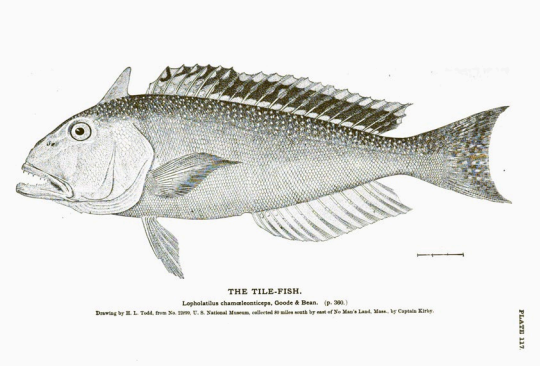
Golden Tilefish Individual Fishing Quota Program Twelve-Year Review



Prepared for

The Mid-Atlantic Fishery Management Council

September 2023

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Abbreviations

ABC	Acceptable biological catch
ACL	Annual catch limit
ACT	Annual catch target
CAMS	Catch Accounting and Monitoring System
CPH	Confirmation of Permit History
CPUE	Catch per Unit of Effort
FMP	Fishery management plan
FY	Fishing Year
GARFO	Greater Atlantic Fisheries Region Office
GTF	Golden tilefish
HHI	Herfindahl-Hirschman Index
IFQ	Individual fishing quota
IVR	Interactive voice response
MAFMC	Mid-Atlantic Fishery Management Council
MFP	Multi-Factor Productivity
MFPI	Multi-Factor Productivity Index
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSY	Maximum sustainable yield
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NMFS	National Marine Fisheries Service
OY	Optimum yield
SSB	Spawning stock biomass
SSC	Scientific and Statistical Committee
TAL	Total allowable landings
TFP	Total Factor Productivity
TTI	Terms-of-trade index
VTR	Vessel trip report

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Executive Summary

The purpose of this document is to review the golden tilefish individual fishing quota (GTF IFQ) program in order to evaluate the success of the program in meeting its management goals since publication of the first five-year review in 2017 (Mid-Atlantic Fishery Management Council 2017a). The first review covered performance in the first six years from fishing year (FY) 2010 to FY2015; the current review updates and adds analyses through FY2021.

Per National Marine Fisheries Service (NMFS) guidance for conducting catch share program reviews (National Marine Fisheries Service 2017), this review focuses on describing changes in the biological, ecological/environmental, economic, social, and administrative conditions in the golden tilefish fishery since the first review was published (FY2016–FY2021). In general, the analysis does not discuss conditions prior to implementation of the program, although some program impacts are analyzed over the entire IFQ period (FY2010–FY2021) in relation to the pre-GTF IFQ program baseline (FY2007–FY2009), primarily if the analysis is unique to the current review. Overall, this review maintains the conclusions made in the first program review that the program is continuing to meet its stated goals and objectives, namely, to reduce overcapacity and latent fishing effort, and secondly, to eliminate, to the extent possible, the problems associated with derby-style fishing.

To enable a quick comparison of findings between this review and the previous review, ES Table 1 provides a summary of findings for each program performance section. Findings in the current review that differ from those in the previous review are marked "Change" (and color coded gold). In addition, findings based on a new analysis not included in the previous review are marked "New" (and color coded blue).

ES Table 1. Summary of Findings

Section	Findings
Economic outcomes	
Participation and earnings trends	The fleet has continued to shrink since the last review from 12 vessels in FY2016 to 8 vessels since FY2018 (Table 4).
	Change: While average effort, landed pounds, and fleetwide revenue have all decreased since the last review, average fleetwide revenue remains higher in the entire IFQ period compared to baseline years (Figure 1).
	Despite lower-than-average revenue FYs 2015 and 2017, overall vessel-level revenue is similar to levels during the first six years of the program (Figure 2).
Utilization	**Change:** On average, utilization has declined 2% between the pre-IFQ and IFQ periods from 92.2% to 90.2%, driven by lower than normal utilization between FYs 2015 and 2017, with a low of 57% utilization in FY2016 (Table 4).
	Potential factors contributing to low utilization in those years include at least one inactive vessel and low catch per unit effort.
	Since FY2018 utilization has ranged between 89.5% and 99.6% (Figure 4).

Section	Findings
Ownership consolidation	**Change:** The number of entities holding shares has decreased since the last review from 12 accounts in FY2016 to 10 accounts since FY2017 (Table 7).
	There have not been any changes to the number of large accounts (those with more than 20% of the allocation) or shareholdings in large accounts since FY2013 (Table 7).
	The number of medium accounts (those with between 5 and 19% of the allocation) has not changed since FY2013, but the total percent of the allocation held in medium accounts increased by approximately 6% as small accounts sold their shares (Table 7).
	No entity has exceeded the share cap of 49%.
Effort consolidation	While consolidation of revenue across vessels has continued to occur consistent with a long-term trend, based on the HHI, the market is still considered moderately concentrated (Figure 5).
	Due to the decline in the number of active vessels with low revenue from the fishery, active vessels have become more equal in their earnings (decline in Gini coefficient from 0.64 in FY2007 to 0.44 in FY2021, Figure 5).
Ex-vessel price and market stability	Consistent with the last review, average prices appear to have increased between the pre-IFQ and IFQ periods from $3.47 to $4.04 per pound and have occurred across all market categories (Figure 1, Figure 9).
	Industry attributes flexibility and coordination for the ability to avoid market gluts and spread landings throughout the year.
	Comparison of average monthly prices in the pre-IFQ and IFQ periods show that price increases have been mostly realized in the first six months of the fishing year (November to April, Figure 8).
Dealer activity	**Change:** The number of dealers reporting purchasing IFQ golden tilefish has decreased from 11 to 9 since the pre-IFQ period (Table 11).
	Despite a decrease in the number of dealers buying IFQ golden tilefish, purchases have become less concentrated since the pre-IFQ period, declining from an HHI of 6,409 in FY2007 to 3,090 in FY2021 (Figure 10).
	Purchasing in New Jersey has increased as a result of increases in IFQ share ownership and leasing to vessels based in this state.
Productivity and profitability	Consistent with the results of the first review, productivity has increased on average in the IFQ period compared to baseline (Table 14).
	The only years with lower productivity than the baseline period were FY2015 and FY2016, years with low CPUE (Table 14).
	New: Profitability has been higher than baseline profitability in every year except for FY2015 and averaged 67% higher between FY2010 and FY2021.
New Section: Operating cost and revenue	**New:** While trip-level operating costs such as fuel, bait, ice, and supplies have increased on average (by 24.4% since the baseline period), revenue has increased more than costs, leading to higher average net operating revenues (revenue minus operating costs), an indicator of profitability (Table 16).
	New: Causes of increased trip costs are not known, but may include costs of bait, which have been reported by industry to have increased in recent years.
	New: Median vessel-level net operating revenue has increased by 61.5% since the baseline period, from $145,314 to $251,329.
Mitigating the race to fish	Consistent with the past review, no early closures have occurred for the fishery since implementation (Table 17), which indicates successful achievement of the goal to create a year-round fishery.
	For vessels that formerly fished in the Full-Time Tier 2 and Part-Time categories, the timing of landings has shifted to later in the year (Figure 16).
Quota market performance	Compared to the first six years of the program, permanent transfers of IFQ shares declined between FY2016 and FY2021 to three total transactions, averaging 2.8% of the annual allocation per year (Table 19).
	One transaction between FY2016 and FY2021 was to a new entrant (67% of pounds permanently transferred). In the first six years 64.5% of pounds transferred were to new entrants (Table 19).
	Lease transactions have increased from 5.3 per year during the first six years to 7.5 per year in the following six years (Table 20).
	As in the previous review, the limited number of lease transactions limits the ability to draw conclusions about the performance of the quota market.

Section	Findings
	Change: Since the first six years of the program, it appears that lease prices as a ratio of ex-vessel prices have decreased from 19.9% to 13.1% on average, potentially a result of more stable leasing arrangements or as participants adjusted to the system (Table 21).
New Section: Diversification and reliance	**New:** The number of active IFQ vessels with earnings in other fisheries has decreased since the baseline period from approximately 75% to 50% of vessels since FY2018, likely the result of more diversified, former Part-Time tier vessels, leaving the fishery (Table 22).
	New: Roughly half of IFQ vessels (4 of 8) participate in the fishery full time whereas the other half receive 51.9% of their revenue from other fisheries, on average (Table 22).
	New: Most IFQ vessels that fish in other fisheries fish in the swordfish and monkfish fisheries (5 and 8 vessels, on average in the IFQ period); a smaller number have participated in squid and scallop fisheries, but those that do have higher earnings (Table 23).
	New: For most entities that own IFQ vessels, they only own one IFQ permit and it is the only permit that they own (5 out 7 entities in FY2021), suggesting that most IFQ vessels do not have other sources of fishery income (Table 24).
New Section: Spatial distribution of effort	**New:** Consistent with the baseline period, most IFQ golden tilefish is harvested in two statistical areas: 537 and 616 (Table 25).
	New: While the proportion of harvests coming from statistical area 537 has not changed since the baseline period, the proportion coming from statistical area 616 has increased from 41.4% to 46.5% (Table 25).
Social and community impacts	
	New: Montauk has been the dominant port during the GTF IFQ program period, accounting for 46–66% of the ex-vessel value of the golden tilefish landed in the region. Barnegat Light accounted for 19–32% during this period, and Hampton Bays accounted for 4–21% (Table 26).
	New: From FY2017 to 2021, there was a decrease in the number of IFQ vessels making landings in both Barnegat Light and Montauk due to a number of factors, including lower quotas and severe weather conditions (Table 27).
	New: Montauk has had the highest dependence on golden tilefish as a percentage of total ex-vessel fishing revenue from all landings. During the GTF IFQ program period, golden tilefish accounted for an average of 19% of the community's total annual fishing revenue. The species contributed an average of 5% and 13% to the total fishing revenue of Barnegat Light and Hampton Bays, respectively (Table 30).
	New: No single species dominated the value of landings in Montauk during the GTF IFQ program period, with the exception of squid in some years. In contrast, squid was nearly always the dominant species landed in Hampton Bays in terms of ex-vessel revenue, while scallops was consistently the major species landed in Barnegat Light.
	New: All three primary communities ranked high on the commercial fishing engagement index in every year for which data were available (2009–2019). For commercial fishing reliance, the results were more mixed, with Montauk and Barnegat Light ranking high or medium-high for all years, while Hampton Bays ranked medium or low (Table 31).
	New: After the initial allocation in 2010, the three primary communities accounted for 94.6% of the total IFQ shares, with share owners in Montauk receiving 66.0%; owners in Barnegat Light receiving 14.4%; and an owner in Oakdale, NY, which is adjacent to Hampton Bays, receiving 14.2% (Table 32).
	Several permanent IFQ share transfers have occurred, but as described in the past review, most of the allocation shares are still geographically located with stakeholders that fish off New York and New Jersey.
	New: For leasing transactions that reported a non-zero value, the largest transfers between IFQ allocation permit holders located in different states occurred between entities in West Newbury, MA and Forked River, NJ. In addition, a single transaction occurred between IFQ allocation permit holders located in different states in 2015 when 100,000 pounds (4.0% of the total) were transferred from an entity in Montauk to one in Barnegat Light. The remainder of the transactions, which accounted for half of the total pounds temporarily transferred, were between IFQ allocation permit holders in Barnegat Light or the neighboring community of Forked River (Table 33).
	Consistent with the past review, for those who have access to sufficient quota, the GTF IFQ program has helped stabilize the fishery; those that do not own significant quota in the IFQ system, especially those that were early participants in the fishery, are frustrated and feel as though they were pushed out of the fishery.
Safety at sea	
	The post-IFQ program shift in fishing effort away from the winter months reported in the first review continued during FY2016–2021.
	According to the first review, there was a low number of safety incidents attributed to the golden tilefish fishery after IFQ program implementation; the fishery continued to experience a low number of incidents during FY2016–2021.

Section	Findings
Biological Impacts	
	The IFQ program was not expected to have any positive or negative biological impacts on golden tilefish, other fish stocks, or essential fish habitat.
	Since the golden tilefish fishery came under IFQ management, it has not been classified as overfished and has not experienced overfishing.
	Reported discards (from VTR data) have been extremely low as a proportion of catch (0.03%) for longline vessels that targeted golden tilefish in the 2016–2020 period.
Administrative Impacts	
	Because the pre-IFQ program golden tilefish fishery management system already had in place a system of data collection, reporting, and monitoring, the administrative costs for these tasks did not significantly increase with the implementation of the IFQ program.
	The first review noted that there were no documented issues related to enforcement of the IFQ program, and only two minor violations have been reported for the fishery since then.
	The first review noted that the recoverable costs associated with management, enforcement, and data collection in the IFQ program include only the incremental (or attributable) costs of the IFQ program.
	New: An increase in recoverable costs in 2016 was due to the additional NMFS staff hours required to complete the first review of the IFQ program.
Incidental fishery impacts	
	New: To ensure that vessels in the incidental catch sector targeted species other than golden tilefish, Framework Adjustment 2 established a landing limit of 500 pounds or 50%, by weight, of all fish, including the golden tilefish, on board these vessels, whichever is less.
	During the post-IFQ implementation, the incidental quota varied from 99,750 pounds for FY2010–2014 to 70,548 pounds for FY2021. Post-IFQ implementation utilization rates varied from 21% in FY2015 to 84% in FY2018.
	New: There is no evidence that the GTF IFQ program has had any significant negative effects on participants in the incidental golden tilefish fishery. Harvesters in the incidental fishery benefit from the ability to add incidentally caught tilefish to their portfolios, and if they are able to acquire IFQ shares, they can enter the IFQ fishery.
Recreational fishery impacts	
	New: To acquire a better understanding of changes in the level of recreational fishing effort and catch, NMFS GARFO implemented mandatory permitting and reporting for private recreational vessels.
	VTR data show that the golden tilefish catch of party/charter boats has increased over the past two decades (Table 38), but this catch continues to account for a small portion of total fishing mortality.
	New: There is no evidence that the GTF IFQ program has had an adverse impact on the recreational sector. The temporal redistribution of commercial fishing effort resulting from the IFQ program could be positive to recreational anglers.

Analysis indicates a change from previous review

Findings from new analysis not included in previous review

1 Introduction

The purpose of this second review of the golden tilefish individual fishing quota (GTF IFQ) program is to evaluate the progress of the program in meeting its management goals since publication of the first five-year review in 2017 (see Mid-Atlantic Fishery Management Council (2017a)]). The period covered during the first review was from Fishing Year (FY) 2010 to FY2015; the current review primarily covers the period from FYs 2016 to 2021.

In general, the outline of this review mirrors that of the first review in order to provide continuity and comparability. The review is organized in sections as follows:

- Purpose and Need of the Review
- Program Goals and Objectives
- History and Development of the Program
- Program Performance and Review
- Summary and Conclusions of the Review
- Appendices
- References

2 Purpose and Need of the Review

Per National Marine Fisheries Service (NMFS) guidance for conducting catch share program reviews (National Marine Fisheries Service 2017), this review focuses on describing changes in the biological, ecological/environmental, economic, social, and administrative conditions in the golden tilefish fishery since the first five-year review was published in 2017. In general, the analysis does not discuss conditions prior to implementation of the program, although some program impacts are analyzed over the entire IFQ period (FY2010–FY2021) in relation to the pre-GTF IFQ program baseline (FY2007–FY2009), primarily if the impact analysis is unique to the current review.

2.1 Background: Requirements for Reviews

The 2007 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) included new requirements related to the monitoring and review of limited access privilege programs, which includes fisheries managed under IFQs. The term "limited access privilege" is defined as a federal permit to harvest a quantity of fish representing a portion of the total allowable catch of the fishery. MSA requires that periodic formal and detailed reviews be conducted to assess whether the program is meeting management goals. Section 303A(c)(1)(G) of the MSA states the following requirements for limited access privilege programs:

> *MSA 303A(c) Requirements for Limited Access Privilege Programs (1) IN GENERAL (G) 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).*

GTF IFQ program regulations under 50 CFR §648.294(i) state that:

> *(i) Periodic review of the IFQ program. A formal review of the IFQ program must be conducted by the MAFMC within 5 years of the effective date of the final regulations. Thereafter, it shall be incorporated into every scheduled MAFMC review of the FMP (i.e., future amendments or frameworks), but no less frequently than every 7 years.*

Per the *Guidance for Conducting Review of Catch Share Programs* (National Marine Fisheries Service 2017), the following elements are required to be addressed in reviews:

1) Purpose and need of the review (discuss legal/policy requirements);

2) Goals and objectives of the program 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;

4) Description of biological, ecological/environmental, economic, social, and administrative environments before and since the program's implementation;

5) Analysis of the program's biological, ecological/environmental, economic, social, and administrative effects;

6) 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.

In addition, the guidance states that within the assessment of the program's performance, it must address 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. Finally, the guidance also requires a discussion of the net benefits to the nation produced by the program.

Table 1 describes where each key area is addressed in the performance analysis conducted for this review. The regulatory provisions of the GTF IFQ program corresponding to these key areas are described in Section 4.1.

Table 1. Performance Analysis Sections Where Key Areas of a Catch Share Program Review Are Addressed

Key Area	GTF IFQ Program Provisions (Sec. 4.1)	Performance Analysis Section: Economic (Sec. 5.3)	Social and Community (Sec. 5.4)	Safety at Sea (Sec 5.5)	Biological (Sec. 5.6)	Administrative (Sec. 5.7)
FMP goals and objectives: Rebuild tilefish so that the optimum yield can be obtained from this resource by achieving the following:						
Prevent overfishing and rebuild the resource to the biomass that would support MSY.					X	
Prevent overcapitalization and limit new entrants.		X				
Identify and describe essential tilefish habitat.					X	
Collect necessary data to develop, monitor, and assess biological, economic, and social impacts of management measures designed to prevent overfishing and to reduce bycatch in all fisheries.						X
GTF IFQ program goals and objectives: Assist the Council in achieving optimal yield by achieving the following:						
Reduce overcapacity and latent fishing effort in the commercial fishery.		X				
Eliminate, to the extent possible, the problems associated with derby-style fishing.		X		X		
Other key areas						
Allocations	X	X	X			
Eligibility	X					
Transferability	X	X	X			
Catch and sustainability	X				X	
Accumulation limits/caps	X	X				
Cost recovery	X					X
Data collection/reporting, monitoring, and enforcement	X					X
Duration	X					
New entrants	X	X				
Auctions and royalties	X					
Net Benefits to the Nation		X	X	X	X	X

3 Program Goals and Objectives

The overall goal of the original Tilefish FMP, which was implemented in 2001, was to rebuild golden tilefish so that the optimum yield (OY) can be obtained from this resource (Mid-Atlantic Fishery Management Council 2000). To meet the overall goal, the following objectives were adopted:

1. Prevent overfishing and rebuild the resource to the biomass that would support MSY (maximum sustainable yield);
2. Prevent overcapitalization and limit new entrants;
3. Identify and describe essential tilefish habitat;
4. Collect necessary data to develop, monitor, and assess biological, economic, and social impacts of management measures designed to prevent overfishing and to reduce bycatch of tilefish in all fisheries.

Amendment 1, which implemented the IFQ program in the directed golden tilefish fishery in 2009, did not change the overall goals and objective of the FMP. The general purpose of the GTF IFQ program is to reduce overcapacity and latent fishing effort in the commercial fishery, and to eliminate, to the extent possible, the problems associated with derby-style fishing, in order to assist the Council in achieving OY (Mid-Atlantic Fishery Management Council 2009).

4 History and Development of the Program

A description of the history and development of the GTF IFQ program, including the path to developing the original FMP and an overview of the management system performance prior to GTFIFQ program implementation, is provided in the first five-year review of the program (Mid-Atlantic Fishery Management Council 2017a). The review notes that the original FMP established three limited access permit categories—a Part-Time and a Full-Time with two different tiers, with each permit holder assigned to a particular category based on their level of participation in the directed golden tilefish fishery.[1] In addition, the FMP included an open access permit category subject to a low trip limit to accommodate incidental quantities of golden tilefish that are occasionally landed while fishing for other species. Five percent of the adjusted total allowable landings (TAL) was set aside for the open access permit category, and 95% was allocated to the limited access fishery, with 19%, 66%, and 15% of the limited access allocation going to the Part-Time, Full-Time Tier 1, and Full-Time Tier 2 permit categories, respectively.

As reported in the first review, the constant harvest strategy and limited entry program implemented under the original FMP appeared to help rebuild the golden tilefish stock. However, derby-style fishing and early closures occurred in the Full-Time Tier 2 and Part-Time permit categories as fishermen competed to catch as much fish as possible before their category annual limit was reached. Full-Time Tier 1 did not experience these difficulties because individuals in this fishing category developed an agreement to further allocate their allocation among themselves.

4.1 Description of the Golden Tilefish IFQ Program

When the GTF IFQ program was implemented under Amendment 1 to the FMP in 2009, the different permit categories were eliminated and replaced with a single commercial vessel permit. Permit holders are restricted to an incidental landing limit unless fishing under an IFQ allocation.

A number of changes have been made to the GTF IFQ program since it began, the most notable being the following: Framework Adjustment 2 to the FMP, implemented in 2018, removed an outdated reporting requirement, modified the incidental trip landings, required commercial golden tilefish be landed with the head attached, and revised how assumed discards are accounted for when setting harvest limits; and Framework Adjustment 7 to the FMP, implemented in 2022, revised the

[1] The following landings qualification criteria were used to assess entry into the limited access program: Full-Time Tier 1 category: at least 250,000 pounds/year for any three years between 1993-1998, at least 1 pound of which was landed prior to June 15, 1993; Full-Time Tier 2 category: at least 30,000 pounds/year for any three years between 1993-1998, at least 1 pound of which was landed prior to June 15, 1993; part-time category: at least 10,000 pounds in any one year between 1988-1993 and at least 10,000 pounds in any one year between 1994-1998 or 28,000 pounds in one year between 1984-1993, at least 1 pound of which was landed prior to June 15, 1993.

specifications process by considering the duration for setting multi-year management measures and the timing of the fishing year.

The key regulatory provisions of the GTF IFQ program are summarized in the following subsections.

4.1.1 Specification Process

Prior to the implementation of Framework Adjustment 2 to the FMP in 2018 (see Section 4.3.1), the annual specification process set the annual catch limit (ACL) for golden tilefish equal to the acceptable biological catch (ABC). The ACL was adjusted to address any management uncertainty to set an annual catch target (ACT), then assumed discards of golden tilefish are deducted from the ACT to generate the TAL.[2] The incidental fishery was then assigned 5% of the TAL, and the remaining 95% was assigned to the IFQ fishery. Framework Adjustment 2 modified the specification process by allocating the ACT between the incidental and IFQ fisheries using the 5%/95% split. Fishery-specific assumed discards are then deducted to establish fishery specific TALs.

Framework Adjustment 7 to the FMP, which became effective in 2022, modified the annual specifications process, so that specifications could be set for the maximum number of years needed to be consistent with the Northeast Region Coordinating Council's approved stock assessment schedule.

The MAFMC periodically reviews and adjusts the ACL for golden tilefish in response to new data and information, which include research track and/or management track (formerly known as benchmark and updated assessments) tilefish stock assessments. As the ACL and associated TAL are adjusted, each IFQ shareholder's IFQ allocation is proportionately adjusted based on the IFQ share the shareholder holds at the time of the adjustment.

Current golden tilefish accountability measures state that if the ACL is exceeded, the amount of the ACL overage that cannot be directly attributed to IFQ allocation holders having exceeded their IFQ allocation will be deducted from the ACL in the following fishing year. All overages directly attributable to IFQ allocation holders are deducted from the appropriate IFQ allocation(s) in the subsequent fishing year.

4.1.2 Eligibility and Allocation

Amendment 1 defined an IFQ share as the percentage of the commercial quota of golden tilefish proportioned to each eligible person based on specified landings data. In order to qualify for an IFQ share allocation, a person or entity had to own a vessel with a fishing history that included a valid tilefish limited access permit for the 2005 permit year, and had to have reported average landings of

[2] In addition to bringing the Tilefish FMP into compliance with the ACL and accountability measure requirements of the MSA, Amendment 3, implemented in 2011, stipulated that discards would be deducted from the ACT to derive an overall TAL, regardless of whether the incidental or IFQ fishery generated the discards (Mid-Atlantic Fishery Management Council 2017b).

golden tilefish from 2001 to 2005 that accounted for at least 0.5% of the average landings in its permit category during that time frame.[3] An individual could also qualify to receive IFQ share allocation if they held a valid Confirmation of Permit History (CPH) for the above criteria. Thirteen vessels were eligible for an IFQ share allocation (4 Full-Time Tier 1, 2 Full-Time Tier 2, and 7 Part-Time vessels).

The MAFMC chose to use average landings of golden tilefish for the 2001–2005 calendar years to allocate IFQ shares to Full-Time Tier 1 and 2 vessels. Each vessel's average landings were divided by the total average landings in their respective permit category for the 2001–2005 calendar years to derive an allocation percentage. Part-time vessels received an equal allocation by dividing the percentage of the adjusted TAL allocated to the Part-Time permit category among those vessels that had landings over the 2001–2005 period.

Amendment 1 defined an IFQ allocation as the actual poundage of tilefish that each IFQ shareholder may land during a given fishing year. Each year, NMFS derives the IFQ allocation (measured in both whole (live) and gutted (landed) weight) for each IFQ shareholder by multiplying the IFQ fishery's TAL by the shareholder's IFQ share percentage. Each IFQ shareholder is issued an IFQ allocation permit. To fish an annual IFQ allocation, an IFQ allocation permit holder must declare in writing the permit numbers of any vessel that will be used to fish the allocation. IFQ allocation permits must be renewed annually. The associated IFQ allocation for any IFQ allocation permit which is not renewed is distributed among the remaining IFQ allocation permit holders.

An IFQ shareholder is not permitted to land any golden tilefish in excess of the shareholder's IFQ allocation. An IFQ allocation that is exceeded is reduced by the amount of the overage in the subsequent fishing year. If an IFQ allocation overage is not deducted from the appropriate allocation before the IFQ allocation permit is issued for the subsequent fishing year, a revised IFQ allocation permit reflecting the deduction of the overage will be issued by NMFS. If the allocation cannot be reduced in the subsequent fishing year because the full allocation had already been landed or transferred, the IFQ allocation permit will indicate a reduced allocation for the amount of the overage in the next fishing year. If an IFQ share is temporarily transferred and the lessee exceeds a permit holder's temporary IFQ allocation, the overage is deducted from the allocation of the permanent IFQ allocation permit holder who leased the IFQ allocation.

Discarding (i.e., high-grading) when fishing an IFQ allocation is prohibited.

4.1.3 Transferability

The GTF IFQ program allows IFQ shares to be transferred on either a permanent or temporary basis to another entity subject to an accumulation limit (see Section 4.1.4) and the requirement that trading partners be permanent U.S. citizens or permanent resident aliens, or corporations eligible to

[3] The 0.5% criterion was included to ensure that the lowest IFQ share allocation would be at least a practical minimum amount with which to participate in the fishery.

own a Coast Guard documented vessel, as long as they meet the requirements under the MSA. A temporary IFQ share transfer allows an IFQ allocation permit holder to lease out a temporary right to land a specified amount of golden tilefish to any eligible person or entity for the remainder of the fishing year. A permanent IFQ share transfer allows an IFQ allocation permit holder to permanently sell some or all of his/her tilefish IFQ allocation. Persons or entities receiving a permanent transfer of allocation in a given fishing year may not be able to fish all of that allocation if the prior owner had already landed tilefish under that year's allocation. The new owner would receive the full IFQ allocation in the following fishing year.

Permanent or temporary transfers of IFQ shares must be approved by NMFS. Transfer requests must include the signatures of the parties to the transfer, the price of the transfer, the amount of IFQ shares to be transferred, and the list of federal permit numbers of the vessels that will fish IFQ allocations. Temporary transfers of IFQ shares may not be sub-leased to any other entity.

4.1.4 Accumulation Limits

An entity may not own, or hold an interest in, more than 49% of the TAL assigned to the IFQ fishery (i.e., 49% of the total IFQ allocation) at any time. Having an interest in IFQ allocation acquired through either a permanent or temporary IFQ share is defined so as to include allocation held in the following ways: In an IFQ allocation permit holder's name; as a shareholder, officer, or partner of a company; by an immediate family member; or as an owner or a part owner of a company.

Permanent and temporary IFQ share transfers are monitored by NMFS to ensure that a transferee does not exceed the accumulation limit at any point during a fishing year. A declaration of interest in IFQ allocation(s), listed by IFQ allocation permit number, is required annually, at the time IFQ allocation permits are renewed.

4.1.5 Cost Recovery

Under section 304(d)(2)(A) of the MSA, NMFS is authorized to collect a fee, not to exceed 3% of the ex-vessel value of fish harvested, to recover the costs directly related to the management, data collection and analysis, and enforcement of IFQ programs. Under the GTF IFQ program, each IFQ allocation permit holder incurs a cost-recovery fee that is paid from the value of golden tilefish landings authorized under his/her IFQ allocation permit, including an IFQ allocation landed under a transfer of an IFQ share. The fee percentage fluctuates from year to year as some tasks may require more time and effort in some years. Payment of the cost-recovery fee is a condition of the renewal of an IFQ allocation permit.

4.1.6 Duration

IFQ allocation permits must be renewed annually. The associated IFQ allocation for any IFQ allocation permit which is not renewed is distributed among the remaining IFQ allocation permit holders.

4.1.7 Data Collection/Reporting

Until the implementation of Framework Adjustment 2 to the FMP in 2018 (see Section 4.3.1), vessels fishing under an IFQ allocation permit had to submit a tilefish catch report by using the interactive voice response (IVR) phone line system within 48 hours after returning to port and offloading. In addition, vessel trip reports (VTRs) had to be maintained on board the vessel and submitted to NMFS for all fishing trips undertaken with commercial permits, regardless of species retained. Framework Adjustment 2 eliminated the IVR reporting requirement, and currently only VTRs are required.

4.1.8 Monitoring and Enforcement

Reporting by commercial dealers with a valid federal tilefish dealer permit is the primary method for ensuring accurate catch accounting by IFQ fishery participants. Dealers must report all purchases of golden tilefish, including the pounds of tilefish purchased and the name, permit number, and trip identification number of the seller. The identification information on the dealer reports facilitates trip-by-trip accounting in order to ensure accurate reporting of landings' weight and value. In addition to this accounting, dockside monitoring and occasional at-sea observers promote compliance with reporting requirements.

4.1.9 New Entrants

The environmental review for Amendment 1 noted that under Sec. 303A(g)(1) of the MSA, a Council may submit, and NMFS may approve and implement, a program which reserves up to 25% of the cost recovery fees collected under a catch share program to be used to issue obligations that aid in financing the purchase or lease of quota shares in that fishery by fishermen who fish from small vessels and by entry-level fishermen (Mid-Atlantic Fishery Management Council 2009). However, the MAFMC and NMFS have not yet established such a loan program for the golden tilefish fishery.

4.1.10 Auctions and Royalties

In consistency with Section 303A(d) of the MSA, the MAFMC considered the use of auctions or royalties for the initial distribution of limited access privileges in the GTF IFQ program. In the environmental review for Amendment 1 the MAFMC assessed three mechanisms to collect royalties in the golden tilefish fishery: 1) auction off the initial allocation; 2) assess a per-unit fee on IFQ allocations; and 3) assess a percentage fee based on the landed value of harvest. However, most MAFMC members were concerned that there were insufficient economic data (e.g., production cost data, fishery profit levels) to make an informed decision regarding the implementation of a royalty collection system. It was felt that implementing a royalty system without adequate information could negatively affect the fishery. For example, under the per-unit fee royalty collection system, there was concern that imposing a fee too high could force some IFQ allocation permit holders to cease fishing. Under the percentage fee assessed on the landed value of harvest collection system, there was concern that an additional burden would be placed on fishermen as this system would collect royalties in a similar fashion as the system developed to collect cost recovery fees. In addition, an

auction system was rejected because the MAFMC was concerned that it could prevent the participation of individuals with limited access to capital. As a result of these concerns, the MAFMC recommended that no collection of royalties be implemented for the initial, or any subsequent, distribution of allocations in the GTF IFQ program (Mid-Atlantic Fishery Management Council 2009).

4.2 Results/Primary Conclusions of First Five-Year Review

The first five-year review concluded that the GTF IFQ program achieved its general purpose. Overcapacity and latent fishing effort in the directed golden tilefish fishery were reduced, and derby-style fishing subsided. The review noted that spreading landings throughout the year and avoiding market gluts may have played an important role in the observed increase in ex-vessel price and increase in price stability throughout the year that has been observed after IFQ program implementation. The review also noted, however, that other important factors (e.g., dogfish and skate interactions, changes in market demand, weather, etc.) may have changed landings patterns in the fishery as well (Mid-Atlantic Fishery Management Council 2017a).

In addition to these economic impacts, the review found that the number of Coast Guard-reported marine casualty incidents (e.g., collisions, allisions, mechanical difficulties, crewmember injury, fire, flooding, etc.) appears to have decreased since the IFQ program was implemented. However, the review indicated that this reduction cannot necessarily be attributed to the introduction of the program (Mid-Atlantic Fishery Management Council 2017a).

Given that the results of the first program review indicated that the program largely met the program purpose of reducing overcapacity and ending the race to fish, and that review results showed that fleet-wide economic trends were positive since the implementation of the IFQ program, the review concluded that major modifications to the program were not needed, although a number of remaining issues suggest that minor improvements to the program were possible (Mid-Atlantic Fishery Management Council 2017a). These issues, together with the review's suggested changes to the program, are summarized in Table 2.

Table 2. GTF IFQ Program Issues and Suggested Changes

Issue	Suggested Change
IFQ shareholders pay cost recovery fee, which means subleasing is prohibited to facilitate tracking	Increase flexibility by assessing fee on landings
The fishing year differs from the period used for stock assessments and cost recovery (i.e., calendar year), so the latter covers two periods and complicates administration	Use the calendar year for both
Vessels are authorized to land during a specific time period, which means all landings are attributable to that IFQ allocation (i.e., harvesting multiple allocations cannot overlap in time)	Require vessels to only fish one IFQ allocation at a time
Interactive voice response reporting is redundant	Eliminate IVR reporting
Landings and dealer reporting are with head on so there is an inconsistency that also complicates monitoring the catch limits	Require golden tilefish to be landed with the head attached

Source: Mid-Atlantic Fishery Management Council (2017a); National Academy of Sciences (2021)

The first five-year review also reported a number of industry concerns with the GTF IFQ program. Summaries of these concerns, along with the responses of the MAFMC and NMFS to the concerns, are presented in Table 3.

Table 3. Industry Concerns with the GTF IFQ Program and Agency Responses

Concern	MAFMC/NMFS Response
Flexibility needed to carry over IFQ allocation to next year	The Fishery Management Action Team recommended that no carryover be implemented because under the catch and landings limits and accountability measures, the ABC equals the ACL and, as such, there are implications for overfishing the following year.
High-grading by small allocation holders	MAFMC and NMFS staff used dealer data in a preliminary evaluation of golden tilefish landings' market category for IFQ vessels and did not observe any significant differences in the patterns of landings by fish size (market size category) among vessels.
Variable cost recovery owed at end of year prevents planning	Recoverable expenses are calculated at the end of the year based on actual revenues and on administrative costs rather than on the projected revenues and administrative costs. NMFS notifies the MAFMC of anticipated costs as early as possible.
Increased recreational landings will negatively impact stock size and IFQ allocations	The Scientific and Statistical Committee (SSC) and Tilefish Monitoring Committee are monitoring recreational efforts in the fishery. The SSC indicated that if the recreational harvest is substantially larger than currently believed, it would recommend that efforts should be made to directly account for this source of removals in the assessment.

Source: Mid-Atlantic Fishery Management Council (2017a); National Academy of Sciences (2021)

4.3 Management Changes in the GTF IFQ program Since the First Five-Year Review

There have been no significant changes to the GTF IFQ program since the first five-year review was completed. However, several minor changes to the program have been made, many of which addressed issues identified in the first five-year review. These management changes are described in the sections below.

4.3.1 Framework Adjustment 2

Framework Adjustment 2 to the FMP (implemented in 2018) made several changes to the management system intended to improve and simplify the administration of the golden tilefish fishery. These changes included removing an outdated reporting requirement, modifying the incidental trip landings, requiring commercial golden tilefish be landed with the head attached, and revising how assumed discards are accounted for when setting harvest limits (Mid-Atlantic Fishery Management Council 2022a). These measures are described in more detail below.

Specification Process

Framework Adjustment 2 modified the specification process by allocating the ACT between the incidental and IFQ fisheries using the 5%/95% split. Fishery-specific assumed discards are then

deducted to establish fishery-specific TALs (National Marine Fisheries Service 2018a). Given that the incidental fishery has not harvested all of its allocation since the GTF IFQ program was implemented, slightly adjusting the incidental catch limit downward to fully account for discards in that fishery is not expected to constrain landings in the incidental fishery given recent fishing patterns (Mid-Atlantic Fishery Management Council 2017b).

Incidental Landing Limit

Amendment 1 to the FMP retained the previously established limit of 300 pounds live weight of golden tilefish per trip for the incidental fishery. Amendment 3, implemented in 2011, increased this landing limit to 500 pounds as this was not expected to change fishing practices. However, in recent years, there have been increasing reports of incidental fishery vessels specifically targeting golden tilefish to land the maximum incidental landing limit. In an effort to ensure that the incidental fishery functions as originally intended, Framework Adjustment 2 modified the incidental landing limit to ensure that these vessels are targeting other species, and only incidentally catching golden tilefish (National Marine Fisheries Service 2018a). Specifically, it established a landing limit of 500 pounds or 50%, by weight, of all fish, including the golden tilefish, on board the vessel, whichever is less (National Marine Fisheries Service 2018a). The addition of the landings ratio/qualifier is expected to deter incidental fishery vessels from targeting golden tilefish (Mid-Atlantic Fishery Management Council 2017a).

If the incidental fishery TAL is reached, NMFS closes the incidental fishery for the remainder of the fishing year. Such a closure does not affect vessels fishing in the IFQ fishery (National Marine Fisheries Service 2018a).

IFQ Allocation Usage

IFQ allocation holders may authorize one or more vessels to land golden tilefish under their allocation. All tilefish landed by those vessels are then deducted from that allocation. Currently, the NMFS monitoring system is not designed to allow a vessel to attribute golden tilefish landings from a single trip to more than one IFQ allocation. To include such a mechanism in the system would increase reporting burden on vessels and dealers and add complexity to the IFQ accounting and cost recovery systems. In order to maintain simple and efficient administration of the IFQ fishery, Framework Adjustment 2 prohibited a vessel from being authorized to land tilefish under multiple IFQ allocations on the same fishing trip. A vessel can still change which IFQ allocation it harvests from over the course of the year, but that harvesting must be on distinct trips (National Marine Fisheries Service 2018a).

Interactive Voice Response System (IVR) Reporting Requirement Removal

The MAFMC originally created the IVR reporting requirement when the golden tilefish fishery was managed under the tier system, which included three permit categories, each with a specific annual landing limit. The IVR reporting requirement provided timely landing reports and allowed managers

to close a permit category if the annual landing limit was reached. However, with the implementation of electronic dealer reporting in 2004, and with improved VTR reporting processing by NMFS, the information provided by vessel operators using the IVR system became redundant. Currently, NMFS uses landings reported in the dealer system as the primary tool to track landings in the golden tilefish fishery. Framework Adjustment 2 eliminated the IVR reporting requirement. While eliminating the IVR system is a purely administrative issue, it is likely that its suspension has had neutral-to-slightly positive economic and social impacts, as this reporting system required some time and effort on the part of fishing vessel operators (Mid-Atlantic Fishery Management Council 2017b; National Marine Fisheries Service 2018a).

Commercial Golden Tilefish Landing Condition

The commercial golden tilefish fishery typically lands fish in a head-on, gutted condition. However, IFQ allocations and the incidental possession limit are in whole (round) weight. Consequently, the fishing industry was required to use a conversion factor to change landed weight to whole weight to comply with the incidental landing limit and IFQ allocations. Framework Adjustment 2 required commercially caught golden tilefish to be landed with the head and fins attached, although they could be gutted. As a result, monitoring of IFQ allocation use and the incidental landing limit is easier and more logical for industry and NMFS enforcement (Mid-Atlantic Fishery Management Council 2017b; National Marine Fisheries Service 2018a).

4.3.2 2020/2021 Emergency Action

The GTF IFQ program does not allow any carryover of unharvested allocation from one fishing year into the next. However, at the April 2020 meeting, the MAFMC voted to request that NMFS implement emergency measures, under the authority provided in Section 305(c) of the MSA, for a onetime carryover of up to 5% of unharvested IFQ allocation from fishing year (FY)2020 into FY2021. Any increase in the 2021 IFQ fishery TAL reflected 2020 IFQ fishery TAL that was not harvested. Thus, total landings for FY2020 and FY2021 remained at or below the combined IFQ fishery TAL for the two years (National Marine Fisheries Service 2021a).

This emergency action was intended to mitigate the severe negative impacts to the golden tilefish fishery as a result of the COVID–19 pandemic. Unforeseen changes in the market for seafood resulting from the pandemic, particularly the loss of restaurant sales due to local closure orders, substantially reduced demand for golden tilefish. A review of golden tilefish IFQ landings from November 1, 2019, through June 30, 2020, shows that landings were approximately 18.5% below the same date in 2018 and 2019. Even after some tilefish dealer activity resumed, the ability of tilefish IFQ shareholders to harvest their shares remained very limited, and a number of fishermen were unable to fully harvest their shares for FY2020. The emergency action helped prevent additional economic losses to industry participants, shoreside businesses, and fishing communities, and helped offset lost fishing opportunities during FY2020 (National Marine Fisheries Service 2021a).

In June 2021, the emergency action was extended past the expiration date of June 19, 2021, until the start of the next golden tilefish fishing year on November 1, 2021. This allowed IFQ shareholders who had not yet had an opportunity to harvest the IFQ allocation they carried over additional time to take full advantage of this opportunity. Of the 10 entities that held IFQ shares, five had unharvested IFQ allocation at the end of FY2020 and were able to carry over some IFQ allocation into FY2021. Some shareholders had already harvested their carryover while others had not yet taken full advantage of this opportunity. Extending the emergency action ensured that all those who received carryover were able to fully benefit from these measures (National Marine Fisheries Service 2021a).

4.3.3 Framework Adjustment 7

In 2021, the MAFMC submitted to NMFS Framework Adjustment 7 to the FMP, which proposed measures to revise the specifications process by considering the duration for setting multi-year management measures and the timing of the fishing year (Mid-Atlantic Fishery Management Council 2022a). These measures, which became effective in 2022, are described in more detail below.

Multi-year Specifications

Framework Adjustment 7 modified the annual specifications process, so that specifications could be set for the maximum number of years needed to be consistent with the Northeast Region Coordinating Council-approved stock assessment schedule. Specifications can be set to cover the time period until a new golden tilefish stock assessment is available. Multi-year annual specifications are expected to relieve some of the administrative demands on the MAFMC and NMFS associated with annual specification requirements. Longer-term specifications also provide greater regulatory consistency and predictability to the fishing sectors (National Marine Fisheries Service 2022a).

Fishing Year Timing

Framework Adjustment 7 changed the golden tilefish fishing year to match the calendar year and would start on January 1. Previous regulations defined the fishing year as the 12-month period from November 1-October 31. Changing the fishing year to the calendar year matches the period used in the stock assessments and the cost recovery program for the IFQ fishery (National Marine Fisheries Service 2022a).

5 Program Performance and Review

5.1 Data and Analysis Notes

As noted, analyses reviewing the performance of the IFQ program generally focus on the period between fishing years 2016 and 2021, but some analyses will look at performance over the entire IFQ period, especially if the analysis has changed or is new since the first program review. For the baseline period, the pre-IFQ fishery is defined by all vessels who participated in the directed fishery (e.g., fished Full-Time Tier 1, Full-Time Tier 2, or Part-Time fishing permits). In most cases, analyses exclude landings of golden tilefish on incidental trips, though in some cases data from both the directed and incidental fisheries are combined due to confidentiality restrictions. In general, all ex-vessel revenue and price data have been adjusted for inflation using the same price index as was used in the previous review, the GDP implicit price deflator, but have been indexed to 2021 (denoted $2021) for this report. Any presentation of nominal price or ex-vessel revenue data will be clearly marked. In addition, most analyses look at trends within and across fishing years, which, for the period of this review, was the 12-month period from November 1-October 31. Calendar year comparisons may be necessary in subsequent reviews due to the calendar and fishing year changes that went into effect starting in fishing year 2022 (National Marine Fisheries Service 2022a).

5.2 Information Sources

This review uses many of the same data sources as used in the first five-year review, but there have been some important changes and updates that we describe below, in terms of the data sources used for raw data analyzed in the report, other NMFS-supplied data and analyses that were available for incorporation into this review, stock assessment information, interviews conducted specifically for this review, and recently published literature.

5.2.1 National Marine Fisheries Services Datasets

For the most part, analyses completed in support of this review relied on industry reported data provided through a data request to the NMFS Greater Atlantic Fisheries Region Office (GARFO). These data include catch, landings, revenue, trip costs, and other important characteristics of fishing trips and purchasing activities by dealers, including when and where catch was harvested and landed. Most data were pulled from the Catch Accounting and Monitoring System (CAMS) databases between December 2022 and August 2023, as specified for individual analyses.[4] In addition, previously completed summaries or analyses of fishery data, per annual fishery performance reports, were also incorporated into the review where relevant.

[4] CAMS is a joint venture between GARFO and NEFSC to implement a shared data system to support quota monitoring, stock assessments, and other fisheries-dependent data analyses.

Given the small numbers of vessels and dealers active in the fishery, NMFS's rules on data confidentiality limited the data available to assess some economic, social, and community impacts. Summary data are made available based on the "rule of 3", i.e., there must be at least three distinct reporting units (e.g., vessels or dealers) included in a summary for the summary information to be made publicly available. Data may be made available if there is no information included that could uniquely link the information to an individual unit (person, vessel, dealers, business, etc.). In preparation of this review, data were aggregated and combined in a number of ways to show as much information as possible without compromising confidentiality. In some cases, data for the incidental fishery and the IFQ fishery are presented together. In other cases, data for primary ports are aggregated with data from other ports or port areas. In addition, data may be summarized across the baseline and IFQ periods, or other periods of time, as relevant to the analysis. Finally, in some instances where the number of reporting units fell below three in a few individual years, data points are redacted from summary tables or figures (denoted with a 'c').

Other data obtained from NMFS GARFO-maintained databases include cost recovery information and IFQ share and lease transaction data. For this analysis, assignment of IFQ shares to a community is based upon the listed registered addresses listed in IFQ allocation permit application files. Caution in the interpretation of this information is warranted. Registered address does not necessarily indicate where IFQ shareholders actually live. Some address information can represent business locations rather than residences. However, the location of ownership address provides a rough indicator of the direction or nature of IFQ share ownership ties to particular communities.

Also used in this review were datasets created by the NMFS Northeast Fisheries Science Center's (NEFSC) Social Science Branch, including operating cost (Werner 2022a; Werner 2022b) and entity affiliation datasets.[5]

5.2.2 NMFS Northeast Regional Stock Assessment Workshop Stock Assessments

This review also incorporates information from the most recent management track assessment completed for golden tilefish in 2020 (Nitschke 2021). This review incorporates estimates of fishing mortality, spawning stock biomass (SSB), and biological reference points, into the discussion of the biological impacts of the program. Estimates of SSB are also incorporated into the productivity analysis (Walden 2023). The next research track assessment for the stock is underway and will be reviewed in the Spring of 2024.

5.2.3 Interviews with Stakeholders

In the spring of 2023, the review team traveled to Long Island, New York and Long Beach, New Jersey to conduct interviews with fishery stakeholders on the performance of the golden tilefish IFQ

[5] Ownership entities were identified using the NMFS NEFSC's archive of ownership data where fishing vessels are linked to together by common ownership as of June 1st in each year. More information can be found at National Marine Fisheries Service (2023a)

program, with a focus on performance between fishing years 2016 and 2021. In total, eight in-person interviews were conducted, including one group interview with five people. In addition, two video conferencing interviews were conducted. Four market visits also occurred. Interviewed populations included charter captains, offload facilities, dealers, vessel owners, captains, crew, and fishing community representatives. Interviews were unstructured in format and used primarily to gain insights across stakeholders about their perspectives on the IFQ program. Information garnered from the interviews was used in discussions of data and trends throughout this review.

5.2.4 Published Literature

This review builds off the wealth of published literature used in the first five-year review, together with more recent literature that evaluates the performance of the GTF IFQ program.

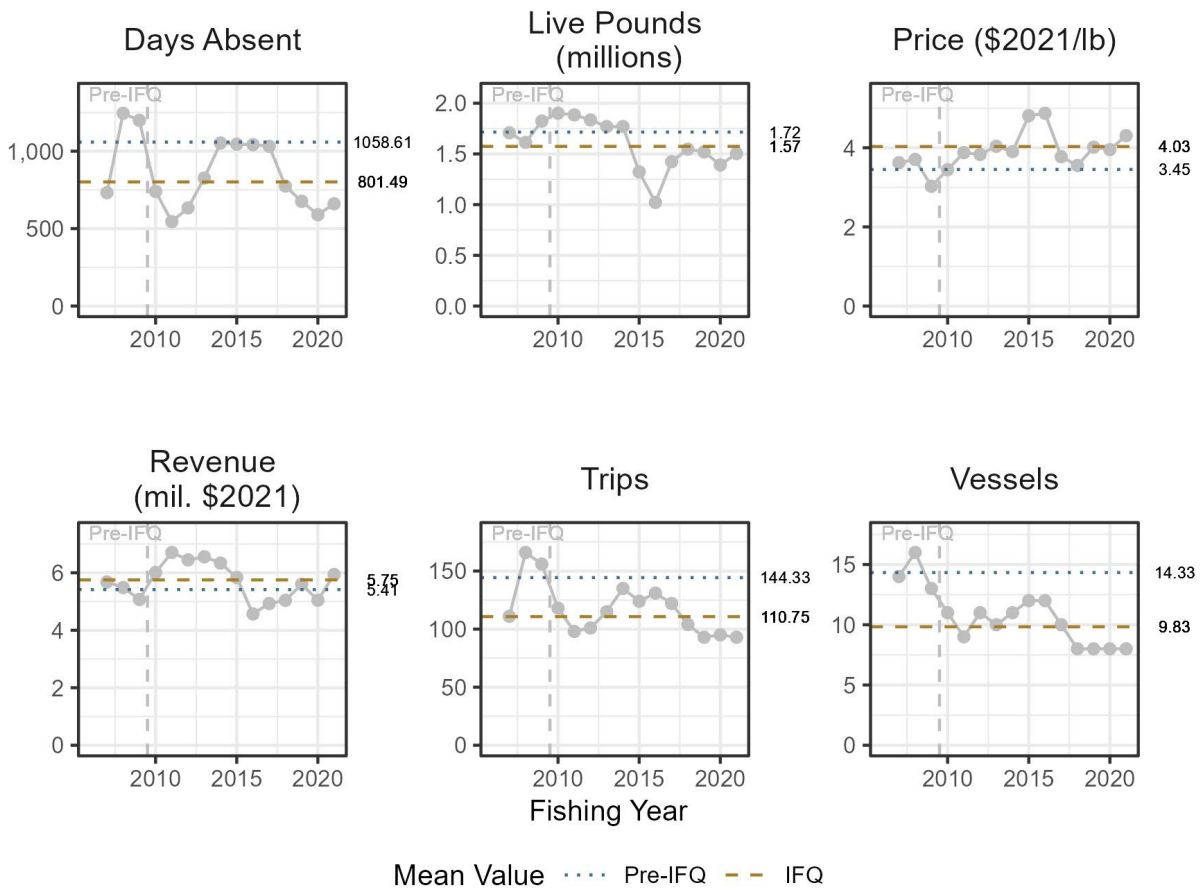
5.3 Economic Outcomes

To evaluate the economic performance of the GTF IFQ program since implementation, we examine a suite of metrics and indicators that span both financial viability (landings, revenue, number of vessels and effort, average vessel performance) and distributional outcomes, many of which were included in the first five-year review of the program and outlined in the *Guidance for Conducting Reviews of Catch Share Programs* (National Marine Fisheries Service 2017). The first section below summarizes major trends in fleetwide economic indicators in the pre-IFQ (FY2007–2009) and IFQ (FY2010–2021) periods. The sections that follow examine trends in more detail with respect to specific economic topics.

5.3.1 Participation and Earnings Trends

Compared to the baseline (pre-IFQ) period, on average, total fleet effort and landings in the golden tilefish fishery decreased during the IFQ period, while revenue and prices increased, although considerable variability occurred in both periods (Figure 1). While decreases in total fleet effort are consistent with trends in the first six years of the program, the fleet has continued to shrink since FY2015, with only eight active vessels participating between FY2018 and FY2021. In addition, fleetwide revenues have been lower in each year than in the first six years of the program, driven by lower landings and quotas. Despite this, average fleetwide revenue over the entire IFQ period has remained slightly higher than the pre-IFQ average ($5.77 million compared to $5.44 million), driven by relatively high earnings in the FY2010–FY2015 period.

Figure 1. Summary of Pre-IFQ Period and IFQ Economic Trends

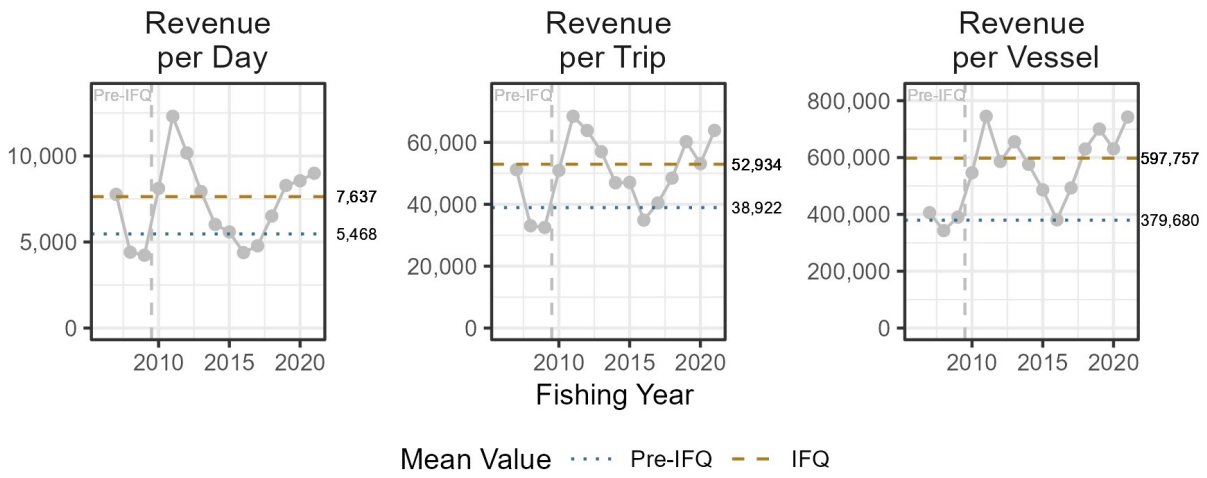


Note: Price and revenue have been adjusted for inflation ($2021). Data represent the directed golden tilefish commercial fishery only (no incidental effort). Dashed and dotted horizontal lines indicate the average value for the pre-IFQ (dotted) and IFQ (dashed) periods. Price is based on landed pounds (not shown). Live pounds are shown instead of landed pounds since live pounds are used for quota monitoring.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

A decrease in the number of active vessels, trips, and days absent, together with the general increase in fleetwide revenue, led to a higher average revenue per vessel, trip, and day absent during most years of the IFQ period, compared to the pre-IFQ period (Figure 2).

Figure 2. Average Revenue per Unit Effort



Note: All revenue data have been adjusted for inflation ($2021). Data represent golden tilefish landings from the directed commercial fishery only (no incidental effort). Dashed and dotted horizontal lines indicate the average value for the pre-IFQ (dotted) and IFQ (dashed) period.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Deviations from this trend are evident between FY2015 and FY2017, where average revenue per trip, vessel, and days absent were relatively low, and utilization rates were also notably lower—approximately 79% in FY2015 and FY2017, while in FY2016, only 57% of the allocation was harvested (Table 4). As discussed in the previous five-year review, low attainment and revenue appears to have resulted from a combination of lower catch rates and some inactive vessels (Mid-Atlantic Fishery Management Council 2017a). In addition, during interviews conducted for this review, industry members reported that severe winter weather conditions and dogfish and skate interactions affected landings in some years.

Table 4. Summary of Pre-IFQ Period and IFQ Economic Trends

Fishing Year	Vessels	Trips	Millions of Live Pounds	Millions of Landed Pounds	Millions of Revenue ($2021)	Days at Sea	Price ($2021/lb)	Total Allocation (millions of pounds)	Utilization (%)
Pre-IFQ									
2007	14	111	1.71	1.57	5.71	732	3.64	1.80	94.8
2008	16	166	1.61	1.48	5.52	1,245	3.73	1.90	85.1
2009	13	156	1.82	1.68	5.10	1,199	3.04	1.89	96.6
Avg.	**14.3**	**144.3**	**1.72**	**1.58**	**5.44**	**1,059**	**3.47**	**1.86**	**92.2**
IFQ									
2010	11	118	1.90	1.74	6.04	741	3.46	1.90	100.3
2011	9	98	1.88	1.73	6.74	545	3.90	1.90	99.4
2012	11	101	1.84	1.68	6.48	634	3.85	1.90	96.8
2013	10	115	1.77	1.62	6.59	826	4.06	1.90	93.4
2014	11	135	1.77	1.62	6.36	1,053	3.92	1.90	93.4
2015	12	124	1.32	1.21	5.85	1,045	4.82	1.67	79.3
2016	12	131	1.02	0.94	4.58	1,042	4.88	1.79	57
2017	10	122	1.42	1.31	4.94	1,032	3.78	1.79	79.4
2018	8	104	1.55	1.42	5.04	775	3.55	1.55	99.6
2019	8	93	1.52	1.40	5.60	676	4.01	1.55	97.8
2020	8	95	1.39	1.28	5.04	590	3.95	1.55	89.5
2021	8	93	1.50	1.38	5.94	660	4.31	1.55	96.8
Avg.	**9.8**	**110.8**	**1.57**	**1.44**	**5.77**	**801**	**4.04**	**1.75**	**90.2**

Note: Data represent golden tilefish landings from the directed commercial fishery only (no incidental effort). All landings and revenue include landings and revenue from golden tilefish only.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

The data presented above were for golden tilefish landings and revenue only; however, other species may be landed on IFQ trips as well. The previous five-year review concluded that the contribution of non-IFQ species to total landings and revenue was minor, a conclusion that is upheld by the current review. Specifically, the previous review found that the proportion of revenues derived from species other than golden tilefish was approximately 1% of total revenue from FY2010 to 2015, compared to 4% in the pre-IFQ period (Mid-Atlantic Fishery Management Council 2017a). Updating this calculation through FY2021 yields nearly the same result, at 0.9%, on average, across the IFQ period (Table 5). FY2021 saw a decline in golden tilefish revenue as a proportion of total revenue; however, in that year there were a small number of high-value trips that reported relatively little golden tilefish, which may be driving this trend. Landings of non-golden tilefish species tend to be variable across years resulting in the proportion of golden tilefish to the total landings volume ranging from 99.8% in 2011 to 85.5% in FY2016. In contrast, the proportion of golden tilefish revenue to total revenue has been higher, ranging from 99.9% to 98.7% in the same years, indicating that other landed species tend to relatively low value. At the species level, dogfish is the most commonly landed other species over the last 12 years, a change from the pre-IFQ period where the most common

species was Loligo squid. Other commonly caught species in the IFQ period include blueline tilefish, eel, and bigeye tuna.

Table 5. Landings and Revenue of Non-IFQ Species on IFQ trips

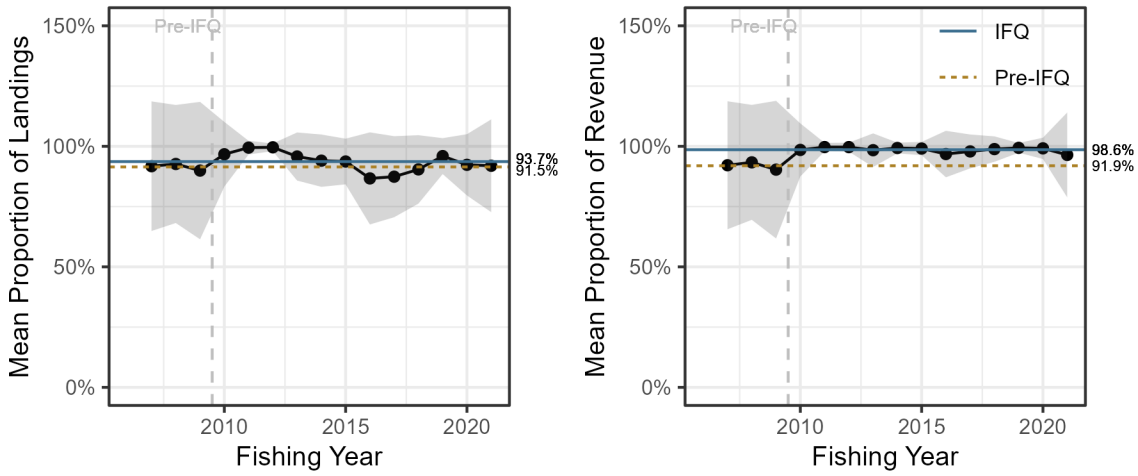
Period	FY	Millions of Total Landings (lb)	Total Revenue ($2021)	Non-IFQ Landings (live lb)	Non-IFQ Revenue ($2021)	IFQ Landings (live lb)	IFQ Revenue ($2021)	GTF Proportion (live lb)	GTF Proportion ($2021)
Pre-IFQ	2007	1.91	5.85	0.20	0.14	1.71	5.71	89.4%	97.7%
	2008	1.97	5.88	0.35	0.36	1.61	5.52	82.1%	93.8%
	2009	2.04	5.36	0.21	0.26	1.82	5.10	89.6%	95.2%
	Avg	**1.97**	**5.70**	**0.26**	**0.25**	**1.72**	**5.44**	**87.0%**	**95.6%**
IFQ	2010	1.95	6.06	0.05	0.02	1.90	6.04	97.6%	99.7%
	2011	1.89	6.75	0.00	0.01	1.88	6.74	99.8%	99.9%
	2012	1.84	6.50	0.01	0.02	1.84	6.48	99.7%	99.8%
	2013	1.84	6.63	0.07	0.05	1.77	6.59	96.4%	99.3%
	2014	1.91	6.38	0.14	0.02	1.77	6.36	92.9%	99.6%
	2015	1.44	5.88	0.12	0.03	1.32	5.85	91.7%	99.5%
	2016	1.19	4.64	0.17	0.06	1.02	4.58	85.5%	98.7%
	2017	1.61	4.98	0.19	0.04	1.42	4.94	88.5%	99.2%
	2018	1.71	5.06	0.16	0.02	1.55	5.04	90.5%	99.7%
	2019	1.60	5.62	0.08	0.03	1.52	5.60	94.8%	99.6%
	2020	1.51	5.05	0.12	0.01	1.39	5.04	91.9%	99.7%
	2021	1.67	6.27	0.17	0.33	1.50	5.94	90.0%	94.7%
	Avg	**1.68**	**5.82**	**0.11**	**0.05**	**1.57**	**5.77**	**93.3%**	**99.1%**

Note: Data include all landings on pre-IFQ (directed golden tilefish) and IFQ trips 2007-2021 to show the relative contribution of landed species other than golden tilefish to total landings and revenue other time. Landings weights represent live pounds.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

At a trip level, we see similar trends to the fishery as a whole, with the average proportion of golden tilefish to total revenues being 98.6% in the IFQ period, compared to 91.9% in the baseline period (Figure 3). As discussed for the fishery overall, in FY2021 there was a slight decrease in the mean as well as an increase in variability across trips (as shown by increase in standard deviation). The difference between the baseline and IFQ period was less pronounced for landings, which increased slightly from 91.5% to 93.7%, with considerable variability both between and within years.

Figure 3. Average Proportion of Golden Tilefish to Total Landings on IFQ Trips



Note: Data include all landings on pre-IFQ (directed golden tilefish) and IFQ trips during fishing years 2007–2021 to show the relative contribution of other species to total landings and revenue over time. Shaded grey area shows one standard deviation, a measure of variability, around the mean. Horizontal lines indicate the average for the pre-IFQ (dashed) and IFQ (solid) period. Landings weights represent live pounds.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.3.2 Utilization

Because the overall goal of the Tilefish FMP is to rebuild golden tilefish and achieve optimum yield, attainment and utilization of the golden tilefish IFQ allocation is an important indicator of how the program is supporting its goal.

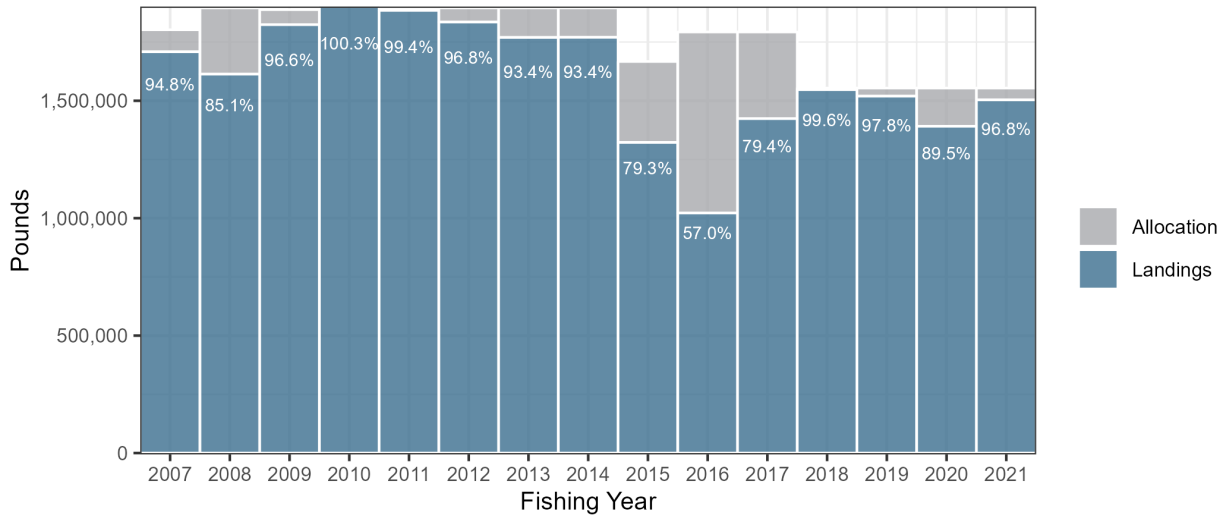
The annual IFQ allocation for golden tilefish averaged 1.86 million pounds during the FY2007–2009 baseline period and remained similarly high at 1.9 million pounds until FY2015, when the allocation decreased to 1.67 million pounds, before being raised to 1.79 million pounds in FY2017 (Table 4). Since FY2018 the allocation has remained at its lowest level at 1.55 million pounds.

While utilization (the proportion of the allocation landed) was initially high under the IFQ program, it decreased from 92.2% in the baseline period to 90.2% over the IFQ period, on average. This marks a slight change from the conclusion in the previous review where overall, it appeared that utilization had increased under the IFQ program (96.7% between FY2010 and FY2014), with the exception of FY2015, which appeared to have been affected by a combination of anomalous conditions and an inactive vessel. Instead, lower than average utilization persisted until FY2018, with a low of 57% utilization in FY2016 (Table 6 and Figure 4). As previously discussed in the participation and earnings trends section, potential factors contributing to low utilization are inactive vessels, interactions with dogfish and skates, and changes in age and size composition resulting in lower catch per unit effort. In FY2015, one IFQ account was sold. That year, the vessel associated with harvesting those IFQ shares did not fish due to mechanical problems. This account contributed to approximately

50% of the overall underage in FY2015. (Mid-Atlantic Fishery Management Council 2017a). In addition, catch rates declined as the last strong year class aged in during FY2015 (As shown by low revenue per day in Figure 2). A decline in the Catch per Unit of Effort (CPUE) results in longer trips and higher costs. (Mid-Atlantic Fishery Management Council 2017a). However, lower catch rates and higher expenses were somewhat offset by higher tilefish prices.. The previous review discussed how larger IFQ holders may have been more constrained by declining CPUE, which may explain why some of the larger IFQ holders also chose to invest in maintenance and upgrades to their vessels in this period, further contributing to underutilization.

Over the last four fishing years, utilization rates have increased due to slight increases in catch relative to lower total annual allocations (Figure 4). The MAFMC's Tilefish Advisory Panel indicated that in FY2019, winter conditions arrived early in October and Northeast winds affected fishing operations towards the end of the fishing year. Some boats were not able to leave the docks and boats that were offshore could not fish (forcing them to relocate to the west). In addition, with the arrival of early winter conditions, dogfish and skates interactions also increased. These factors resulted in a small underage in landings for FY2019 (Mid-Atlantic Fishery Management Council 2020).

Figure 4. Utilization of the Golden Tilefish IFQ Allocation



Note: Annual percent utilization of the IFQ allocation shown in white for each fishing year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Since implementation, the fleet has only exceeded its allocation once, in the first year of the program. Since the first program review there have not been any documented overages (Table 6). On average, underages in the commercial fishery are similar to the pre-IFQ average of 0.2 million pounds.

Table 6. Overage/Underage in the Commercial (Directed and Incidental) Golden Tilefish Fishery (m lb)

Fishing Year	Commercial Quota	Commercial Landings	Overage/Underage
2007	1.995	1.794	-0.201
2008	1.995	1.689	-0.306
2009	1.995	1.906	-0.089
Pre-IFQ Average	**1.995**	**1.796**	**-0.199**
2010	1.995	2.021	+0.026
2011	1.995	1.924	-0.071
2012	1.995	1.873	-0.122
2013	1.995	1.840	-0.155
2014	1.995	1.826	-0.169
2015	1.755	1.351	-0.404
2016	1.887	1.051	-0.836
2017	1.887	1.501	-0.387
2018	1.626	1.624	-0.003
2019	1.626	1.563	-0.064
2020	1.626	1.403	-0.223
2021	1.625/ 1.672*	1.546	-0.125
IFQ Average	**1.838**	**1.627**	**-0.211**

Note: From 2001 to 2021, fishing year = November 1 – October 31 period.

**The MAFMC requested for emergency action to allow unharvested 2020 IFQ pounds to be carried over into the 2021 fishing year, up to 5% of the IFQ shareholders initial 2020 allocation.*

Source: Mid-Atlantic Fishery Management Council (2022a), averages calculated by Northern Economics

5.3.3 Ownership and Effort Consolidation

In this section, we look at consolidation in the fishery in a few different ways, first by changes in the number of entities holding IFQ shares, or the number of allocation accounts, as well as the proportion of quota allocated across IFQ share accounts. Second, we look at how effort in the fishery has consolidated, as shown by the number of active vessels and the distribution of revenue across vessels and entities in the fishery. Together, this information supports the evaluation of the program's goal to reduce overcapitalization and latent effort in the commercial fishery, as well as FMP objectives to prevent overcapitalization and limit new entrants (objective 2), evaluate economic impacts of the program (objective 4), as well as review allocations, transferability, new entrants, and accumulation limits per the *Guidance for Conducting Review of Catch Share Programs* (National Marine Fisheries Service 2017).

IFQ Share Ownership Consolidation

National Standard 4 of the MSA requires that any allocation of fishing privileges be carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. Sec. 303A(c)(5)(D) of the MSA reiterates this mandate in the specific context of

catch share program design and dictates that Councils and NMFS must ensure that participants in a catch share program do not acquire an excessive amount of quota shares in the program by establishing a maximum share, expressed as a percentage of the total quota shares, that a shareholder is permitted to hold, acquire, or use; and establishing any other limitations or measures necessary to prevent an inequitable concentration of quota shares.

The GTF IFQ program stipulates that no person or entity may acquire more than 49% of the annual adjusted golden tilefish TAL at any point during a fishing year. Acquisition includes any permanent or temporary transfer of IFQ shares. Concentration of shares in the hands of one or a few entities can create market power problems, where the IFQ shareholders control market price for either their catches or for IFQ shares in the fishery. The purpose of IFQ share accumulation limit is to prevent individual shareholders from controlling production or control market price for either their fished goods or for IFQ shares in the fishery, as well as achieving management objectives of the FMP.

The first five-year review notes that in developing the GTF IFQ program, the MAFMC reviewed several potential accumulation limits and specifically considered factors such as potential market power and competition (from other fisheries), historical fishing practices, and efficiency of fishing operations (Mid-Atlantic Fishery Management Council 2017a). The accumulation limit that the program adopted is quite large relative to those in other U.S. catch share programs (Office of Inspector General 2014); it allows consolidation to as few as three owners in total. However, the MAFMC did not believe that the accumulation limit would allow harvesters to control the market price for tilefish due to the large number of substitutes for tilefish available in the marketplace (Mid-Atlantic Fishery Management Council 2009).

Table 7 shows the distribution of IFQ shares since the program was implemented (analysis of quota market performance at the community level is presented in Section 5.4.4). Following the convention of the first five-year review, the IFQ shareholdings presented were categorized into three hypothetical account size categories (small, medium, large) to better conceptualize changes within those shareholding size categories.[6] During the first year of IFQ program (2010), 13 IFQ accounts were established. As described in the first five-year review, the distribution of IFQ shares across vessels during the initial allocation was highly correlated with a vessel's position in the tier system that preceded program implementation. The bulk of the initial accounts with small shareholdings (<5%) were previously Part-Time vessels (7 out of 8); cumulatively, these small shareholdings accounts received 20% of the initial allocation. Both of the two initial accounts with large shareholdings (≥20%) were previously Full-Time Tier 1 vessels; cumulatively, these large shareholding accounts received 42% of the initial allocation (Mid-Atlantic Fishery Management Council 2017a).

[6] While technically shares are allocated to allocation permits, consistent with the previous review we use the term 'allocation account' to describe where individual allocations are distributed and from where leases are deducted or credited.

Table 7. Distribution of IFQ Shares by Account Size Category

	Fishing Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Large Accounts (≥ 20%)												
No. of accounts	2	2	2	2	2	2	2	2	2	2	2	2
Average IFQ share per account	0.21	0.21	0.24	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Total allocation	0.42	0.42	0.48	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Medium Accounts (≥5% <20%)												
No. of accounts	3	3	4	2	2	2	2	2	2	2	2	2
Average IFQ share per account	0.13	0.13	0.11	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15
Total allocation	0.38	0.38	0.45	0.25	0.25	0.25	0.28	0.31	0.31	0.31	0.31	0.31
Small Accounts (<5%)												
No. of accounts	8	7	7	8	8	8	7	6	6	6	6	6
Average IFQ share per account	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02
Total allocation	0.20	0.20	0.07	0.21	0.21	0.21	0.19	0.16	0.16	0.16	0.16	0.16
Accumulation Limit	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Total Number of Accounts	13	12	12	12	12	12	11	10	10	10	10	10

Note: Number of allocation accounts does not represent the number of unique entities holding share since accounts may have shared ownership interest. Shared ownership across accounts is tracked by NMFS GARFO using allocation interest declaration forms during the allocation permit application process. In addition, the number of accounts holding share represents the number of accounts in any given fishing year including after any permanent transfers. It should be noted that in several fishing years between 2013 and 2016 some accounts had 0 balances (did not own shares), which were excluded from this analysis

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

Since the first program review, the number of large and medium accounts has remained the same (two in each category) while the number of small accounts has decreased from a high of eight in FY2015 to a low of six in FY2018. The total number of small accounts has remained constant since FY2017. Movement of allocation since 2015 has only occurred between medium and small accounts, as the total allocation share and average per account has remained equal within the large account category since 2013. Small accounts accounted for 21% of the total allocation in 2015 while medium accounts accounted for 25%; this increased to 28% in 2016 and to 31% in 2017, resulting in a commensurate decline in the share held by small accounts (16% in 2017). The decrease in the number of small allocation accounts and subsequent decrease in the number allocation accounts overall marks a change from the previous review, which concluded that the number of allocation accounts had remained steady over the first six years (between 13 and 12), since this has since declined to 10 accounts in every year since FY2018 (Table 7).

There have been no instances of IFQ shareholders exceeding the accumulation limit, and in recent years, the number of accounts has been nearly four times higher than the minimum that could occur under the accumulation limit. While accounts may have shared ownership interest and therefore do not represent unique entities, NMFS GARFO requires this information to be disclosed in allocation interest declaration forms during the allocation permitting process. According to NMFS GARFO while

at least two accounts have shared ownership interest, no entity is close to reaching the accumulation limit (Potts 2023).

Effort Consolidation

While the previous section focused on shareholdings and consolidation of ownership of fishing privileges, this section focuses on consolidation of the use of those privileges and how quota has been used by vessels and ownership entities,[7], by examining the distribution of IFQ earnings over time.

As noted in the summary of Participation and Earnings Trends in Section 5.3.1, the number of active IFQ vessels has declined since implementation and that trend has continued since the previous review from 12 active vessels in FY2015 to 8 active vessels in FY2021. At the same time, the number of ownership entities represented by the pool of active vessels has also decreased from 11 to 7 in the same period, indicating that two active IFQ vessels are affiliated under the same ownership entity in FY2012, 2014, 2015, 2020 and 2021 (Table 8). After accounting for inflation, median earnings at the vessel level have ranged between $381,622 in FY2016 to $749,181 in FY2011, while at the entity level, earnings peaked in FY2021 at $848,561, though high standard deviations in every fishing year indicate a high degree of variability in earnings across both vessels and entities that earn more and less than the mean.

Table 8. Comparison of Vessel and Entity-Level Participation and Earnings

Fishing Year	Number of Active IFQ Vessels	Number of Active IFQ Entities	Revenue per Vessel ($2021)		Revenue per Entity ($2021)	
			Mean	SD	Mean	SD
2010	11	11	549,377	566,729	549,377	566,729
2011	9	9	749,181	661,876	749,181	661,876
2012	11	10	589,350	624,435	648,285	632,575
2013	10	10	658,682	708,269	658,682	708,269
2014	11	10	578,258	615,624	636,084	619,078
2015	12	11	487,695	612,068	532,031	621,785
2016	12	12	381,622	413,630	381,622	413,630
2017	10	10	493,727	489,142	493,727	489,142
2018	8	8	630,146	532,620	630,146	532,620
2019	8	8	699,590	601,781	699,590	601,781
2020	8	7	630,032	551,413	720,037	528,870
2021	8	7	742,491	658,093	848,561	632,990

Note: Entity-level information was only available from FY2010-2021 for this analysis. Ownership entities were identified using the NMFS NEFSC's archive of ownership data where fishing vessels are linked to together by common ownership as of June 1 in each year. More information can be found at National Marine Fisheries Service (2023a).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

[7] Ownership datasets constructed by the NEFSC's Social Sciences Branch were used to group active IFQ vessels and associated permits by ownership entities (Lee 2023b).

While the number of active vessels has continued to decline in recent years, other indicators of effort have also declined in the same period (Table 9). Compared to FY2010–2015, the total number of trips and days absent spent on trips has also declined from FY2016–2021; however, compared to the change in the number of vessels, the reduction in number of trips has decreased less (7.7% compared to 15.9%), and the number of days absent decreased by even less (1.4%), indicating that while total effort has declined, effort by remaining vessels has increased.

Table 9. Average IFQ Effort by Time Period

	Average			
Metric	Baseline	FY2010–2015	FY2016–2021	FY2010–2021
Vessels	14.3	10.7	9.0	9.8
Trips	144.3	115.2	106.3	110.8
Days Absent	1058.6	807.2	795.7	801.5

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

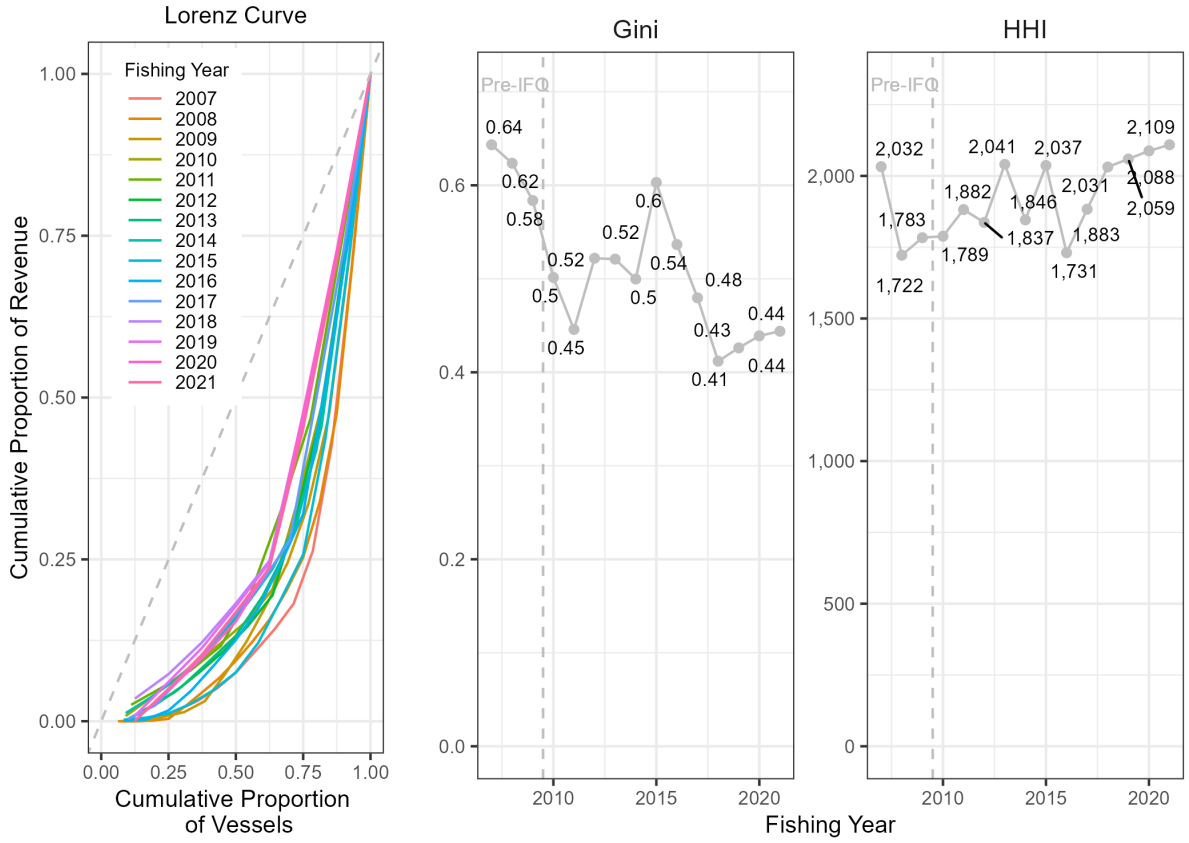
To evaluate change in the concentration and distribution of earnings across vessels and implications for excessive consolidation and market power, we construct both the Herfindahl-Hirschman Index (HHI) as well as the Gini coefficient at both the vessel and entity level The Gini coefficient is a measure of inequality and ranges between 0 (perfect equality) and 1 (perfect inequality), whereas the HHI is a measure of concentration and indicator of the amount of competition in the market. The Gini coefficient is a comparison of cumulative proportions of the population (here number of entities or vessels) against cumulative proportions of revenue. Once plotted in order of increasing levels of revenue (i.e., the Lorenz curve) and against a 1:1 curve of equality (as seen in the lefthand panel of Figure 5 and Figure 6), Gini coefficients are calculated using the area below the line of equality but above the Lorenz curve, divided by the total area under the line of equality and Lorenz curve. The HHI is equal to the sum of market shares, so here, the sum of each vessel or entity's share of the total IFQ revenue earned in a given year. The HHI ranges from 0 to 10,000. The U.S. Department of Justice (2018) and other federal agencies generally consider markets in which the HHI is between 1,500 and 2,500 points to be moderately concentrated, and markets in which the HHI is in excess of 2,500 points to be highly concentrated.

As illustrated by the leftward shift of the Lorenz curve in Figure 5, inequality among IFQ vessels has decreased over time from 0.64 in 2007 to 0.44 in FY2021, while the HHI has increased, but by a much smaller margin, from 2,032 in FY2007 to 2,109 in FY2021. This suggests that the distribution of revenue across vessels has become more equal over time while at the same time becoming more concentrated. This is possible because of the change in the number of active IFQ vessels, and as discussed in the previous section, the loss of accounts and associated vessels with small allocations and low revenues. As the remaining vessels' effort and shares of revenue increased, revenue became more concentrated—increasing the HHI—but these remaining vessels had more equal earnings, decreasing the Gini coefficient.

Due to data availability, the Gini coefficient and HHI could only be calculated for entities from FY2010–2021, but trends and values of each indicator in these periods are very similar to those observed for vessels (Figure 6).

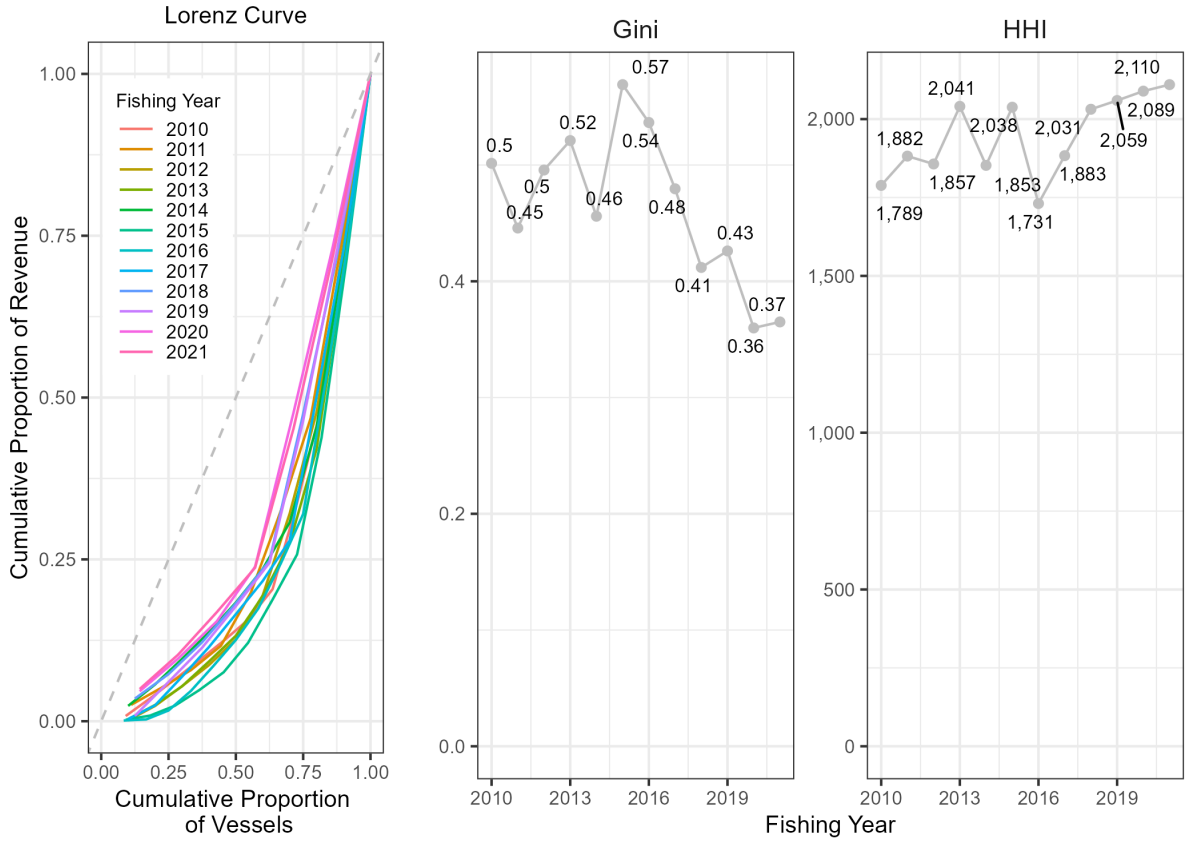
Recent changes in both the HHI and the Gini coefficient represent a continuation of a long-term trend; however, similar to the past evaluations, it remains unclear whether this change is enough to create market power in the IFQ share market that has consequences for entry into the fishery (National Academy of Sciences 2021).

Figure 5. Concentration and Distribution of Revenue Across IFQ Vessels



Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 6. Concentration and Distribution of Revenue Across IFQ Entities



Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.3.4 Ex-vessel Price and Market Stability

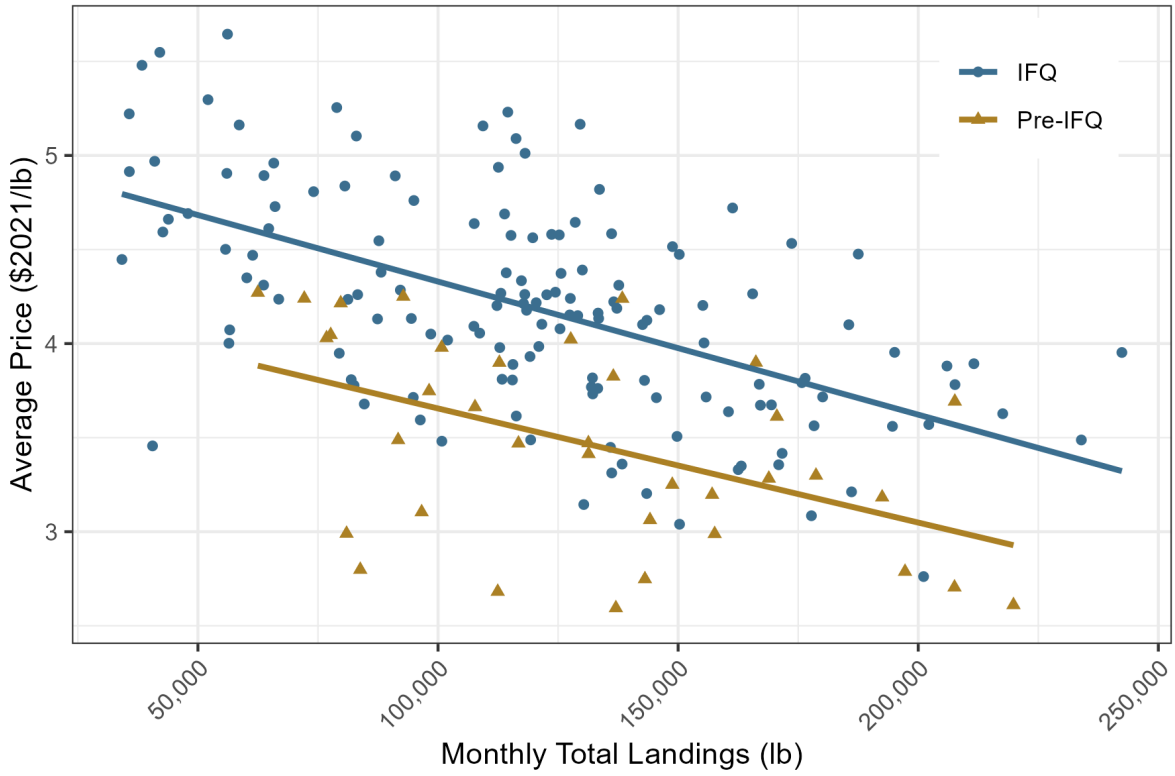
Average price across vessels shows fairly consistent, high prices compared to the baseline for nearly all years (Figure 1, Table 10). Annual average prices for golden tilefish have exceeded the baseline average price of $3.47 in every year, though FY2018's average price of $3.55 was the lowest since implementation. The average price for golden tilefish since implementation is $4.04. A comparison of average monthly prices between the pre-IFQ and IFQ periods shows that prices received for IFQ golden tilefish have been generally higher than prices received before implementation, regardless of the volume of fish landed in any given month (Figure 7). In addition, in the IFQ period, it can also be observed that there were more months with smaller volumes of golden tilefish landed and that these were associated with the highest end of average monthly prices received.

During interviews conducted for this review, industry members commonly reported that golden tilefish prices have been strong and increased since the GTF IFQ program came into place, consistent with reports cited in the first program review. They indicated that a major reason for this is that the golden tilefish industry is able to coordinate times of landings to avoid market gluts and spread the tilefish landings throughout the year. Industry members further indicated that this coordination was

essential during the COVID-19 pandemic where demand decreased sharply due to restaurant closures. The restaurant closures that occurred during the pandemic caused a large reduction in the demand for golden tilefish. As a consequence, there was a dramatic reduction in effort by all vessels. Full-Time vessels in New York capped their trips at about 16,000 pounds and only one vessel landed each week. Barnegat Light (New Jersey), capped landings at about 8,000 to 10,000 pounds per week. Spreading landings helped stabilize prices. However, due to the COVID-19 pandemic and a downward shift in demand, large price reductions occurred, especially at the beginning of the pandemic.

A recent study employed quasi-experimental techniques to investigate whether the GTF IFQ program, along with many other U.S. catch share programs, had any impact on prices (Birkenbach et al. 2023). The study found that prices increased as a result of the GTF IFQ program, but these impacts were not statistically significant. However, the study included only the first six years of the program, which may have reduced the study's ability to detect a signal from noise. As shown in Figure 8, even with 12 years of data there is still considerable overlap in price data ranges between the periods before and after IFQ program implementation, particularly in the second half of the fishing year.

Figure 7. Comparison of Price and Quantity Relationships

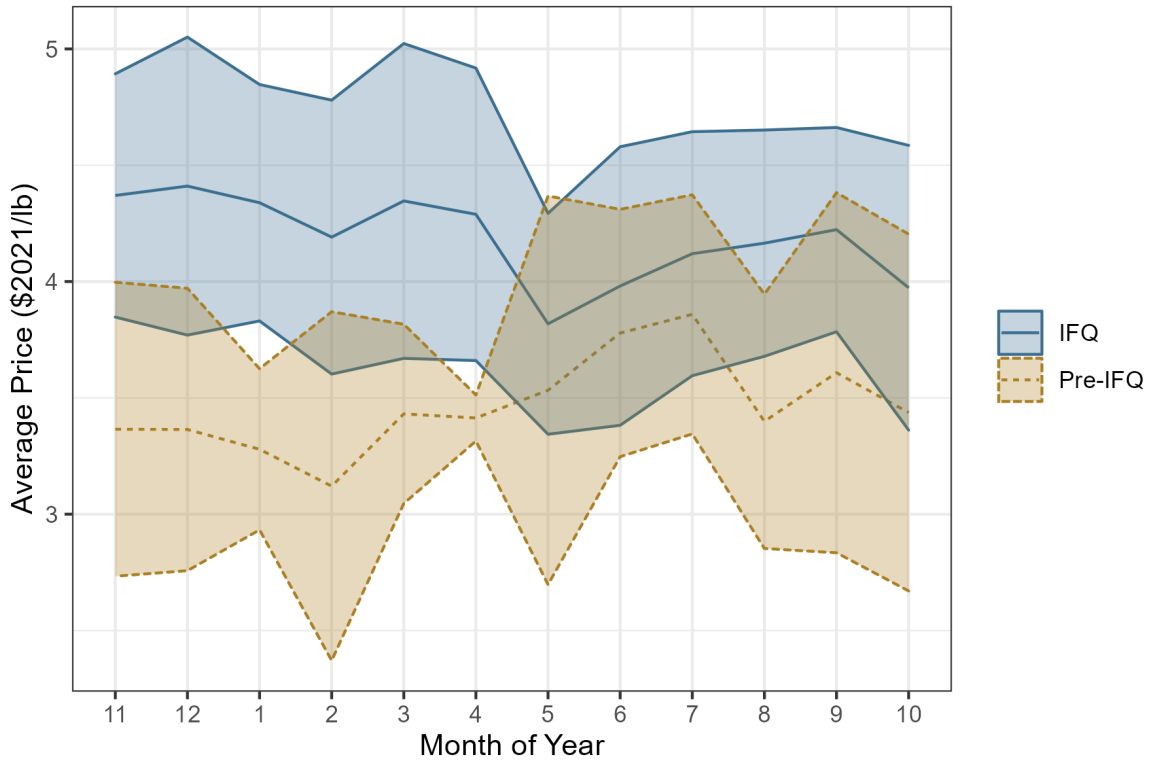


Note: Solid lines indicate linear regression lines fit to each group (IFQ and pre-IFQ), each point represents an individual month in a given fishing year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

While a more detailed discussion of the impacts of the program on the timing of landings is provided in Section 5.3.8, here we briefly summarize the impact of the elimination of derby conditions and those implications on prices. Average monthly prices show that before implementation of the IFQ program, prices would tend to peak around July, nine months into the fishing year. In contrast, under the IFQ program, prices have tended to be highest in the first six months of the fishing year and decline somewhat after May (Figure 8). Most importantly, average prices throughout the fishing year have been higher under the IFQ program than what was observed in the baseline period, but the greatest price increases are observed in the first six months of the year, where prices are roughly one dollar per pound higher, on average. These increases have not been consistent, however. Variability in average monthly prices indicate that prices received are typically within $0.50 of the average monthly price (Figure 8). Price increases are likely the result of former Part-Time and Full-Time Tier 2 vessels spreading out their effort more throughout the year and avoiding market gluts at the beginning of the fishing year (Mid-Atlantic Fishery Management Council 2018b). Historically, the market for golden tilefish has shown high levels of price sensitivity to small changes in landings, stemming from a highly consolidated market for tilefish at the New Fulton Fish Market in New York (Rountree et al. 2008). However, the reason for relatively small price increases observed in the second half of the fishing year has less clear of an explanation.

Figure 8. Average Price by Month and IFQ Period



Note: Average prices represent monthly means. Shaded areas around each line indicated the standard deviation, a measure of variability around the mean monthly price.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

While the golden tilefish price increases that occurred after GTF IFQ program implementation are likely due primarily to changes in the timing of deliveries by previous Part-Time and Full-Time Tier 2 vessels, a number of factors have bolstered prices by spurring demand. During interviews conducted for this review, some harvesters attributed higher golden tilefish prices to the successful efforts of dealers to create higher-end markets for their catch (such as "white tablecloth" restaurants). In addition, local retail fish markets, as well as large grocery store chains and online door-to-door seafood delivery services, began to regularly offer golden tilefish for sale. These new markets were being developed prior to GTF IFQ program implementation, but the program influenced this positive market development by helping create a steady year-round supply of tilefish (Mid-Atlantic Fishery Management Council 2018b).

Consistent with the findings of the first five-year review, average prices for golden tilefish across all size categories increased in the IFQ period except for two categories: extra small, where pre-IFQ data are withheld due to confidentiality restrictions, and large/medium, which did not exist in the pre-IFQ period (Table 10). The price increase was particularly significant for the large and extra-large size categories, which both increased by over a dollar per pound, on average. Price differentials across size categories indicates that larger fish tend to bring higher prices, with the exception of the extra-large category, which generally receives a lower price than the large category (Table 10 and Figure 9).

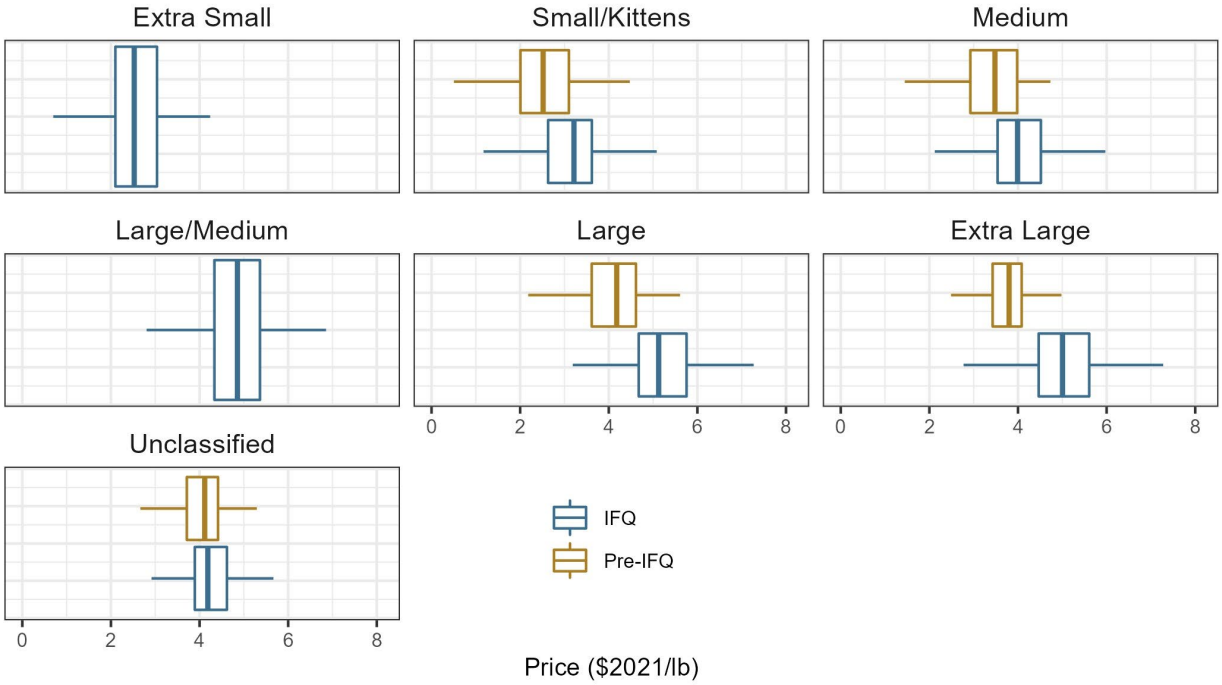
Table 10. Golden Tilefish Market Activity and Prices by Size Category

Size Category	No. Vessels	No. Dealers	No. Trips	Total Landed Pounds	Total Revenue ($2021)	Mean Price ($2021/lb)	St. Dev Price ($/lb)
Pre-IFQ							
Extra Small	7	c	c	c	c	c	c
Small/Kittens	19	10	384	1,037,412	2,450,865	2.58	0.74
Medium	20	14	396	1,043,274	3,566,737	3.47	0.65
Large	21	15	406	1,955,499	7,887,009	4.12	0.72
Extra Large	11	5	134	98,557	333,756	3.71	0.59
Unclassified	9	11	224	455,356	1,761,468	4.01	0.63
IFQ							
Extra Small	16	8	853	342,363	870,421	2.54	0.66
Small/Kittens	20	14	1,223	3,964,331	11,898,519	3.17	0.71
Medium	20	17	1,302	5,565,951	20,825,518	4.04	0.75
Large/Medium	16	11	853	1,400,598	6,340,982	4.82	0.79
Large	20	19	1,316	4,625,370	22,949,941	5.2	0.82
Extra Large	18	11	858	570,751	2,776,170	4.98	0.85
Unclassified	10	10	353	863,528	3,541,871	4.27	0.65

Note: 'c' denotes that data have been withheld due to confidentiality.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 9. Comparison of Pre-IFQ and IFQ Golden Tilefish Prices by Size Category



Note: For the Extra Small market category, data have been withheld due to confidentiality in the pre-IFQ period.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.3.5 Dealer Activity

As noted in the first five-year review, golden tilefish marketing practices (e.g., product form, transportation, and packaging) have not significantly changed as a result of the GTF IFQ program. Most golden tilefish continue to be sold fresh (whole or gutted fish). When the catch arrives at the dock, it is sorted, washed, weighed, boxed, and iced in 60-pound cartons. The fish are then generally transported to wholesale markets by truck for redistribution and sale (Mid-Atlantic Fishery Management Council 2017a).[8]

As discussed in previous sections, the GTF IFQ program has potentially affected participation decisions by fishing vessels and changed the nature of how and when they fish, potentially affecting ex-vessel revenues and prices received for harvests. These changes have implications for dealers as well—or those who purchase harvests first from vessels. Dealers may encompass processors, wholesalers, restaurants, fish markets, or other seafood buyers, including companies owned by fishing vessel owners in the case of vertically integrated companies. In this section, we review changes in the number of federally registered dealers reporting buying golden tilefish and other

[8] When restaurant demand was depressed during the COVID-19 pandemic, golden tilefish harvesters based in Montauk and Barnegat Light also participated in alternative distribution systems that delivered daily landings from the fleet directly to consumers' homes through community-supported fishery programs or direct sales (Anonymous 2020; Local Catch 2022).

species on IFQ trips as well as their total and average purchase volumes and values. Similar to revenue and entity consolidation analyses, we also examine the distribution of purchases across dealers, and changes in the relative dependence of dealers on golden tilefish over time. Due to data availability, we cannot evaluate how purchases of golden tilefish from vessels have affected dealer-level profitability or other parts of the supply chain.

Similar to the number of vessels, the number of dealers purchasing from the directed fishery has declined somewhat since the implementation of the IFQ program from an average of 11 per year to just under 9 (Table 11). This marks a slight change from the previous five-year review, since from FY 2010 to 2015, the number of dealers fluctuated between 6 and 12 in any given year, and overall appeared similar to the pre-IFQ baseline period. In contrast, from FY2017 to 2021, the number of dealers has been more consistently around 9, only rising above 9 to 11 dealers in FY2017. At the same time, while purchases of both golden tilefish and other species on IFQ trips have declined, the total value paid by dealers has increased, reflecting general increases in ex-vessel price as noted in Section 5.3.4. Average purchase volume and value has also increased per dealer, though due to price increases, purchase value increased more from an average of $536,469 to $709,459, compared to an increase in purchase volume from 164,763 to 192,773 pounds.

Table 11. Dealer Purchases from IFQ Golden Tilefish Trips

	Number of Dealers		Purchase Volume (lb)			Purchase Value ($2021)			
Fishing Year	GTF	Other species	All species	GTF	Average Per Dealer (all species)	All species	GTF	Average Per Dealer (all species)	Number of IFQ vessels
2007	12	5	1,908,150	1,708,547	142,379	5,849,748	5,713,501	487,479	14
2008	13	8	1,944,854	1,612,311	124,024	5,882,786	5,517,866	452,522	16
2009	8	8	2,033,425	1,823,093	227,887	5,355,244	5,099,974	669,406	13
2007-2009 Average	**11.0**	**7.0**	**1,962,143**	**1,714,650**	**164,763**	**5,695,926**	**5,443,781**	**536,469**	**14.3**
2010	5	3	1,905,303	1,901,006	380,201	6,061,751	6,043,150	1,212,350	11
2011	6	3	1,887,976	1,884,695	314,116	6,749,057	6,742,633	1,124,843	9
2012	12	3	1,840,341	1,835,103	152,925	6,498,553	6,482,847	541,546	11
2013	9	3	1,786,840	1,769,518	196,613	6,632,239	6,586,823	736,915	10
2014	11	6	1,780,610	1,769,992	160,908	6,384,592	6,360,838	580,417	11
2015	7	4	1,333,818	1,322,405	188,915	5,881,784	5,852,334	840,255	12
2016	8	5	1,058,281	1,022,042	127,755	4,637,826	4,579,462	579,728	12
2017	11	8	1,450,875	1,423,884	129,444	4,978,952	4,937,267	452,632	10
2018	9	5	1,556,471	1,547,185	171,909	5,057,111	5,041,170	561,901	8
2019	9	5	1,532,051	1,519,541	168,838	5,621,949	5,596,716	624,661	8
2020	9	7	1,400,721	1,391,363	154,596	5,054,938	5,040,259	561,660	8
2021	9	4	1,575,193	1,503,500	167,056	6,269,430	5,939,924	696,603	8
2010-2021 Average	**8.8**	**4.7**	**1,592,373**	**1,574,186**	**192,773**	**5,819,015**	**5,766,952**	**709,459**	**9.8**

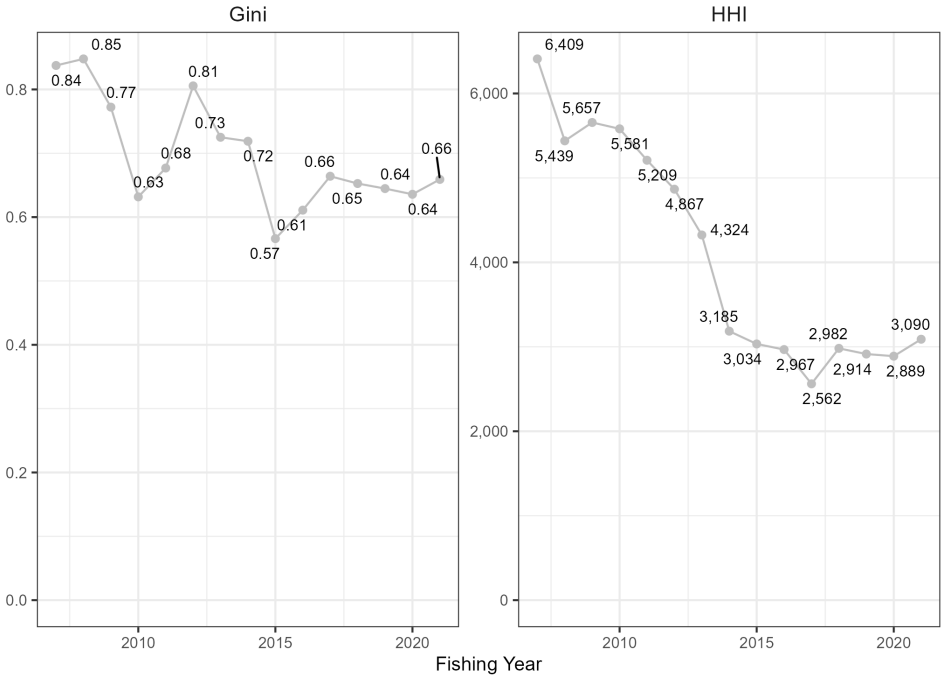
Note: Only includes purchases from directed golden tilefish trips (Tier 1, Tier 2, or part time vessels in the pre-IFQ period and IFQ vessels since FY2010), where other all species includes all species purchased from IFQ trips, not all species purchased by the dealer in the given year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Unlike for vessels, increases in purchase value means an increase in dealer costs (as opposed to revenues), so in the same period dealers would need to have seen a similar or higher increase in wholesale prices for golden tilefish products to have benefitted from these changes. Though data on wholesale prices over the time period are lacking, at Citarella (an extension of Lockwood and Winant, one of the largest buyers of golden tilefish in the New Fulton Fish Market) golden tilefish is sold for $38.99 per fish, which, at approximately two to three pounds, is roughly $13 to $19.50 per pound (Citarella 2023).

While the number of dealers purchasing golden tilefish decreased somewhat since the implementation of the IFQ program, this does not mean that purchases have become more consolidated to a fewer number of buyers. Rather, over time the distribution of purchases across dealers has both become more equal (decline in the Gini coefficient) and less concentrated (decline in the HHI) in the IFQ period as compared to the baseline period (Figure 10, see Section 5.3.3 for a description of both measures). The change is particularly pronounced for the HHI, which dropped from a high of 6,409 in FY2007 to 2,562 in FY2017, noting that an HHI above 2,500 is considered to be highly concentrated. So, while the primary buyers of golden tilefish may purchase significantly more than other buyers, their share of total purchases has decreased under the IFQ program. HHI values for dealers in any year are higher than HHI values for either entities or vessels, though as trends move in opposite directions, this gap is shrinking (Figure 5 and Figure 6).

Figure 10. Revenue Inequality and Concentration Across IFQ Dealers



Note: Only includes purchases from golden tilefish landed on directed golden tilefish trips (Tier 1, Tier 2, or part time vessels in the pre-IFQ period and IFQ vessels since FY2010).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

In addition to the reduced concentration of purchasing activities overall, purchasing has also become less concentrated geographically (Table 12). In the baseline period, the majority of all purchases of golden tilefish occurred in New York (1.45 million pounds per year, on average) compared to all other states, including Maine, Massachusetts, New Jersey, Rhode Island, and Virginia (268,101 pounds per year, on average). Even though purchases were concentrated in New York, the number of dealers purchasing golden tilefish in New York and "other states" was similar, on average (5.3 and 5.7, respectively). In the IFQ period, the average number of dealers purchasing IFQ golden tilefish in New York has increased from 5.3 to 7.4, while the average number of dealers in all other states has decreased (number withheld due to confidentiality, Table 12). Despite the decline in the number of buyers, the volume and value of purchases in all other states has increased (exact number withheld due to confidentiality), even though fishery-wide landings decreased between the two periods. While other state dealer purchases cannot be shown due to confidentiality reasons, a review of the data shows that the bulk of this increase comes from dealer activity in New Jersey, and likely is a result of shifts in IFQ share ownership and leasing to New Jersey-based vessels (see Table 32, Table 33). Another contributing factor to the reduced purchasing concentration is that while New York purchases have decreased overall, there are more dealers purchasing from IFQ vessels.

Table 12. Golden Tilefish Purchasing by Dealer State

Period	Dealer State	Average Number of Dealers	Average Number of Vessels	Average Purchase Volume (lb)	Average Purchase Value ($2021)
Pre-IFQ	NY	5.3	7.7	1,446,550	4,664,792
IFQ	NY	7.4	4.1	1,209,459	4,455,832
Pre-IFQ	Other States	5.7	10.7	268,101	778,988
IFQ	Other States	c	6.3	c	c

Note: Only includes purchases from golden tilefish landed on directed golden tilefish trips, or since 2010, IFQ trips. Other states include Maine, Massachusetts, New Jersey, Rhode Island, and Virginia, where individual purchase volumes cannot be shown due to confidentiality. Values marked 'c' indicates values withheld due to confidentiality.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Table 13 shows the revenue dependence of dealers who purchase golden tilefish, including those who buy golden tilefish landed incidentally. Since the 2009–2013 period, there has been an increase in the number of dealers across all revenue dependence categories, with the exception of the number of dealers who depend very little on golden tilefish landings (less than 5%).

Table 13. Revenue Dependence of Dealers on Golden Tilefish

	Number of dealers		
Percentage of Total Revenue	2009–2013	2013–2017	2017–2021
<5%	82	75	65
5%–10%	3	4	4
10%–25%	2	4	5
25%–50%	3	2	3
>75%	c	3	4

Note: Includes landings on both incidental and directed (including IFQ) trips. Values marked 'c' indicates values withheld due to confidentiality.

Source: Mid-Atlantic Fishery Management Council (2014); Mid-Atlantic Fishery Management Council (2018a); Mid-Atlantic Fishery Management Council (2022a)

5.3.6 Productivity and Profitability

Here we present to indices to measure productivity and profitability changes in the GTF fishery before and after the implementation of the catch share program.

Productivity

Productivity change is an important economic metric because increasing productivity generally leads to increasing profits if prices are stable. In an IFQ fishery, vessels have the chance to buy and lease IFQ shares so that their landings are more in alignment with their underlying costs and inputs, which can contribute to increasing levels of productivity. Here, we measure changes in productivity using a Multi-Factor Productivity (MFP) Index, a measure of all outputs landed by fishing vessels divided by a measure of inputs used to produce those outputs (e.g., fuel, bait, ice, supplies, crew, and capital costs). We refer to this as MFP, rather than the more common "Total Factor Productivity", or "TFP" because certain inputs are not available for the analysis. However, the analysis captures the most important inputs in terms of costs which the fishing vessel incurs, namely fuel, food, and crew. More information about the construction of the MFP index is provided in the appendix in Section 7.

Overall, in most years of the program IFQ vessels generally increased their outputs relative to inputs, as shown by the average productivity index (1.37) and average biomass-adjusted productivity index (1.23, Table 14). Consistent with results from the previous review, biomass has generally been higher during the catch share period than the baseline period, which reduces the biomass-adjusted productivity index compared to the unadjusted index. The biomass index shown in Table 14 has a different interpretation than most quantity indices. A value greater than one indicates a decline in biomass, while a value less than one indicates improving biomass. Details on construction of the biomass index used to adjust our productivity measure can be found in Appendix 7. Overall, the biomass-adjusted productivity index is higher than that of the baseline period, with the exception of the years 2015 and 2016. This is an unsurprising result given the previous observation that landings and revenue dropped in those years despite near constant levels of effort (Figure 1 and Figure 2).

The biomass adjusted productivity measure indicates vessels are improving their productivity while also benefitting from increased biomass.

Table 14. Productivity Index Results

Fishing Year	Vessels	Output Index (Yearly)	Input Index (Yearly)	Productivity Index	Biomass Index	Biomass Adj. Index	Yearly Change
Baseline (2007-2009)	14.3	1	1	1	1	1	--
2010	13	1.70	1.04	1.61	0.99	1.61	1.61
2011	11	1.88	0.94	1.98	0.84	1.67	1.04
2012	14	1.03	0.79	1.29	0.83	1.08	0.64
2013	12	1.49	1.21	1.23	0.91	1.13	1.05
2014	15	1.11	1.13	0.98	1.14	1.12	1.00
2015	14	0.75	1.15	0.64	1.01	0.66	0.58
2016	12	1.02	1.45	0.70	0.82	0.58	0.88
2017	11	1.96	1.65	1.19	0.98	1.16	2.02
2018	10	2.02	1.50	1.33	0.89	1.20	1.02
2019	9	2.41	1.47	1.63	0.87	1.42	1.18
2020	8	3.00	1.57	1.91	0.78	1.48	1.05
2021	8	3.11	1.57	1.98	0.81	1.61	1.09
Average	**9.8**	**1.79**	**1.29**	**1.37**	**0.91**	**1.23**	**–**

Source: Walden (2023)

Profitability

The profitability of a fishing vessel can be expressed by its total revenue divided by its total costs, while profitability change of a vessel can be expressed by the ratio of its profitability in one period to its profitability in another period (Walden et al. 2022). Profitability change can be decomposed into two parts, one that measures output and input price changes (a "terms-of-trade" index (TTI)), and one that measures productivity change (the MFPI index discussed in the previous section). The TTI is the ratio of an implicit output price index to an implicit input price index (O'Donnell 2012; Grifell-Tatjé and Lovell 2015), where output prices are derived from ex-vessel revenue and landings of golden tilefish, and input prices are derived from operating (such as fuel, ice, bait, and supplies), crew, and capital costs. Details of this decomposition can be found in the appendix in Section 7. The importance of this final decomposition is in showing why profitability changed; is it better output prices, or lower input prices, or a positive change in productivity, or some combination of the three? Profitability can increase even in periods of productivity decline if the terms of trade index increases more than productivity declines.

After implementation of the GTF IFQ program, implicit output prices showed a steady increase until FY2015, followed by a generally declining trend until FY2021 (Table 15). However, the FY2021 implicit output price was still 20% higher than the baseline period (1.20). The average implicit output price index was 1.21, showing that on average after the IFQ program was implemented, prices were

21% higher than the baseline period. At the same time, implicit input prices (i.e., operating costs) showed a relatively stable trend with some years being greater than the baseline period, and some lower. On average, the implicit input price index was 0.97, which indicated about a 3% drop in input prices compared to the baseline period. Combining these two series into the TTI showed an increasing TTI until the year FY2016, followed by a decline. In FY2021, the TTI was 1.27, a 27% increase compared to the baseline time period, indicating an improving output to input price ratio. The average TTI during the IFQ time period was 1.25, indicating that the ratio of output prices to input prices increased 25%.

Combining the TTI with the MFPI showed an increasing trend in profitability during the time period FY2010–FY2021, with the exception of 2015 when profitability declined to 0.96, which indicates a drop from the baseline time period. Although the TTI was 1.49 in 2015, the drop in the productivity index (0.64) caused the decline in profitability. Note that in both FY2014 and FY2016 the productivity index was less than one, but the TTI was high enough that vessels still had positive profitability compared to the baseline time period. After implementation of the IFQ program, profitability averaged 1.67, or 67% more than the baseline time period, driven by both productivity and terms-of-trade increases.

Table 15 Shows the Productivity Index, Implicit output Price Index, Implicit Input Price Index and Profitability Index.

Table 15. Profitability Index Results

Fishing Year	Vessels	Productivity Index	Implicit Output Price Index	Implicit Input Price Index	Terms-of Trade Index	Profitability Index
Baseline (2007-2009)	14	1	1	1	1	1
2010	13	1.61	1.07	0.97	1.10	1.78
2011	11	1.98	1.25	1.09	1.15	2.27
2012	14	1.29	1.22	1.04	1.17	1.51
2013	12	1.23	1.24	0.93	1.33	1.63
2014	15	0.98	1.18	0.90	1.31	1.28
2015	14	0.64	1.50	1.00	1.49	0.96
2016	12	0.70	1.41	0.86	1.65	1.16
2017	11	1.19	1.07	0.91	1.17	1.39
2018	10	1.33	1.14	1.01	1.13	1.50
2019	9	1.63	1.18	0.99	1.20	1.95
2020	8	1.91	1.10	1.03	1.07	2.04
2021	8	1.98	1.20	0.95	1.27	2.52
Average		**1.37**	**1.21**	**0.97**	**1.25**	**1.67**

Source: Walden (2023)

5.3.7 Operating Cost and Net Operating Revenue

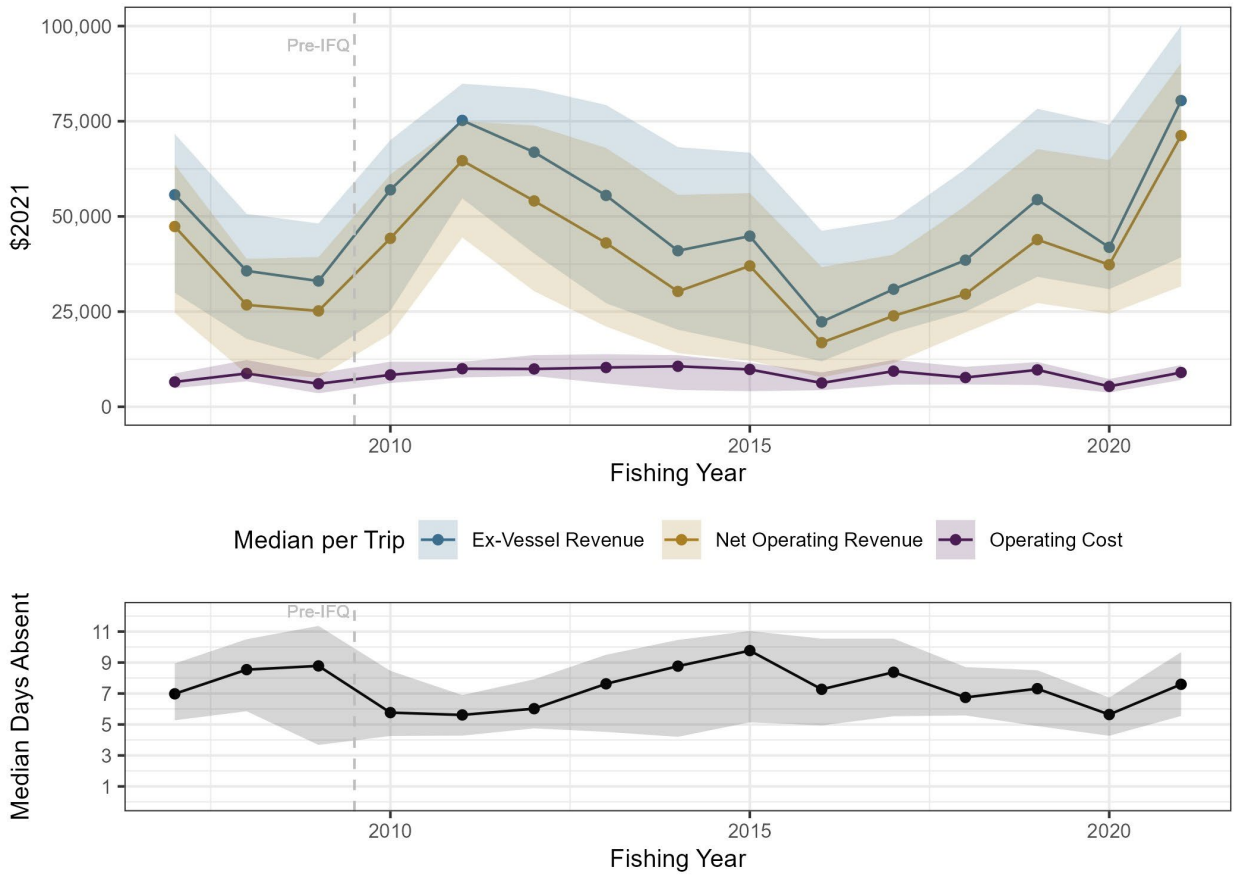
Here, we examine how trip and vessel-level revenue, operating costs, and revenue minus operating costs (termed 'net operating revenue') have changed over time as another indicator of changes in profitability.[9] In this section, we present operating cost estimates provided by the NEFSC as derived using the methods described in Werner et al. (2020). Operating costs include cost of fuel, ice, bait, food/groceries, water, oil, and supplies, as modeled per Werner et al. (2020) based on information collected by at-sea monitors on commercial operating costs and other information derived from vessel trip reports (e.g., trip length, gear type). The models are estimated at the gear-level rather than FMP or fishery level and are corrected for selection bias where necessary, this also means that cost information differs from cost information used in other sections in this report.

Trip-Level Trends

On a trip level, median ex-vessel revenue has varied considerably across years, but increased on average in the IFQ period by 22% (Figure 11, Table 16). Overall, these revenue increases, which are attributable to price and productivity increases as discussed in previous sections, have led to increases in profitability in the IFQ period, as shown by the average increase in median net operating revenue. While median operating costs per trip also increased during the IFQ period (by 24.4%, Table 16), revenue increases more than compensated for these increases leading net operating revenue to increase by 24.5% in the IFQ period (Table 16), similar to the increase in the Terms of Trade index described in the previous section.

[9] True accounting profitability would measure changes in total costs (operating and fixed) relative to total revenue, however, at present, fixed cost information for this fishery is not readily available, so operating revenue (total ex-vessel revenue minus operating costs) is presented as an indicator of accounting profitability.

Figure 11. Median Net Operating Revenue and Days Absent on IFQ Trips



Note: Revenue includes revenue from all species on IFQ or directed golden tilefish trips. Operating revenue represents revenue minus operating costs.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); Werner (2022b)

Overall, even though average trip lengths have decreased (by 11%) since the baseline period, decreases in trip length have not offset increases in costs, as operating costs increased by 24.4% in the same period. Despite this, per-trip revenue increases were higher than cost increases with the average trip earning $9,162 (22%) more in the IFQ period (Table 16). Examining diesel price trends over the pre-IFQ and IFQ periods (Figure 12) suggests that changes in fuel prices generally do not explain increases in operating costs, with an average decrease in diesel prices between the pre-IFQ and IFQ periods of 5%, or $0.23 per gallon (Table 16). A potential explanation for increasing trip costs is the average costs of bait. Previous reports on the fishery noted that the price of Ilex has increased considerably over time from $0.50 to over $1.50 in more recent years, and while domestic squid season/landings have been good, low foreign landings and high demand are expected to keep squid prices at the current high level or even higher (Mid-Atlantic Fishery Management Council 2018b; Mid-Atlantic Fishery Management Council 2020). Due in part to these and other increasing costs, it was reported that vessels are fishing as close to home port as possible to minimize costs, potentially explaining the decrease in average trip length.

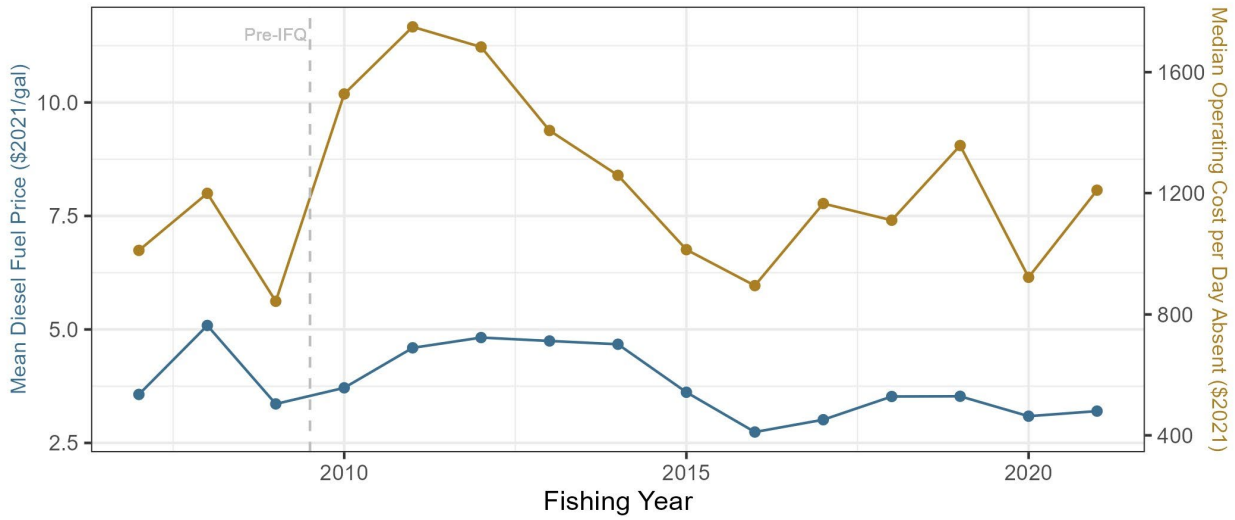
Table 16. Comparison of Average Trip Cost and Net Operating Revenue Outcomes by Period

Variable	Period	Lower Quartile	Median	Upper Quartile	Percent Change
Days Absent	Pre-IFQ	4.93	8.10	10.27	
	IFQ	4.83	7.21	9.08	-11.0%
Operating Cost	Pre-IFQ	5,064	7,146	10,013	
	IFQ	5,780	8,890	11,528	+24.4%
Revenue ($2021)	Pre-IFQ	20,211	41,706	57,138	
	IFQ	28,779	50,868	72,081	+22.0%
Net Operating Revenue ($2021)	Pre-IFQ	13,756	33,280	47,539	
	IFQ	21,987	41,447	61,975	+24.5%
Cost as a Proportion of Revenue	Pre-IFQ	14.5%	20.1%	32.2%	
	IFQ	13.7%	18.5%	27.0%	-8.1%
Cost per Day Absent	Pre-IFQ	773	1,018	1,208	
	IFQ	1,119	1,275	1,449	+25.3%
Average Diesel Cost ($2021/gallon)	Pre-IFQ	-	4.00	-	
	IFQ	-	3.77	-	-5.8%

Note: Revenue includes revenue from all species on directed golden tilefish or IFQ trips. Average diesel cost is the mean annual cost per gallon as reported by the US Energy Information Administration and provided for comparison purposes to the trip level statistics.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); (U.S. Energy Information Administration 2023); Werner (2022b)

Figure 12. Median Operating Costs per Day Absent and Average Diesel Prices



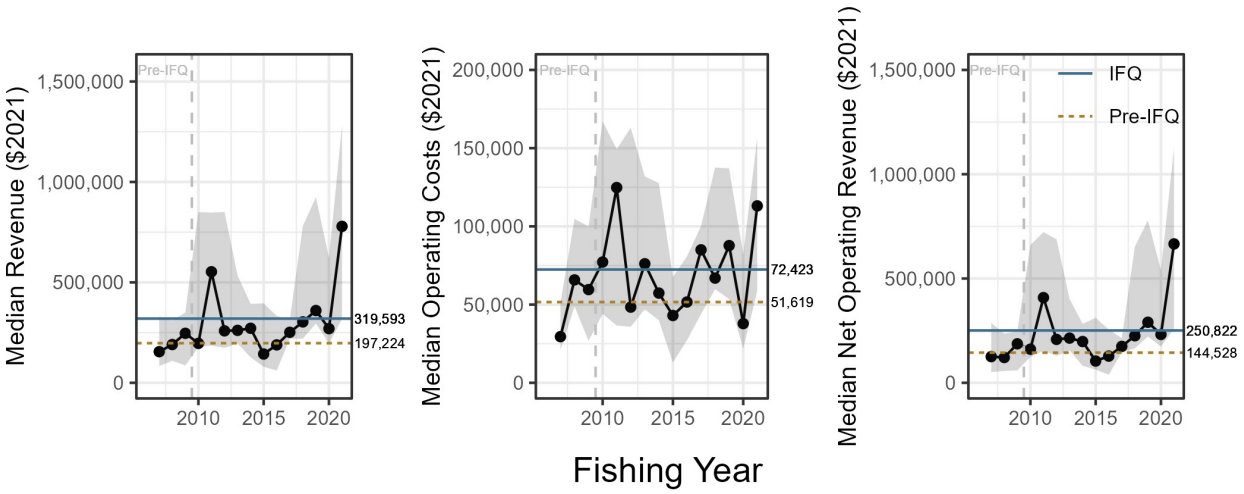
Note: Median operating costs per day absent (right axis) represent the median operating cost across all trips in a given fishing year, while mean diesel prices (left axis) are annual averages across the entire fishing year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); (U.S. Energy Information Administration 2023); Werner (2022b)

Vessel-level Trends

At the vessel-level we see similar trends, with higher average costs and revenues between the pre-IFQ and IFQ periods, but considerable variability across years. However, due to the lower number of active vessels in later years, apparent increases in revenue between the pre-IFQ and IFQ periods are much larger at the vessel-level than at the trip level, with median vessel earnings increasing by 61.5% between the pre-IFQ and IFQ periods, compared to 24.5% at the trip level. In FY2021, the median vessel earned over $750,000 in ex-vessel revenue (Figure 13). On average, between the baseline and IFQ periods vessel-level operating costs increased 39% from $51,900 to $72,016 per year, while revenue increased from $198,298 to $320,256 or 61.5%. Similar to trends in other economic metrics, net operating revenues were particularly low in FY2015 and FY2016, which were the only years in the IFQ period where median net operating revenue was lower than the baseline average. On average, net operating revenue per vessel increased by over $100,000, from $145,314 to $251,329, or by 61.5%, similar to the increase in the average change in the profitability index described in the previous section.

Figure 13. Median Revenue, Costs, and Net Operating Revenue on IFQ Vessels



Note: Revenue includes revenue from all species on IFQ or directed golden tilefish trips. Pre-IFQ (baseline) averages are shown by the dashed horizontal line, IFQ averages are shown by the solid horizontal line.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); Werner (2022b)

5.3.8 Mitigating the Race to Fish

A goal of the GTF IFQ program was to eliminate derby-style fishing practices and the associated race to fish that occurred under the limited access management system, since such conditions can result in shorter fishing seasons, market gluts and depressed prices, as well as unsafe fishing conditions. The previous review concluded that the program has been successful in creating a year-round fishery and that this goal was achieved in the first six years of the program. The present review maintains

these conclusions through FY2021 as there have been no early closures for the fishery (Table 17), and further examines changes in the distribution of landings throughout the year since implementation. Changes in prices and landings stability are discussed in Section 5.3.4 and changes in safety are discussed in Section 5.5.

Table 17. Season Length by Fishing Year

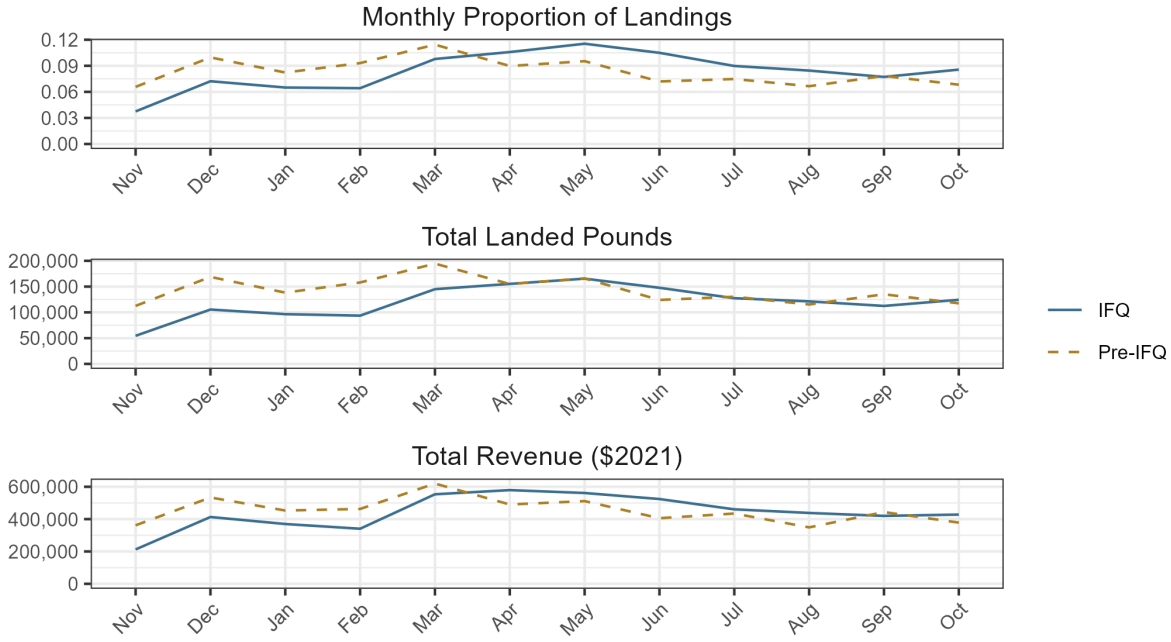
		Fishing Year											
	Baseline	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Season Length (days)	310	365	365	365	365	365	365	365	365	365	365	365	365

Source: Mid-Atlantic Fishery Management Council (2017a); National Marine Fisheries Service (2023b)

Figure 14 compares monthly average landings trends between the baseline (pre-IFQ) and IFQ periods for vessels that participated in both the pre-IFQ and IFQ periods. Table 18 shows the fishery-wide (including incidental fleet) proportion of landings by month in each calendar year from 1999 to 2021, with the month with the highest proportion of landings highlighted. In addition, Birkenbach et al. (2017) examined season length changes across many U.S. fisheries managed under catch share programs, including the golden tilefish IFQ program, and using a quasi-experimental approach, found that the implementation of the GTF IFQ program led to statistically significant increases in the season length (p-value <0.05),[10] when compared to a similar non-IFQ managed fishery in the same time period.

[10] Evidence for season length decompression was measured by a decrease in the Gini coefficient. Treatment effects by fishery can be found in Supplementary Table 2 in Birkenbach et al. (2017).

Figure 14. Monthly Average Landings and Revenue Trends



Note: Data only include vessels that fished in both the pre-IFQ and IFQ periods.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Table 18. Percent of Landings in the Commercial (Directed and Incidental) Golden Tilefish Fishery by Month

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	10.75	10.38	11.28	9.41	8.50	8.29	4.99	9.66	7.55	5.36	6.98	6.86
2000	4.68	9.48	14.41	9.13	9.67	8.95	3.05	8.26	3.78	9.71	8.70	10.18
2001	5.59	7.88	8.30	9.77	7.95	9.32	9.24	8.16	8.13	8.11	8.40	9.14
2002	7.64	12.43	13.76	7.73	8.78	6.28	5.74	7.56	7.91	7.85	3.63	10.70
2003	7.44	7.33	11.98	10.31	8.47	7.52	6.18	7.32	8.52	8.19	7.68	9.05
2004	7.69	14.21	20.64	12.95	5.74	2.23	4.52	4.88	7.25	9.46	2.87	7.57
2005	8.54	10.71	15.77	11.28	2.24	3.82	7.85	6.98	6.43	6.32	9.46	10.60
2006	10.50	11.32	14.65	6.28	6.38	6.22	4.33	7.60	5.82	7.04	8.46	11.41
2007	7.35	7.08	11.55	8.83	9.56	5.79	7.86	7.99	7.53	10.48	4.63	11.35
2008	14.37	12.59	13.40	10.56	7.60	7.50	3.77	5.53	6.18	5.49	6.66	6.35
2009	4.67	7.55	9.64	10.39	12.36	10.97	9.56	8.18	8.16	6.65	4.88	6.99
2010	7.35	6.54	13.49	10.68	9.61	7.73	7.37	7.75	8.68	9.25	4.81	6.74
2011	7.96	4.96	14.13	10.99	11.93	7.20	7.24	7.82	6.30	10.18	3.41	7.88
2012	7.94	6.22	7.72	11.26	8.22	7.11	8.57	11.09	10.14	12.03	2.15	7.55
2013	5.66	6.18	7.84	14.47	12.54	10.37	7.90	8.45	6.75	9.07	3.61	7.14
2014	6.41	5.25	8.20	10.31	10.50	13.09	12.07	9.63	7.55	8.40	2.84	5.74
2015	5.21	5.37	10.97	9.78	13.86	11.15	9.91	9.71	9.40	6.23	3.67	4.73
2016	3.94	4.85	8.34	6.52	10.11	10.97	12.00	12.47	8.39	8.85	7.66	5.91
2017	5.59	4.52	5.05	12.56	12.72	11.67	8.84	8.72	6.87	11.73	3.05	8.68
2018	5.02	8.37	7.73	12.07	9.31	12.20	11.28	9.22	8.31	6.40	3.99	6.10
2019	5.93	6.87	8.53	8.46	15.24	10.64	8.49	8.92	10.26	7.77	2.62	6.27
2020	5.38	6.78	10.24	3.86	13.42	11.43	10.52	9.52	6.66	12.85	4.62	4.71
2021	4.86	7.96	8.14	9.10	11.41	12.09	8.72	10.52	8.30	8.85	3.10	6.94
Total	**7.07**	**8.17**	**11.37**	**10.03**	**9.67**	**8.55**	**7.71**	**8.32**	**7.65**	**8.57**	**5.03**	**7.87**

Note: Highlighted month shows the month with the highest proportion of landings.

Source: Mid-Atlantic Fishery Management Council (2022a)

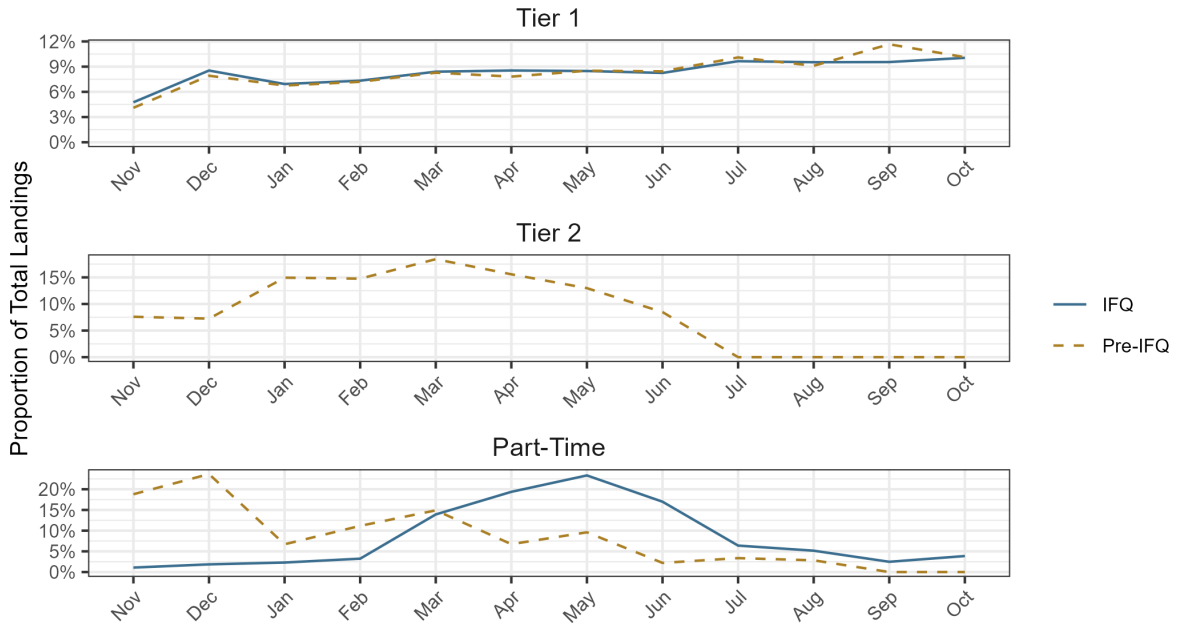
Together, these illustrate that while shifts in landings, revenue, and the proportion of landings to later months in the fishing year exist overall across the fishery, however, it is not as clear as when the data are separated by the what permit category the vessel fished under during the previous tier system (Figure 15). This is because Full-Time Tier 1 vessels (which received the highest share of the allocation) operated under a gentlemen's agreement prior to the catch share program and coordinated their landings throughout the year, which prevented derby conditions from occurring for this segment of the fleet (Kitts et al. 2007). In other tiers, however, derby conditions existed prior to the IFQ program, as shown in Figure 15.

The previous five-year review found that some of the most pronounced changes under the IFQ program were for vessels that formerly fished in the Part-Time category under the tier system. Part-time vessels that qualified for IFQ shares used to land 76% of their tilefish from November to March, and 24% from April to October (Mid-Atlantic Fishery Management Council 2017a). In the first six

years of the program, it was found that these vessels landed 30% of their tilefish from November to March, and 70% from April to October, a significant shift. The updated analysis finds that this trend has generally continued, with roughly 75% of landings occurring from March to June (Figure 15). As shown in section 5.3.4, price improvements have mostly been realized in the first six months of the fishing year, from November to May (Figure 8), consistent with the shift in the timing of landings for Part-Time vessels. Aside from the IFQ program, another factor that may have contributed to these temporal changes in fishing effort was the severe winter conditions that made fishing during this season less productive. In 2020, the MAFMC's Tilefish Advisory Panel reported that for the winter seasons from 2013 to 2019, fishing practices were affected by severe weather (Mid-Atlantic Fishery Management Council 2020).

A change in the timing of landings was not observed for the Full-Time Tier 1 vessels, who as shown in Figure 15, have continued to land consistently through the year, as a result of the gentlemen's agreement between vessels to keep landings consistent throughout the year. While Full-Time Tier 2 trends cannot be shown due to the limited number of vessels, Figure 16 shows the trend with Part-Time and Full-Time Tier 2 vessels, combined, which helps to illustrate that the Full-Time Tier 2 vessels experienced a similar shift in timing of landings. During interviews conducted for this review, several participants noted that a benefit of the IFQ program was the ability to time effort not only around other golden tilefish harvests and fisheries to avoid market gluts, but also to plan effort and participation around other fisheries. Shifts in previously Part-Time vessel effort likely reflect effort around these other fisheries and therefore appear to be more concentrated in March through June (See Section 5.3.10 for more information).

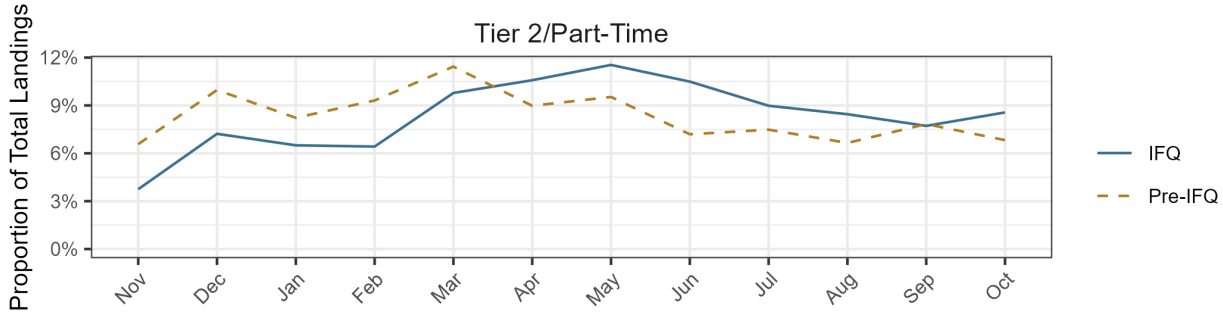
Figure 15. Monthly Proportion of Landings for Pre-IFQ and IFQ Vessels by Permit Category



Note: Data only include vessels that fished in both the pre-IFQ and IFQ periods. Tier 2 IFQ data cannot be shown due to confidentiality restrictions, but it is reasonable to assume that the findings of the first five-year review of the GTF IFQ program have persisted into the 2016–2021 period and similar to Part-Time vessels, there has been a shift in the timing of landings to be more even across the year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 16. Monthly Proportion of Landings for Pre-IFQ and IFQ Vessels for Tier 2 and Part Time Vessels



Note: Data only include vessels that fished in both the pre-IFQ and IFQ periods. Tier 2 IFQ data cannot be shown due to confidentiality restrictions, but it is reasonable to assume that the findings of the first five-year review of the GTF IFQ program have persisted into the 2016–2021 period and similar to Part-Time vessels, there has been a shift in the timing of landings to be more even across the year.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.3.9 Quota Market Performance

Quota markets are an important component of catch share programs where fishing privileges can be bought, sold, and transferred among participants as it sends important signals to both harvesters and

managers about how the program is performing and the value of the fishery. Here, we review the performance of the market for IFQ shares by looking at both permanent transfers of IFQ shares (sale of shares) and temporary transfers of IFQ shares (leases of shares) since IFQ program implementation. This information also helps to evaluate the transferability of IFQ shares per *Guidance for Conducting Review of Catch Share Programs* (National Marine Fisheries Service 2017). More information on distributional changes at the community level is provided in Section 5.4, Social and Community Impacts.

Permanent Transfer of IFQ Shares

As shown in Table 19, IFQ shares were permanently transferred in four out of first six years of the program, with six IFQ shareholders selling their shares in seven separate transactions. An annual average of 5.8% of the overall golden tilefish annual IFQ allocation was permanently transferred during FY2010–2015. A total of 632,248 pounds of IFQ allocation was permanently transferred over the period. An estimated 407,514 pounds (64.5%) were transferred to new entrants to the program, as measured by the number of new IFQ share accounts compared to those who received shares in the initial allocation in FY2010.

From FY2016 to 2021, permanent transfers declined, with two transfers in FY2016 and another in FY2017. An annual average of 2.8% of the annual IFQ allocation was permanently transferred during this period, while the total amount of IFQ allocation transferred was 295,301 pounds. It is estimated that 67% of these pounds was transferred to new entrants in just one of the three total transfers that occurred during this period. Across the entire IFQ period, there have been approximately 5 transfers to new entrants, or half of all the transactions that have occurred.

Table 19. Golden Tilefish IFQ Share Permanent Transfers

FY Period	Fishing Year	IFQ allocation (pounds)	Total pounds permanently transferred	Proportion of IFQ allocation transferred	Proportion of transfers to new entrants	Proportion of IFQ allocation transferred to new entrants	Number of transactions	Number of Accounts Closed
2010–2015	2010	1,895,248	87,452	4.6%	100.0%	4.6%	2	2
	2011	1,895,248	15,442	0.8%	0.0%	0.0%	1	1
	2012	1,895,248	240,638	12.7%	56.5%	7.2%	2	1
	2013	1,895,248	104,615	5.5%	0.0%	0.0%	1	1
	2014	1,895,248	0	0.0%	0.0%	0.0%	0	0
	2015	1,667,138	184,101	11.0%	100.0%	11.0%	1	1
	Average	**1,857,230**	**105,375**	**5.77%**	**42.75%**	**3.80%**	**1.17**	**1.00**
2016–2021	2016	1,792,799	246,639	13.8%	80.3%	11.0%	2	2
	2017	1,792,799	48,662	2.7%	0.0%	0.0%	1	1
	2018	1,554,038	0	0.0%	0.0%	0.0%	0	0
	2019	1,554,038	0	0.0%	0.0%	0.0%	0	0
	2020	1,554,038	0	0.0%	0.0%	0.0%	0	0
	2021	1,554,038	0	0.0%	0.0%	0.0%	0	0
	Average	**1,633,625**	**49,217**	**2.75%**	**13.38%**	**1.83%**	**0.50**	**0.50**
All IFQ Years	**Average**	**1,745,427**	**77,296**	**4.3%**	**28.1%**	**2.8%**	**0.83**	**0.75**

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

IFQ Share Leasing

As shown in Table 20, from FY2010 to 2015, on average 5.3 lease transactions occurred in any given year and 254,088 pounds a year were transferred. Between 10% and 18% of the overall golden tilefish total IFQ allocation was transferred annually over the period. From FY2016 to 2021, transfers between accounts increased to an average of 7.5 per year but were on average smaller quantities than in the first six years at 167,781 pounds, compared to 254,088 pounds. FY2016 and FY2017 had the lowest number of pounds transferred in the whole IFQ program period, at 69,962 pounds and 21,967 pounds, respectively. Lower attainment in these years may help explain part of this decrease if fishermen anticipated lower catches and revenue before they leased IFQ shares for the fishing year.

Table 20. Golden Tilefish IFQ Share Lease Transactions

FY Period	Fishing Year	IFQ allocation (pounds)	Total pounds leased	Number of lease transactions	Proportion of IFQ allocation leased	Proportion of transfers to new entrants	Proportion of IFQ allocation transferred to new entrants
2010–2015	2010	1,895,248	292,080	4	15.4%	0.0%	0.0%
	2011	1,895,248	340,361	5	18.0%	0.0%	0.0%
	2012	1,895,248	254,379	5	13.4%	0.0%	0.0%
	2013	1,895,248	190,813	6	10.1%	29.8%	3.0%
	2014	1,895,248	208,907	6	11.0%	23.5%	2.6%
	2015	1,667,138	237,990	6	14.3%	0.0%	0.0%
	Avg.	**1,857,230**	**254,088**	**5.3**	**13.69%**	**0.93%**	**8.88%**
2016–2021	2016	1,792,799	69,962	7	3.9%	4.7%	0.2%
	2017	1,792,799	21,967	6	1.2%	0.0%	0.0%
	2018	1,554,038	180,644	9	11.6%	0.0%	0.0%
	2019	1,554,038	239,408	9	15.4%	0.0%	0.0%
	2020	1,554,038	246,091	7	15.8%	0.0%	0.0%
	2021	1,554,038	248,616	7	16.0%	40.0%	6.4%
	Avg.	**1,633,625**	**167,781**	**7.5**	**10.67%**	**1.10%**	**7.44%**
All Years	**Avg**	**1,745,427**	**210,935**	**6.4**	**12.18%**	**1.01%**	**8.16%**

Note: New entrants are identified by new allocation accounts, and therefore may include vessels that fished under the pre-IFQ tier system but did not receive an initial allocation.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

Similar to the previous review, there are still very few data points to make meaningful statements regarding price ratio trends in the IFQ fishery in any given year (Table 21). In addition, information concerning the price for IFQ share transfers is not available; thus, only changes in average lease prices are discussed here. It should be noted, however, that in the previous review, little information on IFQ share prices was able to be disclosed due to confidentiality, which is expected to be the same here due to the limited number of permanent sale transactions since FY2015 (Table 19).

In any given year, at least one or two lease transactions were reported with a zero price and due to the limited number of total leases, these zero price leases can have a relatively large impact on average lease prices. In interviews with fishery participants conducted for this review, a few participants noted that these transactions were likely between vessels owned by the same entity, (Table 8). However, when examining lease transactions across affiliated accounts (per the analysis in section 5.3.3), not all zero lease transactions are between affiliated accounts. It is possible that either price information was not reported (i.e., missing), or that some other form of compensation was used, like barter (trade of quota for quota, e.g., see Holland (2013)]). Due to uncertainty around the interpretation of these transactions, we report average prices both across all leases, including these zero price transactions, as well as average prices excluding these values (Table 21).

Table 21. Number and Average IFQ Share Lease Price by Year

Fishing Year	No. Leases	Total Pounds Leased	Total Value of Leased Pounds ($2021)	Min Price Per Pound (non-zero, [$2021/lb])	Mean Price Per Pound (non-zero, [$2021/lb])	Mean Price Per Pound (all leases, [$2021/lb])	Max Price Per Pound ($2021/lb)	Mean Ex-Vessel Price ($2021/lb)	Total Landed Pounds	Lease Price % of Ex-Vessel Price (non-zero)	Lease Price % of Ex-Vessel Price (all leases)
2010	4	292,080	31,108	c	c	0.15	0.60	3.46	1,744,363	c	4.4%
2011	5	340,361	77,250	c	c	0.31	0.92	3.90	1,729,755	c	7.9%
2012	5	254,379	112,971	c	c	0.45	1.16	3.85	1,683,573	c	11.7%
2013	6	190,813	132,010	0.78	0.83	0.69	0.86	4.06	1,623,401	20.4%	17.1%
2014	6	208,907	148,627	0.73	0.84	0.69	0.85	3.92	1,623,946	21.4%	17.5%
2015	6	237,990	181,780	0.79	0.86	0.71	0.95	4.82	1,213,232	17.9%	14.8%
2010-2015 avg	**5.33**	**254,088**	**113,958**	**0.77**	**0.84**	**0.50**	**0.89**	**4.00**	**1,603,045**	**19.9%**	**12.2%**
2016	7	69,962	31,631	0.77	0.78	0.68	0.88	4.88	937,687	16.0%	13.9%
2017	6	21,967	8,603	0.50	0.51	0.34	0.51	3.78	1,306,338	13.4%	8.9%
2018	9	180,644	76,647	0.49	0.49	0.44	0.49	3.55	1,419,417	13.9%	12.4%
2019	9	239,408	103,161	0.48	0.48	0.43	0.49	4.01	1,395,399	12.0%	10.7%
2020	7	246,091	104,939	0.46	0.48	0.41	0.48	3.95	1,276,615	12.1%	10.3%
2021	7	248,616	104,870	0.46	0.47	0.41	0.50	4.31	1,379,621	10.9%	9.4%
2016-2021 avg.	**7.50**	**167,781**	**71,642**	**0.53**	**0.54**	**0.45**	**0.56**	**4.08**	**1,285,846**	**13.1%**	**10.9%**
All Years Average	**6.42**	**210,935**	**92,800**	**0.61**	**0.64**	**0.48**	**0.72**	**4.04**	**1,444,446**	**15.3%**	**11.6%**

Note: Average prices represent weighted means. Values marked 'c' indicates values withheld due to confidentiality.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

Inflation-adjusted nonzero lease prices have ranged between $0.46 per pound in FY2020 and FY2021 and $1.16 per pound in FY2012 and averaged $0.64 across all twelve years. Including zero lease prices, prices have averaged $0.48 per pound over the IFQ period (Table 21). Since the first program review nonzero lease prices have decreased 30 cents, from an average of $0.84 per pound to $0.54, though ex-vessel prices are nearly the same, on average, causing nonzero lease prices as a proportion of ex-vessel prices to drop from 19.9% to 13.1%, on average. This is in contrast to the results of the first review, which found that lease price to ex-vessel price ratios were increasing in the review period. Declining IFQ share prices may be a signal of decreasing profitability in the fishery, since theoretically in an efficient market IFQ share prices should equal the profit or net revenue from a unit of quota. However, based on results from the productivity and net operating revenue analysis in other sections of this document, this appears unlikely, since over the last six years productivity has generally been similar, or higher than in the first six years (Figure 13). Another possibility could be that IFQ share prices may have been higher in the first years of the program as participants adjusted to the system and transaction costs for finding and leasing IFQ shares may have been higher, or uncertainties about the fishery were greater. In interviews with participants, it was noted that there is no central repository for advertising or viewing IFQ share holdings and IFQ shares available for sale or lease. Rather, because the fishery has always been relatively small, this information has always occurred via word of mouth. In addition, over time as the fishery has continued to decrease in size, it

may be that leasing relationships have become more stable or been reduced to a smaller network. The leasing data show that while more individual leases occur in most years, in recent years there has been less variability both within and between years. Additionally, between-community lease transactions are summarized in a separate section (5.4.5, IFQ Share Leasing by Community), which describes how in recent years the majority of lease transactions have occurred within Barnegat Light. The difference between minimum nonzero lease prices and maximum lease prices has decreased—since FY2017 the range of nonzero lease prices has only been between one and four cents (Table 21). In the same period, the average nonzero lease price also changed very little (between $0.51 and $0.47, an 8.9% difference), even as price fluctuated from $3.55 and $4.31, a 21.4% difference.

5.3.10 Diversification and Reliance

Much of the analysis presented in previous sections has focused on how the IFQ program has affected the golden tilefish fishery, but the introduction of the IFQ program also can affect decisions about whether to increase or decrease effort in other fisheries that may be a part of a vessel's portfolio, or affect which vessels enter or exist the fishery, affecting remaining vessels' diversification and reliance on the golden tilefish fishery. Changes in diversification and reliance may be important indicators of how resilient harvesters are to changes in the golden tilefish resource in the future.

Vessel-Level Diversification and Reliance

At the vessel level, the fleet has consistently been composed of vessels who only participate in the directed golden tilefish fishery (previously Full-Time Tier 1 or 2 vessels) and those who participate in other fisheries (previously Part-Time vessels). In the baseline period, while there were approximately 14 vessels who participated in any tier, approximately 75% were vessels who participated in other fisheries for at least some part of the year (Table 22). This has declined over time, to roughly 50% (four of the eight) IFQ vessels participating in other fisheries in three of the last four fishing years. Non-IFQ revenue per vessel and the proportion of revenues coming from non-IFQ effort has also declined, from an average $432,785 in the baseline period to $333,478 over the IFQ period (64.4 percent of total vessel revenues to 51.9% of total revenues). Though golden tilefish composes a greater proportion of vessel-level revenues for these vessels, vessels on average make about as much per year across all fisheries as they did in the baseline period ($658,621 to $651,665). Figure 17 shows that when looking at the concentration of fishing revenue across species groups using the HHI, concentration has increased, particularly since FY2018, reflecting both a decrease in the number of IFQ vessels landing other species and for those that do, a reduction in the proportion of non-IFQ species revenue (Table 22).

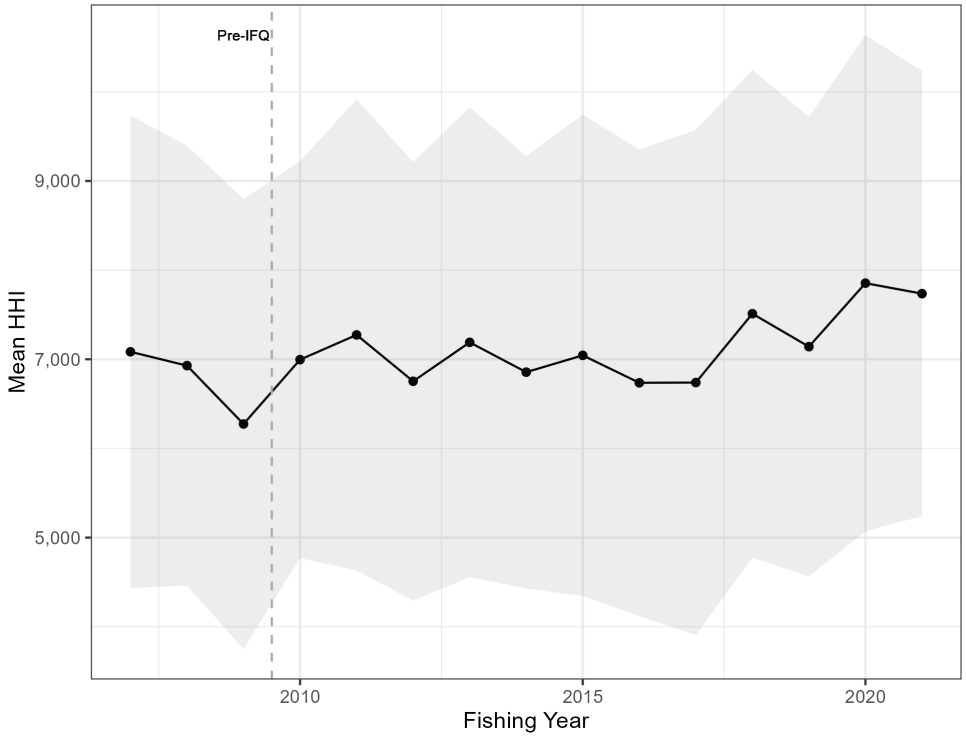
Table 22. Other Ex-Vessel Revenue of IFQ Vessels

	Baseline Average	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	IFQ Average
Non-IFQ revenue ($2021)	4,575,517	3,627,691	3,060,589	4,413,840	2,268,953	2,210,134	2,427,958	2,133,475	1,924,957	1,161,138	1,514,995	995,089	1,448,066	**2,265,574**
IFQ revenue* ($2021)	2,449,865	2,136,734	4,121,505	2,277,339	3,938,350	2,438,062	2,563,259	1,472,635	1,378,638	1,074,806	1,370,451	1,197,084	1,405,434	**2,114,525**
IFQ vessels	14.3	11	9	11	10	11	12	12	10	8	8	8	8	**9.8**
Vessels with non-IFQ revenue	10.7	8	7	8	7	8	10	9	7	4	5	4	4	**6.8**
Non-IFQ Revenue per Vessel ($2021)	432,785	453,461	437,227	551,730	324,136	276,267	242,796	237,053	274,994	290,284	302,999	248,772	362,017	**333,478**
Revenue per Vessel ($2021)	658,621	720,553	1,026,013	836,397	886,758	581,025	499,122	400,679	471,942	558,986	577,089	548,043	713,375	**651,665**
Proportion non-IFQ revenue	64.4%	62.9%	42.6%	66.0%	36.6%	47.5%	48.6%	59.2%	58.3%	51.9%	52.5%	45.4%	50.7%	**51.9%**

*Note: * only includes total IFQ revenues from IFQ vessels with non-IFQ revenue, therefore excludes vessels who only participate in the IFQ fishery. Revenues shown are for active IFQ vessels in a given fishing year. In the baseline period, this includes all other landings when not fishing in the directed fishery for Full-Time Tier 1, Full-Time Tier 2, and Part-Time permitted vessels.*

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 17. Average Vessel Diversification (HHI) Across Species Groups

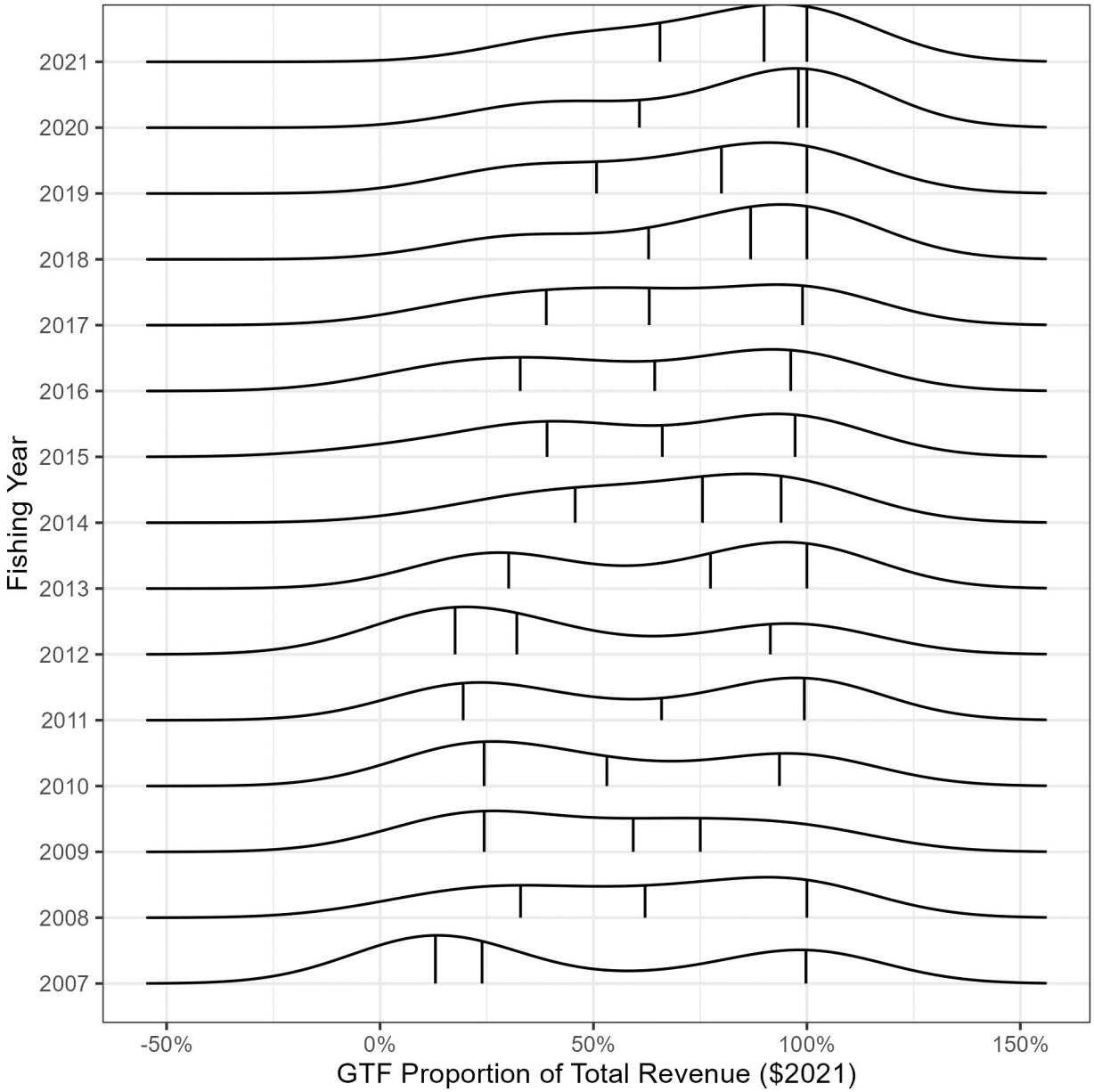


Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 18 shows the distribution of earnings from IFQ golden tilefish as a proportion of total vessel revenues. Across all years there are generally two consistent populations of vessels, those that earn 50 percent or less of their income from golden tilefish and those that are almost entirely reliant on golden tilefish earnings. However, in the last five years vessels from both groups are among the highest earners for golden tilefish (top third of earners, not shown[11]). Vessels who no longer participate in the fishery were more likely to be among the lowest earners in the fishery (bottom third) but not all were active participants in other fisheries, since several had 50 percent or more of their earnings coming from golden tilefish. Middle-tier vessels have inconsistently participated patterns over time and have varied reliance on golden tilefish, from very little to the majority of revenue coming from golden tilefish in any given year (Figure 18). As shown by the rightward shift of the 50th (median) and 25th percentiles, vessels who have been participating in the last six years are generally more reliant on golden tilefish than vessels in the pre-catch share period or in the first six years of the program.

[11] Data describing the relationship between earning tiers and relative dependence on golden tilefish are not shown due to confidentiality restrictions but were assessed by analysts in preparation of this report.

Figure 18. Distribution of Golden Tilefish as a Proportion of Total Revenue Across IFQ Vessels

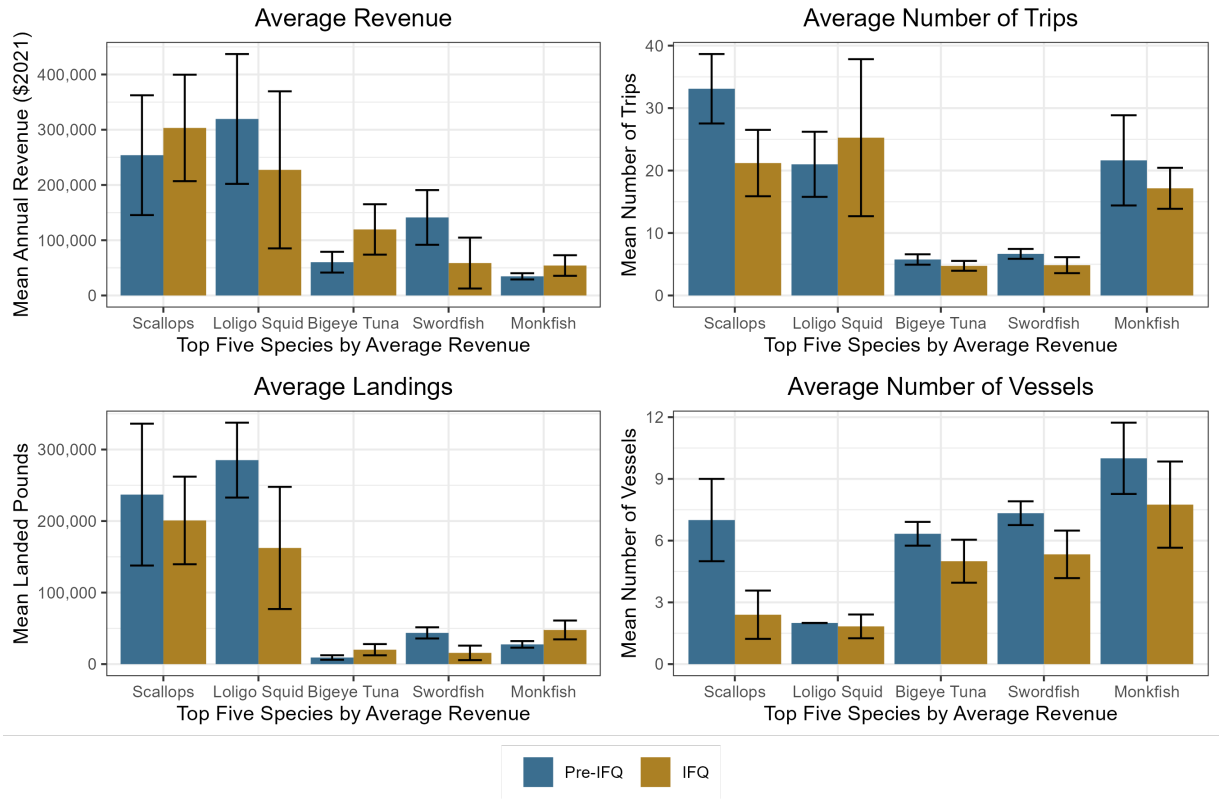


Note: On the righthand plot, vertical lines represent, 25th, 50th (median) and 75th percentiles (from leftmost to rightmost).
Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023c)

For IFQ vessels that do participate in other fisheries, top species groups have included scallops, Loligo squid, bigeye tuna, swordfish, and monkfish (Figure 19). Per vessel, catch, landings, and effort have varied between the pre-catch share and catch share periods, but in the catch share period the highest average revenue species has been scallops, followed by Loligo squid. However, these species were landed by a relatively small number of IFQ vessels in the IFQ period (three or fewer in any given year), compared to swordfish and monkfish (roughly five and eight vessels, on average, Table 23). Compared to the pre-IFQ period, average revenue for monkfish and scallops has increased, despite

fewer trips being taken per vessel. Bigeye tuna revenue is also higher, though the number of trips is relatively the same.

Figure 19. Top Non-Golden Tilefish Species Landings, Revenue, and Participation by IFQ Vessels



Note: Data show average earnings across all other non-tilefish species groups on non-golden tilefish trips by IFQ vessels. Pre-IFQ vessels include all Full-Time Tier 1, Full-Time Tier 2, and part time vessels. IFQ period landings of squid and groundfish cannot be shown due to data confidentiality restrictions.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Table 23. Top Non-Golden Tilefish Species Landings, Revenue, and Participation by IFQ Vessels

Species Group	Period	FY	Number of Vessels		Number of Trips		Live Landed Pounds		Revenue ($2021)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bigeye Tuna	Pre-IFQ	3	6.3	0.6	5.8	0.8	9,213	3,169	60,250	18,785
	IFQ	12	5.0	1.0	4.7	0.8	20,152	7,841	119,526	45,610
Loligo Squid	Pre-IFQ	3	2.0	0.0	21.0	5.2	285,206	52,354	319,494	117,512
	IFQ	12	1.8	0.6	25.3	12.6	162,405	85,402	227,379	142,152
Monkfish	Pre-IFQ	3	10.0	1.7	21.6	7.2	27,581	4,625	34,650	5,641
	IFQ	12	7.8	2.1	17.2	3.3	47,770	13,168	54,204	18,636
Scallops	Pre-IFQ	3	7.0	2.0	33.1	5.6	236,989	99,171	253,922	108,415
	IFQ	10	2.4	1.2	21.2	5.3	200,840	61,228	303,259	96,336
Swordfish	Pre-IFQ	3	7.3	0.6	6.7	0.8	43,659	7,817	141,250	49,506
	IFQ	12	5.3	1.2	4.9	1.3	15,722	10,133	58,669	46,071

Note: Data show average earnings across all other non-tilefish species groups on non-golden tilefish trips by IFQ vessels. Pre-IFQ vessels include all Full-Time Tier 1, Full-Time Tier 2, and part time vessels. IFQ period landings of squid and groundfish cannot be shown due to data confidentiality restrictions.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023c)

As discussed in Section 5.3.8, the implementation of the IFQ program has had particularly strong impacts on the timing of effort among vessels in the former Part-Time and Full-Time Tier 2 permit categories of the previous tier system. The flexibility introduced by the IFQ program allows these vessels to plan their fishing activities throughout the year, rather than being forced into a derby fishery on November 1 (start of the fishing year) if they plan to harvest tilefish in a given year. These vessels participate in several fisheries (e.g., monkfish, scallop, and swordfish) and the IFQ program allows them to "fill in" tile fishing when it works best for them, usually in the spring. The MAFMC's Tilefish Advisory Panel has indicated that even smaller participants in the tilefish IFQ fishery (smaller in terms of IFQ allocation and/or boat size) have greatly benefited from the IFQ management system as they can better plan their fishing operations (fish when and where they need to) and the fact that tilefish prices are relatively good and stable, and in fact, a large proportion of their ex-vessel revenues come from tilefish (Mid-Atlantic Fishery Management Council 2018b).

Vessel Ownership and Affiliate Size

While most of this section focuses on diversification of IFQ vessels, diversification at the entity or ownership level is also important since vessel owners may own multiple vessels that each may participate in one or more fisheries. To gauge this, we can look at the number of fishing permits held by ownership entities who also own vessels that fished in the IFQ fishery in any given year. By looking at the number of permits held across IFQ-affiliated entities, we can gauge how dependent active vessels are on the IFQ fishery. It is important to note that in the NMFS GARFO region, fishing permits carry various “endorsements” to prosecute various fisheries, so the number of fisheries a vessel is permitted to prosecute may not be represented by the number of fishing permits held.

Ownership of active IFQ vessels was summarized by applying the Small Business Administration's principles of affiliation to ascertain ownership of IFQ vessels as well as permits for other fisheries held in common among multiple businesses or people. Since 2010, the NMFS NEFSC Social Sciences Branch has summarized ownership data from all valid commercial fishing permits as of June 1 in support of required regulatory analysis for any given management action. Therefore, these data would not capture changes in permit ownership that may have taken place prior to June 1 but do provide a basis for comparing ownership trends at a common point in time (Lee 2023b). Here, we only look at the ownership composition of active IFQ vessels, that is fishing permits for which IFQ landings were recorded in a given fishing year, and the total number of permits affiliated with the ownership entity. The total number of permits held by an ownership entity is referred to as the "affiliate size" (Table 24). Since 2010 (the first year when ownership data are available), we can examine how many active IFQ fishing permits were owned by the same entity and how many total permits were held.

Over time, the majority of active IFQ vessels have been the only permit held by the ownership entity (affiliate size=1), fluctuating between 5 and 9 vessels across years. In most years, some active permits had larger affiliate sizes of 5 or 7 total permits held within the ownership group, but since 2018 the largest affiliate had 4 total permits. In some years, two active vessels owned by the same entity have participated in the fishery, but as shown by the affiliate size, these permits represent the total two permits held by the entity (Table 24). Overall, this indicates that most active IFQ vessels are part of ownership groups that often do not own more than the active IFQ vessel and the sole source of fishery income comes from the IFQ vessel and any other fisheries that the vessel participates in throughout the year.

Table 24. Affiliate Size of Active IFQ Vessels

	2010					2011				2012				2013			2014				2015				2016				2017				2018			2019			2020		2021	
Affiliate Size	1	2	3	4	6	1	2	3	6	1	2	3	5	1	2	5	1	2	3	5	1	2	4	6	1	2	4	6	1	2	4	7	1	2	4	1	2	4	1	2	1	2
One Active IFQ Vessel	6	2	1	1	1	6	1	1	1	6	2	0	1	8	1	0	8	1	1	1	7	1	1	1	9	1	1	1	7	1	1	1	6	1	1	5	2	1	5	1	5	1
Two Active IFQ Vessels		0	0	0	0		0	0	0		0	1	0		0	0		1	0	0		1	0	0		0	0	0	0	0	0	0		0	0		0	0		1		1

Note: Only includes active IFQ vessels thus permits held but not fished in a given year (lease-only) are not reflected. Shaded cells indicate where there values are illogical (e.g., an affiliate size of 1 cannot have two vessels since the minimum affiliate size in this instance is 2).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); Lee (2023b)

5.3.11 Spatial Distribution of Effort

To analyze how the spatial distribution of fishing effort in the IFQ fishery has changed since implementation, VTR-reported information on fishing locations and statistical areas (i.e., chart areas) fished are analyzed. Vessels must report landings in each statistical area that they fish in on a given trip (National Marine Fisheries Service 2018c). Effort and landings in the IFQ fishery are concentrated along the edge of the continental shelf and primarily take place in two statistical areas—537 and 616 (Table 25 and Figure 20). Across statistical areas, reported catches have not changed much since the implementation of the catch share program, with nearly identical proportions of landings and revenue coming from statistical area 537, though landings in statistical area 616 have increased from 41.4% of landings to 46.5% of landings. Other statistical areas that contributed over 1% or more towards total landings in any period included 611, 613, and 622 in the Pre-IFQ period, and 613 and 526 in the IFQ period.

Table 25. Distribution of Landings and Revenue Across Statistical Areas

Period	Statistical Area	Proportion of Landed Pounds	Proportion of Landed Revenue
Pre-IFQ	537	46.1%	46.5%
	616	41.4%	40.2%
	613	5.5%	5.7%
	Other	3.2%	3.5%
	611	2.3%	2.6%
	622	1.4%	1.5%
IFQ	537	46.5%	46.4%
	616	46.5%	46.2%
	Other	3.5%	3.8%
	613	2.2%	2.1%
	526	1.3%	1.4%

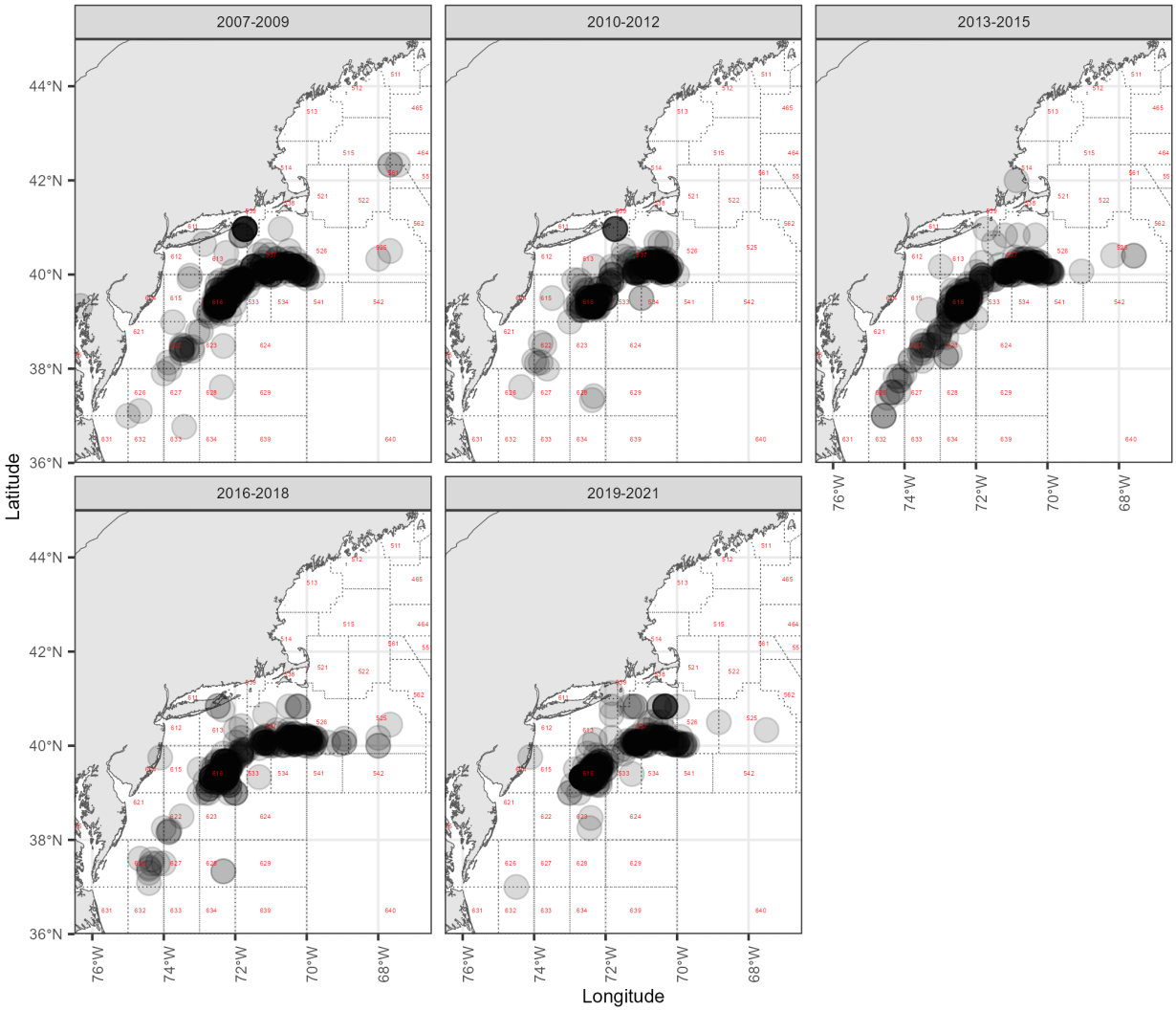
Note: Statistical areas are as reported on vessel trip reports. Other statistical areas include all statistical areas where either fewer than 3 vessels fished or they accounted for less than 1% of total landings.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

VTR-reported fishing locations (latitude and longitude) help show how the geographic nature of the fishery has changed over time. While other sources of geographic fishing effort are more precise for measuring where fishing took place (such as VMS), VTR data provide a rough approximation, as vessels are instructed to indicate a single fishing location where the majority of fishing effort occurred within a given statistical area (National Marine Fisheries Service 2018c). VTR-reported fishing locations, however, should be regarded as approximate representations, since they represent one point over a potentially large area that was fished in a given statistical area, or may contain errors. While fishing effort has always been most densely concentrated in narrow areas in statistical areas 616 and 537, lower levels of effort has occurred outside these areas and have changed somewhat over time, with some years more fishing effort occurring further south (e.g., from FY2013

and 2015), or west into statistical area 526 (FY2016-FY2021). Due to the relatively low levels of effort occurring in these less common statistical areas, it is not clear what, if any, implications this has for management, or the performance of the IFQ program.

Figure 20. VTR Reported Fishing Locations on IFQ Trips



Note: Darker color indicates a higher number of overlapping points, or subtrips, in a given area. Locations shown are VTR-reported fishing locations, a self-reported point where the majority of fishing effort occurred.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.4 Social and Community Impacts

This section describes and analyzes the effects of the GTF IFQ program on coastal communities engaged in the golden tilefish fishery. The focus is mainly on those communities where golden tilefish landings primarily occurred in the years leading up to GTF IFQ program implementation and where IFQ landings primarily occurred after the program was implemented. The three communities that

are the focus of this review are Montauk, NY, Hampton Bays, NY and Barnegat Light, NJ. Between calendar years 2000 and 2005, these three ports accounted for 86% of all tilefish landed in terms of weight and 92% in terms of value (Mid-Atlantic Fishery Management Council 2009). As shown in the sections below, the predominance of these communities in the golden tilefish fishery continued after the program was put in place.

5.4.1 Community-Related Criteria and Program Evaluation Guidance

Amendment 1 had no specific goals or objectives related to community impacts; however, according to the environmental review for Amendment 1, the management measures of the IFQ program were designed not only for meeting the program's purpose but also "preserving the long-term economic viability of the fishery and maintaining the social structure and historical fishery participation" (Mid-Atlantic Fishery Management Council 2009). This statement can be seen as being directly related to National Standard 8 of the MSA, which requires that an FMP take into account the importance of fishery resources to fishing communities in order to provide for the sustained participation of—and minimize adverse economic impacts on—such communities.

In addition, during the development of Amendment 1 the MAFMC recognized that the initial allocation process of a catch share program can lead to changes in the concentration of fishing privileges across communities. Moreover, the MAFMC noted that free transferability of IFQ shares is likely to have a range of social implications. More specifically, over the long-term IFQ shares could become concentrated in some communities, while other communities lose part or the totality of their shares (Mid-Atlantic Fishery Management Council 2009).

The community impact analysis in this review assesses the GTF IFQ program's success in achieving the objectives of Amendment 1 and National Standard 8 by identifying the primary ports where golden tilefish landings are occurring and calculating port involvement and dependence. This review includes community-level indicators developed by Colburn et al. (2017) that aim to monitor community dependence on catch share species. These indicators, which include a Regional Quotient and the Local Quotient, are provided for the primary ports identified in the review.

The analysis then places these changes in golden tilefish landings in the broader socioeconomic context of each of the primary communities. The NMFS *Guidance for Conducting Reviews of Catch Share Programs* (National Marine Fisheries Service 2017) suggests that when analyzing effects on communities per National Standard 8, analysts should include the social indicators developed by Jepson and Colburn (2013). These indicators characterize community well-being for coastal communities engaged in fishing activities and describe their vulnerability in terms of existing local social conditions that are likely to determine how potentially disruptive events affect communities. This review uses the online indicator map at National Marine Fisheries Service (2023f) to provide the most recent social indicators data available for the primary ports.

In addition to examining trends in golden tilefish landings, the analysis explores the location of IFQ allocation permit holders and trends in their location over time. Specifically, it looks at the distribution of IFQ shares across communities after the initial allocation process, and the subsequent flow of IFQ shares among communities as IFQ shares were permanently and temporarily transferred.

Finally, in consistency with the first five-year review, the analysis examines perceived inequalities in the distribution of fishing privileged across communities. This part of the assessment can be seen as being directly related to National Standard 4 of the MSA, which requires that requires all allocations of fishing privileges to be fair and equitable. The sources of past and ongoing inequity perceptions are discussed, together with an update on the MAFMC's response to requirements set forth in NMFS' *Fisheries Allocation Review Policy* (National Marine Fisheries Service 2018b).

In assessing the impact of the GTF IFQ program on fishing communities it is important to recognize that the program is one of many factors affecting the socioeconomic well-being of these communities. Environmental issues such as global warming have affected fisheries (Hare et al. 2016), and the economies of communities reliant on marine species vulnerable to these environmental threats are being adversely affected. In addition, larger economic changes, including market forces (such as the desire to buy more sustainable seafood) and coastal development (such as changes in working waterfronts supporting commercial fishing due to space-use conflicts), affect the economic health of local fishing industries.

5.4.2 Distribution of Vessel Activity, Landings, and Ex-vessel Revenue by Community

This section examines how patterns of landings have shifted geographically during the catch share program. The ports of landing are important not only because they are where dealer facilities are located, but they are also often where vessels purchase services and hire their crews.[12] Moreover, communities have been sites for important collaboration among harvesters and dealers in terms of developing markets for golden tilefish (National Academy of Sciences 2021). Early collaboration in Barnegat Light led to the creation of Viking Village, a successful dock, retail market, and restaurant complex. More recently, vessels landing in this port have sought out more diverse markets, both nationally and internationally (Rountree et al. 2008). According to interviews conducted for this review, harvesters in Montauk have focused more on developing close working relationships with certain buyers in the New Fulton Fish Market. In addition, harvesters within both Barnegat Light and Montauk typically try to coordinate times of landings to avoid market gluts and spread golden tilefish landings throughout the year (Mid-Atlantic Fishery Management Council 2017a).[13]

[12] Port of landing is often used as a proxy for the location of fishing vessel-related shoreside economic activity since no existing datasets provide information on actual vessel spending locations and patterns.

[13] An example of coordination that occurred during the COVID-19 pandemic was reported by interviewees. To bolster golden tilefish prices during this period of low demand, Montauk-based harvesters agreed among themselves to rotate their landings and to a landing limit.

The contribution of each of the primary communities to the total value of golden tilefish landings in the Mid-Atlantic region from FY2007 to 2021 is shown by its Regional Quotient presented in Table 26. This quotient is expressed as a percentage (community value of species/total regional value of species) (Colburn et al. 2017). Montauk has been the dominant port during the GTF IFQ program period, accounting for 46–66% of the ex-vessel value of the golden tilefish landed in the region.[14] Barnegat Light accounted for 17–32% during this period, and Hampton Bays accounted for 4–21%. The combined value of landings in the three communities accounted for an average of 97% of the regional value during the baseline years, and 98% of the regional value during the GTF IFQ program period.

Table 26. Golden Tilefish Regional Quotient by Primary Community

	Fishing Year														
Community	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Barnegat Light (%)	16.7	22.5	24.1	20.1	19.6	19.9	19.4	23.6	25.6	31.8	26.9	24.6	24.4	23.5	23.4
Hampton Bays (%)	7.0	8.7	9.0	13.8	13.0	13.9	13.5	10.8	3.5	20.7	19.4	11.7	14.1	16.9	14.5
Montauk (%)	73.1	65.3	65.5	64.5	66.4	64.8	66.0	62.1	65.8	46.0	50.7	62.0	60.0	56.4	58.4

Note: Quotients are calculated as the ex-vessel revenue landed in a given community as a proportion of the total ex-vessel revenue of all golden tilefish in the region (in both the incidental and directed fisheries).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b); (National Marine Fisheries Service 2023c)

As discussed in the previous review, Mid-Atlantic Fishery Management Council (2017a), there have been various reductions in the number of participants (i.e., vessels) in the directed golden tilefish fishery since the management system for golden tilefish was first implemented. The first major reduction occurred when the original FMP implemented a limited-entry program. The second major reduction occurred when the IFQ program was implemented under Amendment 1. As stated in Amendment 1, the primary purpose of the IFQ program was to reduce overcapacity and latent fishing effort in the commercial golden tilefish fishery, and to eliminate, to the extent possible, the problems associated with derby-style fishing (Mid-Atlantic Fishery Management Council 2009). While these outcomes can improve economic efficiency in the fishery and assist the MAFMC in achieving OY, the reduction in fishing effort could have detrimental impacts on communities in which the fishery is embedded, particularly for communities in which fishing is an important part of the economy and social structure.

As shown in Table 4 in Section 5.3.1, it is estimated that the average annual number of vessels participating in the directed fishery was 14 during the baseline period. During the FY2010–2015

[14] In addition, Colburn et al. (2017) reported that Montauk was the only community meeting criteria of being "highly engaged" in the IFQ fishery based on a catch share program-specific Fishing Engagement Index. This index is a measure of the importance of a specific catch share program to a given community relative to other communities in that program, and is calculated using the pounds and value landed, the number of dealers or first receivers, and the number of permits that are specific to the catch share program (Colburn et al. 2017). Montauk was highly engaged (1.0 standard deviation above the mean) in the golden tilefish fishery for one or more years from the baseline period (2007–2009) through 2013.

period (after IFQ implementation), on average, 11 vessels participated in the fishery. After a one-year increase in FY2012, the number continued to decrease until it stabilized at eight vessels during the FY2018–2021 period. Table 27 shows the trend in the number of vessels making landings of IFQ fish in Barnegat Light and Montauk. Data for IFQ effort in Hampton Bays could not be shown due to confidentiality restrictions. From FY2017 to 2021, there was a decrease in the number of IFQ vessels making landings in both Barnegat Light and Montauk due to a number of factors, including lower quotas and severe weather conditions (see Sections 5.3.1 and 5.3.9). Table 27 also shows the trend in the number of trips landing IFQ fish in the two ports. These data also show a pattern of decline starting in FY2017.

Table 27. IFQ Vessel Activity by Primary Community

	Fishing Year														
Community	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Barnegat Light															
Number of Vessels	7	9	7	7	5	8	6	7	9	8	6	5	5	5	5
Number of Trips	26	59	66	45	30	33	41	58	57	71	52	46	37	40	41
Montauk															
Number of Vessels	3	4	3	4	4	4	4	4	3	4	4	3	3	3	3
Number of Trips	63	77	65	58	56	54	58	63	59	50	69	58	56	55	51

Note: Data for Hampton Bays could not be shown due to confidentiality restrictions. Data from the directed commercial fishery only (no incidental effort, from 2010 on includes only IFQ effort).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

As shown in Table 28 and Table 29, downward trends can also be seen in the amount and value of all golden tilefish landings (including incidental trip landings) in Montauk, where most of the species is landed. These decreases were the result of both Barnegat Light and Hampton Bays accounting for a larger proportion of the total landings across the three communities, together with a general decline in landings in the golden tilefish fishery. Among the three communities, the relative share of Montauk's landings decreased from 68.3% of volume and 70% of value during the pre-IFQ period to 57.5% of volume and 57.3% of value from FY2016-2021.

Table 28. Volume of Golden Tilefish Landings by Primary Community

Fishing Year	Barnegat Light	Hampton Bays	Montauk
	Landed Pounds of golden tilefish (lb)		
2007	318,124	112,870	1,236,797
2008	407,425	145,192	1,035,093
2009	475,670	155,164	1,201,393
FY2007-2009 Avg	**400,406**	**137,742**	**1,157,761**
FY2007-2009 Percent of Total	**23.6%**	**8.1%**	**68.3%**
2010	387,400	264,577	1,270,890
2011	371,009	242,223	1,277,168
2012	382,458	240,921	1,214,411
2013	356,646	251,801	1,170,951
2014	382,210	192,545	1,169,737
2015	333,572	44,708	892,498
FY2010-2015 Avg	**368,883**	**206,129**	**1,165,943**
FY2010-2015 Percent of Total	**21.2%**	**11.8%**	**67.0%**
2016	341,801	198,978	479,680
2017	441,424	246,930	733,844
2018	407,275	164,489	988,541
2019	401,356	192,473	923,572
2020	376,335	213,738	782,056
2021	368,164	207,186	918,218
FY2016-2021 Avg	**389,393**	**203,966**	**804,319**
FY2016-2021 Percent of Total	**27.9%**	**14.6%**	**57.5%**
All IFQ Years Avg	***379,138***	***205,047***	***985,131***
All IFQ Years Percent of Total	***24.2%***	***13.1%***	***62.8%***

Note: Volume in whole (round) weight (live landed pounds). Includes all incidental and directed commercial landings. Percentages do not reflect the proportion of total GTF landings, but rather the proportion of the total GTF landings in the three primary communities.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Table 29. Ex-vessel Value of Golden Tilefish Landings by Primary Community

Fishing Year	Barnegat Light	Hampton Bays	Montauk
	($2021)		
2007	961,995	405,070	4,224,878
2008	1,272,690	492,015	3,693,501
2009	1,249,091	466,354	3,396,967
FY2007-2009 Avg	1,161,259	454,480	3,771,782
FY2007-2009 Percent of Total	21.6%	8.4%	70.0%
2010	1,245,403	855,231	3,989,831
2011	1,339,813	885,553	4,529,263
2012	1,308,105	911,812	4,265,688
2013	1,296,161	906,843	4,418,938
2014	1,531,179	701,052	4,032,715
2015	1,509,484	208,821	3,884,172
FY2010-2015 Avg	1,371,691	744,885	4,186,768
FY2010-2015 Percent of Total	21.8%	11.8%	66.4%
2016	1,471,312	956,649	2,129,365
2017	1,362,607	980,635	2,569,440
2018	1,267,001	605,177	3,198,778
2019	1,380,267	797,233	3,398,449
2020	1,203,404	865,946	2,890,976
2021	1,409,875	873,215	3,521,457
FY2016-2021 Avg	1,349,078	846,476	2,951,411
FY2016-2021 Percent of Total	26.2%	16.4%	57.3%
All IFQ Years Avg	*1,360,384*	*795,681*	*3,569,089*
All IFQ Years Percent of Total	*23.8%*	*13.9%*	*62.3%*

Note: Value in inflation-adjusted dollars ($2021). Includes all incidental and directed commercial landings. Percentages do not reflect the proportion of total GT landings, but rather the proportion of the total GT landings in the three primary communities.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

The first five-year review concluded that it appeared that an orderly and slow reduction in the number of vessels participating in the directed fishery occurred during the initial years of the IFQ program, and that it is unlikely that the capacity reduction in the fleet had significant adverse impacts on fishing communities (Mid-Atlantic Fishery Management Council 2017a).

It is also unlikely that the recent further decline in vessels, together with the decline in the volume and value of landings, had a significant adverse socioeconomic impacts on the primary communities where these decreases occurred (i.e., Montauk). One basis for this conclusion is the Local Quotients for the primary communities shown in Table 30. This quotient is a measure of the importance of a particular species relative to all species landed in a community and is expressed as a percentage (community value of species/total community value for all species) (Colburn et al. 2017). As discussed above, among the three primary communities, Montauk has had the highest dependence on golden tilefish as a percentage of total ex-vessel fishing revenue from all landings. Although

Montauk accounted for the majority of regional golden tilefish landings (Table 28), the Local Quotients presented in Table 30 show that during the GTF IFQ program period, golden tilefish accounted for only an average of 19% of the community's total annual fishing revenue. The species contributed less to the total fishing revenue of both Barnegat Light and Hampton Bays, averaging 5% and 13% of the total, respectively, during the program years.

Table 30. Golden Tilefish Local Quotient by Primary Community

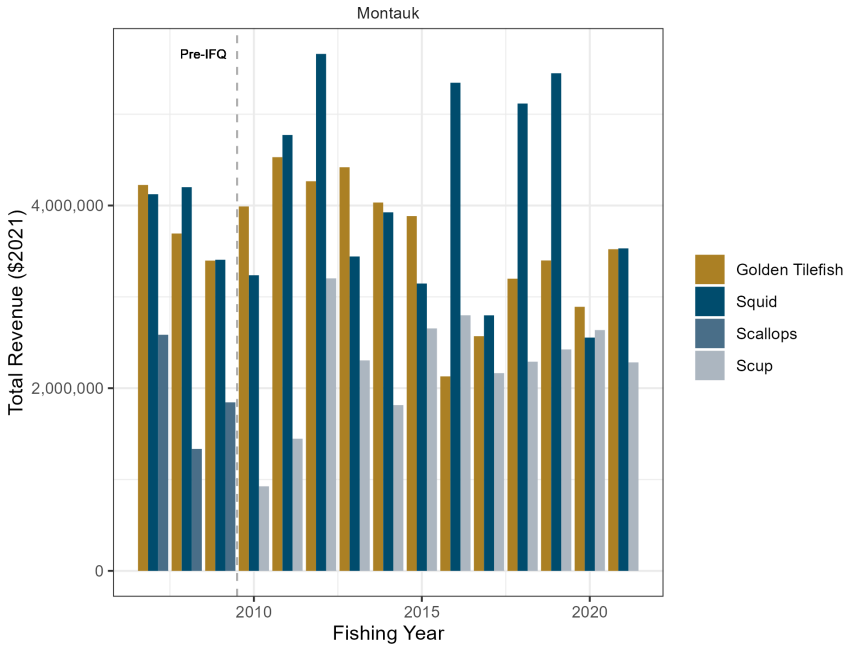
	Fishing Year														
Community	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Barnegat Light	3.4%	4.3%	4.4%	3.9%	3.3%	3.5%	4.4%	5.3%	5.4%	4.7%	5.0%	4.8%	5.2%	5.4%	5.0%
Hampton Bays	5.8%	7.6%	8.5%	16.3%	10.8%	10.2%	13.3%	12.1%	3.7%	11.6%	16.2%	10.8%	14.3%	17.9%	17.6%
Montauk	21.1%	19.6%	19.9%	19.7%	19.1%	15.7%	21.0%	20.4%	22.0%	11.6%	17.3%	17.8%	18.4%	19.2%	23.1%

Note: Percentages calculated as the community value of species/total regional value of species. Quotients are calculated as the ex-vessel revenue landed in a given community as a proportion of the total ex-vessel revenue of all golden tilefish in the region (in both the incidental and directed fisheries).

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

The figures below display additional details on the diversity of species landed in the primary communities. As shown in Figure 21, no single species dominated the value of landings in Montauk during the GTF IFQ program period, with the exception of squid in some years. In contrast, squid was nearly always the dominant species landed in Hampton Bays in terms of ex-vessel revenue (Figure 22), while scallops was consistently the major species landed in Barnegat Light (Figure 23). Like Montauk, however, Hampton Bays and Barnegat Light host a number of vessels fishing for a wide range of species, including monkfish and highly migratory species (e.g., tuna and swordfish). The figures below show that the revenue generated by golden tilefish within each community was relatively consistent from year to year in comparison to most other species.

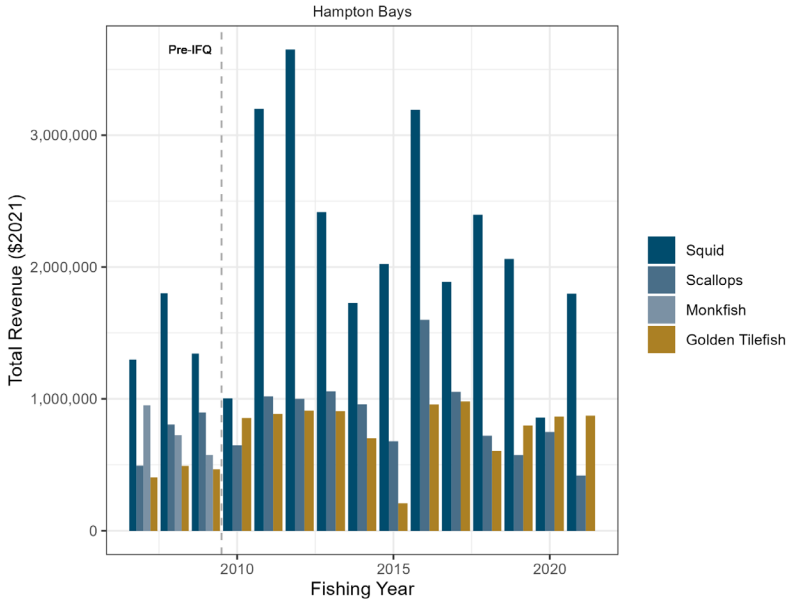
Figure 21. Ex-vessel Fishing Revenue in Montauk by Top Species Group



Note: Inflation-adjusted average annual ex-vessel revenue is shown for the top three fishery groups. For comparison purposes, golden tilefish is included even if it was not among the top three groups. Golden tilefish revenue includes all commercial landings, both directed and incidental.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

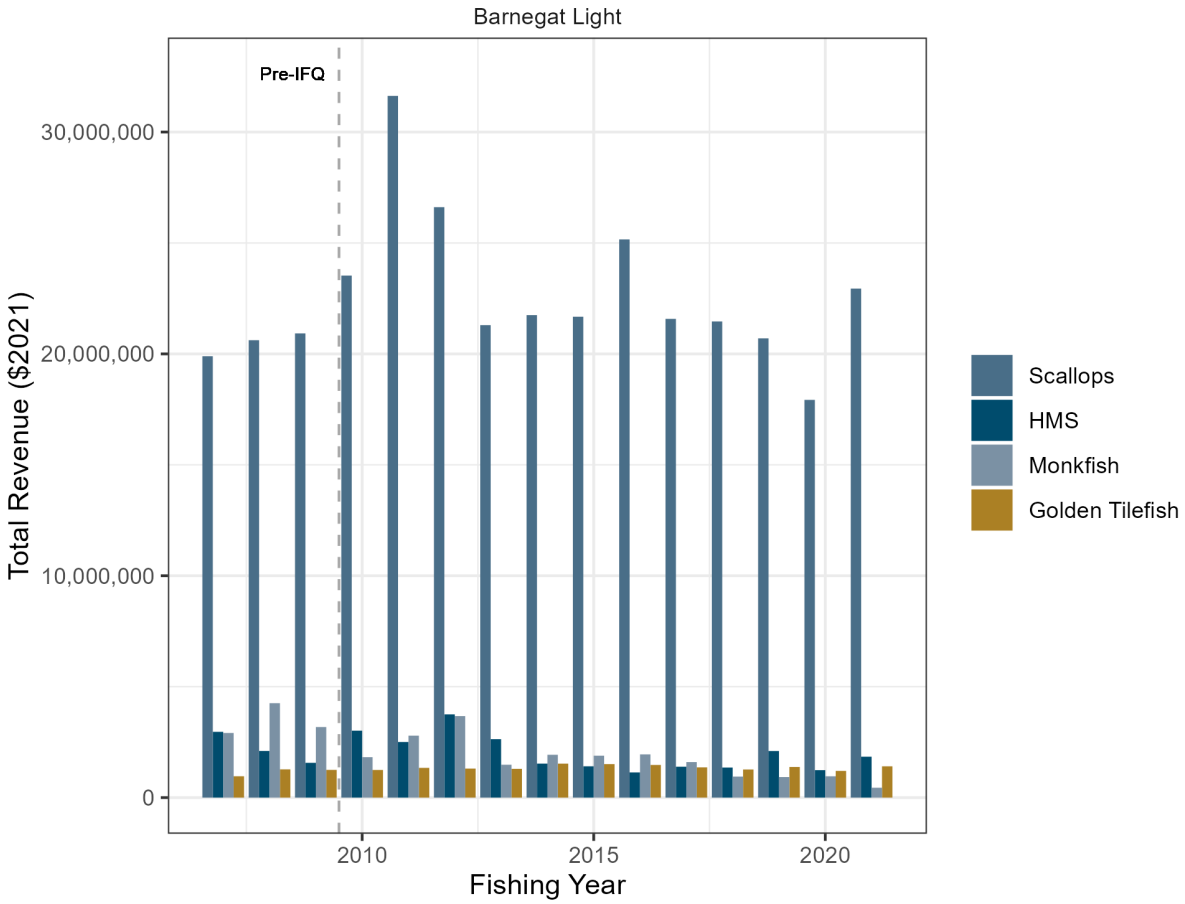
Figure 22. Ex-vessel Fishing Revenue in Hampton Bays by Top Species Group



Note: Inflation-adjusted average annual ex-vessel revenue is shown for the top three fishery groups. For comparison purposes, golden tilefish is included even if it was not among the top three groups. Golden tilefish revenue includes all commercial landings, both directed and incidental.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

Figure 23. Ex-vessel Fishing Revenue in Barnegat Light by Top Species Group



Note: Inflation-adjusted average annual ex-vessel revenue is shown for the top three fishery groups. For comparison purposes, golden tilefish is included even if it was not among the top three groups. Golden tilefish revenue includes all commercial landings, both directed and incidental.

HMS = highly migratory species.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

5.4.3 Fishing Engagement and Reliance Indices and Social Indicators

Additional insights on the vulnerability of the primary communities to changes in the golden tilefish fishery as a result of the GTF IFQ program can be obtained from fishing engagement and reliance indices and community social vulnerability indicators available at National Marine Fisheries Service (2023f). Fishing engagement and reliance indices portray the importance or level of dependence of fishing to coastal communities. Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement. Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates greater reliance. Similar fishing reliance and engagement indices are available for recreational fishing. Community social vulnerability indicators are a set of quantitative

measures of community wellbeing based on demographic characteristics developed primarily from U.S. Census Bureau data. As noted in Pacific Fishery Management Council and National Marine Fisheries Service (2017), these measures suggest that communities may be more or less vulnerable to a variety of socioeconomic shocks, but the causal links between these indicators and shifts in fishery conditions and management systems are not direct and require further development.

As shown in Table 31, all the primary communities ranked high on the commercial fishing engagement index in every year for which data were available (2009–2019). For commercial fishing reliance, the results were more mixed, with Montauk and Barnegat Light ranking high or medium-high for all years, while Hampton Bays ranked medium or low. The consistently high ranking for Barnegat Light is in agreement with the observation in National Academy of Sciences (2021) that the community is perhaps more fishery centered than most, in that fishing (coded in the U.S. Census Bureau data as agriculture/fishing) represents a relatively high percentage of local occupations. All the primary communities ranked high on both the recreational fishing engagement and reliance indices, with the exception of Hampton Bays, which had a recreational fishing reliance ranking of medium or medium-high during some years.

Table 31. Fishing Engagement and Reliance Indices and Social Indicators by Primary Community

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Barnegat Light											
Commercial Fishing Engagement[1]	High	High	High	High	High	High	High	High	High	High	High
Commercial Fishing Reliance[2]	High	High	High	High	High	High	High	High	High	High	High
Recreational Fishing Engagement[3]	High	High	High	High	High	High	High	High	High	High	High
Recreational Fishing Reliance[4]	High	High	High	High	High	High	High	High	High	High	High
Population Composition[5]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Poverty[6]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Personal Disruption[7]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Hampton Bays											
Commercial Fishing Engagement[1]	High	High	High	High	High	High	High	High	High	High	High
Commercial Fishing Reliance[2]	Med	Low	Low	Med	Med	Med	Med	Med	Low	Low	Low
Recreational Fishing Engagement[3]	High	High	High	High	High	High	High	High	High	High	High
Recreational Fishing Reliance[4]	Med	Med	Med	Med	Med-High	High	Med-High	Med	Med	Med	Med
Population Composition[5]	Low	Low	Low	Low	Low	Low	Low	Low	Med	Med	Med-High
Poverty[6]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Personal Disruption[7]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Montauk											
Commercial Fishing Engagement[1]	High	High	High	High	High	High	High	High	High	High	High
Commercial Fishing Reliance[2]	High	Med-High	Med-High	High	High	High	Med-High	High	Med	Med-High	Med
Recreational Fishing Engagement[3]	High	High	High	High	High	High	High	High	High	High	High
Recreational Fishing Reliance[4]	High	High	High	High	High	High	High	High	High	High	Med-High
Population Composition[5]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Poverty[6]	Low	Low	Low	Low	Low	Low	Med	Low	Low	Low	Low
Personal Disruption[7]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

[1] Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement.

[2] Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.

[3] Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.

[4] Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

[5]Population composition corresponds to the demographic makeup of a community, including the percentage of minorities, the percent of young children and female-headed households, and the ability to speak English. A high rating indicates a more vulnerable population.

[6]Poverty is expressed as those receiving assistance, families below the poverty line, and individuals older than 65 and younger than 18 in poverty. A high rating indicates a high rate of poverty and a more vulnerable population.

[7] Personal disruption captures unemployment status, educational attainment, poverty, and marital status. A high rating indicates less personal capacity to adapt to changes and thus a more vulnerable population.

Source: National Marine Fisheries Service (2023f)

Although a community may have a high ranking for commercial fishing reliance, changes in the golden tilefish fishery may not necessarily have a significant socioeconomic impact on the community. As discussed above, all three primary communities function as important commercial fishing centers engaged in a variety of other fisheries. Moreover, in all three places, the vessels targeting golden tilefish are parts of a diversified fishing community—commercial, for hire, and recreational—within a larger coastal community marked by residential and tourist development (National Academy of Sciences 2021).

With respect to social vulnerability, the demographic makeup of the three communities suggests they have populations with a high capacity to adapt to changes. All three had a consistently low ranking for the personal disruption and poverty indicators. Barnegat Light and Montauk also had a consistently low ranking for the population composition indicator, but the ranking for Hampton Bays rose to medium-high in 2021, possibly due to an increase in its minority population.

5.4.4 Distribution of IFQ Shares by Community

This section explores the location of IFQ shareholders and trends in their location over time. Specifically, it looks at the amount of IFQ shares associated with communities and the flow of IFQ shares among communities as IFQ shares are permanently and temporarily transferred.

Although communities derive benefits from landings made in their community, the distribution of income earned from the harvesting of IFQ allocations among communities depends, at least in part, on where IFQ shareholders live.[15] The GTF IFQ program was anticipated to increase the wealth derived by harvesters from the golden tilefish fishery by providing for higher ex-vessel prices and lower harvesting costs. While much of these benefits would be captured by initial recipients of IFQ shares, some of the benefits would also flow to those who acquired IFQ shares subsequent to initial allocations, either through permanent or temporary transfers. This greater wealth was expected to benefit the communities in which the IFQ shareholders live.

Table 32 shows the distribution of IFQ share ownership across communities for FY2010–2021. After the initial allocation in 2010, the three primary communities accounted for 94.6% of the total IFQ shares, with share owners in Montauk receiving 66.0%; owners in Barnegat Light receiving 14.4%; and an owner in Oakdale, NY, which is adjacent to Hampton Bays, receiving 14.2%. As indicated in Section 5.3.9, seven permanent IFQ share transfers occurred from FY2010 to 2021. Nevertheless, in FY2021, nearly all of the IFQ shares were still geographically located in the three primary communities. One IFQ share owner with a small share resided in Massachusetts at the inception of the GTF IFQ program, but they sold the share during the first year. Another Massachusetts-based entity purchased a small IFQ share in FY2011, but they had sold the share by FY2018. However, in some cases the IFQ shares were permanently transferred between IFQ allocation permit holders

[15] The distribution of income earned from the harvesting of IFQ allocations among communities also depends on where others who earn income from the landing of IFQ fish live, including vessel owners, captains, and crewmembers. However, information on the residence addresses of these other fishery participants is not available.

associated with different primary communities. As a result, the percent allocation held by share owners across the primary communities has changed. In particular, a share transfer in FY2017 led to an increase in the percentage of total shares held by share owners in Barnegat Light, and a decrease in the percentage of total shares held by owners in Montauk. In addition, IFQ share transfer activity in FY2017 and FY2018 resulted in an increase in the percentage of total shares held by the share owner in Oakdale. These transfers also resulted in a decrease in the percentage of total shares held by share owners in Montauk as well as in the aforementioned loss of a share held by a Massachusetts-based owner.

Table 32. IFQ Share Ownership by Community

Community		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Barnegat Light, NJ	% of Total IFQ Shares	14.4	14.4	14.4	14.4	14.4	14.4	14.4	22.7	22.7	22.7	22.7	22.7
	Number of IFQ Allocation Accounts	6	6	5	5	5	5	5	5	5	5	5	5
Forked River, NJ	% of Total IFQ Shares	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Number of IFQ Allocation Accounts	1	1	1	1	1	1	1	1	1	1	1	1
Montauk, NY	% of Total IFQ Shares	66	66	66	66	66	66	66	55	55	55	55	55
	Number of IFQ Allocation Accounts	4	4	4	4	4	4	4	3	3	3	3	3
Oakdale, NY	% of Total IFQ Shares	14.2	14.2	14.2	14.2	14.2	14.2	14.2	16.9	19.6	19.6	19.6	19.6
	Number of IFQ Allocation Accounts	1	1	1	1	1	1	1	1	1	1	1	1
West Newbury, MA	% of Total IFQ Shares	0	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0	0	0	0
	Number of IFQ Allocation Accounts	0	1	1	1	1	1	1	1	0	0	0	0
North Chatham, MA	% of Total IFQ Shares	2.7	0	0	0	0	0	0	0	0	0	0	0
	Number of IFQ Allocation Accounts	1	0	0	0	0	0	0	0	0	0	0	0

Note: Permit locations are as identified by registered addresses associated with allocation permits of IFQ shareholders.

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

5.4.5 IFQ Share Leasing by Community

As described in Section 5.3.9, from FY2010-FY2021, 77 leases of golden tilefish IFQ shares were transacted, with a maximum of 9 transactions each in FY2018 and FY2019. Average annual pounds transferred were 210,935 over the time period. Table 33 shows the flow of IFQ allocations between communities in which shareholders were located. Twenty-one of the transactions, which represented about one-third of the total pounds transferred, were likely "self-trades" (i.e., internal company transfers) due to the fact that the location in and location out were the same (i.e., Montauk)

and the price per pound was zero. For leasing transactions that reported a non-zero value, the largest transfers between IFQ allocation permit holders located in different states occurred between entities in West Newbury, MA and Forked River, NJ during FY2010–2015. These transactions accounted for 11.9% of the total pounds leased from FY2010 to 2021. In addition, a single transaction occurred between IFQ allocation permit holders located in different states in 2015 when 100,000 pounds (4.0% of the total) were transferred from an entity in Montauk to one in Barnegat Light. The remainder of the transactions, which accounted for half of the total pounds temporarily transferred, were between IFQ allocation permit holders in Barnegat Light or the neighboring community of Forked River.

Table 33. IFQ Share Temporary Transfers by Community

FY	From Location	To Location	Number of lease transactions	Total pounds leased
2010	Montauk, NY	Montauk, NY	3	240,638
	West Newbury, MA	Forked River, NJ	1	51,442
2011	Barnegat Light, NJ	Forked River, NJ	1	48,281
	Montauk, NY	Montauk, NY	3	240,638
	West Newbury, MA	Forked River, NJ	1	51,442
2012	Barnegat Light, NJ	Forked River, NJ	1	49,076
	Montauk, NY	Montauk, NY	3	153,861
	West Newbury, MA	Forked River, NJ	1	51,442
2013	Barnegat Light, NJ	Barnegat Light, NJ	3	56,680
	Forked River, NJ	Barnegat Light, NJ	1	51,442
	Montauk, NY	Montauk, NY	1	31,249
	West Newbury, MA	Barnegat Light, NJ	1	51,442
2014	Barnegat Light, NJ	Barnegat Light, NJ	4	126,216
	Montauk, NY	Montauk, NY	1	31,249
	West Newbury, MA	Barnegat Light, NJ	1	51,442
2015	Barnegat Light, NJ	Barnegat Light, NJ	2	65,251
	Montauk, NY	Barnegat Light, NJ	2	100,000
	Montauk, NY	Montauk, NY	1	27,488
	West Newbury, MA	Barnegat Light, NJ	1	45,251
2016	Barnegat Light, NJ	Barnegat Light, NJ	4	25,438
	Barnegat Light, NJ	Forked River, NJ	1	11,694
	Barnegat Light, NJ	Montauk, NY	1	3,270
	Montauk, NY	Montauk, NY	1	29,560
2017	Barnegat Light, NJ	Barnegat Light, NJ	3	12,211
	Barnegat Light, NJ	Forked River, NJ	1	4,756
	Montauk, NY	Montauk, NY	2	5,000
2018	Barnegat Light, NJ	Barnegat Light, NJ	6	102,460
	Barnegat Light, NJ	Forked River, NJ	2	52,561
	Montauk, NY	Montauk, NY	1	25,623

FY	From Location	To Location	Number of lease transactions	Total pounds leased
2019	Barnegat Light, NJ	Barnegat Light, NJ	6	156,306
	Barnegat Light, NJ	Forked River, NJ	2	57,480
	Montauk, NY	Montauk, NY	1	25,622
2020	Barnegat Light, NJ	Barnegat Light, NJ	3	123,607
	Barnegat Light, NJ	Forked River, NJ	3	96,862
	Montauk, NY	Montauk, NY	1	25,622
2021	Barnegat Light, NJ	Barnegat Light, NJ	5	181,607
	Forked River, NJ	Barnegat Light, NJ	1	41,387
	Montauk, NY	Montauk, NY	1	25,622

Source: Northern Economics analysis based on data from National Marine Fisheries Service (2023e)

5.4.6 Perceived Inequalities in the Distribution of Limited Access Privileges Across Communities

As noted above, National Standard 4 requires all allocations of fishing privileges to be fair and equitable. Sec. 303A(c)(5)(A) of the MSA reiterates this mandate in the specific context of catch share program design and requires Councils and NMFS to establish procedures to ensure fair and equitable initial allocations, including consideration of current and historical harvests; employment in the harvesting and processing sectors; investments in, and dependence upon, the fishery; and the current and historical participation of fishing communities.

However, the existing National Standard 4 guidelines provide limited guidance on what is meant by ''fair'' and ''equitable'' in order to allow Councils and NMFS the flexibility to interpret these terms as needed within their circumstances, given the variability in fisheries across the country (National Marine Fisheries Service 2023d). As noted in a 2012 report based on a nationwide series of discussions regarding perceptions of allocation issues in marine fisheries management, the concepts of fairness and equity are complicated and often vary depending on individual circumstances. The report concludes: "The result of these differing perceptions of [fair and equitable outcomes] means that the gain of one interest will likely mean a loss for some other interest with dissatisfaction with the outcome being felt by some interest groups. For fishery managers, it means allocation decisions will almost certainly be criticized as unfair, regardless of the process used to design and implement the allocation system" (Lapointe 2012).

The allocation controversy in the GTF IFQ program centers on the distribution of IFQ shares between harvesters based in Barnegat Light and those based in Montauk during the initial allocation process. Barnegat Light-based harvesters consider themselves (or their ascendants) to be the "pioneers" of the fishery. However, due to a confluence of factors occurring during the 1970s and 1980s, including a decline in the health of the golden tilefish stock, opportunities in other fisheries, gear innovations, and vessel improvements, they reduced their fishing effort in the golden tilefish fishery, while harvesters based in Montauk continued to fish the stock at a high rate (Rountree et al. 2008). By the 1990s, Montauk led the region in golden tilefish landings (Mid-Atlantic Fishery Management Council 2000). The dominance of Montauk was reinforced when the tiered limited access system was

established in 2001 and sharply reduced participation in the fishery. All the Full-Time Tier 1 permit holders primarily landed their golden tilefish in Montauk, while the landings of the Part-Time vessels were mostly concentrated in New Jersey and Massachusetts ports (Mid-Atlantic Fishery Management Council 2000; Mid-Atlantic Fishery Management Council 2009). Montauk's central role in the fishery was further secured by the initial allocation of IFQ shares (National Academy of Sciences 2021). As described in Section 5.3.3, the two initial accounts with large shareholdings were previously Full-Time Tier 1 vessels, while the bulk of the initial accounts with small shareholdings were previously Part-Time vessels. Section 5.4.2 notes that the prominence of Montauk has remained more or less the same since, although, as described in Sections 5.4.4 and 5.4.5, subsequent IFQ share trading has led to increased participation of Barnegat Light vessels in the golden tilefish fishery.

The social impact analysis in the first five-year review reported that in a qualitative golden tilefish fishery visioning survey conducted in 2011–2012 by the MAFMC, survey participants who have access to sufficient IFQ shares stated that the IFQ program has made it easier to run a fishing business (Mid-Atlantic Fishery Management Council 2017a). Businesses can work together to plan out trips to minimize effort and maximize/stabilize ex-vessel prices. The review noted, however, that those without significant IFQ shares, especially those within this group who were early participants in the fishery, are frustrated and feel as though they were pushed out of the fishery. These stakeholders believe that the initial allocation of IFQ shares was based on arbitrary qualification dates that benefited fishing businesses with high golden tilefish catches during the years the tier system was in place.

This sentiment among some stakeholders that the initial allocation process led to an inequitable outcome continues today. As reported in National Academy of Sciences (2021), a social impact of the GTF IFQ program has been the persistence of the sentiment that the program intensified differences between "winners" and "losers" in the golden tilefish fishery. The study notes that this continuing source of contention comes out of a long history of progressive consolidation of ownership and participation in the fishery and exclusion of some with perceived claims to the fishery based on their historic roles in developing it. Interviews conducted for this review recorded these same perspectives among some stakeholders, although everyone interviewed also acknowledged the economic benefits they have derived from the IFQ program and felt better off with it in place.

The interviews also revealed a number of factors that will likely perpetuate the contention over the allocation of limited access privileges in the golden tilefish fishery. One factor is that IFQ shares are becoming more valuable as golden tilefish prices increase. Moreover, tilefish is an attractive target species because it can be caught year-round, there is little bycatch in the fishery, and gear costs are relatively low. A second factor is that some of the major other fisheries that many golden tilefish harvesters include in their fishing portfolios are becoming less profitable or more constrained by regulations. In recent years there has been a lack of demand for monkfish, resulting in low prices in the fresh market. Since implementation of the Individual Bluefin Quota program in 2015, it has become more difficult to fish for swordfish and yellowfin tuna, as bluefin tuna can be incidentally

caught in these fisheries. According to industry representatives, the ideal allocation yields enough pounds of golden tilefish each year that a vessel can target the species exclusively. In addition to providing the benefits described above, this stability lets vessels avoid the costs of gear switching and helps them find and maintain a steady crew.

As discussed in the first five-year review, Amendment 1 was developed as a result of a multi-stage process lasting over three years (Mid-Atlantic Fishery Management Council 2017a). For the initial allocation of fishing privileges in the proposed catch share program the environmental review for Amendment 1 considered a range of alternatives (Mid-Atlantic Fishery Management Council 2009). After analyzing the positive and negative consequences of the alternatives, the MAFMC chose to allocate the initial tilefish IFQ in a manner that emphasized more recent participation in the golden tilefish fishery as opposed to more historical participation. NMFS determined that the MAFMC properly analyzed and justified the allocation alternatives in Amendment 1 (National Marine Fisheries Service 2009). Moreover, the MAFMC reviewed all comments provided by stakeholders, the public, and other interested parties when it selected the final suite of preferred alternatives to be included in the final amendment document (Mid-Atlantic Fishery Management Council 2017a).

In 2016, NMFS published Policy Directive 01-119, *Fisheries Allocation Review Policy,* which provides a mechanism to ensure fisheries allocations are periodically evaluated to remain relevant to current conditions. It requires the Councils to identify a trigger for all fisheries that contain an allocation (National Marine Fisheries Service 2018b). The trigger could be based on time, public input, or an indicator. When a specified trigger is met, Councils must assess if a revision to the allocation is needed. However, the policy does not require Councils to implement any changes to the allocation (National Marine Fisheries Service 2023d).

In response to this directive, the MAFMC adopted an allocation review policy in 2019 that identified the criteria that will be used to trigger reviews of allocations for non-catch share fisheries under its jurisdiction (Mid-Atlantic Fishery Management Council 2019). The 2019 allocation policy indicates that allocation reviews will be conducted at least every 10 years based on public input or other factors. For Limited Access Privilege Programs (LAPPs; a type of catch share program) allocation reviews are conducted more frequently as part of the catch share program reviews (i.e., 5/7 year catch share reviews), which follows the *Guidance for Conducting Review of Catch Share Programs* (National Marine Fisheries Service 2017). If a catch share program review indicates that a specific catch share program is not meeting the goals and objectives of the FMP, or there is public interest in a more detailed allocation review, the MAFMC may initiate a review of the fisheries allocation to determine whether or not the development and evaluation of allocation options is warranted (Montañez 2023).

5.5 Safety at Sea

As described in the first five-year review, the GTF IFQ program replaced the derby-style fishing practice that was occurring in the Full-Time Tier 2 and Part-Time categories of the tier system. The IFQ fishery now provides allocation holders more flexibility to plan around potentially hazardous weather since individuals have the entire season to plan their fishing activities (Mid-Atlantic Fishery Management Council 2017a).

In particular, the GTF IFQ program eliminated the need to fish during the winter months. The first five-year review noted that after implementation of the IFQ program there was a shift in effort away from the winter months, especially by those vessels that formerly fished in the Part-Time category under the tier system (Mid-Atlantic Fishery Management Council 2017a). As described in 5.3.8, this trend continued during FY2016–2021.

According to the first five-year review, the number of Coast Guard-reported marine casualty incidents in the golden tilefish fishery decreased after implementation of the IFQ program. During the baseline period (2007–2009) there were, on average, five marine casualties per year associated with fishing vessels that participated in the fishery. During the first five years of the IFQ program there was, on average, one marine casualty per year (Mid-Atlantic Fishery Management Council 2017a). For the current review, safety incident data for the golden tilefish fishery were requested from the National Institute for Occupational Safety and Health. The agency's database, which includes commercial fishing fatality data for 2000–2021 and nonfatal vessel disaster data for 2010–2019, reported no safety incidents attributed to the golden tilefish fishery (Case 2023). The first five-year review noted that this safety record cannot necessarily be tied to the introduction of the GTF IFQ program. However, in interviews conducted for this review, fishery participants consistently reported that fishing was safer under the IFQ program due to the increased ability to time their effort so as to avoid fishing in poor weather conditions.

5.6 Biological Impacts

While IFQ programs can often contribute to the biological protection of fish stocks, for this program it was not expected that IFQ management would further protect or contribute to the protection of the stock (Mid-Atlantic Fishery Management Council 2009). Here, we review any changes in the stock status, fishing morality, spawning stock biomass, recruitment, discards, or other non-target species interactions. Generally, this analysis relied on information provided in the last management track assessment completed for the stock, which was completed through 2020 (Nitschke 2021), though occasionally information from the last specification action, completed in the fall of 2022, was also used. The next research track assessment for golden tilefish is currently underway at the writing of this review and is expected to undergo peer review in the spring of 2024.

Since 2001, the fishery has been managed under a constant quota strategy (Table 34), which has been credited for successful management of the stock despite relatively large fluctuations in catch per unit effort due to year class effects. This strategy has also been credited with creating economic benefits by creating more stability in supply and markets and generating higher prices (MAFMC 2022).

However, while the management of the stock appears to be performing well at keeping the stock at sustainable levels and generating economic benefits, the stock assessment itself is considered a relatively data-poor analytical model with some major sources of uncertainty and large remaining questions (Nitschke 2023). No fishery independent data are used in the assessment model due to the low catchability in the multispecies bottom trawl surveys and large data gaps that occurred over the time series. Questions remain about using fishery CPUE series for indices of abundance. There are also major assumptions about the dome-shape selectivity assumed in the assessment. Benefits to the fishery (stability and higher prices) have occurred since 2001 despite the major questions surrounding the biology and uncertainty in the stock assessment. These benefits over time seem to have resulted in a more active role of the fishery for ensuring that the stock remains sustainable and healthy regardless of the uncertainties. The initial constant quota (905 mt) to rebuild the stock has not resulted in any increases in the quota when the stock was declared rebuilt, but regardless of that fact the stock is still considered a more successful management story. The quota and IFQ fishery have resulted in lower total effort on the stock and benefits to the fishery in terms of profit per unit of effort fishing, which seems to have resulted in the fishery being more concerned about ensuring that the stock remains sustainable under more constant quotas. The use of a more stable constant quota-based management system seems to have resulted in benefits to the fishery despite the fact that the stock assessment indicates relatively large effects on catch rates due to periodic effects of large year classes moving through the fishery.

Table 34. Acceptable Biological Catch and Total Allowable Catch in the Commercial (Directed and Incidental) Golden Tilefish Fishery

Fishing Year	ABC (m lb)	TAL (m lb)
2007	–	1.995
2008	–	1.995
2009	–	1.995
2010	–	1.995
2011	–	1.995
2012	–	1.995
2013	2.013	1.995
2014	2.013	1.995
2015	1.766	1.755
2016	1.898	1.887
2017	1.898	1.887
2018	1.636	1.626
2019	1.636	1.626
2020	1.636	1.626
2021	1.636	1.625

Source: Mid-Atlantic Fishery Management Council (2022a)

5.6.1 Overfishing/Overfished Status

Since the golden tilefish fishery came under IFQ management, it has not been classified as overfished and has not experienced overfishing. As of 2020, the stock was not overfished and not experiencing overfishing relative to updated biological reference points (Nitschke 2021). The commercial ABC or TAL has not been exceeded since FY2010 (Table 35).

Table 35. Summary of Management Measures and Landings

Management Measures	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ABC (m lb)	–	–	–	–	–	–	2.013	2.013	1.766	1.898	1.898	1.636	1.636	1.636	1.636
TAL (m lb)	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.755	1.887	1.887	1.626	1.626	1.626	1.625
Com. quota-(m lb)	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.755	1.887	1.887	1.626	1.626	1.626	1.625/ 1.672*
Com. landings	1.794	1.689	1.906	2.021	1.924	1.873	1.840	1.826	1.351	1.051	1.501	1.624	1.563	1.403	1.546
Com. Overage/ underage (m lb)	-0.201	-0.306	-0.089	+0.026	-0.071	-0.122	-0.155	-0.169	-0.404	-0.836	-0.387	-0.003	-0.064	-0.223	-0.125

Source: Mid-Atlantic Fishery Management Council (2022b)

5.6.2 Fishing Mortality

The biological reference points for golden tilefish were updated during the 2021 management track assessment (Nitschke 2021). The fishing mortality threshold for golden tilefish is $F_{40\%}$ (as F_{MSY} proxy) = 0.261, and $SSB_{40\%}$ (SSB_{MSY} proxy) is 24.23 million pounds (10,995 mt) (Mid-Atlantic Fishery Management Council 2022a)

The latest assessment indicates that the golden tilefish stock was not overfished, and overfishing was not occurring in 2020, relative to the newly updated biological reference points (Nitschke 2021). Fishing mortality in 2020 was estimated at F=0.160; 39% below the fishing mortality threshold of F=0.261 (F_{MSY} proxy) (Mid-Atlantic Fishery Management Council 2022a).

Changes in fishing mortality were not expected to occur as a result of the IFQ program. As discussed in the EIS (Environmental Impact Statement) for the program, it was not expected that the implementation of an IFQ program would negatively impact fishing mortality rates since the fishery was already managed under a hard TAL and the IFQ program would only be dividing and assigning the current quota to individual fishermen (Mid-Atlantic Fishery Management Council 2009).

5.6.3 Spawning Stock Biomass

In the 1980s, spawning stock biomass decreased sharply from 63.070 million pounds (28,608 mt) in 1974 to 5.712 million pounds (2,591 mt) in 1998, the lowest in the time series. In the first program review SSB had increased to 18.693 million pounds (8,479 mt) as of 2016, and as of 2020 it was estimated to be even higher at 23.28 million pounds (10,562 mt), and was at 96% of the biomass target (SSBMSY proxy) (Mid-Atlantic Fishery Management Council 2022a). Spawning stock biomass 90% confidence intervals were 13.752 million pounds (6,238 mt) and 36.240 million pounds (16,438 mt) in 2020 (Nitschke 2021).

5.6.4 Recruitment

Average recruitment from 1971 to 2020 was 1.48 million fish at age 1. Large year classes have occurred in 1998 (2.93 million), 1999 (3.02 million) and 2005 (2.05 million). In 2014, a recent large year class was estimated at 2.5 million. And while an additional above average year class is estimated at 2.1 million in 2017, the size of the 2017 year class remains highly uncertain since it was just entering the fishery in 2020 (Nitschke 2021).

5.6.5 Discards

Discarding (i.e., high-grading) when fishing an IFQ allocation is prohibited. Reported discards (from VTR data) have been extremely low as a proportion of catch (0.03%) for longline vessels that targeted golden tilefish in the 2016–2020 period. A similar low discard rate was reported in the first five-year review. However, low at-sea monitoring rates may reduce the ability to confirm industry self-reported discard data (National Academy of Sciences 2021).

The incentive for vessels participating in the golden tilefish fishery to engage in high-grading appears to be low. When IFQ programs are put in place, it creates a new type of cost for fishermen who lease their quota, and since quota costs tend to be fixed per pound, fishermen are motivated to maximize the value of their catch relative to the price paid for quota. As indicated in section 5.3.4, while there is an evident price differential for various tilefish size categories, leasing and lease prices have become relatively stable and are a low proportion of the ex-vessel price, suggesting incentives for high-grading may be low, especially in the last six years. In addition, as stated in the first five-year review, given the standard hook size/type used by industry all fish caught the golden tilefish fishery are marketable, reducing the cost-effectiveness of high-grading (Mid-Atlantic Fishery Management Council 2017a).

5.6.6 Non-target Species Interactions

The golden tilefish commercial fishery is prosecuted primarily with bottom longline gear. Based on the best available information, it has been determined that the commercial tilefish fishery is not likely to impact multiple Endangered Species Act listed and/or Marine Mammal Protection Act protected species or any designated critical habitat. This determination has been made because either the occurrence of the species is not known to overlap with the area primarily affected by the action and/or based on the most recent 10 years of observer, stranding, and/or marine mammal serious injury and mortality reports, there have been no observed or documented interactions between the species and the primary gear type (i.e., bottom longline) used to prosecute the golden tilefish fishery (Mid-Atlantic Fishery Management Council 2022b).

5.6.7 Essential Fish Habitat

The GTF IFQ program does not include any measures that will adversely impact essential fish habitat for tilefish or any other federally-managed species (Mid-Atlantic Fishery Management Council 2009).

5.7 Administrative Impacts

5.7.1 Data Collection, Reporting, and Monitoring

The pre-IFQ program golden tilefish fishery management system already had in place a system of data collection, reporting, and monitoring (i.e., reporting via VTR and dealer data and IVR system) (Mid-Atlantic Fishery Management Council 2009). Consequently, the administrative costs for these tasks did not significantly increase with the implementation of the IFQ program.

With the implementation of electronic dealer reporting in 2004, and with improved VTR reporting processing by NMFS, the information provided by vessel operators using the IVR system became redundant. Framework Adjustment 2, which became effective in 2018, eliminated the IVR reporting requirement. Elimination of the IVR system reduced the administrative burden on the regulated fishing industry and NMFS, which is consistent with National Standard 7.

5.7.2 Enforcement

The first five-year review noted that the Fishery Management Action Team was not aware of any documented issues related to enforcement of the GTF IFQ program during 2010–2015. For the current review, enforcement incident data for the golden tilefish fishery were requested from the NMFS Office of Law Enforcement. Only two minor violations were reported for the fishery, both of which occurred in 2007 (Lee 2023a).

A review of U.S. catch share programs conducted by the Office of Inspector General in 2014 noted that the GTF IFQ program did not have formal controls to ensure that IFQ shareholders with active sanctions were prevented from buying, selling, or leasing IFQ shares. Although the report did not discover any instances where shareholders with active sanctions participated in the market for IFQ shares, it recommended that NMFS examine whether shareholders with sanctions participated in this market, and take corrective action as necessary (Office of Inspector General 2014).

In addition, low at-sea monitoring rates may reduce the ability to confirm industry self-reported discard data. However, as described in Section 5.6.5, the incentive for vessels participating in the IFQ fishery to engage in high-grading is likely low.

5.7.3 Cost Recovery

Section 304(d)(2)(A) of the MSA requires NMFS to collect fees to recover the "actual cost directly related to the management, data collection, and enforcement" of IFQ programs. The GTF IFQ program stipulates that the fee be paid by the IFQ shareholder, based on the ex-vessel value of golden tilefish landed under the program. Ex-vessel value is calculated as the price paid to the vessel per pound multiplied by the total weight landed during each calendar year. In accordance with the MSA, the fee may be up to, but cannot exceed, 3% of the total ex-vessel value of golden tilefish harvested under the IFQ program.

The first five-year review noted that NMFS GARFO has determined that the recoverable costs associated with management, enforcement, and data collection in the GTF IFQ program include only the incremental (or attributable) costs of the IFQ program. That is, costs that would have been incurred in the administration of the golden tilefish fishery if an IFQ program did not exist are not included. Furthermore, costs associated with the initial development of the IFQ program are not included in recoverable costs. Personnel costs are calculated by multiplying staff hours spent on tasks directly related to the IFQ program by the hourly salary rates for that personnel. Salary rates include the government's share of the benefits on a prorated basis. Lastly, contract expenses are calculated as the cost of contract employees prorated for the percentage of time the contact employee spent on tasks directly related to the IFQ program (Mid-Atlantic Fishery Management Council 2017a).

Table 36 presents the recoverable costs, ex-vessel value, and fee percentage from 2010-2021. The increase in recoverable costs in 2016 was due to the additional NMFS staff hours required to complete the first five-year review of the IFQ program.

Table 36. Recoverable Costs, Ex-Vessel Value, and Fee Percentage

Year	Recoverable Costs	Ex-vessel Value	Fee Percentage
2010	$21,438	$5,054,073	0.424%
2011	$21,353	$5,566,543	0.3835%
2012	$14,242	$5,372,291	0.2650%
2013	$35,966	$5,787,335	0.6214%
2014	$14,662	$5,501,343	0.2665%
2015	$20,744	$5,075,467	0.4087%
2016	$56,166	$4,180,838	1.3434%
2017	$25,420	$4,488,626	0.5663%
2018	$20,161	$4,766,450	0.4230%
2019	$11,466	$5,316,137	0.2157%
2020	$20,845	$4,723,337	0.4413%
2021	$22,317	$6,132,846	0.3639%

Source: National Marine Fisheries Service (2023g)

6 Impacts on Other Golden Tilefish Fisheries

This section examines how the introduction of an IFQ program into the directed golden tilefish fishery changed the nature and magnitude of impacts between that fishery and the incidental and recreational golden tilefish fisheries.

6.1 Incidental Fishery Impacts

There is a large incidental catch sector in the golden tilefish fishery, fishing under open access conditions with a small trip limit. While the IFQ vessels primarily work from three ports in New York and New Jersey, the incidental catch fishery is more widely spread along the coast (National Academy of Sciences 2021). During the pre-IFQ baseline, an average of 100 open access commercial/incidental tilefish permits (valid for both golden and blueline tilefish) were used annually; in the IFQ period from FY2010 to 2021, an average of 110 permits per year were used for incidental catches of tilefish (National Marine Fisheries Service 2023c).

When the MAFMC created the GTF IFQ program through Amendment 1, it continued the incidental sector's allocation of 5% of the overall TAL and retained the previously established limit of 300 pounds live weight of golden tilefish per trip for the incidental fishery. Amendment 3 increased this landing limit to 500 pounds as this was not expected to change fishing practices. Because of allegations that some vessels in the incidental catch fishery were targeting golden tilefish, Framework Adjustment 2 modified the incidental landing limit to ensure that these vessels targeted other species, and only incidentally caught golden tilefish (National Marine Fisheries Service 2018a). Specifically, it established a landing limit of 500 pounds or 50%, by weight, of all fish, including the golden tilefish, on board the vessel, whichever is less (National Marine Fisheries Service 2018a). The addition of the landings ratio/qualifier is expected to deter incidental fishery vessels from targeting golden tilefish (Mid-Atlantic Fishery Management Council 2017a).

Table 37 shows the landings, quota, and utilization percent in the incidental golden tilefish fishery. During the pre-IFQ baseline period, the incidental quota was set at 99,750 pounds each year and landings, on average, were 71% below the incidental quota established for that time period. During the post-IFQ implementation, the incidental quota varied from 99,750 pounds for FY2010–2014 to 70,548 pounds for FY2021. Post-IFQ implementation utilization rates varied from 21% in FY2015 to 84% in FY2018.

Table 37. Landings, Quota, and Utilization in the Incidental Golden Tilefish Fishery

Fishing year	Landings (pounds)	Incidental quota (pounds)	Percent of quota landed (%)
2007	28,897	99,750	29
2008	57,401	99,750	58
2009	46,665	99,750	47
2010	66,197	99,750	66
2011	38,549	99,750	39
2012	36,330	99,750	36
2013	36,442	99,750	37
2014	44,594	99,750	45
2015	18,839	87,744	21
2016	20,929	94,357	22
2017	60,409	94,357	64
2018	61,254	72,752	84
2019	22,246	72,752	31
2020	25,864	72,752	36
2021	25,356	70,548	36

Source: Mid-Atlantic Fishery Management Council (2022a); Northern Economics analysis based on data from National Marine Fisheries Service (2022b)

There is no evidence that the GTF IFQ program has had any significant negative effects on participants in the incidental golden tilefish fishery. National Academy of Sciences (2021) notes that although harvesters in the incidental fishery take a small amount of the TAL, they benefit from the ability to add incidentally caught tilefish to their portfolios, and if they are able to acquire IFQ shares, they can enter the IFQ fishery.

6.2 Recreational Fishery Impacts

The for-hire (party/charter) recreational and private recreational sectors are involved in fishing for golden tilefish, most often as part of offshore large pelagic fishing (e.g., for tuna), although a small number of party/charter vessel conduct directed tilefish fishing trips (Mid-Atlantic Fishery Management Council 2017a; National Academy of Sciences 2021).[16]

There is no recreational allocation, and both the for-hire recreational and private recreational sectors remain open access. The MAFMC predicted that the growth in the biomass of golden tilefish under the constant quota strategy might encourage more recreational fishing activity for this species (National Academy of Sciences 2021). During the development of Amendment 1, some MAFMC

[16] Anglers are highly unlikely to catch golden tilefish while targeting tuna on tuna fishing trips, because they are fishing too far off the bottom. However, these boats may fish deeper for golden tilefish at any time during a tuna trip (i.e., when the tuna limit has been reached, on the way out or on the way in from a tuna fishing trip, or at any time when tuna fishing is slow) (Mid-Atlantic Fishery Management Council 2017b).

members and stakeholders indicated that they observed an increase in recreational golden tilefish landings (Mid-Atlantic Fishery Management Council 2009). As a result, restrictions for the recreational sector were implemented with the intention of acquiring a better understanding of changes in the level of recreational fishing effort and catch and limiting any increases in effort and catch that might occur. Amendment 1 instituted an eight-golden tilefish per trip bag limit for party/charter and private anglers, and Framework Adjustment 2 restricted these anglers to using hook-and-line gear with five or fewer hooks. Amendment 1 also required any owner of a party/charter vessel that fishes for golden tilefish to obtain a federal open-access tilefish party/charter permit and to submit VTRs for all fishing trips. In 2020, NMFS GARFO implemented mandatory private recreational permitting and reporting for tilefish anglers. Under this rule, private recreational vessels (including party/charter boat operators using their vessels for non-charter, recreational trips) are required to obtain a federal vessel permit to target or retain golden or blueline tilefish north of the Virginia/North Carolina border. These vessel operators are also required to submit VTRs electronically within 24 hours of returning to port for trips where tilefish were targeted or retained (National Marine Fisheries Service 2020; Mid-Atlantic Fishery Management Council 2022a).

VTR data show that the golden tilefish catch of party/charter boats has increased over the past two decades (Table 38). However, this catch continues to account for a small portion of total fishing mortality. It is likely that revenues generated from golden tilefish remain relatively small for most of these vessels given the wide range of other species targeted (e.g., summer flounder, scup, black sea bass, bluefish, groundfish, weakfish, striped bass, tautog, and pelagics) (National Marine Fisheries Service 2022a). In 2021, 680 open access charter/party tilefish permits were issued. According to VTR data, 41 party/charter vessels reported a total of 152 trips that landed golden tilefish in 2021 (Mid-Atlantic Fishery Management Council 2022a). These data indicate that the number of golden tilefish kept by party/charter vessels from Maine through Virginia was low for the 1996–2021 period, ranging from 81 fish in 1996 to 8,297 fish in 2015 (Table 38). Mean party/charter catch per angler ranged from two fish or less from 1999 to 2010. From 2011 to 2020, the catch per angler averaged 3.6 fish. From 1996 to 2021, the largest number of golden tilefish caught by party/charter vessels were made by New Jersey-based vessels (57,094; average = 2,196), followed by New York (15,564; average = 599), Virginia (1,566; average = 60), Delaware (1,271; average = 49), Massachusetts (561; average = 22), and Maryland (939; average = 36) (Mid-Atlantic Fishery Management Council 2022a)

Table 38. Landings in the Recreational Golden Tilefish Fishery

Year	Party/Charter		Private	
	Number of golden tilefish kept	Mean catch per angler	Number of golden tilefish kept	Mean catch per angler
1996	81	1.4	–	–
1997	400	7.5	–	–
1998	141	4.7	–	–
1999	91	0.4	–	–
2000	147	0.5	–	–
2001	223	0.6	–	–
2002	774	0.9	–	–
2003	991	1.6	–	–
2004	744	1.2	–	–
2005	502	0.9	–	–
2006	477	1.2	–	–
2007	1,079	1.2	–	–
2008	1,100	1.3	–	–
2009	1,451	1.3	–	–
2010	1,879	2.0	–	–
2011	2,949	3.4	–	–
2012	6,426	2.8	–	–
2013	6,560	3.2	–	–
2014	6,969	3.1	–	–
2015	8,357	4.2	–	–
2016	5,928	4.1	–	–
2017	7,029	4.7	–	–
2018	7,110	3.9	–	–
2019	5,425	3.1	–	–
2020[1]	3,466	3.2	61	4.4
2021	6,833	NA	197	NA

Notes Private recreational harvest information is provided through a permitting and reporting program implemented in 2020. Given that public outreach regarding the requirements of this program is ongoing, these data should be regarded as estimates (Winiarksi 2023).

[1]2020 private recreational landings reported from August 1 to December 31, 2020.

NA = Not available.

Source: Mid-Atlantic Fishery Management Council (2023)

As of October 28, 2021, 814 tilefish permits had been issued for private recreational anglers. This permit allows recreational anglers to land both golden and blueline tilefish. In 2021, the first full year in which catch data were reported, 197 fish were reported landed by 15 boats on 23 private recreational trips (Table 38) (Mid-Atlantic Fishery Management Council 2022a; Mid-Atlantic Fishery Management Council 2023).

It is unlikely that the management measures placed on the recreational sector have resulted in any significant newfound restrictions on access or the recreational fishing experience for party/charter or private anglers beyond those required to effectively monitor recreational effort and harvest. These measures place no significant bound on recreational effort or catch in the fishery, with the bag limits and gear restrictions primarily serving to preserve the recreational character of the fishery (National Academy of Sciences 2021).

Further, there is no evidence that the GTF IFQ program has had an adverse impact on the recreational sector, such as competitive exclusion of fishing grounds. As noted in National Academy of Sciences (2021), the temporal redistribution of commercial fishing effort resulting from the IFQ program could be positive to recreational anglers. Anglers could benefit from lower overall intensity of commercial fishing effort, and it is possible that incentives under the IFQ program could shift commercial effort away from favored recreational fishing times.

6.3 Summary and Conclusions

To summarize the results and major conclusions in this review, we have first broken out major summary points from each major performance section, followed by a discussion of progress the program has made in achieving its goals and objectives. Subsequent sections address net benefits of the program, unexpected effects, and concludes with any identified issues and areas for future research.

6.3.1 Summary of Findings

To enable a quick comparison of findings between this review and the previous review, Table 39 provides a summary of findings for each program performance section. Findings in the current review that differ from those in the previous review are marked "Change" (and color coded gold). In addition, findings based on a new analysis not included in the previous review are marked "New" (and color coded blue).

Table 39. Summary of Findings

Section	Findings
Economic outcomes	
Participation and earnings trends	The fleet has continued to shrink since the last review from 12 vessels in FY2016 to 8 vessels since FY2018 (Table 4).
	Change: While average effort, landed pounds, and fleetwide revenue have all decreased since the last review, average fleetwide revenue remains higher in the entire IFQ period compared to baseline years (Figure 1).
	Despite lower-than-average revenue FYs 2015 and 2017, overall vessel-level revenue is similar to levels during the first six years of the program (Figure 2).
Utilization	**Change:** On average, utilization has declined 2% between the pre-IFQ and IFQ periods from 92.2% to 90.2%, driven by lower than normal utilization between FYs 2015 and 2017, with a low of 57% utilization in FY2016 (Table 4).
	Potential factors contributing to low utilization in those years include at least one inactive vessel and low catch per unit effort.
	Since FY2018 utilization has ranged between 89.5% and 99.6% (Figure 4).

Section	Findings
Ownership consolidation	**Change:** The number of entities holding shares has decreased since the last review from 12 accounts in FY2016 to 10 accounts since FY2017 (Table 7).
	There have not been any changes to the number of large accounts (those with more than 20% of the allocation) or shareholdings in large accounts since FY2013 (Table 7).
	The number of medium accounts (those with between 5 and 19% of the allocation) has not changed since FY2013, but the total percent of the allocation held in medium accounts increased by approximately 6% as small accounts sold their shares (Table 7).
	No entity has exceeded the share cap of 49%.
Effort consolidation	While consolidation of revenue across vessels has continued to occur consistent with a long-term trend, based on the HHI, the market is still considered moderately concentrated (Figure 5).
	Due to the decline in the number of active vessels with low revenue from the fishery, active vessels have become more equal in their earnings (decline in Gini coefficient from 0.64 in FY2007 to 0.44 in FY2021, Figure 5).
Ex-vessel price and market stability	Consistent with the last review, average prices appear to have increased between the pre-IFQ and IFQ periods from $3.47 to $4.04 per pound and have occurred across all market categories (Figure 1, Figure 9).
	Industry attributes flexibility and coordination for the ability to avoid market gluts and spread landings throughout the year.
	Comparison of average monthly prices in the pre-IFQ and IFQ periods show that price increases have been mostly realized in the first six months of the fishing year (November to April, Figure 8).
Dealer activity	**Change:** The number of dealers reporting purchasing IFQ golden tilefish has decreased from 11 to 9 since the pre-IFQ period (Table 11).
	Despite a decrease in the number of dealers buying IFQ golden tilefish, purchases have become less concentrated since the pre-IFQ period, declining from an HHI of 6,409 in FY2007 to 3,090 in FY2021 (Figure 10).
	Purchasing in New Jersey has increased as a result of increases in IFQ share ownership and leasing to vessels based in this state.
Productivity and profitability	Consistent with the results of the first review, productivity has increased on average in the IFQ period compared to baseline (Table 14).
	The only years with lower productivity than the baseline period were FY2015 and FY2016, years with low CPUE (Table 14).
	New: Profitability has been higher than baseline profitability in every year except for FY2015 and averaged 67% higher between FY2010 and FY2021.
New Section: Operating cost and revenue	**New:** While trip-level operating costs such as fuel, bait, ice, and supplies have increased on average (by 24.4% since the baseline period), revenue has increased more than costs, leading to higher average net operating revenues (revenue minus operating costs), an indicator of profitability (Table 16).
	New: Causes of increased trip costs are not known, but may include costs of bait, which have been reported by industry to have increased in recent years.
	New: Median vessel-level net operating revenue has increased by 61.5% since the baseline period, from $145,314 to $251,329.
Mitigating the race to fish	Consistent with the past review, no early closures have occurred for the fishery since implementation (Table 17), which indicates successful achievement of the goal to create a year-round fishery.
	For vessels that formerly fished in the Full-Time Tier 2 and Part-Time categories, the timing of landings has shifted to later in the year (Figure 16).
Quota market performance	Compared to the first six years of the program, permanent transfers of IFQ shares declined between FY2016 and FY2021 to three total transactions, averaging 2.8% of the annual allocation per year (Table 19).
	One transaction between FY2016 and FY2021 was to a new entrant (67% of pounds permanently transferred). In the first six years 64.5% of pounds transferred were to new entrants (Table 19).
	Lease transactions have increased from 5.3 per year during the first six years to 7.5 per year in the following six years (Table 20).
	As in the previous review, the limited number of lease transactions limits the ability to draw conclusions about the performance of the quota market.

Section	Findings
	Change: Since the first six years of the program, it appears that lease prices as a ratio of ex-vessel prices have decreased from 19.9% to 13.1% on average, potentially a result of more stable leasing arrangements or as participants adjusted to the system (Table 21).
New Section: Diversification and reliance	**New:** The number of active IFQ vessels with earnings in other fisheries has decreased since the baseline period from approximately 75% to 50% of vessels since FY2018, likely the result of more diversified, former Part-Time tier vessels, leaving the fishery (Table 22).
	New: Roughly half of IFQ vessels (4 of 8) participate in the fishery full tiime whereas the other half receive 51.9% of their revenue from other fisheries, on average (Table 22).
	New: Most IFQ vessels that fish in other fisheries fish in the swordfish and monkfish fisheries (5 and 8 vessels, on average in the IFQ period); a smaller number have participated in squid and scallop fisheries, but those that do have higher earnings (Table 23).
	New: For most entities that own IFQ vessels, they only own one IFQ permit and it is the only permit that they own (5 out 7 entities in FY2021), suggesting that most IFQ vessels do not have other sources of fishery income (Table 24).
New Section: Spatial distribution of effort	**New:** Consistent with the baseline period, most IFQ golden tilefish is harvested in two statistical areas: 537 and 616 (Table 25).
	New: While the proportion of harvests coming from statistical area 537 has not changed since the baseline period, the proportion coming from statistical area 616 has increased from 41.4% to 46.5% (Table 25).
Social and community impacts	
	New: Montauk has been the dominant port during the GTF IFQ program period, accounting for 46–66% of the ex-vessel value of the golden tilefish landed in the region. Barnegat Light accounted for 19–32% during this period, and Hampton Bays accounted for 4–21% (Table 26).
	New: From FY2017 to 2021, there was a decrease in the number of IFQ vessels making landings in both Barnegat Light and Montauk due to a number of factors, including lower quotas and severe weather conditions (Table 27).
	New: Montauk has had the highest dependence on golden tilefish as a percentage of total ex-vessel fishing revenue from all landings. During the GTF IFQ program period, golden tilefish accounted for an average of 19% of the community's total annual fishing revenue. The species contributed an average of 5% and 13% to the total fishing revenue of Barnegat Light and Hampton Bays, respectively (Table 30).
	New: No single species dominated the value of landings in Montauk during the GTF IFQ program period, with the exception of squid in some years. In contrast, squid was nearly always the dominant species landed in Hampton Bays in terms of ex-vessel revenue, while scallops was consistently the major species landed in Barnegat Light.
	New: All three primary communities ranked high on the commercial fishing engagement index in every year for which data were available (2009–2019). For commercial fishing reliance, the results were more mixed, with Montauk and Barnegat Light ranking high or medium-high for all years, while Hampton Bays ranked medium or low (Table 31).
	New: After the initial allocation in 2010, the three primary communities accounted for 94.6% of the total IFQ shares, with share owners in Montauk receiving 66.0%; owners in Barnegat Light receiving 14.4%; and an owner in Oakdale, NY, which is adjacent to Hampton Bays, receiving 14.2% (Table 32).
	Several permanent IFQ share transfers have occurred, but as described in the past review, most of the allocation shares are still geographically located with stakeholders that fish off New York and New Jersey.
	New: For leasing transactions that reported a non-zero value, the largest transfers between IFQ allocation permit holders located in different states occurred between entities in West Newbury, MA and Forked River, NJ. In addition, a single transaction occurred between IFQ allocation permit holders located in different states in 2015 when 100,000 pounds (4.0% of the total) were transferred from an entity in Montauk to one in Barnegat Light. The remainder of the transactions, which accounted for half of the total pounds temporarily transferred, were between IFQ allocation permit holders in Barnegat Light or the neighboring community of Forked River (Table 33).
	Consistent with the past review, for those who have access to sufficient quota, the GTF IFQ program has helped stabilize the fishery; those that do not own significant quota in the IFQ system, especially those that were early participants in the fishery, are frustrated and feel as though they were pushed out of the fishery.
Safety at sea	
	The post-IFQ program shift in fishing effort away from the winter months reported in the first review continued during FY2016–2021.
	According to the first review, there was a low number of safety incidents attributed to the golden tilefish fishery after IFQ program implementation; the fishery continued to experience a low number of incidents during FY2016–2021.

Section	Findings
Biological Impacts	
	The IFQ program was not expected to have any positive or negative biological impacts on golden tilefish, other fish stocks, or essential fish habitat.
	Since the golden tilefish fishery came under IFQ management, it has not been classified as overfished and has not experienced overfishing.
	Reported discards (from VTR data) have been extremely low as a proportion of catch (0.03%) for longline vessels that targeted golden tilefish in the 2016–2020 period.
Administrative Impacts	
	Because the pre-IFQ program golden tilefish fishery management system already had in place a system of data collection, reporting, and monitoring, the administrative costs for these tasks did not significantly increase with the implementation of the IFQ program.
	The first review noted that there were no documented issues related to enforcement of the IFQ program, and only two minor violations have been reported for the fishery since then.
	The first review noted that the recoverable costs associated with management, enforcement, and data collection in the IFQ program include only the incremental (or attributable) costs of the IFQ program.
	New: The increase in recoverable costs in 2016 was due to the additional NMFS staff hours required to complete the first review of the IFQ program.
Incidental fishery impacts	
	New: To ensure that vessels in the incidental catch sector targeted species other than golden tilefish, Framework Adjustment 2 established a landing limit of 500 pounds or 50%, by weight, of all fish, including the golden tilefish, on board these vessels, whichever is less.
	During the post-IFQ implementation, the incidental quota varied from 99,750 pounds for FY2010–2014 to 70,548 pounds for FY2021. Post-IFQ implementation utilization rates varied from 21% in FY2015 to 84% in FY2018.
	New: There is no evidence that the GTF IFQ program has had any significant negative effects on participants in the incidental golden tilefish fishery. Harvesters in the incidental fishery benefit from the ability to add incidentally caught tilefish to their portfolios, and if they are able to acquire IFQ shares, they can enter the IFQ fishery.
Recreational fishery impacts	
	New: To acquire a better understanding of changes in the level of recreational fishing effort and catch, NMFS GARFO implemented mandatory permitting and reporting for private recreational vessels.
	VTR data show that the golden tilefish catch of party/charter boats has increased over the past two decades (Table 38), but this catch continues to account for a small portion of total fishing mortality.
	New: There is no evidence that the GTF IFQ program has had an adverse impact on the recreational sector. The temporal redistribution of commercial fishing effort resulting from the IFQ program could be positive to recreational anglers.

Analysis indicates a change from previous review

Findings from new analysis not included in previous review

6.3.2 Achievement of Goals and Objectives

The IFQ program's primary goals were to firstly, reduce overcapacity and latent fishing effort, and secondly, to eliminate, to the extent possible, the problems associated with derby-style fishing. As in the past review, this section summarizes the principal conclusions with respect to these goals based on the analysis completed for this review and other sources, as relevant.

Reduce Overcapacity and Latent Fishing Effort in the Commercial Fishery

This review supports conclusions from the first review that fishing capacity has decreased under the GTF IFQ program, and notes that both reductions in fishing effort and in the number of shareholders

both decreased from FY2016 to 2021. In terms of the number of active golden tilefish vessels, the number of vessels with IFQ landings has continued to decrease since the last review. Between FY2016 and FY2021 the number of active vessels declined from 12 to 8 (Table 8), and on average the number of fishing vessels active from FY2010 to 2015 and FY2016 to 2021 decreased from 10.7 to 9 (Table 9). In terms of IFQ ownership, the previous review found that the number of allocation holders had remained steady in the first six years. This review finds that the number of allocation holders has decreased in the last six years from 14 in FY2016 to 10 in each year since FY2018 (Table 7).

Eliminate Problems Associated with Derby-Style Fishing

This review supports conclusions from the first review that derby conditions in the fishery have been eliminated and a year-round fishery for golden tilefish exists under the IFQ program (Table 17). Since the last review, no early closures for the fishery have occurred, consistent with the first six years. Specifically, this review upholds conclusions that there have been noticeable shifts in the timing of landings for previous Full-Time Tier 2 and Part-Time vessels that now fish in the IFQ program (Figure 14). Research conducted on the golden tilefish IFQ program since the last review also found statistically significant impacts on season length as a result of the program (Birkenbach 2017).

This review also confirms conclusions that ex-vessel prices have increased since implementation, particularly in the first six months of the fishing year (Figure 8). In interviews with participants for this review, participants noted that the program gives them greater flexibility on when and where to fish their allocations and observed that ex-vessel prices have been stronger under the IFQ program.

Limited information available as well as the small size of the fishery preclude extensive analysis of the impacts of the program on fishing vessel safety and incidents, but according to the National Institute for Occupational Safety and Health's database, there have been no reported safety incidents attributed to the golden tilefish fishery represented in their databases (Case 2023).

6.3.3 Net Benefits to the Nation

A key question of catch share reviews is to assess whether, on the whole, society is better off under the catch share program than it would have been without the program. Ideally, this change would be measured by comparing changes in consumer and producer surplus against a counterfactual scenario of the fishery without the GTF IFQ program (Anderson and Holiday 2007). While we are unable to construct such a scenario or quantitatively measure changes in consumer and producer surplus, we are able to discuss major drivers of changes in benefits and costs as a result of the IFQ program and the likelihood that net benefits have increased by comparing trends before and after program implementation.

Overall, the benefits of the GTF IFQ program have largely been economic in nature, stemming from increases in efficiency as a result of the elimination of the race to fish and the additional flexibility and control over when harvesters fish. There is evidence that the IFQ program has resulted in a more constant year-round supply of golden tilefish (Section 5.3.4) and price increases (Section 5.3.8), to

the benefit of both consumers (via improved product quality and new high-end markets) and producers (via a higher and steadier revenue stream). In addition, data suggest that harvester productivity and net operating revenues have increased since IFQ program implementation (Section 5.3.6 and Section 5.3.7). Finally, while the program increased fishing costs for those harvesters that must purchase or lease IFQ shares to fish (Section 5.3.9) and through the cost recovery fee (Section 5.7), in interviews conducted for this review, fishery participants consistently reported that they felt they were better off under the IFQ program due to increased fishing flexibility, which in part allowed them to fish in other fisheries when best for them (Section 5.3.8) and to avoid fishing in poor weather conditions (Section 5.5). Overall, given the strong positive economic benefits to consumers and producers, it appears likely that net benefits to the nation have increased under the IFQ program.

6.3.4 Unexpected Effects

This review did not identify any unexpected effects (positive or negative) which do not fall under the program's goals and objectives.

6.3.5 Identified Issues and Areas for Future Research

While the present review did not identify any program issues or areas of concern there are general considerations for future reviews and data needs that have been identified by report authors and are described here. In addition, we also present the research priorities identified by the MAFMC.

One consideration for future reviews is that if the fishery continues to shrink, it becomes increasingly difficult to display socioeconomic information about the fleet that do not violate confidentiality restrictions (less than three reporting units), particularly at the level of fishing communities and dealers. It would be helpful for guidance and/or the development of additional indicators that can be presented to evaluate trends or other ways to present information so that information across communities, groups, and/or individuals is not lost.

Additionally, because of the fishery's size, other economic data collection efforts may not be able to provide information about the fleet, for example the NEFSC's crew survey. If additional social or economic data on the fleet are desirable on these groups, dedicated research efforts may be needed.

Below are the research priorities for golden tilefish that the MAFMC identified in its Comprehensive Five Year (2020–2024) Research Plan (Mid-Atlantic Fishery Management Council 2021).

Short-term/Smaller scale

- Continue to utilize fishery-independent information to assess whether the dome-shaped selectivity curve used in the assessment reflects fishery selectivity or availability, or both.
- Continue to collect and analyze biological samples to create year-specific age-length keys and to improve life history, maturity, and distribution information.

- Develop sampling programs to increase information of recreational landings at size and age.
- Continue to assess the accuracy and reliability of aging techniques.
- Evaluate data collection methods to increase information on gear conflicts, species interactions (i.e., spiny dogfish), and bait type to understand their effects on the commercial CPUE index.

Long-term/Larger scale

- Evaluate the role of the golden tilefish gear restricted areas on the stock and its fisheries.
- Evaluate the effects of climate and environmental indices on stock dynamics.

7 Appendix: Productivity and Profitability Calculation Methodology

7.1 Productivity Analysis Methodology

In order to define and measure Total Factor Productivity (TFP), we begin with an output vector for vessel i in period t, $q_{it} = (q_{1it}, \dots, q_{Nit})'$, where there are 1, … , N outputs. Similarly, we define an input vector, $x_{it} = (x_{1it}, \dots, x_{Mit})'$ for vessel i in period t where there are 1,…,M inputs. TFP for vessel i in period t is defined as $TFP_{it} = Q(q_{it})/X(x_{it})$, where $Q(q_{it})$ is an aggregate output quantity and $X(x_{it})$ is an aggregate input quantity. An output index that compares the outputs of vessel i in period t with the outputs of vessel h in period s using the latter as a reference point is any variable of the form $QI(q_{hs}, q_{it}) = Q(q_{it})/Q(q_{hs})$. Likewise, an index that compares the inputs used by vessels i in period t with the inputs of vessel h in period s using the latter as a reference point is any variable of the form $XI(x_{hs}, x_{it}) = X(x_{it})/X(x_{hs})$. Finally, a TFP index which compares the TFP of vessels i in period t is with that of vessel h in period s using the latter as a reference point is $TFPI(x_{hs}, q_{hs}, x_{it}, q_{it}) = QI(q_{hs}, q_{it})/XI(x_{hs}, x_{it})$, or equivalently $TFPI(x_{hs}, q_{hs}, x_{it}, q_{it}) = \frac{TFP(x_{it}, q_{it})}{TFP(x_{hs}, q_{hs})}$. On most fishing trips, it may not be possible to measure all inputs used, and the resulting productivity metric when not all inputs are used is referred to as "Multi-Factor" productivity (MFP). We use the term "MFPI" for multi-factor productivity index.

In order to construct our output and input quantity indices for this study, we need to find a way to aggregate our outputs and inputs into index numbers. For both output and inputs, we use average market prices from 2007–2021 as weights which yield Lowe output and input quantity indices (O'Donnell 2012; O'Donnell 2018). The Lowe index that compares q_{it} with q_{hs} using the latter as a reference point is: $QI^L(q_{hs}, q_{it}) = \overline{p}' q_{it}/\overline{p}' q_{hs}$. Our outputs are golden tilefish, blueline tilefish and "other species", which are limited to only those species which are also caught on tilefish trips. Similarly, the Lowe index that compares x_{it} with x_{hs} using the latter as a reference point is: $XI^L(x_{hs}, x_{it}) = \overline{w}' x_{it}/\overline{w}' x_{hs}$. For the IFQ vessels in our analysis, we limit the input quantities to days at sea (i.e., effort, E) , crew days (i.e., labor, L), and capital (K) used during a calendar year. Capital is calculated as the percent of time the vessel spent in the tilefish fishery, and takes on a value between zero and one. Price per day at sea is calculated from at-sea monitor data and reflects the amount paid for fuel, food, ice, bait and oil. Since crew are typically paid a share of the catch, crew wages are calculated on a daily basis using an hourly wage for construction workers multiplied by eight. The user cost of capital is calculated using each vessel's projected market value times a capital rental rate which is the sum of the BAA Bond Index rate and a depreciation rate of 5%.

An MFP index (MFPI) is constructed for only the IFQ portion of the tilefish fleet. Instead of using a single reference vessel in our denominator, an average vessel was constructed using the pre-IFQ time period of 2007–2009. Yearly indices were then constructed as a geometric mean of all individual

vessel indices, and then yearly indices were compared to the 2007–2009 time period as $I_y/\bar{I}_{2007-2009}$, where I is either QI or XI. The final MFPI is QI/XI.

One final adjustment needed was to separate out the influence of biomass on MFP, and we follow the approach in Thunberg et al. (2015). First, define MFPBU as "Biomass Unadjusted MFP", and MFPBA as "Biomass Adjusted MFP." The relationship between the two is: MFPBU=MFPBA*B where B is a biomass adjustment factor. Solving for MFPBA yields: MFPBA =MFPBU * B-1 . MFPIBU has until this point been defined as MFP^y/MFP^{base} (for simplicity we use "base" in place of 2007-2009).

The biomass adjusted MFPI measure is:

$$MFPI = \frac{MFP_{BA}^{y}}{MFP_{BA}^{Base}} = \frac{MFP_{BU}^{y}*(B^{y})^{-1}}{MFP_{BU}^{2007}*(B^{2007})^{-1}}.$$

Simplifying and re-arranging terms yields:

$$MFPI = \frac{MFP_{BA}^{y}}{MFP_{BA}^{Base}} = \frac{MFP_{BU}^{y}}{MFP_{BU}^{Base}} * \frac{B^{Base}}{B^{y}}$$

The data used for the biomass (B) values were yearly estimates of SSB derived from the most recent management track assessment and the stock assessment update through 2016 (Table 40).

Table 40. Estimates of Spawning Stock Biomass (SSB)

Year	2007	2008	2009	AVG	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SSB (lb millions)	7.9	8.1	8.7	8.2	8.3	9.8	9.9	9	7.2	8.1	10	8.4	9.2	9.5	10.6	10.1

Source: National Marine Fisheries Service (2021b); Nitschke (2021)

7.2 Profitability Analysis Methodology

The methods shown follow those found in Walden, Lee, and O'Donnell (2021) and O'Donnell (2012). First, define the profitability of vessel *i* in period *t* as revenue divided by cost: $PROF_{it} = R_{it}/C_{it}$, and an index that compares the profitability of vessel *i* in period *t* with the profitability of vessel *h* in period *s* is $PROFI_{hsit} = \frac{PROF_{it}}{PROF_{hs}} = \frac{R_{it}/C_{it}}{R_{hs}/C_{hs}}$.

Input quantities used were consistent with those used in the construction of the productivity index and included effort (days at sea), crew size, and a measure of capital use, which was the percent of time in a year spent by the vessel in the tilefish fishery.

Costs taken from at-sea monitor data for the years 2007-2021 were used to calculate a cost per day at sea in each year. Cost per day at sea was calculated using fuel cost, ice cost, food cost, supply cost,

oil cost and bait cost all deflated to 2012 values. This was multiplied by the effort measure for each vessel.

Crew cost is a daily opportunity cost of labor calculated using the hourly wage rate for Construction Workers obtained from the St. Louis Federal Reserve[17]. The daily crew cost is the number of crew times eight times the daily opportunity cost of labor.

Vessel value was calculated based on shadow prices for vessel age, horsepower, and length published in Färe et al. (2017). From this, the user cost of capital was calculated for each vessel was calculated as (depreciation rate + opportunity cost of capital) times the vessel value. Depreciation was set at 5%, and the opportunity cost of capital in each year was set equal to the BAA bond rate.[18] The user cost of capital was multiplied by capital use (proportion of time spent fishing in the tilefish fishery) to arrive at an estimate of capital costs.

Using our previously defined productivity index (MFPI), our profitability index can be decomposed into the product of a "Terms-of-Trade", which is a measure of output prices divided by input prices:

$PROFI_{hsit} = TTI(p_{hs}, p_{it}, w_{hs}, w_{it}, \dots) \times MFPI(x_{hs}, q_{hs}, x_{it}, q_{it})$ (O'Donnell 2012; Grifell-Tatjé and Lovell 2015).

The decomposition of the profitability index shows the extent to which profitability change is being driven by productivity change and differences in terms-of-trade. For example, the MFPI can be less than (greater than) one, but profitability can be greater than (less than) one due to a TTI which is greater than (less than) one. Productivity may have declined but profitability could still increase due to a rise in the TTI which more than offsets the decline in the MFPI. Further investigation of the TTI can be undertaken to determine if the change was due to rising (declining) output prices or rising (declining) input prices.

In order to fully show how this decomposition is carried out, we begin with creating the TTI. As stated above, the TTI is a measure of output price change divided by a measure of input price change. In other words, a measure of the price for tilefish and other species caught on tilefish trips compared to the prices for inputs used on the trips, such as fuel, food, oil, supplies, bait, crew wages and the vessel capital price. For this analysis, we measure price changes by deflating changes in revenues and costs by output and input quantity indexes which were used in our MFPI. For outputs, the revenue received by vessel i in period t is $R_{it} = p'_{it}q_{it}$ where p_{it} denotes the vector of output prices received. Begin with a revenue index $RI(p_{hs}, q_{hs}, p_{it}, q_{it}) = R_{it}/R_{hs}$ comparing revenue by vessel i in period t to vessel h in period s. An implicit output price index that compares p_{it} with p_{hs} is any variable of the form $PI(p_{hs}, p_{it}, \dots) = RI(p_{hs}, q_{hs}, p_{it}, q_{it})/QI(q_{hs}, q_{it})$ where $QI(\dots)$ is an output index. Similarly, for inputs, the input cost incurred by vessel i in period t is $C_{it} = w'_{it}x_{it}$ where w_{it} denotes the vector of

[17] https://fred.stlouisfed.org/series/CES2000000003#0

[18] https://fred.stlouisfed.org/series/BAA#0

input prices paid. A cost index can then be constructed as $CI(w_{hs}, x_{hs}, w_{it}, x_{it}) = C_{it}/C_{hs}$. An implicit input price index that compares w_{it} with w_{hs} is constructed as $WI(w_{hs}, w_{it}, \dots) = CI(w_{hs}, x_{hs}, w_{it}, x_{it})/XI(x_{hs}, x_{it})$ where $XI(\dots)$ is an input index. Finally, an implicit terms-of-trade index (TTI) that compares the output and input prices of vessel *i* in period *t* with the output and input prices of vessel *h* in period *s* using the latter prices as a reference point is any variable of the form $TTI(w_{hs}, p_{hs}, p_{hs}, p_{it}, \dots) = PI(p_{hs}, p_{it}, \dots)/WI(w_{hs}, w_{it}, \dots)$. In this study, we measure output and input quantity change using Lowe indexes. The associated Lowe implicit output and input price indices are $PI^L(p_{hs}, p_{it}, \dots) = (p'_{it}q_{it}/p'_{hs}q_{hs})/(\overline{p}'q_{it}/\overline{p}'q_{hs})$ and $WI^L(w_{hs}, w_{it}, \dots) = (w'_{it}x_{it}/w'_{hs}x_{hs})/(\overline{w}'x_{it}/\overline{w}'x_{hs})$. This leads to an implicit Lowe TTI:

$TTI^L(w_{hs}, p_{hs}, w_{it}, p_{it}, \dots) = \frac{p'_{it}q_{it}/p'_{hs}q_{hs}}{\overline{p}'q_{it}/\overline{p}'q_{hs}} \times \frac{\overline{w}'x_{it}/\overline{w}'x_{hs}}{w'_{it}x_{it}/w'_{hs}x_{hs}}$. This is equivalent to

$TTI^L(w_{hs}, p_{hs}, w_{it}, p_{it}, \dots) = PI(Q)/WI(X)$.

This index indicates how the output to input price ratio for vessel *i* in period *t* compares to that of vessel *h* in period *s*. A value greater than one means that vessel *i* in period *t* had a higher output to input price ratio than the reference vessel (vessel *h* in period *s*). This could be due to higher output prices, lower input prices, or a combination of both (note that in competitive input and output markets, these prices are beyond the control of a single vessel).

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