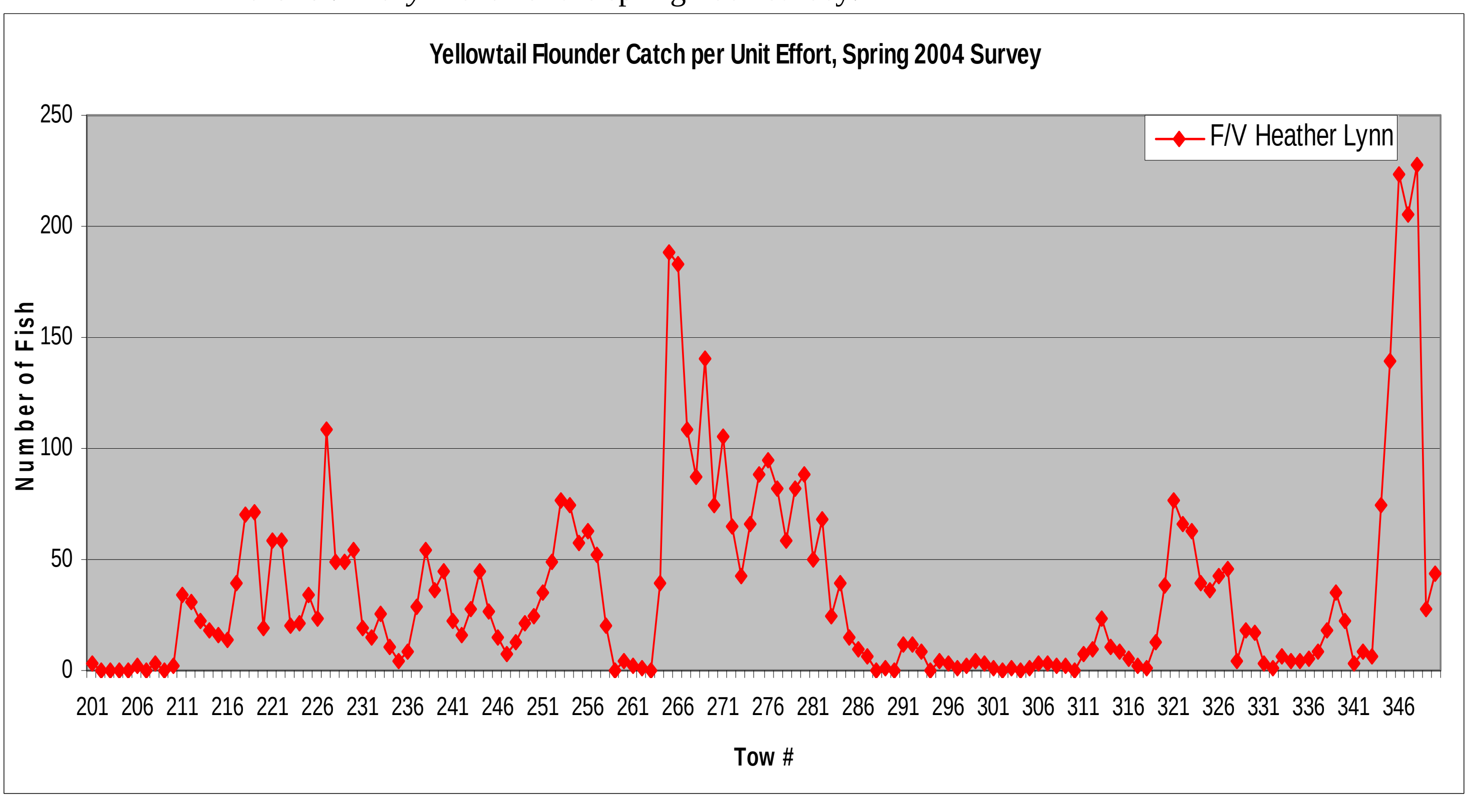


Figure 58. Number of yellowtail flounder caught by tow number based on observations from the F/V *Heather Lynn* for the spring 2004 survey.

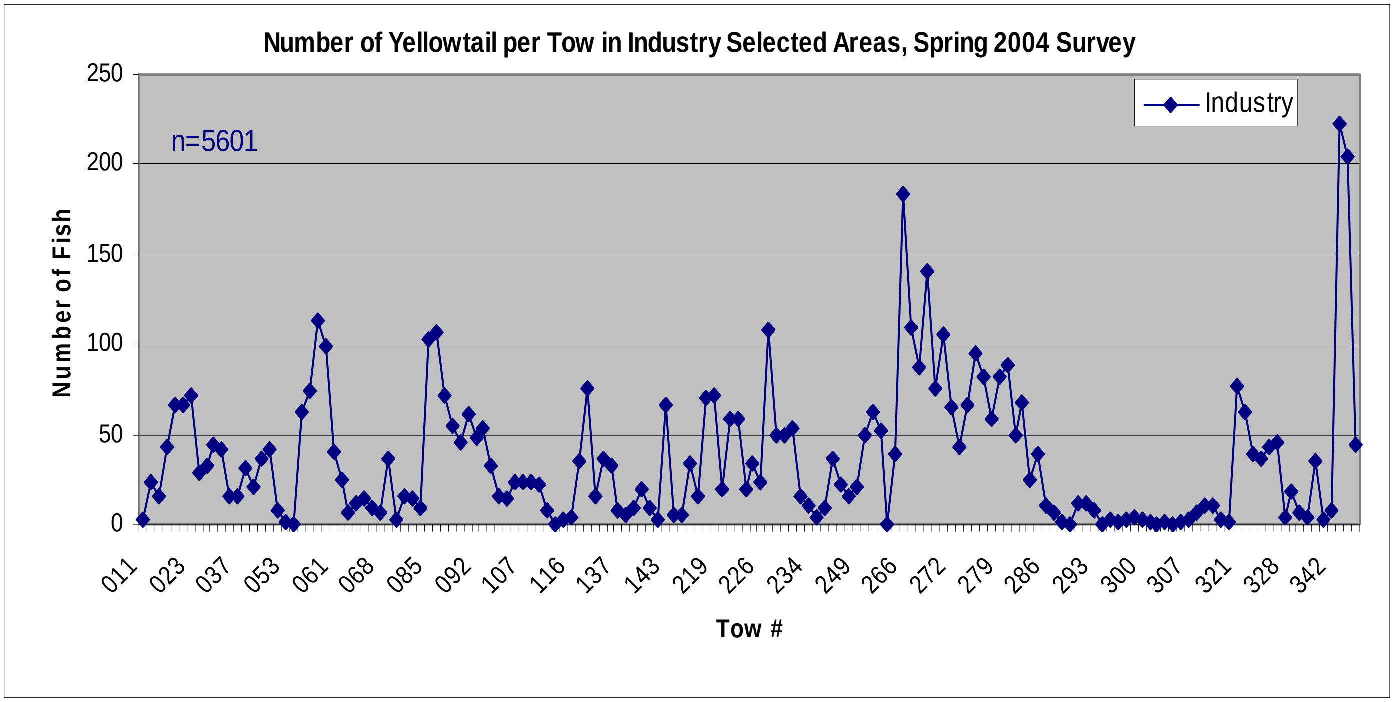


Figure 59. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the spring 2004 survey.

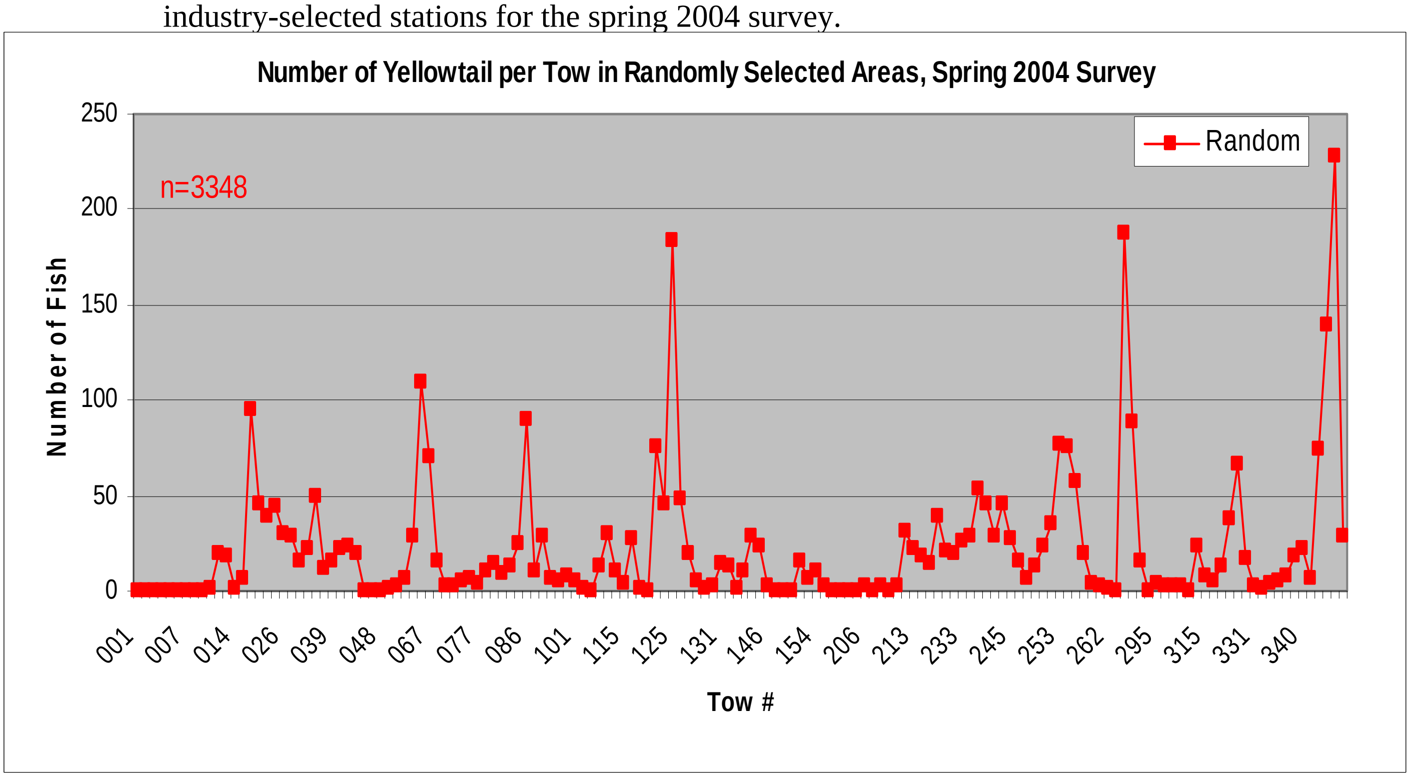


Figure 60. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the spring 2004 survey.

YELLOWTAIL FLOUNDER SUMMARY DATA, FALL 2004

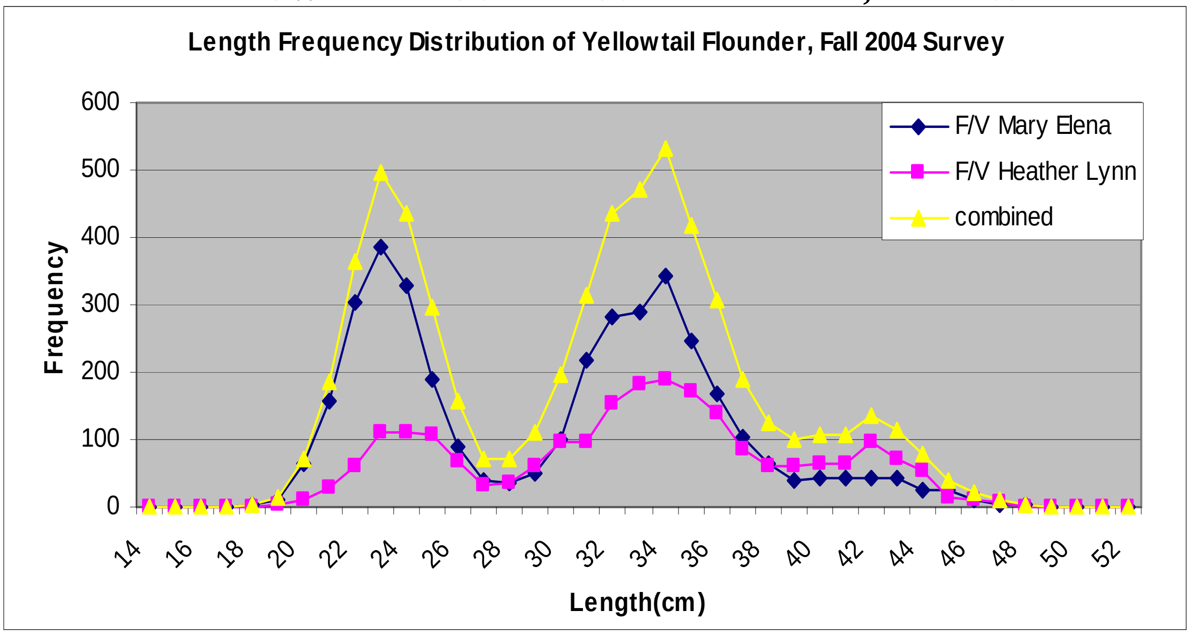


Figure 61. Length-frequency distributions of yellowtail flounder by vessel and combined for the fall 2004 survey.

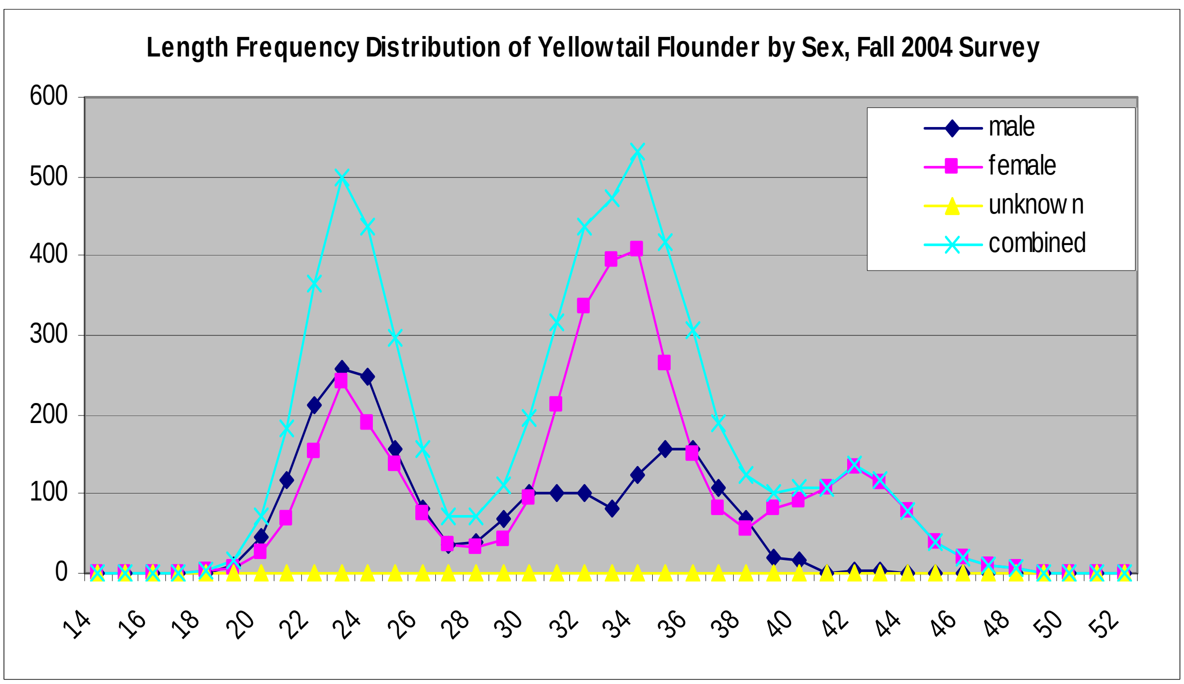


Figure 62. Length-frequency distributions of yellowtail flounder by sex for the fall 2004 survey.

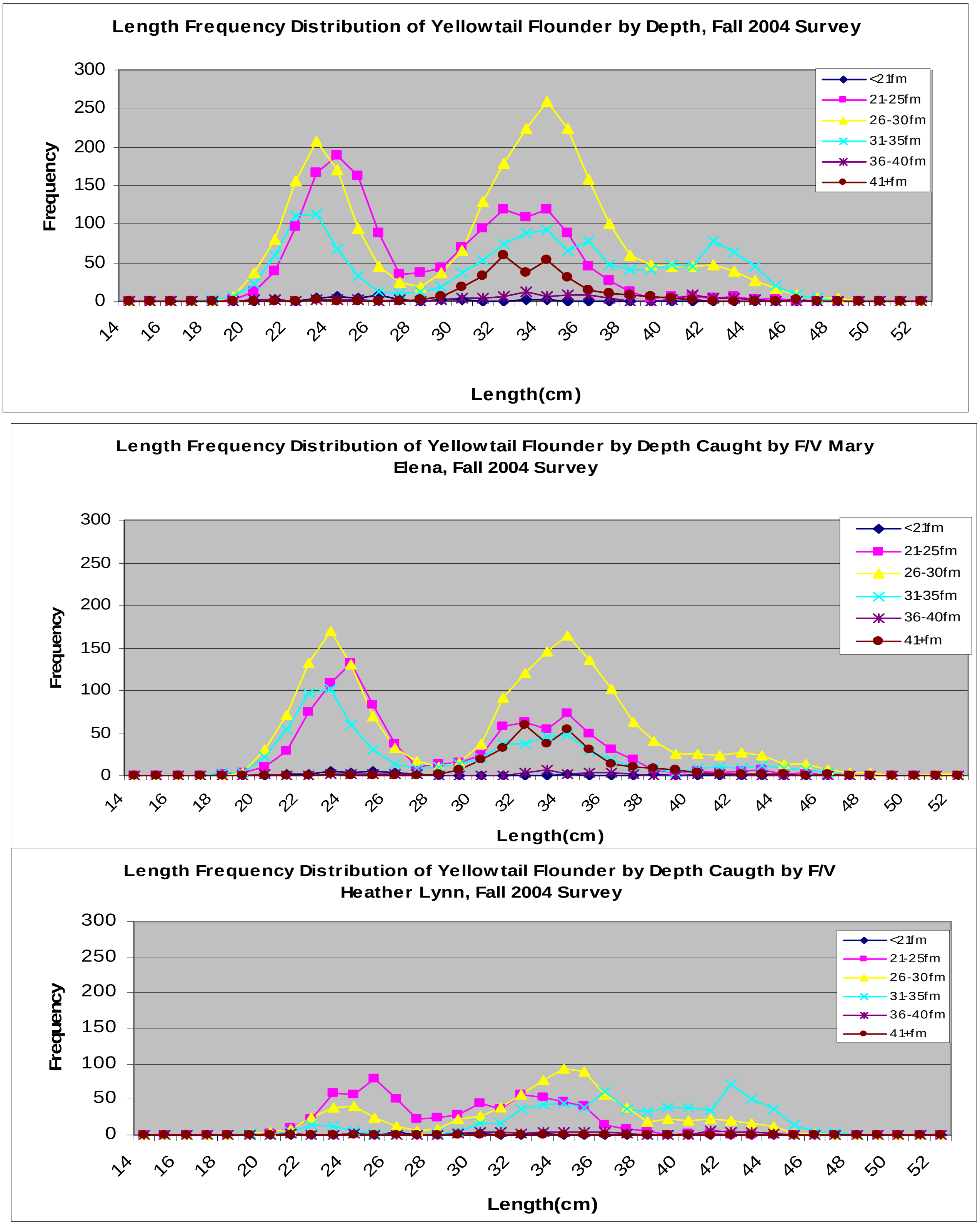


Figure 63. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the fall 2004 survey.

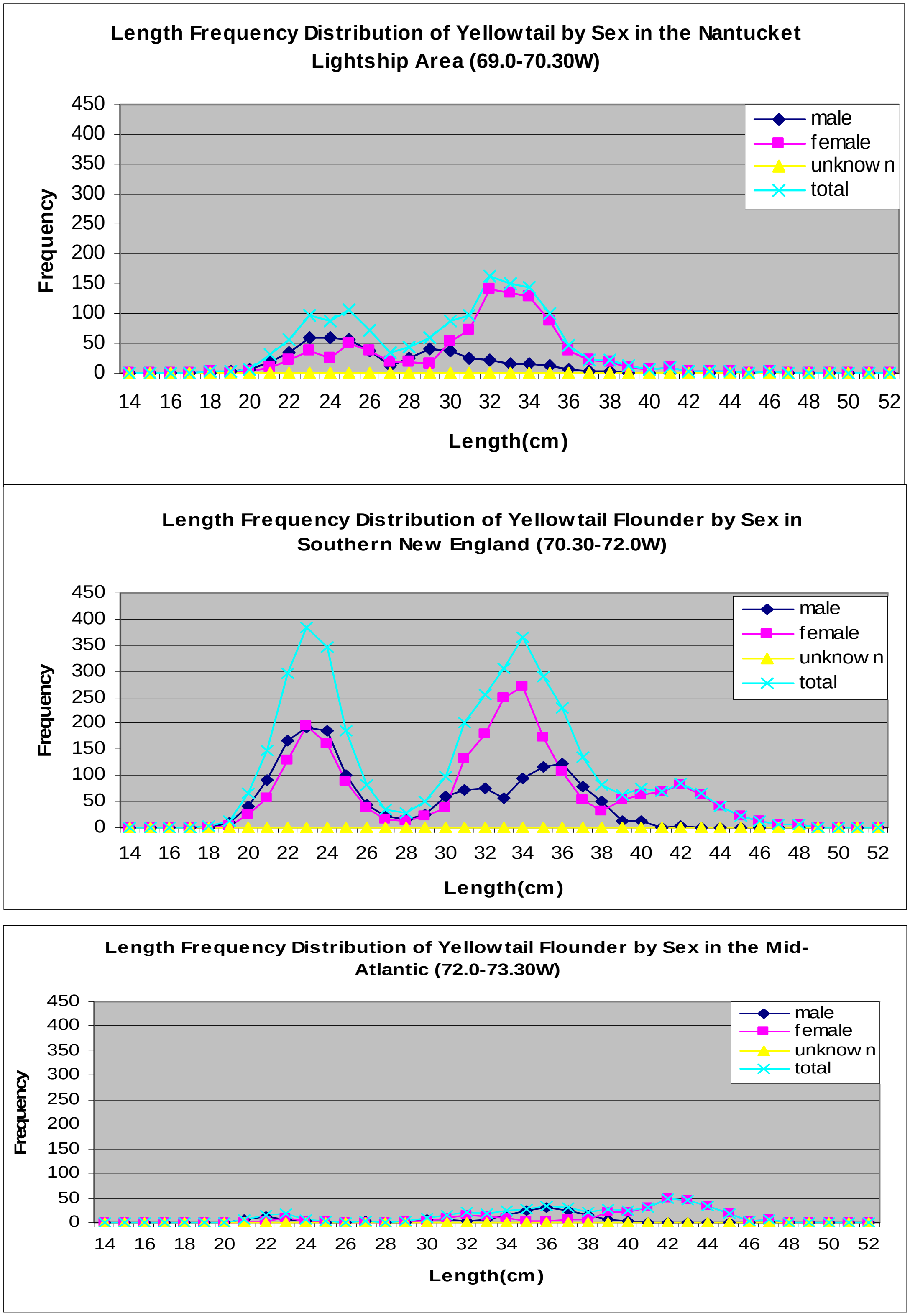


Figure 64. Length-frequency distributions of yellowtail flounder by sex for the Nantucket Lightship, Southern New England, and Mid-Atlantic sub-areas within the SNE range for the fall 2004 survey.

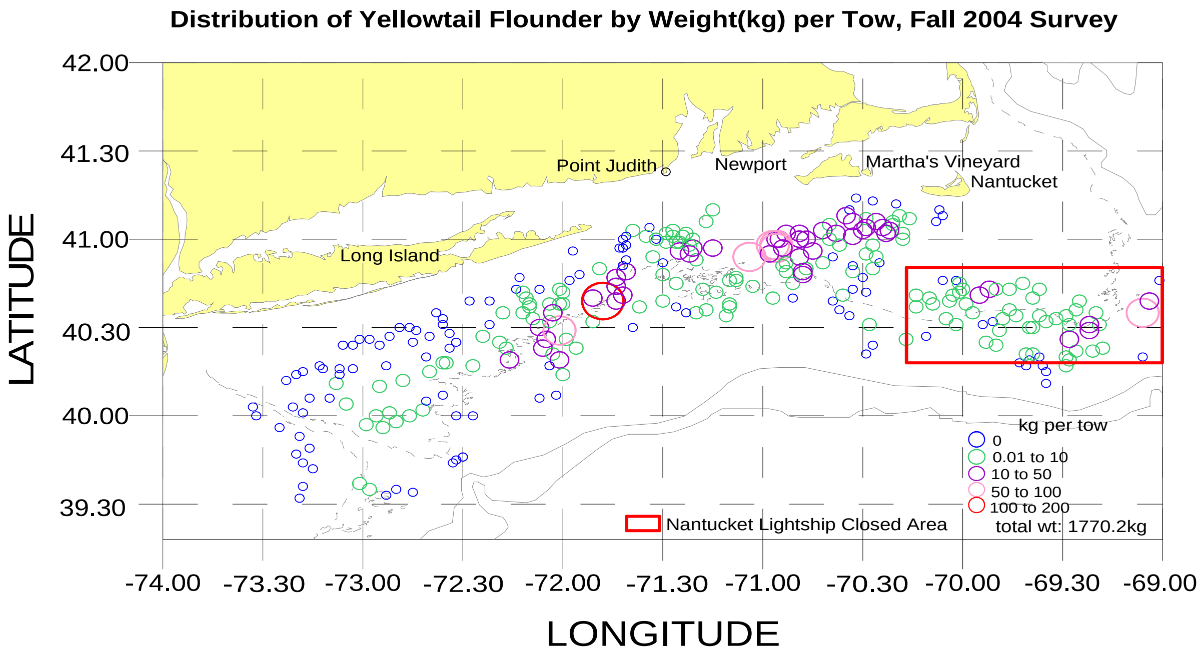


Figure 65. Map of weight per tow by station for the fall 2004 survey. Circles are proportional to the magnitude of the weight per tow.

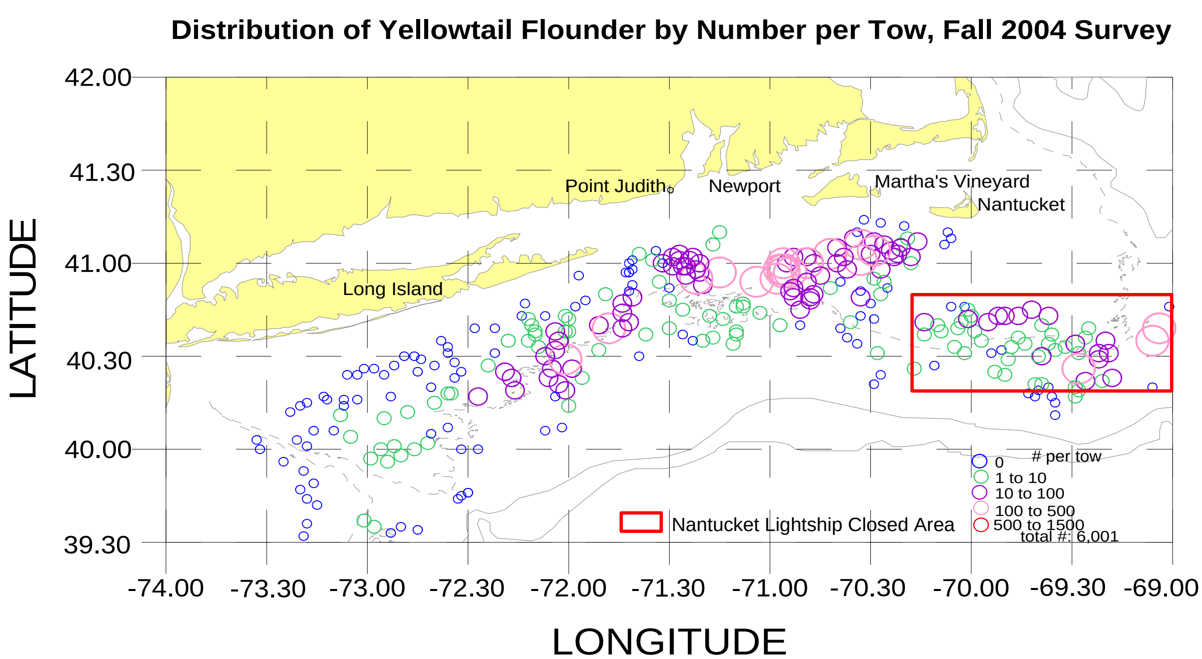


Figure 66. Map of number per tow by station for the fall 2004 survey. Circles are proportional to the magnitude of the number per tow.

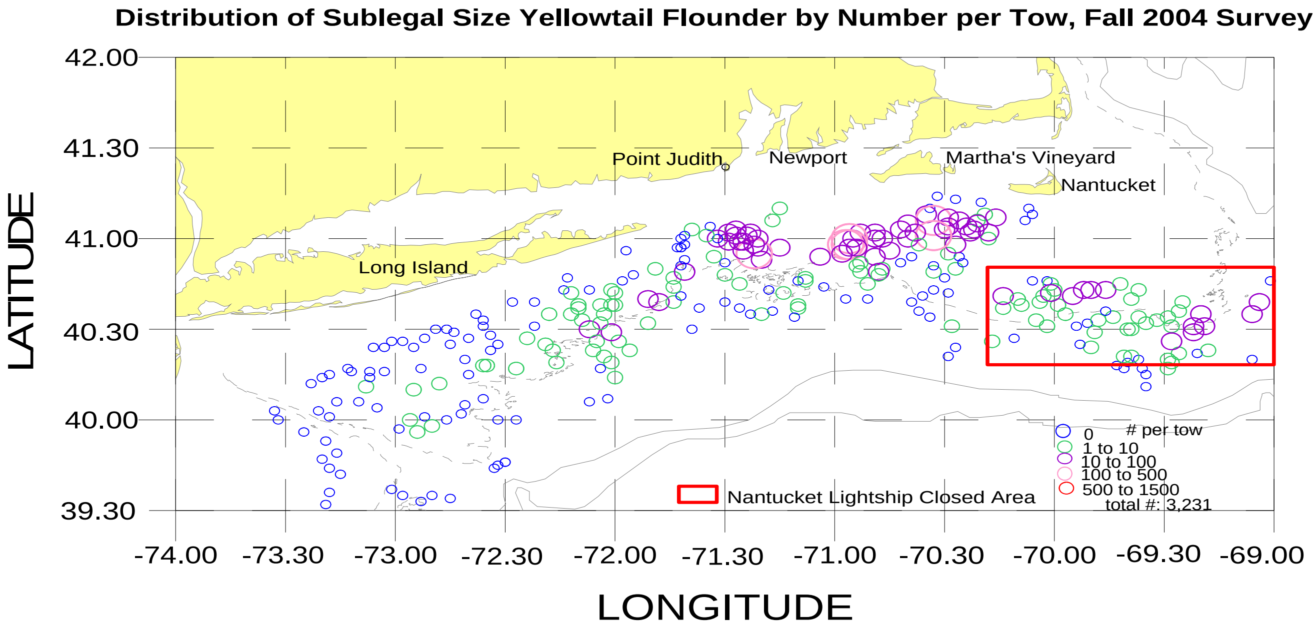


Figure 67. Map of the abundance of sublegal size yellowtail flounder caught at each station for the fall 2004 survey. Circles are proportional to the magnitude of the numbers observed.

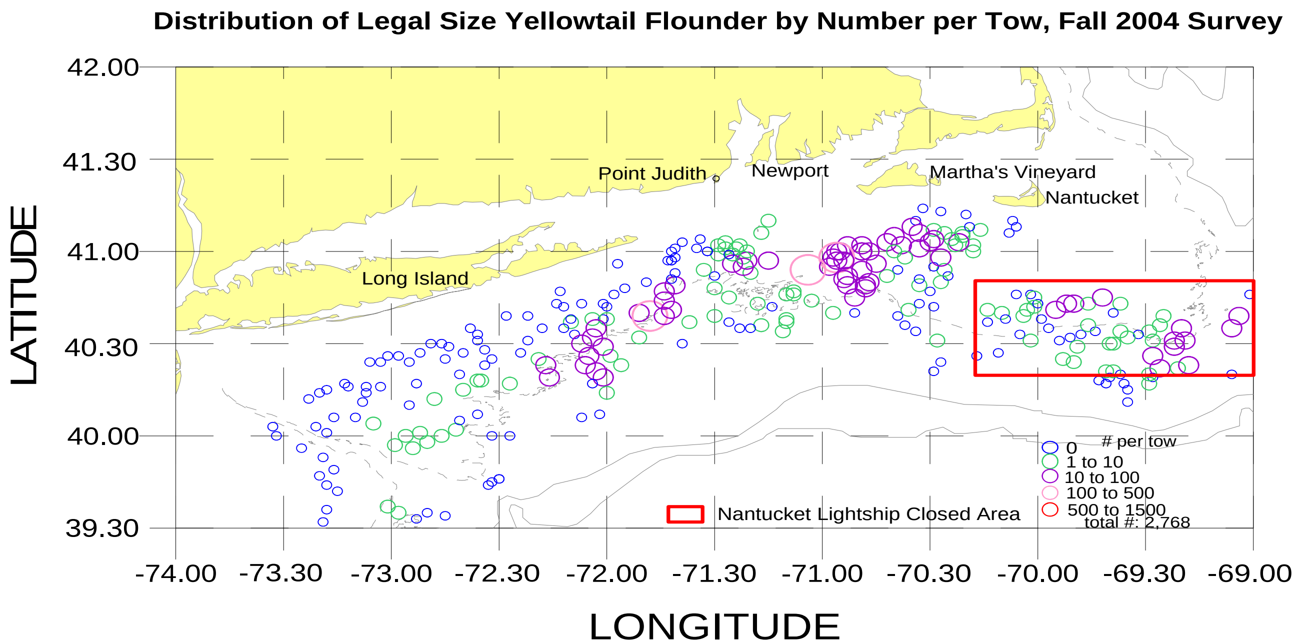


Figure 68. Map of the abundance of legal size yellowtail flounder caught at each station for the fall 2004 survey. Circles are proportional to the magnitude of the numbers observed.

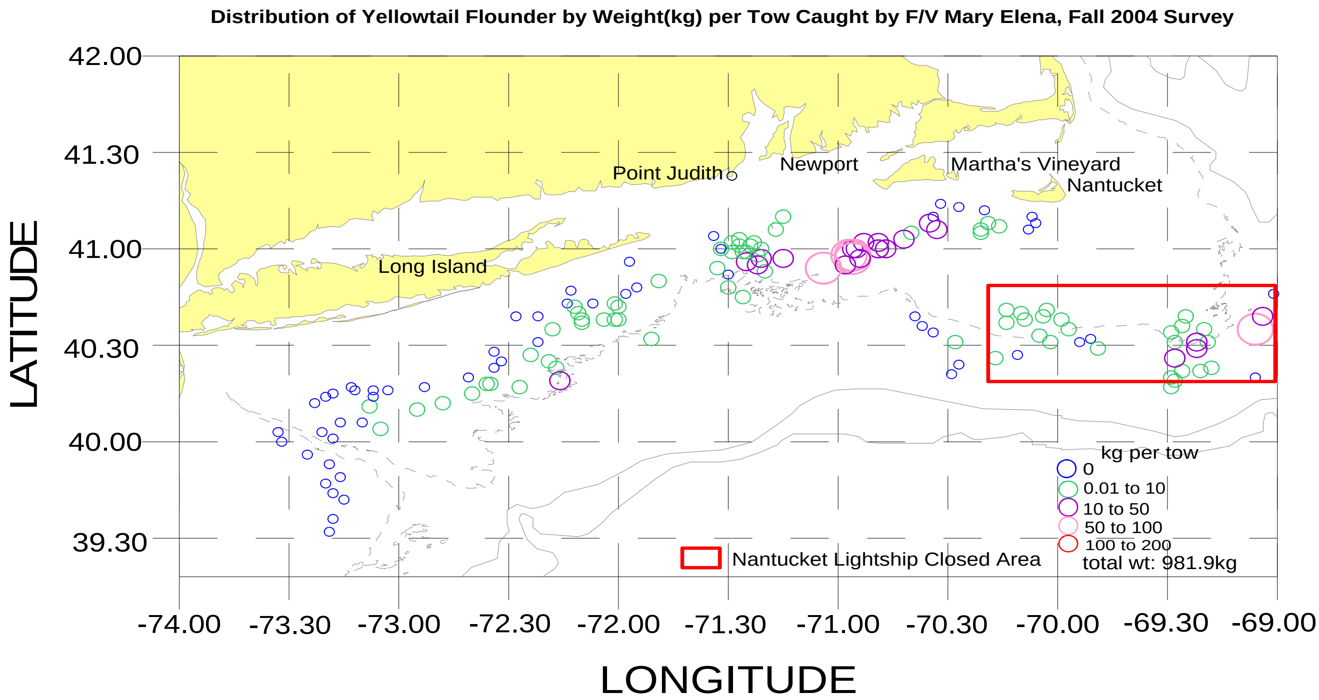


Figure 69. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the fall 2004 survey. Circles are proportional to the magnitude of the weight per tow.

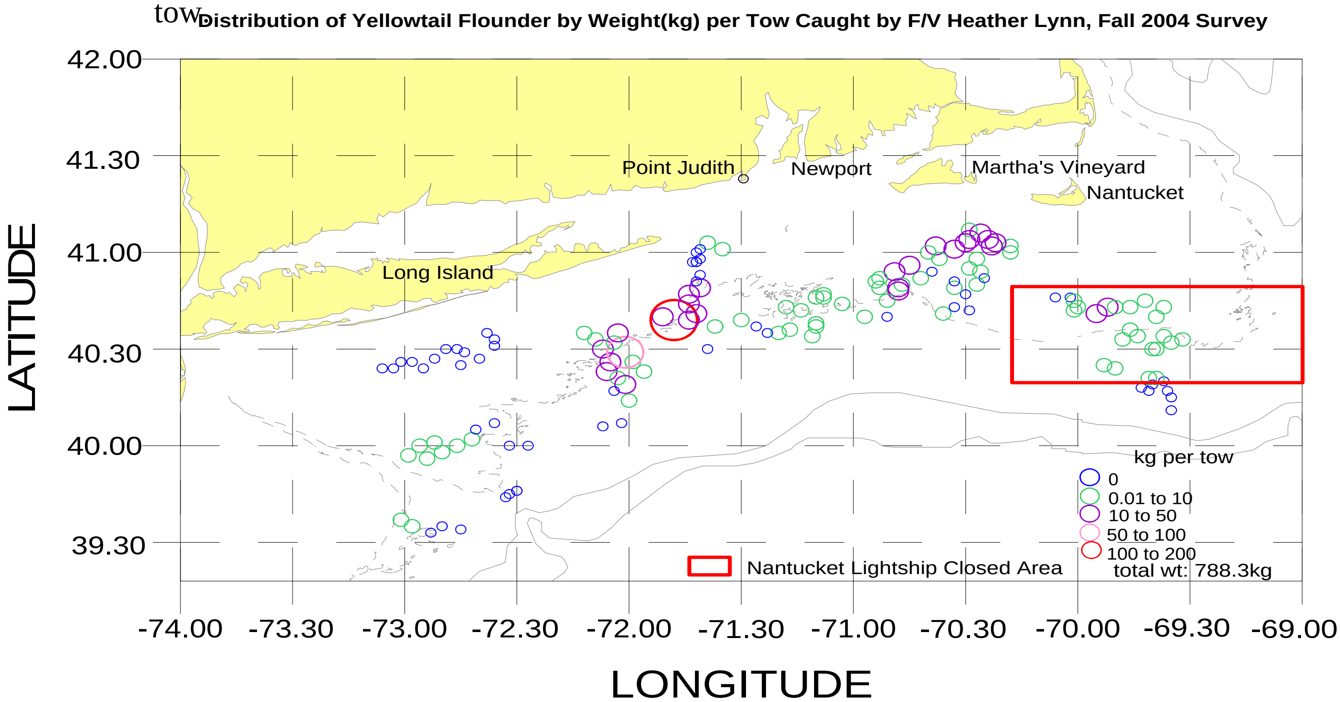


Figure 70. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the fall 2004 survey. Circles are proportional to the magnitude of the weight per tow.

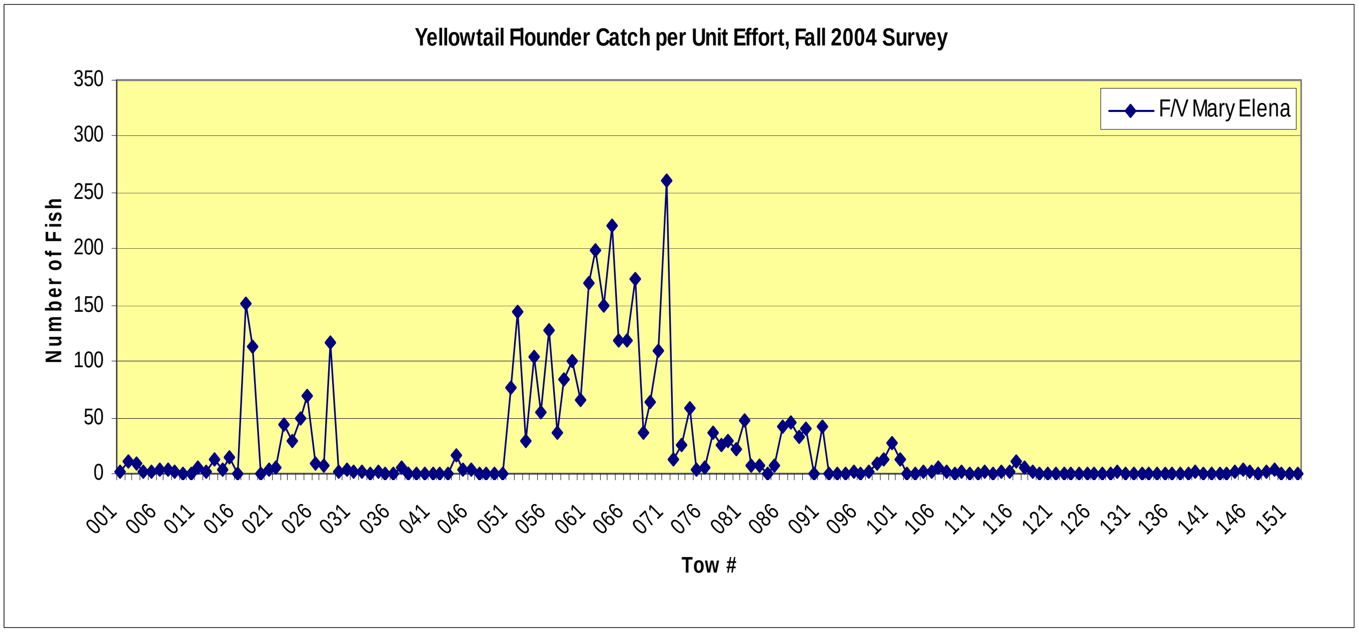


Figure 71. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the fall 2004 survey.

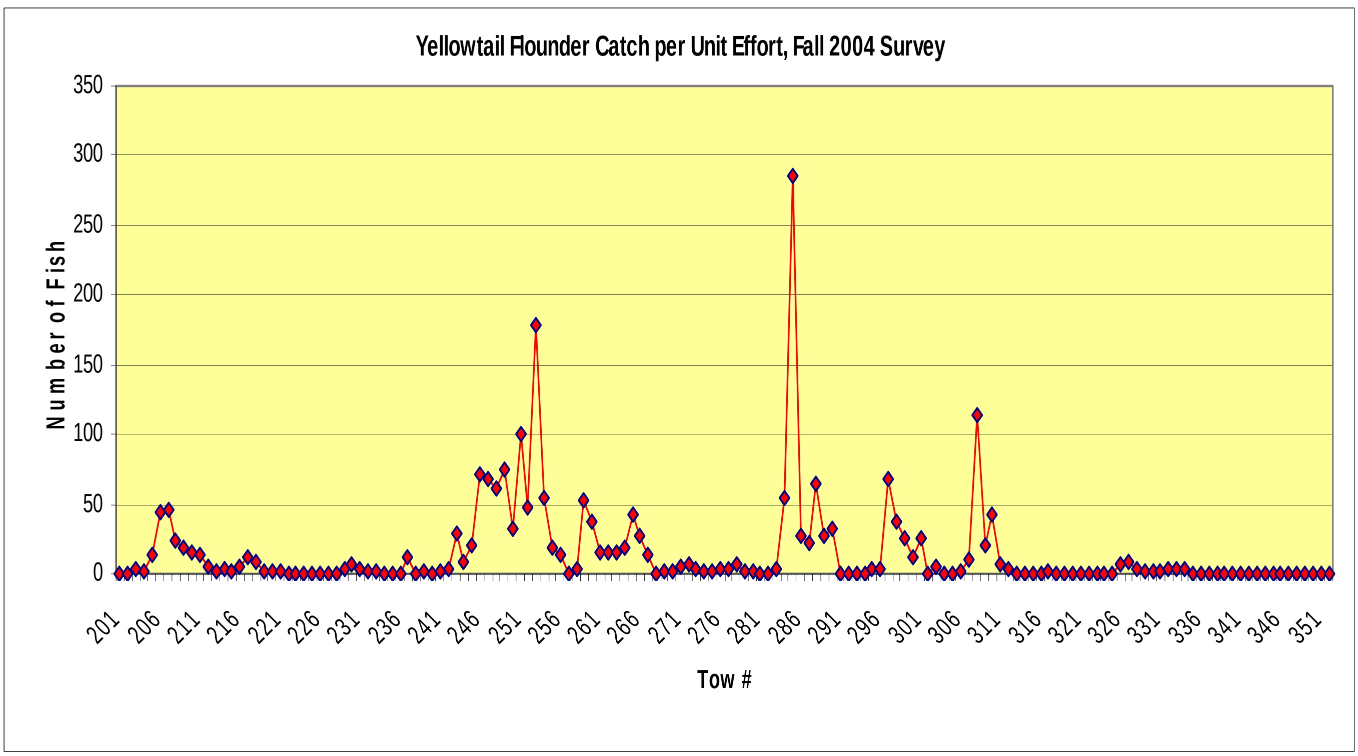


Figure 72. Number of yellowtail flounder caught by tow number based on observations from the F/V *Heather Lynn* for the fall 2004 survey.

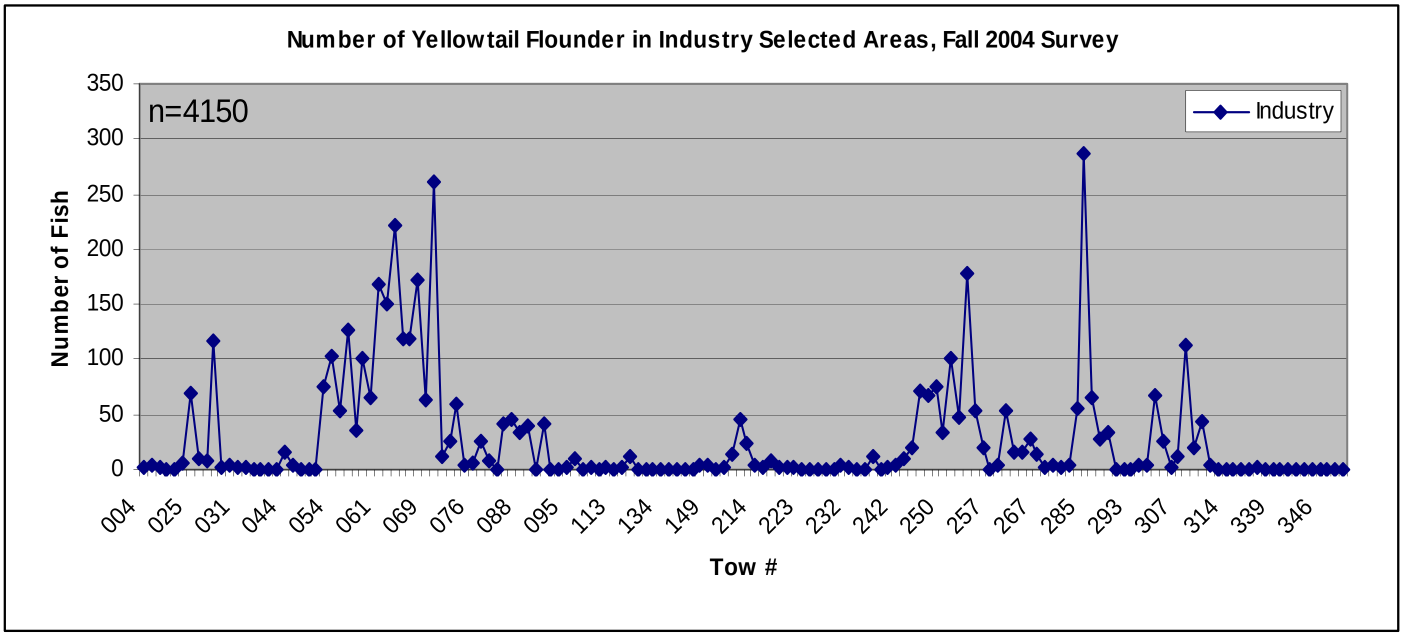


Figure 73. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the fall 2004 survey.

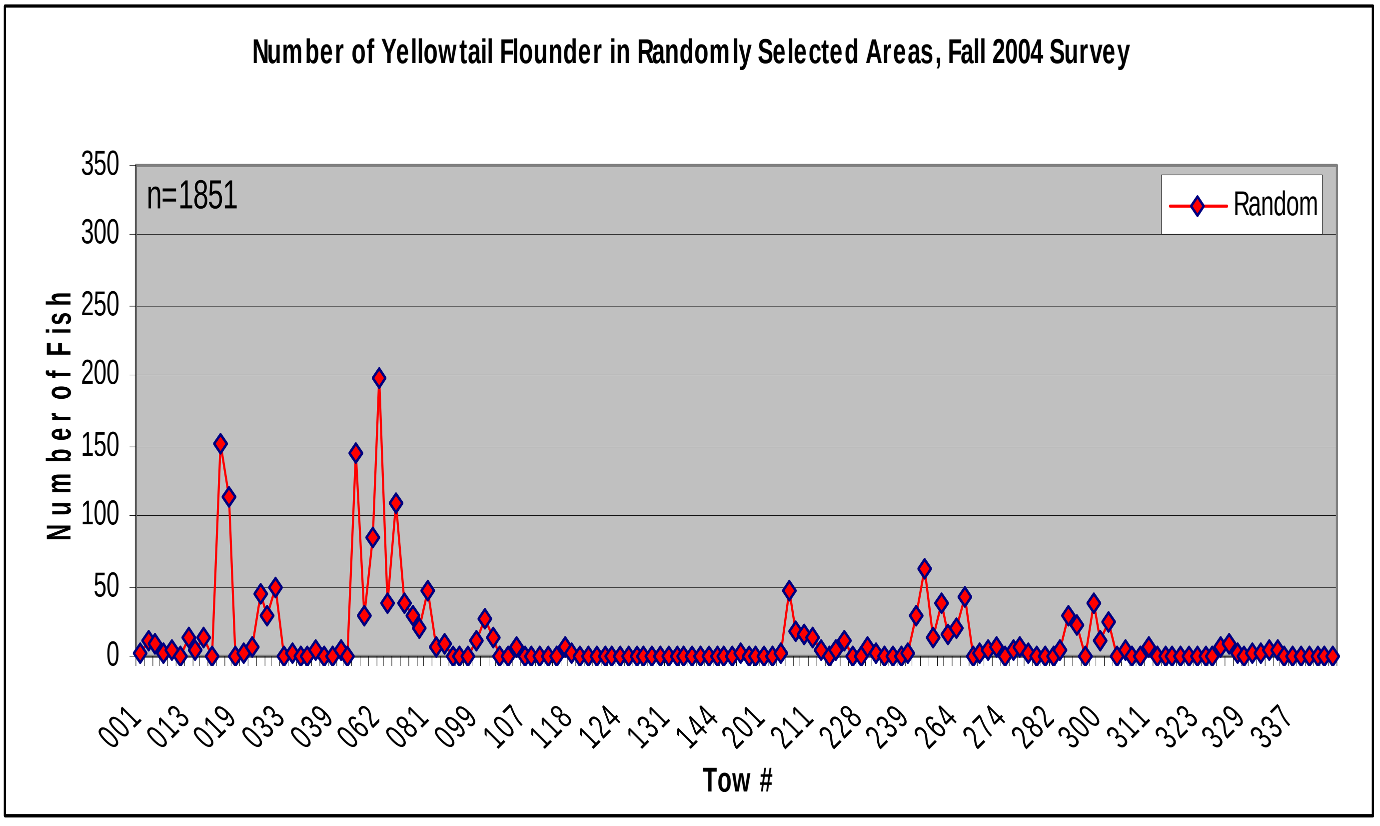


Figure 74. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the fall 2004 survey.

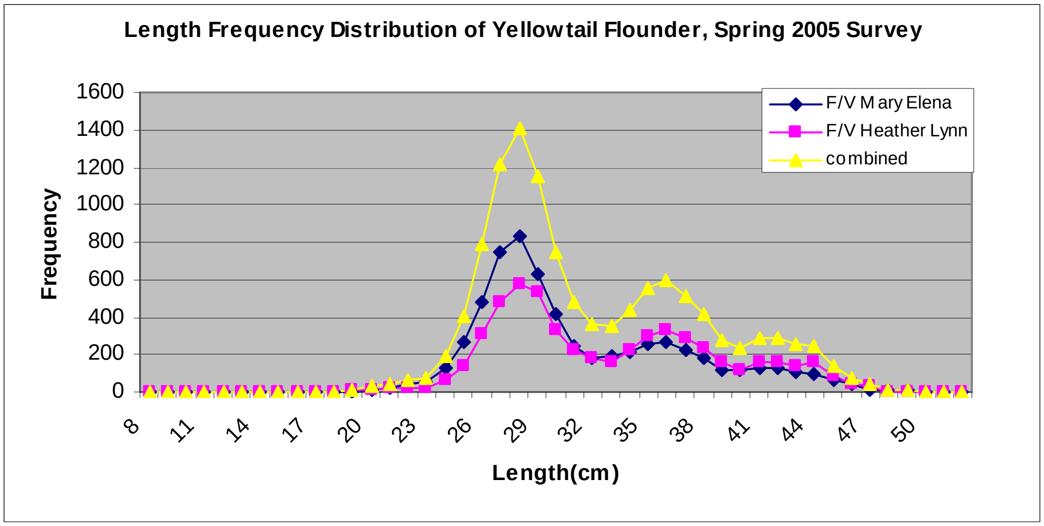


Figure 75. Length-frequency distributions of yellowtail flounder by vessel and combined for the spring 2005 survey.

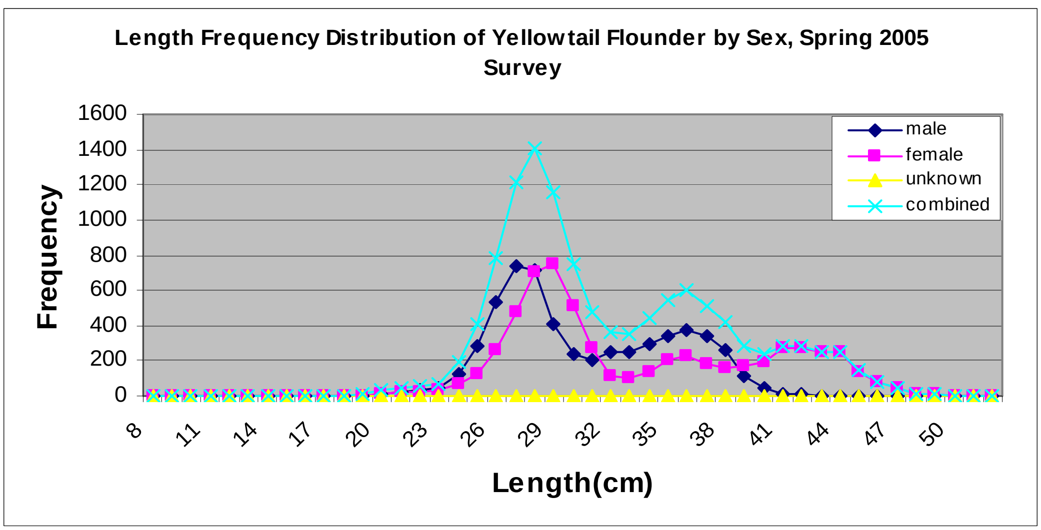


Figure 76. Length-frequency distributions of yellowtail flounder by sex for the spring 2005 survey

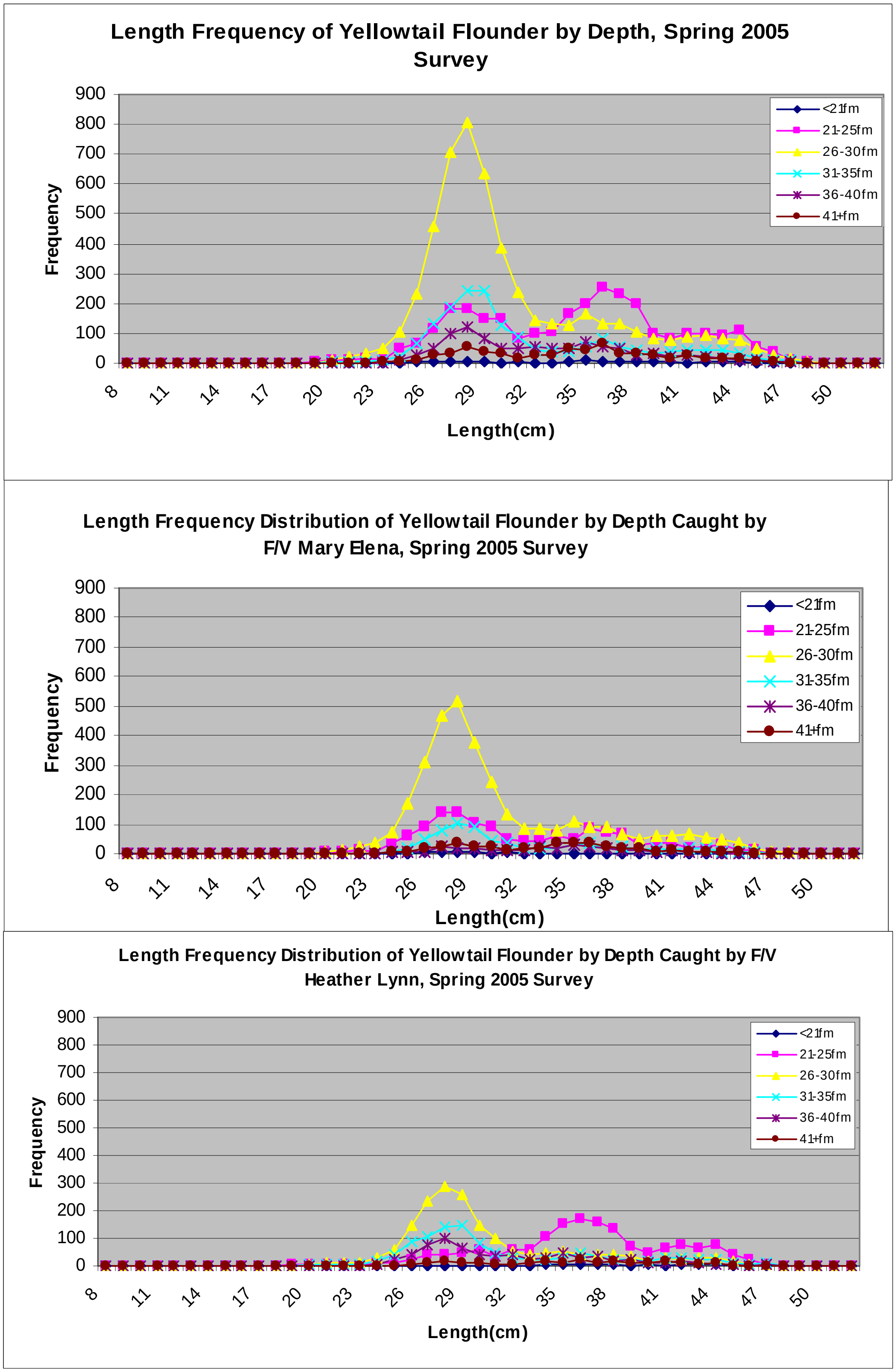
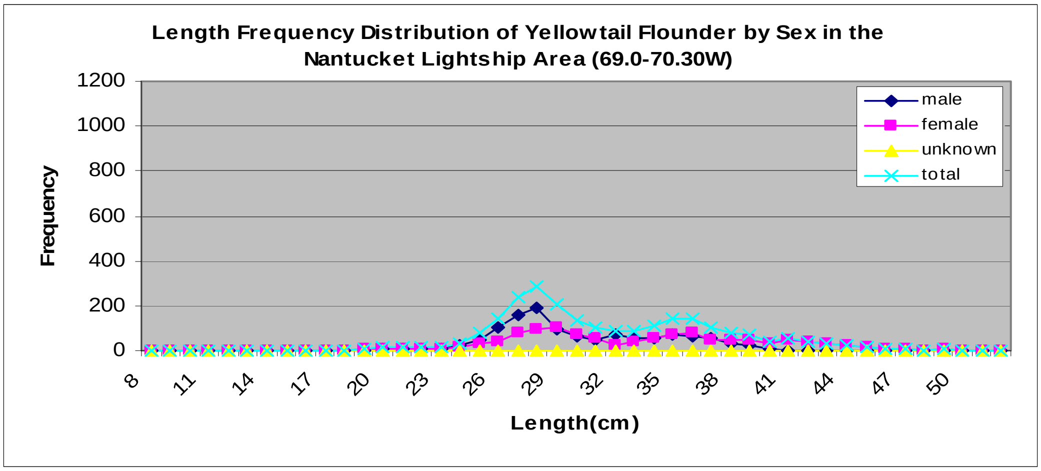
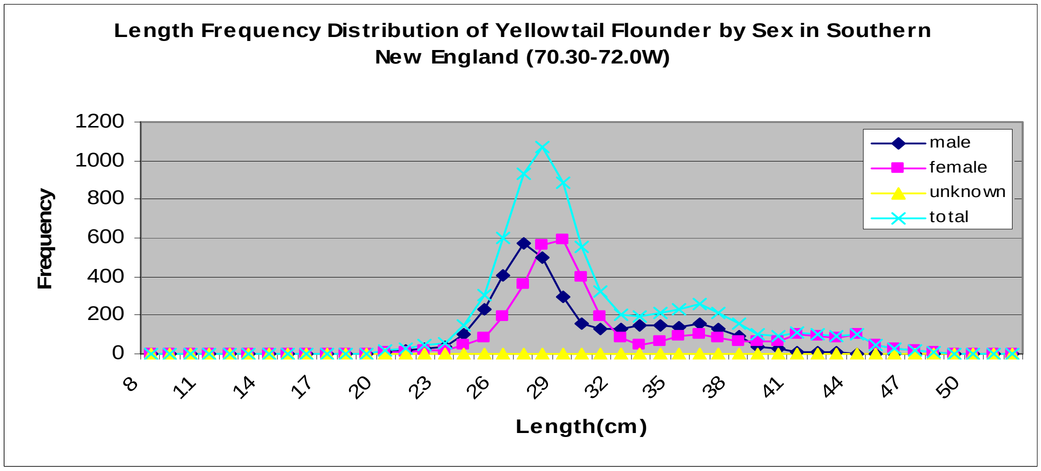


Figure 77. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the spring 2005 survey.





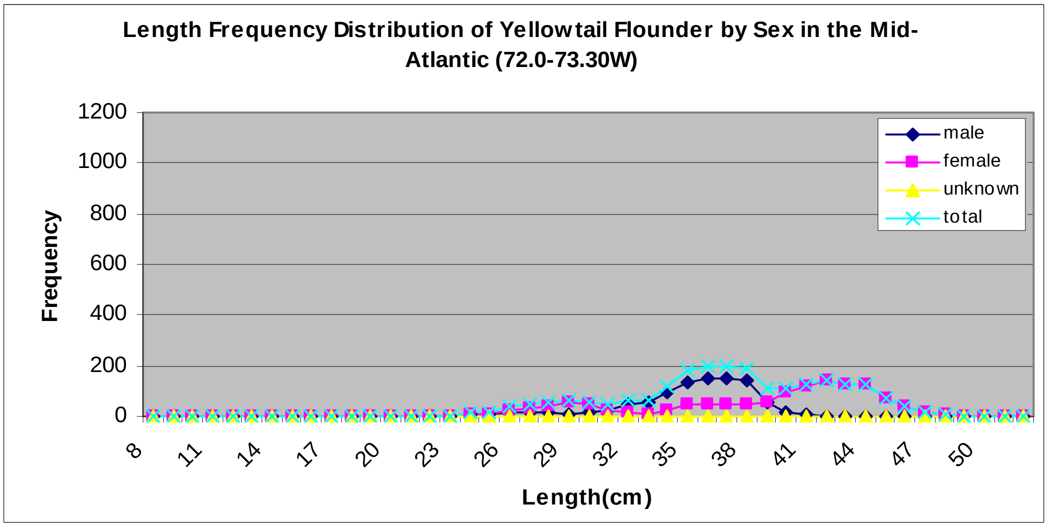


Figure 78. Length-frequency distributions of yellowtail flounder by sex for the Nantucket Lightship, Southern New England, and Mid-Atlantic sub-areas within the SNE range for the spring 2005 survey.

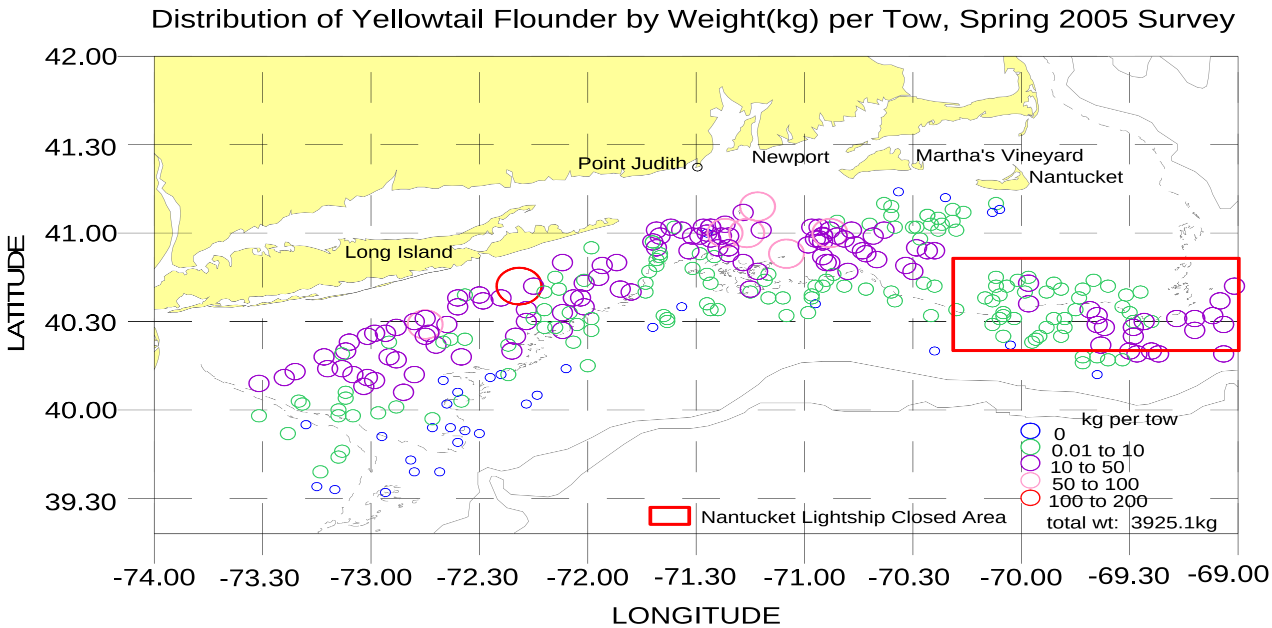


Figure 79. Map of weight per tow by station for the spring 2005 survey. Circles are proportional to the magnitude of the weight per tow.

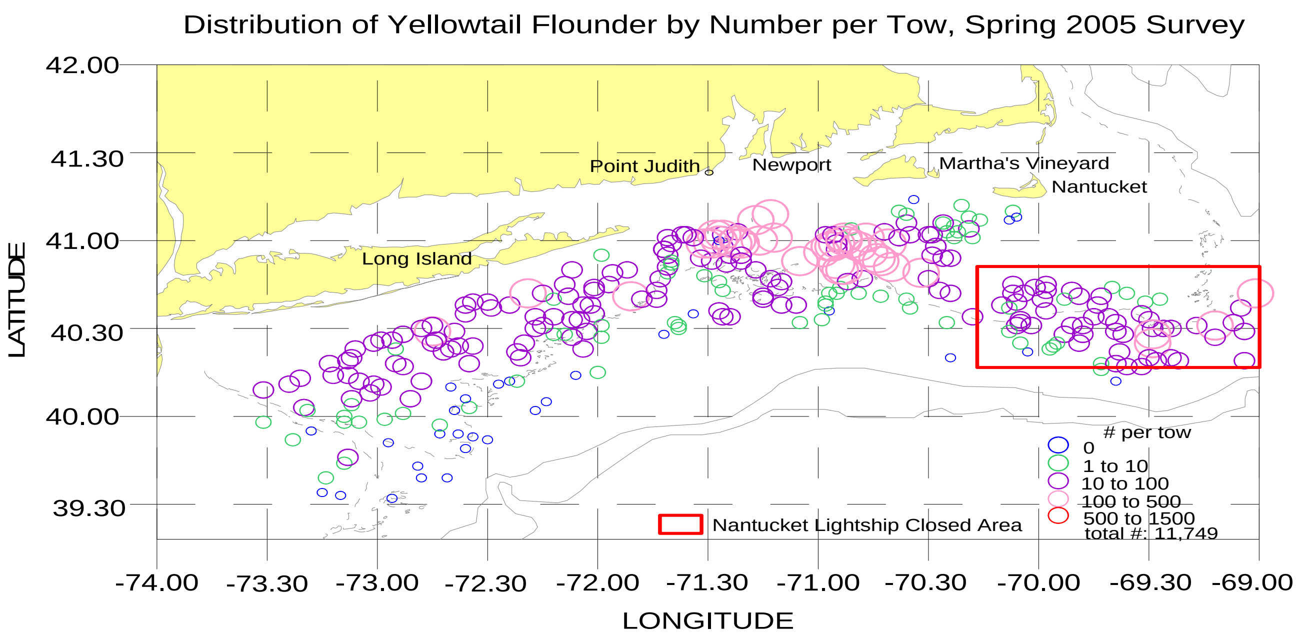


Figure 80. Map of number per tow by station for the spring 2005 survey. Circles are proportional to the magnitude of the number per tow.

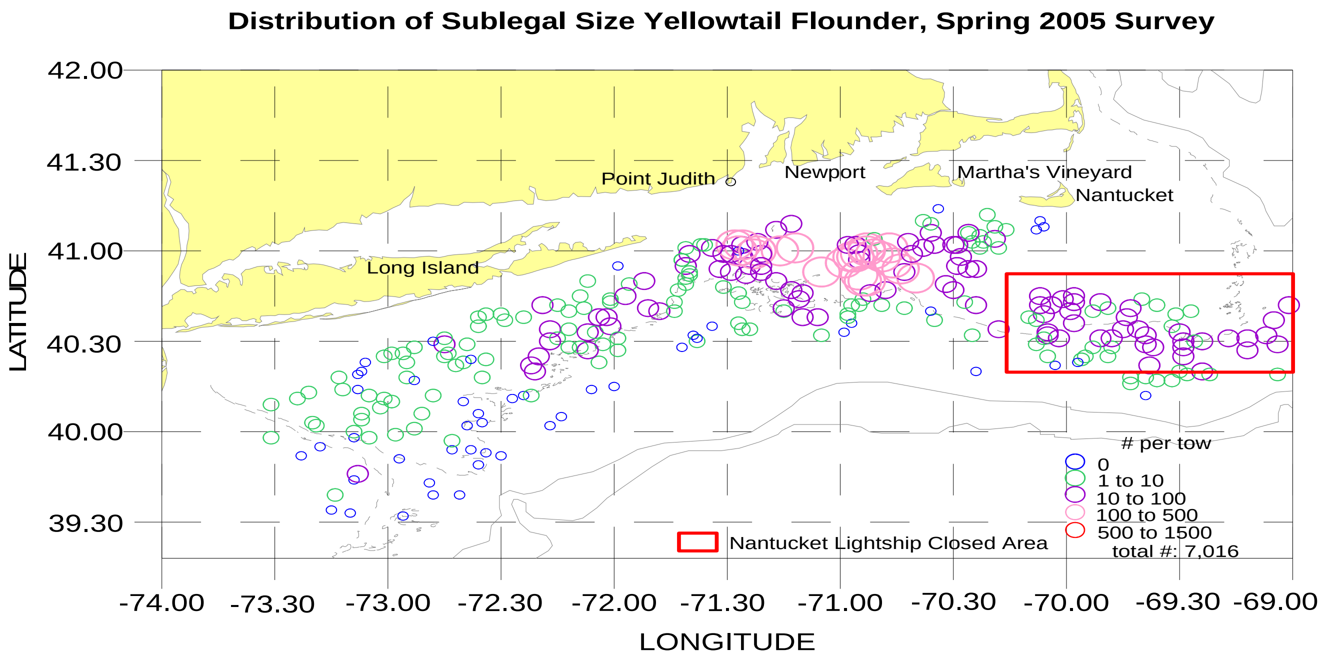


Figure 81. Map of the abundance of sublegal size yellowtail flounder caught at each station for the spring 2005 survey. Circles are proportional to the magnitude of the numbers observed.

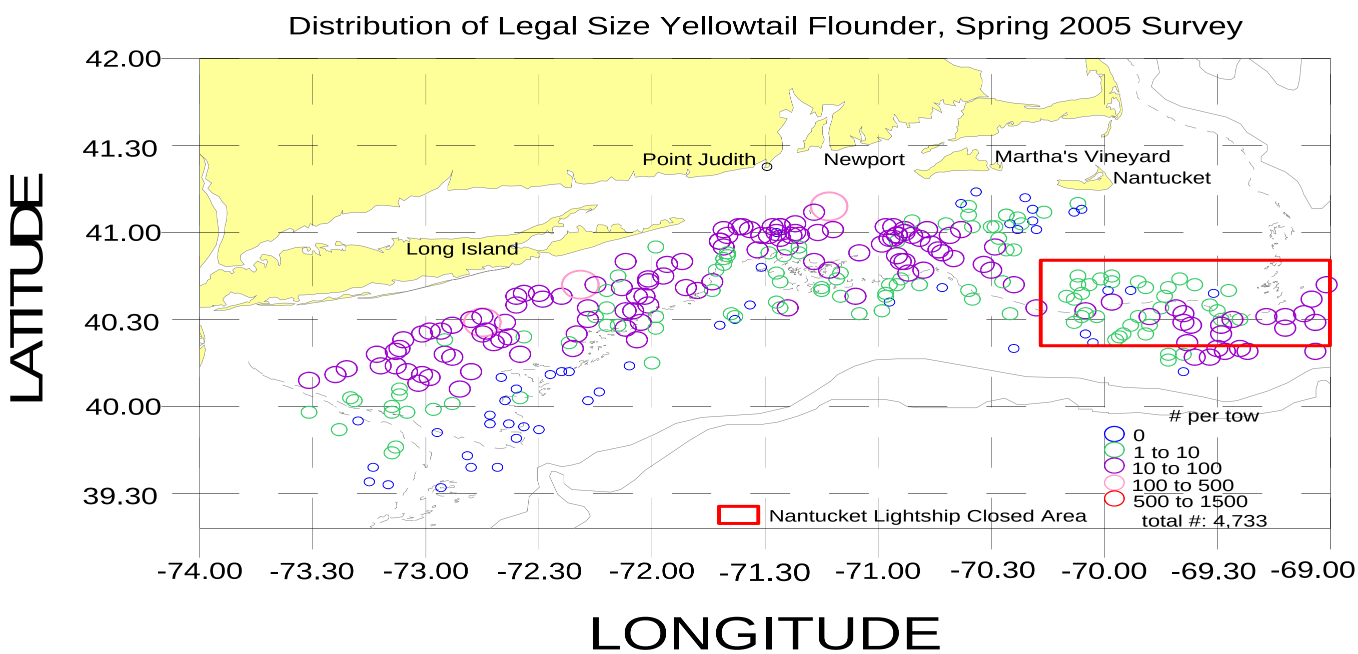


Figure 82. Map of the abundance of legal size yellowtail flounder caught at each station for the spring 2005 survey. Circles are proportional to the magnitude of the numbers observed.

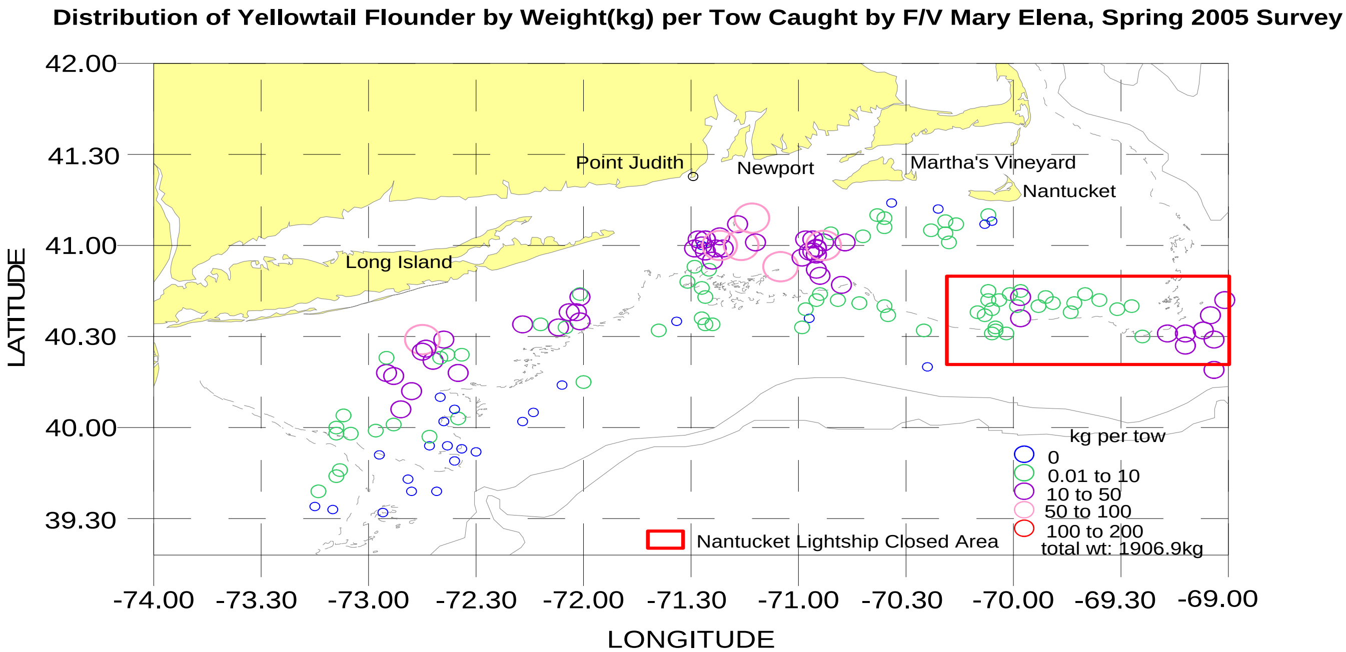


Figure 83. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the spring 2005 survey. Circles are proportional to the magnitude of the weight per tow.

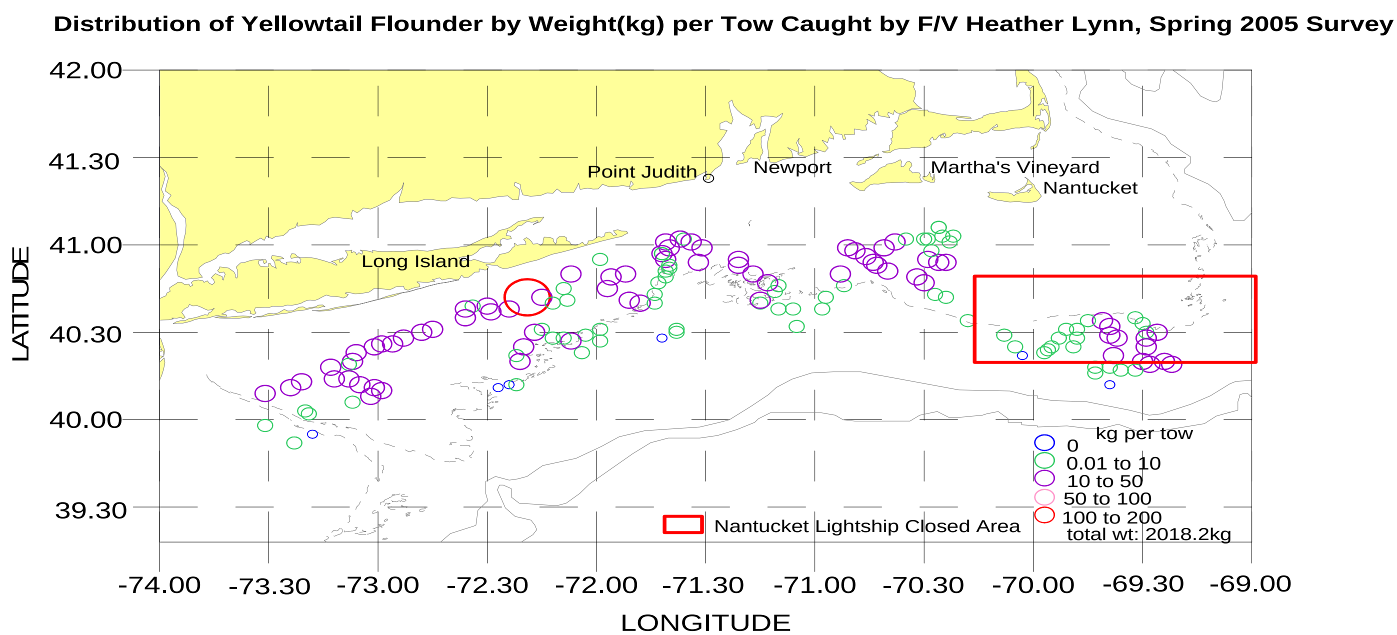


Figure 84. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the spring 2005 survey. Circles are proportional to the magnitude of the weight per tow.

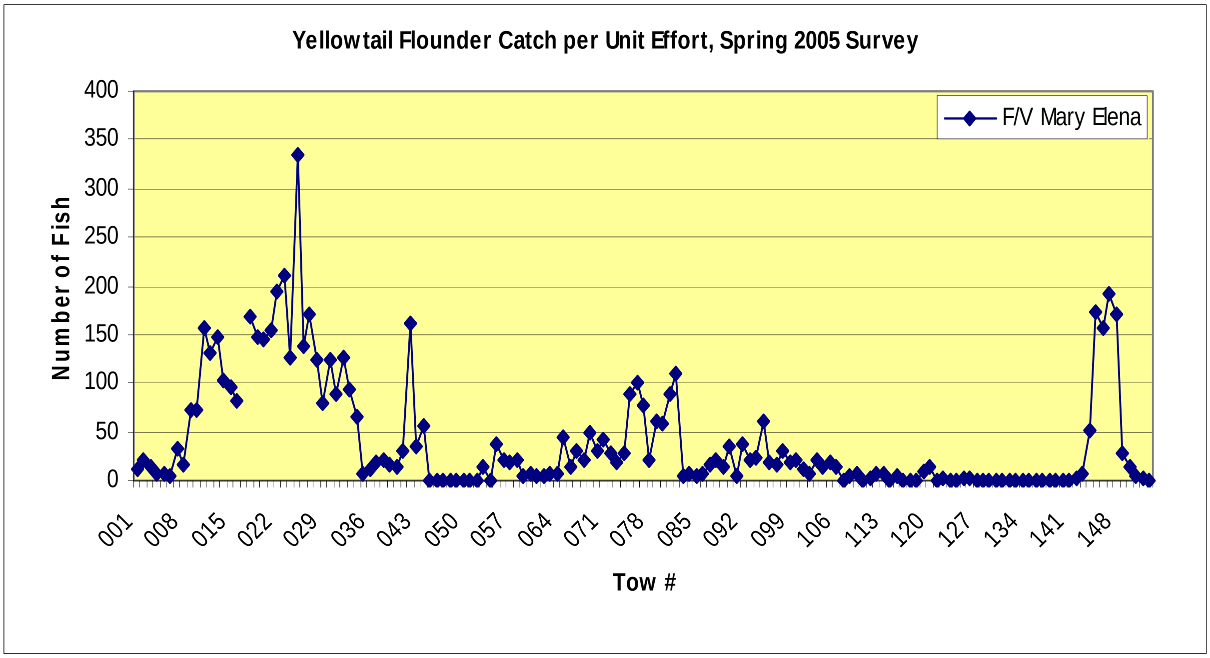


Figure 85. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the spring 2005 survey.

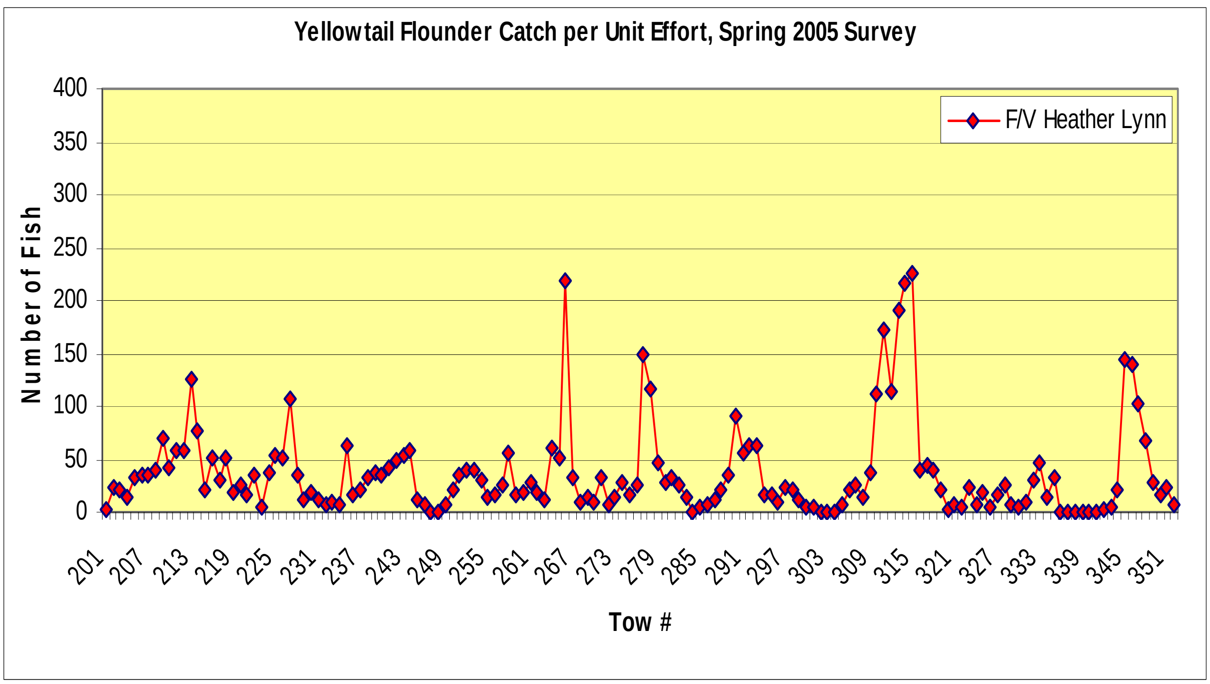


Figure 86. Number of yellowtail flounder caught by tow number based on observations from the F/V *Heather Lynn* for the spring 2005 survey.

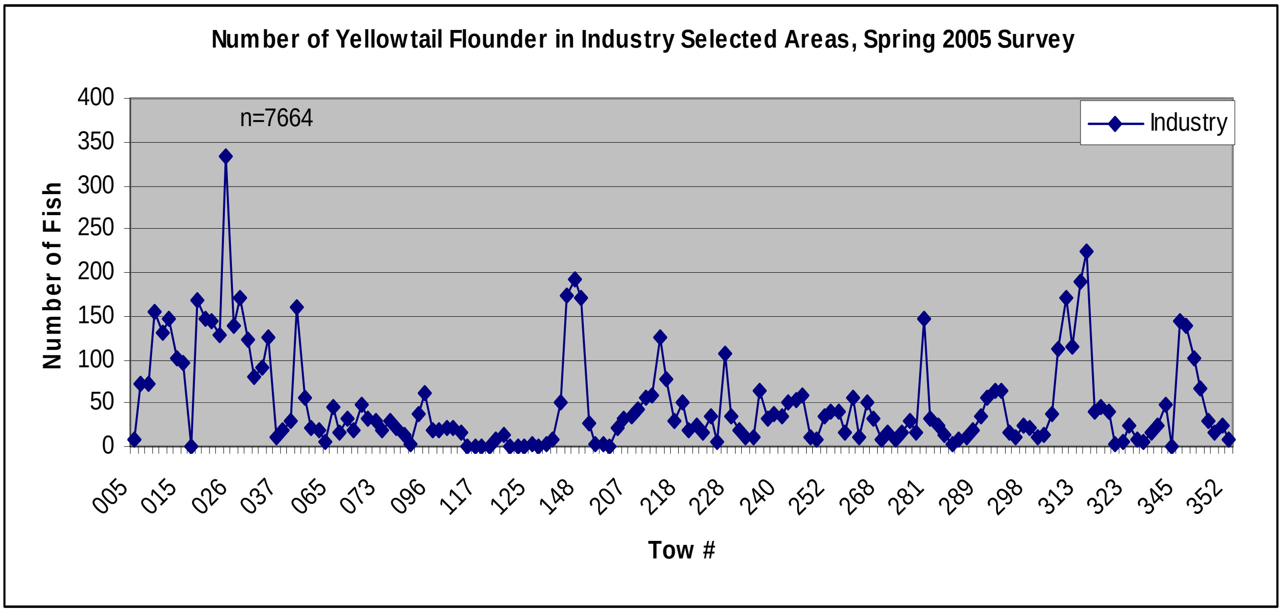


Figure 87. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the spring 2005 survey.

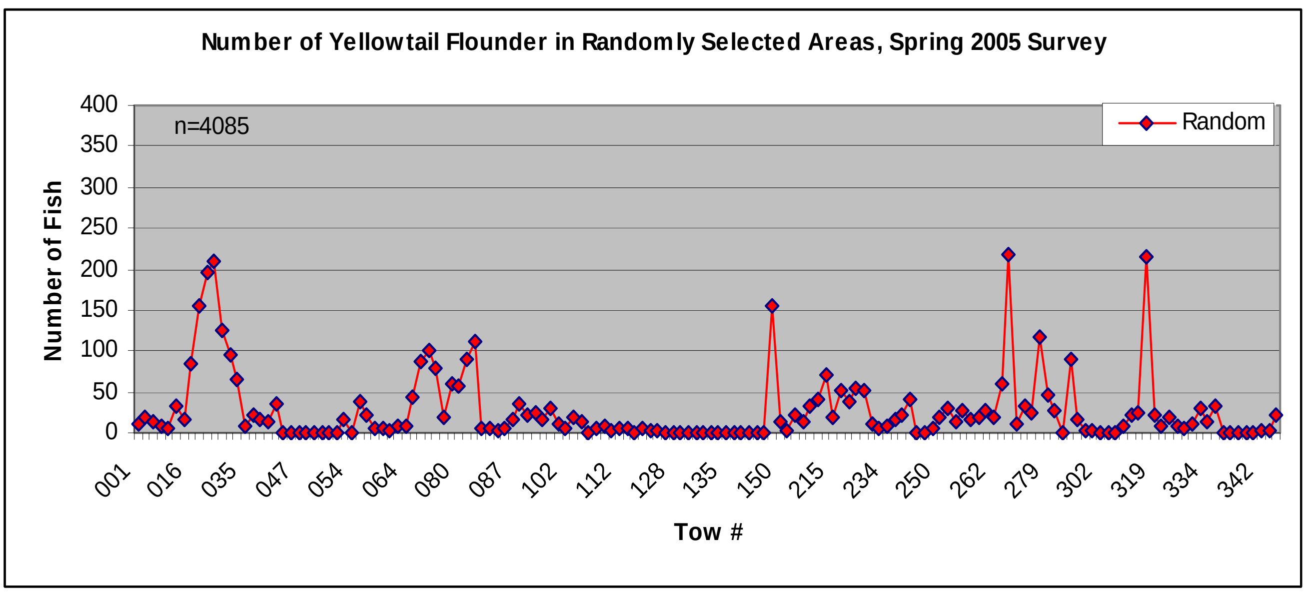


Figure 88. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the spring 2005 survey.

YELLOWTAIL FLOUNDER SUMMARY DATA, FALL 2005

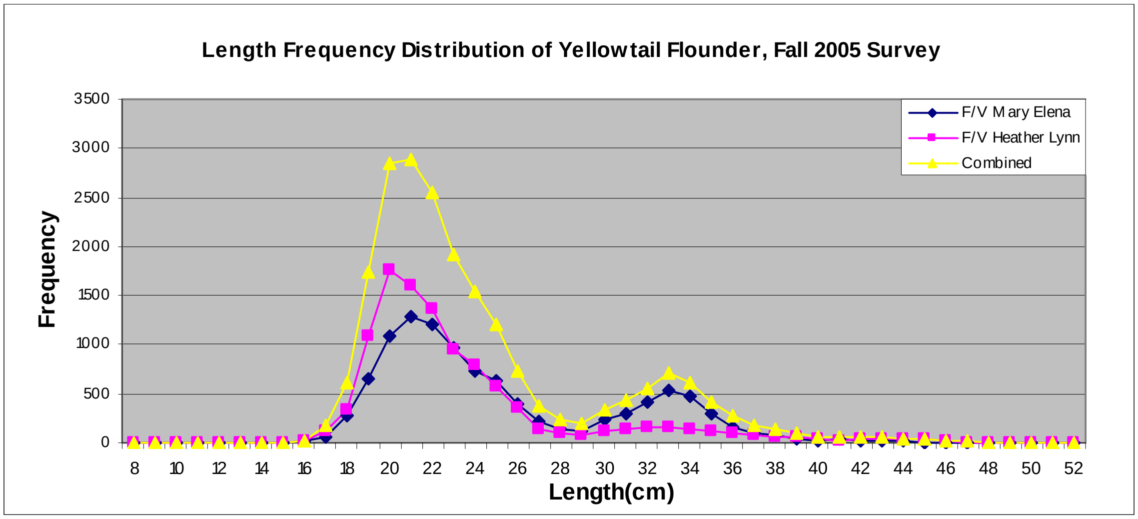


Figure 89. Length-frequency distributions of yellowtail flounder by vessel and combined for the fall 2005 survey.

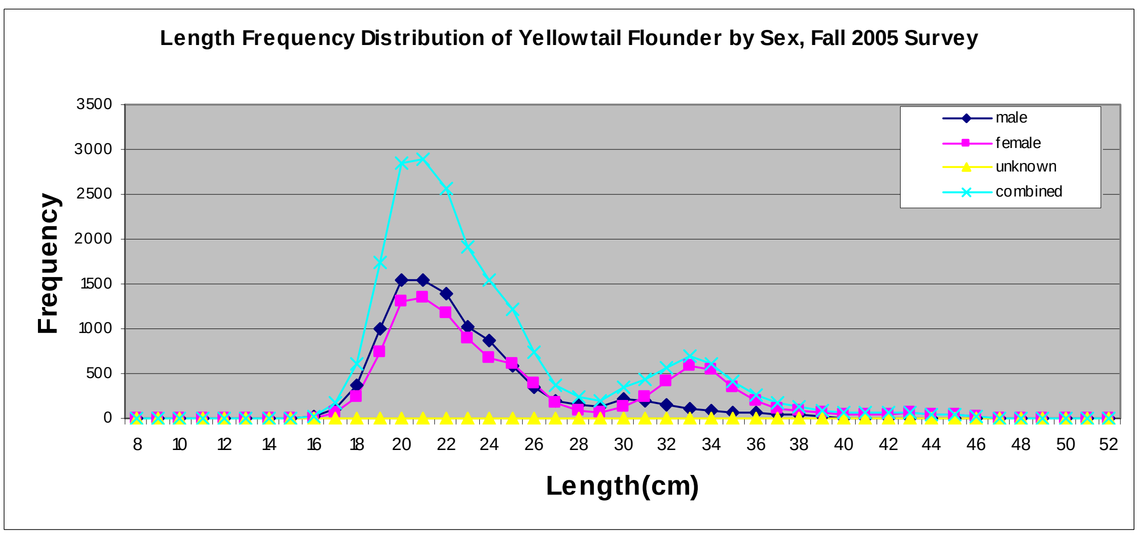
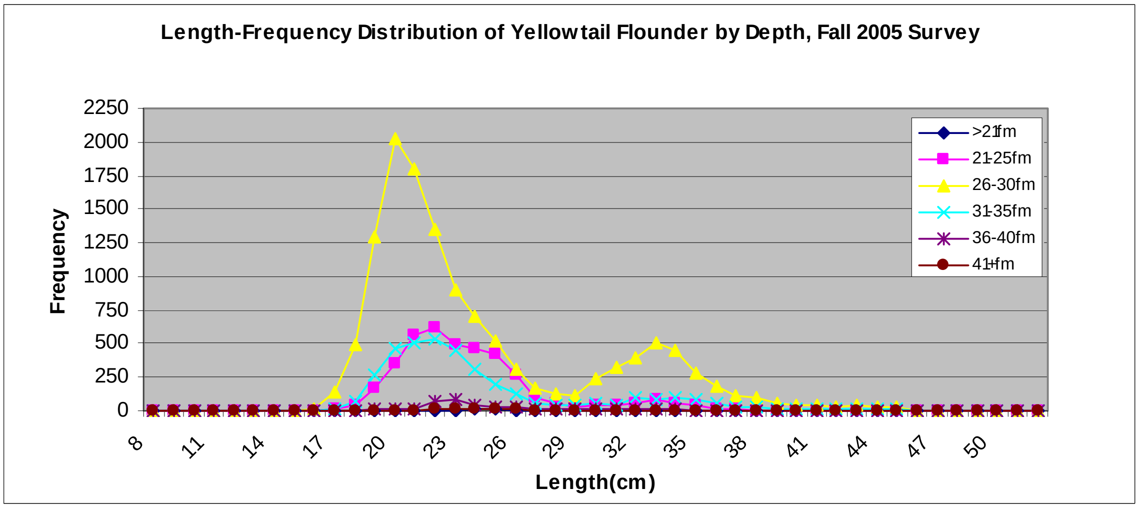
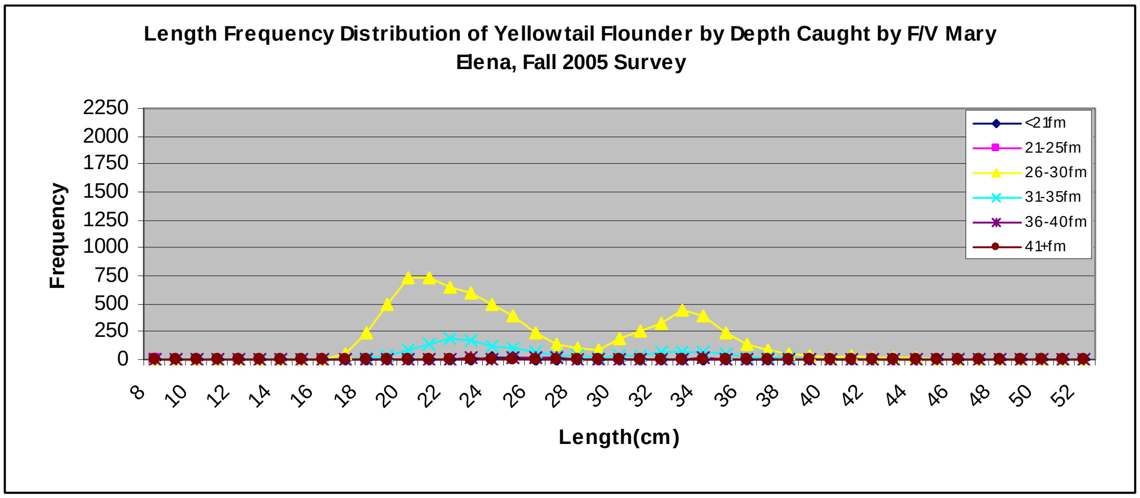


Figure 90. Length-frequency distributions of yellowtail flounder by sex for the fall 2005 survey.





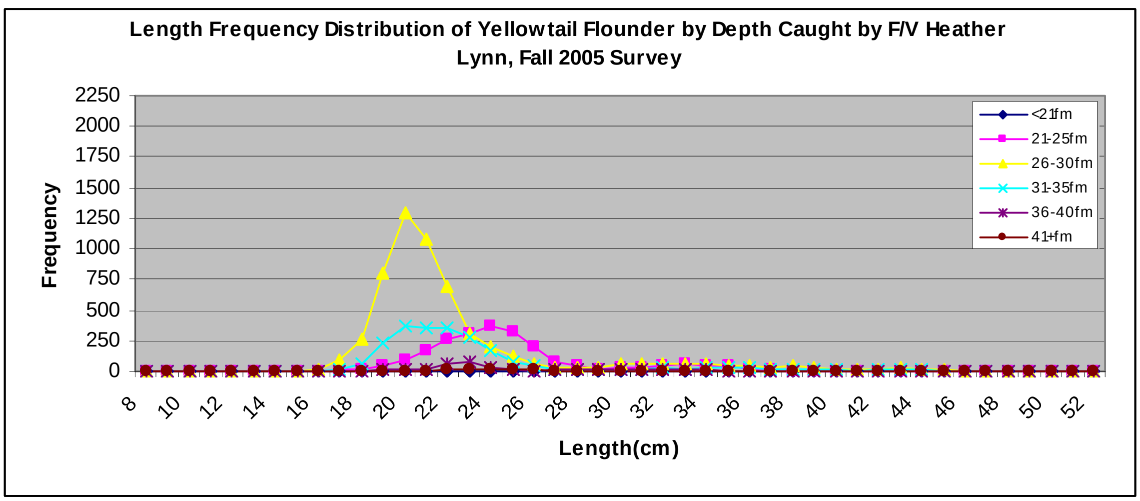


Figure 91. Length-frequency distributions of yellowtail flounder by depth and by depth and vessel for the fall 2005 survey.

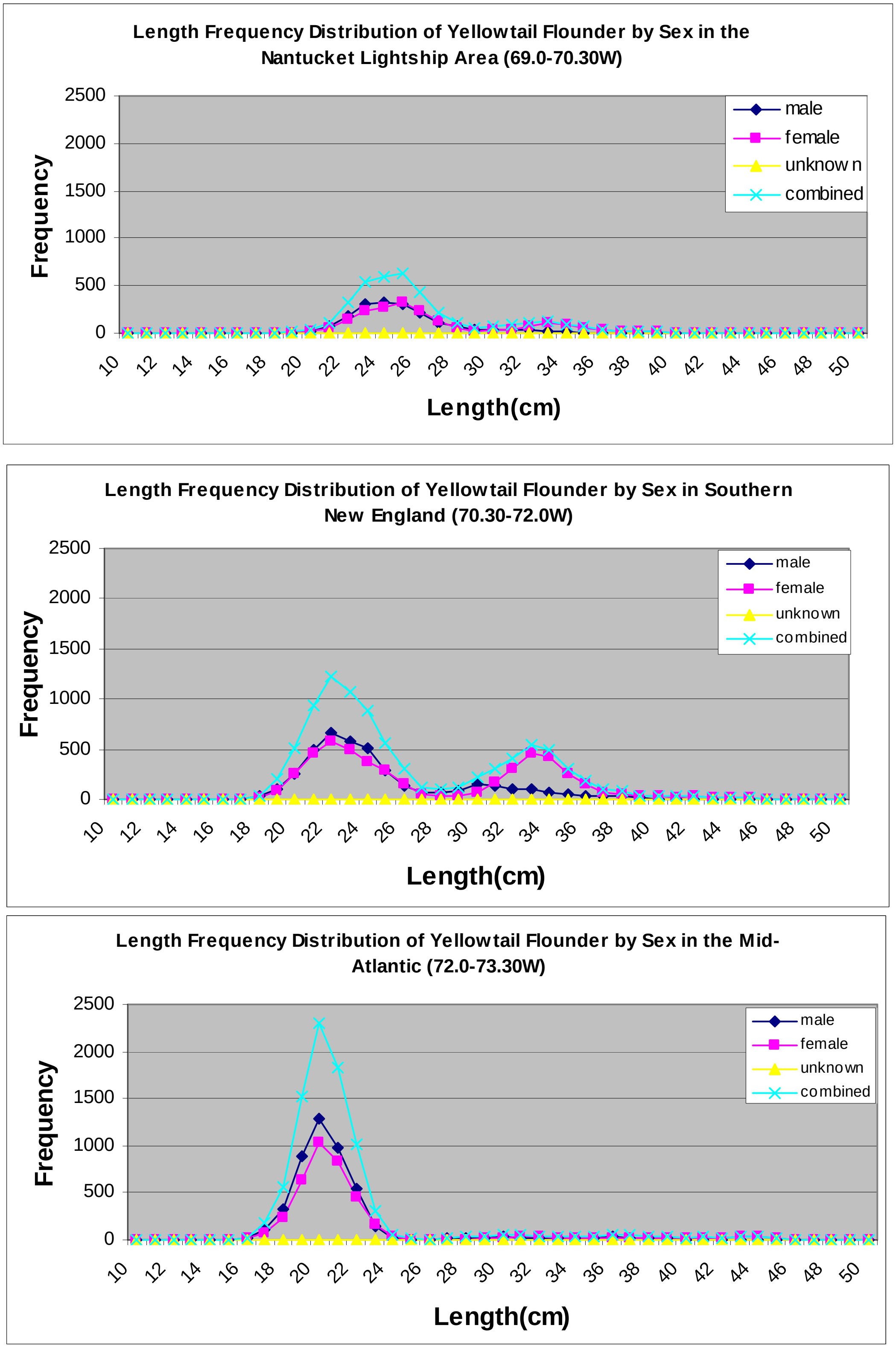


Figure 92. Length-frequency distributions of yellowtail flounder by sex for the Nantucket Lightship, Southern New England, and Mid-Atlantic sub-areas within the SNE range for the for the fall 2005 survey.

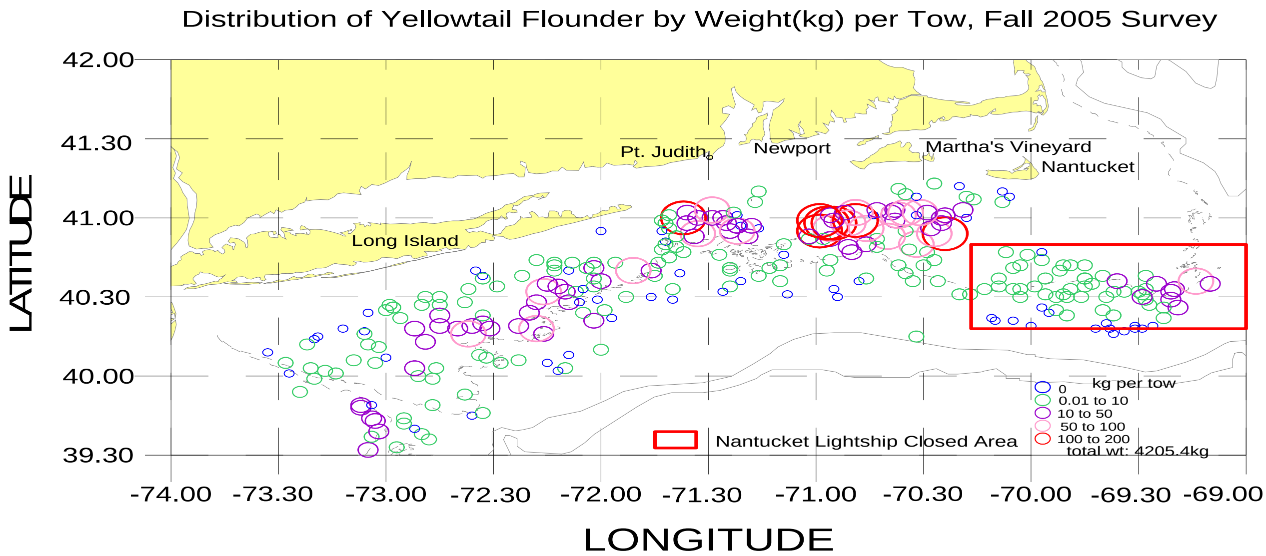


Figure 93. Map of weight per tow by station for the fall 2005 survey. Circles are proportional to the magnitude of the weight per tow.

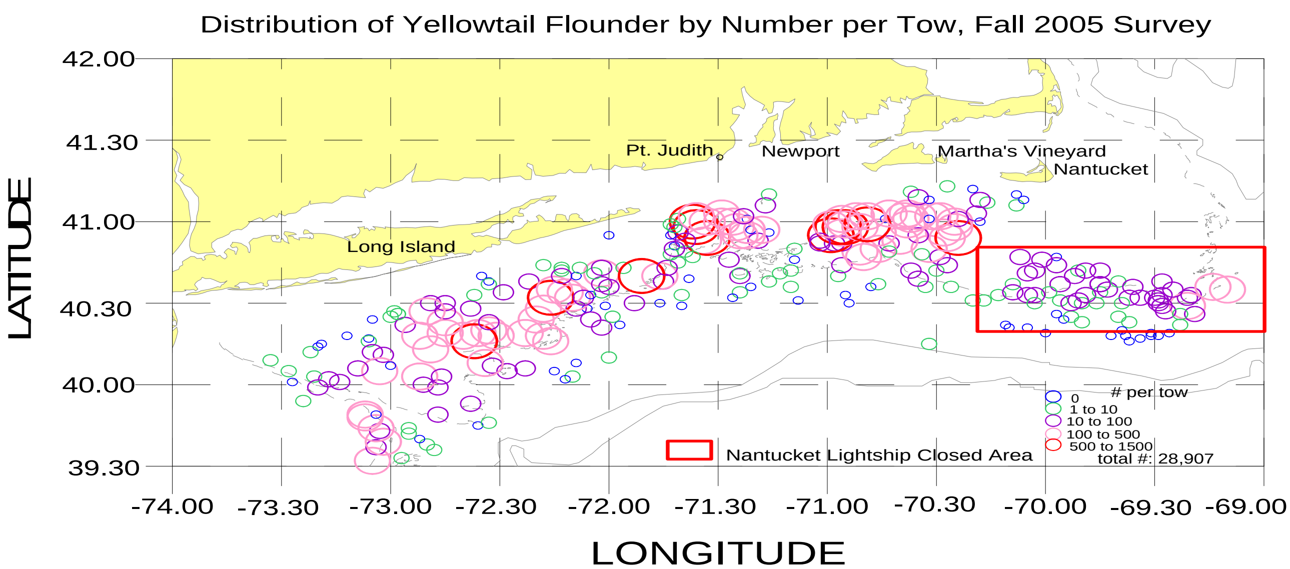


Figure 94. Map of number per tow by station for the fall 2005 survey. Circles are proportional to the magnitude of the number per tow.

Distribution of Sublegal Size Yellowtail Flounder by Number per Tow, Fall 2005 Survey

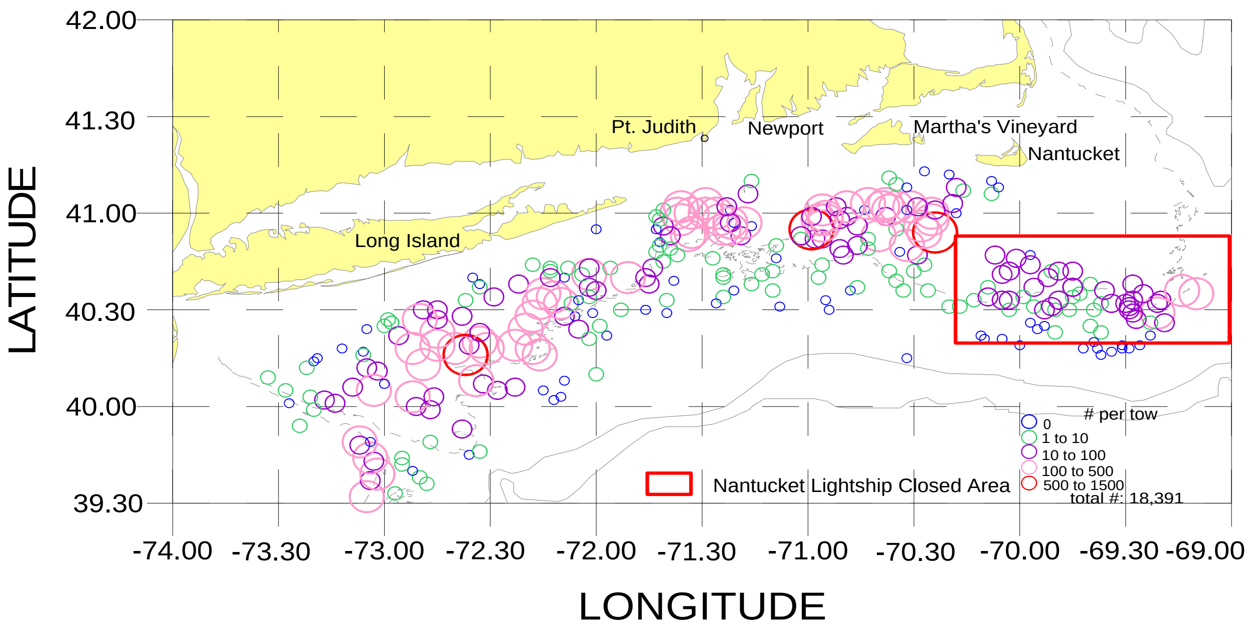


Figure 95. Map of the abundance of sublegal size yellowtail flounder caught at each station for the fall 2005 survey. Circles are proportional to the magnitude of the numbers observed.

Distribution of Legal Size Yellowtail Flounder by Number per Tow, Fall 2005 Survey

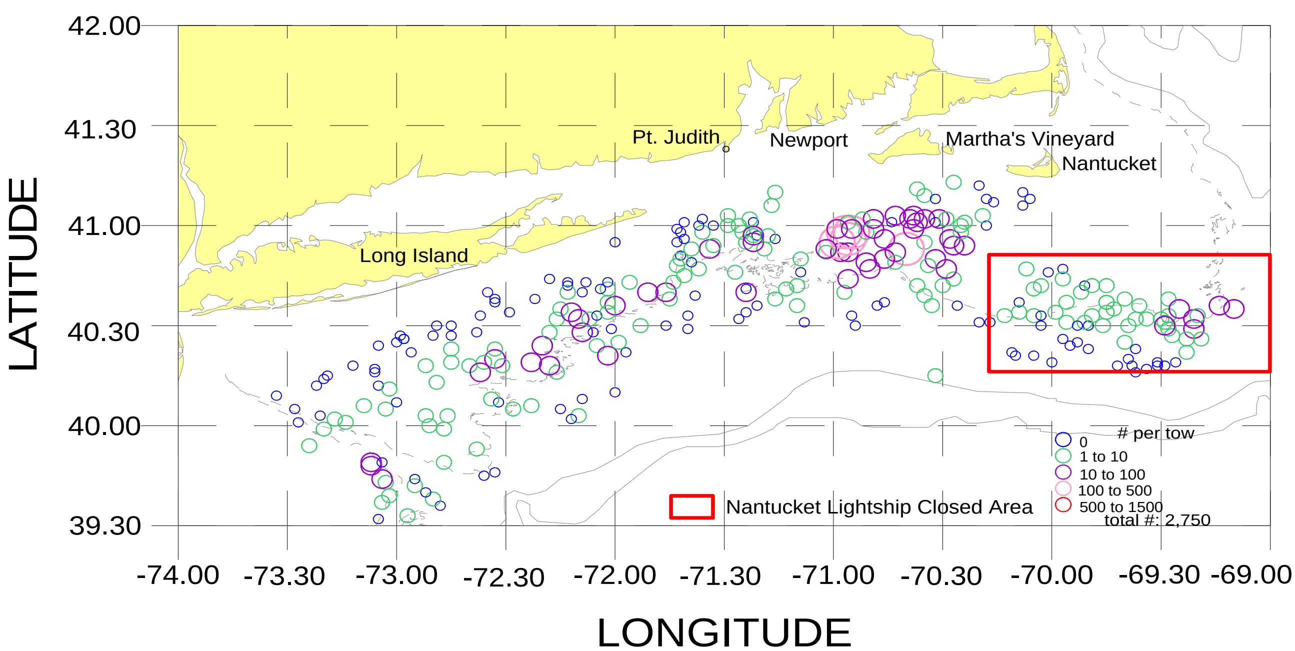


Figure 96. Map of the abundance of legal size yellowtail flounder caught at each station for the fall 2005 survey. Circles are proportional to the magnitude of the numbers observed.

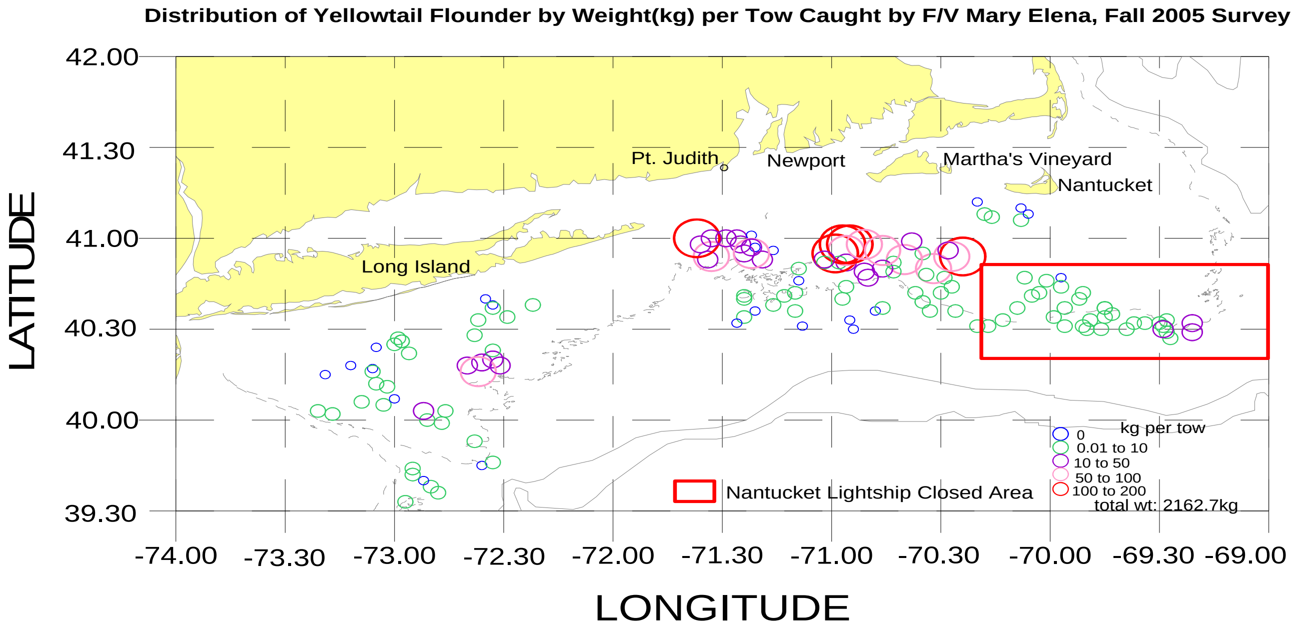


Figure 97. Map of weight per tow by station based on observations from the F/V *Mary Elena* for the fall 2005 survey. Circles are proportional to the magnitude of the weight per tow.

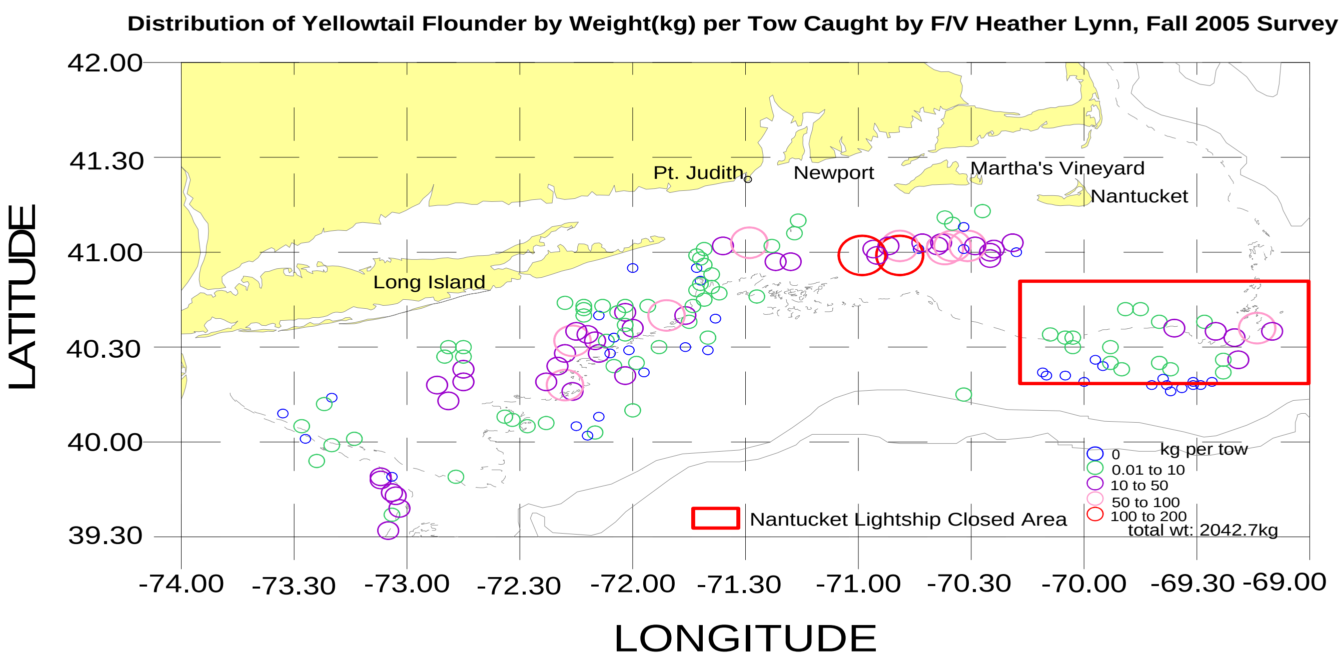


Figure 98. Map of weight per tow by station based on observations from the F/V *Heather Lynn* for the fall 2005 survey. Circles are proportional to the magnitude of the weight per tow.

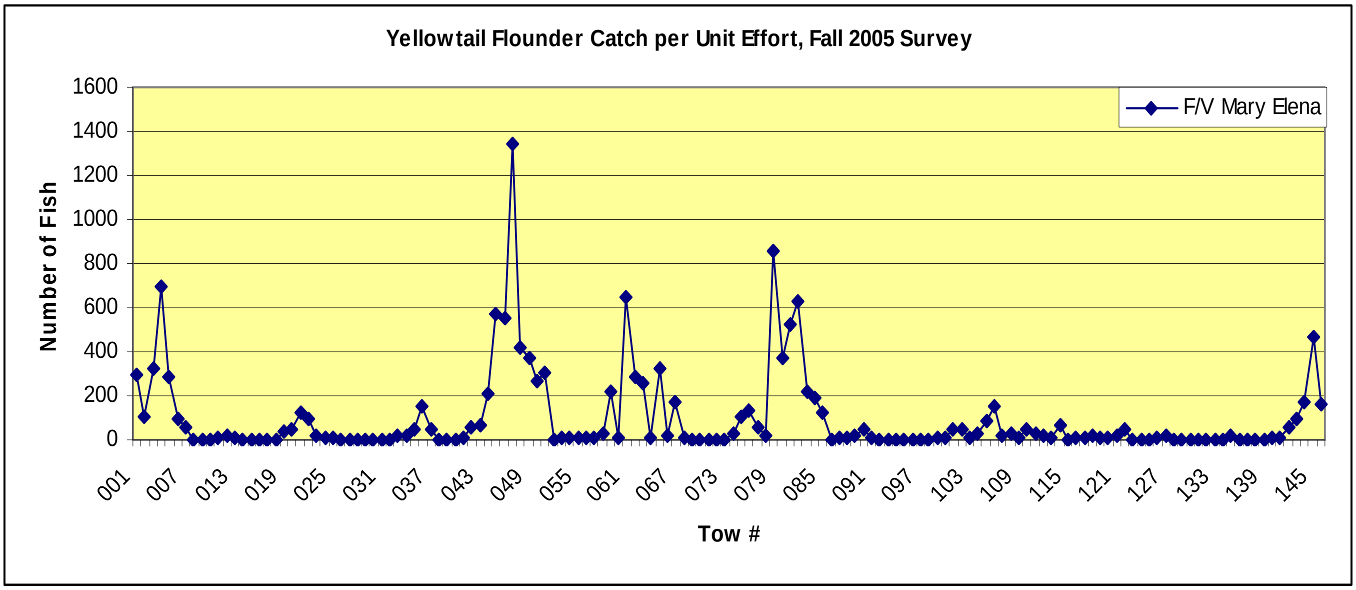


Figure 99. Number of yellowtail flounder caught by tow number based on observations from the F/V *Mary Elena* for the fall 2005 survey.

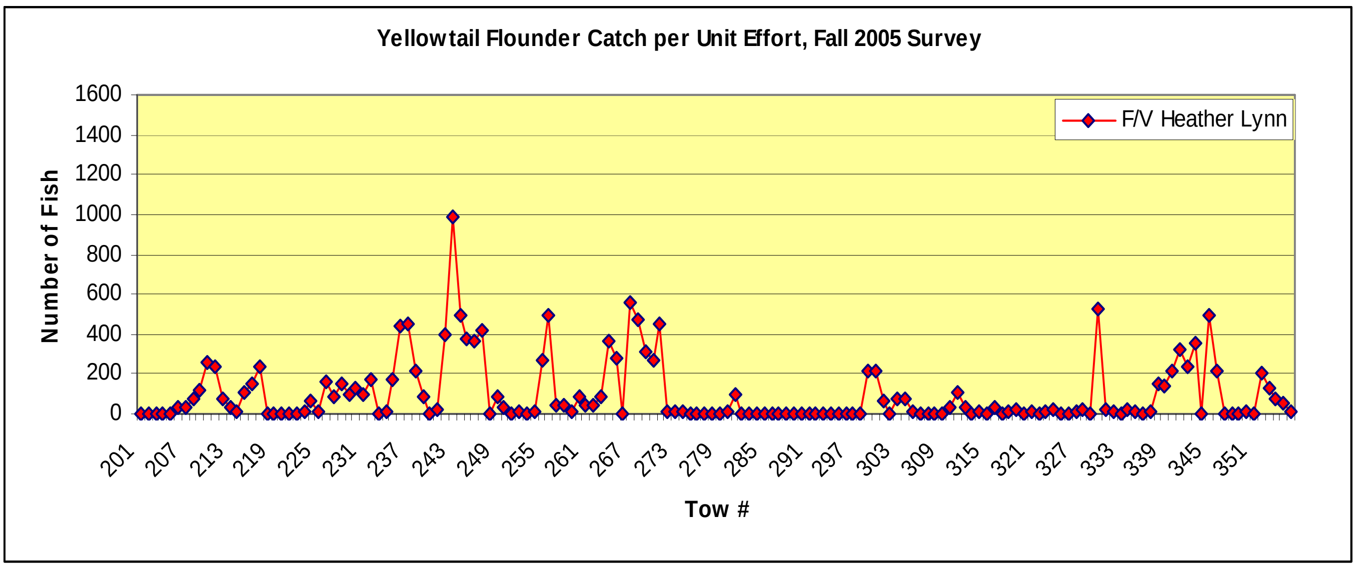


Figure 100. Number of yellowtail flounder caught by tow number based on observations from the F/V *Heather Lynn* for the fall 2005 survey.

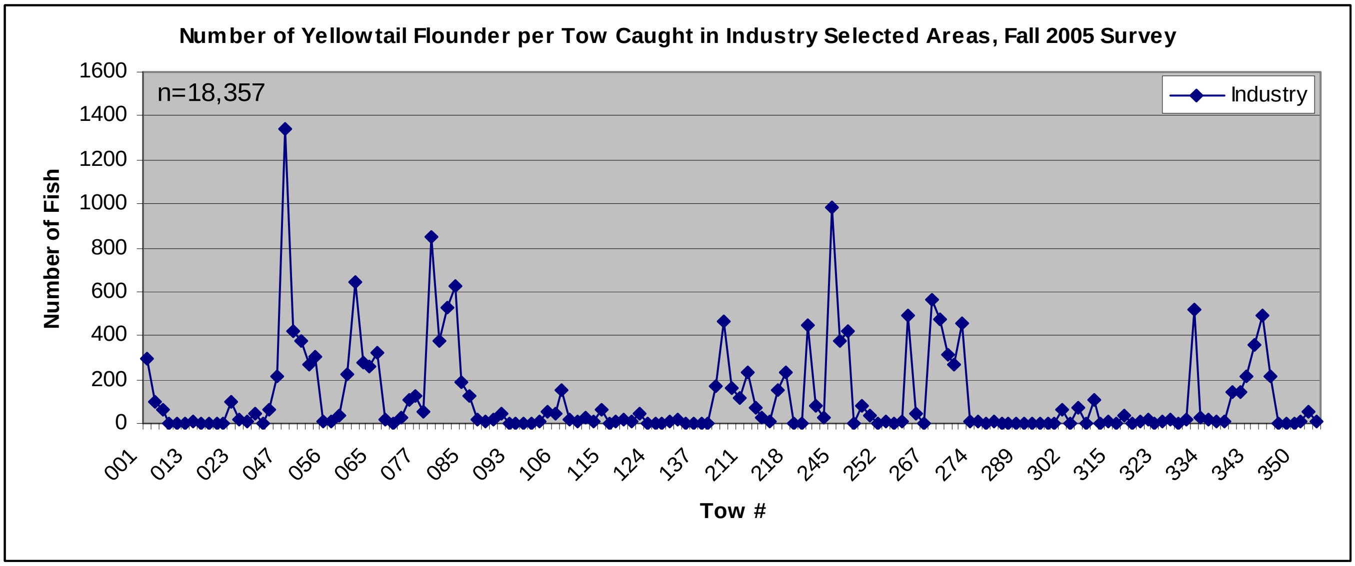


Figure 101. Number of yellowtail flounder caught by tow number based on observations from industry-selected stations for the fall 2005 survey.

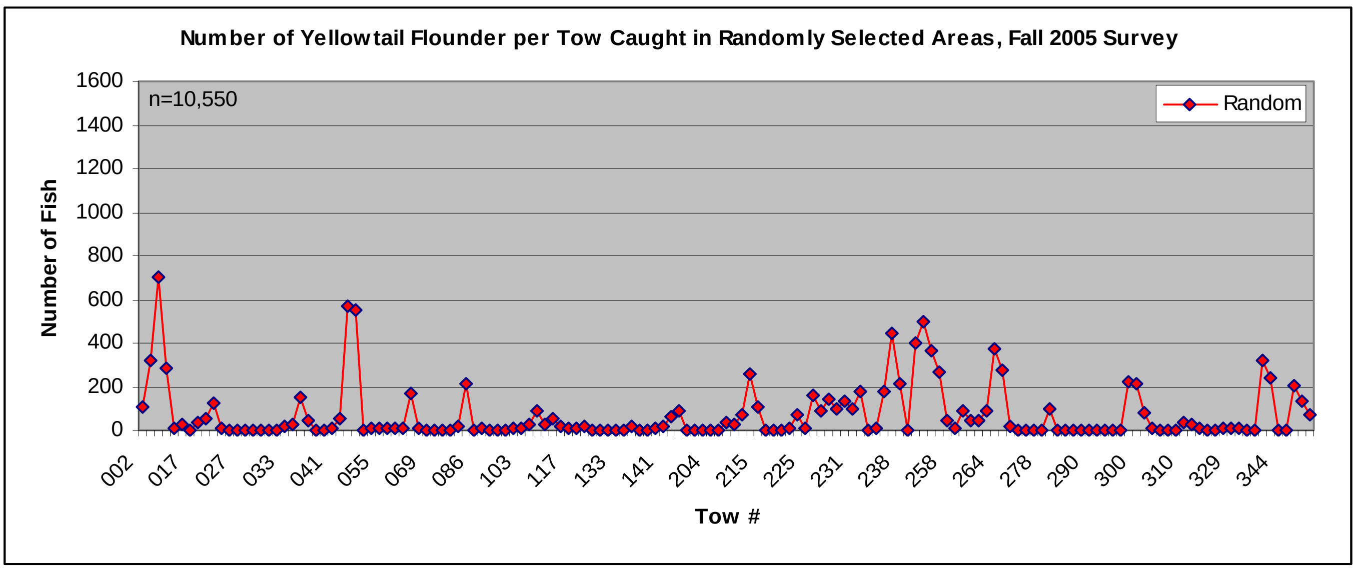


Figure 102. Number of yellowtail flounder caught by tow number based on observations from randomly selected stations for the fall 2005 survey.

5.8 NANTUCKET LIGHTSHIP CLOSED AREA

Nantucket Lightship Closed Area is located on western edge of Georges Bank south, encompassing the area of Nantucket Shoals, with an area of 3,648 square kilometers. The depth ranges from approximately 45 fathoms at the southern boundary and sloping up to approximately 10 fathoms at the northern extent. Shoaler areas are present within the area, where towing is nearly impossible. The area has been historically fished commercially for groundfish species, particularly yellowtail flounder, winter flounder, and cod as well as supporting a substantial whiting fishery until closed to otter trawling.

In 1994, the NEFMC voted to close three substantial areas on Georges Bank, the Nantucket Lightship and Closed Area I and II for groundfish protection, under authority of the Magnuson-Stevens Fishery Conservation and Management Act to eliminate overfishing and to rebuild the principal stocks of the multispecies finfishery (e.g., cod, haddock, and yellowtail flounder). The NLS area, also now referred to as a Marine Protected Area (MPA) was closed in response to industry reports of huge juvenile year-classes being discarded, which was verified through intensive sea sampling.

Discards were from a large 1987 year-class recruiting into the fishery were reported to port agents beginning in the fall of 1988, with discard ratios escalating in 1989 (Valliere 1989). The 1987 cohort was the second highest in three decades (Cadrin and Brown 2006).

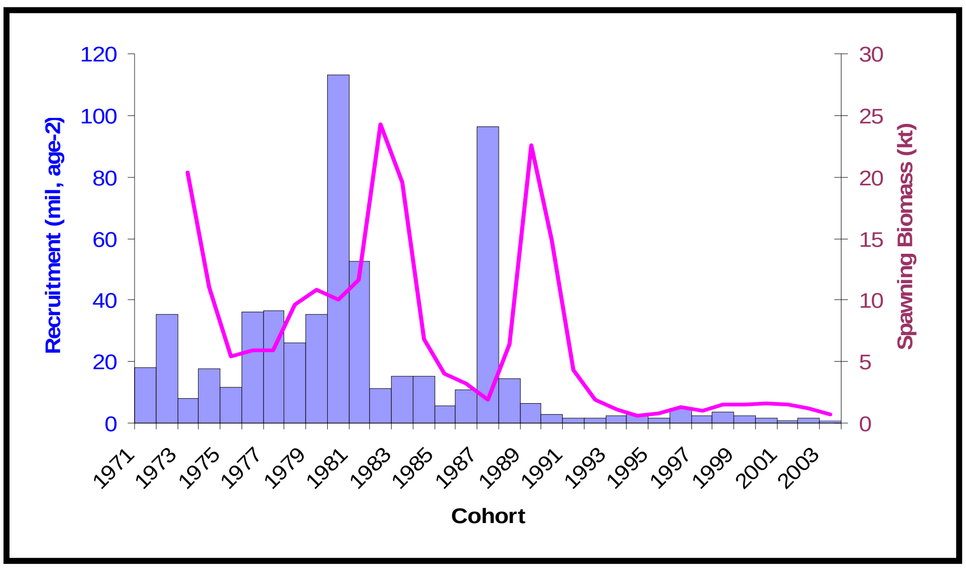


Figure 103. Recruitment patterns and spawning stock biomass.

At the time, small mesh was allowed in many areas, while 5 ½" mesh was required in certain portions of SNE when fishing for yellowtail flounders, including a yellowtail flounder spawning area. Regulations to apply the larger mesh inside the NLS area were implemented in December 1989, however fishermen continued to report discard rates from 50%–90% inside the area during 1990–1991. The NEFMC wrestled to implement emergency closure regulations, however they were not approved until December 1994.

Scallop vessels were allowed back inside the NLS Closed Area under a special sea scallop exemption program established in 2000. The area is closed to scallop fishing every third year (in rotation with sea scallop access area in Closed Area I and Closed Area II). Vessels enrolled in the Scallop Access program are allowed to possess up to 1,000 pounds of all NE multispecies combined, with a limitation of 250 pounds of yellowtail flounder per trip allowed. Fishing with dredge gear designed to take surf clams or ocean quahogs is allowed, provided there is no retention of regulated species. Pot gear and pelagic longline gear is also allowed in the area.

NEFSC scientists developed a model for development and evaluation of closed areas as fisheries management tools (Rago and Brown 1996) and identified difficulties in monitoring closed areas using the NEFSC research survey. They identified the primary variable for the NLS was to detect the rate of movement of yellowtail flounders inside and outside of the area, however the effectiveness of detecting movement is dependent on the accuracy of measurements. The NEFSC survey consistently catches low number of yellowtail flounders and the numerous survey strata that are not depth-stratified. In addition to variable recruitment in shifting habitat, these factors complicate analyses of the NLS based on the NEFSC survey.

The NEFMC recognized the need to monitor MPAs as they increased their utility of closed areas as a management tool to enhance rebuilding and habitat protection. The NEFMC encouraged additional research of MPAs to quantify the effectiveness of closed areas as management tools and recommended that "fisheries managers continue to use closed and restricted areas where and when they are appropriate (Howard, 2002)). The Council also recognized that "fishermen are most important and most impacted stakeholder group" involving MPAs and fishery management plans (FMP).

A current NMFS website (2006) lists several criteria to monitor the effectiveness of closed areas. The 2003–2005 IBS surveys have provided an effective measure for monitoring yellowtail flounder abundance within the NLS, and provide an indicator of habitat and biodiversity within the area. The indices of abundance provide a supplementary evaluation of direct and indirect fishing effects that affect larval settlement and recruitment and should be further analyzed. The fundamental result of the three years of research points out that the NLS closed area may be ill designed, implemented too late to protect the 1987 yellowtail flounder year-class and subsequent cohorts. No more than 3% of the stock by weight was present in the NLS during IBS cruises and in most cases it was less than 1%. This should be considered when evaluating area closures for protecting yellowtail flounder.

Measures Used to Determine Site Effectiveness

Measure	Comment
Periodic survey sampling	NMFS and independent research projects
Performance measures for habitat quality	Independent research projects
Performance measures for biodiversity	Independent research projects
Performance measures for fisheries enhancements	Independent research projects

Activities or Issues of Concern for Site Management

Activity / Issue	Comment
Direct fishing effects	Overfishing/over exploitation of resources
Direct fishing effects	Taking the brooding stock before spawning
Indirect fishing effects	Concerns of fishing gear destroying the habitat
Indirect fishing effects	Fishing related habitat impacts

5.9 IBS Survey inside the Nantucket Lightship Area

The IBS survey vessels were allowed access to the NLS operating under a letter of agreement (LOA) to conduct scientific research. Within the area, both industry-selected (fixed stations) and randomly generated tows were completed during each of the six surveys, for a total of 352 stations. A number of randomly selected tows had to be relocated, due to bottom conditions or fixed gear. Several random tows were successfully completed on hazardous grounds, thanks to a chart from the 1970s with a hot-spot flounder tow that a captain's father had left behind. While most gear was marked with high-flyers, it is notable that captains found the closed area had been used for wet storage for some lobster pots and trawls dropped and left unmarked.

Captains made several observations of the area, both having fished inside the NLS before closure. They noted the changes in bottom substrate, and did not seem to be the healthy substrate formerly observed when targeting flatfish prior to the closure. The dogfish population inside the area had exploded, along with other predatory species, notably skates, sculpins, starfish, four-spot flounders, crabs and big tows of sponges ("monkey-dung").

Table 5. Summary of sampling effort (number of tows) within the Nantucket Lightship Closed Area by vessel for each survey segment.

Segment	F/V *Heather Lynn*	F/V *Mary Elena*	Total
2003 Spring	28	26	54
2003 Fall	28	32	60
2004 Spring	34	27	61
2004 Fall	26	32	58
2005 Spring	26	32	58
2005 Fall	27	34	61

Table 6. Catch of legal and sublegal size yellowtail flounders in numbers and percentage of each size caught based on samples collected in the Nantucket Lightship Closed Area for each survey segment.

	Sublegal		Legal		
Segment	Number Caught	Percent of Total	Number Caught	Percent of Total	Total Number
2003 Spring	1,212	32%	2,611	68%	3,823
2003 Fall	1,073	59%	733	41%	1,806
2004 Spring	741	52%	678	48%	1,419
2004 Fall	570	63%	340	37%	910
2005 Spring	1,201	62%	741	38%	1,942
2005 Fall	1,604	88%	225	12%	1,829

Table 7. Number of yellowtail flounder caught within the Nantucket Lightship Closed Area and percentage caught within NLS closed area out of the entire survey region for each survey segment.

	Nantucket Lightship Closed Area		All Stations
Segment	Number Caught	Percent of Total	Total Number
2003 Spring	3,823	32%	11,877
2003 Fall	1,806	30%	6,051
2004 Spring	1,419	16%	8,949
2004 Fall	910	15%	6,001
2005 Spring	1,942	17%	11,749
2005 Fall	1,829	6%	28,907

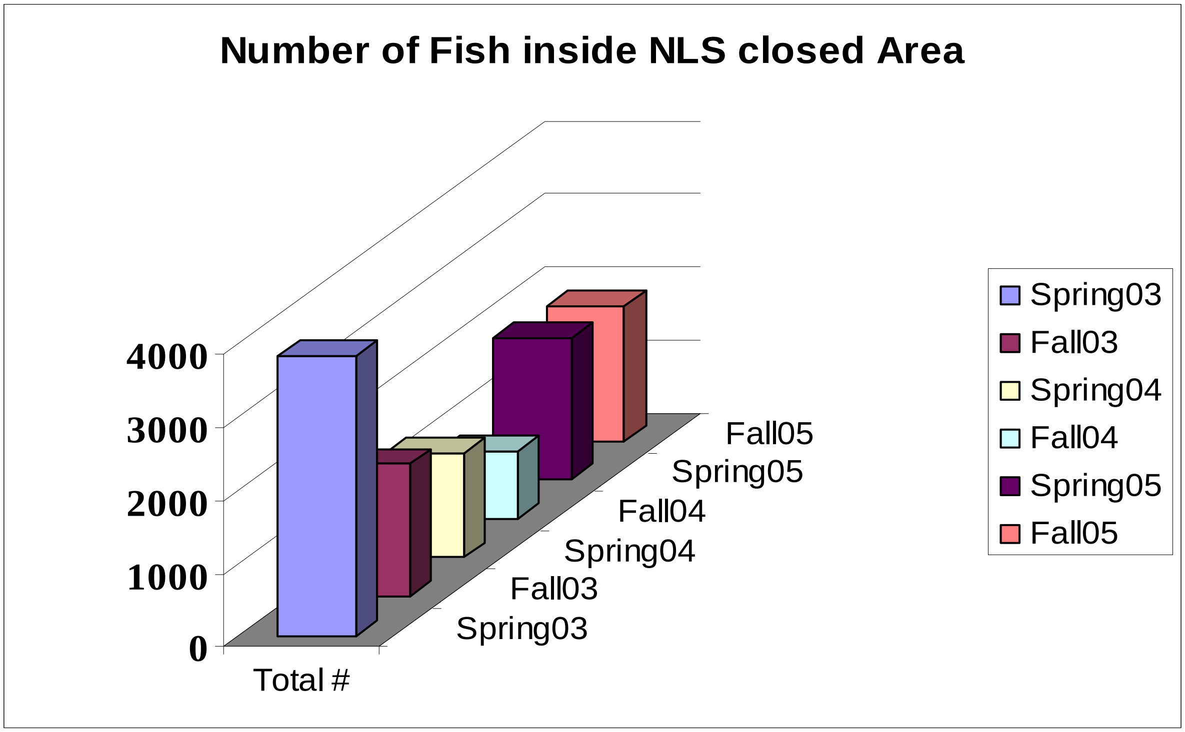


Figure 104. Number of yellowtail flounder caught inside the NLS closed area for each survey segment.

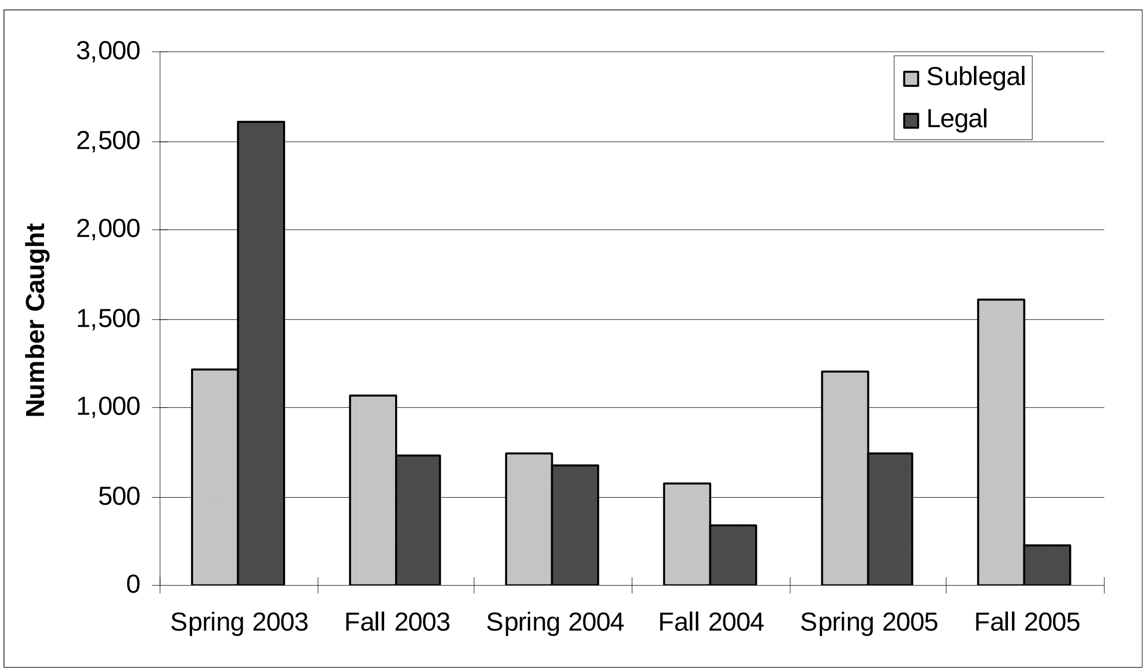


Figure 105. Comparison of the number of sublegal and legal size yellowtail flounder caught in the NLS closed area for each survey segment.

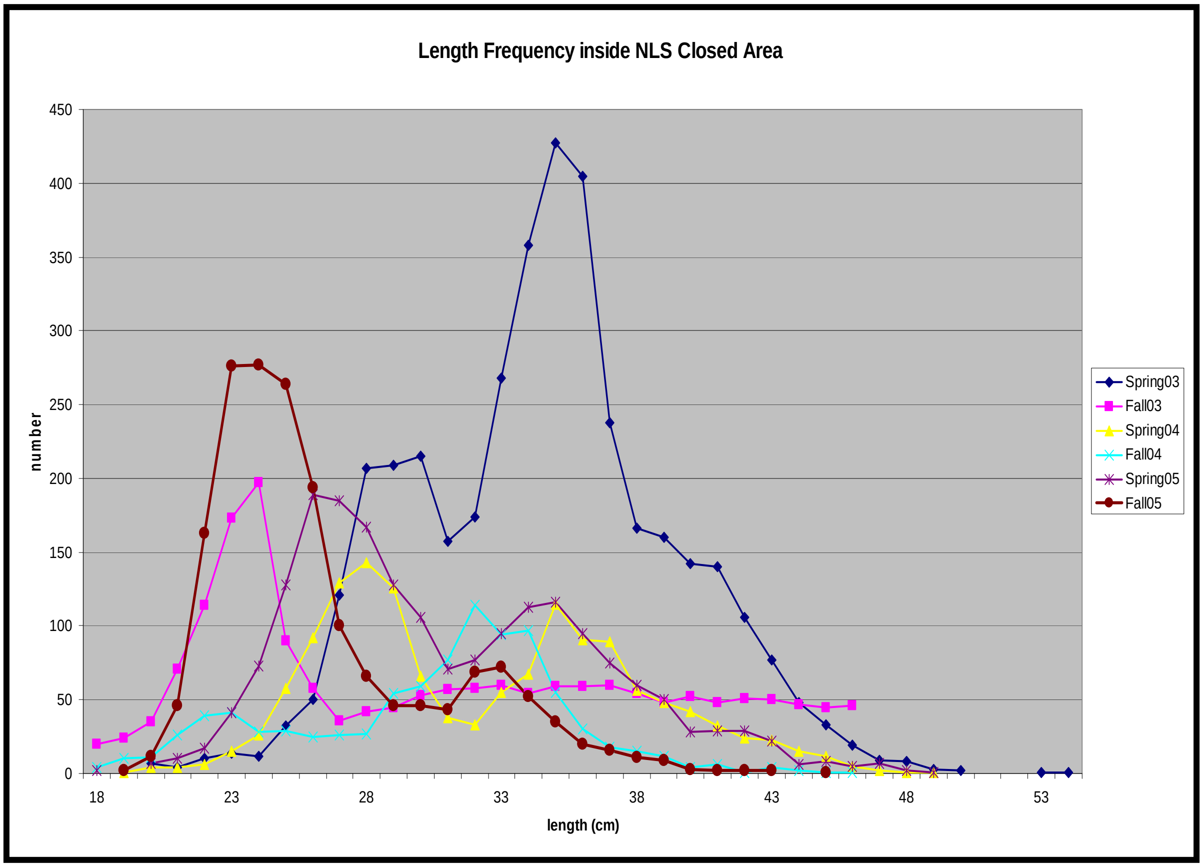


Figure 106. Length frequencies by survey segments inside the Nantucket Lightship Closed Area

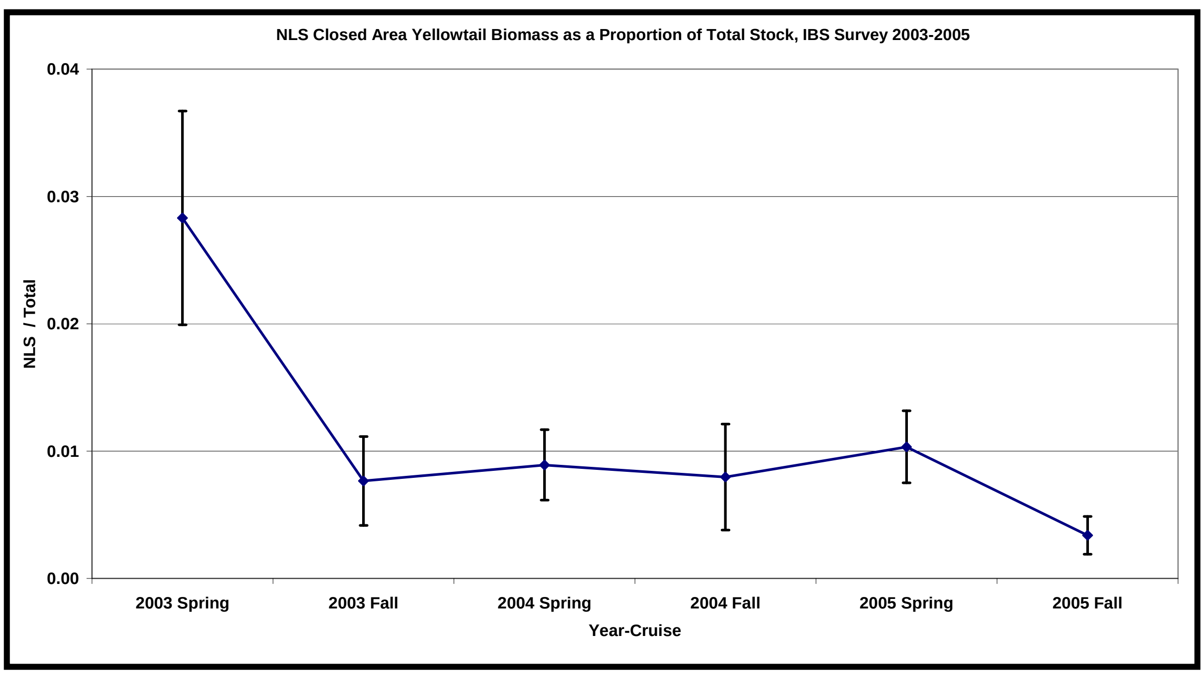


Figure 107. Biomass estimates of yellowtail flounder inside the NLS closed area.

6 BIOMASS ESTIMATES

The area swept method was used to estimate the total biomass of yellowtail flounder for each survey season and year. The duration of each tow was multiplied by the speed of the vessel to calculate the distance towed. Area swept was computed for each tow by multiplying the distance towed by the door spread. Biomass density for each tow was calculated by dividing the weight of yellowtail flounder caught in each tow by the area swept. Data collected from tows that were deemed to be unreliable due to short tow times, net damage, or unrepresentative were not used in the calculations (77 tows out of 1,827, or 4%). Total biomass for the survey region was estimated by multiplying the average biomass density for each survey season and year by the total survey area. Biomass estimates and associated 95% confidence intervals were computed for both the entire survey region and the Nantucket Lightship closed area.

Minimum biomass estimates were made assuming comparable fishing efficiency between vessels, assuming the catchability of all yellowtail flounder was equal to 1. It was assumed that all yellowtail flounder encountered within the door spread were captured. This is likely given the vessel characteristics, net mensuration data, and comparability of CPUE when the vessels fished in close proximity. Since it is a minimum biomass estimate, minor differences in vessel performance are considered negligible.

Yellowtail flounder biomass estimates by cruise for are plotted in Figure 184. Precision of the estimates was generally good with coefficients of variation ranging from 6.6% to 14.8%. Total minimum biomass declined from 1,883 tons in spring of 2003 to 816 tons by fall of 2004. It then rose to a peak of 2,421 tons by the fall of 2005. Comparison of spring IBS biomass estimates to beginning year biomass estimates made by ADAPT VPA in the GARM II report showed that IBS estimates were on average 30% greater than the VPA estimates. Since the IBS estimates are based on an assumption of 100% catch efficiency for encounters between the trawl doors, this difference is undoubtedly greater. In fact, the IBS estimates suggest that the alternative ASPIC biomass dynamic model assessment in GARM II is a better estimate of yellowtail flounder stock biomass. This should be considered when setting total allowable catches (TACs). Yellowtail flounder biomass estimates by cruise for the NLS closed area are also plotted below. Precision of these estimates was fair with coefficients of variation ranging from 13.7% to 26.2%. Total minimum biomass declined from 53.3 tons in spring of 2003 to 5.7 tons by fall of 2003. Biomass has since fluctuated between 6.5 and 15.7 tons since then. Very little of the yellowtail flounder stock biomass was observed in the NLS closed area. No more than 3% of the stock by weight was present in the NLS during IBS cruises and in most cases it was less than 1%. This should be considered when evaluating area closures for protecting yellowtail flounder.

Table 8. Estimated biomass of SNE yellowtail flounder stock within the industry-based survey area for each survey segment.

Segment	Biomass	SE (Biomass)	CV (Biomass)	L95% CL	U95% CL
2003 Spring	1,883	159.9	0.085	1,563	2,203
2003 Fall	745	77.5	0.10	590	900
2004 Spring	1,302	86.7	0.067	1,128	1,475
2004 Fall	816	106.4	0.13	603	1,029
2005 Spring	1,520	100.1	0.066	1,320	1,720
2005 Fall	2,421	357.8	0.15	1,706	3,137

Table 9. Estimated biomass of SNE yellowtail flounder stock within the Nantucket Lightship Closed Area for each survey segment.

Segment	Biomass	SE (Biomass)	CV (Biomass)	L95% CL	U95% CL
2003 Spring	53.3	7.9	0.15	37.5	69.1
2003 Fall	5.7	1.3	0.23	3.1	8.3
2004 Spring	11.6	1.8	0.16	8.0	15.2
2004 Fall	6.5	1.7	0.26	3.1	9.9
2005 Spring	15.7	2.2	0.14	11.4	20.0
2005 Fall	8.2	1.8	0.22	4.6	11.8

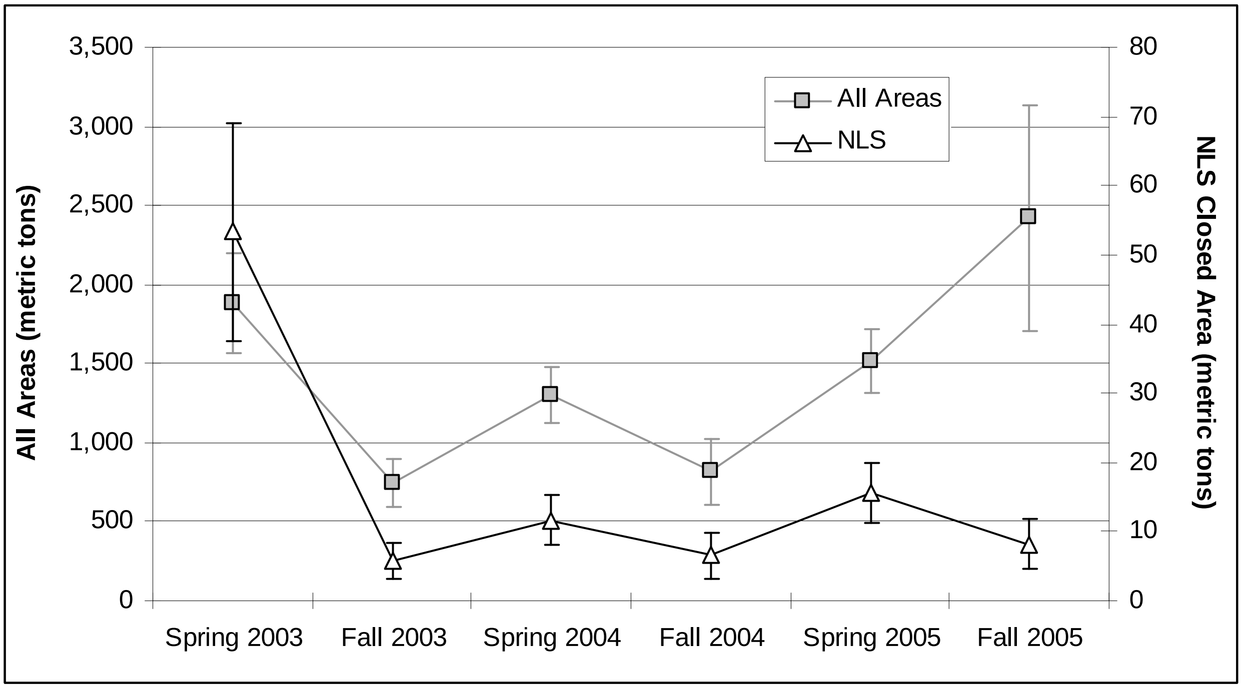


Figure 108. Comparison of biomass (metric tons) estimates for the entire survey region and the NLS closed area for each survey segment. The error bars show the 95% confidence intervals around the biomass estimates.

7 EVALUATION

7.1 GOALS AND OBJECTIVE

To assess the abundance, distribution and size composition of yellowtail flounder (and associated species) temporally and spatially within the Nantucket Lightship closed area, proposed closed areas and adjacent areas. The purpose of this program is for the fishing industry to assist in providing high-resolution data in SNE/MA areas to complement the NEFSC survey, and cover grounds not sampled by the NEFSC vessel. The focus of the project is to derive precise estimates of the abundance of Southern New England yellowtail flounder at age using intense sampling by industry vessels with industry designed "flatfish" trawls.

7.2 Goals and objectives met

As described above, all data to meet the goals and objectives was collected. Calibration and depletion tows were not part of the original goals and objectives, but identified as an important component for utilizing the data in future assessments. As discussed above, funding preempted these studies, and RIDFW has determined the paired compatibility of the two vessels assumes equal fishing efficiency.

7.3 Goals and objectives not met

Estimates of abundance of SNE yellowtail flounder population have not been updated. The NEFSC has undergone severe budgetary cuts and loss of personnel originally intended to provide support and analyses of the IBS data. Additionally, the lack of calibration and depletion studies remains problematic for some scientists to incorporate the data into the 2008 GARM. RIDFW opted with certainty that a biomass calculation could be conducted with an acceptable confidence interval based on vessel compatibility and the three-year time series.

7.4 Dissemination of Project Results

The Pilot Study Report is being submitted to NMFS, and will be subject to a technical peer review during 2006. All survey data resides at both the NEFSC in Oracle database and at RIDFW. Survey results have been posted on the NEFSC website, the RIDEM website, as well as thru *Commercial Fisheries News* and *The Fishermen's Call*. The final report will be posted on the RIDEM website.

8 RESEARCH RECOMMENDATIONS

Additional analytical work suggested for the 2003–2005 data would include:

- Relationship of bottom temperature to yellowtail flounder catch data
- Relationship of bottom temperature to bycatch species
- Classification of maturity staging data
- Predator /prey relationships
- Calibration and depletion studies
- Analysis of tow data for statistical differences in catchability between vessels (requires filtering 1800+ tows to identify tows conducted in close proximity and depth)
- Ageing the 2005 samples (in progress)
- Incorporating the data into the 2008 GARM (will be utilized)
- Providing the data to fisheries managers

A key element now missing is the continued monitoring of two emerging year-classes on the most important stock driving SNE groundfish management. Options to secure long-term funding to continue a modified, scaled-back survey should be investigated. (Beginning in 2006, the NEFSC added stations in the area where large concentrations of juveniles were recruiting into the fishery, based upon both IBS data and fishermen's reports.)

9 REFERENCES

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APPENDICES

A Distribution Plots and Tables of Bycatch Species

B Species List

Alewife
American Eel
American Lobster
American Plaice
American Shad
Argentine
Atlantic Cod
Atlantic Halibut
Atlantic Herring
Atlantic Mackerel
Atlantic Sturgeon
Atlantic Surfclam
Barndoor Skate
Bigeye Searobin
Black Seabass
Blue Runner
Blowfish
Blueback Herring
Bluefish
Bonito
Butterfish
Chain Dogfish
Chiton
Clearnose Skate
Conger Eel
Cownose Ray
Cunner
Dusky Shark
Dog Whelk
False Albacore
Fourbeard Rockling
Fourspot Flounder
Goatfish
Gray Triggerfish
Gulfstream Flounder
Haddock
Hermit Crab
Hickory Shad
Horseshoe Crab
Illex Squid
Jellyfish
Jonah Crab
Lady Crab
Little Skate
Lizardfish
Loligo Squid
Longhorn Sculpin
Lookdown
Lumpfish
Menhaden
Monkfish
Moonsnail
Mud Crab
Mussel
Northern Kingfish
Northern Puffer
Northern Searobin
Ocean Pout
Ocean Quahog
Pipefish
Pollock
Red Hake
Rock Crab
Rosette Skate
Round Herring
Sand Dollar
Sand Lance
Scad
Scup
Sea Anemone
Sea Cucumber
Sea Herring
Sea Mouse
Sea Scallop
Searaven
Sea Star
Sea Urchin
Shrimp
Silver Dollar
Silver Hake
Smallmouth Flounder
Smooth Dogfish
Spider Crab
Spiny Dogfish
Sponge
Spotted Hake
Stone Crab
Striped Bass
Striped Searobin
Summer Flounder
Surf Clam
Swordfish
Toadfish
Torpedo Ray
Triggerfish
Weakfish
Windowpane
Winter Flounder
Winter Skate
Witch Flounder
Wrymouth
Yellowtail Flounder

C NEFSC Sub-sampling Guidance for Cooperative Research

D Standardized Format of Data Logs

E List of Observers

SPRING 2003

	F/V *Mary Elena*	F/V *Heather Lynn*
Trip 1	Azure Westwood, NEFSC	Ben Foster, AIS
	Della Grallert, AIS	Caleb Gilbert, PTSI
	H. Moustafhid, PTSI	Eric Hayward, PTSI
Trip 2	A. Westwood, NEFSC	B. Foster, AIS
	J. Mcnamee, RIDFW	C. Gilbert, PTSI
	H. Moustafhid, PTSI	E. Hayward, PTSI
	D. Grallert, AIS	
Trip 3	J. McNamee, RIDFW	B. Foster, AIS
	H. Moustafhid, PTSI	Brent Kourchone, AIS
	D. Grallert AIS	E. Hayward, PTSI
Trip 4	J. McNamee, RIDFW	Ben, AIS
	H. Moustafhid, PTSI	Brent, AIS
	Della, AIS	A. Morales, PTSI

FALL 2003

	F/V *Mary Elena*	F/V *Heather Lynn*
Trip 1	J. McNamee, RIDFW	Jen Scott, REMSA
	Rebecca Ostrom, REMSA	Alison Zanardi, REMSA
	Jean Higgins, REMSA	Eric Dobbs, REMSA
	Carolina Vasconcolos, REMSA	
Trip 2	J. McNamee, RIDFW	J. Scott, REMSA
	R. Ostrom, REMSA	A. Zanardi, REMSA
	J. Higgins, REMSA	E. Dobbs, REMSA
Trip 3	R. Ostrom, REMSA	A. Zanardi, REMSA
	J. Higgins, REMSA	J. Scott, REMSA
		E. Dobbs, REMSA
Trip 4	R. Ostrom, REMSA	J. Scott, REMSA
	J. Higgins, REMSA	A. Zanardi, REMSA
	Eric Abrams, REMSA	E. Dobbs, REMSA
Trip 5	J. Higgins, REMSA	J. Scott, REMSA
	E. Abrams, REMSA	A. Zanardi, REMSA
	E. Schoemer, REMSA	

E List of Observers, *continued*

SPRING 2004

	F/V *Mary Elena*	F/V *Heather Lynn*
Trip 1	J. McNamee, RIDFW	Anne Magoon, REMSA
	Charles Pitts, REMSA	Bill Martin, REMSA
	Ryan Driscoll, REMSA	Krissy Cahill, AIS
	Jason Dean, NMFS	
Trip 2	J. McNamee, RIDFW	A. Magoon, REMSA
	C. Pitts, REMSA	B. Martin, REMSA
	R. Driscoll, REMSA	K. Cahill, AIS
	J. Dean, NMFS	
Trip 3	C. Pitts, REMSA	A. Magoon, REMSA
	R. Driscoll, REMSA	B. Martin, REMSA
	J. Dean, NMFS	Dan Furno,AIS????
Trip 4	C. Pitts, REMSA	A. Magoon, REMSA
	J. Dean, NMFS	B. Martin, REMSA

FALL 2004

	F/V *Mary Elena*	F/V *Heather Lynn*
Trip 1	R. Johnston, NEFSC	N. Keith, NEFSC
	T. Angell, RIDFW	Andrew Gowan, REMSA
	R. Driscoll, REMSA	C. Pitts, REMSA
	Rachel Potts, REMSA	Dave Mann, REMSA
Trip 2	R. Johnston, NEFSC	A Gowen, REMSA
	R. Driscoll, REMSA	C. Pitts, REMSA
	R. Potts, REMSA	Don DeBeradino, RIDFW
	Laura Kloepper	
Trip 3	R. Driscoll, REMSA	A. Gowen
	R. Potts, REMSA	C. Pitts
	L. Kloepper, REMSA	D. Mann
Trip 4	R. Potts, REMSA	A. Gowen, REMSA
	L. Kloepper, REMSA	C. Pitts, REMSA
	Sarah, AIS	D. Mann, REMSA
Trip 5	R. Potts, REMSA	A Gowen, REMSA
	L. Kloepper, REMSA	C. Pitts, REMSA
	Sarah, AIS	D. Mann, REMSA

E List of Observers, *continued*

	SPRING 2005			FALL 2005	
	F/V *Mary Elena*	**F/V *Heather Lynn***		**F/V *Mary Elena***	**F/V *Heather Lynn***
Trip 1	R. Johnston, NEFSC	N. Keith, NEFSC	Trip 1	M. Palmer, NEFSC	N. Keith, NEFSC
	Mike Palmer, NEFSC	K. Cahill, REMSA		Dan Clem, REMSA	Michelle Cho, REMSA
	C. Pitts, REMSA	A. Magoon, REMSA		Eric Rolla, REMSA	Andrew Gowen, REMSA
	Janine L'Heureux, REMSA	Bob Carr, REMSA		Eric Hoover, REMSA	Andrew Aliapoulis, REMSA
Trip 2	R. Johnston, NEFSC	Jon Duquette, NEFSC	Trip 2	R. Johnston, NEFSC	N. Keith, NEFSC
	Stacy Kubis, NEFSC	K. Cahill, REMSA		D. Clem, REMSA	M. Cho, REMSA
	C. Pitts, REMSA	A. Magoon, REMSA		E. Rolla, REMSA	A. Gowen, REMSA
	J. L'Heureux, REMSA	Laura Kloepper, REMSA		Jeff Robinson, REMSA	A. Aliapoulis, REMSA
Trip 3	S. Kubis, NEFSC	M. Palmer, NEFSC	Trip 3	M. Palmer, NEFSC	F/V *Heather Lynn* broke down, did not go
	C. Pitts, REMSA	K. Cahill, REMSA		D. Clem, REMSA	
	J. L'Heureux, REMSA	A. Magoon, REMSA		E. Rolla, REMSA	
	Meryl Segal, REMSA	L. Kloepper, REMSA		J. Robinson, REMSA	
Trip 4	A. Westwood, NEFSC	Bill Duffy, NEFSC	Trip 4	Carma Gilcrist, REMSA	S. Kubis, NEFSC
	C. Pitts, REMSA	K.Cahill, REMSA		D. Clem, REMSA	M. Cho, REMSA
	J. L'Heureux, REMSA	A. Magoon, REMSA		E. Rolla, REMSA	A. Gowen, REMSA
	M. Segal, REMSA	L. Kloepper, REMSA		J. Robinson, REMSA	A. Aliapoulis, REMSA

E List of Observers, *continued*

FALL 2005

	F/V *Mary Elena*	**F/V *Heather Lynn***
Trip 5	D. Clem, REMSA	A. Gowen, REMSA
	E. Rolla, REMSA	M. Cho, REMSA
	Carma Gilcrist, REMSA	J. Robinson, REMSA
		Sarah Pierce, RIDFW
Trip 6	D. Clem, REMSA	A. Gowen, REMSA
	E. Rolla, REMSA	M. Cho, REMSA
	J. Robinson, REMSA	A. Aliapoulis, REMSA
	Carma Gilcrist, REMSA	Michael Partica, REMSA
Trip 7		A. Gowen, REMSA
		M. Cho, REMSA
		D. Clem, REMSA
		E. Rolla, REMSA

F News Articles

APPENDIX A

2003 – 2005 DISTRIBUTION PLOTS AND TABLES OF BYCATCH SPECIES

2003 DISTRIBUTION PLOTS & TABLES

Table 1: Species Total Weights for Heather Lynn & Mary Elena, Spring 2003`

	HL Total Weight(kg)	*ME Total Weight(kg)*	*Total Weight (kg)*
Species			
Barndoor Skate	1334.16	105.71	1439.87
Black Sea Bass	267.80	367.94	635.74
Fluke	6100.10	6454.47	12554.57
Fourspot Flounder	998.00	1644.24	2642.24
Monkfish	1751.00	1619.12	3370.12
Ocean Pout	5467.40	13511.33	18978.73
Others	6006.98	5984.58	11991.56
Scup	364.10	599.82	963.92
Skate (Little + Winter)	48009.80	29863.30	77873.10
Spiny Dogfish	2605.20	9667.19	12272.39
Windowpane	636.50	1004.19	1640.69
Winter Flounder	1919.90	3419.17	5339.07
Witch Flounder	731.80	585.52	1317.32
Yellowtail Flounder	2114.79	3044.17	5158.96
Total	78307.53	77870.75	156178.28

Figure 1

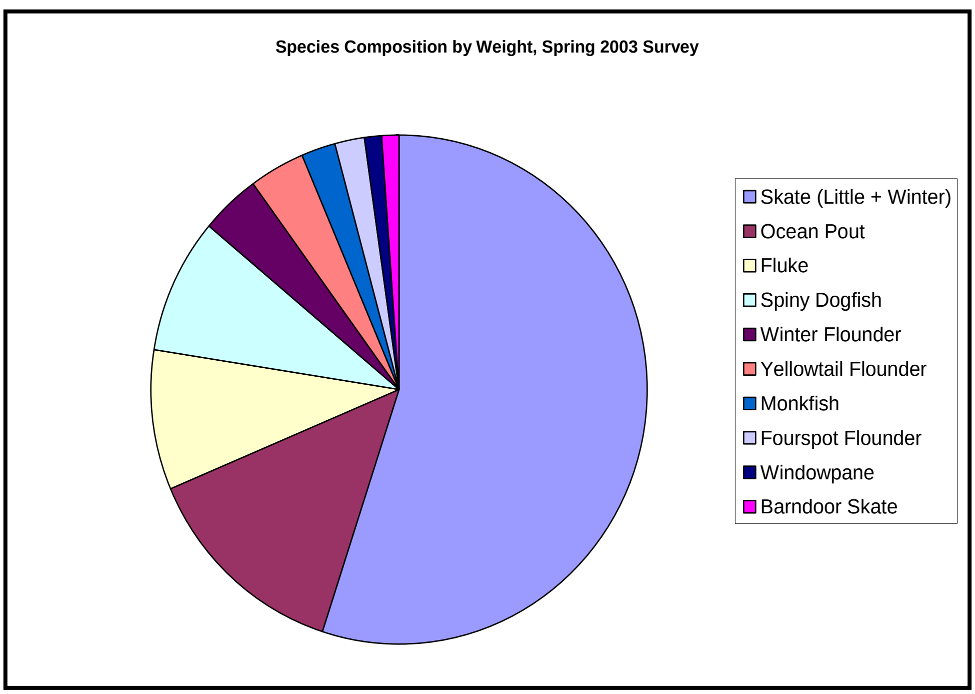
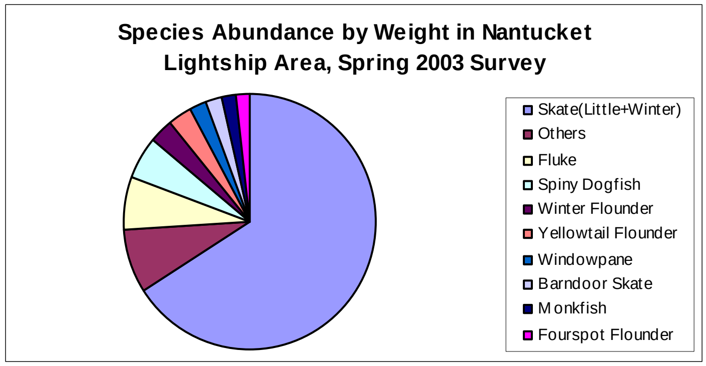


Table 2: Top 10 species weight by area (east, central, west)

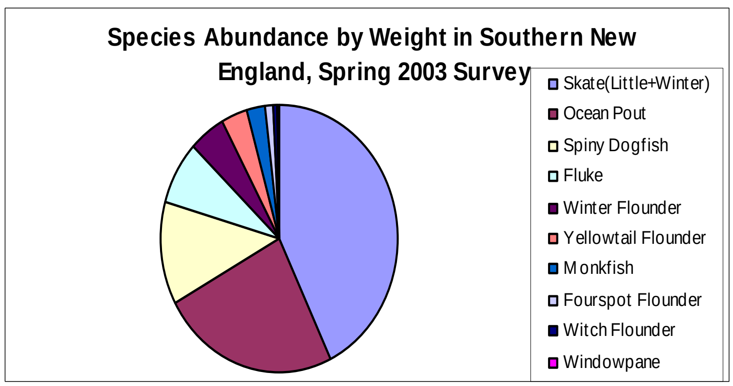
Nantucket Lightship Area

Species	*Weight*
Skate(Little+Winter)	41256.70
Others	5135.95
Fluke	4185.55
Spiny Dogfish	3388.20
Winter Flounder	1925.01
Yellowtail Flounder	1901.11
Windowpane	1451.10
Barndoor Skate	1262.00
Monkfish	1110.70
Fourspot Flounder	1078.60



Southern New England

Species	*Weight*
Skate(Little+Winter)	24023.70
Ocean Pout	13658.00
Spiny Dogfish	6921.20
Fluke	4358.88
Winter Flounder	2744.98
Yellowtail Flounder	2045.57
Monkfish	1305.50
Fourspot Flounder	710.60
Witch Flounder	277.40
Windowpane	160.00



Mid-Atlantic

Species	*Weight*
Skate(Little+Winter)	12592.80
Ocean Pout	4896.50
Others	4122.25
Fluke	4010.14
Spiny Dogfish	1963.00
Yellowtail	1212.27
Scup	955.20
Monkfish	954.00
Fourspot Flounder	853.00
Winter Flounder	669.10

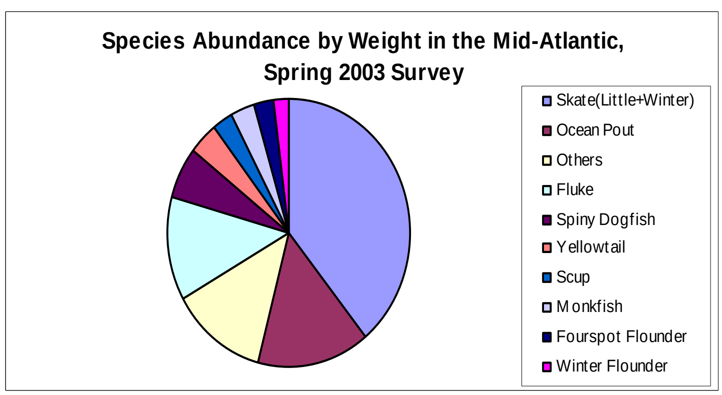


TABLE 3: Species total weights: industry vs. random tows, Spring 2003

	Industry			*Random*			*Industry+Random*
	ME: Weight	*HL: Weight*	*Total Weight(kg)*	*ME: Weight*	*HL: Weight*	*Total Weight(kg)*	*Total Weight*
Species							
Barndoor Skate	39.96	1038.58	1078.54	65.80	295.58	361.38	1439.92
Black Sea Bass	129.00	145.50	274.50	238.90	122.30	361.20	635.70
Fluke	2862.79	3884.11	6746.90	3591.68	2215.99	5807.67	12554.57
Fourspot Flounder	627.70	588.00	1215.70	1016.50	410.00	1426.50	2642.20
Monkfish	376.80	1008.90	1385.70	1242.30	742.10	1984.40	3370.10
Ocean Pout	11732.30	3935.40	15667.70	1779.00	1532.00	3311.00	18978.70
Others	2088.90	3490.14	5579.04	3895.70	2516.84	6412.54	11991.58
Scup	31.90	246.90	278.80	567.90	117.20	685.10	963.90
Skate(Little&Winter)	18493.30	31602.20	50095.50	11370.00	16407.70	27777.70	77873.20
Spiny Dogfish	7492.20	1629.40	9121.60	2175.00	975.80	3150.80	12272.40
Windowpane	223.60	502.30	725.90	780.60	134.20	914.80	1640.70
Winter Flounder	2361.15	1140.79	3501.94	1058.02	779.11	1837.13	5339.07
Witch Flounder	123.40	591.10	714.50	462.10	140.80	602.90	1317.40
Yellowtail	1585.79	1556.24	3142.03	1458.38	558.55	2016.93	5158.96

Table 4: Top 10 species Abundance in Industry Selected Areas

Species	*Weight*
Skate(Little+Winter)	50095.50
Ocean Pout	15667.70
Spiny Dogfish	9121.60
Fluke	6746.90
Others	5579.04
Winter Flounder	3501.94
Yellowtail Flounder	3142.03
Monkfish	1385.70
Fourspot Flounder	1215.70
Barndoor Skate	1078.54

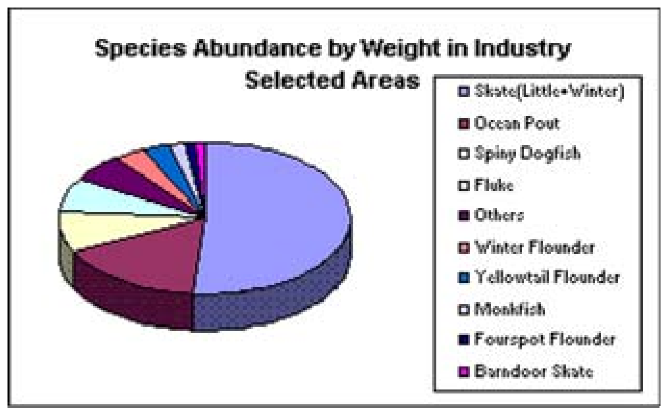


Table 5: Top 10 species Abundance in Randomly Selected Areas

Species	*Weight*
Skate(Little+Winter)	27777.70
Others	6412.54
Fluke	5807.67
Ocean Pout	3311.00
Spiny Dogfish	3150.80
Yellowtail Flounder	2016.93
Monkfish	1984.40
Winter Flounder	1837.13
Fourspot Flounder	1426.50
Windowpane	914.80

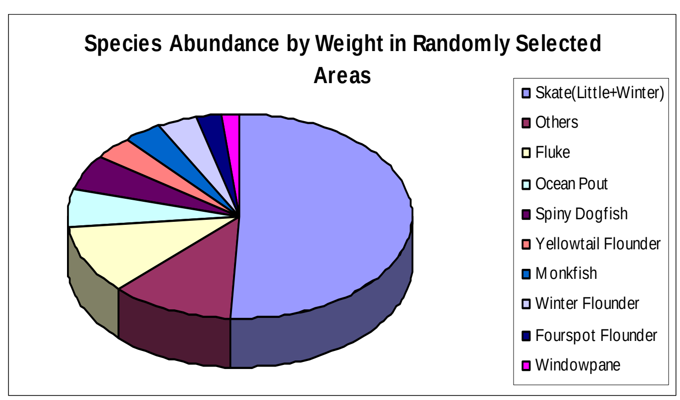


Figure 2

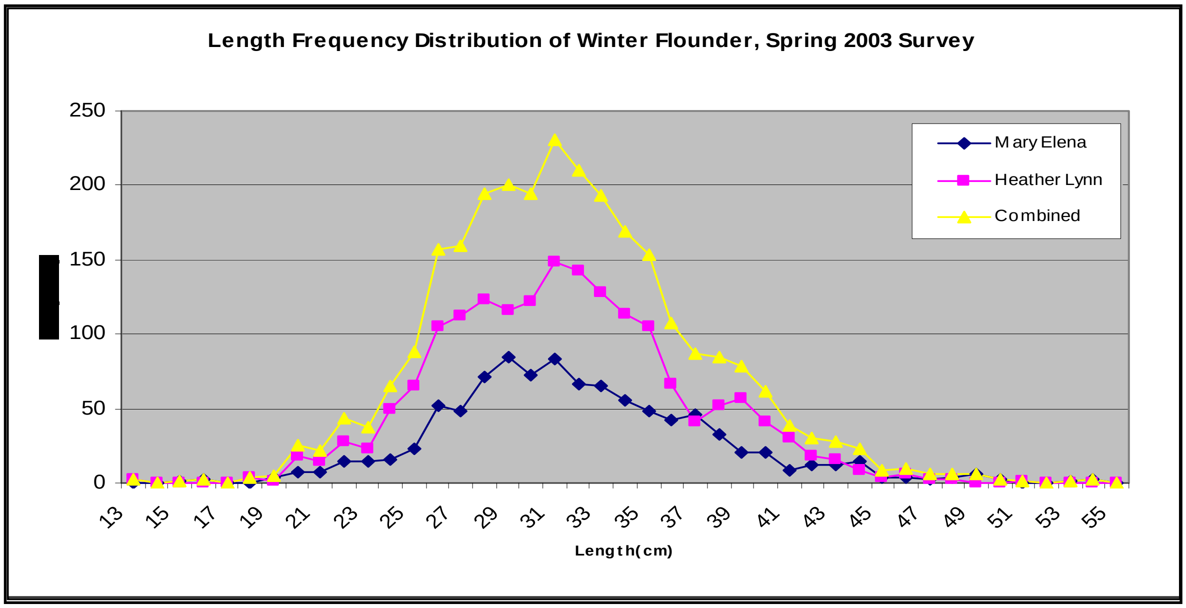


Figure 3 Flounder species composition caught in Spring, 2003 survey

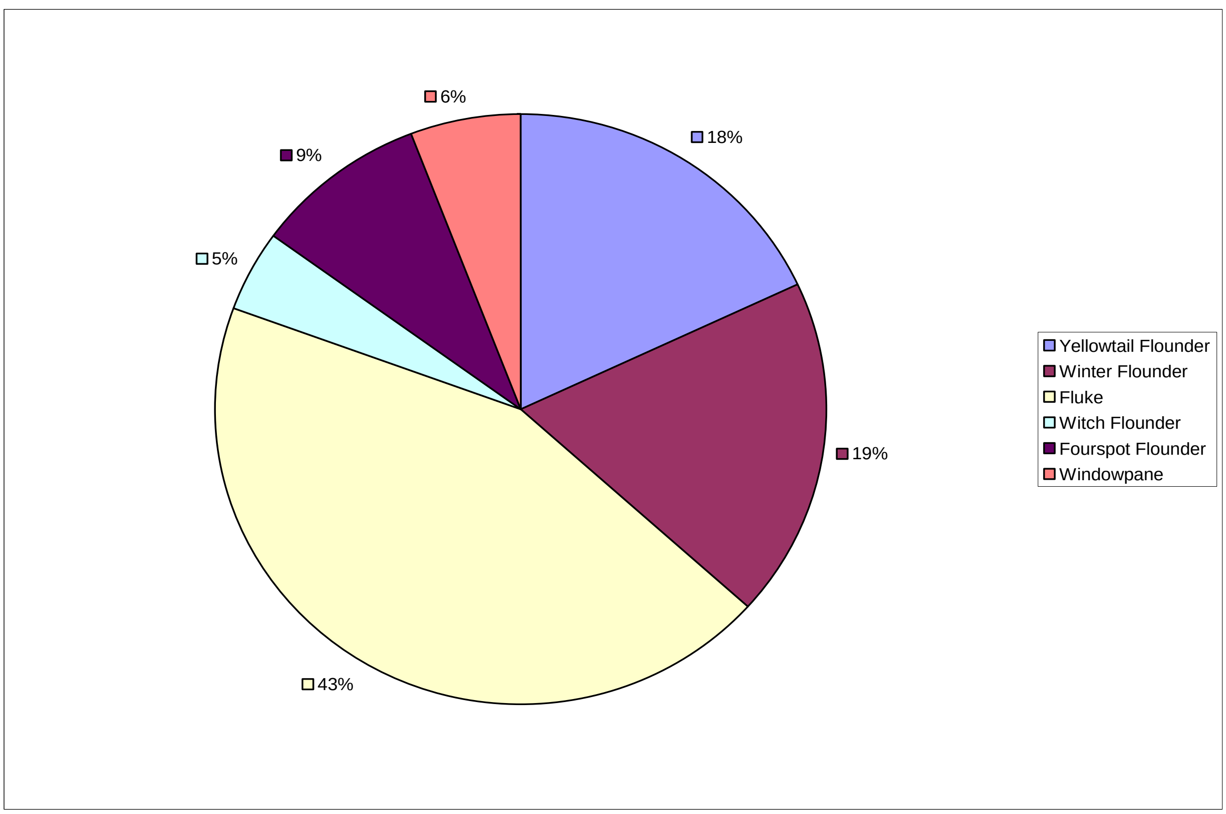


Figure 4

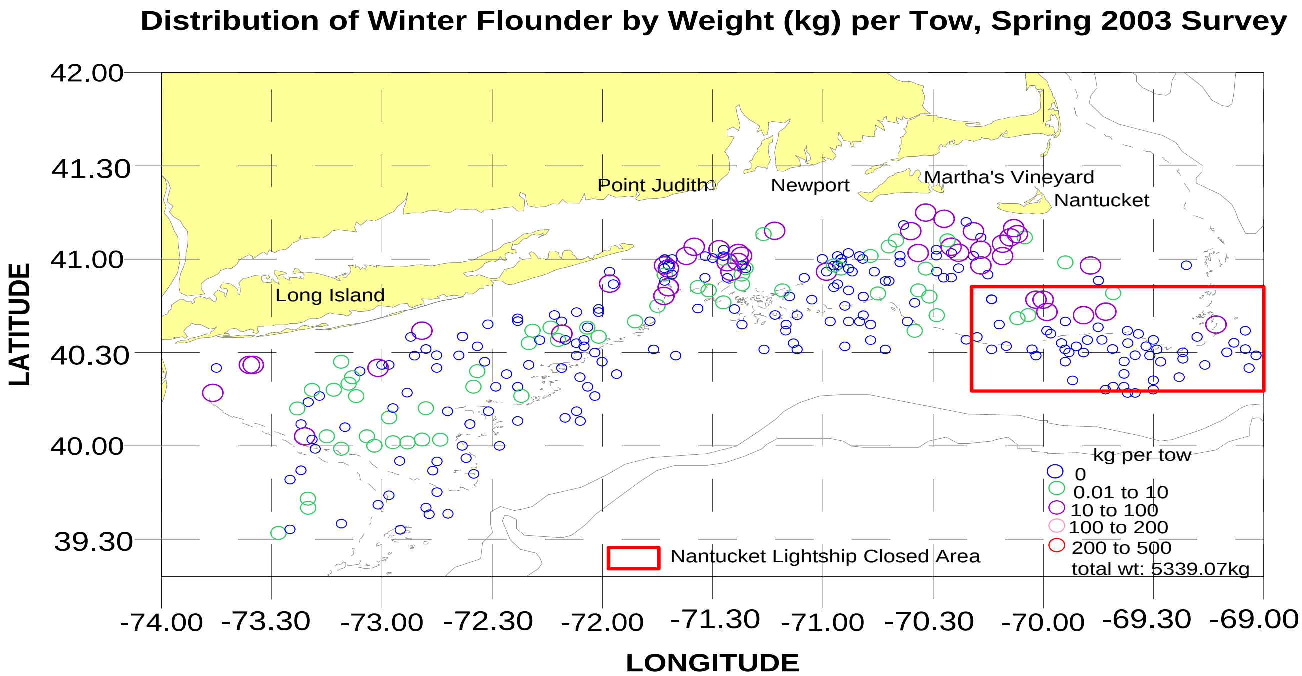
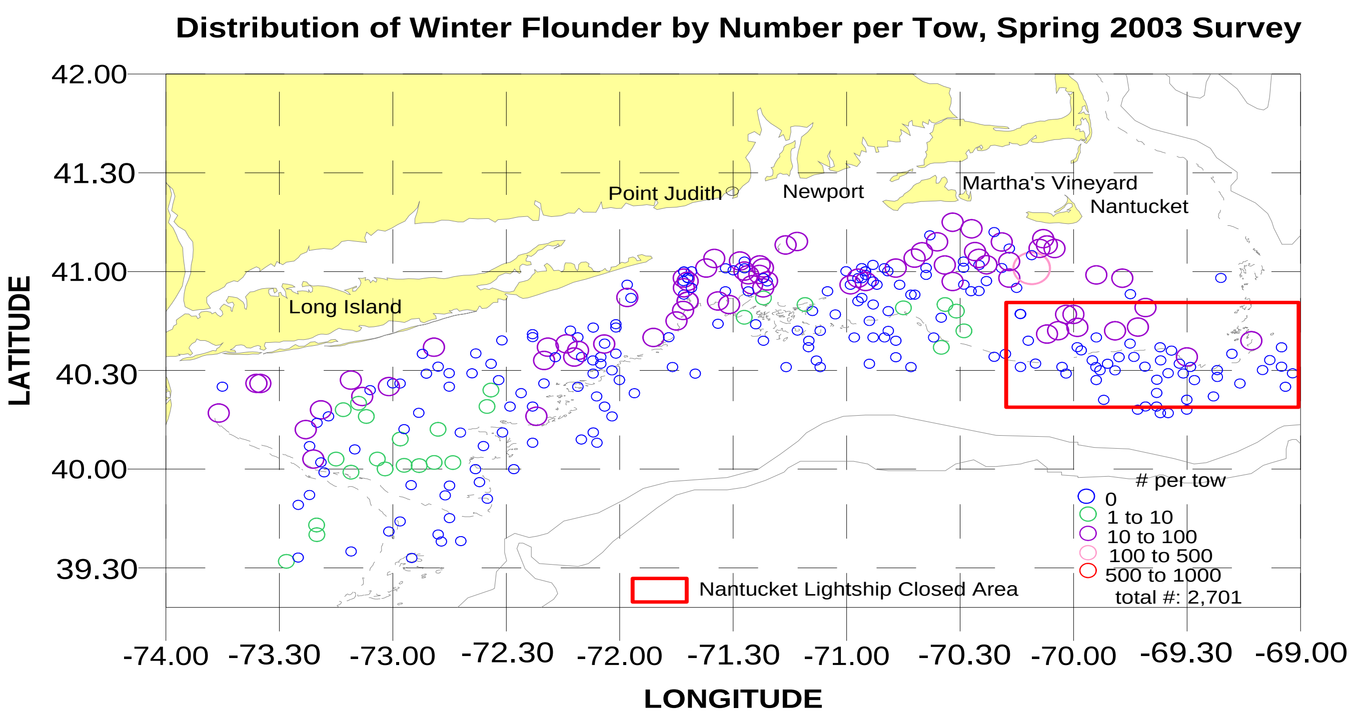
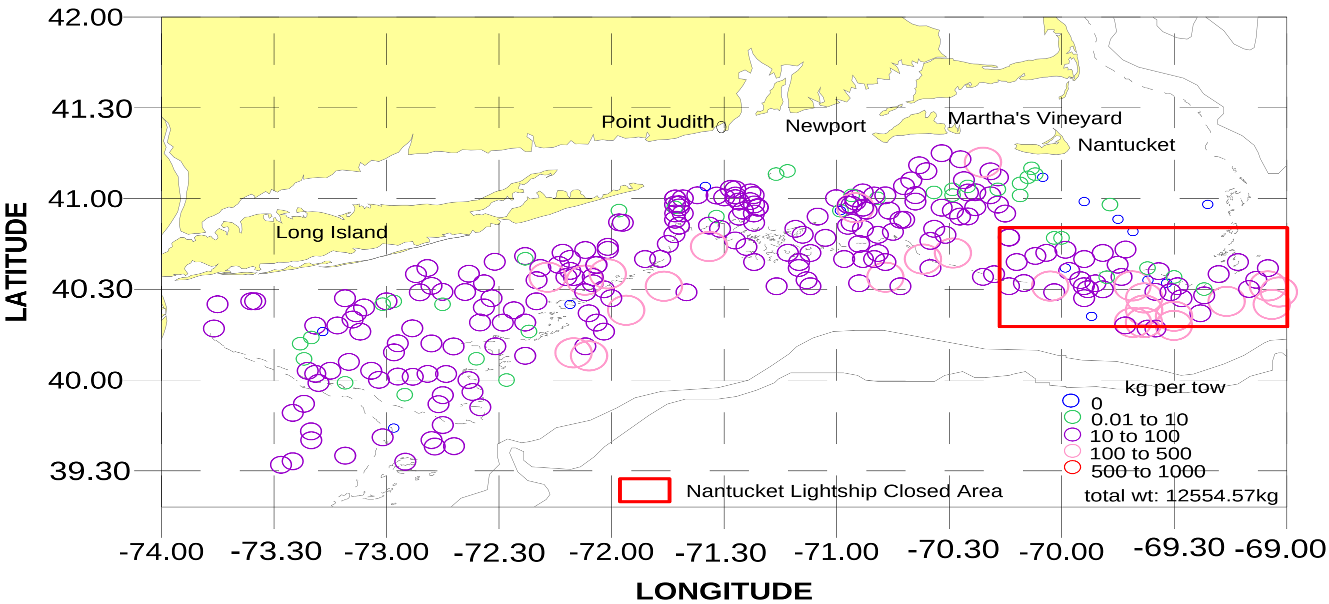


Figure 5

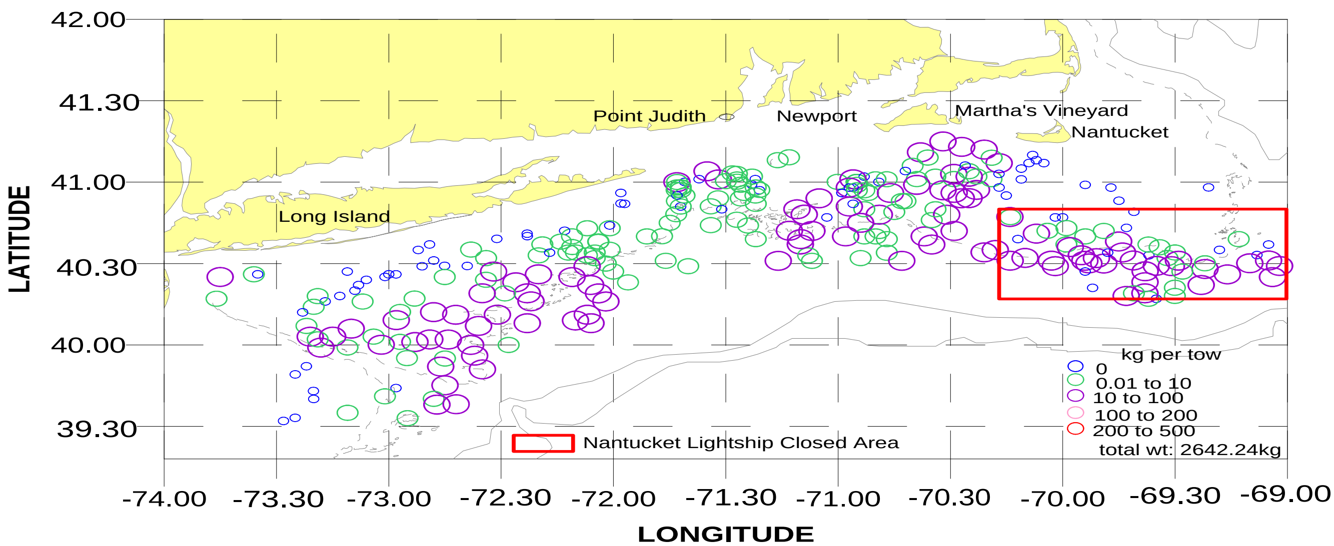


Figures 6-8

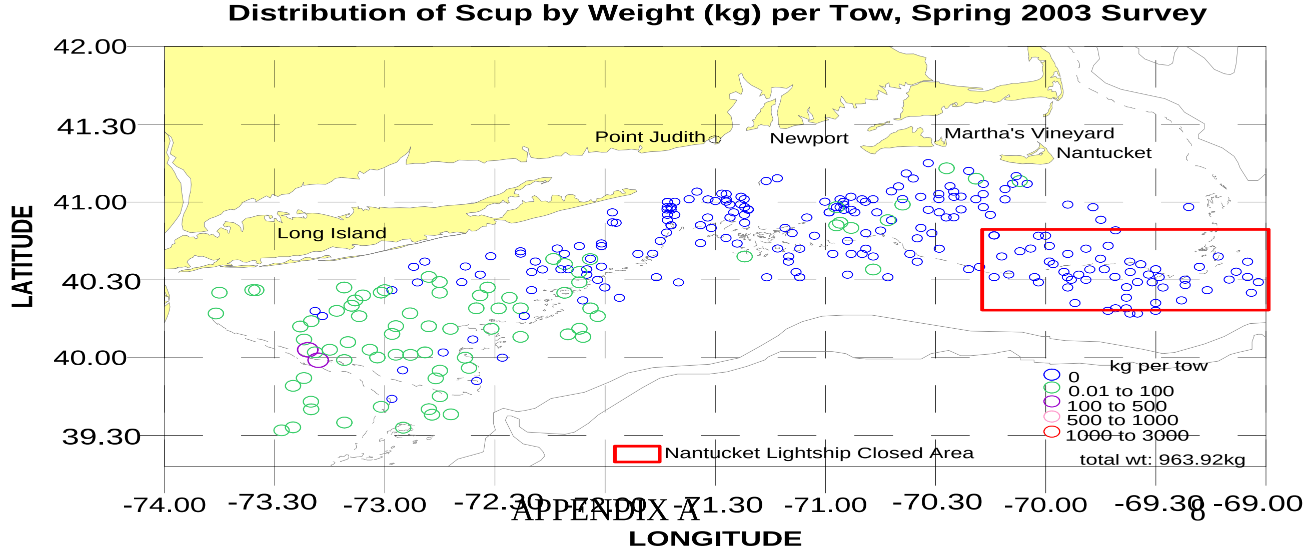
Distribution of Summer Flounder by Weight (kg) per Tow, Spring 2003 Survey



Distribution of Fourspot Flounder by Weight (kg) per Tow, Spring 2003 Survey

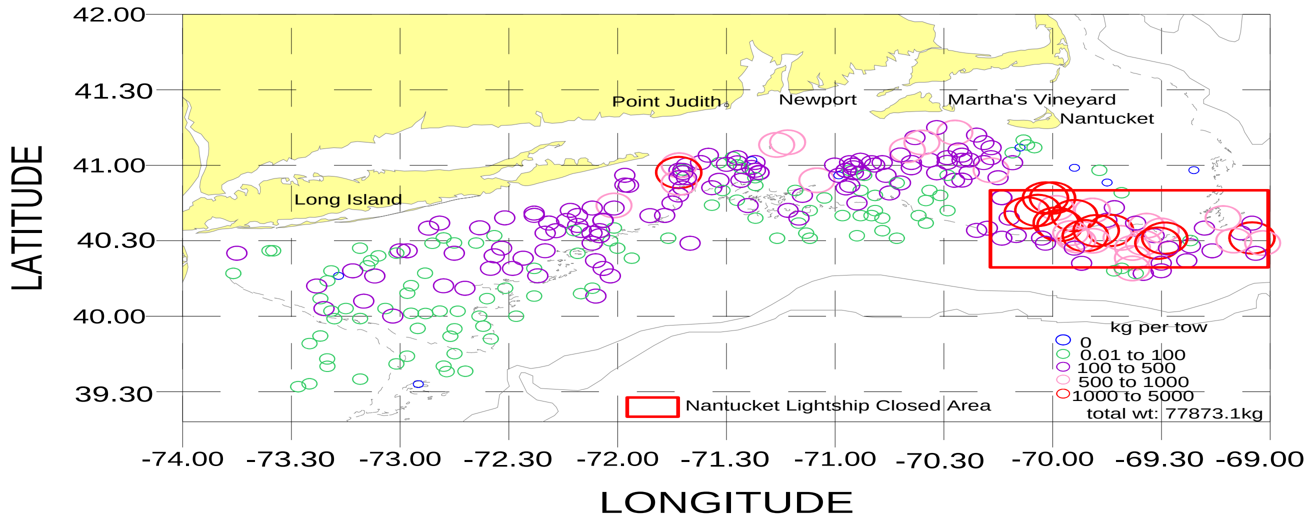


Distribution of Scup by Weight (kg) per Tow, Spring 2003 Survey

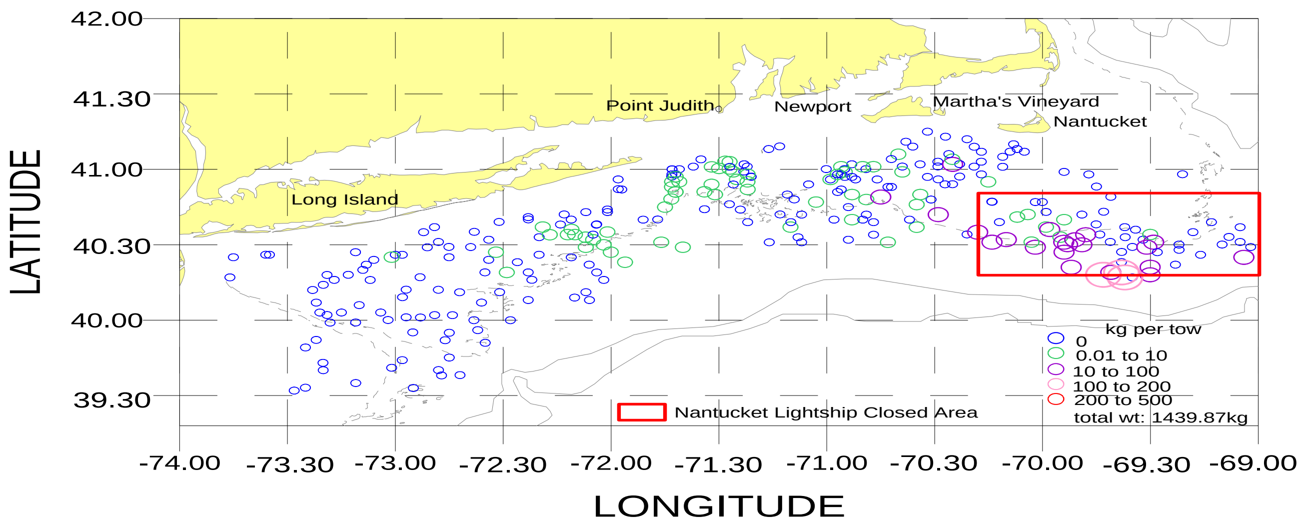


Figures 9-11

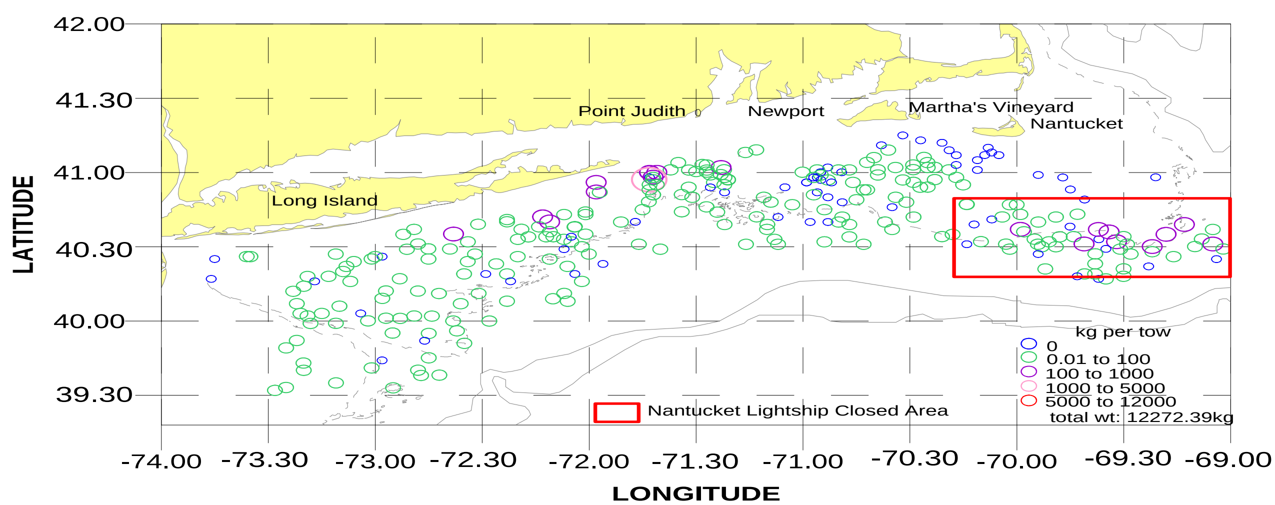
Distribution of Skates(Little+Winter) by Weight(kg) per Tow, Spring 2003 Survey



Distribution of Barndoor Skates by Weight(kg) per Tow, Spring 2003 Survey

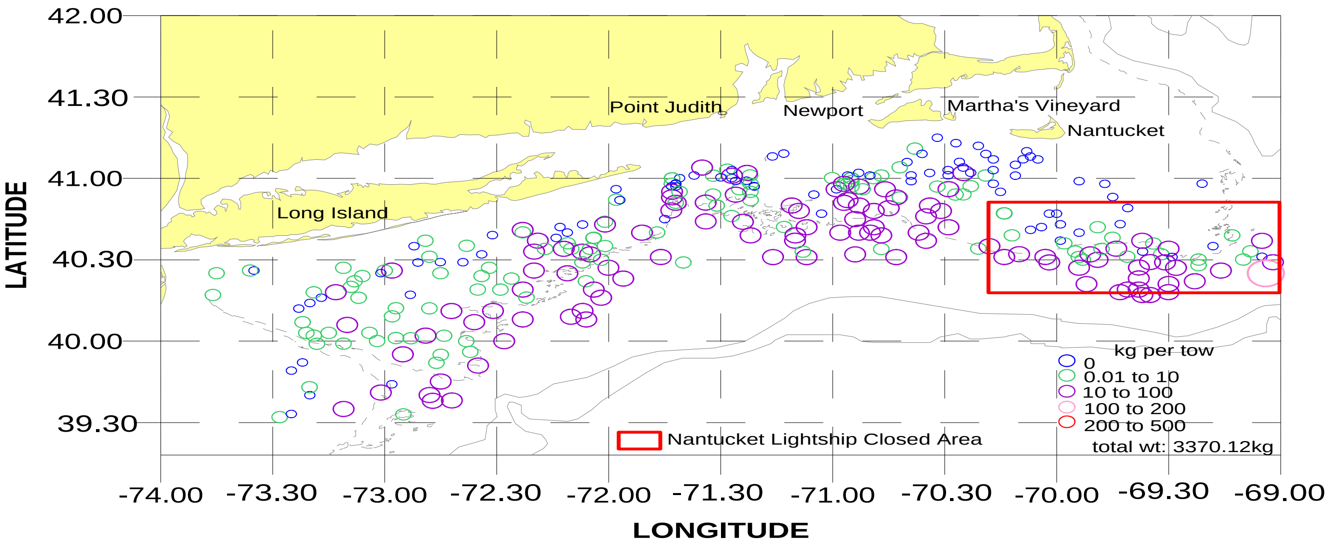


Distribution of Dogfish(Smooth + Spiny) by Weight (kg) per Tow, Spring 2003 Survey

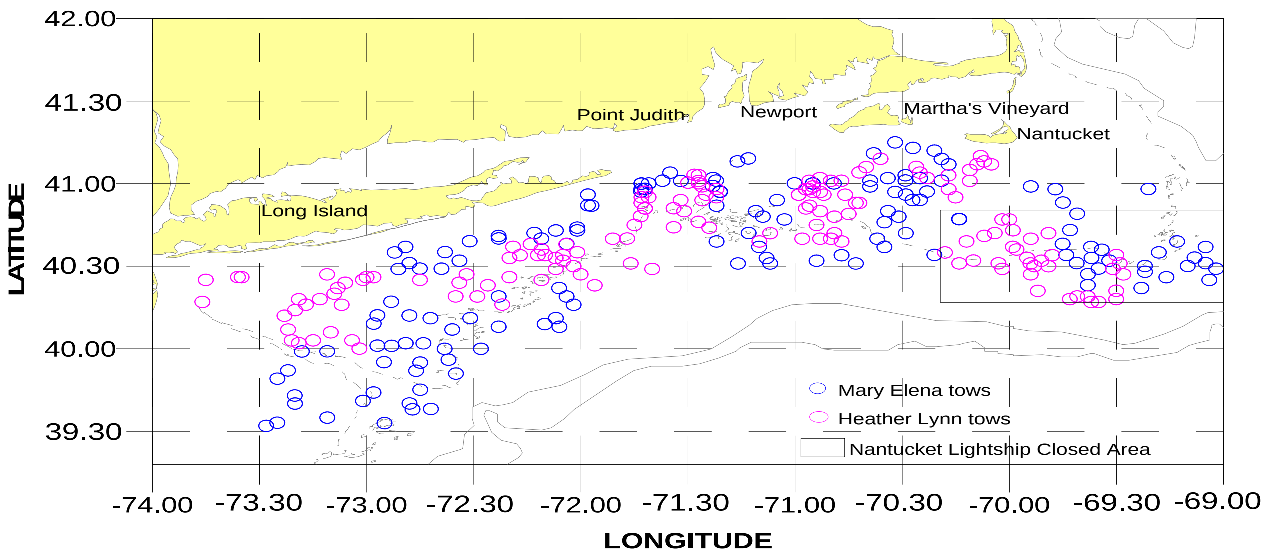


Figures 12-14

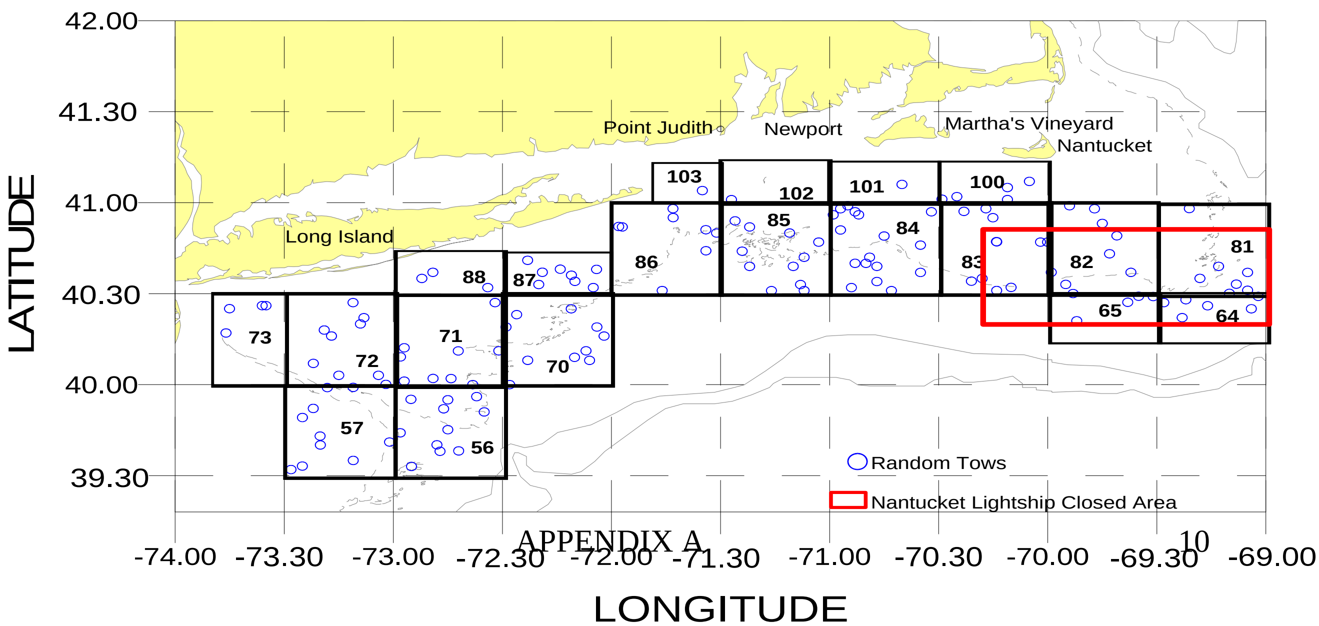
Distribution of Monkfish by Weight (kg) per Tow, Spring 2003 Survey



Tow Locations by Boat, Spring 2003 Survey



Random Tow Locations, Spring 2003 Survey



2004 DISTRIBUTION PLOTS AND TABLES

Table 1: **Species** Total Weights for Heather Lynn & Mary Elena, Fall 2003
(yellowtail & winter numbers actual, due to low subsample size, expanded numbers on all other species should be considered estimates)

	HL Total Weight (kg)	ME Total Weight (kg)	Total Weight (kg)
Species			
Yellowtail	745.11	969.78	1714.89
Winter Flounder	4395.83	5285.44	9681.27
Fluke	7050.51	12047.35	19097.86
Witch Flounder	84.38	74.53	158.91
Fourspot Flounder	4022.21	4768.29	8790.50
Windowpane	647.24	347.41	994.65
Monkfish	3478.56	4162.24	7640.80
Black Sea Bass	1473.00	1044.22	2517.22
Scup	563.37	4199.02	4762.39
Barndoor Skate	396.70	624.69	1021.39
Skates (unc)	38483.03	50699.31	50699.31
Dogfish (unc)	48634.48	52501.44	101135.92
Scallop	2861.08	1492.15	4353.23
All Others	21567.21	14315.33	35882.54
Total	134402.70	152531.20	286933.9

Figure 1

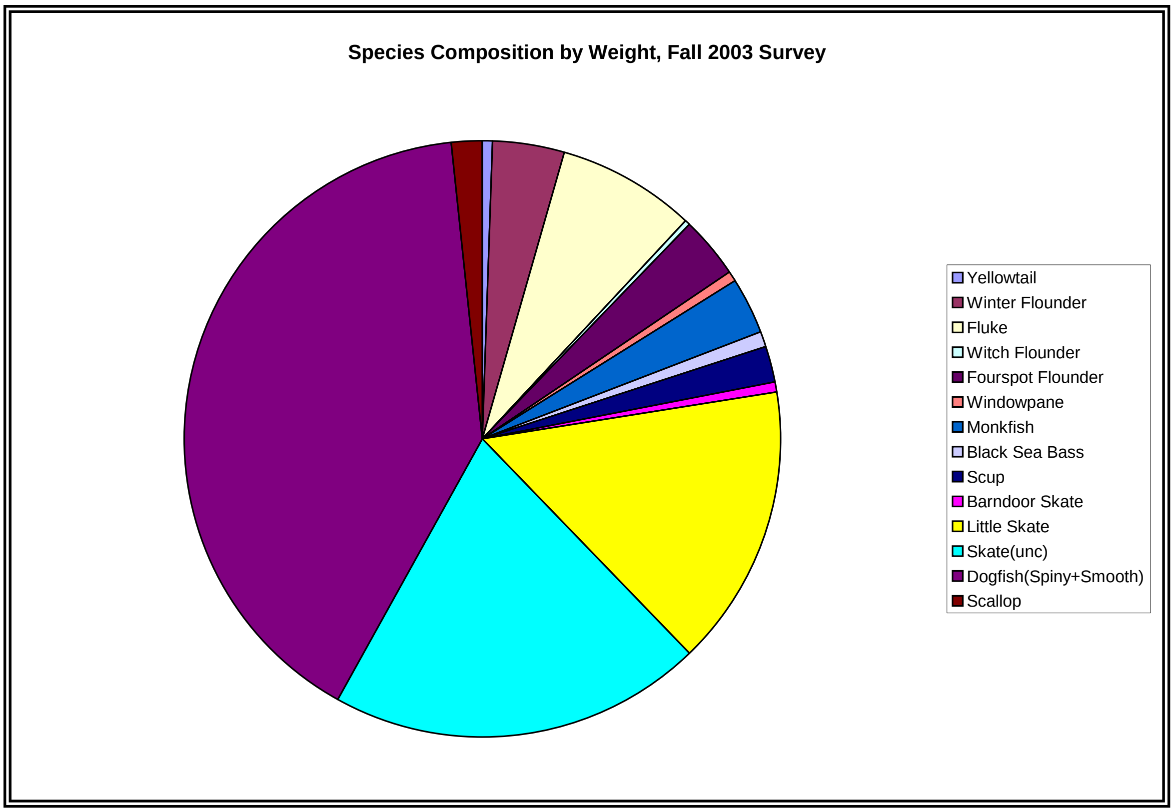
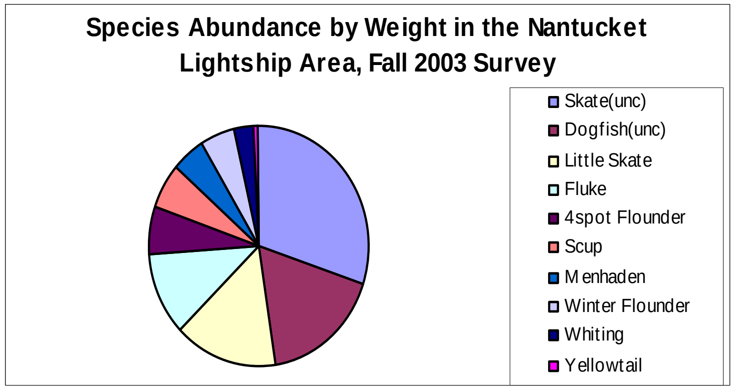
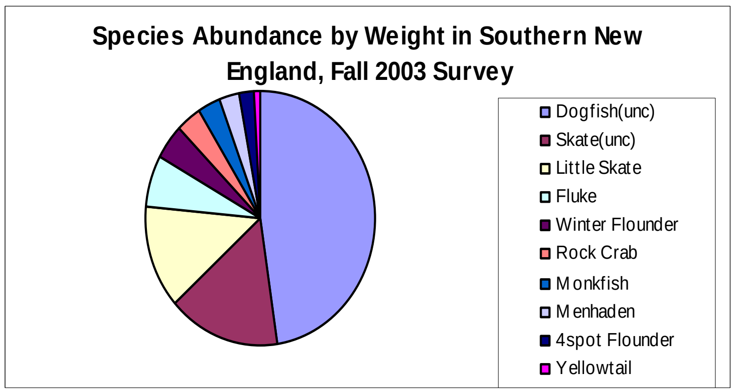


Table 2: Top 10 species by weight (east, central, west)

Nantucket Lightship Area	
Species	***Weight***
Skate(unc)	17757.19
Dogfish(unc)	10001.30
Little Skate	8816.69
Fluke	6507.17
4spot Flounder	3904.51
Scup	3584.27
Menhaden	2940.56
Winter Flounder	2922.00
Whiting	1826.15
Yellowtail	288.46



Southern New England	
Species	***Weight***
Dogfish(unc)	51281.75
Skate(unc)	17373.26
Little Skate	13971.97
Fluke	7233.05
Winter Flounder	4743.03
Rock Crab	3895.56
Monkfish	3574.64
Menhaden	2846.89
4spot Flounder	2562.16
Yellowtail	842.57



Mid-Atlantic	
Species	***Weight***
Dogfish(unc)	39852.87
Skate(unc)	15568.86
Little Skate	15694.37
Fluke	5357.64
Scallop	3695.92
4spot Flounder	2323.83
Monkfish	2311.46
Winter Flounder	2016.24
Rosette Skate	1678.84
Yellowtail	583.86

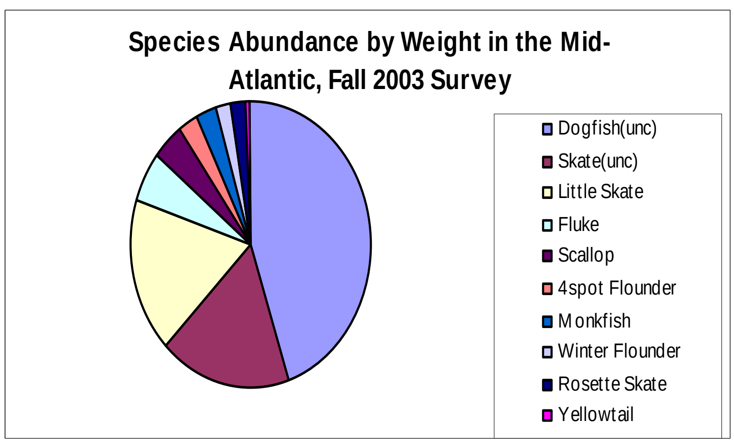
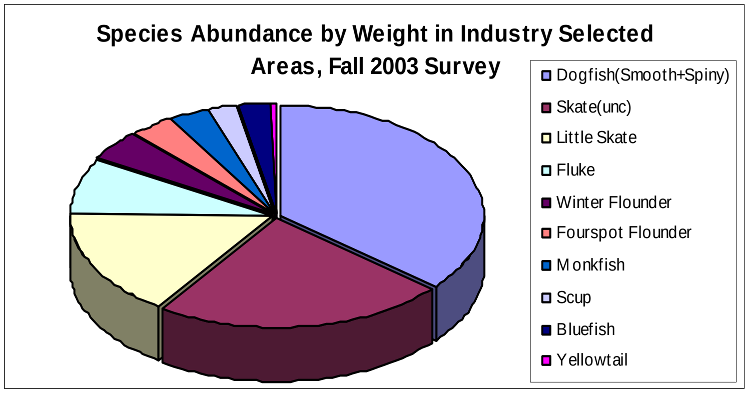


Table 3: Top 10 Species, Industry vs Random Tows

Species	*Weight*
Dogfish(Smooth+Spiny)	43537.55
Skate(unc)	28132.40
Little Skate	19183.92
Fluke	9756.05
Winter Flounder	5525.45
Fourspot Flounder	4360.27
Monkfish	3725.53
Scup	2969.05
Bluefish	2726.54
Yellowtail	885.62



Species	*Weight*
Dogfish(Smooth+Spiny)	57598.37
Skate(unc)	22566.91
Little Skate	19299.11
Fluke	9341.81
Fourspot Flounder	4430.23
Winter Flounder	4155.82
Monkfish	3915.27
Menhaden	3139.65
Rock Crab	2910.26
Yellowtail	829.27

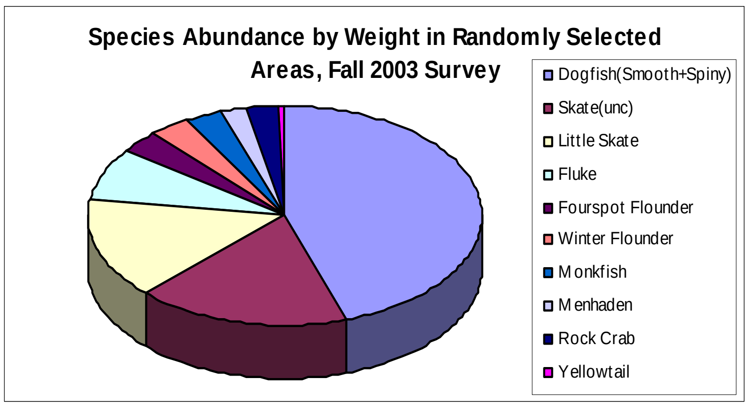


Figure 2

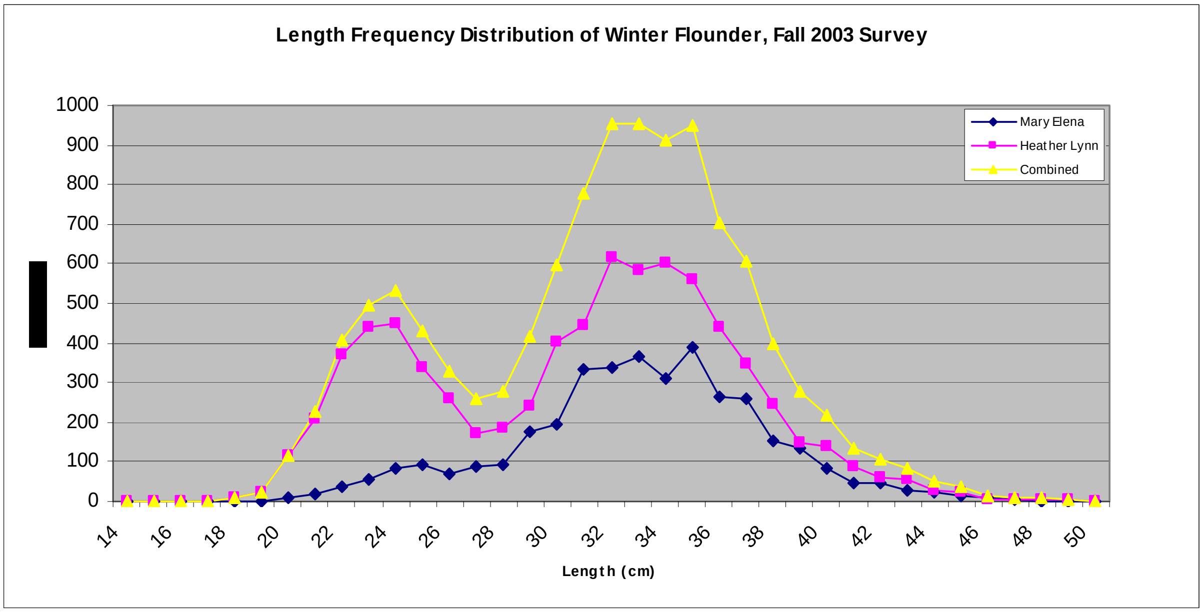


Figure 3

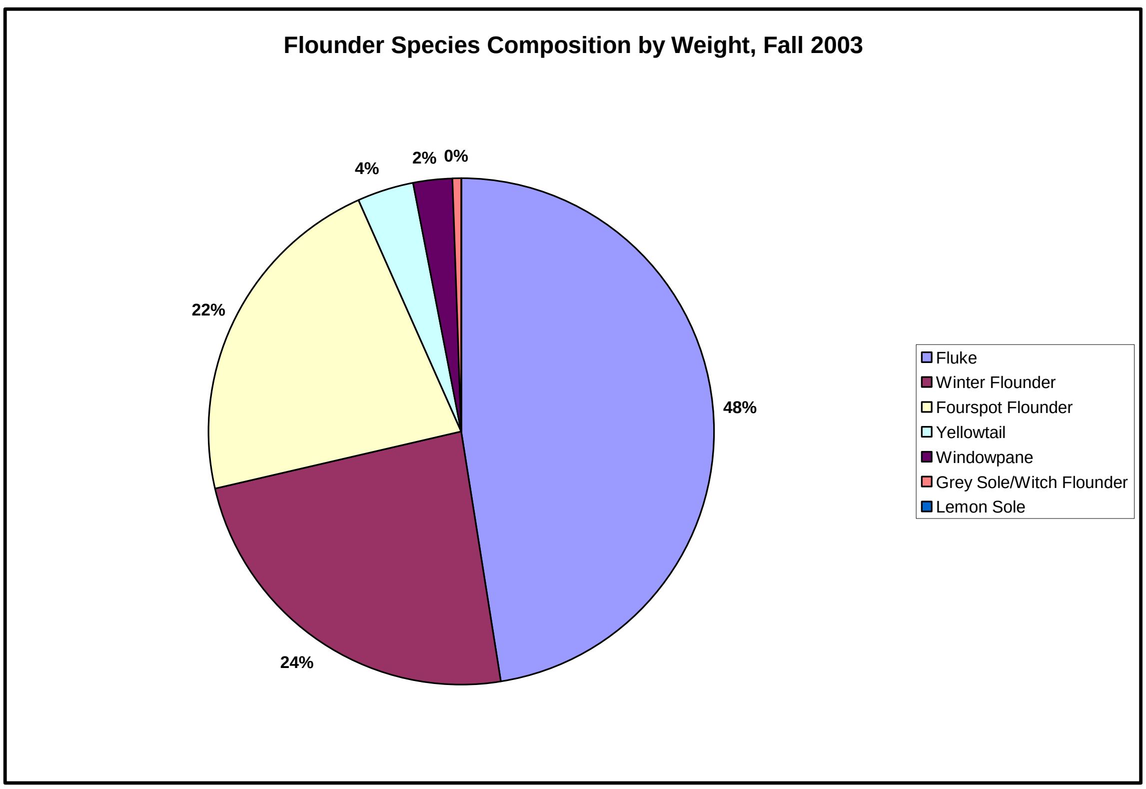


Figure 4

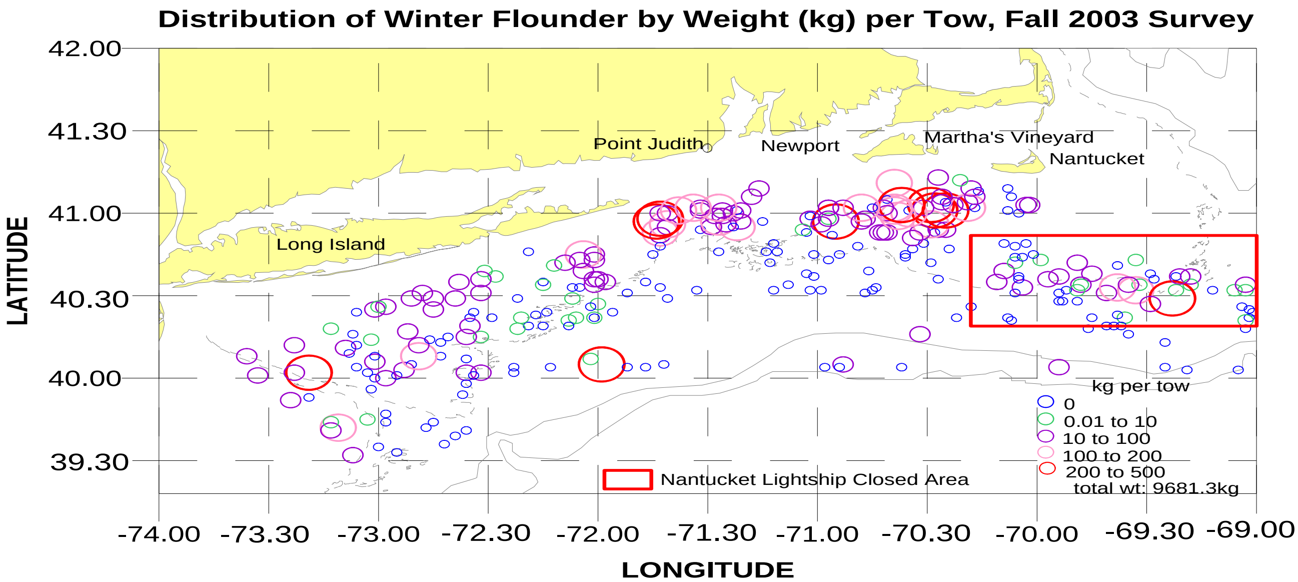
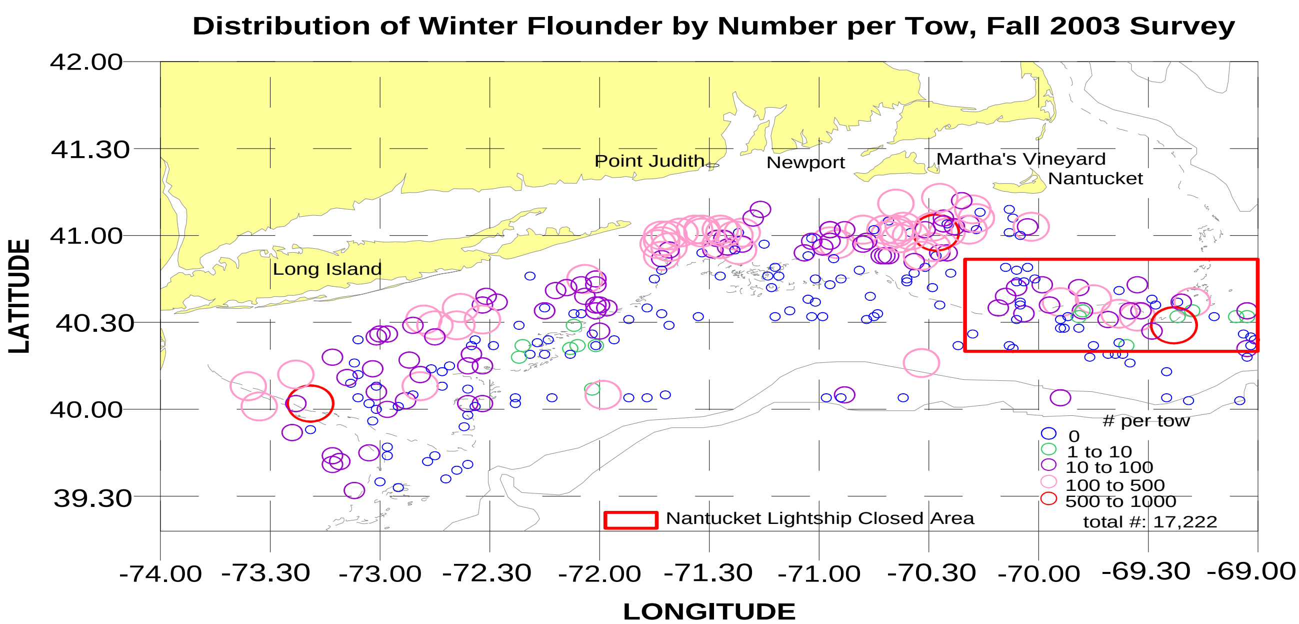


Figure 5



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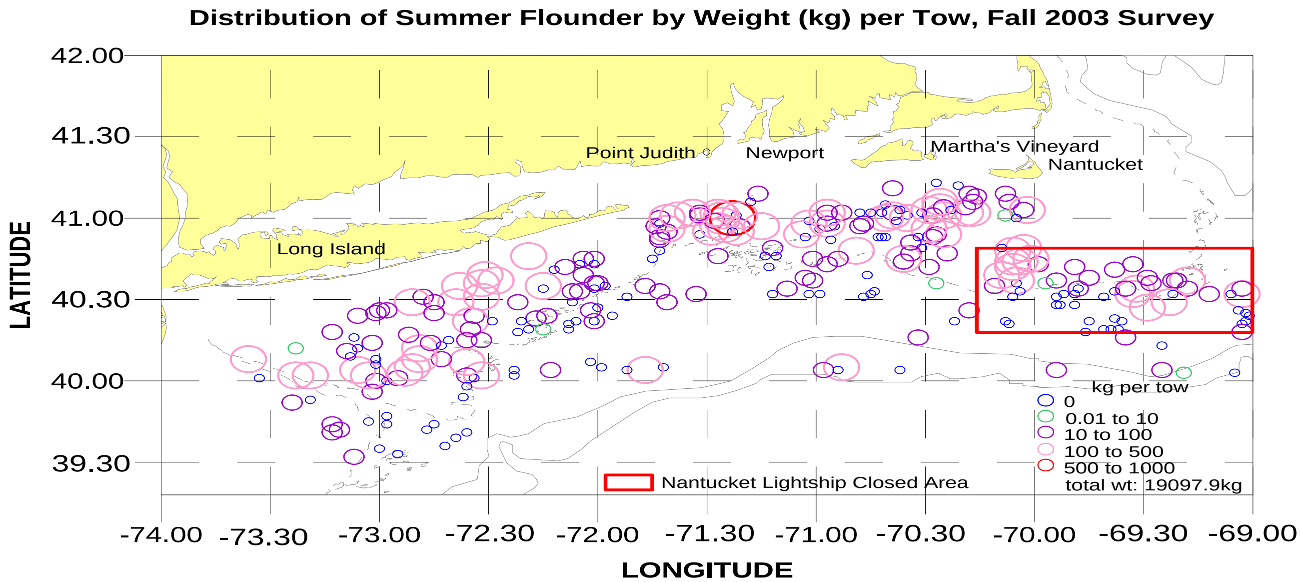


Figure 7

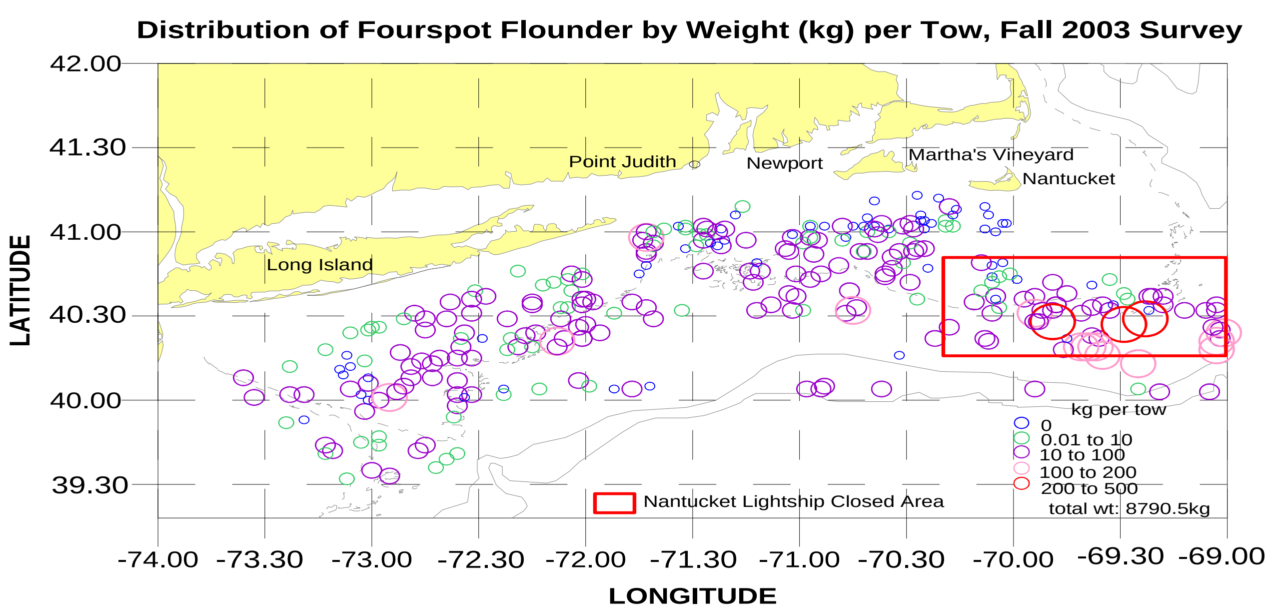


Figure 8

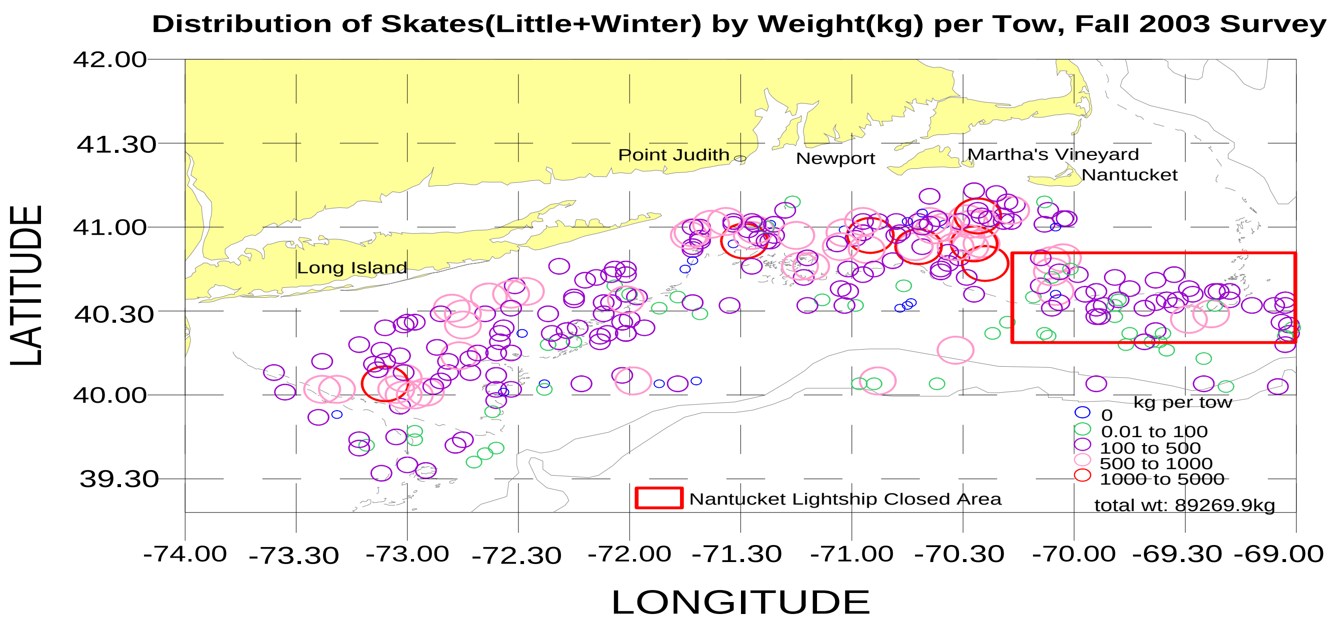
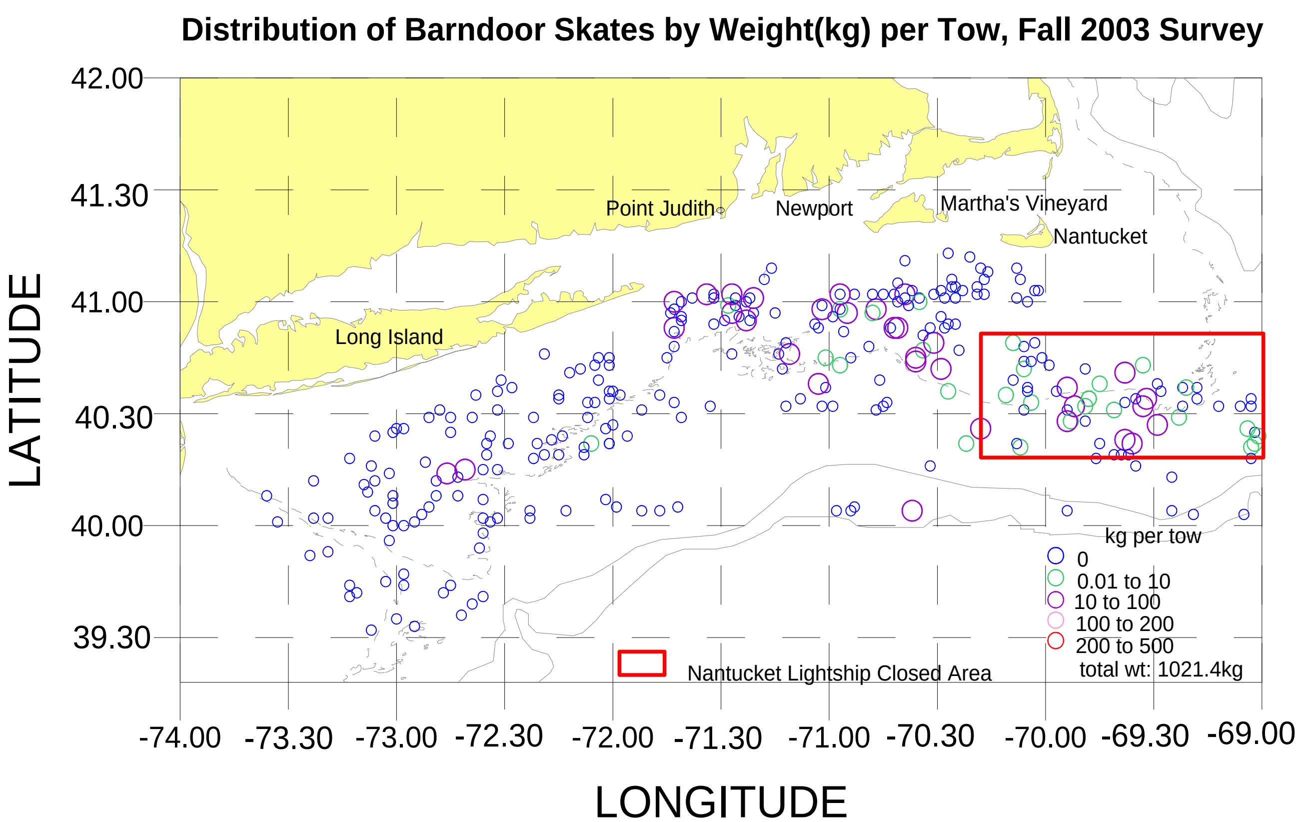


Figure 9



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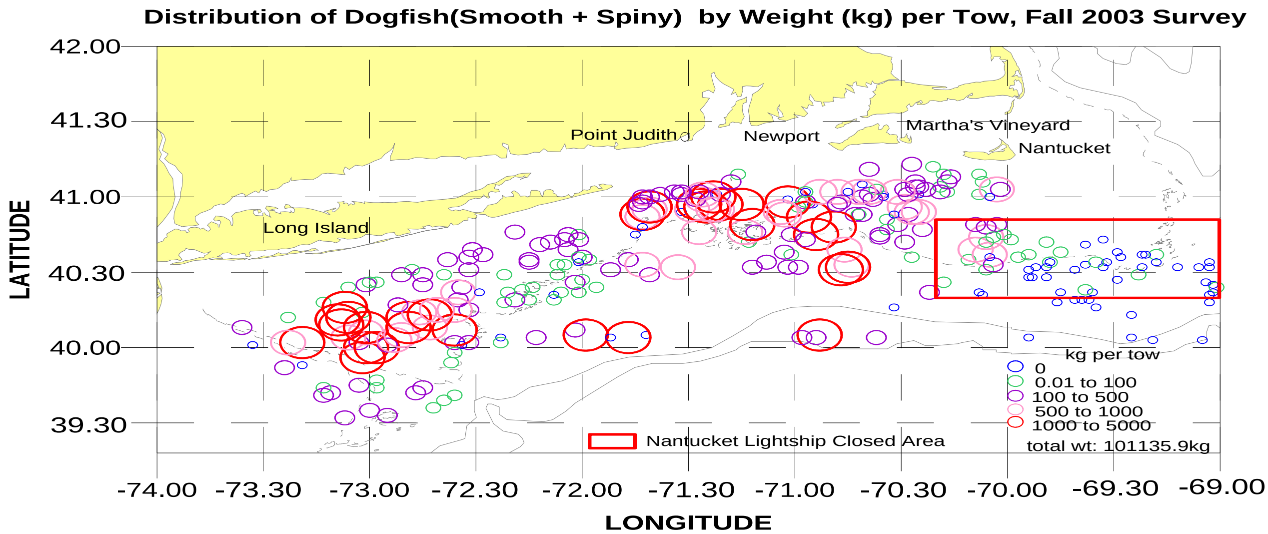


Figure 11

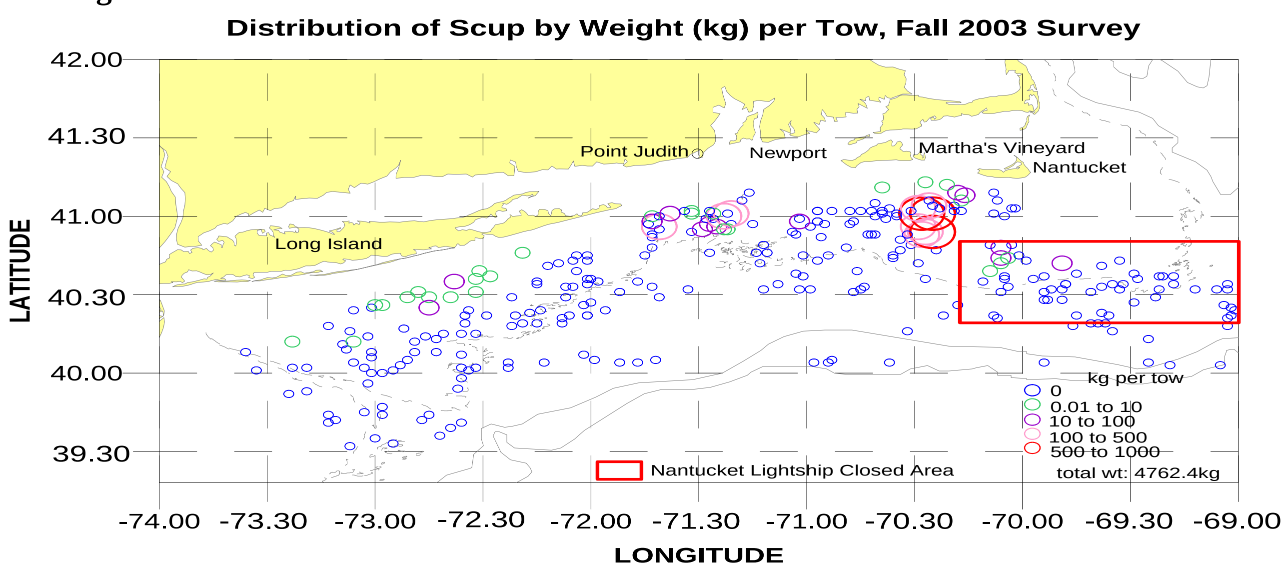


Figure 12

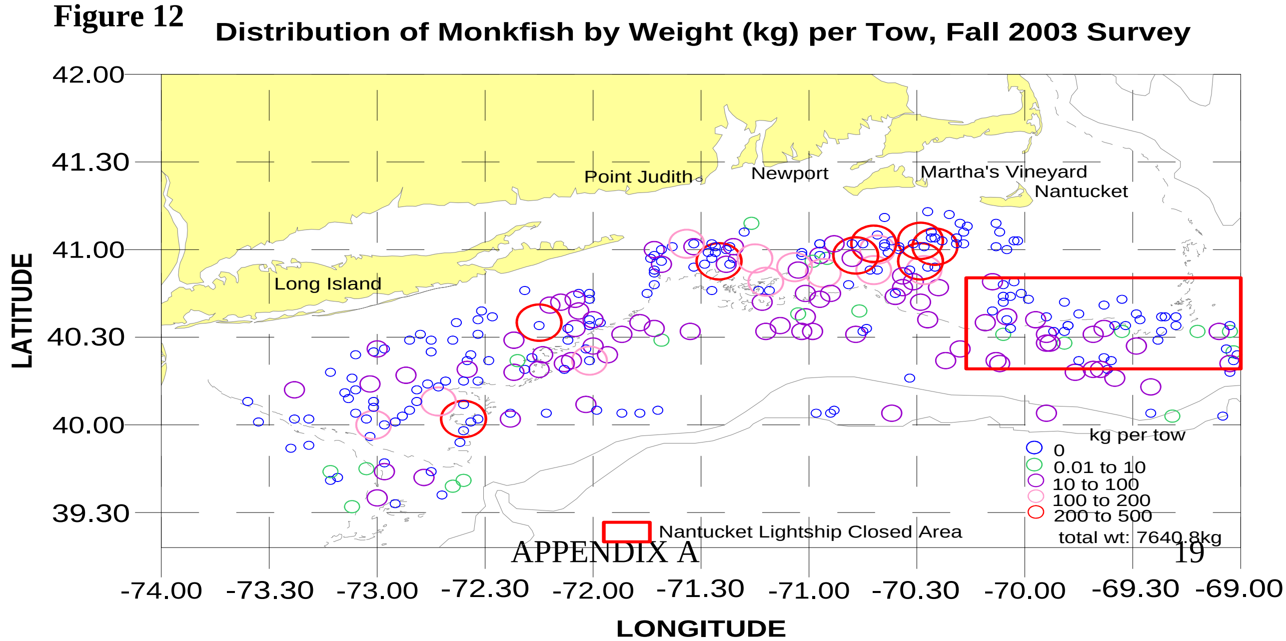


Figure 13

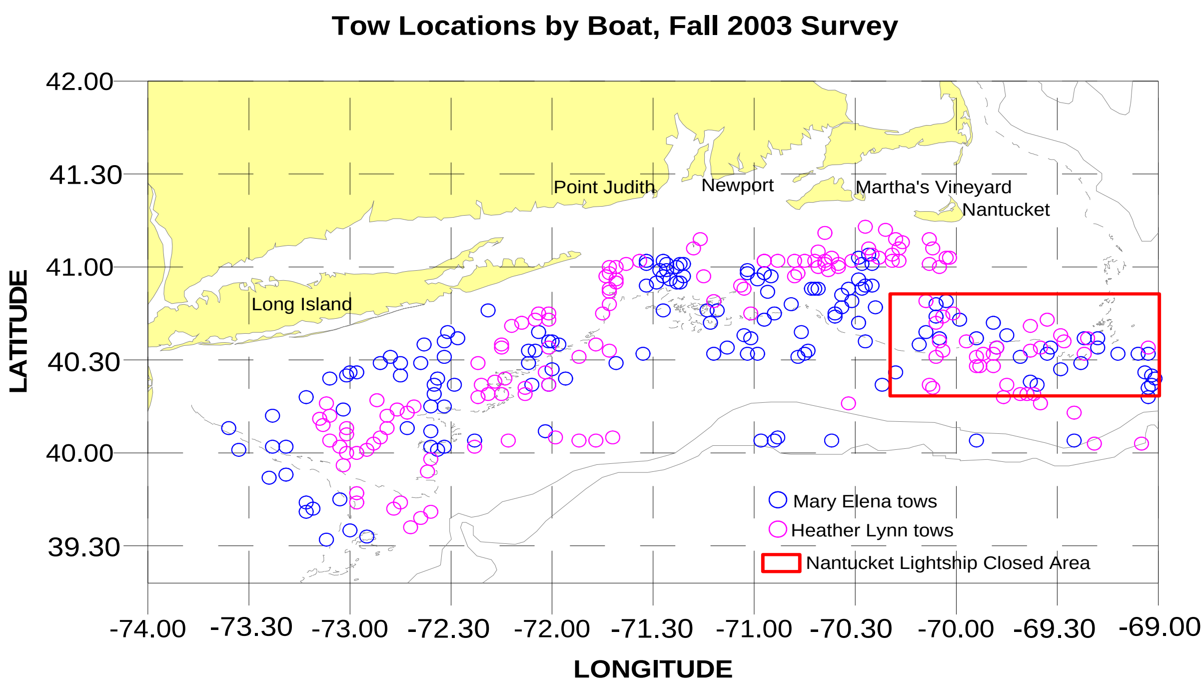
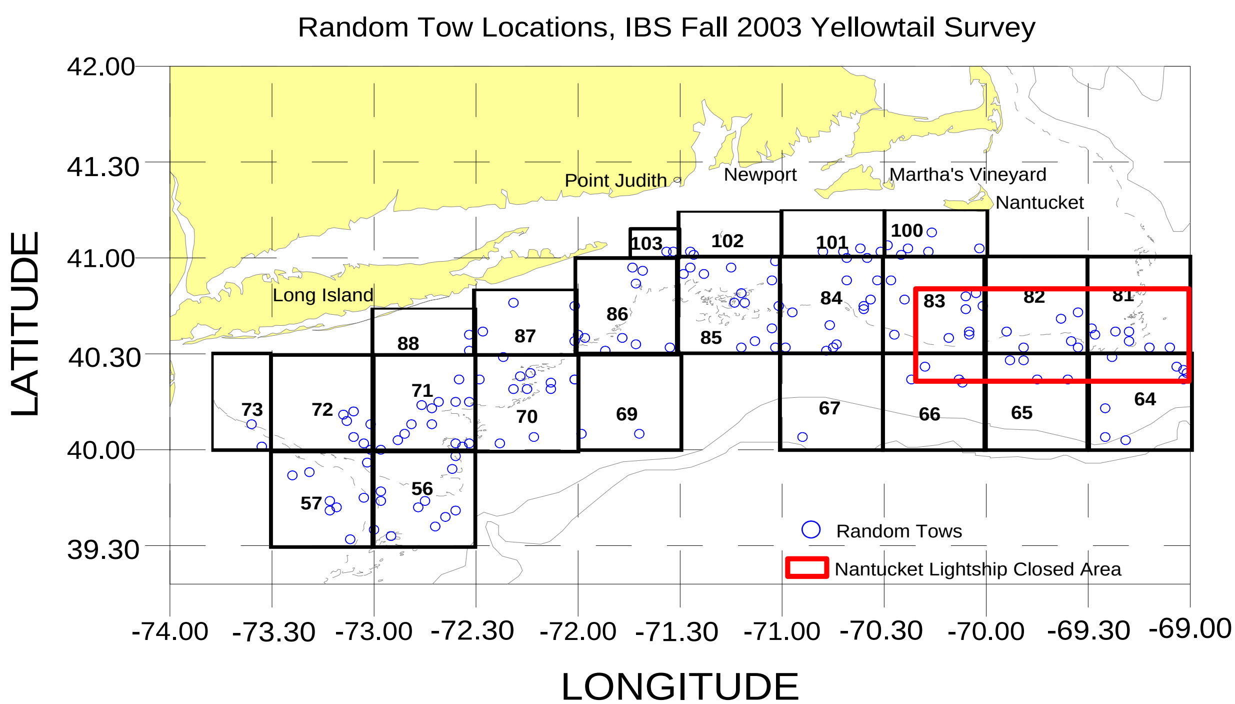


Figure 14



2004
DISTRIBUTION PLOTS AND TABLES

Table 1 : Species Total Weights for Heather Lynn & Mary Elena

Species	*ME Total Weight(kg)*	*HL Total Weight(kg)*	*Total Weight(kg)*
Barndoor Skate	152.5	0	152.5
Black Sea Bass	0.7	0.1	0.8
Dogfish(unc)	573.7	40.43	614.13
Fourspot Flounder	1921.3	521.8	2443.1
Monkfish	1580.1	366	1946.1
Scup	0	9.7	9.7
Sea Scallop	630.4	698.5	1328.9
Skates(unc)	39355.3	39076.7	78432
Spiny Dogfish	3604.9	5819.4	9424.3
Summer Flounder	2096.6	872.3	2968.9
Windowpane Flounder	862.5	625	1487.5
Winter Flounder	1877.7	1645.3	3523
Witch Flounder	658.5	210.2	868.7
Yellowtail Flounder	1506.9	1875.5	3382.4
Other species	19297.02	14460.292	33757.312
Total	74118.12	66221.222	143470.38

Figure 1

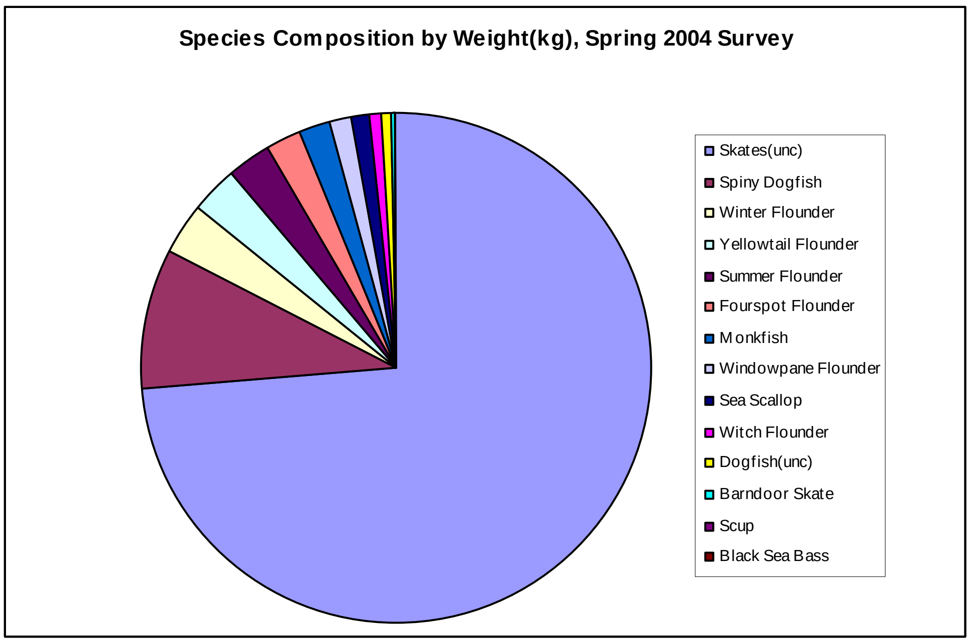
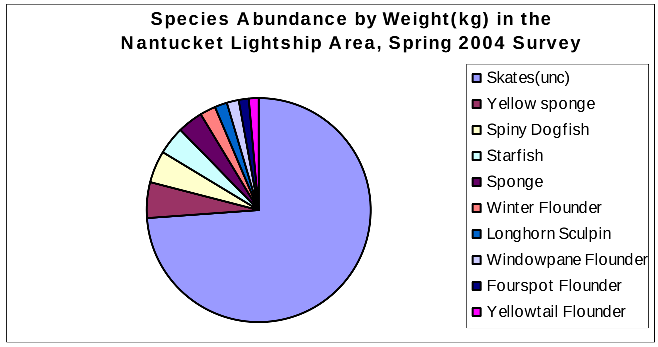
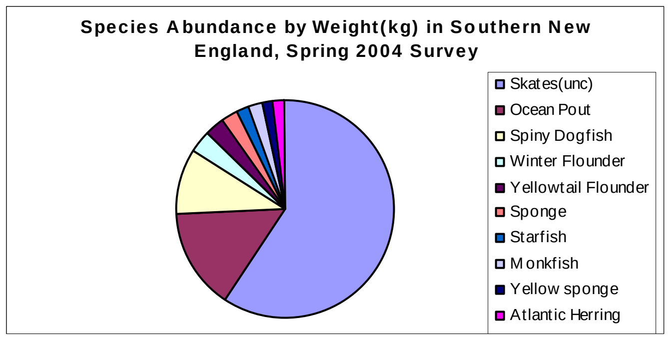


Table 2 : Top 10 Species Abundance by Weight (east, central, west)

Nantucket Lightship Area	
Species	**Weight(kg)**
Skates(unc)	27939.4
Yellow sponge	1904.9
Spiny Dogfish	1781.8
Starfish	1524.44
Sponge	1412.6
Winter Flounder	825.5
Longhorn Sculpin	639.5
Windowpane Flounder	636.9
Fourspot Flounder	599.3
Yellowtail Flounder	498.634



Southern New England	
Species	**Weight(kg)**
Skates(unc)	33708.8
Ocean Pout	8593.5
Spiny Dogfish	5578.3
Winter Flounder	1985.4
Yellowtail Flounder	1624.7
Sponge	1441.7
Starfish	1141
Monkfish	1117.3
Yellow sponge	958.7
Atlantic Herring	944.9



Mid-Atlantic	
Species	**Weight(kg)**
Skates(unc)	16783.8
Ocean Pout	9493.2
Spiny Dogfish	2064.2
Summer Flounder	1706.9
Fourspot Flounder	1310.1
Yellowtail Flounder	1259.07
Starfish	1110.11
Yellow sponge	855.2
Sea Scallops	737.7
Winter Flounder	712.1

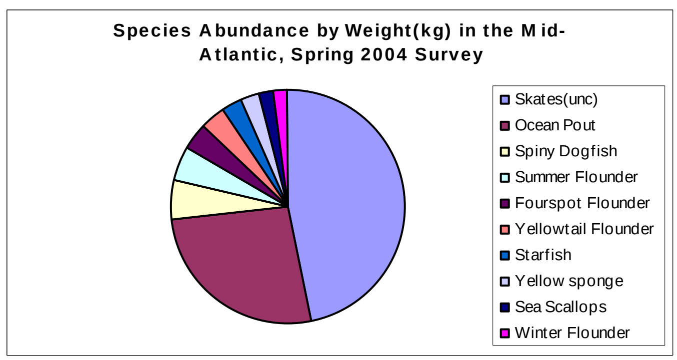


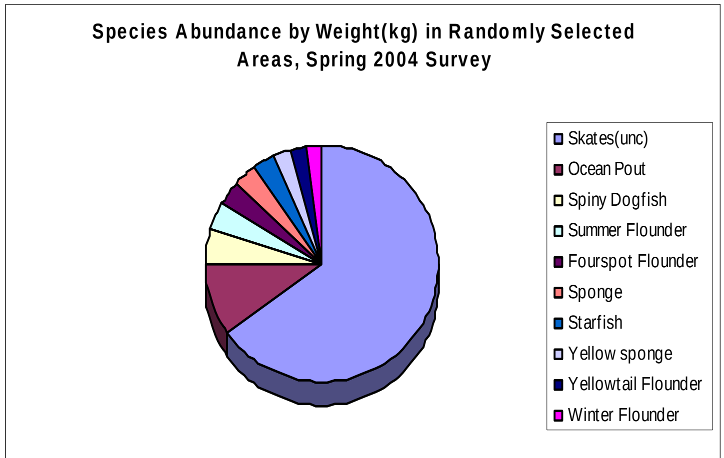
Table 3: Top 10 Species Abundance by Weight & Number: Industry vs. Random Tows

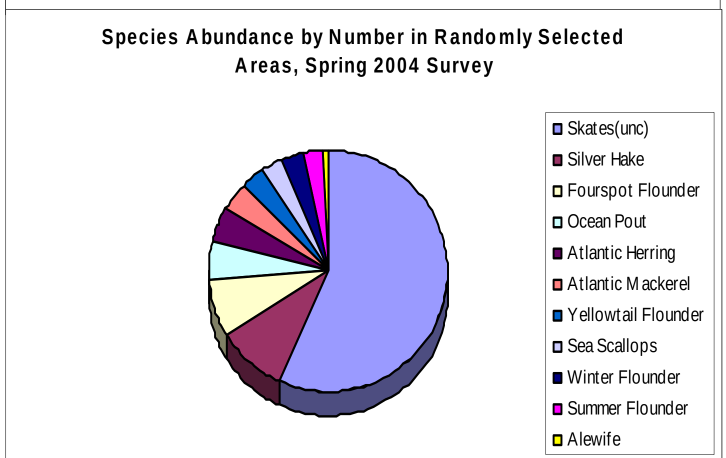
Species	Weight(kg)
Skates(unc)	37741.7
Ocean Pout	5798.7
Spiny Dogfish	2883.4
Summer Flounder	2192.9
Fourspot Flounder	1910.8
Sponge	1868.9
Starfish	1743.41
Yellow sponge	1403.1
Yellowtail Flounder	1308.66
Winter Flounder	1307.9

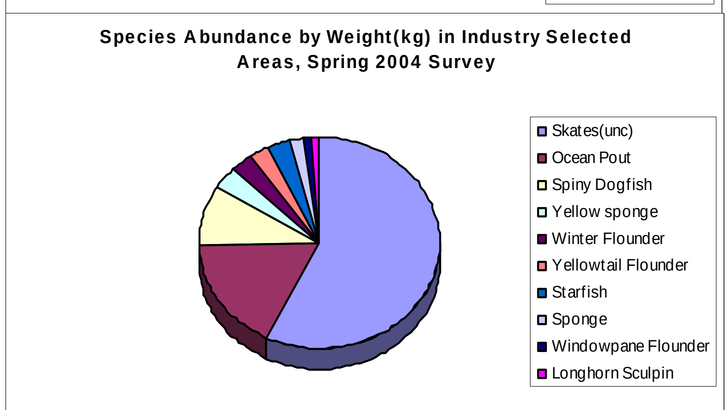
Species	Number
Skates(unc)	59398
Silver Hake	9909
Fourspot Flounder	8142
Ocean Pout	5248
Atlantic Herring	5002
Atlantic Mackerel	4037
Yellowtail Flounder	3348
Sea Scallops	3159
Winter Flounder	3103
Summer Flounder	2723
Alewife	813

Species	Weight(kg)
Skates(unc)	40690.3
Ocean Pout	12462.3
Spiny Dogfish	6540.9
Yellow sponge	2315.7
Winter Flounder	2215.1
Yellowtail Flounder	2073.744
Starfish	2032.14
Sponge	1185.8
Windowpane Flounder	878.4
Longhorn Sculpin	793.3

Species	Number
Skates(unc)	66973
Ocean Pout	11411
Silver Hake	9962
Winter Flounder	6372
Atlantic Herring	5667
Yellowtail Flounder	5601
Windowpane Flounder	3977
Spiny Dogfish	3517
Longhorn Sculpin	2494
Starfish	1987







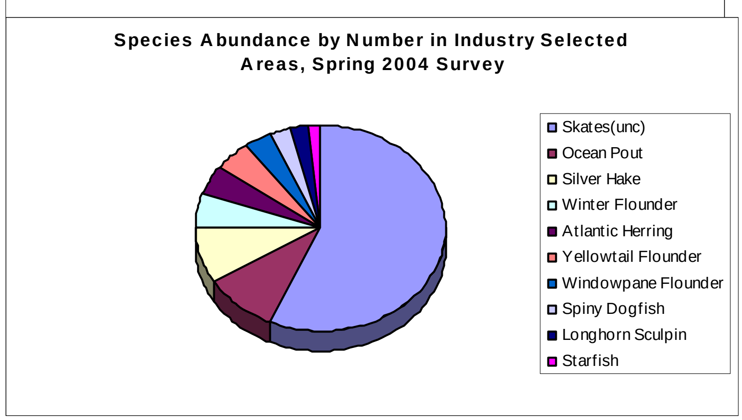


Figure 2

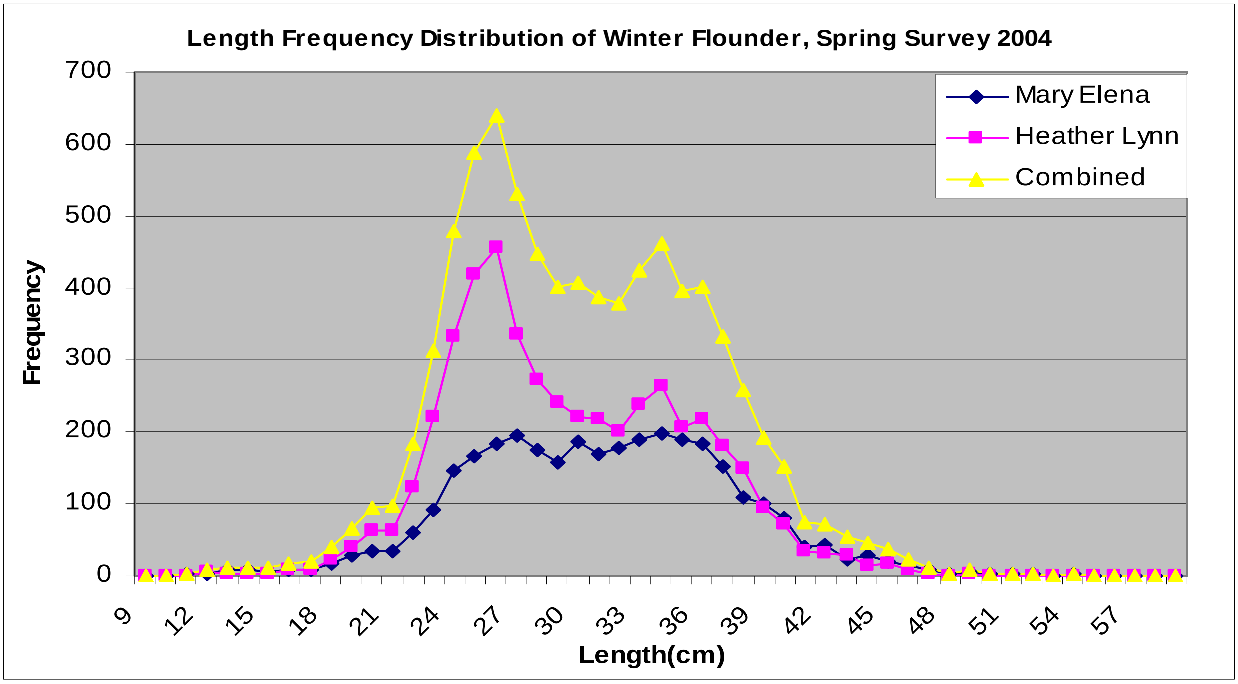
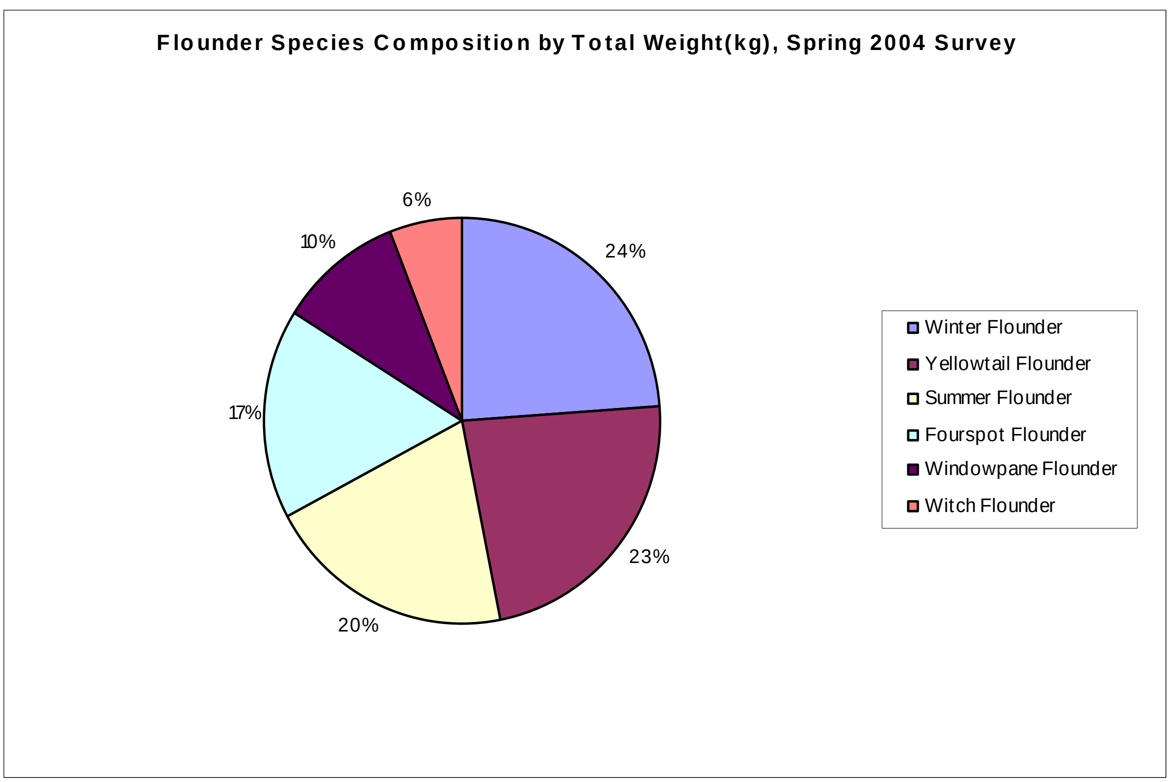


Figure 3



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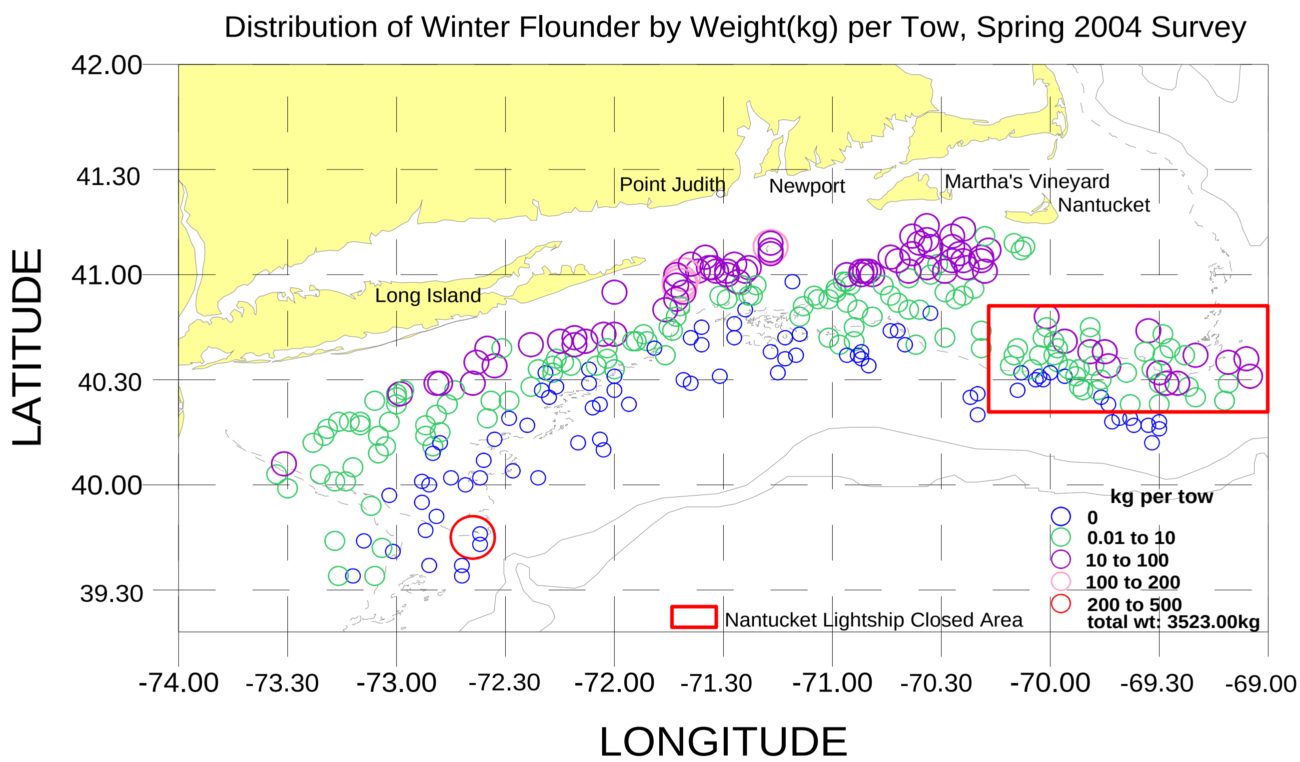
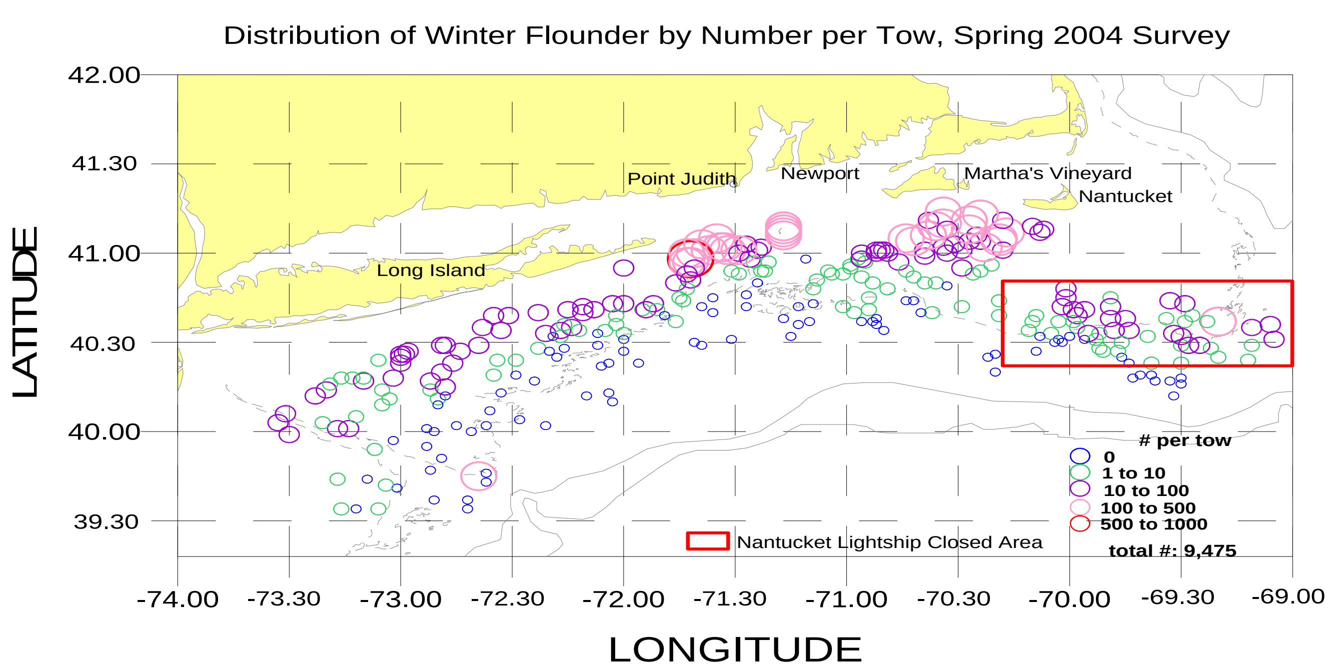


Figure 5



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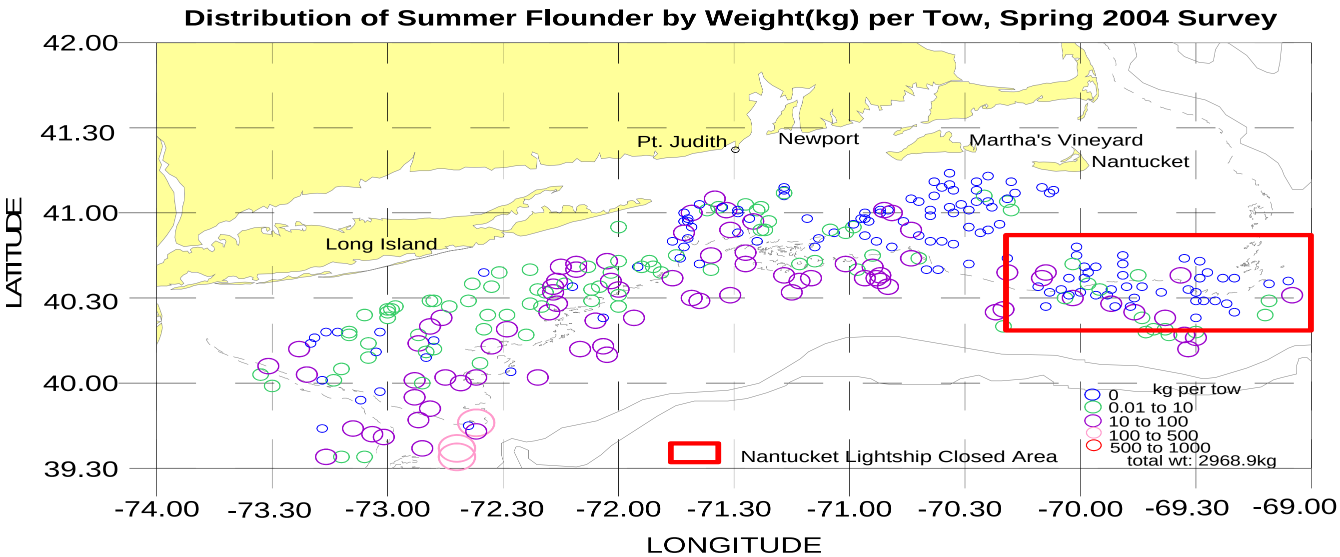


Figure 7

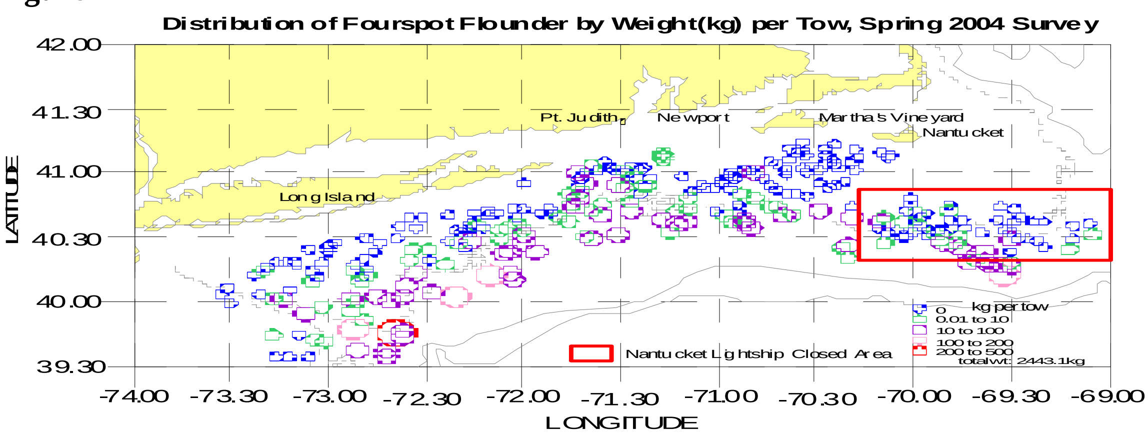


Figure 8

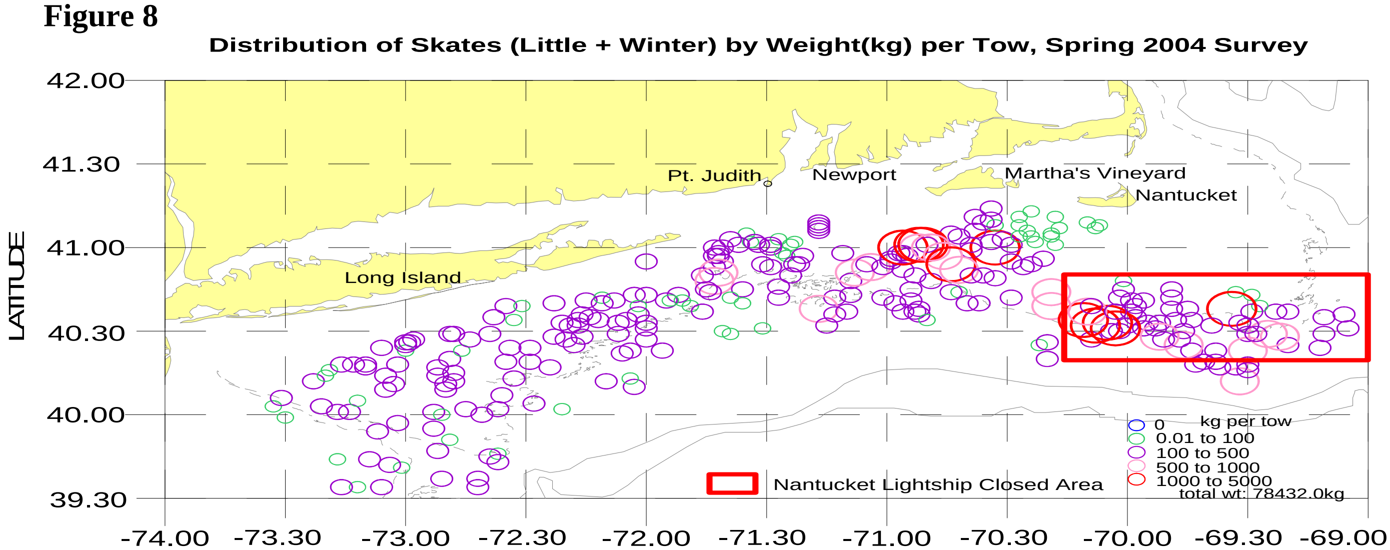


Figure 9

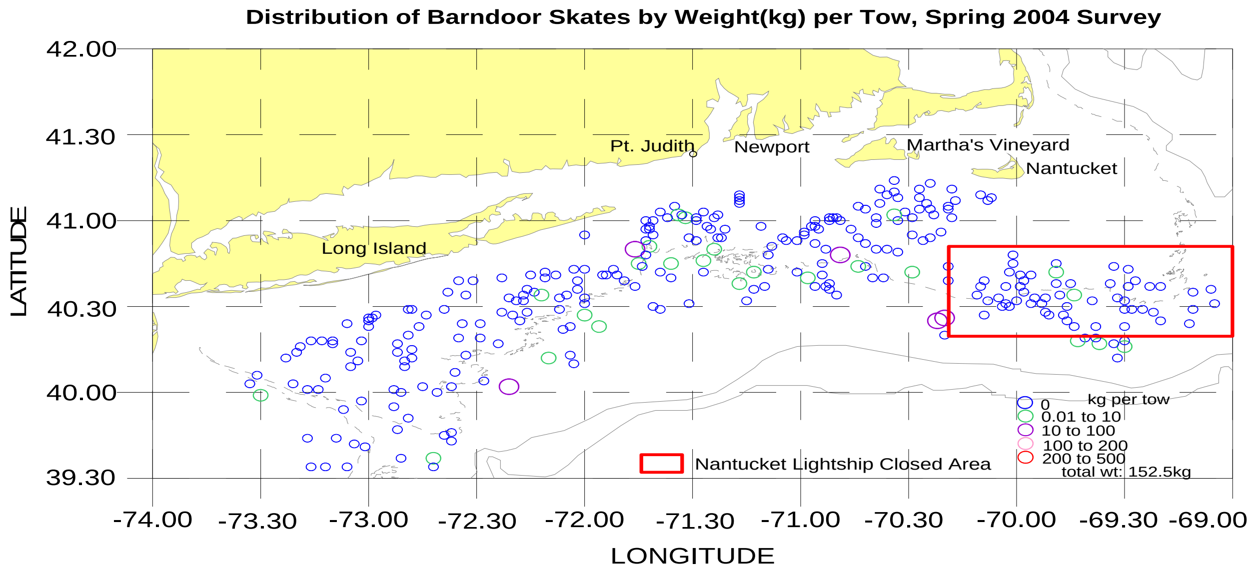


Figure 10

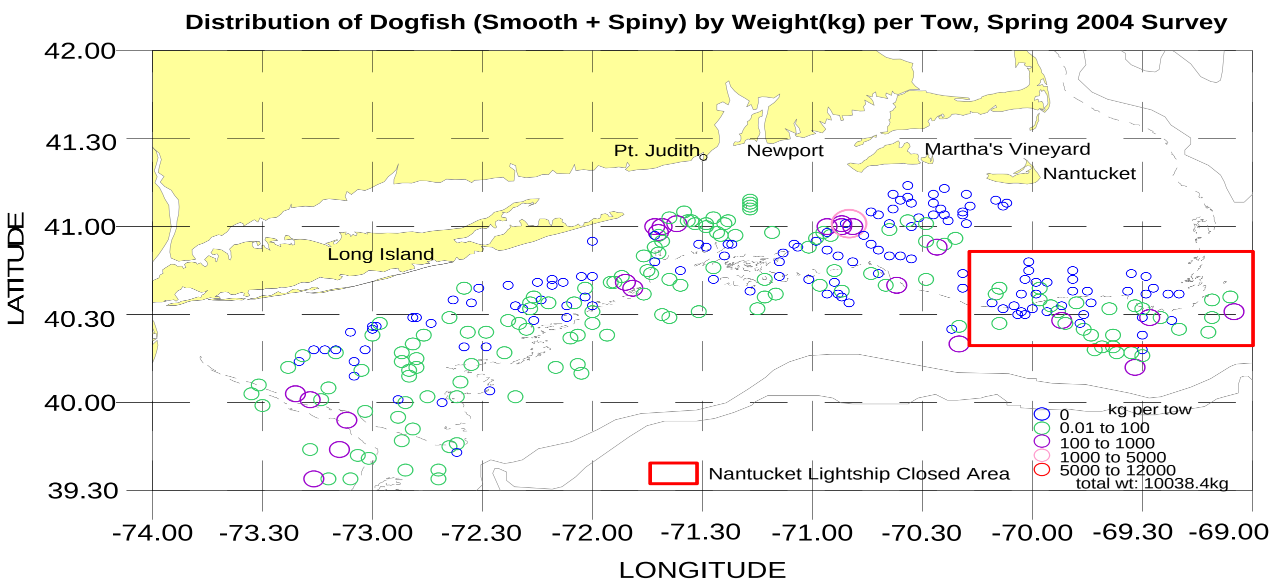


Figure 11

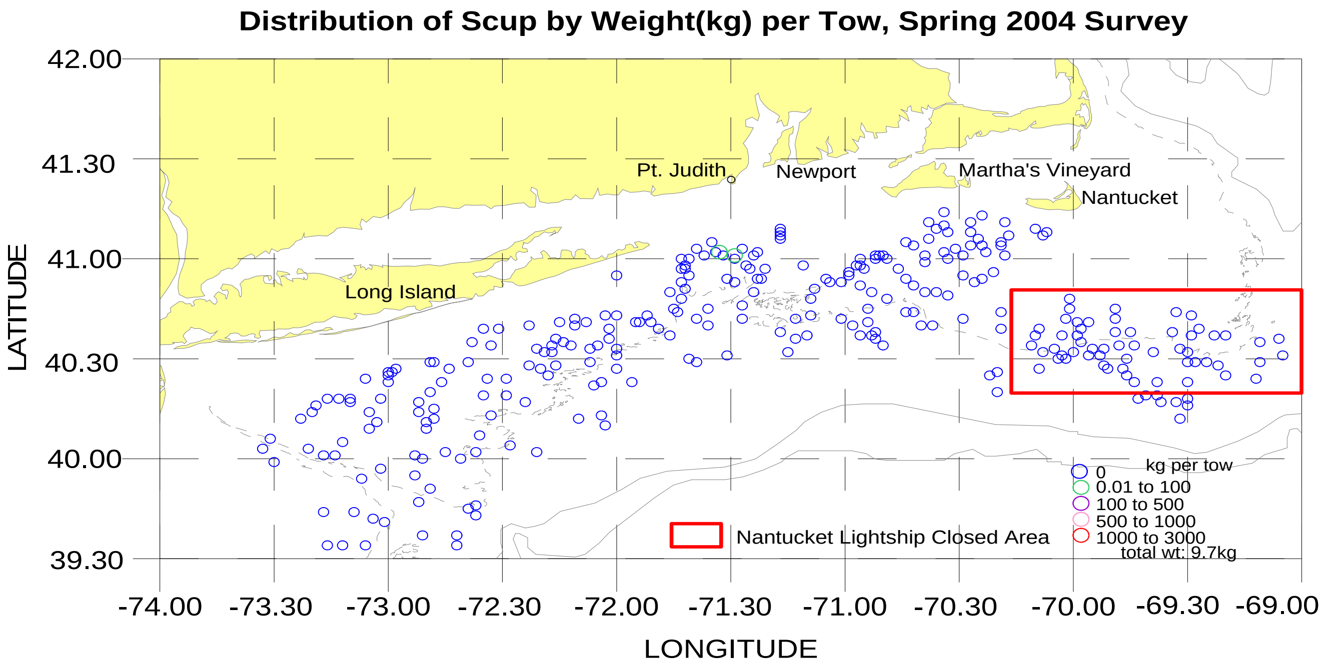


Figure 12

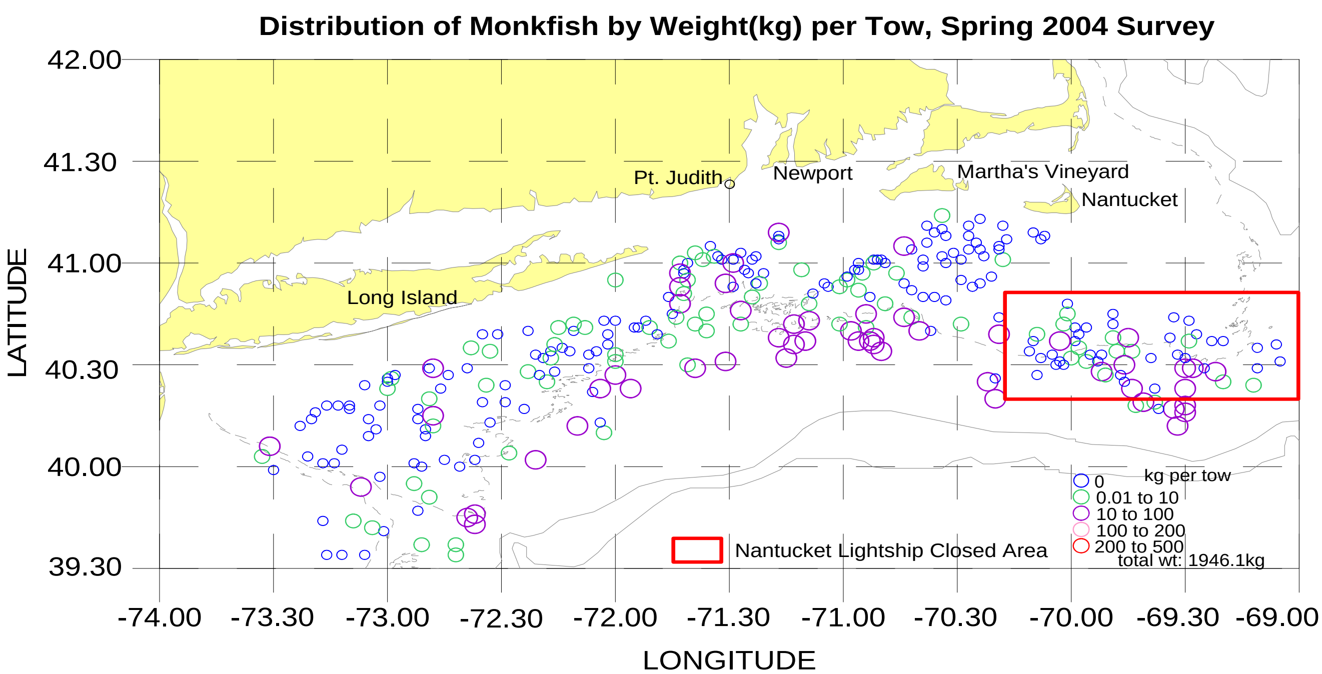


Figure 13

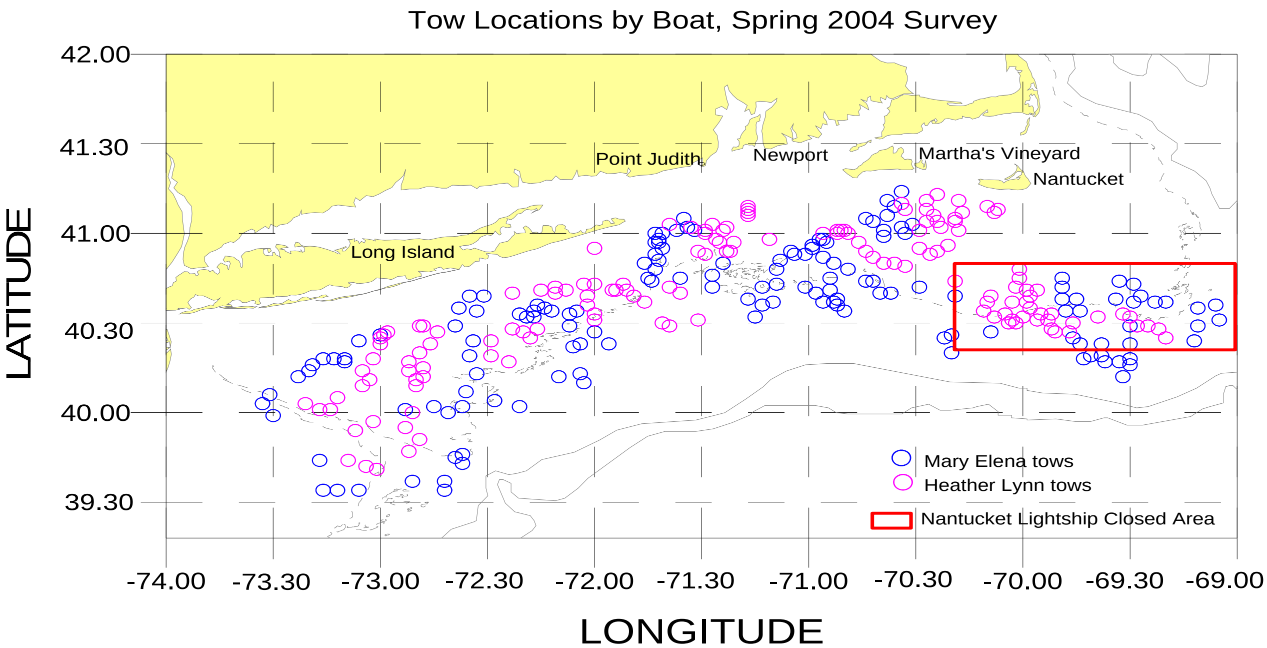
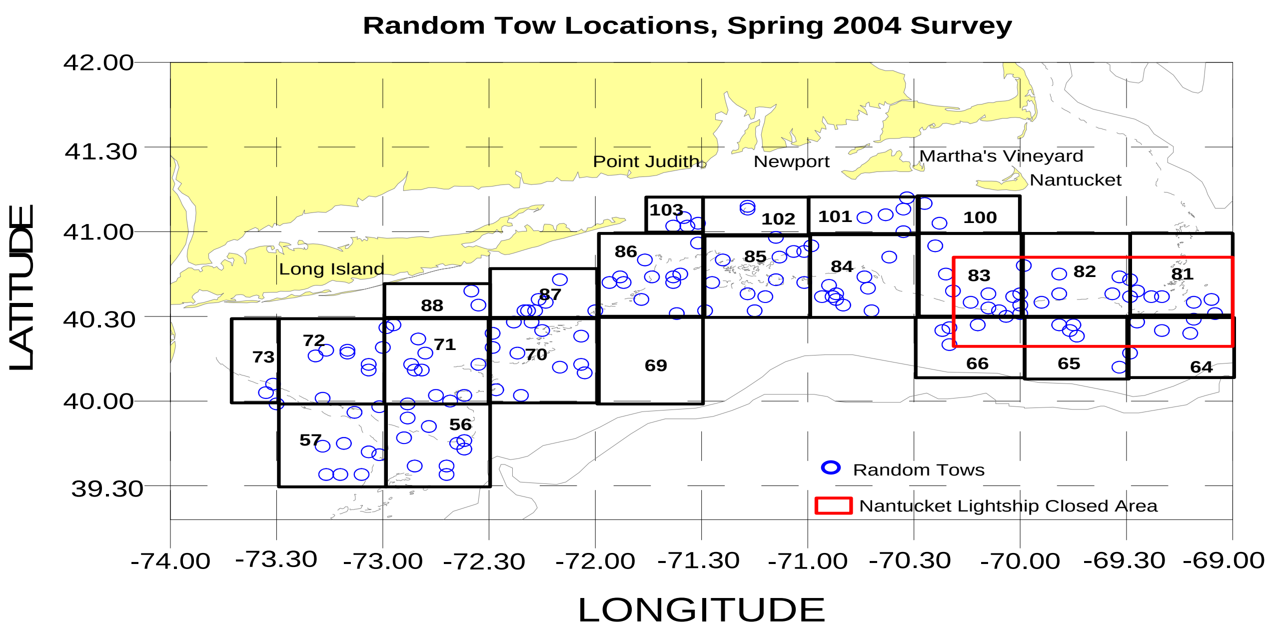


Figure 14



Fall, 2004
Table 1: Species Total Weights for Heather Lynn & Mary Elena

Species	*ME Total Weight(kg)*	*HL Total Weight(kg)*	*Total Weight(kg)*
Barndoor Skate	509.5	1550.5	2060
Black Seabass	406.8	490.8	897.6
Fourspot Flounder	5162.8	6368.4	11531.2
Little Skate	0	54383.9	54383.9
Monkfish	1215.8	3066.7	4282.5
Scup	867.4	2318.7	3186.1
Sea Scallop	3180.3	2012.8	5193.1
Skates(unc)	65878.7	0	65878.7
Smooth Dogfish	1401.6	1213.7	2615.3
Spiny Dogfish	92035.6	106861.5	198897.1
Summer Flounder	6751.9	9431.1	16183
Windowpane	422.2	610.6	1032.8
Winter Flounder	3939.7	3841.7	7781.4
Winter Skate	0	14119.5	14119.5
Witch Flounder	113.8	210.6	324.4
Yellowtail Flounder	981.9	788.3	1770.2
Other species	15661.3	17292.5	32953.8
Total	198529.3	224561.3	423090.6

Figure 1

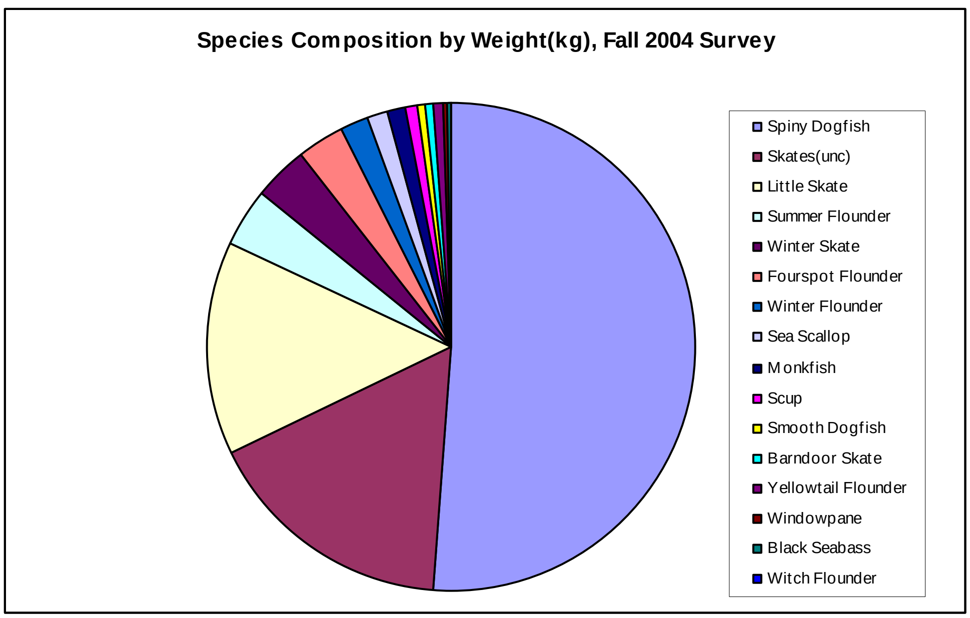
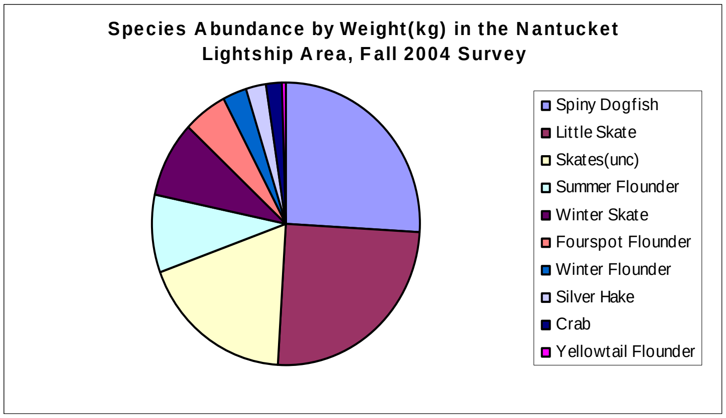
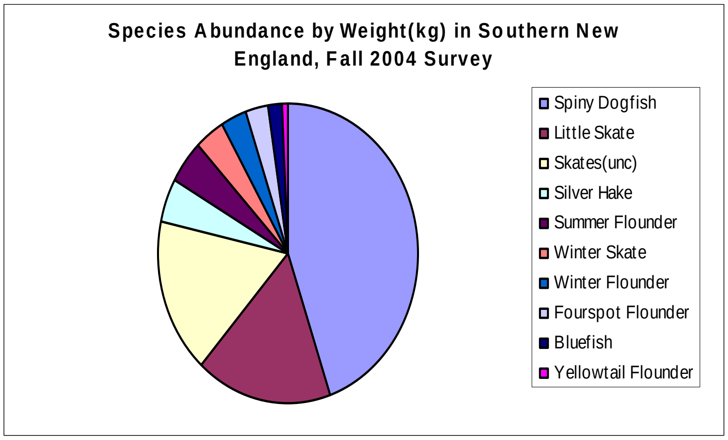


Table 2: Top 10 Species Abundance by Weight (east, central, west)

Nantucket Lightship Area	
Species	***Weight(kg)***
Spiny Dogfish	19002.4
Little Skate	18131
Skates(unc)	13770.8
Summer Flounder	6549.6
Winter Skate	6130.5
Fourspot Flounder	3866.1
Winter Flounder	2295.2
Silver Hake	1708
Crab	1380.4
Yellowtail Flounder	390.8



Southern New England	
Species	***Weight(kg)***
Spiny Dogfish	63696.9
Little Skate	23794.6
Skates(unc)	23691.6
Silver Hake	7038.2
Summer Flounder	6402.5
Winter Skate	5857
Winter Flounder	4318
Fourspot Flounder	3990.2
Bluefish	2225.8
Yellowtail Flounder	1145



Mid-Atlantic	
Species	***Weight***
Spiny Dogfish	116197.4
Skates(unc)	28416.3
Little Skate	12458.3
Fourspot Flounder	3674.9
Summer Flounder	3230.9
Sea Scallops	2973.5
Bluefish	2518.4
Winter Skate	2132
Scup	1668.3
Yellowtail Flounder	234.4

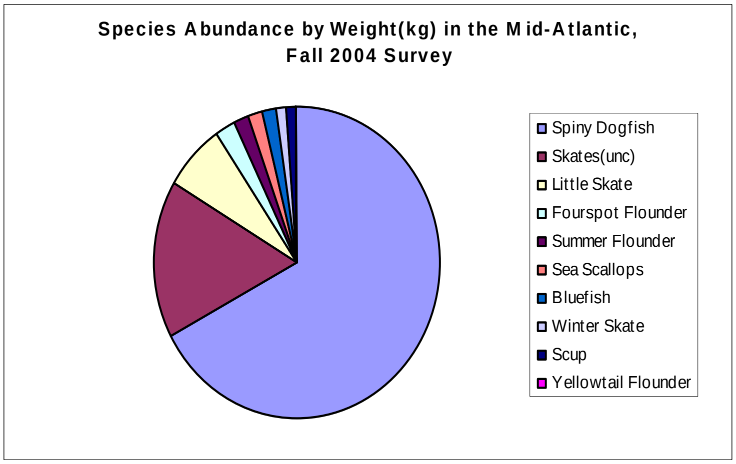
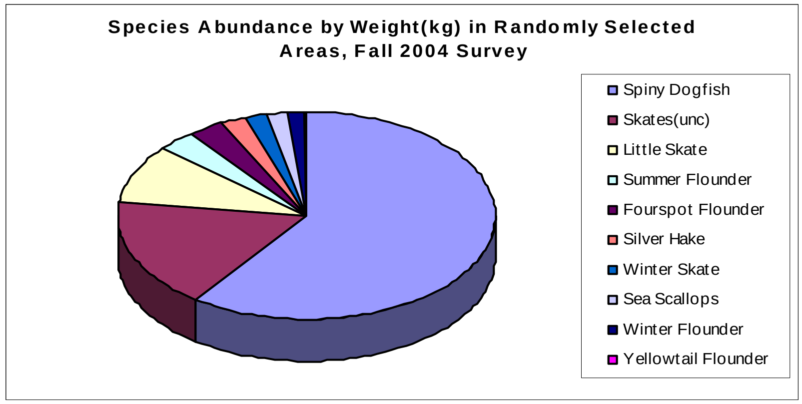
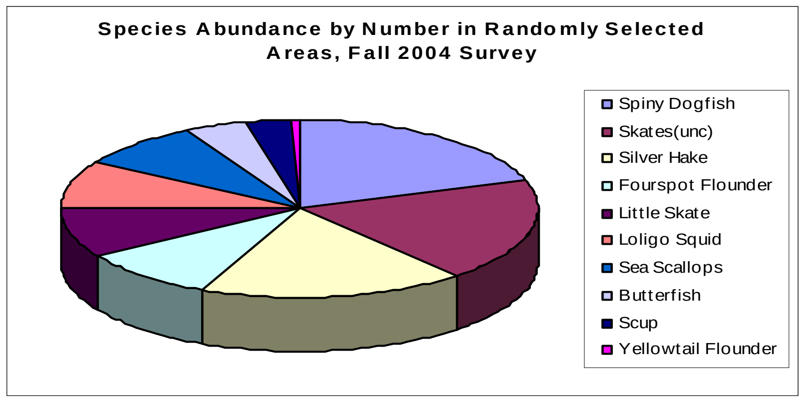


Table 3: Top 10 Species Abundance, weights & numbers, Industry vs Random Tows

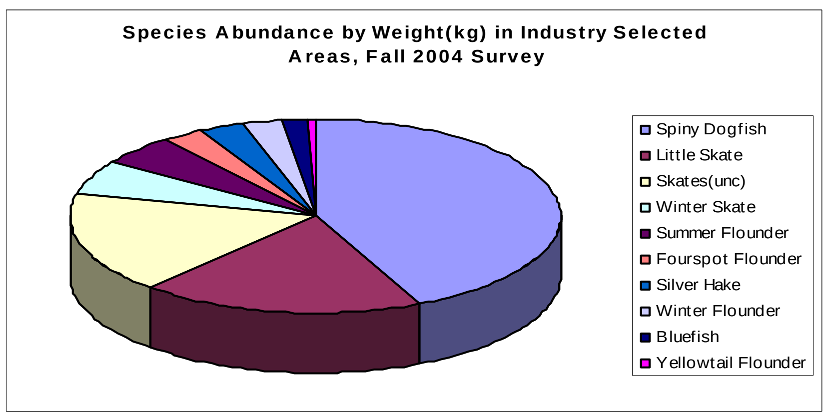
Species	*Weight(kg)*
Spiny Dogfish	114249.2
Skates(unc)	31979.4
Little Skate	17511.9
Summer Flounder	6471.7
Fourspot Flounder	5566.8
Silver Hake	4583.4
Winter Skate	3553
Sea Scallops	3224.4
Winter Flounder	2490.6
Yellowtail Flounder	545.3



Species	*Number*
Spiny Dogfish	64171
Skates(unc)	62265
Silver Hake	59286
Fourspot Flounder	30480
Little Skate	29462
Loligo Squid	28131
Sea Scallops	27895
Butterfish	13871
Scup	10204
Yellowtail Flounder	1851



Species	*Weight(kg)*
Spiny Dogfish	84647.9
Little Skate	36872
Skates(unc)	33899.3
Winter Skate	10566.5
Summer Flounder	9711.3
Fourspot Flounder	5964.4
Silver Hake	5569
Winter Flounder	5290.8
Bluefish	2956.9
Yellowtail Flounder	1224.9



Species	*Number*
Skates(unc)	63363
Little Skate	61363
Silver Hake	46404
Spiny Dogfish	44512
Fourspot Flounder	31842
Loligo Squid	28956
Scup	28115
Winter Skate	20213
Butterfish	17441
Yellowtail Flounder	4150

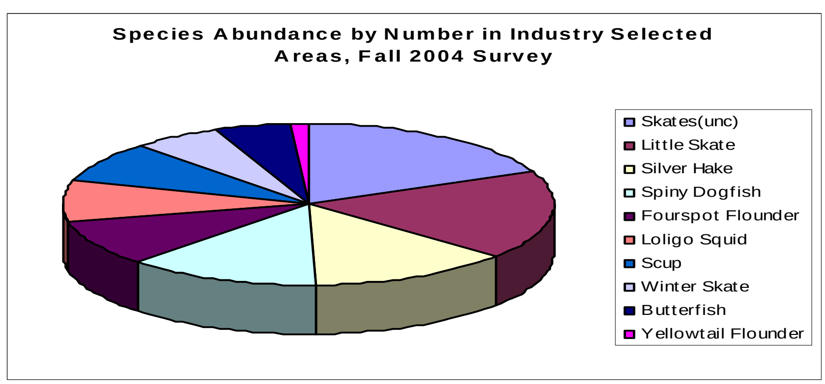


Figure 2

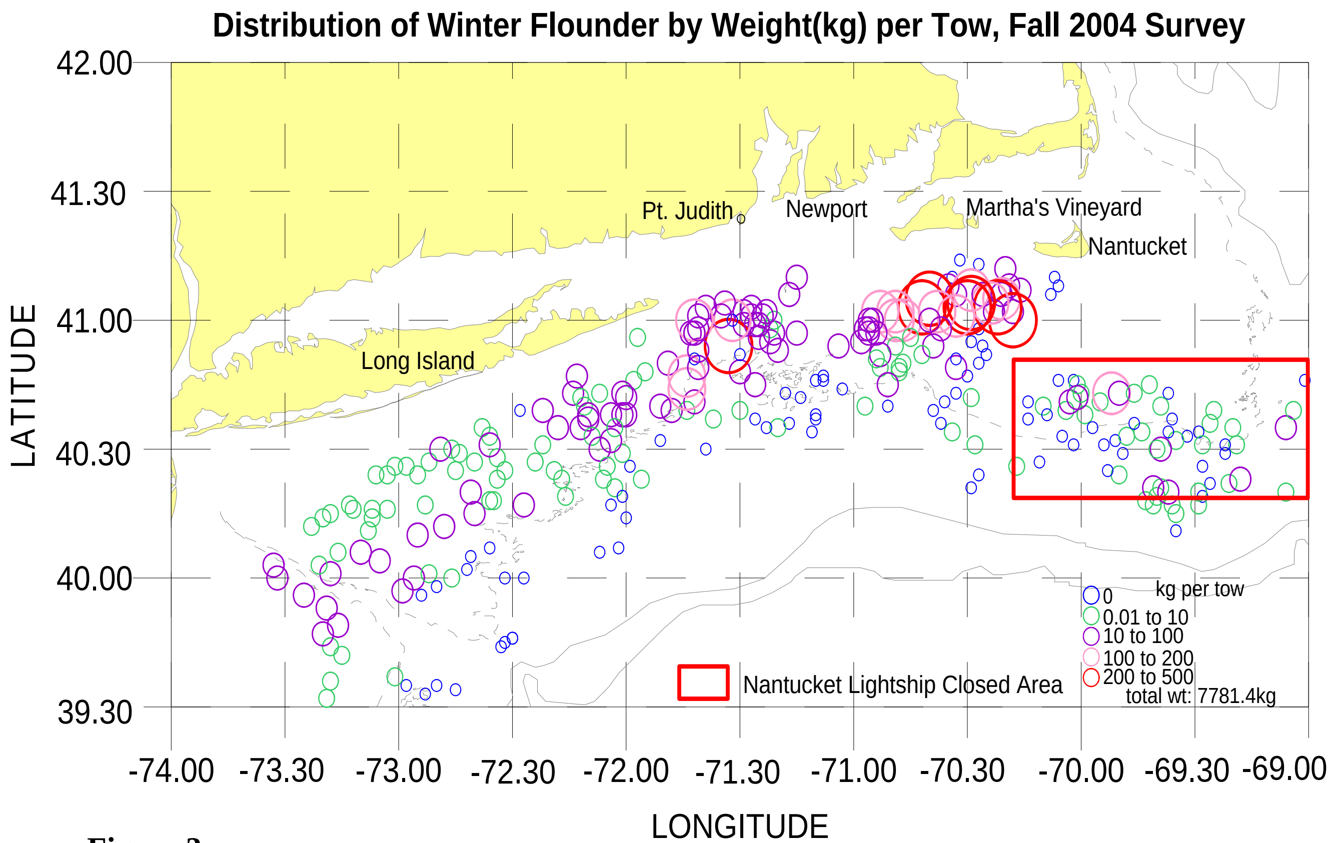
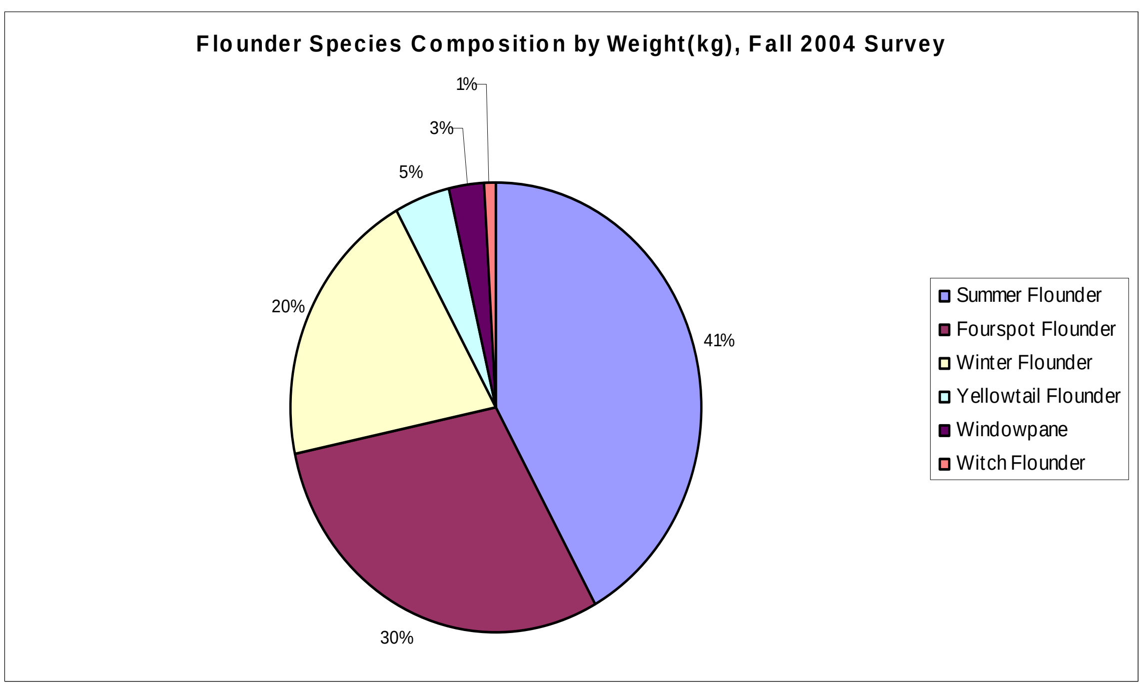


Figure 3



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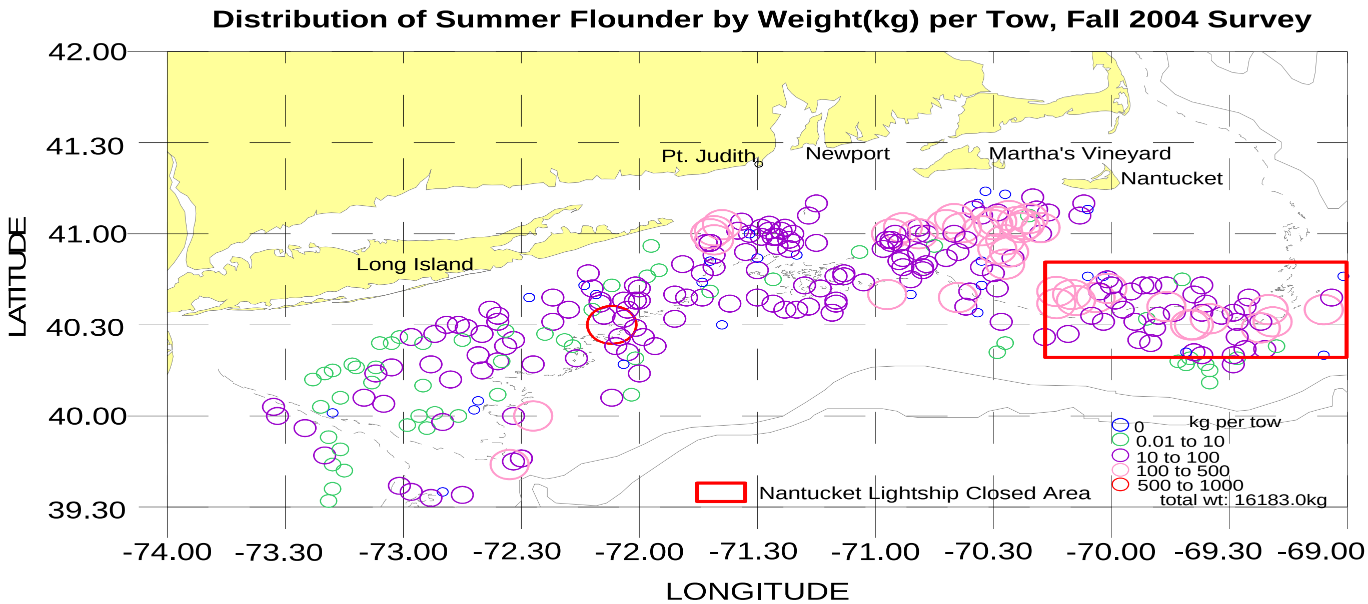
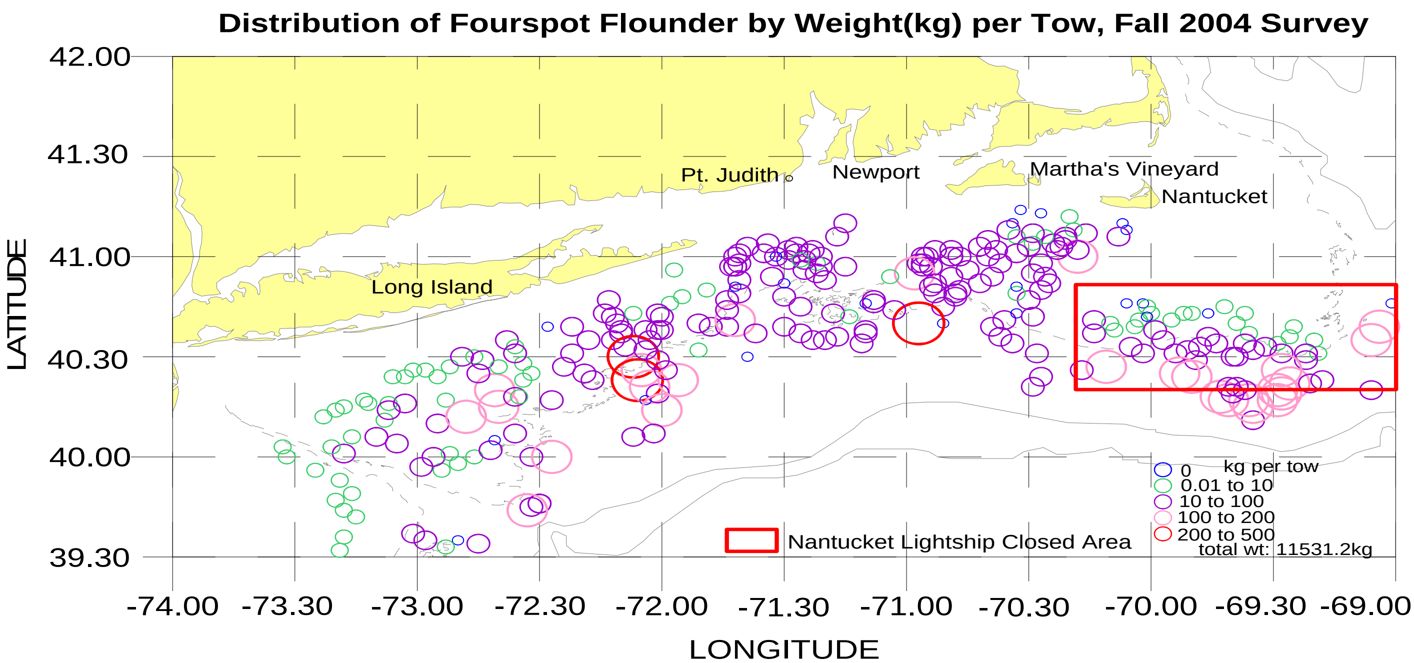


Figure 5



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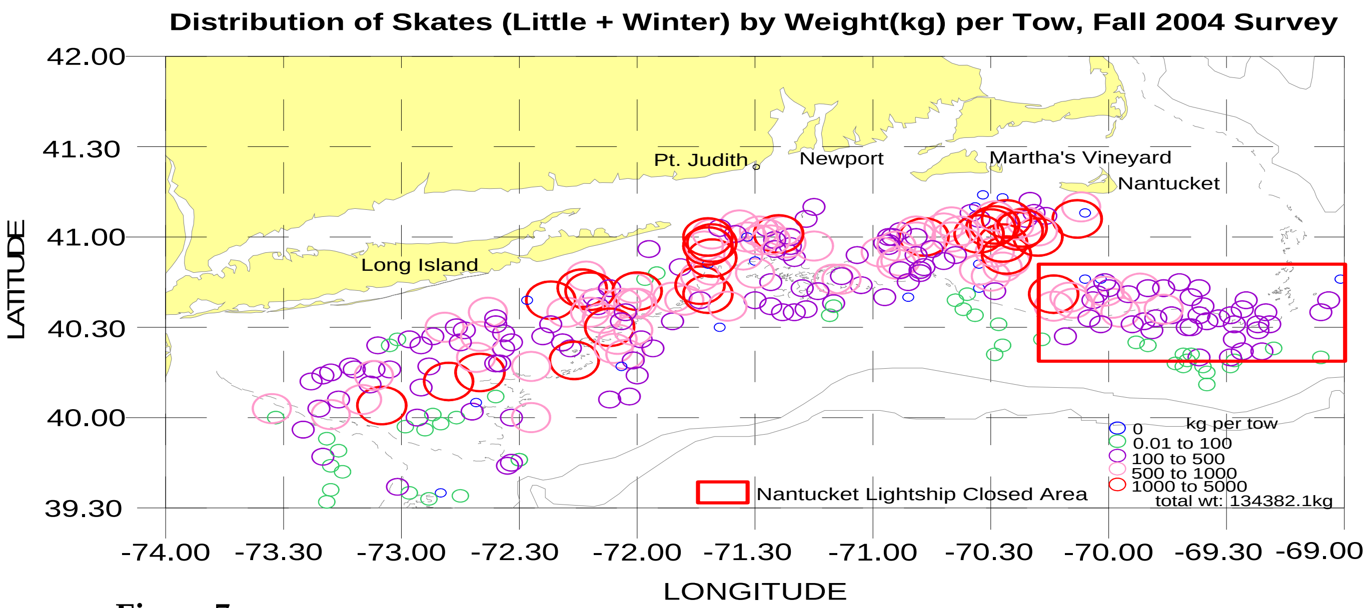

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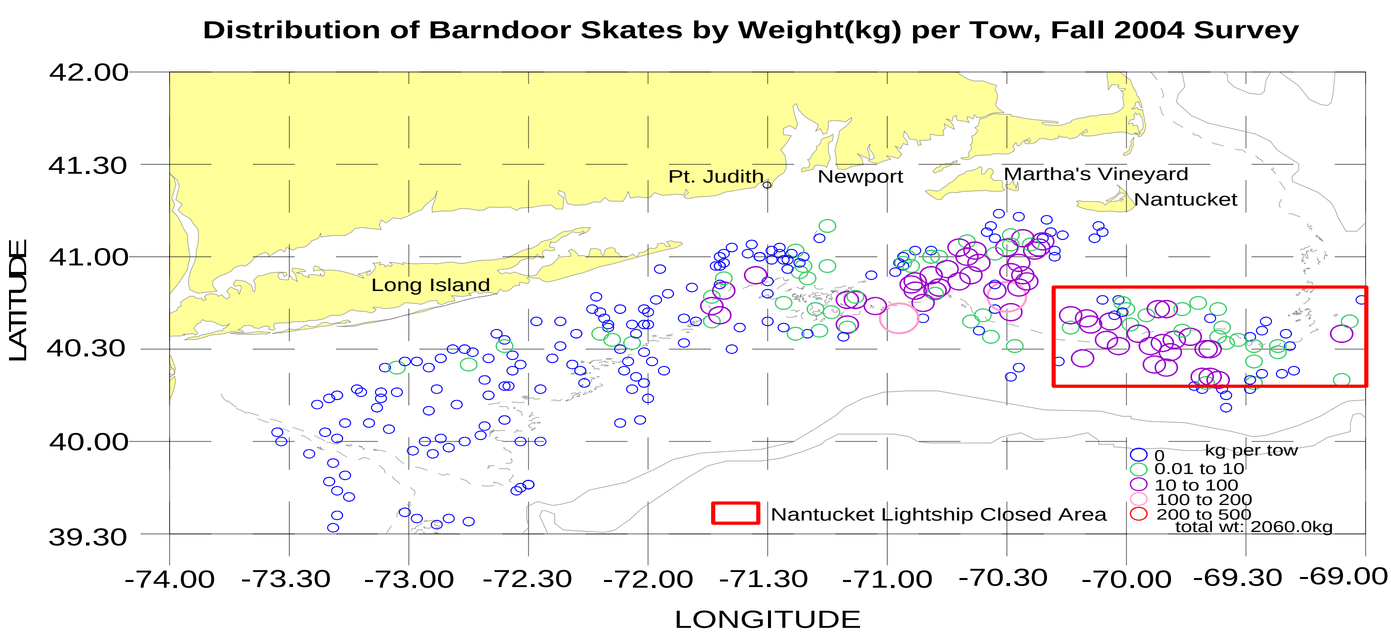

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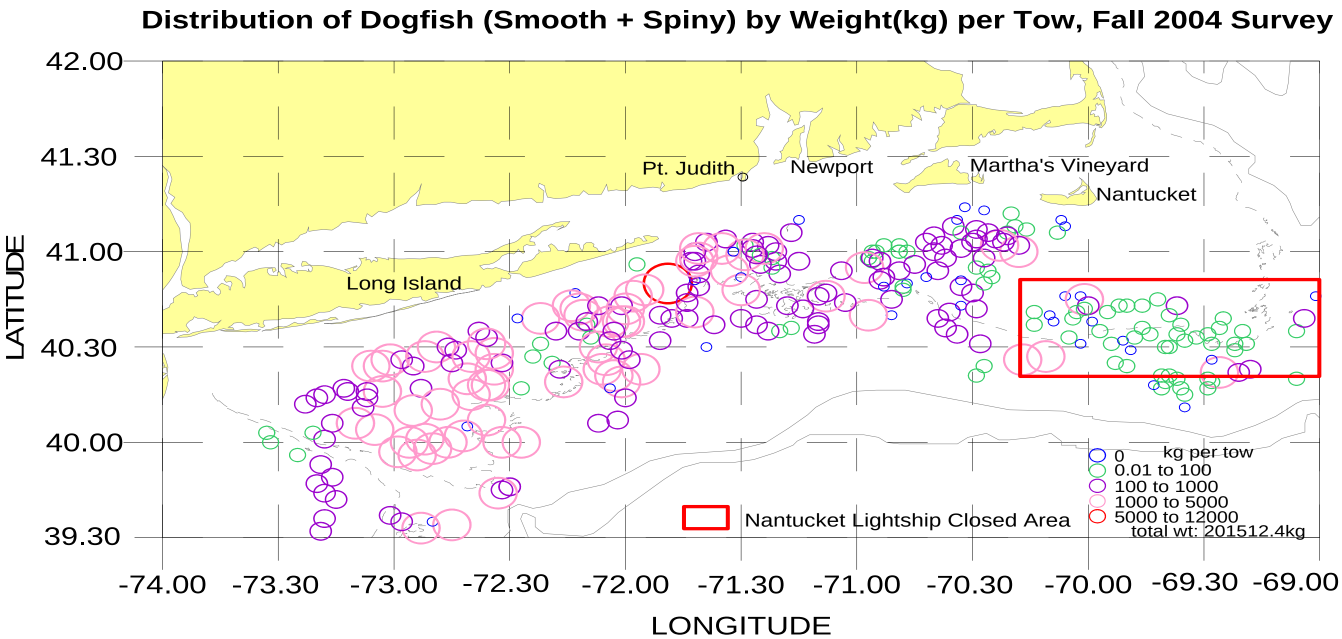

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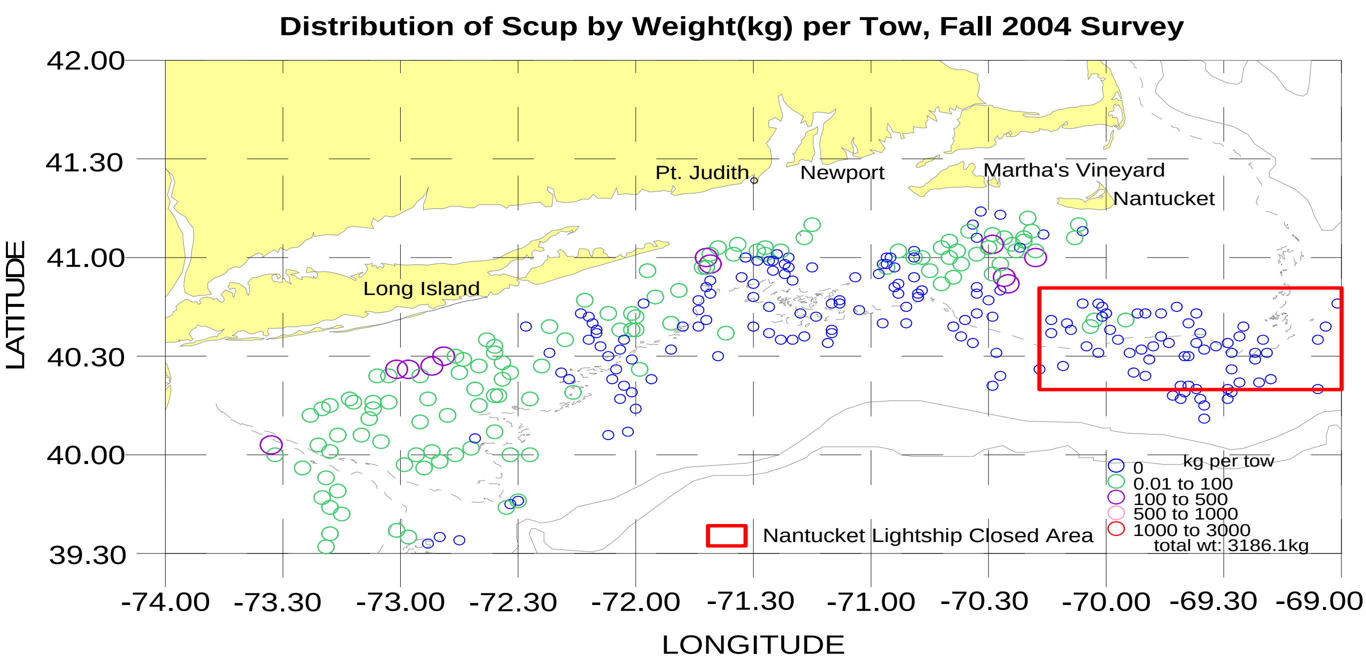

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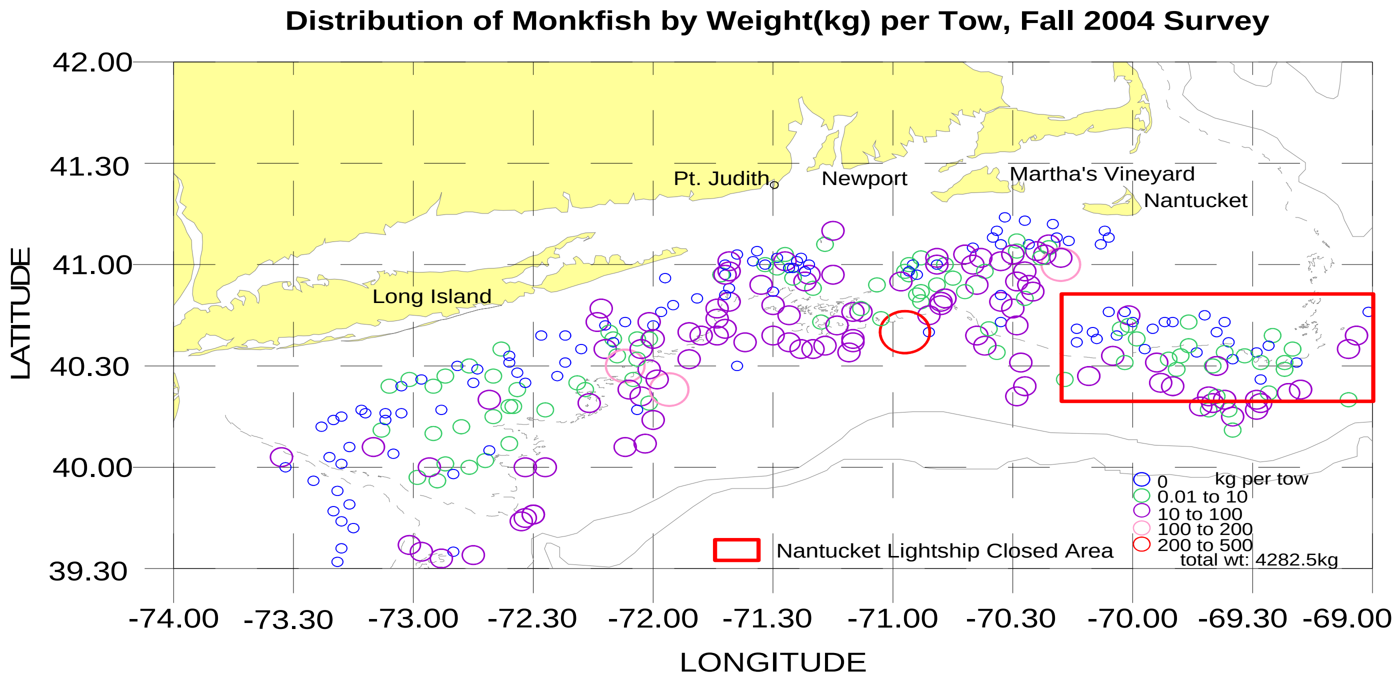


Figure 11

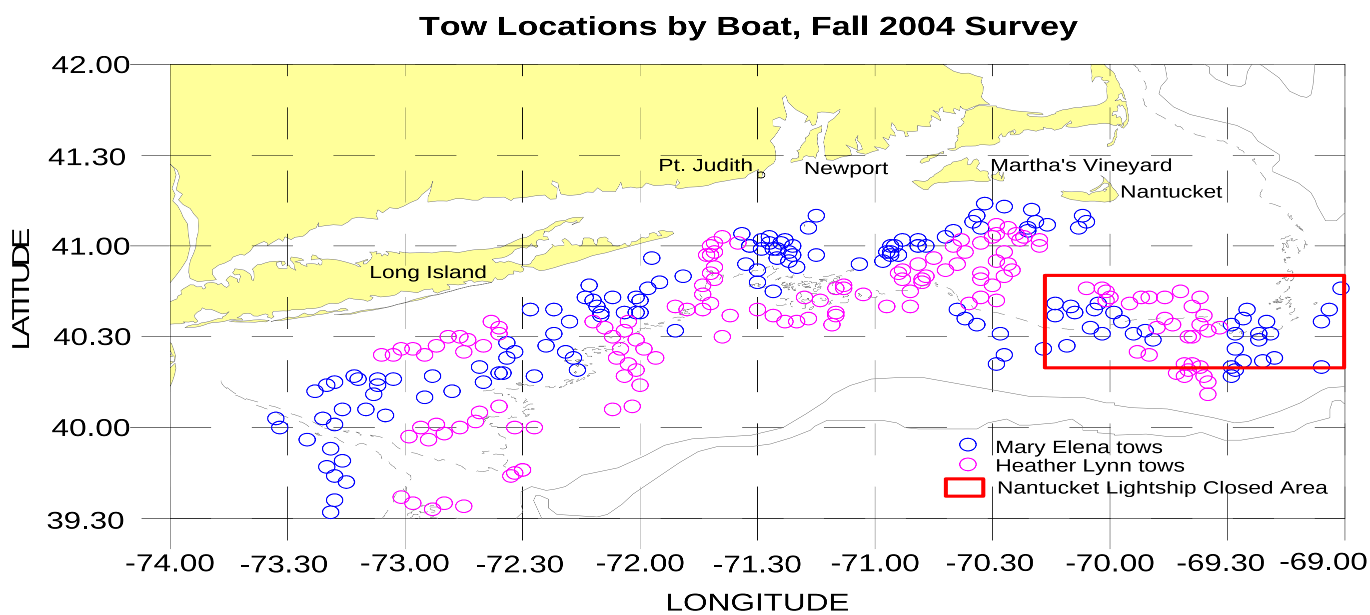
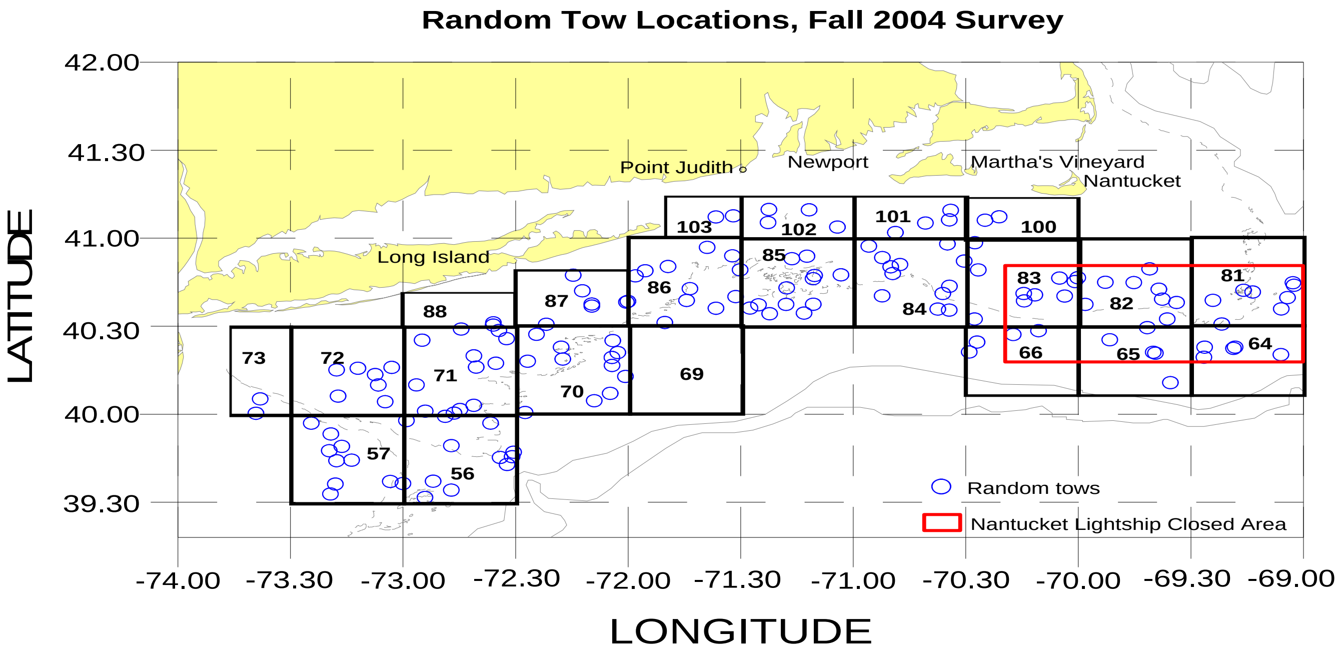
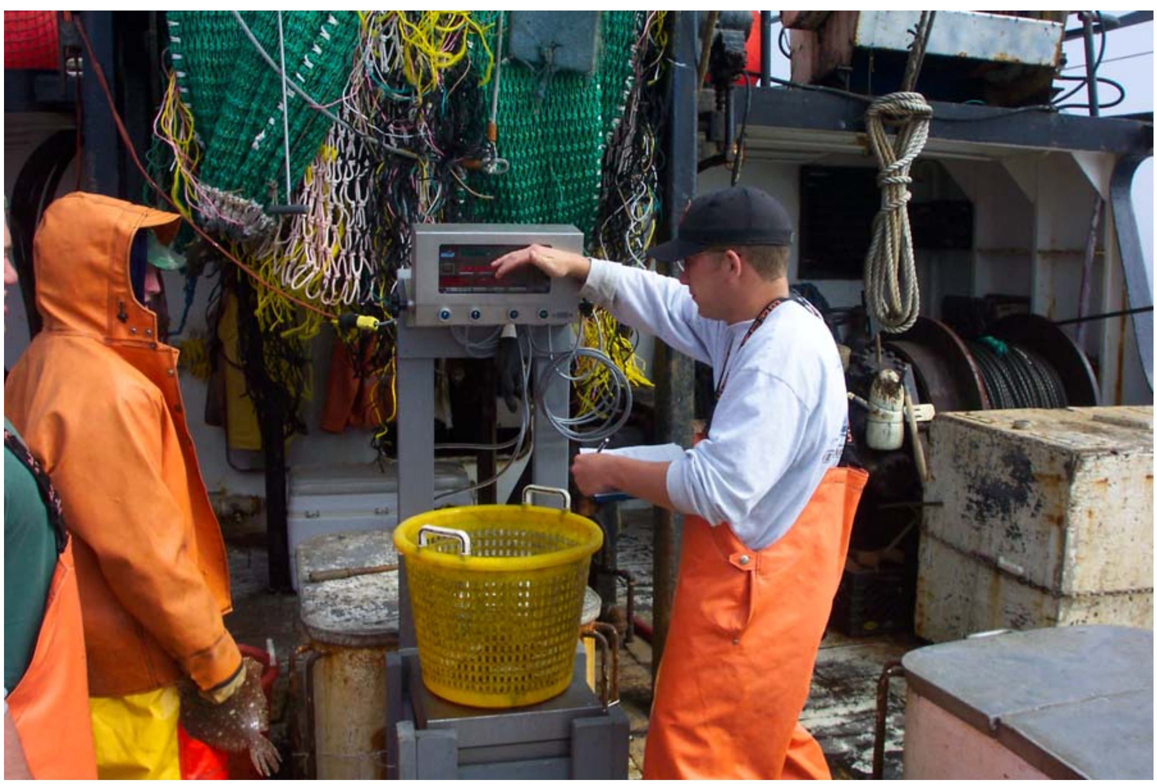


Figure 12





Observers weighing samples with Marel Scales

2005 DISTRIBUTION PLOTS AND TABLES

Spring 2005

Table 1: Species Total Weights for Heather Lynn & Mary Elena

Species	*ME Total Weight(kg)*	*HL Total Weight(kg)*	*Total Weight(kg)*
Barndoor Skate	348.2	360.6	708.8
Black Seabass	21.1	0	21.1
Fourspot Flounder	1932.5	1118.9	3051.4
Monkfish	1401.1	1233.2	2634.3
Scup	68.9	22	90.9
Sea Scallops	1144.4	1352.7	2497.1
Skates(unc)	64347.5	66620.3	130967.8
Spiny Dogfish	3439.6	2674.9	6114.5
Summer Flounder	2150.8	1321.4	3472.2
Windowpane	2284.3	1587	3871.3
Winter Flounder	2322.4	1987.8	4310.2
Winter Skate	76.6	0	76.6
Witch Flounder	360.2	660.6	1020.8
Yellowtail Flounder	1906.9	2018.2	3925.1
Other species	20689.1	33379.9	54069
Total	102493.6	114337.5	216831.1

Figure 1

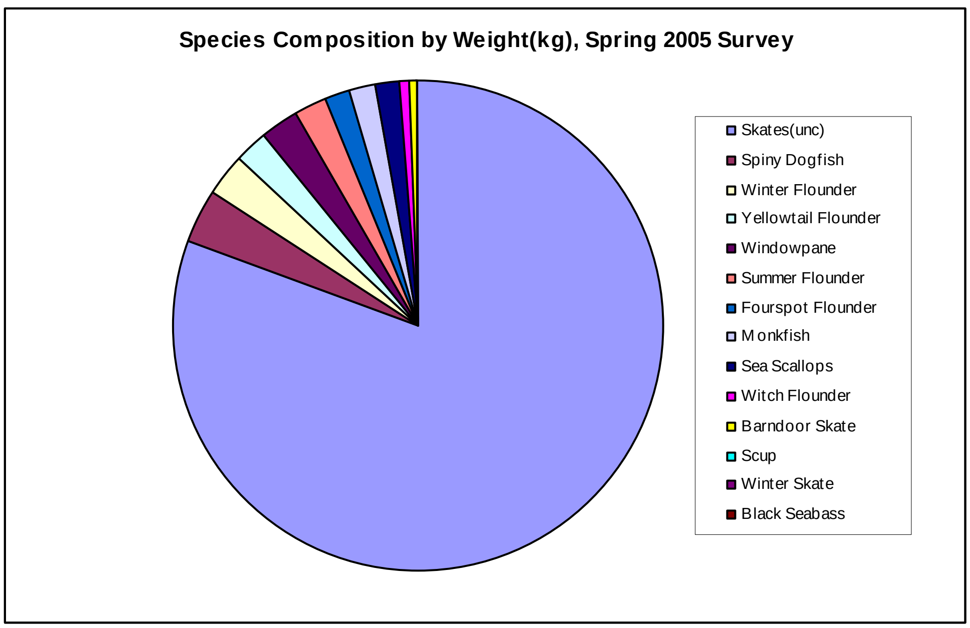
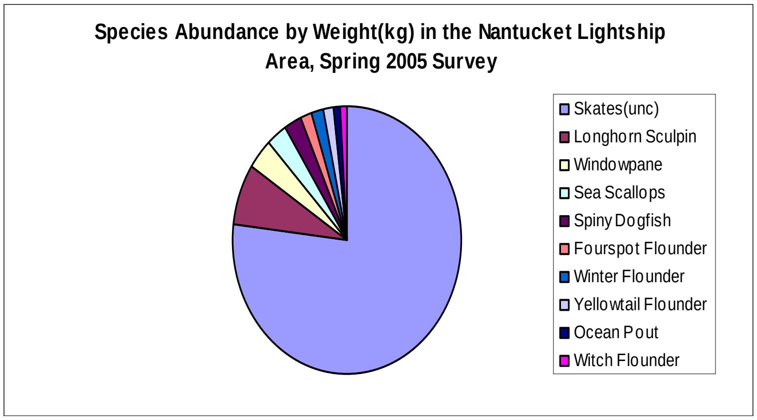
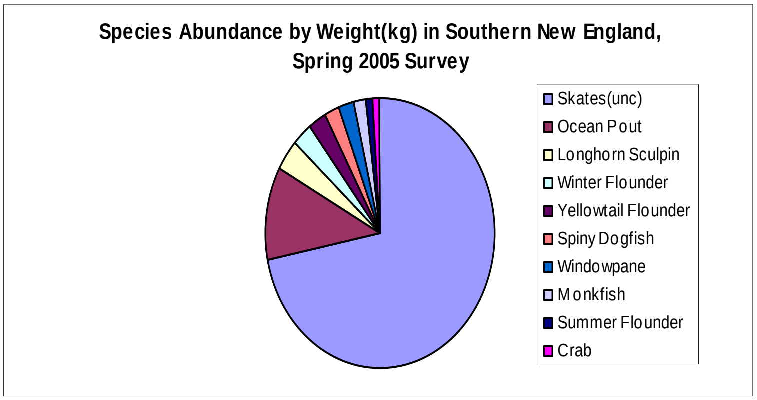


Table 2: Top ten species Abundance by Weight (east, central, west)

Species	*Weight*
Skates(unc)	46121.4
Longhorn Sculpin	4564.7
Windowpane	2077.2
Sea Scallops	1616.6
Spiny Dogfish	1485.2
Fourspot Flounder	1117.7
Winter Flounder	1023.9
Yellowtail Flounder	736.1
Ocean Pout	640.1
Witch Flounder	549.4



Species	*Weight*
Skates(unc)	57255.9
Ocean Pout	9192.2
Longhorn Sculpin	2922.2
Winter Flounder	2193.4
Yellowtail Flounder	2005.3
Spiny Dogfish	1763.2
Windowpane	1730
Monkfish	1416.4
Summer Flounder	1002.4
Crab	557.5



Species	*Weight*
Skates(unc)	27590.5
Ocean Pout	12374.6
Spiny Dogfish	2866.1
Summer Flounder	1972.8
Fourspot Flounder	1457.9
Yellowtail Flounder	1183.7
Atlantic Mackerel	1111.7
Winter Flounder	1092.9
Atlantic Herring	871.6
Sea Scallops	817.5

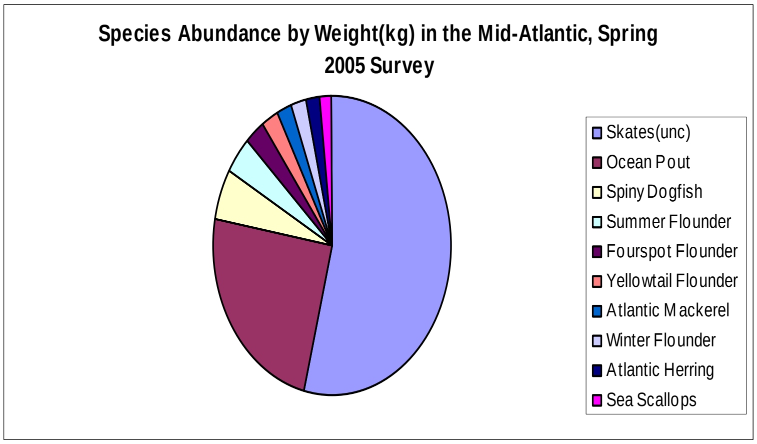
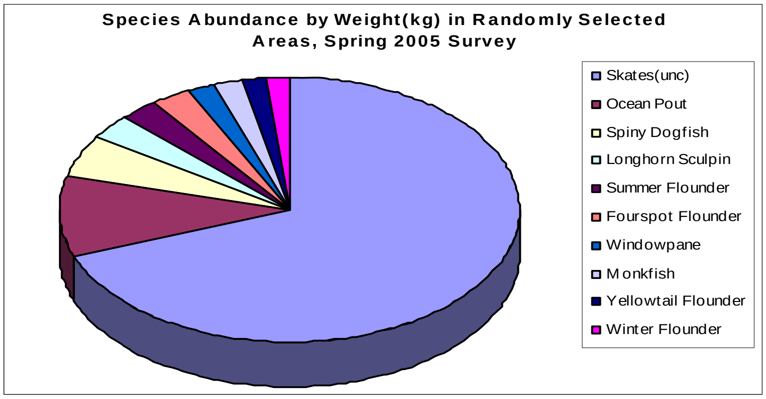
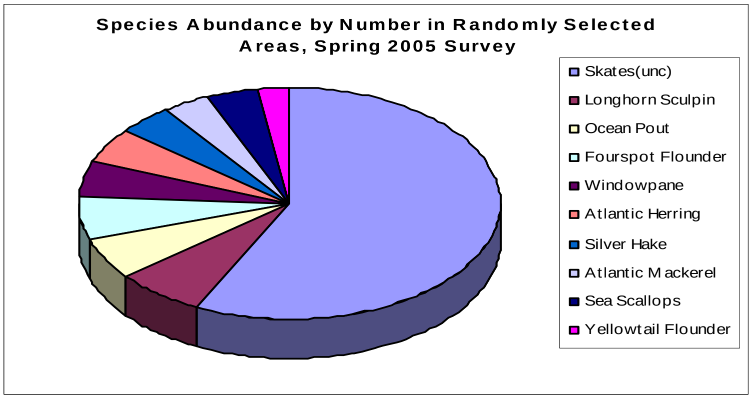


Table 3: top ten species weights & numbers Random vs. IndustryTows

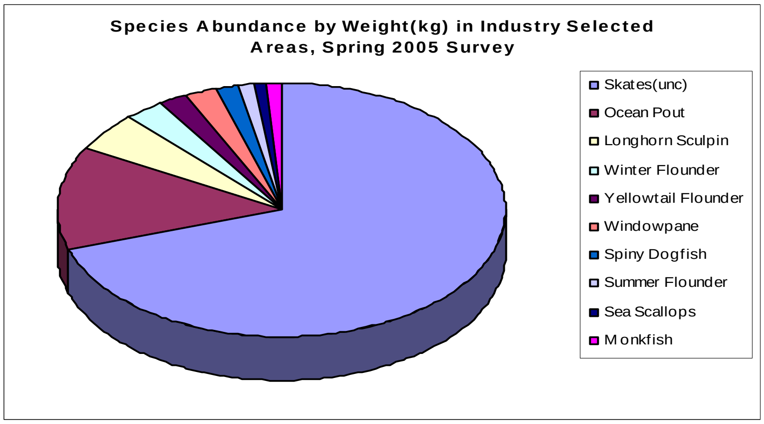
Species	*weight(kg)*
Skates(unc)	58018.3
Ocean Pout	8425.5
Spiny Dogfish	4349.7
Longhorn Sculpin	2613.3
Summer Flounder	2325.7
Fourspot Flounder	2132.7
Windowpane	1680.5
Monkfish	1571.2
Yellowtail Flounder	1476.9
Winter Flounder	1435.5



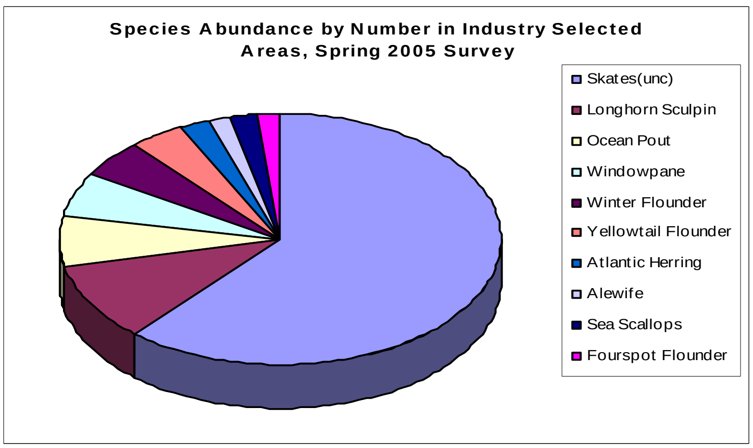
Species	*number*
Skates(unc)	93946
Longhorn Sculpin	11239
Ocean Pout	9850
Fourspot Flounder	9369
Windowpane	8431
Atlantic Herring	8148
Silver Hake	6486
Atlantic Mackerel	6350
Sea Scallops	6175
Yellowtail Flounder	4085



Species	*weight(kg)*
Skates(unc)	72949.5
Ocean Pout	13781.4
Longhorn Sculpin	4970.3
Winter Flounder	2874.7
Yellowtail Flounder	2448.2
Windowpane	2190.8
Spiny Dogfish	1764.8
Summer Flounder	1146.5
Sea Scallops	1074.4
Monkfish	1063.1



Species	*number*
Skates(unc)	125384
Longhorn Sculpin	20101
Ocean Pout	14053
Windowpane	11153
Winter Flounder	10280
Yellowtail Flounder	7664
Atlantic Herring	4556
Alewife	3659
Sea Scallops	3650
Fourspot Flounder	3549



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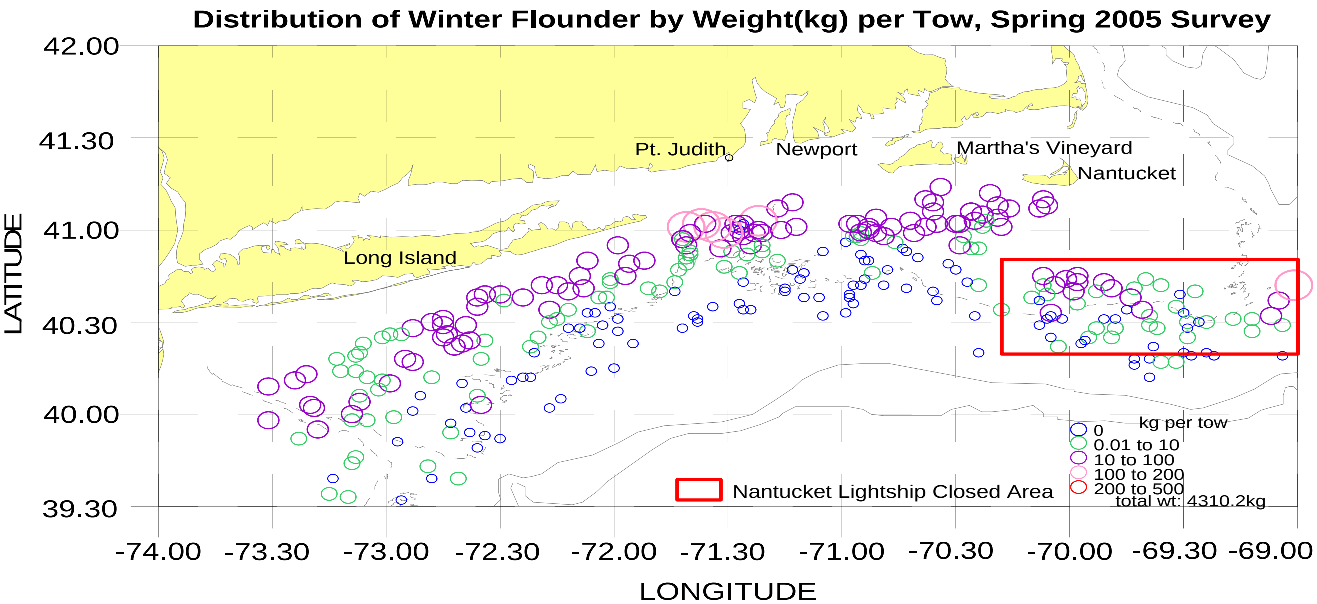
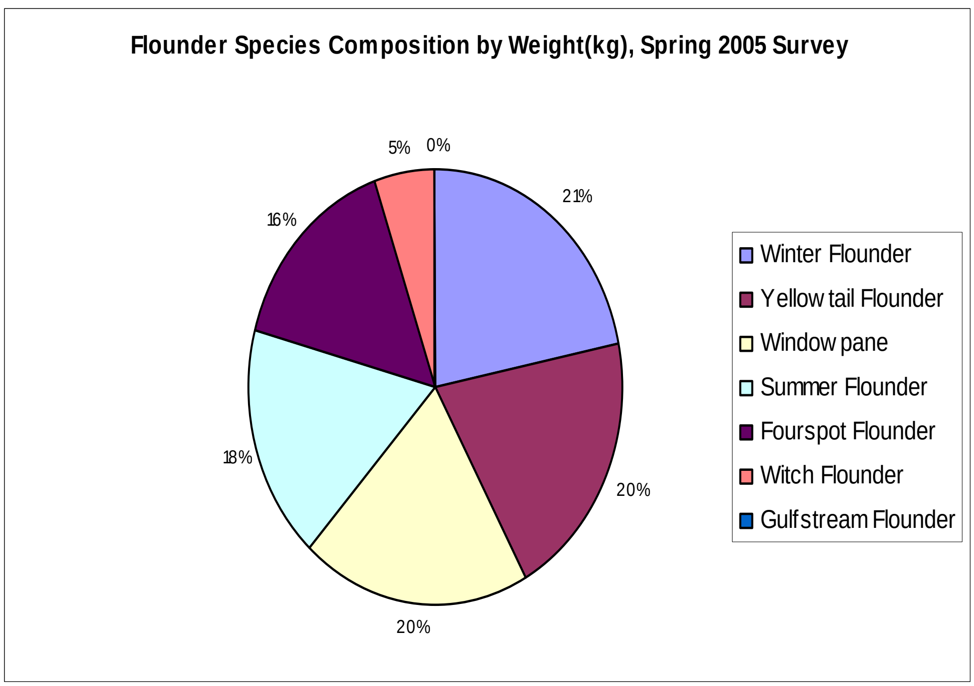


Figure 3



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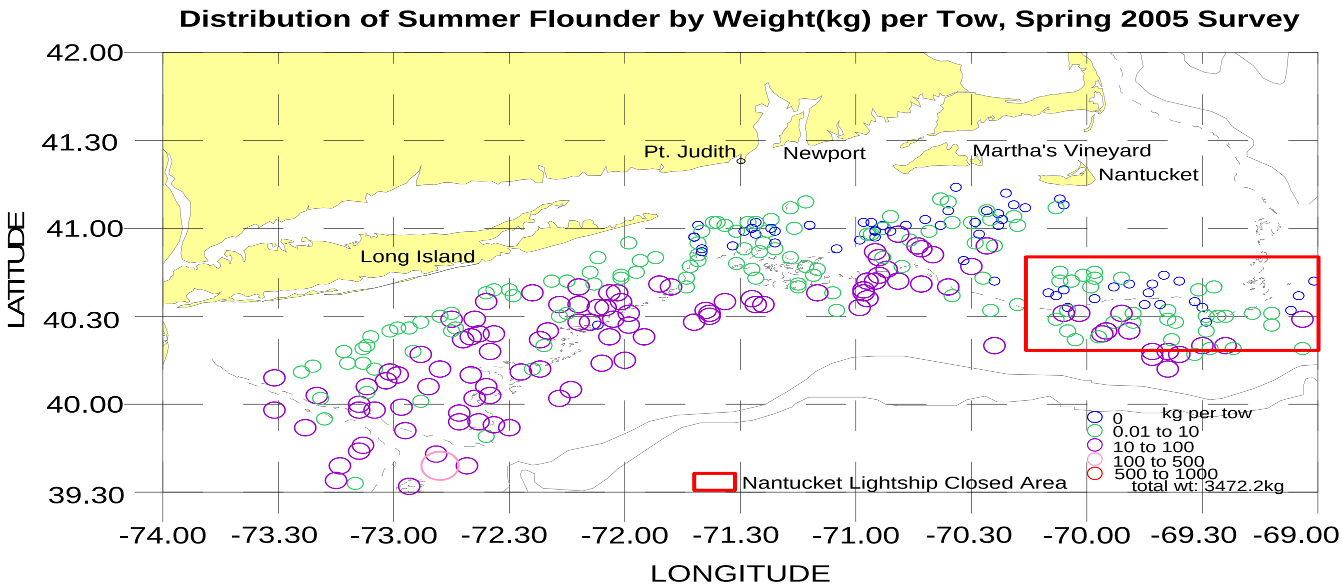
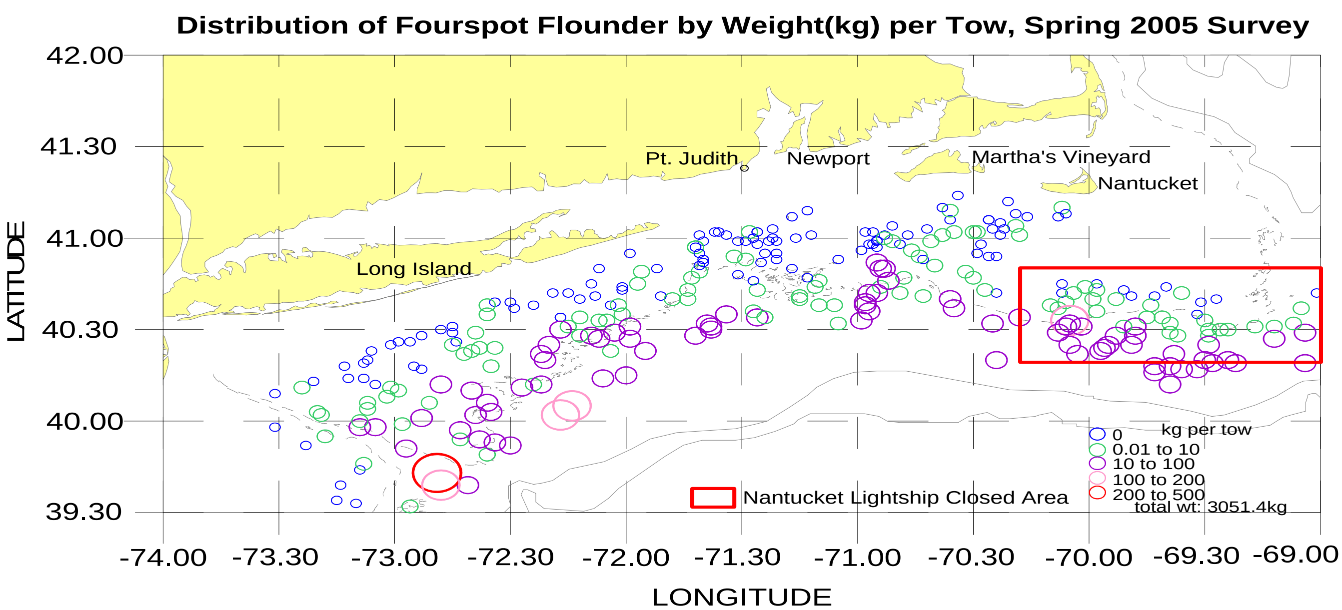


Figure 5



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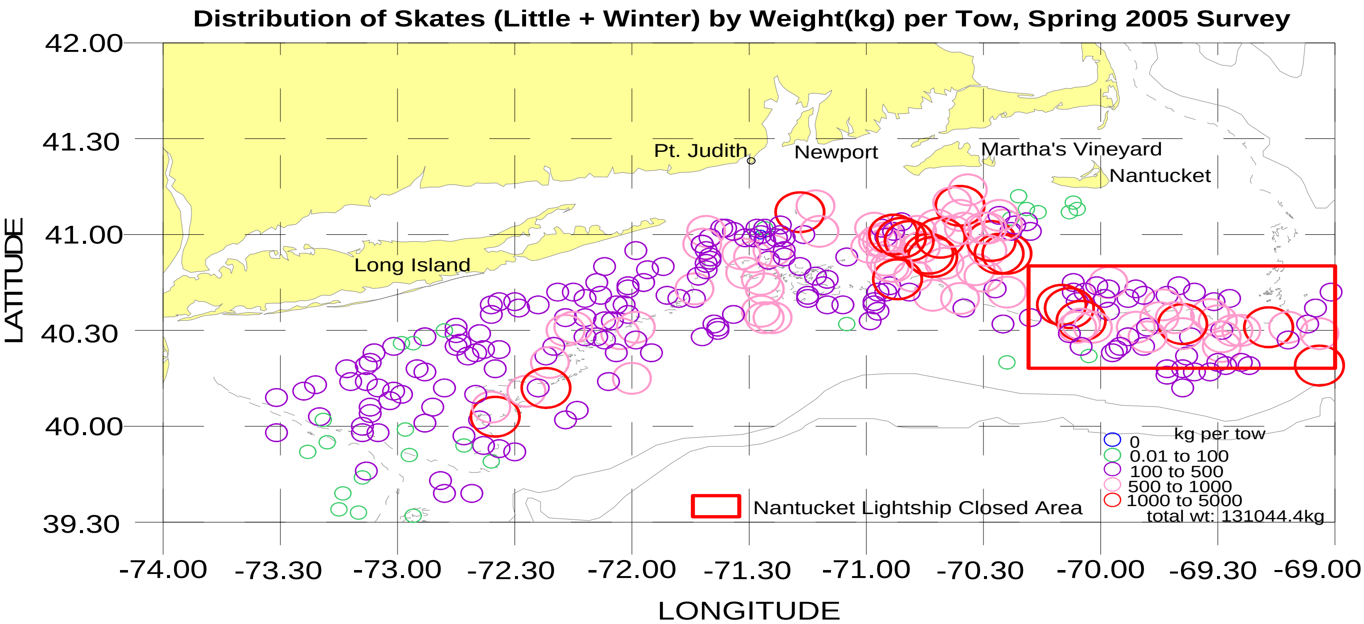

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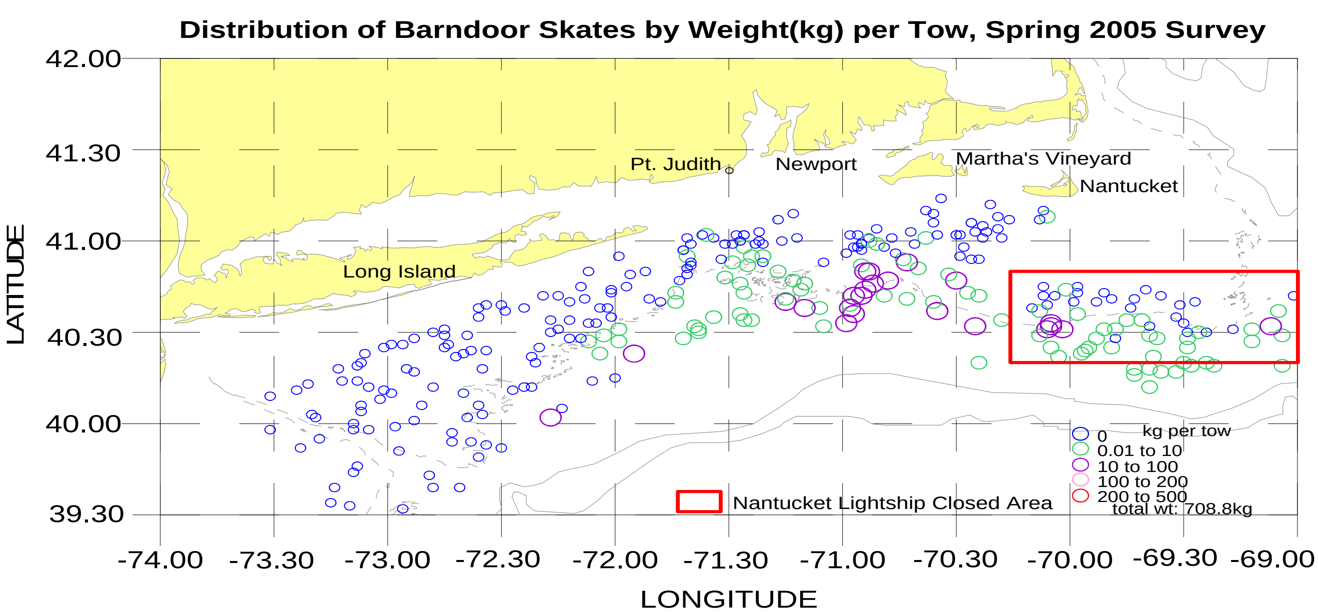

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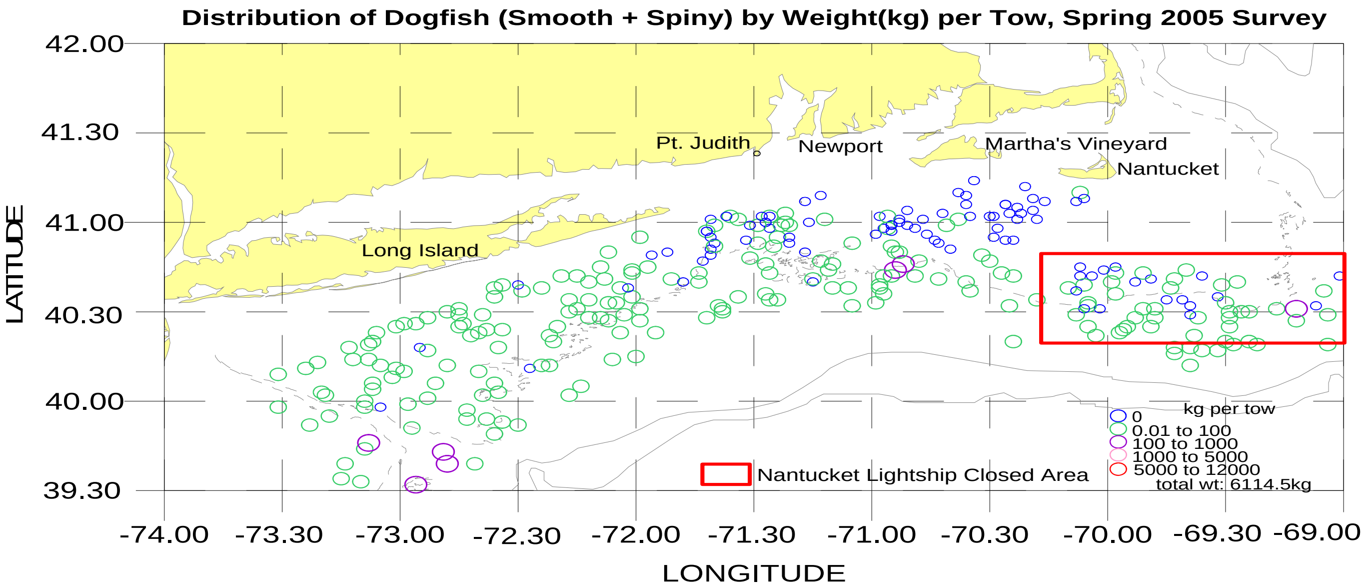

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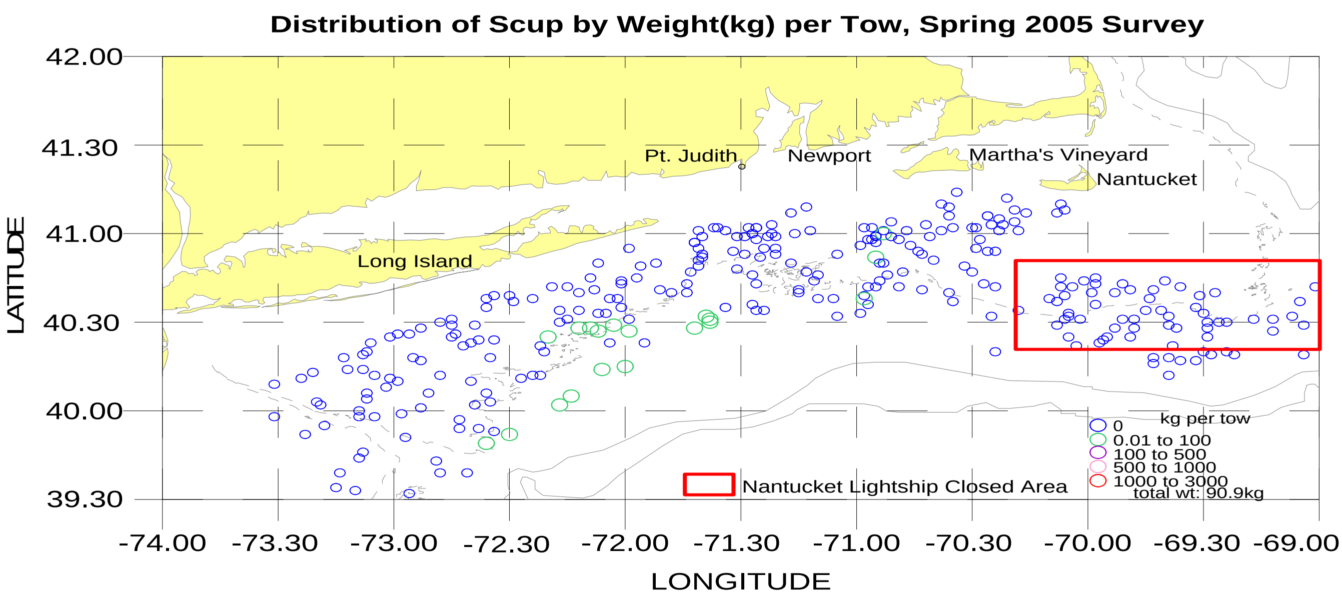

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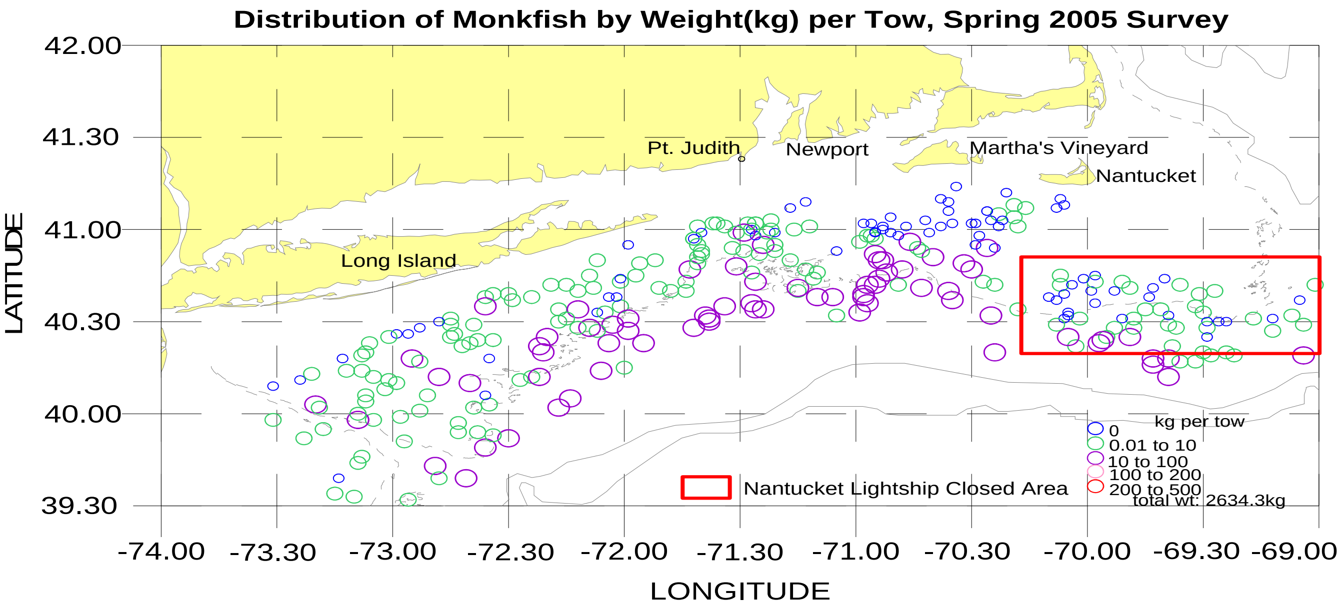
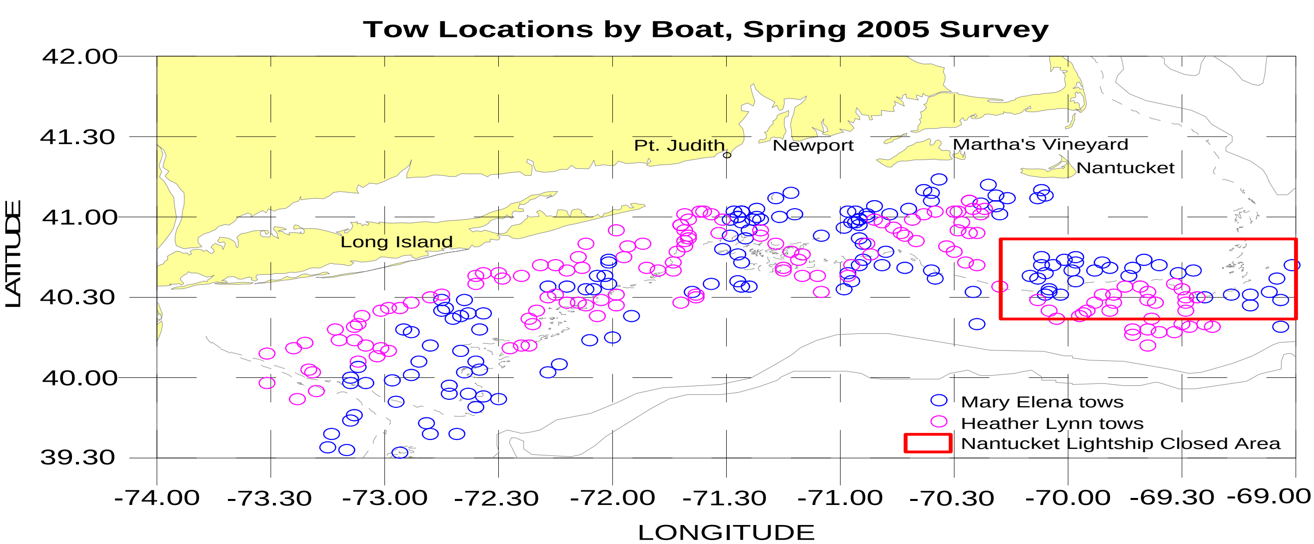


Figure 11



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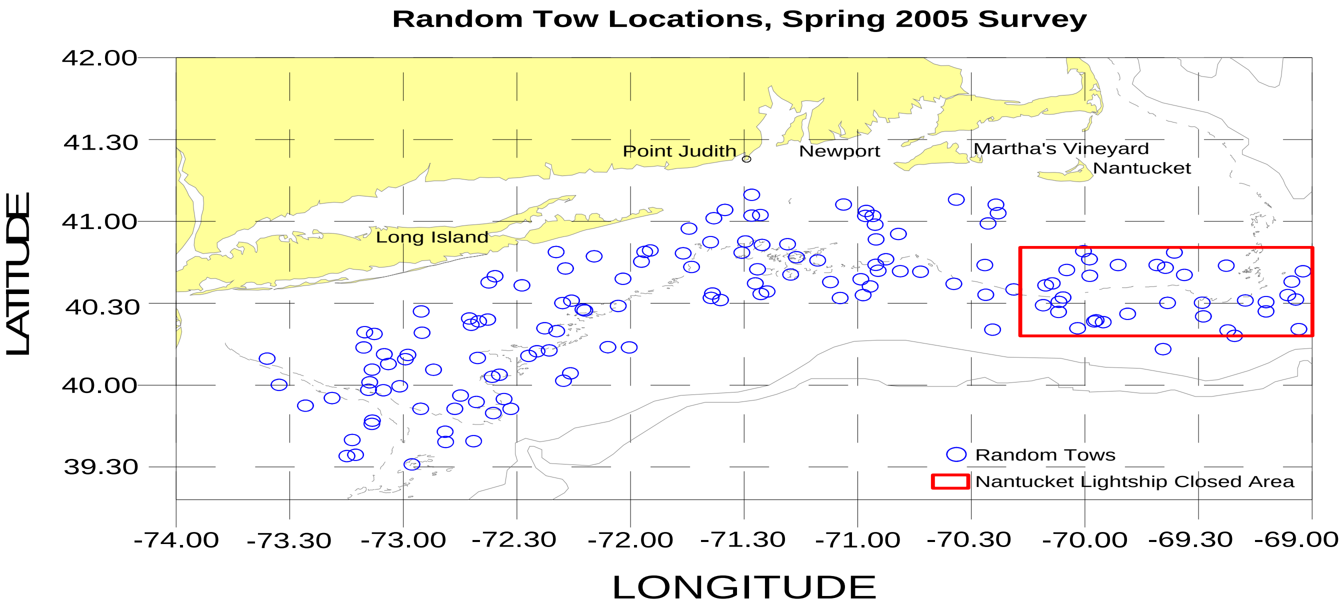


Dogfish were counted, then thrown overboard

Fall, 2005

Table 1: Species Total Weights for Heather Lynn & Mary Elena

Species	*ME Total Weight(kg)*	*HL Total Weight(kg)*	*Total Weight(kg)*
Barndoor Skate	4994.4	1147.6	6142
Black Seabass	38.9	252.8	291.7
Fourspot Flounder	11758.8	11531.1	23289.9
Little Skate	0	2302.9	2302.9
Monkfish	6020.2	3370.9	9391.1
Scup	3403.4	9737.1	13140.5
Sea Scallops	4673.4	2788.9	7462.3
Skates(unc)	120070.8	97786.9	217857.7
Smooth Dogfish	3649.4	2810.7	6460.1
Spiny Dogfish	63359	107218	170577
Summer Flounder	5530.1	6393	11923.1
Windowpane	637.1	836.4	1473.5
Winter Flounder	4970.2	6466.8	11437
Witch Flounder	142.5	192.1	334.6
Yellowtail Flounder	2162.7	2042.7	4205.4
Other species	25226	28354.9	53580.9
Total	256636.9	283232.8	539869.7

Figure 1

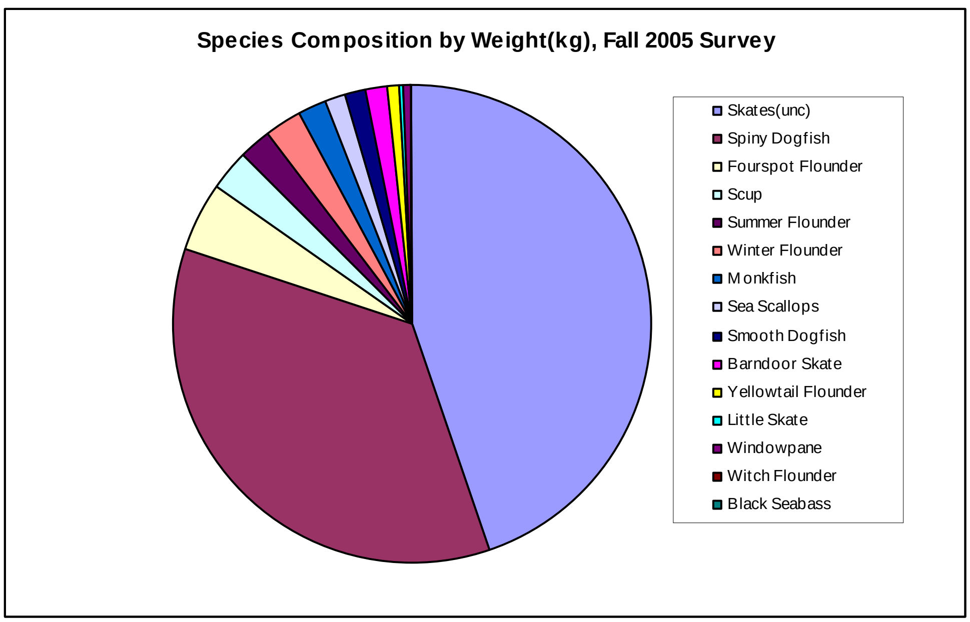
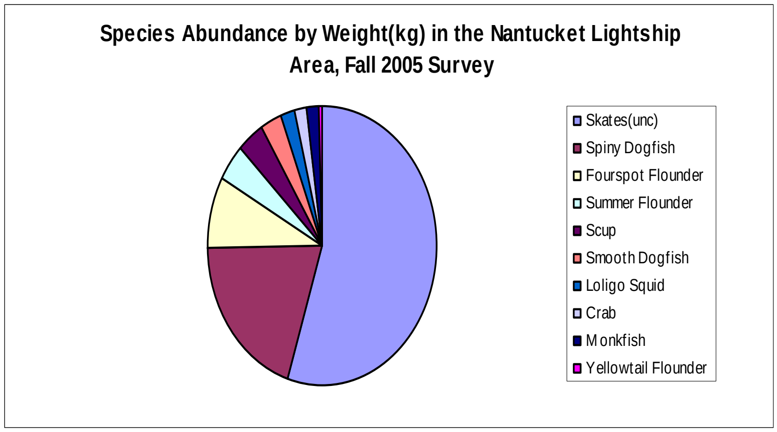
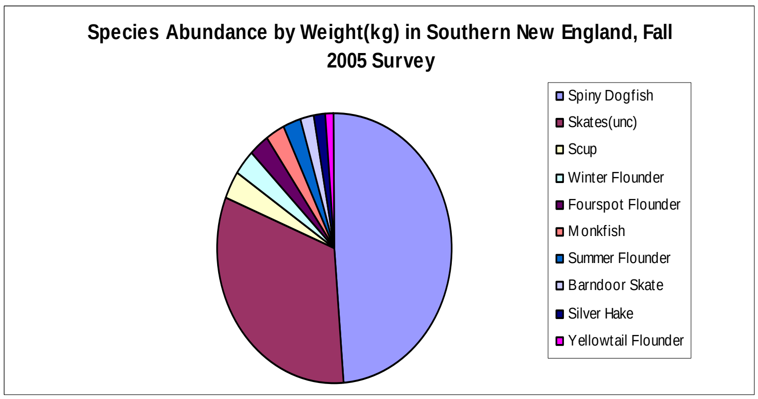


Table 2: Top 10 Species Abundance by Weight (east, central, west)

Nantucket Lightship Area	
Species	***Weight***
Skates(unc)	61887.7
Spiny Dogfish	22397.6
Fourspot Flounder	9277.9
Summer Flounder	4725.4
Scup	4542.4
Smooth Dogfish	3342.9
Loligo Squid	2040.6
Crab	1956.1
Monkfish	1813.2
Yellowtail Flounder	748.1



Southern New England	
Species	***Weight***
Spiny Dogfish	117876.9
Skates(unc)	78492.7
Scup	8422
Winter Flounder	7381.4
Fourspot Flounder	6756.4
Monkfish	6482.3
Summer Flounder	5477.5
Barndoor Skate	4624.7
Silver Hake	4369.4
Yellowtail Flounder	2501.5



Mid-Atlantic	
Species	***Weight***
Skates(unc)	77477.3
Spiny Dogfish	30302.5
Fourspot Flounder	7255.6
Sea Scallops	4774.3
Haddock	3352.8
Loligo Squid	3305.6
Winter Flounder	2295.6
Little Skate	2037.5
Summer Flounder	1720.2
Yellowtail Flounder	955.8

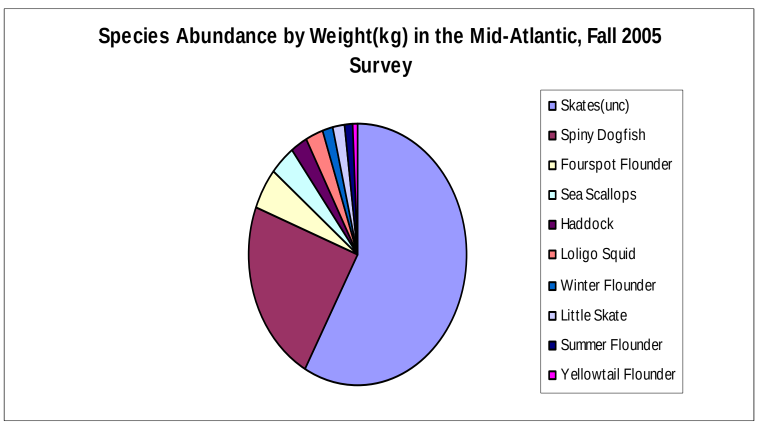
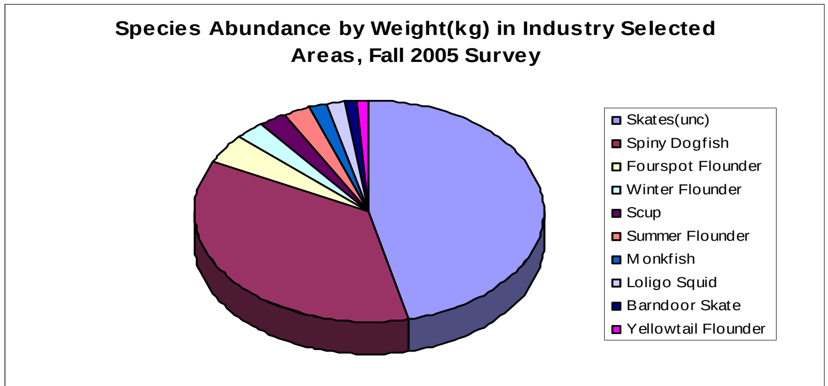
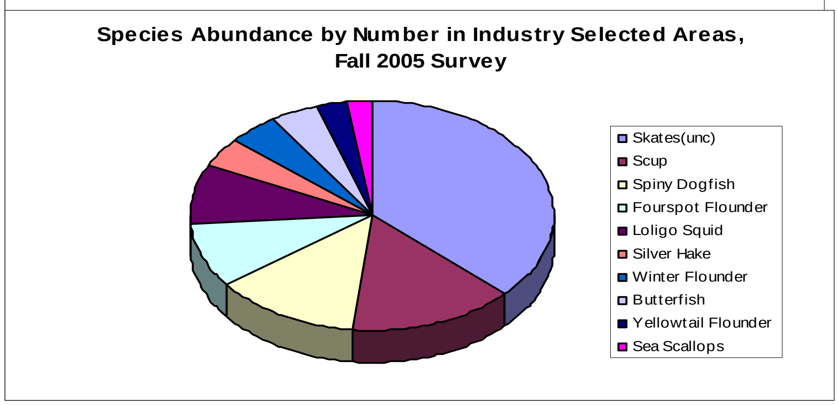


Table 3: Top 10 Species Abundance by Weight & Number, Industry vs. Random

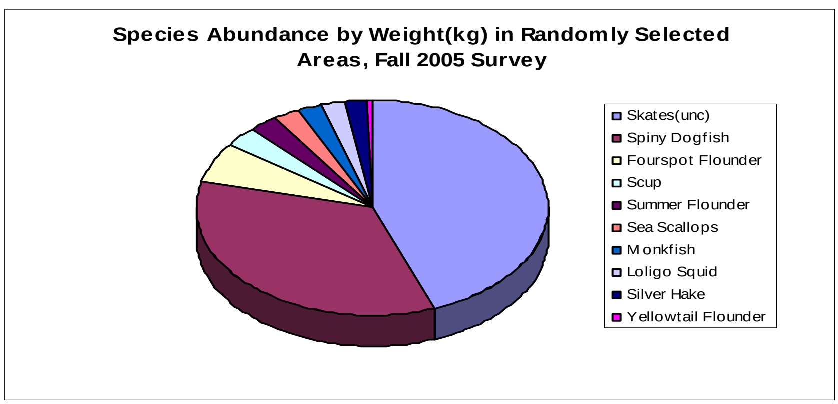
Species	*Weight(kg)*
Skates(unc)	131824.4
Spiny Dogfish	103292.1
Fourspot Flounder	11366.1
Winter Flounder	8290.3
Scup	7272.2
Summer Flounder	6966.7
Monkfish	5028.1
Loligo Squid	4484.1
Barndoor Skate	3374.3
Yellowtail Flounder	2882.4



Species	*Number*
Skates(unc)	235051
Scup	94254
Spiny Dogfish	83386
Fourspot Flounder	59422
Loligo Squid	52249
Silver Hake	27389
Winter Flounder	27355
Butterfish	26370
Yellowtail Flounder	18357
Sea Scallops	14334



Species	*Weight(kg)*
Skates(unc)	86033.3
Spiny Dogfish	67284.9
Fourspot Flounder	11923.8
Scup	5868.3
Summer Flounder	4956.4
Sea Scallops	4633.6
Monkfish	4363
Loligo Squid	4132.8
Silver Hake	3742.3
Yellowtail Flounder	1323



Species	*Number*
Skates(unc)	156019
Haddock	98724
Fourspot Flounder	63833
Loligo Squid	54295
Scup	45621
Spiny Dogfish	35362
Silver Hake	33554
Sea Scallops	30576
Red Hake	23027
Yellowtail Flounder	10550

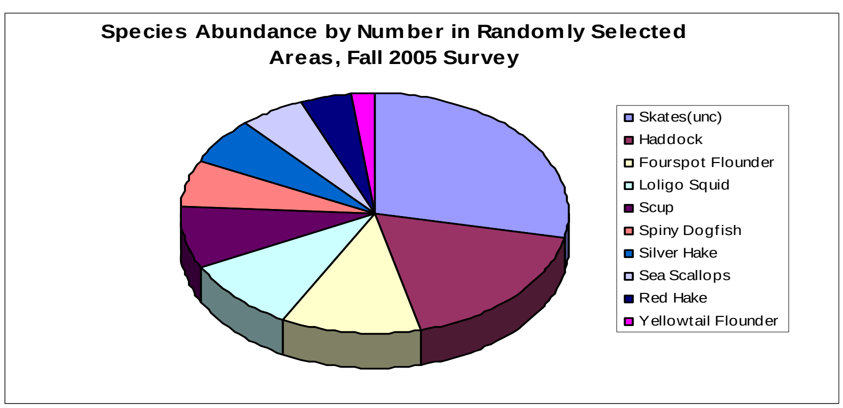


Figure 2

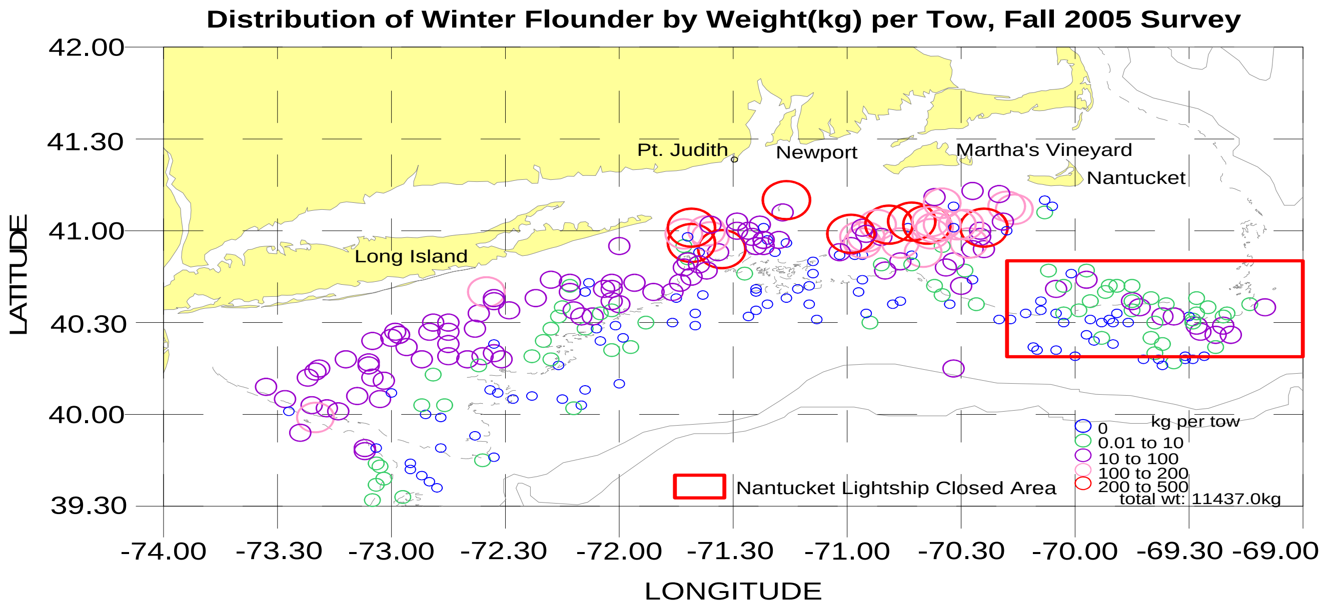


Figure 3

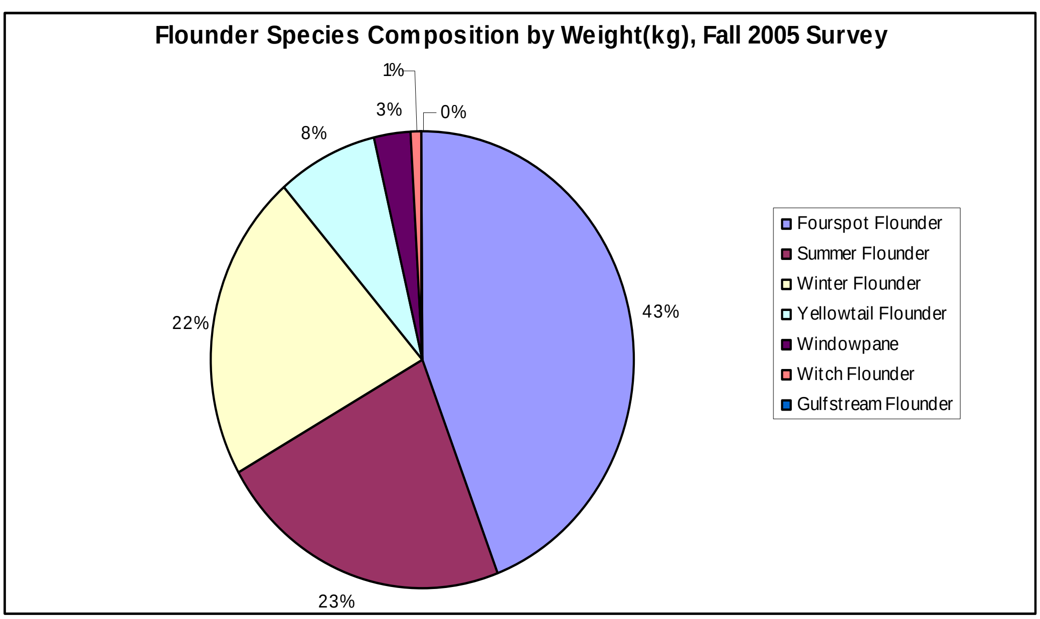


Figure 4

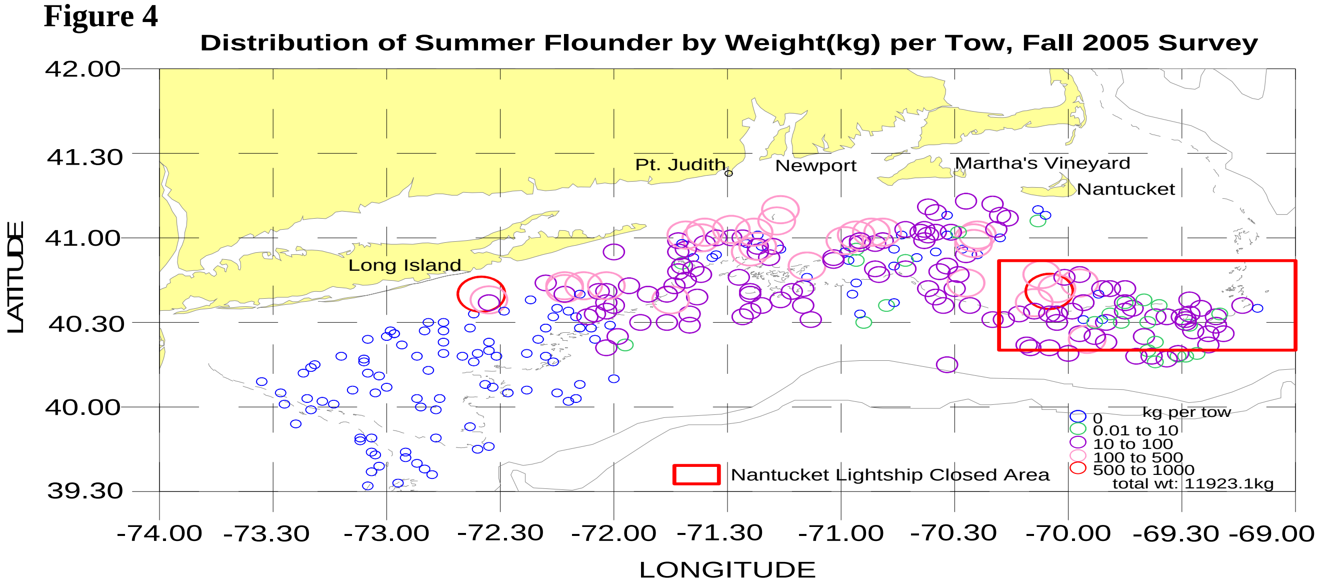


Figure 5

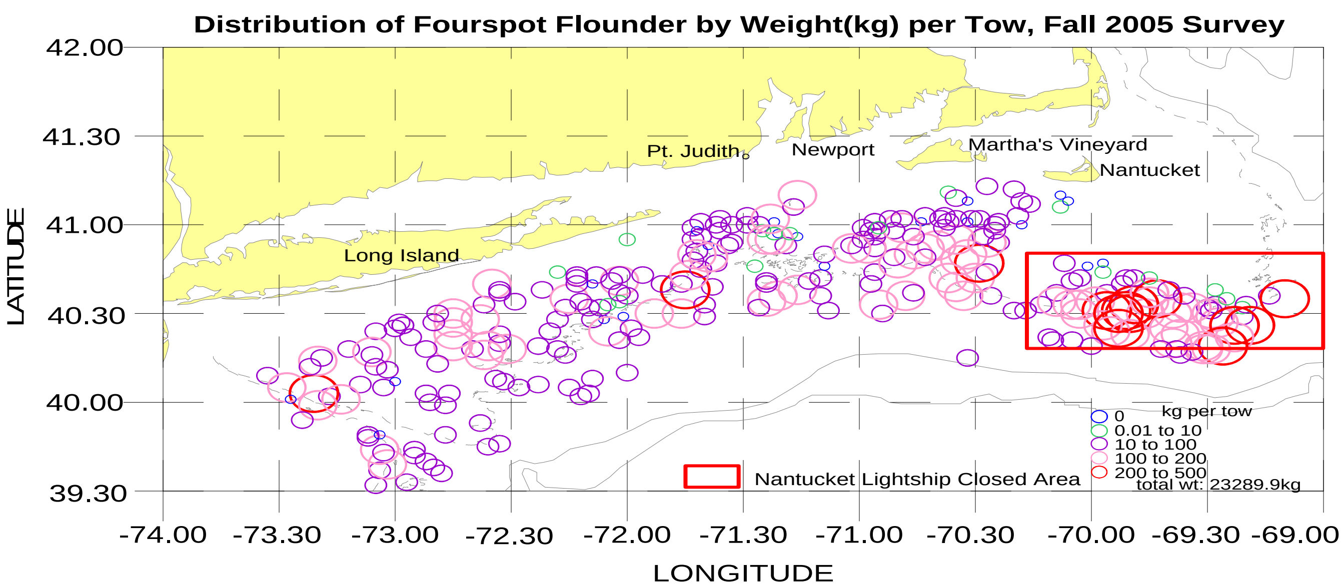


Figure 6

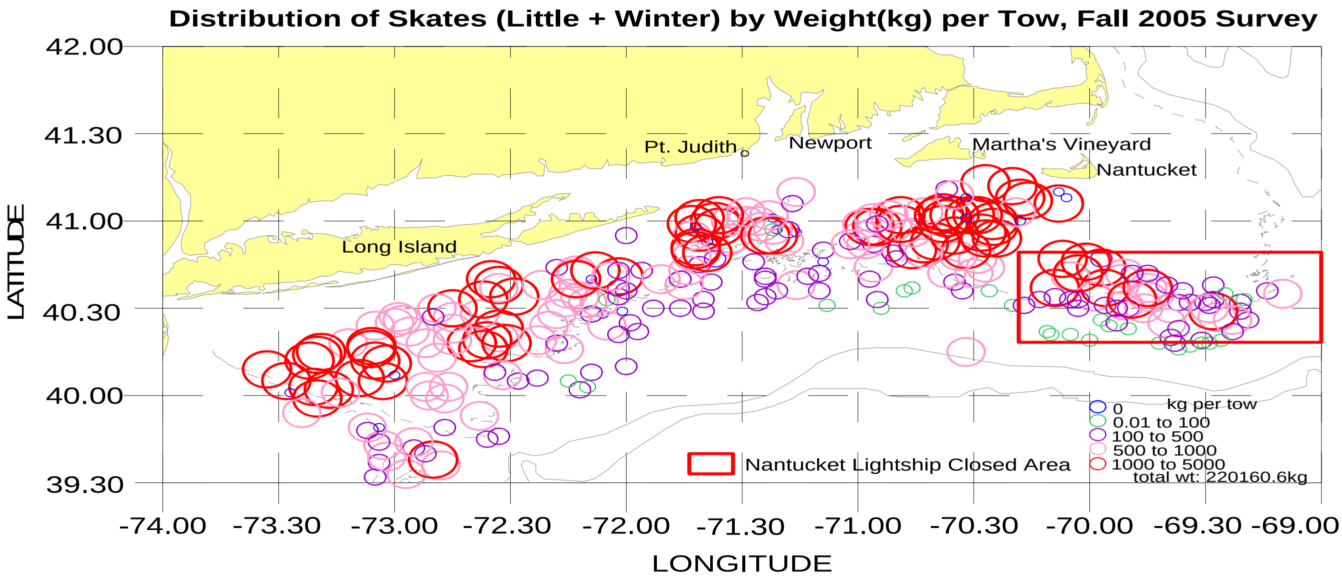


Figure 7

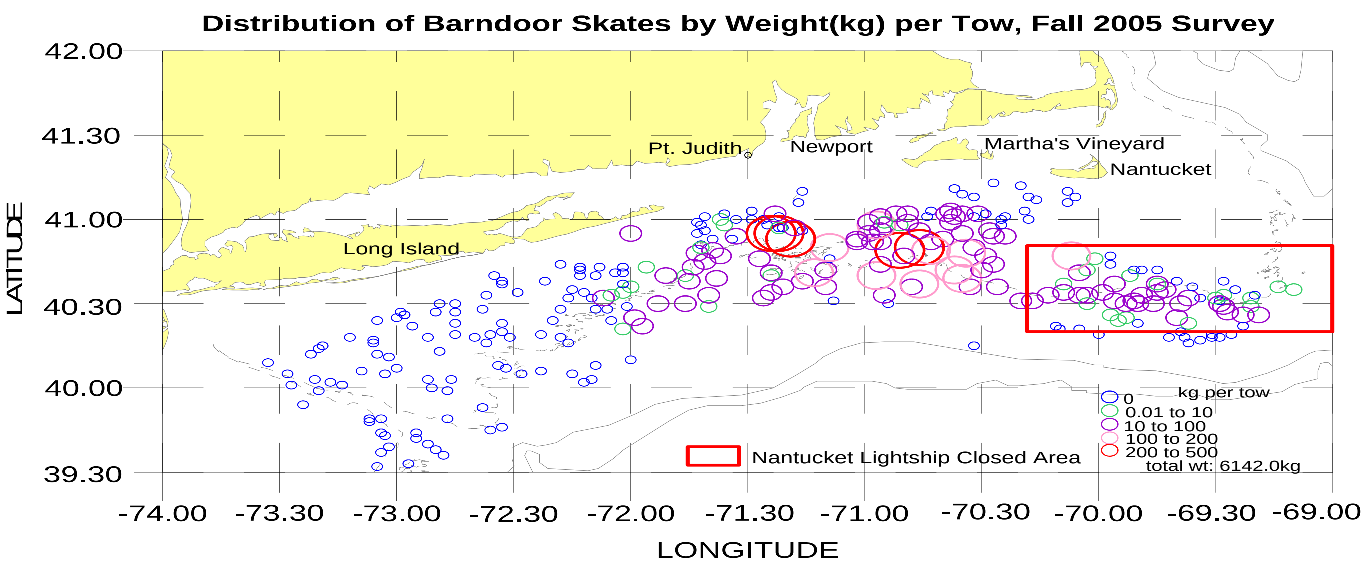


Figure 8

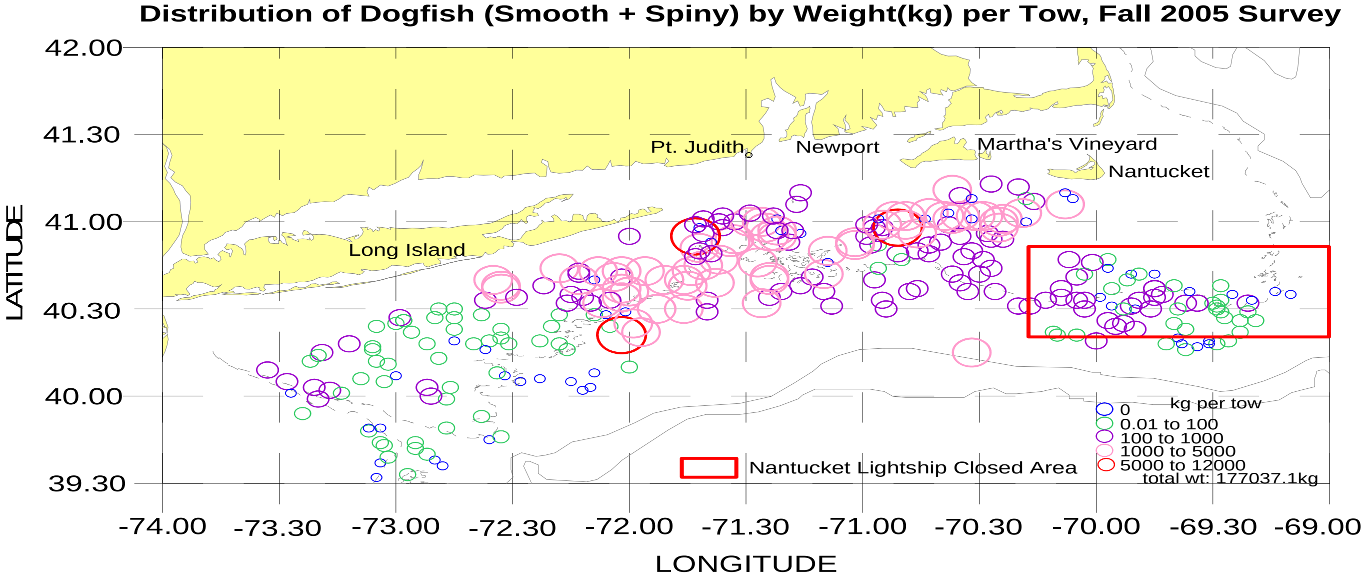


Figure 9

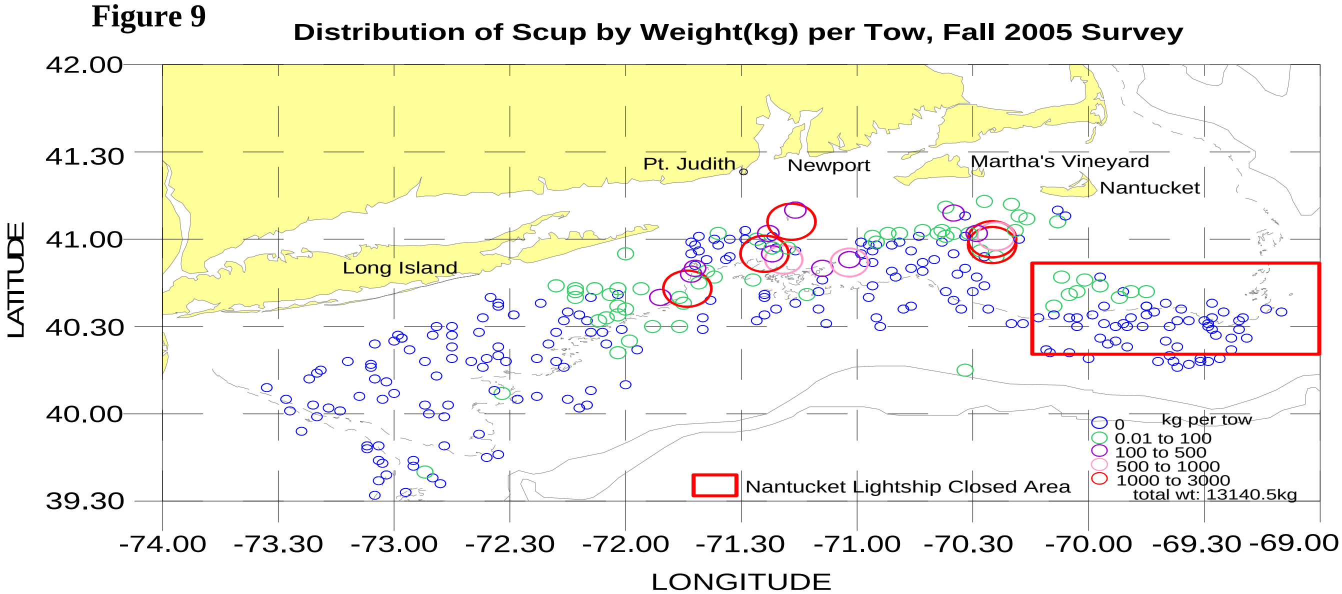


Figure 10

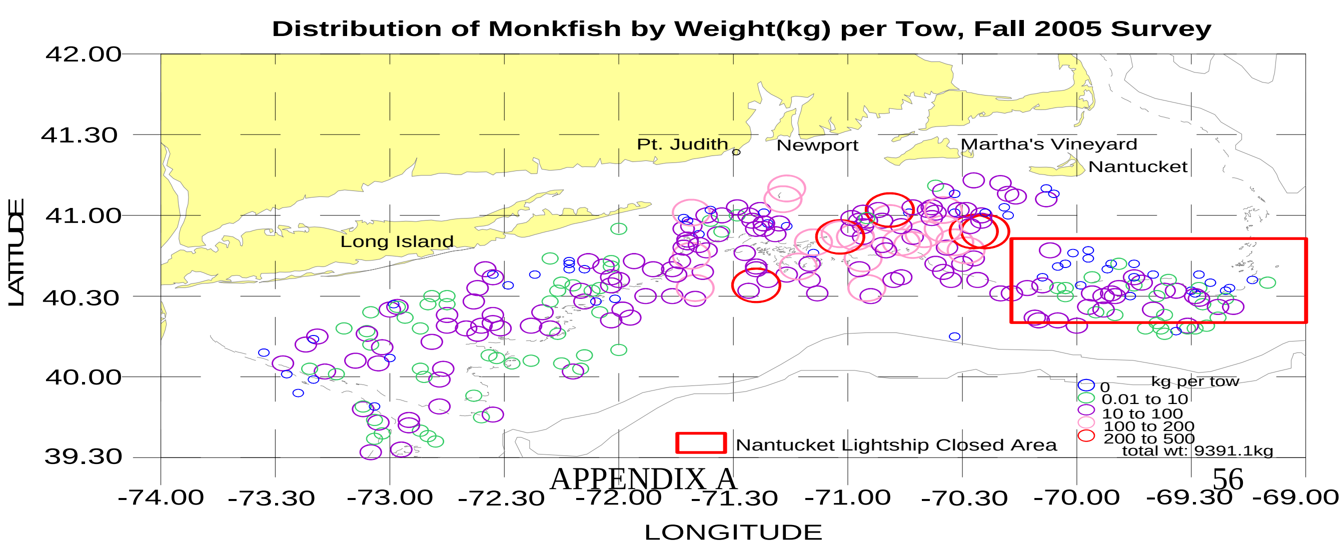


Figure 11

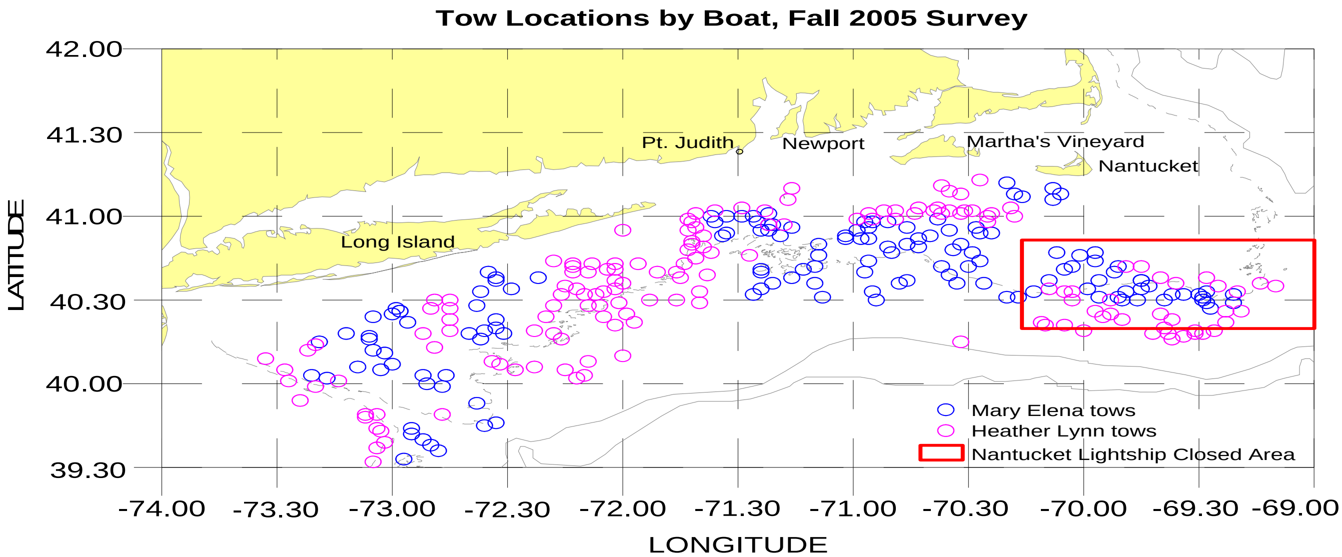


Figure 12