An Overview of the Social Sciences Branch (SSB) Fixed Cost Survey in the Northeast: Protocol and Results for Survey Years 2011, 2012, and 2015

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EXECUTIVE SUMMARY

Fisheries vessel cost data are an important component to economic analyses required under fishery management actions. The Social Sciences Branch (SSB) of the Northeast Fisheries Science Center (NEFSC) has collected cost information, on a voluntary basis, from commercial fishing vessel owners in the Northeast for several years through multiple initiatives. While at-sea observers in the Northeast region collect information on vessel operating costs (i.e., trip costs), such as fuel, bait, and ice, they do not collect data on costs that generally are not incurred at the trip-level. The SSB cost survey is the sole source of cost information collected by NOAA Fisheries in the Northeast region for vessel-level repairs, upgrades, fees and insurance, and business-level/overhead costs (e.g. trucking, advertising, administration). This report summarizes the results of the 3 most recent cost data collection efforts conducted by the SSB. Survey methods and response rates are summarized, followed by an overview of survey results. We conclude with a discussion of possible methods to utilize these survey data in future economic analyses. The results presented here are somewhat hindered by low survey response rates, and continued work is necessary to best capture costs incurred by fishing vessel owners in the Northeast region.

1. INTRODUCTION

The Social Sciences Branch (SSB) of the Northeast Fisheries Science Center (NEFSC) collects cost data from owners of commercial fishing vessels in order to support legislative requirements of fishery management actions. These applicable laws and Executive Orders include the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, E.O. 13771, and the Regulatory Flexibility Act.[3] Outside of regulatory requirements, the SSB relies on cost data to examine economic profitability of fishing businesses, fleet efficiency, and vessel productivity.[4] The cost data are also necessary for input/output modelling, entry/exit modelling, and in the construction of economic indicators. An accurate understanding of the financial costs incurred by commercial fishing vessel owners and businesses is critical for these analyses.

Total costs for a commercial fishing business include the costs of operating at sea (trip costs), the costs of maintaining a vessel (vessel costs) and the overhead costs incurred by the fishing business (business costs). Trip costs consist of variable costs such as fuel, oil, bait, and ice; information on these costs are collected on commercial fishing trips by at-sea observers.[5] Vessel costs and business costs largely consist of quasi-variable costs and fixed costs; information on these costs is collected using voluntary data collection efforts administered by the NEFSC SSB. Vessel costs include repairs and maintenance, vessel upgrades, insurance, mooring fees, and docking fees. Business costs include trucking, association fees, professional fees, advertising, leasing of office space, and administrative support.

The collection of cost information from commercial fishing vessel/business owners has been carried out by the SSB through several initiatives. Specifically, there have been a total of 6 data collection events to date which spanned over 3 implementation "Phases". The first "Phase" included 3 data collection efforts, occurring over 2007-2009, where cost surveys were sent annually to vessel owners in the Northeast region. Owners were instructed to report their costs for the preceding year (e.g., the 2009 survey requested costs incurred during 2008). Surveys were sent to vessel owners alongside permit renewal applications by the Greater Atlantic Regional Fisheries Office (GARFO)[6]. In each of the 3 "Phase 1" years, the entire population of active fishing vessels in the Northeast was surveyed. Active vessels were defined as having at least 1 Northeast Federal fishing permit and having reported commercial landings of at least 1 pound of finfish or shellfish sold through the Northeast seafood dealer reporting system (Das 2013).

There was an observed decline in the 2009 response rate after surveying vessel owners for 3 consecutive years (2007-2009). SSB staff interpreted this decline as survey fatigue, and to alleviate this possibility moving forward, no cost surveys were fielded in 2010 or 2011. This 2 year period also allowed for time to revisit the existing survey instrument and to analyze existing

[3] Specific fishery management actions for which SSB cost survey data has been utilized include Amendment 19 and Framework 27 to the Atlantic Sea Scallop Fishery Management Plan. Cost survey was also used in the 5-year review of the General Category IFQ scallop fishery.

[4] Research projects which utilized SSB cost survey data include an index-based assessment of the "economic health" of the Northeast multispecies trawl fleet (Walden 2013) and a profitability analysis of the New England lobster fleet (Zou et al. 2021).

[5] While at-sea observers collect trip cost information, the deployment of observers is based on a biologically-driven stratification scheme rather than an economically-driven sampling method. Trip costs are not summarized in this paper; for detailed information on trip costs in Northeast region fisheries, see Das (2013) and Werner et al. (2020).

[6] The Greater Atlantic Regional Fisheries Office (GARFO) was known as the Northeast Regional Office (NERO) during the 2007-2009 period.

survey data (Das 2013). Pre-testing of the modified cost survey instrument was conducted through 2 avenues. SSB economists conducted a series of focus groups with federally-permitted commercial fishermen in the Northeast region. In March 2012, 2 focus group sessions were held in Providence, Rhode Island. Four additional focus groups sessions were conducted by SSB economists in May 2012 in Portland, Maine. Each focus group session contained 6-9 commercial fishing vessel owners and was led by 1 moderator. Focus group sessions were recorded via audio. Cognitive interviews were also conducted with commercial fishermen to test the modified survey instrument prior to survey implementation. A total of 6 interviews were conducted in July 2012. Following the cognitive interviews, "Phase 2" of cost surveying was initiated through a split-sample survey fielded in 2012 and 2013. The survey population was slightly modified from "Phase 1" to include all vessels that had dealer reported landings *or* landings reported through Vessel Trip Reports (Das 2016). For this split sampling design, a "stratified" sampling approach was implemented in which strata were determined by principal gear used and vessel length. Surveys were sent to vessel owners of the first half of strata in 2012 and the second half in 2013, such that a census of all active vessels would be captured between the 2 survey installments. Following 2013, the survey instrument was again revisited, with another 2 year break over 2014 and 2015.

The third "Phase" of the cost survey includes the most recent survey effort which was fielded in 2016. The sampling approach was modified to perform a census of active fishing businesses, rather than a census of active vessel owners. Since some businesses can include multiple vessels, not all vessels were surveyed. Similar to the "Phase 1" and "Phase 2" survey efforts, "Phase 3" surveys asked vessel/business owners to report their costs for the year prior to survey implementation.

This paper will focus on the results of the "Phase 2" (data collected in 2012 and 2013) and "Phase 3" (data collected in 2016) surveys only. Hereafter, we will refer to the survey year as the year in which costs were incurred (2011, 2012, and 2015), and not the years in which surveys were sent to vessel owners (2012, 2013, 2016). We present the survey methods, survey results, and conclude with a discussion on the appropriate usage of data resulting from these 3 most recent SSB cost survey efforts.

2. OVERVIEW OF THE COST SURVEY

2.1. Survey Methodology

The population for the 2011, 2012, and 2015 surveys comprised all active federally-permitted commercial fishing vessels owned by individuals operating in the Northeast region, extending from Maine to North Carolina. For 2011 and 2012, an active fishing vessel was defined as holding at least 1 federal fishing permit and reporting landings of at least 1 pound of finfish or shellfish through the Northeast seafood dealer reporting system or through the Vessel Trip Report (VTR) in the year for which costs were being queried. For 2015, this definition was slightly modified to only include vessels that had dealer reported landings, so as to exclude VTRs from federally-permitted party/charter vessels. These criterion led to populations of 4,008 vessels for 2011, 3,821 vessels for 2012, and 3,066 vessels for 2015. The 2011 and 2012 cost surveys were administered by the Eastern Research Group (ERG). Survey materials (see Appendices II & III) were sent to commercial fishing vessel owners by mail. Owners were given an option to return the survey by mail or to complete the survey online by following instructions enclosed in the mailed survey materials.

A split sampling approach was utilized for the 2011 and 2012 surveys where roughly half the population was surveyed in 2011, and the other half was surveyed in 2012, in order to achieve a census of all vessels over the 2 sampling periods. Part of the intent of split sampling was to minimize the burden imposed on vessel owners in a given year (i.e., if an owner had 2 vessels, 1 vessel was surveyed in 2011 and the other was surveyed in 2012). Surveys for these 2 years were split approximately even by principal gear fished and vessel length. Principal gear was determined as the gear type used to generate the highest amount of revenue in the year being queried. Vessel length was classified by a binary variable indicating whether the vessel was above or below average length for the gear group. Longline and purse seine vessels were not divided into separate strata by length due to the small number of vessels in those principal gear groups. Based on analysis of prior SSB cost survey data from 2006-2008, principal gear type and vessel length were determined to be relatively strong indicators of vessel costs. Since a split-sampling approach meant all active vessels would be surveyed between the 2 years, the method of stratification was to ensure roughly an equal number of vessel types to be surveyed in each year. Table 1 shows the average length associated with each gear group in 2011 and 2012. Vessel lengths for 2015 are also included for comparison purposes, though sampling methods changed for 2015.

The 2015 cost survey was administered by a different contracting firm, ICF. Similar to the 2011 and 2012 surveys, the 2015 survey version was sent by mail and vessel owners were given the option to respond either via mail or online. The sampling approach was modified to perform a full census of fishing businesses, rather than a census of active vessels as was done for 2011/2012. Businesses were defined in accordance with the Regulatory Flexibility Act's (RFA) principles of affiliation[7]. The rationale for this sampling design was to maximize business-level information collected, while minimizing sending multiple surveys to vessel owners.[8] For the 2015 survey, sampling in cases of multiple vessels within the same business were handled through 2 different methods. If the business contained a longline or purse seine vessel, force-choosing was employed to capture the costs for those gear groups, as they contain fewer vessels. If the business owned multiple vessels, but did not have a vessel in the longline or purse seine gear groups, the vessel sampled was chosen at random. One final change for the 2015 survey involved the collection of business (affiliate) level costs for vessel repairs and upgrades. Though previous survey versions did collect business level costs, vessel repair and maintenance, as well as upgrade and improvement costs, had only been queried for the vessel specified in the survey. The addition of this section allowed the owner to report repair/maintenance and upgrade/improvement costs associated with any other vessel within their fishing business.

A summary of population size (i.e., the total number of vessels eligible for sampling), sample size, and sampling rates by strata across the 3 survey years is described in Table 2.[9] Given the split-sampling approach for 2011 and 2012, strata sampling rates were generally ~50% for each year. Under the modified census approach for 2015, the sample size increased to 2,489 vessels, each of which belonged to a different business affiliate. The high total sampling percentage for 2015 (81%) indicates that the vast majority of business affiliates in the Northeast region consist of

[7] Herein, an affiliated entity or business is defined as a unique combination of vessel owners, i.e. all owner names listed on federally-permitted vessels.

[8] There was an issue in the initial mailing of the 2015 survey in which the vessel name listed on the survey was in some cases not correct. This problem was resolved and the survey was redistributed. For a copy of the press release describing the mailing error, contact Research Communications Branch at the Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

[9] A few of the sample strata numbers in this table vary slightly from Das (2016).

a single federally-permitted vessel. Low sampling rates at the 2015 strata-level indicate gear types belonging to multiple-vessel businesses and, therefore, were less sampled overall. For example, the considerably lower sampling rate for large dredge vessels indicates that many of these vessels belong to larger business affiliates consisting of multiple vessels.

2.2. Response Rates

The reporting of vessel and business costs which are not incurred on a trip basis is voluntary for commercial fishing vessels owners in the Northeast region. Considerable effort is necessary to gather this cost information. Annual costs associated with commercial fishing vessels and businesses can be difficult to estimate and generally require the owner to refer to their records. This information can also be considered sensitive to some vessel owners. Given these factors, survey response rates vary over time (Table 3). For each of the 3 survey years, a returned survey was considered complete if it had at least 1 cost-related question answered. The overall response rate for the 2011 survey was 28.9% (372 responses) and declined to 20.1% (358 responses) for the 2012 survey and 6.4% (160 responses) for the 2015 survey. Since we focus on cost information collected from commercial fishing vessel owners only, sampled recreational vessels are not considered in the analysis of results, causing the sample sizes for 2011 and 2012 to be lower than those presented in Table 2. The percentage of responses via mail were consistent across the 3 survey years, with a low of 82% for 2011, and a high of 90% for 2015. The affinity for vessel owners to respond via mail may have been partially driven by age demographics.[10]

As mentioned in Section 2.1, the 2011 and 2012 surveys utilized a split sampling approach, while the 2015 survey had a high sampling rate of 81% of the population of eligible vessels. Given these sampling designs, the 2015 survey sampled a large number of the same vessels from the 2011 or 2012 surveys. To better understand the changes in response rate over time, responses from vessel owners who were in both sampling frames were analyzed (Figure 1). A total of 881 vessel owners were sampled in 2011 and again in 2015. Of these 881 owners, 70.4% did not respond to a survey in either year. A total of 244 owners responded in 2011 (independent of 2015 response). Of these 244 owners, 34 (13.9%) responded to the 2015 survey. Of the 637 (881-237) owners who failed to respond in 2011, 17 (2.7%) responded to the 2015 survey. Owners were twice as likely to respond in both 2011 and 2015 (n=34) than they were to respond in only 2015 (n=17). Similar trends follow for owners that were surveyed in both 2012 and 2015. A total of 1,135 owners were surveyed in both of these years, 73.9% of which did not respond to the survey in either year. A total of 262 owners responded in 2012 (independent of 2015 response). Of those 262 owners, 53 (20.2%) responded to the 2015 survey. Of the 873 (1,135-262) owners who failed to respond in 2012, 34 (3.9%) responded to the 2015 survey. Taken together, the likelihood of an owner responding to the 2015 survey was strongly influenced by if they responded to an earlier survey.

Sample sizes, response sizes, and response rates by strata for the 3 survey years are described in Table 4. In line with the overall decline in response rates, a declining response rate trend is evident across survey strata. Response rates by strata ranged from 12.5%-40.0% (28.9% total) for 2011, 4.7%-25.9% (20.1% total) for 2012, and 3.1%-10.0% (6.4% total) for 2015. Vessel

[10] Though the SSB cost survey does not ask for respondent's age, there is some evidence to suggest the fishing industry in the Northeast region is comprised of relatively older participants. Clay and Colburn (2021) document interviews with industry members from Northeast and West Coast fisheries over 2004-2015. These interviews were conducted with a number of fishing industry professionals, and not just vessel owners. Nevertheless, the average participant age was 53 years old, with the largest age group in 10 year increments being 50-60 years old, followed by 60-70 years old.

owners in the pot/trap categories comprised a substantial portion of the total response in all 3 years- 47.3% for 2011, 61.5% for 2012, and 60.0% for 2015. Many of these pot/trap vessels are primarily engaged in the American lobster (*Homarus americanus*) fishery, the highest revenue-generating fishery in the Northeast region in recent years (Zou et al. 2021). Owners of vessels in the dredge categories, largely associated with the Atlantic sea scallop (*Placopecten magellanicus*) fishery, tended to respond below the overall rate. For other gear categories (gillnet, handgear, longline, purse/seine, trawl), response rates did not show any persistent trend above or below the overall rate. Response rates among owners of large vessels in both the dredge and trawl categories were higher than small vessels for all 3 survey years. The reason for this trend within these particular gear groups is not clear. Larger vessels typically incur higher costs, and owners for these types of vessels may have been more compelled to share cost information. Alternatively, larger dredge and trawl vessels may have been more profitable on average than small vessels in these gear groups, and therefore owners may have been more inclined to respond to a National Marine Fisheries Service (NMFS) survey. In other gear groups (gillnet, handgear, pot/trap), similar trends in response are not evident when comparing large and small vessels.

2.3. Nonresponse

Given differences in response rates by strata, nonresponse bias may be present. Since nonresponse bias may lead to biased inferences, it is important to test for the existence of this bias. We do so by performing a chi-square (X^2) test on strata population percentages relative to strata response percentages, following the removal of outlier responses[11]. Results indicate that there is a statistically significant difference between these percentages for 2011 and 2012, while for 2015 we fail to reject the X^2 test of equal proportions. We correct for these differences in response rates by applying weights (Table 5) equal to the reciprocal of the probability of a respondent being in a stratum (Equation 1). N_i represents the population frequency in stratum *i*, and n_i represents the respondents frequency in stratum *i* (Lohr 2019).[12]

$$wi = 1/Pi; \text{ where } Pi = ni/Ni \qquad (\textit{Equation 1})$$

We test for non-response bias based across strata and years on a number of vessel characteristics to highlight if certain vessel responses are missing at random (MAR) or if there are systematic patterns of missing vessel information. From the permit data maintained by the GARFO, we test for statistically significant differences in vessel length, tonnage, horsepower, and age between vessels where the owner responded to the survey versus vessels where the owner did not respond. Furthermore, we test for differences in days absent within the query year by summing the duration of all trips from VTRs. Non-response bias for these vessel characteristics within strata was generally not detected. Non-response bias was detected in some strata/variable combinations though no persistent trends of bias emerged from the 3 survey years. Since there was no indication that the cost data are unrepresentative at the strata-level, data transformations were not made based on these test results. Due to the large number of variables and strata involved in these tests, they are available in Appendix I.

[11] The procedure followed for removal of outlier values is documented in Section 3.2.

[12] Another approach to account for non-response bias from Dillman et al. (2014) is to take the inverse of the response rate for each group or strata. We chose not to take this approach due to differences in sampling rates across survey strata.

Additionally, for each of these same vessel characteristics, we performed T tests for the 3 survey years (Table 6). In general, Pooled T test results are reported unless unequal variances were detected, in which the Satterthwaite T test results are reported. Most T tests failed to reject the null hypothesis of equal means for vessel characteristics, suggesting no significant difference between survey respondents and non-respondents at the aggregate level. For 2011, the null hypothesis (at the 95% confidence level) of vessel length being equal between respondents and non-respondents was rejected. For 2015, the null hypothesis (at the 95% confidence level) of vessel horsepower and vessel age being equal between respondents and non-respondents was rejected. Older vessels were more likely to respond, on average, in 2015. A possible explanation could be that these vessels incurred higher repair/maintenance and/or upgrade/improvement costs, and were more compelled to share their cost information. However, such a difference in response by vessel age was not observed for 2011 or 2012.

3. DATA AND RESULTS

3.1. Description of Questions

A large variety of cost categories were investigated in the 2011, 2012, and 2015 surveys. The format of the surveys was not constant throughout the 3 years, and some rearranging was necessary to form consistent groupings for the purposes of this paper. These cost category groupings are provided in Table 7. The first 5 category groupings (Repair/Maintenance, Upgrade/Improvement, Vessel Fees and Insurance, Business Cost by Vessel, and Other Costs) together comprise what we will refer to as "Fixed Costs". For the purposes of this paper, fixed costs refer to costs that generally are not incurred on a trip basis. Some of the fixed cost categories, such as repair/maintenance, are not truly fixed in that they will vary in the short-run since they are dependent on the level of fishing effort. These costs, however, are still not expected to be incurred on a trip-basis. Other cost components, such as vessel fees and insurance, represent true fixed costs and are not expected to vary in the short-run, regardless of the level of fishing effort. Following the fixed cost results, owner responses for questions related to the value of vessel and associated permits[13] are discussed. Finally, responses for crew payments and crew payment systems are covered. For each survey year, we present the results for fixed costs, value of vessel and permits, and crew payments across all survey respondents, and at the strata-level. Aggregate values across all respondents are presented both as weighted values, according to the formula in Section 2.3, and unweighted values.

A small number of questions from the 3 surveys are not discussed in this paper. For example, data related to quota leasing costs and at-sea monitoring costs are not covered since response to these questions was low, likely attributed to the fact that these costs are only applicable in certain fisheries. Given the small number of responses to these questions, the ability to present results would be severely limited by data confidentiality rules[14]. Survey responses for operating costs (fuel, ice, bait) are also not discussed in this paper. A few questions that were included in the

[13] Limited access permits exist for a number of fisheries in the Northeast region. For fishery specific permit information see: https://www.fisheries.noaa.gov/new-england-mid-atlantic/resources-fishing/greater-atlantic-region-forms-and-applications-summary

[14] For information related to data confidentiality, see the National Oceanic and Atmospheric Administration (NOAA) Administrative Order 216-100: Protection of Confidential Fisheries Statistics https://www.noaa.gov/organization/administration/nao-216-100-protection-of-confidential-fisheries-statistics

2015 survey, but not in the 2011 or 2012 surveys, such as the vessel owner's primary fisheries, and specific trip costs that are deducted from the owner's share or crew's share, are also not discussed.

3.2. Data Auditing

A meticulous data auditing process was necessary in order to maximize the accuracy and usability of survey responses. The general process was as follows:

- A small number of vessel owners responded to surveys both via mail and online. In these cases, the first response received was retained for analysis.
- At the end of the surveys, vessel owners were given the option to fill in "other costs" (see Section 3.1) that the survey did not address. Addtionally, a comments section at the end of the surveys provided opportunity for the respondent to list other costs. In cases where the respondent listed other costs, these items were compared to the appropriate survey sections to ensure costs were not being double-counted.
- In cases where the respondent reported a range, rather than a single value, the average was taken and used for analysis.
- For the 2012 and 2015 results, business cost per vessel was calculated by dividing the total business cost by the number of vessels owned. If the respondent did not fill in the number of vessels owned, the business cost by vessel could not be calculated. Those surveys for which business cost by vessel could not be calculated were excluded from the total fixed cost calculations. For the 2012 survey, 22 out of 313 (7.0%) vessel owners that listed business costs did not indicate the number of vessels owned. For the 2015 survey, 6 out of 150 (4.0%) owners that listed business costs did not indicate the number of vessels owned.
- Outlier removal was performed based on a 5 standard deviation approach from the mean for cost categories 1-4 in Section 3.1 (Repair/Maintenance, Upgrade/Improvement, Vessel Fees and Insurance, Business Costs by Vessel). The total number of outlier observations removed was 12 for the 2011 survey, 7 for the 2012 survey, and 5 for the 2015 survey.
- Aggregate results were weighted by survey strata, as described in Section 2.3. However, we also present unweighted results for comparison purposes.
- Blank responses to individual questions were fairly common for all 3 survey years. In these cases, it was not possible to tell if there was no cost for that particular item, or if the vessel owner chose not to provide information. To account for both possibilities, fixed cost categories were analyzed under both assumptions. In cases where a fixed cost category comprised multiple items (e.g. vessel fees and insurance comprised mooring fees, permit fees, and vessel insurance), the category was only considered blank if all sub-components were left unanswered.
- Values from the 2011 and 2012 surveys were converted into 2015 dollars using the gross domestic product (GDP) implicit price deflator.[15]

3.3. Data Summary

[15] Conversion to 2015 dollars using quarterly, seasonally adjusted GDP implicit price deflator and averaging annually. GDP deflator values from the Federal Reserve Bank of St. Louis, available at: https://fred.stlouisfed.org/

The following section summarizes survey results from the cost categories as described in section 3.1, following the data auditing processes described in section 3.2. A total of 866 responses are included in the analysis: 360 responses from 2011, 351 from 2012, and 155 from 2015. However, due to variation in response across individual survey questions, the number of observations is not constant.

Fixed costs

Summary statistics for all fixed cost categories, in unweighted terms, are shown in Table 8. Cost categories are presented with missing/blank information both counted as a non-response and as a zero cost value. Mean total fixed costs were highest in 2011 ($79,616 per vessel) and lowest in 2015 ($48,301 per vessel). Among the fixed cost categories, repair/maintenance represented the highest mean cost for 2011 and 2012, while upgrade/improvement costs represented the highest mean value for 2015. Business costs by vessel were the second-highest mean fixed cost in 2011, while upgrade/improvement costs were the second-highest mean fixed cost in 2012 and repair/maintenance costs were second highest in 2015. For each of the 3 survey years, vessel fees and insurance was the smallest fixed cost category, excluding other costs. The comparatively smaller mean values for other costs, as well as $0 median values, is an indication that the survey has generally adequately captured vessel owner expenses not occurring at the trip-level.

Weighted values for all fixed cost categories are presented in Table 9. Weighting resulted in higher mean values for total fixed costs in each of the 3 survey years, indicating that some of the higher cost strata may have been under-represented by respondents (discussion of strata-level results can be found below). Mean weighted total fixed costs were highest for 2011 ($86,014 per vessel) and lowest in 2015 ($58,395 per vessel). Median weighted fixed costs were lowest in 2012. Weighted values were generally higher than unweighted values across fixed cost categories, though these increases were not uniform. For example, mean values for upgrade/improvement in 2012 were comparable in weighted ($14,310) and unweighted ($14,413) terms.

Mean total fixed cost values exceeded median values (Table 8 and Table 9) in all 3 survey years, indicating skewed distributions in the positive direction (Figure 2 and Figure 3). These distributions were similar across the 3 survey years, with $0 - $24.9K being the most common cost band (36.6% of vessels), followed by $25K - $49.9K (26.2% of vessels), and $50K - $74.9K (13.2% of vessels). For 2011, a fairly large number of vessels (32) incurred total fixed costs in excess of $250K. The number of vessels reporting these high costs decreased markedly for 2012 and 2015.

Total fixed costs by strata are presented in Table 10 and the distribution of these costs are shown in Figure 4. Large dredge and large trawl vessels exhibited the highest mean and median values for each of the 3 survey years, though considerable year-to-year variability was present. For example, large dredge vessels incurred the highest mean cost in 2011 at $350,594 per vessel, while large trawl vessels incurred the highest mean costs in 2012 at $155,595 per vessel. Small handgear vessels had the lowest mean and median costs for each year, and mean costs for this strata declined throughout the 3 survey years. For 2015, the small handgear mean and median costs of $6,817 and $5,205 per vessel, respectively, represent the lowest values in the time series. Pot/trap vessels, particularly in the small category, exhibited relatively small variation in mean and median costs across survey years. Mean values for small pot/trap vessels ranged from $32,002 for 2011 to $34,991 for 2015. The large proportion of responses from pot/trap vessels had a great deal of influence on total unweighted mean and median values for all 3 survey years.

One of the major changes for the 2015 survey, compared to the 2011 and 2012 surveys, was in the structure of the repair/maintenance and upgrade/improvement questions (Table 7). For 2011 and 2012, sub-components to these costs (engine, hull, fishing gear) were queried in an itemized approach, while in 2015 vessel owners were instructed to list a single composite value for vessel repair/maintenance and vessel upgrade/improvement. It is not clear what effect this change had on the way in which vessel owners responded to these questions. Trends for repair/maintenance and upgrade/improvement costs differ across the 3 surveys. Variance in these cost categories is to be expected given that they are somewhat dependent on the level of fishing effort. For 2015, repair/maintenance mean ($19,200) and median ($9,125) values were the lowest over the 3 survey years. Upgrade/improvement mean ($18,289) and median ($6,000) values for 2015 were the highest over the 3 years. One possible effect of the shift from itemized to composite variables was an increase in non-response. The percentage of blank responses for the repair/maintenance category was considerably higher in 2015 (12.9%) than for 2011 (1.7%) or 2012 (0.6%). An additional change for the repair/maintenance and upgrade/improvement categories in the 2015 survey was for these costs to not only be queried at the vessel-level, but also at the business-level (Table 7). For owners of a single vessel, respondents were instructed to skip these business-level questions. For those owners of multiple vessels who did respond, there was an indication that there may have been some confusion in answering these questions. As an example, there were 13 survey responses which indicated a positive upgrade/improvement value for the selected vessel, of which 5 responses indicated a larger upgrade/improvement value for the selected vessel than the business as a whole. Due to this apparent confusion, we chose not to discuss these business-level responses for repair/maintenance and upgrade/improvement for 2015.

Another change in the survey instrument over time was in the format of business cost queries. For 2011, the vessel owner was asked to only provide the business cost associated with the vessel listed on the survey. For 2012 and 2015, total business costs for all vessels owned were queried and then divided by the number of vessels owned. For 2011, mean ($27,607) and median ($11,650) business cost by vessel values were considerably higher compared to 2012 and 2015. This could suggest that vessel owners had difficulty in apportioning business costs across vessels in the 2011 survey. Alternatively, business costs may be unequally distributed across all owned vessels. For example, an owner of multiple vessels may not have had all these vessels actively fish in 2012 or 2015. By dividing through across all owned vessels, the business cost associated with the vessel surveyed may have been underestimated for those years. Higher business costs for 2011 may also be influenced by differences in business characteristics in survey response across years. Considerably higher values for 2011 are present using both unweighted (Table 8) and weighted values (Table 9), however weighting is only performed in accordance with survey strata. We tested for differences in vessel characteristics within survey strata (Appendix I), but did not have necessary information to test for differences in business characteristics.

Strata-level repair/maintenance costs are presented in Table 11. These costs are relatively higher in 2011 compared to 2012 and 2015, averaging $27,453 across all strata. The highest average repair/maintenance costs were reported in 2011 for 6 of the 11 strata when compared across all years, suggesting that the higher average total cost observed in 2011 was not driven by a single outlying strata. The highest repair/maintenance costs were in the large dredge category for all survey years, with average costs of $120,621 in 2011, $56,962 in 2012, and, $83,676 in 2015. The most frequent range, in $10,000 increments, for repair/maintenance costs was $1-$9,999 in all 3 survey years (Figure 5).

Upgrade/improvements costs by strata are presented in Table 12. As described in Table 7, upgrade/improvement costs represent the upfront cost to the vessel owner, and do not incorporate the lifespan of capital/rate of depreciation. These (unweighted) costs are relatively higher in 2011 compared to 2012 and 2015, averaging $16,691 across all strata. The highest average upgrade/improvement costs were reported in 2011 for 5 of the 11 strata when compared across all years. The large dredge category had the highest mean upgrade/improvement costs for 2011 ($45,509) and 2015 ($45,000), while the longline and purse/seine strata had the highest mean cost for 2012 ($33,483). A reported upgrade/improvement cost of $0 was fairly common in all 3 survey years, occurring more frequently than any $10,000 cost range (Figure 6).

Vessel fees and insurance were fairly constant throughout the 3 survey years (Table 13). Mean values ranged from a high of $13,956 for 2011 to a low of $10,064 for 2012. The vast majority of vessel owners indicated vessel fees and insurance costs in the range of $1 - $9,999, while very few owners reported no cost for this category (Figure 7). The absence of $0 responses for this cost category was expected, given that these costs are generally fixed.

Total average business costs (i.e., overhead costs) were relatively consistent for 2012 and 2015, with averages across all strata (unweighted) in the $13K range for both years, respectively (Table 14). Business costs for 2011 are relatively higher compared to the other 2 years, averaging $25,083 across all strata. The highest average business costs were reported in 2011 for 7 of the 11 strata when compared across all years, suggesting that the higher average total cost observed in 2011 was not driven by a single outlying strata. The distribution of costs is shown in Figure 8, where higher vessel frequencies are shown in the vessel business cost categories greater than $9,999 in 2011 compared to 2012 and 2015. Business costs demonstrated some consistency across sampling years in terms of gear types, with the highest and lowest business costs. In each of the 3 years, handgear (small and large) were among the lowest 3 strata with respect to average business costs. Small handgear was consistently the strata with the lowest average business cost across the 3 survey years, with averages ranging from $992 in 2015 to $4,526 in 2011. Across the 3 survey years, the vessel gear types which incurred the highest average business costs were dredge, trawl, and longline/purse seine. Large dredge vessels incurred an average cost of $118,696 in 2011 compared to an average cost of $42,889 incurred by large trawlers in 2012, and $36,058 incurred by longline and purse seine vessels in 2015.

Value of vessel and permits

The market value of queried vessels, including the value of the permits attached to these vessels, is summarized in Table 15. As described in Table 7, the format of questions pertaining to market value differed across the 3 survey years. For the 2011 and 2012 surveys, a single question requesting the market value for the vessel, including all equipment, fishing gear, permits, and fishing history was asked. For the 2015 survey, multiple questions on market value were included. The combined vessel/permit value query was retained, but owners were also asked to provide separate market value estimations for the vessel and its associated permits. Focus groups conducted in the summer of 2019 with commercial vessel owners in the Northeast offered support to owners being able to split out the value of their vessel from its associated permits. However, we are unable to present the 2015 results for separate vessel and permit values given low response rates. For 2015, 119 participants reported a positive combined value for the selected vessel and its associated permits. Of these 119 responses, values were reported for individual vessel value and permit value on only 75 surveys and 14 surveys, respectively. In

addition, of those owners that supplied both individual vessel and permit values, only 3 responses added up to the reported combined value, which was asked in a separate question.

In focusing on combined vessel/permit values, mean unweighted market values were highest for 2011 ($451,578 per vessel) and lowest in 2012 ($323,600 per vessel). These values changed considerably when weights were applied. The weighted mean value was highest in 2015 ($647,556 per vessel) and lowest in 2012 ($480,759). Weighted values exceeding unweighted values can be explained by weights greater than 1.0 for some strata consisting of higher value vessel/permits, such as large dredge, and weights less than 1.0 for some strata consisting of lower value vessel/permits, such as small handgear (Table 5). As with the fixed cost categories, mean vessel/permit market values greatly exceeded median values, indicating skewed distributions with long tails in the positive direction (Figure 9 and Figure 10).

By strata, large vessel/permit combinations were of higher market value than small vessel/permit combinations for all gear types (Table 15). Large dredge vessels had the highest mean and median permit and vessel values by a considerable margin for all 3 years. Mean and median values for this strata exceeded $3,000,000 in each of the 3 survey years. These results may be a reflection of the value of a limited access scallop permit, more so than the value of the vessel. For example, Färe et al. (2017) estimated an average capital stock value of $400,000 for steel-hulled vessels in the Northeast. Small handgear vessels had the lowest mean and median market values for vessels/permits in all survey years. Trawl vessels showed declines in mean market values across the 3 survey years, though the 2015 mean value was based off of a small number of owner responses.

Crew payments and crew payment system

The methods which vessel owners and/or captains compensate their crew may vary. For the 2011 and 2012 surveys, no explicit question on crew payment systems was included. Rather, vessel owners were asked to fill-in a diagram of owner share of revenue and crew share. If the owner felt that the diagram did not represent their method of compensating crew, they were instructed to describe their method on the following survey page. For the 2015 survey, a specific question on crew compensation method was included. The results showed that 74.4% (87 responses) used a share system, while 25.6% (30 responses) indicated the use of a flat rate (per day at sea or trip) system. In each of the 3 survey years, the use of a hired captain was queried. Splits between whether the vessel was primarily owner-operated or manned by a hired captain were consistent across the 3 surveys (85.8%/14.2% for 2011; 89.9%/10.1% for 2012; 86.4%/10.9% for 2015).

Total payments to crew and hired captains are presented in Table 16. Crew payments are often tied to revenue, which is influenced by factors such as quota availability and ex-vessel prices. That is, the information presented here alone is not sufficient to draw conclusions regarding how crew shares may have varied. Some trends by strata however clearly are present across the 3 survey years. For example, large dredge vessels had considerably higher mean and median crew costs compared to other gear/size categories. Most of these vessels were engaged in the scallop fishery, a high-value, crew-intensive fishery. Small handgear vessels on the other hand, exhibited the lowest mean and median crew payments in each of the 3 survey years. Median values for 2012 and 2015, in fact, were $0.00. None of the 45 small handgear vessels who responded to the 2012 survey, nor the 14 who responded to the 2015 survey, indicated hiring a captain. Vessels in the large and small pot/trap strata, largely comprised of vessels engaged in the lobster fishery, displayed fairly consistent mean and median crew payments across the 3 survey years. A number

of gear/size categories which are associated with the groundfish fishery (small gillnet, small and large handgear, small and large trawl) exhibited lower mean crew payments in 2015 than in 2011. While vessels in these strata would certainly have been expected to be active in a variety of fisheries, those that were active in the groundfish fishery may be showing trends consistent with previous findings of declining payments to crew (Murphy et al. 2018). Crew payment distributions over all strata are illustrated in Figure 11 and Figure 12. The largest percentage of vessel owners indicated crew costs in the $0-$24,999 range, followed by $25,000-$49,999 and $50,000-$74,999. A fairly large number of vessel owners reported crew payments in excess of $250,000 (31 vessels in 2011, 19 vessels in 2012, and 10 vessels in 2015).

3.4. Aggregation of Data and Future Modeling of Costs

Given the results summarized in this paper, the following section provides an overview of caveats and possible methods to employ when using these cost data for economic analyses. Consistency in the survey instrument is an important consideration when dealing with multiple years of survey responses. As discussed in earlier sections, changes were made over the course of the 3 survey years to the repair/maintenance and upgrade/improvement questions (itemized in 2011/2012 vs. composite in 2015) and to the business cost questions (owner apportioned costs in 2011 vs. avg. costs taken in 2012/2015). Keeping these changes in mind, we assess the possibility of pooling the various data by major cost category across the 3 survey years. Weighted t tests of the major cost categories were conducted for the 2011 vs. 2012 survey results and the 2012 vs. 2015 results (Table 17). Given skewness present in the data, the natural log of each weighted value was calculated in order to conduct the test of equal means across survey years. Since testing on variance across survey years failed to reject the null hypothesis of equal variances, the Pooled T test was utilized.

Results indicate that pooling data between 2011 and 2012 may not be appropriate, as we rejected the null hypothesis of equal means at either the .05 or .01 significance level for all cost categories. In testing the 2012 vs. 2015 data, we failed to reject the null hypothesis for 3 of 4 cost categories, with the exception of upgrade/improvement. In looking at the individual cost categories, the repair/maintenance results were somewhat unexpected. The null hypothesis was rejected in testing the 2011 vs. 2012 results, when these costs were queried in an itemized approach in both years. However, we failed to reject the null of equal means for 2012 vs. 2015, when the repair/maintenance question format was inconsistent between the 2 survey years. For upgrade/improvement, we rejected the null of equal means in both cases at the .05 significance level. This category in particular had a large number of $0 responses (Figure 6), resulting in a considerable decrease in the number of usable responses when taking the natural log. Vessel fees and insurance are largely fixed in a given year, and the survey instrument was consistent in how these costs were queried. Still, the null hypothesis of equal means was rejected for this category in comparing the 2011 and 2012 means. For business costs by vessel, we rejected the null for 2011 vs. 2012 at the .01 significance level, but failed to reject the null in comparing 2012 vs. 2015. These results suggest that the change in how costs were apportioned in 2011 vs. 2012/2015 may have had a significant effect in how vessel owners responded to business cost queries.

These test results are an important consideration in assessing how modelling of data may be used to fill in survey gaps. The combination of vessel characteristics from permit data, as well as effort data from VTRs (Table 6) may provide exogenous variables that can be utilized in exploring the modelling of costs which are not incurred on a trip-basis. Comparing the 2011, 2012,

and 2015 survey results with early SSB survey results from 2006-2008 may also be appropriate in these efforts. As the number of comparable survey populations/samples increases, the analysis of variance (ANOVA) can be used to test for statistical difference in means. It should be noted that conducting multiple pairwise comparisons using the same dataset increases the chances of a Type I error, in which the null hypothesis is incorrectly rejected. A number of methods to alleviate this issue are possible, including the Bonferroni and Šidák corrections. Other more intensive empirical methods, such as bootstrapping of datasets or Monte Carlo simulations are also possible. The appropriateness of pooling data across multiple years can also be analyzed by testing the equality of medians, including the nonparametric Mood's median test and the Kruskal-Wallis test (McDonald 2014). Other methods, encompassing both parametric and nonparametric approaches, are also possible (Yusof et al. 2013). A more thorough analysis of pooling options moving forward will help inform best practices for utilizing and modeling the full suite of NEFSC cost survey data.

4. CONCLUDING REMARKS

This paper summarizes the results of the 3 most recent commercial fishing vessel cost data collection efforts by the Social Sciences Branch (SSB) of the Northeast Fisheries Science Center (NEFSC) for 2011, 2012, and 2015. The SSB cost survey is the only survey administered by NOAA Fisheries in the Northeast region to collect information on commercial fishing vessel and business costs that are not incurred on a trip-basis. The success of this survey is critical both from a fishery management and a socioeconomic research perspective. In regards to survey response, there are 4 major points from the most recent surveys to consider; 1) Response rates declined over time - from 29% for 2011, down to 20% for 2012, and further down to 6% for 2015; 2) The decline in response rates was not confined to a few vessel types, but rather over all gear and length categories; 3) Earlier response from vessel owners (in 2011 or 2012) was a strong indicator of whether an owner would respond in 2015, such that those who responded in the earlier year were 4-5 times more likely to respond in 2015 than those who did not respond in the earlier year; 4) For some gear types (dredge and trawl), large vessels had higher response rates than small vessels. The reason for these trends within these particular gear groups is not clear. Larger vessels typically incur higher costs and owners for these types of vessels may have been more compelled to share cost information. Alternatively, larger dredge and trawl vessels may have been more profitable on average than small vessels in these gear groups, and therefore owners may have been more inclined to respond to a NMFS survey. These trends in response did not occur when comparing large and small vessels in other gear groups, such as gillnet and pot/trap.

Survey results show that mean and median costs, both in unweighted and weighted terms, were frequently higher for 2011 than those for 2012 or 2015. A change in how business (overhead) costs were queried and analyzed may have been a contributing factor to these higher costs. Owners were instructed to apportion these costs across vessels for 2011, rather than to take an average value over all vessels, as was done for 2012 and 2015. Continued analysis of this issue is warranted ahead of future SSB survey efforts. Another significant change in the survey instrument over time was in the format of questions related to repair/maintenance and upgrade/improvement costs. For the 2011 and 2012 surveys, these costs were queried in an itemized approach, while the 2015 survey queried composite values. It is not clear what effect this change had on response values, as T tests for repair/maintenance yielded a rejection of the null hypothesis of equal means for 2011 vs. 2012 values, but not in comparing 2012 and 2015 values. Repair/maintenance costs are not truly fixed and will vary based on output (fish landed). An increase (decrease) in vessel repairs therefore could be driven by an increase (decrease) in the quantity of repairs required for the vessel,

rather than a change in price. There was a somewhat substantial increase in the percentage of respondents who skipped the repair/maintenance question altogether under the composite approach of 2015.

Large vessels exhibited higher mean and median costs than small vessels, for all gear types, in each of the survey years. Large dredge vessels had the highest mean and median costs in 2011 and 2015, while large trawl vessels had the highest costs in 2012. Small handgear vessels exhibited the lowest mean and median costs for each of the 3 years. Small pot/trap vessels comprised the greatest share of survey response in each year, with these vessels exhibiting smaller costs than dredge and trawl vessels in each year, but higher costs compared to small handgear vessels. Some vessel types, such as large dredge and trawl vessels, are somewhat frequently owned by larger corporations or owners of multiple vessels. In these cases, it is critical to ensure when cost information collected is at the vessel-level, as compared to the business or affiliation level. Though past cost survey instructions were clear on the level of costs being collected, the accuracy of information collected from multiple vessel owners remains an important topic ahead of the next iteration of the SSB cost survey.

Considerable skewness was present in cost distributions for all 3 survey years. Skewness in cost data has been previously observed in commercial fishing trip cost data in the Northeast region (Werner et al. 2020) and in previous analyses of the SSB cost survey data (Das 2016). The distribution of these data, and the ability/inability to pool data across multiple years are important considerations in modelling these costs for the Northeast commercial fishing fleet.

Concerning future cost data collection efforts, the SSB is engaged in relaunching the cost survey in the near future. The new effort will build on lessons from past surveys in order to improve survey coverage and data quality, and to enhance future analyses and evaluations of the economic status of commercial fisheries in the Northeast. In the months leading up to implementation of previous surveys, SSB staff gave presentations to the New England Fishery Management Council and participated in the Maine Fishermen's Forum to publicize the survey. Other survey outreach efforts also occurred- the details of which can be found in Appendices II, III, and IV. The SSB is in the process of expanding on these previous efforts by building a formal communications plan in order to engage with industry and better explain the importance of cost data collection in the region. Customizing the cost survey based on vessel gear type also will be utilized to encourage participation. Through customization and simplification of the survey instrument, and increased industry outreach, the SSB hopes to improve response rates and close existing data gaps to maximize the utility of vessel cost data collected in the Northeast region.

ACKNOWLEDGEMENTS

The authors thank numerous individuals who contributed to the collection and analysis of the cost data presented, including Chhandita Das and Scott Steinback. The authors thank Andrew Kitts and John Walden for their efforts in survey design, and Chad Demarest and Sharon Benjamin for assisting in outreach following the mail merge error in implementing the 2015 cost survey. The assistance of Eastern Research Group (ERG), for administering the 2011 and 2012 surveys, and ICF, for administering the 2015 survey, are duly appreciated. Lastly, the authors are especially grateful to all of the commercial fishing vessel owners who responded to the cost surveys.

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TABLES

Table 1. Average vessel length in feet by principal gear group for each of the 3 cost survey populations.

Gear Type	*2011*	*2012*	*2015*
Dredge	72.5	72.1	71.1
Gillnet	40.2	40.1	40.7
Handgear	38.5	38.7	32.3
Longline	44.9	46.9	46.9
Pot/Trap	38.0	38.1	38.3
Purse/Seine	61.0	59.5	68.7
Trawl	61.0	60.9	60.2

Note: For the 2015 survey, sampling was performed by taking a census of commercial fishing businesses. Here, we include all vessels in calculating 2015 averages for comparison purposes.

Table 2. Cost survey population and sample size frequencies, by strata.

	2011			2012			2015		
Strata	***Population***	***Sample***	***% Sampled***	***Population***	***Sample***	***% Sampled***	***Population***	***Sample***	***% Sampled***
Dredge_Large	326	163	50.0%	316	87	27.5%	264	123	46.6%
Dredge_Small	199	100	50.3%	193	88	45.6%	164	119	72.6%
Gillnet_Large	140	70	50.0%	140	64	45.7%	105	96	91.4%
Gillnet_Small	142	71	50.0%	143	65	45.5%	93	84	90.3%
Handgear_Large	271	137	50.6%	227	28	12.3%	137	87	63.5%
Handgear_Small	577	216	37.4%	491	201	40.9%	167	140	83.8%
Longline	42	21	50.0%	54	34	63.0%	55	49	89.1%
Pot/Trap_Large	898	336	37.4%	683	396	58.0%	705	618	87.7%
Pot/Trap_Small	941	353	37.5%	1,112	694	62.4%	1,046	918	87.8%
Purse/Seine	13	7	53.8%	13	5	38.5%	12	9	75.0%
Trawl_Large	226	111	49.1%	218	89	40.8%	148	97	65.5%
Trawl_Small	233	118	50.6%	231	123	53.2%	170	149	87.6%
Total	4,008	1,703	42.5%	3,821	1,874	49.0%	3,066	2,489	81.2%

Note: The population and sample sizes for 2011 and 2012 included vessels that primarily engaged in recreational fishing. The population and sample sizes for 2015 included only those vessels primarily engaged in commercial fishing. For 2015, the population consisted of all active vessels, while the sample included all fishing businesses within the population of vessels.

Table 3. Total survey response rates and response frequencies by survey mode for commercial fishing vessel owners.

Sample/Response	*2011*	*2012*	*2015*
Total Sample	1287	1778	2489
Total Response	372	358	160
Response Rate	*28.9%*	*20.1%*	*6.4%*
Web Response	67	55	16
Mail Response	305	303	144
% Response by Mail	*82.0%*	*84.6%*	*90.0%*

Note: The total sample includes all surveys sent to commercial fishing vessel owners. Some of these surveys were ultimately undeliverable due to the address on file in the permit data not corresponding to the intended vessel owner.

Table 4. Cost survey sample size and response, by strata.

	2011			2012			2015		
Strata	***Sample***	***Response***	***% Response***	***Sample***	***Response***	***% Response***	***Sample***	***Response***	***% Response***
Dredge_Large	144	29	20.1%	83	16	19.3%	123	7	5.7%
Dredge_Small	82	11	13.4%	86	4	4.7%	119	5	4.2%
Gillnet_Large	60	24	40.0%	61	14	23.0%	96	3	3.1%
Gillnet_Small	58	16	27.6%	62	12	19.4%	84	7	8.3%
Handgear_Large	32	4	12.5%	27	7	25.9%	87	7	8.0%
Handgear_Small	114	43	37.7%	186	45	24.2%	140	14	10.0%
Longline & Purse/Seine	25	8	32.0%	38	6	15.8%	58	5	8.6%
Pot/Trap_Large	276	80	29.0%	380	92	24.2%	618	36	5.8%
Pot/Trap_Small	295	96	32.5%	657	128	19.5%	918	60	6.5%
Trawl_Large	101	33	32.7%	86	22	25.6%	97	7	7.2%
Trawl_Small	100	28	28.0%	112	12	10.7%	149	9	6.0%
Total	1287	372	28.9%	1778	358	20.1%	2489	160	6.4%

Table 5. Population frequencies, response frequencies, and weighting factors by strata. Chi-squared test results reflect the testing of the null hypothesis of equal population and response frequencies by strata.

	2011			2012			2015		
Strata	***Population***	***Response***	***Weight***	***Population***	***Response***	***Weight***	***Population***	***Response***	***Weight***
Dredge_Large	9.03	6.11	1.48	8.28	3.13	2.64	8.61	4.52	1.91
Dredge_Small	5.65	2.78	2.03	5.06	1.14	4.44	5.35	3.23	1.66
Gillnet_Large	3.91	6.67	0.59	3.67	3.99	0.92	3.42	1.94	1.77
Gillnet_Small	3.97	4.44	0.89	3.75	3.42	1.10	3.03	4.52	0.67
Handgear_Large	1.84	1.11	1.66	5.95	1.99	2.98	4.47	4.52	0.99
Handgear_Small	9.81	11.94	0.82	12.71	12.82	0.99	5.45	9.03	0.60
Longline & Purse/Seine	1.54	1.94	0.79	1.76	1.71	1.03	2.19	3.23	0.68
Pot/Trap_Large	25.18	22.22	1.13	17.92	26.21	0.68	22.99	21.94	1.05
Pot/Trap_Small	26.33	26.67	0.99	29.16	36.47	0.80	34.12	38.71	0.88
Trawl_Large	6.20	8.33	0.74	5.71	5.70	1.00	4.83	3.23	1.50
Trawl_Small	6.54	7.78	0.84	6.05	3.42	1.77	5.54	5.16	1.07
X^2		23.70			55.23			12.76	
DF		10			10			10	
$Pr > X^2$		<.0084 ***			<.0001 ***			<.2374	

Note: *** indicates rejection of the null hypothesis at the 1% level of statistical significance.

Table 6. Non-response bias T test results for vessel characteristics, testing the null hypothesis of equal means between respondents and non-respondents.

Characteristic	*2011*			*2012*			*2015*		
Length (feet)	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Non-respondent	915	48.2	19.4	1419	42.7	16.3	2330	42.5	14.8
Respondent	372	45.6	18.6	358	42.4	15.3	159	41.4	15.1
	T stat = 2.18			T stat = 0.37			T stat = 0.88		
	DF = 1,285			DF = 1,775			DF = 2,487		
	Pr > |t| = 0.03**			Pr > |t| = 0.7116			Pr > |t| = 0.3778		
Gross Tonnage^	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Non-respondent	914	46.7	54.5	1,418	32.6	43.3	2,330	32.2	41.7
Respondent	372	40.7	51.1	358	32.5	41.7	159	29.3	37.0
	T stat = 1.82			T stat = 0.06			T stat = 0.85		
	DF = 1,284			DF = 1,774			DF = 2,487		
	Pr > |t| = 0.06922			Pr > |t| = 0.9535			Pr > |t| = 0.3934		
Horsepower	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Non-respondent	915	447.7	272.7	1,418	404.1	222.2	2,330	416.5	235.6
Respondent	372	436.0	286.6	358	423.3	322.0	159	375.5	240.3
	T stat = 0.69			T stat = -1.07^^			T stat = 2.12		
	DF = 1,285			DF = 446.35^^			DF = 2,487		
	Pr > |t| = 0.4928			Pr > |t| = 0.2873^^			Pr > |t| = 0.0343**		
Age (years)	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Non-respondent	915	22.9	12.1	1,419	22.4	11.7	2,330	24.2	11.8
Respondent	372	23.3	12.7	358	22.1	12.0	159	26.7	11.9
	T stat = -0.55			T stat = 0.36			T stat = -2.52		
	DF = 1,285			DF = 1,775			DF = 2,487		
	Pr > |t| = 0.5855			Pr > |t| = 0.7161			Pr > |t| = 0.0117**		
Days Absent	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Non-respondent	552	56.8	50.7	700	48.2	48.2	1,062	47.8	46.5
Respondent	238	56.6	55.9	189	55.2	58.5	91	43.7	53.6
	T stat = 0.04			T stat = -1.51^^			T stat = 0.8		
	DF = 788			DF = 260.72^^			DF = 1,151		
	Pr > |t| = 0.9644			Pr > |t| = 0.1332^^			Pr > |t| = 0.4235		

^Represent the gross registered tonnage as recorded on the vessel USCG documentation.

^^Indicates Satterthwaite T Test utilized due to rejection of equal variance assumption.

**Rejection of null hypothesis at .05 significance level.

Table 7. Categories summarized from the 2011, 2012, and 2015 cost surveys.

Cost Category	Description
Repair/Maintenance	There are many components of a fishing vessel, such as the engine, hull, and electronics that may require repairs due to general wear and tear. For the 2011 and 2012 surveys, the cost of repairs for each of these vessel components was queried separately. For the 2015 survey, a composite value across all vessel components was queried (see Appendices II, III, and IV). Additionally, for the 2012 survey, a separate line item for "Other Repair/Maintenance Costs" was queried. These costs were binned into "Other Costs" to maintain consistency in the repair/maintenance category. The 2011 and 2012 surveys queried only vessel-level repair/maintenance costs, while the 2015 survey queried these costs at the vessel-level and business-level. However, there appeared to be confusion among respondents in the querying of business-level costs. As a result, only vessel-level costs are summarized.
Upgrade/Improvement	As with repairs, there are many components of a fishing vessel that may require an upgrade. Vessel upgrades were separated from repairs since the former increases the value of the capital stock associated with the vessel, while the latter does not. For the 2011 and 2012 surveys, the cost of upgrades for each vessel component was queried separately. For the 2015 survey, a composite value across all vessel components was queried. Additionally, for the 2012 survey, a separate line item for "Other Upgrade/Improvement Costs" was queried. These costs were binned into "Other Costs" to maintain consistency in the upgrade/improvement category. Since the method for querying upgrade/improvement costs varied across the 3 survey years, the same depreciation factors could not be applied (i.e. the lifespan/rate of depreciation for various vessel components will differ). To maintain a consistent approach across the 3 surveys, upgrade/improvement values simply represent the upfront cost to the vessel owner. As with repair/maintenance costs, the 2011 and 2012 surveys queried only vessel-level upgrade/improvement costs, while the 2015 survey queried these costs at the vessel-level and business-level. Due to apparent confusion among respondents for business-level costs, only vessel-level costs are summarized.
Vessel Fees and Insurance	Vessel permit fees, mooring fees, and vessel insurance premiums were queried separately for all 3 surveys. Since these are all true fixed costs- expenses that would be expected to be incurred even if the vessel was inactive in a given year- they were grouped together into the vessel fees and insurance category.

Cost Category	Description
Business Costs by Vessel	Vessel owners may incur a number of costs associated with running a fishing business that are independent of vessel-related costs. Business costs include principal and interest paid on loans, vehicle usage costs (for transport of unloaded catch), association fees (such as groundfish sector fees), and advertising costs. For the purposes of reporting vessel-level costs, business-level costs have to be apportioned. For the 2011 survey, owners of multiple vessels were instructed to only report their business costs associated with the vessel specified at the beginning of the survey (i.e., vessel owners were asked to apportion a percentage of their total business cost to the specified vessel). For the 2012 and 2015 surveys, owners of multiple vessels were instructed to report their cumulative business costs across all vessels, and to also provide the number of vessels owned. For these later 2 survey years, we divide through to calculate the average business cost per vessel.
Other Costs	For all 3 survey years, vessel owners were given the option to note additional costs at the end of the survey that were not collected earlier. The vast majority (95%) of respondents across the 3 survey years did not list any additional costs in this section. A slightly higher proportion of respondents filled in other costs for the 2015 survey, compared to 2011 and 2012. For the 2015 survey, haul-out costs were the most frequent other cost listed.
Value of Vessel and Associated Permits	In determining the economic health of a fishing business, it is necessary to understand the value of capital owned. For all 3 survey years, vessel owners were asked to provide the current combined market value of the selected vessel and its associated fishing permits. For the 2015 survey, the value of the vessel and its associated permits were also investigated separately.
Total Payment to Crew/Hired Captain and Crew Payment System	Vessel payments to crew/hired captain and benefits paid to crew/hired captain were queried separately during each of the 3 survey years. The vast majority of vessel owners across all years (~90%) indicated they did not provide benefits to crew. Crew payments and benefits were aggregated to form the total payment to crew/hired captain category. In terms of the system of crew payment, the 2011 and 2012 surveys instructed vessel owners to fill in a diagram of the crew share and owner share. A share system was determined to be the most likely form of payment, and if the diagram did not accurately depict the system of payment, the owner was instructed to describe their system on the following page. For the 2015 survey, vessel owners were asked directly if their method of crew payment was a share system, a flat rate, or a combination. Additionally, for all survey years, the vessel owner was asked whether the vessel listed was run owner-operator or if a captain was hired.

Table 8. Summary statistics for unweighted values of fixed cost categories and total fixed costs (2015 USD).

	2011						2012					
Major Categories	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Repair/Maintenance	354	27,453	42,224	12,566	0	321,913	349	18,181	23,954	9,718	0	161,022
with blanks as zero	*360*	*26,995*	*42,017*	*12,424*	*0*	*321,913*	*351*	*18,078*	*23,925*	*9,646*	*0*	*161,022*
Upgrade/Improvement	322	16,691	30,976	4,260	0	216,171	271	14,310	23,558	5,005	0	161,545
with blanks as zero	*360*	*14,930*	*29,737*	*2,130*	*0*	*216,171*	*351*	*11,048*	*21,547*	*1,802*	*0*	*161,545*
Vessel Fees & Insurance	349	13,956	23,069	5,229	106	151,789	350	10,064	16,586	4,402	52	119,721
with blanks as zero	*360*	*13,530*	*22,840*	*5,122*	*0*	*151,789*	*351*	*10,035*	*16,571*	*4,392*	*0*	*119,721*
Business Costs by Vessel	332	25,083	41,749	10,702	0	339,725	288	13,382	19,342	6,619	0	128,551
with blanks as zero	*360*	*23,132*	*40,649*	*8,704*	*0*	*339,725*	*291*	*13,245*	*19,289*	*6,428*	*0*	*128,551*
Other Costs	360 (13*)	1,029	10,674	0	0	164,433	351 (5*)	444	2,986	0	0	35,550
Total Fixed Cost	**360**	**79,616**	**108,790**	**41,568**	**0**	**787,024**	**291**	**53,380**	**59,693**	**33,982**	**826**	**365,885**

Note: The total number of vesels for which total fixed costs could be calculated in 2012 and 2015 was smaller than the number of observations in the datasets, as some respondents did not provide information on the number of vessels owned. In these cases, calculating business costs per vessel was not possible.

*Numbers in parenthesis indicate the number of surveys that year where other costs exceeding $0.00 were reported.

Table 8 (cont). Summary statistics for unweighted values of fixed cost categories and total fixed costs (2015 USD).

	2015					
Major Categories	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Repair/Maintenance	135	15,310	24,889	7,000	0	200,000
with blanks as zero	*155*	*13,334*	*23,781*	*5,006*	*0*	*200,000*
Upgrade/Improvement	125	15,846	29,486	5,000	0	200,000
with blanks as zero	*155*	*12,779*	*27,194*	*2,150*	*0*	*200,000*
Vessel Fees & Insurance	152	10,315	17,883	4,908	0	121,944
with blanks as zero	*155*	*10,116*	*17,765*	*4,834*	*0*	*121,944*
Business Costs by Vessel	140	13,745	19,831	5,672	0	96,750
with blanks as zero	*144*	*13,363*	*19,683*	*5,180*	*0*	*96,750*
Other Costs	155 (18*)	308	1,823	0	0	20,868
Total Fixed Cost	**144**	**48,301**	**59,066**	**31,422**	**0**	**497,000**

Table 9. Summary statistics for weighted values of fixed cost categories and total fixed costs (2015 USD).

	2011						2012					
Major Categories	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Repair/Maintenance	354	29,191	45,844	13,364	0	321,913	349	20,133	25,823	10,665	0	161,022
with blanks as zero	*360*	*28,598*	*45,646*	*12,566*	*0*	*321,913*	*351*	*20,048*	*25,782*	*10,456*	*0*	*161,022*
Upgrade/Improvement	322	18,148	32,691	4,792	0	216,171	271	14,413	22,247	5,960	0	161,545
with blanks as zero	*360*	*16,263*	*31,406*	*2,396*	*0*	*216,171*	*351*	*10,891*	*20,501*	*1,974*	*0*	*161,545*
Vessel Fees & Insurance	349	15,006	24,618	5,324	106	151,789	350	13,768	20,748	4,977	52	119,721
with blanks as zero	*360*	*14,551*	*24,374*	*5,218*	*0*	*151,789*	*351*	*13,741*	*20,728*	*4,967*	*0*	*119,721*
Business Costs by Vessel	332	27,607	46,591	11,650	0	339,725	288	14,021	21,674	6,378	0	128,551
with blanks as zero	*360*	*25,627*	*45,303*	*9,371*	*0*	*339,725*	*291*	*13,752*	*21,646*	*5,847*	*0*	*128,551*
Other Costs	360 (13*)	975	9,678	0	0	164,433	351 (5*)	584	3,601	0	0	35,550
Total Fixed Cost	**360**	**86,014**	**118,765**	**42,930**	**0**	**787,024**	**291**	**58,535**	**64,409**	**34,118**	**826**	**365,885**

Note: The total number of vesels for which total fixed costs could be calculated in 2012 and 2015 was smaller than the number of observations in the datasets, as some respondents did not provide information on the number of vessels they owned. In these cases, calculating business costs per vessel was not possible.

*Numbers in parenthesis indicate the number of surveys that year where other costs exceeding $0.00 were reported.

Table 9 (cont). Summary statistics for weighted values of fixed cost categories and total fixed costs (2015 USD).

	2015					
Major Categories	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Repair/Maintenance	135	19,200	31,356	9,125	0	200,000
with blanks as zero	*155*	*16,861*	*29,919*	*6,500*	*0*	*200,000*
Upgrade/Improvement	125	18,289	33,727	6,000	0	200,000
with blanks as zero	*155*	*14,937*	*31,086*	*3,500*	*0*	*200,000*
Vessel Fees & Insurance	152	13,095	20,519	5,592	0	121,944
with blanks as zero	*155*	*12,886*	*20,385*	*5,413*	*0*	*121,944*
Business Costs by Vessel	140	15,537	21,200	7,740	0	96,750
with blanks as zero	*144*	*14,964*	*21,107*	*7,019*	*0*	*96,750*
Other Costs	155 (18*)	281	1,729	0	0	20,868
Total Fixed Cost	**144**	**58,395**	**71,665**	**38,221**	**0**	**497,000**

Table 10. Summary statistics for total fixed cost by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	22	350,594	177,299	342,701	129,163	787,024	9	150,211	85,200	138,073	16,956	339,494
Dredge_Small	10	59,452	42,807	58,695	0	150,468	*	*	*	*	*	*
Gillnet_Large	24	72,311	72,266	52,144	11,053	305,056	12	47,000	21,865	46,070	14,272	77,374
Gillnet_Small	16	44,531	43,660	31,212	3,408	169,743	11	39,473	42,389	21,173	7,855	123,380
Handgear_Large	4	44,766	37,601	43,848	106	91,261	4	32,243	21,247	25,084	15,744	63,062
Handgear_Small	43	18,114	15,399	14,908	0	84,179	38	14,883	13,034	9,646	1,051	49,666
Longline & Purse/Seine	7	120,085	59,471	153,095	12,631	177,457	5	107,909	146,369	43,405	22,637	365,885
Pot/Trap_Large	80	71,682	64,980	53,364	1,278	326,919	76	62,165	61,406	40,742	1,778	345,402
Pot/Trap_Small	96	32,002	29,443	22,865	0	187,169	106	34,764	23,111	29,839	826	104,737
Trawl_Large	30	195,155	127,174	165,730	6,602	438,732	18	155,595	67,823	158,634	23,526	294,014
Trawl_Small	28	51,649	37,823	49,247	0	162,075	10	66,283	73,026	32,790	6,605	244,213
Total	360	79,616	108,790	41,568	0	787,024	291	53,380	59,693	33,982	826	365,885

Note: Asterisks (*) denote statistics that cannot be disclosed due to data confidentiality.

Table 10 (cont). Summary statistics for total fixed cost by strata (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	7	205,909	136,982	139,000	102,427	497,000
Dredge_Small	4	51,399	31,504	45,271	20,055	95,000
Gillnet_Large	3	60,289	17,083	57,748	44,619	78,500
Gillnet_Small	7	20,831	11,446	23,350	5,990	37,257
Handgear_Large	6	32,382	37,321	16,113	3,650	101,993
Handgear_Small	11	6,817	6,776	5,205	1,061	23,877
Longline & Purse/Seine	5	51,065	52,541	29,850	900	120,753
Pot/Trap_Large	30	56,002	46,799	42,893	893	202,000
Pot/Trap_Small	59	34,991	34,151	25,884	0	153,650
Trawl_Large	5	79,753	46,502	96,000	3,000	118,204
Trawl_Small	7	44,830	32,440	48,800	4,200	102,519
Total	144	48,301	59,066	31,422	0	497,000

Table 11. Summary statistics for repair/maintenance costs by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	21	120,621	86,237	101,565	0	321,913	11	56,962	38,772	59,599	7,528	128,085
Dredge_Small	9	22,497	13,361	24,212	3,195	41,504	4	22,812	8,604	22,585	12,809	33,269
Gillnet_Large	24	28,659	21,264	23,039	3,993	83,061	14	28,253	17,505	30,556	5,725	57,724
Gillnet_Small	16	14,100	14,977	9,581	532	55,374	12	12,936	13,206	7,871	209	43,601
Handgear_Large	4	7,800	6,999	7,135	0	16,932	7	13,323	16,718	8,783	3,008	50,837
Handgear_Small	43	4,745	5,077	3,747	0	21,298	45	5,068	6,994	2,928	0	30,845
Longline & Purse/Seine	7	50,842	43,548	25,557	6,985	117,137	6	35,760	61,886	10,979	2,091	161,022
Pot/Trap_Large	80	20,755	22,572	12,406	0	113,943	91	23,071	26,803	15,161	0	143,247
Pot/Trap_Small	93	11,367	10,686	8,439	0	57,914	127	10,627	9,650	8,312	0	45,013
Trawl_Large	30	72,877	55,496	63,455	6,450	217,769	20	47,440	34,182	40,831	5,385	134,858
Trawl_Small	27	21,276	18,834	15,041	0	66,236	12	11,900	12,806	7,196	0	44,961
Total	354	27,453	42,224	12,566	0	321,913	349	18,181	23,954	9,718	0	161,022

Table 11 (cont). Summary statistics for repair/maintenance costs by strata (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	7	83,676	63,765	67,290	17,000	200,000
Dredge_Small	5	7,800	8,672	8,000	0	21,000
Gillnet_Large	3	11,311	7,776	8,928	5,006	20,000
Gillnet_Small	7	4,370	2,118	5,000	2,000	7,589
Handgear_Large	6	6,251	8,478	4,428	150	23,000
Handgear_Small	10	2,467	3,091	1,500	0	9,730
Longline & Purse/Seine	5	8,108	9,066	5,000	0	23,127
Pot/Trap_Large	29	15,778	13,138	12,000	0	40,000
Pot/Trap_Small	53	10,892	12,953	5,954	0	56,000
Trawl_Large	3	20,325	9,908	20,776	10,200	30,000
Trawl_Small	7	25,579	30,263	16,339	2,300	92,864
Total	135	15,310	24,889	7,000	0	200,000

Table 12. Summary statistics for upgrade/improvement costs by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	22	45,509	48,633	31,038	0	146,078	9	24,705	23,868	17,775	0	65,509
Dredge_Small	7	18,453	30,341	4,260	0	83,913	*	*	*	*	*	*
Gillnet_Large	19	12,315	18,945	4,792	0	79,866	9	6,140	9,688	993	0	28,231
Gillnet_Small	13	5,755	8,678	2,023	0	26,622	10	16,528	29,307	5,333	0	92,535
Handgear_Large	4	15,734	22,138	7,987	0	46,961	3	6,413	5,864	7,737	0	11,502
Handgear_Small	40	5,536	12,355	934	0	70,975	38	3,167	4,241	1,103	0	14,954
Longline & Purse/Seine	6	13,016	10,701	15,441	0	25,557	3	33,483	35,648	20,912	5,824	73,714
Pot/Trap_Large	75	23,970	40,637	11,714	0	216,171	69	20,826	32,921	7,842	0	161,545
Pot/Trap_Small	83	8,789	15,881	2,130	0	93,710	100	11,284	16,499	4,182	0	89,921
Trawl_Large	27	29,094	43,388	6,389	0	151,214	17	26,841	30,291	16,625	0	103,062
Trawl_Small	26	10,008	15,324	3,426	0	63,041	11	13,208	19,954	5,005	0	58,031
Total	322	16,691	30,976	4,260	0	216,171	271	14,310	23,558	5,005	0	161,545

Note: Asterisks (*) denote statistics that cannot be disclosed due to data confidentiality.

Table 12 (cont). Summary statistics for upgrade/improvement costs by strata (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	6	45,000	78,422	10,000	0	200,000
Dredge_Small	5	16,000	24,341	0	0	55,000
Gillnet_Large	3	21,192	18,642	10,864	10,000	42,713
Gillnet_Small	6	7,117	7,999	5,000	0	20,000
Handgear_Large	5	14,880	28,014	2,500	400	64,902
Handgear_Small	11	1,060	1,696	200	0	5,092
Longline & Purse/Seine	4	3,750	7,500	0	0	15,000
Pot/Trap_Large	27	25,509	40,718	15,000	0	200,000
Pot/Trap_Small	47	12,157	17,194	4,850	0	70,000
Trawl_Large	4	20,590	10,730	23,500	5,361	30,000
Trawl_Small	7	11,571	14,570	0	0	31,000
Total	125	15,846	29,486	5,000	0	200,000

Table 13. Summary statistics for vessel fees and insurance costs by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	22	67,815	34,238	62,961	11,662	151,789	11	62,509	23,276	60,645	5,489	92,495
Dredge_Small	9	13,290	13,130	6,049	2,476	43,926	4	20,886	16,876	21,500	2,823	37,722
Gillnet_Large	24	14,162	22,641	8,093	213	116,285	14	7,628	4,398	6,069	3,241	18,804
Gillnet_Small	15	6,854	6,598	6,070	1,810	29,710	12	4,728	4,893	3,664	314	17,984
Handgear_Large	4	8,076	5,666	9,690	106	12,816	7	10,784	3,574	12,225	5,121	14,220
Handgear_Small	40	4,917	2,948	4,624	240	14,056	45	4,688	3,325	4,078	340	14,712
Longline & Purse/Seine	7	15,144	9,598	12,566	4,047	30,062	6	30,965	44,257	15,769	4,296	119,721
Pot/Trap_Large	79	7,294	7,341	5,133	1,246	49,411	91	8,508	11,537	4,977	1,223	80,511
Pot/Trap_Small	94	4,834	11,327	3,088	442	107,873	128	3,508	2,552	3,184	52	20,912
Trawl_Large	29	43,175	29,144	44,153	383	128,319	20	40,179	18,473	39,767	523	73,773
Trawl_Small	26	7,647	5,574	5,963	330	19,168	12	7,382	7,087	4,732	575	25,746
Total	349	13,956	23,069	5,229	106	151,789	350	10,064	16,586	4,402	52	119,721

Table 13 (cont). Summary statistics for vessel fees and insurance costs by strata (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	7	58,076	12,461	56,000	45,702	73,000
Dredge_Small	5	10,794	3,655	9,616	8,100	17,200
Gillnet_Large	3	7,333	3,177	5,592	5,407	11,000
Gillnet_Small	7	4,660	2,734	4,900	1,500	7,600
Handgear_Large	6	7,291	3,220	8,430	2,750	11,000
Handgear_Small	13	3,571	2,709	3,700	250	9,050
Longline & Purse/Seine	5	3,899	5,065	2,440	361	12,695
Pot/Trap_Large	34	15,621	27,385	6,274	893	121,944
Pot/Trap_Small	59	4,399	3,254	3,700	0	16,030
Trawl_Large	5	18,075	14,772	18,070	0	35,848
Trawl_Small	8	7,768	6,707	6,024	1,748	21,600
Total	152	10,315	17,883	4,908	0	121,944

Table 14. Summary statistics for vessel-level business costs by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	22	118,696	87,955	98,324	3,839	339,725	9	21,101	40,936	9,154	0	128,551
Dredge_Small	9	15,919	12,964	13,594	2,662	43,660	*	*	*	*	*	*
Gillnet_Large	22	14,061	13,239	8,599	1,331	46,630	12	5,241	5,130	3,572	0	19,344
Gillnet_Small	14	22,090	34,278	14,083	745	135,240	11	5,518	10,665	2,614	0	37,066
Handgear_Large	4	13,156	12,565	12,255	0	28,113	3	3,305	3,905	2,300	0	7,614
Handgear_Small	34	4,526	3,999	2,682	213	13,631	38	2,873	4,214	627	0	14,743
Longline & Purse/Seine	7	42,447	33,651	36,206	703	109,148	5	11,085	13,802	8,779	0	34,170
Pot/Trap_Large	78	20,351	22,983	13,151	213	107,766	75	14,835	16,216	8,365	0	65,868
Pot/Trap_Small	88	9,393	9,516	5,591	0	37,320	106	11,002	11,598	7,568	0	49,143
Trawl_Large	29	56,149	48,611	33,650	479	154,674	18	42,889	32,628	32,432	0	97,617
Trawl_Small	25	16,341	14,383	14,589	639	51,160	9	33,167	39,954	16,520	0	126,455
Total	332	25,083	41,749	10,702	0	339,725	291	13,245	19,289	6,428	0	128,551

Note: Asterisks (*) denote statistics that cannot be disclosed due to data confidentiality.

Table 14 (cont). Summary statistics for vessel-level business costs by strata (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	6	29,850	37,123	12,101	0	96,750
Dredge_Small	3	34,575	45,409	17,725	0	86,000
Gillnet_Large	3	20,452	18,548	23,157	700	37,500
Gillnet_Small	7	5,629	5,546	3,500	0	14,868
Handgear_Large	6	6,160	9,452	438	0	21,418
Handgear_Small	11	992	1,349	300	0	3,212
Longline & Purse/Seine	5	36,058	43,501	8,550	200	84,931
Pot/Trap_Large	30	15,927	14,744	15,825	0	53,900
Pot/Trap_Small	57	10,941	16,193	5,600	0	79,290
Trawl_Large	5	33,011	23,046	28,500	3,000	56,856
Trawl_Small	7	6,577	11,156	1,000	0	31,081
Total	144	13,363	19,683	5,180	0	96,750

Table 15. Summary statistics for vessel/permit value, by strata, (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	21	3,293,545	1,879,524	4,259,536	4,473	5,324,421	10	3,225,662	1,905,493	3,920,984	261,399	5,227,978
Dredge_Small	10	924,852	1,272,813	372,709	10,649	3,940,071	4	569,850	573,110	365,958	135,927	1,411,554
Gillnet_Large	24	405,765	447,069	282,194	0	2,129,768	13	330,408	253,957	261,399	3,137	784,197
Gillnet_Small	16	183,027	170,967	125,124	21,298	638,930	12	164,246	166,796	130,699	31,368	627,357
Handgear_Large	4	178,368	165,800	178,368	10,649	346,087	6	162,939	90,274	156,839	52,280	313,679
Handgear_Small	41	73,098	64,455	53,244	50	351,412	44	77,897	54,705	52,280	10,456	261,399
Longline & Purse/Seine	7	346,848	189,384	372,709	53,244	585,686	6	548,938	523,320	418,238	130,699	1,568,393
Pot/Trap_Large	80	264,256	195,422	212,977	106	1,064,884	91	320,090	300,046	261,399	47,052	2,091,191
Pot/Trap_Small	94	122,020	74,484	106,488	10,649	425,954	127	144,638	95,458	125,471	63	522,798
Trawl_Large	30	672,652	423,187	585,686	0	1,597,326	19	611,508	328,350	522,798	52,280	1,359,274
Trawl_Small	27	364,827	444,545	212,977	149	1,916,791	12	308,451	429,204	156,839	47,052	1,568,393
Total (Unweighted)	354	451,578	919,705	159,733	0	5,324,421	344	323,600	645,752	156,839	63	5,227,978
Total (Weighted)	354	546,370	1,094,070	159,733	0	5,324,421	344	480,759	979,532	182,979	63	5,227,978

Note: Asterisks (*) denote statistics that cannot be disclosed due to data confidentiality.

Table 15 (cont). Summary statistics for vessel/permit value, by strata, (2015 USD).

	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	7	4,150,000	3,741,546	6,500,000	0	8,000,000
Dredge_Small	*	*	*	*	*	*
Gillnet_Large	3	241,667	14,434	250,000	225,000	250,000
Gillnet_Small	7	79,150	71,821	60,000	0	200,000
Handgear_Large	4	160,000	193,735	70,000	50,000	450,000
Handgear_Small	10	35,200	21,107	27,500	5,000	65,000
Longline & Purse/Seine	5	600,000	734,745	120,000	10,000	1,500,000
Pot/Trap_Large	27	358,667	411,136	240,000	0	2,000,000
Pot/Trap_Small	50	159,260	180,124	120,000	0	1,205,000
Trawl_Large	5	363,000	84,971	390,000	225,000	450,000
Trawl_Small	5	220,000	135,093	200,000	100,000	450,000
Total (Unweighted)	125	439,704	1,259,037	130,000	0	8,000,000
Total (Weighted)	125	647,556	1,686,966	160,000	0	8,000,000

Table 16. Summary statistics for crew/captain payments, by strata (2015 USD).

	2011						2012					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	21	587,009	360,888	664,488	0	1,079,792	11	476,557	362,106	621,687	0	873,072
Dredge_Small	8	209,463	282,944	123,305	13,517	878,529	4	148,022	185,093	74,760	20,912	421,658
Gillnet_Large	21	88,760	64,679	69,217	3,195	272,102	14	84,785	60,187	69,009	6,901	188,207
Gillnet_Small	10	54,346	35,751	38,868	21,298	117,137	12	27,087	20,981	23,049	0	57,508
Handgear_Large	3	23,435	25,331	17,786	1,406	51,114	7	16,246	17,059	15,684	0	41,824
Handgear_Small	12	7,739	15,347	3,088	0	55,374	44	2,747	9,488	0	0	53,325
Longline & Purse/Seine	6	95,839	39,330	79,448	62,828	150,981	6	178,409	233,198	85,895	0	597,035
Pot/Trap_Large	70	58,991	73,039	36,739	0	402,526	89	58,553	89,406	34,067	0	659,353
Pot/Trap_Small	70	23,166	16,964	21,298	0	80,931	126	24,741	32,216	20,488	0	262,444
Trawl_Large	29	236,609	205,637	229,952	5,007	851,575	20	164,631	125,710	148,409	220	551,029
Trawl_Small	22	54,768	56,483	39,012	0	234,142	12	32,301	42,428	13,590	0	147,724
Total (Unweighted)	272	113,846	203,257	37,271	0	1,079,792	345	59,885	126,269	24,049	0	873,072
Total (Weighted)	272	131,019	233,953	37,691	0	1,079,792	345	85,238	177,097	24,049	0	873,072

Table 16 (cont). Summary statistics for crew/captain payments, by strata (2015 USD).

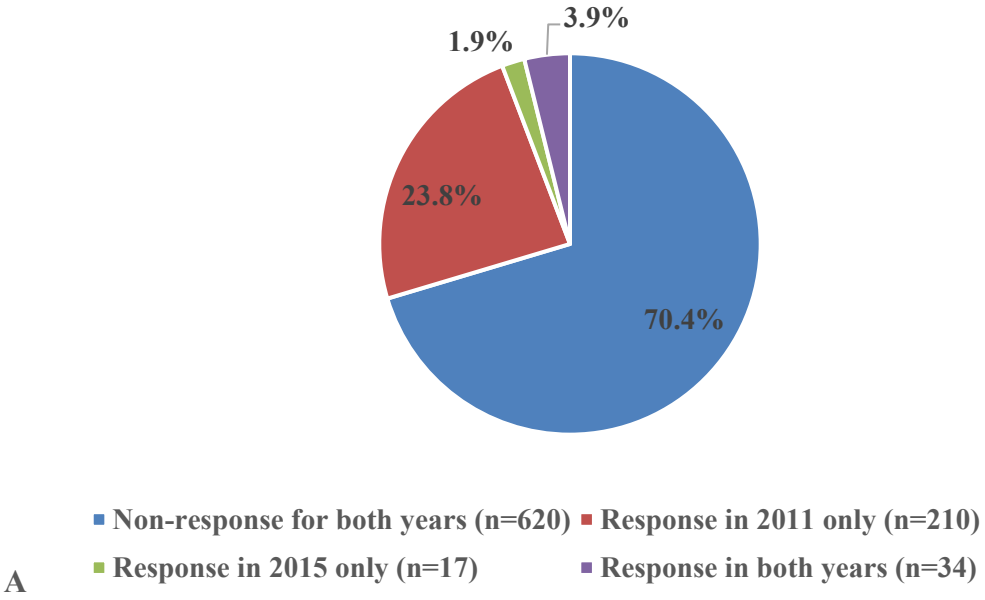
	2015					
Strata	***N***	***Mean***	***St dev***	***Median***	***Min***	***Max***
Dredge_Large	7	632,893	284,374	490,994	260,000	1,000,000
Dredge_Small	5	42,487	53,674	30,000	0	130,000
Gillnet_Large	3	106,828	80,138	150,000	14,361	156,124
Gillnet_Small	6	13,617	18,792	6,600	0	48,500
Handgear_Large	5	18,600	22,733	12,000	0	58,000
Handgear_Small	11	1,006	2,119	0	0	6,875
Longline & Purse/Seine	5	59,559	130,953	0	0	293,794
Pot/Trap_Large	29	70,142	101,946	40,000	0	486,476
Pot/Trap_Small	54	21,744	20,415	17,000	0	65,000
Trawl_Large	5	75,316	34,775	80,000	22,141	113,440
Trawl_Small	8	48,182	43,329	40,096	0	122,107
Total (Unweighted)	138	68,240	156,452	24,116	0	1,000,000
Total (Weighted)	138	99,037	203,253	33,000	0	1,000,000

Table 17. Pooled T-test results for the natural log of weighted fixed cost categories.

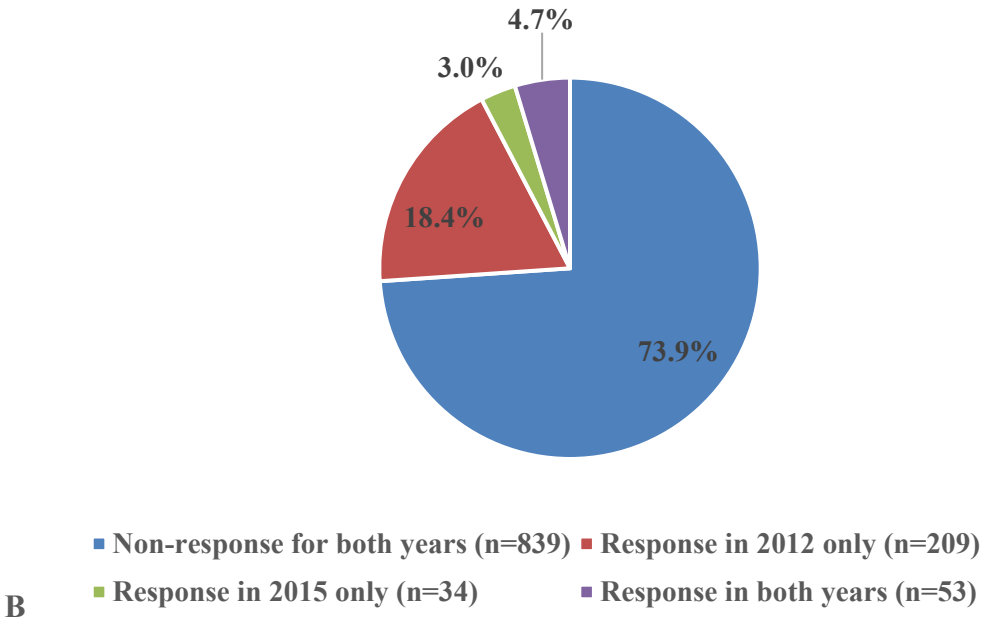
Cost Category	**2011 Mean** *(St Dev)*	**2012 Mean** *(St Dev)*	**2015 Mean** *(St Dev)*	**2011 vs. 2012** *T stat*	*p value*	**2012 vs. 2015** *T stat*	*p value*
Repair/Maintenance	9.42 *(1.36)*	9.03 *(1.4)*	8.91 *(1.47)*	3.7	0.0002***	0.85	0.3955
Upgrade/Improvement	9.17 *(1.66)*	8.79 *(1.55)*	9.25 *(1.49)*	2.48	0.0137**	-2.36	0.0187**
Vessel Fees & Insurance	8.71 *(1.25)*	8.41 *(1.3)*	8.52 *(1.29)*	3.12	0.0019**	-0.91	0.3622
Business Costs by Vessel	9.12 *(1.57)*	8.55 *(1.64)*	8.79 *(1.61)*	4.32	<.0001***	-1.31	0.1905

Note: *, **, and *** indicate rejection of the null hypothesis of equal mean costs between 2 survey years at 10%, 5%, and 1% statistical significance levels, respectively.

FIGURES



A



B

Figure 1. Response tendencies for owners of vessels sampled in 2015 after being sampled in 2011 (A), and for owners of vessels sampled in 2015 after being sampled in 2012 (B).

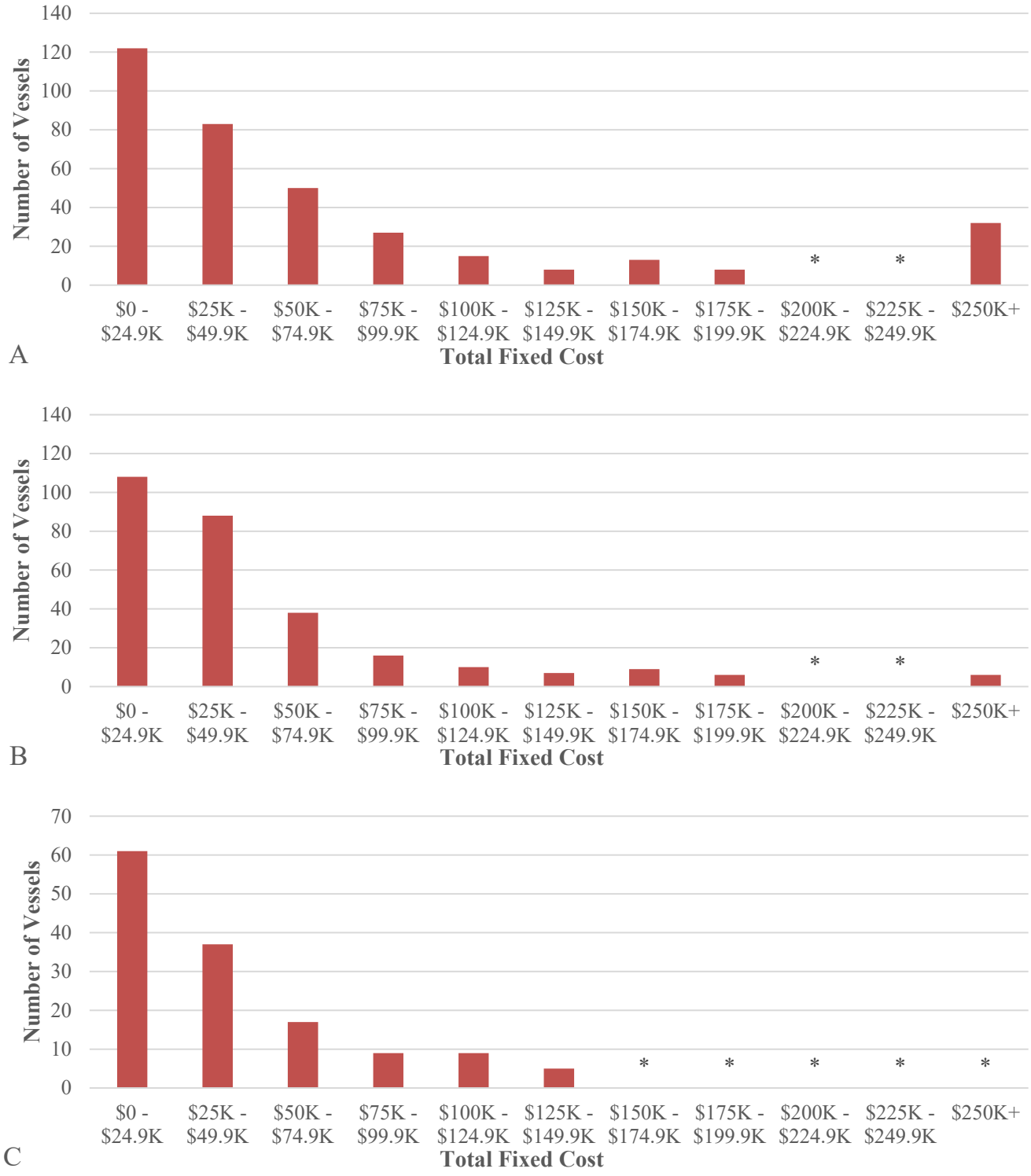


Figure 2. Number of vessels by fixed cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

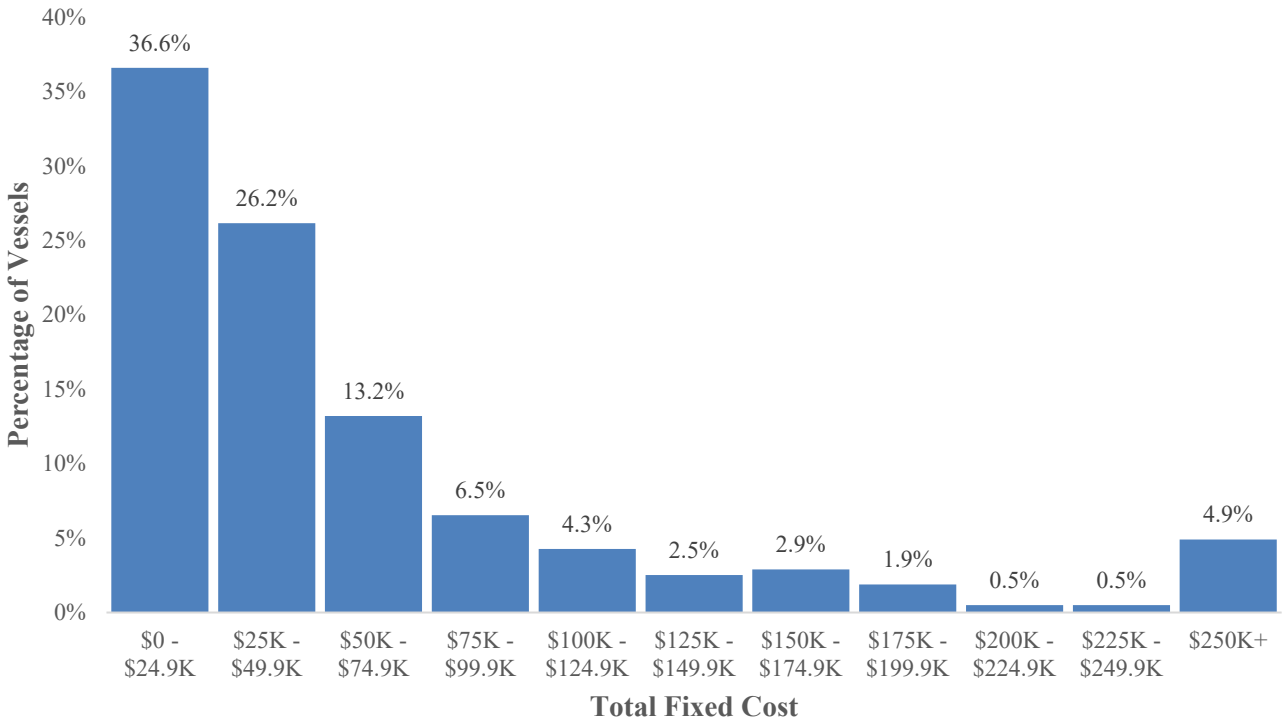
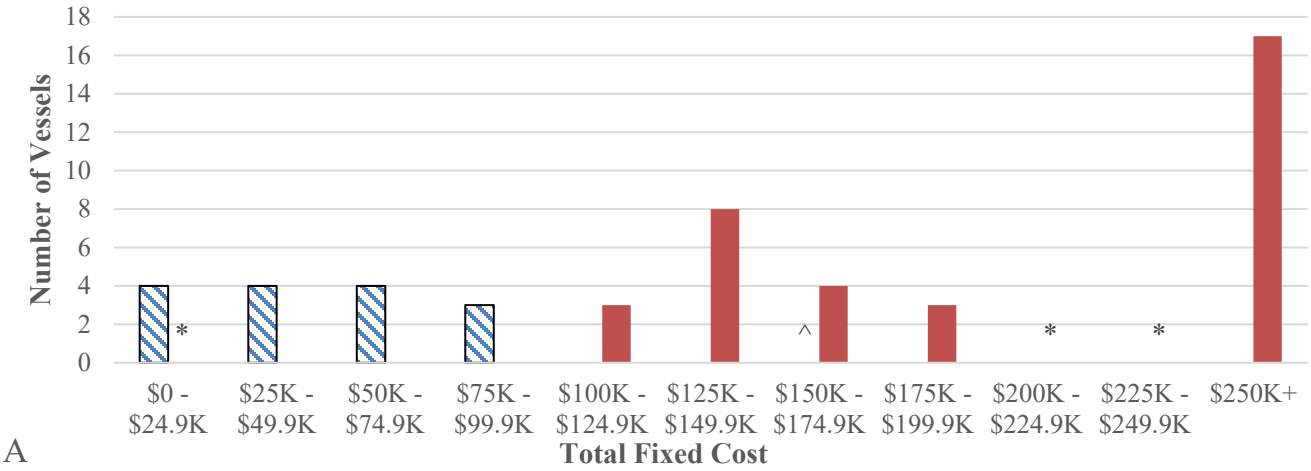
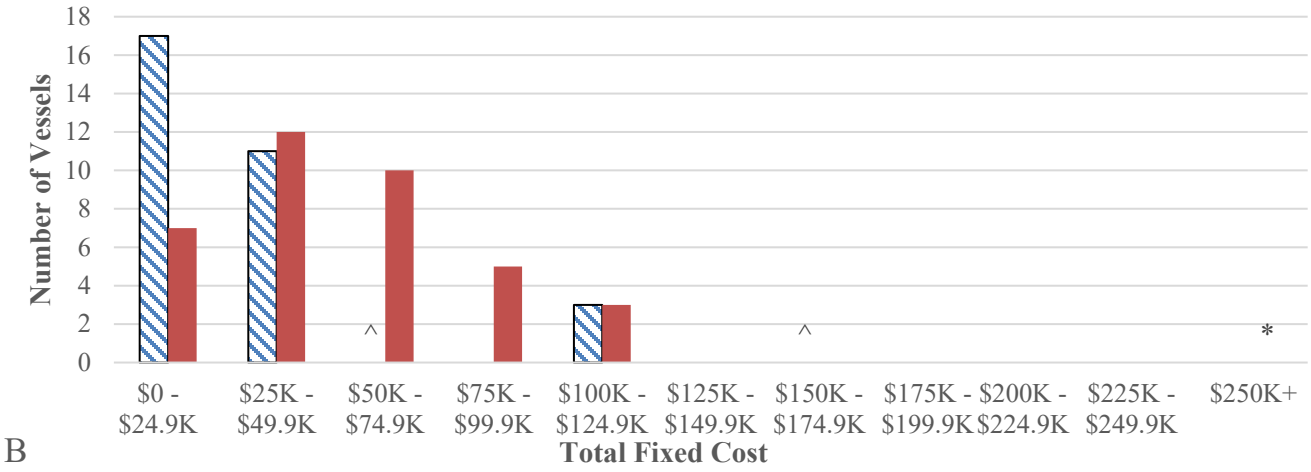


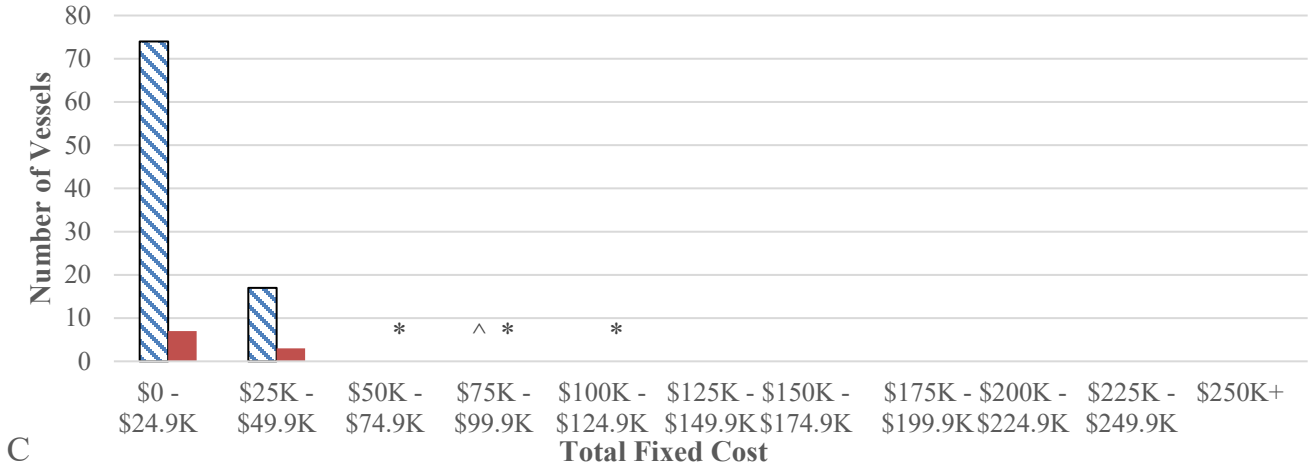
Figure 3. Percentage of vessels by total fixed cost range, with 2011, 2012, and 2015 survey responses combined.


Number of Vessels
18
16
14
12
10
8
6
4
2
0
*
^
*
*
$0 - $24.9K
$25K - $49.9K
$50K - $74.9K
$75K - $99.9K
$100K - $124.9K
$125K - $149.9K
$150K - $174.9K
$175K - $199.9K
$200K - $224.9K
$225K - $249.9K
$250K+
Total Fixed Cost

A


Number of Vessels
18
16
14
12
10
8
6
4
2
0
^
^
*
$0 - $24.9K
$25K - $49.9K
$50K - $74.9K
$75K - $99.9K
$100K - $124.9K
$125K - $149.9K
$150K - $174.9K
$175K - $199.9K
$200K - $224.9K
$225K - $249.9K
$250K+
Total Fixed Cost

B


Number of Vessels
80
70
60
50
40
30
20
10
0
*
^ *
*
$0 - $24.9K
$25K - $49.9K
$50K - $74.9K
$75K - $99.9K
$100K - $124.9K
$125K - $149.9K
$150K - $174.9K
$175K - $199.9K
$200K - $224.9K
$225K - $249.9K
$250K+
Total Fixed Cost

C

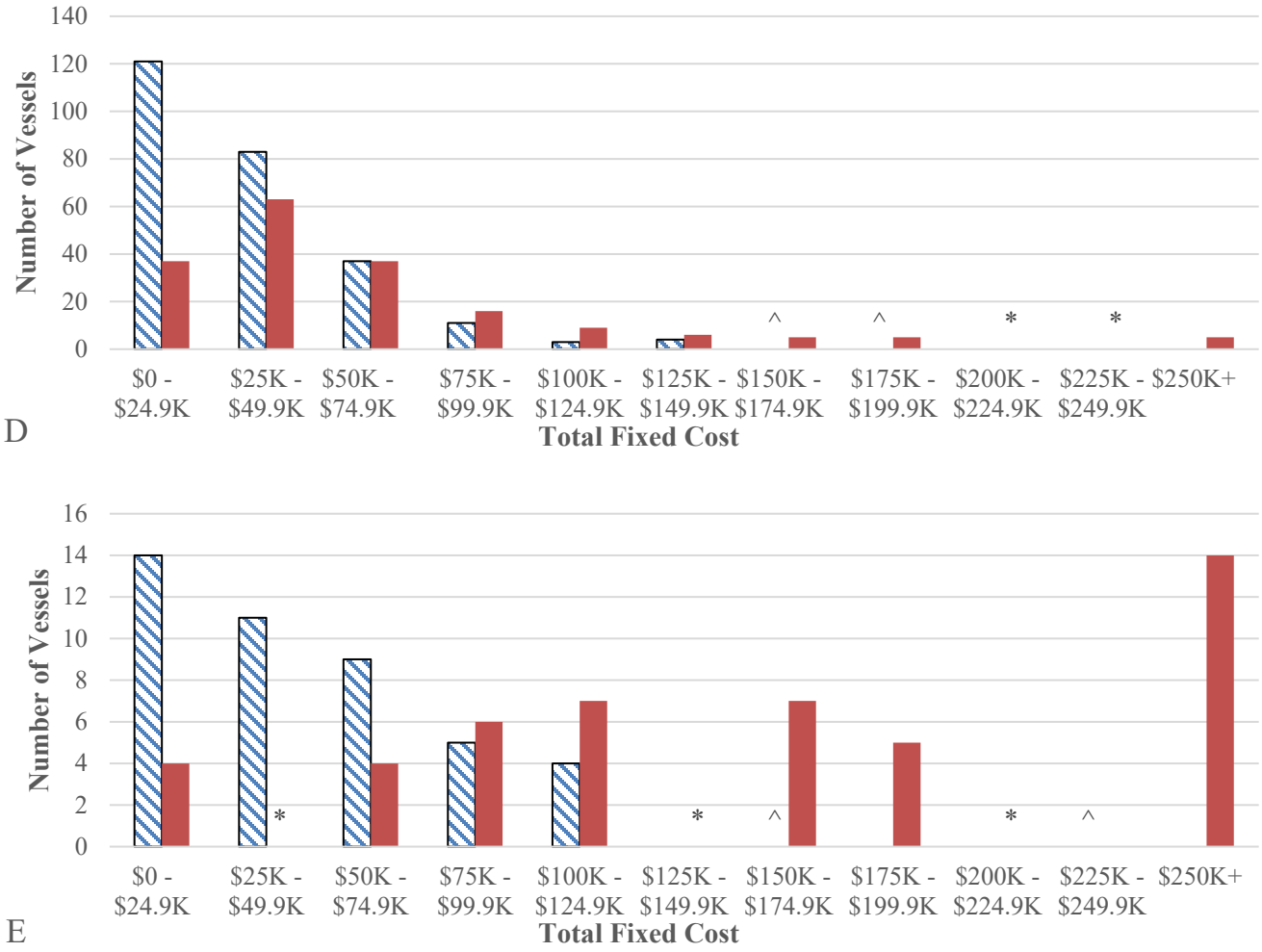


Figure 4. Number of vessels by fixed cost ranges and gear type across 2011, 2012, and 2015 surveys. Gear types include dredge (A), gillnet (B), handgear (C), pot/trap (D), and trawl (E). Small vessels within gear types represented by striped bars; large vessels within gear types represented by solid bars.

Note: Confidential data (<3 responses) denoted by asterisks (*) for large vessels and carrots (^) for small vessels. Note change in Y-axes across the different gear types.

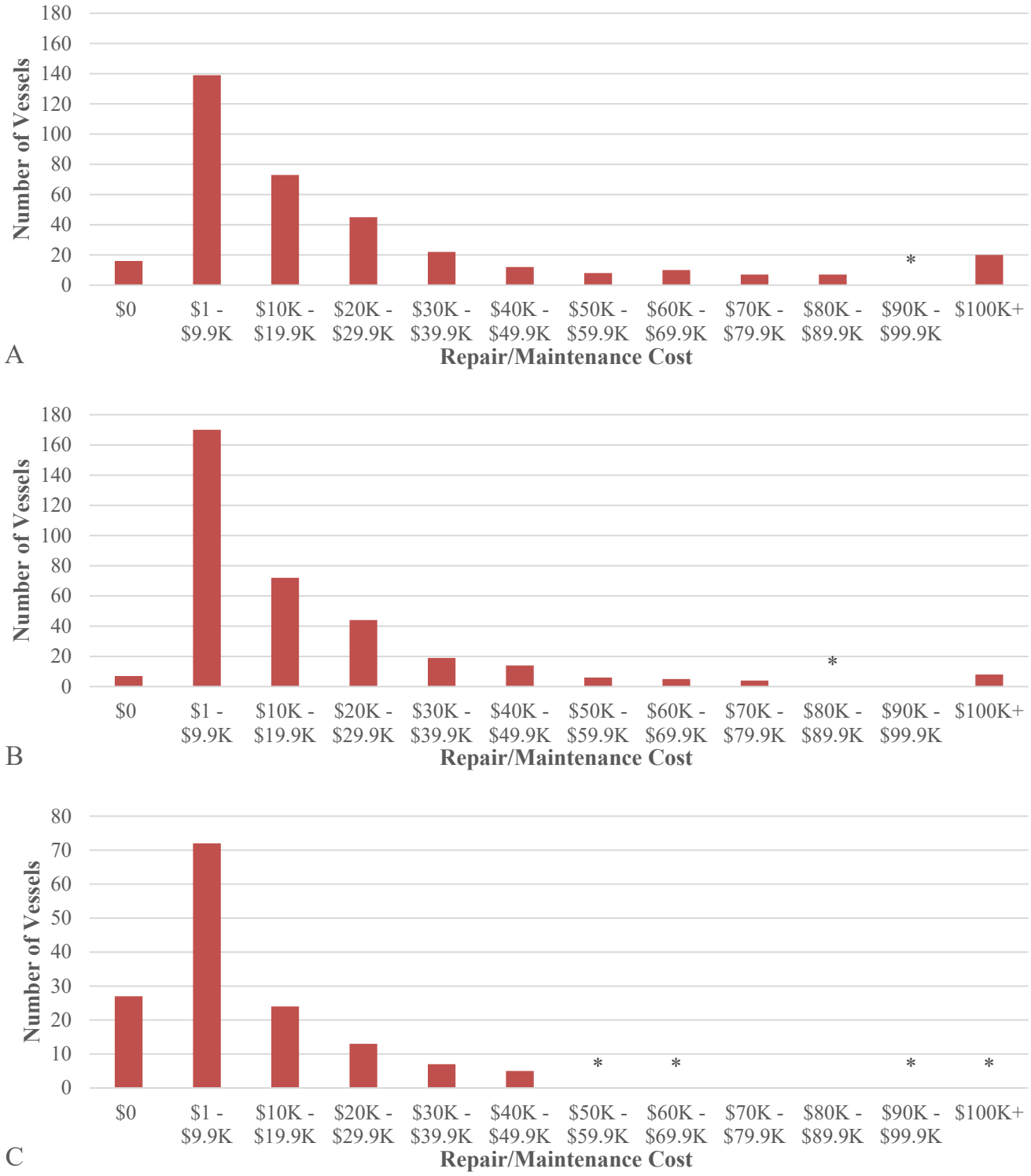


Figure 5. Number of vessels by repair/maintenance cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

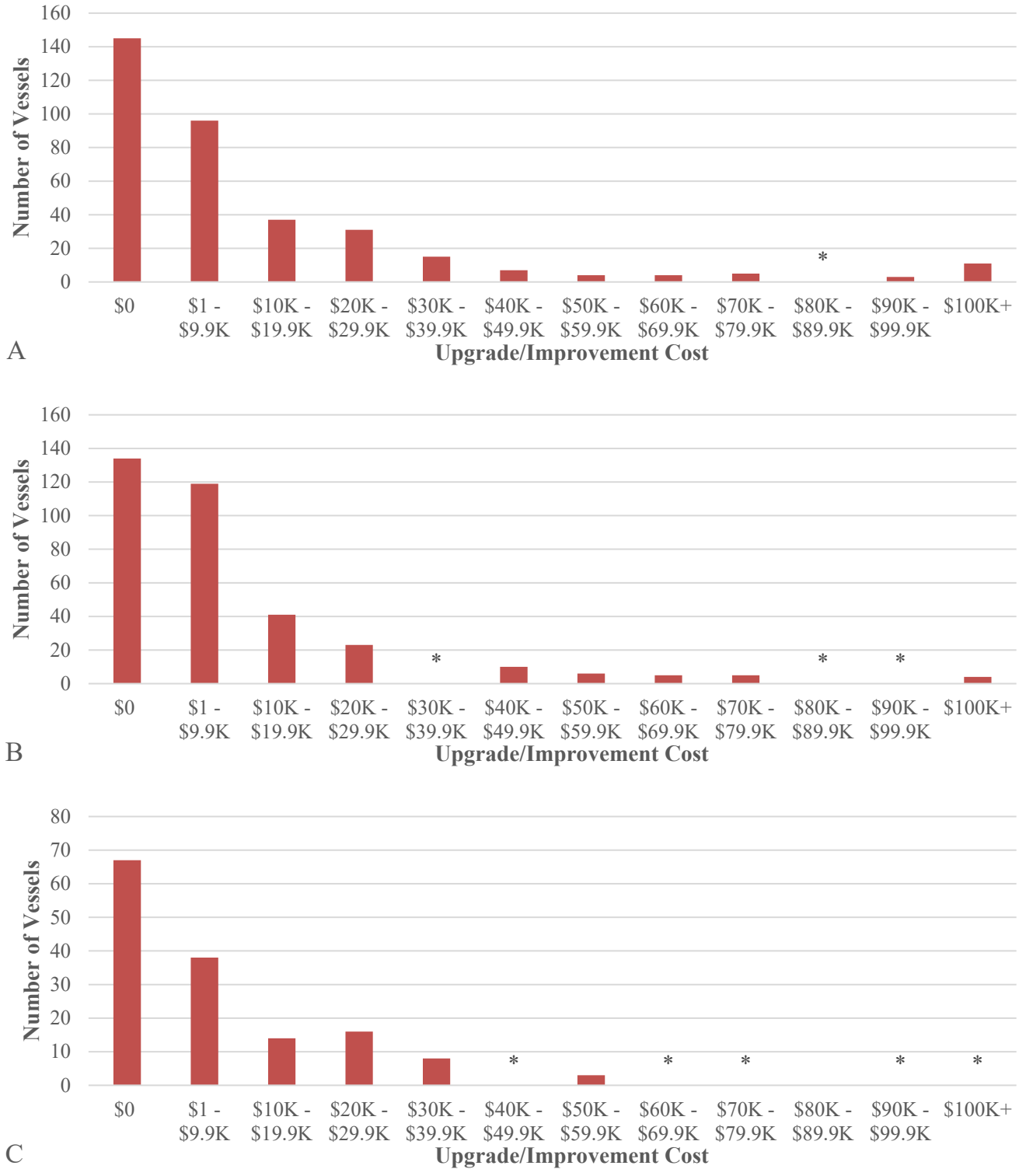


Figure 6. Number of vessels by upgrade/improvement cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

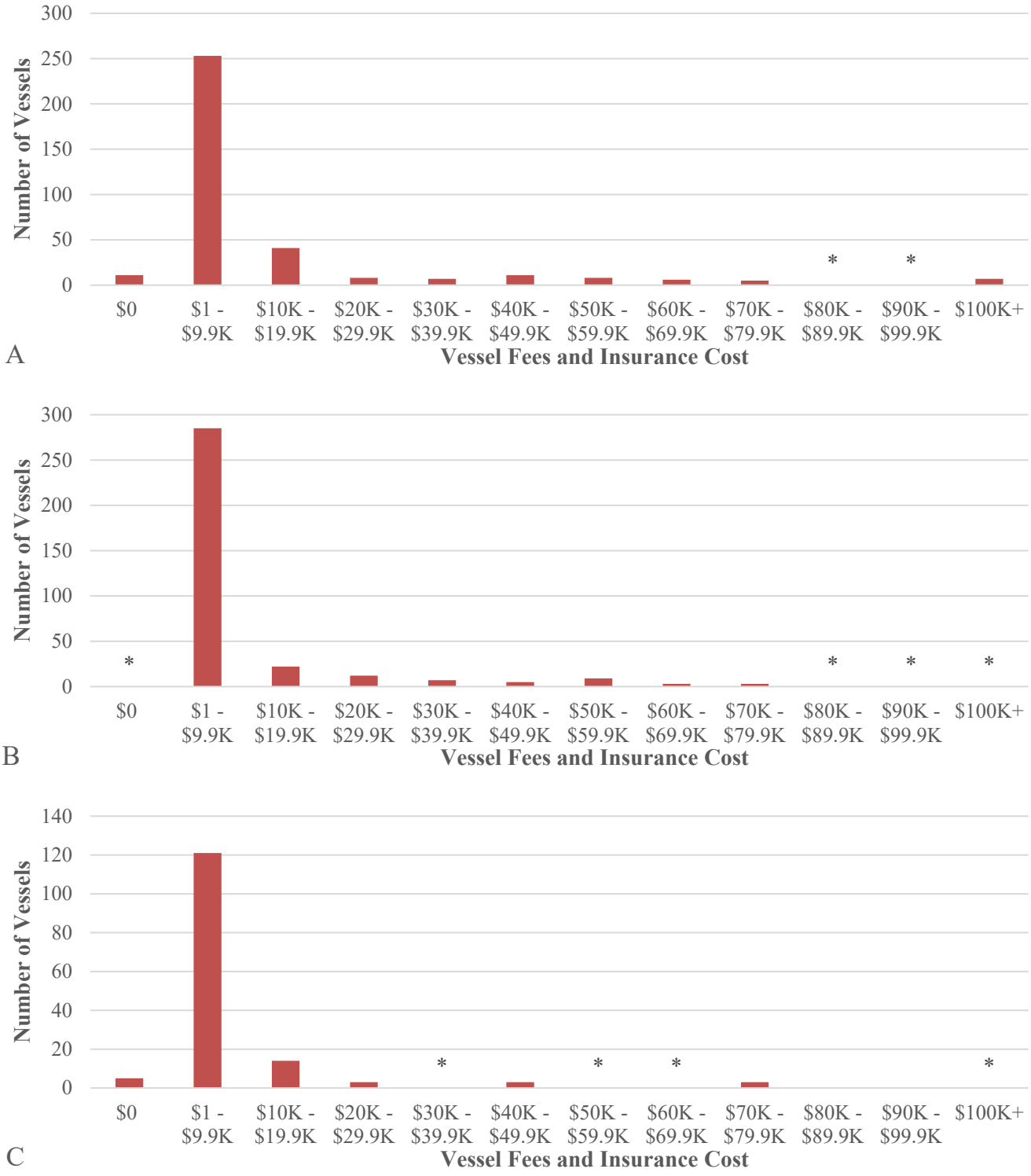


Figure 7. Number of vessels by vessel fees and insurance cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

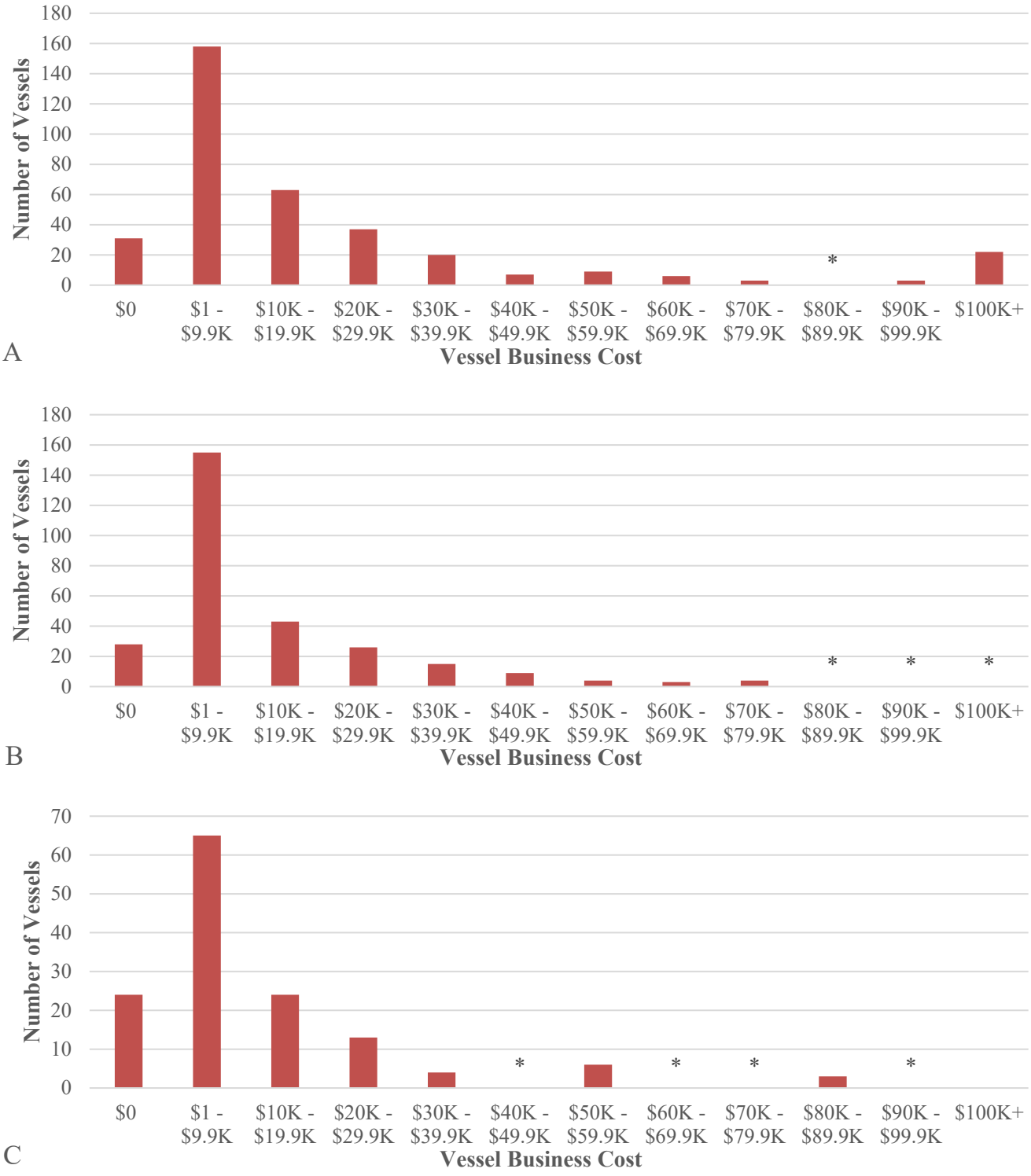


Figure 8. Number of vessels by vessel-level business cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

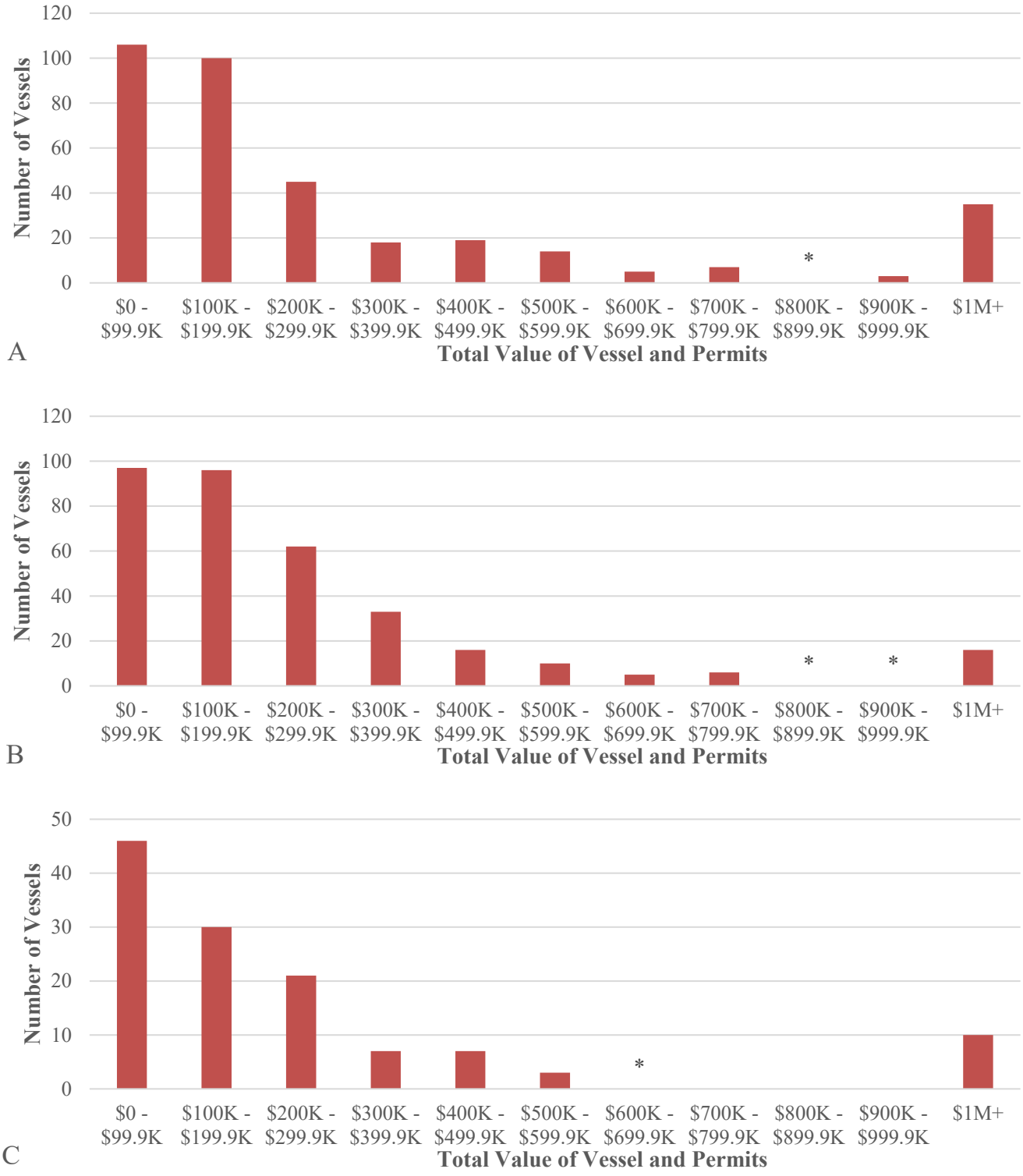


Figure 9. Number of vessels by value of vessel and permit ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axis for 2015.

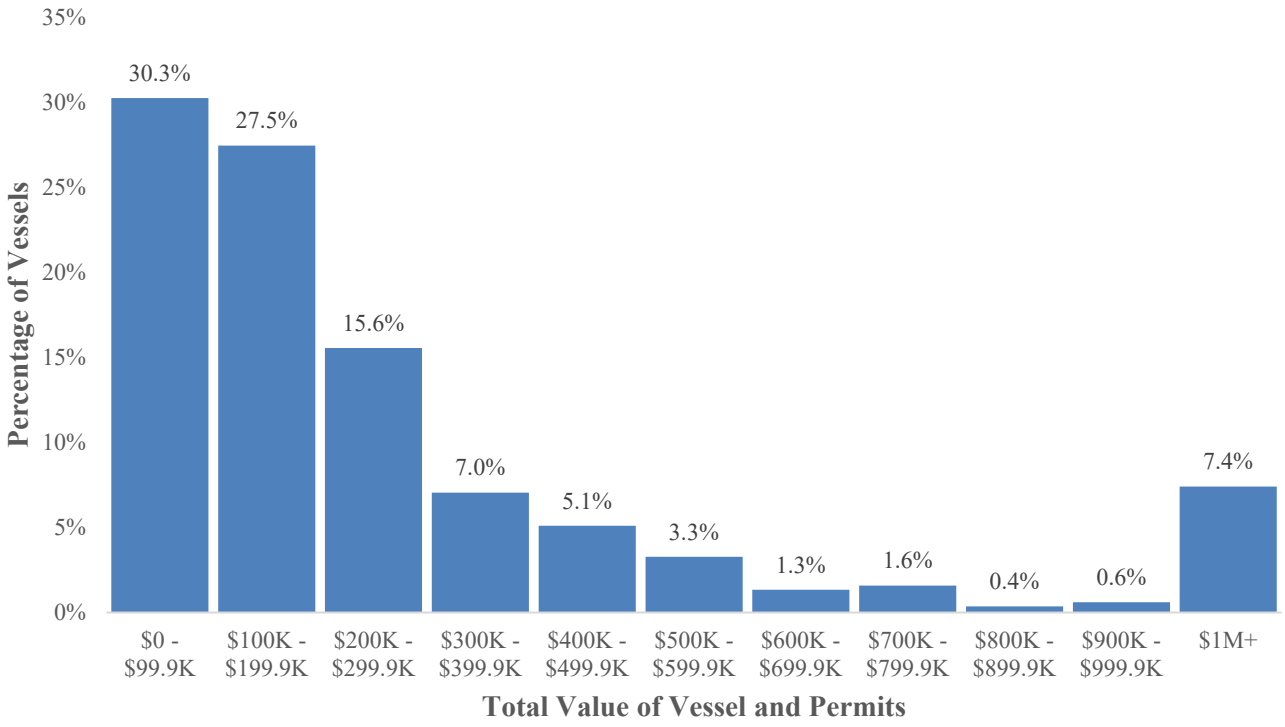


Figure 10. Percentage of vessels by value of vessel and associated permits, with 2011, 2012, and 2015 survey responses combined.

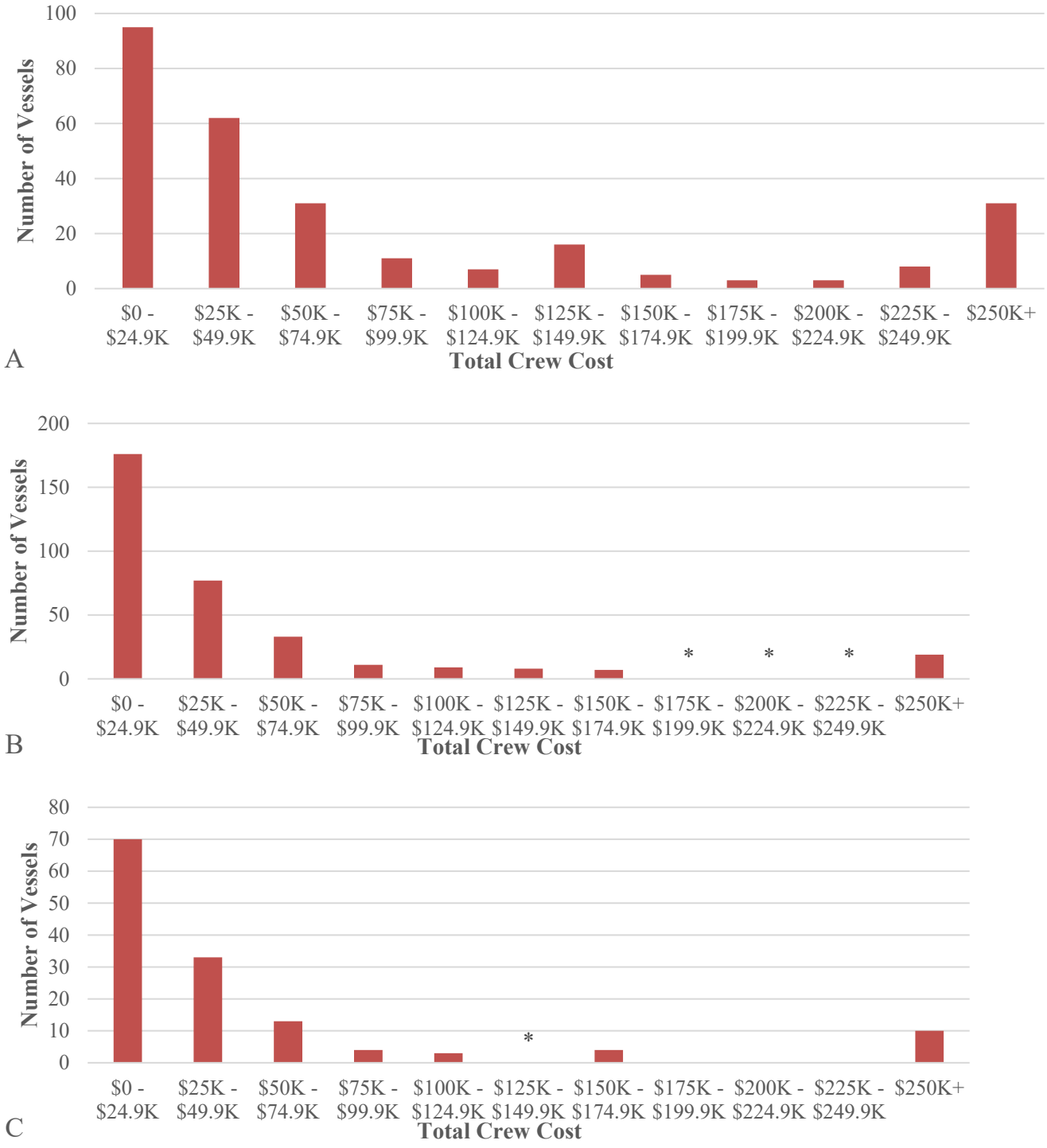


Figure 11. Number of vessels by total crew cost ranges for survey years 2011 (A), 2012 (B), and 2015 (C).

Note: Confidential data (<3 responses) denoted by asterisks (*). Note change in Y-axes across the 3 survey years.

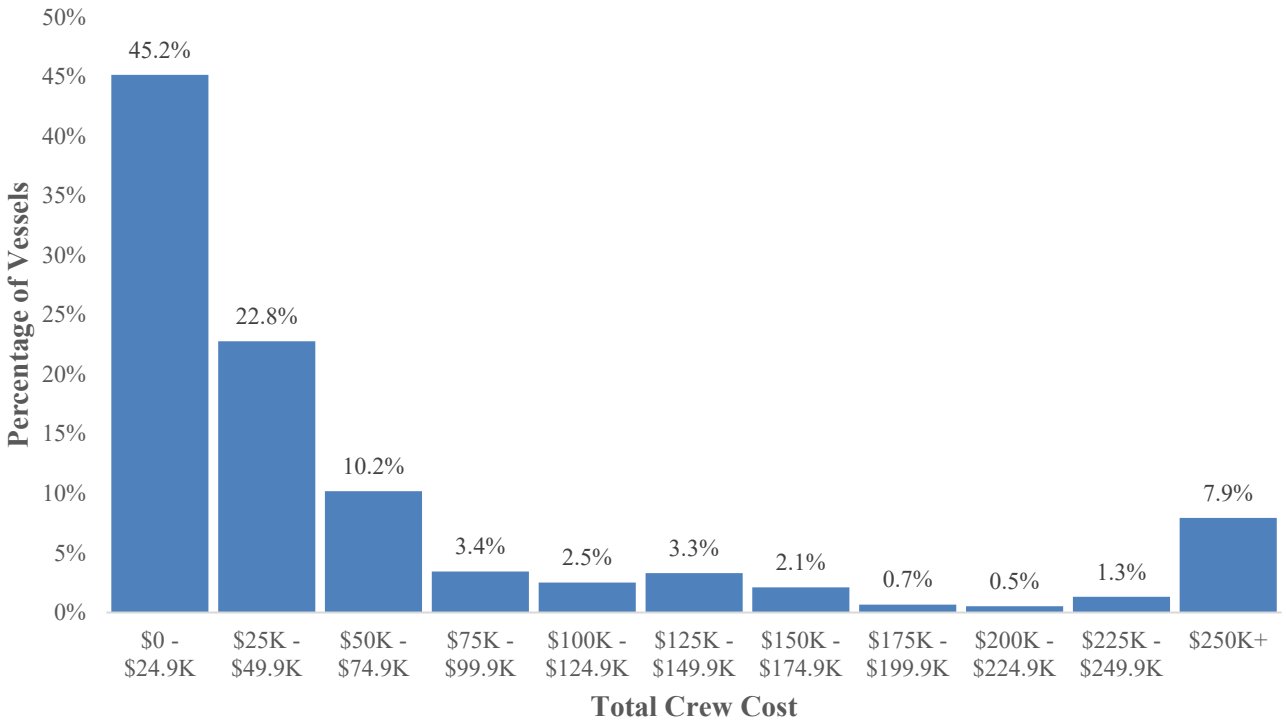


Figure 12. Percentage of vessels by total crew cost range, with 2011, 2012, and 2015 survey responses combined.