Limited Access General Category (LAGC) IFQ Fishery Program Review 2010 - 2015 (LAGC IFQ REPORT)

June 15, 2017

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1.0 EXECUTIVE SUMMARY

The New England Fishery Management Council (Council) created the Limited Access General Category Individual Fishing Quota (LAGC IFQ) through Amendment 11 to the Atlantic Sea Scallop Fishery Management Plan (FMP). As a Limited Access Privilege Program (LAPP) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the LAGC IFQ program is subject to periodic program reviews. A 3-year review of the LAGC IFQ program was completed in 2014[1].

The scope of this program review was informed by the MSA guidance, NOAA Fisheries Guidance for Conducting Review of Catch Share Programs, NOAA Fisheries Catch Share Policy, and the goals and objectives of Amendment 11 (Section 2.0). The Council's Scientific and Statistical Committee (SSC), Scallop Advisory Panel, and Scallop Committee also provided input on the scope of this report. A formal technical work group consisted of staff from the Northeast Fisheries Science Center (NEFSC), Greater Atlantic Regional Fisheries Office (GARFO), and Council. The report considers "baseline" information from fishing years (FY) 2007 – 2009 when appropriate, and focuses analyses over the six year period from FY 2010 – FY 2015. In accordance with guidance documents and the goals of Amendment 11, this program review addresses the following questions:

Has the LAGC IFQ Fishery:

1. Resulted in benefits to the Nation, including the evaluation of biological, economic, and social criteria in such decision making?
2. Preserved the ability for vessels to participate in the general category fishery at different levels? Has the IFQ program prevented excessive shares?
3. Controlled capacity, controlled mortality, and promoted fishery conservation and management?
4. Promoted safety, compliance, and enforcement?

Amendment 11 transitioned the general category component from an open access fishery to limited access. Vessels with at least 1,000 lbs of landings history during a qualifying year (2000 – 2004) were eligible for an IFQ permit and "contribution factor" (allocation), while general category vessels that did not qualify for an IFQ permit were eligible for Northern Gulf of Maine scallop permits, or incidental catch permits.

The primary goal of the LAGC IFQ program was to control capacity and mortality in the general category scallop fishery to prevent overfishing of the scallop resource. The Council intended to preserve the ability for vessels to participate in the general category fishery at different levels. The Councils' vision of the general category fishery after Amendment 11 was implemented was to have a fleet made up of relatively small vessels, with possession limits to maintain the historical character of this fleet and provide opportunities to various participants including vessels from smaller coastal communities.

[1] Three year LAGC IFQ report:

1.1 NET BENEFIT TO THE NATION

1. *Has the IFQ program resulted in benefits to the Nation, including the evaluation of biological, economic, and social criteria in such decision making?*

Net Economic Benefits

The impacts of the IFQ program on net economic benefits to the nation, as measured by producer surplus, were positive relative to a baseline period of three years (2007-2009) before implementation of Amendment 11, and since the start of the program period in 2010. Producer surplus under the IFQ program was estimated to be 16% to 22% higher during 2010-2015 compared to a scenario if the reduced TAC were shared among a larger number of participants with no flexibility for leasing or transferring quota (Section 4.3). Net revenues and producer surplus increased during the program period, buoyed by a decline in fuel prices and the increase to a 600 lb possession limit in 2011. Gross revenue and profit margins also increased during this time period. There has been a decline in the ratio of the lease prices to quota prices in those six years from 13% in the 2010 fishing year to about 10% in the 2012 fishing year. Decline in this ratio could be a sign of a decline in the perceived uncertainties about future returns. Increased productivity and concentration of effort in fewer vessels and affiliations resulted in higher profits from the baseline period as well as compared to the FY 2010 levels.

Distributional Impacts

This program review considers participation in the fishery by vessels and affiliations. In this report, an affiliation represents IFQ LAGC permit holders that are affiliates of each other based on the definition of Small Business Administration (SBA). Distributional impacts were partially examined by binning affiliations and vessels into quartiles based on their rank relative to other affiliations. Economic benefits were not equally distributed among affiliations as landings, revenues and profits concentrated in the top 25% of the affiliations. However, the results of various analyses showed that those inequalities declined slightly during 2010-2015. Profits per owner were estimated to be higher for those owners who lease-in quota (Section 1.3.4.4). The estimated impacts on crew were not necessarily positive. If crew paid the lease costs, income per crew DAS declined by 9% from 2010 – 2015 (from $528 in 2010 to $481 per day-at-sea). If crew paid half of lease costs, income per crew per DAS would have increased by 15% from $583 per-at-sea in 2010 to $670 in 2015 (Section 1.3.5). However, even when net income per crew per DAS declined, the increase in total employment by 15% in 2015 (measured by CREW*DAS) helped to increase in total crew incomes in the LAGC fishery during this period.

Landings, revenues and profits were highly concentrated among the top 25% of active affiliations (Section 1.4.3.4). For example, about 32 affiliations in this group landed about 63% of scallops in the LAGC IFQ fishery in FY 2010. IFQ fleet profits were unequally distributed with over 75% of the profits going to the top 25% of the affiliations during 2010-2015. This proportion declined from 81% in 2010 to 76% of total profits in 2015 for the top 25% group as the number of affiliations in this group declined from 58 affiliations in 2010 to 48 affiliations in 2015 ((Table 17). However, the top 9 affiliations in 2010 and top 8 affiliations in 2015 earned about 25% of total profits, while many affiliations in the bottom 25% quantile either left the fishery or joined other affiliations (Section 1.4.3.5). The distributional impacts of the IFQ program is analyzed in detail, in Section 4.4.

The Gini coefficients for landings, revenues and profits of affiliations were above 0.50 indicating that economic benefits were not distributed equally during 2010-2015. However, these values were lower compared to the Gini coefficients for the groundfish fishery if the revenues of all species were included in the calculation and were lower than values of Gini coefficients if only the groundfish revenues were included in the estimation (Tammy Murphy, NEFSC Report for GF Fishery, January 2014).

The impacts of the IFQ program on net economic benefits (as measured by producer surplus) were positive relative to a baseline period of three years (2007-2009) before implementation of Amendment 11, and since the start of the program period in 2010. Increased productivity and concentration of effort in fewer vessels and affiliations resulted in higher profits from the baseline period as well as compared to the FY 2010 levels. These economic benefits were not equally distributed among affiliations with landings, revenues and profits concentrated in the top 25% of the affiliations. However, the results of various analyses showed that those inequalities declined slightly during 2010-2015.

1.2 PARTICIPATION AT VARYING LEVELS AND EXCESSIVE SHARES

2. *Has the IFQ program preserved the ability for vessels to participate in the general category fishery at different levels? Has the IFQ program prevented excessive shares?*

1.2.1 Participation at varying levels of the IFQ fishery:

As noted above, this program review considers participation in the fishery by vessels and affiliations, and an affiliation represents IFQ LAGC permit holders that are affiliates of each other based on the definition of Small Business Administration (SBA). Active affiliations include both active IFQ vessels as well as permits in CPH and those permit holders that participate in fisheries other than scallops. Inactive affiliations do not own any active IFQ vessel that participated in the scallop fishery.[2] The program maintained the ability for vessels and affiliations to participate at different levels in the LAGC IFQ fishery. The distribution of landings, revenue and profits were not uniform across vessels and affiliations (Section 4.2). The number of affiliations that had a dependency of more than 25% on scallop revenue was relatively stable during the 2010-2015 fishing years. However, there has been a significant decline in the number of active affiliations that have a 25% or less dependence on scallop revenue, from 42 in 2010 to 17 in 2015. This implies that these affiliations leased out or sold their quota to others that target scallops or who has a higher dependency on scallop fishery as a source of their revenue.

[2] "Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists."
https://www.law.cornell.edu/cfr/text/13/121.103

From FY2010 to FY2015, landings, revenue, and quota fluctuated slightly from year to year; this was likely reflective of the strength of the resource and the quality of fishing as opposed to trends that were dictated by the LAGC IFQ program in and of itself. The number of permits in the program declined by 5% from FY2010 to FY2015, while the number of active permits decreased by 15% over the same time period. The distribution of landings, revenue, and quota allocation among active vessels was relatively consistent (Section 4.2). The number of active vessels <50' increased by 13% from FY2010 to FY2015, while the number of larger vessels (≥75') participating in the program has remained stable. These findings suggest that capacity of the general category fleet has been reduced without reducing overall performance of the fleet (in terms of landings and revenue). Furthermore, these findings support that the opportunity for stakeholders to participate in the fishery at varying levels has been preserved.

Despite this decline in relative diversity compared to 2010, about half of the LAGC IFQ fleet participated in the scallop fishery at varying levels, while the other half, 53 affiliations in 2010 and 52 in 2015, mostly targeted scallops. Average scallop landings per active affiliation increased from 43,693 lb. in 2010 to 58,111 lb. in 2015, both as a result of increase in allocations and the concentration of effort. While the average scallop landings of the top 25% of the affiliations ranged from about 43,700 lb. to about 62,000 lb. during 2010-2015 fishing years, those in the bottom 25% landed about 900 lb. to over 2500 lb. per year. The scallop landings of those affiliations in the second quintile ranged from about 5,500 lb. to 13,200 lb. and the landings of those in the third quantile ranged from about 20,000 lb. to 35,400 lb. (Fig.74). Cumulative distribution of net scallop revenues and profits are consistent with the distribution of landings. Quantile analyses indicate that the share of each group (consists of one fourth of the affiliations) fluctuated during 2010-2015 fishing years without any significant changes in trends.

There has been some changes in the species diversity of landings during 2010-2015 compared to the pre-implementation period. The changes in the species diversity was measured using Herfindahl indices for the 3,090 active vessel/FY combinations since 2004 fishing year. The results showed that there is an upward trend, indicating a less diverse catch portfolio across active vessels. FY2015 had an especially pronounced spike in indices. This means that among vessels that earn more revenue from scallops than any other species group in a given fishing year, at least half of these vessels earn all, or nearly all, of their revenue from scallops (Appendix G).

There have been some fluctuations in the geographical distributional of landings and leasing in the IFQ fishery since 2010. However, majority of these changes could probably attributed to the changes in the scallop productivity by area (Section 4.4.2.9).

There have not been any major changes in the distribution of landings by fishery of vessels that did not qualify for an IFQ permit. These vessels were primarily engaged in groundfish, surf clam/ocean quahog, and squid fisheries during the qualification years, and continue to remain active in those fisheries. For non-qualifying vessels active during the qualification period, and during the program period (2010 – 2015), the percent revenue from scallop landings has increased from 0.1% during the qualification period to 1.2% during the program period. (Section 1.4.3.9).

1.2.2 Excessive Shares

Quota allocations among LAGC IFQ affiliations were unequally distributed both in 2010 and 2015, although in 2015, concentration appears to have become more equal. In 2010, 90% of the affiliations held 57% of the quota, with remaining 10% held 43%. In 2015, 90% held 64% while the rest of the 10% held 36% of the IFQ allocations (Figure 81).

In terms of distribution of quota by activity status, 106 inactive affiliations held about 32% of total quota in 2010 and 90 inactive affiliations held 34% of the quota in 2015 fishing year (Table 21, Section 1.4.3.6). These include about 5 permit banks operating in the LAGC IFQ fishery, which held about 10% of the overall quota in 2010 and about 8% of the quota in 2015. Inactive affiliations included those with CPH permits with no revenue from other species, as well as those affiliations that are active in other species but do not participate in the scallop fishery.

Although, distribution of quota remains to be unequal, the analysis of market concentration based on the Herfindahl-Hirschman index (HHI) indicated that market for quota shares in the IFQ fishery is competitive. The concentration of quota in the LAGC IFQ fishery is far below the potential limits sets set by the caps on ownership and vessel quotas. Those caps probably contributed in preventing further consolidation of ownership in the LAGC IFQ fishery (Section **4.4.2.8**). At a 5% share cap the smallest possible number of affiliates would be 20, but in 2015, there were 192 affiliates, which is 9.6 times that of the level the share cap would allow. Distribution of the quota holding were competitive within the active and inactive affiliations. However, concentration of quota among the active owners declined during this period. These conclusions are consistent with the analyses presented in other sections, indicating that there has been more consolidation among inactive compared to the active affiliations (Section 1.4.3.7).

This review also examined the movement of quota between IFQ participants. A quota transfer represents the permanent sale of IFQ, while quota leasing refers to non-permanent transfer of IFQ pounds for harvest in a FY. In terms of share transfer network, the LAGC IFQ program was characterized by few participants, low cohesion, and one-time transfers between business entities. However, quota leasing network was characterized by many participants, increasing cohesion, and multi-year participation, but also by few multi-year leasing relationships between participants (Appendix J, Network Analysis)

1.3 FISHERY CAPACITY, AND CONSERVATION AND MANAGEMENT

3. *Has the IFQ program controlled capacity, controlled mortality, and promoted fishery conservation and management?*

The LAGC IFQ program instituted catch limits and reduced the number of permits in the general category fishery. In transitioning from an open access fishery to a limited access IFQ program, the number of active vessels in the fishery declined from a high of 592 vessels in FY 2006 to 152 active vessels in 2010 at the end of the phase in period. There were 128 active vessels in FY 2015 (15% decline from 2010). An index of IFQ vessel characteristics (average vessel length, horsepower, gross tonnage, and number of active vessels) showed a “capacity” decline of 33.2% from FY 2010 – FY 2015. With respect to overfishing and scallop mortality, landings by the LAGC IFQ component did not exceeded limits between FY 2010 – FY 2015 (Section 4.5).

Based on six years of information, the sub-ACLs and IFQs in place are controlling mortality from this component of the fishery. Over 85% of the total sub-ACL for the LAGC IFQ fishery was harvested annually during the program review period. The IFQ component has fished within its sub-ACL after the implementation of up to 15% carryover pounds. From a biological perspective this IFQ and sub-ACL management program has been effective at controlling mortality and preventing overfishing.

As the IFQ component is allocated 5.5% of the annual catch limit, scallop harvests by this component represent a very small proportion of total removals from the resource. The LAGC IFQ component also accounts for a small proportion of bycatch of stocks for which the scallop fishery has sub-ACLs. Non-target catch as measured by discard to kept ratios (d:K) on observed dredge trips suggests that bycatch of SNE/MA yellowtail and SNE/MA windowpane was less than 4% of kept catch (shucked scallop meat weight) during the baseline period and program period. Not unsurprisingly, the d/K ratios of the same species were higher for scallop trawl net gear over the time period. Bycatch of CC/GOM yellowtail and GOM/GB windowpane declined in the early years of the IFQ program (FY 2010 – FY2013), but has increased from those low levels in FY 2014 and FY 2015. Catch rates on observed trips of those stocks were less than 4% of kept catch in FY 2015, which is below baseline year levels for both stocks. It should be noted that the 2015 groundfish operational assessments found that SNE/MA windowpane flounder is not overfished and overfishing is not occurring, and the stock is rebuilt, while the update found that SNE/MA yellowtail flounder is overfished and overfishing is occurring.

1.4 SAFETY, COMPLIANCE, AND ENFORCEMENT

4. *Has the IFQ program promoted fishing safety, compliance, and enforcement?*

The number of IFQ MRIs with quota overages declined from 2012 to 2015, as did the overage total. IFQ overages made up a small percentage of the total allocated IFQ quota in all years examined. Compliance with VMS reporting requirements has generally improved during the IFQ program period from 2010 – 2015, though compliance on non-IFQ declared trips (ex: groundfish, or surf clam/ocean quahog) remains low. While VMS pre-land compliance has improved, the total number of offloads that are monitored remains very low (<1% of total trips). The average vessel age among active vessels increased from 1982 to 1986 between FY 2010 and FY 2015. The oldest vessels in the fleet in FY 2010 (built before 1940) are no longer active.

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2.0 PURPOSE, NEED, AND SCOPE OF THE SCALLOP LAGC IFQ REVIEW

The Magnuson-Stevens Act § 303A (c)(1)(G) requires a detailed review 5 years after the implementation of the program "determining progress in meeting the goals of the program and this Act, and any necessary modification of the program to meet those goals…". In other words, the IFQ review should address both the goals of the program as specified in Amendment 11 as well as the general goals of the MSA including those related to limited access privileges as follows:

1. Primary goal of the IFQ program (Amendment 11) was to control capacity and mortality in the general category scallop fishery to prevent overfishing of the scallop resource. Furthermore, the Council intent also included a desire to preserve the ability for vessels to participate in the general category fishery at different levels with a vision of a fleet "made up of relatively small vessels, with possession limits to maintain the historical character of this fleet and provide opportunities to various participants including vessels from smaller coastal communities. " The goals and objectives from Amendment 11 are attached at the end of this document, as well as the vision statement.
2. The MSA National Standards require that "all management actions achieve the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and that any allocation of fishing privileges be fair and equitable and reasonably calculated to promote conservation". The goals of the LAPPs as specified in MSA § 303A (c)(1)(A) to (F) include: reducing over-capacity, promoting safety, fishery conservation and management, and social and economic benefits. Furthermore, Section 301(a)(4) indicates that allocation of fishing privileges should be "carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges."

Based on these standards, NOAA catch share policy indicated that the five-year performance report should address the following criteria:

1. The report should review if the allocations (or the IFQ program) resulted in the greatest overall benefit to the Nation, including the evaluation of biological, economic and social criteria in such decision making.
2. Performance measures may include "how fishery stocks responded to management; what were the impacts on fishing communities, participation and entry into the fishery; what happened to prices, revenues and profits; and how recreational fishery access and participation rates changed after program initiation".
3. Performance measures need to be linked back to the initial objectives in a FMP. This means that it should performance report should address "if the specific goals of IFQ program as stated in Amendment 11 are met".

2.1 KEY QUESTIONS ADDRESSED IN THIS REVIEW

As noted in the Section 1.0, in accordance with those goals specified above, and the NOAA catch share policy, this report addresses the following questions. Has the IFQ program:

1. Resulted in benefits to the Nation, including the evaluation of biological, economic and social criteria in such decision making?

2. Preserved the ability for vessels to participate in the general category fishery at different levels and/or prevented excessive shares?
3. Controlled capacity, controlled mortality, and promoted fishery conservation and management?
4. Promoted fishing safety, compliance, and enforcement?

3.0 ATLANTIC SEA SCALLOP FISHERY

3.1 SUMMARY OF ATLANTIC SEA SCALLOP RESOUCE

The Atlantic sea scallop (Placopetcen magellanicus) is a bivalve mollusk that is distributed along the continental shelf, typically on sand and gravel bottoms from the Gulf of St. Lawrence to North Carolina (Hart and Chute, 2004). The species generally inhabit waters less than 20^{o} C and depths that range from 30-110 m on Georges Bank, 20-80 m in the Mid-Atlantic, and less than 40 m in the near-shore waters of the Gulf of Maine. Although all sea scallops in the US EEZ are managed as a single stock, assessments focus on two main parts of the stock and fishery that contain the largest concentrations: Georges Bank and the Mid-Atlantic, which are combined to evaluate the status of the whole stock. See Section 4.5 for more information.

3.2 SUMMARY OF MANAGEMENT HISTORY

The Council established the Scallop FMP in 1982. A number of Amendments and Framework Adjustments have been implemented since that time to adjust the original plan. Amendment 4 was implemented in 1994 and introduced major changes in scallop management, including a limited access program to stop the influx of new vessels and a day-at-sea (DAS) reduction plan to reduce mortality and prevent recruitment overfishing. Limited access vessels were assigned different DAS limits according to which permit category they qualified for: full-time, part-time or occasional. Amendment 4 also created the general category scallop permit for vessels that did not qualify for a limited access permit. Although originally created for an incidental catch of scallops in other fisheries, and for small-scale directed fisheries, the general category fishery and fleet has evolved since its creation in 1994.

Under Amendment 4 the general category scallop fishery was established as an "open access" fishery. Open access means any vessel that wants to apply for a permit can; there were no specific qualifications to receive a general category permit. The main control on mortality for this component of the scallop fishery was a daily possession limit.

Starting in 1999 there was considerable growth in fishing effort and landings by vessels with general category permits, primarily as a result of resource recovery and higher scallop prices. Landings went from an average of about 200,000 pounds from 1994-2000 to over one million pounds consistently from 2001-2003, and 3-7 million pounds each year from 2004-2006 (NEFMC, 2007). Without additional controls on the general category fishery, there was a great deal of uncertainty with respect to potential fishing mortality from this component of the scallop fishery, thus the potential for overfishing was increased. Therefore, the Council initiated Amendment 11 to consider a range of measures to control fishing mortality by this component of the fishery, improving the ability of this plan to prevent overfishing of the scallop resource overall.

A control date was implemented for the general category scallop fishery on November 1, 2004 (69 CFR 63341). A control date serves as advance notice to vessels that future access to that fishery may be limited in some way. Specifically, a control date can be used for establishing eligibility criteria for determining levels of future access and it implemented to discourage speculative entry into a fishery while a Council develops a management program to control effort.

The Council began working on Amendment 11 in 2005 in June 2007 the Council approved Amendment 11 to the Scallop FMP and it was effective on June 1, 2008. To help focus Amendment 11 during development, the Council approved policy guidance as well as a "vision statement" for the general category fishery to help define the scope of issues that would be considered during the amendment. These have been included in this document to help identify potential indicators and evaluate whether the program implemented by Amendment 11 has achieved the goals and objectives set by the Council as well as the vision developed for this fleet.

The policy guidance read:

> *Amendment 11 will focus on addressing capacity in the general category fishery by considering measures that will better control fishing mortality by this component of the fishery. Specifically, the amendment will consider limited entry and implementation of a hard total allowable catch (hard TAC) to prevent overfishing. This amendment will not consider measures that maintain the general category fishery as an open access fishery with input controls as the only mechanism to manage general category effort (i.e. possession limits and crew restrictions).*

3.2.1 Vision for general category fishery adopted under Amendment 11

The Council recognizes that the general category scallop fishery has changed since development and implementation of Amendment 4 in 1994. While some of the participants are the same, many have changed and fishing behavior has evolved with time. The general category scallop fishery has been and still is very diverse. This component of the fishery is prosecuted by vessels of different size and gear types. For example, some general category vessels fish for scallops full-time but only seasonally, another component of the fleet lands scallops above incidental levels while fishing for other species, and some are full-time day boat vessels that target scallops year round.

Amendment 11 implemented measures that were designed to control capacity and mortality in the general category scallop fishery. In order to accommodate this diverse fleet, this amendment considered a range of measures that take these differences into account. The action established a limited entry program, a hard TAC (now ACL) and other management measures to control capacity and mortality.

The overall intent of the action was to stabilize capacity and prevent overfishing from the general category fishery. In doing so, the Council's vision for the general category fleet was to maintain the diverse nature and flexibility within this component of the scallop fleet. Specifically, the Council considered measures that were anticipated to control mortality from this component of the fleet, but preserve the ability for vessels to participate in the general category fishery at different levels. In doing so, the Council recognized the importance of this component of the fishery for small fishing communities, as a component of overall catch for some individual vessel owners, and the value this "dayboat" scallop product has in the scallop market. Overall, the Councils' vision of the general category fishery after Amendment 11 was implemented was to have a fleet made up of relatively small vessels, with possession limits to maintain the historical character of this fleet and provide opportunities to various participants including vessels from smaller coastal communities.

3.2.2 Goals and Objectives of Amendment 11 related to the General Category Fishery

The primary goal of Amendment 11 was to control capacity and mortality in the general category scallop fishery. In order to achieve this goal, the Council identified the following list of objectives:

1. Allocate a portion of the total available scallop harvest to the general category scallop fishery.
2. Establish criteria to qualify a number of vessels for a limited entry general category permit.
3. Develop measures to prevent the limited entry general category fishery from exceeding their allocation.
4. Develop measures to address incidental catch of scallops while fishing for other species.

Amendment 11 ultimately implemented a limited entry IFQ program for about 340 vessels (Category A LAGC permits). Each qualifying vessel received a "contribution factor" based on their catch history and years in the fishery. Vessels are allocated annual scallop poundage based on their individual contribution factor. Vessels are still subject to a possession limit; Amendment 11 maintained the limit of 400 pounds, but that was increased in a subsequent action to 600 pounds. The fleet of qualifying Category A general category vessels received a total allocation of 5% of the total projected (LA and LAGC) scallop catch each fishing year.[3]

Amendment 11 also established separate limited entry programs for other classes of general category permits. Category B permits are restricted to fishing for scallop in the Northern Gulf of Maine and those vessels qualified under a separate set of criteria with different gear and possession limit restrictions. Category C LAGC permits are for vessels permitted to land and sell up to 40 pounds of scallop meat per trip while fishing for other species. There is a target TAC for this permit category of 50,000 pounds per year. Finally, about 120 limited access vessels (in Permit data, there are only 40 limited access vessels with IFQ permits in 2009-2012) also qualified for a LAGC IFQ permit under the same qualifying criteria). These vessels are allocated an overall 0.5% of the total projected annual scallop catch, and each permit has an

[3] Amendment 15 to the Scallop FMP changed the LAGC IFQ allocation to 5% of the annual catch limit (ACL). The Council has since modified the approach adopted in Amendment 15 to allocated to this component of the fishery, and revert to using 5% of the projected landings for the LAGC IFQ allocation.

individual contribution factor. These other limited access general category permits will not be evaluated in this report. This report is focused on LAGC IFQ vessels only, Category A permits.

Amendment 11 was implemented before the start of the 2008 fishing year, but there was a transition period for the first two years of the program. For fishing years 2008 and 2009 the fishery was managed under a quarterly hard-TAC equivalent to 10% of the total projected catch for the scallop fishery. The Council developed these interim measures because it was expected to take at least 12 months to implement a limited entry IFQ program. The Council adopted a quarterly TAC based on public comments related to potential derby fishing and safety concerns. The Council selected 10% because that is the value that was used in recent projections for assumed scallop mortality from the general category fishery, and that level of catch had not had substantial impacts on the limited access fleet during that time period. Furthermore, the Council selected a higher value than the long-term allocation of 5% to reduce short-term impacts on vessels that would ultimately qualify for limited entry from additional effort expected under the appeals process.

3.2.3 Summary of changes to the IFQ program since Amendment 11

Since Amendment 11 there have been several of adjustments made to the IFQ program. The first action following Amendment 11, Framework 21 allowed partial leasing of general category IFQ allocations during the fishing year. The Council adopted this alternative to increase flexibility for general category qualifiers and to improve overall economic profits of the IFQ program. In addition, the amount of compensation a general category vessel can receive on observed access area trips was limited to 400 pounds per trip. This measure is not directly related to improvements of the IFQ program, but it does help prevent excessive compensation for observed LAGC trips, thus improving overall monitoring for both the LA and LAGC fleets. Limiting the compensation per trip will help the total observer set-aside compensation pool last longer, reducing the chance of the pool running out before the end of the year.

In 2010, Framework 22 considered modifications to various aspects of the LAGC program including VMS, accountability measures for YT flounder, and possession of in-shell scallops. None of these measures were adopted, and none were specific to the IFQ program. In 2011, the Council approved Framework 23 which again did not consider any specific changes to the IFQ program, but modify one part of the NGOM LAGC permit. This action changed the NGOM management program so that a vessel with a Federal NGOM permit can fish exclusively in state waters and that catch would not apply against the federal NGOM TAC. Vessels could still fish in federal waters, but if they do all catch from that trip would apply against the federal TAC.

Amendment 15 included changes to the LAGC IFQ program specifically designed to make the IFQ program more effective and efficient for participating vessels. First, a rollover of 15% of the permit holder's original annual allocation will be allowed to a subsequent fishing year to increase flexibility and provide a safety mechanism in the case of a late-season breakdown. Second, the possession limit was increased from 400 to 600 pounds to allow for more efficient harvest of quota, without the increase being large enough to change the nature of this small day-boat fishery and creating competition between the fleets. Third, the maximum amount of quota one vessel can harvest was increased from 2% to 2.5% to be more consistent with the maximum individual ownership value of 5%. Finally, IFQ vessels will be allowed to split the IFQ from their IFQ permit and other fishery permits to facilitate permanent IFQ transfers from vessels with a suite of fishery permits.

In 2012, the Council approved Framework 24 to set fishery specifications for 2013, as well as a handful of other measures. Several were specific to the LAGC IFQ program. One measure designed to improve flexibility and efficient use of LAGC IFQ during the year was to allow LAGC vessels to sub-lease IFQ as well as lease IFQ during the fishing year even if some fishing has occurred. A handful of other measures adjust management for LAGC vessels, but were not specific to the IFQ program: specific yellowtail flounder accountability measures (YT AMs) for the LAGC fishery; adjustment to the timing of YT AMs in the scallop fishery; expand the observer set-aside program to include LAGC trips in open areas; and modify the observer set-aside TAC so that it is still 1% of the ABC, but it would not be area specific. These last few measures were developed to make LAGC vessels more accountable for bycatch, as well as improve overall monitoring of this fishery.

Framework 25 included proactive and reactive accountability measures for the scallop fishery – including the LAGC IFQ component. A reactive AM for catch overages of southern windowpane flounder requires the use of a maximum 5-row apron and maximum 1.5:1 hanging ratio in an area west of 71° W. The length of the AM is dependent upon how much the sub-ACL is exceeded by. The proactive AM required the use of a maximum 7-row apron in same areas as southern windowpane AM area. This proactive AM was subsequently expanded to include the entire fishery in 2015 through FW26.

3.3 SUMMARY OF THE GENERAL CATEGORY FISHERY

3.3.1 Permit Types

The general category permit was first established under Amendment 4 to the Scallop FMP. In 1994 it was established as an "open access" fishery; any vessel could apply for a permit. There were no specific qualifications to receive a permit and the primary control on mortality for this component of the scallop fishery was a daily possession limit.

Since Amendment 11, adopted in FY2008, there are now three types of LAGC permits; LAGC Category A permits which are IFQ permits; LAGC Category B permits which are restricted to fishing in the NGOM; and LAGC Category C permits which are incidental catch permits restricted to 40 pounds of scallop catch. Within the LAGC Category A permits there are two types: vessels that qualified for an IFQ permit that can transfer and lease quota; and limited access scallop vessels that also qualified for a LAGC IFQ permit, but are prohibited from leasing and transferring quota. Limited access scallop vessels can also qualify for the other general category permits (NGOM and incidental catch).

Many limited access scallop vessels also hold some type of LAGC permit. For example, in 2011 19 full-time limited access vessels also held LAGC-IFQ permits, another 19 full-time vessels held LAGC-NGOM permits, and about 83 full-time vessels also held LAGC-incidental permits. The number of general category permits declined considerably after 2007 as a result of the

Amendment 11 provisions. Before Amendment 11 about 2,500 to 3,000 vessels had open access general category permits, and in 2011 fewer than 700 vessels had one of the four types of limited access general category permits.

Limited entry into the Atlantic sea scallop fishery began in 1994 through Amendment 4 to the FMP. See Table 1 for a summary of the limited access programs in the fishery and information on qualifying criteria.

Table 1 - Summary of scallop permit categories and qualifying criteria.

Permit Type	Year Created	Action	Qualifying Criteria	Permit Category
Limited Access (Multiple categories)	1994	Amendment 4	One trip with more than 400 pounds in either 1988 or 1989, extended for new vessels under construction	Based on number of days used in 1990, or average of 1985-1990 days
LAGC IFQ	2008	Amendment 11	Possess Open Access GC permit	1,000 pounds landings in a year (FY2000-2004), individual allocation based on best year indexed by # of years active in the fishery
LAGC NGOM	2008	Amendment 11	Possess Open Access GC permit	No landings history required
LAGC Incidental	2008	Amendment 11	Possess Open Access GC permit	No landings history required

Harvest limits vary within the scallop FMP by permit category. Table 2 summarizes the existing harvest limits and the various forms of allocations across permit categories (ex: DAS, IFQ, etc.).

Table 2 - Summary of harvest limits and allocation types by permit category

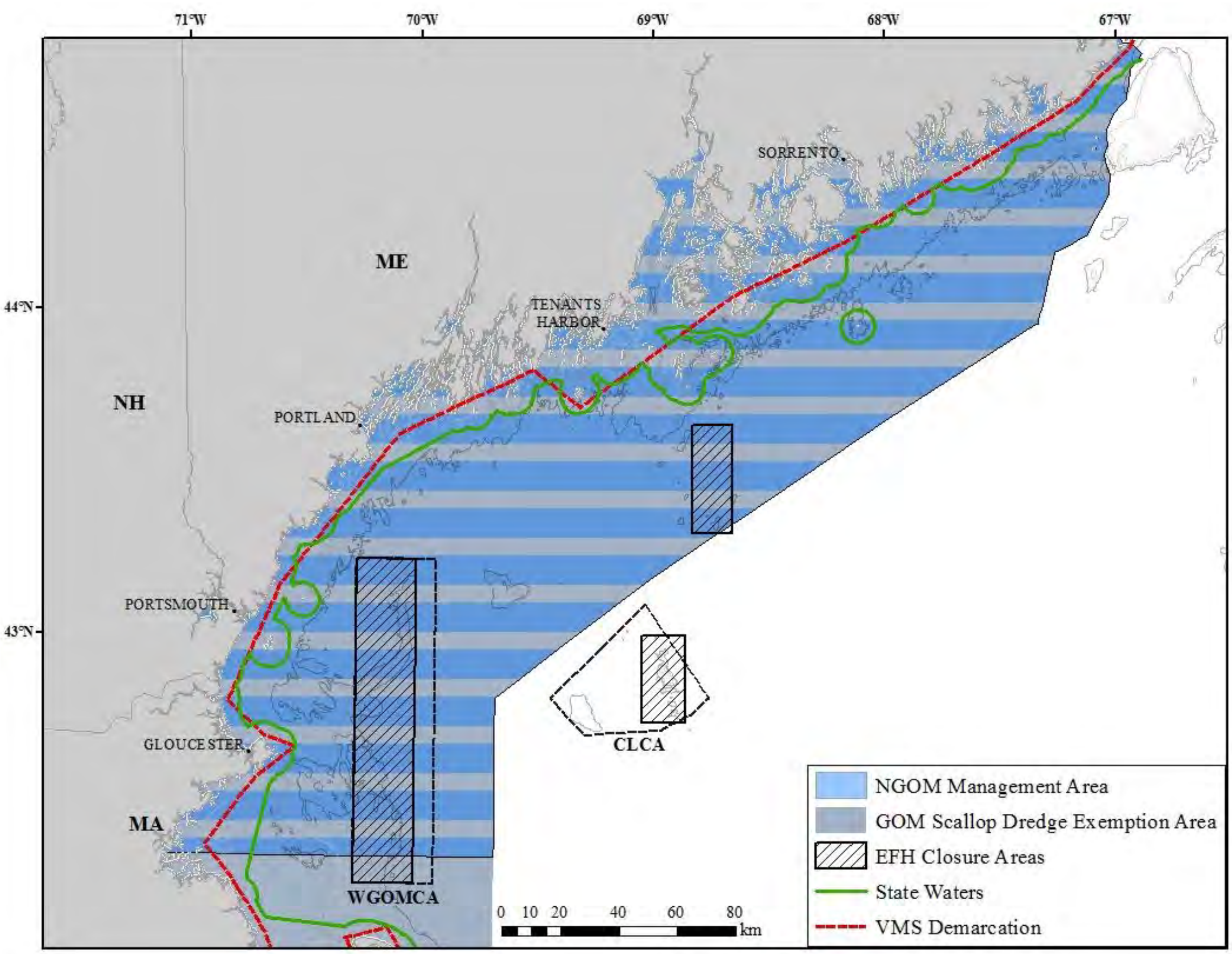
Permit Type	Harvest Limits	Vessel level allocation?	Form of allocation
Limited Access	94.5% of annual projected landing, after set-asides and incidental catch removed	Yes	DAS and access area trips
LAGC IFQ (Cat. A)	5.5% of annual projected landing, after set-asides and incidental catch removed	Yes	IFQ pounds; set # AA trips at fleet level
LAGC NGOM (Cat. B)	Up to TAC for management area, not linked to annual projected landings estimate	No	Harvest in area until LAGC fleet reaches TAC
LAGC Incidental (Cat. C)	Deducted from annual projected landings before allocating to LA and LAGC IFQ	No	Harvest allowed until limit is reached

3.3.1.1 Category B – LAGC Northern Gulf of Maine Permits and Management Area

In addition to the IFQ program, Amendment 11 established a permit category and management area in the Gulf of Maine to accommodate a fleet made up of relatively small vessels, with possession limits to maintain the historical character of this fleet and provide opportunities to various participants including vessels from small communities (NEFMC, 2007 Amendment 11).[4] Traditionally this small-vessel fleet fished only seasonally for scallops in months when primary fisheries (i.e. lobster, groundfish) were slow. This pattern has continued since 2008; for example, NGOM landings have consistently increased in months where Maine lobster landings decrease further demonstrating the value of this opportunistic winter fishery. Vessels operating under NGOM permit can only fish within the bounds of the NGOM management area.

[4] For more information on the Northern Gulf of Maine Management area, see: http://s3.amazonaws.com/nefmc.org/Doc.4a-NGOM-Discussion-Document.pdf

Figure 1 - The extent of the Northern Gulf of Maine Management Area is shown in blue, and is defined as the area north of 42° 20'N latitude and within the boundaries of the Gulf of Maine Scallop Dredge Exemption Area.



LAGC IFQ vessels can operate in this area, but are required to abide by lower trips limits (200 lbs per trip vs. 600 lbs per trip in other areas), and landings count against the NGOM TAC and the vessel's IFQ.

The NGOM management program has supported general category scallop fishing in the Gulf of Maine after the transition from open access to limited access, though the majority of active permit holders and annual landings have come from LAGC NGOM vessels since FY2012 (Table 3). Table 3 describes the number of vessels with LAGC NGOM permits excluding LA vessels, and the number and percent of LAGC NGOM vessels actively fishing in the management area from FY2010-FY2015, as well as the number of active NGOM vessels by fishing year. Before FY 2013, combined annual landings by IFQ and NGOM vessels filled a small portion of the NGOM TAC, in several years landing less than 20%. A strong year class of scallops on Platts Bank in FY2013 was followed by an increased LAGC NGOM fishing effort in this area through FY2014. LAGC IFQ vessels have typically focused effort to the southern portion of the management area around Cape Ann. IFQ landings nearly doubled between FY2014 and FY2015, with LAGC IFQ vessels working on aggregations of scallops located in Ipswich Bay and to the east and southeast of Cape Ann. FY 2015 marked the first year that the NGOM TAC was reached (overage of approximately 2,500 lbs). The NGOM management program has also supported general category IFQ and NGOM fishing activity by vessels homeported in Maine, New Hampshire, and Massachusetts (Table 4). With respect to the preservation of diversity in the general category fishery, the NGOM program has supported continued and increasing scallop landings from the federal fishery by vessels homeported in states bordering the Gulf of Maine.

Table 3 - The total number of LAGC NGOM permits.

FY	NGOM (including LA)	NGOM (excluding LA)	Active NGOM	Percent Active
2010	122	94	6	6.4%
2011	103	81	4	4.9%
2012	110	70	6	8.6%
2013	97	77	11	14.3%
2014	103	76	17	22.4%
2015	90	72	20	27.8%

Table 4 - Number of trips and landings from NGOM and IFQ vessels by homeport state from FY2010 - FY2015.

	MA		ME		NH	
FY	Trips	Landings	Trips	Landings	Trips	Landings
2010-2012	120	11,168	74	7,174	69	4,645
2013	32	9,780	182	27,614	198	18,056
2014	145	13,488	150	23,425	259	20,929
2015	335	39,443	100	10,114	273	23,219

4.0 EVALUATION OF THE LAGC IFQ PROGRAM

4.1 INTRODUCTION AND SUMMARY

This report provides an assessment of the economic and social performance of the limited access general category (LAGC) IFQ fishery for the six years since the implementation of the LAGC IFQ program in the 2010 fishing year, excluding the limited access vessels that also have an LAGC IFQ permit. In explaining the trends in the economic variables, the impacts of the factors that are external to the functioning of the LAGC fishery, such as changes in scallop resource conditions and prices, were distinguished from factors that were the results of the IFQ program itself, such as leasing or permanent transfers of quota from one vessel to another.

The fluctuations in landings and revenues for the LAGC IFQ fishery since 2010 were mainly due to the reasons external to the functioning of this fishery. The increase in IFQ allocations and the resulting increase in landings, coupled with a rise in ex-vessel scallop prices to over $10 per pound since 2011, led to a 50% increase in total LAGC IFQ fleet revenue in the 2011 and to a 47% increase in 2015 (Figure 8 and Figure 9). Scallop revenue rose from $20.8 million in 2010 to $30.6 million in 2015, a 47% increase since 2010. Real ex-vessel scallop prices increased by 36% in the same year compared to the 2010 fishing year. The LAGC IFQ fishery has very small impacts on the overall price of scallops, however, the analyses indicate that the IFQ program resulted in an increase in the estimated price premium for this fishery ranging from 13 to 32 cents per pound according to the predicted prices (Section 4.3.2.1).

The decline in the number of active vessels and affiliations in the LAGC fishery were, however, directly related to the economic incentives created by the opportunity to transfer quota as a result of the LAGC IFQ program. An affiliation represents IFQ LAGC permit holders who have joint ownership of IFQ permits based on the definition of Small Business Administration (SBA) [5]. Affiliations include permit banks and cooperatives such as the Maine Permit Bank Program (MPBP), The Cape Cod Community Hook Fishermen's Association (CCCHFA), and Lower Cape Cod Community Development Corporation (LCCDC), with each permit bank or co-op considered as one 'affiliation'. Active affiliations are those who own at least one active vessel that participates in the scallop fishery as well as those who own CPH permits and vessels that operate in other fisheries while leasing out to or using their quota on active vessels in the IFQ fishery. On the other hand inactive affiliations include those with active vessels in other fisheries as well as those without any fishing activity, that is, those own CPH permits (Section 4.2.3).

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[5] According to the Small Business Administration (SBA), entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. For example if individual A and B own permit 1, individuals B and C own permit 2, and individuals C and D own permit 3, these three individuals are considered to form an affiliation. This approach takes into account that the interests of the joint owners could be, at the least, indirectly related through those interactions arising from joint ownership combinations of those 3 vessels. SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists (https://www.law.cornell.edu/cfr/text/13/121.103).

Those affiliations with allocations relatively too small to generate economic profits after covering for the trip costs, as well as the maintenance, insurance, labor, and other fixed costs from operating a vessel resorted to either leasing their IFQ or selling their shares permanently to other affiliations. On the other hand, affiliations with higher allocations of IFQ found it more profitable to increase their share of landings by leasing or buying quota from others in addition to using their own allocations to target scallops as their prime fishing activity. As a result, the number of active vessels declined from 151 in 2010 to 128 in 2015, and the number of active affiliations declined from 127 in 2010 to 102 in the 2015 fishing year. This trend indicates that some of the excess capacity in the LAGC fishery decreased since 2010. The number of IFQ permits in CPH increased from 62 in 2010 to 101 in 2015, and those that are active in other fisheries but do not participate in the scallop IFQ fishery declined from 117 in 2010 to 84 in 2015. The number of inactive affiliations declined from 106 in 2010 to 90 in 2015, but permits owned by those affiliations increased from 121 in 2010 to 132 in the 2015 fishing year, indicating that there has been some movement of quota from active owners to inactive affiliations. The majority of the IFQ affiliations earned their income from leasing out their entire quota (Section 4.2.3.2).

The permanent transfers of quota by vessels surged in 2012 to over 50 from about 10 in the 2010 fishing year as the LAGC IFQ allocations and the scallop ex-vessel prices increased fueling the demand for scallop IFQ (Section 4.3.4.1). However, leasing activity was more prevalent than permanent transfers of IFQ. The number of lease transactions almost doubled, from 195 in 2010 to 350 in 2015, because of several factors, including the increase in scallop ex-vessel prices in overall IFQ quota (by 25% in 2011 from 2010 levels), an increase in the possession limit from 400 lb. to 600 lb., and the increase in the maximum quota one general category vessel can fish from 2% to 2.5% with the implementation of Amendment 15 in July 2011. The majority of the lease transactions took place between different owners (Section 4.3.4.2). Permit-banks leased out about 15% of the leasing that took place during 2010-2015, although these proportions varied slightly each year (Figure 32, Section 4.3.4.2)). As a result, the lease prices per pound of scallops more than doubled in 2015 compared to the values in 2010, including lease prices offered by the permit banks, and quota prices almost tripled in the same period (Figure 30). On the other hand, there has been a decline in the ratio of the lease prices to quota prices in the same period from 13% in the 2010 fishing year to about 11% in the 2015 fishing year, implying that perceived uncertainties about future returns might have been decreased slightly during this period (Figure 31).

Section 4.3.2 analyzed changes in landings, revenues, and net economic benefits with the IFQ program in comparison to the three years before implementation, as suggested in the NOAA Fisheries' Guidelines for Conducting Review of Catch Share Programs[6]. During 2010-2015, both the aggregate productivity and the producer surplus for the LAGC IFQ fishery was greater than the baseline time period of 2007-2009. The results of scenario analyses showed that estimated net benefits under the IFQ program as measured by producer surplus would be 16% to 22% higher during 2010-2015 compared to a scenario if the reduced TAC were shared among a larger

[6] http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf

number of participants with no flexibility for leasing or transferring quota. As indicated in Section 4.3.2.5.2, productivity is a component of profitability. The estimates of total factor productivity (TFP) was measured by the ratio of aggregate outputs to aggregate inputs, or LOWE index. According to the results of this analysis, productivity was estimated to be 12% or 34% greater than the baseline time period. The scenario analysis also showed that profits would be higher with the IFQ program. These results are not surprising given that the IFQ program helped to optimize profits in the LAGC fishery by providing the opportunity for IFQ permits holders to transfer their allocations through leasing or sale of quota to those owners, either with more efficient operations or financial resources to buy/lease quota from others to lower their fishing costs per unit of production by targeting scallops.

The analyses of the trends in net scallop revenue and profits during the implementation period of 2010-2015 support the same conclusions (Section 4.3.3). The percentage increase in net fleet revenue and producer surplus since the 2010 fishing year exceeded the increase in gross revenue due to the decline in fuel prices by 10%, increase in the possession limit to 600 lb.in 2011 as well as to the concentration of effort in a smaller number of possibly more efficient vessels (Figure 24, Section 4.3.3.1). There has been an increasing trend in both profits and profit margins in the period 2010-2015 for the same reasons discussed above (Section 4.3.4.5). In short, the economic analyses provided in Section 4.3, both relative to a baseline period of three years (2007-2009) before implementation of the IFQ program as well as since 2010, show that the impacts on net national benefits as measured by producer surplus were positive. Increased productivity and concentration of effort in fewer vessels and affiliations resulted in higher profits from the baseline period as well as compared to the 2010 fishing year levels.

The results of Section 4.3.5 indicate that the increase in overall DAS combined with a slight increase in the average number of crew employed per active vessel led to a rise in employment by 15% in 2015 as measured by CREW*DAS (Table 16). However, an increase in average number of crew per vessel does not necessarily indicate an increase in the numbers of unique people employed in the fishery since the same crew members could be working on different boats. Increase in total crew income was less, about 5%, due to the decline in estimated crew income per DAS from $528 in 2010 to $481 per day-at-sea, or by about 9% in 2015, assuming that crew paid the leasing costs. On the other hand, if crew paid half of lease costs, income per crew per DAS would have increased from $583 per-at-sea in 2010 to $670 in 2015, which is a 15% increase.

The distributional impacts of the IFQ program were not uniform since some vessels were prevented from access to the general category fishery while those vessels that qualified for the permit benefited with the implementation of Amendment 11. Profits per affiliation are estimated to be higher for active owners who participate in the fishery mainly to target scallops and lease-in quota from others (Section 4.3.4.5). While aggregate accounting profits for the active affiliations more than doubled during 2010-2015, profits per owner almost tripled in 2015 compared to levels in 2010 (Section 4.3.4.5.4) due to the decline in active affiliations with consolidation. Profits of inactive affiliations consist of revenue from leasing. Profit per inactive affiliation almost quadrupled in the same period, both as a result of increase in leased pounds and a doubling of lease period in 2015 compared to the 2010 fishing year.

Section 4.4 provides detailed analyses addressing the distributional impacts and the impacts of the program on fleet diversity and market concentration. Although the LAGC IFQ fleet is diverse with various vessels participating at different levels, landings were still highly concentrated among the top 25% of active affiliations (Section 4.4.2.5). About 32 affiliations in this group landed about 63% of total scallop landings in the LAGC IFQ fishery in the 2010 fishing year, while the bottom 25% landed about 1% of scallop landings (Figure 76). There has been hardly any change in those percentages in 2015, although the number of affiliations in the top 25% declined to 26 in this year as result of fleet consolidation. Distribution of net scallop revenue and profits exhibited similar trends. The top 25% of the affiliations earned 65% of total LAGC IFQ fleet net revenue in 2010 and a slightly lower percentage, 64%, in 2015 (Figure 78). IFQ fleet profits were unequally distributed with over 75% of the profits going to the top 25% of the affiliations during 2010-2015. This proportion declined from 81% in 2010 to 76% of total profits in 2015 for the top 25% group as the number of affiliations in this group declined from 58 affiliations in 2010 to 48 affiliations in 2015 (Table 30). However, the top 9 affiliations in 2010 and top 8 affiliations in 2015 earned about 25% of total profits, while many affiliations in the bottom 25% quantile either left the fishery or joined other affiliations (Section 4.4.2.6). Section 4.4.2.7 presents distributional analyses based on GINI coefficients and LORENZ curves. The Gini coefficients for landings, revenues, and profits of affiliations were above 0.50, indicating that economic benefits were not distributed equally during 2010-2015. However, the trends in the GINI coefficients since 2010 indicated that there was no significant changes in the distribution landings, revenues, and profits.

The analysis of market concentration based on the Herfindahl-Hirschman index (HHI) indicated that the market for quota shares in the IFQ fishery is competitive and that caps on ownership and vessel quotas were effective in preventing excessive shares in the LAGC IFQ fishery (Section 4.4.2.8). However, concentration of quota among the active owners declined during this period, while those among inactive affiliations increased during the 2010-2015 period. These conclusions are consistent with the analyses presented in other sections, indicating that there has been more consolidation among inactive compared to active affiliations.

There have been some fluctuations in the geographical distributional of landings and leasing in the IFQ fishery since 2010. However, the majority of these changes could probably be attributed to the changes in the scallop productivity by area (Section 4.4.2.9). Section 4.4.2.10 indicated that failing to qualify for an IFQ permit did not force these vessels to dramatically alter their fishing choices.

4.2 AGGREGATE TRENDS DURING 2010-2015 FISHING YEARS

4.2.1 IFQ allocations and landings

There has been a significant increase in allocations, landings, and revenues for the LAGC IFQ fishery since the Amendment 11 implemented a limited entry program for this fishery, where each qualifying vessel received an individual allocation in pounds of scallop meat subject to a possession limit of 400 lb. up to the 2010 fishing year and 600 lb. starting with the 2011 fishing year.

The allocations for the LAGC IFQ from about 2.3 million lb. in 2010 to 2.9 million lb. in 2011, or by 25%, and to 3.1 million lb. in 2012, or by 33%, compared to the 2010 level as the improved scallop resource conditions led to an increase in scallop ABC increasing allocations for both LA and LAGC IFQ fisheries (Figure 2 and Figure 3). As a result, scallop landings for the LAGC IFQ fishery increased from about 2.2 million lb. in 2010 to over 3 million lb., or by 30% in 2012 (Figure 2 and Figure 3).

Although limited access landings increased in this period as well, the rate of increase was much smaller due to the method used in allocations for these fisheries (6%, Figure 4). The annual catch limits for the LA and LAGC fisheries were consistent with decisions made in Amendment 11 (94.5% to the LA fishery and 5% to the LAGC IFQ fishery and 0.5% to the LA vessels with IFQ permits). However, under the ACL structure, the LA fishery allocations (DAS and allocations in access areas) were constrained by the available biomass from areas that are open only, while the LAGC fishery allocation is based on available biomass from all areas. Due to this disconnect between the catch limits and fishery allocations, the share of the LAGC IFQ fishery in total landings was about 4% in 2010, but went up to 5% in 2011 and 2012 and surpassed 5% of scallop landings in the 2013- 2015 fishing years (6% in 2013, 7% in 2014-2015, Figure 5).

The rate of quota usage in the IFQ fishery was about 95% in 2010-2011, and it went below 88% in 2012 as Amendment 15 allowed an IFQ permit holder to carry forward up to 15% of their IFQ to the proceeding fishing year. Carry-over quota by active IFQ permit holders increased since 2011 with the implementation of Amendment 15 in July 2011 (Figure 7). Both the allocations of scallop landings went down in 2014 due to the relatively poor resource conditions, especially in areas LAGC IFQ vessels access (Figure 3). There was an increase in IFQ allocations in 2015 compared to 2013-2014, however, quota usage went down to 82% in this year both due to the unfavorable resource conditions, especially in some inshore areas, and also availability of carry-over quota from previous years (Figure 5). Still, LAGC IFQ fishery landings increased in this year compared to both 2010 and 2013-2014, whereas scallop landings by LA fishery declined considerably in 2015 (Figure 4).

Therefore, the changes in scallop landings of the IFQ fishery were mainly due to the allocation method, changes in scallop ABC, and resource productivity during 2010-2015 fishing years, rather than the result of the IFQ program itself. This system was in place until recently but revised with Framework 28. Under the new spatial management system, the LAGC IFQ component would receive 5.5% of the projected landings after set-asides (RSA and observer) and incidental landings are accounted. The impacts of this system remain to be seen in the upcoming years.

Figure 2. LAGC IFQ allocations and scallop landings by IFQ and LA fisheries (lb.)

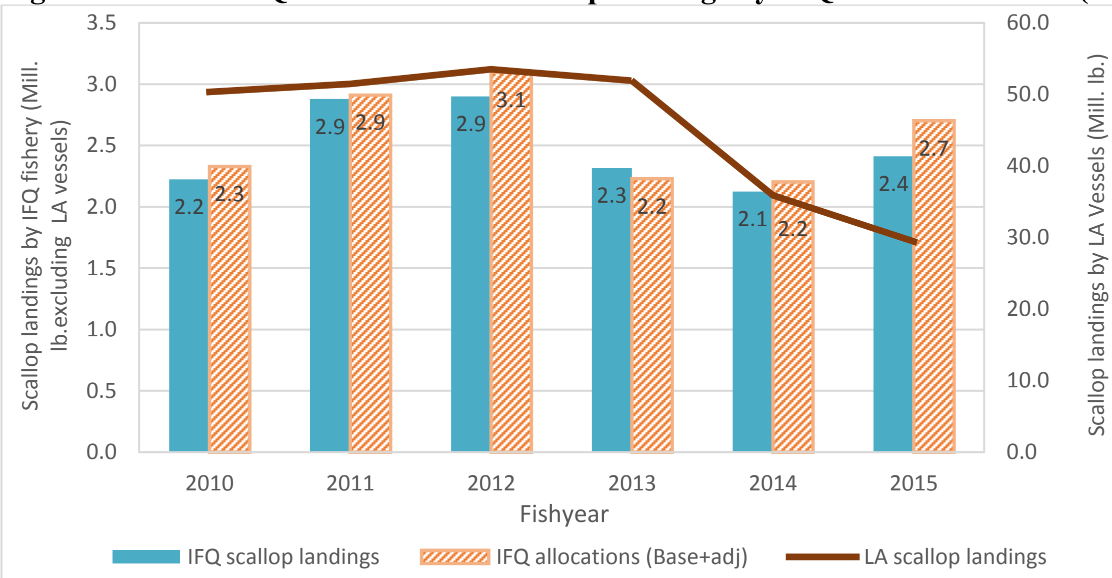


Figure 3. Percentage change in landings and allocations from 2010 values

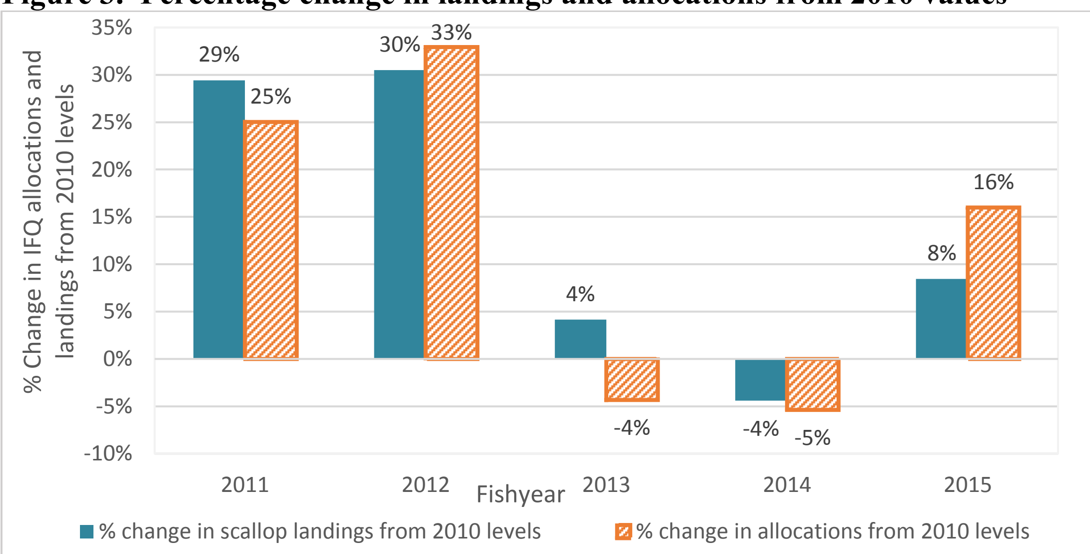


Figure 4. Percentage change scallop landings of IFQ and LA fisheries from 2010 levels

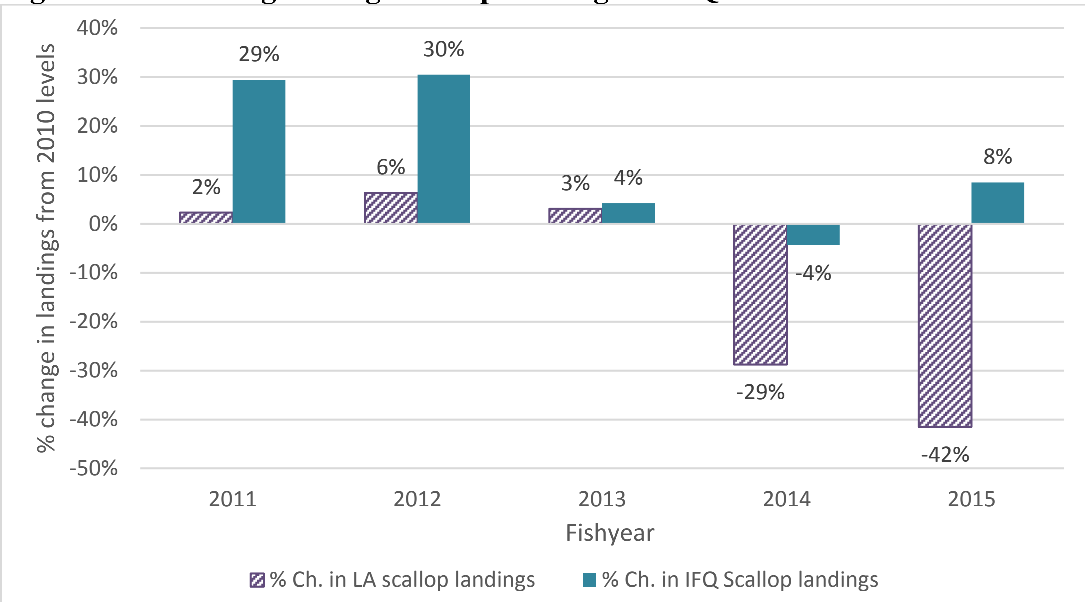


Figure 5. LAGC IFQ landings as a percentage of total allocations and scallop landings

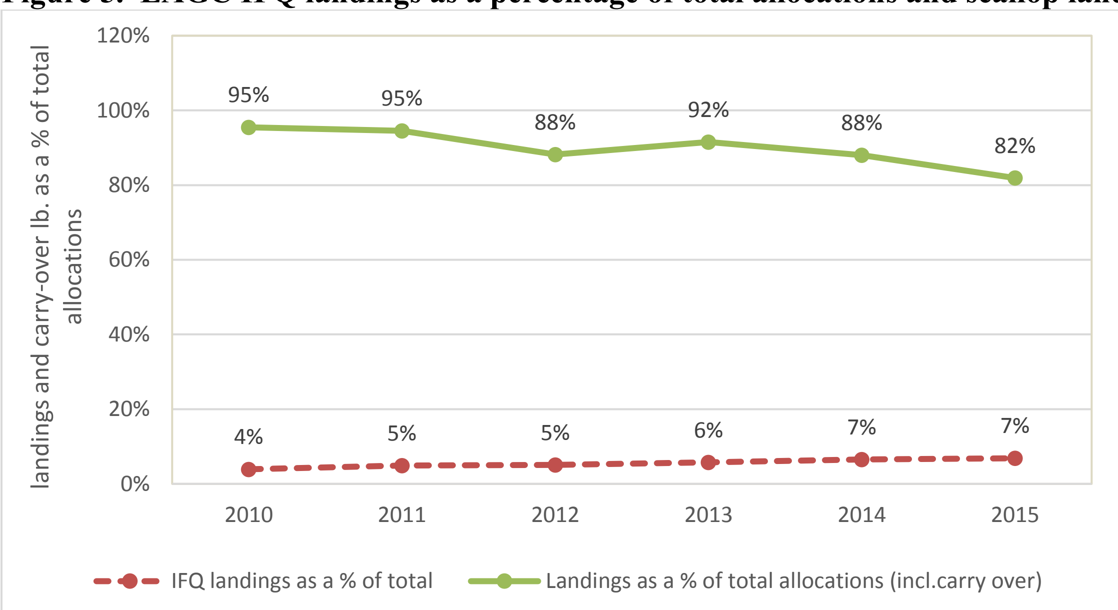


Figure 6. Percentage change in Scallop revenues for IFQ and LA fisheries from 2010 levels

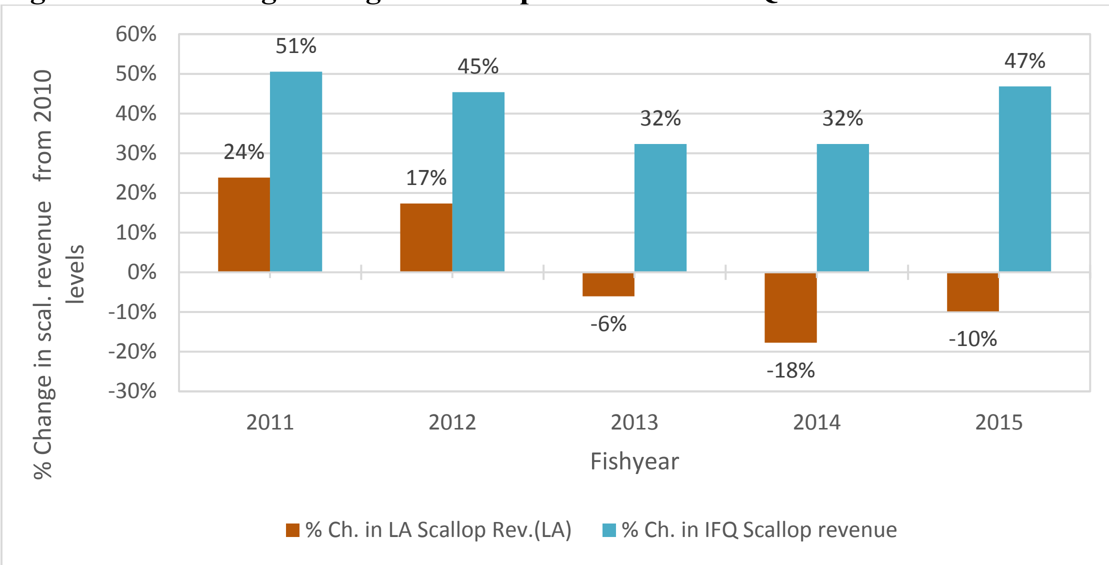
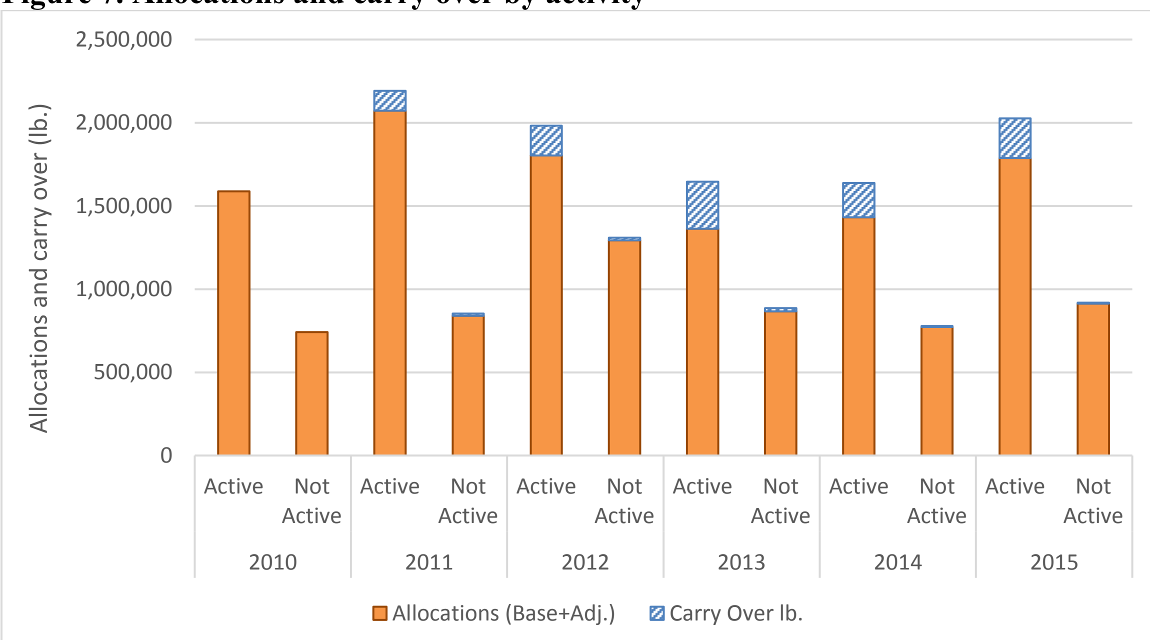


Figure 7. Allocations and carry over by activity



4.2.2 Comparative trends in scallop revenue for IFQ and LA fisheries (2010-2015)

The increase in landings, coupled with a rise in ex-vessel scallop prices to over $10 per pound since 2011, led to a 50% increase in total LAGC IFQ fleet revenue in the 2011 and to a 47% increase in 2015 (Figure 8 and Figure 9). Scallop revenue rose from $20.8 million in 2010 to $30.6 million in 2015, a 47% since 2010 (Figure 8, in 2015 dollars). Real ex-vessel scallop prices increased by 36% in the same year compared to the 2010 fishing year. Average ex-vessel price received by the LAGC IFQ fishermen exceeded the overall average ex-vessel price of scallops due to better quality and freshness of scallops from day trips. The IFQ program may also have been a factor in the increase of price premium for this fishery since the implementation in 2010 (Section 4.3.2.1). In comparison, scallop revenue for the LA fishery declined in 2015 compared to 2010 mainly due to lower landings for this fishery (Figure 10). There could be several reasons for this result, including the management system that allocated about 7% of total projected landings to the IFQ fishery. In addition, the differences in the ways those two fisheries are regulated could have impacts on their catch. The LA fishery is subject to DAS controls in the open areas and trip restrictions in the access areas, while the IFQ fishery is limited to 600 pounds per DAS but has the flexibility to fish the entire quota in open areas.

Figure 8. LAGC IFQ total scallop fleet revenue and ex-vessel scallop price (in 2015 dollars)

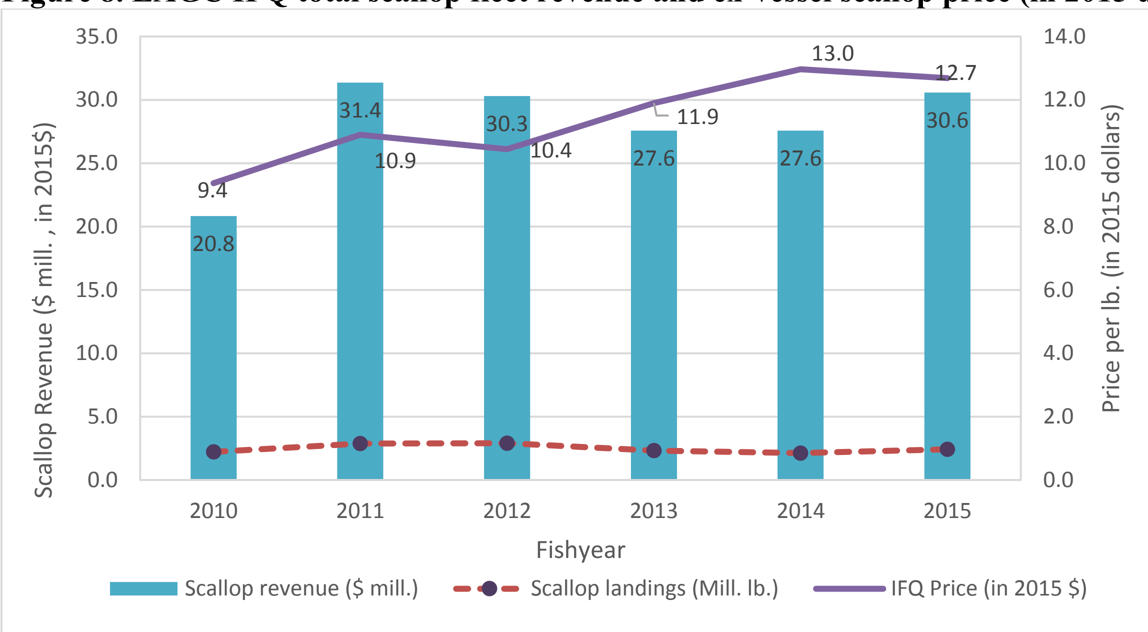


Figure 9. Percentage change in landings and scallop revenue from 2010 values

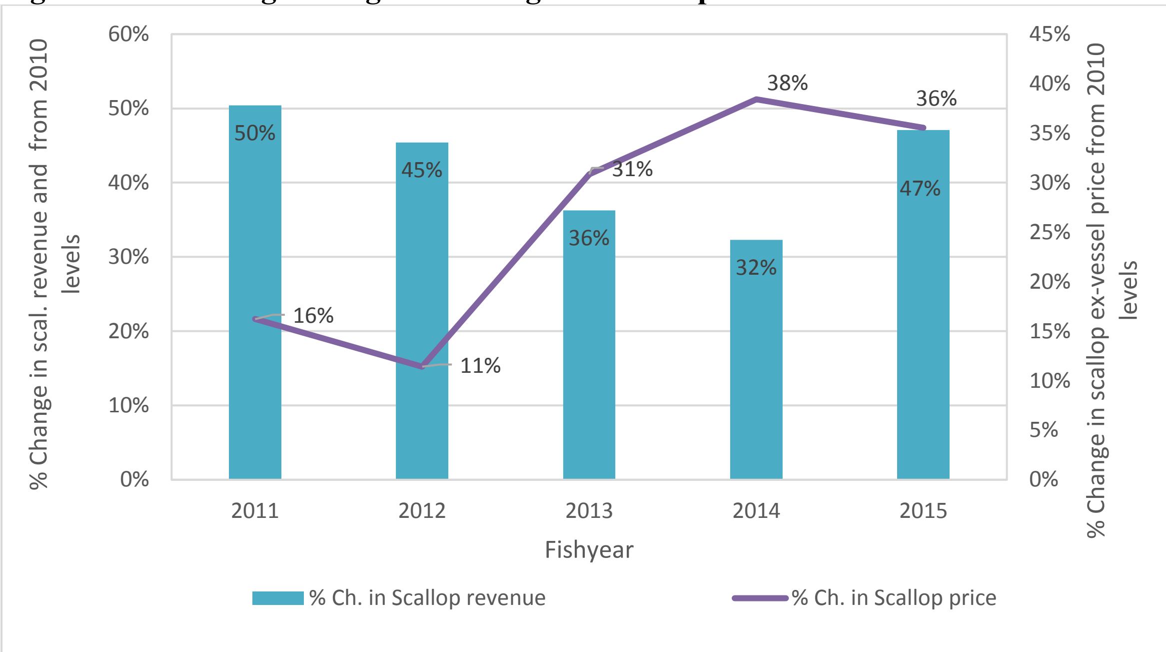
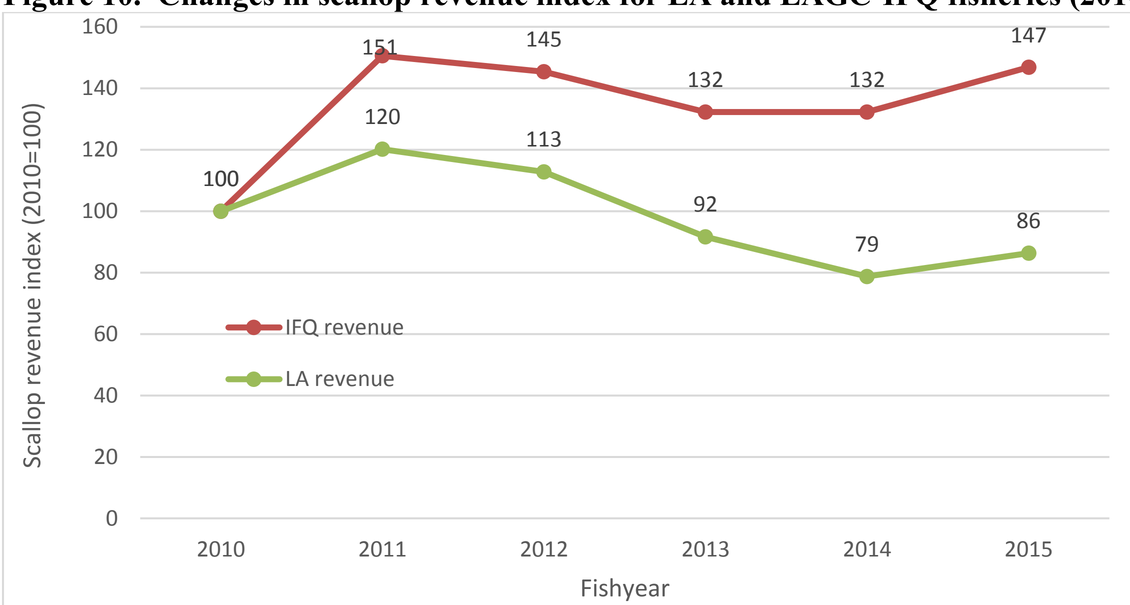


Figure 10. Changes in scallop revenue index for LA and LAGC-IFQ fisheries (2010=100)



4.2.3 Permits and affiliations

4.2.3.1 Permits, landings, and quota by vessels

The changes in effort and activity since the implementation of Amendment 11 in the 2010 fishing year is evaluated in terms of active permits and permits in CPH. However, not every vessel with an active IFQ permit participated in the scallop fishery. An active vessel is defined as a vessel that landed any amount of scallops under a limited access general category IFQ permit, excluding those limited access (LA) vessels that also have an LAGC IFQ permit.

There has been a relatively small decline in the total number of permits in this fishery from 331 in 2010 to 313 in 2015, including the active permits and permits in CPH. The numbers in Figure 11 and Figure 12 are by moratorium ID (MRI), so they exclude the number of permits for the replacement vessels in order to capture the totality of activity for each active unit at a given point in time. Those numbers also include permits in CPH as of the beginning of each fishing year starting in 2010. All of these permits, except for a few active vessels included in Figure 11 and Figure 12, had an IFQ allocation at the beginning of the year. There has been a noticeable change, however, in the composition of permits due to the decline in the number for active vessels from 152 in 2010 to 128 in 2015 and an increase in the number of permits in CPH from 63 in 2010 to 101 in the 2015 fishing year (Figure 12).

There was also a decline in the number of active permits that did not participate in the scallop fishery, from 117 in 2010 to 84 in 2015. It is evident that the majority of these 33 active permits were transferred to the CPH category by 2015 given that the number of CPH permits increased by 38 in 2015 compared to the numbers in 2010. Those permit holders that are not active in the fishery, 84 in 2015, included those that lease-out their quota as well as permits that were not involved in any leasing activity, some of which probably transferred their quota during the course of each fishing year or carried over their allocations to the future years. Those who leased out their quota included the permits in CPH as well as those active IFQ permit holders. The share of those permit holders in CPH in total leased out pounds increased from 43% in 2010 to 55% in 2015, and the share of IFQ permit holders that did not land any scallops declined from 49% in 2010 to 25% in 2015 (Figure 13). There has been also some leasing out with active vessels in the fishery comprising 8% of total leased out pounds in 2010 and 20% in 2015. It is more likely that those pounds were leased out to other active vessels in the same affiliation as will be examined in Section 4.3.4.

The share of active vessels in total IFQ allocation was a about 54% in 2015, up slightly from 52% in 2010, while the share of permits in CPH in total IFQ allocation increased from 23% in 2010 to 30% in 2015 and the share of active permit holders that do not participate in the scallop fishery declined from 25% to 16% in the same years (**Figure 14**). Distribution of allocation among owners is different from these numbers because some of the inactive vessels and permits in CPH are owned by active affiliations who consolidated their IFQ on one or more vessels to fish for scallops. The next section evaluates these trends in terms of affiliations.

Figure 11. Number of permits and affiliations

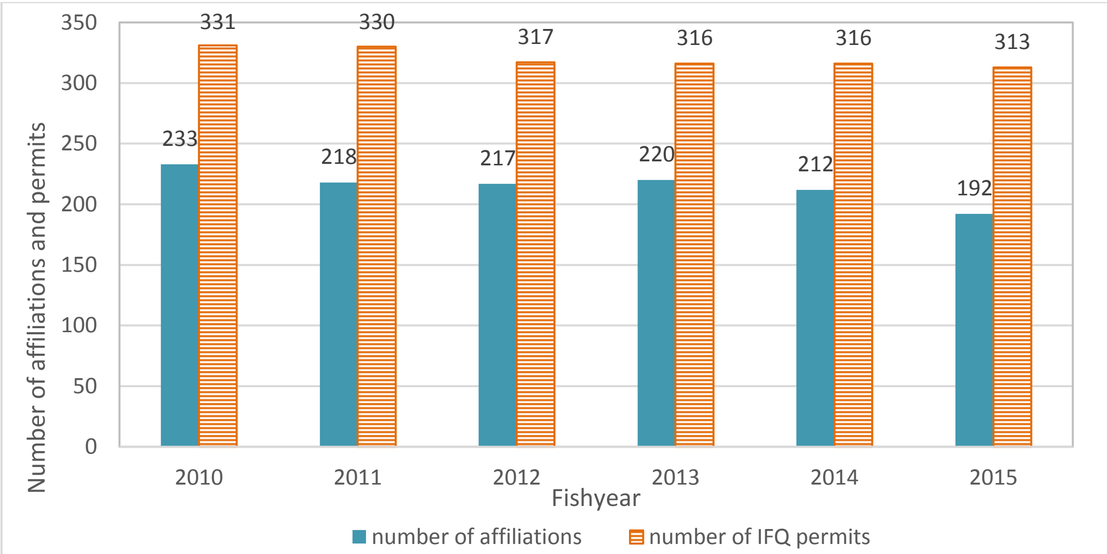


Figure 12. Number permits by activity status by fishing year

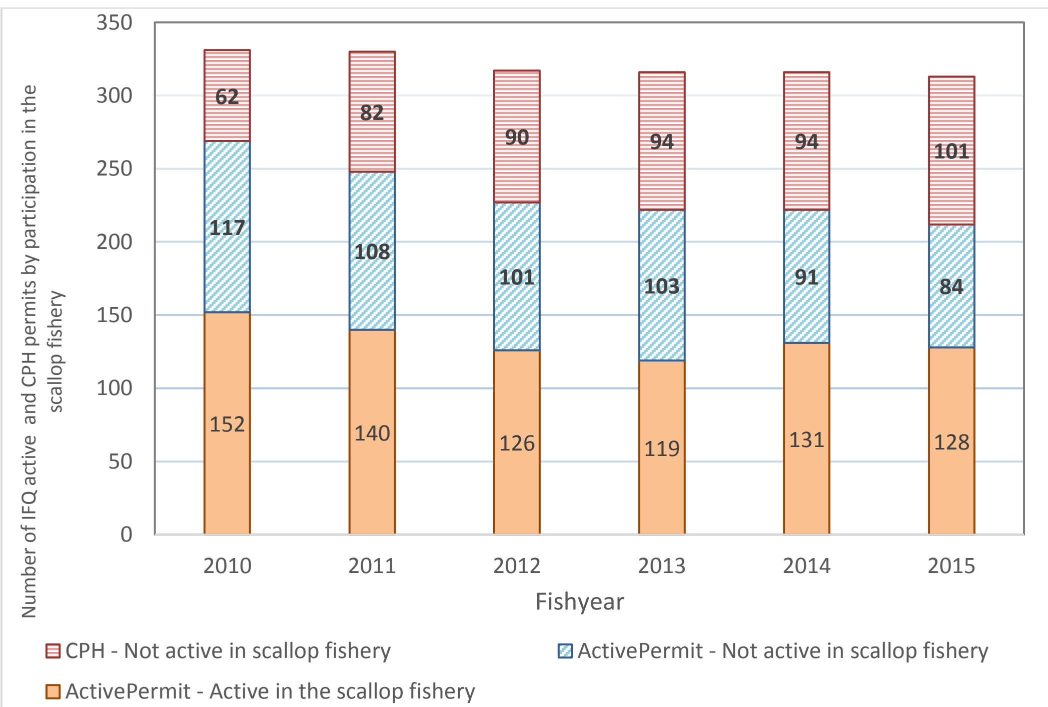


Figure 13. Leasing-out pounds as a percentage of total leasing by permit status

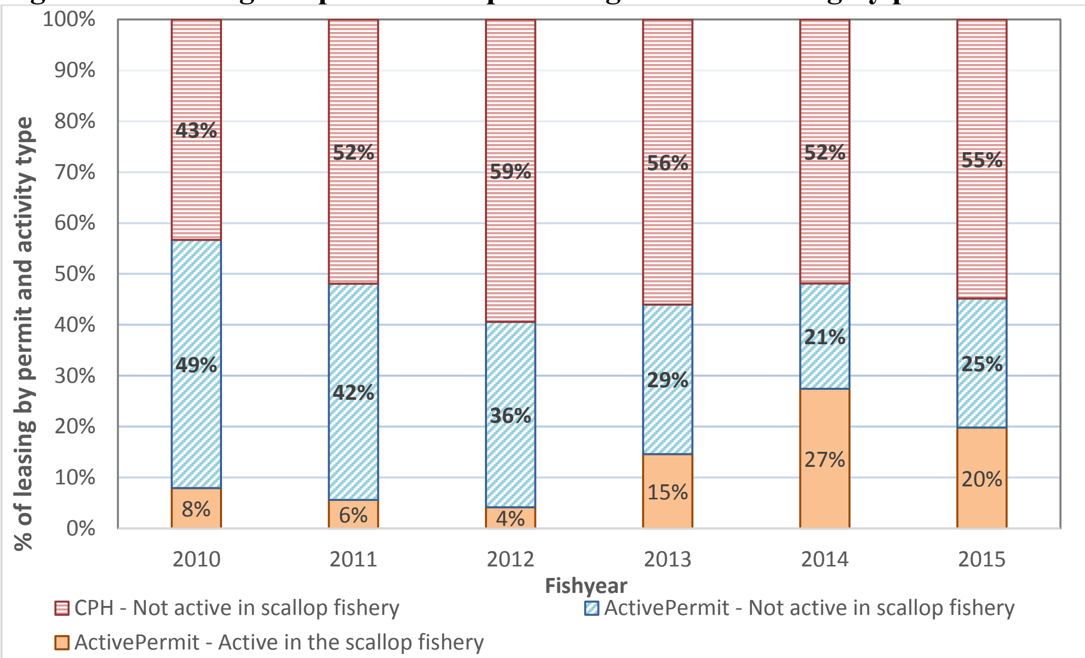
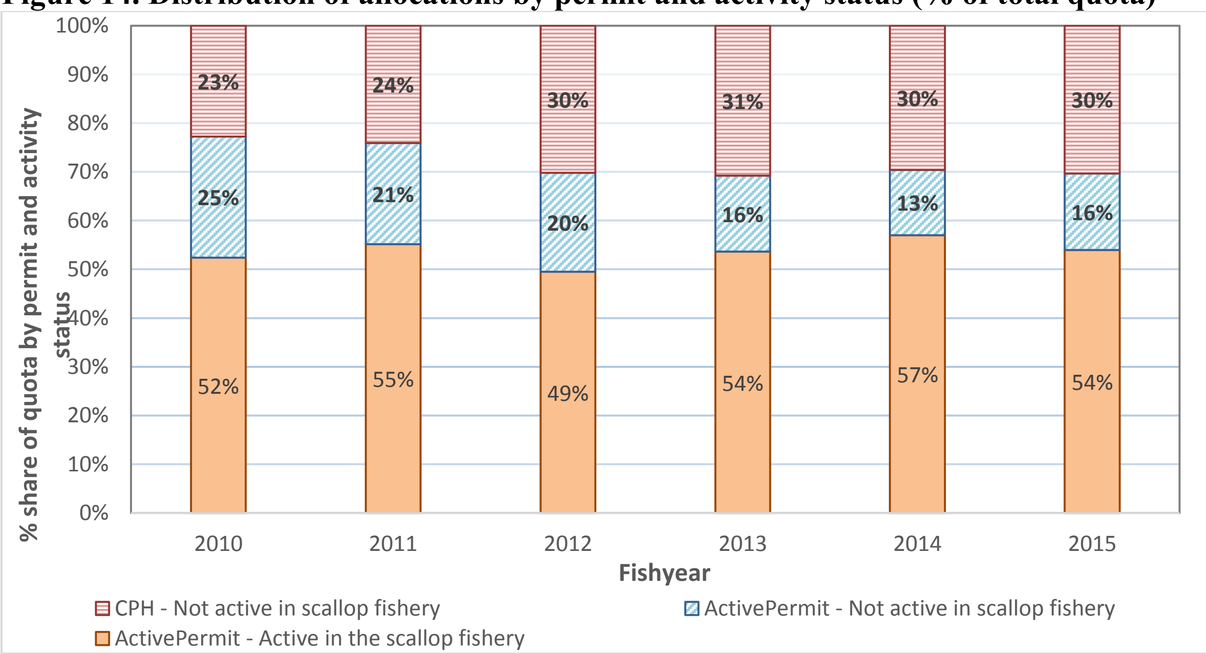


Figure 14. Distribution of allocations by permit and activity status (% of total quota)



4.2.3.2 Affiliations and distribution of landings and quota by activity

This report uses the term 'owner' interchangeably with the term 'affiliations' except as specified otherwise. According to the ownership data, almost every vessel and permit holder in the scallop fishery has multiple owners, and some owners of a particular vessel have ownership interest in other vessels with different individuals. In order to identify affiliations of individual owners, this report employed a very broad definition of ownership using a "Group ID." For example if individual A and B own permit 1, individuals B and C own permit 2, and individuals C and D own permit 3, all three permits were assigned to the same Group ID. Therefore, this approach takes into account that the interests of these 4 owners could be, at the least, indirectly related through those interactions arising from joint ownership combinations of those 3 vessels.

Affiliations include permit banks and cooperatives such as the Maine Permit Bank Program (MPBP), The Cape Cod Community Hook Fishermen's Association (CCCHFA), and Lower Cape Cod Community Development Corporation (LCCDC), with each permit bank or co-op considered as one 'affiliation'. There has been about 5 permit banks operating in the LAGC IFQ fishery. Those permit banks owned about 10% of the overall quota in 2010 and about 8% of the quota in 2015.

The number of affiliations in the LAGC IFQ fishery declined from 233 in 2010 to 192 in the 2015 fishing year as quota was consolidated in fewer owners since the implementation of the LAGC IFQ program in the 2010 fishing year through quota transfers. There has been a decline in the number of both inactive and active affiliations. Active affiliations are those who own at least one active vessel that participates in the scallop fishery as well as CPH permits and vessels that operate in other fisheries while leasing out to or using their quota on active vessels in the IFQ fishery. The number of active affiliations declined from 127 in 2010 to 102 in 2015 alongside with the permits and vessels owned by them (Figure 15). In 2010, active affiliations owned 152 vessels that landed scallops and 58 permits that did not participate in the fishery. In 2015, the number of active vessels owned by active affiliations declined to 128, and inactive permits or vessels owned by the same affiliations decreased to 53. Unfortunately, due to the lack of reliable ownership data prior to 2010, these analyses could not be extended to the period before the implementation of Amendment 11.

Figure 15. Number of affiliations and permits by activity status by fishing year

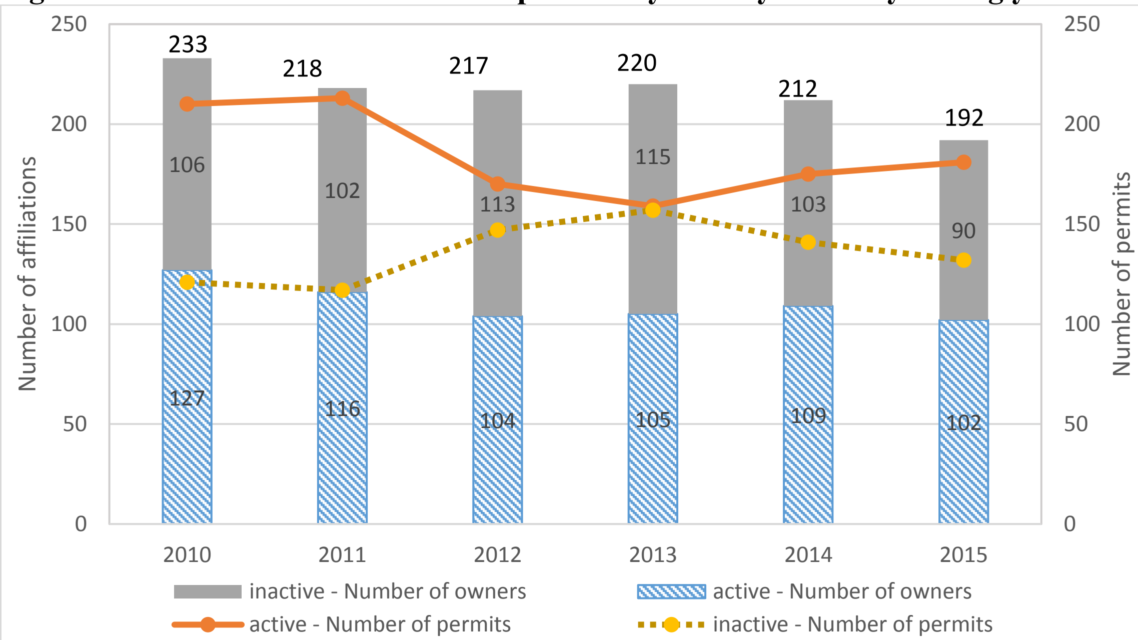
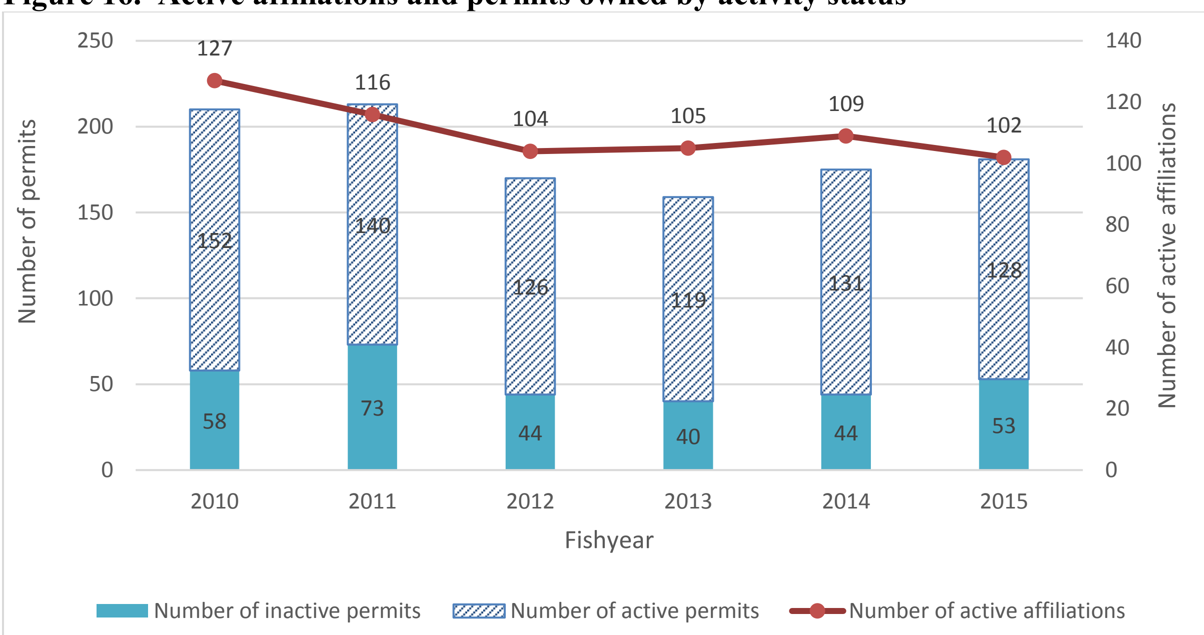


Figure 16. Active affiliations and permits owned by activity status

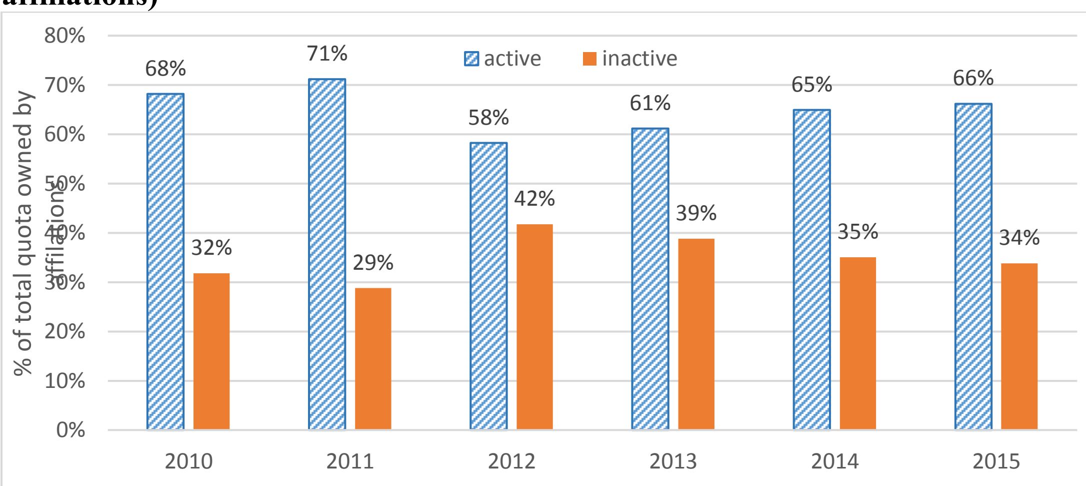


However, trends for permits (CPH or active) owned by inactive affiliations were different. The number of inactive affiliations declined from 106 in 2010 to 90 in 2015, but permits owned by those affiliations increased from 121 in 2010 to 132 in the 2015 fishing year, indicating that there has been some movement of quota from active owners to inactive affiliations (Figure 14). As

Figure 16 shows, the share of inactive affiliations in total quota increased slightly from 32% in 2010 to 34% in 2015, and the share of active affiliations declined from 68% to 66% in the same period. The share of active affiliations is greater than the share of active vessels (54% in 2015) in total IFQ allocation because active owners also own inactive vessels and use their allocation to fish for scallops (Figure 13 and Figure 15). However, both the number of permits owned by inactive affiliations and their share of overall quota declined in 2014 and 2015 compared to the levels in 2012 and 2013 (Figure 14). This may be due to higher demand for quota by the active affiliations as total allocations declined and scallop prices increased in those later years. This is consistent with the increase in the number of active and CPH permits held by active affiliations in 2014 and 2015 compared to the previous fishing years (Figure 15).

The opportunity to lease out and transfer quota to other affiliations was the main factor that made consolidation possible among fewer affiliations. The majority of those affiliations (over 95%) that do not participate in the fishery lease out their shares to active affiliations, while others carry over their quota to the future years or could not lease-out at the prices they preferred (Figure 25). The number of affiliations that were net leasers of quota varied from 98 in 2010 to 103 in 2013, and declined to 87 in 2015. This decline was mainly due to the overall reduction in the number of affiliations in this period (Figure 11). Leasing activity, gross and net revenues, profits, and distribution of income by affiliations are analyzed in Section 3.3.7, Section 3.3.8 and Section 3.3.10 below.

Figure 17. Distribution of quota by activity status (including active and inactive affiliations)



4.2.4 Vessel characteristics and trends in comparison to the LA fleet

Overall, active LAGC IFQ vessels were smaller compared to limited access vessels (Table 5, Table 6). Along with the number of active vessels in the fleet, the average HP, GRT, and vessel length of active LAGC IFQ vessels fluctuated annually from FY2010 to FY2015 (Table 5). Because fishing power (i.e. HP, GRT, and vessel length) varied annually at the individual vessel level, an index was used to describe trends in capacity across the entire fleet. The fleet capacity index is defined here as the weighted average HP, GRT, and vessel length by the total number of active vessels for each year in comparison to values from FY2010.

Figure 18 shows index values in relation to annual scallop landings of LAGC IFQ vessels from FY2010 to FY2015. From FY2010 to FY2015, fleet capacity decreased by 33.2%, suggesting that active vessels were decreasing in HP, GRT, and vessel length during this time period. However, this decrease in fleet capacity was not directly correlated with a decrease in annual scallop landings; for example, from FY2010 to FY2012, fleet capacity decreased by 24.6% while scallop landings during this time increased by 30.5%. Furthermore, fleet capacity was 33.2% less in FY2015 compared to FY2010, while scallop landings were 8.5% greater in FY2015 compared to FY2010.

When compared to the fleet capacity of full-time, double dredge LA vessels (Figure 19), the reduction of LAGC IFQ fleet capacity becomes much more evident. Though trends in LA and LAGC IFQ annual landings were proportionally similar from FY2010 to FY2015, LA fleet capacity increased by 2.8% during this time while LAGC IFQ fleet capacity decreased by 33.2%. Assuming that LA and LAGC IFQ vessels were targeting a relatively similar resource during this time and that landings trends were proportional to the number and size of active vessels in each component, these findings suggest that reduction in capacity of the LAGC IFQ fleet did not severely impact annual landings. In other words, LAGC IFQ fleet capacity adjusts to the available quota.

Figure 18. LAGC IFQ fleet capacity index of average HP, GRT, and vessel length weighted by the number of active vessels. The secondary access displays annual scallop landings (lb.) from the LAGC IFQ fleet (red dashed line).

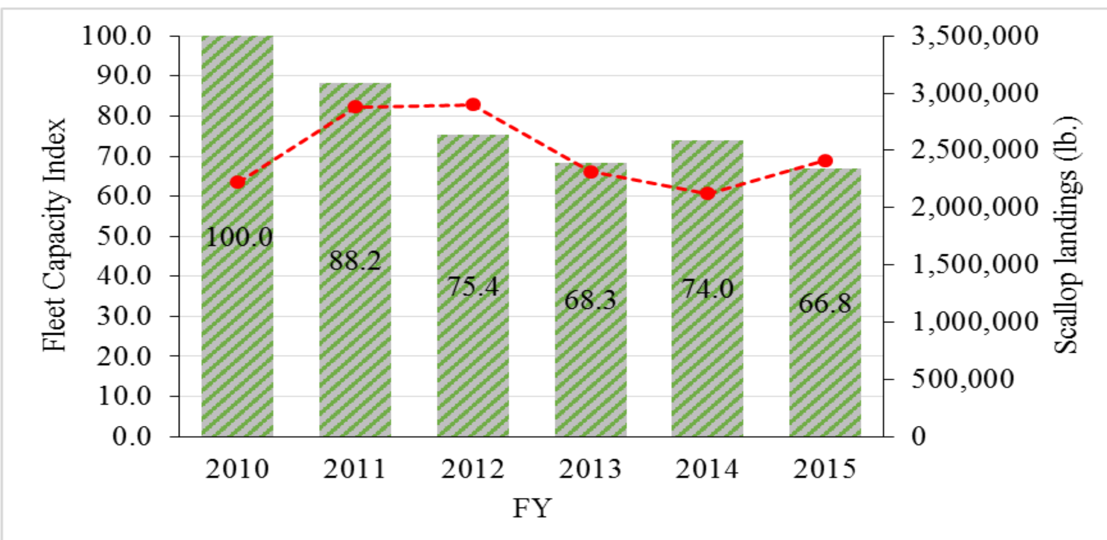


Figure 19. Full-time, double dredge LA fleet capacity index of average HP, GRT, and vessel length weighted by the number of active vessels. The secondary access displays annual scallop landings (lb.) from the full-time, double dredge LA fleet (red dashed line). Values shown exclude full-time, double dredge LA vessels that also held a LAGC IFQ permit.

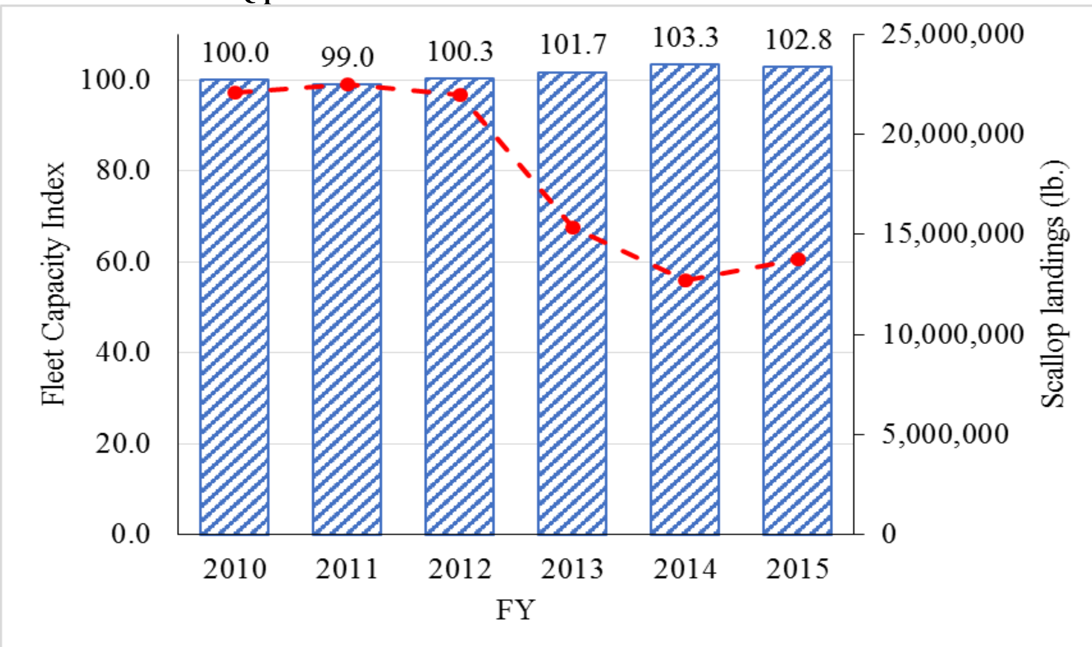


Table 5. Average GRT, HP, and length for active LAGC IFQ vessels.

FY	GRT	HP	Length
2010	64	435	58
2011	62	437	56
2012	59	445	55
2013	57	437	55
2014	57	441	54
2015	54	436	53

Table 6. Average GRT, HP, and length for active LA vessels.

FY	GRT	HP	LEN
2010	155	808	83
2011	155	808	82
2012	155	812	82
2013	156	835	82
2014	156	853	82
2015	156	852	82

4.3 ECONOMIC PERFORMANCE AND NET BENEFITS

4.3.1 Introduction

This section provides an assessment of the program's effect on net benefits to the nation mainly from an economical perspective consistent with NMFS' Economic Guidelines for conducting cost-benefit analyses[7]. The objective of the cost-benefit analysis is to evaluate the net economic benefits arising from changes in consumer and producer benefits that are expected to occur with implementation of a regulatory action. As the NMFS Guidelines for the Economic Analysis of the Fishery Management Action (NMFS, 2007) state "the proper comparison is '*with the action*' to '*without the action'* rather than to *'before and after the action,*' since certain changes may occur even without action and should not be attributed to the regulation." However, Guidelines for Conducting Review of Catch Share Programs suggests that the baseline considered for analyses of CSPs should be an appropriate number of years prior to the implementation of the CSP, and not what would have been likely to occur in the absence of the CSP. In this regard, the guidance indicates that "A baseline period of at least 3 years is preferable, but this may be modified depending on circumstances surrounding the creation and implementation of each program." [8]

However, the complexity of the measures included in Amendment 11 as well as changes in scallop prices, fuel costs, scallop stock biomass, and other factors external to this fishery make the comparison to previous years challenging. A straightforward evaluation of the costs and benefits relative to the pre-program period would not only reflect the impacts of the IFQ program, but it would also capture the effects of the reduction in overall TAC to 5% of the increase in scallop prices in general and fluctuations in annual IFQ allocations in response to changes in scallop stock biomass. Gradual implementation of some aspects of the IFQ program during the two years prior to full implementation in 2010 further compounds this issue. For these reasons, Section 4.3.2 to Section 4.3.2.4 provide a semi-quantitative discussion of the likely impacts of the IFQ program on economic benefits based on some scenario analyses holding prices, landings and costs constant to identify the economic impacts attributable to the IFQ program alone. Section 4.3.2.5 provides a multi-productivity analysis of the fishery holding prices and input costs constant at the pre-Amendment levels but including the species other than scallops as well in the calculation of outputs.

In contrast, Section 4.3.3 evaluates the changes that took place since the implementation of the CSP for the LAGC scallop fishery and identifies those impacts attributable mainly to the core aspects of the IFQ program since 2010 fishing year, including transferability and limited access. Section 4.3.6 summarizes the results of the analyses in terms of the impacts of the program on net economic benefits and profits and evaluates these changes in terms of the goals and objectives of the Amendment and FMP.

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[7] http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf, p.7

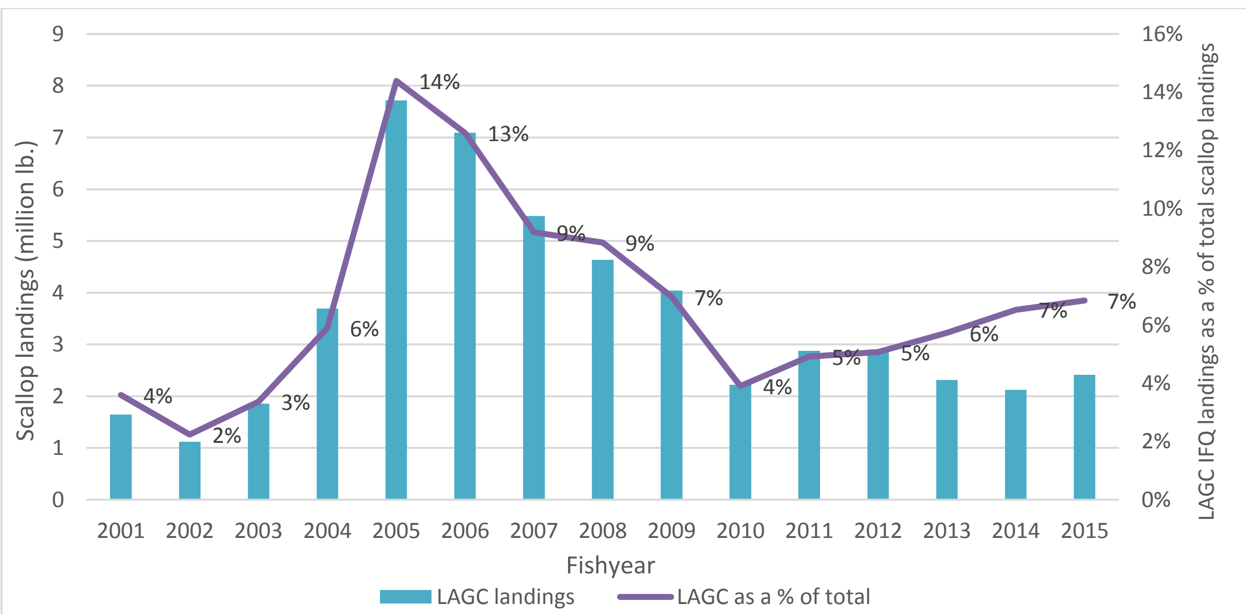
[8] http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf

However, as indicated in the NOAA Fisheries' Guidelines for Conducting Review of Catch Share Programs[9], net benefits are not exclusively economic in nature, but also include potential economic, environmental, public health and safety, and other advantages, distributive impacts, and equity (NMFS guidelines[10]). Although some of the distributional impacts of the LAGC IFQ program is evaluated in terms of changes in net revenue per active vessel and affiliation in Section 4.3.2.4 and in terms of profits per affiliation in Section 4.3.4.5.4, extensive analyses of distributive impacts are provided in Section 4.4.

4.3.2 Comparison of economic benefits to the pre-IFQ program levels

The complexity of the measures included in Amendment 11 and in the transition period of 2008-2009, as well as the adjustments made to the IFQ program in 2011 with the implementation of Amendment 15, make comparisons to previous years challenging. Amendment 11 not only created a limited access program for the LAGC scallop fishery with individual allocations for the qualifiers, it also restricted TAC of this fishery to 5% of the annual catch limit (ACL). This was considerably smaller than the share of general category fishery in the previous 6 years, which exceeded 5% since 2004, peaked at 14% of scallop landings in 2005, and remained at about 9% until the 2009 fishing year (**Figure 20**).

Figure 20. LAGC IFQ scallop landings (mill.lb.)



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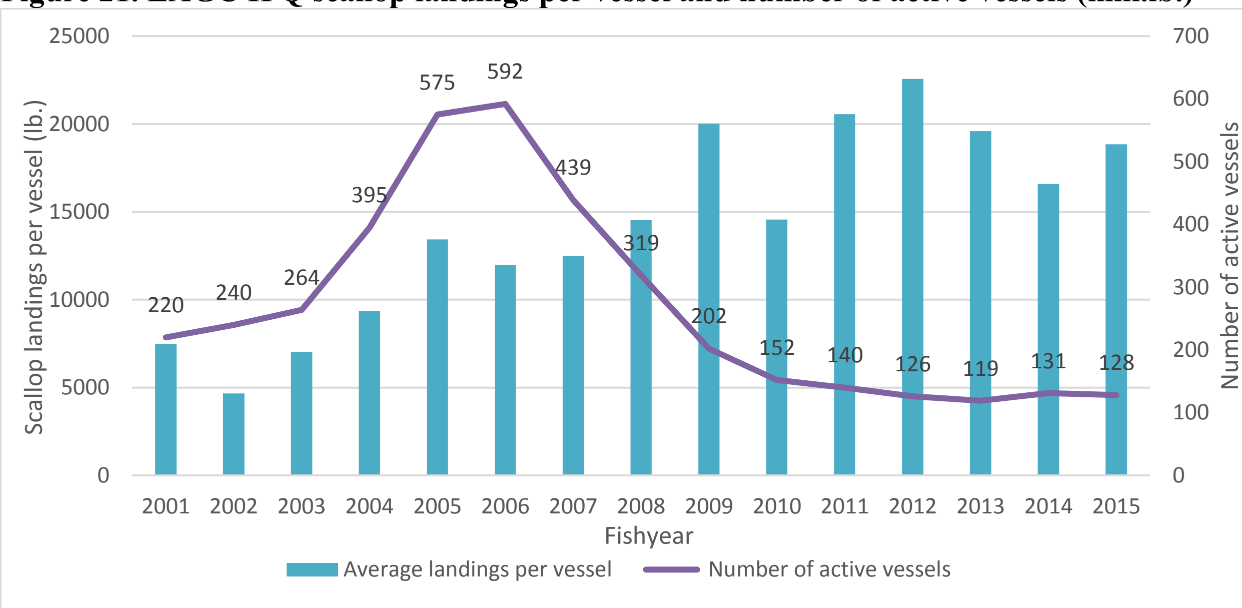
9 http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf

10 http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf, p.17

Amendment 11 became effective in the 2008 fishing year, but there was a transition period for the first two years of the program. Starting in June 1, 2008, those vessels that entered the fishery after the control date in November 1, 2004 with no history of scallop landings in the previous five years could no longer participate in the LAGC scallop fishery. However, the process of review to determine if vessels met the 1000 lb. of scallop landings qualification criteria, as well determining contribution factor for each vessel, continued for two years. As a result, the number of active vessels in the fishery declined from 439 in 2007 to 319 in 2008 and to 202 vessels in 2009 until the review was completed, and the qualifying vessels were assigned their contribution factors in 2010 (Figure 21).

Figure 21. LAGC IFQ scallop landings per vessel and number of active vessels (mill.lb.)



During the interim period, the fishery was managed under a quarterly hard-TAC in 2008 and 2009 equivalent to 10% of the total projected catch for the scallop fishery to address public concerns related to potential derby fishing and safety issues. Furthermore, the Council selected a higher value than the long-term allocation of 5% to reduce short-term impacts on vessels that would ultimately qualify for limited entry from additional effort expected under the appeals process.

IFQ landings varied greatly after 2010 due both to the allocation method included in Amendment 11 and the changes in overall scallop biomass in the open and access areas. IFQ allocations has been based on scallop projected landings at F=0.38 in all areas, including closed areas. On the other hand, LA allocation has been based on projected landings for the fishing year, after accounting for the research set-aside, observer set-aside, incidental landings, and the LAGC IFQ share (5.5% of the ACL including LA vessels with IFQ permits). In this way, the allocation to LA was spatially explicit, while the LAGC IFQ allocation was not. As a result, the actual share of the LAGC IFQ fishery in total scallop landings varied from 4% in 2010 to 7% in 2015 instead of being equivalent to 5% (Figure 20). However, average annual scallop landings for the IFQ fleet during 2010-2015 were still lower relative to levels both in 2007-2009 (48% lower) and relative to 2004-2006 (60% lower) (Figure 22 and Table 7).

Table 7. Average annual landings, revenues and price

Period	Average annual scallop revenue (million $, 2015 dollars)	Average annual fleet landings (million lb.)	Average annual Scallop price per lb. (in 2015 dollars)
2004-2006	47.3	6.2	7.4
2007-2009	34.3	4.7	7.3
2010-2015	28.0	2.5	11.4
% change from 2004-2006	-41%	-60%	53%
% change from 2007-2009	-18%	-48%	56%

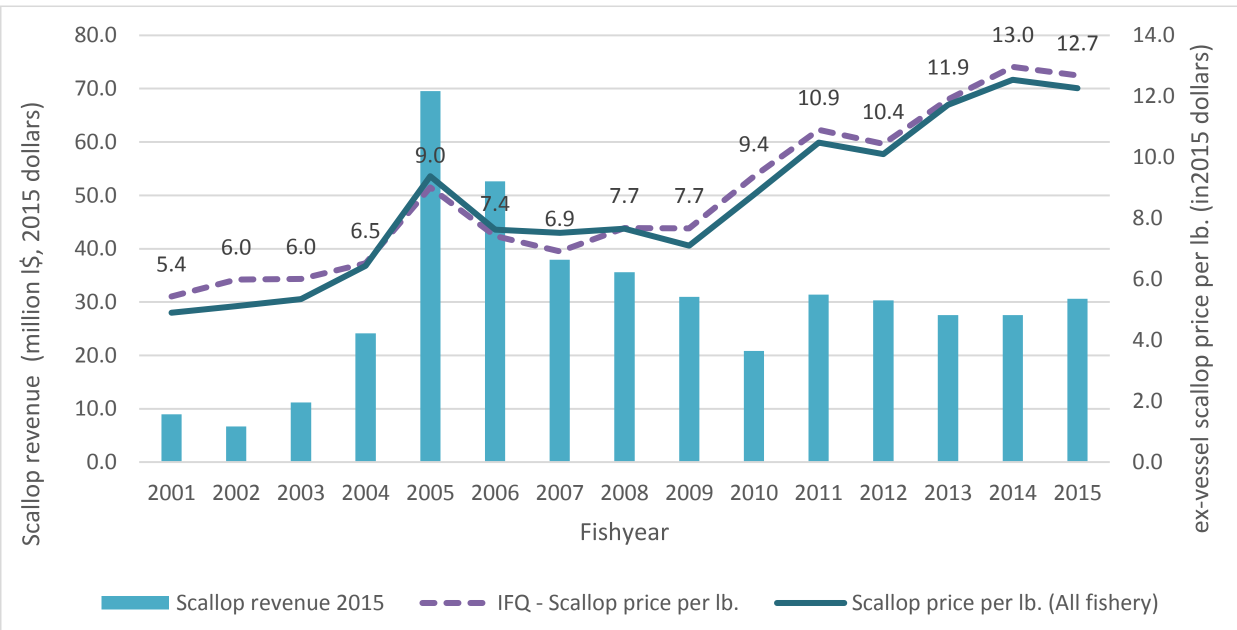
In addition, the spike in scallop prices after 2010, increase in the possession limit from 400 lb. in 2010 to 600 lb. in Amendment 15, and changes in fuel and other fishing costs had impacts on revenues and fishing costs for the LAGC IFQ fishery. Due to the drastic decline in the landings of the IFQ fishery compared to the pre-Amendment levels, average annual IFQ fleet revenue in 2010-2015 was still lower relative to levels both in 2007-2009 (18% lower) and in 2004-2006 (48% lower) even though average annual scallop prices increased more than 50% in the 2010-2015 fishing years (Table 7).

Therefore, a straightforward comparison of the costs and benefits to the pre-Amendment period would not only reflect the impacts of the IFQ program, but it would also capture the impacts of the reduction in overall TAC to 5% and of other factors that are external to this fishery. These include the increase in prices and fluctuations in annual IFQ allocations in response to changes in scallop stock biomass. Gradual implementation of some aspects of the IFQ program during the two years prior to full implementation in 2010 further compounds this issue. For these reasons, the following section provides a semi-quantitative discussion of the likely impacts of the IFQ program on economic benefits based on some scenario analyses holding prices, landings and costs constant to identify the economic impacts attributable to the IFQ program alone. The productivity analysis of the fishery presented in Section 4.3.2.5 provides further insight about the economic cost and benefits of the program by holding prices and input costs constant at the pre-Amendment levels but including the species other than scallops as well in the calculation of outputs.

4.3.2.1 Impacts of the IFQ program on ex-vessel prices

Average annual scallop ex-vessel prices for the IFQ fleet exceeded overall ex-vessel prices since 2009 fishing year by about 20 cents to 60 cents during the period 2009 to 2015 (Figure 22) while in the previous years from 2005 to 2007, IFQ prices were lower than rest of the fleet. These changes could be due to several factors that affect size composition of landings by the IFQ vessels as well as changes in price premiums for large scallops external to the IFQ fishery. Changes in the scallop stock abundance especially in areas where IFQ vessels fish, allocations for the access area trips versus open area allocations, location of access areas that are provided access, intensity of fishing effort, numbers and characteristics of active vessels fishing in the same areas have impacts on the size composition of landings. Changes in the seasonal distribution of effort and in fishing behavior due the implementation of the IFQ program would also have impacts on size composition of scallop landings and prices received by the boats participate in this fishery.

Figure 22. Scallop ex-vessel prices for the IFQ and LA fisheries (in 2015 dollars) with annual general category revenue.



For these reasons, it is not possible to attribute these price differentials directly to the implementation of the IFQ program without a comprehensive model that takes into account various factors that could impact prices. A hedonic price model [13, Appendix] based on data for daily sales transactions of scallops over the 12 year period from 2004 to 2015 attempted to separate the impacts of several variables on the price differences of the LA and LAGC-IFQ fleet observed during 2004-2007, 2008-2009 and 2010-2015 fishing years. The explanatory variable of the model included fishing location, gear fished, trip length, state and port of landing, month landed and scallop market sizes. Using this model, the discrete effects of permit category and scallop size were calculated. According to the model results, the GC fleet is predicted to receive very similar prices to LA vessels during 2004-2007, the Transition fleet receives lower prices than the LA fleet during 2008-2009, and the IFQ fleet receives a premium in all fishing years from 2010-2015. The predicted IFQ premium ranges from $0.18 (1.5%) in 2013 to $0.32 (3.4%) in 2010.

The IFQ and LA fleets operate very differently, and there are a number of reasons why a premium for IFQ vessels exist. IFQ vessels have landed a greater percentage of U10 scallops than LA vessels, and the premium for U10 scallops has increased sharply in recent years. IFQs are transferable while DAS and access area trips are not; states with higher ex-vessel prices have seen an increase in landings under transferable quotas. Additionally, generally shorter trips by the IFQ fleet yield a fresher product than the LA fleet; permit category and trip length are interacted in the model, however a lack of long IFQ trips is a barrier to completely conditioning out the effect of trip length. In terms of increased ex-vessel prices for the IFQ period relative to the transition period, derby-style fishing during the transition period was apparent in the model variable distributions, with a lack of observations in late fall and winter. The IFQ fleet also tends to land on days where fewer scallops are brought to port than the LA fleet.

These findings are consistent with the comparative trends in the average annual IFQ for 2010 onward as depicted in Figure 22 above except for the 2009 fishing year as a whole. During this transition year, the number of active vessels qualified for IFQ fishery declined from 319 in 2008 and to 202 vessels in 2009 and LAGC IFQ fishery was allocated 10% of the TAC with a quarterly quota to reduce derby fishing (Figure 21). This may be one reason why annual average IFQ price exceeded LA price starting in 2009 fishing year, while the predicted from the model shows that during 2008-2009 IFQ fleet received $0.13 discount. This discrepancy, however small, may be due to several factors. Annual average prices show values by Fishyear and based on the dealer data which lumps up larger size U12 scallops with the smaller sizes in the 10 to 20 category. Also, annual average prices are based on actual data, while the predicted prices based on daily scallop prices from auctions with a better classification of market size categories. Despite these differences, it is certain that IFQ prices received a premium after 2010 based on both the predicted (Ranging from $0.13 to $0.32) and actual average annual price data (an average of $0.39 premium for 2010-2015 fishing years, Figure 22).

4.3.2.2 Impacts of the IFQ program on producer surplus and profits compared to the pre-amendment period – A scenario analysis

Catch share review guidance requires an assessment of the program's effects on net benefits to the Nation consistent with the NMFS Guidelines for Economic Analyses (NMFS 2007)[12]. This section evaluates economic costs and benefits using some scenario analyses to identify to the extent possible the impacts of the IFQ program as distinct from the effects of factors external to the fishery.

Total costs and benefits of the fishery actions are estimated as a sum of producer and consumer surpluses taking into account the changes in fishing revenues and costs as a result of the specific management measures. Because the LAGC-IFQ fishery landings constitute a small part of the Atlantic Sea Scallop fishery, prices changes are usually external to the IFQ component although

[12] http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf

there is some evidence that the IFQ program might have helped to increase scallop prices received by the IFQ vessels after 2010 by preventing derby fishery (Section 4.3.2.1). Since consumer surplus declines as prices increase and landings decline, in the short-term on consumer benefits could be slightly negative if there were no improvements on the quality of the product due to the IFQ program. However, it is reasonable to assume that the impacts of the IFQ program on the consumer surplus were probably marginal, and economic impacts were mostly on the producer surplus from this fishery.

Producer surplus is estimated as the excess of total revenue over the total variable costs minus the opportunity costs of labor and of capital. Because crew shares part of the gross revenue and pays the trip expenses according to the lay system common in the scallop fishery, producer surplus is equal to sum of rent to vessels and rent to labor. In estimating economic profits, fixed costs of production and opportunity costs of capital are taken out of the boat share of revenues. Fixed costs for scallop fishing include repairs and maintenance, hauling costs, insurance, office expenses and professional fees, interest payments on mortgages and loans, association fees, travel, and vehicle expenses. See Section 4.3.4.5.1 for a detailed description of the methods used in estimating fixed costs and profits.

In order to have meaningful estimates of benefits, the impact of changes in ex-vessel prices and in landings due to reduction in the share of fishery with a 5% TAC should be treated separately from the impacts of the main components of the IFQ program. "Catch Shares" generally refers to fisheries management strategies that dedicate a secure share of fish to individual fishermen, cooperatives, or fishing communities for their exclusive use. From that perspective, core aspects of the LAGC IFQ program include limited access and individual allocations per vessel combined with transferability. With the implementation of the IFQ program, the number of active vessels in the fishery declined due to both limited access and transferability measures. Therefore, one way to evaluate economic costs and benefits is to analyze how producer surplus would have changed if the same number vessels that were active during 2007-2009 continued to be active each year during 2010-2015.[13]

A simple scenario analysis provided in Table 8 and Table 9 assumes that an average of 320 vessels (equivalent to 2007-2009 average) participated in the LAGC IFQ fishery during 2010-2015, while revenues fluctuated from year to year with the actual change in allocations and prices (Scenario B). It is assumed that total IFQ allocations were divided among 320 active vessels in proportions resembling actual percentile distribution of quota in each year among qualifiers. In this scenario, each vessel had to take fewer trips due to smaller allocations per vessel, but the total number of scallop trips would stay constant. Furthermore, total trip costs and opportunity costs of labor would not necessarily increase if those 320 vessels have the average

[13] It would be quite time consuming to estimate this scenario using the individual data by permit prior to and after 2010. Several data issues including changes in permit numbers as vessels are upgraded or transferred to new owners, inaccuracies in the dealer and permit databases and availability of data in terms of MRI for 2010-2015 but not for before 2010 would complicate estimation and reduce accuracy. It's also not necessary to conduct such as disaggregated analysis by permit to assess if the IFQ program had a positive impact on producer surplus.

vessel characteristics and crew skills equivalent to those vessels that were active in 2010-2015 after the implementation of the IFQ program.

Table 8 presents this simple scenario for the producer surplus and Table 9 for economic profits. Under this scenario, there would be no change in the total fleet costs and opportunity costs of labor, but both fixed costs and opportunity costs of capital would go up due to more capital being tied up in a larger number of vessels. Fixed costs and opportunity costs of capital were estimated for Scenario B with the ratio of 320 to the actual number of vessels that were active in each year during 2010-2015. The results show that estimated producer surplus under the IFQ program would be 16% to 22% higher compared to scenario B if the reduced TAC were shared among a larger number of participants with no flexibility for leasing or transferring quota. In reality, the percentage change in the producer surplus could be higher than estimated in Table 7. The transferability of quota probably allowed more efficient vessels, and in closer proximity to the fishing grounds, to lease or buy quota from others. If this was the case, the trips would be shorter and trip and opportunity costs of labor would be lower. Under the same scenario (Scenario B), fleet profits would probably be negative in the absence of an IFQ program that allowed leasing and transferability of the quota (Table 9). Even if the TAC was set to a higher value, such as 10% of overall ACL), the profits for the fishery as a whole would be higher under the IFQ program due to a reduction in the excess capital and lower the fixed costs and opportunity cost of capital in addition to potentially higher price premium for the IFQ fishery (Section 4.3.2.1).

It must be noted that analyses in Table 8 and Table 9 include just one scenario (Scenario B) out of many. Another scenario would have been fewer vessels participating in the fishery even without the implementation of the IFQ program due to the 5% limit on total catch. However, under that scenario that would be a derby fishery as vessels rush to catch as much as they can before the fishery is closed due to the TAC limits. This would have possibly reduced the prices received by those vessels as market flooded with catch within a short-period of time. Derby fishing could also lead to higher costs compared to a more optimal distribution of effort throughout the year. In fact, the price model results presented in Section 4.3.2.1showed that the price premium received by the IFQ fishery increased after 2010 compared to the transition period when fishery was managed by quarterly quotas. Therefore, producer surplus from the LAGC part of the fishery would have been lower for this scenario as well, compared to the levels that was achieved with the implementation of the IFQ program.

In summary, analyses provided in this section focused on the economic impacts of the IFQ program separately from the impacts of a reduction in TAC to 5% and examined how producer surplus and profits would be different if the TAC was shared among a larger number of vessels with no individual allocation and transferability. These analyses indicate that under the IFQ program, economic benefits (producer surplus) and profits for the LAGC fishery increase compared to the pre-implementation years.

Although this report focuses on impacts of limited access combined with individual allocations and transferability, the next section provides a discussion of the potential economic impacts of a higher or lower TAC with and without an IFQ program.

Table 8. Scenario analyses with the estimated producer surplus (5% TAC, Revenues and costs are in 2015 dollars

Fishyear	Number of active vessels	Scallop Revenue (actual values)	Total trip costs	Total Opportunity costs of crew	Total Opportunity costs of capital	Producer surplus	% Change in producer surplus from compared to Scenario B
Scenario A: Number of active vessels = Actual numbers							
2010	152	20,834,225	1,736,941	277,291	2,660,497	16,159,496	22%
2011	140	31,365,484	2,458,720	335,333	2,868,009	25,703,422	17%
2012	126	30,289,090	2,366,235	307,542	2,413,501	25,201,811	17%
2013	119	27,562,202	2,065,134	277,229	2,417,728	22,802,112	22%
2014	131	27,561,793	1,975,581	293,709	2,246,695	23,045,808	16%
2015	128	30,585,507	1,811,785	345,168	2,617,626	25,810,929	18%
Scenario B: Assumes the number of active vessels equaled average for 2007-2009							
2010	320	20,834,225	1,736,941	277,291	5,601,047	13,218,946	
2011	320	31,365,484	2,458,720	335,333	6,555,448	22,015,983	
2012	320	30,289,090	2,366,235	307,542	6,129,526	21,485,786	
2013	320	27,562,202	2,065,134	277,229	6,501,453	18,718,387	
2014	320	27,561,793	1,975,581	293,709	5,488,111	19,804,393	
2015	320	30,585,507	1,811,785	345,168	6,544,066	21,884,489	

Table 9. Scenario analyses with estimated profits (5% TAC, Revenues and costs are in 2015 dollars)

Fishyear	Number of active vessels	Scallop Revenue (actual values)	Total fixed costs	Total Opportunity costs of capital	Total profits
Scenario A: Number of active vessels = Actual numbers					
2010	152	20,834,225	5,646,300	2,660,497	2,110,315
2011	140	31,365,484	6,880,817	2,868,009	5,933,916
2012	126	30,289,090	6,735,428	2,413,501	5,995,616
2013	119	27,562,202	6,296,929	2,417,728	5,066,445
2014	131	27,561,793	6,442,044	2,246,695	5,092,157
2015	128	30,585,507	6,681,051	2,617,626	5,994,076
Scenario B: Assumes the number of active vessels equaled average for 2007-2009					
2010	320	20,834,225	11,886,948	5,601,047	(7,070,882)
2011	320	31,365,484	15,727,582	6,555,448	(6,600,288)
2012	320	30,289,090	17,105,849	6,129,526	(8,090,831)
2013	320	27,562,202	16,932,917	6,501,453	(9,653,269)
2014	320	27,561,793	15,736,292	5,488,111	(7,443,506)
2015	320	30,585,507	16,702,628	6,544,066	(7,953,940)

4.3.2.3 Economic impacts of overall TAC on the IFQ and limited access fisheries

There is no question that the overall share of the IFQ fishery in total TAC had impacts on the economic benefits for this fishery compared to pre-implementation levels of Amendment 11. The share of the IFQ fishery during 2007-2009 averaged about 8% and over 10% during 2005 and 2006 but fluctuated between 2% to 6% during 2001-2004 (Figure 20). Setting the LAGC IFQ fishery share at 5% of the total TAC lowered the economic benefits compared to the previous three as well as relative to the prior 6 years but increased the benefits compared to the pre-moratorium levels. For example, if the LAGC TAC was set at 10% instead of 5% combined with an IFQ program, scallop revenues for this fishery would double. Even if a higher TAC provided incentive for more quota owners to participate in the fishery increasing trip costs, and opportunity costs of labor and capital, producer surplus would be higher relative to the levels under a 5% TAC. This is because costs comprise a relatively small proportion of total revenues in the scallop fishery. The reverse would have been be true if the overall TAC was set at lower than 5%. However, a higher quota for the IFQ fishery would imply a lower share and reduced economic benefits for the limited access component of the scallop fishery. Therefore, impacts of

TAC were allocative with probably marginal impacts on the total economic benefits from the Atlantic sea scallop fishery as a whole.

There are not questions that without an overall TAC, the IFQ program would not have been successful in increasing economic benefits for this fishery. While the reduction in the overall scallop catch allocated to the LAGC fishery had negative impacts on the revenues compared to the levels in the previous three years, in the absence of measures that controlled overall scallop landings by general category vessels, the fishing mortality for the scallop fishery would have continued to increase beyond the target levels if the vessels that qualify for limited access increased the number of trips targeting scallops. This could have negative impacts on both the limited access and the general category vessels as scallop catch per day-at-sea declined and fishing costs per pound of scallops increased. The increase in costs and landings would have reduced producer surplus for the scallop fishery as a whole. Therefore, limiting access to a subset of historical participants and allocating a separate TAC for the LAGC IFQ fishery probably had positive economic benefits to the scallop fishery and increased the net national benefits over the long-term.

4.3.2.4 Distributional impacts compared to pre-amendment

The distributional economic impacts of the IFQ program were not uniform since some vessels were prevented from access to the general category fishery while those vessels that qualified for the permit benefited. The average number of active vessels in the LAGC fishery declined from 521 in 2004-2006 and 320 in 2007-2009 to about 133 in 2010-2015 while the landings per active vessel increased from 11,588 lb. in 2004-2006 and 15,676 lb. in 2007-2009 to 18,787 lb. in 2010-2015 (Table 10 and Figure 21). Due to the increase in average landings per vessel combined with the increase in scallop prices by more than 50% after 2010, scallop revenue per active vessel more than doubled in 2010-2015 compared to 2004-2006 levels and increased by 82% compared to the 2007-2010 levels.

Table 10. Average scallop landings and revenues per vessel

Period	Average of Scallop revenue per active vessel (in 2015 $)	Average of landings per active vessel	Number of vessels
2004-2006	90,288	11,588	521
2007-2009	117,132	15,676	320
2010-2015	213,743	18,787	133
% change from 2004-2006	137%	62%	-75%
% change from 2007-2009	82%	20%	-59%

4.3.2.5 Changes in the productivity of the LAGC IFQ fishery

4.3.2.5.1 Estimation method

This section updates previous productivity estimates found in the NMFS national report on productivity change in catch share fisheries.[14] Productivity refers to multi-factor productivity, which is also known as total factor productivity (TFP). TFP is defined as a ratio of aggregate outputs to aggregate inputs, and TFP change is the ratio of aggregate output change to aggregate input change during an appropriate time period, which for our purposes is a fishing year. Aggregate output and input changes can be measured through construction of output and input quantity indices, using prices as weights for the different outputs and inputs. As was done in the national productivity report, fixed prices for both outputs and inputs are used as weighting factors, and the subsequent TFP measure is called the Lowe index. The numerator in the Lowe index is the value of all landings on all trips in a fishery during a year using a fixed base price, while the denominator is the value of all inputs from all trips in a fishery during a year, using fixed prices on the same trips. In this manner, the construction of the index results in a measure of productivity change at the aggregate fishery level.

For this fishery, productivity estimates are for vessels which used scallop dredge gear to land scallops, held a general category permit, and took a general category scallop trip between fishing years 2007 and 2015. The output quantities contained in the output index include scallops, and other species which were landed during a general category trip. Inputs included vessel capital, labor used (crew times days spent at sea), energy (fuel used on each trip), and materials (ice). Days spent fishing on each trip and crew size data were obtained from vessel logbook records. Vessel physical characteristics, such as length and horsepower, were taken from vessel permit files. Quantities of fuel and ice used on each trip were estimated using regression models.[15] Trip outputs and inputs from each vessel were then aggregated for each year, and then summed across vessels in a year to arrive at total output produced from the fishery, and total inputs used producing the output.

During the process of compiling the data for the report, additional general category trips in 2011 and 2012 were identified which had not been included in the original report. Therefore, some of the reported totals are higher in this report than previously indicated. Additionally, we did not adjust the productivity estimates for changes in biomass as was done in the national report. This is because the IFQ program is allocated a small percentage of the overall quota, the resource tends to be patchy, which means location is important when estimating a biomass index, and the majority of the resource is harvested by the non-IFQ fleet. Future studies are needed to better address how to incorporate biomass change in the productivity change metric for this fleet.

[14] Walden, J., Agar, J., Felthoven, R., Harley, A., Kasperski, S., Lee, J., Lee, T., et al. 2014. Productivity Change in US Catch Share Fisheries.

[15] Details on the regression models used are available upon request.

4.3.2.5.2 Discussion

A three year average of outputs and inputs from 2007-2009 were used as the baseline years in the indices to be consistent with the previous work in the national report. During the first year of the catch share program (2010), both outputs and inputs fell relative to the baseline time period (Table 1). In both 2011 and 2012, outputs rose before declining in 2013 and 2014. In 2015, outputs were slightly less than the baseline time period. Input usage also fell in 2010, before rising in 2011 and 2012, and then falling in 2013, 2014 and 2015. The falling input levels were likely caused by the exit of vessels from the fishery.

In 2015, productivity was estimated to be 1.34, or 34% greater than the baseline time period. But, productivity change was not consistent in the time period, with gains occurring in some years and declines in other years compared to the prior year. Beginning in 2011 and 2012, both outputs and inputs rose relative to the baseline time period. Since outputs rose more than inputs, the Lowe index increased (Table 2) in both 2011 and 2012 compared to the baseline time period, indicating a productivity gain. The index showed a productivity increase of 21% in 2011 compared to the baseline and a 15% gain from 2010 levels. One important factor in the increase in productivity in 2011 could be the increase in the possession limit by 50% from 400 lb. to 600 lb. per trip, which must have reduced the inputs per trip especially in terms of fuel and other materials as well the labor used in each trip.

The next year (2012) productivity declined by 8% compared to 2011, although it was still 12% greater than the baseline time period. The decline in 2012 compared to 2011 was caused by a slight drop in outputs, while inputs increased by roughly 7%. In 2013, there was an 18% productivity gain compared to 2012 levels, and the index showed a 32% productivity gain over the baseline time period. Although the output index dropped substantially in 2013, the input index declined by substantially more from 2012 levels. This resulted in an overall productivity gain. In 2014, outputs dropped again compared 2013, while inputs did not change. This led to an 11% decline in productivity compared to 2013, but compared to the baseline time period, productivity change was still positive. In 2015, output increased while inputs declined slightly, leading to a 14% productivity gain from 2014 levels.

Future productivity gains will depend on whether there is additional fleet consolidation, and how quotas for this fleet change. At some point, productivity gains will be limited as the fleet reaches a stable point in terms of vessel numbers and quotas. After that occurs, productivity gains might still occur if there is further technological innovation. For example, innovations in engine design leading to more fuel efficient vessels would increase productivity as fuel consumption declines. Spatial shifts in the distribution of scallops could also lead to productivity gains if the resource moved further inshore. Again, vessels would not need to use as much fuel input to harvest the resource, resulting in a productivity gain. Finally, productivity needs to be recognized as just one component of profitability, which is ultimately the most important performance metric for active vessels in this fishery.

Table 11. Outputs produced and inputs used, northeast general category scallop IFQ program

Year	Output	Capital	Labor	Energy	Materials	Total Inputs
2007	28,639,698	1,804,387	4,248,779	7,389,719	189,454	13,632,339
2008	12,481,429	637,796	1,459,307	2,047,107	58,885	4,203,095
2009	16,731,913	725,011	1,843,553	2,987,370	70,693	5,626,627
Baseline Average	**19,284,346**	**1,055,731**	**2,517,213**	**4,141,399**	**106,344**	**7,820,687**
2010	17,644,048	911,423	2,243,174	3,546,126	87,093	6,787,817
2011	24,918,458	1,040,836	2,936,312	4,246,819	111,231	8,335,197
2012	24,554,333	1,047,908	2,962,483	4,777,340	107,922	8,895,653
2013	19,004,234	722,886	1,878,781	3,168,038	73,413	5,843,117
2014	17,135,901	715,194	1,812,536	3,291,445	77,977	5,897,151
2015	19,192,028	636,508	1,869,464	3,219,098	78,660	5,803,730

Table 12. Output, Input and Productivity Indices, northeast general category scallop IFQ program

Period	Output Index	Input Index	Productivity Index (Unadjusted)	Change
2007-2009	1	1	1	
2010	0.91	0.87	1.05	1.05
2011	1.29	1.07	1.21	1.15
2012	1.27	1.14	1.12	0.92
2013	0.99	0.75	1.32	1.18
2014	0.89	0.75	1.18	0.89
2015	1.00	0.74	1.34	1.14

4.3.3 Trends in net revenue and producer surplus in the implementation period (2010 – 2015)

This section provides an analysis of the trends in economic benefits and profits since the full implementation of the IFQ program in 2010. Evaluating the changes that took place since then makes it possible to identify those impacts attributable mainly to the core aspects of the IFQ program; Individual allocations per vessel combined with transferability and limited access in addition to some modifications made to the program in 2011 in Amendment 15.

4.3.3.1 Net revenue and producer surplus

For active owners, the net revenue for each year is estimated as the difference between the scallop revenue and trip costs. Trip expenses include food, fuel, oil, ice, water, and supplies and are estimated using the trip cost equation provided in Appendix B, using the observer data from 2001 to 2015 fishing years for the limited access and limited access general category vessels. The trip costs per day-at-sea was postulated to be a function of vessel crew size, vessel length and horsepower, fuel prices, and dummy variables for limited access general category (LGC) and small dredge (SMD) vessels. Annual trip costs were estimated using the day-at-sea data for each IFQ vessel while fishing for scallops.

Producer surplus is an important component of the net national benefits within a cost/benefit framework The producer surplus (PS) is defined as the area above the supply curve and the below the price line of the corresponding firm and industry, which also equals to the sum of rent to vessels and rent to labor. It is estimated as net revenue minus the opportunity costs of capital and labor. Opportunity cost of capital were based on estimated vessel values and evaluated using Moody's Seasoned Baa Corporate Bond Yield (Appendix J). Opportunity costs of labor we estimated using average hourly earnings of production and nonsupervisory employees.

Net fleet revenue increased by 51% from $19 million in 2010 to about $29 million in 2015 and the producer surplus increased by 60% from $16 million in 2010 to $26 million in 2015 (in 2015 dollars, Figure 23 and Figure 24). As discussed in Section 4.2 above, scallop revenue increased by 47% in this period due to the rise in scallop prices by 40% in 2015 from 2010 levels combined with an 8% increase in scallop landings during the same period (Figure 9, Section 4.2). The percentage increase in net fleet revenue and producer surplus exceeded the increase in gross revenue due to the decline in fuel prices by 10%, increase in possession limit from 400 lb. in 2010 to 600 lb. in 2011 and also due to the concentration of effort in a smaller number of possibly more efficient vessels (Figure 25). The decline in the number of active vessels from 152 in 2010 to 128 in 2015, reduced the total opportunity costs of capital in the LAGC IFQ fishery (Figure 24 and Figure 25). The increase in possession limit to 600 lb. per pound after 2010 fishing year also helped lower trip costs (Section 3.2). As was discussed in Section 4.3.2.1, LAGC IFQ prices for scallops exceeded the prices for the limited access fishery after the implementation of the IFQ program in 2010.

Figure 23. Total net scallop revenue and producer surplus

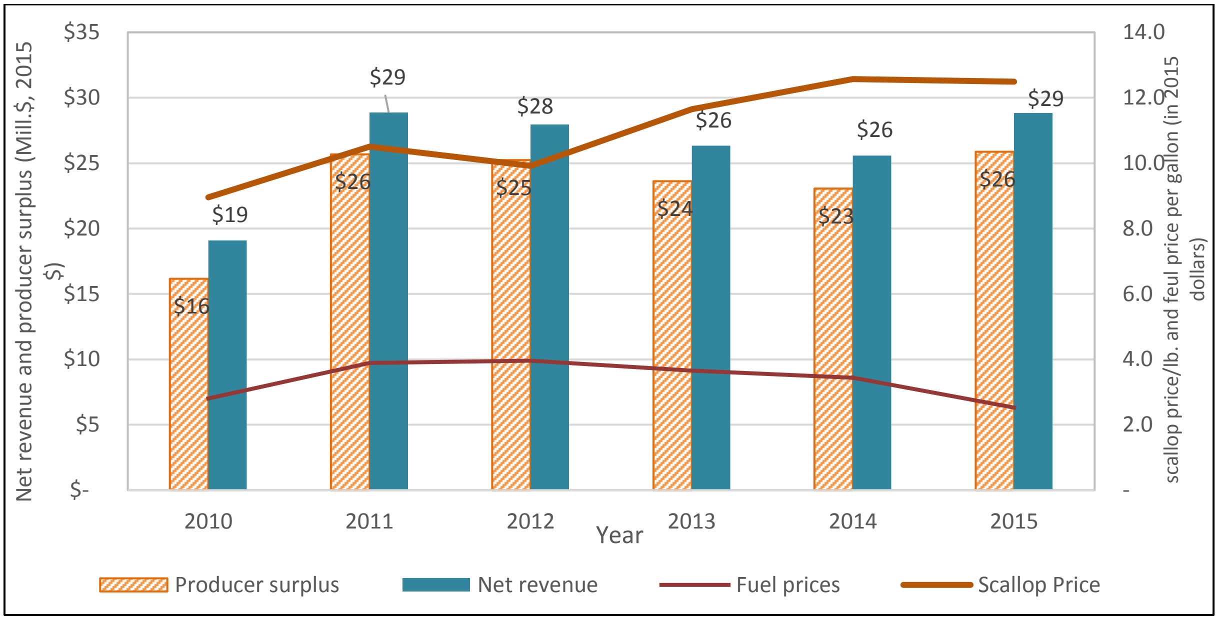


Figure 24. Percentage change in net scallop revenue, producer surplus and scallop landings

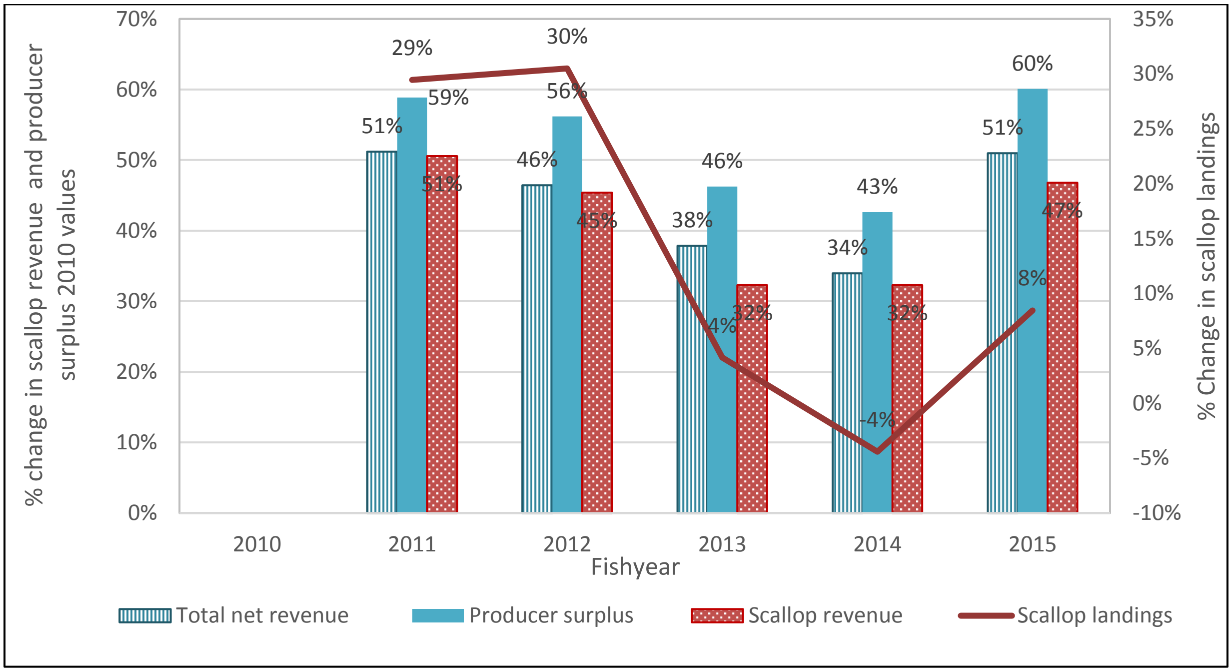
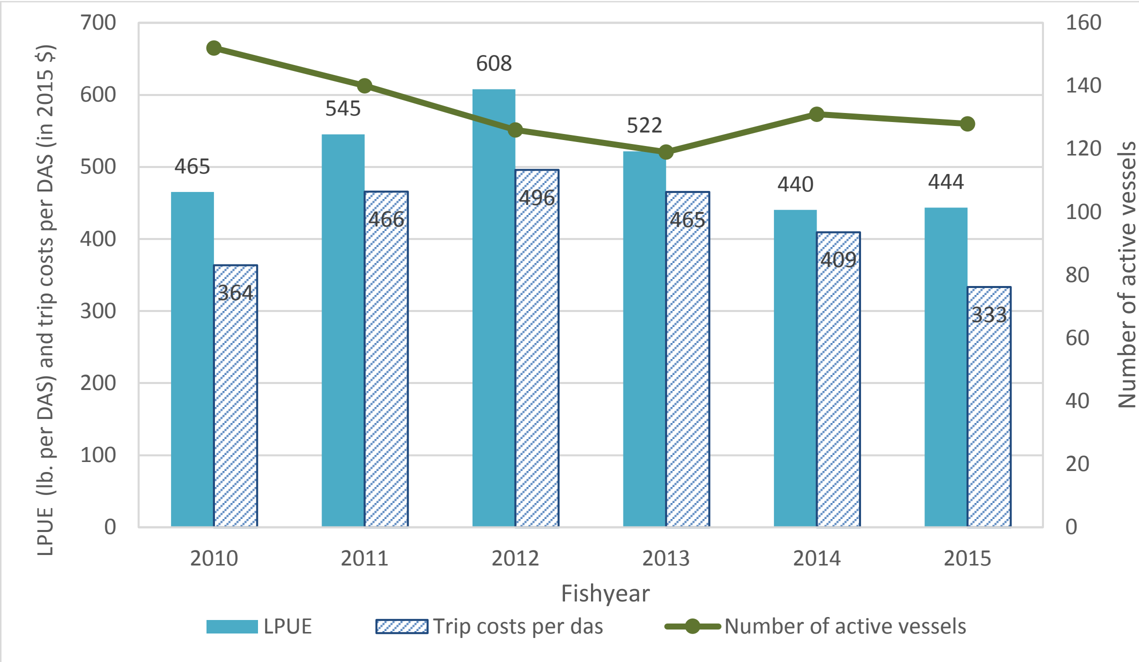


Figure 25. Trip costs per DAS, LPUE and active vessels



4.3.3.2 Net revenue per active vessel and affiliation

Since the implementation of Amendment 11 in 2010, there has been a decline both in the number of active vessels and the number of affiliations resulting in a larger share per vessel and affiliation in 2015. Average net revenue per active vessel increased by 79% from about $125,000 in 2010 to about $225,000 in 2015 (Figure 26 and Figure 27).

Active affiliations include vessels that participate in the IFQ fishery as well as CPH permits that are owned by the same affiliation that lease-out their quotas. Average real net revenue per active affiliation (in 2015 dollars) increased from about $150,000 in 2010 to about $283,000 in the 2015 fishing year, an 88% increase (Figure 28).

A major part of this increase was due to an increase in total fleet net revenue (by 51%) due to the reasons discussed above while the concentration of effort through leasing and permanent transfers contributed to the increase in net revenues per affiliation. This implies that as much as 37% of the increase in the net average revenue could be due to the consolidation of ownership since the implementation of the IFQ program in 2010. The changes in the net revenue per affiliation was not uniformly distributed, however, based on the trends by activity and leasing groups, Gini coefficients and Lorenz curves as examined in Section 4.4.2.7).

Figure 26. Percentage increase in average and total net fleet revenue from 2010 levels

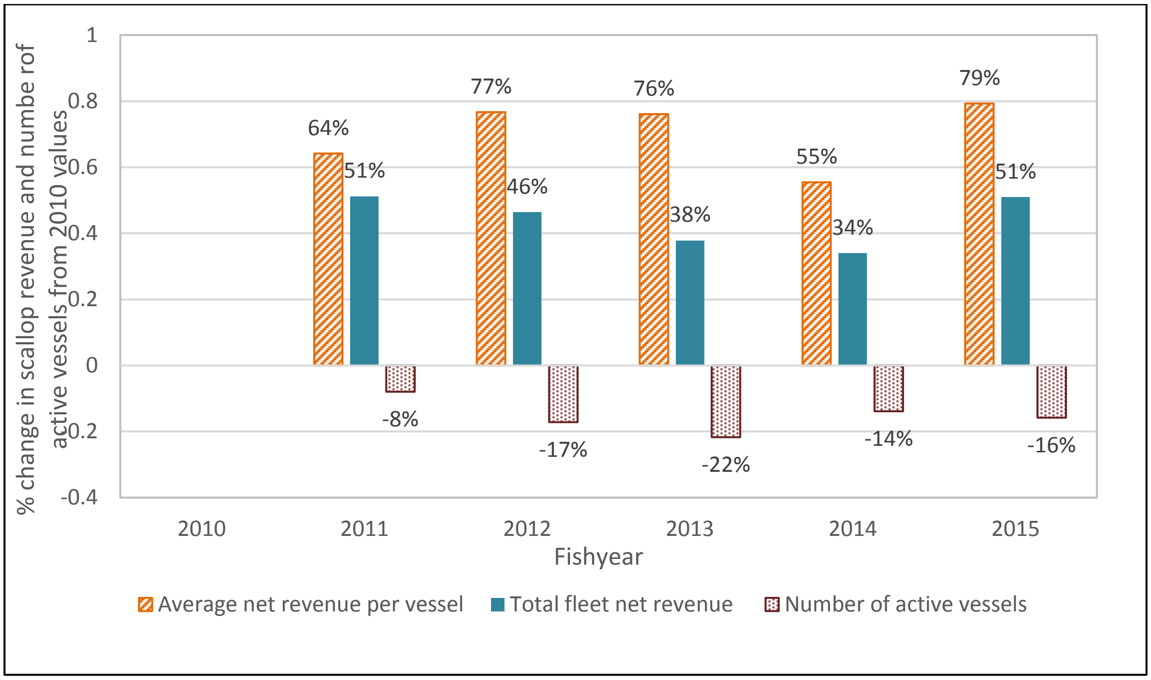


Figure 27. Average net scallop revenue per active IFQ vessel (net of trip costs)

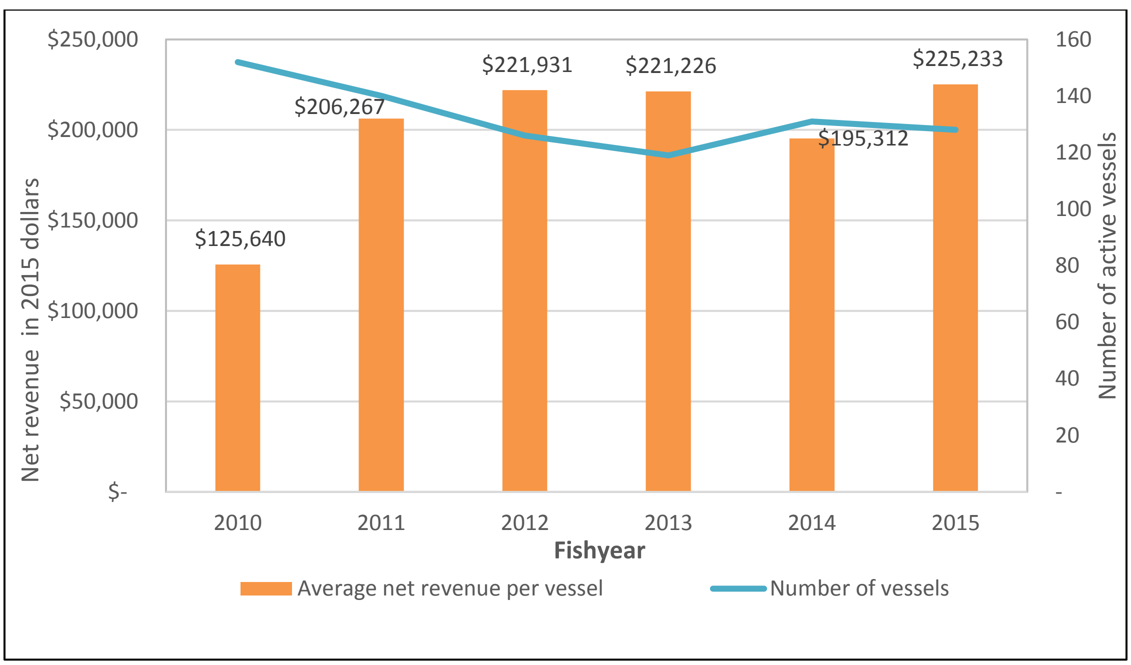
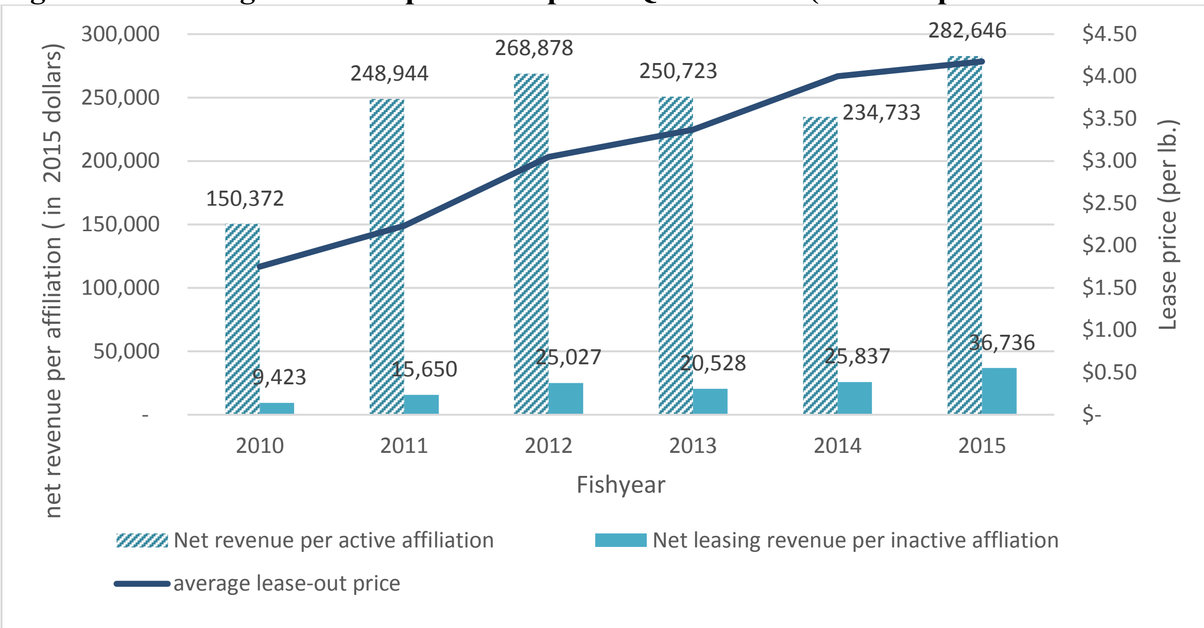


Figure 28. Average net scallop revenue per IFQ affiliation (net of trip costs



4.3.4 Leasing and transfers

This section provides empirical analyses to address the transferability aspects of the LAGC IFQ program. As indicated in Catch Share Review Guidance, Section 303A(c)(7) of the MSA requires a Council to establish a policy and criteria for the transferability of limited access privileges and that the "The review should determine whether existing transferability provisions are conducive to achieving the specified objectives, keeping in mind that trade-offs often exist between objectives." [CSRG, p.13, D. Transferability].

The following subsections examine the impacts of the transferability measures included in Amendment 11 and subsequent modifications to the program in Amendment 15 on permanent transfer and leasing activity as well as on the lease prices from the 2010 to 2015 fishing years (Section 4.3.4.1 and 4.3.4.2). Summary and conclusions are provided in Section 4.3.4.4.

4.3.4.1 Permanent transfers

There has been a surge in the number of transfers from 10 in 2010 and 8 in 2011 to 53 in the 2012 fishing year, increasing from 1% in 2010 to 10% of the base allocations in 2012 (Figure 29). The increase in allocations by 25% in the 2011 and by 33% in the 2012 fishing years combined with an increase in ex-vessel prices over $10 per pound of scallops translated into more revenue for each active owner fueling the demand for scallop IFQ and resulting, in turn, in higher quota prices per pound of scallops (Figure 29, Table 13 and Figure 30). The number of IFQ transfers is not equivalent, however, to the number of exits from the LAGC IFQ fishery since some sellers transferred part of their allocations and landed scallops with the rest. The term "transfers" will be used interchangeably to refer to "permanent transfers" in the rest of this document while, for "temporary transfers" the term "leasing" will be employed.

Modifications to the IFQ program regarding the amount of quota that could be transferred were also among the important factors that led to an increase in transfers in 2012. Prior to 2012, each vessel was restricted to own a maximum 2% quota and was required to transfer the entire amount of their IFQ to another vessel. Beginning in 2012, Amendment 15 increased this restriction to 2.5% of the total general category allocation and allowed IFQ permit holders to permanently transfer some or all of the quota allocation to another IFQ permit holder. These measures made it easier to permanently transfer quota to those active vessels that now can accumulate a higher percentage of the overall quota on one unit.

The share of active vessels in total allocations declined from 55% in 2011 to 49% in 2012 while more quota was consolidated in CPH permits, adding to the demand for quota by active vessel owners. The percentage share of CPH permits in allocations increased from 24% in 2011 to 30% in 2012 while the share of inactive vessels with active IFQ permits stayed at almost the same level in those years (Table 13). In the same year, the transfer price per pound of quota spiked from about $19 per lb. in 2011 to $30 per lb. in 2012, a 57% increase (Figure 30).

In 2013 and 2014, the number of transfers declined to 23 and 24 respectively as total IFQ allocations are reduced by 4% in 2012 and 5% in 2013 from the 2010 levels. The increase in total IFQ allocations in 2015 by 16% compared to the levels in 2010 led to another surge in transfers in this fishing year comprising 8% of total IFQ allocations (Table 13 and Figure 29 Quota prices increased in the period 2013-2015 relative to prior years ranging from $36 to $38 per pound of quota (Figure 30).

Figure 29. Number of transfers (by MRI)

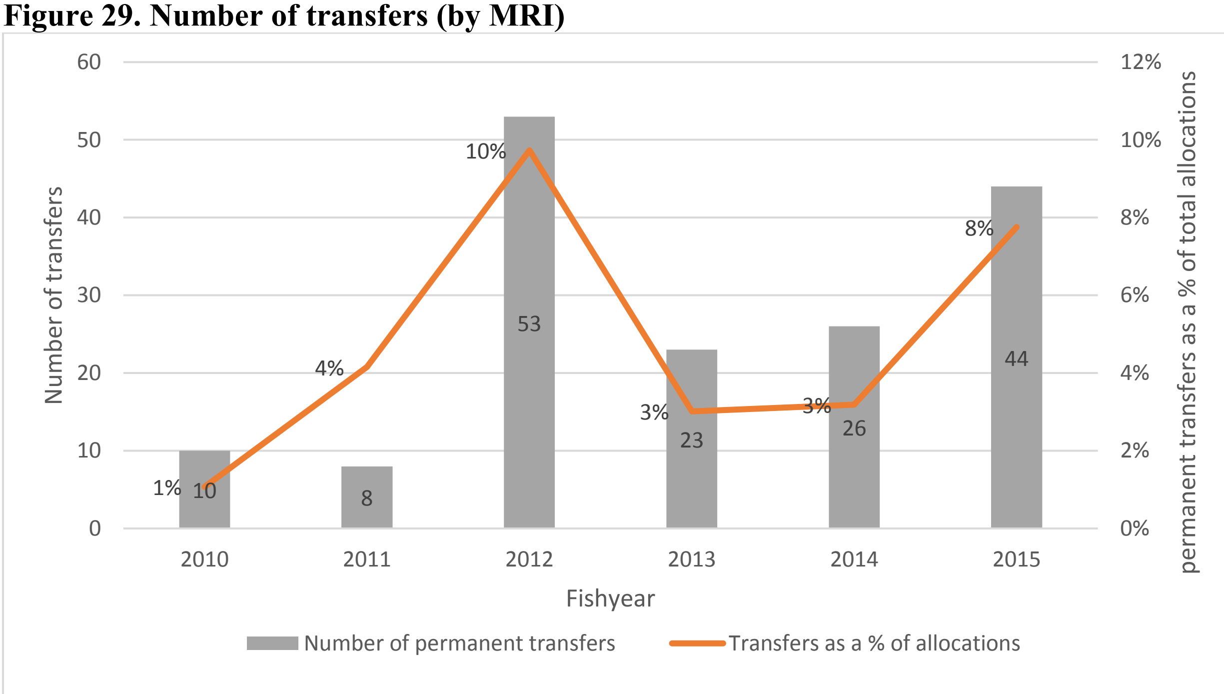
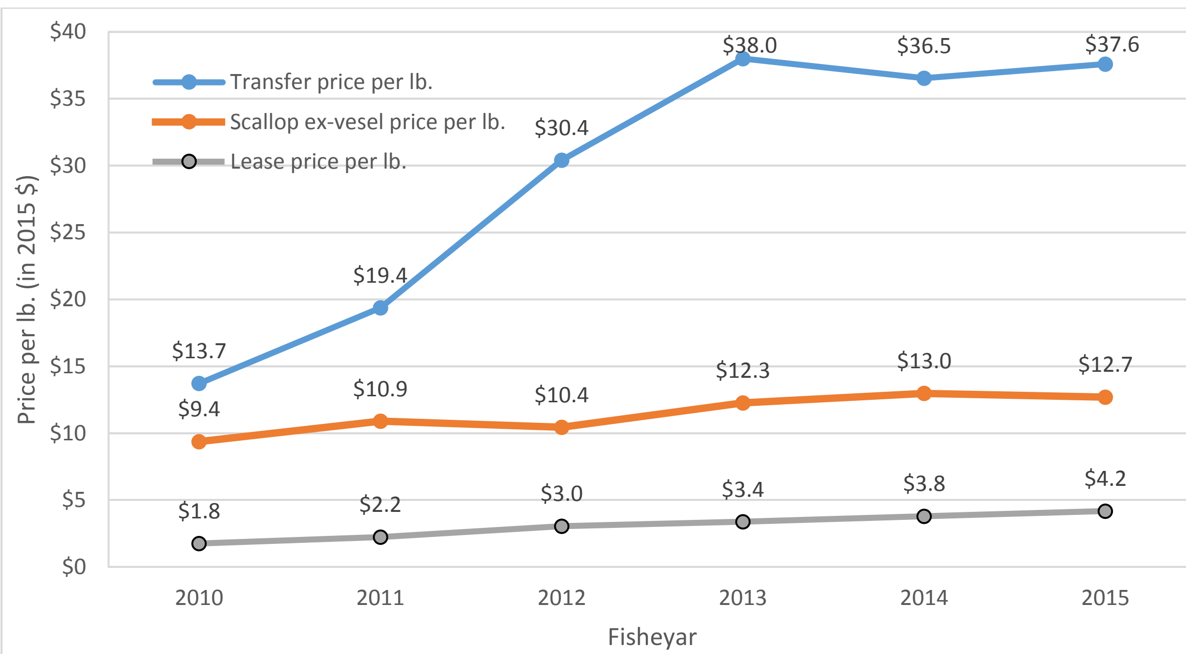


Table 13. Change in allocations and share of IFQ permit holders by permit and activity status

Values	2010	2011	2012	2013	2014	2015
Allocations (Base+adjustment, lb.)	2,329,500	2,912,270	3,096,960	2,228,630	2,204,140	2,701,970
% change in allocations from 2010		25%	33%	-4%	-5%	16%
% Share of active vessels in total IFQ allocation	52%	55%	49%	54%	57%	54%
% share of permits in CPH in total IFQ allocation	23%	24%	30%	31%	30%	30%
% share of inactive vessels with IFQ permits	25%	21%	20%	16%	13%	16%

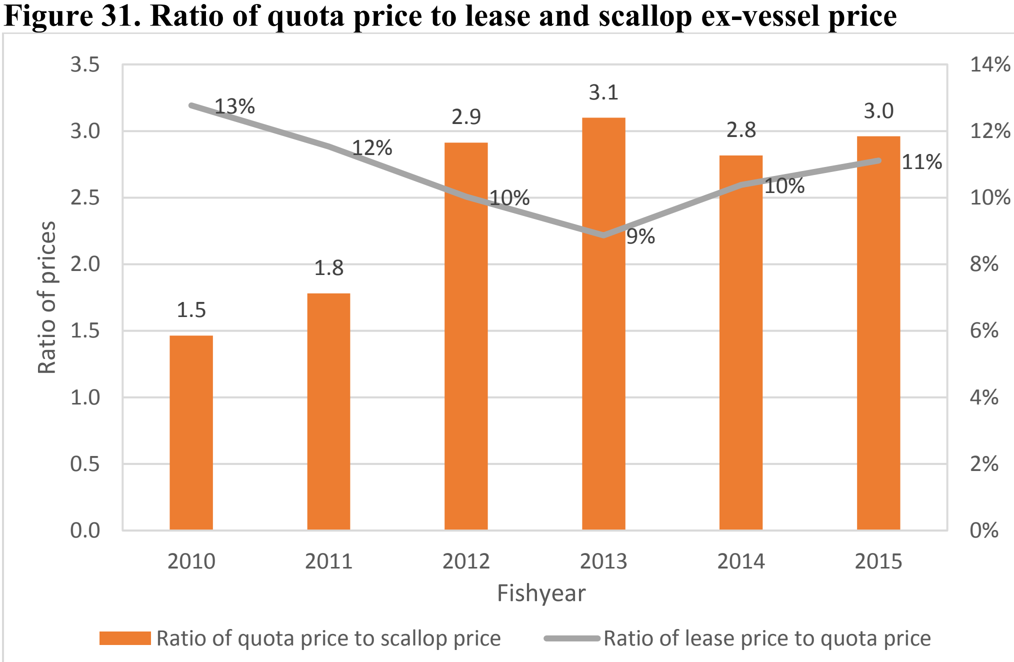
Figure 30. IFQ transfer, lease and ex-vessel price per pound of scallops (In 2015 dollars)



It must be pointed out that the permanent transfer data does not include price information for each transaction. Using this data, the ratios of annual lease price to quota price as well as the ratio of quota prices to scallop prices are depicted in Figure 31. In a competitive market, the quota prices reflect the expected present value of the net economic returns from the fishery subject to the expectations and uncertainties regarding the scallop prices, landings, ecological, and biological factors. Therefore, an increase in fish prices, decrease in costs, increase in quota demand, and a decline in uncertainties regarding the future stock conditions increase the quota prices. The increase in average quota price exceeded the increase in scallop ex-vessel prices by a greater margin since 2012. However, the ratio of the quota price to scallop price stabilized around 3 during 2012-2015 (Figure 31). On the other hand, there has been a decline in the ratio of the lease prices to quota prices in the same period from 13% in the 2010 fishing year to about 10% in the 2012 fishing year. This number ranged from 9% to 11% in 2013-2015. This ratio reflects the implicit of discount for quota since the quota prices should be equal to the expected present value of the net economic returns from the fishery subject to the expectations and uncertainties regarding the scallop prices, landings, ecological, and biological factors. A decline in this ratio could be a sign of a decline in the perceived uncertainties about future returns.

Other factors that could affect quota prices include the supply of quota by co-ops that lease-out at almost half the price of the market rates, asymmetric information held by buyers and sellers and climate uncertainties. The determinants of IFQ lease price and permanent transfer prices for the LAGC IFQ fishery were examined in a paper by the SSB branch of NEFSC (An empirical analysis of individual fishing quota market trading, Di Jin a,*, Min-Yang Lee b, Eric Thunberg, October 2016). A unique micro data set on individual IFQ transactions and related vessel and stock information for the 6-year time period, fishing year 2010-2015, was used to estimate models of quota markets and individual transactions. The study found that IFQ lease price is generally affected by factors influencing profitability of the fishery as well as the competitiveness of the leasing market. Results of the analysis also suggest that the price for IFQ transfers captures the capitalized profits in the fishery over time with adjustment for relevant risks. Overall, the IFQ market performance is in general agreement with economic theory. The results of this study are summarized in Section 4.3.4.3.2 below.

Figure 31. Ratio of quota price to lease and scallop ex-vessel price



4.3.4.2 Trends in leasing (temporary transfers) and lease prices

Extensive use of leasing IFQ is probably one of the most noticeable changes that took place in the general category fishery since the full implementation of Amendment 11 in the 2010 fishing year.[16] The number of lease transactions almost doubled, from 195 in 2010 to 350 in 2015 as a result of several factors including the increase in scallop ex-vessel prices, in overall IFQ quota (by 25% in 2011 from 2010 levels), increase in the possession limit from 400 lb. to 600 lb., and the increase in the maximum quota one general category vessel can fish from 2% to 2.5% with the implementation of Amendment 15 in July 2011. The majority of the lease transactions took place between different owners (Table 14). Permit-banks leased out about 15% of the leasing that took place during 2010-2015, although these proportions varied slightly each year (Figure 32).

Table 14. Lease transactions by ownership of quota

Fishyear	Leased to different owner	Leasing to different owner (% of total)	Leased to same owner (% of total)	Leased to same owner	Grand Total
2010	165	82%	30	18%	195
2011	291	83%	42	17%	333
2012	270	91%	30	9%	300
2013	286	87%	30	13%	316
2014	322	86%	37	14%	359
2015	310	87%	40	13%	350

[16] This document uses the term ‘leasing’ interchangeably with the term ‘temporary IFQ transfers’. The term ‘leasing’ was used more often than the later term, however, because of its brevity.

Figure 32. Percentage share of leased pounds by affiliation type

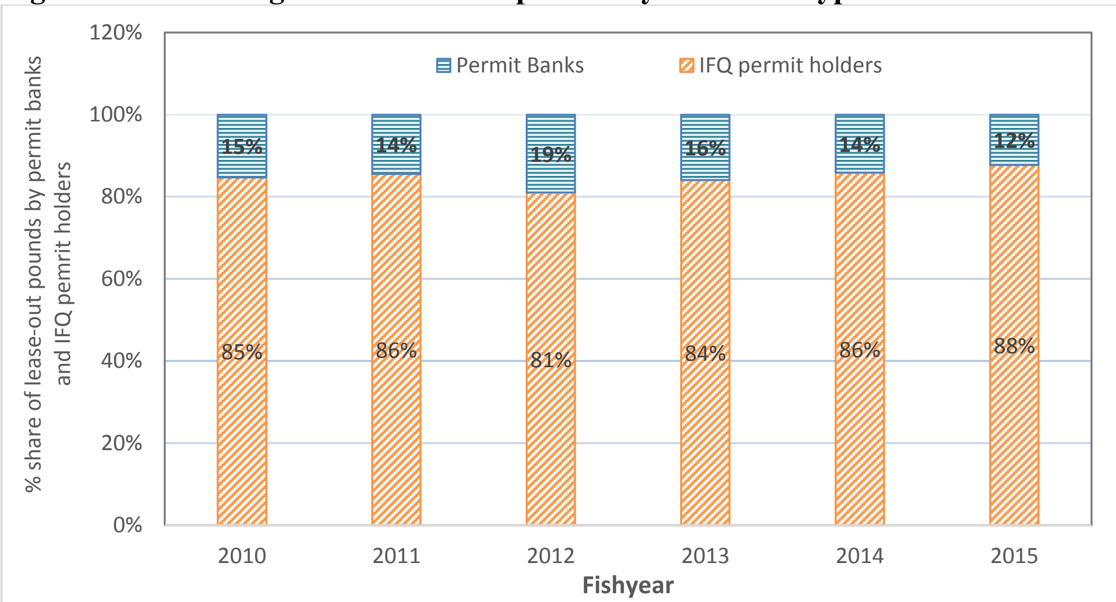


Figure 33 and Figure 34 show a unique number of IFQ owners (by MRI) involved in those transactions. There were about 71 active vessels in 2010 and 82 in 2015 that leased-in quota (Figure 33). About 52 of these vessels leased from different owners in 2010, and 63 leased from different owners in 2015. There has been also an increase in the number of IFQ permit holders who leased out quota from 160 in 2010 to 171 in 2014, and most of these leased out quota to different owners (Figure 34).

Figure 33. Number of individual IFQ owners or vessels who leased-in quota (by MRI)

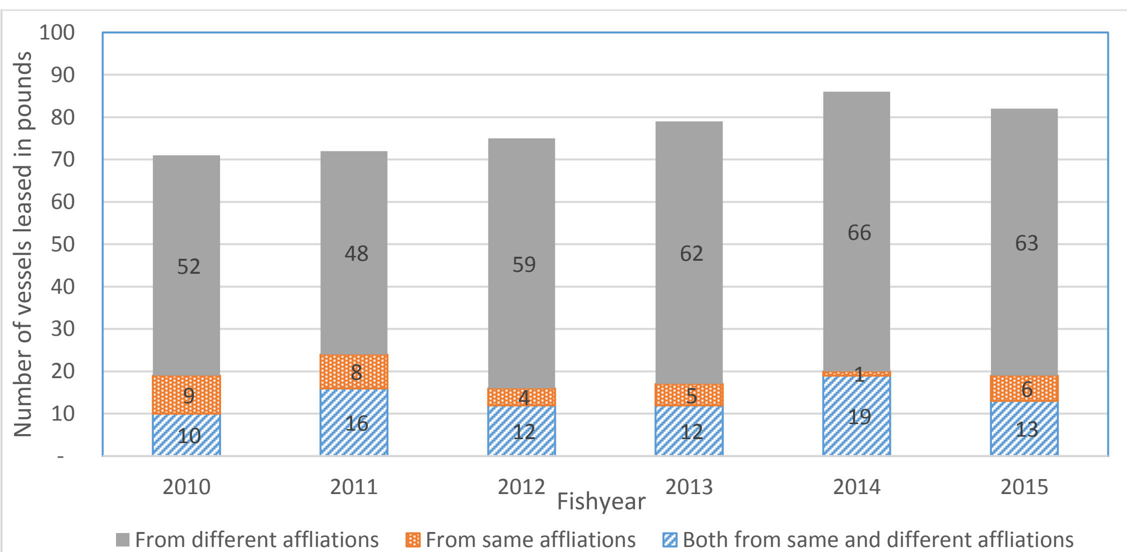
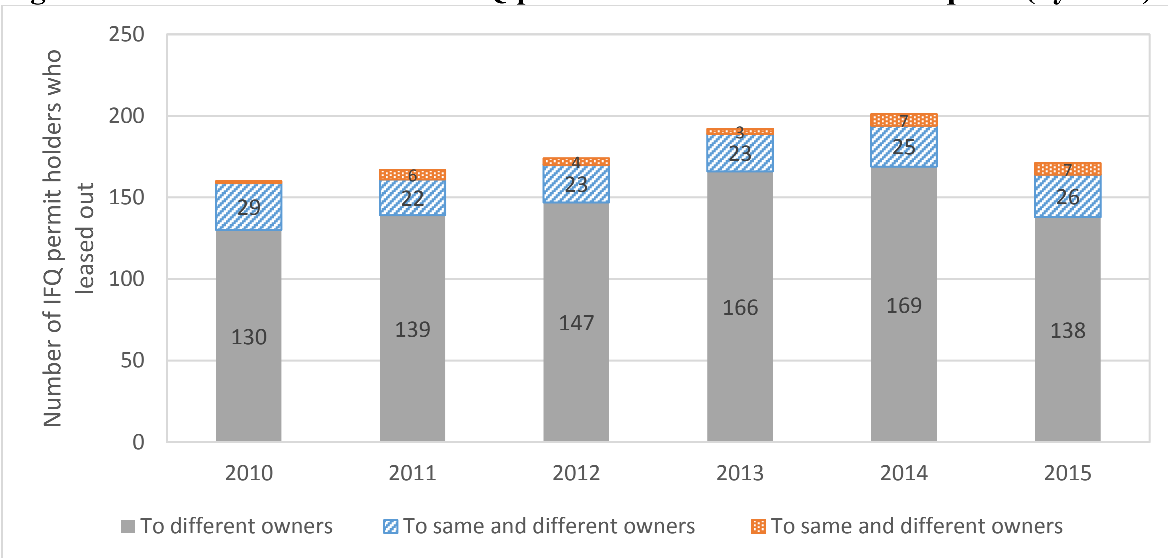


Figure 34. Number of individual IFQ permit holders who leased-out quota (by MRI)



During 2010-2015, total scallop IFQ leased in from vessels that belong to different owners increased from about 0.7 million lb. in 2010 to about 1.3 million lb. in the 2015 amounting to 31% of the total allocations in 2010 and 47% of the total LAGC IFQ allocations in 2015 (Figure 35 and Figure 36). If the transfers of IFQ from one vessel to another owned by the same person or corporation were included in the leasing activity, leased pounds would be higher, over 1.1 million lb. in 2010 (47% of total allocations) and about 1.7 million lb. in 2015 (63%) of total allocations excluding carry-over pounds (Figure 36).

Figure 35. Allocations and leased pounds

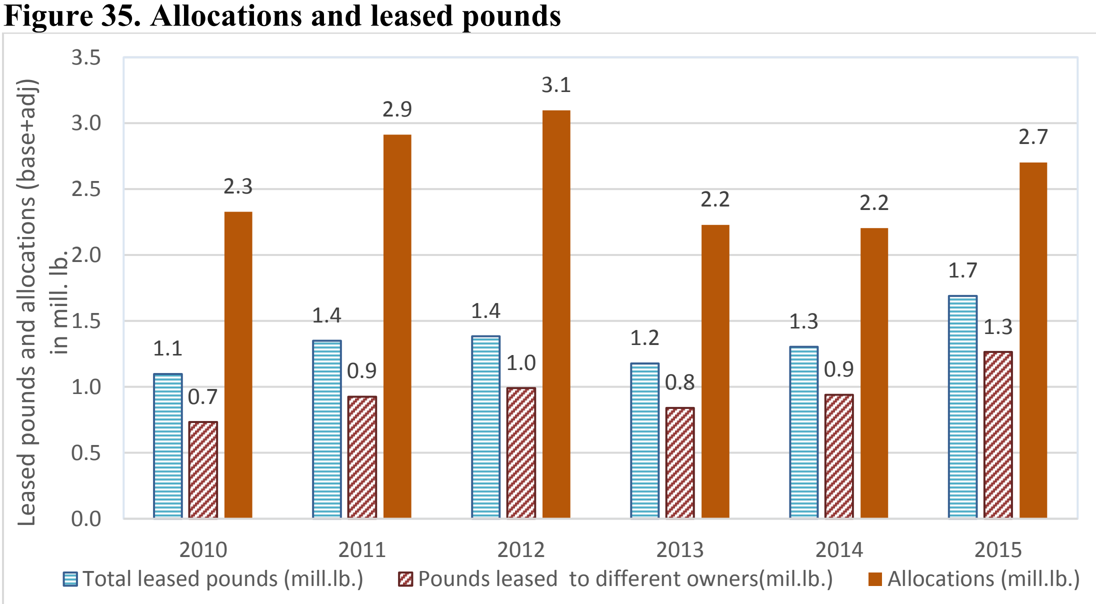
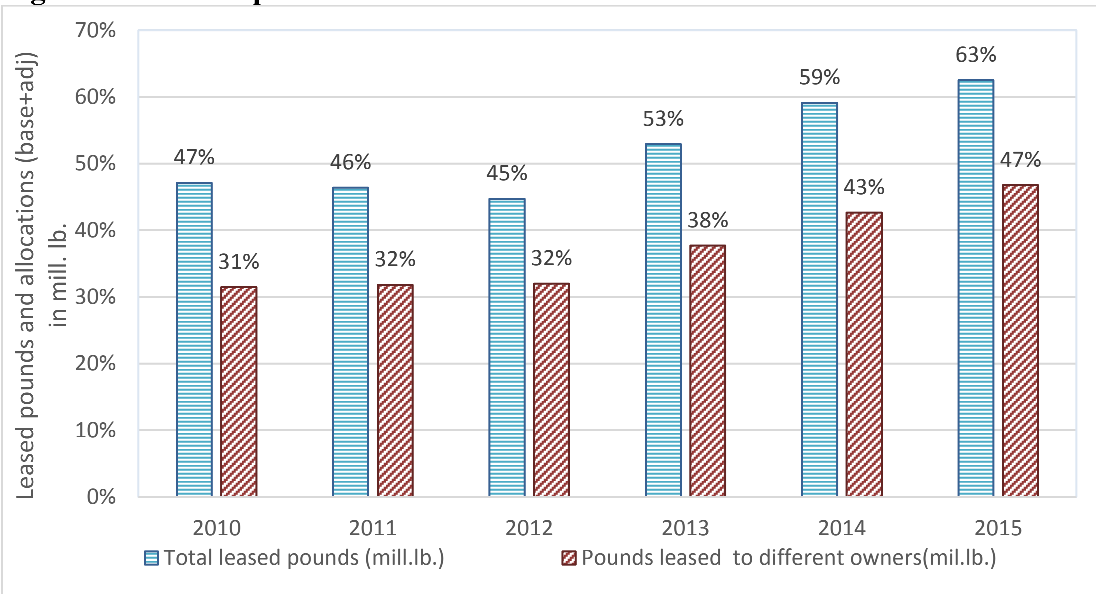


Figure 36. Leased pounds as a % of allocations



Some affiliations leased out some of their quota while at the same time leasing some pounds from other affiliations. Figure 37 shows that net leased pounds increased from 0.7 million in 2010 to 1.1 million lb. in 2012 and then stabilized around 0.8 to 0.9 million pounds. Leased pounds comprised about 30% of the LAGC IFQ scallop landings in 2010, 38% of landings in 2012, and about 36% of landings in the 2014 -2015 fishing years. The number of affiliations that leased out declined from 98 in 2010 to 87 in 2015 as a result of consolidation within this group, and the number of those affiliations that did not lease quota decreased from 76 in 2010 to 48 in 2015 (Figure 38). On the other hand, the number of affiliations that leased quota from others ranged from 53 in 2011 to 64 in 2013.

In terms of allocations, those affiliations that were net leasers of quota had higher allocations compared to those who leased out or did not engage in any leasing transaction during the period 2010- 2015. However, this trend changed in 2015 as quota was consolidated in fewer affiliations who mainly lease out quota. Allocations per affiliation for this group exceeded average allocations per affiliation that lease-in quota (Figure 38). This does not mean, however, that every affiliation that lease-out has a higher allocation than every affiliation that lease-in. Nevertheless, Figure 40 shows that a greater proportion of total IFQ allocations were owned by those affiliations that were leased-out, their quota increasing from 46% of IFQ quota in 2010 to 58% in 2015.The percentage share of active affiliations also increased slightly from 32% in 2010 to 35% in 2015, while allocations of the group that do not lease out quota declined from 22% to 7% (Figure 40). This indicates that a major proportion of the quota owned by this last group was transferred to the affiliations that lease out quota.

Figure 37. Net leased pounds and percentage of scallop landings by leased pounds

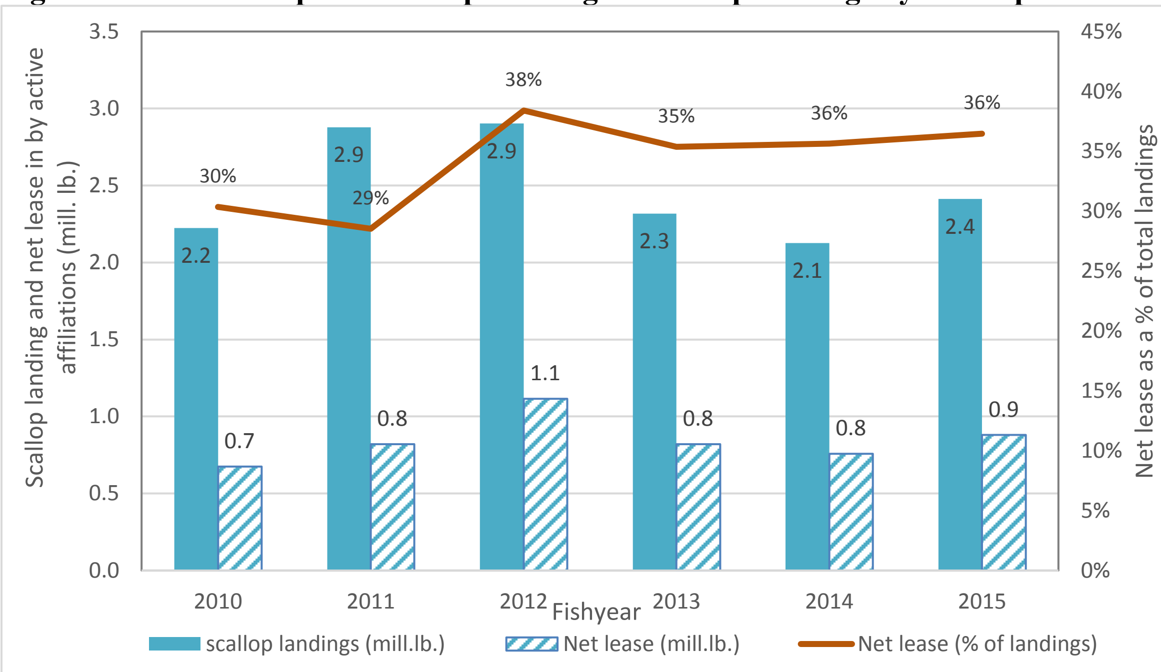


Figure 38. Number of affiliations by net leasing activity (including active and inactive affiliations)

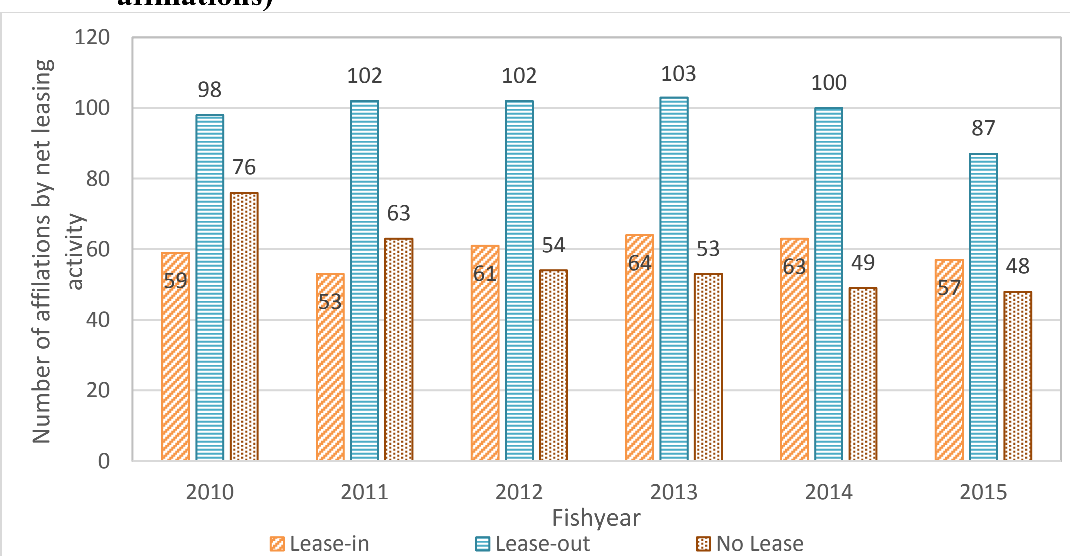


Figure 39. Average annual IFQ allocation per affiliation by net lease group (in pounds)

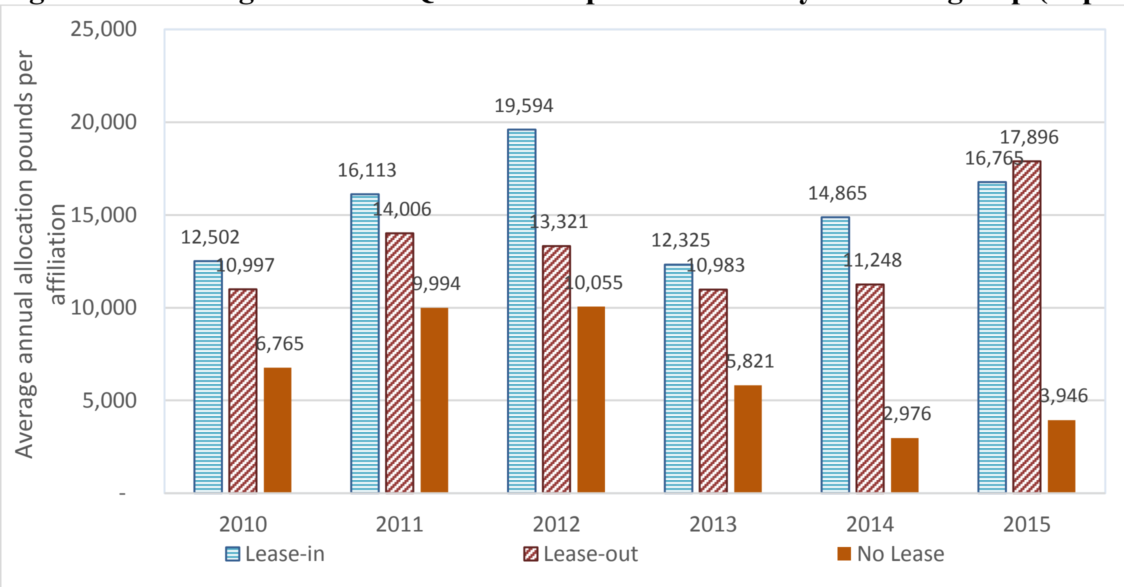
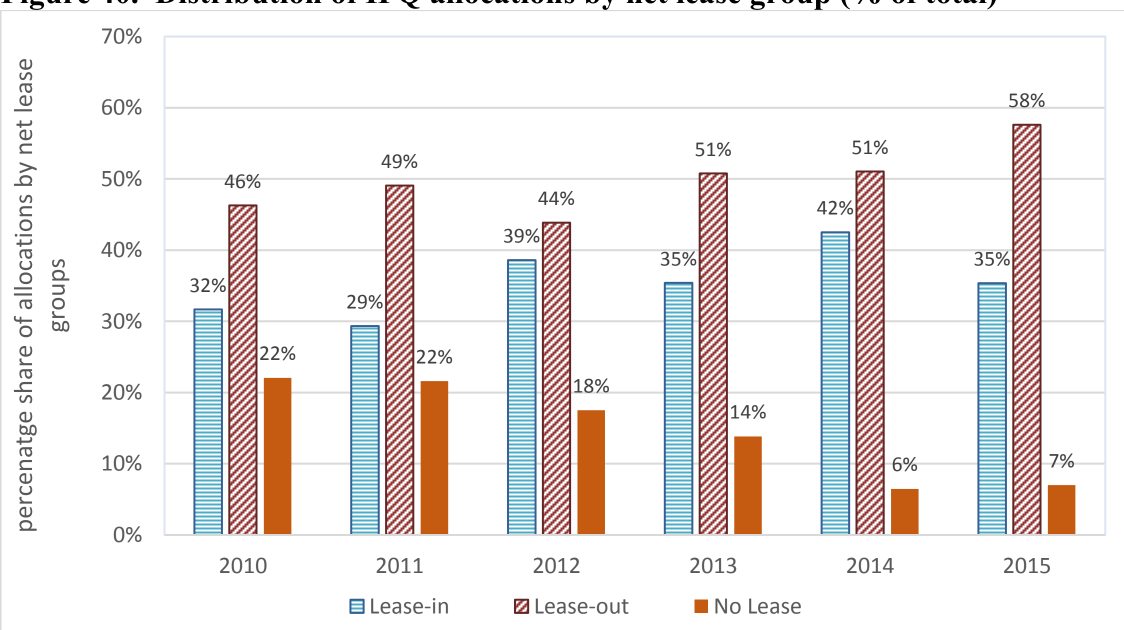


Figure 40. Distribution of IFQ allocations by net lease group (% of total)



4.3.4.3 Lease prices

Lease prices vary by an interlay of several factors that affect profitability of fishing as well as factors that affect the supply of quota from year to year. In addition to the changes in scallop prices, fishing costs, and productivity of the scallop resource in areas accessed by the LAGC-IFQ fishery, fishing seasons, distribution of IFQ allocations, and lease-out prices also differ according to whether 1) IFQ is leased to a vessel in the same affiliation or a different affiliation and also 2) if the quota leased out by an individual or by a permit bank. Permit banks always leased-out to a different owner.

As indicated in the previous section, the majority of the lease transactions involved different owners, whereas some represented a temporary transfer of IFQ from one vessel to another owned by the same individual or affiliation. The data show that for 65% of the lease-in transactions that took place among different owners during the 2010-2015 fishing years had a reported value for lease prices above a dollar, while 35% included either no price or a price between zero and $1 (Table 6, Appendix A). In contrast, only about 20% of the lease transactions among the same affiliations had a reported value of greater than a dollar, while 80% either had a zero or a very low value associated with them. It is not certain if any monetary transaction actually took place among the vessels with no or very low lease price, or if those reported values were just symbolic amounts. (Table 5, Appendix 6). Leasing-out data is similar in terms of reported lease-out values (Table 7 and Table 8, Appendix 7). As expected, average lease price was higher for transactions that took place between those different than those involved in the same affiliations.

There has also been differences in lease-out values according to whether it was conducted by permit banks or individual IFQ owners. Individual IFQ owners leased about 85% to 88% of the leased-out pounds, while the permit banks leased out the remaining 12% to 19% (Figure 32). Most of the leasing transactions that involved permit banks had lease values greater than zero. Table 15 includes all transactions with a positive value since permit banks usually leased at lower prices including at unit value. The lease price per pound of quota leased by the permit banks was almost half of the price leased by individual IFQ owners (Table 15).

Table 15. Lease-out prices by lease-ownership type (in current dollars, lease data)

Fishyear	IFQ holders	Permit Banks
2012	2.81	1.50
2013	3.26	1.80
2014	3.68	1.72
2015	3.77	1.83
Grand Total	**2.91**	**1.47**

Note: Only values greater than “zero” were included in those values.

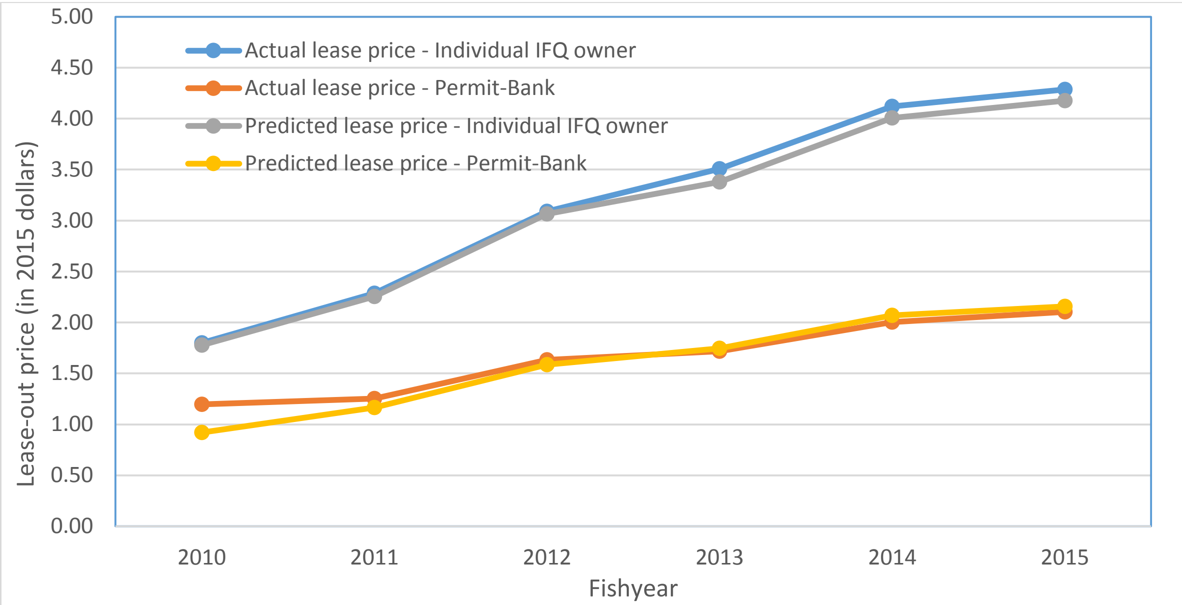
The following sections present two different models to explain the changes in the average annual and monthly lease prices. The annual model was constructed to estimate lease prices and then use these estimates to calculate estimated lease costs for vessels and affiliations and profits net of lease costs (Section 4.3.4.3.1). Section 4.3.4.3.2 presents a monthly model (developed by the SSB branch of NEFSC) to explain monthly lease prices as a function of scallop price and revenue, other species prices and revenue, fishing costs, resource availability (quota allocation and stock), market competitiveness and permit type, macroeconomic conditions, and both seasonal effects and yearly effects. The same sections also provide a summary of a micro-model of IFQ lease prices and explain lease prices as a function of the variables in the macro model, plus buyer and seller characteristics.

4.3.4.3.1 Estimation of Annual IFQ Lease Prices

Annual average IFQ lease prices were estimated using lease-out prices by inactive owners for the 2010-2015 fishing years using those records for which both lease price and lease value were greater than unity and excluding the lease group which leased out to both same and different owners. Each observation corresponded to an IFQ permit holder specified in terms of moratorium right id (MRI). The explanatory variables included scallop price net of trip costs per pound of scallops, number of vessels that were net leasers in each year, total IFQ allocations for active owners as a percentage of total IFQ allocation for the LAGC IFQ fleet, dummy variables for owner group, and affiliation type. If the quota was transferred to another vessel in the same affiliation, owner group variable was set to zero, otherwise it was set to unity. For the affiliation type, the dummy variable for permit banks was set to zero and for others it was set to unity.

The empirical results showed that these variables explain over 68% of the variation in annual lease prices during the 2010-2015 fishing years (Appendix A). All of the coefficients of the model had theoretically expected signs and were statistically significant. The predicted and actual lease prices shown Figure 41 indicate that this model provides a good fit for the estimation of annual lease prices per IFQ holder especially for the period 2012-2015. The predicted price for permit banks was consistently lower than the market lease prices and increased slowly starting in 2012, while the predicted lease prices for the transactions that took place among different affiliations more than doubled in the 2010-2015 fishing years (Figure 41). The percentage share of active vessels in total allocations was inversely correlated with the lease price indicating as their share declined lease prices increased (Appendix A).

Figure 41. Actual and estimated annual lease-out price (different owners)



4.3.4.3.2 IFQ Quota Market Model

Summary of results

- Trade volume in the permanent transfer market has increased, particularly after 2011. Trade volume in the leasing market has also increased. This is consistent with other ITQ markets.
- Permanent transfer prices have increased to approximately $40 per pound, although there is some variability. Leasing prices are approximately $4 per pound, and Sagain there is some variability.
- The leasing market appears to be related to underlying fundamentals: scallop prices affect prices in both the macro and micro models.
- Lease prices decline within a fishing year, consistent with decay of the time value component of this property right and other empirical findings.

Model description and discussion

A clear understanding of the quota market is crucial under ITQ management. According to Arnason (1990), under certain conditions (e.g., perfectly competitive markets), the fishery manager only needs to monitor the quota market price and to adjust the total quota (TAC) until the current total quota market value is maximized, which is the "minimum information management" scheme to achieve the socially optimal condition for the fishery. There are at least three functions of an efficient quota pounds (QP) market: to allocate QP to those who value it most, to encourage efficient use and discipline inefficient use of QP, and to provide information for business planning and policy decisions (Holland, 2016; Newell et al., 2007).

Previous studies of other tradable programs have found market activity was sufficiently high in the economically important markets and that price dispersion decreases over time (Newell et al, 2005). Market design and imperfections may be important in these new markets; Anderson (2004) illustrates how trading limitations can lead to very different final outcomes using a laboratory experiment. Lee (2012) illustrates the effects of trading limitations; Ropicki and Larkin (2014) examine the role of differences in information for the Gulf of Mexico Red Snapper quota market. Holland (2016) illustrates the market imperfections in the Pacific Groundfish market.

We estimate models of quota markets and individual transactions using data from the 2010-2015 fishing years following the general framework of Newell et al. (2005) and Lee (2012). During this period, the scallop IFQ lease market was quite active, with 1,852 lease (QP) transactions. In contrast, there were only 169 permanent IFQ share (QS) transfers. Participation was high; over 70% of the IFQ permit holders participated in trading QP.17

During the 2010 and 2011 fishing years, entities that made permanent transfers of QS were required to transfer their entire QS allocation prior to use of IFQ, and vessels that utilized any IFQ could not subsequently transfer IFQ later in the fishing year. Beginning in 2012, permanent transfers of QS that were less than an entity's QS allocation were allowed. In addition, vessels cannot be allocated more than 2% of the sub-ACL and individuals cannot have an ownership interest of more than 5% of the sub-ACL (73 Federal Register 20092-20093). There are also two "permit banks" that own QS and lease quota. The Cape Cod Fisheries Trust works with the Cape Cod Community Development Partnership to lease QP to local fishermen at below market rates. A similar permit bank is operated by the State of Maine.

Primary data sources for the study included separate data files on approved IFQ lease transactions, IFQ permanent transfers, vessel logbook (fishing trip records), and scallop fishing quota base allocation, vessel permit data, and scallop biomass data from the National Marine Fisheries Service (NMFS). The total value of leases increased from, on average, $74 thousand per month in 2010 to $350 thousand per month in 2015. Similarly, total lease quantity grew from 37 thousand to 90 thousand pounds per month (Figure 42).18 Significant seasonal variation existed in the lease market, and the number of lease transactions fluctuated between 10 and 60 leases per month. About half of the transactions involved CPH sellers. Scallop price was rising from approximately $9/lb. to $13/lb. in the study period. A similar trend was also present in IFQ lease price, increasing from about $2/lb. in 2010 to over $4/lb. in 2015 (Figure 43).

For our analysis, we developed two types of models: a macro-model of the aggregate IFQ lease market and a micro-model of individual quota lease transactions. The macro-model explains monthly lease prices as a function of scallop price and revenue, other species prices and revenue, fishing costs, resource availability (quota allocation and stock), market competitiveness and

[17] The 40 dual-permitted vessels (LA and LAGC-IFQ) are not allowed to transfer or lease their QS or QP and not included in the analysis.

[18] The annual quantity accounted for about 42% of the total quantity of all lease transactions (including those with missing lease value information) in fishing year 2010, and around 65% in fishing years 2013-2015.

permit type, macroeconomic conditions, and both seasonal effects and yearly effects. The macro models fit well; R-squares around 0.85. The estimation results suggest that the lease price is positively related to scallop price, which is consistent with economic theory and the findings of Newell et al. (2005). Lease prices are also inversely related to the number of permit-bank sellers that were active, which is consistent with the missions of these organizations to offer quota at below-market prices to encourage fishing activity in their communities. IFQ lease price is expected to be higher if the total scallop revenue in the previous month was high, and lower if the percent of scallop quota fished is high. The percentage of the quota fished was found to be inversely related to QP prices. This may reflect either a decreases in the "time" or "option-value" of holding IFQ or within-season decreases in the value of exercising the real-option. Other results indicate that positive relationships exist between IFQ lease price and variation of fishing costs across vessels (measured as the standard deviation of trip cost), macroeconomic condition (GDP), and trade in September.

The micro-model of IFQ lease prices explains lease prices as a function of the variables in the macro model, plus buyer and seller characteristics. The micro models fit well also. The lease price is positively related to scallop prices, GDP, and trade in September, and negatively related to percent of scallop quota fished. Furthermore, the micro-model results suggest that IFQ lease price is expected to be lower if the number of sellers in a month is large, the seller is part of a permit bank or a frequent seller, the buyer has large quota base allocation, and the buyer's vessel is large.

According to economic theory, the price for IFQ transfer (QS) is equal to the capitalized profits in the fishery over time, whereas the IFQ lease price reflects the marginal net return in the fishery. These two should be positively correlated (Figure 44), and the ratio of lease prices to transfer prices reflects the discount rate perceived by scallop IFQ traders.

Figure 45 illustrates that the general movement of the lease to transfer price ratio follows that of the rate of 10-year Treasury note. The mean T-note rate and mean price ratio are 2.4% and 9.9%, respectively. On average, the price ratio is 4.3 times the T-note rate. Fishing, as well as investing in a newly-created property right associated with fishing, is far riskier than investing in US Treasury securities.

Figure 42. Monthly Total IFQ Lease Quantity and Value

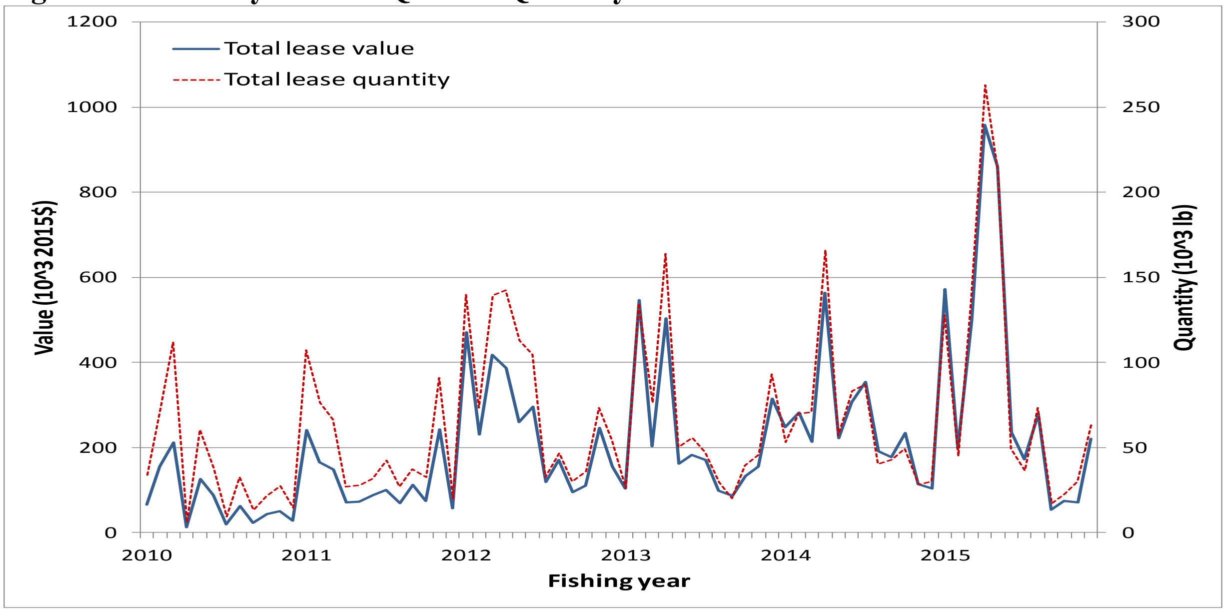


Figure 43. Monthly Mean IFQ lease Price and Scallop Price

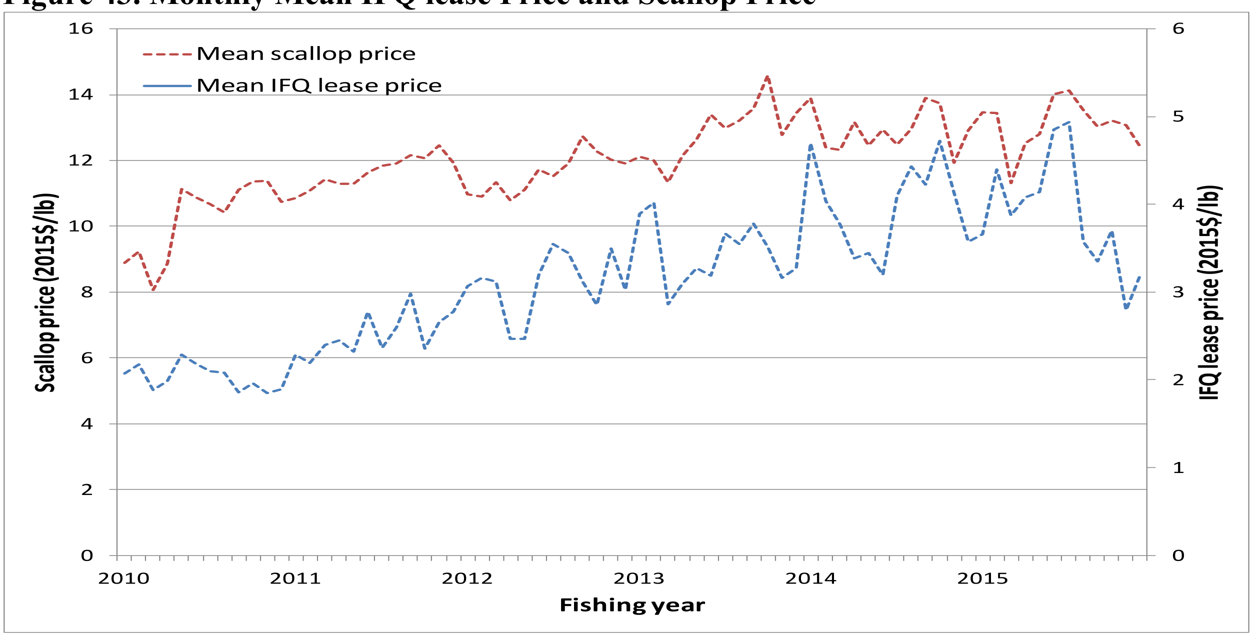


Figure 44. Monthly Mean IFQ Lease and Transfer Prices

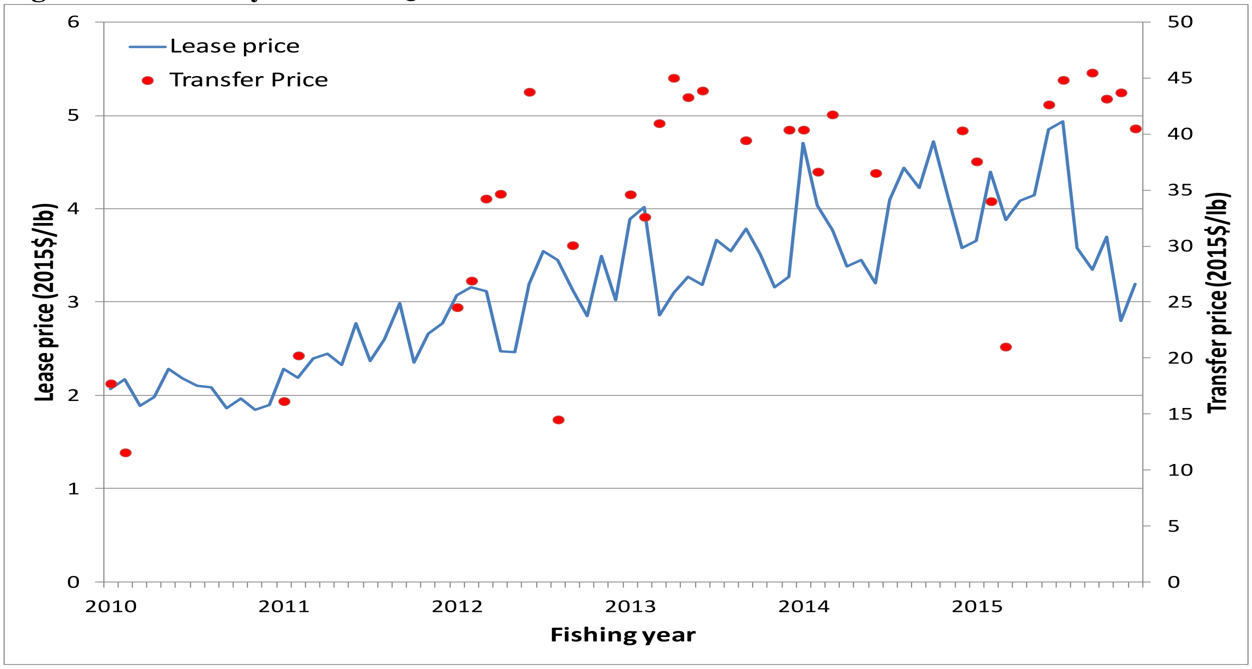
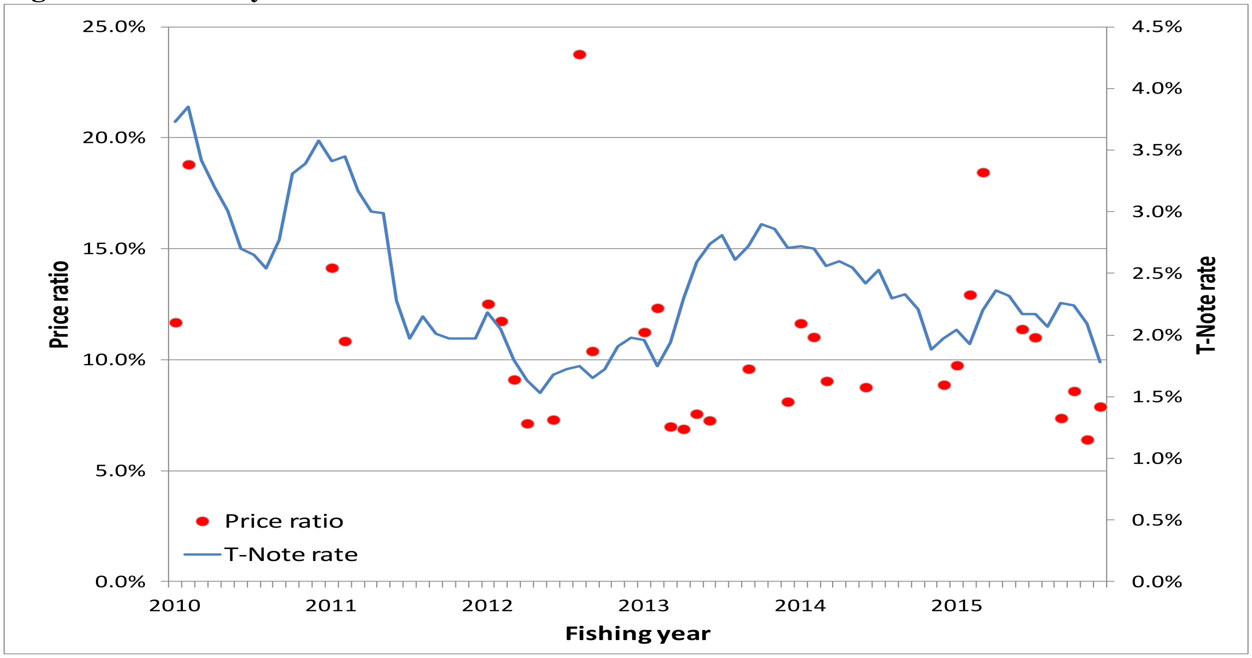


Figure 45. Monthly Lease-Transfer Price Ratio vs. T-Note Rate



4.3.4.4 Conclusions

There is no question that transferability measures included in measures included in Amendment 11 led to a surge in quota transfers and leasing especially after some of the restrictions on transfers were reduced with the subsequent modifications to the program in Amendment 15. Transferability facilitated movement of quota from IFQ holders with relatively smaller allocations to active affiliations with larger allocations that target scallops during the period

2010-214. However, this trend was reversed in 2015 as quota was consolidated in fewer inactive affiliations.

The analyses of the quota and lease markets show that lease prices varied with the changes in demand and supply for quota as expected by the economic theory. During 2010-2015, quota and lease prices increased due to the rise in scallop ex-vessel prices, lower fuel costs, the increase in the number of vessels participating in the fishery, and concentration of a higher proportion of overall IFQ allocations in the affiliations that lease out quota consistent with the findings of the annual lease price model. The results of the monthly model of the quota market showed the lease price is positively related to scallop prices, to the GDP, and trade in September, and negatively related to the percent of scallop quota fished. Furthermore, the micro-model results suggested that IFQ lease price is expected to be lower if the number of sellers in a month is large, the seller is part of a permit bank or a frequent seller, the buyer has large quota base allocation, and the buyer's vessel is large.

According to economic theory, the price for IFQ transfer (QS) is equal to the capitalized profits in the fishery over time, whereas the IFQ lease price reflects the marginal net return in the fishery. These two should be positively correlated (Figure 16) and the ratio of lease prices to transfer prices reflects the discount rate perceived by scallop IFQ traders. There has been a decline in the ratio of the lease prices to quota prices in those six years from 13% in the 2010 fishing year to about 10% in the 2012 fishing year. This number ranged from 9% to 11% in 2013-2015. Decline in this ratio could be a sign of a decline in the perceived uncertainties about future returns.

4.3.4.5 Trend in Profits in the implementation period (2010 – 2015)

4.3.4.5.1 Estimation method for fixed costs and profits

This section estimates profits using two definitions; economic profit, which consists of revenue minus implicit (opportunity), and explicit (monetary) costs and accounting profit, which consists of revenue minus explicit costs. In either definition, the fixed costs of production are taken out of the boat share of revenues. Fixed costs for scallop fishing include repairs and maintenance, hauling costs, insurance, office expenses and professional fees, interest payments on mortgages and loans, association fees, travel, and vehicle expenses. The 2011 and 2012 cost surveys provided by the Social Services Branch of NEFSC are used to estimate fixed costs in 2015 dollars. The survey data comprised about 55 scallop vessels with limited access and LAGC IFQ permits. Using this sample, fixed costs were estimated as a function of vessel characteristics, and a dummy variable for vessels with IFQ permits only and total revenue as described in Section 4 of Appendix I. The resulting fixed cost equation is used to project the fixed costs for the active vessels in the LAGC IFQ fleet after adjusting for the percentage of income derived from scallops and the number of trips.

Another piece of information required for the estimation of profits is the 'lay system' used to divide the revenues and costs among the boat owner and the crew for each vessel. According to the anecdotal information from the participants of scallop fishermen, the lay system varies from one boat to another. Furthermore, some vessel owners may share lease costs with the crew while others may take them out of the crew share applying a different lay formula. Profits are estimated in this section assuming either lease costs are shared equally among the owner or the crew or lease costs are paid entirely by crew.

According to the cost survey data for 2011-2012, boat share for the scallop vessels was 48.7% in 2011 and was 51.2% in 2012, averaging to about 50%. Based on this information, the boat and crew are assumed to share 50% of the gross revenue while the crew pays for the trip costs and the boat owner pays for the fixed costs. Profits for each affiliation were estimated as a sum of profits from each vessel that belong to that affiliation.

Cost or revenues from leasing were based on the actual values of the leased quantities and lease price estimates. Lease prices are estimated as a function of ex-vessel price net of trip costs per pound of scallops, affiliation type, share of active owners in total IFQ allocations, and number of vessels that lease quota using the annual lease cost equation discussed in Appendix A. Lease-out values are treated as a part of profits for affiliations that lease quota to others. For affiliations that lease-in quota, profits are estimated using two assumptions: by either assuming that boat share 50% of the lease-in costs or that lease-in costs are entirely paid by crew. The transaction costs in leasing quota could not be taken into account because no data were available on the costs associated with arranging leases between individuals. In addition, the net revenues for the owners who lease in from other owners could be overestimated if some owners acquire bank loans to lease quota and pay interest on those loans. Information regarding the terms and prevalence of such bank loans among active owners require an extensive survey and could be considered as a part of future research. For the estimation of the economic profits, opportunity costs of capital are deducted from the accounting profits. Opportunity cost of capital were based on estimated vessel values and evaluated using Moody's Seasoned Baa Corporate Bond Yield. (Appendix J).

It must be cautioned that actual profits will be different for each vessel from the profits estimates provided in this section since fixed cost estimates and the crew share formula was based on a small group of vessels included in the cost survey. For these reasons, the resulting numbers and figures should be considered as rough estimates of both accounting and economic profits.

Finally, it must be pointed out that the analyses provided in this section do not aim to estimate net economic gains of an owner from fishing his/her quota relative to gains he/she would obtain from leasing out or from permanently transferring his/her IFQ. Rather the goal is to evaluate how profits for different groups of owners in terms of activity or leasing have changed relative to the 2010 fishing year with the implementation of the IFQ program.

4.3.4.5.2 Profits for active vessels

The estimated accounting profits for the active vessels more than doubled from $4.9 million in 2010 to $10 million in 2015 (in 2015 dollars) assuming that all the lease-in costs are paid by the crew (Figure 46). The rise in profits would be smaller, an increase from $4.1 million in 2010 to $7 million in 2015, if the lease-in costs were shared equally by crew and boat owner. The increase in scallop landings (by 8%) was relatively small during this period. Major factors in this trend were the rise in scallop revenue by 47% due higher scallop prices and the consolidation of effort on fewer vessels, possibly with more efficient crew and vessel platform (reducing fixed costs such as maintenance, insurance and repairs from operating multiple vessels. In addition, there was a decline in vessel size during this period which probably helped to reduce costs (Section 4.2.4).

The economic profits are lower than accounting profits because they are net of the opportunity costs of capital. However, the rate of increase in economic profits was higher, an increase of threefold or more, from $1.5 million in 2010 to $4.4 million in 2015 assuming the lease-in costs were shared equally by crew and boat owner or from $2.2 million in 2010 to $7.4 million in 2015 assuming lease-in costs were paid by crew. This was due to the reduction in excess capital and reduction in opportunity costs of capital as fewer vessels participated in the IFQ fishery (Figure 47).

Assuming lease-in costs were paid by crew, accounting profit margin grew from 23% in 2010 to 33% in 2015 and economic profit margin increased from 11% to 24% in the same period (Figure 48 and Figure 49). However, if the lease costs were shared equally by the crew and the boat, the increase in accounting profit margins would be smaller, from 20% in 2010 to 23% in 2015 for accounting profits, but economic profits would still double from 7% to 14% during the same period due to the rise in the lease prices.

Figure 46. Accounting profits including leasing revenue (active vessels)

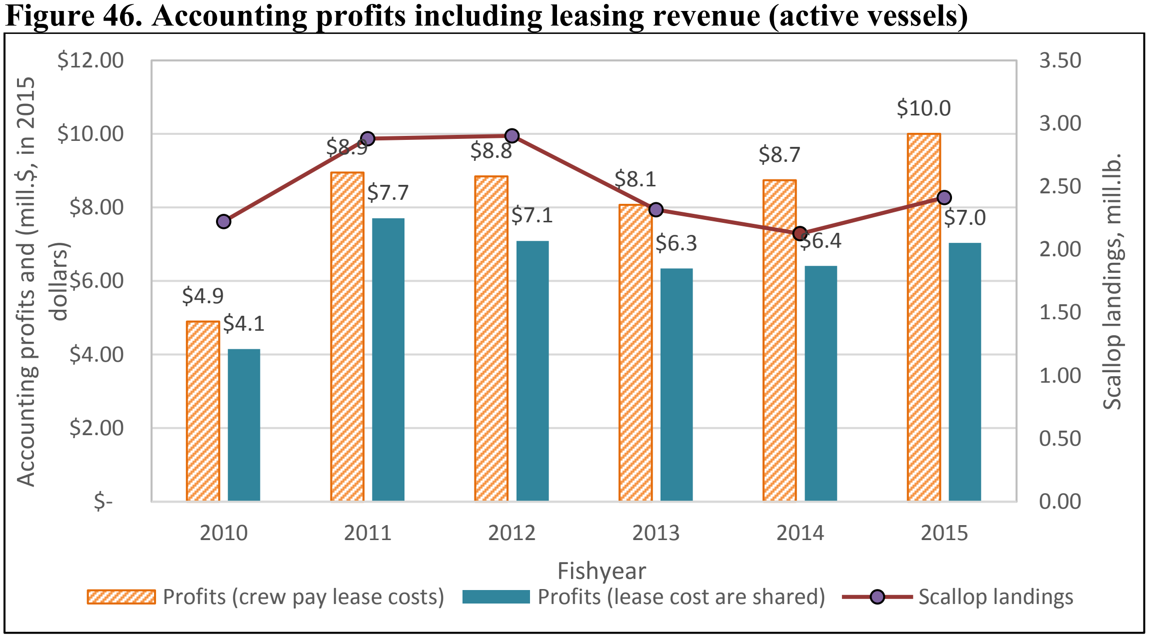


Figure 47. Economic profits of active vessels (includes opportunity costs of capital, lease cost and revenue)

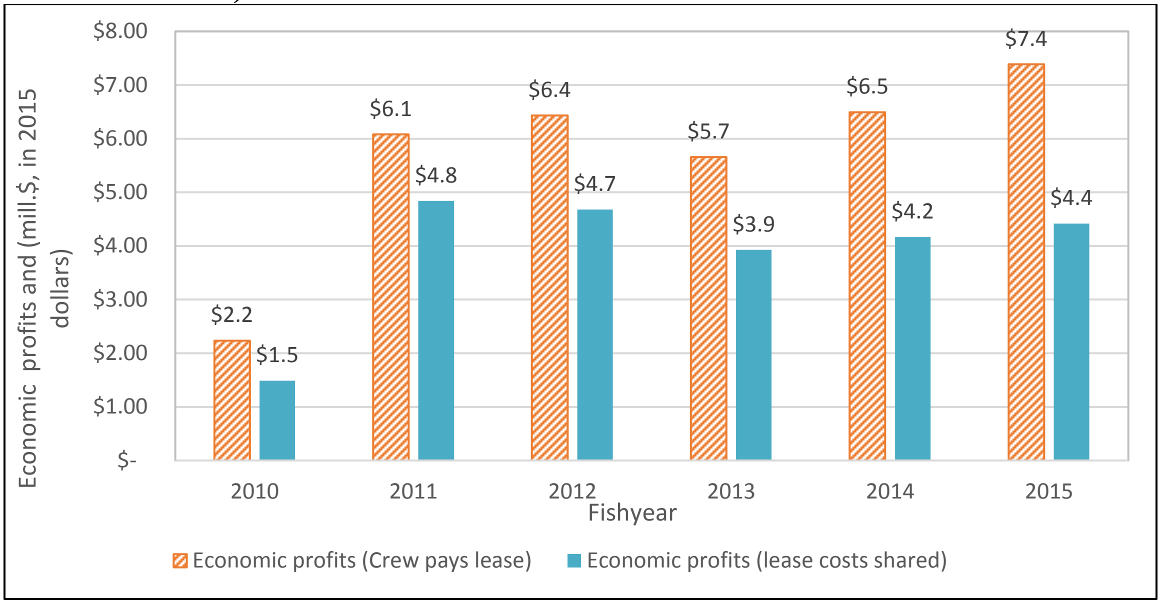


Figure 48. Accounting profit margin (active vessels, excluding opportunity costs of capital, includes leasing revenue)

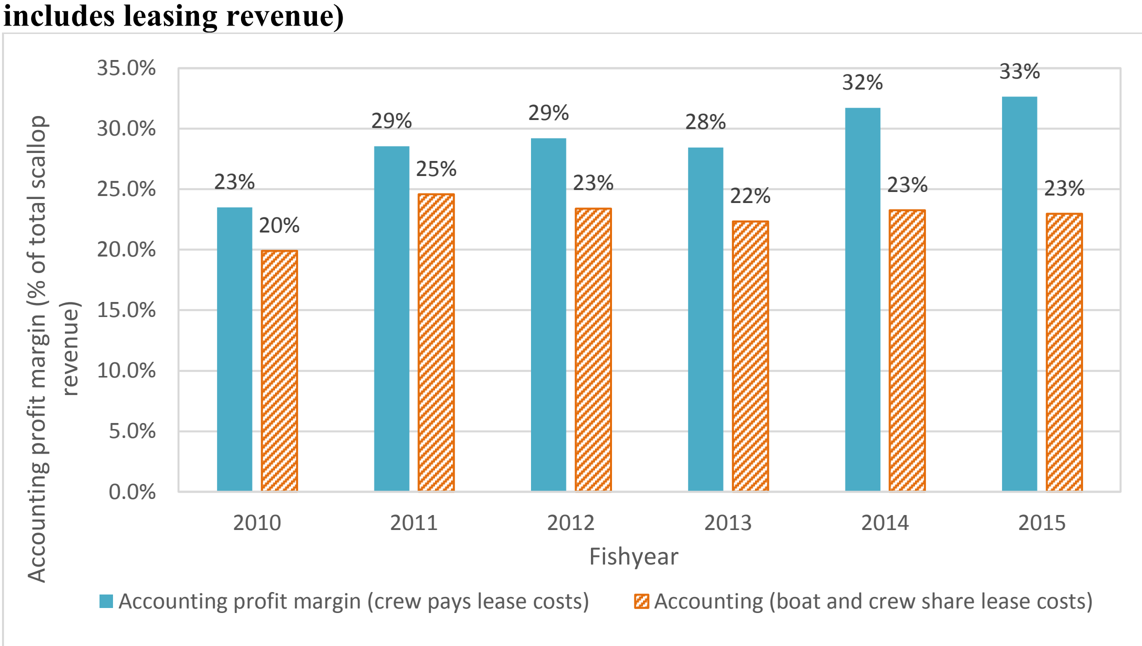
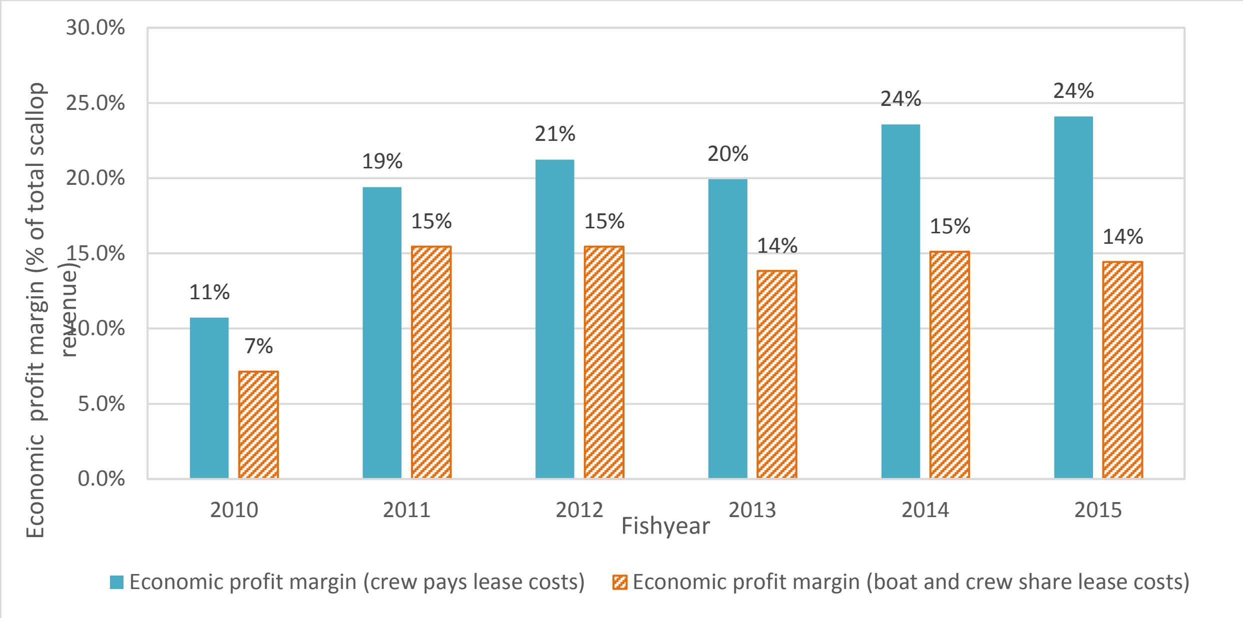


Figure 49. Economic profit margin (active vessels, including opportunity costs of capital, includes leasing revenue)



4.3.4.5.3 Profits for affiliations

Aggregate profits of active vessels could underestimate true value of the fleet profits because it does not take into account leasing that took place within the same affiliations. About 127 active affiliations in 2010 owned about 210 permits, and about 102 affiliations in 2015 owned about 181 permits. Of these, 58 permits in 2010 and 53 permits in 2015 did not participate in the scallop fishery but transferred their quota to active vessels either within the same or a different affiliation (Figure 16).

Therefore, when profits are estimated by affiliation, net cost of leasing would be zero if the quota was leased from another permit in the same affiliation. This results in higher profits for the active affiliations as a whole compared to total profits for active vessels. According to these estimates, aggregate accounting profits of *active* affiliations more than doubled from $5.3 million in 2010 to $11.4 million in 2015, and economic profits more than tripled from $2.7 million in 2010 to $8.8 million in 2015 if it was assumed that crew paid the leasing costs but earnings from leasing out were kept by the boat owners (Figure 50). Using the same assumptions, accounting profit margins are estimated to increase from 26% to 37% and the economic profit margins from 15% to 29% in the same period (Figure 50). Even if lease costs were shared equally by crew and the boat owner, both accounting and economic profits for *active* affiliations would still increase significantly. Accounting profit margins would reach to about 26% in 2015 from about 21% in 2010 and economic profit margins would increase to 19% in 2015 from about 9% in 2010 (Figure 51).

If the earnings from leasing are included as pure profits for inactive affiliations that lease out their entire quota, aggregate accounting profits for the fleet as a whole would again more than double from about $6.5 million to $15.2 million during 2010-2015 assuming crew pays the lease costs and economic profits would increase from $3.9 million in 2010 to $12.5 million in 2015 (Figure 52). Similarly, both the accounting and economic profits would at least double during this period even if lease costs were shared by the crew and the boat owner (Figure 53).

Overall economic profit margins would increase from 19% to 41% if crew paid the lease costs and they would increase from 14% to 30% if lease costs were shared by the boat and crew (Figure 53). Accounting profit margins would increase as well from 31% to 50% if crew paid lease costs and would increase from 27% to 39% if leasing costs were shared (Figure 53).

In terms of the distribution of profits by activity, the share of active affiliations in total accounting profits declined from 82% in 2010 to 75% in 2015 as lease prices increased during this period producing more income for inactive affiliations (Figure 54). In terms of economic profits, however, there was almost no change in the share of active and inactive affiliations from 2010 to 2015 due to the decline in opportunity costs of capital as the active affiliations consolidated effort on fewer vessels (Figure 55). However, share of the active affiliations were higher in 2011, 2012 and 2013 and 2014 compared to inactive affiliations, assuming crew paid the leasing costs (Figure 55). One factor for the higher share of the active affiliations in 2011 was the increase in the share in overall quota owned by those affiliations from 68% in 2010 to 72% in 2011. However, in other years, the share of active affiliations in the overall quote was lower from the levels both in 2010 and 2011, to 58% in 2012 and 61% in 2013 and 65% in 2014 (Figure 17).

It was probably consolidation of the effort on fewer vessels owned by the active affiliations during these years that reduced fixed costs and increased profits. The number of active vessels owned by active affiliations declined to 126 in 2012 and 129 in 2013. More vessels participated in the IFQ fishery in 2014 and 2015 due to the jump in scallop prices to about $13 per pound in 2014 and to $12.7 per pound in 2015 from about $11.9 per pound in 2013 and less than $11 in the years before. However, the number of active vessels were still less than what they were in 2010 (152 vessels) and 2011 (140 vessels) (Figure 16). As analyzed in Section 0 above, the reduction in excess capital, increase in prices and lower fuel costs scallop resulted in higher net revenue per active vessel and per active affiliation during 2011-2015 compared to the levels in 2010 (Figure 25, Figure 27 and Figure 28).

Figure 50. Accounting and economic profits (active affiliations, crew pays leasing costs)

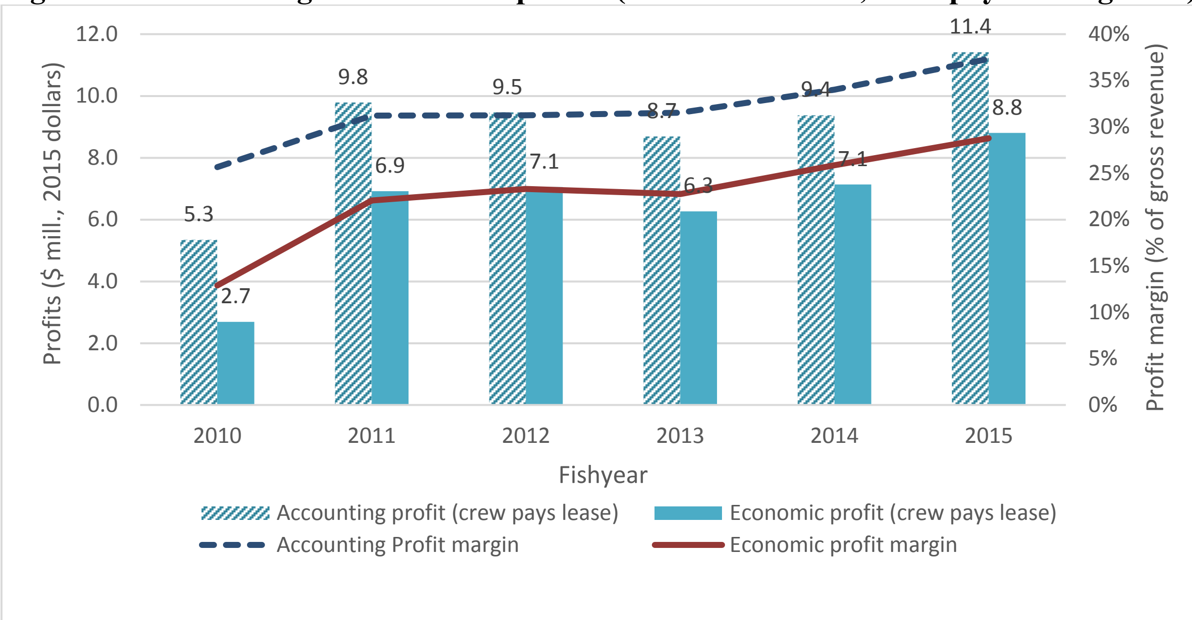


Figure 51. Accounting and economic profits (active affiliations, lease costs are shared)

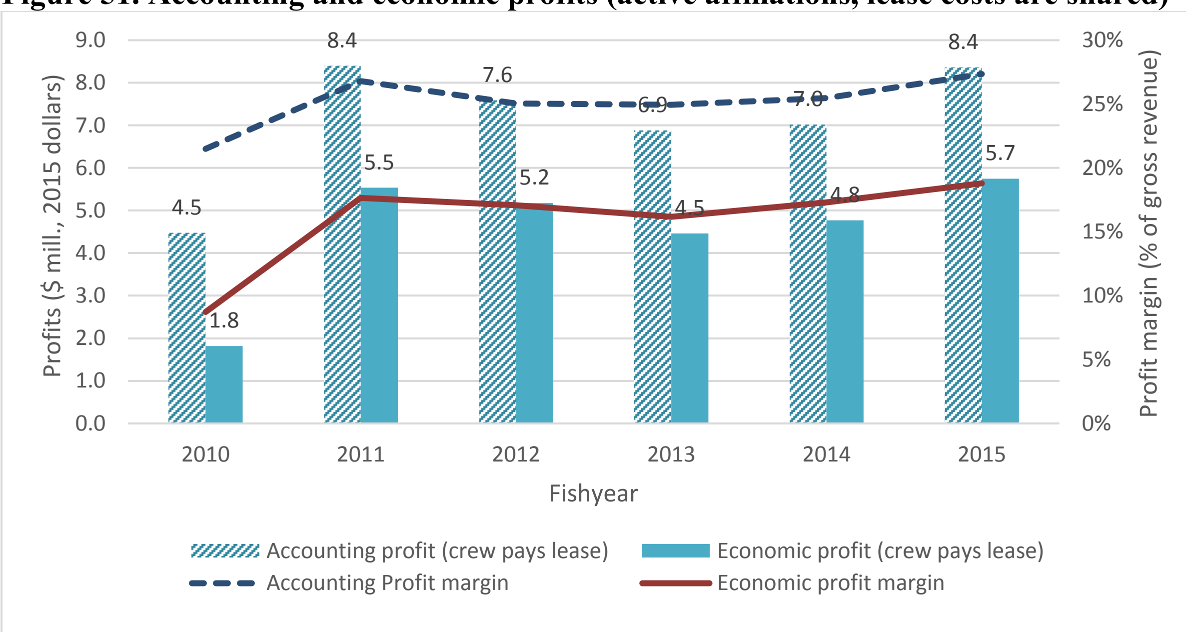


Figure 52. Profits (all affiliations, crew pays lease costs)

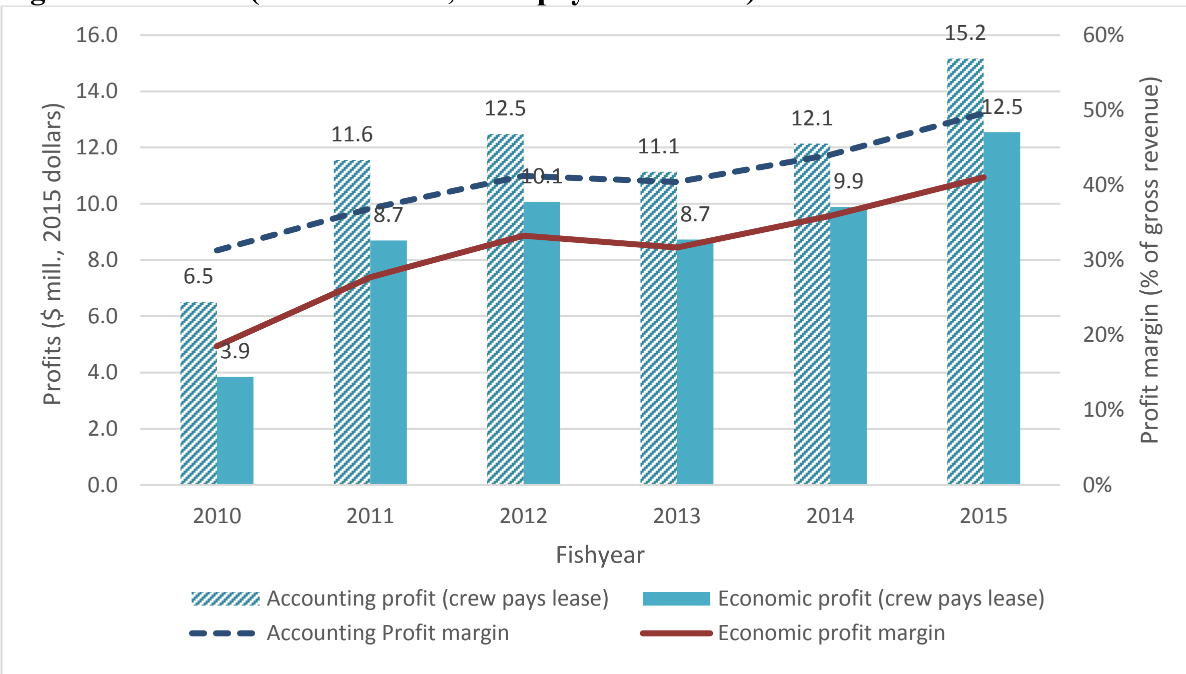


Figure 53. Profits (all affiliations, lease costs shared)

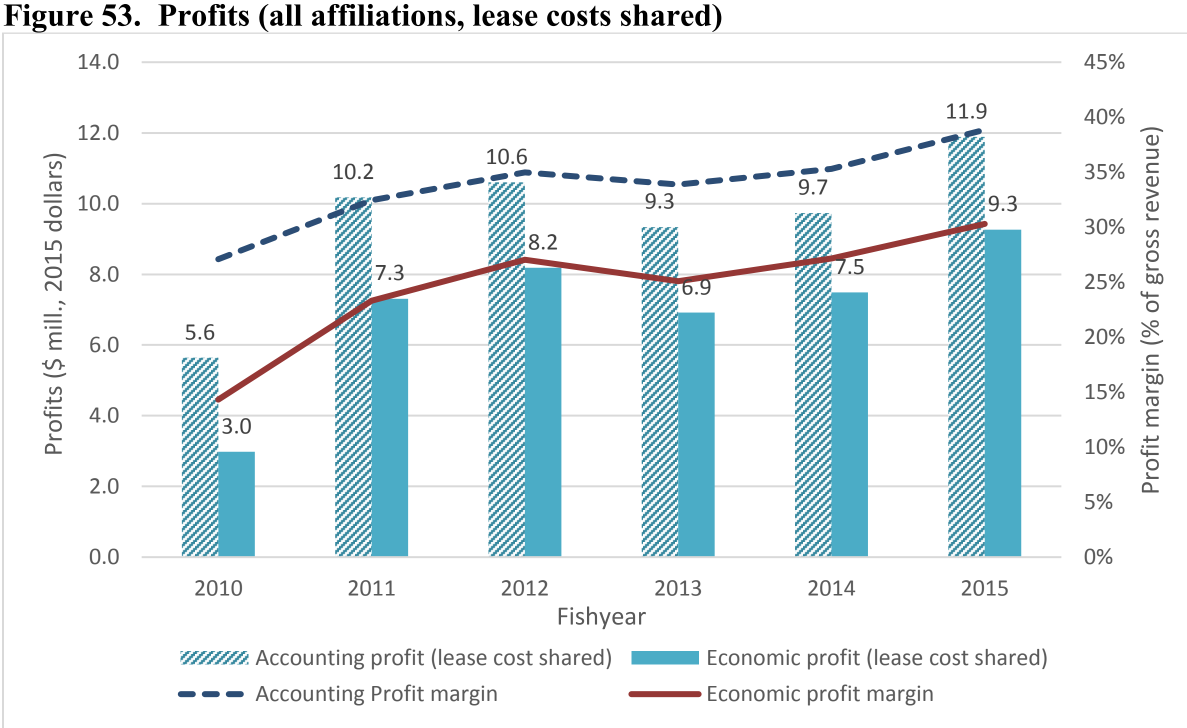


Figure 54. Distribution of total accounting profits by activity status (assuming crew pays for leasing costs)

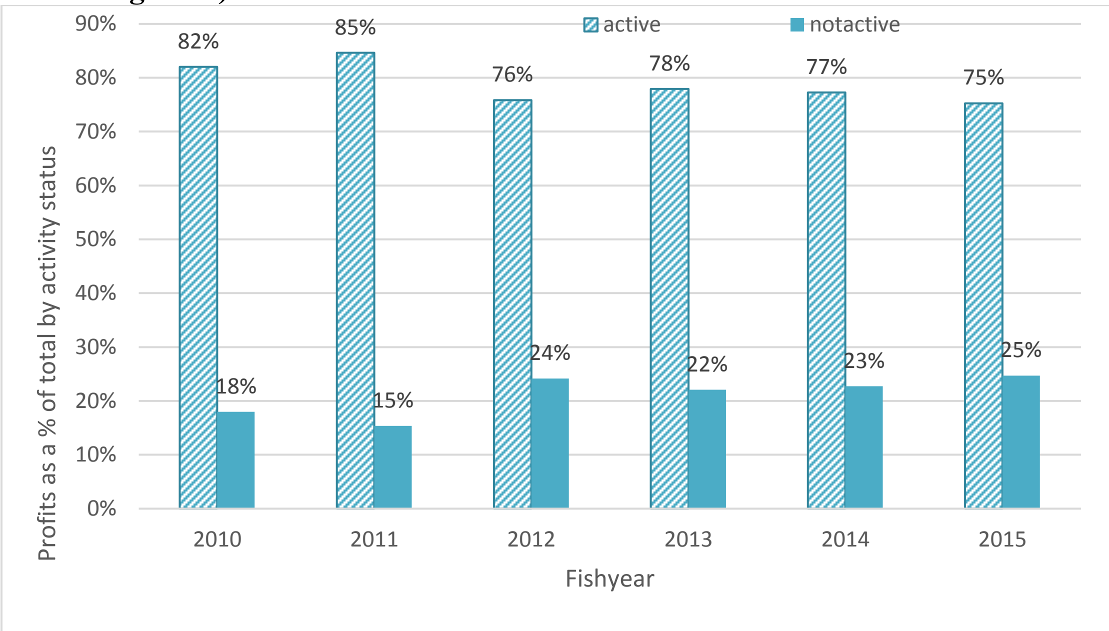
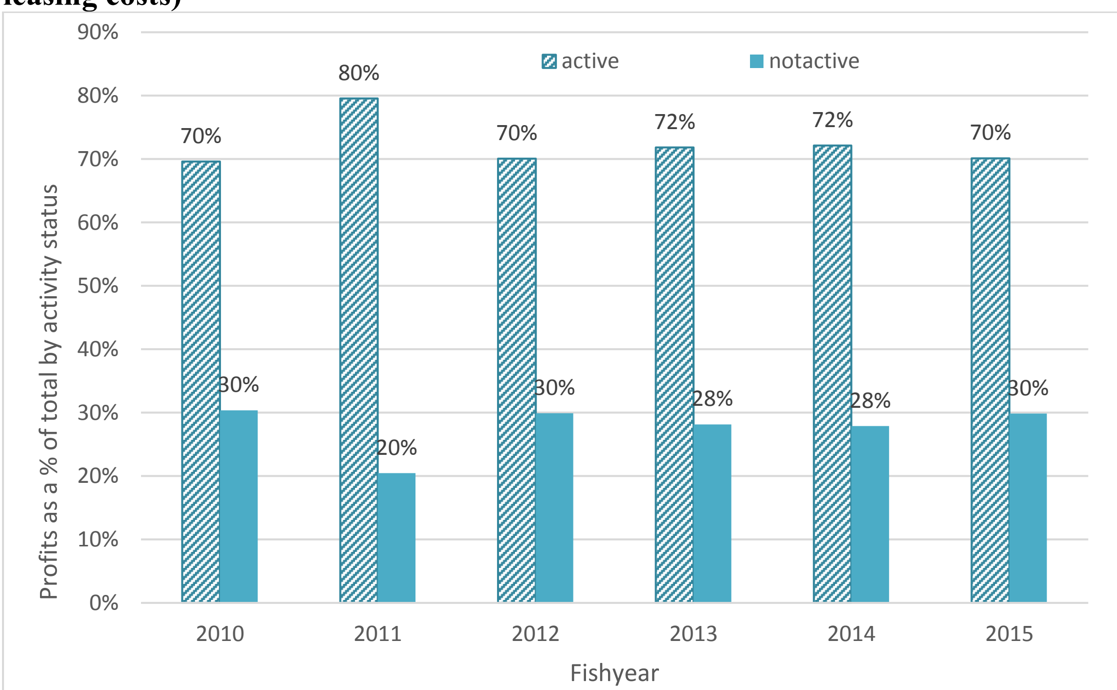


Figure 55. Distribution of total economic profits by activity status (assuming crew pays for leasing costs)



4.3.4.5.4 Profits for the LAGC IFQ per affiliation

Estimated annual accounting profits per affiliation increased substantially during 2010-2015, from $42,093 in 2010 to $111,936 in 2015 (or by 166%) for active affiliations, assuming crew pay the leasing costs and from $11,054 to $41,650 (a fourfold increase) per inactive affiliation during the same period (Figure 56). During this period the total IFQ fleet accounting profits for active affiliations increased by 114% while scallop revenues increased by 60% mostly due to the increase in allocations and ex-vessel prices. Consolidation of quota in fewer vessels, possibly on vessels with more efficient platform and skilled crew led to even a higher rate of increase per active affiliation (Figure 57).

Similarly, economic profits per active affiliation increased from $21,144 in 2010 to $86,273 in 2015, while economic profits per active affiliation increased from 11,054 to $41,650 (a fourfold increase) per inactive affiliation in the same period (Figure 58 and Figure 59). This was due to doubling of the lease-out price from $1.80 per pound of quota in 2010 to $4.29 in 2015 for affiliations and from $1.20 in 2010 to $2.10 in 2015 for the permit banks as well as the increase in leased out pounds by 71% per inactive affiliation (Figure 60). Inactive affiliations include those with permits in CPH and others without a vessel that participate in the scallop fishery so that opportunity costs of capital invested in their vessels are assumed to be zero.

In conclusion, the trends for profits in the LAGC IFQ fishery were positive from 2010 to 2015 fishing years, mostly driven by the increase in scallop landings, prices and revenues during the time period, but also due to the consolidation of quota in fewer vessels and among fewer owners. Profits per owner are estimated to be higher for those owners who lease-in quota, participate in the fishery mainly to target scallops and lease-in quota form others. The numerical results of this section should be interpreted with caution since the fixed costs were projected using a small sample of survey cost data and based on some strong assumptions regarding the value of fixed costs for vessels and owners with a low participation in the LAGC fishery. Therefore, actual profits are likely to differ from the estimated profits and the numerical results of this section should be used solely for purposes of comparison and in assessing the trends since 2010.

Figure 56. Accounting profits per affiliation (assuming crew pays for leasing costs)

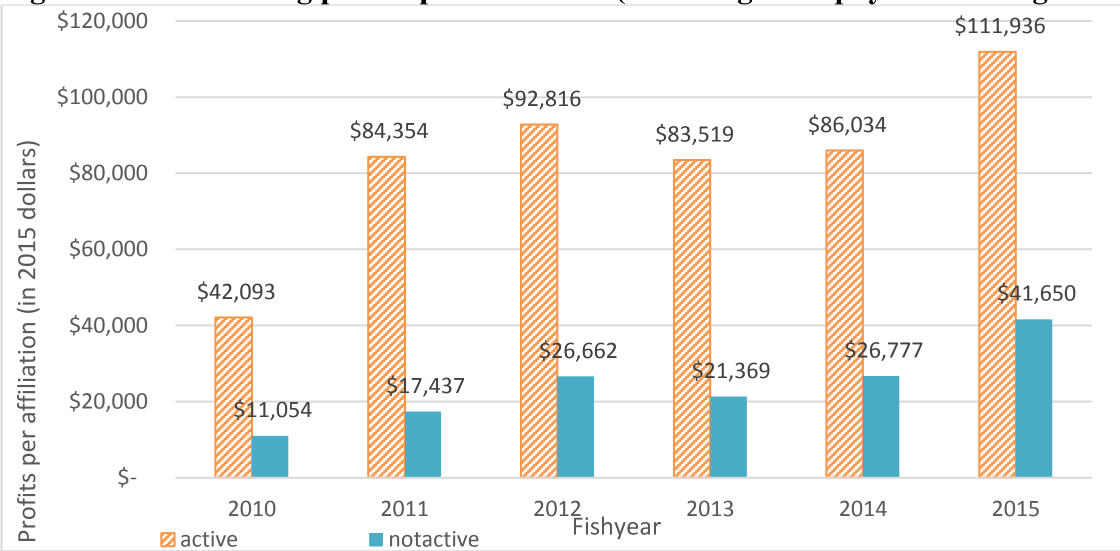


Figure 57. Percentage change in accounting profits per active affiliation (assuming crew pays for leasing costs)

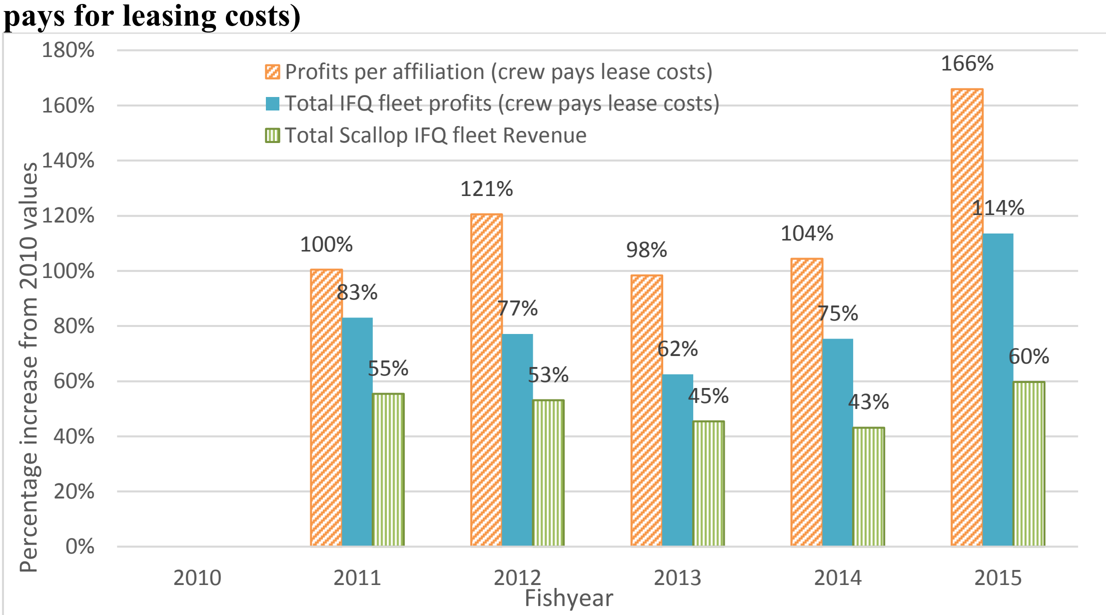


Figure 58. Economic profits by per affiliation (assuming crew pays for leasing costs) =

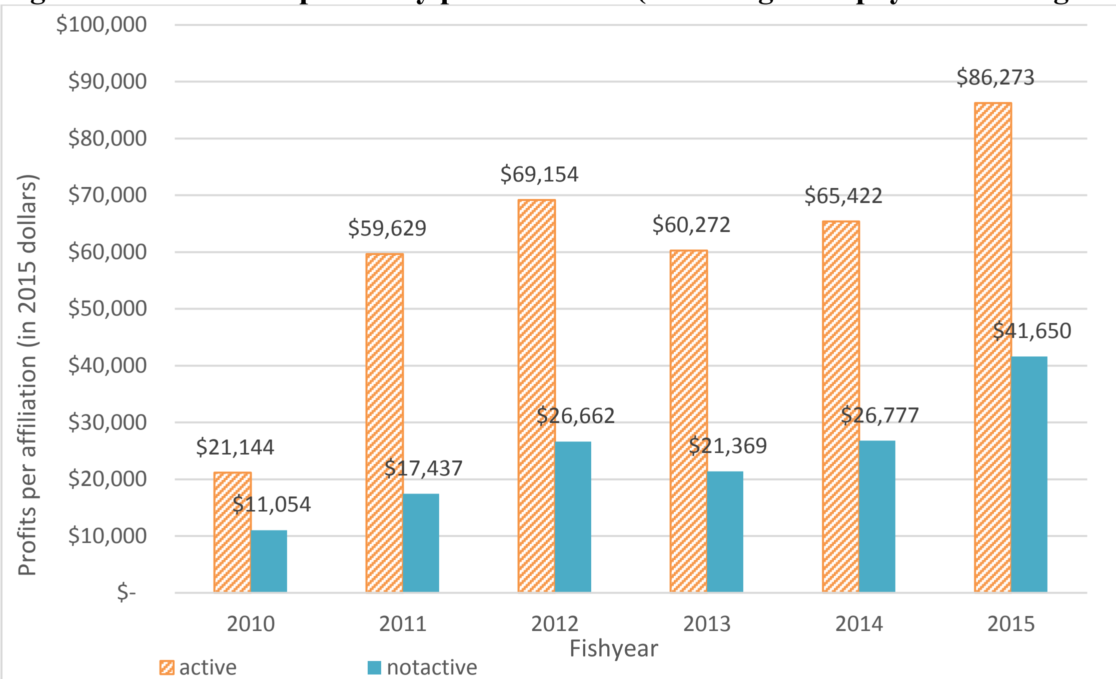


Figure 59. Percentage change in economic profits by per affiliation since 2010 fishing year (assuming crew pays for leasing costs)

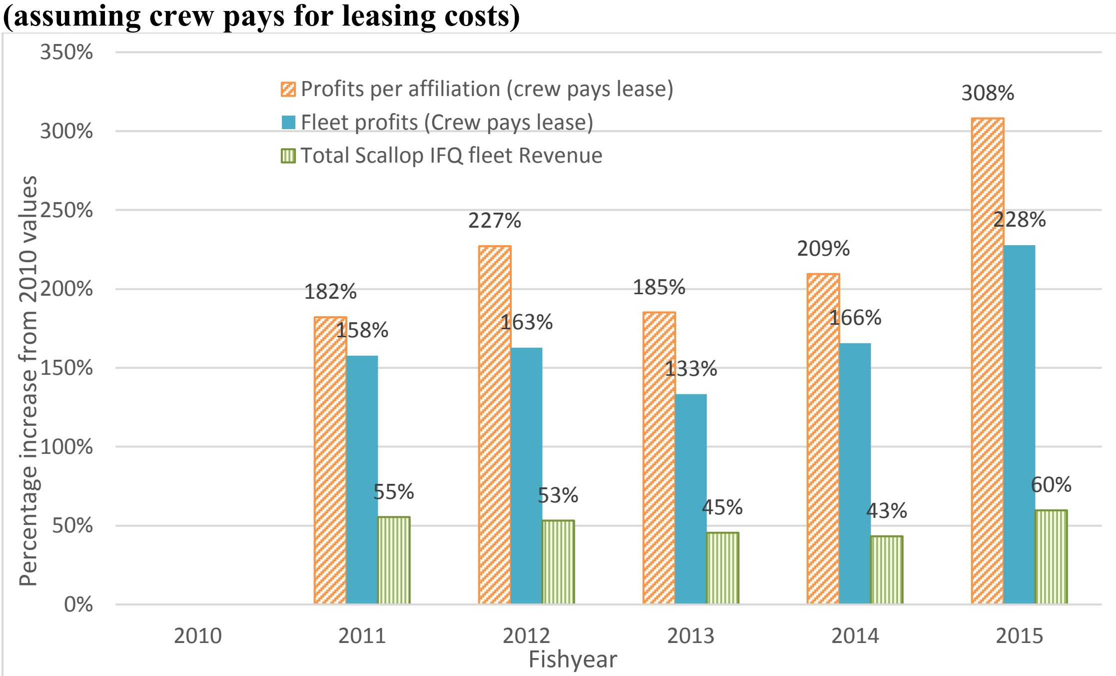
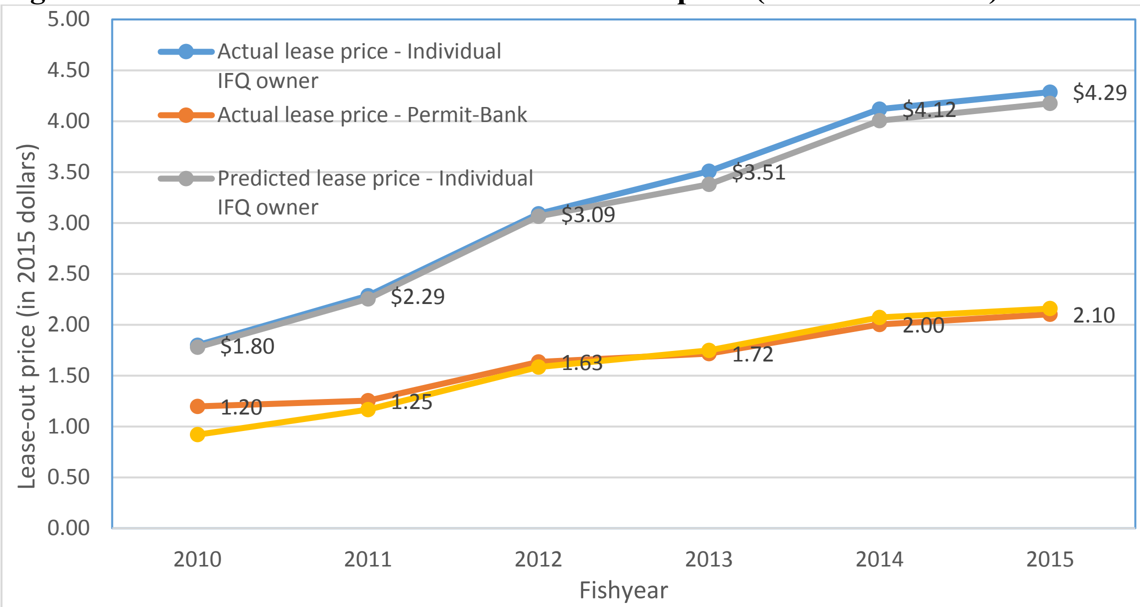


Figure 60. Actual and estimated annual lease-out price (different owners)



4.3.5 Trends in employment and crew shares

The changes in the number of active vessels, in overall landings, possession limit and LPUE are factors that determine the changes in total DAS spent on scallop trips and the level of employment in the LAGC IFQ fishery. There has been a decline in the number of active vessels from 152 in 2010 to 128 in 2015, leading to a decline in the total number of crew positions as measured by summing average crew size of all active vessels from 433 in 2010 to 369, or by 15% in the 2015 fishing year. There has been a very slight increase in the number of crew employed per vessel in the same period.

It is uncertain, however, to what extent those changes reduced actual number of crew employed in the fishery. If each LAGC IFQ boat employed different individuals as crew to begin with, then a decline in the number of boats would reduce total number of crew positions by 15% in the 2015 fishing year relative to the levels in 2010 (Table 16). However, if the same crew members were employed on different boats for different shifts, especially on those owned by the same individual or company, then there could be a smaller decline in the total numbers of individuals employed as a result of consolidation of effort in fewer vessels. Furthermore, not every active vessel participated in this fishery at the same level as many boats derived a major proportion of their revenue from species other than scallops and took only a few trips targeting scallops. The decline in the number of those vessels with little dependence on the scallop revenue would probably have little impact in employment in the LAGC fishery. Therefore, for a better estimate of the employment in this fishery, time spent for fishing scallops should be taken into account. The number of trips is another indicator for the opportunities available to the crew members to earn a share of revenues from each trip. However, crew trips do not take into account the changes in trip duration due to changes in LPUE which affects total hours of employment and earning opportunity per trip. Therefore, crew hours or crew DAS would be a better estimate of the changes in employment in the fishery. The total crew hours were converted to crew days (CREW*DAS) in Table 16.

Total DAS from scallop trips increased by 14% in 2015 compared to levels in the 2010 fishing year due to the increase in the possession limit by 50% from 400 lb. per trip in 2010 to 600 lb. starting with the 2011 fishing year as well as due to the increase in scallop landings by 8%. In addition, LPUE decreased by 4% in 2015 compared to the levels in 2010 as scallop abundance in areas fished by the LAGC IFQ vessels declined in 2014 and 2015. The decline in the number of vessels led to an increase in the average DAS per vessel on scallop trips by 35% in 2015. The increase in overall DAS combined with a slight increase in the average number of crew employed on the active vessels resulted in a rise in employment by 15% in 2015 as measured by CREW*DAS (Table 16).

Table 16. Number of active vessels, crew, effort and changes in employment

Fishyear	2010	2011	2012	2013	2014	2015
Number of active vessels	152	140	126	119	131	128
Average number of crew per vessel	2.8	3.0	3.1	3.0	2.9	2.9
Total numbers of crew positions	433	417	395	355	382	369
% change in the number of crew positions		-4%	-9%	-18%	-12%	-15%
Average LPUE	475	629	662	545	458	458
% Change in LPUE		32%	39%	15%	-4%	-4%
Scallop landings (mill. lb.)	2.2	2.9	2.9	2.3	2.1	2.4
% change in landings from 2010		29%	30%	4%	-4%	8%
Total DAS (on scallop trips)	4,778	5,278	4,773	4,439	4,827	5,437
% change in total DAS from 2010		10%	0%	-7%	1%	14%
DAS per vessel (on scallop trips)	31.4	37.7	37.9	37.3	36.8	42.5
% Change in DAS per vessel from 2010		20%	21%	19%	17%	35%
Crew*DAS	13,612	15,730	14,963	13,246	14,058	15,686
% Change in Crew*DAS		16%	10%	-3%	3%	15%

Crew incomes are estimated using a 50%/50% lay formula then deducting the trips costs and either all or half of the leasing costs from gross scallop revenue. Under both of these assumptions crew incomes increased in this period, however, the increase in leasing and lease prices dampened this increase greatly. Estimated lease prices for quota leased from individuals as opposed to permit banks more than doubled in this period from $1.5 per pound of scallops in 2010 to $4.2 per pound of scallops leased in 2015 (Figure 30). Assuming that the lease costs are paid by crew, total crew income increased by 5% in 2015 compared to 2010 fishing year, less than the increase in total scallop revenue by 47% in the same period.

On the other hand, if it is assumed that boat owner and the crew share leasing costs of quota, total crew shares would increase by 33% (including the captain's share) from about $7.9 million in 2010 to about $10.5 million in the 2012 fishing (Table 17). Assuming that the number of crew declined by 15% in 2015 as shown in Table 16 above, the estimated annual income per crew increased by 23%, from $16,596 in 2010 to $20,436 in 2015 if crew paid the lease cost (Table 17). If crew paid only half of the lease costs, the increase in the annual income per crew would be around 55% in 2015 compared to 2010 fishing year. Since in the scallop fishery trip costs are usually taken out of crew shares, the decline in fuel prices in 2015 by about 10% in 2015 compared to 2010 fishing year helped to increase net crew incomes.

Different assumptions regarding the crew lay formula and payment of lease costs would result in different impacts in terms of crew income per DAS. If crew paid the lease costs, income per crew per DAS net of trip and leasing costs would have declined from $528 in 2010 to $481 per day-at-sea, or by about 9% in 2015, while if crew paid half of lease costs, income per crew per DAS would have increased from $583 per-at-sea in 2010 to $670 in 2015, which is a 15% increase (Table 17). As discussed above, even when net income per crew per DAS declined, the increase in total employment by 15% in 2015 (measured by CREW*DAS) helped to increase in total crew incomes in the LAGC fishery during this period (Table 16). Again, it must be cautioned that these are rough estimates based on a lay formula obtained from a small sample of vessels and under two different assumptions regarding who pays the leasing costs. In reality, lay formula could change from one vessel to another and from one year to another. Actual crew incomes could be different from the estimates provided in this section. Obviously, if leasing costs were entirely paid by vessel owners, crew incomes would have increased more compared to the estimates provided in Table 17. Thus the results on this section should be used not in determining the absolute values of the crew shares, but rather in assessing overall trends in the 2010-2015 fishing years.

Table 17 - Crew incomes, revenues and costs (in 2015 inflation adjusted prices)

Fishyear	2010	2011	2012	2013	2014	2015
Crew pays lease cost						
Total crew income	$7.2	$10.7	$9.2	$8.3	$7.1	$7.5
Percent change in total crew income from 2010		49%	28%	15%	-1%	5%
Income per crew member	$16,596	$25,741	$23,371	$23,235	$18,723	$20,436
Percent change in income per crew from 2010		55%	41%	40%	13%	23%
Total crew income per DAS	$1,504	$2,035	$1,934	$1,859	$1,480	$1,388
Income per DAS per crew member	$528	$683	$617	$623	$508	$481
Percent change in income per crew per DAS from 2010		29%	17%	18%	-4%	-9%
Lease costs are shared						
Total crew income	$7.9	$12.0	$11.0	$10.0	$9.5	$10.5
Percent change in total crew income from 2010		51%	39%	26%	19%	33%
Income per crew member	$18,321	$28,717	$27,861	$28,115	$24,832	$28,471
Percent increase in income per crew from 2010		57%	52%	53%	36%	55%
Total crew income per DAS	$1,660	$2,270	$2,306	$2,249	$1,963	$1,934
Income per DAS per crew member	$583	$762	$735	$754	$674	$670
Percent increase in income per crew per DAS from 2010		31%	26%	29%	16%	15%

4.3.6 Summary and conclusions

Section 4.3 evaluated the LAGC IFQ program in terms of net revenues, profits, and producer surplus consistent with the with NMFS' Economic Guidelines for conducting cost-benefit analyses[19]. For analyses presented in Section 4.3.2 to Section 4.3.2.5, the economic benefits of the program are assessed relative to a baseline period of 3 years (2007-2009) before implementation, although trends in landings, revenues, and prices in the period 2010-2015 were also compared to average levels in 2004-2006. Scallop landings of the IFQ fishery declined considerably during 2010-2015 compared to the pre- IFQ program levels mainly due to the reduction of the share of this fishery, 5% of the overall TAC of for the scallop fishery as a whole, and also because of changes in the scallop stock biomass during these years.

As a result, average annual IFQ fleet revenue in 2010-2015 declined relative to average levels both in 2007-2009 (18% lower) and in 2004-2006 (48% lower) even though average annual scallop prices increased more than 50% in the 2010-2015 fishing years due to both overall scallop prices and a premium for prices received by the IFQ vessels beginning in 2010 (Figure 22, Table 7). In Section 4.3.2.2, the impacts of the main components of the IFQ program on

[19] http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf

producer surplus and profits are examined separately from the changes in landings and prices using a scenario analysis. This scenario amounts to holding scallop landings and prices and prices of inputs and the productivity of the scallop resource constant during the pre- and post IFQ program period. Based on these assumptions, analyses identify solely the impacts of the program on producer surplus and profits due to the changes in the number of active vessels, variable and fixed inputs with the implementation of the catch share program. The average number of active vessels in the LAGC fishery declined from 521 in 2004-2006 and 320 in 2007-2009 to about 152 in 2010 and 128 in 2015, averaging about 133 active vessels during the period 2010-2015 (Table 10 and Figure 25).

The results show that estimated producer surplus under the IFQ program would be 16% to 22% higher during 2010-2015 compared to a scenario if the reduced TAC were shared among a larger number of participants with no flexibility for leasing or transferring quota. Under the same scenario, fleet profits would probably be negative in the absence of an IFQ program that allowed leasing and transferability of the quota (Table 8 and Table 9).

Section 4.3.2.5 presented a different approach to measure the changes in productivity of the LAGC IFQ fishery in 2010-2015 relative to a baseline period of 3 years (2007-2009) before the implementation. Total factor productivity was calculated using the LOWE index, which is the ratio of the value of all landings on all trips in a fishery during a year using a fixed base price to the value of all inputs from all trips in a fishery during a year, using fixed prices on the same trips. While the scenario analyses in Section 4.3.2.2 included revenues and costs from scallop fishing only, the output quantities contained in the output index Section 4.3.2.5 included both scallops and other species that were landed during a general category trip. Another difference was that while scenario analysis was conducted in terms of fishing year, productivity analysis was based on calendar year. Inputs included vessel capital, labor used (crew times days spent at sea), energy (fuel used on each trip), and materials (ice). In contrast to the scenario analyses in Section 4.3.2.2, this analysis included the impacts of the changes in allocations due to 5% TAC and changes in scallop stock productivity in 2010-2015.

Both of these approaches have some limitations. The scenario analysis does not take into account the potential change in the efficiency of active vessels, and multi-factor productivity analysis does not separate the impacts of changes in scallop resource abundance on productivity. Because species other than scallops included in the analysis, aggregate productivity index also includes the changes in the stock biomass of those other species. For example, results of the latter analysis show that LOWE's index declined in 2014 compared to 2013 ( ). In the same year, there was a decline in the LPUE of the IFQ fishery probably due to lower stock abundance in areas near shore where those vessels access areas, affecting the aggregate productivity of IFQ fleet (Figure 25, Section 4.3.3.1).

Despite the differences in approach, the results of these analyses are consistent with each other. During 2010-2015, both the aggregate productivity and the producer surplus for the LAGC IFQ fishery was greater than the baseline time period of 2007-2009 (Table 8 and Table 12). As indicated in Section 4.3.2.5.2, productivity is a component of profitability. The scenario analysis also showed that profits would be higher with the IFQ program (Table 9). These results are not

surprising given that the IFQ program helped to optimize profits in the LAGC fishery by providing opportunity for IFQ permits holders to transfer their allocations through leasing or sale of quota to those owners, either with more efficient operations or financial resources to buy/lease quota from others to lower their fishing costs per unit of production by targeting scallops.
The analyses of the trends in net scallop revenue and profits since 2010 support the same conclusions (Section 4.3.3). The percentage increase in net fleet revenue and producer surplus since the 2010 fishing year exceeded the increase in gross revenue due to the decline in fuel prices by 10%, an increase in the possession limit to 600 lb.in 2011 as well as due to the concentration of effort in a smaller number of possibly more efficient vessels (Figure 24, Section 4.3.3.1). There has been an increasing trend in both profits and profit margins in the period 2010-2105 for the same reasons discussed above (Section 4.3.4.5).

The result of Section 4.3.5 indicates that the increase in overall DAS combined with a slight increase in the average number of crew employed on the active vessels resulted in a rise in employment by 15% in 2015 as measured by CREW*DAS (Table 16). Assuming that the lease costs are paid by crew, total crew income increased by 5% in 2015 compared to the 2010 fishing year, less than the increase in total scallop revenue by 47% in the same period.

The distributional impacts of the IFQ program were not uniform since some vessels were prevented from access to the general category fishery while those vessels that qualified for the permit benefited with the implementation of Amendment 11. Profits per owner are estimated to be higher for those owners who lease-in quota and participate in the fishery mainly to target scallops and lease-in quota from others (Section 4.3.4.5). The distributional impacts of the IFQ program are analyzed in Section 4.4.

In short, the economic analyses provided in Section 4.3, both relative to a baseline period of three years (2007-2009) before implementation of the IFQ program as well as since 2010, show that the impacts on net national benefits as measured by producer surplus were positive. Increased productivity and concentration of effort in fewer vessels and affiliations results in higher profits from the baseline period as well as compared to the 2010 fishing year levels.

4.4 DISTRIBUTIONAL ANALYSES: DIVERSITY AND CONCENTRATION

4.4.1 Introduction

Although the overall intent of Amendment 11 was to stabilize capacity and prevent overfishing from the general category fishery, the Council's intent also included a desire to preserve the ability for vessels to participate in the general category fishery at different levels with a vision of a fleet "made up of relatively small vessels, with possession limits to maintain the historical character of this fleet and provide opportunities to various participants including vessels from smaller coastal communities. Furthermore, the goals of the LAPPs as specified in MSA § 303A (c) (1) (A) to (F) include: reducing over-capacity, promoting safety, fishery conservation and management, and social and economic benefits. Furthermore, Section 301(a) (4) indicates that allocation of fishing privileges should be "carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges." This section provides distributional analyses to address whether these specific goals of IFQ program as stated in Amendment 11 and goals of the LAPPS as defined in Section 301(a)(4) are met.

An analysis of the distribution of quota, landings, and revenues by active vessels was presented in Section 0 and by affiliations in Section 4.2.3.2. Revenue per active and inactive affiliation from scallops and other species is analyzed in subsection 4.4.2.1, while Section 4.4.2.2 provides a detailed analysis of the trends in the dependency on scallop fishery by active affiliations. The number of permits owned by inactive and active affiliations and distribution of quota among single- and multi-permit holders are analyzed in Section 4.4.2.4. Section 4.4.2.5 provides a quantile analysis of cumulative distribution of landings, revenue, and lease-in pounds for active affiliations and 4.4.2.6 presents a quantile analysis of cumulative distribution of profits of both active and inactive affiliations. Section 4.4.2.7 presents distributional analyses based on GINI coefficients and LORENZ curves, and Section 4.4.2.8 addresses the trends in market shares and concentration in the LAGC-IFQ fishery using the Herfindahl-Hirschman index (HHI). Summary and conclusions of the distributional analyses are provided in Section 4.4.4.

4.4.2 Distribution of landings, quota and revenues by affiliations

Section 4.2.2 analyzed distribution of landings and revenues in terms of active LAGC IFQ vessels. This section provides an analysis of the distribution of quota, landings, revenues and profits for active and inactive affiliations to examine the changes in the diversity of the fishery and evaluate if these trends were consistent with the Council's vision of maintaining the diverse nature and flexibility within the general category component of the scallop fleet. Section 4.4.2.1 examines the distribution of revenues per affiliation and dependency on the scallop fishery as a source of revenue. Section 4.4.2.4 evaluates the changes in number of permits owned by active and inactive affiliations. Section 4.4.2.5 cumulative distribution of landings and net revenue and Section 4.4.2.6 analyzes changes in the cumulative distribution pf profits based on quantiles. Distribution of allocations, revenue and profits were analyzed in Section 4.4.2.7 using Lorenz curves and Gini coefficients. Trends in the concentration of the market shares are examined in Section 4.4.2.8 and changes in geographic distributions of allocations in analyzed in Section 4.4.2.9. Section 4.4.2.10 evaluates impacts of the IFQ program on non-qualifiers.

4.4.2.1 Revenue per active and inactive affiliation and dependence on the scallop fishery

Scallop revenue per active affiliation almost doubled from $164,049 in 2010 to $299,858 both as a result of an increase in total fleet revenue and a decrease in the number of active affiliations in this period (Figure 61). As discussed in Section 4.2.3.2, the number of active affiliations declined from 127 in 2010 to 102 in 2015, the number of active vessels owned by these affiliations declined from 152 in 2010 to 128 in 2015. Active affiliations also owned 58 permits in 2010 and 53 permits in 2015 that did not participate in the fishery (Figure 15). Similarly, the number of inactive affiliations declined from 106 in 2010 to 90 in 2015, but permits owned by those affiliations increased from 121 in 2010 to 132 in the 2015 fishing year indicating that as some quota moved from active owners to inactive affiliations (Figure 14). As a result, the share of inactive affiliations in total quota increased slightly from 32% in 2010 to 34% in 2015, and the share of active affiliations declined from 68% to 66% in the same period. (Figure 16). Inactive affiliations lease out their quota to others and some of these affiliations also earn revenues by participating in fisheries other than scallops.

Both the active and inactive affiliations also earned revenue from other species. Average annual revenue per inactive affiliation from other fisheries exceeded those for active vessels significantly (Figure 62). The dependence on the scallop fishery as revenue source varied greatly among the active fleet as discussed in Section 4.4.2.2.

About 45 out of the 106 inactive affiliations earned revenues from other fisheries in 2010 while 61 affiliations had no record of fishing revenues except for estimated earnings from leasing out their IFQ quota (Figure 20). The numbers of inactive affiliations that participate in other fisheries ranged from 36 in 2011 to 47 in 2013 while those affiliations with no fishing activity either in the scallop or other fisheries declined from 61 in 2010 to 49 in 2015. Average revenue per inactive affiliation from leasing out quota increased from $12,600 in the 2010 fishing year to $62,617 in the 2015 fishing year (Figure 22). However, revenue earned from other species was over $300,000 in 2010 and over $500,000 in 2015 for those affiliations that are active in other fisheries (Figure 21).

Figure 61. Revenue per active affiliation from scallops

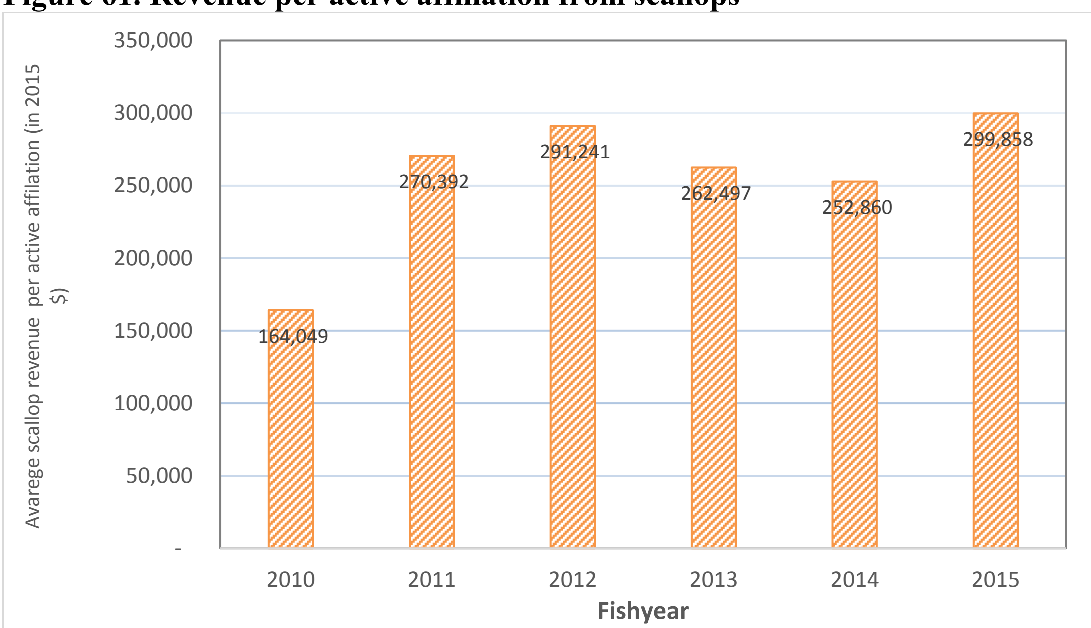


Figure 62. Revenue per active and inactive affiliation from other species

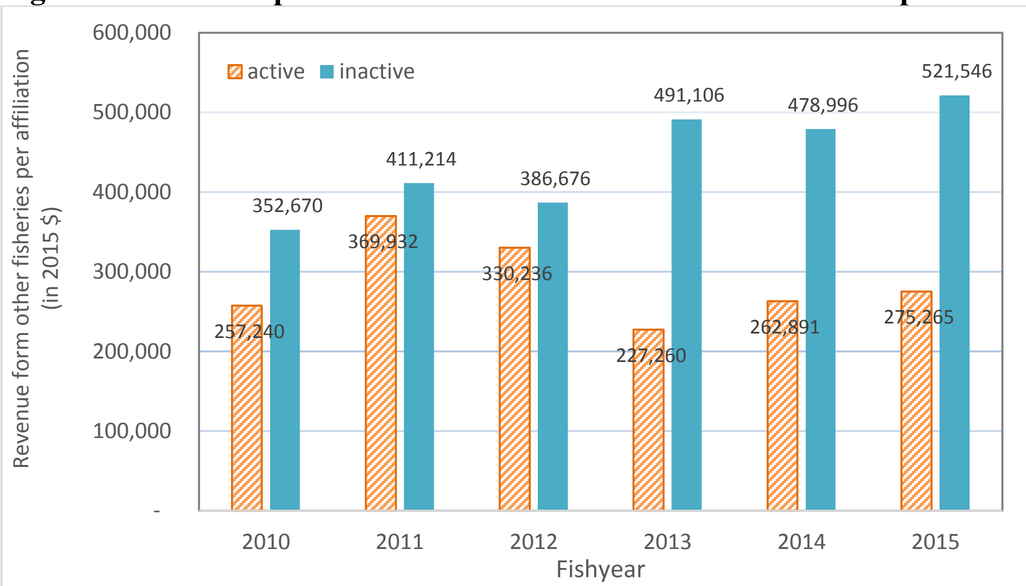


Figure 63. Number of inactive affiliations by activity in other fisheries

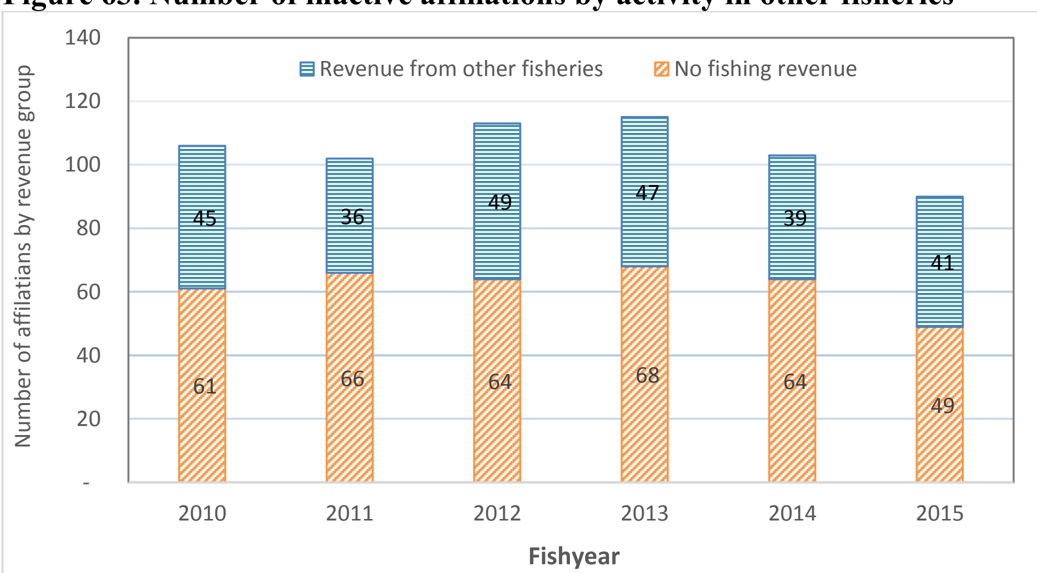
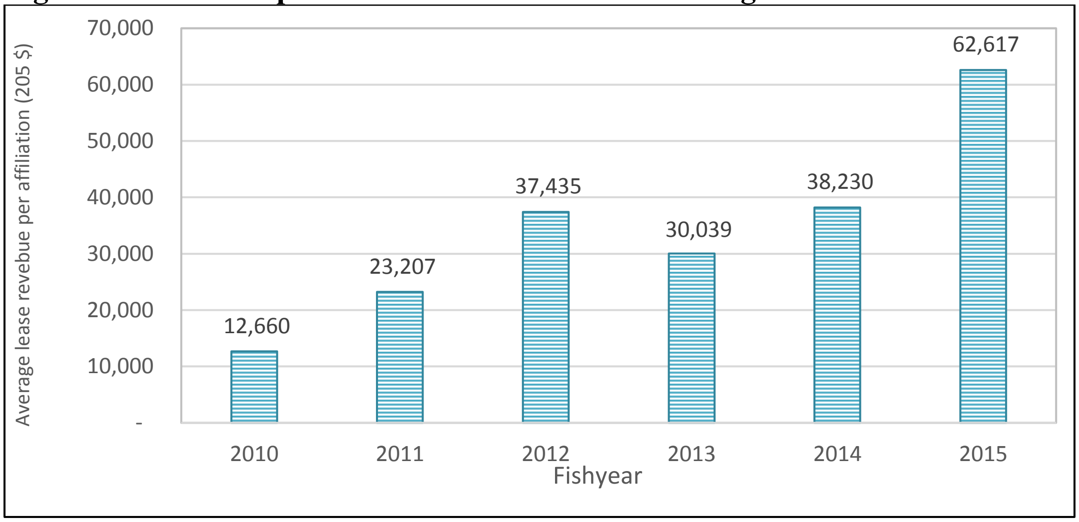


Figure 64. Revenue per inactive affiliation from leasing out



4.4.2.2 Active affiliations by dependency on scallop revenue

The number of affiliations that had a high dependency on scallop revenue was relatively stable during the 2010-2015 fishing years. About 53 out of 127 active affiliations in 2010 and 52 out of 102 active affiliations in 2015 derived more than 75% of their revenue from scallops (Figure 65). Those numbers varied between 55 in 2011 to 59 in 2013 depending on the changes in the allocations, prices, and revenue earned from other species. The changes in the number of affiliations that derived more than 25% of their revenue from scallops were relatively small as well. However, there has been a significant decline in the number of active affiliations that have a 25% or less dependence on scallop revenue, from 42 in 2010 to 17 in 2015. This implies that these affiliations leased out or sold their quota to others that target scallops or have a higher dependency on scallop fishery as a source of their revenue. However, as the number of affiliations in this category declined, the average revenue per affiliation quadrupled in the 2015 fishing year compared to 2010 (Figure **66**). Average dependency on the scallop revenue in the top group of affiliations that target scallops was 95% or over and increased slightly to 97% in 2014 and 2015 ( ). Average revenue for these affiliations with the lowest dependence (up to 25%) on scallop revenue exceeded half a million dollars in 2010, and was close to a million dollars in 2015 (Figure 68).

Scallop revenue per affiliation increased for other dependency groups as well due to a rise in prices and allocations in 2015 compared to the levels in the 2010 fishing year. The share of the affiliations that derive more than 75% of their revenue from scallops fluctuated from 66% to 71% as a percentage of total IFQ fleet scallop revenue during 2010 – 2015 (Figure 69).

Figure 65. Active Affiliations by dependence on the scallop fishery

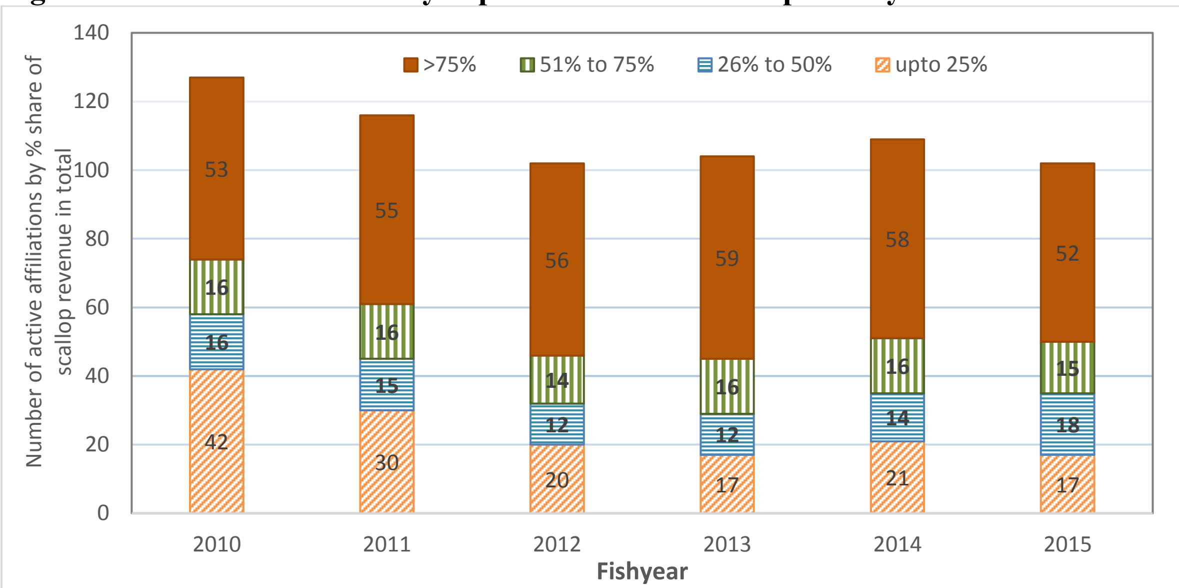


Figure 66. Average scallop revenue per active affiliation (in 2015 $)

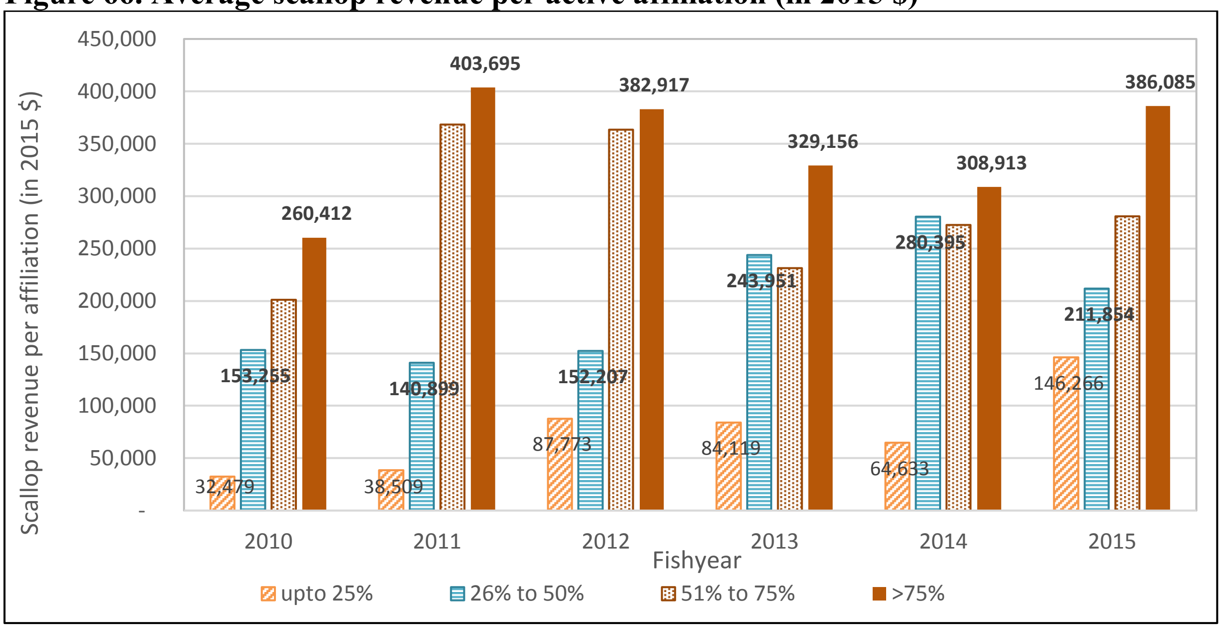


Figure 67. Ratio of scallop revenue to total revenue per active affiliation (averages per active affiliation)

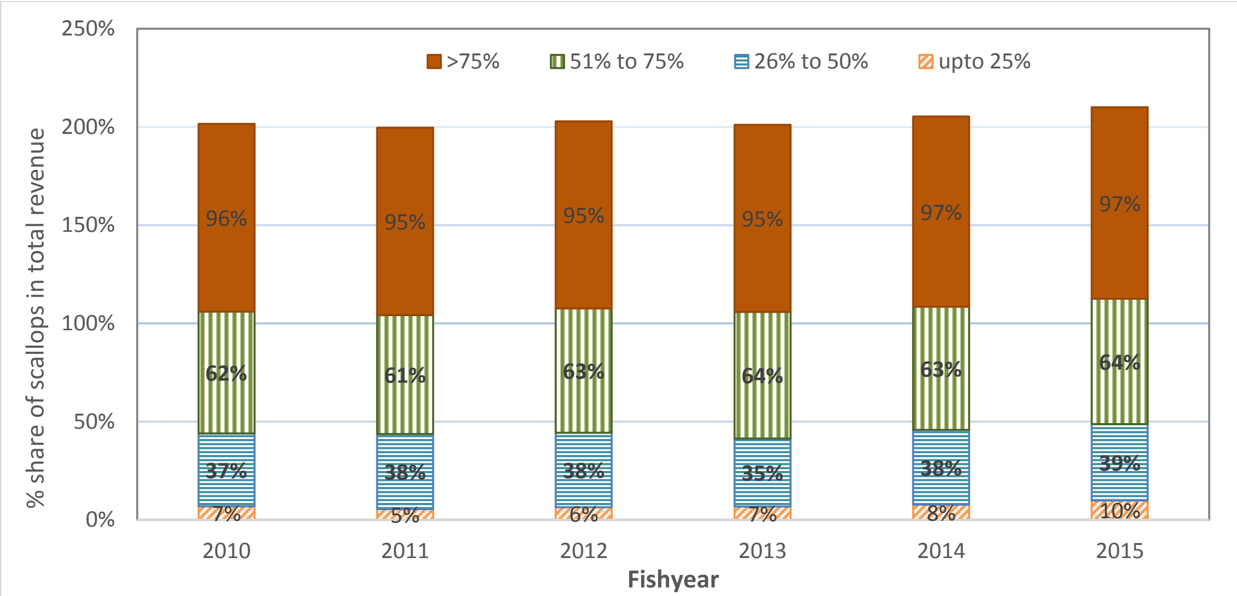


Figure 68. Average revenue from other species per active affiliation (in 2015 $)

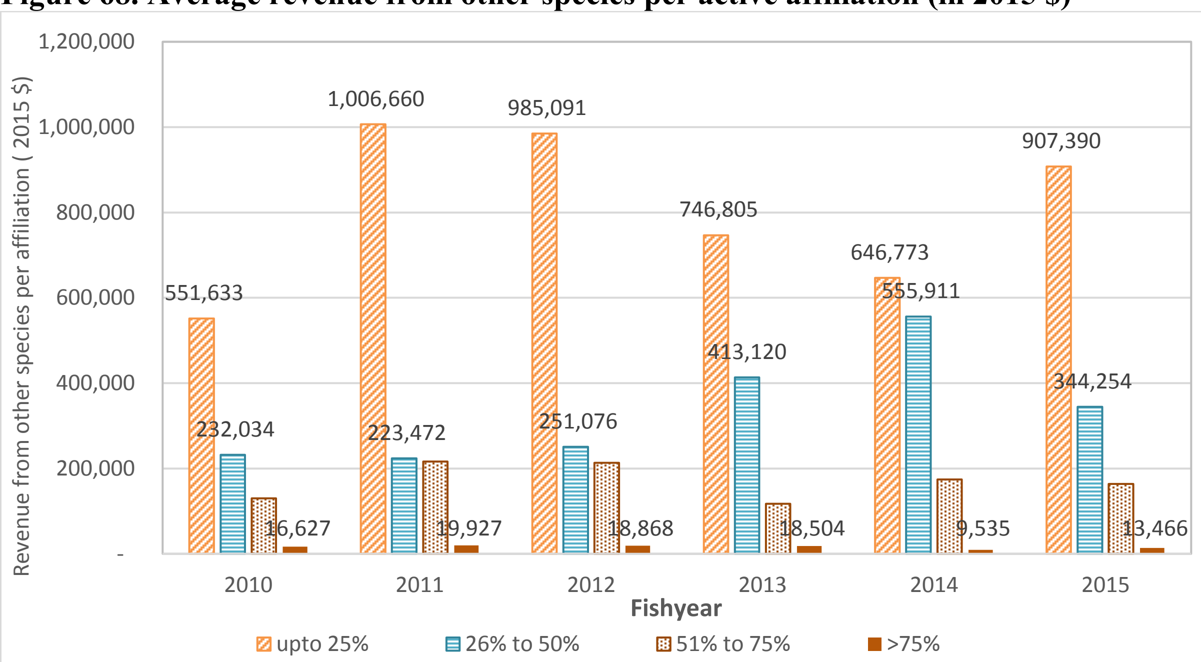
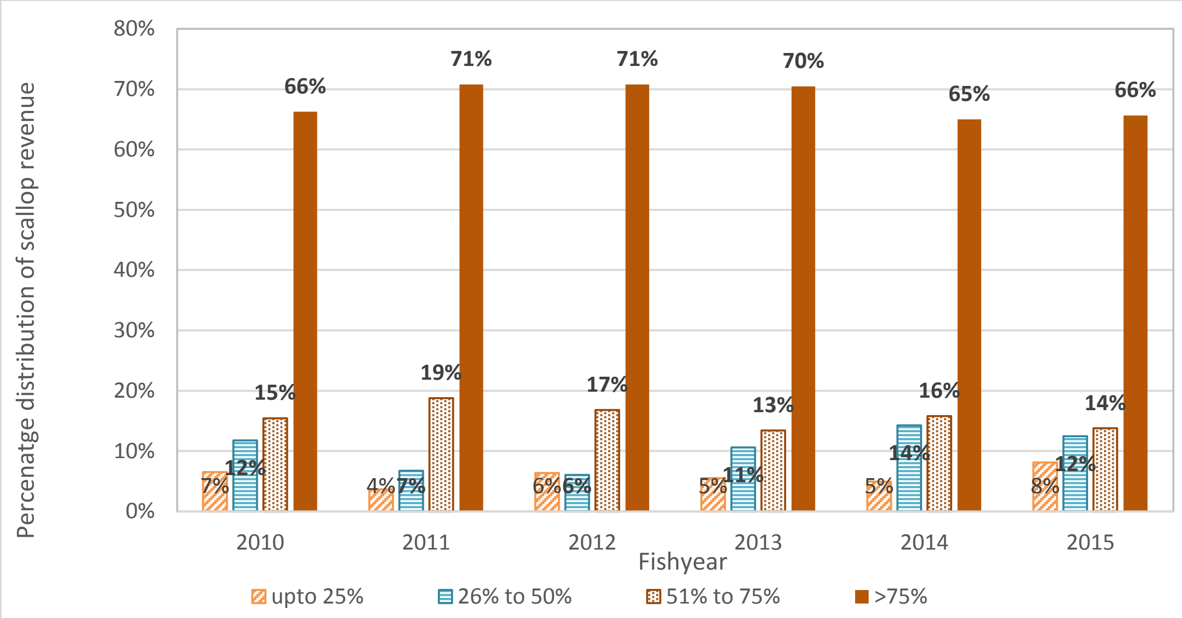


Figure 69. Distribution of scallop revenue by dependency group (% of total IFQ scallop fleet revenue)



4.4.2.3 Activity in other fisheries

Although this report does not evaluate comprehensively the impacts of the LAGC IFQ scallop fishery on other fisheries, Table 18 to Table 26 provide information on the landings of and revenues from other species for active vessels and affiliations that participated in the scallop fishery, as well as for those inactive vessels and affiliations that leased out their IFQ quota to others but activity in other fisheries. These tables mostly include those species which constituted at least 1% of the total revenue.

The trends in terms of activity in other fisheries show that for active vessels, except for mackerel, menhaden and seabass, the landings of other species either declined or remained fairly stable during the 2010-2015 fishing years (Table 18). However, for vessels that did not participate in the scallop fishery but leased their quota to other vessels, there was an increase in landings of redfish, white hake, summer flounder, winter flounder, lobster, angler and seabass and since 2010 fishing year (Table 21).

There could be several factors affecting these trends including the changes in the stock conditions, prices, spatial distribution of stocks, changes in ownership patterns as well as changes in management measures for each species and a potential increase in effort by those LAGC IFQ vessels that no longer participate in the scallop fishery but redirect their effort to fishing for other species. However, in this regard, it is also important to take into account the potential reduction in effort in those other fisheries by active vessels that primarily targeted scallops to see to what extent this counteracted the increase in landings by inactive vessels. Table 24 shows that in terms of total landings by all vessels, including those that lease out their quota, there has been a decline in landings of cod, haddock, summer flounder, witch flounder, yellowtail, pollock, ocean quohog, and skates of unknown category in 2015 compared to the 2010 fishing year. However, the landings redfish, white hake, winter flounder, bigelow skates, mackerel, angler fish were higher in 2015 from the levels in 2010 fishing year.

The issue of effort displacement and its impacts are further complicated by lack of information regarding the activity of those owners who placed their LAGC IFQ permits in CPH and lease their quota to other owners. For example, there is no information available regarding if the proceeds from leasing are employed in buying quota or invested in another vessel that is active in other fisheries. Identifying the relative impacts of the LAGC IFQ program on other fisheries separately from the other potential factors that affect landings of each species including changes in the biological environmental, relative prices, consumer preferences and management measures is beyond the scope of this review.

4.4.2.3.1 Landings of and revenues from other species by active vessels

Table 18 shows landings of species other than scallops by active vessels including those that lease-in, lease-out part of their quota and those that are not involved in any leasing activity. Those trends in terms of activity in other fisheries since the 2010 fishing year indicate that, except for mackerel, menhaden and seabass, the landings of other species either declined or remained fairly stable during the 2010-2015 fishing years (Table 18)[20]. Although the consolidation of fishing activity in fewer vessels that mainly target scallops might have contributed to this decline, there are too many other factors that could affect landings including the changes in the stock abundance, spatial distribution of fish, prices and management changes that could not be addressed within the framework of this report. In terms of percentage revenues, ocean quahog and summer were among the top species that contributed earnings of active vessels (Table 19 and Table 20).

Table 18. Landings by species for active LAGC IFQ vessels (lb.)

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	2,200,088	3,069,107	2,936,057	2,301,107	2,371,960	2,606,072
Ocean quohog	7,848,960	4,351,030	4,595,780	3,635,320	4,485,120	4,062,080
Summer flounder	2,731,143	3,015,060	2,219,047	1,885,615	1,615,527	1,493,084
Angler	595,716	707,768	566,499	237,100	378,131	273,493
Haddock	1,231,538	1,521,337	400,883	50,794	423,531	123,158
Cod	632,048	1,019,711	350,649	107,562	183,336	77,241
Winter flounder	568,940	1,097,077	421,247	313,070	334,623	214,312
Lobster	189,473	258,177	203,329	60,803	80,149	216,933
Mackerel	15,280	43,088	14,454	40,726	222,580	516,564
Skates bigelow	215,573	354,272	115,176	128,408	351,706	283,701
Sea bass	200,101	116,426	100,953	140,492	217,344	203,079
Other	8,389,345	11,315,582	9,004,571	10,264,420	8,392,028	21,834,015*
Grand Total	**24,587,352**	**26,471,275**	**20,799,015**	**18,996,283**	**18,481,749**	**31,103,467**

[20] According to the dealer data, there has been a big increase in the menhaden landings in 2015 by about 10 million lb. by a handful of boats with IFQ permits perhaps due to the easing of caps on this fishery in 2015. Menhaden is included as a part of other species in the Tables.

Table 19. Revenues by species for active LAGC IFQ vessels (current values)

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	19,220,003	31,657,911	29,976,127	27,499,118	30,204,527	32,878,464
Ocean quohog	5,483,776	3,057,467	2,968,402	2,416,634	3,344,016	3,251,216
Summer flounder	4,774,998	5,542,389	4,642,139	4,239,142	4,316,457	4,408,964
Angler	1,426,124	1,954,264	1,359,122	532,766	881,804	632,571
Haddock	1,336,586	2,072,986	785,243	87,172	496,442	133,342
Cod	1,200,959	2,065,175	802,133	231,031	330,361	154,459
Winter flounder	1,142,097	1,878,407	876,680	503,885	668,927	433,684
Lobster	739,421	1,069,048	808,577	258,345	354,990	1,020,718
Mackerel	9,581	25,290	11,693	34,653	154,543	361,010
Skates bigelow	142,168	230,359	73,229	92,446	272,437	166,066
Sea bass	704,435	432,925	315,326	484,230	726,650	808,458
Other	6,266,875	8,104,927	8,017,348	7,961,271	7,351,090	8,812,332
Grand Total	**42,295,274**	**57,835,499**	**50,551,097**	**44,213,594**	**48,675,264**	**52,534,208**

Table 20. Percentage revenues by species for active vessels with LAGC IFQ permits

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	45.4%	54.7%	59.3%	62.2%	62.1%	62.6%
Ocean quohog	13.0%	5.3%	5.9%	5.5%	6.9%	6.2%
Summer flounder	11.3%	9.6%	9.2%	9.6%	8.9%	8.4%
Angler	3.4%	3.4%	2.7%	1.2%	1.8%	1.2%
Haddock	3.2%	3.6%	1.6%	0.2%	1.0%	0.3%
Cod	2.8%	3.6%	1.6%	0.5%	0.7%	0.3%
Winter flounder	2.7%	3.2%	1.7%	1.1%	1.4%	0.8%
Lobster	1.7%	1.8%	1.6%	0.6%	0.7%	1.9%
Mackerel	0.0%	0.0%	0.0%	0.1%	0.3%	0.7%
Skates bigelow	0.3%	0.4%	0.1%	0.2%	0.6%	0.3%
Sea bass	1.7%	0.7%	0.6%	1.1%	1.5%	1.5%
Other	14.8%	14.0%	15.9%	18.0%	15.1%	16.8%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

4.4.2.3.2 Activity in other fisheries by inactive vessels that lease-out their quota

The inactive vessels with IFQ permits that lease-out their quota to other vessels increased their landings of redfish, white hake, summer flounder, winter flounder, lobster, angler and seabass in 2015 compared to 2010 fishing year (Table 21). However, landings of groundfish species including cod, haddock, yellowtail, witch flounder as well as skates declined during the same period. Percentage revenue earned from the top two species, haddock (19.8%) and cod (7.1%) declined in 2015 from levels in 2010 (Table 22 and Table 23). Although increase in effort by those LAGC IFQ vessels that no longer participate in the scallop fishery but redirect their effort to fishing for other species could be one of the factors affecting these trends, there could be several other factors including the changes in the stock conditions, prices, spatial distribution of stocks, changes in ownership structure as well as changes in management measures might have contributed to these changes.

Table 21. Landings by species for inactive vessels with LAGC IFQ permits (in pounds)

SPECIES	2010	2011	2012	2013	2014	2015
Cod	1,437,393	2,263,068	1,529,558	1,299,232	1,037,756	992,957
Haddock	5,049,432	2,514,311	821,633	1,450,346	3,630,655	4,647,940
Winter flounder	957,018	1,586,505	2,311,457	3,141,139	1,963,016	1,736,272
Lobster	382,405	316,617	464,064	514,503	360,329	410,109
Summer flounder	561,972	1,034,768	1,074,002	1,146,478	916,164	723,226
Angler fish	320,619	424,326	546,793	662,338	601,913	861,342
Pollock	784,852	1,220,591	1,523,419	1,229,499	671,041	771,257
yellowtail	688,518	856,980	673,550	304,602	222,401	201,940
Witch flounder	244,498	265,683	254,527	248,675	151,308	186,915
Redfish	262,457	364,009	735,076	2,080,658	1,735,861	2,595,252
Sea bass	50,151	73,130	101,603	131,533	142,333	87,382
Skates nk	878,303	472,973	643,964	484,510	212,736	75,299
Whitehake	271,889	509,791	390,275	463,807	259,036	369,480
Other	9,884,179	4,299,131	3,695,052	3,194,457	5,346,884	4,886,671
Grand Total	**21,773,686**	**16,201,883**	**14,764,973**	**16,351,777**	**17,251,433**	**18,546,042**

Table 22. Revenues by species for inactive vessels with LAGC IFQ permits (current values)

SPECIES	2010	2011	2012	2013	2014	2015
Cod	2,709,423	4,589,840	3,671,649	2,622,956	1,999,555	1,914,600
Haddock	5,755,566	3,800,594	1,650,182	2,112,463	4,653,365	5,308,009
Winter flounder	1,928,180	2,751,365	4,390,315	5,149,113	3,746,903	3,628,069
Lobster	1,451,279	1,227,951	1,784,354	2,083,845	1,580,221	2,032,137
Summer flounder	929,535	1,796,041	2,314,906	2,229,468	2,585,111	2,025,184
Angler fish	1,032,910	1,454,395	1,568,573	1,721,183	1,495,816	2,082,511
Pollock	731,198	1,015,378	1,454,891	1,319,614	791,780	845,678
yellowtail	937,042	1,046,484	900,710	500,572	307,808	327,362
Witch flounder	526,561	514,284	461,750	605,940	392,422	463,479
Redfish	149,491	235,480	479,386	1,061,972	937,298	1,521,610
Sea bass	125,266	256,072	402,422	435,357	470,025	326,631
Skates nk	561,504	329,788	413,270	383,366	231,381	47,978
Whitehake	317,091	590,495	648,133	754,948	462,031	647,565
Other	2,241,882	2,239,225	3,532,109	3,355,535	4,796,891	5,640,113
Grand Total	**19,396,928**	**21,847,392**	**23,672,650**	**24,336,332**	**24,450,607**	**26,810,926**

Table 23. Percentage revenues by species for inactive vessels with LAGC IFQ permits

SPECIES	2010	2011	2012	2013	2014	2015
Cod	14.0%	21.0%	15.5%	10.8%	8.2%	7.1%
Haddock	29.7%	17.4%	7.0%	8.7%	19.0%	19.8%
Winter flounder	9.9%	12.6%	18.5%	21.2%	15.3%	13.5%
Lobster	7.5%	5.6%	7.5%	8.6%	6.5%	7.6%
Summer flounder	4.8%	8.2%	9.8%	9.2%	10.6%	7.6%
Angler fish	5.3%	6.7%	6.6%	7.1%	6.1%	7.8%
Pollock	3.8%	4.6%	6.1%	5.4%	3.2%	3.2%
yellowtail	4.8%	4.8%	3.8%	2.1%	1.3%	1.2%
Witch flounder	2.7%	2.4%	2.0%	2.5%	1.6%	1.7%
Redfish	0.8%	1.1%	2.0%	4.4%	3.8%	5.7%
Sea bass	0.6%	1.2%	1.7%	1.8%	1.9%	1.2%
Skates nk	2.9%	1.5%	1.7%	1.6%	0.9%	0.2%
Whitehake	1.6%	2.7%	2.7%	3.1%	1.9%	2.4%
Other	11.6%	10.2%	14.9%	13.8%	19.6%	21.0%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Activity in other fisheries by all vessels with an LAGC IFQ permit

As discussed in the above sections there has been an increase in landings for some species by the inactive vessels that lease out their shares but a decrease in landings of some of those species by active LAGC IFQ vessels that primarily target scallops. Thus it is important to evaluate overall landings by the LAGC fishery to see if those two opposite trends counteracted each other. Table 24 shows that in terms of total landings by all vessels, including those that lease out their quota, there has been a decline in landings of cod, haddock, summer flounder, witch flounder, yellowtail, pollock, ocean quohog, and skates of unknown category in 2015 compared to the 2010 fishing year. However, the landings of redfish, white hake, winter flounder, bigelow skates, mackerel and angler fish were higher in 2015 from the levels in 2010 fishing year. The percentage share of scallops in total revenue 30.4% in 2010 40.8% in 2015. Again, it is not possible to make a definitive statement about the impacts of the LAGC IFQ program solely based on the data presented in this report since the impacts of the several other important factors that affect landings such as stock abundance, management changes, prices and changes in ownership structure should also be taken into account.

Table 24. Landings by species for all vessels with an LAGC IFQ permit

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	2,200,088	3,069,107	2,936,057	2,301,107	2,371,960	2,606,072
Summer flounder	3,293,115	4,049,828	3,293,049	3,032,093	2,531,691	2,216,310
Haddock	6,280,970	4,035,648	1,222,516	1,501,140	4,054,186	4,771,098
Cod	2,069,441	3,282,779	1,880,207	1,406,794	1,221,092	1,070,198
Winter flounder	1,525,958	2,683,582	2,732,704	3,454,209	2,297,639	1,950,584
Ocean quohog	7,848,960	4,351,030	4,595,780	3,635,320	4,485,120	4,062,080
Lobster	571,878	574,794	667,393	575,306	440,478	627,042
Angler	916,335	1,132,094	1,113,292	899,438	980,044	1,134,835
Pollock	1,192,542	1,953,425	1,797,282	1,251,875	739,091	791,019
Yellowtail	1,071,276	1,756,221	963,776	426,943	375,446	314,866
Witch flounder	317,542	431,745	362,366	275,737	228,888	261,413
Redfish	378,099	670,247	981,724	2,086,328	1,763,789	2,604,420
Mackerel	17,852	43,333	14,657	40,911	224,425	516,888
Sea bass	250,252	189,556	202,556	272,025	359,677	290,461
Skates bigelow	262,357	372,082	177,823	155,654	738,839	678,385
Skates nk	1,277,187	1,010,376	930,811	602,655	327,715	107,306
Whitehake	304,664	651,824	499,206	473,481	342,380	379,411
Other	18,273,524	15,614,713	12,699,623	13,458,877	13,738,912	26,720,686
Grand Total	**48,052,040**	**45,872,384**	**37,070,822**	**35,849,893**	**37,221,372**	**51,103,074**

Table 25. Revenues by species for all vessels with LAGC IFQ permits (current values)

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	19,220,003	31,657,911	29,976,127	27,499,118	30,204,527	32,878,464
Summer flounder	5,704,533	7,338,430	6,957,045	6,468,610	6,901,568	6,434,148
Haddock	7,092,152	5,873,580	2,435,425	2,199,635	5,149,807	5,441,351
Cod	3,910,382	6,655,015	4,473,782	2,853,987	2,329,916	2,069,059
Winter flounder	3,070,277	4,629,772	5,266,995	5,652,998	4,415,830	4,061,753
Ocean quohog	5,483,776	3,057,467	2,968,402	2,416,634	3,344,016	3,251,216
Lobster	2,190,700	2,296,999	2,592,931	2,342,190	1,935,211	3,052,855
Angler	2,459,034	3,408,659	2,927,695	2,253,949	2,377,620	2,715,082
Pollock	1,090,766	1,667,610	1,693,303	1,341,390	870,164	864,992
Yellowtail	1,452,082	2,118,616	1,297,911	680,389	547,958	508,043
Witch flounder	686,738	804,397	634,304	670,738	590,182	660,322
Redfish	222,366	454,195	658,300	1,066,137	954,860	1,527,751
Mackerel	11,048	25,463	11,830	34,850	155,456	361,298
Sea bass	829,701	688,997	717,748	919,587	1,196,675	1,135,089
Skates bigelow	169,975	241,143	113,764	112,042	556,889	367,435
Skates nk	778,990	680,912	597,469	469,445	336,224	68,875
Whitehake	356,371	751,279	817,945	770,383	601,873	665,627
Other	8,508,757	10,344,152	11,549,457	11,316,806	12,147,981	14,452,445

Grand Total	63,237,651	82,694,597	75,690,433	69,068,888	74,616,757	80,515,805

Table 26. Percentage revenues by species for all vessels with an LAGC IFQ permit

SPECIES	2010	2011	2012	2013	2014	2015
Scallop	30.4%	38.3%	39.6%	39.8%	40.5%	40.8%
Summer flounder	9.0%	8.9%	9.2%	9.4%	9.2%	8.0%
Haddock	11.2%	7.1%	3.2%	3.2%	6.9%	6.8%
Cod	6.2%	8.0%	5.9%	4.1%	3.1%	2.6%
Winter flounder	4.9%	5.6%	7.0%	8.2%	5.9%	5.0%
Ocean quohog	8.7%	3.7%	3.9%	3.5%	4.5%	4.0%
Lobster	3.5%	2.8%	3.4%	3.4%	2.6%	3.8%
Angler	3.9%	4.1%	3.9%	3.3%	3.2%	3.4%
Pollock	1.7%	2.0%	2.2%	1.9%	1.2%	1.1%
Yellowtail	2.3%	2.6%	1.7%	1.0%	0.7%	0.6%
Witch flounder	1.1%	1.0%	0.8%	1.0%	0.8%	0.8%
Redfish	0.4%	0.5%	0.9%	1.5%	1.3%	1.9%
Mackerel	0.0%	0.0%	0.0%	0.1%	0.2%	0.4%
Sea bass	1.3%	0.8%	0.9%	1.3%	1.6%	1.4%
Skates bigelow	0.3%	0.3%	0.2%	0.2%	0.7%	0.5%
Skates nk	1.2%	0.8%	0.8%	0.7%	0.5%	0.1%
Whitehake	0.6%	0.9%	1.1%	1.1%	0.8%	0.8%
Other	13.5%	12.5%	15.3%	16.4%	16.3%	17.9%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Another study addressed the changes in species diversity using Herfindahl indices for the 3,090 active vessel/FY combinations since 2004 fishing year (Appendix F). The results showed that there is an upward trend, indicating a less diverse catch portfolio across active vessels. FY2015 had an especially pronounced spike in indices. This means that among vessels that earn more revenue from scallops than any other species group in a given fishing year, at least half of these vessels earn all, or nearly all, of their revenue from scallops. This is consistent with the average annual revenue per active affiliation depicted in Figure 67 above.

4.4.2.4 Affiliations by number of permits owned

Most of the affiliations in the LAGC IFQ fishery owned only one permit. In 2010, 189 out of 233 affiliations, or 81%, were owners of a single permit, while 29 owned two and the rest owned 3 or more permits (Figure 70). The number of affiliations with a single IFQ permit declined to 135, or to 70% of all affiliations in 2015. Similarly, while 73% of the active affiliations owned only one permit in 2010, this number declined to 65% in 2015 (Figure 74). The number of active affiliations that have two or more permits increased, and those that owned 5 or more permits reached 7% of the active affiliations in 2015 (Table 27). The same observation is also true for the inactive affiliations, which explains the decline in the total number of affiliations. Those having only one permit declined from 91% of the total inactive affiliations in 2010 to 77% in 2015, and those that have 2 to 4 permits more than doubled (Table 27).

This trend in consolidation of permits in fewer affiliations explains the overall reduction in the number of affiliations in the LAGC IFQ fishery. Including all affiliations, the percentage share of single permit owners in overall quota declined from 55% in 2010 to 37% in 2015, while the share of affiliations that have more than more permit increased from 45% to 63% for those who own 2 to 4 permits, and from 17% to 23% for those who own 5 or more permits (Figure 73). The share of those affiliations who owned 3 to 5 vessels doubled form 15% in 2010 to 30% in 2015. This trend was more pronounced especially among the inactive affiliations (Table 28). While the share of quota for inactive affiliations declined from 77% in 2010 to 32% in 2015 for those who own one permit, the share of those who own 2 to 4 permits increased from 14% to 32%, and those who own 5 or more permits increased from 9% in 2010 to 36% in 2015 as a percentage of quota owned by inactive affiliations (Table 28). There has been some fluctuation in the share of scallop landings of active affiliations that owned a single vessel ranging from 63% in 2011 to 74% in 2015 (Figure 74). This is reflective of the increase in the number of active vessels from 119 in 2013 to 131 in 2014 as the increase in scallop prices to about $13 per pound in 2014 from less than $12 per pound in 2013 made fishing for scallops more profitable (Section 4.3.2.1).

Figure 70. Affiliations by number of permits owned (includes both active and inactive affiliations)

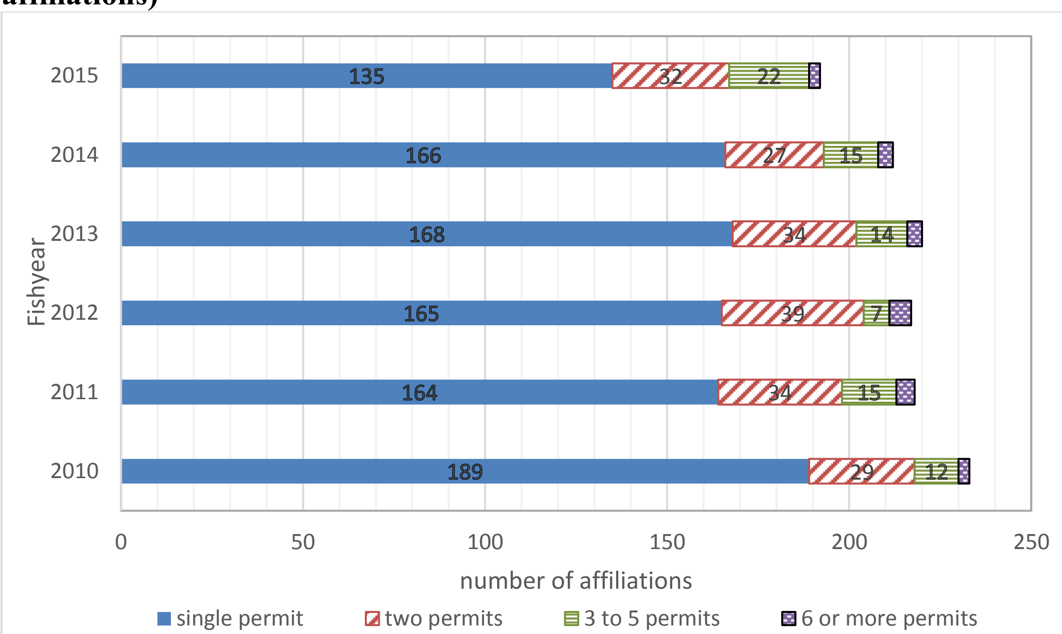


Table 27. Number of permits owned by affiliations by activity status (as a % of total permits)

Activity Group	Fishyear	1 permit	2 to 4	5 or more	Grand Total
active	2010	73%	24%	3%	100%
	2011	63%	32%	5%	100%
	2012	66%	29%	5%	100%
	2013	70%	27%	3%	100%
	2014	74%	22%	4%	100%
	2015	65%	28%	7%	100%
active Total		**69%**	**27%**	**4%**	**100%**
inactive	2010	91%	8%	1%	100%
	2011	89%	10%	1%	100%
	2012	85%	12%	3%	100%
	2013	82%	16%	3%	100%
	2014	83%	15%	3%	100%
	2015	77%	20%	3%	100%
inactive Total		**84%**	**13%**	**2%**	**100%**
Grand Total		**76%**	**20%**	**3%**	**100%**

Figure 71. Active affiliations by number of permits owned (affiliations that landed scallops)

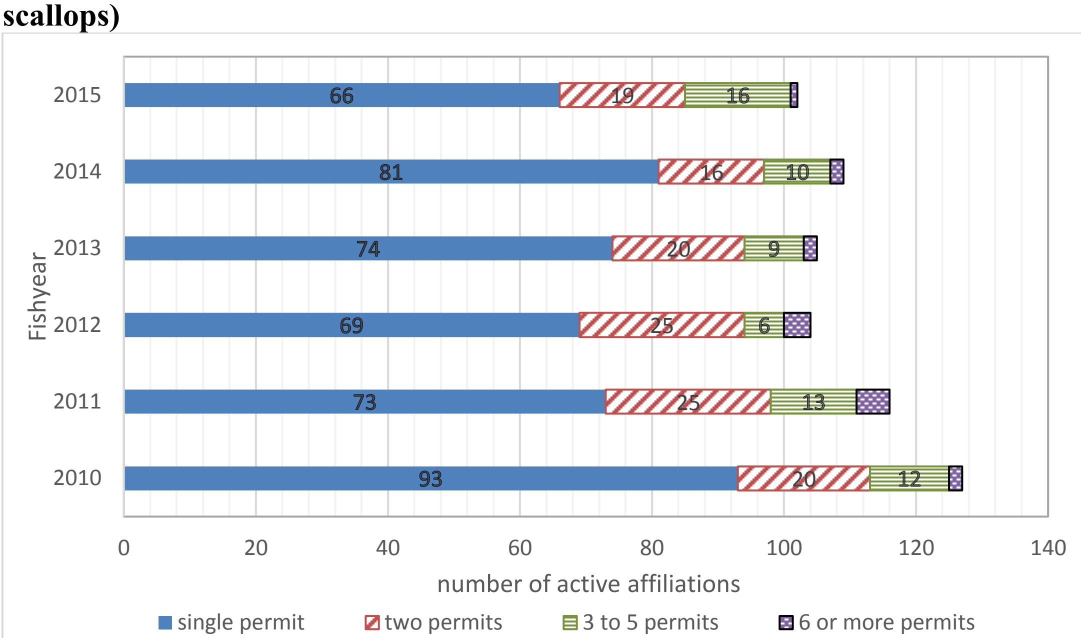


Figure 72. Inactive affiliations by number of permits owned (no landings of scallops)

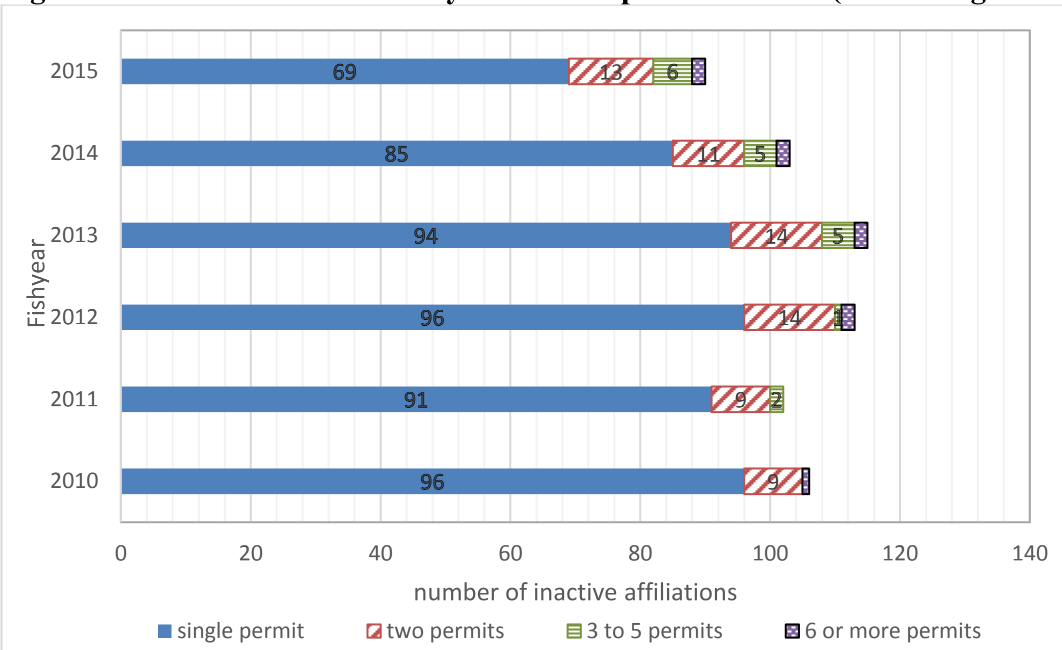


Figure 73. IFQ allocations by number of vessels owned (% of total allocations)

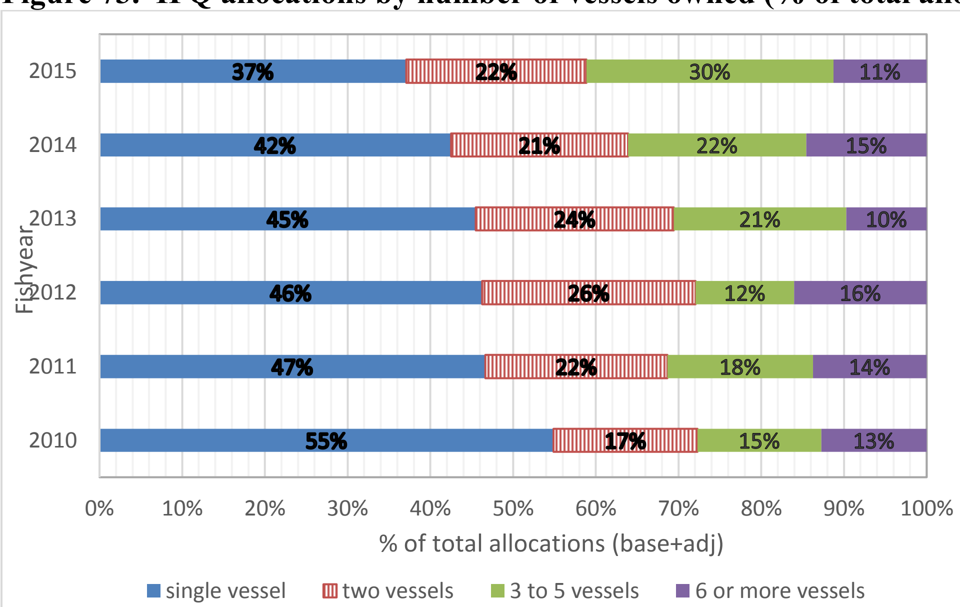
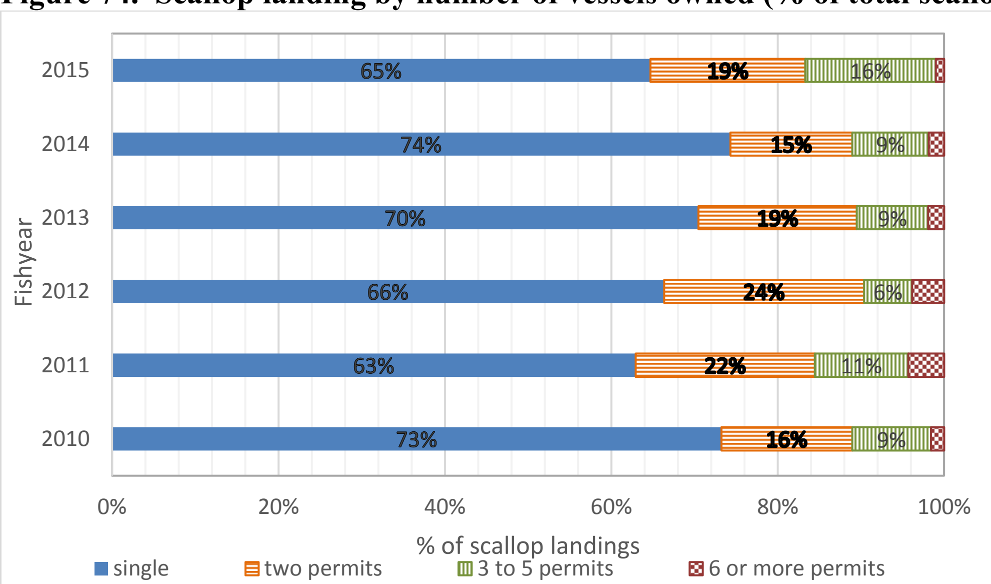


Table 28. Percentage of quota owned by active and inactive affiliations by number of permits owned

Activity Group	Fishyear	1 permit	2 to 4	5 or more	Grand Total
active	2010	45%	35%	21%	100%
	2011	36%	41%	22%	100%
	2012	49%	37%	14%	100%
	2013	48%	46%	6%	100%
	2014	46%	41%	13%	100%
	2015	40%	44%	16%	100%
active Total		**44%**	**41%**	**16%**	**100%**
inactive	2010	77%	14%	9%	100%
	2011	72%	20%	8%	100%
	2012	42%	25%	33%	100%
	2013	41%	29%	30%	100%
	2014	37%	29%	34%	100%
	2015	32%	32%	36%	100%
inactive Total		**49%**	**25%**	**26%**	**100%**

Figure 74. Scallop landing by number of vessels owned (% of total scallop landings)



4.4.2.5 Cumulative distribution of landings, leasing and net revenue by active affiliations

The distribution of landings is analyzed using cumulative distribution of landings and the number of active owners by ordering scallop landings per affiliation from smallest to largest. For the purposes of this analysis, the data is divided into four quadrants such that each quadrant is equivalent to about 25% of the total number of active affiliations in the LAGC IGQ fleet ranked starting with the bottom 25% who had the smallest amount of scallop landings in each year (Table 29).

The results show that landings were highly concentrated among the top 25% of active affiliations. About 32 affiliations in this group landed about 63% of total scallop landings in the LAGC IFQ fishery in the 2010 fishing year, and the bottom 25% landed about 1% of scallop landings (Figure 76). There has been hardly any change in those percentages in 2015, although the number of affiliations in the top 25% declined to 26 in this year as result of fleet consolidation. Average scallop landings per affiliation increased from 43,693 lb. in 2010 to 58,111 lb. in 2015, both as a result of increase in allocations and the concentration of effort (Figure 75). Although there has been some decline in the share of the top 25% of the affiliations in scallop landings to about 55% of total scallop landings in 2012 and 2013 overall, changes in those trends during 2010-2015 were not significant (Figure 76). In terms of leasing, again the top 25% of affiliations leased in about 71% of total leased pounds in 2010 and 67% of in 2015. There has been some decline in those shares in 2011-2012 probably because higher allocations in those years made it possible for some vessels with a smaller quota to earn a positive rate of return by fishing (Figure 77). In addition, there has been an increase in the carry-over pounds especially in 2012 and 2013 by the active vessels, probably reducing the need for additional leasing (Figure 2 and 3 in the aggregate impacts section). Quantile distribution of net revenue exhibits similar trends with the top 25% of the affiliations earning 65% of total LAGC IFQ fleet net revenue in 2010 and a slightly lower percentage (64%) of it in 2015 (Figure 78).

Table 29. Number of active affiliations per quantile and by Fishyear

Fishyear	Bottom 25%	Second Quantile	Third Quantile	Top 25%	Grand Total
2010	32	32	31	32	127
2011	29	29	29	29	116
2012	26	26	26	26	104
2013	27	26	26	26	105
2014	28	27	27	27	109
2015	26	25	25	26	102

Figure 75. Scallop landings per affiliation

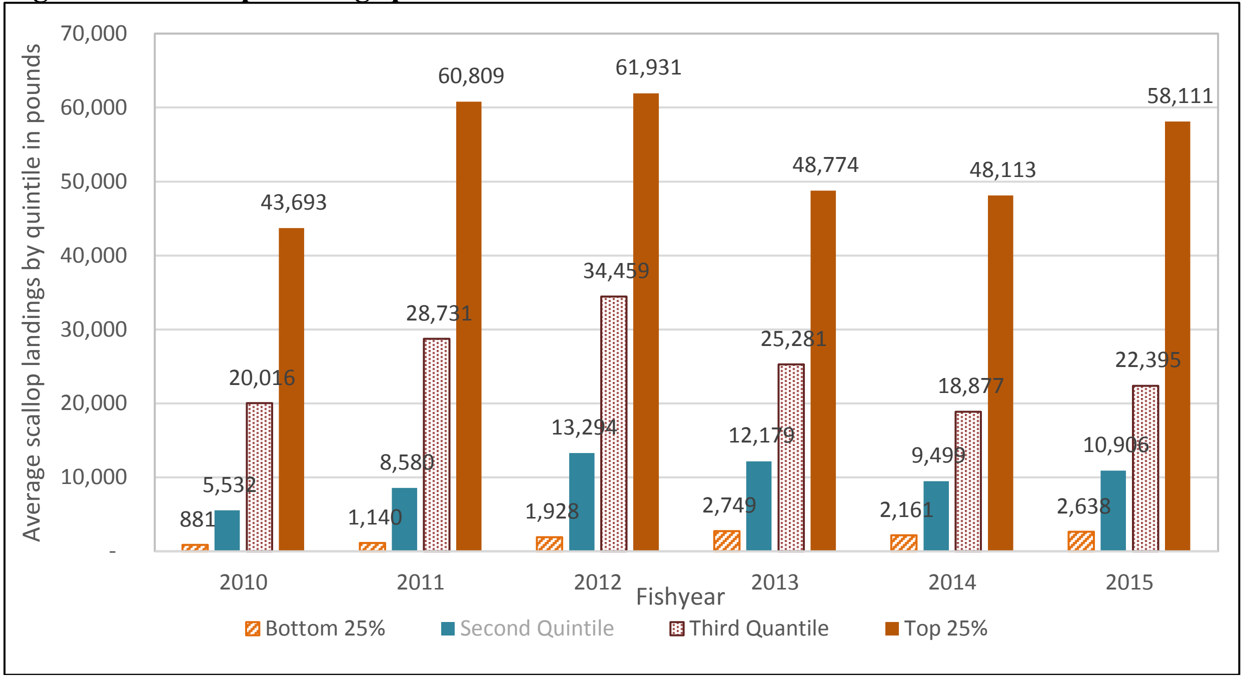


Figure 76. Composition of total scallop landings by quantiles

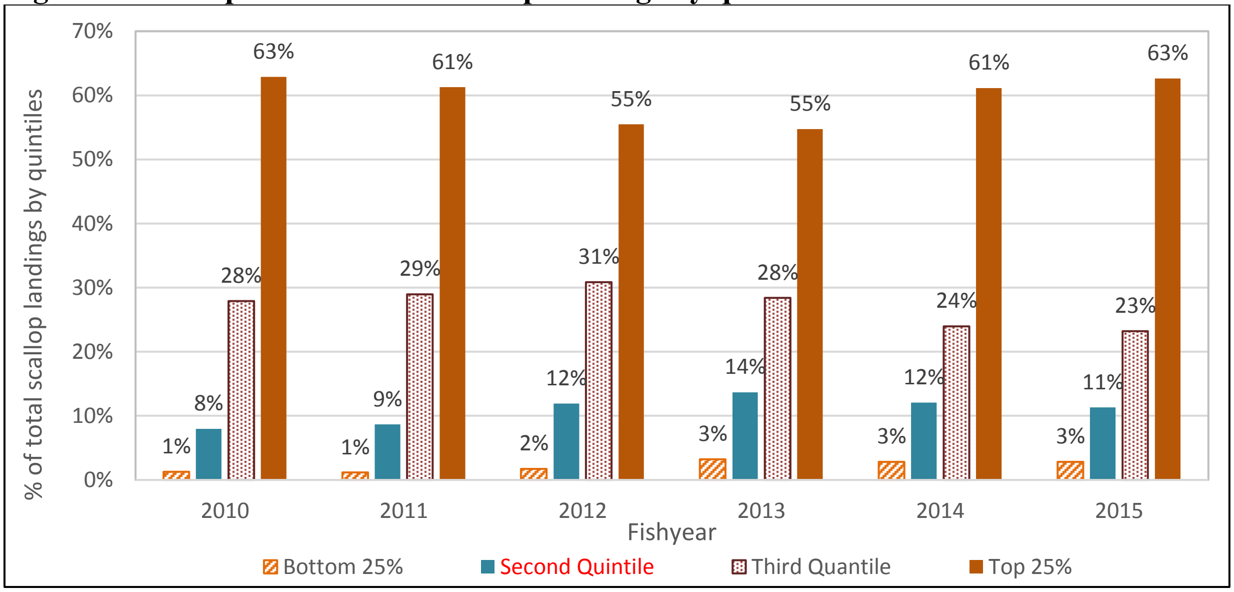


Figure 77. Percentage distribution of leased-in pounds by quantiles

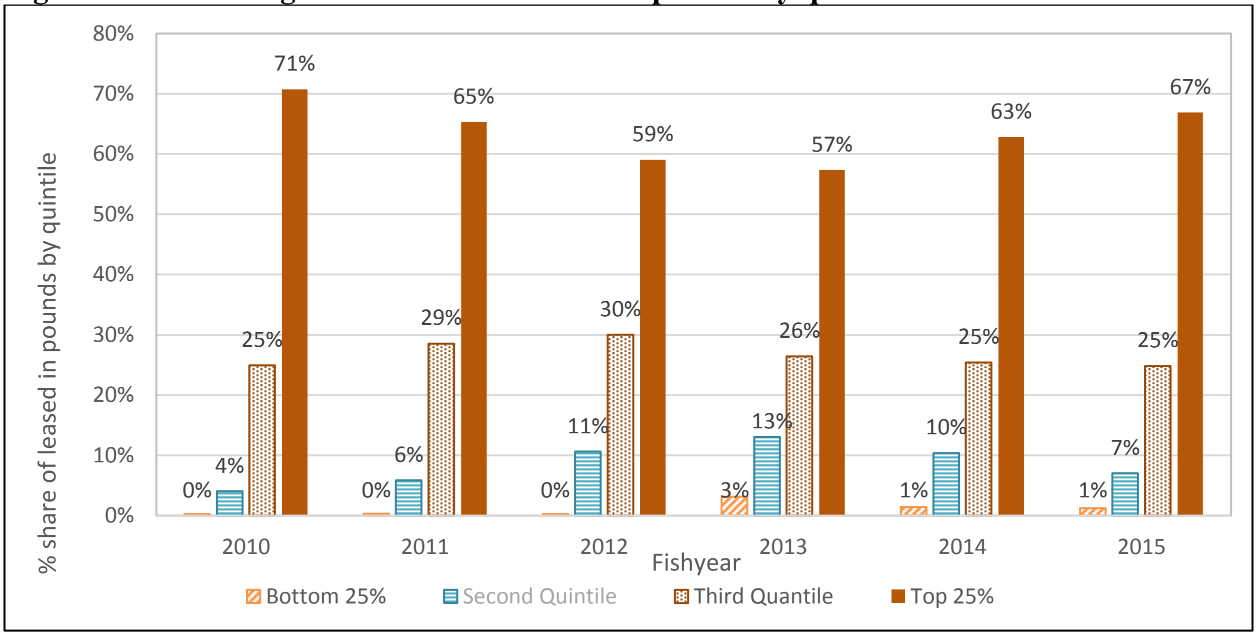
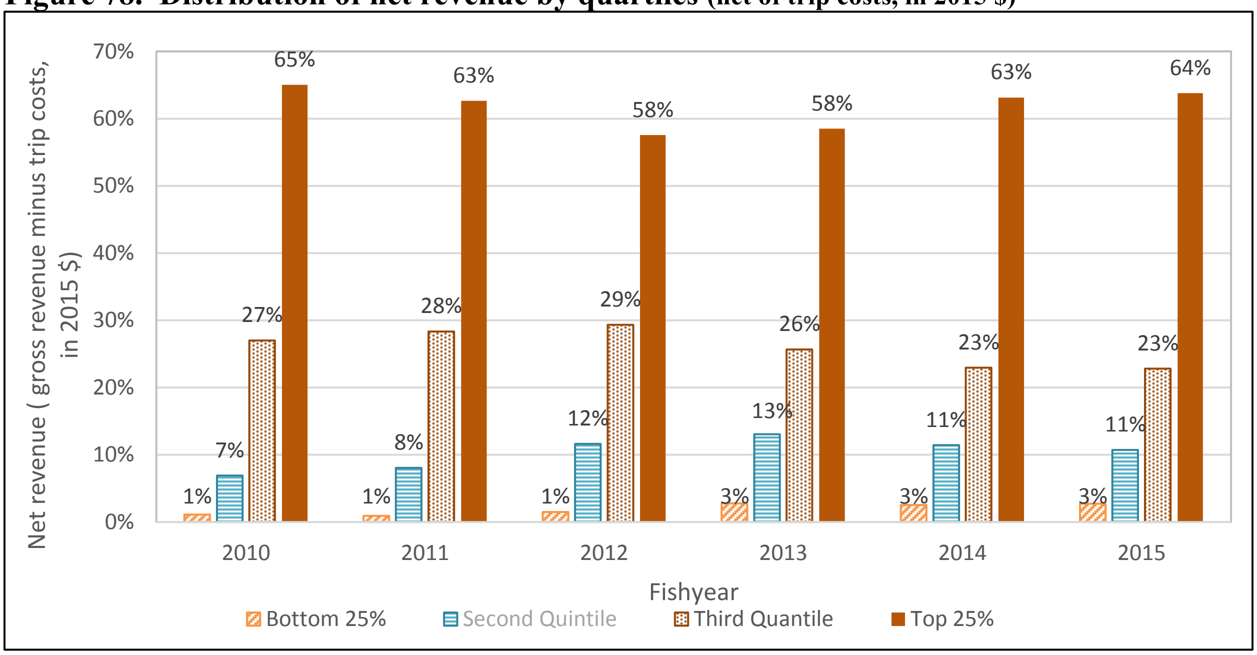


Figure 78. Distribution of net revenue by quartiles **(net of trip costs, in 2015 $)**



4.4.2.6 Cumulative distribution of profits

This section provides an analysis of accounting profits, which are measured as the difference between the boat share of gross revenue minus the fixed costs of production. Furthermore, profits were estimated either by assuming that lease costs are paid entirely by crew or shared equally between the crew and boat owner. For the inactive affiliations, accounting profits are assumed to consist of revenues obtained by leasing out. For the purposes of this analysis, the data is divided into four quadrants such that each quadrant is equivalent to about 25% of the total number of active affiliations in the LAGC IGQ fleet ranked starting with the bottom 25% who had the smallest amount of profits in each year (Table 30). Those at the lowest 25% quantile (Q1), earned about 6% their revenue from scallops, while those at the top 25% earned more than 50% of their revenues from the scallop fishery (Table 31).

The results show that the average profits per affiliation more than doubled since 2010 for all quantiles, assuming crew pays the lease costs (Figure 79). IFQ fleet profits were unequally distributed with over 75% of the profits going to the top 25% of the affiliations during 2010-2015. However, this proportion declined from 81% in 2010 to 76% of total profits in 2015 for the top 25% group. However, the number of affiliations declined from 233 in 2010 to 192 in 2015. As a result, the top 25% included 58 affiliations in 2010 while in 2015 it included 48 affiliations ((Table 30). Another way of looking at the distribution of profits is to divide total profits into four equivalent quantiles such that profits for each group equals 25% of total profits and determine how many affiliations there are in each of these quantiles. Table 32 is calculated by this approach and shows that the top 9 affiliations in 2010 and 8 affiliations in 2015 earned 25% of total profits, while many affiliations in the bottom 25% quantile either left the fishery or joined other affiliations. Finally, it was assumed that lease costs are shared by the boat owner and the crew, the decline in the share of top 25% of the affiliations in 2015 would be slightly less compared to 2010 and to Figure 80 (Figure 81). Section analyses these changes using GINI coefficients by taking into account the decline in the number of affiliations since 2010.

Table 30. Number of affiliations per quantile (profit – crew pay lease) by activity status

Fishyear	Activity group	Bottom 25%	Second Quantile	Third Quantile	Top 25%	Total
2010	Active	31	22	23	51	127
	Not Active	28	36	35	7	106
2010 Total		**59**	**58**	**58**	**58**	**233**
2011	Active	23	19	23	51	116
	Not Active	32	35	31	4	102
2011 Total		**55**	**54**	**54**	**55**	**218**
2012	Active	19	13	25	45	102
	Not Active	35	41	28	9	113
2012 Total		**54**	**54**	**53**	**54**	**215**
2013	Active	12	17	30	45	104
	Not Active	43	38	24	10	115
2013 Total		**55**	**55**	**54**	**55**	**219**
2014	Active	16	21	29	43	109
	Not Active	37	32	24	10	103
2014 Total		**53**	**53**	**53**	**53**	**212**
2015	Active	14	17	36	35	102
	Not Active	34	31	12	13	90
2015 Total	Active	**48**	**48**	**48**	**48**	**192**

Table 31. Dependency on scallop revenue per quantile (all affiliations)

Fishyear	**Q1**	**Q2**	**Q3**	**Q4**
2010	6%	6%	17%	80%
2011	6%	5%	50%	64%
2012	6%	6%	36%	68%
2013	6%	8%	45%	61%
2014	5%	11%	51%	56%
2015	6%	7%	34%	64%

Figure 79. Average profits from scallops per affiliation (crew pays lease costs, in 2015 $)

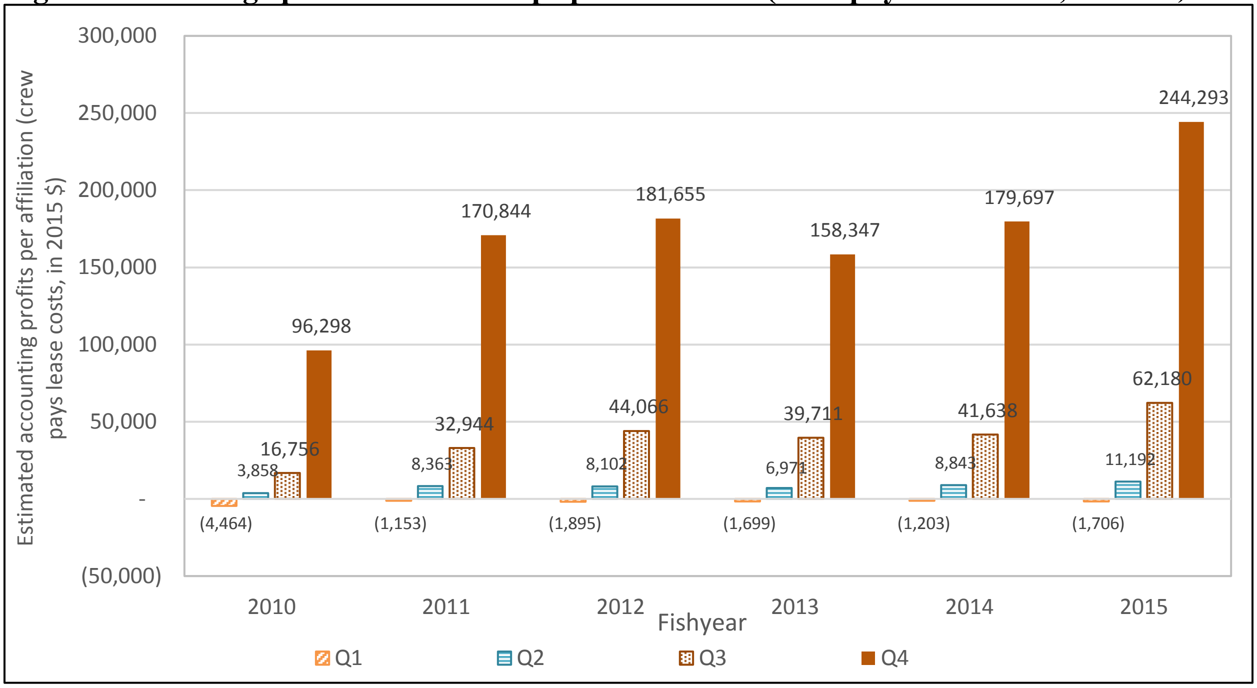


Figure 80. Percentage distribution of profits by quantiles (crew pays lease costs, excludes loss and zero profits)

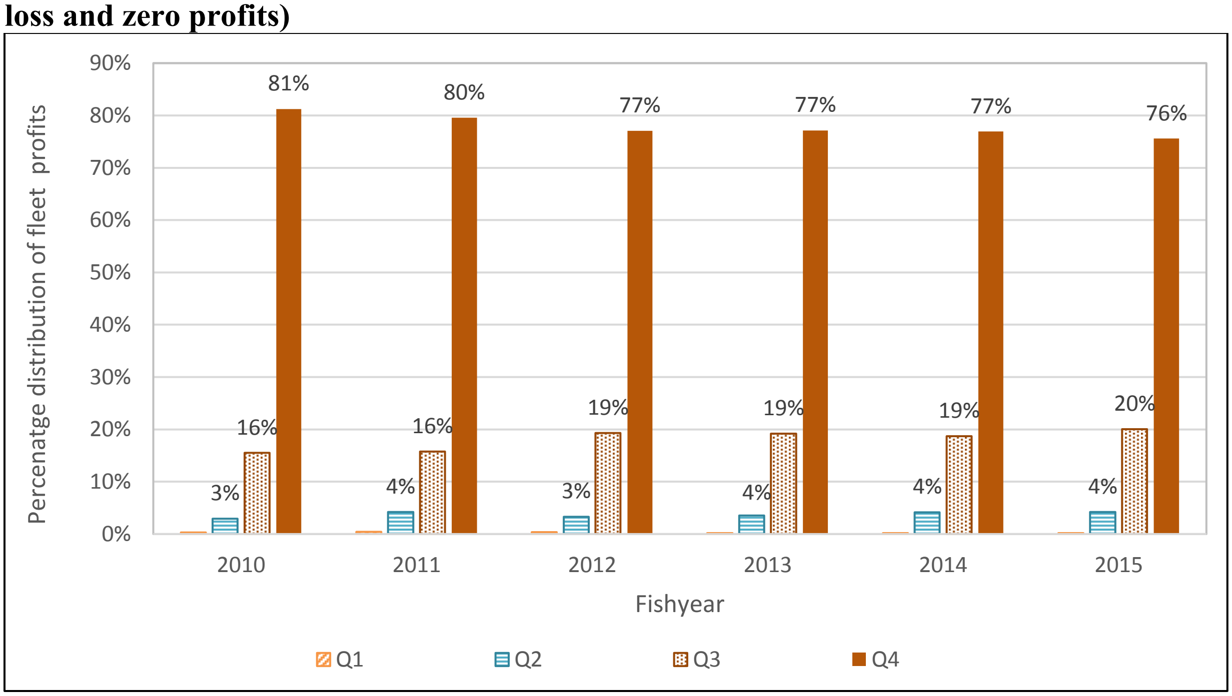


Figure 81. Percentage distribution of profits by quantiles (lease costs shared, excludes loss and zero profits)

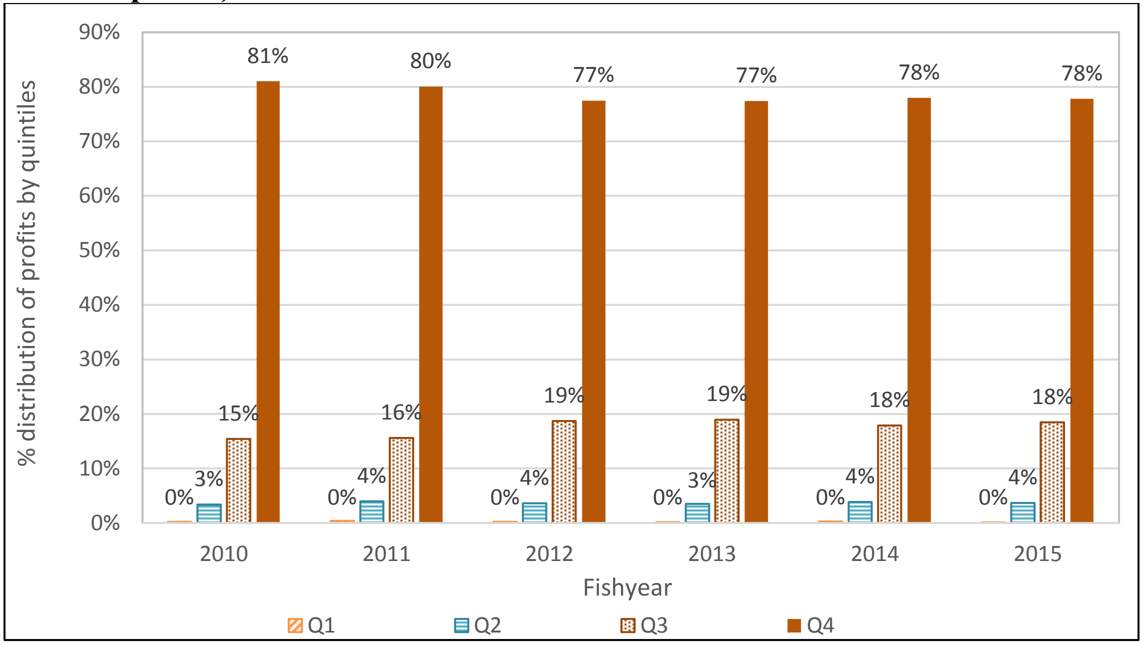


Table 32. Number of affiliations by profit quantiles

Profit Quantiles	2010	2,015
Bottom 25%	185	147
Second quantile	24	24
Third quantile	15	13
Top 25%	9	8

4.4.2.7 Distribution of allocations, revenue and profits using Lorenz curves and Gini coefficients

Lorenz Curve is a graphical representation of concentration of wealth that plots the proportion of the total wealth of the population (y axis), that is cumulatively earned by the bottom x% of the population. On the graph, a straight diagonal line represents perfect equality of wealth; the Lorenz curve lies beneath it, showing the actual wealth distribution. (Figure 82). The difference between the straight line and the curved line is the amount of inequality of income distribution and is described by the Gini coefficient. A low Gini coefficient indicates a more equal distribution, with "0" corresponding to complete equality, while higher Gini coefficients indicate more unequal distribution, with "1" corresponding to complete inequality.

In Figure 82, estimates are presented for Lorenz curves for the share of IFQ allocations per affiliation including those that are not active in the fishery but lease out their quota. The horizontal axis represents proportion of IFQ affiliations with shares arrayed in deciles of ascending order, with the first decile being equivalent to the 10% of IFQ affiliations with smallest shares, and the tenth decile equivalent to the largest 10% shares. The vertical axis shows the proportion of quota shares. Perfect equality is represented by the 45° line, the distribution of IFQs for 2010 is represented by the dotted line, and distribution for 2015 is represented by the solid line. Unfortunately, due to the lack of dependable ownership data prior to 2010, Lorenz curves and Gini coefficients could not be compared to the years before the implementation of the IFQ program.

It is evident from the Lorenz curves depicted in Figure 82 and from the value of Gini coefficients provided in Figure 83 that quota allocations among LAGC IFQ affiliations were unequally distributed both in 2010 and 2015, although in 2015, it seems that concentration became less unequal. In 2010, 90% of the affiliations owned 57% of the quota, with remaining 10% owned 43%. In 2015, 90% owned 64% while the rest of the 10% owned 36% of the IFQ allocations (Figure 82). However, this figure excludes those IFQ owners or affiliations who sold their quota to others, basically showing that quota distribution become more equal among the remaining owners in the fishery. Therefore this method could underestimate the inequality resulting from quota sellouts since fewer IFQ-holders “generally means that less needs to be redistributed in order to attain perfect equality”. The number of affiliations declined from 233 in 2010 to 192 in 2015 (Figure 11).

In Figure 83, Gini coefficients are compared with and without including those observations on affiliations that have sold all their quotas in previous years. The dotted line in Figure 83 includes only those who still have their quotas, while the solid line at the top includes all the affiliations. For example, if an affiliation held a quota in any of the fishing years from 2010 to 2015 but then sold out completely, its quota holdings are included in the data with zero values after they sold their shares. The Gini coefficients indicate that concentration of quota became more unequal in 2015 (Gini=0.67) compared to 2010 (Gini=0.62) if all the affiliations were included, but slightly less unequal (Gini=0.62 in 2010 and 0.60 in 2015) if those that sold out their shares are excluded. The bottom line in Figure 83 show that distribution of quota became more equal among active affiliations which participate in the LAGC IFQ fishery (Gini=0.61 in 2010, 0.57 in 2015).

As noted by Agnarsson, Matthiasson and Giry [2016], “this approach is appropriate if the owners of the selling firm leave the fisheries business altogether, it may be more questionable if those selling quotas have merged or have been taken over by other firms but still remain in partial ownership of a harvesting company. However, the bias from including only firms with positive quota holdings is probably greater than the bias from including all firms that have sold their quotas, as mergers or takeovers have probably been less common than sellouts and exits from the industry.”

Figure 82. Lorenz curve for distribution of IFQ allocations (2010 and 2015 fishing years)

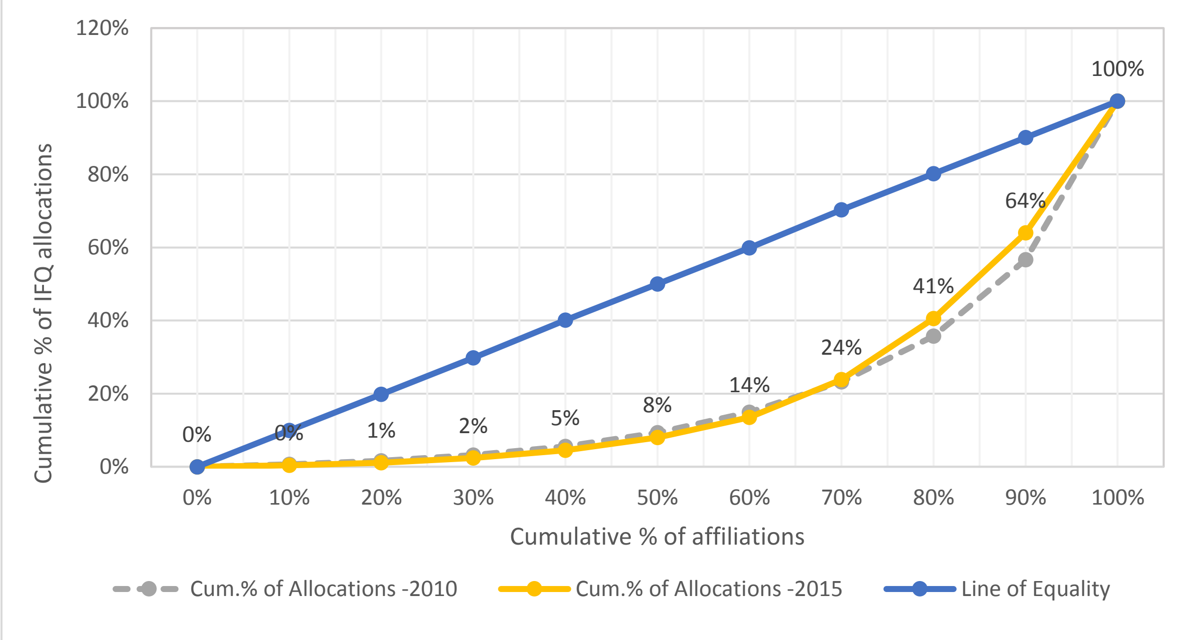
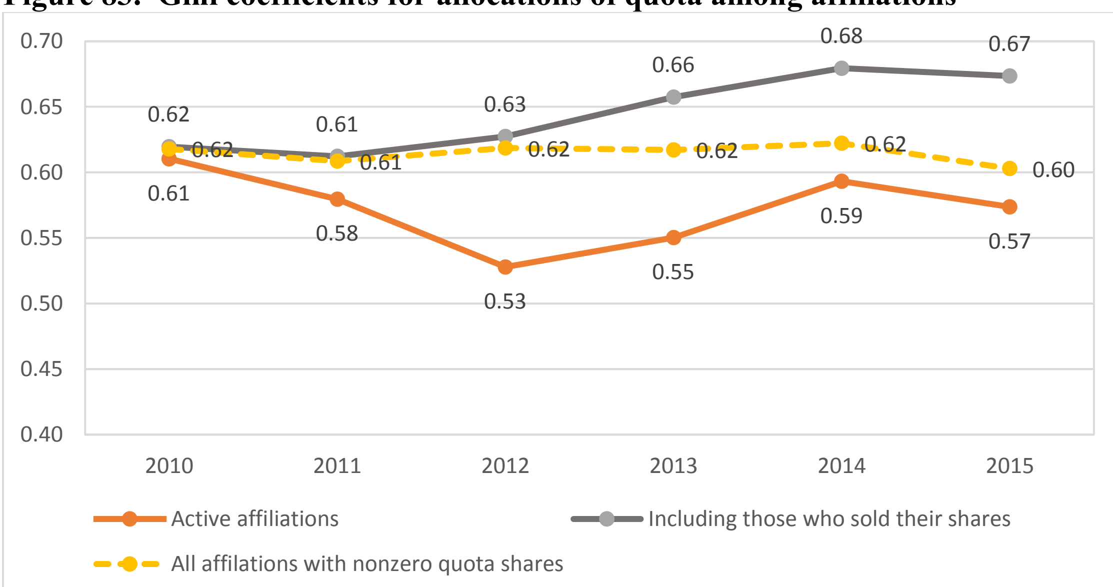


Figure 83. Gini coefficients for allocations of quota among affiliations



The Gini coefficients for landings and revenues of active affiliations were above 0.55 for the 2010 to 2011 fishing years but came down in 2012 and 2013 as the number of active vessels declined in those years and increased again in 2014 and 2015 as new vessels became active. When all affiliations were included in the estimation of GINI coefficients including those inactive owners, Gini coefficients went over 0.76 and changed slightly during the fishing years from 2010 to 2015 becoming less unequal. These values were lower compared to the Gini coefficients for the groundfish fishery if the revenues of all species were included in the calculation and were lower than values of Gini coefficients if only the groundfish revenues were included in the estimation (Tammy Murphy, NEFSC Report for GF Fishery, January 2014).

The Gini coefficients for the profit estimates provided in Table 33 were above 0.65; however, the decline in the inequality was more significant than estimates for revenues whether lease costs paid by crew or shared and whether either active or all affiliations were included. The reason for this trend was probably because leasing revenue were included as a part of profits for all affiliations and as lease prices increased over time, there has been an increase in the profits of inactive affiliations reducing the earning gaps compared to the active affiliations (Figure 30).

The reductions in the value of the Gini coefficients from 2010 to 2012 imply that the distribution of revenues became slightly more equal. This could be partly attributed to the reduction in the number of low revenue earners after 2010 as some of those owners either sold their shares to others or consolidated them with some small quota owners in partnership. It is also due to the increase in lease prices and in the revenues from leasing for owners who lease-out their quota relative to active owners who also lease-in quota and tend to have higher net revenues compared to inactive owners.

Table 33. Gini Coefficients for landings, revenues and profits

Variable	2010	2011	2012	2013	2014	2015
Scallop landings - active affiliations	0.55	0.55	0.49	0.47	0.52	0.53
Scallop landings - all affiliations	0.76	0.76	0.76	0.75	0.76	0.75
Scallop revenue - active affiliations	0.57	0.56	0.48	0.47	0.53	0.55
Scallop revenue - all affiliations	0.77	0.77	0.76	0.75	0.76	0.76
Profits (active affiliations, crew pay lease)	0.66	0.66	0.63	0.61	0.62	0.62
Profits (all affiliations, crew pay lease)	0.72	0.71	0.69	0.69	0.69	0.69
Profits (active affiliations, lease costs shared)	0.65	0.65	0.63	0.60	0.62	0.61

4.4.2.8 Concentration, market shares and HHI

The Herfindahl-Hirschman index (HHI) is a commonly accepted measure of market concentration and is used by the U.S. Department of Justice for evaluating potential merger issues. It takes into account the relative size distribution of the firms in a market by squaring the market share of each firm competing in a market, and then summing the resulting numbers. Value of HHI approaches zero for a market comprised of a large number of firms of relatively equal size and equals 10,000 points when a market is controlled by a single firm. Either a decrease in the number of firms in the market or an increase in the disparity of market shares would result in higher HHI.

The U.S. Department of Justice considers a market with an HHI of less than 1,500 to be a competitive marketplace, an HHI of 1,500 to 2,500 to be a moderately concentrated marketplace, and an HHI of 2,500 or greater to be a highly concentrated marketplace [2]. HHI values of less than 1000 indicate low market concentration.

The HHI values for the distribution of quota holdings in the LAGC-IFQ fishery are much lower than 1000, below 200 for the whole fishery, including active and inactive affiliations, which indicates that the market for quota shares is competitive (**Table 34**). This is the natural result of the percentage ownership restrictions included in Amendment 11 to prevent a few individuals or corporations from dominating the fishery and to help to redistribute gains from the limited access more equitably among more fishermen. The LAGC IFQ program prohibits an individual or corporation from having more than 5% ownership interest of the total general category allocation. Furthermore, the maximum amount of quota one vessel could harvest was originally set at 2% by Amendment 11, but increased to 2.5% in 2011 by Amendment 15 to be more consistent with the maximum individual ownership value of 5%. At a 5% share cap the smallest possible number of affiliates would be 20, but in 2015 there were 192 affiliates, which is 9.6 times that of the level the share cap would allow. These restrictions also helped reduce the potentially negative impacts of consolidation on employment and crew incomes due to the decrease in the number of vessels, and have positive economic impacts on communities that depend on the small day-boat fishery.

There has been hardly any change in the HHI values for quota holdings in 2015 compared to the 2010 fishing year when the whole IFQ fleet was included in the sample. In fact, HHI declined in the years 2011 – 2013, and then increased again to about 160 in 2014 and 2015 due to the decline in the number of affiliations. Interestingly, concentration of quota among the active owners declined during this period, with HHI values declining from 289 in 2010 to 207 in 2015, while the HHI values including only inactive affiliations increased from 271 in 2010 to 616 in 2015 (Table 34). With the HHI value standards, distribution of the quota holding were competitive both within the active and inactive affiliations. There has been a slight decrease in the share of active affiliations in this period from 68% in 2010 to 66% in 2015 and a corresponding increase in the share of inactive affiliations from 32% in 2010 to 34% in 2015. In short, the analysis supports the conclusion that caps on ownership and vessel quotas were effective in maintaining competitiveness in the LAGC IFQ fishery according to the HHI standards.

Table 34. Quota concentration measured by Herfindahl-Hirschman Index (HHI)

Fishyear	2010	2011	2012	2013	2014	2015
Active Affiliations						
HHI	289	227	188	195	220	207
Number of affiliations	127	116	104	105	109	102
% share of total allocations	68%	71%	58%	61%	65%	66%
Inactive affiliations						
HHI not active	271	266	475	461	548	616
Number of affiliations	106	102	113	115	103	90
% share of total allocations	32%	29%	42%	39%	35%	34%
All affiliations						
HHI all	162	137	147	142	160	161
Number of affiliations	233	218	217	220	212	192
% share of total allocations	100%	100%	100%	100%	100%	100%

- The Atlantic Sea Scallop General Category IFQ share transfer network is characterized by few participants, low cohesion, and one-time transfers between business entities.
- The Atlantic Sea Scallop General Category IFQ quota leasing network is characterized by many participants, increasing cohesion, and multi-year participation, but also by few multi-year leasing relationships between participants.
- The number of federally permitted seafood dealers receiving landings from the IFQ fleet has decreased over time, and relationships between fishing businesses and dealers tend to be short term. There is some consistency in the largest sea scallop dealers across years.

4.4.2.9 Trends in the geographic distribution of allocations, landings and leasing activity

There has been hardly any change in the number of active vessels homeported in Massachusetts in 2015 relative to 2010 fishing year although those numbers declined to 49 in 2013 and increased again to 59 in 2015. In contrast, the number of active vessels in the Mid-Atlantic states declined from 94 in 2010 to 69 in 2015 (Figure 84). Most of the reduction took place in North Carolina as the number of active vessels declined from 23 in 210 to 9 in 2015 (Table 35). The number of active vessels from New Jersey and Massachusetts exceeded the number of active vessels from other states.

In terms of the allocations for active vessels only, the share of Massachusetts increased from 23% in 2010 to 26% in the 2015 fishing year while the share of states in Mid-Atlantic region declined during the same years from 41% in 2010 to 37% in 2015 (Figure 85). However, in terms of allocations for all permits, including those that lease out their shares, there has been almost no change in the share of vessels home ported in the Mid-Atlantic States other than North Carolina (Table 36). Those with unknown home state belonged to the IFQ permit holders in CPH with no active vessel in operation.

The percentage share of the vessels home ported in Massachusetts in total landings increased from 29% in 2010 to 35% in 2015 (Table 37). This proportion was higher in 2012 (39%) and 2013 (38%) when the scallop resource conditions were more favorable in the New England area. Consistent with these trends, there has been a shift in the leasing-in activity from Mid-Atlantic to the New England area in 2012 with Massachusetts becoming the main state with net leasing of IFQ from other states (Table 39,
Table 40 and Figure 88). The existence of permit banks and co-ops might also have had an effect on the shifts of leasing activity by state as well as the location of access areas open to fishing in each year. For example, in 2010 fishing year, majority of access areas open to fishing were located in Mid-Atlantic, and in 2011 the NLS access area was closed to fishing by emergency action. This might explain why more leasing took place and more scallops are landed by active vessels located in Mid-Atlantic in 2010-2011 fishing years (Table 20, Appendix K). In 2012, there has been a sizable increase in the productivity of scallop resources in the open areas fished by IFQ vessels measured by landings per DAS especially in New England, prompting more vessels homeported in MA to increase leasing activity compared to NJ and NC (Figure 87). This trend was reversed in especially in 2014 and 2015 as the productivity of the scallop resource in inshore areas of Massachusetts declined relative to other areas and access areas of Mid-Atlantic became more productive (Table 38). In those years, the percentage share of the Mid-Atlantic

region in net leased scallop pounds increased from 52% in 2013 to 61% in 2014 and to 55% in 2015 (Figure 89).

The fishing activity of the LAGC IFQ component overlaps spatially with the LA fishing activity. From 2012 – 2015 there was greater overlap in the areas where both components fished compared to earlier years probably driven by changes in resource condition in "inshore" areas (Appendix H).

LAGC IFQ vessels have landed scallops in ports as far north as Massachusetts and as far south as North Carolina from FY2010 to FY2015 (Figure 90). The port with the most cumulative LAGC IFQ scallop landings during this time was Barnegat Light/Long Beach, NJ. Barnegat Light/Long Beach, NJ had the most scallops landed in FY2010, FY2011, FY2012, and FY2015, while Point Pleasant, NJ had the most scallops landed in FY2013 and FY2014.

Figure 84. Number of active vessels by region

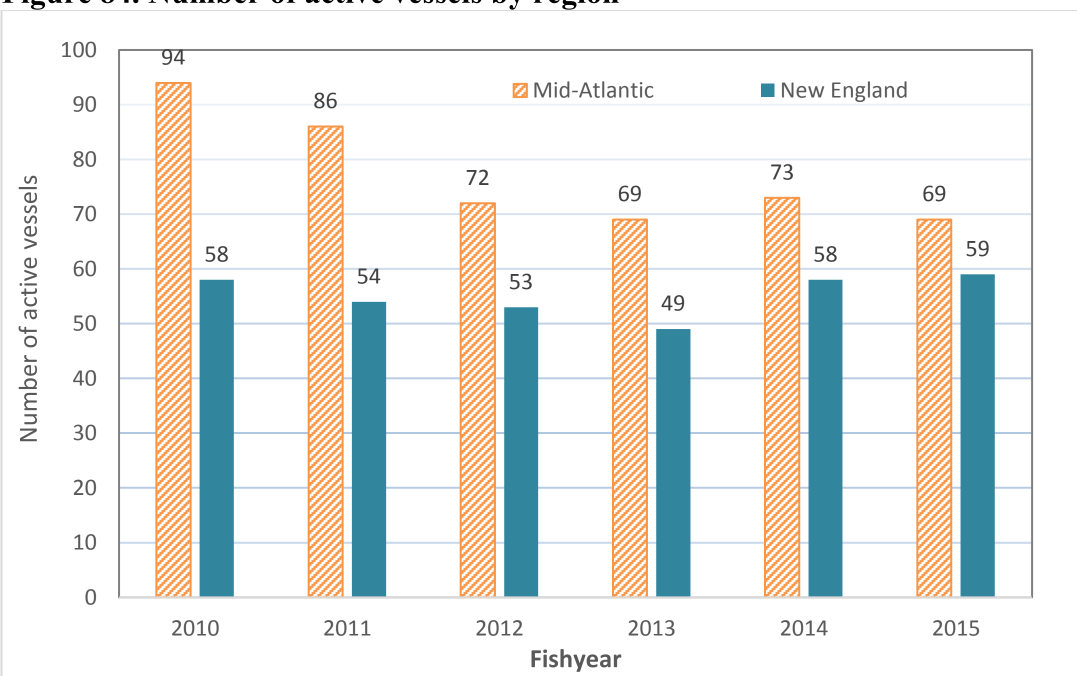


Table 35. Number of active vessels by home State

STATE	2010	2011	2012	2013	2014	2015
MA	41	41	39	36	39	41
NC	23	16	10	10	9	9
NJ	43	44	38	39	43	41
NY	16	15	14	12	13	12
Oth.Mid.At	12	11	10	8	8	7
Oth.NE	17	13	14	13	19	18
Grand Total	152	140	125	118	131	128

Figure 85. Distribution of LAGC IFQ allocations by region (% of total)

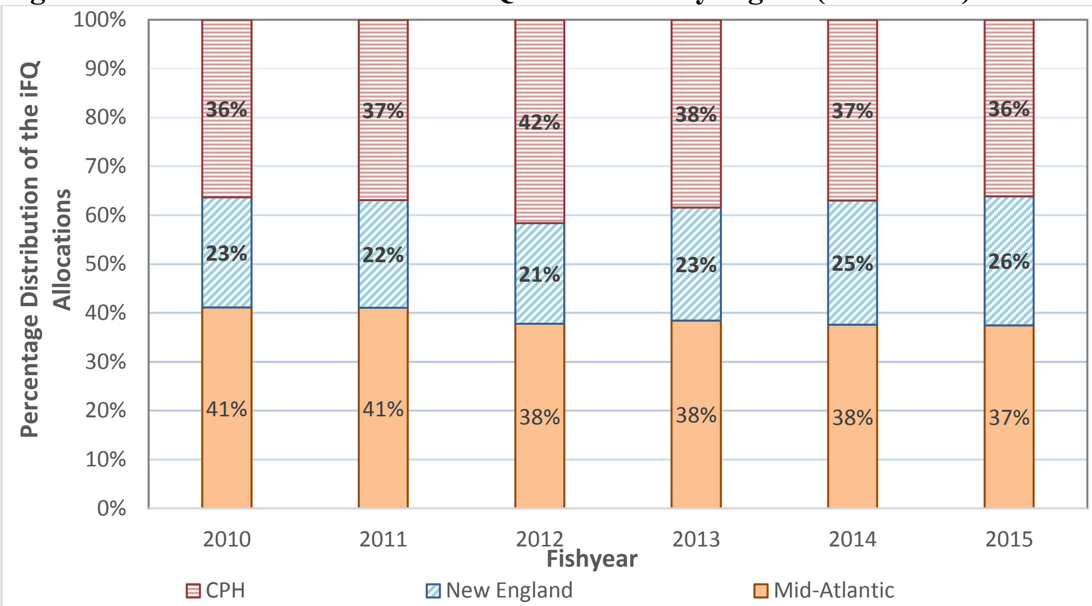


Table 36. Distribution of LAGC IFQ allocations by home state (% of total)

STATE	2010	2011	2012	2013	2014	2015
MA	16%	19%	17%	20%	21%	22%
NC	8%	7%	7%	4%	4%	4%
NJ	23%	24%	21%	24%	24%	24%
NY	6%	6%	6%	5%	5%	6%
Oth.Mid.At	4%	4%	4%	5%	4%	4%
Oth.NE	6%	3%	4%	3%	4%	5%
Permits in CPH	36%	37%	42%	38%	37%	36%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 37. Distribution of LAGC IFQ scallop landing by home state (% of total)

STATE	2010	2011	2012	2013	2014	2015
MA	29%	32%	39%	38%	31%	35%
NC	14%	11%	6%	7%	7%	6%
NJ	36%	39%	36%	36%	41%	42%
NY	10%	9%	8%	9%	10%	6%
Oth.Mid.At	6%	4%	5%	3%	4%	3%
Oth.NE	5%	4%	6%	6%	7%	7%
Permits in CPH	0%	0%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Figure 86. Distribution of scallop landings by home state (% of total, LAGC IFQ vessels)

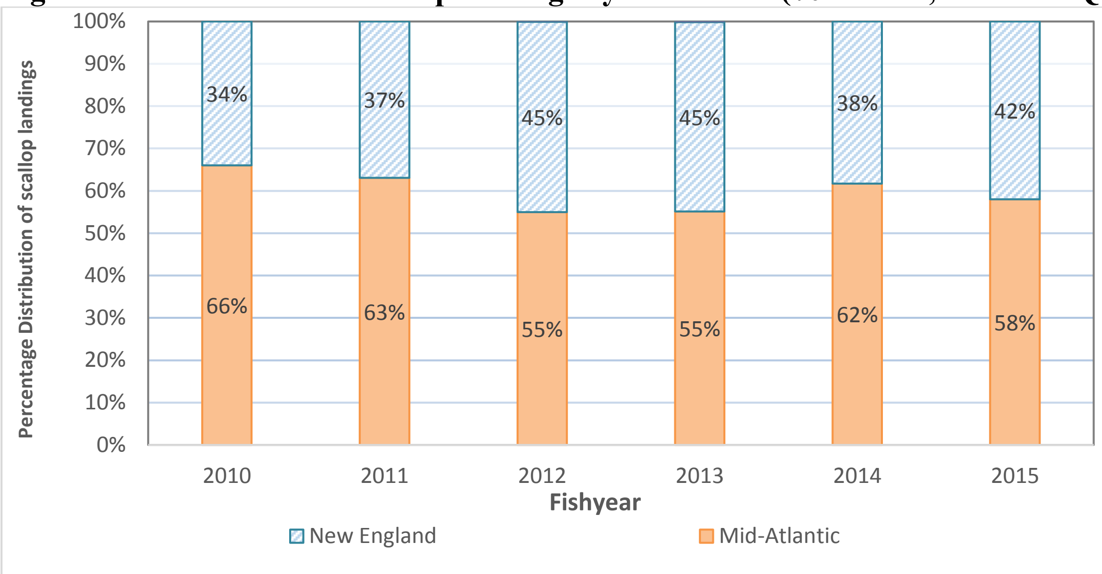


Figure 87. LPUE by area for IFQ vessels (scallop pounds per DAS, annual average)

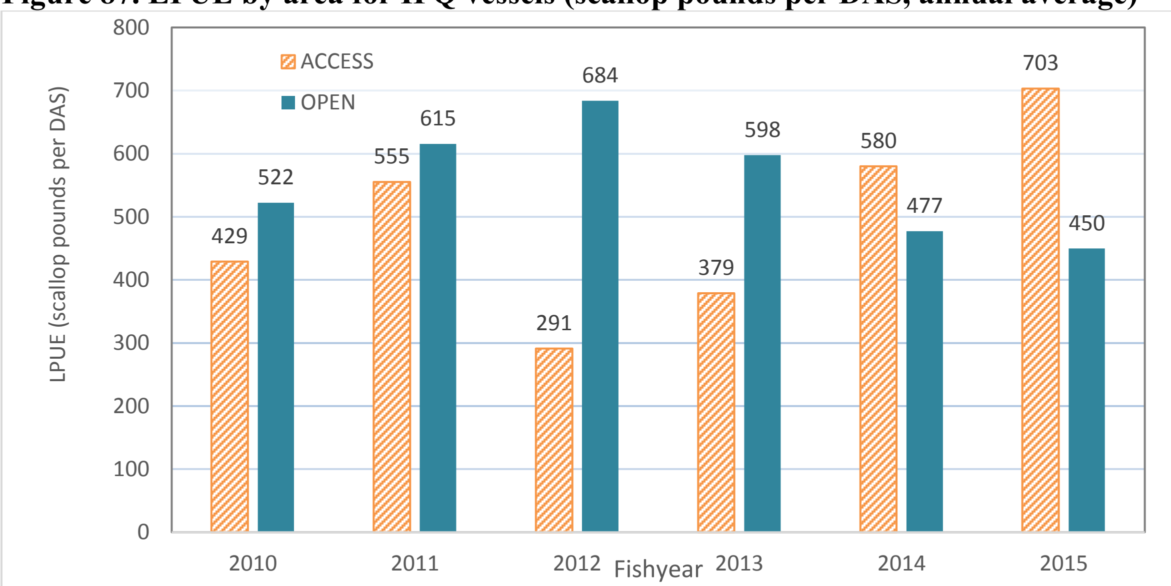


Table 38. LAGC IFQ landings by open and access areas

Fishyear	2012	2013	2014	2015
Open areas	2,692,929	2,174,239	1,811,897	1,190,478
% of total landings	98%	98%	89%	51%
NLS	19,205	37,573	1,906	0
Delmarva	1,353		225,911	0
HC	42,079	634		0
Mid-Atlantic total	62,637	38,207	225,911	1,134,099
All areas	2,755,566	2,212,446	2,039,714	2,324,577
sub-ACL	3,095,450	2,227,142	2,202,859	2,700,663
% of ACL	89%	99%	93%	78%

Figure 88. Distribution of leased-in quota by home state (% of total, LAGC IFQ vessels)

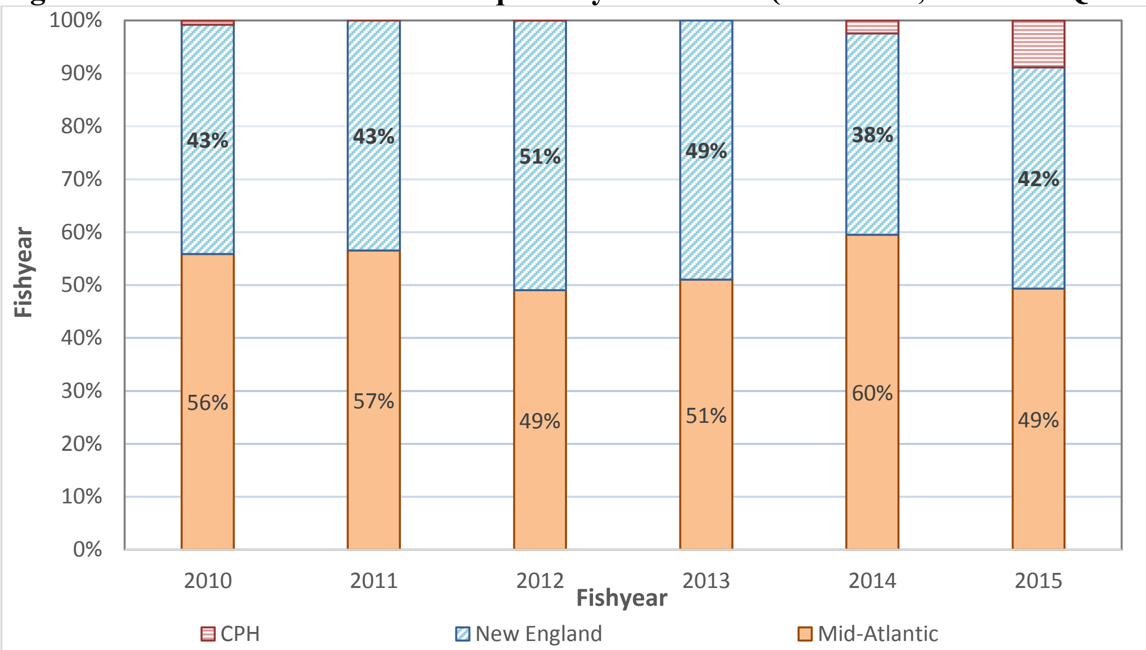


Table 39. Distribution of LAGC IFQ leased-in quota by home state (% of total)

STATE	2010	2011	2012	2013	2014	2015
MA	41%	40%	47%	43%	32%	37%
NC	11%	12%	7%	9%	7%	5%
NJ	35%	35%	30%	31%	40%	38%
NY	5%	7%	9%	8%	10%	4%
Oth.Mid.At	5%	2%	3%	3%	3%	2%
Oth.NE	3%	3%	4%	6%	6%	4%
Permits in CPH	1%	0%	0%	0%	2%	9%

Figure 89. Distribution of net leased in quota by home state (% of total, LAGC IFQ vessels)

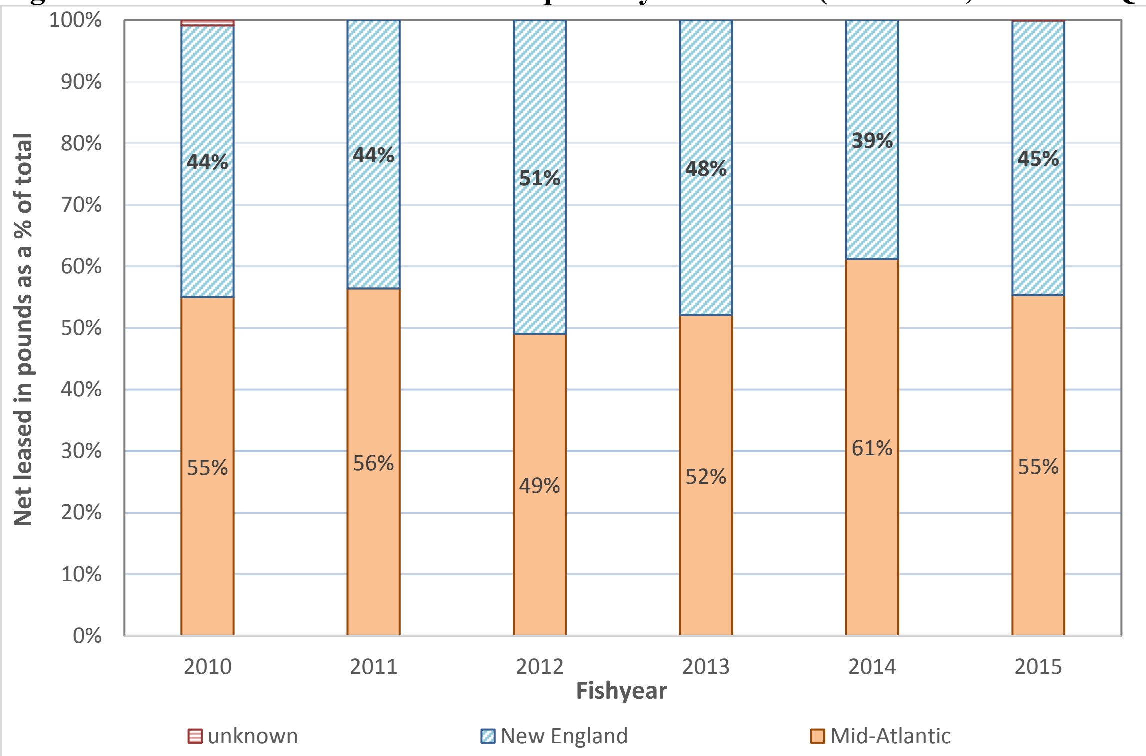
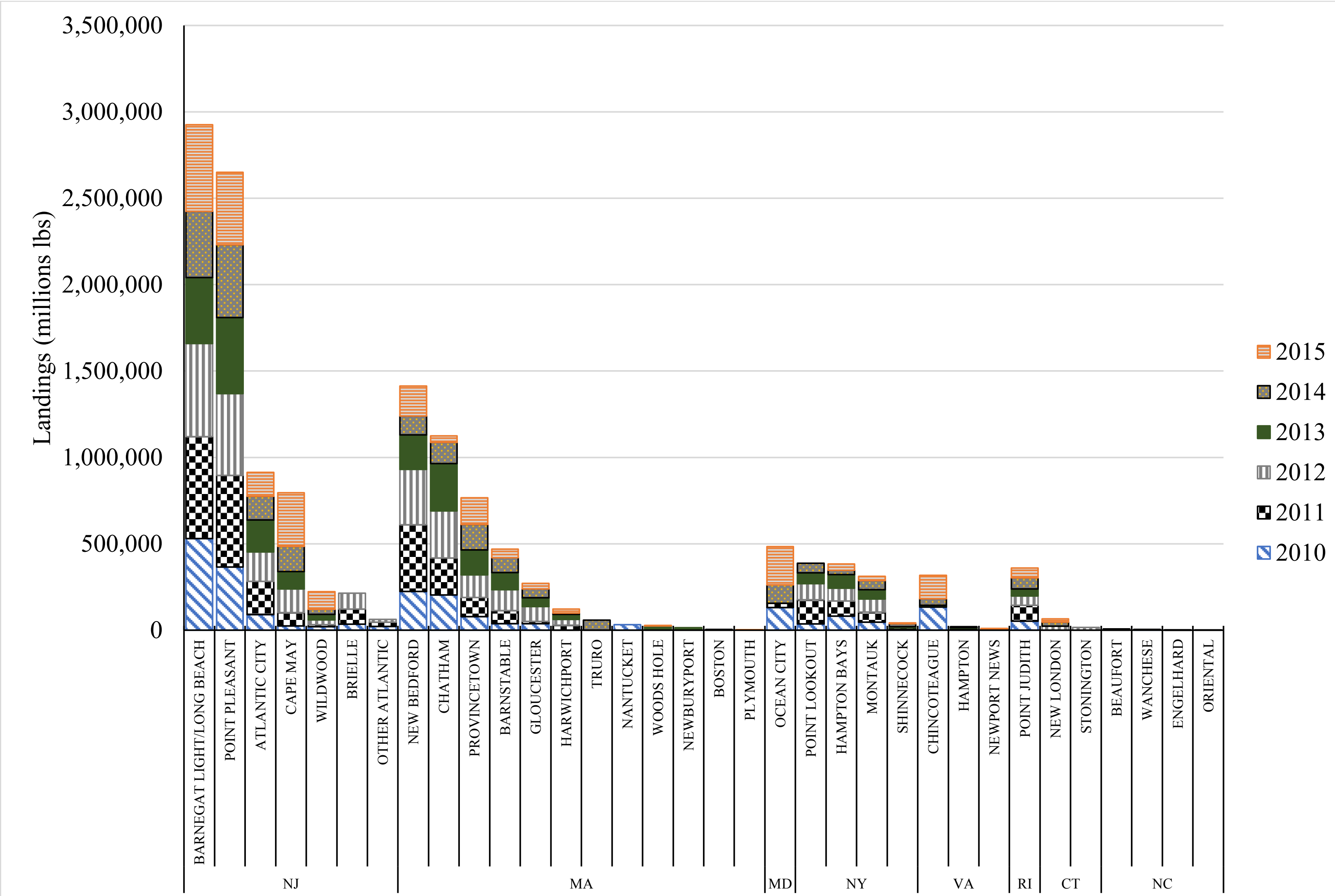


Table 40. Distribution of net leased in quota by home state (% of total, LAGC IFQ vessels)

STATE	2010	2011	2012	2013	2014	2015	Grand Total
MA	42%	40%	47%	42%	33%	40%	41%
NC	11%	12%	7%	9%	8%	5%	9%
NJ	33%	35%	30%	31%	39%	43%	35%
NY	6%	7%	9%	9%	11%	5%	8%
Oth.Mid.At	5%	2%	3%	3%	3%	2%	3%
Oth.NE	3%	3%	4%	6%	5%	5%	4%
Permits in CPH	1%	0%	0%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Figure 90 - LAGC IFQ scallop landings by dealer port and state from FY2010 to FY2015. Ports included had landings from at least 3 different vessels in a given year.



4.4.2.10 Impacts of the IFQ program on non-qualifiers

To qualify for an IFQ permit, a General Category scallop vessel had to have 1,000 pounds of scallop meat landings during any fishing year over the qualification period (3/1/2000 to 11/1/2004). This section focuses on those vessels that did not meet the IFQ criteria, but did land scallops during the qualification period and continued to remain active in any fishery during the IFQ period (3/1/2010 - 2/29/2016). The purpose is shed some light on how reliance across species groups differed among these vessels during the two time periods as well as examining how many vessels may have qualified for an IFQ permit had the qualification criterion been lower. For purposes of analysis reliance was measured by the percent of total revenue earned from designated species groups. The species groups were assembled according to the FMPs of the New England and Mid Atlantic Fishery Management Councils. Species that are not explicitly managed by an FMP in either Council were combined into an “other” group.

Non-qualifiers were identified by first extracting all dealer purchases of sea scallops from NFMS dealer data for scallop fishing years 2000-2004. The vessel permit number of the seller to the dealer was then matched to permit data, so that only sales by General Category vessels were kept. Annual scallop sales (by fishing year) were then summed by vessel. Any vessel that landed scallops but had less than 1,000 pounds of scallop landings in all of the qualifying years was identified as a non-qualifier. Dealer data for each of these non-qualifying vessels were summarized by species group and fishing year for the IFQ period 3/1/2010 to 2/29/2016. Any vessel that did not report landings of any species during the entire IFQ period was deemed to be inactive and was eliminated from further consideration. This left a total of 180 non-qualifying vessels that had landed scallops during the qualifying period and were active in at least one year during the IFQ period.

In terms of fishery participation, the 180 non-qualifying vessels were active in a wide variety of fisheries during the qualification period, and continued to do so during the IFQ period. The percent of total revenue by species group among non-qualifiers during the qualification period and during the IFQ period is shown in Table 41. Sea scallop revenue comprised a small percentage of total revenue during both periods. Across the designated species groups, sea scallop revenue was the smallest revenue component to the 180 non-qualifiers. Groundfish comprised the greatest percentage of revenue during both periods, though the percentage decreased during the IFQ period. Table 41 would suggest that failing to qualify for an IFQ permit did not force these vessels to dramatically alter their fishing choices. It appears that the far larger impact to the non-qualifying General Category vessels as a whole arose from changing conditions and management in the groundfish fishery. Still, of these 180 non-qualifying vessels, the majority (99) did not participate in the scallop fishery during the IFQ period. However, it must be cautioned that this study does not address potential changes in fishing behavior for non-qualifiers if they qualified for limited access and in response to increase in scallop prices after the implementation of the IFQ program (Appendix F).

Table 41. Percentage of revenue generated by species group among non-qualifying vessels (N=180) during qualification (3/1/2000 to 11/1/2004) and IFQ periods (3/1/2010 to 2/29/2016)

Species Group	Percentage of revenue generated by non-qualifiers during qualification period	Percentage of revenue generated by non-qualifiers during IFQ period
Sea Scallop	0.1%	1.2%
American Lobster	1.9%	4.9%
Groundfish	33.8%	23.7%
Monkfish	7.1%	4.5%
Scup/Fluke/Black Sea Bass	7.5%	13.5%
Squid	14.3%	17.8%
Surf Clam/Ocean Quahog	20.5%	15.8%
Whiting	6.9%	7.4%
Other	7.9%	11.3%
Total	*100.0%*	*100.0%*

4.4.3 Comparative analysis of crew surveys in the LAGC IFQ fishery

The Crew Survey component of the LAGC IFQ review utilizes the Survey on the Socio-Economic Aspects of Commercial Fishing Crew in New England and Mid-Atlantic conducted by the NEFSC Social Sciences Branch (SSB) from 2012 to 2013 (Appendix I). Due to small sample sizes, this report utilizes a two-group t test approach to compare mean responses of crew members working on IFQ vessels versus those on non-IFQ vessels. This report also analyses differences in means between IFQ, non-IFQ, and crew members who worked on vessels that fished primarily for multispecies (groundfish) and lobster. Several subject areas were covered by the survey items analyzed. These included views about the management process, the fishery management plan, fishing area access, rules and regulations, environmental stewardship attitudes and behaviors, and finally job satisfaction and overall health and wellbeing. The main findings from this report are summarized by the bulleted statements below. These findings focus specifically on differences between crew members on IFQ vessels and crew on non-IFQ vessels. Please refer back to the main report for a description of the differences between these two groups and crew members on vessels fishing primarily for groundfish and lobster.

- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that they did not trust managing authorities to make the right decisions when it came to regulating fisheries.
- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that their captains were able to fish where he wanted to.
- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that overall levels of bycatch and discards were high in their primary fisheries. IFQ vessel

crew members were also more likely than non-IFQ crew to report that regulations had increased levels of bycatch and discards in their primary fishery.

- There were no significant differences between IFQ and non-IFQ crew members on any of the items assessing job satisfaction or overall health and wellbeing. Both groups of crew members generally expressed satisfaction with their earnings, time away from home, and the adventure of the job. Both groups also generally expressed that they felt connected to other fishermen and that they were proud to be fishermen.

4.4.4 Summary and Conclusions

The number of active vessels and affiliations in the LAGC IFQ fishery declined in the period 2010-2015. The opportunity to lease out and transfer quota to other owners made consolidation possible among fewer affiliations. The number of active affiliations declined from 127 in 2010 to 102 in 2015 along with the permits and vessels owned by them (Figure 16). However, trends for the number of permits owned by inactive affiliations, including permits in CPH, were different. The number of inactive affiliations declined from 106 in 2010 to 90 in 2015, but permits owned by those affiliations increased from 121 in 2010 to 132 in the 2015 fishing year, indicating that there has been some movement of quota from active owners to inactive affiliations (Figure 14). However, the change in the distribution of quota between active and inactive affiliations was rather small. The share of inactive affiliations in total quota increased slightly from 32% in 2010 to 34% in 2015, and the share of active affiliations declined from 68% to 66% in the same period (Figure 17).

Scallop revenue per active affiliation almost doubled from $164,049 in 2010 to $299,858 both because of an increase in total fleet revenue and a decrease in the number of active affiliations in this period (Figure 61). Some active and inactive affiliations also earned revenue from other species, and the average revenue from other species per active affiliation exceeded significantly those for active affiliations (Section 4.4.2.1).

The number of affiliations that had a dependency of more than 25% on scallop revenue was relatively stable during the 2010-2015 fishing years. However, there has been a significant decline in the number of active affiliations that have a 25% or less dependence on scallop revenue, from 42 in 2010 to 17 in 2015. This implies that these affiliations leased out or sold their quota to others that target scallops or who have a higher dependency on scallop fishery as a source of their revenue. Despite this decline in relative diversity compared to 2010, about half of the LAGC IFQ fleet participate in the scallop fishery at varying levels, while the other half, 53 affiliations in 2010 and 52 in 2015, mostly targeted scallops. Nevertheless, distribution of scallop revenue was quite concentrated with the share of those in the top group of owners with more than 75% dependency on overall scallop fleet revenue ranging from 65% to 71% during the 2010-2015 fishing years (Section 4.4.2.5). This is due to the transferability measures included in the IFQ program that made it possible for those with a higher dependence on scallop fishing to lease or buy quota from owners who mainly derive their income from other fisheries, or from those with permits in CPH without an operating fishing vessel.

The majority of the affiliations in the LAGC IFQ fishery owned only one permit. However, the number of owners with a single IFQ permit declined from 81% in 2010 to 70% of total affiliations in 2010. The number of active affiliations that have two or more permits increased, and those that owned 5 or more permits reached 7% of the active affiliations. Similarly, the number of inactive affiliations with two or more permits increased from 9% in 2010 to 23% in 2015 of all inactive affiliations. As a result, the share of those affiliations who owned 3 to 5 vessels (22 in 2010 and 12 in 2015) doubled from 15% in 2010 to 30% in 2015 (Figure 73).

The quantile analysis of cumulative distribution of landings and net revenues showed that landings were highly concentrated among the top 25% of active affiliations (Section 4.4.2.5). About 32 affiliations in this group landed about 63% of total scallop landings in the LAGC IFQ fishery in the 2010 fishing year while the bottom 25% landed about 1% of scallop landings (Figure 76). There has been hardly any change in those percentages in 2015, although the number of affiliations in the top 25% declined to 26 in this year as result of fleet consolidation. Quantile distribution of net scallop revenue exhibited similar trends with the top 25% of the affiliations earning 65% of total LAGC IFQ fleet net revenue in 2010 and a slightly lower percentage (64%) of it in 2015 (Figure 78). IFQ fleet profits were unequally distributed with over 75% of the profits going to the top 25% of the affiliations during 2010-2015. This proportion declined from 81% in 2010 to 76% of total profits in 2015 for the top 25% group as the number of affiliations in this group declined from 58 affiliations in 2010 to 48 affiliations in 2015 (Table 30). However, the top 9 affiliations in 2010 and top 8 affiliations in 2015 earned about 25% of total profits, while many affiliations in the bottom 25% quantile either left the fishery or joined other affiliations (Section 4.4.2.6).

The value of Gini coefficients for quota allocations among LAGC IFQ affiliations are consistent with these results. Although quota was unequally distributed both in 2010 and 2015, it seems that concentration became less unequal in 2015. In 2010, 90% of the affiliations owned 57% of the quota, with the remaining 10% owning 43%. In 2015, 90% owned 64% while the rest of the 10% owned 36% of the IFQ allocations (Figure 82). However, this figure excludes those IFQ owners or affiliations who sold their quota to others, basically showing that quota distribution become more equal among the remaining owners in the fishery. If GINI coefficients were calculated by including those observations on affiliations that have sold all their quotas in previous years, the results show that concentration of quota became somewhat more unequal in 2015 (Gini=0.67) compared to 2010 (Gini=0.62) (Section 4.4.2.7).

The analysis of market concentration based on the Herfindahl-Hirschman index (HHI) indicated that market for quota shares in the IFQ fishery is competitive and that caps on ownership and vessel quotas were effective in preventing excessive shares in the LAGC IFQ fishery (Section 4.4.2.8). With the HHI value standards, distribution of the quota holding were competitive both within the active and inactive affiliations. However, concentration of quota among the active owners declined during this period, with HHI values declining from 289 in 2010 to 207 in 2015, while the HHI values including only inactive affiliations increased from 271 in 2010 to 616 in 2015. These conclusions are consistent with the analyses presented in other sections, indicating that there has been more consolidation among inactive compared to the active affiliations.

There has been some fluctuations in the geographical distributional of landings and leasing in the IFQ fishery since 2010. However, the majority of these changes could probably be attributed to the changes in the scallop productivity by area (Section 4.4.2.9). Section 4.4.2.10 indicated that failing to qualify for an IFQ permit did not force these vessels to dramatically alter their fishing choices.

4.5 CONSERVATION AND MANAGEMENT

4.5.1 Stock Status and 2014 Benchmark Assessment

The sea scallop resource had a benchmark assessment in 2014 (SARC59, 2014). Therefore, all of the data and models used to assess the stock were reviewed. The final results from that assessment were incorporated into subsequent actions, including updated reference points for status determination. Overall, a handful of issues were updated as a result of the assessment and are summarized below. The full benchmark assessment and summary report can be found at: http://www.nefsc.noaa.gov/publications/crd/crd1409/ .

The major highlights from the benchmark assessment include:

1. several changes to the dredge index;
2. use of a separate Habcam index;
3. splitting out GB open and GB closed subareas;
4. several model parameter adjustments (a. increased estimates for natural mortality; b. increased natural mortality for larger scallops; and c. new growth estimates for three different time periods); and
5. new reference points based on these modifications.

Several changes were reviewed and approved related to the dredge survey index: 1) VIMS survey data was integrated for all areas from 2005-2013; 2) tows were standardized to one nautical mile in length instead of using a vessel correlation factor that was used in the last assessment; and 3) marginal areas on GB were dropped from the survey index. Adding the VIMS survey data had modest effects on the index, but improved the overall CV.

Habcam data used as a separate survey index for the first time in this assessment (GB 2011-2013 and MA 2012 and 2013). Previously simple kriging was completed with Habcam data to estimate access area biomass in scallop actions. But this assessment used a more complex a three step model (GAM plus ordinary kriging) to obtain biomass and abundance estimates. A stratified mean was also used as a backup estimate or “sanity check”. Paired habcam/dredge tows were used to obtain survey dredge efficiency estimates.

The GB model results were unstable; therefore the region was divided into two sub-regions: GB open and GB closed. Model for GB open performed very well, no retrospective patterns. For GB closed, the model does not believe the large survey years, so underestimates biomass for those years. The assessment panel discussed that density dependence juvenile mortality could be causing this, but that issue was not fully tested in this assessment.

Three model parameters were adjusted: 1) natural mortality increased in all areas, and was increased from 0.12 to 0.16 on GB and from 0.15 to 0.2 in the MA; 2) natural mortality for the plus group was assumed to be 1.5 times that of other size classes (i.e., 0.24 for GB and 0.3 for MA); and 3) different growth estimates used for different time periods. Analyses were completed to support all of these adjustments.

Based on all these changes the assessment approved new reference points for status determination.

4.5.1.1 Stock status

The scallop stock is considered overfished if F is above Fmsy, and overfishing is occurring if biomass is less than ½ Bmsy. The previous estimate of Fmsy was 0.38 and Bmsy was 125K mt (1/2 Bmsy = 62K mt). SARC59 revised these reference points and increased Fmsy to 0.48 and reduced Bmsy to 96,480 mt (½ Bmsy = 48,240 mt). A comparison of the reference points are described in Table 42.

Table 42 – Summary of old and new reference points

	SARC 50 (2010)	SARC 59 (2014)
OFL	F = 0.38	F = 0.48
ABC/ACL (25% chance of exceeding OFL)	F = 0.32	F = 0.38
ACT for LA fishery (25% chance of exceeding ABC)	F = 0.28	F = 0.34
Bmsy (1/2 Bmsy)	125,358 (62,679)	96,480 (48,240)

Four types of mortality are accounted for in the assessment of the sea scallop resource: natural, discard, incidental, and fishing mortality. The updated stock assessment established new values for natural mortality on both stocks; it was increased from 0.12 to 0.16 on GB and from 0.15 to 0.2 in the MA. In addition, natural mortality for the plus group was assumed to be 1.5 times that of other size classes (i.e., 0.24 for GB and 0.3 for MA).

Discard mortality occurs when scallops are discarded on directed scallop trips because they are too small to be economically profitable to shuck or due to high-grading during access area trips to previously-closed areas. Total discard mortality (including mortality on deck) is uncertain, but was estimated at 20% in this assessment, as well as the previous two assessments.

Incidental mortality is non-landed mortality associated with scallop dredges that likely kill and injure some scallops that are contacted but not caught by crushing their shells, and this source of mortality is highly uncertain. The last benchmark assessment in 2010 used 0.20 on Georges Bank and 0.10 in the Mid-Atlantic (NEFSC, 2010), compared to earlier values of 0.15 on Georges Bank and 0.04 for Mid-Atlantic. There is no new information to modify the values used in 2010, but several studies are in process, and SARC59 did run some sensitivity analyses of this source of mortality. In general, incidental mortality does not have a very large impact on the overall assessment of the stock.

Finally, fishing mortality, the mortality associated with scallop landings on directed scallop trips, is calculated separately for Georges Bank and the Mid-Atlantic because of differences in growth rates. Fishing mortality peaked for both stocks in the early 1990s, but has decreased substantially since then as tighter regulations were put into place including area closures, and biomass levels recovered. shows F and biomass estimates for the combined stock overall through 2013.

SARC 59 included a formal stock status update through FY2013, and the reference points were updated in this benchmark assessment. The updated estimates for 2013 are: F=0.32 and B=132K, so the stock is not overfished and overfishing is not occurring, under both the old and new reference points (Figure 92 and Table 43). The main driver for the increase in Fmsy is due to increases in natural mortality and weakening of MA stock recruit relationships. In general Fsmy is uncertain because the Fmsy curve for MA is very flat, uncertain where Fmax is for that region.

Figure 91 - Whole stock estimate of fishing mortality through 2013 (SARC59) Fishing mortality (red line) and biomass estimates (y^{-1}, gray bars) from the CASA model

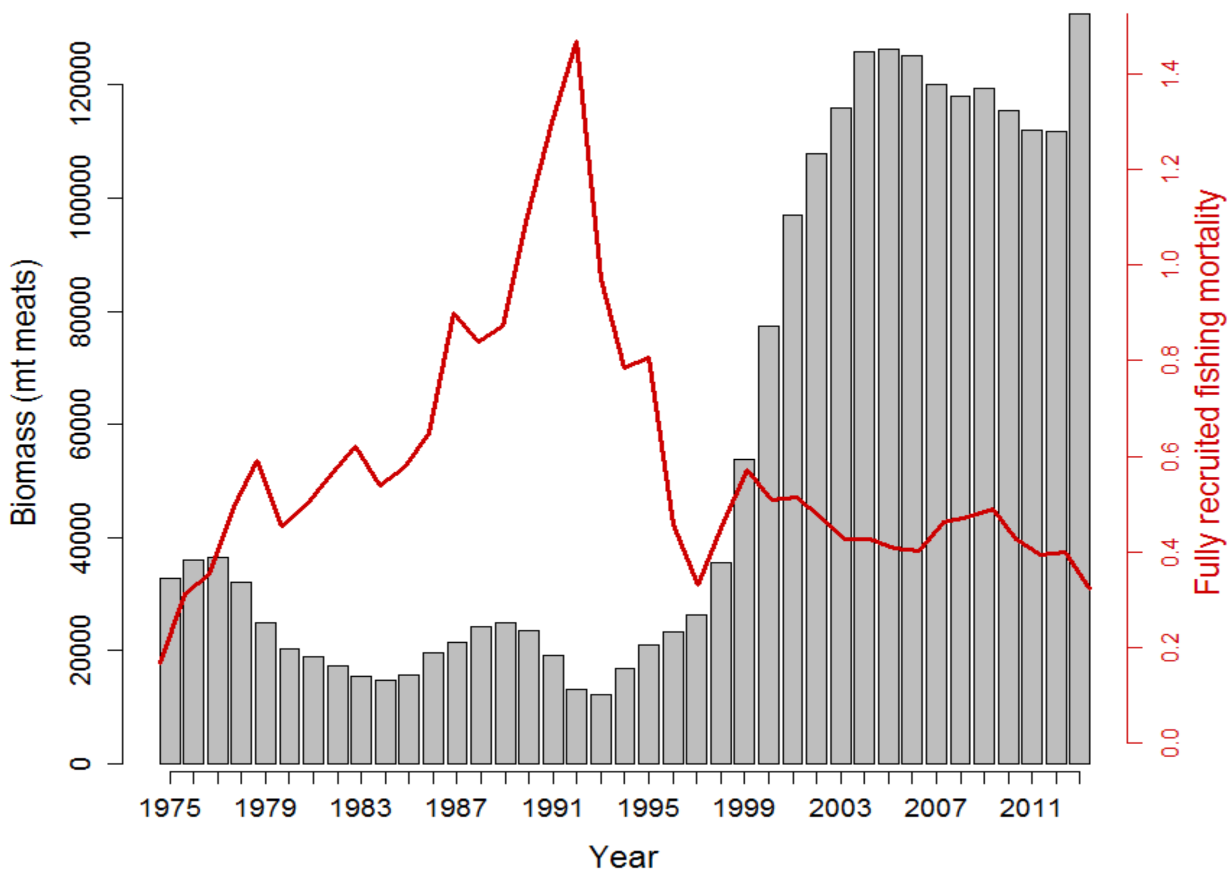


Figure 92 – Fully recruited annual fishing mortality rate for scallops from 1975-2013

Note that trends are different for partially recruited scallops because of changes in commercial size selectivity. SARC59 Fmsy is shown with green dashed line for the most recent period; Fmsy would have been smaller in past years when selectivity was different.

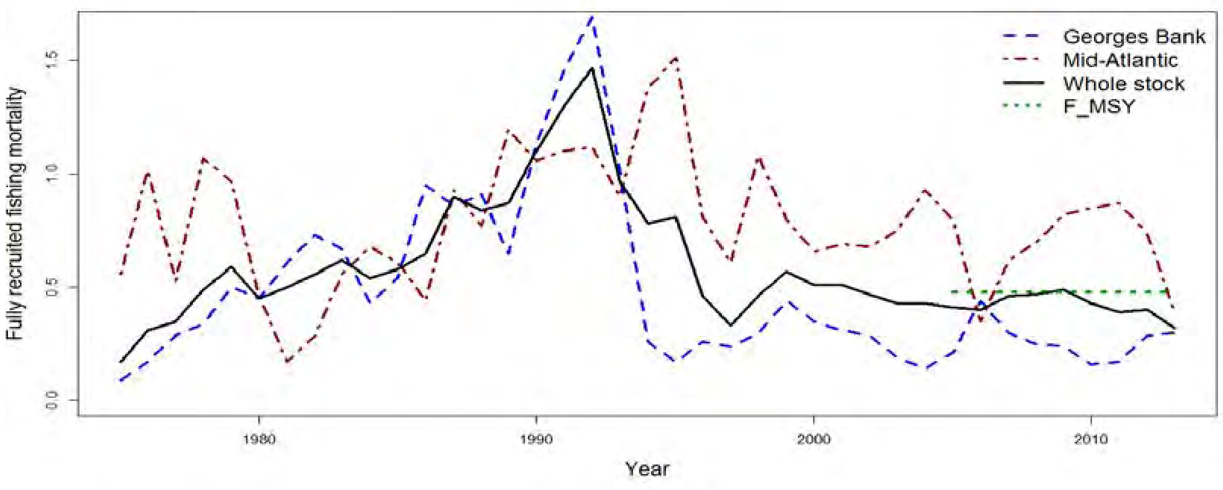


Table 43 – 2013 sea scallop stock status – overfishing is not occurring and the resource is not overfished

	Total 2013 Estimate	Stock Status Reference Points
Biomass (in 1000 mt)	133	½ Bmsy = 48,240
F	0.32	OFL = 0.48

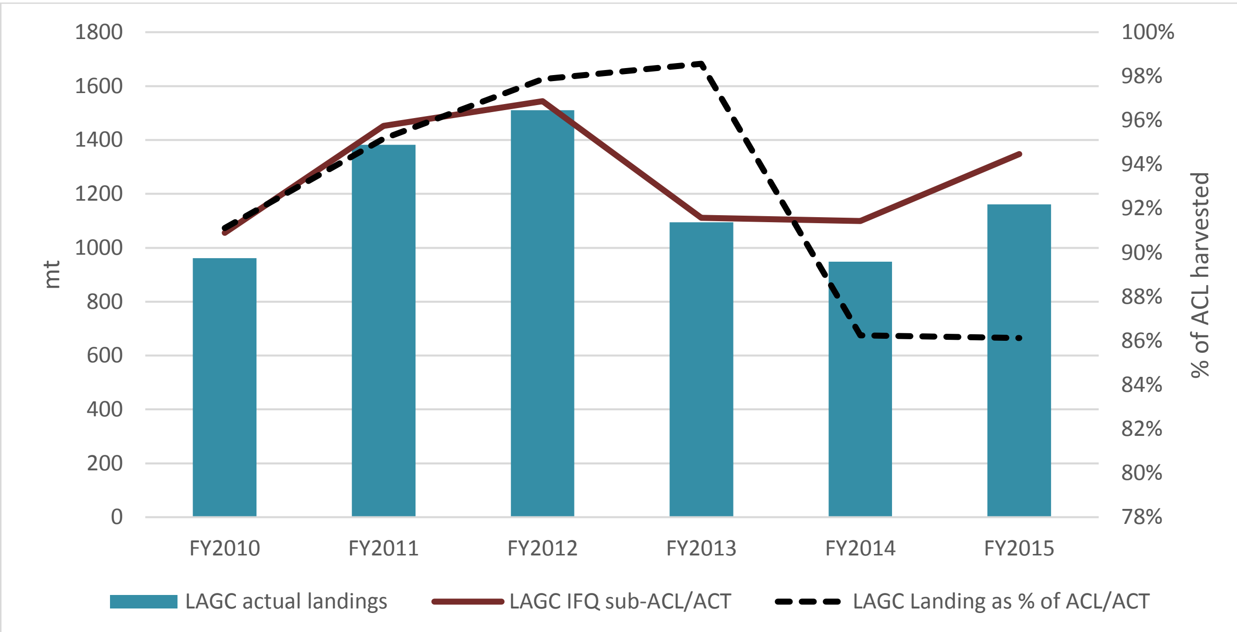
4.5.2 Allocation and Landings

The LAGC IFQ component is allocated 5% of the ACL, which corresponds to an F=0.38 in the most recent benchmark formulation. The fishing mortality from the LAGC IFQ fishery, measured in terms of total catch, is estimated to be about 5% of the total projected fishing mortality. The LAGC component is allocated a total allowable quota of 5% of the projected catch after other sources of mortality are removed such as incidental catch and set-asides for observer coverage and research. Estimating how much of the total LAGC IFQ sub-ACL is harvested can be viewed as an indirect measure of fishing mortality and biological performance.

In some cases LAGC IFQ vessels may have a lower fishing mortality than larger limited access vessels due to smaller gear and lower area swept. However, in other cases the mortality and impacts on the environment could be similar or even higher if general category vessels are fishing in areas with lower scallop densities, potentially having higher impacts on scallop mortality and bycatch per unit of effort. If it is assumed that fishing mortality from all scallop fishing is similar, then assessing the amount of catch harvested from the total available catch allocated is one way to measure the biological performance of this fishery in terms of associated fishing mortality.

Based on six years of information, the sub-ACLs and IFQs in place are effectively controlling mortality from this component of the fishery. Over 85% of the total sub-ACL for the LAGC IFQ fishery was harvested annually during the program review period. It should be noted that the IFQ component has fished within its sub-ACL after the implementation of up to 15% carryover pounds. In summary, from a biological perspective this IFQ and sub-ACL management program has been effective at controlling mortality and preventing overfishing.

Figure 93 - Comparison of LAGC IFQ actual landings with sub-ACL for FY2010 - FY 2015



4.5.3 LPUE

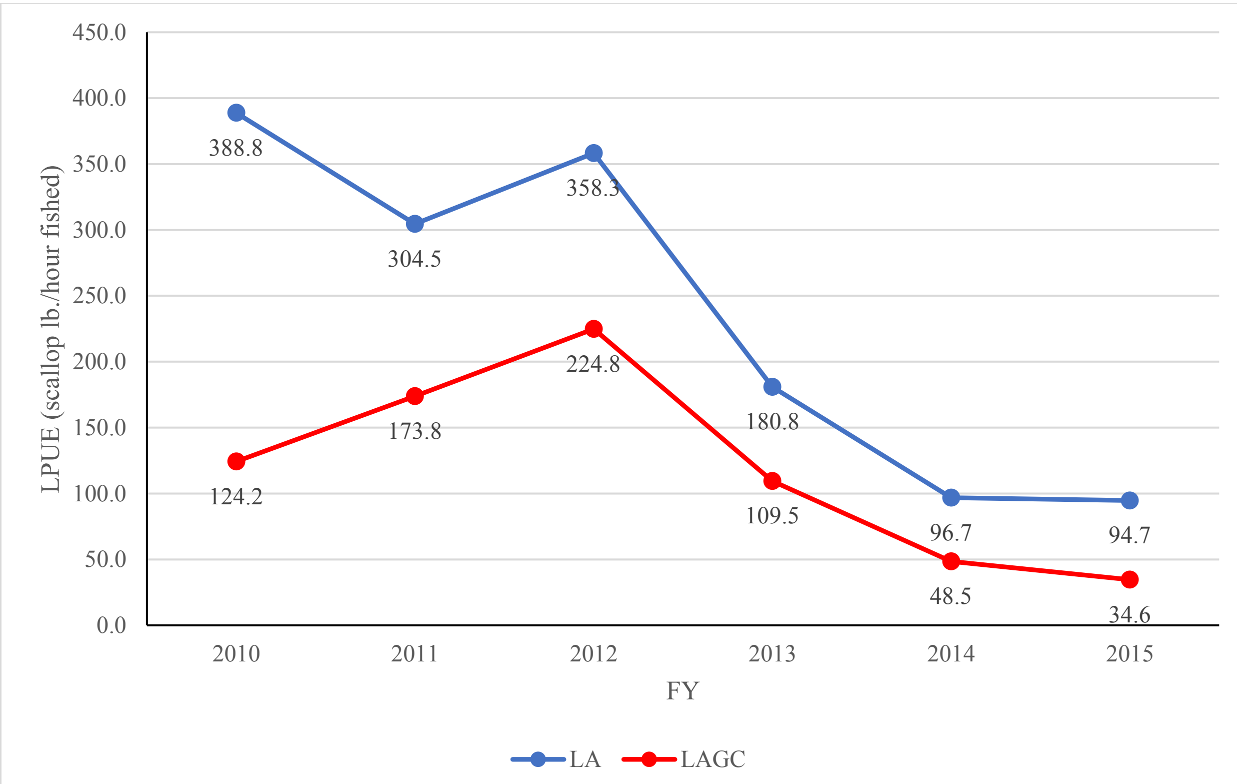
Observer data from standard observer trips on LAGC IFQ and LA vessels between FY2010 and FY2015 were used to estimate average annual landings per unit of effort (LPUE). This approach measured LPUE at the haul level to determine weight of kept scallops per hour using the equation:

$$\frac{1}{n}\sum_{i=1}^{n}\frac{K_{obs}}{t_{obs}}$$

Where n = the total number of observed hauls per fishing year, K_{obs} = the weight of scallops kept per observed haul (lbs), and t_{obs} = time the dredge(s) were in the water per haul (hours).

The average open-area LPUE (scallop lb. per hour fished) of LA and LAGC IFQ vessels fishing on Georges Bank is shown in Figure 94. Overall, average LA LPUE was higher than LAGC IFQ LPUE, corresponding to LA vessels having more fishing power (i.e. larger vessels, more horsepower, more and larger dredges than LAGC IFQ vessels). Between FY2010 and FY2012, LAGC IFQ LPUE increased 81% while LA LPUE decreased approximately 8%. From FY2010 to FY2015, LPUE decreased in both LAGC IFQ and LA components of the fishery by approximately 23% and 50%, respectively. Data indicates that LPUE for the LAGC IFQ and LA components of the fleet fishing open-area days at sea in the Mid-Atlantic from FY2010 to FY2015. As was seen for Georges Bank, average open area LPUE of vessels fishing in the Mid-Atlantic was higher for the LA component than the LAGC IFQ component. For LAGC IFQ vessels, average Mid-Atlantic LPUE was lower than open area LPUE for Georges Bank during the same time period; however, Mid-Atlantic LPUE was < 1% less than Georges Bank LPUE in FY2014, and approximately 6.7% less than Georges Bank LPUE in FY2015. FY2012 saw the highest LAGC IFQ open area LPUE in the Mid-Atlantic (82.1 scallop lb. per hour fished) and decreased each year after that. From FY2012 to FY2015, average LAGC IFQ open area LPUE in the Mid-Atlantic decreased approximately 60.7%.

Figure 94. The average observed open-area LPUE (scallop lb./hour fished) for LA (blue line) and LAGC (red line) vessels fishing on Georges Bank.



The data also displays the percent of allocated trips actually taken by LAGC IFQ vessels, and Figure 96 describes average trip length (in days) of access area trips and open trips. Average trip length seemed to be an indicator of the quality of fishing for LAGC IFQ vessels. For example, very few (< 1%) allocated trips were taken in the Elephant Trunk access area in FY2011 while average trip length was more than double the overall average for that year, and higher than any other area from FY2010 to FY2015 (Figure 96). In instances where fishing was better, a greater proportion of allocated trips were taken to a specific area while average trip length would be decreased compared to other areas. For example, all allocated Mid-Atlantic access area trips were taken in FY2015, and the average trip length was approximately 15% less than the average for that year and approximately 25% less than for open trips.

LAGC IFQ vessels have fished predominantly open trips from FY2010 to FY2015. From FY2010 to FY2014, between 81.1% and 98.6% of trips taken were open trips. A notable decrease in the proportion of open trips taken occurred in FY2015 (from 91.5% in FY2014 to

61.7% in FY2015), as an increased proportion of trips were taken in the Mid-Atlantic access area (38.3% in FY2015). This redirected effort could be attributed to FY2015 being the first year the Mid-Atlantic access area was incorporated into management, offering participants a broader area to fish compared to the smaller, previously sectioned Mid-Atlantic access areas (i.e. DelMarVa, Elephant Trunk, Hudson Canyon). The pulse of effort in the MAAA in FY2015 was also likely due to improved fishing in the area compared to previous years, and improved fishing compared to open-area Mid-Atlantic LPUE in FY2015 (Figure 95).

LPUE generally declined for the LAGC IFQ component between 2010 and 2015 on Georges Bank and in the Mid-Atlantic, though the reduction on Georges Bank was more pronounced over this time period.

Figure 95. The average observed open-area LPUE (scallop lb./hour fished) for LA (blue line) and LAGC (red line) vessels fishing in the Mid-Atlantic.

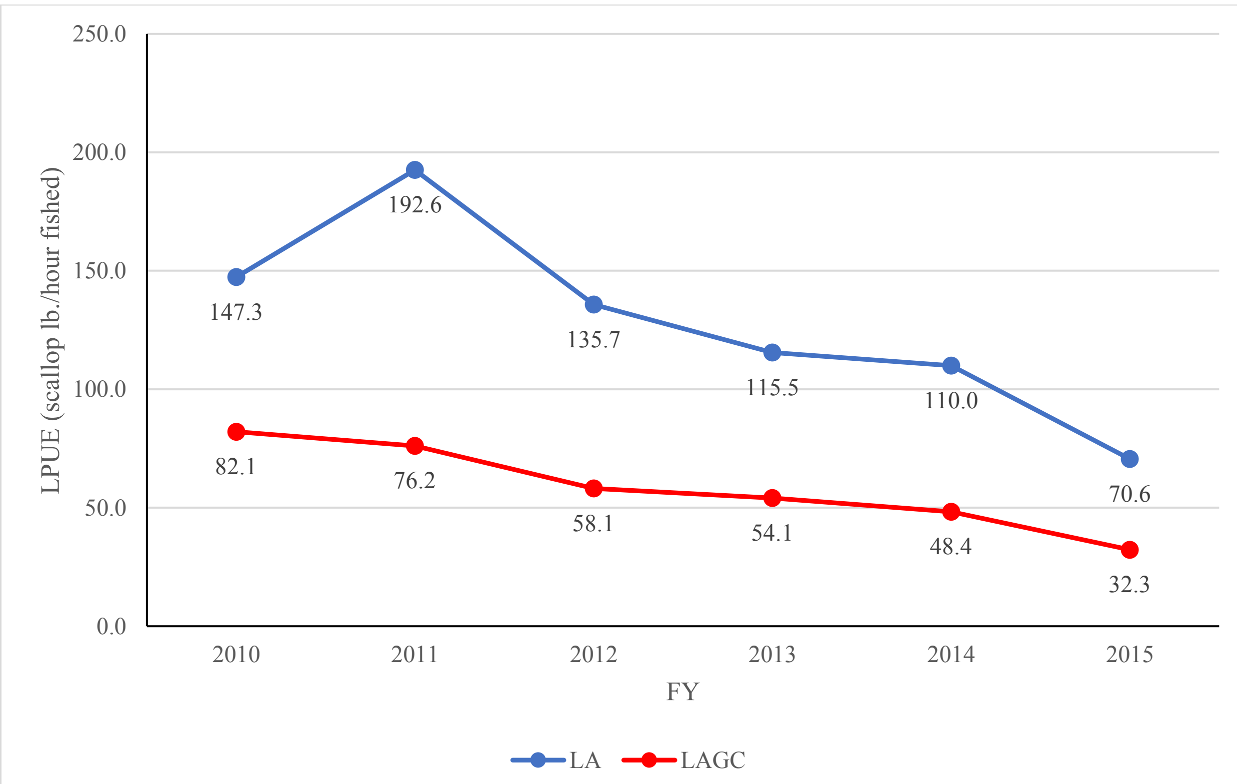


Table 44. The proportion of LAGC IFQ trips taken each year by trip type from FY2010 to FY2015. The percent of access area (AA) trips shown are only for years where trips were allocated to that area.

FY	CAI AA Trips Taken	NLS AA Trips Taken	DMV AA Trips Taken	ET AA Trips Taken	HC AA Trips Taken	MA AA Trips Taken	Open Trips Taken
2010		7.5%	10.5%	0.9%			81.1%
2011	0.7%		1.0%	0.2%	9.0%		89.1%

2012	0.0%	0.6%	0.1%		2.1%		97.2%
2013	0.0%	1.2%			0.2%		98.6%
2014		0.1%	8.4%		0.0%		91.5%
2015						38.3%	61.7%

Table 45. The percent of allocated access area trips taken by LAGC IFQ vessels from FY2010 to FY2015. Data used in the table also includes RSA compensation trips.

FY	**CAI AA** Trips Taken	**NLS AA** Trips Taken	**DMV AA** Trips Taken	**ET AA** Trips Taken	**HC AA** Trips Taken	**MA AA** Trips Taken
2010		69.5%	96.6%	4.3%		
2011	5.5%		11.8%	0.8%	103.9%	
2012	0.0%	12.8%	1.7%		14.2%	
2013	0.0%	31.1%			2.8%	
2014		1.2%	79.3%			
2015						101.5%

Figure 96. The average trip length (days) of LAGC IFQ vessels fishing open trips and trips in Nantucket Lightship AA, Delmarva AA, Elephant Trunk AA, Hudson Canyon AA, Mid-Atlantic AA, and Closed Area I AA from FY2010 to FY2015. The dashed red line shows the annual combined average trip length.

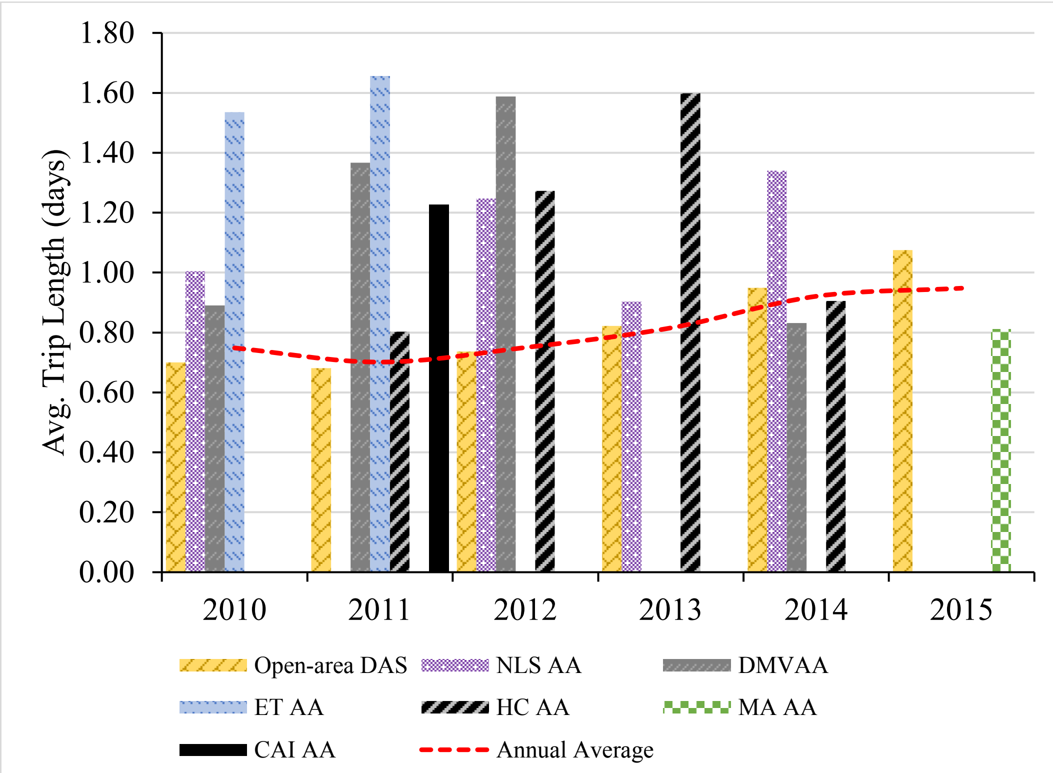


Table 46. The number of access area and open trips taken by LAGC IFQ vessels from FY2010 to FY2015.

FY	**CAI** No. Trips	**NLS AA** No. Trips	**DMV AA** No. Trips	**ET AA** No. Trips	**HC AA** No. Trips	**MA AA** No. Trips	**Open** No. Trips
2010		496	690	59			5,329
2011	49		70	11	616		6,082
2012	0	38	5		126		5,954
2013	0	64			9		5,117
2014		3	409				4,439
2015						2,097	3,379

4.5.4 Bycatch

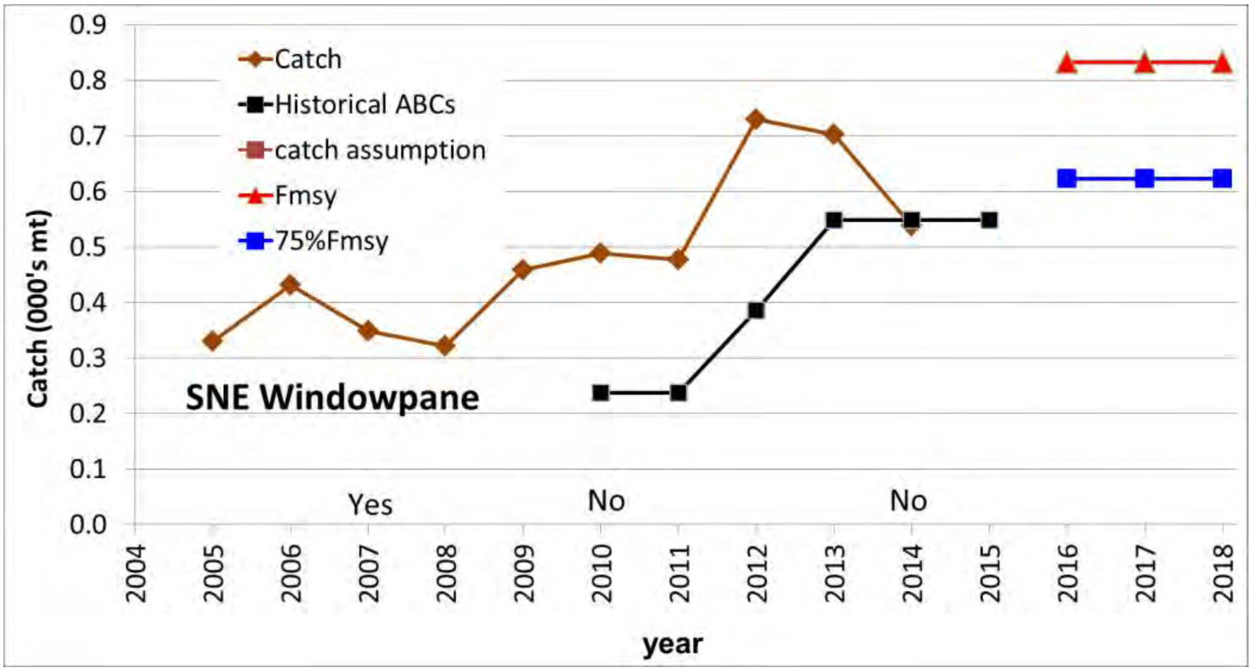
The biological performance of the IFQ program can also be measured in terms of impacts on non-target species or bycatch. Again, the LAGC IFQ fishery is a relatively small component of the scallop fishery and LAGC IFQ bycatch estimates represent a small proportion of total fishery estimates. As previously stated, the transition to limited access and IFQ through Amendment 11 dramatically reduced fishing capacity for this part of the fishery. Because the fishery was open access prior to the implementation of the IFQ program, changes in bycatch from the period before Amendment 11 cannot be directly attributed to the implementation of an IFQ in and of itself. Also, the implementation of hard TACs and ultimately ACLs with accountability measures for the targeted catch of scallops are likely to influence bycatch estimates, which are a function of fishing effort and total landings.

There are several considerations when interpreting bycatch and fishery behavior with respect to non-target species. These include: Changes to the status of each stock, the triggering and timing of reactive accountability measures, the implementation on proactive accountability measures, changes in possession requirements, spatial constraints of the LAGC IFQ fishery, changes in fleet capacity and activity, the availability of the scallop resource in near-shore areas where the LAGC component prosecutes the fishery, and the type of gear used in fishing operations (i.e. dredge vs. trawl).

This section will focus on bycatch of two key stocks for which the entire scallop fishery has sub-ACL and accountability measures. While the scallop fishery also has a sub-ACL for GB yellowtail, the GB yellowtail stock boundary is almost entirely outside of the scallop dredge exemption areas where the LAGC IFQ component can fish. Analysis is also provided on the discard to kept ratio for LAGC IFQ dredge activity for CC/GOM yellowtail founder and GOM/GB windowpane flounder.

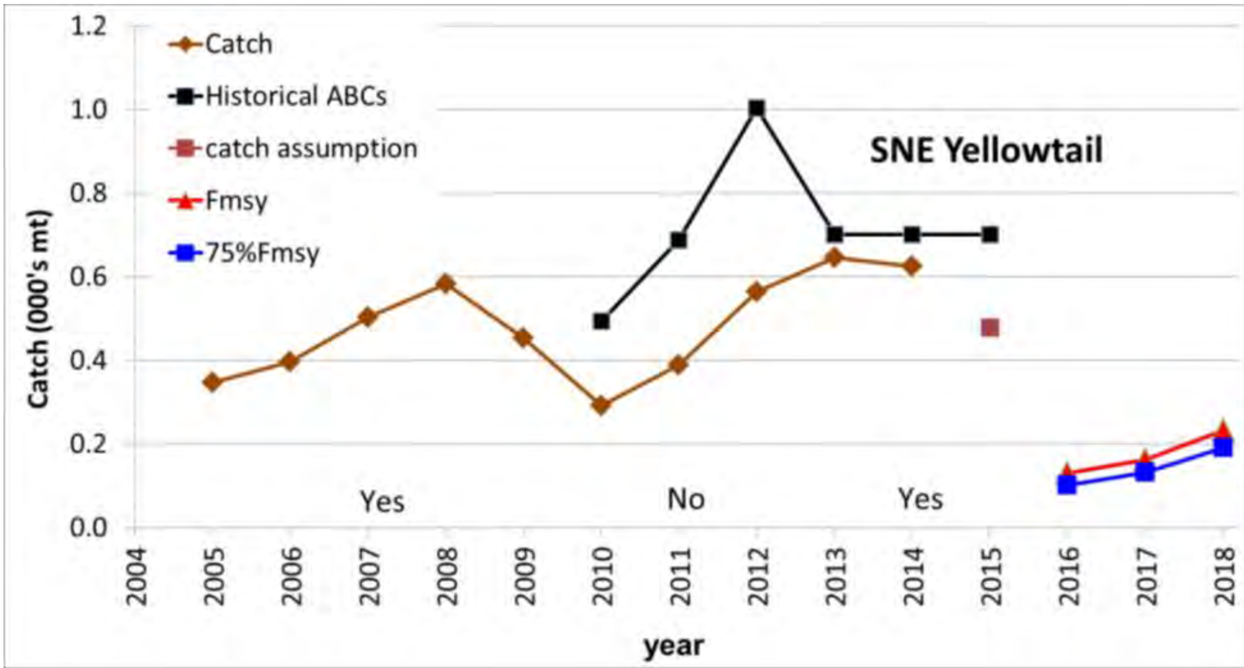
The 2015 groundfish operational assessments found that southern windowpane flounder is not overfished and overfishing is not occurring, and the stock is rebuilt. As shown in Figure 97, total estimated catch of southern windowpane by all fishery components exceeded historical ABCs in all years except 2014, and the stock status did not change. The upward trend of OFL/ABC values from 2011 – 2015, as well as the recommendation to increase these values for 2016 – 2018, is a consideration when interpreting the LAGC IFQ catch of this stock. The assessment suggests that there are more windowpane, which may result in increased catch of this stock, keeping fishing behavior constant.

Figure 97 - Catch performance for southern windowpane flounder including: catches from CY 2005- CY 2014, historical ABCs since FY 2010, CY 2015 "bridge year" catch assumption, and projections for FY 2016-FY 2018 at FMSY and 75%FMSY. Overfishing status in the terminal year of the assessment indicated on the x-axis (Yes = overfishing, No= not overfishing, and unknown = unknown overfishing status). Source: Groundfish Framework 55.



SNE/MA yellowtail flounder, a key bycatch species for the LAGC IFQ component, was also assessed during the 2015 groundfish operational assessments. The update found that SNE/MA yellowtail flounder is overfished and overfishing is occurring. The stock was not in a rebuilding plan at the time because it was considered rebuilt as of 2011. In 2014, the stock was at 26% of the previous rebuilding target SSB. While total catch of SNE YT remained below the historical ABCs, stock status had declined between 2011 and 2014 (Figure 98). The 2015 assessment indicated that there were fewer yellowtail than previous thought, which may result in decreased catch of this stock, keeping fishing behavior constant.

Figure 98 - Catch performance for Southern New England/Mid-Atlantic yellowtail flounder including: catches from CY 2005- CY 2014, historical ABCs since FY 2010, CY 2015 "bridge year" catch assumption, and projections for FY 2016- FY 2018 at FMSY, and 75%FMSY. Overfishing status in the terminal year of the assessment indicated on the x-axis (Yes = overfishing, No= not overfishing, and unknown = unknown overfishing status). Source: Groundfish Framework 55.



The IFQ component is held jointly accountable with the LA component for sub-ACL overages. During the time period in question (2010 – 2015), the scallop fishery was not subject to any accountability measures that would have implemented time/area closures. The overall fishery did exceed its sub-ACL of southern windowpane flounder after it exceeded its sub-ACL in FY2015. However, the accountability measures did not go into place until FY2017, because reliable data to base this determination on is not available until the following fishing year (FY 2016). The LAGC component is not subject to in-season closures for bycatch overages as the current approach of implementing accountability measures in year 3 after a year 1 overage is determined in year 2 (scenario above). A proactive accountability measure of a maximum 7-row apron for all dredge vessels was implemented in 2014.

The LAGC IFQ's percent share of bycatch for SNE yellowtail and SNE windowpane is proportionally larger than its overall scallop allocation (>5%) when compared to the LA component. This result is not altogether unexpected when considering the regulatory constraints of the dredged exemption areas, and the Amendment 11 vision of a fleet made up of relatively smaller vessels. Said another way, LAGC IFQ vessels cannot fish in all of the places that the LA component can (by regulation, and as practical matter of range/vessel size), but are allocated 5.5% of the annual projected landings from all areas. In practice, this means that the LAGC IFQ component interacts very little with the GB stocks, and fishing in concentrated in more near-shore areas which coincide with SNE YT and SNE windowpane stock boundaries, as well as the CC/GOM yellowtail stock boundary, and the GOM/GB windowpane stock area.

One way to assess bycatch in fisheries is to evaluate the ratio of discarded species to kept catch. In the scallop fishery, the convention is to use scallop meat weight (shucked product) when calculating the ratio of discards to kept catch. Flatfish discard to kept (d:K) ratios were calculated for SNE/MA yellowtail flounder and SNE/MA windowpane flounder for both dredge and trawl gear, and for CC/GOM yellowtail flounder and GOM/GB windowpane flounder for dredge gear from FY 2007 – FY 2015 on an annual basis using observer data from the NEFSC. The d/K ratios of SNE/MA YT and SNE/MA windowpane for dredge gear have remained relatively low throughout the time series, though the d/K for windowpane increased during the program period. Figure 99 also illustrates that bycatch in scallop trawl gear tends to be higher than dredge gear for SNE/MA yellowtail and SNE/MA windowpane. Figure 100 depicts d/K ratios for CC/GOM yellowtail and GOM/GB windowpane flounder declined during baseline years from 2007 – 2009, and during the program period. Bycatch of these stocks declined in the early years of the IFQ program (FY 2010 – FY2013), but has increased from those low levels in FY 2014 and FY 2015.

Figure 99 - Annual d/K ratios of flatfish catch by LAGC IFQ trawl and dredge vessels in Southern New England.

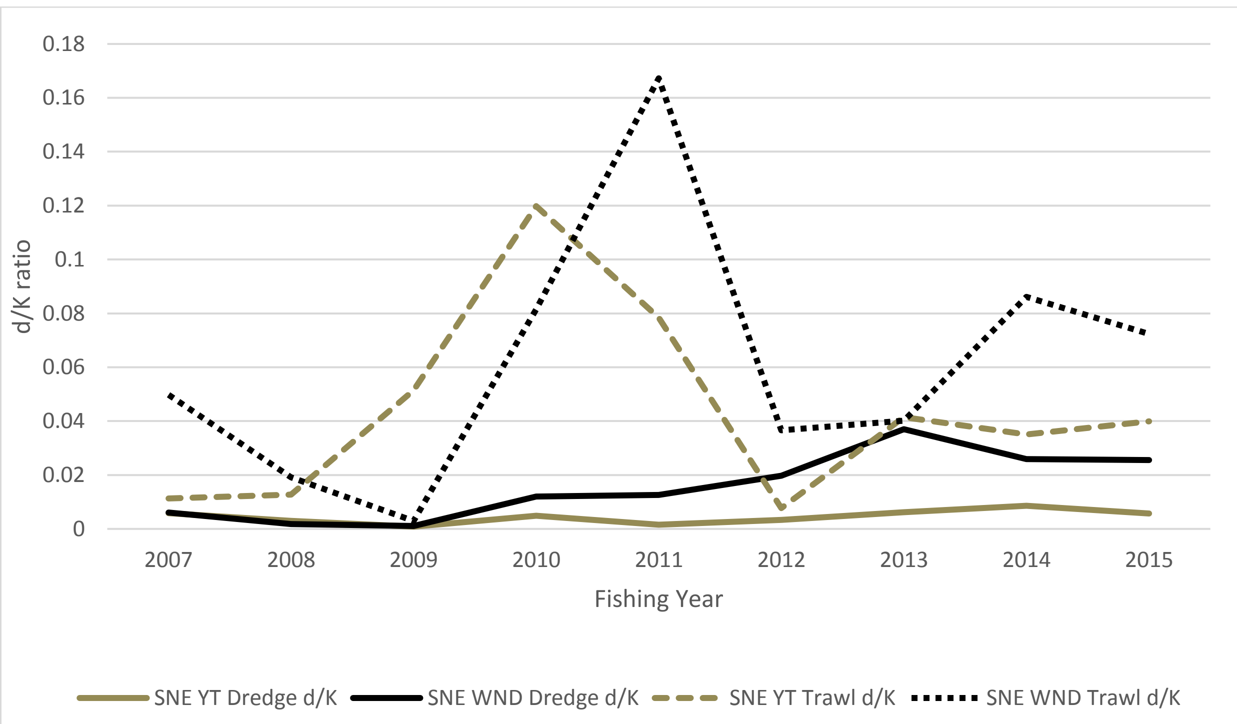
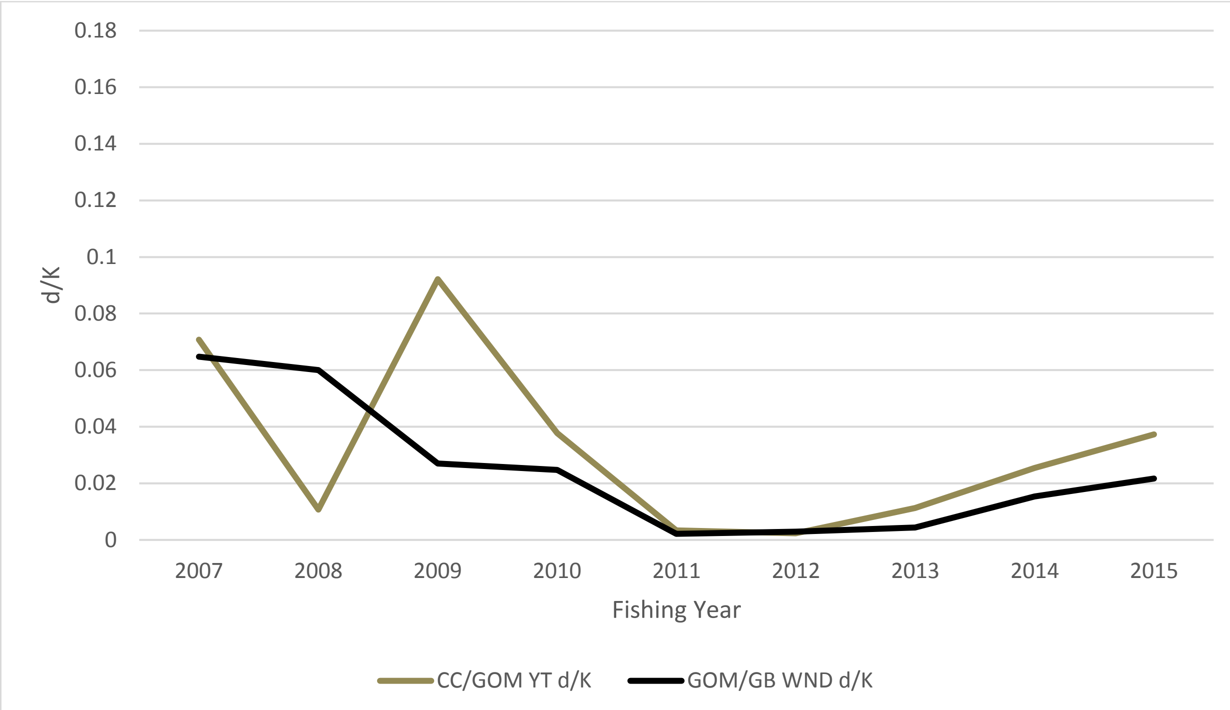


Figure 100 - Annual d/K ratios of flatfish catch by LAGC IFQ trawl vessels for CC/GOM YT and Northern windowpane flounder.



Scallop fishery catches of SNE/MA yellowtail and SNE/MA have varied over the course of the program period. Table 47 indicates that the while the bycatch of SNE/MA YT declined in the trawl fishery from FY 2011 – FY 2015, the bycatch estimates for the dredge fishery increased. The opposite was true for SNE/MA windowpane catch estimates by gear type. While trawl fishery catches increased, the estimated catch dredge catch of windowpane decreased. The increase in windowpane bycatch from FY2013 – FY 2015 may be a driven by several factors, including the timing for the fishery, and the improved status of the windowpane resource.

Table 47 - Catch SNE/MA yellowtail flounder by components of the scallop fishery

SNE Yellowtail	FY2011		FY2012		FY2013		FY2014		FY2015	
	Est. Catch	% Catch	Est. Catch	% Catch	Est. Catch	% Catch	Est. Catch	% Catch	Est. Catch	% Catch
Limited Access	200,810	82%	99,558	80%	88,634	83%	126,099	88%	62,239	82%
LAGC IFQ Trawl	40,958	17%	20,456	16%	11,280	11%	7,917	6%	6,848	9%
LAGC IFQ Dredge	2,707	1%	4,533	4%	7,146	7%	8,911	6%	7,089	9%
Total	244,475		124,548		107,060		142,927		76,176	
% of sub-ACL caught	135%		44%		111%		98%		79%	
sub-ACL	180,779		279,987		96,122		145,505		96,342	

Table 48 - Catch of SNE/MA windowpane flounder by components of the scallop fishery

SNE Windowpane	FY2013		FY2014		FY2015	
	Est. Catch	% Catch	Est. Catch	% Catch	Est. Catch	% Catch
Limited Access	221087	78%	257901	84%	411353	89%
LAGC IFQ Trawl	14,321	5%	16,951	5%	39,088	8%
LAGC IFQ Dredge	49,139	17%	33,892	11%	13,509	3%
Total	284,547		308,744		463,950	
% of sub-ACL caught	71%		77%		115%	
sub-ACL	403,466		403466		403,466	

4.6 SAFETY, COMPLICANCE, AND ENFORCEMENT

4.6.1 Compliance with individual quota allocations

NMFS monitors the IFQ catches per vessel and usually several months into the fishing year reports any overages from the previous fishing year directly to vessels. Table 49 summarizes the number of MRIs with IFQ overage for 2012 to 2015, as the total overage amount. Overall, a relatively small amount of total quota is over at the end of the year, under 40,000 pounds, and less than 25 MRIs have any overage during the time series.

Table 49 - Number of scallop LAGC IFQ MRI's with quota overages, and total overage by FY.

FY	Total MRI	Overage Total
2012	23	17,507
2013	14	35,118
2014	19	38,760
2015	6	5,426
Total	62	96,811

4.6.2 Compliance based on VMS reports

LAGC IFQ vessels are required to submit a pre-landing notification to NMFS through VMS six hours prior to landing. These reports include information on the estimated catch, time and location of landing. Data was analyzed separately for IFQ-declared and non-IFQ declared trips in terms of the level of compliance with this regulation. Vessels on IFQ declared trips are principally targeting scallops, while vessels on non-IFQ declared trips may be active in other fisheries, such as groundfish or surf clam/ocean quahog trips.

Each year around 6,000 LAGC IFQ trips are taken. The total number of trips varies based on the total quota available for the year, and the possession limit increased from 400 pounds to 600 pounds in 2011. Table 50 summarizes the number of IFQ declared trips that were in compliance with this requirement, and the overall compliance rate for the fleet. Table 51 presents the same information, except for non-IFQ declared trips. For all years combined the overall compliance rate for IFQ declared trips was 74%, while non-IFQ compliance with VMS pre-land requirements was 23%. Overall, the pre-land compliance rate for both IFQ and non-IFQ declared trips improved between FY 2010 and FY 2015, though compliance on non-IFQ declared trips remains low.

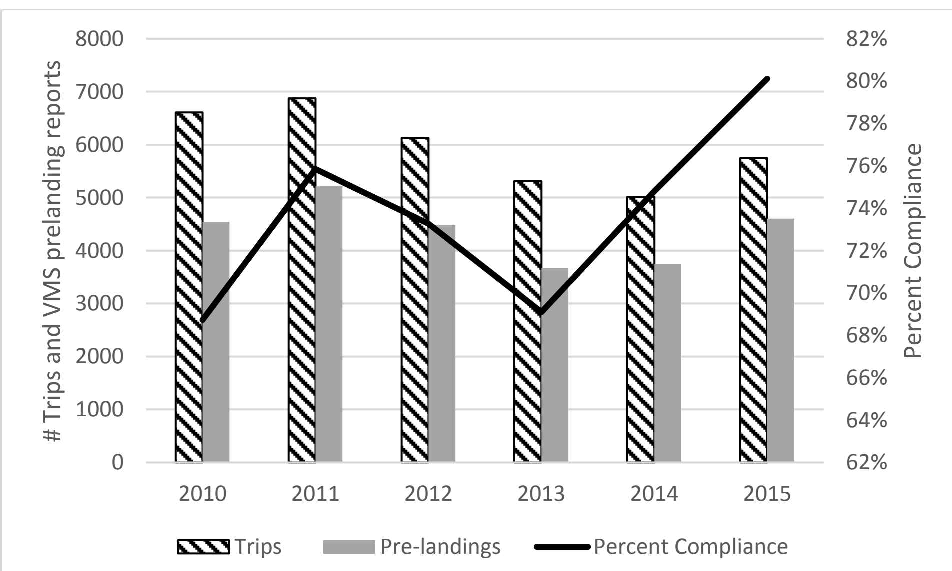
Table 50 - VMS reporting compliance for scallop IFQ declared trips by LAGC IFQ vessels (FY 2010 - FY 2015).

FY	Trips	Pre-landings	Percent Compliance
2010	6610	4543	69%
2011	6876	5215	76%
2012	6128	4490	73%
2013	5310	3669	69%
2014	5012	3749	75%
2015	5742	4600	80%
Total	35,678	26,266	74%

Table 51 - VMS reporting requirements for non-IFQ declared trips by LAGC IFQ vessels (FY 2010 - FY 2015)

FY	Trips	Pre-landings	Percent Compliance
2010	170	29	17%
2011	277	67	24%
2012	225	42	19%
2013	284	35	12%
2014	477	132	28%
2015	302	99	33%
Total	1735	404	23%

Figure 101 - VMS reporting compliance for scallop IFQ declared trips by LAGC IFQ vessels (FY 2010 - FY 2015).



4.6.3 Enforcement: Monitored offloads

Dockside monitoring and enforcement has been very limited for the LAGC IFQ program. Over the six year period that this report covers, only 65 LAGC IFQ were offloads were officially monitored by Enforcement agents between Maine and North Carolina. Compared to the total number of LAGC IFQ trips, the proportion of trips that had an offload monitored is very low (<1% in all years).

Table 52 - Number of NMFS monitored offloads by year (FY 2010 - FY 2015)

FY	Offloads observed
2010 - 2011	14
2012	14
2013	11
2014	11
2015	15
Total	65

4.6.4 Enforcement: Violations

The total number of violations by IFQ permit holders, and number of scallop violations have remained fairly consistent during the program (~14 per year), with a high of 42 in FY 2011, and a low of 6 in FY 2013 (Table 53). The number of violations that by vessels with IFQ permits was many times higher than violations in the scallop fishery. The exact nature of the violations in not reported.

Table 53 Number of violations by vessels holder LAGC IFQ permits, and the total number of scallop related violations for IFQ vessels by fishing year.

FY	# of Violations by IFQ vessels	# of Scallop violations
2010	85	14
2011	172	42
2012	51	15
2013	68	6
2014	67	12
2015	118	16

4.6.5 Safety – Average vessel age and fishing locations

Table 54 shows the average year of active vessels in the LAGC IFQ fleet, Figure 102 a histogram displaying the frequency of active vessels in FY 2015 (in 5 year bins). The average year that active LAGC IFQ vessels were built increased each year from 1982 in FY2010 to 1986 in FY2015, meaning that newer vessels were being used in the fleet in FY2015 compared to in FY2010. Figure 103 indicates that the oldest vessels in the fleet in 2010 (built before 1940) are no longer active, the median age of vessels has increased, and newer vessels have entered the fishery since 2010.

Trends in vessel age serve as an indicator of the level of interest that stakeholders have in the LAGC IFQ program. For example, and as was seen here for LAGC IFQ vessels from FY2010 to FY2015, when the age of vessels decreases over time, it indicates that either newer vessels are being built to participate in the fishery, or that older vessels are being retired. The increase in in average could be due in part to the decrease in active vessels from FY2010 to FY2015, which consolidated revenue to fewer vessels; therefore, because active participants in the fishery were making a greater share of the overall profit, they were able to invest in new vessels with improved technology and ultimately reducing trip costs (i.e. more fuel efficient vessels). Because newer vessels are typically safer than older vessels, this trend also suggests that safety measures were improved in FY2015 compared to FY2010.

Figure 102 - Histogram of the age of vessels (year built) that were active in FY 2015.

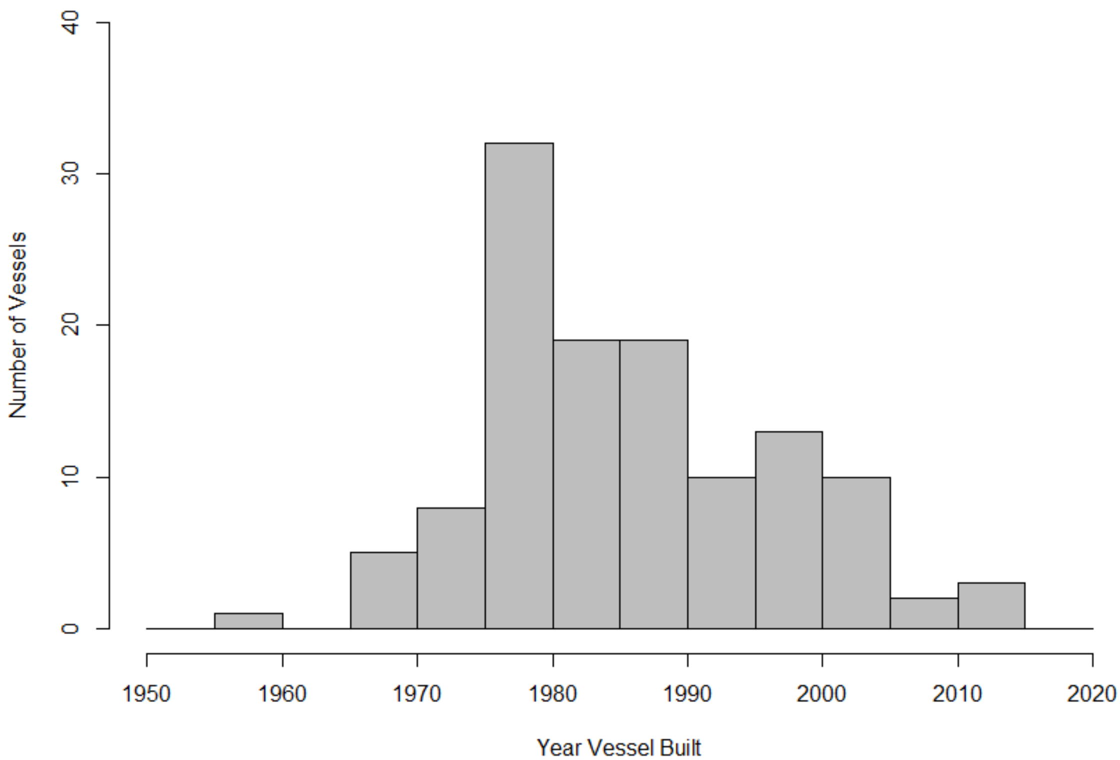


Figure 103 - Box plot displaying the vessel age of active LAGC IFQ vessels from FY2010 to FY2015

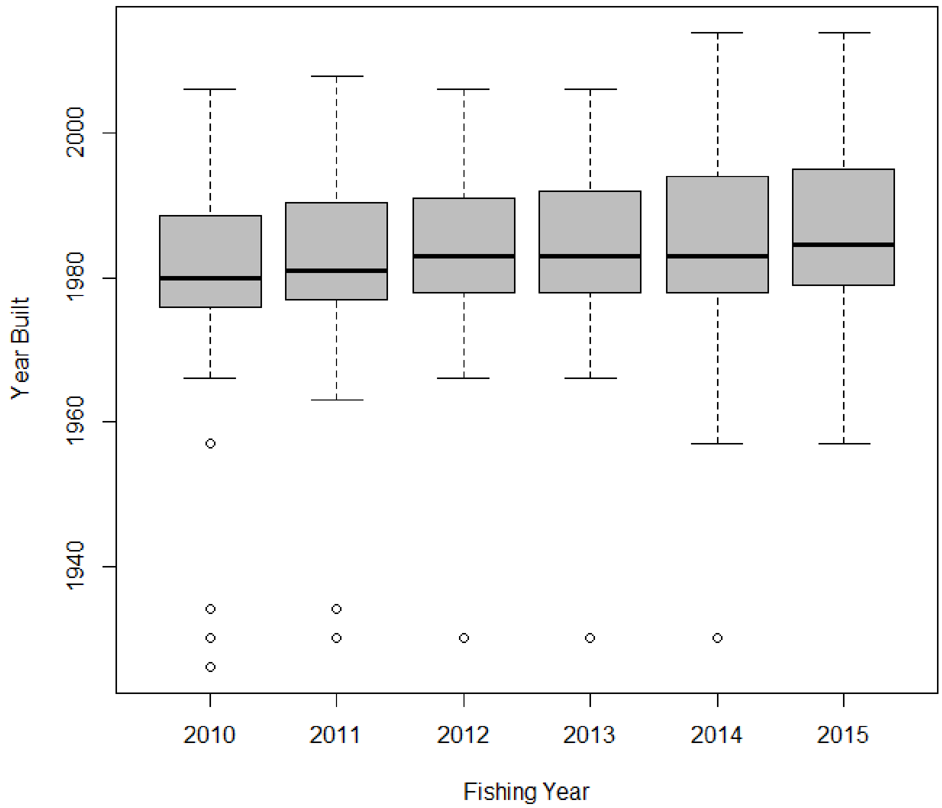


Table 54. The average year active LAGC IFQ vessels were built and the number of active vessels from FY2010 to FY2015.

FY	Average Year Built	Active Vessels
2010	1982	151
2011	1983	140
2012	1984	126
2013	1984	120
2014	1985	131
2015	1986	128

As the LAGC IFQ component generally consists of smaller vessels with limited range, fishing distance from shore and days fished were examined as indicators for safety in the fishery. Figure 104 suggest that the number of days fished declined between the baseline period of 2007 – 2009, and 2010 – 2015. From 2007 – 2009, the number of days fished ranged from 3000 – 4000+, before falling to around 2000 days fished per year for the remainder of the time series. A reduction in the time on the water can be viewed as a potential improvement in safety within this individual fishery. Fishing proximity from shore is a function of the availability of the scallop resource and management measures. For example, the scallop resource is primarily found in depths between 30 – 100 meters, and rotational management impacts to where and when harvest may occur. Figure 104 suggests that the overwhelming majority of LAGC scallop fishing occurs within 50 nm from shore, while Figure 104 suggests, not unsurprisingly, that the LA component fish areas further offshore. It should be noted that the LAGC IFQ component is required to operate within the dredge exemption areas, which generally cover inshore areas but do not extend to Georges Bank.

Figure 104 - Number of days fished by 10nm zone for LAGC IFQ component. Data through September 2015.

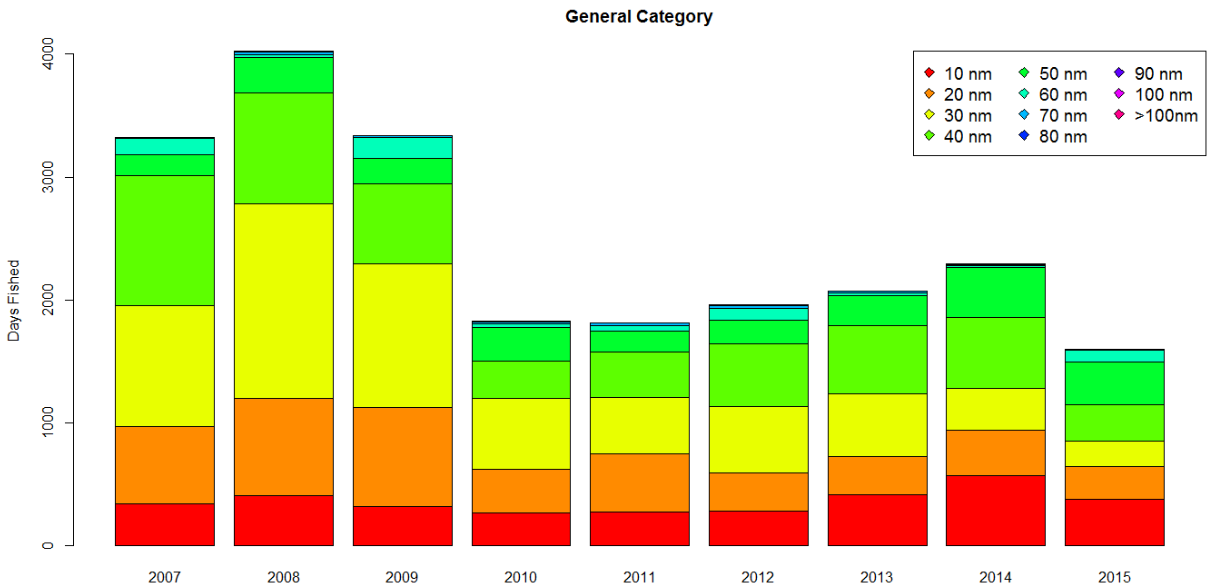
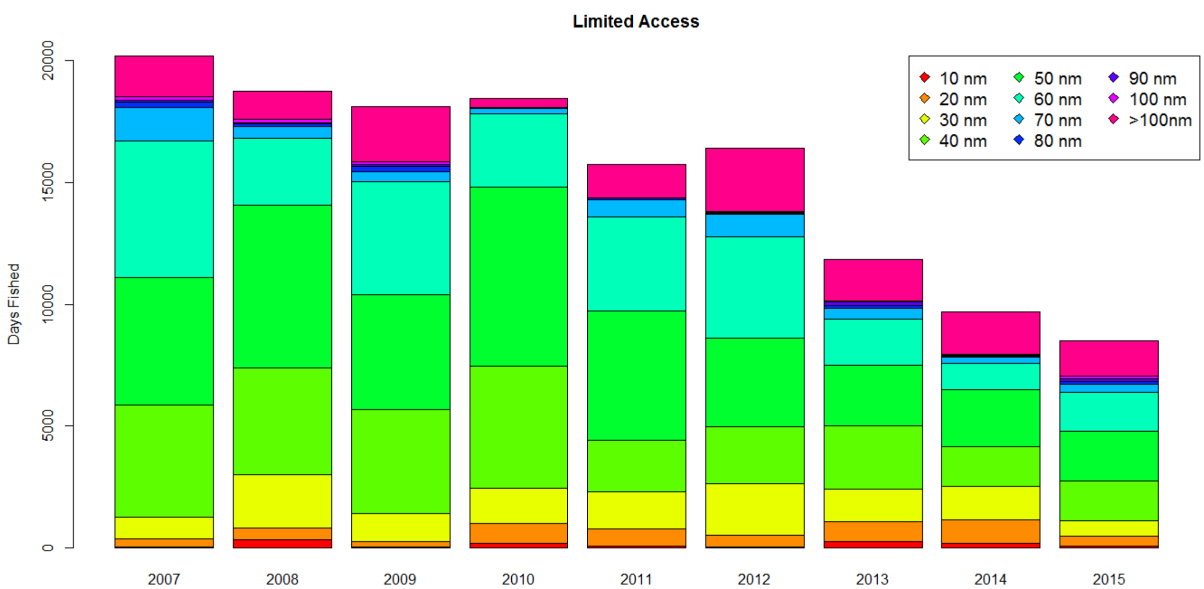


Figure 105 - Number of days fished by 10nm zone for LA component. Data through September 2015.



5.0 SUMMARY OF FINDINGS

The following section focuses on summarizing the results of this review with respect to the four key questions outlined in the scope of this report (Sections 5.1 - 5.4).

5.1 NET BENEFIT TO THE NATION

1. Has the IFQ program resulted in the greatest overall benefit to the Nation, including the evaluation of biological, economic and social criteria in such decision making?

Net Economic Benefits

NOAA Fisheries' Guidelines for Conducting Review of Catch Share Programs requires an assessment of the program's effects keeping in mind that the net benefits are not exclusively economic in nature[21]. Furthermore, the guidance indicates that "A baseline period of at least 3 years is preferable, but this may be modified depending on circumstances surrounding the creation and implementation of each program."

Section 4.3.3 evaluated the LAGC IFQ program in terms of its impact on net revenues, profits, and producer surplus consistent with the with NMFS' Economic Guidelines for conducting cost-benefit analyses[22]. The results show that the IFQ Program's effects on the net benefits to the nation as measured by the producer surplus relative to the levels in the baseline period of 2007-2009 were positive. Producer surplus under the IFQ program was estimated to be 16% to 22% higher during 2010-2015 compared to a scenario if the reduced TAC were shared among a larger number of participants with no flexibility for leasing or transferring quota (Section…). The impacts of the program on the total factor productivity was also positive (1.3.2.5.2). The productivity as measured by ratio of aggregate outputs to aggregate inputs, or by LOWE index, was estimated to be 12% or 34% greater than the baseline time period. As indicated in Section 4.3.2.5.2, productivity is a component of profitability. The scenario analysis also showed that profits would be higher with the IFQ program compared to the pre-implementation levels.

The analyses of the trends in net scallop revenue and profits during the program period of 2010-2015 support the same conclusions (Section 4.3.3). The percentage increase in net fleet revenue and producer surplus since the 2010 fishing year exceeded the increase in gross revenue due to the decline in fuel prices by 10%, increase in the possession limit to 600 lb.in 2011 as well as due to the concentration of effort in a smaller number of possibly more efficient vessels (Figure 24, Section 4.3.3.1). There has been an increasing trend in both profits and profit margins in the period 2010-2015 (Section 4.3.4.5). These results are not surprising given that the IFQ program helped to optimize profits in the LAGC fishery by providing opportunity for IFQ permits holders to transfer their allocations through leasing or sale of quota to those owners with a higher dependence on the scallop fishery as well as more efficient operations and/or financial resources

[21] http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf
[22] http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf, p.7

to buy/lease quota from others to lower their fishing costs per unit of production by targeting scallops.

The functioning of the lease and quota markets provide insights about the impacts of the IFQ program on economic benefits: "Transferability is generally thought to improve technical efficiency and thus aid in achieving economic efficiency in a fishery, which, for example, is a goal under National Standard 5"[23]. The analyses of the quota and lease markets show that lease prices varied with the changes in demand and supply for quota as expected by the economic theory. During 2010-2015, quota and lease prices increased due to the rise in scallop ex-vessel prices, lower fuel costs, the increase in the number of vessels participating in the fishery, and concentration of a higher proportion of overall IFQ allocations in the affiliations that lease out quota consistent. According to economic theory, the price for IFQ transfer (QS) is equal to the capitalized profits in the fishery over time, whereas the IFQ lease price reflects the marginal net return in the fishery. These two should be positively correlated (Figure 16) and the ratio of lease prices to transfer prices reflects the discount rate perceived by scallop IFQ traders. There has been a decline in the ratio of the lease prices to quota prices in those six years from 13% in the 2010 fishing year to about 10% in the 2012 fishing year. This number ranged from 9% to 11% in 2013-2015. Decline in this ratio could be a sign of a decline in the perceived uncertainties about future returns.

Distributional Impacts of the IFQ program

The distributional impacts of the IFQ program were not uniform, however, as some vessels were prevented from access to the LAGC IFQ fishery while those vessels that qualified for the permit benefited with the implementation of Amendment 11. Profits per owner were estimated to be higher for those owners who lease-in quota, and participate in the fishery mainly to target scallops (Section 1.3.4.4). The estimated impacts on crew were not necessarily positive. If crew paid the lease costs, income per crew per DAS net of trip and leasing costs would have declined from $528 in 2010 to $481 per day-at-sea, or by about 9% in 2015, while if crew paid half of lease costs, income per crew per DAS would have increased by 15%from $583 per-at-sea in 2010 to $670 in 2015 (Section 1.3.5) However, even when net income per crew per DAS declined, the increase in total employment by 15% in 2015 (measured by CREW*DAS) helped to increase in total crew incomes in the LAGC fishery during this period (Table 16).

Landings, revenues and profits were highly concentrated among the top 25% of active affiliations (Section 1.4.3.4). About 32 affiliations in this group landed about 63% of total scallop landings in the LAGC IFQ fishery in the 2010 fishing year bottom 25% landed about 1% of scallop landings (Figure 75). The distribution of net scallop revenue exhibited similar trends with the top 25% of the affiliations earning 65% of total LAGC IFQ fleet net revenue in 2010 and a slightly lower percentage (64%) of it in 2015 (Figure 77). IFQ fleet profits were unequally distributed with over 75% of the profits going to the top 25% of the affiliations during 2010-2015. This proportion declined from 81% in 2010 to 76% of total profits in 2015 for the top 25% group as the number of affiliations in this group declined from 58 affiliations in 2010 to 48

[23] http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf, p.13

affiliations in 2015 ((Table 17). However, the top 9 affiliations in 2010 and top 8 affiliations in 2015 earned about 25% of total profits, while many affiliations in the bottom 25% quantile either left the fishery or joined other affiliations (Section 1.4.3.5). The distributional impacts of the IFQ program is analyzed in detail, in Section 4.4.

The Gini coefficients for landings, revenues and profits of affiliations were above 0.50 indicating that economic benefits were not distributed equally during 2010-2015. However, these values were lower compared to the Gini coefficients for the groundfish fishery if the revenues of all species were included in the calculation and were lower than values of Gini coefficients if only the groundfish revenues were included in the estimation (Tammy Murphy, NEFSC Report for GF Fishery, January 2014). The Gini coefficients for the profit estimates provided in **Table 33** were above 0.65; however, the decline in the inequality was more significant than estimates for revenues whether lease costs paid by crew or shared and whether either active or all affiliations were included. The reason for this trend was probably because leasing revenue were included as a part of profits for all affiliations and as lease prices increased over time, there has been an increase in the profits of inactive affiliations reducing the earning gaps compared to the active affiliations.

The reductions in the value of the Gini coefficients from 2010 to 2012 imply that the distribution of revenues became slightly more equal. This could be partly attributed to the reduction in the number of low revenue earners after 2010 as some of those owners either sold their shares to others or consolidated them with some small quota owners in partnership. It is also due to the increase in lease prices and in the revenues from leasing for owners who lease-out their quota relative to active owners who also lease-in quota and tend to have higher net revenues compared to inactive owners.

The impacts of the IFQ program on net economic benefits (as measured by producer surplus) were positive relative to a baseline period of three years (2007-2009) before implementation of Amendment 11, and since the start of the program period in 2010. Increased productivity and concentration of effort in fewer vessels and affiliations resulted in higher profits from the baseline period as well as compared to the 2010 fishing year levels. These economic benefits were not equally distributed among affiliations with landings, revenues and profits concentrated in the top 25% of the affiliations. However, the results of various analyses showed that those inequalities declined slightly during 2010-2015.

An analysis of crew perceptions in the LAGC fishery concluded that there were no significant differences between IFQ and non-IFQ crew members on any of the items assessing job satisfaction or overall health and wellbeing. Both groups of crew members generally expressed satisfaction with their earnings, time away from home, and the adventure of the job. Both groups also generally expressed that they felt connected to other fishermen and that they were proud to be fishermen (Appendix I)

5.2 PARTICIPATION AT VARYING LEVELS AND EXCESSIVE SHARES

2. Has the IFQ program preserved the ability for vessels to participate in the general category fishery at different levels? Has the program prevented excessive shares?

Participation at varying levels of the IFQ fishery

This program review considers participation in the fishery by vessels and affiliations. In this report, an affiliation represents IFQ LAGC permit holders that are affiliates of each other based on the definition of Small Business Administration (SBA). Active affiliations include both active IFQ vessels as well as permits in CPH and those permit holders that participate in fisheries other than scallops. Inactive affiliations do not own any active IFQ vessel that participated in the scallop fishery.[24] The program maintained the ability for vessels and affiliations to participate at different levels in the LAGC IFQ fishery, although the distribution of landings, revenue and profits were not uniform across vessels and affiliations (Section 4.4). The number of affiliations that had a dependency of more than 25% on scallop revenue was relatively stable during the 2010-2015 fishing years. However, there has been a significant decline in the number of active affiliations that have a 25% or less dependence on scallop revenue, from 42 in 2010 to 17 in 2015. This implies that these affiliations leased out or sold their quota to others that target scallops or who has a higher dependency on scallop fishery as a source of their revenue.

From FY2010 to FY2015, landings, revenue, and quota did fluctuate slightly from year to year; this was likely reflective of the strength of the resource and the quality of fishing as opposed to trends that were dictated by the LAGC IFQ program in and of itself. The number of permits in the program declined by 5% from FY2010 to FY2015, while the number of active permits decreased by 15% over the same time period. The distribution of landings, revenue, and quota allocation among active vessels was relatively consistent (Section 0). The number of active vessels <50' increased by 13% from FY2010 to FY2015, while the number of larger vessels (≥75') participating in the program has remained stable. These findings suggest that capacity of the general category fleet has been reduced without reducing overall performance of the fleet (in terms of landings and revenue). Furthermore, these findings support that the opportunity for stakeholders to participate in the fishery at varying levels has been preserved.

Despite this decline in relative diversity compared to 2010, about half of the LAGC IFQ fleet participated in the scallop fishery at varying levels, while the other half, 53 affiliations in 2010 and 52 in 2015, mostly targeted scallops. Average scallop landings per active affiliation increased from 43,693 lb. in 2010 to 58,111 lb. in 2015, both as a result of increase in allocations and the concentration of effort. While the average scallop landings of the top 25% of the

[24] An affiliation "Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists." https://www.law.cornell.edu/cfr/text/13/121.103

affiliations ranged from about 43,700 lb. to about 62,000 lb. during 2010-2015 fishing years, those in the bottom 25% landed about 900 lb. to over 2500 lb. per year. The scallop landings of those affiliations in the second quintile ranged from about 5,500 lb. to 13,200 lb. and the landings of those in the third quantile ranged from about 20,000 lb. to 35,400 lb. (Figure74).

Cumulative distribution of net scallop revenues and profits are consistent with the distribution of landings. Quantile analyses indicate that the share of each group (consists of one fourth of the affiliations) fluctuated during 2010-2015 fishing years without any significant changes in trends. There has been some changes in the species diversity of landings during 2010-2015 compared to the pre-implementation period. The changes in the species diversity was measured using Herfindahl indices for the 3,090 active vessel/FY combinations since 2004 fishing year. The results showed that there is an upward trend, indicating a less diverse catch portfolio across active vessels. FY2015 had an especially pronounced spike in indices. This means that among vessels that earn more revenue from scallops than any other species group in a given fishing year, at least half of these vessels earn all, or nearly all, of their revenue from scallops (Appendix G).

There have been some fluctuations in the geographical distributional of landings and leasing in the IFQ fishery since 2010. However, majority of these changes could probably attributed to the changes in the scallop productivity by area (Section 3.2.1).

There have not been any major changes in the distribution of landings by fishery of vessels that did not qualify for an IFQ permit. These vessels were primarily engaged in groundfish, surf clam/ocean quahog, and squid fisheries during the qualification years, and continue to remain active in those fisheries. Interestingly, the percent revenue from scallop landings has increased from 0.1% during the qualification period to 1.2% during the program period. (Section 3.2.1).

Excessive Shares

Quota allocations among LAGC IFQ affiliations were unequally distributed both in 2010 and 2015, although in 2015, that concentration appears to have become more equal. In 2010, 90% of the affiliations held 57% of the quota, with remaining 10% held 43%. In 2015, 90% held 64% while the rest of the 10% held 36% of the IFQ allocations (Figure 81). The Gini coefficients indicated that concentration of quota became more unequal in 2015 (Gini=0.67) compared to 2010 (Gini=0.62) if all the affiliations were included, but slightly less unequal (Gini=0.62 in 2010 and 0.60 in 2015) if those that sold out their shares are excluded.

In terms of distribution of quota by activity status, 106 inactive affiliations held about 32% of total quota in 2010 and 90 inactive affiliations held 34% of the quota in 2015 fishing year (Table 21, Section 1.4.3.6). These include about 5 permit banks operating in the LAGC IFQ fishery, which held about 10% of the overall quota in 2010 and about 8% of the quota in 2015. The rest of the quota was held by 127 active affiliations in 2010 and 102 active affiliations in 2015 fishing year (Figure 14, Section 1.2.3). Inactive affiliations included those with CPH permits with no revenue from other species, as well as those affiliations that are active in other species but do not participate in the scallop fishery.

Although, distribution of quota remains to be unequal, the analysis of market concentration based on the Herfindahl-Hirschman index (HHI) indicated that market for quota shares in the IFQ fishery is competitive. The concentration of quota in the LAGC IFQ fishery is far below the potential limits sets set by the caps on ownership and vessel quotas. At a 5% share cap the smallest possible number of affiliates would be 20, but in 2015 there were 192 affiliates, which is 9.6 times that of the level the share cap would allow. Those caps probably contributed in preventing further consolidation of ownership in the LAGC IFQ fishery (Section 4.4.2.8). With the HHI value standards, distribution of the quota holding were competitive both within the active and inactive affiliations. However, concentration of quota among the active owners declined during this period, with HHI values declining from 289 in 2010 to 207 in 2015, while the HHI values including only inactive affiliations increased from 271 in 2010 to 616 in 2015. However, concentration of quota among the active owners declined during this period. These conclusions are consistent with the analyses presented in other sections, indicating that there has been more consolidation among inactive compared to the active affiliations (Section 1.4.3.7).

This review also examined the movement of quota between IFQ participants. A quota transfer represents the permanent sale of IFQ, while quota leasing refers to non-permanent transfer of IFQ pounds for harvest in a FY. In terms of share transfer network, the LAGC IFQ program was characterized by few participants, low cohesion, and one-time transfers between business entities. However, quota leasing network was characterized by many participants, increasing cohesion, and multi-year participation, but also by few multi-year leasing relationships between participants (Appendix J).

5.3 FISHERY CAPACITY AND CONSERVATIONS AND MANAGEMENT

3. Has the IFQ program controlled capacity, controlled mortality, and promoted fishery conservation and management?

A primary goal of Amendment 11 was to control capacity and mortality in the general category scallop fishery. The LAGC IFQ program instituted catch limits and reduced the number of permits in the general category fishery. In transitioning from an open access fishery to a limited access IFQ program, the number of active vessels in the fishery declined from a high of 592 vessels in 2006 to 152 active vessels in 2010 at the end of the phase in period. There were 128 active vessels in FY 2015. There was also a decline in the total number of affiliations in the IFQ fishery between 2010 and 2015 from 233 to 192. The LAGC IFQ component operated under quarterly hard-TAC in FY 2008 and FY 2009 during a phase-in period. The IFQ component has not exceeded its sub-ACL allocation since the program was fully instituted in FY 2010. Through Amendment 11, the LAGC IFQ component was allocated 5% of the fishery-wide ACL was to LAGC IFQ permit holders, and 0.5% to limited access vessels that also qualified for the IFQ program. The LAGC IFQ program allows for participants to permanently transfer and/or annually lease individual quota among other qualifiers. LA vessels with IFQ permits cannot transfer or lease their individual quota.

The analyses provided in Section 4.0 of this report conclude that these measures were effective in both controlling capacity of the LAGC IFQ fleet and in reducing excess capacity during fishing years 2010 to 2015. Limiting access to the qualifiers as determined in Amendment 11 prevented an increase in the number of IFQ permits. The opportunity to lease out and transfer quota to other participants resulted in the consolidation of quota across fewer vessels and affiliations, and ultimately consolidated effort to fewer active vessels from FY2010 to FY2015. The number of total IFQ permits declined from 331 in 2010 to 313 in 2015 and the number of affiliations declined from 233 to 192 in the same period (Fig.10 AG). The number of active affiliations that own at least one vessel that participated in the scallop fishery declined from 127 in 2010 to 102 in 2015 and the number of inactive affiliations declined from 106 in 2010 to 90 in 2015. The number of active vessels declined from an average of 320 vessels in the previous 3 years before the implementation of Amendment 11 to 152 in 2010 and to 128 in 2015 (Figure 15 and Figure 16, Section 4.2). There was also a reduction in the average gross tonnage, horsepower and the length of active LAGC IFQ vessels during 2010-2015. The fleet capacity index, as measured by the weighted average HP, GRT, and vessel length by the total number of active vessels for each year, declined from 100 in 2010 to 66.8 in 2015 (Fig.17, AG). These changes led to an increase in the total factor productivity of the LAGC IFQ fishery in FY2015 compared to FY2010, as well as an overall increase (measured by LOWE Index) in FY2015 compared to the pre-implementation period (Section 1.3.2.5).

Landings by the IFQ component since the inception of the program have not exceeded catch limits. The IFQ component is allocated 5.5% of the ACL, and accounted for 4% - 7% of total scallop landings between 2010 and 2015. Overall, this component of the fishery accounts for a small percentage of the overall fishing mortality. LPUE generally declined for the LAGC IFQ component between 2010 and 2015 on Georges Bank and in the Mid-Atlantic, though the reduction on Georges Bank was more pronounced over this time period. It should be noted that LPUE for LAGC IFQ component on Georges Bank was comparable to LPUE of the LA component in the Mid-Atlantic in FY 2011, FY 2012, and FY 2013. The pattern of open area and access area harvest suggests that the fleet is mobile, and that fishing activity tracks the availability of the resource. In years when few access area trips were used, open bottom fishing was very productive (Section 4.2). As open area LPUE declines, and overall landings remain steady or increase, the overall amount of area swept is also expected to increase.

The biological performance of the IFQ program can also be measured in terms of impacts on non-target species or bycatch. Again, the LAGC IFQ fishery is a relatively small component of the scallop fishery and LAGC IFQ bycatch estimates represent a small proportion of total fishery estimates. As previously stated, the transition to limited access and IFQ through Amendment 11 dramatically reduced fishing capacity for this part of the fishery. Because the fishery was open access prior to the implementation of the IFQ program, changes in bycatch from the period before Amendment 11 cannot be directly attributed to the implementation of an IFQ in and of itself. Also, the implementation of hard TACs and ultimately ACLs with accountability measures for the targeted catch of scallops are likely to influence bycatch estimates, which are a function of fishing effort and total landings. Scallop fishery catches of SNE/MA yellowtail and SNE/MA have varied over the course of the program period. While the bycatch of SNE/MA YT declined in the trawl fishery from FY 2011 – FY 2015, the bycatch estimates for the dredge fishery increased. The opposite was true for SNE/MA windowpane catch estimates by gear type. While trawl fishery catches increased, the estimated catch dredge catch of windowpane decreased. The increase in windowpane bycatch from FY2013 – FY 2015 may be a driven by several factors, including the timing for the fishery, and the improved status of the windowpane resource. Catch ratios of CC/GOM yellowtail and GOM/GB windowpane flounder during baseline years from 2007 – 2009, and during the program period. Bycatch for of these stocks declined in the early years of the IFQ program (FY 2010 – FY2013), but has increased from those low levels in FY 2014 and FY 2015.

5.4 SAFETY, COMPLIANCE, AND ENFORCEMENT

The number of IFQ MRIs with quota overages declined from 2012 to 2015, as did the overage total. IFQ overages made up a small percentage of the total allocated IFQ quota in all years examined. Compliance with reporting requirements has generally improved during the IFQ program period from 2010 – 2015, though compliance on non-IFQ declared trips (ex: groundfish, or surf clam/ocean quahog) remains low. While VMS pre-land compliance has improved, the total number of offloads that are monitored remains very low (<1% of total trips). The average vessel age among active vessels increased from 1982 to 1986 between FY 2010 and FY 2015. The oldest vessels in the fleet in FY 2010 (built before 1940) are no longer active.

5.5 FUTURE DATA AND RESEARCH NEEDS

This report evaluated the performance of the LAGC IFQ fishery based on the data for allocations, landings, revenues, prices, ownership, leasing, transfers and fishing costs. Several data issues identified in the three year IFQ report (2014) that made it difficult to track activity of the vessels and affiliations were remedied in preparation for this report. However, there is still room for improvement in terms of ownership data. While it was possible to identify owners and affiliations for active permits, for those with permits in CPH, ownership data did not have matching business and owner ids or MRIs. For this reason, staff identified owners and affiliations for CPH permits manually for many entries using the allocation tables and other databases for each year from 2010 to 2016, which was very time consuming. It is recommended that either the present ownership data should be modified to include an affiliation id for those permits or a new data should be developed specifically for CPH permits so that future analyses can be conducted in a more timely way.

There is a good amount of data about quota lease and transfer prices; however, the information regarding how lease costs are divided between the vessel owner and the crew is inadequate at this point. This report used the 2011 and 2012 cost survey, the most recent available data, to estimate costs and the lay system. The coverage of the LAGC IFQ vessels in the survey was rather small making it difficult to fully assess current lay systems and how they may have changed since 2010. Given that different boat owners apply a different formula in dividing revenues and costs between the crew and the owner, expanding the survey to include more LAGC IFQ vessels would help to determine the common practices and to improve the accuracy of the estimates for crew and boat incomes. The 2015 cost survey results may address some of these issues when it becomes available.

Other information that was not available at this time was the costs associated with bank loans to lease quota. Anecdotal information suggested some owners got into a lot of debt to purchase or lease quota, and interest payments on such debt became a new cost item for many LAGC fishermen since the implementation of the IFQ program in 2010. Therefore, collecting information regarding bank loans and interest payments would be helpful in assessing how these factors affect the viability and the distribution of income in the fishery. It would be very useful if the coverage of future cost surveys could be expanded to include more LAGC IFQ boats and if the interest payments for bank loans versus vessel mortgage are identified separately. Having more information about these borrowing and transaction costs for leasing and transfers, and activity by co-ops would also improve the analyses regarding quota and lease prices.

The changes in the employment patterns in the LAGC fishery are another area that needs further research. Because a lot of vessels are involved in this fishery on a part-time basis, a survey to determine if crew members are employed year round on different vessels for different shifts would help the analysis of the changes in employment opportunities in the LAGC IFQ fishery. Finally, further research could also include sociological surveys to evaluate the impacts of the IFQ program on communities.

6.0 COST RECOVERY

The MSA allows for cost recovery up to 3% of ex-vessel value of scallops harvested under the IFQ program. Fees are used to cover actual costs that are directly related to the management, data collection, and enforcement of the IFQ program. Fees are calculated by multiplying the permit holder's landings by the average price per pound and the fee percentage.

The MSA requires that the Councils and NMFS conduct a formal and detailed review five years after the implementation of an IFQ program to review the operations of the program. Most of the work to conduct this review and write the report took place during the 2016 fee period and resulted in additional staff time for both the Regional Office and the Northeast Fisheries Science Center, which was recoverable under this program. This additional work resulted in a significant increase in recoverable costs in the 2016 fee period.

Individual bills for cost recovery ranged from $18 to ~$7,000 in fee year 2016. As recoverable costs are based on landings, active permit holders are fully accountable for covering program costs. Because recoverable costs were less than 3% for fee year 2016, permit holders were assessed total recoverable costs of the 2016 fee period.

The 2016 Scallop IFQ Fee Annual Report is available as an appendix to this report.

Table 55 – Scallop IFQ recoverable costs, fishery value, and fee percentage by year.

Fee Year	Recoverable Costs	Total Fishery Value	Fee Percentage
2011	$82,557	$28,004,530	0.2948%
2012	$106,745	$33,684,037	0.3169%
2013	$118,509	$31,863,299	0.3719%
2014	$123,743	$29,249,990	0.4230%
2015	$131,361	$35,453,100	0.3705%
2016	$270,823	$44,698,121	0.6058%

7.0 ACKNOWLEDGEMENTS AND MEETINGS

This report was prepared by a technical work group of staff from the New England Fishery Management Council, the Greater Atlantic Regional Fisheries Office, and the Northeast Fisheries Science Center (Table 56). In addition to the technical work group, several individuals and groups with NMFS assisted in data gathering, input, and analysis, including: Min-Yang Lee, John Walden, Lisa Colburn, Tammy Murphy, Andrew Kitts, Dvora Hart, the Northeast VMS team, and OLE, APSD, IRM. Table 57 provides a summary of official workgroup and Council related meetings where this program review was discussed.

Table 56 - LAGC IFQ Technical Work Group

Agency	Name	Role
NEFMC	Jonathon Peros	Primary point of contact for NEFMC, Present and communicate review with Advisory Panel/Committee/Council, Coordinate overall document preparation.
NEFMC	Demet Haksever	Lead analyst on several parts of review, primary author of several sections of this report.
NEFMC	Deirdre Boelke	NEFMC lead while scallop FMP analyst, coordinated development of program review with technical group.
NEFMC	Sam Asci	Lead analyst on several parts of review, author of several sections of this report.
NMFS, NEFSC	Eric Thunberg	Primary point of contact for NEFSC
NMFS, NEFSC	Matt Cutler	Lead analyst on several parts of review
NMFS, NEFSC	Greg Ardini	Lead analyst on several parts of review
NMFS, GARFO	Travis Ford	Primary point of contact for GARFO
NMFS, GARFO	Shannah Jaburek	Lead analyst on several parts of review
NMFS, GARFO	Ben Galuardi	Develop several databases needed for this review, Lead analyst on several parts of review

Table 57 - Summary of Meetings Related to the LAGC IFQ Program Review

Meeting	Date	Location	Focus
IFQ Data Needs	August 28, 2014	Gloucester, MA	Gathering data for IFQ program review
Technical Workgroup #1	March 3, 2016	Gloucester, MA	Roles and responsibilities, updates on data availability, discuss draft work plan
Scallop PDT	March 9, 2016	Conference Call	Input on draft work plan
Scallop Advisory Panel	March 22, 2016	Warwick, RI	Input on draft work plan
Scallop Committee	March 23, 2016	Warwick, RI	Input on draft work plan
Council	April 20, 2016	Mystic, CT	Input on draft work plan
Technical Workgroup #2	April 27, 2016	Conference Call	Review Council input, ongoing analyses
Technical Workgroup #3	May 26, 2016	Conference Call	Review updated catch share guidance, ongoing analyses
SSC	June 2, 2016	Boston, MA	Input on draft work plan
Technical Workgroup #4	June 29, 2016	Conference Call	Review SSC input, ongoing analyses
Technical Workgroup #5	August 3, 2016	Woods Hole, MA	Present analyses
Technical Workgroup #6	December 2, 2016	Conference Call	Present analyses
Technical Workgroup #7	May 5, 2017	Video Conference – Gloucester, MA and Woods Hole, MA	Discuss draft sections of program review

APPENDICES TO THE SCALLOP LAGC IFQ PROGRAM REVIEW

Contents

APPENDIX A – ANNUAL IFQ QUOTA LEASE MODEL (COUNCIL STAFF)

Dr. Demet Haksever, Council Staff

Lease prices by vessels

Since there were more IFQ holders that leased-out their quota than the number of active vessels, the number of transactions that reported a price greater than 1 was higher compared to lease-in transactions. For analytical purposes, such as estimating leasing costs, only those unit values greater than $1 were assumed to be reflect reliable estimates of leasing prices.

Table 1. Number of vessels that leased (in) quota by lease-price data group

Number of vessels	Lease price per lb. of scallops leased			
FY	Zero or NA	$0.1-$1	>$1	Grand Total
2010	16	26	31	73
2011	16	26	32	74
2012	14	11	52	77
2013	9	10	62	81
2014	23	14	58	95
2015	19	16	58	93
Grand Total	**97**	**103**	**293**	**493**

Table 2. Average lease-in prices by lease price data group including leasing to the same affiliations

FY	Zero/NA	$0.1-$1	>$1
2010	0.00	0.43	1.57
2011	0.00	0.69	1.77
2012	0.00	0.68	2.47
2013	0.00	0.48	2.89
2014	0.00	0.35	3.42
2015	0.00	0.42	3.46

Note: averages are obtained by dividing sum of lease value with the sum of lease lbs.

Table 3. Number of vessels that leased (out) quota by lease-price data group

Number of vessels	Lease price per lb. of scallops leased			
FY	**Zero or NA**	**$0.1-$1**	**>$1**	**Grand Total**
2010	51	34	75	160
2011	52	28	87	167
2012	37	11	125	173
2013	43	10	139	192
2014	52	17	131	200
2015	43	13	114	170
Grand Total	**278**	**113**	**671**	**1,062**

Table 4. Average lease-out prices by lease-price data group including leasing to the same affiliations

FY	Zero/NA	$0.1-$1	>$1
2010	0.00	0.73	1.74
2011	0.00	0.88	2.16
2012	0.00	0.41	2.89
2013	0.00	0.45	3.27
2014	0.00	0.28	3.96
2015	0.00	0.51	4.09

Note: averages are obtained by dividing sum of lease value with the sum of lease lbs.

The differences in price when all transactions are included versus when only those transactions that took place between different owners with (and those with a price of higher than $1 are included) could be seen in Figure 1. As expected, the lease-in prices for transactions involving two different owners were higher than prices when all leasing transactions were included.

Figure 1. Lease-in prices per lb. of quota leased

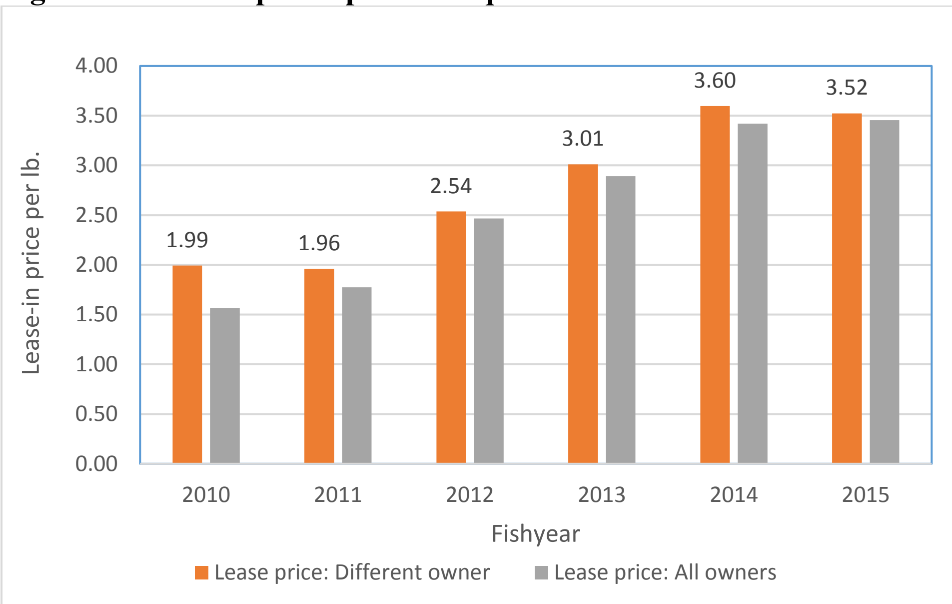


Table 5. Leasing-in from same affiliation and lease-in prices (2010-2015)

Lease price	Number of vessels	Number of vessels as % of total	Average leasing price
ZERO or NA	89	74%	NA
$0.1-$1	7	6%	0.50
>$1	25	20%	2.77
Grand Total	**121**	**100%**	**NA**

Note: Number of transactions could be higher if each vessel was involved in more one lease transactions annually.

Table 6. Leasing-in from a different owner or affiliation and lease prices (2010-2015)

Lease price	Number of vessels	Number of vessels as % of total	Average leasing price
ZERO or NA	73	16%	NA
$0.1-$1	86	19%	0.51
>$1	297	65%	2.90
Grand Total	**456**	**100%**	**NA**

Note: Number of transactions could be higher if each vessel was involved in more one lease transactions annually.

Table 7. Leasing-out same affiliation and lease-in prices (2010-2015)

Lease price	Number of vessels	Number of vessels as % of total	Average leasing price
ZERO or NA	89	74%	NA
$0.1-$1	7	6%	0.50
>$1	25	20%	2.77
Grand Total	**121**	**100%**	**NA**

Note: Number of transactions could be higher if each vessel was involved in more one lease transactions annually.

Table 8. Leasing – out different owner or affiliation and lease prices (2010-2015)

Lease price	Number of vessels	Number of vessels as % of total	Average leasing price
ZERO or NA	344	32%	NA
$0.1-$1	95	9%	0.58
>$1	624	59%	3.15
Grand Total	**1063**	**100%**	**NA**

Note: Number of transactions could be higher if each vessel was involved in more one lease transactions annually.

Table 9. Estimation of lease-out prices (by MRI)

Nonlinear GMM Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
lnleasepr	7	546	22.5968	0.0414	0.2034	0.7058	0.7025

Nonlinear GMM Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
intc	-1.64363	0.3511	-4.68	<.0001
netprice	0.233027	0.0118	19.78	<.0001
owngrp	0.113312	0.0419	2.70	0.0071
affgrp	0.583337	0.0303	19.27	<.0001
pctactallo	-4.32643	0.4869	-8.88	<.0001
numves	0.026664	0.00344	7.76	<.0001
trans	-0.03161	0.00644	-4.91	<.0001

Netprice: ex-vessel price per lb. net of trip costs per lb. of scallops
owngrp: if leased out to different affiliation=1, if leased out to same afflation=0
affgrp: individual owner=1, permit bank=0
pctactallo= total ifq allocation for the active owners as a % of total ifq allocation
numves= number of vessels that were net leasers (lease-in)
trans= Number of lease-out transactions by each individual owner

Figure 2. Actual and estimated annual lease-out price (different owners)

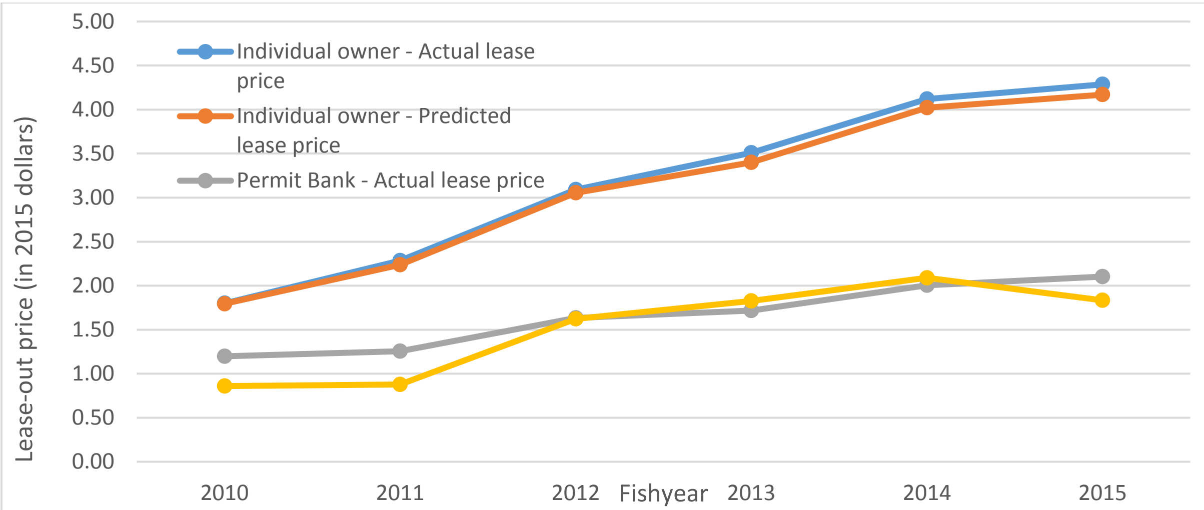


Table 10. Actual and predicted lease price for leasing out a different or same affiliation

Fishyear	Lease-out owner type	Actual lease price	Predicted lease price	Number of individual IFQ owners
2012	Different owner	3.09	3.05	95.00
	Same owner	2.97	2.77	9.00
2012 Total		**3.08**	**3.03**	**104.00**
2013	Different owner	3.51	3.40	87.00
	Same owner	2.91	3.07	10.00
2013 Total		**3.45**	**3.37**	**97.00**
2014	Different owner	4.12	4.02	74.00
	Same owner	3.70	3.65	10.00
2014 Total		**4.07**	**3.98**	**84.00**
2015	Different owner	4.29	4.17	67.00
	Same owner	3.87	3.78	16.00
2015 Total		**4.21**	**4.09**	**83.00**

APPENDIX B – ESTIMATION OF TRIP COSTS

Dr. Demet Haksever, Council Staff

Data for variable costs, i.e., trip expenses include food, fuel, oil, ice, water and supplies and damage costs. Trip costs for limited access and LAGC- IFQ vessels are obtained from the observer cost data for 1999-2015. The trip costs per day-at-sea (ffiwospda) were estimated as a function of vessel crew size (CREW), vessel horse power (HP), vessel length (LEN) fuel prices (FUELP), and dummy variables for limited access general category (LGC) and small dredge (SMD) vessels to identify important variables that affect trip expenses. This cost equation was assumed to take a double-logarithm form and estimated with data obtained from observer database. The empirical equation presented in **Table 11** estimated more than 80% of the variation in trip costs and has proper statistical properties using the observer data from 1994 to 2015 fishing years (1709 observations) for the limited access and limited access general category vessels.

Table 11. Estimation of total trip costs per DAS used for the limited access and limited access general category vessels

Nonlinear GMM Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin Watson
lnffiwospda	7	1702	166.7	0.0979	0.3130	0.8105	0.8098	1.4501

Nonlinear GMM Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
intc	1.158278	0.2884	4.02	<.0001
len	0.797279	0.0788	10.11	<.0001
hp	0.119528	0.0365	3.28	0.0011
crew	0.590184	0.0672	8.79	<.0001
fuelp	0.80674	0.0286	28.25	<.0001
LGC	-0.63291	0.0620	-10.21	<.0001
SMD	-0.15493	0.0336	-4.61	<.0001

APPENDIX C – ESTIMATION OF FIXED COSTS

Dr. Demet Haksever, Council staff

The fixed costs include those expenses that are not usually related to the level of fishing activity or output. These are insurance, maintenance, license, repairs, office expenses, professional fees, dues, taxes, utility, interest, communication costs, upgrade costs, association fees and dock expenses. Because of the composition of the sample data in terms the vessel characteristics is not the same as the composition of the fleet, average sample values do not necessarily equal to the average costs for the scallop fleet as whole.

Fixed cost estimates are updated using the 2011-2012 cost survey data collected by the SSB of NEFSC. This data set contained 932 vessels operating in different fisheries. Only 134 of these vessels had a scallop permit however.

Permit category	2011	2012	Total
LA	28	15	43
FT	21	14	35
PT	7	1	8
LAGC	55	36	91
IFQ	24	15	39
B or C	31	21	52
Total	83	51	134

The model shown in **Table 12** is based on the fixed cost survey data for vessels that have a scallop limited access and limit access IFQ permit and estimates basic fixed costs as a function of horse power*length (HPLEN), total revenue from fishing (TOTREV) and a dummy variable for IFQ (IFQ) vessels. Fixed costs were estimated by using the 54 observations for vessels with a positive entry for each of the component of basic fixed costs including insurance, maintenance and repairs as well as a positive value for horse power and length. The results show these three variables (HPLEN, total revenue and IFQ dummy variable) explain about 71% of the variation in fixed costs with statistically significant coefficients. These estimates will be updated using the 2015 cost survey data when it becomes available.

Table 12. Estimation of basic fixed costs

Nonlinear GMM Summary of Residual Errors								
Equation	**DF Model**	**DF Error**	**SSE**	**MSE**	**Root MSE**	**R-Square**	**Adj R-Sq**	**Durbin Watson**
lnFC	4	50	8.8455	0.1769	0.4206	0.7245	0.7080	2.5636

Nonlinear GMM Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
INTERCEPT	4.399791	1.4354	3.07	0.0035
HPLEN	0.279186	0.1254	2.23	0.0305
LAGC	-0.3737	0.1744	-2.14	0.0371
TOTREV	0.36226	0.0929	3.90	0.0003

Table 13. Actual and estimated fixed costs, vessel size and average total revenue (Cost survey data sample)

Data	LA	LA+LAGC	LAGC
FC – Estimated/per vessel	$348,563.92	$303,881.58	$112,358.60
FC – Actual values/per vessel	$440,125.18	$274,801.38	$120,056.34
Horse Power	991.79	725.17	467.21
Length	85.94	80.83	63.35
Total Revenue	$1,821,149	$1,607,972.50	$530,954.07
Number of vessels	14	12	28

APPENDIX D – EX-VESSEL PRICE ANALYSIS OF THE IFQ FISHERY

Northeast Fishery Science Center, SSB

Over the first six years of the IFQ fishery (2010-2015), average annual scallop *ex-vessel* prices exceeded those of the Limited Access fishery in all years by a range of $0.29-$0.72 per pound. In contrast, the General Category and IFQ-qualifying fleet fishing under TACs only received higher prices in two years from 2004-2009. To better understand the scallop price premium received by IFQ vessels, a hedonic model of *ex-vessel* prices was estimated using micro-level data in order to control for many of the other determinants of prices.

To construct the dataset used to estimate the model, all purchases of scallops from vessels for fishing years 2004-2015 were extracted from NMFS dealer databases. The sale date, species, market category, quantity, and value were added directly into the model, with prices normalized to 2016 Q1 using the GDP Implicit Price Deflator. VTR serial numbers were used to determine fishing location, trip length, and gear fished for each scallop sale. The permit number of the vessel was used to extract the category of scallop permit(s) held by that vessel. Some vessels possess multiple scallop permits in a fishing year, and to account for this, the trip limits in place for the various permit categories were used as cutoff points in assigning a vessel sale to a permit category.[1] Dummy variables for the day-of-the-week, month, and fishing year of each scallop sale were included. Additionally, the aggregate daily quantity of scallops landed across all ports was captured both directly and indirectly. Interaction terms for permit category and scallop size, as well as permit category and trip length, were included to better capture differences across various components of the scallop fishery. The final dataset contains 204,655 sales transactions representing 98.4% of all scallop meat sales over the 12 year period.

Five model specifications were run. The preferred linear model includes an Instrumental Variables (IV) estimator in which the one-day lag of daily quantities is used as an instrument for daily quantities, as it was thought that daily scallop quantities are potentially determined simultaneously with prices. Permit category results are relative to the Limited Access (LA) fleet, and for other dummy variables, bases were set to the category with the most observations (e.g. 11-20 count scallops for size; New Jersey for state of landing). The preferred model fits well with an R^2 of .865 and diagnostics reject under-identification. While the results are extensive, those of primary interest are the IFQ fleet receiving a $0.09 premium relative to the LA fleet, while the General Category fleet receives a $0.03 premium and the transition period fleet receives a $0.13 discount. This residual IFQ premium may be attributed in part to unobservable production characteristics common to the IFQ fleet, such as improved handling of scallops, or may be attributed to the buyer side of the equation.

From the preferred model results, the discrete effects of permit category and scallop size were calculated. That is, after prices have been predicted for all sales transactions, the permit category (or size) categorical variable was set to a particular value and any corresponding interaction terms were modified as appropriate. The predicted price of the base case (LA for permit category; 11-20 count for size) was subtracted and averages were computed after grouping by fishing year. Figure 3 illustrates predicted prices for selected permit categories over their active time period.[2] The GC fleet is predicted to receive very similar prices to LA vessels during 2004-2007, the Transition fleet receives lower prices than the LA fleet during 2008-2009,

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[1] While this is an imperfect way to classify trips, model results are quite robust to moderate changes in this cutoff.

[2] Standard errors for each group are computed using the delta method

and the IFQ fleet receives a premium in all fishing years from 2010-2015. The predicted IFQ premium ranges from $0.18 (1.5%) in 2013 to $0.32 (3.4%) in 2010. In terms of size effects, all permit categories receive higher prices for larger scallops than smaller scallops. IFQ vessels receive higher prices than Transition vessels for all size categories and receive higher prices than LA vessels for all size categories other than unclassified. Size effects across the scallop fishery as a whole have been increasing (Figure 4). U10 scallops have received large premiums during 2014-2015, and 31+ count scallops have received sizable discounts during these years.

The IFQ and LA fleets operate very differently, and there are a number of reasons why a premium for IFQ vessels exist. IFQ vessels have landed a greater percentage of U10 scallops than LA vessels, and the premium for U10 scallops has increased sharply in recent years. IFQs are transferable while DAS and access area trips are not; states with higher ex-vessel prices have seen an increase in landings under transferable quotas. Additionally, generally shorter trips by the IFQ fleet yield a fresher product than the LA fleet; permit category and trip length are interacted in the model, however a lack of long IFQ trips is a barrier to completely conditioning out the effect of trip length. In terms of increased *ex-vessel* prices for the IFQ period relative to the transition period, derby-style fishing during the transition period was apparent in the model variable distributions, with a lack of observations in late fall and winter.

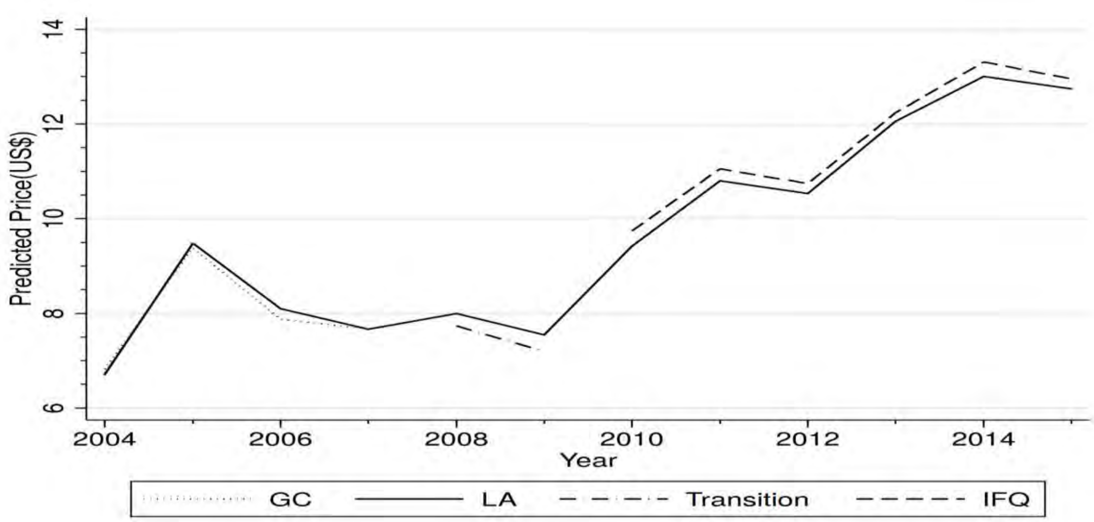

Figure 3: Predicted Prices over time by Scallop Permit Category.

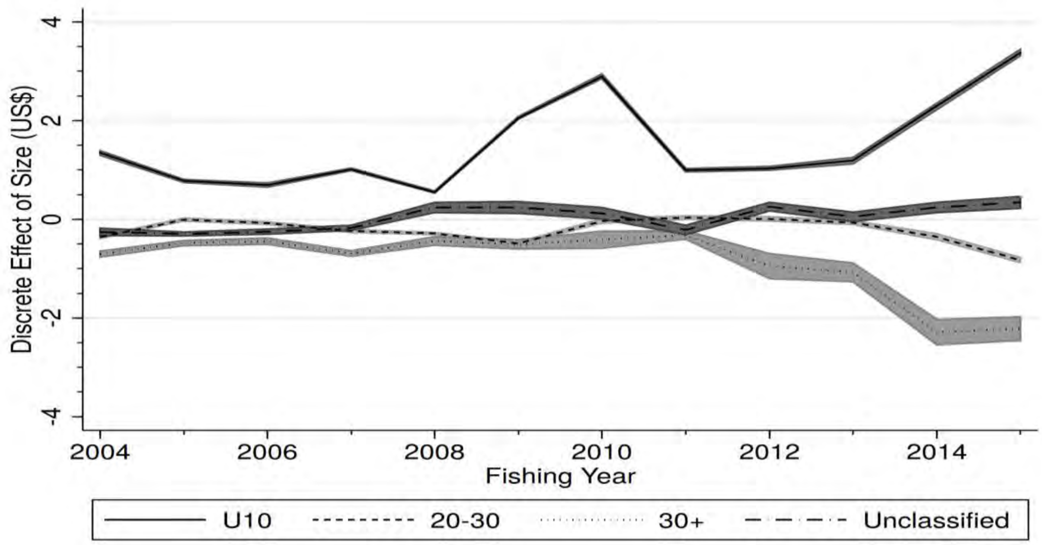

Figure 4: Discrete premia (lines) and 95% confidence intervals (ranges) relative to the 11-20 market **category over time.**

APPENDIX E – AN EMPIRICAL ANALYSIS OF INDIVIDUAL FISHING QUOTA MARKET TRADING

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Running Title: Individual fishing quota market trading

An empirical analysis of individual fishing quota market trading

Abstract

In the study, we investigate determinants of IFQ lease price and permanent transfer share in the General Category Scallop fishery of the Northeastern United States. A unique micro data set on individual IFQ transactions and related vessel and stock information for the 6-year time period, fishing year 2010-2015, was used to estimate models of quota markets and individual transactions. We find that IFQ lease price is generally affected by factors influencing profitability of the fishery as well as the competitiveness of the leasing market. Results of the analysis also suggest that the price for IFQ transfers captures the capitalized profits in the fishery over time with adjustment for relevant risks. Overall, the IFQ market performance is in general agreement with economic theory.

1. Introduction

Over the past four decades, individual transferable quota (ITQ) or similar programs have been increasingly incorporated into fisheries management around the world. The number of empirical studies of the effectiveness of these programs has also been growing (Weninger, 1998; Shotton, 2001; Newell et al., 2005; Chu, 2009; Walden et al., 2012). Costello et al. (2008) investigated 121 fisheries managed using catch shares by 2003 and found that catch share program could improve economic efficiency, reduce over-capitalization, and halt the depletion of fish stocks. Economic efficiency gains associated with ITQ programs have been reported in a number of studies, such as fisheries in Iceland (Arnason, 2005) and Denmark (Andersen et al., 2010), and the Gulf of Mexico red snapper fishery (Solís et al., 2015). Based on their assessment of all major United States federal catch share fisheries and associated shared stock fisheries in British Columbia, Grimm et al. (2012) find that catch shares result in improvements in resource conservation, economic returns, and social performance, relative to industry performance under traditional management.[3]

[3] Multiple studies also examine issues and concerns about ITQ management, such as its undesirable distributional impacts on fishing communities (Anderson, 1991; Gauvin et al., 1994; Matulich et al., 1996; McCay et al., 1998; McCay, 2004; Brandt, 2005; Anderson et al., 2008; Yandle and Dewees, 2008; Carothers, 2013) and its effectiveness in stock conservation (Chu, 2009; Acheson et al., 2015; Bromley, 2015; Kahui et al., 2016).

In the Northeast United States, the Limited Access General Category (LAGC) Scallop Individual Fishing Quota (IFQ) program was implemented in 2010. The Program established quota shares (QS) that, when multiplied by the annual catch limit (ACL) for the IFQ fishery, determines the quota pounds (QP) of scallop meats that may be harvested in a given year by any one entity holding QS. The IFQ program allows trading of both QS and QP. The former is the permanent share while the latter is a short term leasing arrangement for a single year. Economic theory predicts that, on average, the price for QS (i.e., a permanent transfer of the IFQ share) is equal to the capitalized profits in the fishery over time, whereas the price for QP (i.e., an IFQ lease) reflects the marginal net return in the fishery. The objective of this study is to evaluate general economic performance of the QS and QP transactions in the General Category Scallop IFQ program and to test whether the market prices are consistent with economic theory.

A clear understanding of the quota market is crucial under ITQ management. According to Arnason (1990), under certain conditions (e.g., perfectly competitive markets), the fishery manager only needs to monitor the quota market price and to adjust the total quota (TAC) until the current total quota market value is maximized, which is the "minimum information management" scheme to achieve socially optimal condition for the fishery. There are at least three functions of an efficient QP market: to allocate QP to those who value it most, to encourage efficient use and discipline inefficient use of QP, and to provide information for business planning and policy decisions (Holland, 2016; Newell et al., 2007).

In spite of the importance of information on IFQ markets, there has been a lack of systematic studies of ITQ trading using empirical data, due to the fact that price information on catch share transfers is often limited or unavailable in most catch share programs (Holland et al., 2015). Newell et al. (2005) examine the ITQ fisheries in New Zealand Using a 15-year panel dataset from New Zealand that covers 33 species and more than 150 markets for fishing quotas, Newell et al. (2005) assessed trends in market activity, price dispersion, and the fundamentals determining quota prices. They found that market activity was sufficiently high in the economically important markets and that price dispersion had decreased. They also found evidence of economically rational behavior through the relationship between quota leases and sale prices and between fishing output and input prices, ecological variability, and market interest rates. Market design and imperfections may be important in these new markets; Anderson (2004) illustrates how trading limitations can lead to very different final outcomes using a laboratory experiment. Lee (2012) finds that institutional limitations lead to bargaining power in the Northeast US Multispecies Days-at-Sea market. Ropicki and Larkin (2014) find that informational differences, proxied by social network indicators, had similar effects in the Gulf of Mexico Red Snapper quota market. Holland (2016) illustrates the market imperfections in the Pacific Groundfish market.

The General Category Scallop IFQ program provides a unique opportunity to investigate new IFQ markets using empirical data. The fishery targets a single species, and thus, its quota market does not involve the many complexities associated with IFQs for multispecies fisheries. We compile a micro data set with information on individual transactions as well as relevant vessels and fishing quota allocations. We estimate models of quota markets and individual transactions, following the general framework of Newell et al. (2005) and the Lee (2012).

2. Background

The study period covers fishing years 2010-2015, i.e., March 1, 2010 through February 28, 2016. During this period, the scallop IFQ lease market was quite active, with 1,852 lease (QP) transactions. In contrast, there were only 169 permanent IFQ share (QS) transfers. There were approximately 330 permits in the General Category scallop fishery, and over 70% percent participated lease trade.[4]

The Atlantic sea scallop fishery is managed by the New England Fishery Management Council (NEFMC). Limited Access (LA) was introduced in 1994; permit-holders that did not qualify into the LA fishery could fish under a General Category (GC) permit, which remained an open-access fishery with a 400 pound trip limit (NEFMC, 1993). Amendment 11 created the Limited Access-General Category (LAGC) fishery and further divided it into the IFQ, Northern Gulf of Maine, and Incidental fisheries. The goal of Amendment 11 was to control fishing capacity and scallop mortality in the LAGC fishery. The NEFMC also adopted a vision for the LAGC fleet to "maintain the diverse nature and flexibility within this component of the scallop fleet" (NEFMC, 2007. p8).

The LA and IFQ fleets are affected by spatial closures to protect scallop habitat, groundfish habitat, and groundfish. A rotational access system also affects the LA and IFQ fleet. In this system, areas of the ocean with an abundance of juvenile scallops are closed to allow those scallops to grow larger. Regulations for the IFQ fleet include a possession limit, currently 600 lbs, and a fleet-level aggregate limit on trips into scallop rotational access areas. The aggregate limit was reached three times during the study period, Delmarva (in 2010), Hudson Canyon (2011), and Mid-Atlantic Access Area (2015). The life-history characteristics of sea scallops are favorable for spatial management: scallops grow quickly, adults have low levels of natural mortality, and scallops are relatively immobile after settling on the ocean floor (Hart and Rago, 2006). Due to the importance of the rotational management system, finely detailed biomass data is collected to inform managers (See NEFSC, 2014 and NEFMC, 2015 for examples) and used to project future biomass using the Scallop Area Management Simulator (SAMS).

A few institutional limitations and peculiarities of the market are worth describing. During the 2010 and 2011 fishing years, entities that made permanent transfers of QS were required to transfer their entire QS allocation prior to use of IFQ, and vessels that utilized any IFQ could not subsequently transfer IFQ later in the fishing year. Beginning in 2012, permanent transfers of QS that were less than an entity's QS allocation were allowed. In addition, vessels cannot be allocated more than 2% of the sub-ACL and individuals cannot have an ownership interest of more than 5% of the sub-ACL (73 Federal Register 20092-20093). These ownership caps were desired by fishery managers to limit consolidation. There are also two "permit banks" that own QS and lease quota. The Cape Cod Fisheries Trust works with the Cape Cod Community Development Partnership to lease QP to local fishermen at below market rates. A similar permit bank is operated by the State of Maine. IFQ trades occur through word of mouth and are often facilitated through brokers; no centralized market exists. Fishing right holders are required to report lease and transfer information to the Greater Atlantic Fisheries Regional Office (GARFO), including buyer and seller permit numbers, QS transferred or QP leased, and the price that was paid. Finally, the "Confirmation of Permit History" (CPH) program can be utilized by right-holders. The catch history of a fishing vessel and therefore QS in the IFQ scallop program can be separated from the fishing vessel itself. Rights holders can then transfer this to a new vessel, sell this right, or lease out the corresponding of QP on an annual basis.

The total value of leases increased from, on average, $74 thousand per month in 2010 to $350 thousand per month in 2015. Corresponding total lease quantity grew from 37 thousand to 90 thousand

[4] There are an additional 40 fishing vessels that are dual permitted in the Limited Access fishery (managed under Days-at-Sea) and the IFQ fishery. These vessels are not allowed to transfer or lease their QS or QP.

pounds per month (Figure 1).[5] The actual monthly lease quantity was even greater than those depicted in the figure, as over 30% of the lease quantity were excluded due to missing value information in the lease trade records (e.g., when quota was transferred between two vessels with the same owner). Significant seasonal variation existed in the lease market, and the number of lease transactions fluctuated between 10-60 per month. About half of the transactions involved CPH sellers. Spatial variation in lease trade was also evident, and most buyers and sellers were in Massachusetts and New Jersey.

Scallop price was rising from approximately \$9/lb to \$13/lb in the study period. A similar trend was also present in IFQ lease price, increasing from about \$2/lb in 2010 to over \$4/lb in 2015 (Figure 2). Changes in the IFQ transfer price generally followed the same pattern as the lease price (Figure 3; Pearson correlation coefficient between lease and transfer prices = 0.58 ($p<0.01$), excluding the two low-transfer-price outliers in 2012 and 2015). Transfer prices for QS have been around \$40/lb in recent years (Figure 3).

3. Method

One approach to examine general economic performance of IFQ market is to investigate the determinants of quota price movement using regressions (Newell et al., 2005). As shown by Newell et al., quota price may be affected by multiple factors including returns from fisheries, cost of fishing, resource conditions, and general economic climate. For our analysis, we develop two types of models: a macro-model of aggregate IFQ lease market and a micro-model of individual quota lease transactions.

The general specification of the macro-model of IFQ lease price (y) is:

$$y_t = \beta_0 + \mathbf{s}_t'\boldsymbol{\beta}_1 + \mathbf{r}_t'\boldsymbol{\beta}_2 + \mathbf{c}_t'\boldsymbol{\beta}_3 + \mathbf{b}_t'\boldsymbol{\beta}_4 + \mathbf{m}_t'\boldsymbol{\beta}_5 + \mathbf{e}_t'\boldsymbol{\beta}_6 + \mathbf{t}_t'\boldsymbol{\beta}_7 + \varepsilon_t \quad (1)$$

where βs are coefficients to be estimated and ε is an error term. At time t, **s** is the vector of scallop price and revenue, **r** is the vector of price and revenue of other species, **c** is the vector of fishing cost, **b** is the vector of scallop resource availability (quota allocation and stock), **m** is the vector of market competitiveness and permit type, **e** is the vector of macroeconomic condition, and **t** is the vector of seasonal effects and time trend. Different versions of Equation (1) (e.g., with lagged variables) are estimated using monthly data and autoregressive error model corrected for 1st-3rd order autocorrelation (Yule-Walker estimates).

Following Lee (2012), the general specification of the micro-model of IFQ lease price (y) is:

$$y_i = \gamma_0 + \mathbf{x}_i'\boldsymbol{\gamma}_1 + \mathbf{g}_i'\boldsymbol{\gamma}_2 + \mathbf{h}_i'\boldsymbol{\gamma}_3 + u_i \quad (2)$$

where γs are coefficients to be estimated and u is an error term. For transaction i, **x** is the vector including the same set of independent variables in Equation (1), **g** is the vector of the characteristics of buyer, and **h** is the vector of the characteristics of seller. We employ White estimator to calculate heteroscedasticity consistent standard errors (Greene 2012).

4. Data

Primary data sources for the study include separate data files on approved IFQ lease transactions, IFQ permanent transfers, vessel logbook (fishing trip records), scallop fishing quota base allocation,

[5] The annual quantity accounted for about 42% of the total quantity of all lease transactions (including those with missing lease value information) in fishing year 2010, and around 65% in fishing years 2013-2015.

vessel permits data, and scallop biomass data from the National Marine Fisheries Service (NMFS). For convenience of data compilation, we identify buyer and seller in an IFQ trade using their fishing permit numbers. Note that about 84% of the permit numbers were associated with the same hull number during the study period. Thus, IFQ trade among permits captures the general pattern of trade among vessels, and in turn, vessel owners.

Fishing histories and other characteristics of buyer and seller of an IFQ trade (e.g., catch quantities, revenues, and costs) are constructed through merging data on IFQ transactions, logbook, and other files by permit number. For aggregate market variables, trip-level information is merged by permit number for each month and fishing year. Prices and values are converted to real 2015 dollars using the Producer Price Index for unprocessed and prepared seafood.

The data sets for regression analyses exclude IFQ transactions without price information. We also exclude observations with prices that are likely to be data errors or non-response answers: lease transactions with prices between $1.01/lb -$10/lb and transfers with prices between $1.01/lb -$100/lb are used in the analysis. Tables 1-2 present definition and descriptive statistics of variables in the macro-model of lease market. Tables 3 and 4 summarize similar information for the micro-model of lease transactions.

Vessel trip costs were estimated using a regression model for scallop dredge developed using NMFS Sea Sampling data and corresponding logbook information (Jin et al., 2016). In the model, trip cost is a function of vessel size (i.e., tonnage) and trip duration (days absent). Since relevant trip-level data are available for vessels involved in IFQ transactions, trip costs for those vessels can be easily calculated.

5. Results

We develop IFQ lease market and transfer market models using Equations (1) and (2) and project data sets each includes a large set of variables on prices and revenues of scallop and other species, fishing costs, scallop resource availability, as well as market and vessel permit information. Separate stepwise regressions were used to analyze the effects of these variables on IFQ lease price and transfer share. The result of a stepwise regression is an ordinary least-squares estimation of a linear multivariate model including only variables significant at or above the 15% level, which helps to identify key factors affecting the dependent variable in each case.

5.1. IFQ Lease Market

Table 5 reports the results from Yule-Walker estimations of two separate macro-models for monthly mean IFQ lease price in Equation (1) using the data set with selected variables described in Tables 1 and 2. The table includes results for statistically significant explanatory variables and constant terms. The models fit the data well with R-squares around 0.85. Most of the variables are significant at the 1% level and all are at the 10% level. The estimation results from both models suggest that the lease price is positively related to scallop price, which is consistent with economic theory and the findings of Newell et al. (2005). Lease prices are also inversely related to the number of permit-bank sellers that were active, which is consistent with the missions of these organizations to offer quota at below-market prices to encourage fishing activity in their communities. IFQ lease price is expected to be higher if the total scallop revenue in the previous month was high, and lower if the percent of scallop quota fished is high (Model II).

The percent quota fished describes the cumulative scallop harvest by month over a fishing year of all IFQ market participants relative to their total quota allocation. As the percent quota fished increases, the overall remaining quota declines, and the fishing year is closer to the end. The percentage of the quota fished was found to be inversely related to QP prices. There are two possible explanations for this findingThis is consistent with the theory of real-options, in which the "option value" component will declined to zero as the expiration date approached (Anderson, 1987). Alternatively, this could reflect within-season decreases in the value of exercising the real-option; Valcu and Weninger (2013) show that this can occur in an IFQ fishery if there are large stock effects in production or heterogenous-in-value stock. Both of these phenomena are likely in the IFQ fishery: the life history of scallops can result in patches of high density scallop beds (Hart and Chute, 2004) and large scallops receive high prices relative to smaller scallops (Ardini and Lee, 2016).

Other results indicates that positive relationships exist between IFQ lease price and variation of fishing costs across vessels (std of trip cost), macroeconomic condition (GDP), and trade in September (Model I). Note that a larger variation in fishing costs across vessels reflects an increased heterogeneity in vessel operational efficiency, which may lead to elevated market activities. Low-cost vessels are likely offer higher price, according to classical bidding models (Wilson 1977).[6]

Table 6 reports the results the White estimator for IFQ lease price in equation (2) using the data set on individual lease transactions (Tables 3 and 4). As in the macro-models of IFQ leases, the lease price is, on average, positively related to scallop price, GDP, and trade in September, and negatively related to percent of scallop quota fished. Furthermore, the micro-model results suggest that IFQ lease price is expected to be lower if the number of sellers in a month is large, the seller is part of a permit bank or a frequent seller, the buyer has large quota base allocation, and the buyer's vessel is large. Buyers with large quota allocations are less eager to acquire additional fishing quota, and they may be well informed about the state of the fishery and have an informational advantage. Buyer and seller locations (states) also affect the lease price. Lease quantity also positively influences lease price; this may be related to search costs for buyers.

5.2. Relationship between IFQ Lease and Transfer Prices

As noted in the introduction, according to economic theory, the price for IFQ transfer (QS) is equal to the capitalized profits in the fishery over time, whereas the IFQ lease price reflects the marginal net return in the fishery. Under dynamic quota arbitrage, assuming stable (competitive) market, the relationship between transfer price (P_T) and lease price (P_L) may be expressed as (Newell et al. 2005):

$$P_T = \frac{P_L}{\delta} \quad \text{or} \quad \frac{P_L}{P_T} = \delta \tag{3}$$

where δ is the discount rate perceived by scallop IFQ traders.

Figure 4 shows that the general movement of the lease to transfer price ratio follows that of the rate of 10-year Treasury note (Pearson correlation coefficient = 0.48 ($p<0.01$), excluding the two outliers in 2012 and 2015). The mean T-note rate and mean price ratio are 2.4% and 9.9%, respectively. On

[6] We also investigated the effects of vessel net revenues on the IFQ lease price, and the results were not statistically significant. This could be related to the fact that vessels in the General Category Scallop IFQ fishery catch both scallop and other species. The share of scallop landings fluctuates in a year between 60% (typically in May or June) and 30% (typically in November). Vessel owners maximize the total net revenue across different species.

average, the price ratio is 4.3 times the T-note rate. Fishing, and investing in a newly-created property right associated with fishing, is far riskier than investing in US Treasury securities. In particular, there is uncertainty about future stock levels, volatility in costs of fishing, and concerns about the the quality of the newly established property right (Arnason 2005; Scott 1996 and 1999). Thus, the IFQ trader's discount rate is significantly higher,

6. Conclusions

This study has investigated determinants of IFQ lease (QP) price and permanent transfer shares (QS) in the General Category Scallop fishery of the Northeastern United States. Detailed data on individual IFQ transactions and related vessel and stock information for the 6-year time period, fishing year 2010-2015, were used to estimate models of quota market and individual transactions.

The estimation results suggest that IFQ lease price is generally affected by factors influencing profitability of the fishery as well as the competitiveness of the leasing market. Specifically, lease price is positively associated with scallop price, general economic condition, and wider variation of fishing costs across vessels. Lease price is negatively associated resource availability, permit-bank sellers, and the presence of large number of sellers. Significant seasonal and spatial effects on lease price are also identified. Generally, for an IFQ market to function well, we need a large number of boats and active trading activities.

The number of permanent IFQ transfers is small due to ownership caps, high costs to obtain QS, and the convenience of a robust leasing market. Although QS trade is infrequent, changes in mean transfer price seem related to the movements in mean lease price. The results imply that, on average, the price for IFQ transfers reflects the capitalized profits from fishing over time, adjusted for risks associated with the scallop fishery. Overall, the scallop IFQ market performance has been consistent with economic theory.

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Table 1: Lease Market Model Variable Description

Variable	Unit	Description
Dependent Variables		
Mean lease price	2015$/lb	monthly average lease price
Independent variables		
Scallop price	2015$/lb	monthly average scallop price
Std of trip cost	10^3 2015$	standard deviation of trip cost across permits by month
Lagged total scallop revenue	10^3 2015$	total scallop revenue in previous month
Number of permit-bank seller		number of permit-bank sellers by month
Percent quota fished		percent of TAC fished by month in a fishing year
GDP	10^12 2009$	US quarterly real GDP
September		monthly dummy
Fishing year 2013		yearly dummy
Fishing year 2014		yearly dummy
Fishing year		time trend

Table 2. Lease Market Data Descriptive Statistics

Variable	Mean	Std Dev	Minimum	Maximum
Dependent variable				
Mean lease price	3.15	0.81	1.85	4.93
Independent variables				
Scallop price	12.06	1.27	8.07	14.58
Std of trip cost	6.11	1.53	3.55	12.59
Lagged total scallop revenue	2.11	1.18	0.72	6.16
Number of permit-bank sellers	3.40	3.93	0	20
Percent quota fished	0.61	0.31	0.04	1.17
GDP	15.56	0.55	14.60	16.51
September	0.08	0.28	0	1
Fishing year 2013	0.17	0.38	0	1
Fishing year 2014	0.17	0.38	0	1
Fishing year	2012.50	1.72	2010	2015

Table 3. Micro Model Variable Description

Variable	Unit	Description
Dependent Variables		
Lease price	2015$/lb	lease price
Independent variables		
Lease quantity	10^{4} lb	lease quantity
Scallop price	2015$/lb	monthly average scallop price
Percent quota fished		percent of TAC fished by month in a fishing year
Number of sellers		number of sellers by month
Permit bank seller		seller is in permit bank
Frequent seller		Seller sold more than 20 times in the study period
GDP	10^{12} 2009$	US real GDP
Buyer vessel gross ton	10^{2} ton	buyer vessel gross tons
Buyer quota allocation	10^{6} lb	buyer base allocation
RI buyer		state dummy
DE buyer		state dummy
MA buyer		state dummy
ME buyer		state dummy
NC seller		state dummy
NY seller		state dummy
RI seller		state dummy
August		monthly dummy
September		monthly dummy
Fishing year 2010		yearly dummy
Fishing year 2011		yearly dummy

Table 4. Lease Transaction Data Descriptive Statistics

Variable	Mean	Std Dev	Minimum	Maximum
Dependent variable				
Lease price	3.03	1.25	1.02	8.66
Independent variables				
Lease quantity	0.40	0.44	0.00	3.58
Scallop price	12.14	1.14	8.07	14.58
Percent quota fished	0.59	0.30	0.04	1.17
Number of sellers by month	25.82	9.60	4	49
Permit bank seller	0.18	0.38	0	1
Frequent seller	0.24	0.43	0	1
GDP	15.61	0.52	14.60	16.51
Buyer vessel gross ton	0.53	0.38	0.05	1.37
Buyer quota allocation	0.01	0.01	-0.01	0.05
RI buyer	0.01	0.08	0	1
DE buyer	0.01	0.07	0	1
MA buyer	0.58	0.49	0	1
ME buyer	0.03	0.17	0	1
NC seller	0.03	0.18	0	1
NY seller	0.03	0.17	0	1
RI seller	0.01	0.10	0	1
August	0.09	0.29	0	1
September	0.08	0.27	0	1
Fishing year 2010	0.10	0.29	0	1
Fishing year 2011	0.19	0.39	0	1

Table 5. Model of IFQ Market: Monthly Mean IFQ Lease Price

	Model I		**Model II**	
Variable	**Coefficient**	**Std Error**	**Coefficient**	**Std Error**
Scallop price	0.176***	0.056	0.231***	0.062
Std of trip cost	0.124***	0.027	-	-
Lagged total scallop revenue	-	-	0.098*	0.049
Number of permit-bank seller	-0.029***	0.011	-0.047***	0.012
Percent quota fished	-	-	-0.404**	0.168
GDP	0.847***	0.163	-	-
September	0.210*	0.125	-	-
Fishing year 2013	-	-	-	-
Fishing year 2014	0.522***	0.171	-	-
Fishing year	-	-	0.253***	0.051
Intercept	-12.917***	2.231	-507.759***	101.755
# Of observations	72		71	
R-squared	0.86		0.84	

*, **, and *** denote significance at 10, 5, 1% significance levels, respectively.

Table 6. Model of Individual Transactions: IFQ Lease Price

Variable	Coefficient	Std Error
Intercept	-6.491***	1.266
Lease quantity	0.134***	0.051
Scallop price	0.134***	0.040
Percent quota fished	-0.419***	0.112
Number of sellers	-0.005**	0.003
Permit bank seller	-1.445***	0.060
Frequent seller	-0.355***	0.056
GDP	0.578***	0.094
Buyer vessel gross ton	-0.131**	0.065
Buyer quota allocation	-13.309***	2.552
RI buyer	-1.031***	0.357
DE buyer	-0.513***	0.195
MA buyer	-0.124**	0.052
ME buyer	-0.271*	0.153
NC seller	0.316***	0.084
NY seller	0.622***	0.115
RI seller	1.151**	0.478
August	0.262***	0.074
September	0.326***	0.090
Fishing year 2010	-0.956***	0.105
Fishing year 2011	-0.744***	0.072
# of observations	1,189	
R-squared	0.62	

*, **, and *** denote significance at 10, 5, 1% significance levels, respectively.

Figure 1. Monthly Total IFQ Lease Quantity and Value

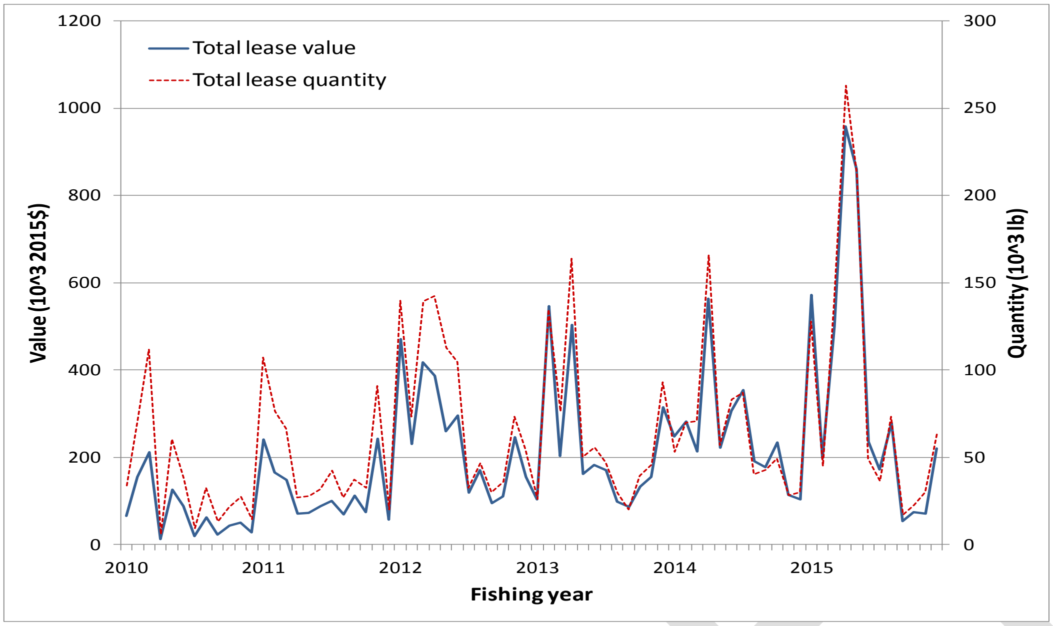


Figure 2. Monthly Mean IFQ lease Price and Scallop Price

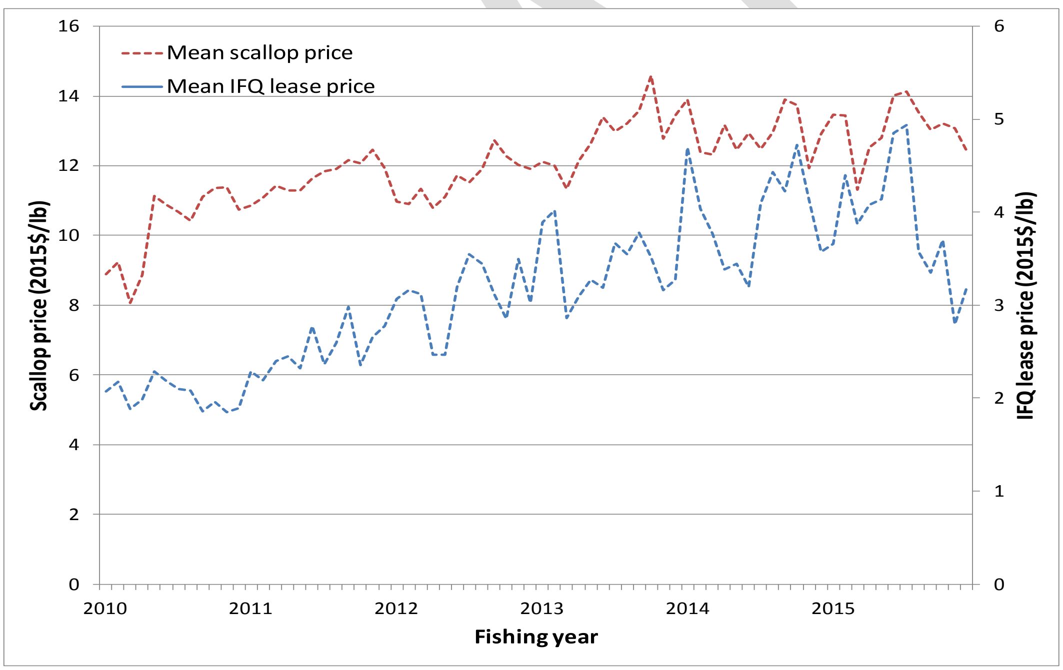


Figure 3. Monthly Mean IFQ Lease and Transfer Prices

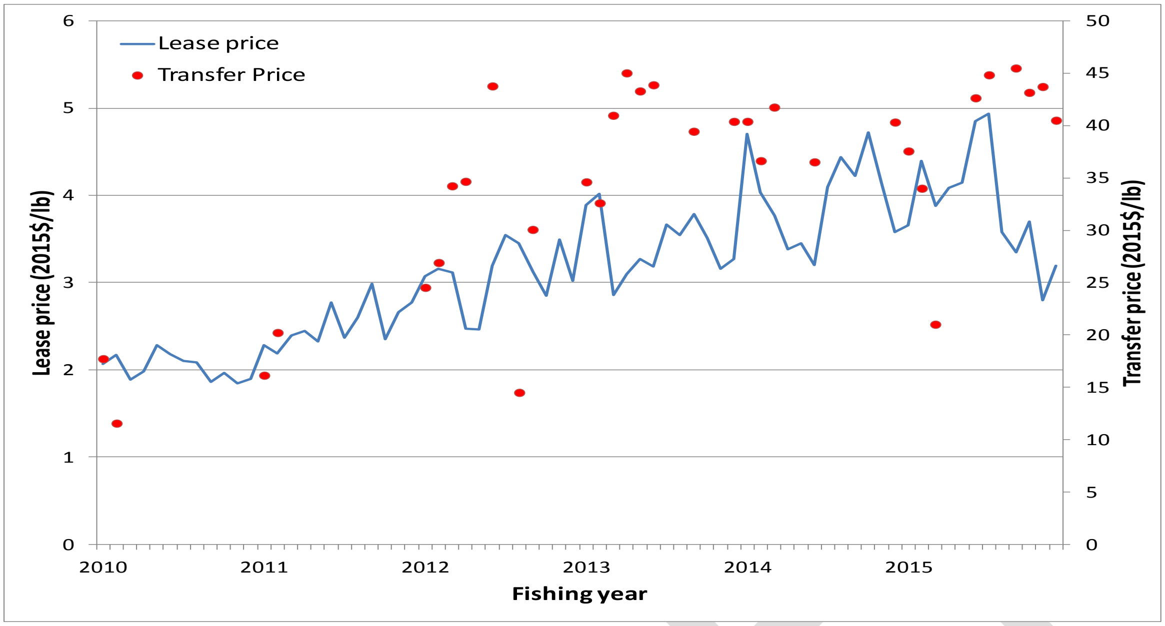
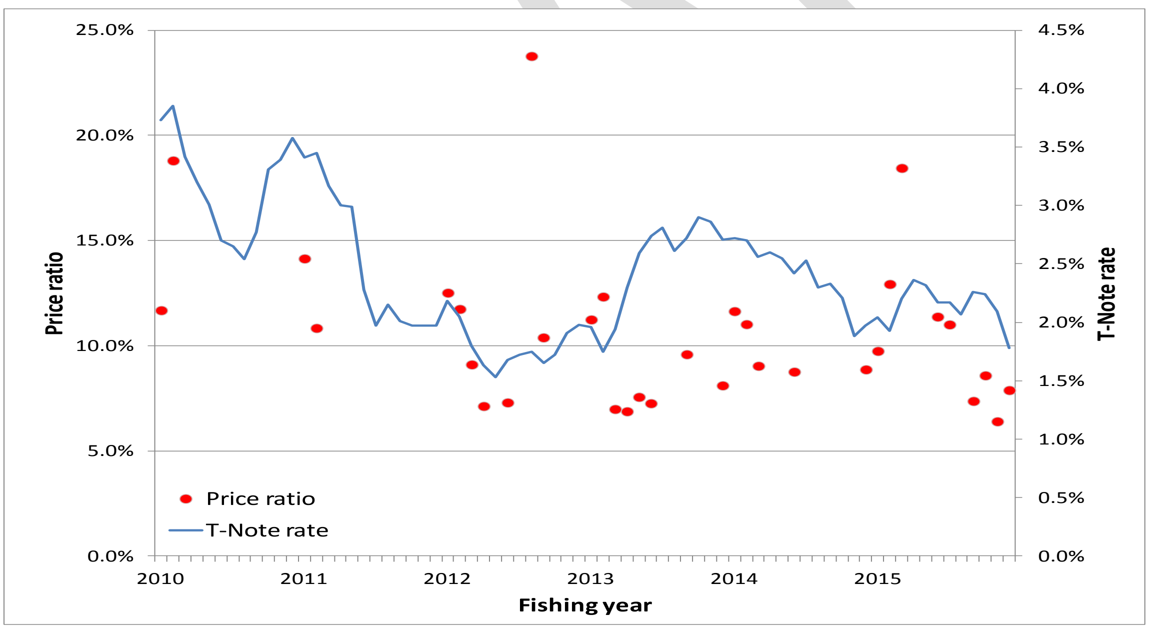


Figure 4. Monthly Lease-Transfer Price Ratio vs. T-Note Rate



APPENDIX F – GENERAL CATEGORY PERMIT HOLDERS THAT DID NOT QUALIFY FOR AN IFQ PERMIT

Greg Ardini, Northeast Fishery Science Center, SSB

Intro and Methods

To qualify for an IFQ permit, a General Category scallop vessel had to have 1,000 pounds of scallop meat landings during any fishing year over the qualification period (3/1/2000 to 11/1/2004). This section focuses on those vessels that did not meet the IFQ criteria, but did land scallops during the qualification period and continued to remain active in any fishery during the IFQ period (3/1/2010 - 2/29/2016). The purpose is shed some light on how reliance across species groups differed among these vessels during the two time periods as well as examining how many vessels may have qualified for an IFQ permit had the qualification criterion been lower. For purposes of analysis reliance was measured by the percent of total revenue earned from designated species groups. The species groups were assembled according to the FMPs of the New England and Mid Atlantic Fishery Management Councils. Species that are not explicitly managed by an FMP in either Council were combined into an "other" group.

Non-qualifiers were identified by first extracting all dealer purchases of sea scallops from NFMS dealer data for scallop fishing years 2000-2004. The vessel permit number of the seller to the dealer was then matched to permit data, so that only sales by General Category vessels were kept. Annual scallop sales (by fishing year) were then summed by vessel. Any vessel that landed scallops but had less than 1,000 pounds of scallop landings in all of the qualifying years was identified as a non-qualifier. Dealer data for each of these non-qualifying vessels were summarized by species group and fishing year for the IFQ period 3/1/2010 to 2/29/2016. Any vessel that did not report landings of any species during the entire IFQ period was deemed to be inactive and was eliminated from further consideration. This left a total of 180 non-qualifying vessels that had landed scallops during the qualifying period and were active in at least one year during the IFQ period.

Results and Discussion

Trends among actual non-qualifiers

As noted above, there were 180 non-qualifying vessels identified. Of these 180 vessels, 97 (54%) actively fished for scallops in only one fishing year during the qualification period, while just 11 vessels (6%) actively fished for scallops in all five years (Table 1). This suggests that most non-qualifiers were generally not engaged in the scallop fishery throughout the qualification period.

Table 14: Number of active fishing years (>0 lbs. scallop landings) by non-qualifying general category vessels during qualification period (fishing years 2000-2004)

# Active fishing years	# Vessels
1	97
2	44
3	17
4	11
5	11
Total	*180*

As Table 1 demonstrates only a handful of non-qualifying vessels were active in every year during the qualifying years, meaning that there were a substantial number of vessels moving in and out of the fishery over time. In FY2000, 62 of the 180 non-qualifiers landed scallops (Table 2). Of these 62 vessels, 30 exited the fishery and did not land scallops during FY2001. In FY2001, 67 non-qualifying vessels landed scallops (a net increase of 5 vessels). These 67 vessels were comprised of 35 vessels that entered the fishery in 2001 (they did not land any scallops during FY2000) and 30 vessels that landed scallops in both FY2000 and FY2001. FY2002 saw the largest net decrease in active vessels (-13), the largest number of exiting vessels (-41), the lowest number of entering vessels (28), and the lowest number of vessels that remained from the previous FY (26). This was followed by an increase in active vessels in FY2003 from 54 to 77, with the largest number of entering vessels (46) and the smallest number of exiting vessels (-23) occurring in that FY.

Table 15: Number of active, non-qualifying vessels by fishing year during qualification period

	FY2000	FY2001	FY2002	FY2003	FY2004
Active, non-qualifying scallop vessels	62	67	54	77	75
Entry (# vessels active after being inactive in previous FY)	N/A	35	28	46	37
Exit (# vessels inactive after being active in previous FY)	N/A	-30	-41	-23	-39
Remain **(# of vessels that fished in the current year and previous FY)**		32	26	31	38
Year to year Net Change	*N/A*	*5*	*-13*	*23*	*-2*

In terms of fishery participation, the 180 non-qualifying vessels were active in a wide variety of fisheries during the qualification period, and continued to do so during the IFQ period. The percent of total revenue by species group among non-qualifiers during the qualification period and during the IFQ period is shown in Table 3. Sea scallop revenue comprised a small percentage of total revenue during both periods. Across the designated species groups, sea scallop revenue was the smallest revenue component to the 180 non-qualifiers. Groundfish comprised the greatest percentage of revenue during both periods, though the percentage decreased during the IFQ period. Table 3 would suggest that failing to qualify for an IFQ permit did not force these vessels to dramatically alter their fishing choices. It appears that the far larger impact to the non-qualifying General Category vessels as a whole arose from changing conditions and management in the groundfish fishery. Still, of these 180 non-qualifying vessels, a majority (99) did not participate in the scallop fishery during the IFQ period.

Table 16: Percentage of revenue generated by species group among non-qualifying vessels (N=180) during qualification (3/1/2000 to 11/1/2004) and IFQ periods (3/1/2010 to 2/29/2016)

Species Group	Percentage of revenue generated by non-qualifiers during qualification period	Percentage of revenue generated by non-qualifiers during IFQ period
Sea Scallop	0.1%	1.2%
American Lobster	1.9%	4.9%
Groundfish	33.8%	23.7%
Monkfish	7.1%	4.5%
Scup/Fluke/Black Sea Bass	7.5%	13.5%
Squid	14.3%	17.8%
Surf Clam/Ocean Quahog	20.5%	15.8%
Whiting	6.9%	7.4%
Other	7.9%	11.3%
Total	*100.0%*	*100.0%*

Non-qualifiers under hypothetical landing requirements

The potential effect that a more liberal poundage qualification might have had on the number of non-qualifiers was evaluated by selecting the "best" year among the 180 non-qualifiers. The resulting distribution of non-qualifiers' best years is illustrated in Figure 1. The distribution illustrates that many of the 180 non-qualifiers still would not have been eligible for an IFQ permit if the landings criteria was lowered. For example, if the criteria were 500 lbs., there would have been 139 non-qualifiers (41 fewer). The species breakdown of these 41 vessels that came closest to qualifying is shown in Table 4. In comparison to Table 3, the percentage of revenue that came from sea scallops during the qualification period is slightly higher; though still less than 1%. Somewhat surprisingly, the percentage of revenue from sea scallops during the IFQ period was lower among these 41 vessels than the entire group of non-qualifiers. This sub-group of vessels also was heavily reliant on groundfish during the qualification period, collecting 52.5% of total revenue from this species group. During the IFQ period, this percentage dropped to 33.4%.

Figure 5: Number of General Category vessels that would fail to qualify for an IFQ permit under hypothetical landings criteria during qualification period

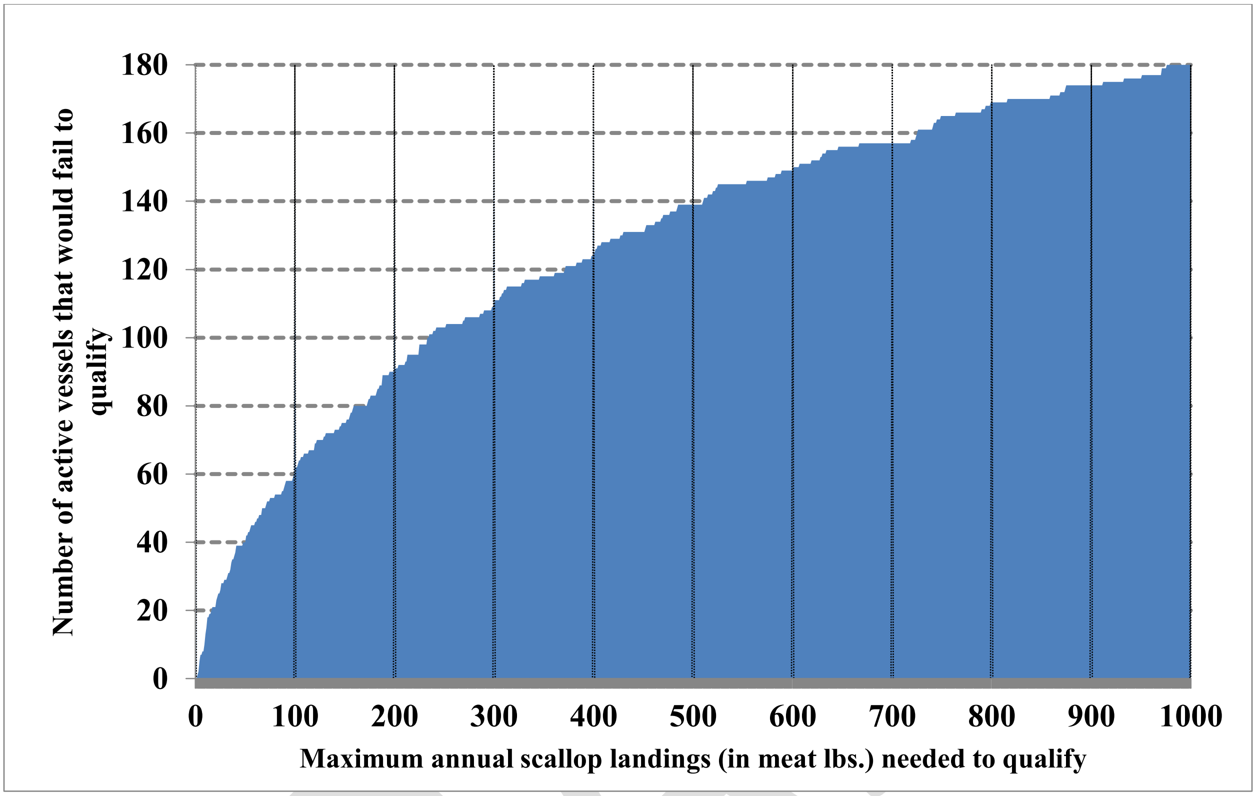


Table 17: Percentage of revenue generated by species group among non-qualifying vessels that would have qualified under a 500 lb. landing criteria (N=41) during qualification (3/1/2000 to 11/1/2004) and IFQ periods (3/1/2010 to 2/29/2016)

Species Group	Percentage of revenue generated by select non-qualifiers during qualification period	Percentage of revenue generated by select non-qualifiers during IFQ period
Sea Scallop	0.3%	0.4%
American Lobster	2.7%	6.3%
Groundfish	52.5%	33.4%
Monkfish	8.9%	5.5%

Scup/Fluke/Black Sea Bass	5.0%	11.2%
Squid	10.2%	9.2%
Surf Clam/Ocean Quahog	5.6%	10.4%
Whiting	7.2%	13.5%
Other	7.6%	10.1%
Total	*100.0%*	*100.0%*

APPENDIX G – MEASURING SPECIES DIVERSITY AMONG IFQ VESSELS USING THE HERFINDAHL INDEX

Greg Ardini, Northeast Fishery Science Center, SSB

Intro and Methods

The Herfindahl Index is a metric that is commonly used to measure concentration in a market place. In this more generally utilized form, the calculation of the index involves squaring the share each firm holds in a market. For the purposes of this section, the Herfindahl Index is used to measure the concentration of revenue by IFQ vessels among various species groups, such that the proportion of revenue from each species group is squared (Equation 1). The species-related revenue used to calculate the index was retrieved from NMFS dealer data. The grouping by species is shown in Table 1.

The Herfindahl Index was calculated for scallop fishing years 2004-2015 for all vessels that had an IFQ permit for at least one fishing year during 2010-2015. Calculations were made for all fishing years in which a vessel was active, resulting in a Herfindahl measurement of 3,090 vessel/fishing year combinations. To highlight those vessels most dependent on scallops, the dataset was then filtered to only include those vessel/fishing year combinations that had a majority of their total revenue from scallops, resulting in 1,636 combinations. For the purposes of comparison, the Herfindahl indices were then replotted for this subset.

Equation 1: $$H = \sum_{i=1}^{N} s_i^2$$

Where s_i = the share of a vessel's total revenue from species group i; N=total number of species groups. For example: a vessel collecting 80% of revenue from scallops and 20% from lobster; $H = (.8)^2 + (.2)^2 = .68$

Table 18: Species grouping used in calculating the Herfindahl Indices

Species Group Name	Species Included in Group (if not identified in the group name)
Atlantic Scallop	
Black Sea Bass and Fluke	
Bluefish (Mid-Atlantic)	
Bluefish and Scup (New England)	
Butterfish, Whiting, Red Hake	
Halibut (New England)	
Atlantic Herring	
Highly Migratory Species	Tunas, Sharks, Swordfish
Illex Squid	
Lobster	
Loligo Squid	
Mackerel	
Menhaden	
Mid-Atlantic Groundfish	Cod, Wolffish, American Plaice, Witch Flounder, Unspecified Hake, Haddock, Pollock, Redfish, Halibut
Monkfish (Mid-Atlantic)	

New England Groundfish	Cod, Winter Flounder, Witch Flounder, Yellowtail Flounder, Haddock, American Plaice, Pollock, Whiting, Redfish, Monkfish
Ocean Pout (New England)	
Ocean Quahog	
Offshore Hake	
Scup (Mid-Atlantic)	
Shrimp	
Skates	
Spiny Dogfish	
Surf Clam	
Tilefish	
Unspecified Hake (New England)	
White Hake	
Windowpane Flounder (New England)	
Windowpane Flounder and Ocean Pout (Mid-Atlantic)	
Winter Flounder (Mid-Atlantic)	
Wolffish (New England)	
Yellowtail Flounder (Mid-Atlantic)	
Other Species	

Secondly, the full set of 3,090 vessel/fishing year combinations were grouped into two different time periods to illustrate changes in reliance on scallops over time. The first time period (FYs 2004-2009) covers when these vessels were fishing under a General Category (GC) permit and when they were fishing under an IFQ permit with a fleet-wide TAC. The second period (FYs 2010-2015) covers when these vessels were fishing under a true IFQ permit. This method is a more simplified approach in which all non-scallop revenue is aggregated at the vessel level. Conversely, the number of species groups a vessel lands aside from scallops will change its Herfindahl Index (Equation 1).

<u>Results and Discussion</u>

Herfindahl Index Trends

A plot of the Herfindahl indices for the 3,090 active vessel/FY combinations is shown in Figure 1. Over time, there is an upward trend, indicating a less diverse catch portfolio across active vessels. FY2015 had an especially pronounced spike in indices. In recent years, the median (the horizontal line within the box) is higher than the mean (the diamond in the box) indicating a distribution shifted towards the maximum Herfindahl value of 1. The box extends from the 25th percentile to the 75th percentile for each fishing year, while the line outside the box covers all observations that are within 1.5*IQR[7] of the 25th or the 75th percentiles. The 75th percentile is very close to 1.0 in every fishing year, but some vessels do have a Herfindahl around 0.2 in every fishing year as well. It is important to mention that some vessels that had a high index in a given fishing year may not necessarily derive most of their revenue from sea scallops. These vessels may very well mainly rely on another species group from Table 1.

Figure 2 shows the inverse of the Herfindahl indices presented in Figure 1. The inverse Herfindahl index represents the number of species groups that would comprise aggregate revenue if revenue shares were equal across all species (e.g. a vessel with a Herfindahl index of

[7] IQR refers to Interquartile Range and is the distance between the 25th and 75th percentiles.

.5 could attain all of their revenue from 2 species groups equally). The fact that the vast majority of data points in Figure 2 lie below 2.0 is an indication there tends to be a relatively small number of species groups that comprise most of the revenue generated by IFQ qualifiers. Circles in the figure are considered outliers (beyond 1.5*IQR from the 25th or 75th percentiles) and roughly correspond to inverse values >3.0 in most fishing years. Therefore a vessel that could generate revenue from 3 species groups equally would be considered rare.

In comparison to Figure 1, Figure 3 shows the Herfindahl indices for the subset of 1,636 vessel/FY combinations in which scallops were the top revenue-earning species group. Compared to Figure 1, the indices tend to be higher. This is not a huge surprise, considering all of these vessels qualified for an IFQ permit and scallop prices are higher than most other species. There also appears to be a slight upward trend in Herfindahl indices in Figure 3, though not nearly as pronounced as in Figure 1. The indices in Figure 3 did start at a higher point than those in Figure 1, leaving less room for an upward trend across vessels. For all fishing years in Figure 3, the median is higher than the mean indicating a distribution shifted towards the maximum Herfindahl value of 1. In fact, the median in all fishing years is not far from 1. This means that among vessels that earn more revenue from scallops than any other species group in a given fishing year, at least half of these vessels earn all, or nearly all, of their revenue from scallops.

Figure 4 shows the inverse of the Herfindahl indices presented in Figure 3. Again, the inverse Herfindahl index represents the number of species groups that would comprise aggregate revenue if revenue shares were equal across all species. In comparison to Figure 2, the distribution is even closer to 1 (where all revenue is generated by one species group). Figure 4 shows that IFQ qualifiers that earn more revenue from scallops than any other species group generally do not have secondary groups that come close to rivaling the importance of scallops. This is evidenced by the fact the in most fishing years, a value above 2.0 is considered an outlier.

Figure 6: Herfindahl indices by vessels holding an IFQ permit in at least one fishing year from 2010-2015, includes all active vessel/fishing year combinations

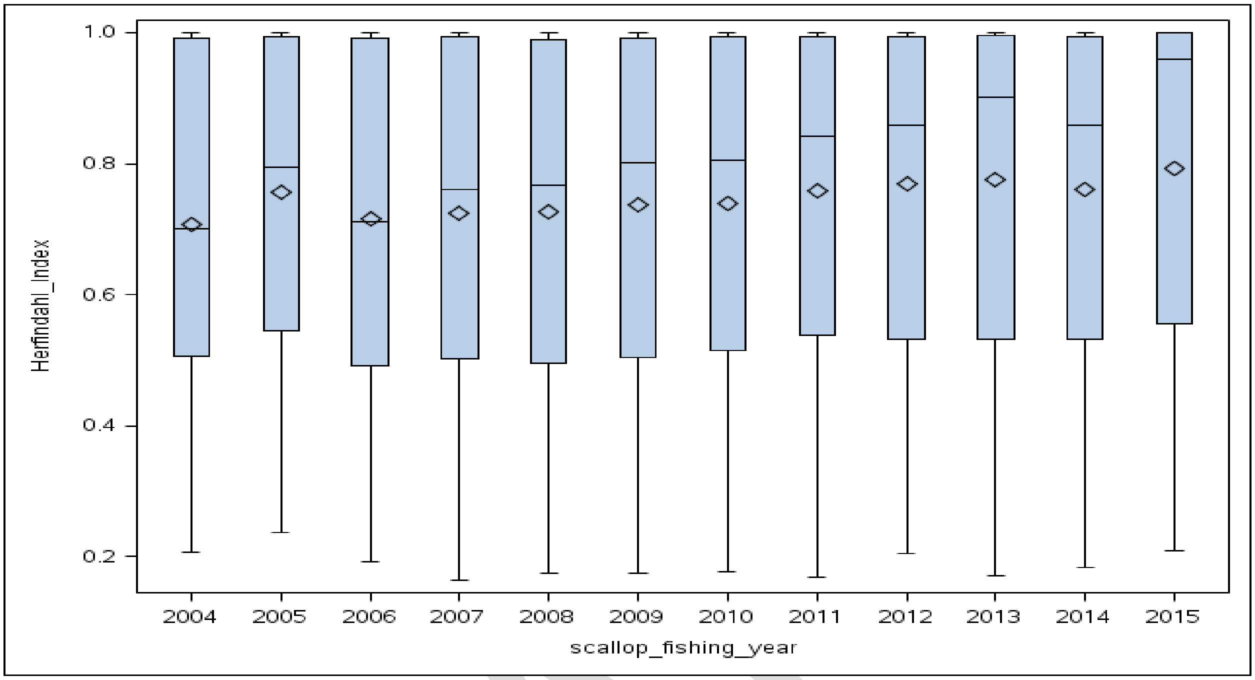


Figure 7: Inverse of the Herfindahl indices (Figure 1) by vessels holding an IFQ permit in at least one fishing year from 2010-2015, includes all active vessel/fishing year combinations

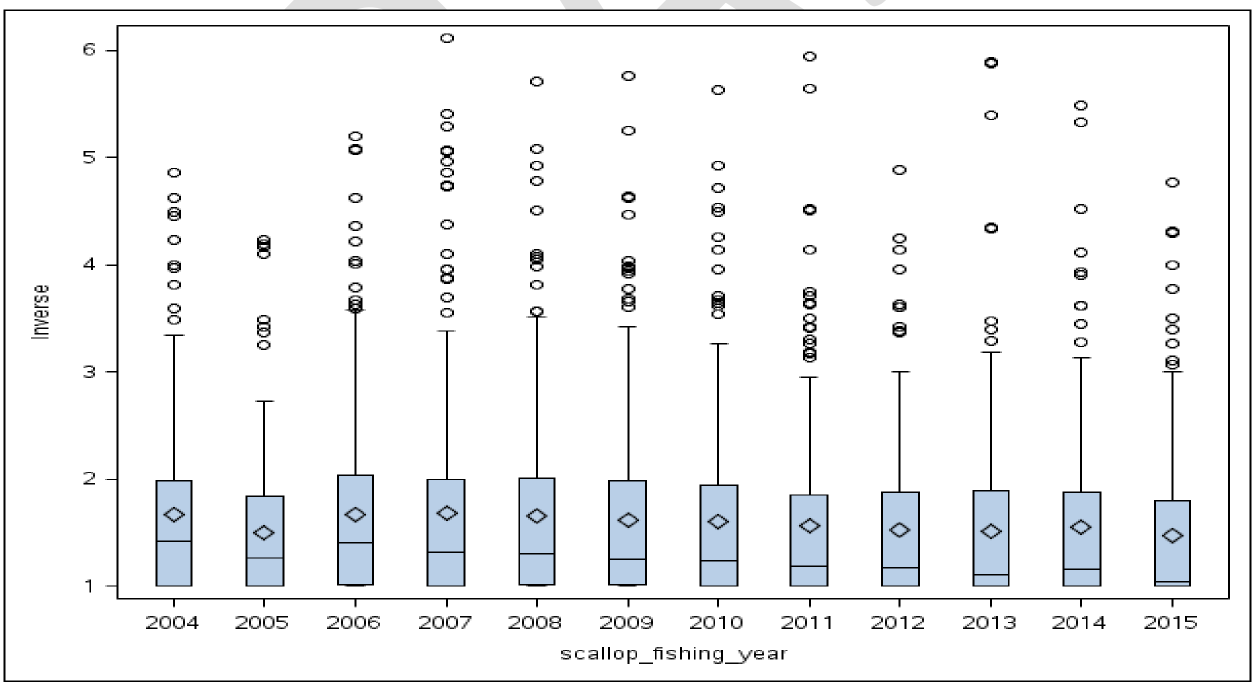


Figure 8: Herfindahl indices by vessels holding an IFQ permit in at least one fishing year from 2010-2015, includes all active vessel/fishing year combinations in which scallops were top revenue earning species group

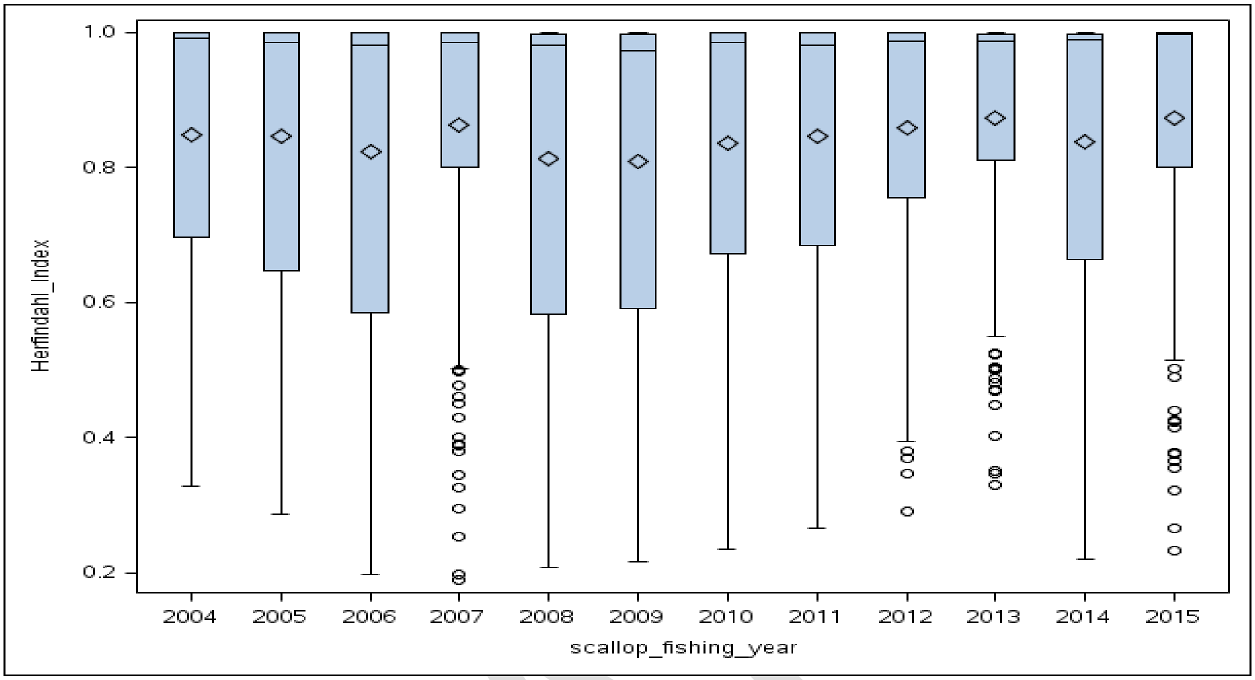
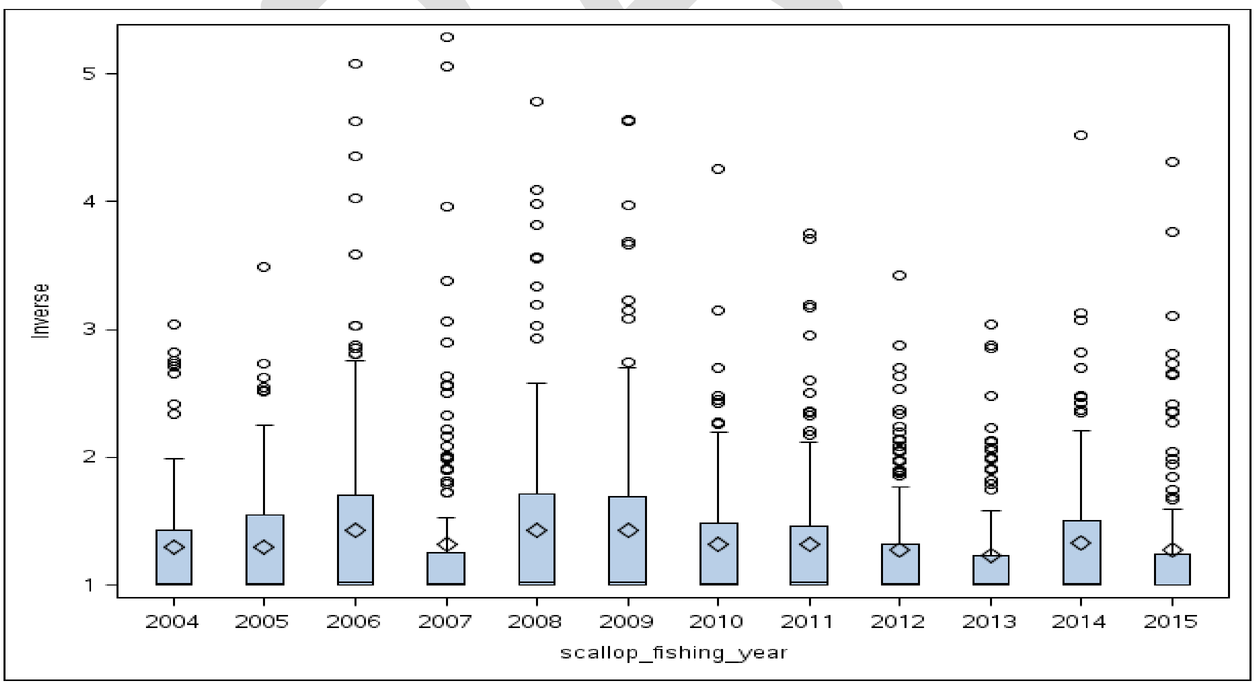


Figure 9: Inverse of the Herfindahl indices (Figure 3) by vessels holding an IFQ permit in at least one fishing year from 2010-2015, includes all active vessel/fishing year combinations in which scallops were top revenue earning species group



IFQ Revenue Trends

Table 2 gives the breakdown of scallop landings revenue relative to overall landings revenue. A few interesting trends stand out. First, the absolute number and percentage of vessels deriving 0% of their landings revenue from scallops sharply increase during the IFQ period vs. the six years prior. This could be an indication that a fair number of vessels that qualified for an IFQ permit leased out their entire quota. Second, there is a decline in vessels collecting less than half of their landings revenue from scallops during the IFQ period. It may be that vessels that were not among the most reliant on scallops prior to IFQs were the ones that started leasing out their quota when the IFQ fishery started. Third, the percentage of vessels receiving over half of their revenue from scallops increased during the IFQ period. As a counter to vessels less reliant on scallops, these vessels may have been the ones that were more likely to lease in quota. The increased price for scallops in more recent fishing years also would result in some vessels being more reliant on scallops.

Table 19: Reliance on revenue from scallops among vessels holding an IFQ permit in at least one fishing year from 2010-2015

% Revenue from scallops	**Fishing Years**	
	2004-2009	2010-2015
0%	25 (8%)	60 (20%)
0% - <25%	88 (28%)	62 (21%)
25% - <50%	40 (13%)	18 (6%)
50% - <75%	32 (10%)	39 (13%)
75% - <100	113 (36%)	107 (36%)
Total	*315*	*297*

Table 20: Percentage of revenue generated by species group among non-qualifying vessels (N=180) during qualification (3/1/2000 to 11/1/2004) and IFQ periods (3/1/2010 to 2/29/2016)

Species Group	Percentage of revenue generated by non-qualifiers during qualification period	Percentage of revenue generated by non-qualifiers during IFQ period
Sea Scallop	0.1%	1.2%
American Lobster	1.9%	4.9%
Groundfish	33.8%	23.7%
Monkfish	7.1%	4.5%
Scup/Fluke/Black Sea Bass	7.5%	13.5%
Squid	14.3%	17.8%
Surf Clam/Ocean Quahog	20.5%	15.8%
Whiting	6.9%	7.4%
Other	7.9%	11.3%
Total	*100.0%*	*100.0%*

Non-qualifiers under hypothetical landing requirements

The potential effect that a more liberal poundage qualification might have had on the number of non-qualifiers was evaluated by selecting the "best" year among the 180 non-qualifiers. The resulting distribution of non-qualifiers' best years is illustrated in Figure 1. The distribution illustrates that many of the 180 non-qualifiers still would not have been eligible for an IFQ permit if the landings criteria was lowered. For example, if the criteria were 500 lbs., there would have been 139 non-qualifiers (41 fewer). The species breakdown of these 41 vessels that came closest to qualifying is shown in Table 4. In comparison to Table 3, the percentage of revenue that came from sea scallops during the qualification period is slightly higher; though still less than 1%. Somewhat surprisingly, the percentage of revenue from sea scallops during the IFQ period was lower among these 41 vessels than the entire group of non-qualifiers. This sub-group of vessels also was heavily reliant on groundfish during the qualification period, collecting 52.5% of total revenue from this species group. During the IFQ period, this percentage dropped to 33.4%.

Figure 10: Number of General Category vessels that would fail to qualify for an IFQ permit under hypothetical landings criteria during qualification period

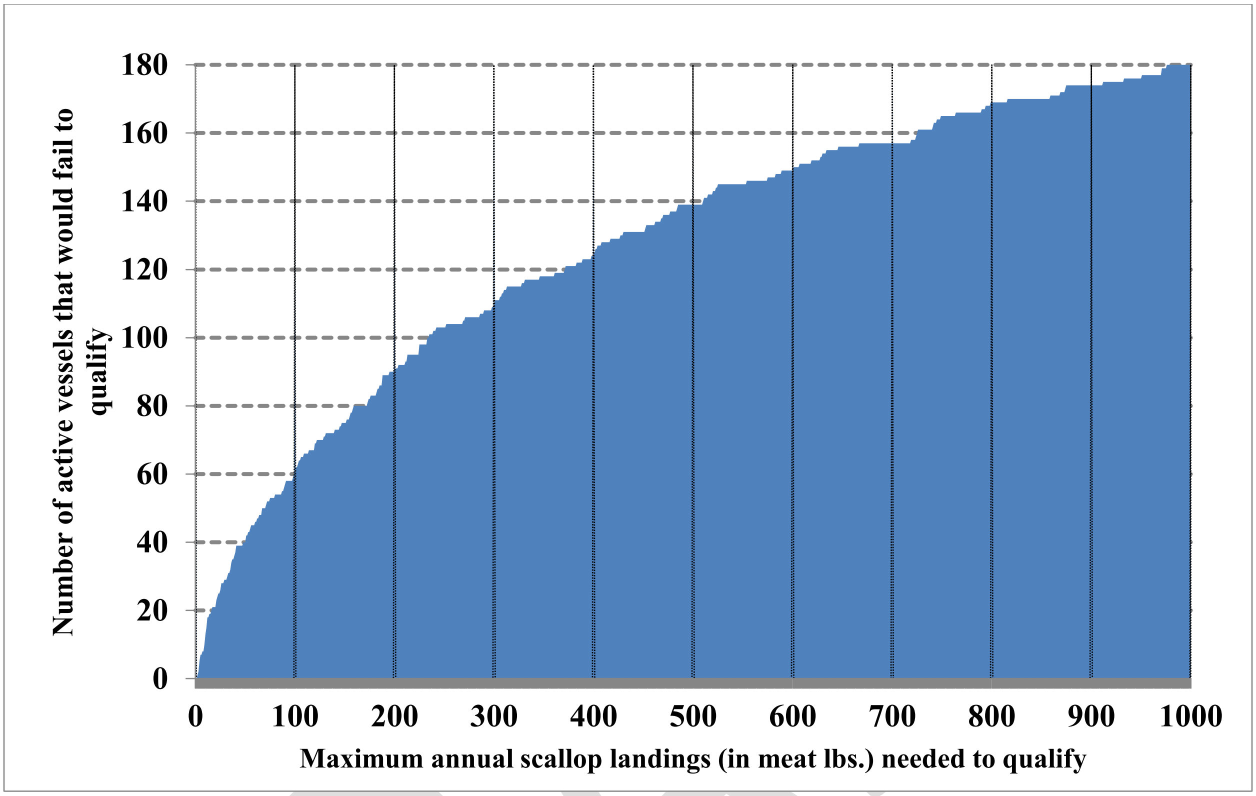


Table 21: Percentage of revenue generated by species group among non-qualifying vessels that would have qualified under a 500 lb. landing criteria (N=41) during qualification (3/1/2000 to 11/1/2004) and IFQ periods (3/1/2010 to 2/29/2016)

Species Group	Percentage of revenue generated by select non-qualifiers during qualification period	Percentage of revenue generated by select non-qualifiers during IFQ period
Sea Scallop	0.3%	0.4%
American Lobster	2.7%	6.3%
Groundfish	52.5%	33.4%

Monkfish	8.9%	5.5%
Scup/Fluke/Black Sea Bass	5.0%	11.2%
Squid	10.2%	9.2%
Surf Clam/Ocean Quahog	5.6%	10.4%
Whiting	7.2%	13.5%
Other	7.6%	10.1%
Total	*100.0%*	*100.0%*

APPENDIX H – GEOGRAPHICAL DIVERSITY

Dr. Min Yang Lee, Northeast Fishery Science Center, SSB

Important Findings

- Since 2010, the IFQ fishery landed in ports that are less similar to the all ports, but there is not particular trend in the IFQ fishery in relation to the LA fishery.
- The LAGC-IFQ fleet is using areas of the ocean that are similar to areas of the ocean used by the entire fishery.
- The overlap between the LAGC-IFQ and LA fleets decreased for 2 years, indicating the two fleets were using different areas of the ocean. However, from 2012-2015, the overlap indices have been increasing, indicating that the fleets have been using increasingly similar areas of the ocean.

1. Introduction and Motivation

The location, dispersion, and concentration of economic activity are frequently studied phenomena in regional science and economics[8]. This section describes the geography of the LAGC-IFQ scallop fishery using three methods. The first method characterizes the concentration of the IFQ scallop fishery across ports using relative and absolute indexes. The second uses similar techniques to characterize the concentration of the IFQ scallop fishery across the ocean, also using relative and absolute indices. The final method examines the amount of overlap between the IFQ and Limited Access fisheries.

2. Methods

We use a Generalized Theil index of disproportionality (Bickenbach and Bode, 2008) to characterize various geographic trends (dispersion and concentration) in the LAGC-IFQ scallop fishery. We also construct the Czekanowski (1909) overlap index applied to fishing locations for the LAGC-IFQ and LA fisheries. Where relevant, we also compute index values for the GC fleet to illustrate changes over time. The general form of the Theil index of concentration (*T*) for industry *i* in time period *t* is written as:

$$T_{it} = \sum_{r=1}^{R} w_{rt} \frac{\frac{X_{irt}}{\Pi_{irt}}}{\sum_r w_{rt} \frac{X_{irt}}{\Pi_{irt}}} \ln \left(\frac{\frac{X_{irt}}{\Pi_{irt}}}{\sum_r w_{rt} \frac{X_{irt}}{\Pi_{irt}}} \right) \qquad (1)$$

where X_{ir} is the measure of economic activity of industry *i* in region *r* and time *t* . For all analysis, X_{ir} is nominal dollars of value in the LAGC-IFQ scallop fishery in region *r* and Fishing Year *t*. Π_{irt} is a reference distribution of activity that formalizes the null hypothesis of "no concentration" for industry *i*. The regional weights, w_{rt}, reflect the importance of each spatial unit and are selected so that $\sum_r w_{rt} = 1$. For all metrics, the regional weights, w_{rt}, are set to X_{ir};

[8] See Holmes and Stevens (2004), Combes and Overman (2004), and Fujita et al. (2004) for an overviews of concentration and specialization in North America, Europe, and East Asia respectively.

this weighting system maintains that each dollar of value is equally important in the aggregation. The $\frac{X_{irt}}{\Pi_{irt}}$ term is referred to as a region-specific proportionality factor (RSPF).

The VTR data are used as the source for commercial landings (pounds) and port. For many earlier years in the VTR database, smaller, less-frequented ports were aggregated at the data entry step. We have corrected these aggregation problems by examining original images. The dealer data are used to construct the prices needed to compute value. We classify landings and value as either in or out of the IFQ fishery. We use the permit data to determine category (or categories) of scallop permit held by a vessel on the landing date. Trips taken by vessels holding a single category of permit are easily classified. Trips taken by vessels holding both LA and LAGC-IFQ scallop permit categories are classified into or out of the IFQ fishery based on reported landings. The scallop IFQ fishery allows for increased possession when an observer is onboard, therefore, we apply a weight cutoff of 700lbs before August 1, 2011 and 900 lbs after that date for these trips.

2.1 Dispersion and Concentration in landing ports

The spatial unit *i*, is the 2013 U.S. Census County Subdivision[9]. Aggregating to this spatial unit is likely to reduce or eliminate the effects of any remaining coding errors and combines nearby ports into a single unit. Most studies that examine relative disproportionality use a higher-level aggregate, such as sectoral or total employment, in region *r* as the reference (Brullhart and Traeger 2005; Cutrini 2010; Bickenbach et al. 2010). We follow this convention and use two references that implicitly benchmark the dispersion of the GC and LAGC-IFQ fisheries against two aggregates: the first is all fishing (R1), the second is all scallop fishing (RS). We also construct an absolute index that uses the uniform distribution ($\Pi_r = 1$) as the reference.

2.2 Dispersion and Concentration of Ocean Use (Fleet-wide).

The spatial units in this analysis are 0.5x0.5 km^2 grid cells. The basic data used in the previous section is supplemented with latitude and longitude from VTR. We used the method described in DePiper (2014) to convert these points into areas. We then aggregate to the fishing year to construct a map of fishing for the GC, LAGC-IFQ, and aggregate fishery. We use one reference, all scallop fishing (RS), to construct the relative dispersion index. We also construct an absolute index that uses the uniform distribution as the reference.

2.3 Overlap in ocean use between the IFQ fleet and the LA fleet

The spatial units in this analysis are 0.5x0.5 km^2 grid cells. We use the same data that is described in the previous section (mapped VTR data, aggregated to the GC, LAGC-IFQ, or aggregate fishery for each fishing year). For each spatial unit *r*, the share of fleet *i*'s activity in that cell is computed as:

$$s_{ir} = \frac{x_{ir}}{\sum_{r=1}^{N} x_{ir}} \qquad (2)$$

[9] The Census county subdivisions correspond roughly to a "town": they are minor civil divisions (MCDs) for states that have governmental or administrative units that are smaller than a county and Census County Divisions (CCDs) for states that do not.

The Czekanowski Overlap index[10] (1909) is then constructed as:

$$Cz(i,j) = \sum_{r=1}^{N} \min(s_{ir}, s_{jr}) \quad (3)$$

3. Results

3.2 Dispersion and Concentration of Ocean Use

The Relative Theil Index benchmarks the GC and LAGC-IFQ fleets against the entire scallop fishery. The Relative index indicates a relatively stable pattern of similarity of ocean use between the fleets through the time series. This indicates that GC and later LAGC-IFQ fleet is using areas of the ocean that are similar to areas of the ocean used by the entire fishery.

The Absolute Theil Index illustrates a general decrease from 2000 through 2008, indicating that the GC fleet was becoming more diffuse or spread out in the ocean. There was a increase in this index from 2008 through 2011, followed by a moderate decrease from this peak from 2012-2015.

3.3 Overlap in ocean use between the IFQ fleet and the LA fleet

The Czekanowski overlap index illustrates general increases in overlap of ocean use between the GC and LA fleets from 2000-2008. The pattern is not monotone; there are decreases in overlap in 2002, 2005-2006, and 2009. After 2010, the overlap between the LAGC-IFQ and LA fleets decreased for 2 years, indicating the two fleets were using different areas of the ocean. However, from 2012-2015, the overlap indices have been increasing, indicating that the fleets have been using increasingly similar areas of the ocean. We suspect that recent changes in this index are driven by changes in resource condition in "inshore" areas (that can be profitably used by the LAGC-IFQ fleet) and use of access areas.

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[10] See also Bray and Curtis (1957) and Finger and Kreinin (1979)

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Figure 3.1 The R1 (Relative to All fishing), RS (Relative to All Scallop fishing) and Absolute Theil Indices of Geographic Disproportionality for the General Category (GC) and LAGC-IFQ fisheries calculated across ports.

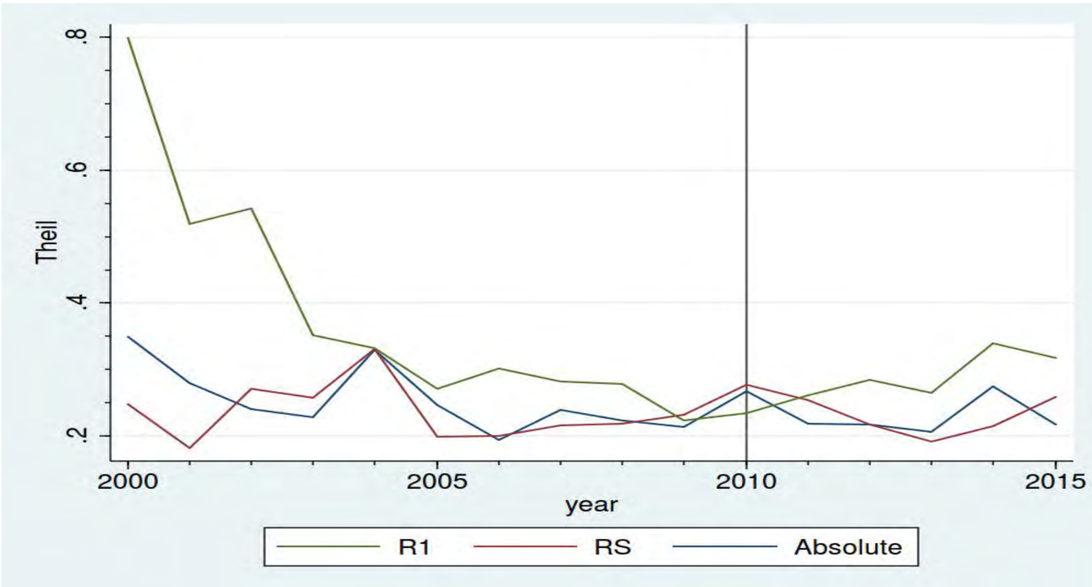


Figure 3.2 The RS (Relative to All Scallop fishing) and Absolute Theil Indices of Geographic Disproportionality for the General Category (GC) and LAGC-IFQ fisheries calculated across fishing locations.

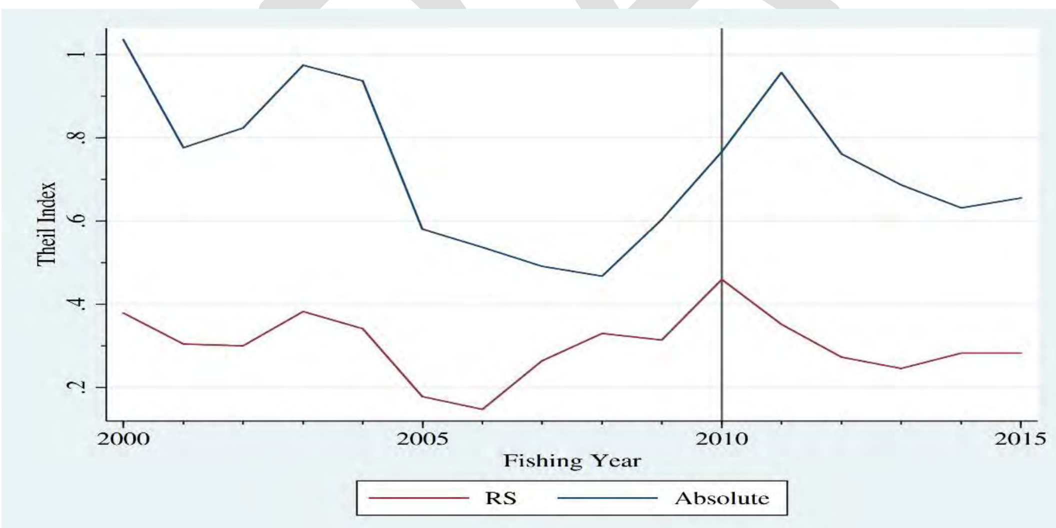
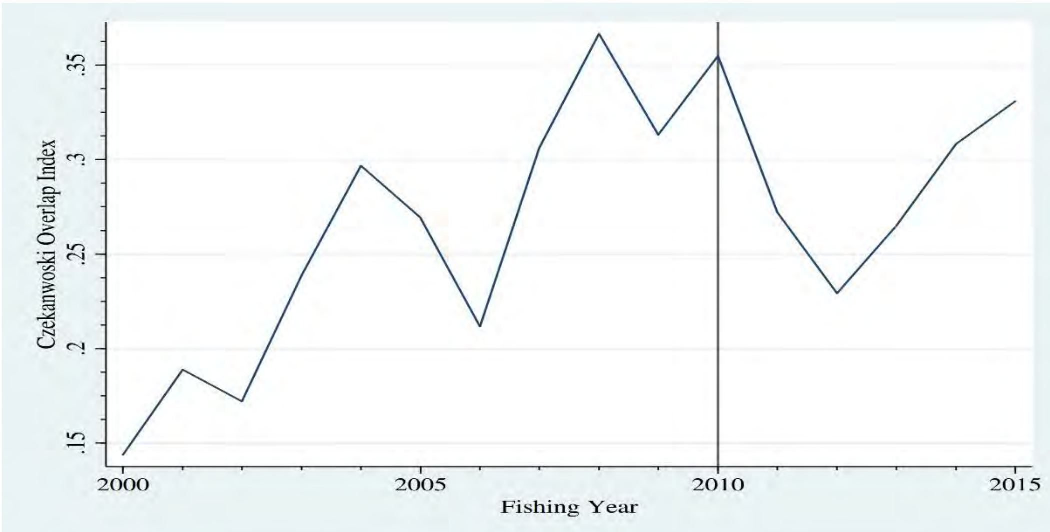


Figure 3.3 The Czekanowski Overlap Index between the LAGC-IFQ fleet and the LA fishery. Overlap between the GC and LA fishery prior to 2010 is also presented.



APPENDIX I – CREW SURVEY COMPONENT OF THE LAGC IFQ REVIEW

Dr. Matt Cutler, Northeast Fishery Science Center, SSB

Executive Summary

The Crew Survey component of the LAGC IFQ review utilizes the Survey on the Socio-Economic Aspects of Commercial Fishing Crew in New England and Mid-Atlantic conducted by the NEFSC Social Sciences Branch (SSB) from 2012 to 2013. Due to small sample sizes, this report utilizes a two-group t test approach to compare mean responses of crew members working on IFQ vessels versus those on non-IFQ vessels. This report also analyses differences in means between IFQ, non-IFQ, and crew members who worked on vessels that fished primarily for multispecies (groundfish) and lobster. Several subject areas were covered by the survey items analyzed. These included views about the management process, the fishery management plan, fishing area access, rules and regulations, environmental stewardship attitudes and behaviors, and finally job satisfaction and overall health and wellbeing. The main findings from this report are summarized by the bulleted statements below. These findings focus specifically on differences between crew members on IFQ vessels and crew on non-IFQ vessels. Please refer back to the main report for a description of the differences between these two groups and crew members on vessels fishing primarily for groundfish and lobster.

- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that they did not trust managing authorities to make the right decisions when it came to regulating fisheries.
- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that their captains were able to fish where he wanted to.
- Crew members of IFQ vessels were more likely than those on non-IFQ vessels to report that overall levels of bycatch and discards were high in their primary fisheries. IFQ vessel crew members were also more likely than non-IFQ crew to report that regulations had increased levels of bycatch and discards in their primary fishery.
- There were no significant differences between IFQ and non-IFQ crew members on any of the items assessing job satisfaction or overall health and wellbeing. Both groups of crew members generally expressed satisfaction with their earnings, time away from home, and the adventure of the job. Both groups also generally expressed that they felt connected to other fishermen and that they were proud to be fishermen.

1. Introduction and research methodology

This report provides an assessment of the social aspects of performance of the limited access general category (LAGC) individual fishing quota (IFQ) fishery for the five years following the program's implementation in fishing year 2010. Specifically, this section of the report analyzes survey data of commercial fishing crew members sampled from the population throughout ports in New England and the Mid-Atlantic regions. Data came from the Survey on the Socio-Economic Aspects of Commercial Fishing Crew in New England and Mid-Atlantic (hereafter referred to as the Crew Survey) conducted by the Social Sciences Branch (SSB) of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Northeast Fisheries Science Center (NEFSC). This survey was in part intended to gather information about both the socio-demographic characteristics of crew members and their perceptions of and attitudes towards the management of their primary fisheries. This approach is unique because few studies have systematically investigated attitudes and perceptions of commercial fishing crew. This is especially true within the context of evaluating the performance of specific fisheries management programs and IFQ programs in particular.

Past survey efforts in the New England region have considered the behavioral changes of fishermen in response to imposed limitations on fishing effort. After a trap limit was imposed on the Maine lobster fishery, Acheson and colleagues (2001) conducted a survey of approximately half of the lobster license holders in the state of Maine in order to investigate the potential correlates of behavior in the aftermath of the new set of rules regarding the number of traps to be used. They found a variety of factors in play in determining fishermen's decisions to either increase or decrease the amount of traps used, leading Acheson to conclude that, "one of the most important problems facing fisheries management is determining under what circumstances fishermen will generate rules to conserve fisheries," (Acheson 2001). In 2011, Acheson and Gardner also conducted a follow-up survey in order to investigate the potential reasons for the relative failures of the groundfish management regime. Regarding the views of fishermen towards the goals of regulations and the science underlying the management regime, the authors found that, "[f]rom the fishermen's perspective, the goal of management should be to protect fish in vulnerable parts of their life cycle, (i.e., to protect small fish, gravid fish, and essential spawning and nursery grounds) by enacting mesh size regulations, closures, or both," that "fishermen do not believe that scientists know how many fish there are," and that fishermen "distrust the methods scientists use to collect fish population data," (Acheson and Gardner 2011). These are important insights from the industry regarding specific beliefs about what management should focus on and how well managers and fisheries scientists communicate their work and reasoning for choosing their methodologies. This all underscores the need for further survey research to this end and this research is in part an attempt to add depth to our understanding of the attitudes and beliefs that may also impact the relative successes or failures of the scallop IFQ program in particular.

In addition to particular management actions, prior survey efforts have assessed social capital and general attitudes towards management among commercial fishermen in the Northeast. Holland and colleagues conducted a survey of Northeast Multispecies (groundfish) permit holders to "develop a baseline of social capital in the groundfish fishery and to document attitudes toward the current management system based on days at sea and the new system based on sector allocations," (Holland et al 2010). While social capital was not the focus of the present study, their results regarding the views of groundfish permit holders about management provide a useful reference point for comparison. They found general dissatisfaction among groundfish permit holders with their fishery and the management system governing it, as well as mistrust in the science underlying the decisions made by those in management (Holland et al 2010). Other attempts to collect survey data of commercial fishermen looked at resilience in the face of changing management. In a 2007 survey of commercial fishermen in Northern Australia, Marshall and Marshall found that those who actively developed new fishing methods or had the business management skills requisite to adaptation were more likely to score highly on their measure of resilience to policy changes (Marshall and Marshall 2007). These results are suggestive of a potentially fruitful aspect worthy of investigation within the LAGC scallop IFQ fishery in the Northeast. The IFQ management system may have impacted the ability of scallop fishermen to adapt to changes in the fishery or other aspects of its management. While a number of indicators of performance are included in this overall report, there is room for further investigation into whether and the extent to which scallop fishermen taking part in the IFQ program have felt able to adapt and manage their businesses or employment circumstances as the fishery changes. This component of the review was not able to assess resiliency, per se, but some of the findings discussed in the following sections are noteworthy for a variety of other important reasons related to the impact and performance of the IFQ program since its inception several years ago. Moreover, this component of the review establishes a baseline of survey findings, which can not only inform managers and stakeholders, but also future survey research efforts aimed at assessing views and attitudes among both scallop fishermen and those in other fisheries as well.

1.2 Methods

1.2.1 *Sample*

The Crew Survey began in the fall of 2012 and lasted approximately one year. Given the lack of a registry or population database to draw a crew sample from, the Crew Survey was conducted mainly through in-person interviews using an intercept method at the docks of sampled ports. Ports from Maine to North Carolina were randomly sampled based on a stratified sampling design that took into consideration seasonally-based fishing activity and geographic diversity in the region's fisheries (Henry and Olson 2014). A sample size of 1,330 was calculated from an estimated crew population of 30,000[11]. Crew members were interviewed using an intercept method with interviewers approaching crew on the docks and entering survey responses into Nook tablet computers. The final number of completed surveys was 359, with 42 incompletes and 654 refusals (Henry and Olson 2014). A variety of factors contributed to the difficulty SSB had in obtaining a higher response rate, including scheduling problems related to the arrival and departure times being at odd/random hours and outright refusals to participate. The ports with the largest number of respondents were (in descending order) New Bedford, MA (n = 58), Gloucester, MA (n = 48), Cape May, Newport News, VA (n = 29), NJ (n = 27), Point Judith, RI (n = 27), Chatham, MA (n = 17), Rockland, ME (n = 14), Portland, ME (n = 14), Montauk, NY (n = 14), and Wanchese, NC (n = 14), and Portsmouth, NH (n = 11).

1.2.2 *Dependent Variables*

The dependent variables utilized in this research were originally conceived as indicators of five primary components of performance—financial viability, distributional outcomes, stewardship, governance, and well-being (Henry and Olson 2014). The survey items which comprised each of these measures were presented to respondents as statements about personal experiences and beliefs fishermen may have had regarding the process of fisheries management, regulations and rules, job satisfaction, and beliefs about the environment. Respondents were asked to respond to each statement by selecting one of five categories on a Likert-type scale ranging from "strongly disagree" to "strongly agree." Items related to governance included views about the fairness and inclusivity of the management process to fishermen ("Management Process"), the efficacy of the fisheries management plan for respondents' primary fisheries ("Fisheries Management Plan"), and the effect of regulations on fishing practices ("Rules and Regulations"). Items related to well-being included questions about satisfaction with earnings, time away from home, and whether or not respondents' would advise youth to enter the fishing industry in any capacity ("Satisfaction and Well-being"). Finally, items comprising the environmental stewardship measure included views about fishermen's responsibility to participate in management, effort to not harm the

[11] The crew population size was estimated based on SSB work with IMPLAN (Minnesota IMPLAN Group, 2008 IMPLAN System (data and software), 1725 Tower West Suite 140, Stillwater, MN 55082 www.implan.com). Information used to estimate this number came from fishing employment data from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages and the Bureau of Economic Analysis' Regional Economic Information System data which includes self-employment.

fishery, whether overfishing is possible, and the importance of the environment to respondents ("Environmental Stewardship"). Descriptions of these items are displayed throughout Tables 1-5.

1.2.3 *Analytical Strategy*

There has been a dearth of survey research looking at both the direct and multiplicative effects of demographic and fishery-related characteristics of individual fishermen on their attitudes and perceptions about management regimes. Additionally, few studies to date have utilized the measures of social and economic performance developed by Clay and colleagues (2014) in a systematic, quantitative method to assess the views of commercial fishermen about the fisheries management process. This is especially timely and useful given the growing need to develop long-term data collection efforts in the social sciences directed at fisheries and their participants (Henry and Olson 2014). The present study intends to address these gaps in the extant literature by contributing a unique quantitative analysis of recent survey data on commercial fishing crew members.

Statistical analyses were aimed at exploring potential differences in views about management between IFQ scallop program participants and non-participant scallop fishers among respondents to the Crew Survey, as well as those in other fisheries. This involved a series of two-sample *t* tests comparing means of IFQ scallop crew to non-IFQ scallop crew (hereafter referred to as IFQ crew and non-IFQ crew), groundfish crew, and lobster crew on responses to the dependent variables. Groundfish and lobster crew were utilized as comparison groups because they were the second- and third-largest sub-populations of primary fisheries represented in the sample. This approach was preferred due to the extremely limited response rates to many of the chosen dependent variables in this study. Sub-sample sizes on each outcome variable of interest were simply not large enough to provide for a robust and reliable multivariate analysis involving other independent predictors and controls. Future research efforts will need to utilize larger samples of crew members in order to tease out the possibility of spurious, confounding, mediating, moderating, or any other "third-variable" effects which may emerge from the inclusion of the socio-demographic or –cultural characteristics of individual crew members.

2. Results

2.1 *Management Process*

The majority of scallop-fishing respondents either agreed or strongly agreed that fishermen have a responsibility to participate in the management process. This sentiment was shared with no significant differences in means across all major fisheries represented in the sample and by both IFQ and non-IFQ crew. Just over half of scallop fishers either agreed or strongly agreed that people in charge of the management process were not fair. IFQ and non-IFQ crew did not report significantly different views on fairness of management (Table 2), but both reported significantly less often than groundfish crew that management was unfair (Appendix A). The majority (77%) of scallop fishers either disagreed or strongly disagreed with the notion that they felt integrated into the management process. The difference in means of IFQ and non-IFQ crew was not significant, but both groups were significantly less likely to feel integrated into the management process than lobster boat crew members (Appendix A). Finally, majorities across all fisheries and both IFQ and non-IFQ participants expressed disagreement with the notion that managers were serious about involving fishermen in the process.

A slight majority (55%) of all scallop fishing respondents expressed either agreement or strong agreement towards the statement that they did not trust management, but a substantial portion (32%) also remained neutral to the question of distrust of management. IFQ scallop crew significantly differed from non-IFQ crew on this item. According to the results from the two-sample *t* test, crew respondents in the IFQ scallop fishery were significantly more likely to express agreement that they did not trust management than their non-IFQ counterparts (Table 2). This difference is depicted graphically in Figure 1. Non-IFQ scallop crew members also expressed significantly less distrust of management than their groundfish crew counterparts (Appendix A).

There were no significant differences in mean responses between IFQ, non-IFQ, and crew members in the groundfish or lobster fisheries on a host of items related to the management process. Generally across all fisheries, respondents most often felt that they did not believe the information presented, that they had no opportunity to correct inaccurate information, that they did not have the opportunity to add new information to the process, and that opinions of fishermen were not taken seriously by managing authorities. On the other hand, views were more varied regarding the ability of fishermen to appeal unfair decisions by management. Roughly 46% and 47% of scallop and other fishers, respectively, disagreed that they had the right to appeal, whereas about 54% and 53% of scallop and others, respectively, were neutral, agreed, or strongly agreed with this notion.

2.2 *Fishery Management Plan*

Scallop fishers overall were fairly split on the issue of whether the goals of their FMP were being met. Approximately 47% of scallop crew either agreed or strongly agreed that their FMP was meeting its goals, as compared to roughly 37% who either disagreed or strongly disagreed. There was no significant difference between IFQ and non-IFQ scallop program participants. IFQ participants did differ significantly from groundfish crew, however, such that IFQ crew expressed slightly more agreement with the notion that their FMP's goals were being met than crew members in the groundfish fishery (Appendix B). Interestingly, those in the non-IFQ scallop fisheries did not differ from groundfish crew on this item.

Slightly more than half of all scallop-fishing respondents either agreed or strongly agreed that their FMP helped to protect the number of fish. While IFQ and non-IFQ scallop crew did not differ significantly, both groups did differ from groundfish crew on this matter. Mean responses for both IFQ and non-IFQ scallop crew were significantly higher than groundfish crew, suggesting that members of scallop fisheries were generally more likely than those in the groundfish fishery to believe their FMPs had helped to protect fish (Appendix B). Finally among the items assessing views about the FMP specifically, there were no significant differences by fishery or scallop permit types with respect to agreement with the notion that management can change quickly as conditions of the fishery change. Generally speaking, slightly under half of all crew either agreed or strongly agreed that management can change quickly in reaction to the changing conditions of the fishery.

2.3 *Fishing area access*

In general, about 65% of scallop crew members either disagreed or strongly disagreed that they were able to fish where they wanted to. Some of this effect was driven by non-IFQ scallop crew members as demonstrated by the two sample *t* test comparing means of IFQ and non-IFQ crew members. As presented in Table 7, the mean response of IFQ scallop crew was significantly higher than non-IFQ scallop crew. This effect is depicted graphically in Figure 2. While they differed from each other, both IFQ and non-IFQ scallop crew members were significantly much less likely to agree that they could fish where they wanted to than members of crew in the lobster fishery (Appendix B). Similar to views about being able to fish where they wanted, scallop fishers also generally disagreed (78%) with the notion that they were able to fish when they wanted to. Feelings of not being able to fish when desired held across IFQ and non-IFQ participants. Again, both IFQ and non-IFQ scallop crew differed significantly from lobster crew on this issue, such that they were less likely than lobster crew to agree that they could fish when they wanted (Appendix B). Finally, scallop crew members were generally divided on the issue of whether management should allow new fishermen into their fisheries. About 43% of all scallop fishers either disagreed or strongly disagreed with the notion that management should maximize the number of fishermen, whereas about 38% either agreed or strongly agreed with this sentiment. IFQ and non-IFQ scallop crew members did not differ significantly in their responses to this item.

With respect to broader access to fishing areas, respondents in the scallop fishery generally reported less agreement with the notion that fishing areas should be off-limits to users other than fishermen. Approximately 73% of scallop crew either disagreed or strongly disagreed that fishing areas should be off-limits to other users. IFQ and non-IFQ scallop crew did not differ significantly in their relative mean responses to this item, but both groups differed significantly from members of the groundfish and lobster fisheries. In each of the two-sample *t* tests, the mean responses of IFQ and non-IFQ scallop crew were significantly lower than both lobster and groundfish crew, meaning that, regardless of IFQ status, scallop crew were less likely to agree that fishing areas should be off-limits to other users than crew in the lobster and groundfish fisheries (Appendix B).

2.4 *Rules and Regulations*

A variety of interesting findings emerged from the analyses of items related to compliance with rules and regulations. In terms of how easy it has been finding information about rules and regulations, those in the scallop fishery did not differ much from those in other fisheries in how they viewed the ease with which they could find information. Most respondents across all fisheries either agreed or strongly agreed that it was easy to find information. On the other hand, about 65% of scallop fishers agreed that the rules governing their primary fishery have been easy to comply with, whereas only about 48% of those in all other fisheries reported the same. While the mean responses of IFQ and non-IFQ scallop crew did not differ significantly, there was a difference in how the two groups of scallop crew compared to the means of groundfish crew. IFQ scallop crew were significantly more likely than groundfish crew to agree that the rules had been easy to comply with, whereas non-IFQ scallop crew did not differ significantly from groundfish crew on this issue (Appendix C).

While scallop fishers generally felt the rules were easy to comply with, they more often reported that the rules and regulations of their primary fishery were too restrictive. Approximately, 76% of scallop crew members either agreed or strongly agreed that the rules of their primary fishery were too restrictive. IFQ and non-IFQ scallop fishers did not differ significantly in their respective views about the restrictiveness of the rules and regulations, but the IFQ program participants did express significantly different views from those in the lobster fishery. IFQ scallop crew members were more likely than lobster crew to view the rules and regulations as restrictive, whereas non-IFQ scallop crew did not differ significantly from lobster crew on this issue (Appendix C). The restrictiveness of rules and regulations appears to have been more salient to those participating in the IFQ program than to those in other major fisheries.

There were a few interesting differences by fishery on survey items related to the fairness of primary fishery rules and regulations. Just under half (47%) of respondents representing all fisheries reported that they agreed or strongly agreed that the regulations in their primary fisheries were unfair. Non-IFQ scallop crew members were slightly less likely than groundfish crew to agree that their regulations were unfair (Appendix C). With respect to the fairness of fines, roughly half of both scallop (54%) and those in other fisheries (49%) either disagreed or strongly disagreed with the notion that the fines were fair in their primary fisheries. Views about the fairness of fines did not differ significantly between IFQ and non-IFQ participants.

In addition to issues related to compliance and fairness, respondents were asked to assess the effect that regulations had on levels of bycatch, discarding, and highgrading in their primary fisheries. While the majorities of respondents reported that the effect of regulations produced no significant change in these levels, there were significant differences among IFQ and non-IFQ crew and fishery in terms of respondents' likelihood of reporting that bycatch levels had either decreased or increased. The mean responses of IFQ and non-IFQ scallop crew differed significantly such that IFQ crew more often reported that regulations had increased levels of bycatch (Table 8). This difference is depicted graphically in Figure 3. In similar fashion, IFQ scallop crew expressed significantly different views from their non-IFQ counterparts about the effect of regulations on levels of discards. IFQ scallop crew members were significantly more likely than non-IFQ crew to report that regulations had increased levels of discards (Table 8). This effect is shown in Figure 4. With respect to comparisons to other fisheries, non-IFQ scallop crew were significantly more likely to report that regulations had decreased levels of discards than crew-member respondents in the lobster fishery, while IFQ scallop crew were significantly less likely than groundfish crew members to report that regulations had decreased levels of discards.(Appendix C). Finally, in contrast to views about the effect of regulations on discards and bycatch, the vast majorities of respondents across all fisheries reported that regulations did not change levels of highgrading in their primary fisheries and no significant differences emerged by fishery in the bivariate analyses.

2.5 *Environmental Stewardship*

A number of interesting findings emerged through the analysis of survey items focused on assessing respondents' attitudes about environmental stewardship. Overwhelming majorities across all fisheries either agreed or strongly agreed that they made an effort to not harm their fisheries. There were no significant differences according to comparison of means tests between members of different fisheries or scallop IFQ and non-IFQ programs. Similar to self-reported efforts to not harm fisheries, respondents across all fisheries generally disagreed with the notion that the ocean is too large to overfish, although the majorities in this instance were not quite as large. There were no significant differences in mean responses by fishery or scallop IFQ and non-IFQ program crew in bivariate analyses. Finally among items related to environmental attitudes, respondents were asked whether they agree that the environment was important to them within the context that it was how they made their living. The overwhelming majority of respondents across all fisheries either agreed or strongly agreed that the environment was important to them because it was how they made their living. Much like the previous two items, the mean responses were not significantly different by fishery or scallop IFQ or non-IFQ program.

In addition to assessing attitudes about environmental stewardship, the Crew Survey also featured items which focused on some of the common fishing practices relating to stewardship, namely bycatch, discarding, and highgrading. Unlike the attitudinal items, however, these were not assessed on a five-point, likert-type "agreement" scale. Instead, respondents were asked whether overall levels of bycatch, discards, and highgrading were “low,” “medium,” or “high” in their primary fisheries. Majorities of respondents reported that levels were low for all three of these practices in their primary fisheries, but there were a number of interesting differences by fishery and scallop program. First, as presented in Table 9, IFQ scallop crew members reported higher levels of both bycatch and discards than those in non-IFQ scallop fisheries. IFQ scallop crew members also expressed higher levels of each than members of the lobster fishery (Appendix D). Interestingly, while IFQ scallop crew did not differ significantly from those in the groundfish fishery, non-IFQ scallop crew differed significantly such that they were reported lower levels of bycatch and discards than groundfish crew (Appendix D). Finally among these items, respondents’ views about highgrading were virtually identical across all fisheries. Roughly 81% of scallop fishers and 79% of those fishing in all other fisheries reported low levels of highgrading in their primary fisheries. No significant differences emerged when comparing mean responses of those fishing on scallop IFQ or non-IFQ vessels or between scallop fishers and members of other fisheries either.

2.6 *Satisfaction and well-being*

Sharp differences emerged in the comparison of satisfaction with earnings between scallop fishers and members of all other fisheries. About 72% of scallop fishing respondents were either somewhat or extremely satisfied with their earnings from fishing, whereas only 44% those in all other fisheries represented felt the same way. Means tests provided greater clarity about the differences in satisfaction with earnings between members of specific fisheries. While IFQ and non-IFQ scallop crew members did not differ significantly in their relative satisfaction with their earning, both groups were significantly more likely to feel satisfied than those in the groundfish fishery (Appendix E). Similarly to satisfaction with earnings, respondents in the scallop fishery much more often reported satisfaction with their time away from home while fishing than those in all other fisheries represented in the sample. Both IFQ and non-IFQ scallop crew were more likely than groundfish crew respondents to be satisfied with their time away (Appendix E). Finally among items assessing respondents’ satisfaction with aspects of fishing as a job, individuals across all fisheries generally felt satisfied with the adventure of the job. No differences emerged from means comparisons by IFQ/non-IFQ scallop participants.

Several other items were assessed in addition to measures of satisfaction in order to explore the various aspects of respondents’ well-being as crew members. Among these were whether respondents; 1) would advise the young to enter commercial fishing; 2) felt like fishing was just a job to them; 3) considered fishing part-time; 4) considered leaving fishing altogether; 5) were proud to be commercial fishermen; 6) felt connected to other fishermen; 7) felt like leaders in their primary fisheries; and 8) felt like leaders in their local communities. With respect to encouraging younger generations, roughly 56% of scallop fishers said they would advise youth to enter fishing, compared with only about 38% of those in other fisheries. This difference was driven mostly by the disparities between groundfish crew and both IFQ and non-IFQ scallop crew groups (Appendix E). While the majorities of respondents in all fisheries either disagreed or strongly disagreed that fishing was just a job to them, *t* test results revealed that IFQ scallop crew were significantly less likely than lobster crew members to view fishing as just a job. Majorities of respondents also disagreed with the notion that they would want to fish part-time, but non-IFQ scallop crew reported significantly less often than both groundfish and lobster crew members that they would have wanted to fish part-time. Finally among the items assessing views about fishing as a career, respondents were generally split on whether they had considered leaving the fishing industry. Roughly 43% of all respondents agreed that they had considered leaving the industry, whereas about 47% disagreed with the notion that they had considered it. The comparison of means test revealed a significant difference in means between non-IFQ scallop crew and lobster crew members such that non-IFQ crew were significantly more likely to have considered leaving than lobster crew.

The final series of items relating to well-being were constructed to explore levels of social capital among respondents. Since they were also intended as indicators of well-being, several separate analyses of each item were conducted in order to investigate whether and how scallop fishing in general, and IFQ participation in particular, was associated with these questions of social connectedness, pride, and leadership in respondents' primary fisheries. The vast majority of all respondents agreed that they were proud to identify as fishermen. According to a comparison of means, however, non-IFQ scallop crew members were significantly more likely to have agreed with this notion than crew members in the lobster fishery (Appendix E). Similar to feelings of pride, respondents overwhelmingly agreed that they felt a connection to other fishermen, but multiple differences emerged from comparisons of mean responses between fisheries. Both IFQ and non-IFQ scallop crew members reported significantly higher mean responses than crew in the lobster fishery, while only IFQ crew significantly differed from groundfish crew.

In terms of self-reported leadership, slightly over half of respondents disagreed with the notion that they were a leader in their communities and there were no significant differences by fishery. On the other hand, respondents were much more evenly divided on the question of whether they felt like leaders in the primary fisheries. Roughly 41% disagreed, 25% were neutral, and 39% agreed with the notion that they were leaders in their primary fisheries. According to *t* test results, comparisons of IFQ scallop, non-IFQ scallop, groundfish, and lobster yielded interesting results. Both IFQ and non-IFQ crew were significantly more likely to self-report their own leadership in their primary fisheries than lobster crew, but only non-IFQ crew expressed a higher mean response than groundfish crew on this item (Appendix E).

3. Discussion

There have been relatively few scientific efforts to understand commercial fishing crew members' views about fisheries management regimes and policies through the vehicle of survey research. Fewer still have there been any targeted efforts to understand the impacts of IFQ permit programs on attitudes and beliefs of commercial fishermen, and vice versa, specifically in the Northeast and Mid-Atlantic regions. This research contributes to the extant literature by directly addressing the impacts of the LAGC scallop IFQ program five years after its implementation through the investigation of the attitudes, beliefs and other aspects of commercial fishing crew members' perspectives on management, environmental stewardship, and overall job satisfaction. A multitude of interesting findings emerged from the descriptive statistics and comparative bivariate analyses using primary fishery as the predictor variable. While this study did not have the sample size necessary for reliable and representative multivariate analyses, future survey research should consider gathering larger representative samples of commercial fishing vessel crew and owners in order to construct a more complete picture of the correlates and potential third-variable effects associated with the variety of salient socio-demographic characteristics of individuals among these populations.

In summation, scallop crew members on vessels participating in the IFQ program differed from those on non-IFQ vessels in a few interesting ways. First, IFQ scallop crew were more likely than non-IFQ crew to report that they did not trust managing authorities to make the right decisions when it comes to managing fisheries. Prior research using data from surveys of Northeast recreational anglers has shown general distrust of federal-level management and scientific assessments of commercial fisheries compared to relative trust in local or regional management regimes, suggesting that part of this effect could be due to a regionally-specific cultural bias against federal management of fisheries. However, the effect was not static across all fisheries and scallop IFQ and non-IFQ programs, lending evidence to the possibility that the IFQ program has fostered more distrust of management or alternatively participants in the IFQ program were predisposed to distrust of management based on prior experiences and were driven into the program for these reasons. Second, IFQ scallop crew members were significantly more likely than non-IFQ crew to report that they were able to fish where they wanted to. While both groups were not highly likely to report being able to fish where they want, participants in the IFQ program appear to have slightly more flexibility than participants in other scallop permit categories. This is interesting given the rotational closures of the scallop fishery in general and the requirement of the LAGC IFQ vessels to fish in specific exemption areas within the open access areas. Third, IFQ scallop crew members were significantly more likely than non-IFQ crew to report that regulations had increased both levels of bycatch and discards in their primary fisheries. This was echoed by the fourth and final difference between these permit categories that IFQ scallop crew members were also significantly more likely than non-IFQ crew to report higher levels of bycatch and discards overall in their primary fisheries.

Perhaps as interesting as the differences between IFQ and non-IFQ scallop crew were those items on which they did not differ while mutually differing from those in other fisheries. There were no significant differences in any of the indicators of well-being and job satisfaction by IFQ status among crew members surveyed. Both IFQ and non-IFQ crew members expressed relatively high satisfaction with their earnings, time away from home, and the adventure of the job. Both groups of crew were also generally highly likely to express that they felt connected to other fishermen and were proud to be fishermen. As compared to crew fishing primarily in other fisheries, both IFQ and non-IFQ scallop crew members were significantly more likely to feel satisfied with their earnings and time away from home than crew members in the groundfish fishery. Moreover, both IFQ and non-IFQ scallop crew were significantly more likely to say they would advise the young to enter into fishing as a career than crew members in the groundfish fishery.

With respect to the future of the management of the LAGC scallop IFQ program, a number of important takeaways emerged from these analyses. First, future approaches to managing this fishery should consider ways to build trust in managers and the management process among members of the IFQ fishery. As identified by prior research, fishermen have been distrustful of the methods used to make species assessments and, ultimately, the amount of catch to allocate to particular fisheries (Acheson and Gardner 2011). This is particularly important to catch share programs in which utilization rates are generally high and leasing quota is common because those actually fishing may be adversely impacted by reductions in quotas or constraining stocks due to changes in assessments. Engaging with fishermen about the methods used to conduct scientific assessments of stocks, as well as considering their feedback about such methods or potential alternative approaches, could help to foster increased trust in the management process among fishermen. Trust among recreational fishermen has also been shown to be important to the effectiveness of management policies, especially in the case of trust in federal management regimes (Gray et al 2012).

Another important issue to consider for the future of the LAGC scallop IFQ program is the possibility that the program contributes in some way to levels of discarding and bycatch. As mentioned above, IFQ scallop crew were more likely to report high levels of bycatch and discards than non-IFQ crew members and were also more likely to report that regulations had been responsible for increasing these levels of bycatch and discards. The first LAGC IFQ performance report, published in 2014, concluded that the "overall impact of this fishery on bycatch is relatively small," (NEFMC 2014). This contrast in views among crew members in the IFQ fishery and the finding of this previous performance report regarding bycatch suggests the need for further investigation of whether and the extent to which bycatch has increased and whether the current management system has had any impact on this phenomenon. Additionally, it will be useful in future surveys of crew or other stakeholders in the fishery to include questions about the specific causes of bycatch and discarding, among other aspects of the management system and its impact on fishing methods.

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Table 1: Descriptive Information for "Management Process" Dependent Variables

Survey Item	N	Range	Mean	Standard Deviation
Participate – *"Fishermen have a responsibility to participate in the fisheries management process."*	363	1 (Strongly Disagree) – 5 (Strongly Agree)	3.91	0.97
Unfair – *"The people in charge of the process were not equally fair to everyone involved"*	190	1 (Strongly Disagree) – 5 (Strongly Agree)	3.70	1.14
Believe – *"I did not believe the information the people in charge of the process presented."*	184	1 (Strongly Disagree) – 5 (Strongly Agree)	3.54	1.19
Correct – *"I had no opportunity to correct information that I thought was inaccurate."*	174	1 (Strongly Disagree) – 5 (Strongly Agree)	3.47	1.18
Appeal – *"I had the right to appeal decisions that were being made that I thought were unfair."*	169	1 (Strongly Disagree) – 5 (Strongly Agree)	2.71	1.27
Add Info – *"I had the opportunity to add new information that was relevant to the decision making process"*	179	1 (Strongly Disagree) – 5 (Strongly Agree)	2.54	1.11
Opinions – *"I felt like the opinions of commercial fishermen were not taken seriously."*	195	1 (Strongly Disagree) – 5 (Strongly Agree)	4.02	1.08
Integrate – *"Commercial fishermen have been effectively integrated into the management process."*	72	1 (Strongly Disagree) – 5 (Strongly Agree)	2.18	1.21

Serious – *"I feel like fisheries managers are serious about involving commercial fishermen in the process of fisheries management."*	71	1 (Strongly Disagree) – 5 (Strongly Agree)	2.29	1.20
Not Welcome – *"I do not feel welcome in public meetings about fisheries management."*	71	1 (Strongly Disagree) – 5 (Strongly Agree)	2.94	1.19
Don't Trust – *"I do not trust the managing authorities to make the right decisions when it comes to regulating fisheries."*	71	1 (Strongly Disagree) – 5 (Strongly Agree)	3.90	1.07

Table 2. Descriptive Information for "Fisheries Management Plan" Dependent Variables

Survey Item	N	Range	Mean	Standard Deviation
Goals – *"The goals of the management plan for my primary fishery are being met."*	148	1 (Strongly Disagree) – 5 (Strongly Agree)	3.00	1.16
Protects – *"The management plan for my primary fishery helps protect the number of fish."*	153	1 (Strongly Disagree) – 5 (Strongly Agree)	3.06	1.17

Where – *"In my primary fishery, I am able (Crew - My fishing captain is able) to fish where I want."*	165	1 (Strongly Disagree) – 5 (Strongly Agree)	2.72	1.28
When – *"In my primary fishery, I am able (Crew – My fishing captain is able) to fish when I want.*	163	1 (Strongly Disagree) – 5 (Strongly Agree)	2.51	1.22
Opportunity – *"Opportunities for existing fishermen should not be reduced by new fishermen entering the fishery."*	157	1 (Strongly Disagree) – 5 (Strongly Agree)	3.59	1.16
Maximize – *"Management should aim to maximize the possible number of fishermen."*	154	1 (Strongly Disagree) – 5 (Strongly Agree)	2.78	1.05
Offlimits – *"Fishing areas should belong to the fishermen who use them and should be off limits to other users (for example, fishermen from another fishery or wind farm activity)."*	162	1 (Strongly Disagree) – 5 (Strongly Agree)	2.83	1.16

Change – *"Management can change quickly when conditions (income, stock levels, safety) change."*	147	1 (Strongly Disagree) – 5 (Strongly Agree)	3.20	1.15

Table 3. Descriptive Information for "Rules and Regulations" Dependent Variables

Survey Item	N	Range	Mean	Standard Deviation
Comply – *"The rules and regulations were easy for me to comply with when I was fishing in 2012."*	163	1 (Strongly Disagree) – 5 (Strongly Agree)	2.99	1.19
Restrict – *"Regulations in my primary fishery in 2012 were too restrictive."*	163	1 (Strongly Disagree) – 5 (Strongly Agree)	3.75	1.14
Fines – *"The fines associated with breaking the rules and regulations in my primary fishery were fair in 2012."*	131	1 (Strongly Disagree) – 5 (Strongly Agree)	2.43	1.21

Regs_Unfair – *"Most of the regulations in my primary fishery in 2012 were unfair."*	161	1 (Strongly Disagree) – 5 (Strongly Agree)	3.46	1.12
Easy – *"It was easy to find information about the rules and regulations that governed my primary fishery in 2012."*	149	1 (Strongly Disagree) – 5 (Strongly Agree)	3.11	1.23
Reg_Bycatch – *"[Under regulations] - Level of bycatch (catch of non-target species)."*	149	1 (Significantly Decreased) – 5 (Significantly Increased)	2.87	0.58
Reg_Discards – *"[Under regulations] Level of discards (live or dead catch of target or non-target species that is thrown overboard)."*	156	1 (Significantly Decreased) – 5 (Significantly Increased)	3.04	0.66
Reg_High – *"[Under regulations] Level of highgrading (low value fish thrown overboard in order to keep higher value fish)."*	150	1 (Significantly Decreased) – 5 (Significantly Increased)	2.95	0.53

Table 4. Descriptive Information for "Environmental Stewardship" Dependent Variables

Survey Item	N	Range	Mean	Standard Deviation
Harm – *"I make every effort to ensure my actions do not harm the fishery unnecessarily."*	370	1 (Strongly Disagree) – 5 (Strongly Agree)	4.43	0.66
Overfish – *"The ocean is very large, there is no way we can over-fish it."*	359	1 (Strongly Disagree) – 5 (Strongly Agree)	2.35	1.11
Environment – *"The natural environment is important to me because that is how I make my living."*	369	1 (Strongly Disagree) – 5 (Strongly Agree)	4.38	0.74
Bycatch – *"[For primary fishery] Level of bycatch"*	161	1 (Low), 2 (Medium), 3 (High)	1.35	0.63
	163	1 (Low), 2 (Medium), 3 (High)	1.57	0.82

Discards – *"[For primary fishery] Level of discards"*				
High – *"[For primary fishery] Level of highgrading"*	153	1 (Low), 2 (Medium), 3 (High)	1.28	0.60

Table 5. Descriptive Information for "Satisfaction and Well-Being" Dependent Variables

Survey Item	N	Range	Mean	Standard Deviation
Adventure – *"Adventure of the job."*	363	1 (Extremely dissatisfied) – 5 (Extremely satisfied)	3.43	1.08
Away – *"The amount of time spent away from home."*	361	1 (Extremely dissatisfied) – 5 (Extremely satisfied)	2.73	1.17

Earn – *"Your actual earnings."*	360	1 (Extremely dissatisfied) – 5 (Extremely satisfied)	3.34	1.22
Advise – *"Would you advise a young person to enter fishing?"*	353	0 (No), 1 (Yes)	0.48	0.50
Just Job – *"Fishing is just a job to me."*	367	1 (Strongly Disagree) – 5 (Strongly Agree)	2.12	1.10
Part-time – *"Right now, I want to continue fishing, but only part-time until I retire."*	363	1 (Strongly Disagree) – 5 (Strongly Agree)	2.07	1.00
Leave – *"Leaving the fishing industry is something I have considered."*	364	1 (Strongly Disagree) – 5 (Strongly Agree)	2.93	1.25
Proud – *"I am proud to identify myself as a fisherman."*	367	1 (Strongly Disagree) – 5 (Strongly Agree)	4.44	0.67
Connect – *"I feel a strong connection to other fishermen in the community."*	366	1 (Strongly Disagree) – 5 (Strongly Agree)	4.19	0.79

Leader – *"Most people (Crew – I feel like I am) would say that I am a leader in my local community."*	364	1 (Strongly Disagree) – 5 (Strongly Agree)	2.47	1.01
Leader2 – *"Most people would say (Crew – I feel like I am) that I am a leader in my primary fishery."*	364	1 (Strongly Disagree) – 5 (Strongly Agree)	2.85	1.06

Table 6: Two-group *t* tests comparing means of IFQ and non-IFQ scallop crew members on "Management Process"

	IFQ		**Non-IFQ**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Participate	3.911	0.793	3.857	1.102	-0.276	99
Unfair	3.227	1.307	3.428	1.200	0.566	48
Believe	3.286	1.230	3.542	1.062	0.749	43
Correct	3.631	1.645	3.385	1.416	-0.621	43
Appeal	2.952	1.395	2.880	1.235	-0.187	44

Add Info	2.545	1.101	2.461	1.272	-0.242	46
Opinions	4.240	0.779	3.900	1.062	-1.330	53
Integrated	1.750	1.165	2.143	1.099	0.789	20
Serious	2.250	0.412	2.000	0.961	-0.544	20
Not Welcome	2.500	1.414	2.846	1.143	0.616	19
Don't Trust	**4.125**	**0.991**	**3.214**	**0.699**	**-2.526***	**20**

***-p<.05**

Table 7. Two-group *t* tests comparing means of IFQ and non-IFQ scallop crew members on "Fishery Management Plan"

	IFQ		**Non-IFQ**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Goals	3.278	1.018	3.077	1.197	-0.581	42
Protects	3.421	1.071	3.320	1.029	-0.317	42
Where	**2.800**	**1.152**	**2.077**	**1.055**	**-2.214***	**44**
When	2.300	0.923	2.153	1.008	-0.505	44

Opportunity	3.842	1.167	4.269	0.827	1.438	43
Maximize	2.750	0.966	2.800	1.080	0.162	43
Off-limits	2.350	0.875	2.346	0.892	-0.015	44
Change	3.222	0.943	3.417	1.139	0.588	40

***-p<.05**

Table 8. Two-group *t* tests comparing means of IFQ and non-IFQ scallop crew members on "Rules and Regulations"

	IFQ		**Non-IFQ**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Comply	3.428	0.978	3.346	1.056	-0.275	45
Restrict	4.095	0.768	3.692	1.049	-1.469	45
Fines	2.167	1.115	2.875	1.147	1.636	26
Regs_Unfair	3.400	1.046	3.231	1.032	-0.548	44

Easy	3.389	1.195	3.591	1.007	0.580	38
Reg_Bycatch	**3.118**	**0.485**	**2.833**	**0.381**	**-2.102***	**39**
Reg_Discards	**3.222**	**0.428**	**2.875**	**0.338**	**-2.941****	**40**
Reg_High	3.059	0.242	2.917	0.408	-1.282	39

***-p<.05**

****-p<.01**

Table 9. Two-group *t* tests comparing means of IFQ and non-IFQ scallop crew members on "Environmental Stewardship"

	IFQ		**Non-IFQ**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Harm	4.378	0.111	4.414	0.078	0.273	101
Overfish	2.432	1.227	2.035	0.925	-1.853	99
Environment	4.341	0.479	4.500	0.504	1.611	100

Bycatch	**1.474**	**0.697**	**1.115**	**0.326**	**-2.306***	**43**
Discards	**1.579**	**0.901**	**1.115**	**0.326**	**-2.422***	**43**
High	1.368	0.684	1.192	0.567	-0.943	43

***-p<.05**

Table 10. Two-group *t* tests comparing means of IFQ and non-IFQ scallop crew members on "Satisfaction and well-being"

	IFQ		**Non-IFQ**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Earn	3.886	1.104	3.696	1.320	-0.766	98
Away	3.432	1.043	3.036	1.095	-1.833	98
Adventure	3.659	0.963	3.411	1.058	-1.212	98
Advise	0.636	0.487	0.536	0.503	-1.007	98
Just Job	1.795	0.878	2.158	1.265	1.622	99

Part-time	1.953	1.068	1.719	0.818	-1.242	98
Leave	2.773	1.118	3.107	1.330	1.337	98
Proud	4.523	0.731	4.631	0.555	0.851	99
Connect	4.454	0.589	4.411	0.862	-0.297	98
Leader	2.581	1.052	2.536	1.159	-0.202	97
Leader2	3.091	1.030	3.196	1.052	0.502	98

Figure 1. "Don't trust management" by scallop permit type

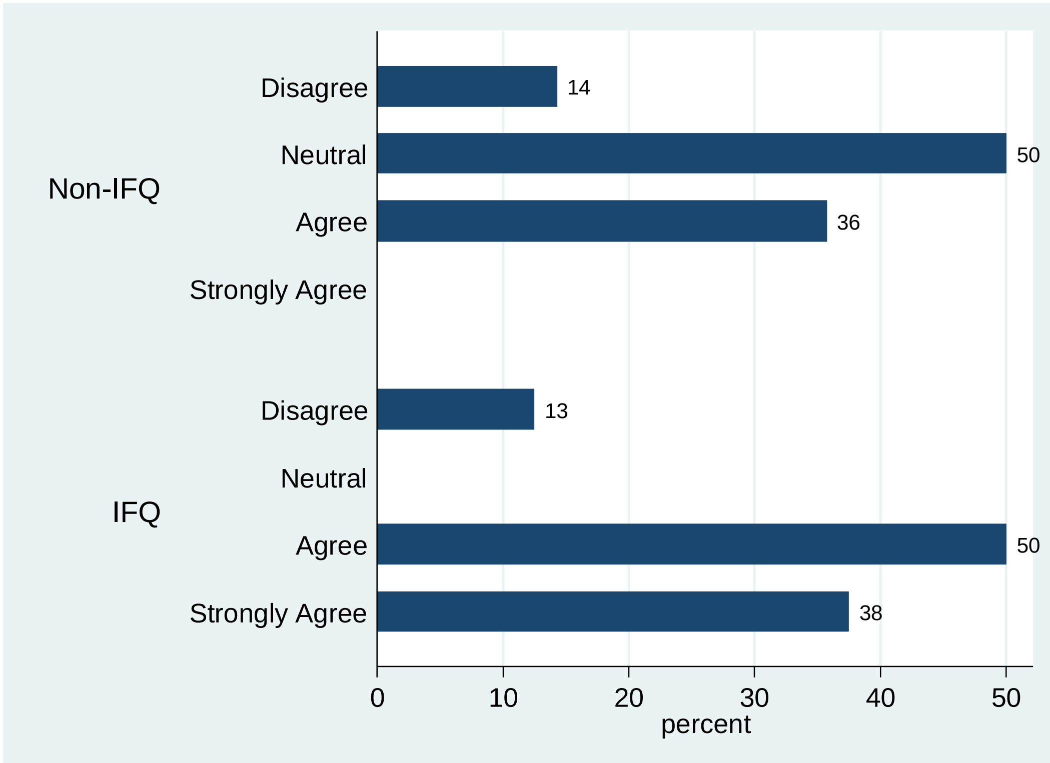


Figure 2. "Able to fish where we want" by scallop permit type

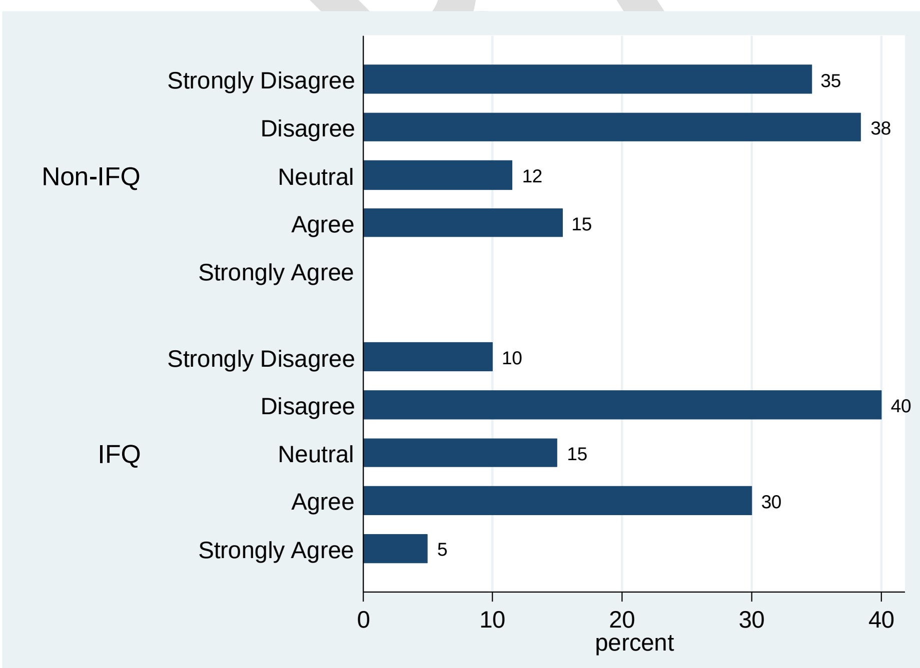


Figure 3. "Regulations' effect on bycatch" by scallop permit type

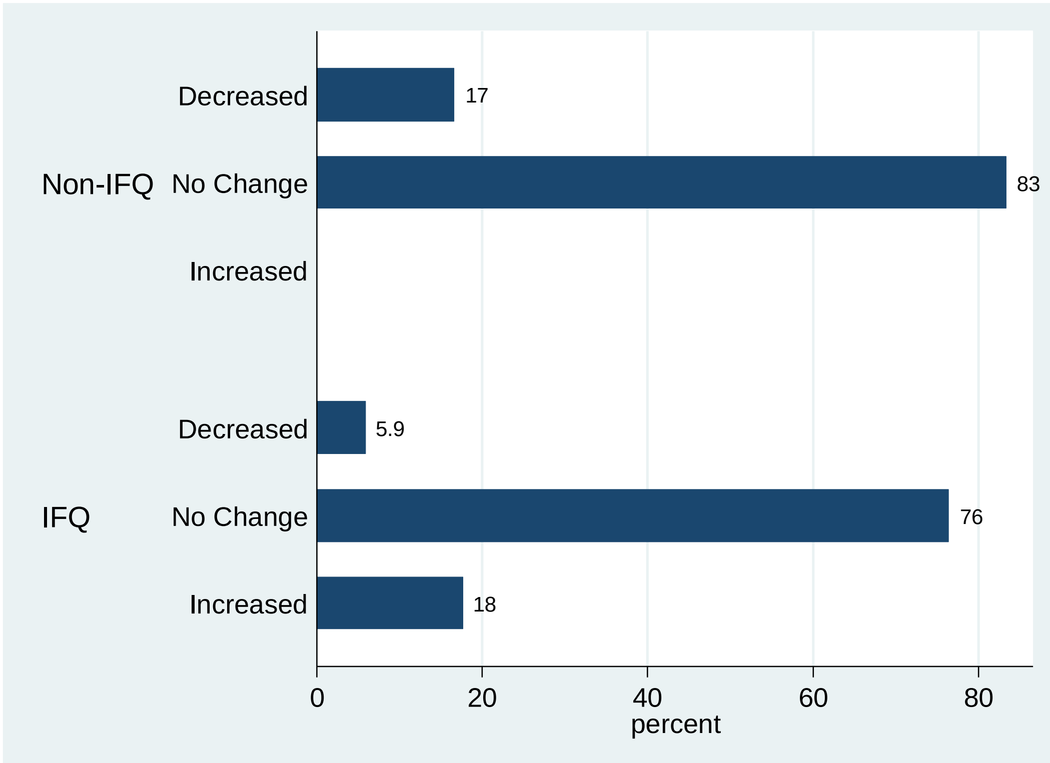


Figure 4. "Regulations' effect on discards" by scallop permit type

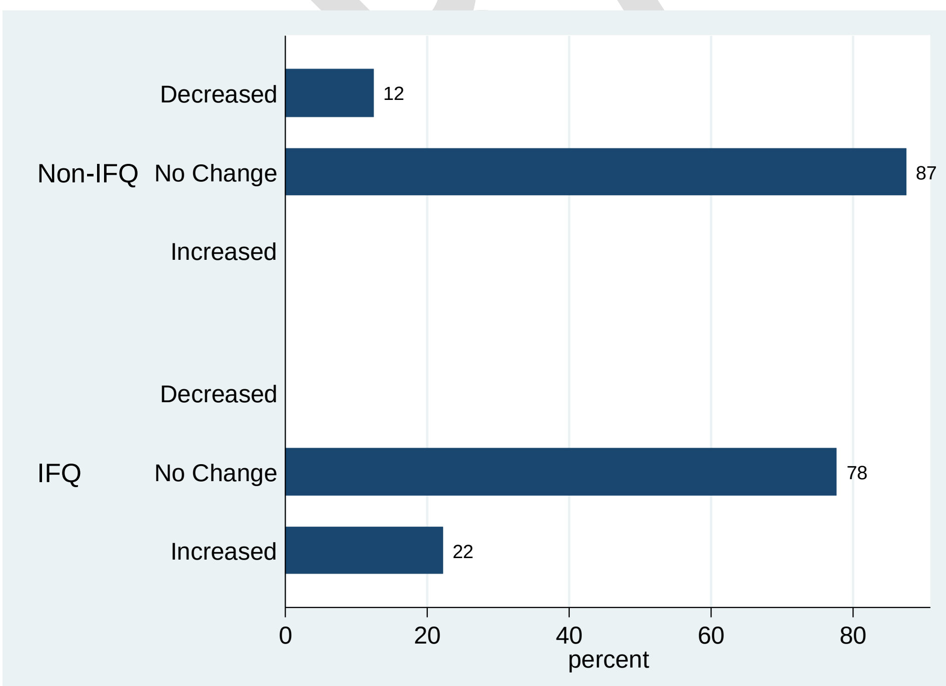


Figure 5. "Level of bycatch in primary fishery" by scallop permit type

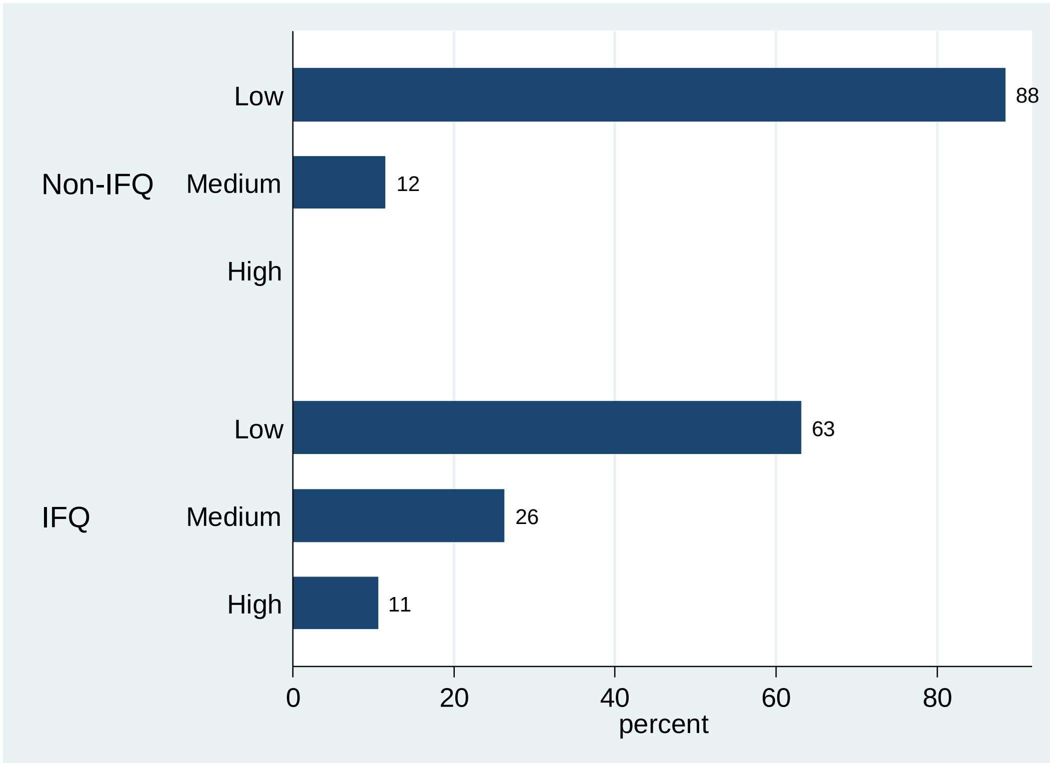
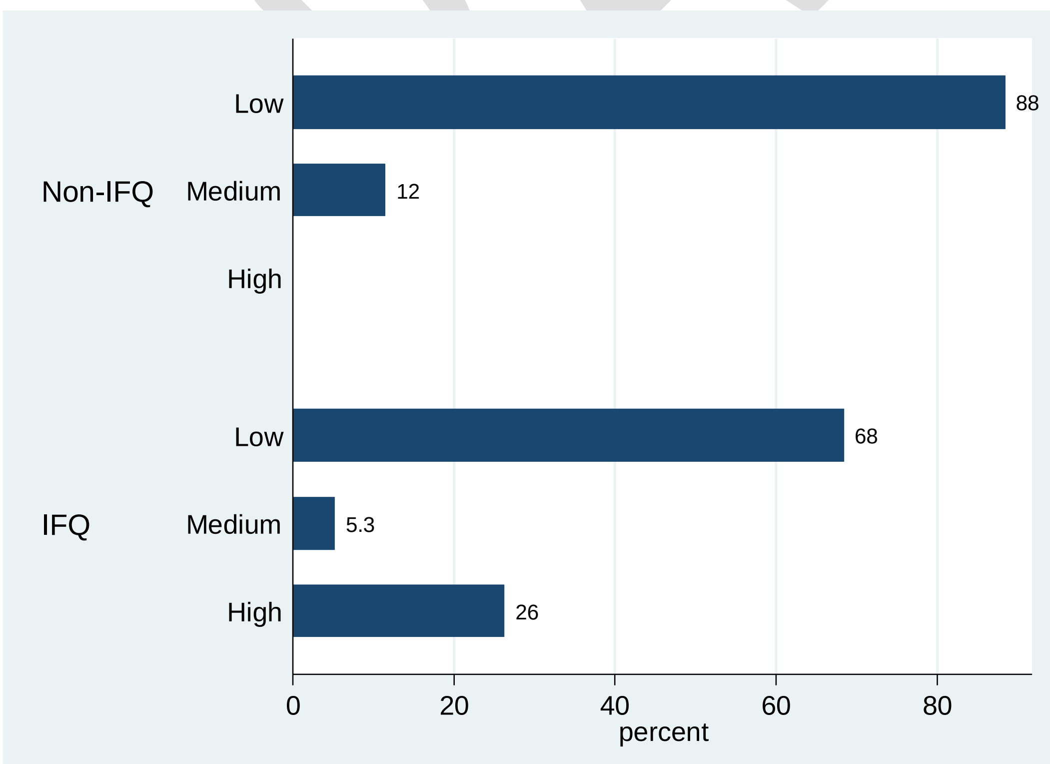


Figure 6. "Level of discards in primary fishery" by scallop permit type



Appendix A.

Table 11: Two-group *t* tests comparing means of IFQ scallop and Groundfish crew members on "Management Process"

	IFQ		Groundfish			
	Mean	Standard Deviation	Mean	Standard Deviation	*t*	*df*
Participate	3.911	0.793	3.864	1.094	-0.250	109
Unfair	**3.227**	**1.307**	**4.031**	**1.177**	**2.358***	**52**
Believe	3.286	1.230	3.806	1.108	1.590	50
Correct	3.631	1.165	3.893	1.031	0.809	45
Appeal	2.953	1.395	2.704	1.382	-0.616	46
Add Info	2.545	1.101	2.310	1.039	-0.780	49
Opinions	4.240	0.779	4.097	1.106	-0.547	54
Integrated	1.750	1.650	2.250	1.055	0.996	18
Serious	2.250	1.165	2.333	1.371	0.141	18
Not Welcome	2.500	1.414	2.833	1.267	0.551	18
Don't Trust	4.125	0.991	4.500	0.522	1.109	18

***-p<.05**

Table 12 Two-group *t* tests comparing means of non-IFQ scallop and Groundfish crew members on "Management Process"

	Non-IFQ		Groundfish			
	Mean	Standard Deviation	Mean	Standard Deviation	*t*	*df*

Participate	3.857	1.102	3.864	1.093	0.033	120
Unfair	**3.428**	**1.200**	**4.031**	**1.177**	**1.961***	**58**
Believe	3.542	1.062	3.806	1.108	0.895	53
Correct	3.385	1.416	3.893	1.031	1.516	52
Appeal	2.880	1.235	2.704	1.382	-0.484	50
Add Info	2.461	1.272	2.310	1.039	-0.485	53
Opinions	3.900	1.062	4.097	1.106	0.708	59
Integrated	2.143	1.099	2.250	1.055	0.252	24
Serious	2.000	0.961	2.333	1.371	0.726	24
Not Welcome	2.846	1.143	2.833	1.267	-0.027	23
Don't Trust	**3.214**	**0.699**	**4.500**	**0.522**	**5.234*****	**24**

***-p<.05**

*****-p<.001**

Table 13: Two-group *t* tests comparing means of IFQ and Lobster crew members on "Management Process"

	IFQ		Lobster			
	Mean	Standard Deviation	Mean	Standard Deviation	*t*	*df*
Participate	3.911	0.793	4.028	0.636	1.094	124
Unfair	3.227	1.307	3.615	1.042	1.273	59
Believe	3.286	1.230	3.210	1.212	-0.227	57
Correct	3.631	1.165	3.400	0.945	-0.791	52
Appeal	2.953	1.395	2.871	0.991	-0.246	50

Add Info	2.545	1.101	2.735	1.024	0.658	54
Opinions	4.240	0.779	3.820	1.167	-1.583	62
Integrated	**1.750**	**1.650**	**3.454**	**1.036**	**3.363****	**17**
Serious	2.250	1.165	2.800	1.135	1.010	16
Not Welcome	2.500	1.414	2.545	1.036	0.081	17
Don't Trust	4.125	0.991	3.200	1.135	-1.815	16

****-p<.01**

Table 14: Two-group *t* tests comparing means of non-IFQ scallop and Lobster crew members on "Management Process"

	Non-IFQ		Lobster			
	Mean	Standard Deviation	Mean	Standard Deviation	*t*	*df*
Participate	3.857	1.102	4.028	0.636	1.094	124
Unfair	3.428	1.200	3.615	1.042	0.679	65
Believe	3.542	1.062	3.210	1.212	-1.098	60
Correct	3.385	1.416	3.400	0.945	0.051	59
Appeal	2.880	1.235	2.871	0.991	-0.030	54
Add Info	2.461	1.272	2.735	1.024	0.924	58
Opinions	3.900	1.062	3.820	1.167	-0.292	67
Integrated	**2.143**	**1.099**	**3.454**	**1.036**	**3.036****	**23**

Serious	2.000	0.961	2.800	1.135	1.865	22
Not Welcome	2.846	1.143	2.545	1.036	-0.670	22
Don't Trust	3.214	0.699	3.200	1.135	-0.038	22

****-p<.01**

Appendix B.

Table 15. Two-group *t* tests comparing means of IFQ scallop and Groundfish crew members on "Fishery Management Plan"

	IFQ		**Groundfish**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Goals	**3.278**	**1.018**	**2.548**	**1.312**	**-2.027***	**47**
Protects	**3.421**	**1.071**	**2.677**	**1.275**	**-2.122***	**48**
Where	2.800	1.152	2.286	1.319	-1.454	53
When	2.300	0.923	1.886	1.157	-1.369	53
Opportunity	3.842	1.167	3.273	1.008	-1.851	50
Maximize	2.750	0.966	3.029	1.141	0.918	52
Off-limits	**2.350**	**0.875**	**3.228**	**1.215**	**2.836****	**53**
Change	3.222	0.943	2.844	1.221	-1.136	48

***-p<.05**

****-p<.01**

Table 16. Two-group *t* tests comparing means of non-IFQ scallop and Groundfish crew members on "Fishery Management Plan"

	Non-IFQ		Groundfish			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Goals	3.077	1.197	2.548	1.312	-1.575	55
Protects	**3.320**	**1.029**	**2.677**	**1.275**	**-2.039***	**54**
Where	2.077	1.055	2.286	1.319	0.664	59
When	2.154	1.008	1.886	1.157	-0.944	59
Opportunity	**4.270**	**0.827**	**3.273**	**1.008**	**-4.071*****	**57**
Maximize	2.800	1.080	3.029	1.141	0.780	57
Off-limits	**2.346**	**0.892**	**3.228**	**1.215**	**3.129****	**59**
Change	3.417	1.139	2.844	1.221	-1.788	54

***-p<.05**

****-p<.01**

*****-p<.001**

Table 17. Two-group *t* tests comparing means of IFQ scallop and Lobster crew members on "Fishery Management Plan"

	IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***

Goals	3.278	1.018	3.481	0.975	0.674	43
Protects	3.421	1.071	3.467	1.008	0.151	47
Where	**2.800**	**1.152**	**4.043**	**1.055**	**4.868*** **	**49**
When	**2.300**	**0.923**	**3.100**	**1.241**	**2.460** **	**48**
Opportunity	3.842	1.167	3.633	1.159	-0.613	47
Maximize	2.750	0.966	2.621	1.115	-0.421	47
Off-limits	**2.350**	**0.875**	**3.069**	**1.252**	**2.219***	**47**
Change	3.222	0.943	3.071	1.086	-0.483	44

***-p<.05**

****-p<.01**

*****-p<.001**

Table 18. Two-group *t* tests comparing means of non-IFQ scallop and Lobster crew members on "Fishery Management Plan"

	Non-IFQ		**Lobster**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Goals	3.077	1.197	3.481	0.975	1.351	51
Protects	3.320	1.029	3.467	1.008	0.532	53

Where	**2.077**	**1.055**	**4.043**	**1.055**	**8.535*** **	**55**
When	**2.154**	**1.008**	**3.100**	**1.241**	**3.100** **	**54**
Opportunity	**4.270**	**0.827**	**3.633**	**1.159**	**-2.329***	**54**
Maximize	2.800	1.080	2.621	1.115	-0.598	52
Off-limits	**2.346**	**0.892**	**3.069**	**1.252**	**2.440** **	**53**
Change	3.417	1.139	3.071	1.086	-1.117	50

***-p<.05**

****-p<.01**

*****-p<.001**

Appendix C.

Table 19. Two-group *t* tests comparing means of IFQ scallop and Groundfish crew members on "Rules and Regulations"

	IFQ		**Groundfish**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Comply	**3.428**	**0.978**	**2.788**	**1.218**	**-2.027***	**52**
Restrict	4.095	0.768	4.235	1.046	0.531	53
Fines	2.167	1.115	2.029	1.218	-0.343	44
Regs_Unfair	3.400	1.046	3.844	0.987	1.541	50
Easy	3.389	1.195	3.031	1.257	-0.983	48
Reg_Bycatch	**3.118**	**0.485**	**2.677**	**0.748**	**-2.183***	**46**
Reg_Discards	**3.222**	**0.864**	**2.735**	**0.864**	**-2.243***	**50**
Reg_High	2.806	0.749	2.806	0.749	-1.345	46

***-p<.05**

Table 20. Two-group *t* tests comparing means of non-IFQ scallop and Groundfish crew members on "Rules and Regulations"

	Non-IFQ		Groundfish			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Comply	3.346	1.056	2.788	1.218	-1.851	57
Restrict	**3.692**	**1.049**	**4.235**	**1.046**	**1.989***	**58**
Fines	**2.875**	**1.147**	**2.029**	**1.218**	**-2.331***	**48**
Regs_Unfair	**3.231**	**1.032**	**3.844**	**0.987**	**2.304***	**56**
Easy	3.591	1.007	3.031	1.257	-1.738	52
Reg_Bycatch	2.833	0.381	2.677	0.748	-0.931	53
Reg_Discards	2.875	0.338	2.735	0.864	-0.751	56
Reg_High	2.917	0.408	2.806	0.749	-0.649	53

***-p<.05**

Table 21. Two-group *t* tests comparing means of IFQ scallop and Lobster crew members on "Rules and Regulations"

	IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Comply	3.428	0.978	3.290	1.189	-0.441	50
Restrict	**4.095**	**0.768**	**3.133**	**1.306**	**-3.023****	**49**
Fines	2.167	1.115	2.928	1.215	1.861	38
Regs_Unfair	3.400	1.046	2.933	1.201	-1.415	48
Easy	3.389	1.195	3.233	1.278	-0.418	46
Reg_Bycatch	3.118	0.485	3.036	0.508	-0.533	43
Reg_Discards	2.735	0.864	3.367	0.615	0.876	46
Reg_High	2.806	0.749	2.965	0.499	-0.720	44

****-p<.01**

Table 22. Two-group *t* tests comparing means of non-IFQ scallop and Lobster crew members on "Rules and Regulations"

	Non-IFQ		**Lobster**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Comply	3.346	1.056	3.290	1.189	-0.186	55
Restrict	3.692	1.049	3.133	1.306	-1.747	54
Fines	2.875	1.147	2.928	1.215	1.861	38
Regs_Unfair	3.231	1.032	2.933	1.201	-0.986	54
Easy	3.591	1.007	3.233	1.278	-1.087	50
Reg_Bycatch	2.833	0.381	3.036	0.508	1.603	50
Reg_Discards	**2.875**	**0.338**	**3.367**	**0.615**	**3.517*****	**52**
Reg_High	2.917	0.408	2.965	0.499	0.384	51

*****-p<.001**

Appendix D.

Table 23. Two-group *t* tests comparing means of IFQ scallop and Groundfish crew members on "Environmental Stewardship"

	IFQ		Groundfish			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Harm	4.378	0.747	4.551	0.557	1.414	112
Overfish	2.432	1.227	2.318	1.242	-0.472	108
Environment	4.341	0.479	4.464	0.901	0.832	111
Bycatch	1.474	0.697	1.529	0.706	0.277	51
Discards	1.579	0.901	1.543	0.780	-0.154	52
High	1.368	0.684	1.258	0.514	-0.649	48

Table 24. Two-group *t* tests comparing means of non-IFQ scallop and Groundfish crew members on "Environmental Stewardship"

	Non-IFQ		Groundfish			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Harm	4.414	0.593	4.551	0.557	1.340	125
Overfish	2.035	0.925	2.318	1.242	1.414	121
Environment	4.500	0.504	4.464	0.901	-0.272	125
Bycatch	**1.115**	**0.326**	**1.529**	**0.706**	**2.768****	**58**
Discards	**1.115**	**0.326**	**1.543**	**0.780**	**2.625****	**59**
High	1.192	0.567	1.258	0.514	0.459	55

****-p<.01**

Table 25. Two-group *t* tests comparing means of IFQ scallop and Lobster crew members on "Environmental Stewardship"

	IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Harm	4.378	0.747	4.444	0.500	0.578	115
Overfish	2.432	1.227	2.265	0.924	-0.820	110
Environment	4.341	0.479	4.430	0.668	0.776	114
Bycatch	**1.474**	**0.697**	**1.129**	**0.427**	**-2.173***	**48**
Discards	1.579	0.901	1.968	0.912	1.469	48
High	1.368	0.684	1.393	0.737	1.115	45

***-p<.05**

Table 26. Two-group *t* tests comparing means of non-IFQ scallop and Lobster crew members on "Environmental Stewardship"

	Non-IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Harm	4.414	0.593	4.444	0.500	0.319	128

Overfish	2.035	0.925	2.265	0.924	1.382	123
Environment	4.500	0.504	4.430	0.668	-0.655	128
Bycatch	1.115	0.326	1.129	0.427	0.133	55
Discards	**1.115**	**0.326**	**1.968**	**0.912**	**4.523*****	**55**
High	1.192	0.567	1.393	0.737	1.114	52

*****-p<.001**

Appendix E.

Table 27. Two-group *t* tests comparing means of IFQ scallop and Groundfish crew members on "Satisfaction and well-being"

	IFQ		**Groundfish**			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Earn	**3.886**	**1.104**	**2.882**	**1.178**	**-4.512*** **	**110**
Away	**3.432**	**1.043**	**2.209**	**0.977**	**-5.277*** **	**109**
Adventure	**3.659**	**0.963**	**3.203**	**1.145**	**-2.193***	**111**
Advise	**0.636**	**0.487**	**0.242**	**0.432**	**-4.454*** **	**108**
Just Job	1.795	0.878	2.101	1.139	1.516	111
Part-time	1.953	1.068	2.103	0.995	0.749	109
Leave	2.773	1.118	3.014	1.289	1.022	111
Proud	4.523	0.731	4.435	0.675	-0.654	111
Connect	**4.454**	**0.589**	**4.145**	**0.809**	**-2.193***	**111**
Leader	2.581	1.052	2.449	0.978	-0.675	110
Leader2	3.091	1.030	2.765	1.173	-1.506	110

***-p<.05**

*****-p<.001**

Table 28. Two-group *t* tests comparing means of non-IFQ scallop and Groundfish crew members on "Satisfaction and well-being"

	Non-IFQ		Groundfish			
	Mean	Standard Deviation	Mean	Standard Deviation	*t*	*df*
Earn	**3.696**	**1.320**	**2.882**	**1.178**	**-3.625*****	**122**
Away	**3.036**	**1.095**	**2.209**	**0.977**	**-4.423*****	**121**
Adventure	3.411	1.058	3.203	1.145	-1.044	123
Advise	**0.534**	**0.503**	**0.242**	**0.432**	**-3.465*****	**120**
Just Job	2.158	1.265	2.101	1.139	-0.263	124
Part-time	**1.719**	**0.818**	**2.103**	**0.995**	**2.326***	**123**
Leave	3.107	1.330	3.014	1.289	-0.394	123
Proud	4.631	0.555	4.435	0.675	-1.763	124
Connect	4.411	0.826	4.145	0.809	-1.809	123
Leader	2.536	1.159	2.449	0.978	-0.452	123
Leader2	**3.196**	**1.052**	**2.765**	**1.173**	**-2.136***	**122**

***-p<.05**

*****-p<.001**

Table 29. Two-group *t* tests comparing means of IFQ scallop and Lobster crew members on "Satisfaction and well-being"

	IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Earn	3.886	1.104	3.609	1.046	-1.346	111
Away	**3.432**	**1.043**	**2.971**	**1.076**	**-2.250***	**112**
Adventure	3.659	0.963	3.543	1.003	-0.612	112
Advise	0.636	0.487	0.682	0.469	0.490	108
Just Job	**1.795**	**0.878**	**2.268**	**0.999**	**2.577****	**113**
Part-time	1.953	1.068	2.183	0.915	1.218	112
Leave	2.773	1.118	2.614	1.231	-0.693	112
Proud	4.523	0.731	4.324	0.692	-1.465	113
Connect	**4.454**	**0.589**	**4.056**	**0.791**	**-2.880****	**113**
Leader	2.581	1.052	2.535	0.954	-0.241	112
Leader2	**3.091**	**1.030**	**2.620**	**0.916**	**-2.555****	**113**

***-p<.05**

****-p<.01**

Table 30. Two-group *t* tests comparing means of non-IFQ scallop and Lobster crew members on "Satisfaction and well-being"

	Non-IFQ		Lobster			
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	***t***	***df***
Earn	3.696	1.320	3.609	1.046	-0.415	123
Away	3.036	1.095	2.971	1.076	-0.331	124
Adventure	3.411	1.058	3.543	1.003	0.717	124
Advise	0.534	0.503	0.682	0.469	1.657	120
Just Job	2.158	1.265	2.268	0.999	0.548	126
Part-time	**1.719**	**0.818**	**2.183**	**0.915**	**2.986****	**126**
Leave	**3.107**	**1.330**	**2.614**	**1.231**	**-2.154***	**124**
Proud	**4.631**	**0.555**	**4.324**	**0.692**	**-2.724****	**126**
Connect	**4.411**	**0.826**	**4.056**	**0.791**	**-2.458****	**125**
Leader	2.536	1.159	2.535	0.954	-0.003	125
Leader2	**3.196**	**1.052**	**2.620**	**0.916**	**-3.299*****	**125**

***-p<.05**

****-p<.01**

*****-p<.001**

APPENDIX J – NETWORK ANALYSIS

Multi-Scale Network Analysis of the Atlantic Sea Scallop General Category IFQ Program

Gabriela Stocks, Ph.D., Independent Contractor, Environmental Anthropology

Summary of Key Findings

The Atlantic Sea Scallop General Category IFQ share transfer network is characterized by few participants, low cohesion, and one-time transfers between business entities.

The Atlantic Sea Scallop General Category IFQ quota leasing network is characterized by many participants, increasing cohesion, and multi-year participation, but also by few multi-year leasing relationships between participants.

The number of federally permitted seafood dealers receiving landings from the IFQ fleet has decreased over time, and relationships between fishing businesses and dealers tend to be short term. There is some consistency in the largest sea scallop dealers across years.

1. Introduction

While all fishery management actions include an assessment of potential social and economic impacts, finer scale analyses of the post-implementation impacts of regulatory action is often lacking. In particular, the evaluation of catch share programs, which dedicate a secure share of annual quota to qualifying fishermen and/or vessels, requires a detailed assessment of the longitudinal effects of this management strategy. Changes in fishing practices due to catch share programs may involve shifts in relationships between fishermen, entrance into or exit from certain fisheries as constraints change, shifts in the species composition of vessel catch, etc.

The project described in this report was developed as one method for evaluating the first six years of the Atlantic Sea Scallop General Category Individual Fishing Quota (IFQ) program. The Final Rule for the IFQ program was published on April 14, 2008 (effective June 1, 2008) as part of the development of a limited access program for the General Category Atlantic scallop fishery. There was then a two-year transition from open access fishing to IFQ fishing. The goal of the program was to reduce overcapacity in the fishery, as the number of General Category vessels landing scallops had increased from 181 in 1994 to 600 in 2005. This new management strategy allocated 95% of the annual scallop fishery allocation to a limited access "days at sea" fleet and 5% of the annual allocation to an IFQ fleet. Initial IFQ shares were distributed to vessels based on their best year of scallop landings and the number of fishing years that they were active between March 1, 2000 and November 1, 2004, with an accumulation limit of 2.5% per vessel and 5% per individual.

This report describes the use of network analysis as an exploratory tool for understanding various dynamics of the Atlantic Sea Scallop IFQ fleet from 2010-2015. Specifically, the project analyzed two large datasets:

1. Share and lease transactions from the Atlantic Sea Scallop IFQ program for the 2010-2015 fishing years
2. Dealer transactions for the 2010-2015 fishing years, minus the last two months (January and February) of the 2015 fishing year.

The primary goal of this study was to begin to characterize how the introduction of the Atlantic General Category Sea Scallop IFQ program in the mid-Atlantic region may have influenced relationships between fishermen and between fishermen and seafood dealers.

2. A Brief Introduction to Social Network Analysis

This project employed both one- and two-mode network analysis. One-mode network analysis was used to analyze IFQ share and lease transaction data, while two-mode network analysis was used to analyze dealer data.

2.1 One-Mode Network Analysis

In one-mode network analysis, a network is composed of only one type of entity. For example, a researcher may be interested in the relationships among people in a specific group (e.g., a classroom or a company). An adjacency matrix like Table 1 reflects whether or not each person has a tie with every other person in the group (a "1" indicates the presence of a tie, a "0" indicates the absence of a tie). The tie can be anything defined by the researcher, for example knowing someone, having worked with someone, liking/disliking someone, etc. The entities in the rows and columns in one-mode networks are identical but the ties are not necessarily symmetrical (i.e., Sue might claim to know Mark but Mark might not claim to know Sue).

Table 1: A one-mode network adjacency matrix

	Sue	Mark	John	Bob	Bill
Sue		1	1	0	1
Mark	1		1	0	0
John	1	1		1	1
Bob	0	0	1		0
Bill	1	0	1	0	

Table 1: A one-mode network adjacency matrix

Network analysis software, like UCINET and its accompanying network visualization program Netdraw, can translate Table 1 into a network diagram, automatically arranging the nodes in space based on their similarity (Figure 1). In Figure 1, the group members (aka “nodes”) are represented by squares, and the relationships between them are represented by lines (aka “edges” or “ties”). The nodes in Figure 1 are sized based on degree centrality (i.e., the number of other nodes to whom a particular node is connected). In this case, John has the highest degree centrality because he is the only person who has ties to all four remaining group members.

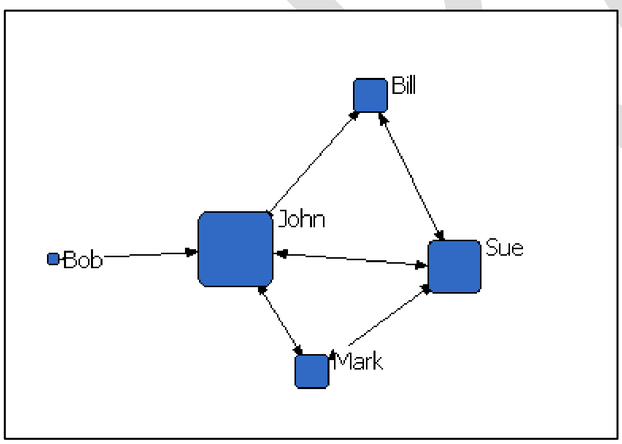


Figure 1: A one-mode network diagram

Degree centrality can also be directional based on the number of nodes who claimed to have a tie with a given node (aka “in-degree centrality”, often associated with the social prominence of that node) or the number of nodes with whom a particular node claimed to have a tie (aka “out-degree centrality”, often associated with the social influence of that node). Other individual measures of centrality include betweenness centrality (a measure of the extent to which a node lies on the pathway between other nodes) and closeness centrality (a measure of the distance of a given node from all other nodes in the network). At the whole network level, a number of compositional and structural measures can also be calculated. Compositional measures include number of nodes, number of ties, and the distribution of node attributes (e.g., age, gender, occupation, etc. of network members). Structural measures include network density (the number of ties in the network as a proportion of the total possible number of ties), network centralization (a measure of the concentration of power within a network), number of components (isolated sub-groups), and average degree centrality (the average number of connections between nodes).

2.2 Two-Mode Network Analysis

In two-mode network analysis, the network is composed of two different types of entities. For example, a researcher may be interested in understanding membership patterns in various community organizations. In Table 2, rows represent people and columns represent organizations to which people might belong (a "1" indicates membership; a "0" indicates the absence of membership). Again, this tie can be anything defined by the researcher.

	PTA	Elk's Club	Rotary Club
Sue	1	1	1
Mark	1	0	1
John	1	1	0

Table 2: A two-mode network adjacency matrix

A network analysis software package translates Table 2 into a network diagram (Figure 2). In Figure 2, people are represented by red circles and organizations are represented by blue squares. Membership is represented by edges that link people to organizations. The nodes in Figure 2 are sized based on degree centrality (i.e., the number of organizations to which a person belongs or the number of people that belong to an organization). In this case, Sue has the highest individual degree centrality because she is a member of all three organizations. The PTA has the highest organizational degree centrality because all three people are members.

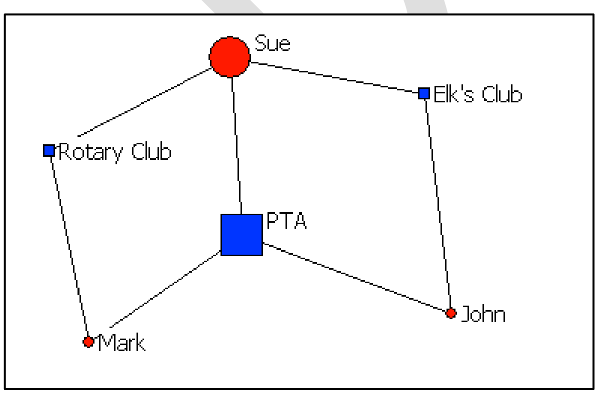


Figure 2: A two-mode network diagram

As in one-mode network analysis, betweenness centrality and closeness centrality can also be calculated, as can other network-level structural and compositional measures. In addition, two-mode networks can be transformed into one-mode networks through a correspondence analysis of entities that share ties. In Figure 2, for example, we could construct new one-mode networks of only people or only organizations with ties representing co-membership (e.g., if two organizations had members in common, those organizations would be connected in the one-mode network).

3. Atlantic Sea Scallop IFQ Share and Quota Transaction Networks

As noted above, the Atlantic Sea Scallop IFQ program reserves 5% of the annual sea scallop allocation for an IFQ fleet composed of smaller-scale fishing vessels. The initial distribution of shares, based on vessels' fishing histories, occurred in 2010, after which shares could be permanently transferred and quota pounds could be annually leased to other vessels that qualified for the program. Share and quota transactions occur between IFQ participants and therefore represent social and/or economic relationships between these entities. These relationships can be used to conduct a social network analysis, which, in turn, allows us to understand how the IFQ transaction networks may have changed over the life of the Atlantic General Category Sea Scallop IFQ program. For the current project, one-mode network analysis was conducted for all share and quota transfers that occurred in each of the 2010-2015 fishing years.

3.1 Data Processing

Records of share and quota transfers are maintained by the Greater Atlantic Regional Fisheries Office (GARFO). Transfers occur between a "transferor" and a "transferee", each of whom is identified by a combination of a moratorium right id (MRI) and a permit number. On any given date, the MRI-permit combination is affiliated with a unique business entity, though this affiliation can change at any point, potentially daily, as rights and permits can be transferred (either together or independently) to other IFQ participants at any time. Data collected about each transfer also includes the date of transfer, share or pounds transferred, and value of the transfer.

To date, most analyses of the IFQ program have used data associated with individual permit numbers, rather than on an accumulation of ownership basis. For the current social network analysis, however, we believed that it was important to understand the relationships between fishing businesses, many of which have multiple permitted vessels, rather than between the individual vessels themselves. Because a vessel can change ownership at any time, tracking IFQ share and quota transfers at the vessel level provides very little information about the human actors involved in the transactions. By aggregating transfers at the business entity level, we get a better sense of the social map created in response to the IFQ program. In some cases, the transferor and the transferee are different business entities. In other cases, the transferor and transferee are the same business entity and are transferring shares or quota from one vessel to another, or are different business entities but have some overlap in ownership. This information is important to assessing the impact of the program on fishermen.

The data cleanup required to connect the MRI-permit combination to business entities was substantial due to gaps in ownership data associated with Confirmation of Permit History (CPH) vessels. CPH vessels, otherwise known as “paper boats”, do not have active fishing permits, which means that ownership information is only updated if/when the vessel permits are sold.[12] Because current ownership data was not easily accessible for CPH vessels, the business entity was missing for any transfers originating from or terminating with a CPH vessel. For share transfers, a CPH vessel was the transferor, transferee, or both in 105 of 183 transfers (57%) from 2010-2015; for quota leases a CPH vessel was the transferor, transferee, or both in 963 of 1853 transfers (52%) from 2010-2015.

The first round of data cleanup involved matching MRI-permit combinations with the business entity associated with that combination *on the date of the IFQ share or lease transfer*. This was achieved through a relatively simple database query. The second round of data cleanup involved manually filling in missing CPH vessel ownership data, which required searching for individual CPH vessel permit numbers in a variety of databases, including permit applications, moratorium right eligibility records, and business ownership records (which included ownership data at the person level). When the date of the IFQ transfer did not match the ownership data in these datasets—which was the case for the majority of records—the most recent ownership data on record was used. As such, the business entity data used to generate the transaction networks discussed in the following two sections should be viewed with caution and would benefit from ground truthing.

3.2 IFQ Share Transaction Networks

Figure 3 represents the networks of Atlantic Sea Scallop IFQ share transfers for the 2010-2015 fishing years. In the network diagrams, nodes represent businesses entities, lines represent at least one transfer of shares in that fishing year, and arrowheads indicate the direction of the transfer (transferor to transferee). Grey lines represent transfers between unrelated accounts (i.e., no owners in common), red lines represent transfers between related accounts (i.e., at least one owner in common), and green lines represent transfers between accounts of unknown relation due to missing data.

[12] The original purpose for the CPH program was to allow vessel owners whose vessel was sunk or otherwise disabled, or the owner was unable to fish due to illness or injury, to put all permits into suspended animation until the owner was able to replace a lost vessel and start fishing. Permits attached to a vessel put in CPH also stay there until the permits are sold. Since the permits in CPH do not have to be renewed every year, the ownership information stays the same for as long as the vessel remains in CPH. However, if the permits in CPH are sold, the ownership change is recorded.

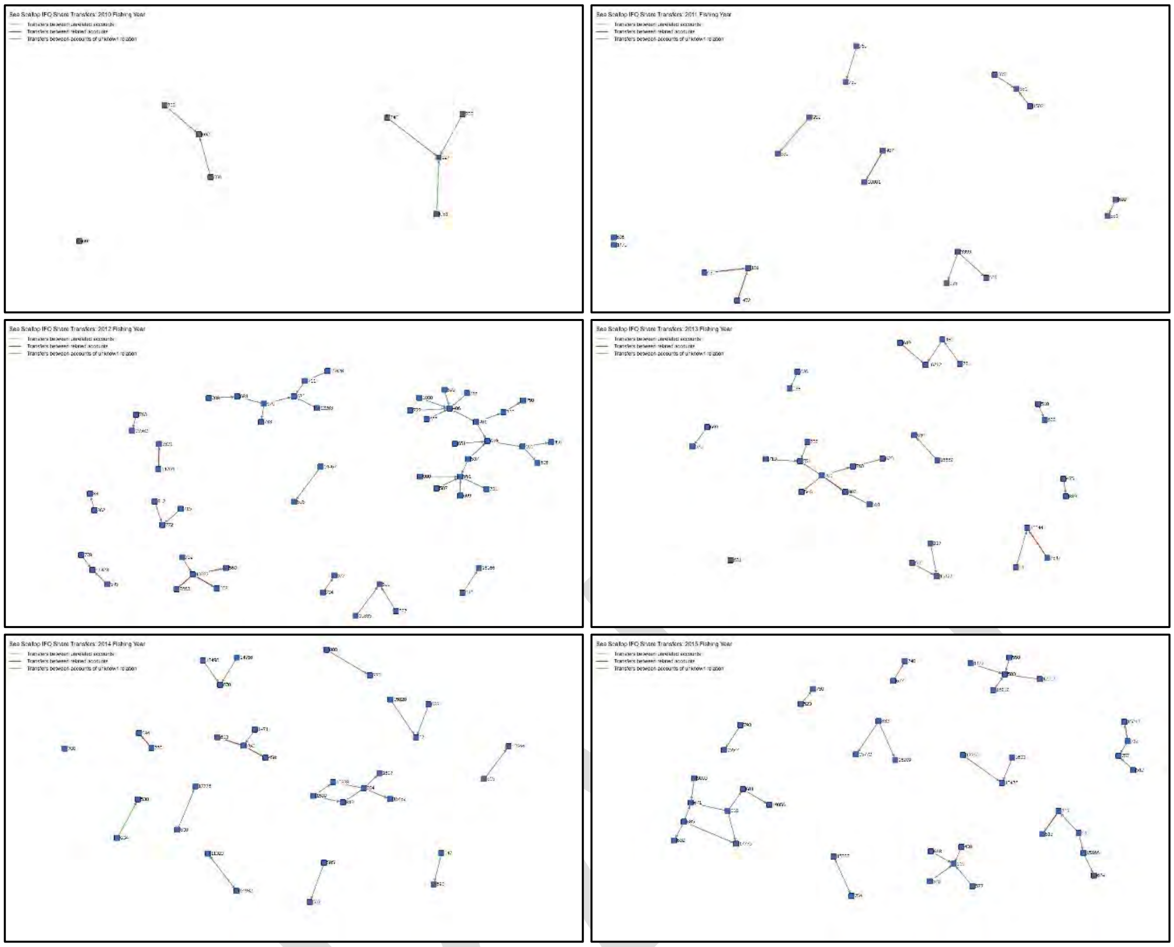


Figure 3: Atlantic Sea Scallop IFQ share transfer networks, 2010-2015 fishing years (first row: 2010-2011; second row: 2012-2013; third row: 2014-2015). Nodes represent business entities; lines represent at least one share transfer in that fishing year.

In 2010, only 8 businesses entities participated in share transfers, one of which was between related accounts (the isolated node in the lower left hand corner represents the transfer of shares between permits owned by the same business entity). The 2010 network diagram reveals that some business entities attempted to accumulate shares from other shareholders in the first year of the program, forming small sub-groups of interconnected actors (aka “components”). Specifically, Business 602 acquired shares from Businesses 732 and 660, while Business 827 acquired shares from Businesses 746, 702, and GS1. On the whole, however, the low number of participants in the 2010 share transaction network indicates that participants were not particularly interested in permanently transferring shares in the first year of the IFQ program. In subsequent years, more participants began to transfer shares: 19 in 2011, 54 in 2012, 30 in 2013, 33 in 2014, and 41 in 2015 (Figure 4).

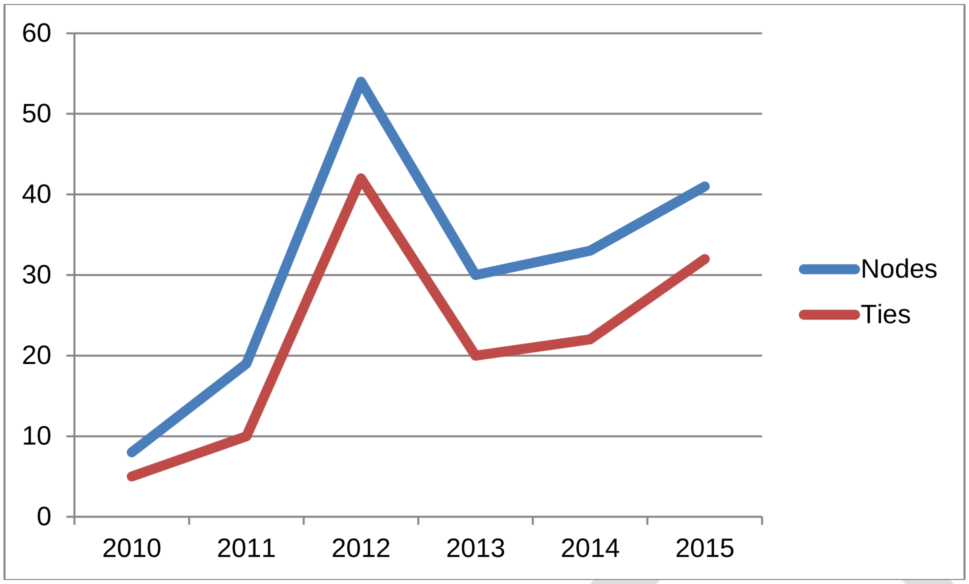


Figure 4: Number of nodes and ties in the Atlantic Sea Scallop IFQ share transfer networks, 2010-2015 fishing years.

In all years, share transfers usually occurred among small components of 2-3 nodes. The 2012 fishing year was somewhat anomalous in both the number of participants and the size of the components. This may be due to the fact that 2012 was the first year in which IFQ vessels could sell portions of shares rather than full shares.

Though some larger components formed in 2012 and later years, they were largely ephemeral. For example, of the 20 nodes in the largest component in 2012, only two remained in the same component in 2013. Furthermore, of the most eight most frequent participants in share transfers, only one entity transferred shares to the same entities in more than one year (Business 615 transferred shares to Business 15166 in 2012 and 2015, and to Business 15544 in 2013 and 2014). In sum, the vast majority of participants transferred shares in only one year, and few repeat relationships were formed. Figures 5-7 illustrate these patterns. Figure 4 is a diagram of the aggregated share transfer networks from 2010-2015, with nodes sized and colored by the number of years of participation in share transfers. Small blue nodes (participants in only one year) dominate the network.

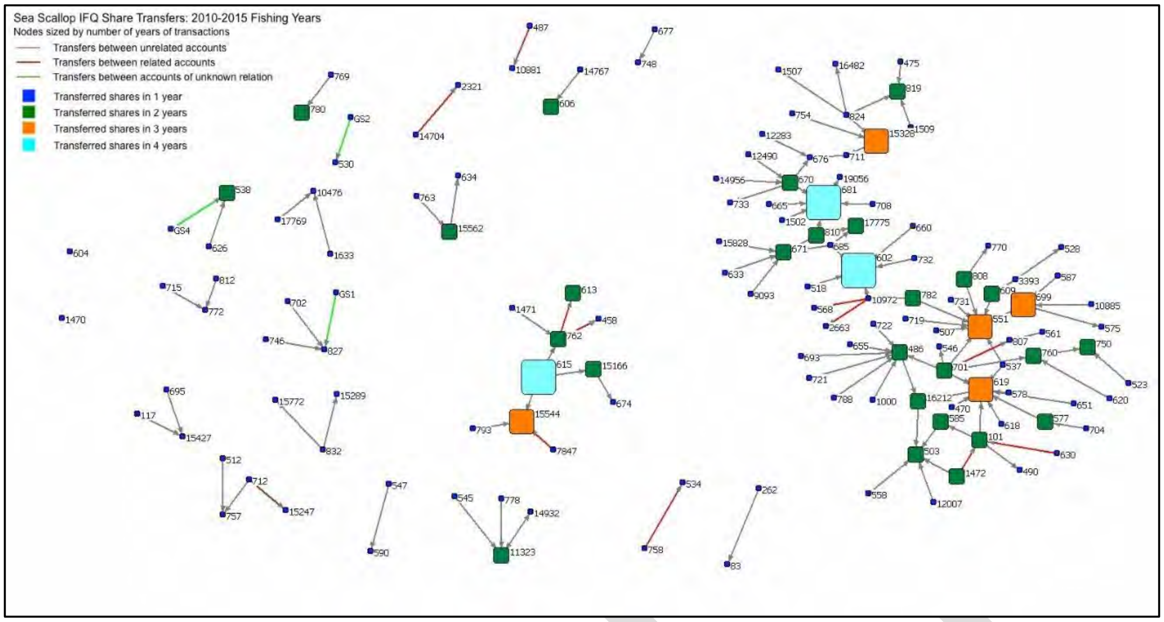


Figure 5: The aggregated 2010-2015 share transfer network. Nodes are colored and sized by the number of years they participated in share transfers.

Figure 6 quantitatively summarizes the network in Figure 5. Of 140 total unique business entities, 106 transferred shares in only one year, 26 in two years, 5 in three years, and 3 in four years. No participants transferred shares in more than four years between 2010 and 2015.

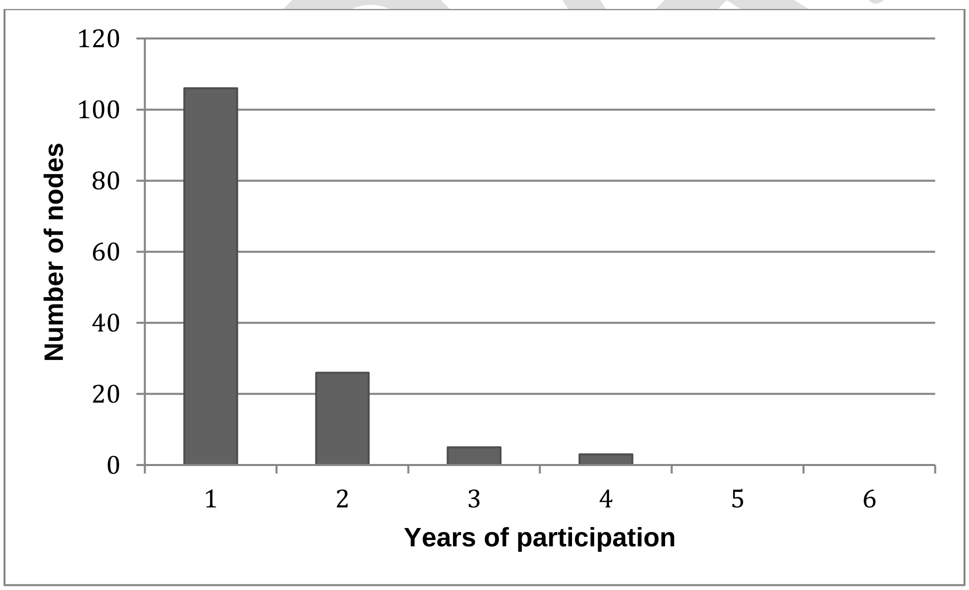


Figure 6: Years of participation in share transfers. A majority of participants transferred shares in only one year.

Figure 7 illustrates the number of years in which share transfers occurred between the same entities, indicating a small number of repeat relationships. Of 137 unique pairs of transferors and transferees between 2010-2015, 129 pairs transferred shares in only one year and eight pairs transferred shares in two years (including share transfers between related accounts). No pairs of nodes transferred shares in more than two years. There are two likely explanations for this phenomenon. First, share transferors may have been selling their entire quota and therefore were unable to participate in more transactions. Second, share transferees may have reached the cap on quota accumulation and thus would not participate in future transactions.

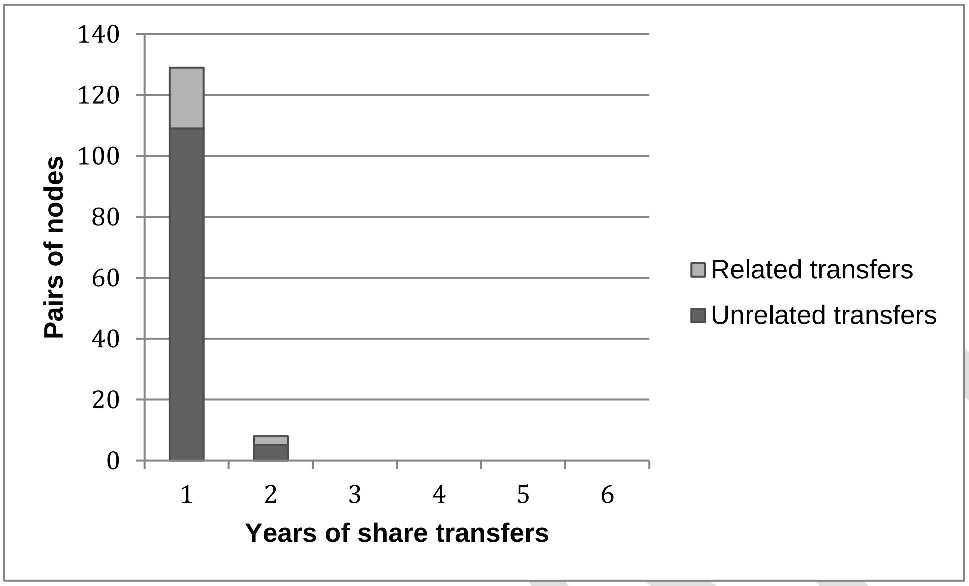


Figure 7: Length of relationship of share transfer network participants. A majority of participants interacted with each other in only one year.

In addition to the compositional network characteristics just discussed, some structural measures of network cohesion can also be calculated. Cohesion can be thought of as how "interconnected" a network is. Table 3 summarizes these measures. It should be noted that these measures were calculated only for share transfers that occurred between *unrelated* accounts in order to get a sense of the structure of the network of independent actors. When the relationship between actors was unknown, they were assumed to be unrelated for the purposes of this analysis.

Fishing Year	Unrelated Nodes	Unrelated Ties	Network Density	Components	Degree Centralization	Average Degree Centrality
2010	7	5	0.238	2	0.367	1.429
2011	12	7	0.106	5	0.091	1.167
2012	49	38	0.032	11	0.097	1.551
2013	28	18	0.048	10	0.068	1.286
2014	28	19	0.048	11	0.108	1.286
2015	39	30	0.039	11	0.07	1.487

Table 3: Measures of network cohesion for IFQ share transfer networks (unrelated transfers only).

Network density (i.e., the interconnectedness of the network as measured by the number of existing ties as a proportion of the number of possible ties) was quite low across all years, indicating a sparsely populated and potentially disconnected network. In 2010 and 2011, network density was higher than in later years due to the small number of nodes. From 2012-2015, network density ranged from only 3.2%- 4.8%.

Another measure of the connectedness of a network is the number of components (i.e., disconnected sub-groups) that form the network. Assuming the same number of network participants, the smaller the number of components, the more connected the network. In 2010-2011, there were few components due to the small number of actors. From 2012 to 2015, the number nodes decreased but the number of components stayed relatively stable, pointing to a network that may be becoming less cohesive over time. The extent to which this is true in this particular network is questionable, however, given the low frequency of repeat relationships. Less cohesion may simply be an artifact of mostly new actors engaging in transfers each year; it would not be expected that networks formed of new participants would be particularly cohesive.

Network degree centralization is a measure of the concentration of power in a network. A star network in which a central actor has exclusive access to all other actors, and therefore controls the flow of information and resources between actors, has a degree centralization of 100%. The General Category Atlantic Sea Scallop IFQ share transaction network is both sparse and disconnected and thus had low degree centralization over the life of the program, ranging from a low of 6.8% in 2013 to a high of 36.7% in 2010. Once again, the high level of centralization in 2010 is somewhat misleading because of the small number of nodes in the network and the existence of a small star sub-group. Years 2012-2015 are a more accurate representation of degree centralization in the share transaction network, with an average of 8.5% across those years. This suggests that power is largely distributed throughout the network; no one actor has disproportionate influence. Researchers concerned with equity among actors in a network would consider this a positive finding.

The structural measures just discussed focus on the network as a whole. Average degree centrality is slightly different in that it calculates node-level degree centrality across all of the individual nodes in a network. Recall from above that degree centrality refers to the number of other nodes to which a node is connected. In the IFQ share transaction network, average degree centrality is quite low across all years, ranging from 1.167 to 1.551. While every social network has unique structural characteristics that make comparisons difficult, this could be interpreted as a small average number of connections, again indicating a sparse network and low cohesion.

3.3 IFQ Quota Leasing Networks

Figure 8 represents the networks of Atlantic Sea Scallop IFQ leases for the 2010-2015 fishing years. As in the previous analysis of share transfers, nodes represent businesses entities, lines represent at least one transfer of quota in that fishing year, and arrowheads indicate the direction of the transfer (transferor to transferee). Grey lines represent quota leases between unrelated accounts (i.e., no owners in common), red lines represent leases between related accounts (i.e., at least one owner in common), and green lines represent leases between accounts of unknown relation due to missing data.

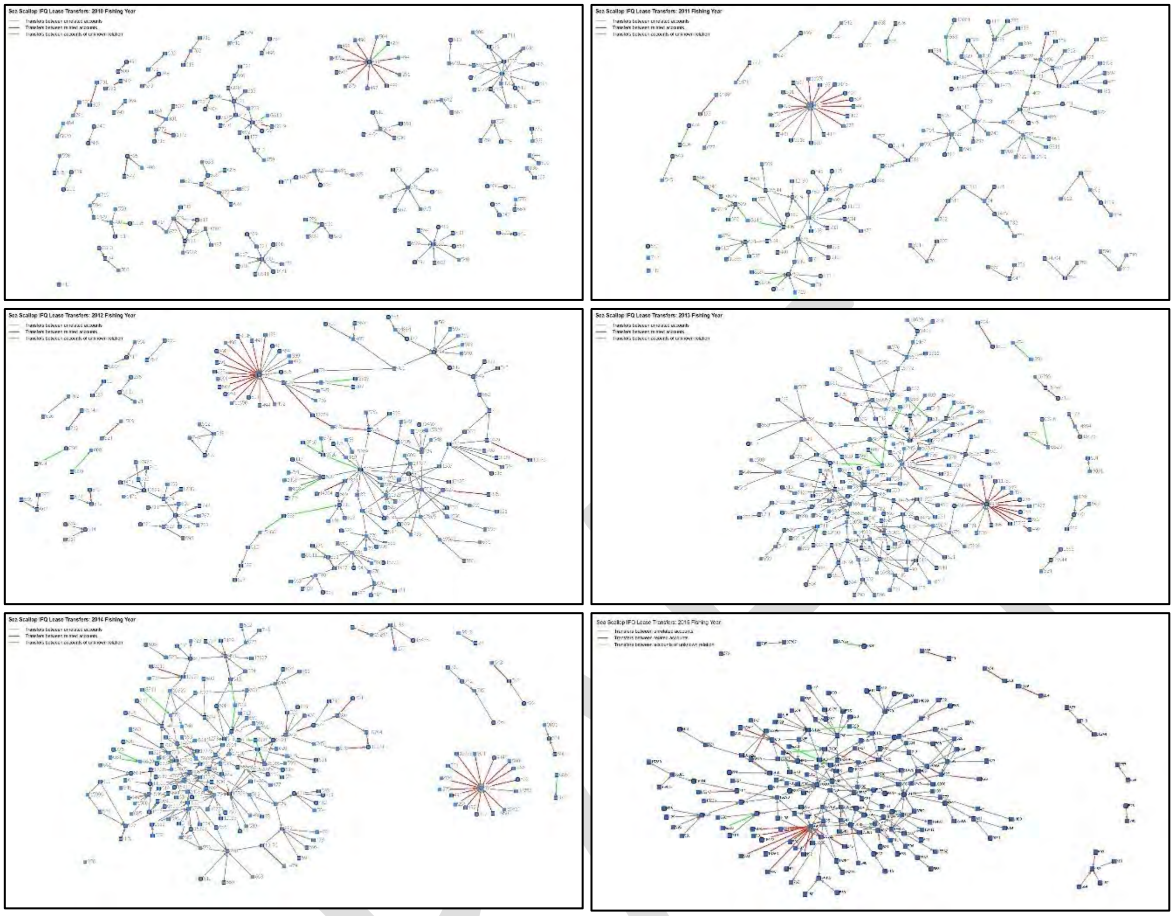


Figure 8: Atlantic Sea Scallop IFQ quota leasing networks, 2010-2015 fishing years (first row: 2010-2011; second row: 2012-2013; third row: 2014-2015). Nodes represent business entities; lines represent at least one quota lease in that fishing year.

It is immediately apparent that the IFQ leasing networks are significantly different from the share transfer networks in both composition and structure. First, the number of participants and the number of relationships in the leasing network are much greater. In 2010, 177 business entities participated in lease transactions (versus eight in the 2010 share transaction network); this number increased in subsequent years. In addition, in 2010 there were 147 ties between business entities, which increased to 256 in 2015 (Figure 9).

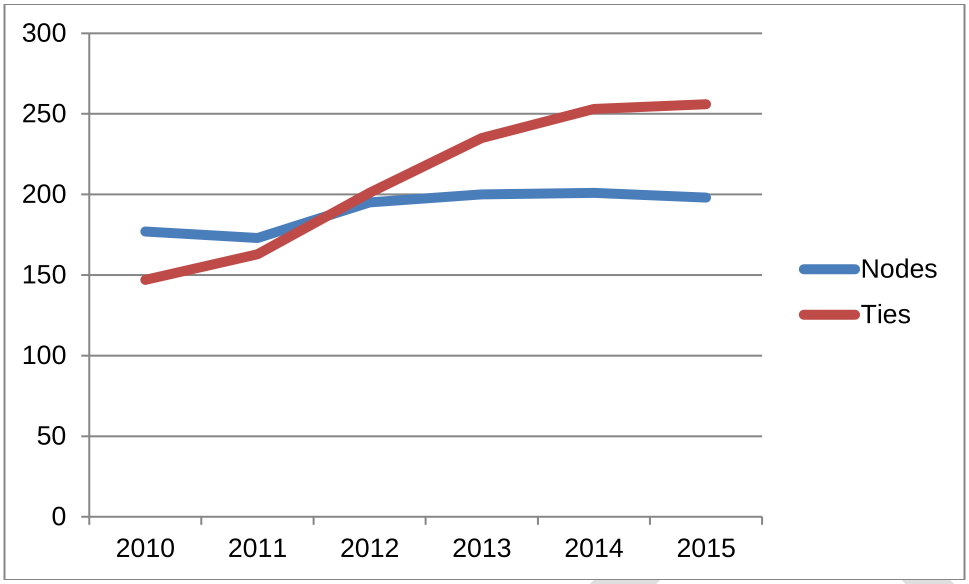


Figure 9: Number of nodes and ties in the Atlantic Sea Scallop IFQ quota leasing networks, 2010-2015 fishing years.

Second, while share transfers usually occurred among small components of 2-3 nodes, particularly in the earlier years, the quota leasing networks are characterized by much larger components. The 2010 network contains components ranging from 2 to 20 nodes. In later years, the main (i.e., largest) component size increased substantially as the network became more cohesive, peaking at 178 participants in 2013. Other measures of network cohesion will be discussed in more detail below.

Third, unlike in the share transfer networks in which actors tended to participate in transfers in only one year, the quota leasing networks are characterized by reoccurring actors. However, much like in the share transfer networks, few repeat relationships occurred. Figures 10-12 illustrate these patterns. Figure 10 is a visualization of the aggregated quota leasing networks from 2010-2015, with nodes shaded according to the number of years of participation in quota leases. Darker nodes participated in quota leasing more frequently and form about half of the network.

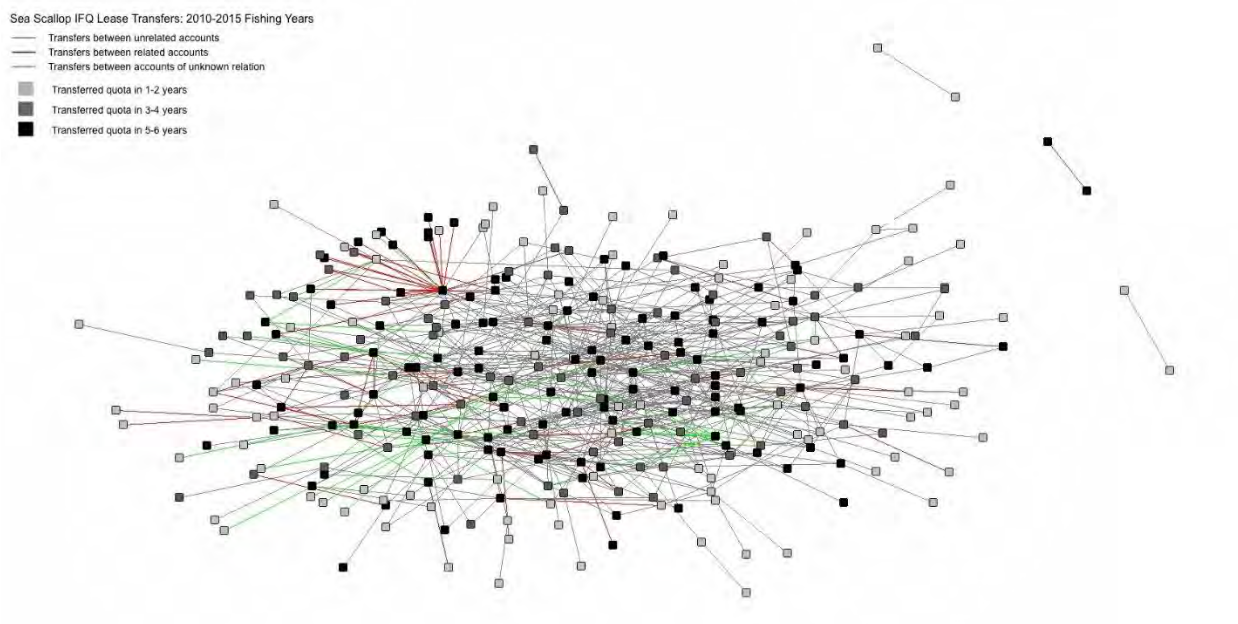


Figure 10: The aggregated 2010-2015 quota leasing network. Nodes are shaded according to the number of years they participated in quota leasing.

Figure 11 quantitatively summarizes the network in Figure 10. Of 312 total unique business entities, 79% participated in lease transactions in two or more years, and 53% participated in lease transactions in four or more years between 2010 and 2015.

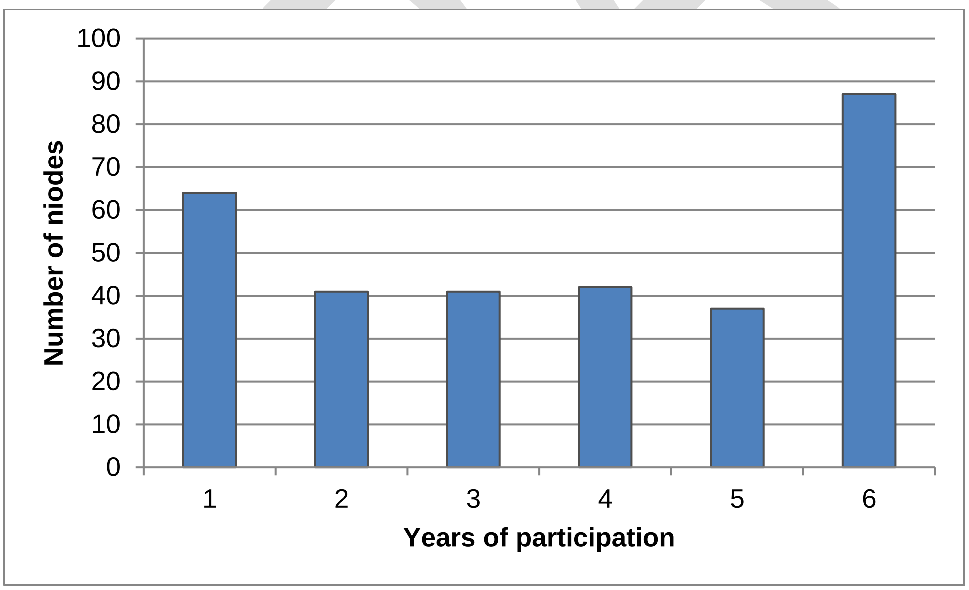


Figure 11: Years of participation in quota leasing. Over 50% of participants participated in quota leasing in four or more years.

Figure 12 illustrates the number of years in which transfers occurred between the same pairs of business entities, indicating a small number of repeat relationships. Of 837 unique pairs of quota transferors and transferees between 2010-2015, 639 pairs (74%) transferred shares in only one year. Only 14 pairs of nodes transferred quota in all six years, eight of which were between related accounts.

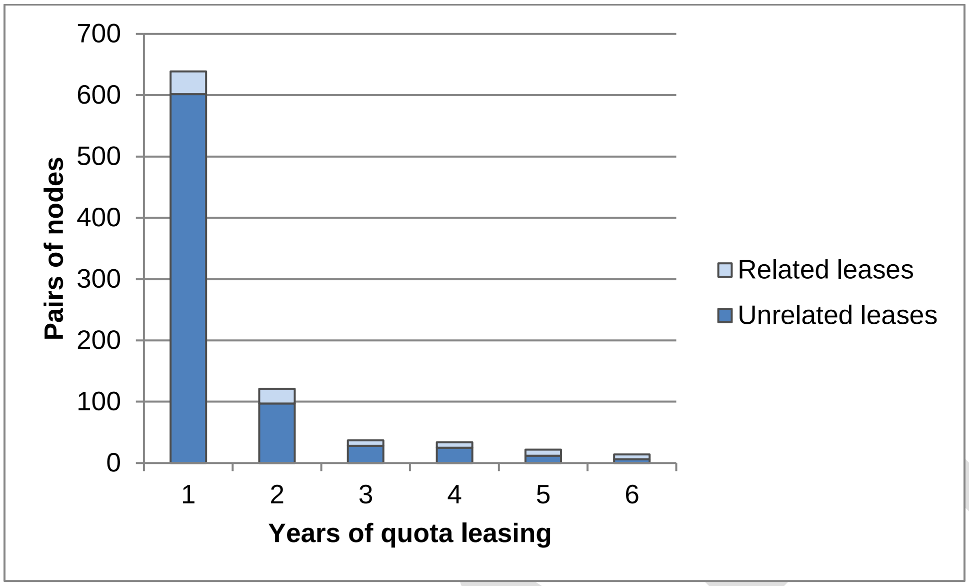


Figure 12: Length of relationship of quota leasing network participants. A majority of participants interacted with each other in only one year.

As in the analysis of share transfers, structural measures of network cohesion were also calculated for the quota leasing networks. Table 4 summarizes these measures. These measures were calculated only for quota leases that occurred between *unrelated* accounts, again assuming no relation where one was unknown.

Fishing Year	Unrelated Nodes	Unrelated Ties	Network Density	Components	Degree Centralization	Average Degree Centrality
2010	150	124	0.011	34	0.05	1.653
2011	144	136	0.013	15	0.058	1.889
2012	169	173	0.012	14	0.072	2.047
2013	178	204	0.013	10	0.067	2.292
2014	176	218	0.014	9	0.073	2.42
2015	173	226	0.015	7	0.067	2.601

Table 4: Measures of network cohesion for the IFQ quota leasing networks (unrelated transfers only).

Network density increased slightly between 2010-2015 but was generally low, ranging from 1.1%-1.5%. This stability in network density is due to simultaneous increases in the number of nodes and ties. In other words, while the number of ties increased over time, which would normally lead to an increase in density, so did the number of nodes. Thus the proportion of actual ties to possible ties remained stable over time. This indicates that that network is growing over time, but that actors are not necessarily forming many redundant pathways to each other (i.e., the networks remained sparse).

Changes in the number of components tell a similar story. In 2010, the quota leasing network had 34 individual components. This number decreased each year, culminating in only seven components in 2015. This decrease in the number of components occurred despite an increase in the number of nodes, indicating that the network became more connected over time and incorporated new nodes into the main component. This is clearly visible in the network diagrams above (Figure 8) as the main component gets larger, incorporating the smaller peripheral components.

Network degree centralization in the quota leasing networks was relatively low, ranging from a low of 5% in 2010 to a high of 7.3% in 2014. The highest levels of degree centralization occurred in 2012 and 2014, likely due to a few actors who were in key bridging positions between large clusters of nodes, giving them more the power to control information flow throughout the network. These actors were not consistently in the same bridging positions in multiple years, however, so their positions in the 2012 and 2014 networks may have been a random event. Overall, an average degree centralization of 6.4% across all years is low, suggesting that power is distributed throughout the network. Various pathways are available to connect network actors and no one actor has disproportionate influence.

Finally, average degree centrality increased over time, beginning at 1.653 in 2010 and culminating in 2.601 in 2015. On average, then, network participants became more connected to each other over time. While an average of 2.6 connections is relatively low, it is an indication that the network became more cohesive over time.

In sum, stable network density despite an increase in network size, a decrease in the number of components, and an increase in average degree centrality all suggest that the IFQ quota leasing network has become more cohesive over time, potentially consolidating into a leasing market. However, power in the network, as measured by degree centralization, has not become monopolized by only a few actors.

4. IFQ Fleet Dealer Transaction Networks

Fishery management actions do not simply affect fishermen, but can also have cascading effects throughout the fishing industry. Given that fact, the final component of this project consisted of an analysis of the relationships between federally permitted seafood dealers and the IFQ fleet. In this case, the IFQ fleet was defined as vessels that held only an IFQ permit for sea scallops (i.e., were not dual permitted for scallops) in the given fishing year. However, not all vessels in these networks sold sea scallops, nor did all dealers in these networks purchase sea scallops from each IFQ vessel with which they interacted.

4.1 Data Processing

This analysis was conducted using a database of sales transactions between federally permitted seafood dealers and permitted vessels for the 2010-2015 fishing years, minus the final two months of the 2015 fishing year (January and February 2016). Fields in the sales database for each transaction included the date (month/year), vessel permit number, dealer number, species, landings, and value. Again, it is important to note that while all dealers in this analysis received landings of at least one species from IFQ vessels, they did *not* necessarily receive sea scallops from those vessels.

As in the IFQ share and quota transaction analysis discussed in Section 3 of this report, we believed that it was most informative to conduct this analysis using the business entities associated with permitted vessels, rather than the vessels themselves. This allows for a better understanding of the social and economic relationships between fishermen and dealers (remembering that many businesses have multiple permitted vessels and that those vessels can change ownership). By aggregating transfers at the business entity level, we get a better sense of the social and economic map created in response to the IFQ program. Dealer data was not aggregated in any way.

As in prior analyses, linking businesses entities to vessel permits involved significant effort. The first step consisted of matching the date of the sales transaction to the vessel permit owner *on that date*. This was done using a database of permit applications that contained the permit number, dates the permit was issued and canceled, and the business name and ID. This process resulted in exact matches for approximately half of the records; for the other half, the date of the transaction did not match with the time span of a permit for that vessel. This was further complicated by the fact that the dealer data is reported monthly, but permit ownership can and does change multiple times within a given month. Filling in missing data required manually searching for the permit numbers in the ownership database and using the most recent owner prior to the date of the dealer transaction, or making an educated guess when changes of ownership occurred within a month. For example, when permit ownership changed hands for only one day in a given month, and landings were reported in that same month, it was assumed that the one-day owner was the business entity that was conducting the fishing and completing the dealer transaction. Ultimately, of 57,913 sales transaction records between 2010-2015, only 646 records were filled in using questionable data, all of which were repetitions of the same 28 business entities. The networks generated from this analysis are therefore likely largely correct, but should still be viewed with some caution.

4.2 Dealer Transaction Networks

Figure 13 presents the two-mode dealer networks for select fishing years between 2010 and 2015. Dealers are represented by blue squares and business entities are represented by red diamonds. Edges indicate landings of at least one species (not necessarily sea scallops). Dealer nodes are sized by the pounds of sea scallop received in that fishing year, and those that received more than 50,000 pounds of sea scallops in that year (aka “key dealers”) are labeled with an ID number.

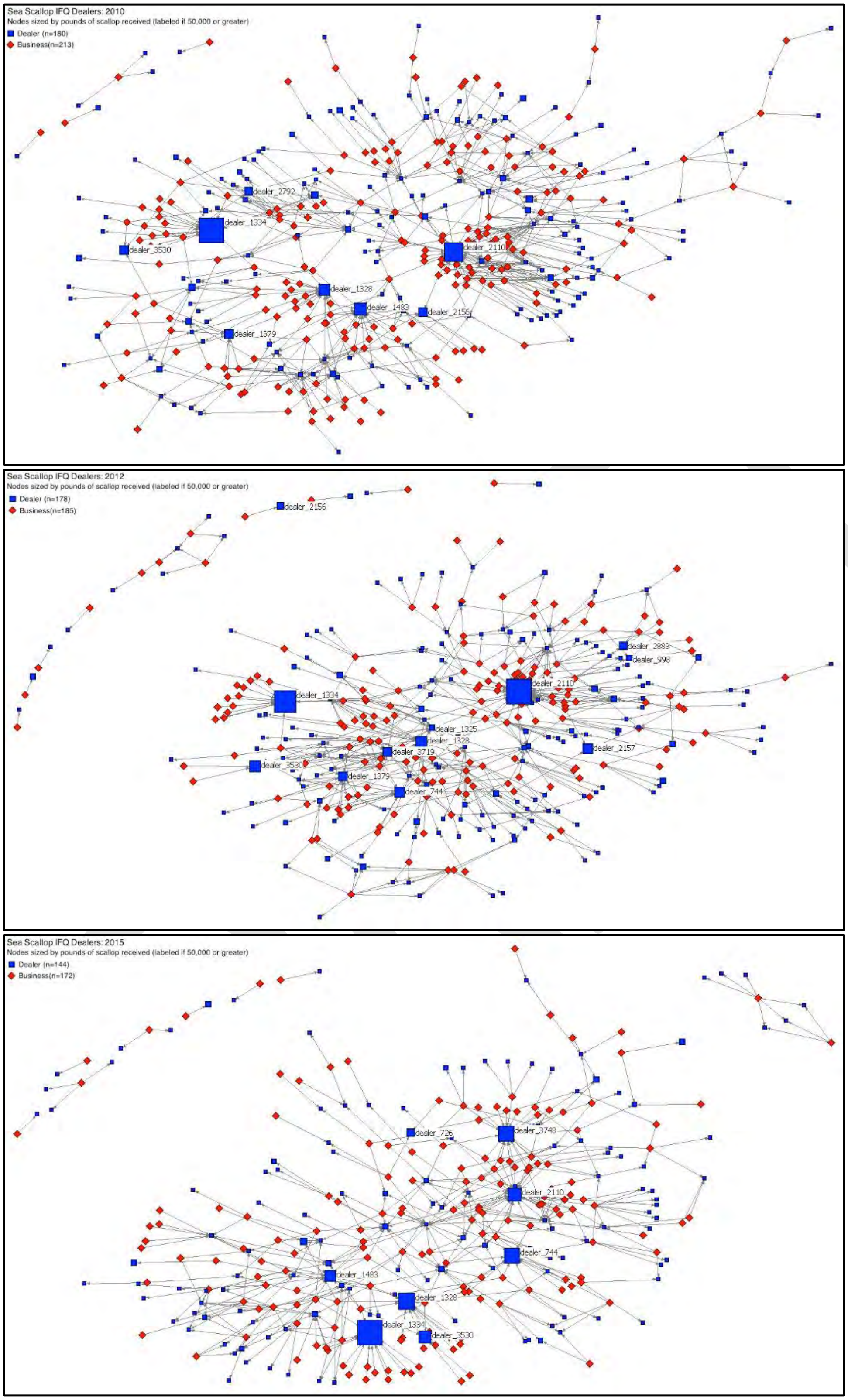


Figure 13: Sea scallop IFQ dealer networks for the 2010, 2012, and 2015 fishing years. Dealers are represented by blue squared, businesses entities are represented by red diamonds. Dealer nodes are

sized by pounds of sea scallop received in that fishing year. Dealers that received more than 50,000 lbs of sea scallops are labeled.

In interpreting these networks, four characteristics are notable. First, the networks are quite consolidated. Essentially all of the nodes are part of the main central component and there are very few peripheral sub-groups (only 5 in 2010, 10 in 2012, and 9 in 2015). Second, despite the high level of consolidation, the networks are extremely sparse. Network density is quite low; only 1-2% of all possible ties exist, indicating that fishing businesses tend to transact with a small number of dealers, and vice versa. Third, over the course of the IFQ program, the number of IFQ-associated businesses entities has decreased, as has the number of dealers receiving landings from them (Figure 14).

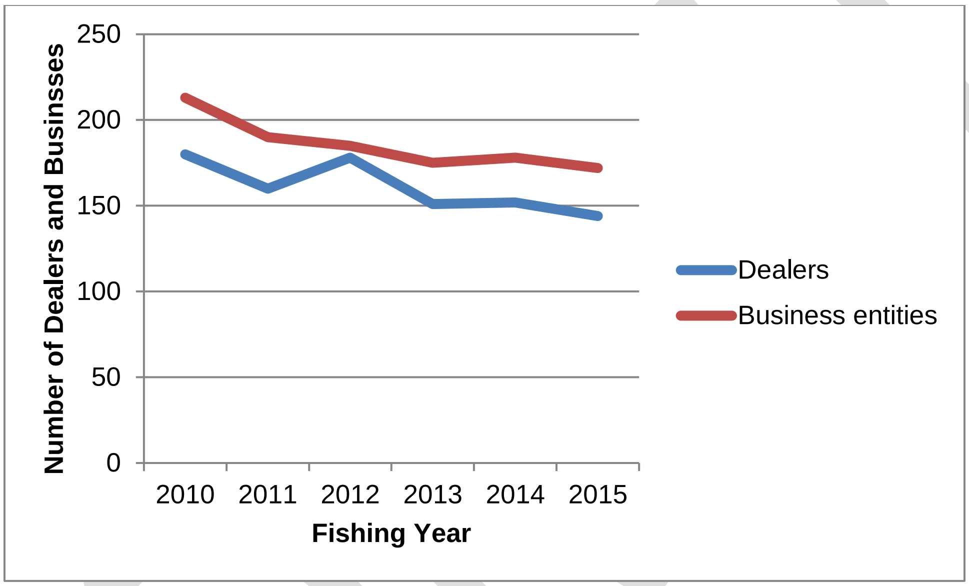


Figure 14: Number of dealers and businesses in the IFQ dealer network over time.

In addition, as in the IFQ share and lease transaction networks, a majority (68%) of participants in the dealer network interacted with each other in only one or two years (Figure 15). Longer-term relationships were more rare; only 10% of participants interacted in all six years of the program. It should be noted, however, that these seemingly short-term relationships could be an artifact of individual owners conducting business under different businesses entities from year to year with the same dealers.

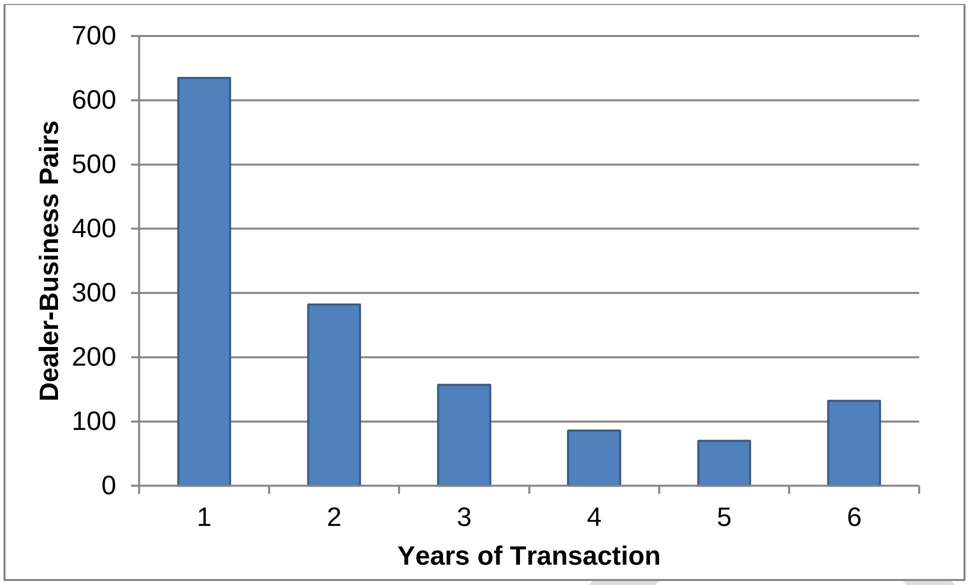


Figure 15: Number of dealers and businesses in the IFQ dealer network over time.

Finally, there is some consistency in a dealer's role as a "key dealer". Across all six fishing years, there were 19 dealers that received more than 50,000 lbs of sea scallops in at least one year. Of those, five (26%) achieved this status in two or fewer years, and 14 (74%) achieved this status in three or more years (Figure 16). In other words, the largest dealers have remained somewhat consistent over time, though new actors occasionally emerge.

Figure 16: Number of years in which key dealers (i.e., those receiving more than 50,000 lbs of sea scallop in at least one fishing year) retained their status as key dealers.

7. Conclusions

Network analysis can be a useful tool for understanding the cumulative and longitudinal impacts of catch share programs. Visual representations of transaction networks can be extremely informative, allowing for the identification of patterns that may be difficult to see when transactional data are stored in a traditional database format. In addition, network analysis allows for a deeper understanding of the social environment created in response to shifts in natural resource management policies. What, then, can be said about the Atlantic Sea Scallop IFQ Program in the six years since its inception?

The IFQ program, similar to many catch share programs around the country, stimulated the formation of an active leasing market, in which participation is relatively consistent across years. The same cannot be said for the share market, which is much more limited in scope and in which participation is largely inconsistent. However, in both the lease and share transaction networks, very few relationships lasted more than a year or two, indicating that the relationships that form are likely economic in nature, perhaps driven by convenience, rather than new lasting social connections that might influence behavior in the future. The same seems to be true of seafood dealer-fisherman relationships. While the largest seafood dealers have retained their status since the beginning of the IFQ program, the relationships they form with fishermen largely seem to be short-lived.

The current project is the first attempt to use network analysis to evaluate long-term effects of the Atlantic Sea Scallop IFQ program, six years after its implementation. This report presents a summary of the activities conducted for this project. For more information, please contact Lisa Colburn (lisa.l.colburn@noaa.gov) or Gabriela Stocks (gabriela.stocks@gmail.com).

Average degree centrality: The average number of nodes to which other nodes are connected.

Components: Portion of the network that are disconnected from each other; isolated sub-groups.

Degree centralization: A measure of the concentration of “power" in a network. A star network, in which one central actor is connected to all other actors but those other actors are not connected to each other, has a degree centralization of 1.0 or 100%.

Density: The number of existing ties as a proportion of the total number of possible ties.

Edge/Tie: A line indicating a relationship between network nodes.

Node: An actor in a network

APPENDIX K – TABLES AND FIGURES

Prepared by Dr. Demet Haksever, Council Staff

Table 22. Affiliations, permits and allocations

Fishyear	Values	Business entity	Permit Bank	Grand Total
2010	Number of affiliations	230	3	233
	Number of permits	309	22	331
	% share of allocations	90%	10%	100%
2011	Number of affiliations	214	4	218
	Number of permits	315	15	330
	% share of allocations	93%	7%	100%
2012	Number of affiliations	213	4	217
	Number of permits	301	16	317
	% share of allocations	92%	8%	100%
2013	Number of affiliations	216	4	220
	Number of permits	299	17	316
	% share of allocations	92%	8%	100%
2014	Number of affiliations	208	4	212
	Number of permits	300	16	316
	% share of allocations	92%	8%	100%
2015	Number of affiliations	188	4	192
	Number of permits	296	17	313
	% share of allocations	92%	8%	100%

Figure 11. Number of inactive affiliations by leasing activity

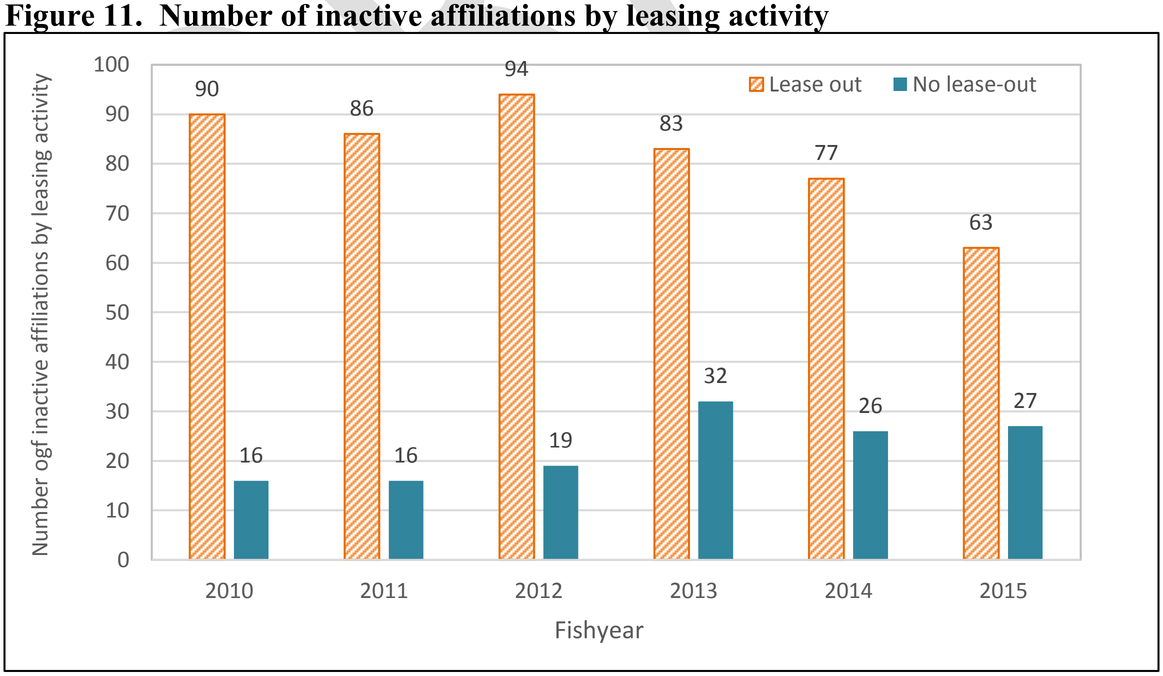


Table 23- DAS and access area allocations per full-time vessel

Year	Action	AA trips	CA1	CAII	NLS	HC	ETA	DMV
2010	FW21	4	Closed	Closed	1 trip	Closed	2 trips	1 trip
2011	FW22 and EA	4	1.5 trips	0.5 trips	Closed by emergenc y	1 trip	converted to open area	1 trip
2012	FW22 and EA	4	1 trip[13]	1 trip	0.5 trips	1.5 trips	Closed (Dec 12, 2012, by EA)	Closed by EA (trips convert ed to CA1)
2013	FW24	2	118 trips[14]	182 trips	116 trips	210 trips	Closed	Closed
2014	FW25	2	Closed	197 trips	116 trips	Closed	Closed	313 trips[15]
2015	FW26	3[16]		Closed	Closed	Merged into one MAAA, but inshore part of ETA closed		

[13] *1 trip after emergency action May 2012 (157 vessels get initial trip per FW22 and 156 get CA1 trip converted from initial DMV trip).*
[14] *FW25 then allows unused trips to be carried over to future year.*
[15] *Vessels given choice of Delmarva trip or 5 DAS.*
[16] *Vessels were not allocated trips in access areas, instead a poundage was allocated with a possession limit.*

APPENDIX J – OPPPORTUNITY COSTS OF CAPITAL

Prepared by Dr. Demet Haksever, Council Staff

As a first step in estimating opportunity costs of capital, scallop vessel values are estimated using 2011-2012 cost survey data. Because the data is available and only for a limited number of vessels, the estimations including some macro values such as interest rates or vessel characteristics other than length turned out to be statistically insignificant. For those reasons, values of vessels active in the scallop fishery are estimated as function of vessel length (LEN), crew size (CREW), and scallop revenue (SCREV) using a double logarithmic function including vessels with IFQ permits. The results show that those three variables (LEN, CREW and SCREV) explain about 80% of the variation in vessel values with statistically significant coefficients. The variations in the level of scallop revenue per vessel seems to have the largest influence, followed by length of vessels and crew size (Table 24).

The equation provided in Table 24 is used to estimate the values for each vessel operating in the fishery. In the next step, opportunity costs for the fleet were estimated using Moody's Seasoned Baa Corporate Bond Yield.

Table 24. Estimation of vessel values

The MODEL Procedure

Nonlinear GMM Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin Watson
lnvesval	4	46	11.1107	0.2415	0.4915	0.8138	0.8017	2.0734

Nonlinear GMM Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
INTERCEPT	2.035421	1.2991	1.57	0.1240
CREW	0.688399	0.2547	2.70	0.0096
LEN	2.043248	0.3625	5.64	<.0001
SCREV	0.189819	0.0250	7.58	<.0001

Number of Observations		Statistics for System	
Used	50	Objective	4.12E-26
Missing	3	Objective*N	2.06E-24

Opportunity costs of labor we estimated using average hourly earnings of production and nonsupervisory employees.

APPENDIX K - Guidance for Conducting Review of CSPs

Department of Commerce · National Oceanic & Atmospheric Administration · National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE PROCEDURAL INSTRUCTION 01-121-01
April 13, 2017

Fisheries Management
Catch Share Policy 01-121

Guidance for Conducting Review of Catch Share Programs

NOTICE: This publication is available at: http://www.nmfs.noaa.gov/op/pds/index.html

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SUMMARY OF REVISIONS:

Signed Emily Menashes 4/13/2017
Emily Menashes
Acting Director, Office of Sustainable Fisheries
Date

I. Introduction

The goal of this guidance is to provide a resource to help ensure the reviews of catch share programs (CSPs) are comprehensive and targeted at meeting statutory requirements; coordinated with stakeholders; carried out in a transparent, efficient, and effective manner; and are conducted by applying consistent standards across the country while allowing necessary regional flexibility. This guidance applies to CSPs established by the Regional Fishery Management Councils (Councils) or the Secretary of Commerce (Secretary).[1,2] This guidance is based on a variety of sources, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA),[3] particularly sections 301, 303, and 303A; the NOAA Catch Share Policy (CS Policy);[4] The Design and Use of Limited Access Privilege Programs (LAPPs) (Holliday and Anderson 2007);[5]

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[1] This guidance is also applicable to Atlantic Highly Migratory Species CSPs established by the Secretary under MSA sec. 304(g).

[2] Please consult with NMFS and NOAA General Counsel regarding questions on the application or implementation of this guidance.

[3] http://www.nmfs.noaa.gov/sfa/magact/MSA_Amended_2007%20.pdf

[4] http://www.nmfs.noaa.gov/sfa/management/catch_shares/about/documents/noaa_cs_policy.pdf

[5] http://spo.nmfs.noaa.gov/tm/tm86.pdf

reviews that have already been completed (Bering Sea and Aleutian Islands (BSAI) Crab Rationalization,[6] Amendment 80 (BSAI non-pollock Cooperatives),[7] Gulf of Mexico (GOM) Red Snapper,[8] and Pacific sablefish permit stacking);[9] reviews currently underway and interim reports related to such reviews for various CSPs, including Gulf of Alaska (GOA) rockfish,[10] GOM grouper-tilefish Individual Fishing Quotas (IFQ),[11] Northeast Limited Access General Category Scallops IFQ,[12] and Pacific groundfish trawl rationalization,[13] as well as discussions among National Marine Fisheries Service (NMFS) staff.

II. Applicability of Guidance

Section 303A(c)(1)(G) of the MSA requires the Councils and Secretary to "include provisions for the regular monitoring and review by the Council and the Secretary of the operations of the program, including determining progress in meeting the goals of the program and this Act, and any necessary modification of the program to meet those goals, with a formal and detailed review 5 years after the implementation of the program and thereafter to coincide with scheduled Council review of the relevant Fishery Management Plan (FMP); but no less frequently than once every 7 years)" of all LAPPs established after January 12, 2007. [14,15] This requirement applies to LAPPs established under Secretarial authority as well. The date a program was established is the effective date of the action in the final rule that implemented the program. If a component from this guidance is determined not applicable for a specific review, the Council should document in its final plan for the review its rationale for why the component is not applicable.

[6] http://www.npfmc.org/crabrationalization/
[7] https://npfmc.legistar.com/View.ashx?M=F&ID=3300713&GUID=DB925E16-602F-41BD-8690-8156BEC4FB82
[8] http://www.gulfcouncil.org/docs/amendments/Red%20Snapper%205-year%20Review%20FINAL.pdf
[9] http://www.pcouncil.org/wp-content/uploads/2015/06/Final_FGSPS_PrgmRev.pdf
[10] http://www.npfmc.org/wp-content/PDFdocuments/catch_shares/Rockfish/RPPreview508.pdf
[11] http://sero.nmfs.noaa.gov/sustainable_fisheries/ifq/documents/pdfs/annual_reports/2015_gt_annualreport_final.pdf
[12] http://www.nefmc.org/library/ifq-report-information
[13] http://www.pcouncil.org/groundfish/five-year-review-trawl-catch-share-program-amendment-20-intersector-allocation-amendment-21/
[14] The CS Policy indicates that periodic reviews are expected of all CSPs, regardless of whether the program is a LAPP or when it was put in place. Thus, the Northeast Multispecies Sector, which is not a LAPP, and CSPs implemented prior to January 12, 2007, should undergo periodic review. The CS Policy states: "NOAA recommends Councils apply the LAPP review and duration principles and requirements to all catch share programs."
[15] Reviews of the Western Alaska (AK) Community Development Program (CDQs) are not covered by this guidance as that program is subject to separate statutory requirements for review, and the state of AK has responsibility for conducting that review.

III. Periodicity of Reviews

A. Initial Reviews. For CSPs established after January 12, 2007, the initial review should be initiated no later than 5 years after the program was implemented (MSA sec. 303A(c)(1)(G)). For CSPs established prior to January 12, 2007, the requirement to initiate the first review 5 years after implementation does not apply. However, because the CS Policy indicates that periodic reviews are expected of all CSPs, reviews for CSPs established prior to January 12, 2007, should be initiated no later than 7 years after the CS Policy went into effect in 2010 (i.e., no later than the end of calendar year 2017), consistent with MSA's requirement for subsequent reviews.

The MSA does not preclude an earlier review, but it is not recommended. The Councils and NMFS should be mindful that it takes time for program participants and related entities (e.g., dealers/first receivers, processors, bait/tackle shops, etc.) to adjust to a new program. In turn, there will be a lag between when those behavioral adjustments occur and when they can be discerned, analyzed, and understood. The Councils and NMFS should also follow any timelines for additional program reviews specified by the FMP or FMP amendment (hereinafter collectively referred to as "FMP") that created or modified the CSP.

B. Subsequent Reviews. According to Section 303A(c)(1)(G) of the MSA, all subsequent reviews should coincide with scheduled Council review of the relevant FMP, but no less frequently than once every 7 years.[16] Thus, for CSPs established after January 12, 2007, the second review should be initiated before the end of the program's 12th year, regardless of when the initial review was actually completed. How and when Councils review their FMPs, or parts thereof, varies by Council. The Councils and NMFS should follow any timelines for additional program reviews specified by the FMP creating the CSP and should not conduct reviews more frequently than every 3 years for the purpose of complying with the MSA requirement or CS Policy.

IV. Process and Procedures

A. Review Plan. Ideally, a general plan for conducting future reviews should be outlined when the CSP is being developed, or as soon as feasible thereafter. This outline should cover necessary data collections, data analyses/models, a timeline for implementing and/or completing each required task within that plan, as well as staff and funding requirements. Since the review will require data from the first day of the program, and preferably prior to the program's

[16] As with a new program, if significant changes are made to an existing program, it will take time for program participants and related entities to adjust and lags between when the adjustments occur and when they can be discerned, analyzed, and understood should be expected.

implementation, every effort should be made to ensure the necessary data collection programs are put in place when the program is being developed or implemented. Otherwise, potentially significant data gaps may be created which will later confound the analyses needed for the review. The first year or two of a program is critical with respect to discerning how program participants and related entities are adjusting to the program. Further, data collections associated with CSPs will most likely require Paperwork Reduction Act (PRA) clearance, and that process often takes at least 6 months. Similarly, if external assistance is needed to conduct certain analyses, the contracting process can also introduce delays. The content of the outline should be periodically refined, revised, and updated as additional information becomes available and issues are identified.

The review plan outline should be converted into a final plan prior to initiating the review. The earlier the plan is finalized, the more time is available to conduct any necessary supplementary/specialized data collections and acquire the resources needed to conduct the review, if any. This detailed review plan should provide a transparent overview of how the review will be conducted and over what time period, and includes what elements will and/or will not be analyzed as part of the review as outlined in sections V and VI below. Additionally, approval of the review plan by the Council and concurrence from NMFS that the review plan meets the requirements of the MSA should occur at this point.

B. Review Team. Establishment of a review team is an effective way to facilitate the development of the review plan and process. The Council should determine appropriate members for the review team. It would be useful to include members of the Plan Development Team, or equivalent, who worked on the implementing action or made significant changes to the program where possible, as well as staff responsible for administering or overseeing the program. This will promote continuity in the program's development, implementation, evaluation, and revision process. The Council should consider representatives from the Council, Regional Office, Science Center and Office of Law Enforcement to ensure their respective issues and concerns are appropriately addressed in a timely manner.[17] If needed, external expertise or contract support can be included as part of the review team. The distribution and nature of responsibilities for the review should be clearly identified as early as possible in the process, with the Council determining the "lead" or "co-leads" of the review team. Each organization represented on the review team should play a role in the review, understanding that the distribution of appropriate staff, data management responsibilities, and analytical capabilities varies by region and Council.

C. Interim Reports. In some cases, Regional Offices, Science Centers, and/or Councils have already developed annual or biennial reports for existing CSPs. These reports should be

[17] For CSPs created under Secretarial authority, team composition will vary to some degree.

considered when completing the 5/7 year reviews as they can serve to refine and revise the review plan and act as important source documents for the 5/7 year review.[18] Further, the annual/biennial reports could be used to identify gaps in the available data and analyses and other unforeseen issues, in turn allowing time for these gaps to be filled and issues addressed prior to the conduct of the more formal and detailed review. For example, a Stock Assessment and Fishery Evaluation (SAFE) report that adequately covers the program under review may be an additional source document for the 5/7 year review. Although interim reports should make use of standardized approaches to the extent possible, specific content is a local determination. These interim reports could be used to elicit feedback from program participants and interested stakeholders about the pros and cons of the program.

D. External Input. Program participants and other entities have a vested interest in program performance and the outcomes arising from program reviews. Therefore, each Council should establish a mechanism for public input that could include sharing drafts of the 5/7 year program review document with Council advisory groups (e.g., Scientific and Statistical Committees (SSCs), Advisory Panels (AP), etc.).

E. Finalizing Reviews. The 5/7 year review will be considered a Council document. The Regional Administrator (or designee) will participate in the review process as a partner in the Council process, and serve as the NMFS primary point of contact. Once the review is completed, the results would be submitted to the Council for approval and NMFS for concurrence[19] that the review meets the requirements of the MSA and is consistent with this guidance.

V. General Approach, Scope of Review, and Use of Standardized Approaches

A. General Approach. The initial review will compare and analyze the fishery before and after the program's implementation, to the extent necessary data prior to the program's implementation are available. Best available scientific information should be used for the review. If quantitative analyses are not available, qualitative assessments may suffice. We reference existing analytical approaches throughout this document, but use of new or updated approaches is encouraged where appropriate. As part of the initial development of a CSP, the Council and Secretary will have conducted an analysis of the program's expected effects (i.e., an ex-ante analysis) in the FMP that created the program and its associated National Environmental Policy Act (NEPA) analyses. A 5/7 year review of a CSP is a retrospective evaluation of an

[18] See Section I of this Guidance for examples of such reports in certain programs.
[19] Such concurrence will likely be given at the time of Council approval as any substantive issues regarding whether the review itself meets the requirements of the MSA should have been resolved in the development of the review plan.

established program[20]. Thus, rather than analyzing the program's expected effects, the task in a 5/7 year review is to describe and analyze the effects that have actually taken place since the "baseline" time period prior to the CSP's implementation, or since the program's implementation (i.e., an ex-post analysis). Therefore, Councils need to consider an appropriate baseline for comparison. A baseline period of at least 3 years is preferable, but this may be modified depending on circumstances surrounding the creation and implementation of each program.

Additional data collection programs have been implemented in conjunction with most, if not all, CSPs, so the initial 5-year review may be somewhat limited by a lack of data for the time prior to when the CSP was established. However, subsequent reviews should not be similarly hindered as, ideally, all necessary data collection programs will be in place prior to those reviews. Even if pre-program data are somewhat limited, the review should describe and analyze any changes that have taken place since the program's implementation, with a general focus on performance trends over that time rather than performance in a specific year.

The review should contain the following eight elements. If an element is determined not applicable for a specific review, the Council should document in its final plan for the review its rationale for not conducting a more formalized analysis of that element. The eight elements are: 1) purpose and need of the review (discuss legal/policy requirements), 2) goals and objectives of the program, the FMP, and the MSA, 3) history of management, including a description of management prior to the program's implementation, a description of the program at the time of implementation (including enforcement, data collection, and monitoring), and any changes made since the program's implementation or the previous review (including an explanation of why those changes were made), 4) a description of biological, ecological/environmental, economic, social, and administrative environments before and since the program's implementation[21], 5) an analysis of the program's biological, ecological/environmental, economic, social, and administrative effects, 6) an evaluation of those effects with respect to meeting the goals and objectives (i.e., program performance), including a summary of the conclusions arising from the evaluation, 7) a summary of any unexpected effects (positive or negative) which do not fall under the program's goals and objectives, and 8) identification of issues associated with the program's structure or function and the potential need for additional data collection and/or research.

The review should contain an assessment of the program's effects on net benefits to the Nation,

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[20] Other examples of retrospective analyses done by NMFS include reviews of regulatory actions conducted under Executive Order 13563 (http://www.nmfs.noaa.gov/sfa/laws_policies/economic_social/eo13563.pdf) and regulatory reviews completed under section 610 of the Regulatory Flexibility Act (RFA) http://www.nmfs.noaa.gov/sfa/laws_policies/economic_social/rfa_revised_through_2010_jobs_act.pdf).

[21] For subsequent reviews of the program, analyses should discuss changes since the last review and may not need to go back to the conditions prior to implementation of the program.

keeping in mind that net benefits are not exclusively economic in nature. This assessment should be consistent with NMFS' Economic Guidelines for conducting cost-benefit analyses. [22] However, one exception is the baseline considered for analyses of CSPs should be an appropriate number of years prior to the implementation of the CSP, and not what would have been likely to occur in the absence of the CSP, which is how a baseline is defined in the Economic Guidelines. In particular, the identification of economic costs and benefits in the review should be consistent with the Economic Guidelines. For example, increases in employment and tax revenues are not economic benefits within a cost-benefit analysis. The latter is a transfer and the former is an example of an economic impact. Changes in economic impacts at the regional, state, and/or community level are also an important consideration and should be assessed as they are often of key interest to Council members and other stakeholders.

Reviews should not be restricted to a particular length. The review should contain sufficient background information to provide the reader with the necessary context for understanding the analyses contained in the review. However, for the sake of brevity, if particular information has not changed since the program was implemented or last reviewed (e.g., biology of the species), that information can be incorporated by referencing the appropriate document. In addition, if a detailed analysis of a particular component of a program or certain aspect of that component has been conducted elsewhere, the detailed analysis can be incorporated by reference. However, a summary of the findings and their implications with respect to evaluating the program's performance should be included in the review.

B. Scope of Review. In general, the review should use as holistic an approach as possible given available data and resources. Interdependencies between related fisheries can generate spillover effects that may be unexpected or unintended. When this occurs and it is difficult to separate impacts from the CSP under review from impacts of other management measures, programs should be considered together. For example, the operations of vessels and associated businesses are frequently not limited to the boundaries of a specific CSP. In the Gulf of Mexico Reef Fish fishery, some species are managed within a CSP (e.g., red snapper and grouper-tilefish) while others are not (e.g., vermillion snapper, greater amberjack, gray triggerfish, etc.). Species from within and outside the CSP can be harvested on the same trip. In this case, it would be best to analyze the effects of the CSP by analyzing the harvest of all species since the costs associated with harvesting these species cannot be separated. When evaluating a program's effects on those businesses, analyses should take into account the entirety of those operations, not just those which take place within the program's bounds. Councils should determine if analyzing the CSP alone will likely mischaracterize the program's performance, and the effects on human communities, fish stocks, and the ecological communities/environment. In instances where two

[22] http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf

or more CSPs are found to have significant interdependencies, joint program reviews would lead to a more holistic approach and thus more accurate analysis, as well as reduce administrative costs associated with the conduct of these reviews. However, if the CSPs were established in different years, a joint initial review may not be feasible, particularly if they were established more than 5 years apart. Thus, joint reviews may be more likely for subsequent rather than initial reviews.

In addition, in cases with significant interdependencies or spillover effects between programs, the review could also consider whether interdependencies between programs interfere with and possibly preclude achieving the goals and objectives of each program. These issues would be particularly acute in situations where there is significant overlap in the vessels and businesses that participate in multiple programs. If the review identifies issues with interdependencies, the Council could consider potential changes such as adding or removing species or gear types from a program, merging separate CSPs, or reallocating species or gears across CSPs.

C. Use of Standardized Approaches. When describing current conditions, changes since the baseline period, analyzing the effects of the program, and evaluating program performance, the review should make use of standardized performance indicators or metrics developed at the national level, to the extent practicable. Reviews could also make use of additional indicators that may have been developed at the regional level and properly vetted by an appropriate scientific body (e.g., Science Center, Scientific and Statistical Committee, etc.). [23]

For example, with respect to biological conditions and effects, the reviews should make use of information contained in the most recent stock assessment. Additional information on other key biological indicators will also likely be necessary, depending on the program's goals and objectives (e.g., changes in bycatch, discard mortality, etc.). This information can be obtained from stock assessment reports, observer program reports, SAFE reports, and other sources.

When describing economic and social conditions and analyzing economic and social effects, reviews should make use of the NMFS Office of Science and Technology's (S/T) economic and social performance indicators to the extent possible.[24,25] New indicators may also be used, such as a Walden, et al.'s (2014) method of measuring multi-factor productivity changes in CSPs.[26] Further, although Holland et al. (2014) indicates that sufficient data on the prices of Quota Shares (QS) and Quota Pounds (QP) are not available for every program,[27] a 5/7 year review

[23] http://nefsc.noaa.gov/read/socialsci/pdf/publications/IIFET2010-PMC-PPDS-AK-revised%20gfish%20list.pdf
[24] http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/
[25] http://www.st.nmfs.noaa.gov/economics/fisheries/commercial/catch-share-program/index
[26] http://spo.nmfs.noaa.gov/tm/TM146.pdf
[27] http://spo.nmfs.noaa.gov/tm/TM145.pdf

should contain an analysis of trends in these indicators when sufficient data are available.[28] Although some of S/T's indicators are not purely economic or social in nature (e.g., catch and landings, effort, cost recovery, etc.), they should still be used where appropriate. Also, the suite of economic and social performance indicators for CSPs is still under development and so the review team should check for updates during the review process.[29] If quantitative estimates of particular indicators are not available, a qualitative assessment is acceptable.

Social impacts on fishermen and communities are an important aspect of all fishery management decisions. For example, National Standard 8 requires that fishery conservation and management measures take into account potential impacts on fishing communities. S/T's social indicators for CSPs are not as developed across all regions as the economic indicators. As an alternative or in addition to using the social indicators for CSPs, analysts should adapt the social indicators developed by Jepson and Colburn (2013) to assess community vulnerability, resilience, and dependency on the CSP to the extent possible.[30] In addition, the description of social conditions and analysis of social effects should include safety at sea.[31,32] This is consistent with other provisions of the MSA, such as National Standard 10, which requires fishery conservation and management measures to promote the safety of human life at sea. It is recommended the review team consult with the U.S. Coast Guard, and the National Institute for Occupational Safety and Health's (NIOSH) Alaska Pacific Office[33] on issues related to safety, data, and analyses.[34] Finally, reviews should analyze changes in concentration and distributional changes (e.g., revenue, landings, QS, QP, etc.). Current guidance documents suggest using the Herfindahl–Hirschman Index (HHI)[35] to measure changes in concentration, and Gini coefficient to document distributional changes,[36] but other indicators may be appropriate. The analysis of distributional effects should also examine whether small entities have been disproportionately affected relative

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[28] QS refers to the long-term catch privileges generally denominated as shares of the total allowable catch (TAC) for a species, area, and/or fishery sector and QP refers to the annual form of quota in a CSP. The QS price reflects expected economic profits in the long-term while the QP price reflects expected economic profits in the short-term. Both are critical to assessing the program's economic effects on participants, particularly if current data are insufficient to directly estimate net revenue or economic profits.

[29] See http://www.st.nmfs.noaa.gov/economics/fisheries/commercial/catch-share-program/indicators-definition/

[30] http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/index

[31] Changes in safety at sea can also be covered in the description of economic conditions and analysis of economic effects.

[32] Guidance on Fishing Vessel Risk Assessments and Accounting for Safety at Sea in Fishery Management Design. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OSF-2, 57 p., available at: fisheries.noaa.gov/sfa/publications/technical-memos/nmfs_osf_tm2.pdf

[33] Requests for data and analytical assistance should be sent to Jennifer Lincoln, PhD, APO Director, at jlincoln@cdc.gov

[34] NIOSH provided data that contributed to the analysis of safety at sea in the Gulf of Mexico Red Snapper 5-year review and conducted the analyses for the 5-year reviews of the Amendment 80 and Crab Rationalization CSPs in the North Pacific.

[35] http://www.justice.gov/atr/public/guidelines/hmg-2010.html

[36] http://www.st.nmfs.noaa.gov/economics/fisheries/commercial/catch-share-program/index

to large entities, consistent with the RFA and the CS Policy.

VI. Describing and Analyzing Program Performance

As outlined in the MSA, the purpose of the review is to evaluate whether the CSP is meeting its goals and objectives and the goals of the MSA. Based on the outcome of the review, the goals and objectives of the CSP may need to be revised through a subsequent action. In order to properly describe and analyze a CSP's performance relevant to the goals of the program and the MSA, the 5/7 year review must address the components identified in the CS P's goals and objectives and the following key areas: A) goals and objectives, B) allocations, C) eligibility, D) transferability, E) catch and sustainability, F) accumulation limits/caps, G) cost recovery, H) data collection/reporting, monitoring, and enforcement, I) duration, J) new entrants, and K) auctions and royalties. If a component is determined not applicable for review, the Council should document in its final plan for the review its rationale for not conducting a more formalized analysis of the component. Such documentation is necessary to produce a strong record demonstrating that the component has been at least initially considered. Further, if a particular component of a program is the subject of a current management action,[37] that component does not need to be addressed in a detailed manner within the review. A summary containing a description of, rationale for, and current status of the management action is sufficient.

A. Goals and Objectives. According to Section 303A(c)(1)(G) of the MSA, a primary goal of the review is to assess progress in meeting the goals of the program and the MSA. The CS Policy indicates it is necessary to examine objectives as well, including those of the FMP (see p. iii and p. 7). Thus, the goals and objectives in this case include those identified in the implementing Amendment, the FMP, the CS Policy, and the MSA, particularly those specific to LAPPs, though the primary focus should be on those identified in the implementing Amendment.

In addition, the goals and objectives of the Amendment and FMP should be evaluated with respect to whether they are clear, measurable (at least qualitatively[38]), achievable (i.e., are two or more objectives mutually exclusive?), and still appropriate under the current circumstances. Fishery performance changes over time, and for other reasons than the effects of the program or other management measures. Such changes should be taken into account when evaluating the efficacy of the original goals and objectives. If certain goals and objectives are found not to be clear, measurable, achievable, and/or still appropriate, the review should note deficiencies for the Council to address.

[37] A current management action is an issue currently being deliberated by the Council.
[38] For example, qualitative objectives that provide a direction of the desired change may be used when quantitative objectives that provide explicit details on the magnitude of the change are not possible.

When a goal or objective is found to be unclear, the review team should seek clarification from Council members or members of NMFS leadership directly involved with the program's development. If this approach proves unsuccessful, the review team should make its best attempt to interpret the Council's or NMFS' intent in each case rather than not address it. A common example of an unclear goal or objective is when an objective is stated in the form of an action that was taken in the Amendment (e.g., allocate a portion of the total available harvest to a specific sector of the fishery). While this is a valid action associated with the implementation of the CSP, it does not clarify a fundamental objective of the fishery; the action is not the objective but rather the tool used to achieve that objective. The team should make its best effort to discern what that action was meant to achieve using the identified approaches.

Another complication review teams are likely to encounter is the lack of specific performance standards to evaluate whether, or to what extent, the goals and objectives have been met. For example, a Council may have indicated that a goal of the program is to reduce overcapacity. Such a goal tells the review team the direction of the desired change in overcapacity, but not the magnitude of the desired change. If the Council actually meant to indicate that its goal was to eliminate overcapacity, then the goal needs to be clarified. If it has a particular target level of reduction in mind, or alternatively a particular level of harvesting capacity, then that level should be stated explicitly in the FMP. Thus, one specific purpose of the reviews is to encourage Councils and NMFS to clearly identify specific performance standards that can be used in assessing whether, or to what extent, the goals and objectives have been met.

If the program is performing as expected at the time of implementation, then the various goals and objectives either should have been achieved or substantial progress should have been made towards achieving them. If the analysis concludes otherwise, such conclusions may serve as the basis for future changes to the program. If the review identifies numerous and serious problems with the existing program, it is recommended that the Council evaluate if the problems can be solved by modifying the existing program, whether the CSP's current form is still preferable to other alternatives, and if the program should be continued or eliminated.

B. Allocations. The MSA requires initial allocations to be fair and equitable under all LAPPs. In 2016, NMFS and the Council Coordination Committee[39] finalized the Fisheries Allocation Review Policy[40] and two associated Policy Directives[41] that provide a mechanism to ensure fisheries allocations are periodically evaluated to remain relevant to current conditions. The first procedural directive outlines three categories of triggers that can be used by a Council to initiate an allocation review: public interest-, time-, or indicator-based. Each Council will identify one

[39] http://www.nmfs.noaa.gov/sfa/management/councils/ccc/ccc.htm
[40] http://www.fisheries.noaa.gov/op/pds/documents/01/01-119.pdf
[41] http://www.nmfs.noaa.gov/op/pds/documents/01/119/01-119-01.pdf, and http://www.nmfs.noaa.gov/op/pds/documents/01/119/01-119-02.pdf

or more triggers for each fishery with an allocation by August 2019, or as soon as practicable. The second procedural directive identifies four main types of information that should be considered when reviewing and updating allocations: ecological, economic, social, and indicators of performance and change. If the 5/7 year review is identified as a trigger for a CSP, then the allocations for that program should be reviewed during the 5/7 year reviews. However, if an alternative trigger has been chosen for a CSP (public input, indicator-based or some other time-based), the Council should note this, and discuss their method for determining if the identified trigger has been met. If the 5/7 year review is not identified as a trigger, and the alternative identified trigger has not been met, a full analysis of allocation is not necessary in the 5/7 year review.

The allocations to be reviewed include the allocations between individuals or entities within the program, the allocations between subgroups (e.g., gear types) within the program, and the allocations between the commercial and recreational sectors in instances where both sectors harvest the species covered by the CSP.[42] In the analysis and evaluation of allocations between individuals or entities, existing caps/limits on QS and QP should be explicitly taken into account. Thus, any analyses completed on changes to those allocations should consider the potential for individuals or entities to exceed the existing caps/limits on QS and QP under an alternative allocation and, in turn, the possibility they would be forced to divest under a different allocation.

Because an evaluation of allocations between subgroups as well as individuals or entities in the program may require considerable time and resources, and is expected to be analytically complex, it may be appropriate to conduct the detailed analysis separately from the other components of the review. As stated in Section V, part A, of this guidance, the detailed analysis can be incorporated by reference and the review need only contain a summary of the analytical findings and a discussion of their implications with respect to evaluating the program's performance. In addition, if the underlying allocation between subgroups is the subject of a current management action, that would be a compelling reason not to address it in the 5/7 year review. As stated in Section V, part A, of this guidance, a summary containing a description of, rationale for, and current status of the management action is sufficient for this review. Other compelling reasons may exist for not addressing the underlying allocation between subgroups, but would need to be determined on a case-by-case basis.

[42] The NOAA Catch Share Policy (http://www.nmfs.noaa.gov/sfa/management/catch_shares/about/documents/noaa_cs_policy.pdf) states: "For all fishery management programs, including catch shares, the underlying harvest allocations to specific fishery sectors (e.g., commercial and recreational) should be revisited on a regular basis, and the basis for the allocation should include consideration of conservation, economic, and social criteria used in specifying optimum yield and in furtherance of the goals of the underlying FMP." The CS Policy also states, "if the underlying allocation between sectors for a given fishery has not been reviewed by the Council since a LAP was initially approved, the Council should include such an assessment as part of its 5-year review unless there are compelling reasons not to do so" (emphasis added).

C. Eligibility. Section 303A(c)(1)(D) of the MSA indicates that eligibility requirements must be established for LAPPs. Reviews should evaluate eligibility requirements regarding who is allowed to hold QS or QP (e.g., owner on board provisions, etc.). The review may determine that certain restrictions on eligibility are inhibiting or precluding the achievement of certain objectives. The review may also indicate that additional restrictions are necessary to achieve particular objectives.

When analyzing the program's economic and social effects, if resources are available, it could be useful to also assess the effects on "historical" participants who were previously but are no longer involved in the fishery or program (i.e., prior to the program's implementation or the last review). If resources allow, a survey to assess current and historical participants' satisfaction with the program and changes in their well-being would be useful in understanding why the historical participants no longer participate and could clarify the program's social and economic effects, and its performance.

D. Transferability. Section 303A(c)(7) of the MSA requires a Council to establish a policy and criteria for the transferability of limited access privileges. All existing CSPs in the United States allow for at least some transferability of QS or QP. Transferability is generally thought to improve technical efficiency and thus aid in achieving economic efficiency in a fishery, which, for example, is a goal under National Standard 5. Therefore, restrictions on transferability are thought to result in technical and economic inefficiency. However, economic efficiency is not a CSP's only objective. Restrictions on transferability may serve to meet other objectives, such as equity, which is also a goal under National Standard 4, providing for the sustained participation of and minimizing adverse economic effects on fishing communities, which is also a goal under National Standard 8, or reducing adverse effects on particular types of habitat (e.g., Essential Fish Habitat). The review should determine whether existing transferability provisions are conducive to achieving the specified objectives, keeping in mind that trade-offs often exist between objectives.

E. Catch and Sustainability. With limited exceptions,[43] MSA section 303(a)(15) requires that FMPs or FMP amendments must establish mechanisms for specifying annual catch limits (ACLs) at a level such that overfishing does not occur in the fishery, including measures to ensure accountability. Reviews should discuss whether the CSP has helped to keep harvests/landings within the applicable limit(s). If overages have occurred, the frequency and magnitude of such overages should be discussed along with an analysis of why they occurred. The review should also describe and analyze changes in the status of stocks within the CSP.

[43] *See* 50 C.F.R. §600.310(h) describing exceptions for species that have a life cycle of approximately one year unless the Secretary has determined the fishery is subject to overfishing, and for stocks or stock complexes subject to management under an international agreement to which the United States is a party).

Additionally, the review should analyze whether the program is encouraging full utilization of the available ACL, total allowable catch (TAC), or quota. If full utilization is not taking place, the review should assess why this is the case. Full utilization of the ACL, TAC, or quota should not be confused with achieving optimum yield (OY; a provision under National Standard 1), which involves the consideration of many other factors, including available harvesting capacity, since harvesting capacity is not determined by the available ACL, TAC, or quota.

The review also should assess changes in bycatch and discard mortality to determine whether the program is minimizing bycatch and bycatch mortality to the extent practicable. This is consistent with provisions of the MSA, such as National Standard 9.

F. Accumulation limits/caps. Section 303A(c)(5)(D) of the MSA requires Councils and NMFS to establish limits or caps to prevent the excessive accumulation of harvesting privileges. The accumulation of excessive shares is thought to potentially create market power in the product market, input markets (e.g., gear, bait, labor, etc.), and/or the markets for QS and QP. Market power creates economic inefficiency, and the MSA reflects concern over such inefficiency. For example, National Standard 5 requires that fishery conservation and management measures consider efficiency in the utilization of fishery resources. Even if market power is not created, excessive shares are also to be avoided for equity/distributional reasons. This is reflected in various MSA provisions, such as National Standard 4, National Standard 8, and section 303A(c)(5)(D)(ii) of the MSA. Reviews should analyze and evaluate the equity/distributional impacts of existing caps and the impacts those caps have had on the creation of market power by affected entities.

In addition, Holliday and Anderson (2007)[44] indicate that a primary concern with accumulation limits and caps is their ability to prevent firms from being technically efficient (i.e., firms could produce more output with their current inputs, or they could use less inputs to product their current output). Technical inefficiency would in turn prevent firms from fully utilizing existing economies of scale and producing at the minimum average cost per unit of harvest (i.e., firms are also productively inefficient). Because caps on QS do not necessarily limit a firm's production in a given year, and QS owners can purchase additional QP, this concern primarily applies to caps or limits on QP. Reviews should analyze whether and to what extent QP caps or limits have generated technical inefficiency for firms operating in a CSP.

As with allocations, an analysis of market power is expected to be analytically complex and therefore may require considerable time and resources. Thus, it may be appropriate to conduct the detailed analysis separately from the other components of the review. In that case, the review need only contain a summary of the analytical findings and a discussion of their implications

[44] http://www.fisheries.noaa.gov/sfa/management/catch_shares/resources/design_and_use_laps_2007.pdf

with respect to evaluating the program's performance. An analysis of market power in the Mid-Atlantic Surf Clam/Ocean Quahog Individual Transferable Quota (ITQ) program has already been conducted[45] and was the subject of a review by the Center for Independent Experts (CIE).[46] An analysis using the same approach has also been conducted for the Northeast Multispecies Sectors program,[47] which was also reviewed by the CIE.[48] However, the conclusions of the two CIE reviews differ with respect to the appropriateness of the approach and data used to reach the conclusions and recommendations in the respective analyses. Analysts are advised to take into account the concerns and deficiencies noted in the CIE review of the analysis for the Sectors program when conducting market power analyses.

Further, the review should address whether existing data collection and monitoring programs are sufficient to accurately determine each entity's ownership level and thus whether entities are exceeding the existing caps. The review should also address whether the caps are being applied at the appropriate levels to ensure they are serving their intended purpose. Because caps typically apply to all "persons" [49], the review team should determine whether "persons" are being identified in the program in a manner consistent with the Council's intent and other agency practices and guidance (e.g., accounting for affiliation, consistent with the Small Business Administration's regulations, where practicable). For example, if the caps are being applied in a manner that precludes the estimation of an appropriate HHI or Gini coefficient, that should be noted and addressed in the review.

One of the anticipated effects of limits and caps is to limit the degree of consolidation within the fleet. Consolidation would typically be expected to result in a reduction in capacity and overcapacity, which is a goal of most CSPs. Analyses of changes in capacity and overcapacity should be conducted in a manner consistent with the terminology and methods outlined in NMFS' National Plan of Action for the Management of Fishing Capacity.[50]

G. Cost Recovery. The review should discuss whether a cost recovery program is in place, per Section 303A(e) of the MSA, the cost recovery fee percentage, any changes to the fee, and the amount of fees collected on an annual basis. According to the CS Policy, "[i]ncremental government costs for management, data collection and analysis, and enforcement of limited

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[45] http://www.nefsc.noaa.gov/read/socialsci/pdf/SCOQ_ITQ_Exc_Share_Rec_2011-05-03.pdf
[46] http://www.nefsc.noaa.gov/read/socialsci/pdf/CIE_report_final.pdf
[47] http://www.nefmc.org/nemulti/planamen/Amend%2018/compass_lexecon/NEMFC%20Report%20Final.pdf
[48] https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2014/2014_07_22%20Weninger%20excessive%20shares%20review%20report.pdf
[49] The MSA defines "person" to mean "any individual (whether or not a citizen or national of the United States), any corporation, partnership, association, or other entity (whether or not organized or existing under the laws of any State), and any Federal, State, local or foreign government or any entity of any such government." MSA section 3.
[50] http://www.nmfs.noaa.gov/op/pds/documents/01/113/01-113-01.pdf

access privilege programs shall be recovered from participants as required by the MSA."[51] The review should determine whether the program is assessing fees in a manner such that all incremental costs are included in the assessment, whether the collected fees cover all incremental costs (i.e., does the 3% cap imposed by MSA preclude collecting fees to cover all incremental costs?), and evaluate the current economic effect of these fees on program participants (e.g., what is the reduction in gross revenue, net revenue, or profits on average per participant?). Any compliance or enforcement issues related to cost recovery should also be discussed. If the program does not include cost recovery, the review should include an explanation of that decision along with a discussion of plans to develop such a program in the future, where applicable.

H. Data Collection/Reporting, Monitoring, and Enforcement. According to Section 303A(c)(1)(H) of the MSA, each LAPP must include "an effective system for enforcement, monitoring, and management of the program, including the use of observers or electronic monitoring systems." Thus, the review should contain a description and assessment of the existing data collection, monitoring, and enforcement programs (e.g., observers, logbooks, economic data reporting, etc.), including a discussion of any changes since the CSP's implementation or the previous review. Specific attention should be paid to assessing whether the existing programs are sufficient to assess the program's performance relative to the various goals and objectives.

Important data gaps or deficiencies, including gaps in the ability to validate collected data, should be discussed. Cost estimates for filling any gaps or deficiencies could also be provided so that a net benefit assessment can be conducted, as certain data improvements may be cost prohibitive given current resources and other factors. In addition, particular attention should be paid to documenting the reporting burden on CSP participants.[52] It may be useful to evaluate whether current CSP data collection programs are redundant with other existing programs so that the Council and NMFS can consider eliminating overlapping requirements. In general, potential means to reduce reporting burden should be identified and discussed.

Specific attention should be given to describing and assessing the use of electronic technologies versus paper-based and other more labor intensive methods, particularly with respect to their effect on the accuracy of the collected data and resulting statistical estimates but also with respect to their effect on the ability to engage in real-time reporting. In general, electronic reporting is more conducive to achieving real-time reporting. Another purpose of this assessment is to estimate the administrative costs associated with data collection and monitoring, as these costs are either borne by industry (e.g. via cost recovery fees) or the public via tax

[51] http://www.nmfs.noaa.gov/sfa/management/catch_shares/about/documents/noaa_cs_policy.pdf, pg iii.
[52] If resources allow, a customer satisfaction survey may be useful in discerning participants' views on this issue.

collections. Potential cost saving changes should be identified and discussed.

With respect to enforcement, particular attention should be paid to assessing whether the current enforcement provisions and activities, including resources for conducting the latter, are sufficient to ensure a high rate of compliance with program requirements. Wide-spread non-compliance can adversely affect the ability of other CSP attributes to achieve their desired goals and objectives. Information collected can be used by the Council to clarify what can be considered a sufficiently "high" rate of compliance.

Although cost recovery, data collection/reporting, monitoring, and enforcement should each be individually addressed, a description and overall assessment of the CSP's administrative costs should be provided to determine whether total administrative costs are being minimized to the extent practicable, which is consistent with National Standard 7. It is likely there will be trade-offs in the various types of administrative costs. If the review indicates various types of improvements may be necessary to achieve the CSP's goals and objectives, the Council and NMFS will want to know the potential change in total administrative costs.

I. Duration. The review should indicate the lifespan of catch privileges within the CSP. QS are not issued in perpetuity. According to Section 303A(f) of the MSA, their lifespan is limited to 10 years if the program was established after January 12, 2007, though they will be renewed if not revoked, limited, or modified.[53] The review should discuss the pros and cons of the current duration of catch privileges, given the CSP's goals and objectives and other factors (e.g., lending practices of financial institutions).

J. New Entrants. The issue of new entrants is one that cuts across multiple program design features, including but not necessarily limited to allocations (e.g., is there a set-aside?), transferability (e.g., do the transferability rules make it more or less difficult for new entities to participate in the program?), duration (are QS prices increasing over time as a result of the QS duration?), and auctions (e.g., are auctions being used to provide another means for new entities to participate in the program?). An additional consideration is whether loan programs have been established to help new entities participate in the CSP, consistent with Section 303A(g) of the MSA. Programs to assist new entrants are supposed to be considered when CSPs are initially developed. Where possible, an assessment of the costs of entry should be provided, along with a discussion of whether entry costs have increased to the point where market power is being exercised and economic inefficiencies are being created. A discussion of equity/distributional

[53] For example, see the rules to revoke inactive QS in the wreckfish ITQ program (https://www.federalregister.gov/articles/2012/09/26/2012-23731/fisheries-of-the-caribbean-gulf-of-mexico-and-south-atlantic-snapper-grouper-fishery-off-the) and the Pacific halibut/sablefish IFQ program (https://alaskafisheries.noaa.gov/sites/default/files/finalrules/77fr29556.pdf)

considerations should also be provided, including where possible, an assessment of any inter-generational effects.

K. Auctions and Royalties. For CSPs implemented after January 12, 2007, section 303A(d) of the MSA requires Councils and NMFS to consider the use of auctions or royalties for the initial or any subsequent distribution of limited access privileges. Royalties and auctions are means to collect resource rents and return some of the economic value of the resource to the general public. Resource rent is the difference between the price at which fish can be sold and the respective production costs, which include a normal return to the privilege holder. Thus, royalties and cost recovery fees are not synonymous.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

JUN - 2 2017

Thomas A. Nies
Executive Director
New England Fishery Management Council
50 Water Street
Newburyport, MA 01950

Dear Tom:

Please find the enclosed *2016 Annual Report of the Scallop Individual Fishing Quota (IFQ) Cost Recovery Program*. The 2016 fee period (October 1, 2015, through September 30, 2016) was the sixth year that we collected fees from scallop IFQ vessels. This report details the recoverable costs, fishery value, fee percentage, and individual fee calculations for scallop IFQ vessels during the 2016 fee period. The scallop IFQ cost recovery fee is based on expenses and landings made during the October through September fee period.

Recoverable costs in 2016 were higher than in 2015 and prior years because of the costs associated with the five-year review of the scallop IFQ program. As you know, the Magnuson-Stevens Fishery Conservation and Management Act requires that all Limited Access Privilege Programs, such as the scallop IFQ program, must undergo a review every five years. The five-year review is directly related to the management of the scallop IFQ program. While higher, the resulting cost recovery fee percentage of 0.6058 percent remains well below the 3-percent maximum allowed under the Magnuson-Stevens Act. Additional details are explained in the report.

If you have questions, please contact Michael Pentony at 978-281-9283.

Sincerely,

John K. Bullard
Regional Administrator

Enclosure
cc: Moore; Luisi; Quinn

2016 Annual Report of the Atlantic Sea Scallop Individual Fishing Quota Cost Recovery Program

June 2017

Prepared by:
Greater Atlantic Regional Fisheries Office
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930

Background

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires NOAA's National Marine Fisheries Service (NMFS) to collect fees to recover the "actual costs directly related to the management, data collection, and enforcement" of an individual fishing quota (IFQ) program (16 U.S.C. 1854(d)(2)). The law provides that IFQ allocation holders pay a fee based on the ex-vessel value of fish landed under the program. The fee may be as high as, but cannot exceed, 3 percent of the ex-vessel value of the fish harvested under the IFQ program. For the Limited Access General Category (LAGC) scallop IFQ program, the ex-vessel value is calculated as the average price paid per pound of scallops during the fee period multiplied by the total weight landed.

Although the 2016 scallop fishing year ran from March 1 through the last day of February, the cost recovery fee is based on expenses and landings made during the fee period, which runs from October 1 through September 30 each year. The 2016 fee period (October 1, 2015, through September 30, 2016) was the sixth year that NMFS collected fees from scallop IFQ vessels.

Use of Funds

Payments received as a result of the scallop IFQ cost recovery program are deposited in the Limited Access System Administrative Fund as required by the Magnuson-Stevens Act. Funds deposited in this account are available only to the Secretary of Commerce and may only be used to defray the costs of management, data collection, and enforcement of the fishery for which the fees were collected. Therefore, fees collected as part of this cost recovery program will be used for management, data collection, and enforcement of the scallop IFQ program.

Determining the Value of the Fishery

As required in the Atlantic Sea Scallop Fishery Management Plan (FMP), NMFS determines the value of the scallop IFQ fishery by multiplying the total landings of IFQ scallops by the average price paid by dealers to IFQ scallop vessels for IFQ scallops. While ex-vessel prices for scallops vary over the course of the fee period, the Scallop FMP requires that the price of all IFQ scallops landed during the entire fee period be the basis of the average price (as opposed to the average price per vessel, per month, or some other unit of scallop landings). Federally permitted scallop dealers must report the weight and price paid for all scallops purchased. From these data, we calculated an average price of $13.26 per lb paid to vessels participating in the scallop IFQ fishery during the 2016 fee period. The total of all LAGC IFQ landings during the 2016 fee period was 3,370,899 lb (shucked meats). Using this average price, we determined that the total value of LAGC IFQ landings was $44,698,121 for the 2016 fee period. NMFS used this value to determine the overall fee percentage and the individual fees for vessel owners. We describe these determinations on page 4 of this report.

Cost of Management, Data Collection, and Enforcement

The Magnuson-Stevens Act requires the collection of the IFQ fee to recover the actual costs of the program. We have determined that the recoverable costs associated with the management, data collection, and enforcement for the scallop IFQ program include only the incremental costs of the IFQ program, and not the costs that would still have been incurred regardless of the fishery's status as an IFQ.

The Magnuson-Stevens Act requires that the Councils and NMFS conduct a formal and detailed review five years after the implementation of an IFQ program to review the operations of the program. Most of the work to conduct this review and write the report took place during the 2016 fee period and resulted in additional staff time for both the Regional Office and the Northeast Fisheries Science Center, which was recoverable under this program. This additional work resulted in a significant increase in recoverable costs in the 2016 fee period.

We calculated personnel costs by multiplying hours spent by staff on tasks directly related to the IFQ program, with the hourly salary rates for those individuals. Salary rates included the Government's share of benefits, prorated. We calculated contract expenses as the cost of contract employees prorated for the percentage of time the contract employees spent on tasks directly related to the IFQ program. In the 2016 fee period, the bulk of the recoverable expenses was comprised of costs related to developing the five-year review of the scallop IFQ program. This includes a combined cost of $179,794 from the Northeast Fisheries Science Center and their contractors to provide data analysis and prepare reports for this review. Additional recoverable expenses consisted of time spent by personnel working on tasks related to the administration of the IFQ program. The following is a breakdown of the tasks by division:

<u>Sustainable Fisheries Division (SFD)</u>
SFD is primarily responsible for the management and implementation of the Atlantic Sea Scallop FMP, which includes the LAGC IFQ program. SFD staff provides oversight to the IFQ program and associated allocation monitoring and cost recovery requirements.

<u>Analysis and Program Support Division (APSD)</u>
APSD is responsible for most of the LAGC IFQ implementation tasks. These include issuing annual IFQ allocations and processing and tracking temporary leases and permanent allocation transfers. APSD is also responsible for generating individual fees, mailing bills, tracking payments, and following up on late payments under the cost recovery program. APSD is responsible for data collection and analysis, including extensive quality control of incoming data sources and tracking of landings against IFQ allocations. In addition, quality control is a critical function of APSD and of any IFQ program because it ensures that the landings data NMFS uses to calculate IFQ landings and, ultimately, the individual fee is correct and consistent with owners' records. APSD staff therefore committed time to working with vessel owners, dealers, and other NMFS offices to correct landings data.

<u>Information Resource Management (IRM)</u>
IRM is responsible for development and maintenance of the information systems to support the scallop IFQ program. These systems include the internal databases and computer systems for handling allocations, the Fish Online website, and the new web interface to the U.S. Department of the Treasury's Pay.gov service. These databases are critical to monitoring the IFQ program because they track individual landings, IFQ leasing, and permanent allocation transfers that take place in the LAGC IFQ fishery.

<u>Operations and Budget Division (OBD)</u>

OBD ensures the calculations of personnel costs and other costs are correct and meet required standards, as well as tracking the use of collected receipts.

The Office of Law Enforcement (OLE)
OLE determined there were no increased enforcement activities as a result of the scallop IFQ program for the 2016 fee period, and, therefore, there were no recoverable expenses for enforcement.

Stakeholder Engagement Division (SED)
This division contains our port agents in the Region, as well as our communications team. SED determined there were no recoverable expenses associated with the scallop IFQ program during the 2016 fee period.

NOAA General Counsel (GC)
The Northeast Section of the NOAA Office of General Counsel provides legal advice to NMFS and the Councils and reviews management actions for consistency with applicable legal requirements. GC determined that there were no recoverable expenses associated with the scallop IFQ program during the 2016 fee period.

Northeast Fisheries Science Center (NEFSC)
NEFSC staff incurred recoverable costs during the 2016 fee period for the first time since the start of the scallop IFQ program. Staff from both the Social Science Branch, Population Dynamics Branch, and their contractors contributed significant work to the five-year review of the IFQ program. Tasks include assembly and synthesis of data from prior surveys of crew, captains and secondary sources, providing data analysis, and preparing reports to review the operations of the program.

Table 1 provides details of the recoverable costs by division within the Greater Atlantic Regional Fisheries Office and the Northeast Fisheries Science Center.

Table 1: Recoverable costs associated with management and enforcement of the scallop IFQ program, 2016 fee period

	APSD	**SFD**	**IRM**	**OBD**	**NEFSC**	**Total**
Personnel †	$48,401	$2,381	$7,839	$7,678	$31,641	$97,940
Travel	$-	$-	$-	$-	$-	$0
Postage	$751	$-	$-	$-	$-	$751
Supplies	$144	$-	$-	$-	$-	$144
Equipment	$-	$-	$-	$-	$-	$0
Other	$-	$19,950	$3,500	$384	$148,153	$171,987
Total	$49,297	$22,331	$11,340	$8,062	$179,794	$270,823

SFD (Sustainable Fisheries); APSD (Analysis and Program Support); IRM (Information Resource Management); OBD (Operations and Budget); NEFSC (Northeast Fisheries Science Center).
* Includes contractor costs to assist with data collection and analyses and collection fees
† Personnel costs include all benefits

Calculating the Fee as a Percentage of Total Fishery Value

We calculated that the recoverable costs for the scallop IFQ program for the 2016 fee period represent 0.6058 percent of the value of the scallop IFQ fishery. We calculated the fee percentage with the total fishery value of $44,698,121 and total recoverable program costs of $271,056 using the following formula:

$$\frac{\$270{,}823}{\$44{,}698{,}121} \text{ x } 100 = 0.6058 \text{ percent}$$

This value of 0.6058 percent is less than the possible upper limit fee percentage of 3.0 percent (see background section, above). Thus, we were able to assess permit holders the total recoverable costs of fee period 2016.

Calculating Fees Assessed to Individual Permit Holders

Under the scallop IFQ program regulations, an LAGC IFQ permit holder is responsible for the IFQ fee based on the value of the landings of scallops attributed to his/her LAGC scallop IFQ permit, including landings made from an allocation that he/she transferred in (permanent or temporary (lease)) from another IFQ holder. The allocation tracking program that we have developed is able to identify all scallop IFQ transfers and attribute landings to the vessel that landed the scallops. To determine the appropriate IFQ fee for each LAGC IFQ permit holder, we multiply the permit holder's landings by the average price per lb and then by the fee percentage. This is represented by the following formula:

$$\text{(Vessel's IFQ landings by lb) x (\$13.26) x (0.6058 percent)} = \text{2016 cost recovery fee}$$

Based on this calculation, fees ranged from $18.71 to $6,886.04 per vessel.

We mailed bills for the scallop IFQ 2016 fee period to 160 LAGC IFQ permit holders on April 11, 2017. Permit holders have until June 1, 2017, to pay the balance due through the Pay.gov section of the Greater Atlantic Region's Fish Online website.

Changes from Previous Years

Total recoverable costs can fluctuate from year to year. Some management tasks may need to be done every year, and some tasks may require more time and effort in some years. As shown in Table 2, the scallop IFQ recoverable costs in 2016 were higher than previous years. The bulk of this increase was due to increased staff time to conduct analysis required for the five-year review of the IFQ program.

Table 1. Scallop IFQ recoverable costs, fishery value, and fee percentage by year

Fee Year	Recoverable Costs	Total Fishery Value	Fee Percentage
2011	$82,557	$28,004,530	0.2948%
2012	$106,745	$33,684,037	0.3169%
2013	$118,509	$31,863,299	0.3719%
2014	$123,743	$29,249,990	0.4230%
2015	$131,361	$35,453,100	0.3705%
2016	$270,823	$44,698,121	0.6058%