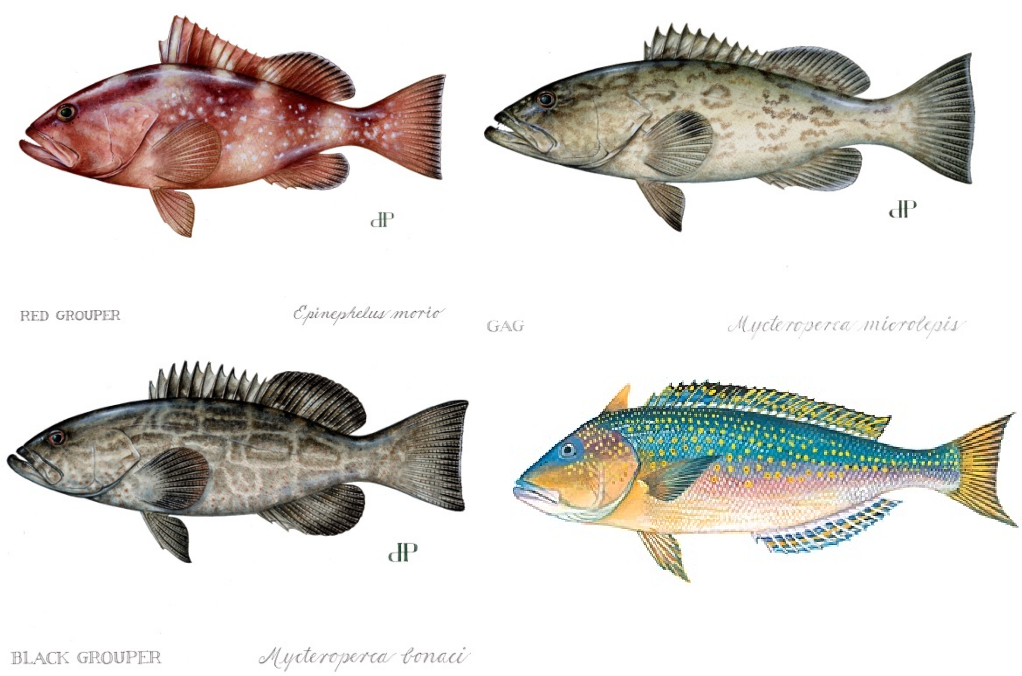
Red Snapper and Grouper-Tilefish Individual Fishing Quota Programs Review



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ABBREVIATIONS USED IN THIS DOCUMENT

ABC	acceptable biological catch
ACL	annual catch limit
AM	accountability measure
Council	Gulf of Mexico Fishery Management Council
CS Policy	Catch Share Policy
CSP	Catch Share Program
DLMTool	Data Limited Methods Tool
DM	discard mortality
DWG	deep-water grouper
EEZ	exclusive economic zone
EFH	essential fish habitat
EIS	environmental impact statement
EJ	environmental justice
EOY	end of year
ESA	Endangered Species Act
FMP	Fishery Management Plan
FTE	full-time equivalent
GG	gag (grouper)
GGM	gag multi-use
GT-IFQ	grouper-tilefish individual fishing quota (program)
Guidance	Guidance for Conducting Reviews of Catch Share Programs
Gulf	Gulf of Mexico
gw	gutted weight
HHI	Herfindahl-Hirschman Index
IFQ	individual fishing quota
ITQ	individual transferable quota
JEA	joint enforcement agreement
LAPP	Limited Access Privilege Program
LKE	lowest known entity
LL	longline
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
mp	million pounds
MSST	minimum stock size threshold
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
OFL	overfishing limit
OLE	Office of Law Enforcement
PP	public participant
pw	product weight
Reef Fish FMP	Reef Fish Fishery Management Plan
RFOP	Reef Fish Observer Program
RG	red grouper
RGM	red grouper multi-use

RQ	regional quotient
RS	red snapper
RS-IFQ	red snapper individual fishing quota (program)
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SOI	Segments of Interest
SERO	Southeast Regional Office
SOI	Segments of Interest
SSC	Scientific and Statistical Committee
SWG	shallow-water grouper
TF	tilefish
TIP	Trip Interview Program
TL	total length
VL	vertical line
VMS	vessel monitoring system
VSI	value of statistical injury
VSL	value of statistical life

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CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 Legal Requirements and Guidance for the Review

The National Marine Fisheries Service (NMFS) published the Guidance for Conducting Reviews of Catch Share Programs (Guidance) in 2017 (NMFS 2017).[1] This Guidance is based on the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as well as other agency guidance in the National Oceanic and Atmospheric Administration's (NOAA) Catch Share Policy (CS Policy)[2] and The Design and Use of Limited Access Privilege Programs (LAPP) (Anderson and Holliday 2007).[3] The goals of the Guidance are to ensure these reviews meet statutory requirements, are generally consistent across the country, and are carried out in a transparent, efficient, and effective manner. The objectives of the Guidance are to specify the process that should be followed, the elements a review should contain, and the program components that should be addressed when completing a review. The Guidance applies to all U.S. catch share programs regardless of whether they were established under the provisions of Section 303A of the Magnuson-Stevens Act, with the exception of the Western Alaska (AK) Community Development Program as it is subject to separate statutory requirements for review.

The Magnuson-Stevens Act specifies that fishing privileges established under LAPPs are not permanent and may be revoked, limited, or modified at any time. If a program is meeting its stated objective(s) then it would likely be continued. However, the Gulf of Mexico Fishery Management Council (Council) reserves the right to terminate or modify a program for cause, including if the system is found to have jeopardized the sustainability of the stock or the safety of fishermen. The review provision specified by the Magnuson-Stevens Act requires the Council to evaluate the effectiveness of LAPPs and consider whether they should be modified, extended, or terminated. More specifically, the Magnuson-Stevens Act 303A(c)(1)(G) requires the Council and Secretary of Commerce (Secretary) to:

> *"(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 these 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 (but not less frequently than once every 7 years);"*

The date a program was established is the effective date of the action in the final rule that implemented the program. The initial review should be initiated no later than 5 years after the program was implemented. The Council and NMFS should also follow any timelines for additional program reviews specified by the Fishery Management Plan (FMP) or FMP amendment (hereinafter collectively referred to as "FMP") that created or modified the Catch

[1] https://media.fisheries.noaa.gov/dam-migration/01-121-01.pdf
[2] https://media.fisheries.noaa.gov/dam-migration/01-121.pdf
[3] https://media.fisheries.noaa.gov/dam-migration/tech_memo_holiday_and_anderson.pdf

Share Program (CSP). All subsequent reviews should coincide with scheduled Council review of the relevant FMP, but no less frequently than once every 7 years. This joint review is the first subsequent review of the Gulf of Mexico (Gulf) red snapper individual fishing quota (RS-IFQ) and the grouper-tilefish IFQ (GT-IFQ) programs. The reviews are considered Council documents. Once the review is completed, the results are to be submitted to the Council for approval and NMFS for concurrence that the review meets the requirements of the Magnuson-Stevens Act and is consistent with the Guidance.

Best available scientific information should be used for the review. If quantitative analyses are not available, qualitative assessments may suffice. The review of a CSP is a retrospective evaluation of an established program. Thus, rather than analyzing the program's expected effects, as is done in the implementing FMP, the task in a review is to describe and analyze the effects that have actually taken place since the baseline time period. Therefore, Councils need to consider an appropriate baseline for comparison. A baseline period of at least 3 years is preferable, but this may be modified depending on the circumstances. For subsequent program reviews, such as this joint review, analyses should discuss changes since the last review and need not evaluate the program's performance in years prior to the last review. Although the initial review of the GT-IFQ program went through 2014, the initial review of the RS-IFQ program only went through 2012 and thus this joint review examines program performance from 2012-2018.

The review should contain the following eight elements. If a Council determines that one or more of these elements is not applicable to a specific review, the Council should document its rationale for not conducting a more formal analysis of that element. The eight elements are:

1) purpose and need of the review (discuss legal/policy requirements),
2) goals and objectives of the program, the FMP, and the Magnuson-Stevens Act,
3) history of management, including a description of management prior to the program's implementation, a description of the program at the time of implementation (including enforcement, data collection, and monitoring), and any changes made since the program's implementation or the previous review (including an explanation of why those changes were made),
4) a description of biological, ecological, economic, social, and administrative environments before and since the program's implementation,
5) an analysis of the program's biological, ecological/environmental, economic, social, and administrative effects,
6) an evaluation of those effects with respect to meeting the goals and objectives (i.e., program performance), including a summary of the conclusions arising from the evaluation,
7) a summary of any unexpected effects (positive or negative) which do not fall under the program's goals and objectives, and
8) identification of issues associated with the program's structure or function and the potential need for additional data collection and/or research.

In general, the review should use as holistic an approach as possible given available data and resources. Interdependencies between related fisheries can generate spillover effects that may be unexpected or unintended. It is difficult to separate effects from the CSP under review from the effects of other CSPs and management measures in related fisheries. Councils should determine if analyzing the CSP alone will likely mischaracterize the program's performance, and the effects on human communities, fish stocks, and the ecological communities/environment. In instances where two or more CSPs are found to have significant interdependencies, they should be considered together under a joint review. Joint program reviews would be expected to lead to a more holistic approach and thus more accurate analysis, as well as reduce administrative costs associated with the conduct of these reviews. However, if the CSPs were established in different years, a joint initial review may not be feasible, particularly if they were established more than 5 years apart. Thus, joint reviews may be more likely for subsequent rather than initial reviews. The RS-IFQ and GT-IFQ programs were established 3 years apart; thus, a joint review is feasible. Further, after reviewing the GT-IFQ program 5-year review, the Council's Scientific and Statistical Committee (SSC) recommended that the next review be a joint review of both IFQ programs.

1.2 Description of RS-IFQ and GT-IFQ Programs

1.2.1 IFQ Program Goals and Objectives

According to Section 303A(c)(1)(G) of the Magnuson-Stevens Act, a primary goal of the review is to assess progress in meeting the goals of the IFQ programs and the Magnuson-Stevens Act. NOAA's CS Policy indicates it is necessary to examine objectives as well, including those of the FMP. Thus, the goals and objectives in this case include those identified in the implementing amendment, the FMP, the CS Policy, and the Magnuson-Stevens Act, particularly those specific to LAPPs, though the primary focus should be on those identified in the implementing amendment. The goals and objectives of the amendment(s) and FMP should be evaluated with respect to whether they are clear, measurable (at least qualitatively[4]), achievable (i.e., are two or more objectives mutually exclusive?), and still appropriate under the current circumstances. Fishery performance changes over time and for reasons other than the effects of the program or other management measures. Such changes should be taken into account when evaluating the efficacy of the original goals and objectives. If certain goals and objectives are found not to be clear, measurable, achievable, and/or still appropriate, the review should note deficiencies for the Council to address. Thus, one specific purpose of the reviews is to encourage Councils and NMFS to clearly identify specific performance standards that can be used in assessing whether, or to what extent, the goals and objectives have been met.

If the program(s) is performing as expected at the time of implementation, then the various goals and objectives either should have been achieved or substantial progress should have been made towards achieving them. If the analysis concludes otherwise, such conclusions may serve as the basis for future changes to the program.

In addition to the specific goals and objectives of the RS-IFQ and GT-IFQ programs described below, Section 303A(c)(1) of the Magnuson-Stevens Act established goals specific to LAPPs, which include:

[4] For example, qualitative objectives that provide a direction of the desired change may be used when quantitative objectives that provide explicit details on the magnitude of the change are not possible.

- assist in rebuilding if established for one or more species that are subject to overfishing or are overfished,
- contribute to reducing overcapacity if established in a fishery where overcapacity exists,
- promote fishing safety,
- promote fishery conservation and management, and
- promote social and economic benefits.

The primary objectives of the RS-IFQ program, as defined in Amendment 26 to the FMP for the Reef Fish Resources of the Gulf of Mexico (Reef Fish FMP), were to reduce overcapacity and mitigate derby fishing conditions (GMFMC 2006). The objectives of the GT-IFQ program were similar, as defined in Reef Fish Amendment 29 (GMFMC 2009). Anticipated benefits of the programs included: increased market stability; elimination of quota closures; increased flexibility for fishing operations; cost-effective and enforceable management of the commercial harvest of red snapper and grouper-tilefish species; improved safety at sea; and balancing social, economic, and biological benefits. Additionally, the program is intended to provide direct and indirect biological benefits to the IFQ-managed species and other marine resources by eliminating quota overages and reducing bycatch and discard mortality. The social, economic, and biological benefits collectively are intended to assist NMFS and the Council in preventing overfishing and rebuilding the Gulf red snapper population and GT-IFQ stocks through the stewardship aspects of the IFQ program.

Given that the programs have been in place for a number of years, the Council should use this review to evaluate 1) whether the original goals of the programs have since been met or if further progress is needed toward achieving the goals, and 2) should new goals be added to address changes in the fishery that have come about as a result of the IFQ programs. This review also allows an opportunity for further clarification of the goals and objectives.

For example, a Council may have indicated that a goal of the program is to reduce overcapacity. Such a goal tells the review team the direction of the desired change in overcapacity, but not the magnitude of the desired change. Further, if the goal is to reduce overcapacity, the Council may determine a desired level of capacity in these programs or for the reef fish fishery as a whole based on the results of this review. If the Council intended to indicate that its goal was to eliminate overcapacity, then the goal needs to be clarified. If it has a particular target level of capacity reduction in mind or, alternatively, a particular level of harvesting capacity, then that level should be stated explicitly.

The RS-IFQ and GT-IFQ programs have fundamentally changed the way fishing for IFQ-managed species is conducted. Goals and objectives might need to be modified because of these changes. For example, would further reductions in overcapacity be consistent with the goal to reduce discards and bycatch if multi-species reef fish fishermen are not able to obtain quota for incidentally caught IFQ-managed species? Due to the multi-species nature of the reef fish fishery, many commercial trips (especially bandit boats) are targeting an array of species. Without available quota, discard mortality may become an increasing concern. Reducing overcapacity has the effect of reducing the number of vessels engaged in the fishery, which may also lead to a decrease in employment. The Council should weigh these concerns in light of the review and determine if changes or clarifications are needed to the goals and objectives of the programs. This review will also highlight access to shares and allocation, new entrants, changing behavior or relationships, distributional issues, and continuing inefficiencies in the fishery.

1.2.2 IFQ Design and Structure

The RS-IFQ program is a single-species, single-share category program, implemented by the Secretary of Commerce on January 1, 2007, through Amendment 26 to the Reef Fish FMP (GMFMC 2006). For the first 5 years of the program (2007-2011), anyone who possessed a valid Gulf of Mexico (Gulf) federal dealer permit or a Gulf commercial federal reef fish permit (reef fish permit) was eligible to participate in the program. Beginning January 1, 2012, all U.S. citizens and permanent residents were eligible to obtain a RS-IFQ shareholder account to purchase shares and allocation. Shares are a percentage of the red snapper commercial quota, while allocation refers to the poundage that can be possessed, landed, or transferred during a given calendar year. At the beginning of each year, allocation is distributed to IFQ shareholder accounts. The amount allocated to an account is based on the share percentages of the annual quota held by the IFQ shareholder. Allocation is annual and expires on December 31. Only accounts with allocation and a valid Gulf reef fish permit can legally harvest red snapper.

The GT-IFQ program was established by Amendment 29[5] to the Reef Fish FMP in fall 2009 and the first fishing year of the program began on January 1, 2010. The GT-IFQ program began with five different GT-IFQ share categories for 17 species: DWG, gag grouper (GG), red grouper (RG), other SWG, and (TF) (Table 1.2.2.1). DWG included the following species: snowy grouper, speckled hind, warsaw grouper, yellowedge grouper, and misty grouper. SWG included black grouper, scamp, yellowfin grouper, yellowmouth grouper, rock hind, and red hind. TF included blueline tilefish, golden tilefish, goldface tilefish, anchor tilefish, and blackline tilefish. The GG share category includes only gag, while RG only includes red grouper. In 2012, the following species were removed from the IFQ program: rock hind, red hind, misty grouper, anchor tilefish, and blackline tilefish. Each GT-IFQ share category has distinct shares and associated allocations. Allocation can then be used to harvest GT-IFQ species or sold to another valid account holder.

For the first 5 years of the GT-IFQ program, shares and allocation could only be sold to and fished by an entity that held a valid commercial Gulf reef fish permit and had an active GT-IFQ online account. Beginning January 1, 2015, all U.S. citizens and permanent residents were eligible to purchase GT-IFQ shares and allocation, although a valid Gulf reef fish permit was still required to harvest, possess, and land any IFQ-managed species.

[5] https://www.fisheries.noaa.gov/action/gulf-mexico-reef-fish-historical-amendments-and-rulemaking-1983-2017

Table 1.2.2.1. IFQ-managed species by share category.

IFQ Category	Species[1]
Red Snapper (RS)	Red snapper
Gag (GG)	Gag[2]
Red Grouper (RG)	Red grouper
Deep-water Grouper (DWG)	Snowy grouper; Speckled hind; Warsaw grouper; Yellowedge grouper
Other Shallow-water Grouper (SWG)	Black grouper; Scamp; Yellowfin grouper; Yellowmouth grouper
Tilefish (TF)	Blueline tilefish (grey); Golden tilefish; Goldface tilefish

Adjustments in commercial quotas can occur if a species' annual catch limit (ACL)changes as a result of a new assessment or through the reallocation of the ACL between sectors. An in-season quota increase is distributed proportionately among shareholder accounts based on the percentage of shares each account holds at the time of the adjustment for that species. Allocation and landings are in lbs gw.

The RS-IFQ and GT-IFQ programs use an online system, where all transactions are completed through a web-based portal maintained in NMFS' Southeast Regional Office (SERO). The Southeast Catch Share Program portal[6] also houses the Bluefin Tuna Individual Bycatch Program (2015 – current), and the Headboat Collaborative program (2014 – 2015). Participants in the IFQ programs use an online account for all transactions including share and allocation transfers, landings, and cost recovery fee payment. Each account has its own unique user identifier and password.

There are three main account types in the IFQ online system: shareholder, vessel, and dealer accounts. Shareholder accounts may hold shares and allocation or just hold allocation. These accounts are the main way in which fishermen interact with the web-based system. Shareholder accounts can transfer shares and allocation, submit landing notifications, as well as view associated vessel accounts and activity ledgers (i.e., share ledger, allocation ledger, landing ledger).

Vessel accounts belong to shareholder accounts and may hold allocation; they do not hold shares. There may be multiple vessel accounts associated with one shareholder account. A vessel account is linked to a Gulf of Mexico (Gulf) commercial reef fish permit. Any vessel account that is not associated with a valid reef fish permit may not be used to harvest IFQ species. Sufficient allocation must be in the vessel account prior to completing the landing transaction. Upon completion of a landing transaction, the IFQ online system deducts the allocation from the vessel account.

Dealer accounts are associated with federal dealer permit holders. Prior to August 7, 2014, the federal dealer permit was the Gulf reef fish dealer permit; afterwards the federal permit became

[6] https://secatchshares.fisheries.noaa.gov/

the Gulf and South Atlantic Dealer (GSAD) permit. Dealers are limited to initiating and completing landing transactions and paying the allocation holder's cost recovery fees. All IFQ dealers are required to have a Gulf IFQ endorsement, which may be printed through their IFQ account. A printed copy of the IFQ dealer endorsement must accompany vehicles used to transport IFQ species on land. Endorsements are valid when a dealer's permit is valid and the dealer has submitted all collected cost recovery fees to NMFS.

The Magnuson-Stevens Act, in section 304(d)(2)(A)(i), requires a fee to recover the actual costs required to directly administer, manage, and enforce the RS and GT-IFQ programs. This fee may not exceed 3% of the actual ex-vessel value. The current cost recovery fee is set at 3%. The Regional Administrator (RA) may review and adjust this fee annually. The IFQ allocation holder specified in the landing transaction is responsible for the payment of the cost recovery fees, while the dealer who receives the fish is responsible for collecting the cost recovery fee and submitting the fee to NMFS on a quarterly basis. Complete regulations governing the IFQ program can be found at 50 CFR 622.228[7] and the program can be accessed through the SERO website.[8] Important information regarding the RS and GT-IFQ program is available for download on the website under Additional Information.

Each shareholder account is composed of a unique set of entities (single or combination of individuals and/or business) and no two accounts may be composed of the same set of entities. A unique entity may be an individual or business, or a combination of individuals and/or businesses. For any business that has a shareholder account, NMFS collects information on the owner(s) of that business and the percentage owned by each individual. If a business is owned in part or in total by another business, NMFS collects the ownership information of all parent companies. Owners of a business and the percentage of ownership held by each owner may change over time. Any time there is a change in the ownership of a business (e.g., owners, percentage of business owned, address, etc.), the business must inform NMFS. NMFS tracks business owners throughout time using start and end dates for each change submitted to NMFS. SERO maintains a list of shareholder accounts and the shares held per category on its website.[9]

The GT-IFQ program has several built-in flexibility measures to accommodate the multi-species nature of the commercial reef fish fishery and reduce bycatch. There is a multi-use provision for both GG and RG that allows a portion of the RG quota to be harvested under GG and vice versa. A portion of the GG or RG allocation may be reserved each year for multi-use allocation, which may be used to land either gag or red grouper. These portions are placed into two allocation categories: GGM and RGM. The multi-use provision is to ensure that there may be allocation to use if either gag or red grouper are landed as incidental catch. The percentage of multi-use may change each year and may even be zero. Since 2013, the red grouper multi-use (RGM) and gag multi-use (GGM) allocation was based on formulas (see below) utilizing the commercial quota and the annual catch limits for gag and red grouper. If either stock is under a rebuilding plan, the percentage of the other species multi-use allocation will equal zero. Multiuse allocation cannot be used until all the species-specific allocation has been landed or transferred, including allocation in shareholder and all associated vessel(s) accounts. For example, gag may not be

[7] www.ecfr.gov
[8] https://secatchshares.fisheries.noaa.gov/home
[9] https://portal.southeast.fisheries.noaa.gov/reports/foia/IFQShareholders.htm

landed under GGM or RGM unless there is no GG allocation remaining in the shareholder and associated vessel(s) accounts. Similarly, multi-use allocation may only be transferred after landing or transferring all the corresponding species-specific allocation in the shareholder and associated vessel(s) accounts. The three remaining share categories (SWG, DWG, and TF) are multi-species categories, consisting of species complexes that are commonly caught together. Three grouper species (scamp, warsaw grouper, and speckled hind) are found in both shallow and deep-water habitats. Thus, flexibility measures are included in the GT-IFQ program to allow these species to be landed under either DWG or SWG categories. Scamp are designated as a SWG species, but may be landed using DWG allocation once all SWG allocation in an account has been harvested. Warsaw grouper and speckled hind are designated as DWG species and may be landed using SWG allocation after all DWG allocation in an account has been harvested.

The RS and GT-IFQ programs have a built-in 10% overage measure to allow a once-per-year allocation overage per share category for any IFQ account that holds shares in that share category. For shareholder accounts with shares, a vessel associated with that account can land 10% more than its remaining allocation in the vessel account once during the year. NMFS deducts this overage from the shareholder account's allocation in the following fishing year. Because overages need to be deducted in the following year, IFQ accounts without shares cannot land an excess of their remaining allocation in that share category. Further, IFQ accounts with shares are prohibited from selling shares that would reduce the account's shares to less than the amount needed to repay the overage in the following year.

The Magnuson-Stevens Act requires fishery managers to ensure that no one IFQ participant acquires an excessive share of the quota. The IFQ program is monitored to prevent one or more participants from obtaining shares in excess of the established share cap for each category (Table 1.2.2.2). The share cap for each category was based on the maximum RS and GT-IFQ shares issued to a single entity at the time of initial apportionment. An allocation cap for the GT-IFQ program is set annually and equals the sum of the total allocation (pounds) associated with the five share category caps. The RS-IFQ program does not have an allocation cap.

Table 1.2.2.2. Share caps in the IFQ programs.

Category	Share Cap %
RS	6.020300
DWG	14.704321
GG	2.349938
RG	4.331882
SWG	7.266147
TF	12.212356

When harvesting IFQ species, vessels are required to have a valid reef fish permit and submit a declaration of intent to fish ("hail-out") before leaving port. Declarations can be made through a Vessel Monitoring System (VMS) or through a dedicated phone line. While at sea, vessels are monitored using VMS, which is required to record the location every hour. When returning to port, vessels landing IFQ species must provide an advanced notification of landing ("hail-in";

hereafter referred to as landing notification) indicating the time and location of landing, the intended dealer, and the estimated pounds to be landed by species. Landing notifications can be made via VMS, 24-hour call service center, or through the IFQ online system. Prior to October 27, 2014, the landing notification had to be submitted 3 to 12 hours in advance of landing. An administrative rule extended the landing notification reporting window from 12 to 24 hours and required a vessel to land within 1 hour after the arrival time given in the landing notification. Landing locations must be approved in advance to ensure the sites actually exist and law enforcement agents can access the site. Landing locations must be publicly accessible by land and water. Proposed landing locations can be submitted via the Catch Share website and new locations will be approved or denied only at the end of each calendar-year quarter.

Landing may occur at any time, provided that landing notification has been given between 3 to 24 hours prior to landing. However, offloading of IFQ species is restricted to the hours of 6 a.m. and 6 p.m. local time. The administrative rule in 2014 revised regulations to allow offload to continue after 6 p.m. if an authorized officer is present, available to remain on site, and authorizes the continue offloading. A landing transaction report is completed by the IFQ dealer and validated by the fisherman using the vessel account's Personal Identification Number (PIN). The landing transaction includes the date, time, and location of transaction; weight and actual ex-vessel value of fish landed and sold; and the identity of the shareholder account, vessel, and dealer. All landings data are updated as landing transactions are processed on a real-time basis. The administrative rule in 2014, required dealers to complete a landing transaction on the day of offload and within 96 hours of landings. The rule also prohibited the deduction of ice and water weight when reporting an IFQ landing transaction, unless the actual weight of the ice and water could be determined using a scale. The intent of these modifications was to improve the timeliness and accuracy of landing transactions.

For each transaction, NMFS collects share, allocation, and ex-vessel prices. Share transfers are a two-step process with the transferor initiating the transaction, but the transfer of shares is not finalized until the transferee accepts the transaction. There may be a delay between initiation and final acceptance of the transfer. For share transfers, the total value for transfer is entered by the transferor. In 2013, NMFS began also collecting the value from the transferee. The total share value is analyzed as a price per equivalent pound. A price per equivalent pound is the share percentage that would be equal to one pound for that point in time. The exact share percentage that is equivalent to the one pound depends on the commercial quota at that time and will change as the quota increases or decreases. Allocation transfers are an immediate one-step process. As soon as the transferor completes the transaction, the allocation is transferred to the other account. For allocation transfers, the price per pound is entered into the system. Ex-vessel prices are entered through the landing transaction process. Ex-vessel prices are a price per pound before any deductions are made for transferred (e.g., "leased") allocation and goods and/or services (e.g., bait, ice, fuel, repairs, machinery replacement, etc.).

1.2.3 Quotas for RS-IFQ and GT-IFQ Share Categories

Table 1.2.3.1 provides the annual quotas for the share categories of both IFQ programs, and notes the date of quota increases. Quotas for the year prior to implementation of each program are provided for comparison. Landings by share category and for each species within the share categories are provided in Chapter 3.

Table 1.2.3.1. Annual quotas for IFQ share categories including quota increases since implementation of the IFQ programs (pounds gutted weight) and for the year prior to each IFQ program's implementation.

DWG	1-Jan	Quota Increase	Increase Date	31-Dec
2009*	1,020,000			1,020,000
2010	1,020,000			1,020,000
2011	1,020,000			1,020,000
2012	1,020,000	107,000	Jan 30	1,127,000
2013	1,118,000			1,118,000
2014	1,110,000			1,110,000
2015	1,101,000			1,101,000
2016	1,024,000			1,024,000
2017	1,024,000			1,024,000
2018	1,024,000			1,024,000

GG	1-Jan	Quota Increase	Increase Date	31-Dec
2009*	1,320,000[1]			1,320,000
2010	1,410,000			1,410,000
2011	100,000	330,000	Jun 1	430,000
2012	430,000	137,000	Mar 12	567,000
2013	708,000			708,000
2014	835,000			835,000
2015	939,000			939,000
2016	939,000			939,000
2017	939,000			939,000
2018	939,000			939,000

RG	1-Jan	Quota Increase	Increase Date	31-Dec
2009*	5,750,000[1]			5,750,000
2010	5,750,000			5,750,000
2011	4,320,000	910,000	Nov 2	5,230,000
2012	5,370,000			5,370,000
2013	5,530,000			5,530,000
2014	5,630,000			5,630,000
2015	5,720,000			5,720,000
2016	5,720,000	2,060,000	Oct 12	7,780,000
2017	7,780,000			7,780,000
2018	7,780,000			7,780,000

SWG	1-Jan	Quota Increase	Increase Date	31-Dec
2009*	410,000[1]			410,000
2010	410,000			410,000
2011	410,000			410,000
2012	410,000	99,000	Jan 30	509,000
2013	518,000			518,000
2014	523,000			523,000
2015	525,000			525,000
2016	525,000			525,000
2017	525,000			525,000
2018	525,000			525,000

TF	1-Jan	Quota Increase	Increase Date	31-Dec
2009*	440,000			440,000
2010	440,000			440,000
2011	440,000			440,000
2012	440,000	142,000	Jan 30	582,000
2013	582,000			582,000
2014	582,000			582,000

RS	1-Jan	Quota Increase	Increase Date	31-Dec
2006*	4,189,189			4,189,189
2007	2,297,297	689,189	Jun 1	2,986,486
2008	2,297,297			2,297,297
2009	2,297,297			2,297,297
2010	2,297,297	893,694	Jun 2	3,190,991
2011	3,190,991	109,910	May 31	3,300,901
2012	3,300,901	411,712	Jun 29	3,712,613
2013	3,712,613	174,774 1,166,667	May 29 Sep 30	5,054,054
2014	5,054,054			5,054,054

2015	582,000			582,000
2016	582,000			582,000
2017	582,000			582,000
2018	582,000			582,000

2015	5,054,054	1,516,216	Jun 1	6,570,270
2016	6,097,297			6,097,297
2017	6,003,604	309,009	Jun 7	6,312,613
2018	6,312,613			6,312,613

Note: Beginning in 2012, quotas equal the ACT.

* Indicates the quota in the year prior to the IFQ program.

[1] The total shallow-water grouper quota was an aggregate of the other shallow-water species, red grouper, and gag which was 7.48 mp in 2009. In this table, the gag and red grouper individual quotas are listed, while the remainder of the aggregate quota is listed as the SWG quota.

CHAPTER 2. DATA COLLECTION AND REPORTING

According to Section 303A(c)(1)(H) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), each limited access privilege program (LAPP) must include "an effective system for enforcement, monitoring, and management of the program, including the use of observers or electronic monitoring systems." This review should highlight any important data gaps or deficiencies, including gaps in the ability to validate collected data and any cost estimates for filling any gaps or deficiencies as some data improvements may be cost prohibitive given current resources and other factors. This review should document the reporting burden on participants, evaluate if current data collection programs are redundant, and identify any potential means to reduce reporting burden.

The grouper-tilefish and red snapper individual fishing quota (GT and RS-IFQ) programs use an online electronic system. All participants must log into their accounts through a web-based portal using assigned user names and passwords. Participants complete all actions through the web-based portal. Transactions include allocation transfers, share transfers, landing notifications, and landing transactions. Participants can also submit new landing locations through the online system and view and pay their cost recovery fees through the website. The electronic nature of the program makes it a near real-time reporting system.

Share transfers are initiated by the transferor and must be accepted by the transferee. Share transfers collect the following information: transferor account, transferee account, share category, share percentage being transferred, total value for the share transfer, and transfer reason. Since mid-year 2010, a minimum transfer price of $0.01 has been required for all share transfers. Despite requiring participants to enter a transaction price for share transfers, many share transactions specify a transaction value of $0.01. Prior to submission of the transfer, the online system calculates the equivalent pounds for the transferred shares and the equivalent price per pound. Starting in 2013, the system began collecting a transfer reason for each share transfer. Participants must choose among seven transfer reasons: barter for allocation, barter for shares, gift, no comment, package deal, transfer to a related account, and sale to another shareholder. Also in 2013, the system began collecting price information from the transferee as well as the transferor. While value information is required for a share transfer in order to estimate share price, participants may mis-report or under-report prices. Reasons for mis-reported or under-reported prices include: entering a price per pound equivalent[10] instead of transaction price, reluctance to enter price information, gifts, transferring to a related account, part of a package deal (e.g., sale of shares with a permit, vessel, and/or other equipment), and/or unrecorded bartering of shares within the GT-IFQ or RS-IFQ programs.

Allocation transfers are initiated by the transferor but do not require any action from the transferee. Allocation transfers can be to a shareholder account or a vessel account. Allocation transfers collect the following information: transferor, transferee (shareholder and/or vessel account), share category, pounds to be transferred, price per pound, and transfer reason.

[10] A price per pound equivalent is the share percentage that would equal one pound for that particular period. The exact share percentage that is equivalent to one pound depends on the total commercial quota and will change as the quota changes from year to year or within a year for any quota increases.

Allocation transfer prices are currently not required by the online system (e.g., a zero value may be entered). Similar to share transfers, from 2013 onward, participants must pick one of the seven transfer reasons. As with share transfers, allocation prices may be mis-reported or under-reported and the potential reasons for mis-reporting or under-reporting are similar to those for share prices.

Participants are required to submit an advance notice of landing (landing notification) prior to landing. For the purposes of these regulations, the term "landing" means to arrive at a dock, berth, beach, seawall, or ramp. The landing notification can be made through a vessel monitoring system (VMS) unit, the website, or a 24-hour call service center. Landing notifications contain the following information: vessel and associated shareholder account, landing location, dealer, date/time of arrival, share category and the estimated pounds to be landed. The submission of a landing notification sends an email to law enforcement and port agents, as well as the dealer listed in the notification (if the dealer supplied an email address and requested notification). The landing notification requirement is intended to provide law enforcement officers the opportunity to be present at the point of landing so they can monitor and enforce IFQ program requirements dockside.

Landing transactions are initiated by the dealer but need to be confirmed by the owner of the shareholder account through the use of a vessel Personal Identification Number (PIN). The dealer enters the pounds (gutted) and actual ex-vessel value of landed fish of each species, the facility where the fish are processed, the official ID of the vessel landing the fish, the landing notification confirmation number (when available), and the state trip ticket number (optional). The system automatically records the dealer, the date/time of the landing location, and calculates the total value for the transaction and the associated cost recovery fee. The dealer submits the landing transaction, but before it is finalized, the owner of the shareholder account must enter the vessel PIN to confirm the landing transaction. This step is also used to verify that there is sufficient allocation in the vessel account for this landing. Occasionally, landing transaction corrections are needed. These must be submitted on paper, and be signed by both the dealer and owner of the shareholder account. In 2011, the National Marine Fisheries Service (NMFS) defined actual ex-vessel value as the price paid per pound of fish before any deductions are made for transferred ("leased") allocation and goods and services (e.g., bait, ice, fuel, repairs, machinery replacement, etc.). Landing transactions must be entered on the day of the offload, and within 96 hours of the arrival time given on the pre-landing notification. Ice and water weight may not be deducted from the landing transaction, unless the actual weight of ice and water are determined using a scale.

2.1 Data Gaps

The IFQ system is an electronic online system that can require specific information before submission to the system. This limits the degree of data gaps that can occur in this system. One area where the IFQ program has a small deficiency is in gathering accurate price information from all participants. The IFQ system collects information used to estimate share transfer prices (total value of shares transferred, which in combination with the percentage of shares transferred is used to estimate price per equivalent pound), allocation transfers (price per pound), and ex-vessel prices (price per pound). According to economic theory, allocation prices should reflect the expected annual profit from harvesting one pound of quota, while share prices should reflect the net present value of the expected profit from harvesting one pound of quota in the long-run. Therefore, changes in these prices over time reflect changes in expected profitability. Because profits are an indicator of economic performance, they also reflect changes in the economic performance of the program. This information is particularly important when it is difficult to estimate the profits on a timely basis for management purposes.

Although ex-vessel prices are required to complete a landings transaction, and share prices must be at least $0.01, allocation prices were not required to complete allocation transfers until December 2020. Particularly in the program's first few years, prices were under-reported for a relatively high percentage of share and allocation transfers (e.g., total value of shares transferred reported as $0.01). Share transfers that had reported low value could be due to, but not limited to, any of the following: entering a price per pound equivalent[11] instead of transaction price, reluctance to enter price information, gifts, transferring to a related account, part of a package deal (e.g., sale of shares with a permit, vessel, and/or other equipment), and/or unrecorded bartering of shares within the GT-IFQ or RS-IFQ programs. Share prices were analyzed to determine which prices are "valid" (i.e., they represent the actual market value of the shares transferred). Descriptive statistics were generated for share prices by year and share category. The distributions of share prices were generally skewed to the right. Maximum valid share prices were selected to exclude unusually high and infrequent share prices, while minimum valid share prices were selected based on low-value statistical outliers. Excluding these outliers is thought to result in a more accurate estimate of the average price.

The percentage of valid share prices was low in both the RS-IFQ and GT-IFQ programs, with between 511% and 69% of share prices reported determined to be valid since 2012. Within share categories, tilefish (TF) shares typically have the lowest percentage of valid share prices, with only 30% seen in 2018 (Table 2.1.1). Substantial changes occurred in 2013 when NMFS made a concerted effort to educate participants about the importance of share price information when analyzing the program. By 2014, 67% of the share transfers had valid prices. A reduction in valid share prices was seen in 2018, which could have been a response the quota increases seen for RG, as well as a result of the strong hurricane season that occurred in the Gulf of Mexico (Gulf) toward the end of 2017. In 2013, shareholders were asked to provide a reason for transferring their shares. Specifically, they were asked to pick one of seven potential reasons for transferring shares: "Barter trade for allocation," "Barter trade for shares," "Gift," "Transfer to a related account," "Sale to another shareholder," "Package deal," and "No comment." Each year, "Sale to another shareholder" was the most commonly selected reason for a transfer in both the GT-IFQ (Table 2.1.2 and Table 2.1.3) and RS-IFQ (Table 2.1.4 and Table 2.1.5) programs. The majority of shares were also typically transferred for this reason. The two other reasons selected most often were "Transfer to a related account" and "No comment." The transfer reasons were used to refine the process of identifying price outliers and shed light on why the reported values were outliers. For example, when "Package deal" was selected, price per equivalent pound tended to be either extremely low (less than or equal to $1/lb) or extremely high ($80/lb to $660,000/lb). Price per pound for the "Gift" reason was typically low, near $1/lb, but also

[11] A price per pound equivalent is the share percentage that would equal one pound for that particular period. The exact share percentage that is equivalent to one pound depends on the total commercial quota and will change as the quota changes from year to year or within a year for any quota increases.

ranged up to over $20,000/lb. The "Transfer to a related account" reason typically had the lowest value to be entered at $0.01/lb, but also ranged as high as $310,000/lb.

Table 2.1.1. Percentage of valid share price information.

DWG	N	%
2010	53	33%
2011	44	46%
2012	34	44%
2013	30	57%
2014	38	61%
2015	40	47%
2016	37	66%
2017	23	74%
2018	15	44%

GG	N	%
2010	107	42%
2011	47	34%
2012	68	53%
2013	52	59%
2014	78	74%
2015	94	61%
2016	55	65%
2017	42	63%
2018	39	62%

RG	N	%
2010	111	42%
2011	76	45%
2012	124	61%
2013	106	73%
2014	107	74%
2015	150	70%
2016	81	69%
2017	90	77%
2018	53	63%

SWG	N	%
2010	76	39%
2011	42	40%
2012	41	42%
2013	49	60%
2014	33	52%
2015	62	64%
2016	26	46%
2017	25	56%
2018	27	49%

TF	N	%
2010	38	42%
2011	24	41%
2012	14	32%
2013	13	45%
2014	17	50%
2015	33	58%
2016	21	62%
2017	16	67%
2018	6	30%

GT-IFQ	N	%
2010	385	40%
2011	233	41%
2012	281	51%
2013	250	63%
2014	273	67%
2015	379	63%
2016	220	63%
2017	196	69%
2018	140	55%

RS	N	%
2007	21	19%
2008	22	52%
2009	38	51%

2010	36	46%
2011	28	36%
2012	36	44%
2013	47	62%
2014	47	52%
2015	62	52%
2016	58	62%
2017	84	72%
2018	53	54%

Table 2.1.2. GT-IFQ share transfer reason counts.

Share Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	-	7	16	4	1	-
Barter trade for shares	8	10	40	12	14	1
Gift	11	11	-	2	13	6
No comment	67	68	164	94	62	83
Package deal	22	22	8	4	7	34
Transfer to related account	66	44	91	55	36	24
Sale to another shareholder	223	247	287	136	151	108

Table 2.1.3. GT-IFQ percent of shares transferred for each transfer reason.

Share Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	-	0.97	1.28	0.03	0.01	-
Barter trade for shares	0.22	4.62	7.95	0.59	1.62	0.10
Gift	0.12	2.49	-	0.15	1.12	0.84
No comment	12.74	10.68	32.28	24.09	4.54	10.67
Package deal	3.62	3.40	0.87	0.35	0.03	8.00
Transfer to related account	12.88	11.06	46.58	12.42	5.10	3.26
Sale to another shareholder	14.76	39.73	61.22	19.06	9.28	24.97

Table 2.1.4. RS-IFQ share transfer reason counts.

Share Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for shares or allocation	6	6	4	-	1	2
Gift	-	6	-	3	3	9
No comment	12	17	47	29	35	36
Package deal	2	5	-	-	1	2
Transfer to related account	14	9	19	13	15	9
Sale to another shareholder	42	48	50	32	61	40

Table 2.1.5. RS-IFQ percent of shares transferred for each transfer reason.

Share Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for shares or allocation	1.92	0.33	0.07	-	0.02	0.02
Gift	-	1.08	-	0.08	0.35	0.14
No comment	0.38	1.94	6.10	2.22	3.86	0.93
Package deal	0.01	0.95	-	-	0.01	0.01
Transfer to related account	1.37	0.18	4.24	0.72	1.55	1.65
Sale to another shareholder	1.05	1.09	4.82	0.85	2.89	3.68

Allocation transfer prices are collected on a per pound basis. Transfers that had low or no price information may be due to, but not limited to, any of the following: reluctance to enter price information, gift, transferring to a related account, part of package deal, or bartering for shares and/or allocation in the IFQ program. Allocation prices were analyzed to determine which prices were deemed valid or representative of the program. Allocation prices were analyzed on a yearly basis and generally had a bimodal distribution that depicted a subset of transactions with low price information. The minimum allocation price was set to the lowest point between the bimodal distributions. The maximum allocation prices were selected to exclude unusually high and infrequent allocation prices, including all prices in excess of the maximum ex-vessel price reported.[12] Excluding these outliers is thought to result in an accurate estimate of the average price.

The percentage of valid allocation prices has improved since 2012 when only 34% of allocation transfer price were considered valid, but still remains low at 42% in 2018 for the GT-IFQ program (Table 2.1.6). Allocation transfer prices in the RS-IFQ program also saw improvement in representative allocation transfer prices from 31% in 2012 to 55% in 2018. As with share prices, the uptick in 2014 of valid reported allocation prices coincided with NMFS' outreach efforts to educate the participants on the benefits of providing valid allocation prices. In 2013, participants were asked to supply a reason for each allocation transfer. In both 2013 and 2014, the most commonly reported reasons were "No comment," followed by "Sale to another shareholder," and "Transfer to a related account" in both the GT-IFQ program (Table 2.1.7 and Table 2.1.8) and the RS-IFQ program (Table 2.1.9 and Table 2.1.10).

Table 2.1.6. Percentage of valid allocation price information.

DWG	N	%
2010	68	14%
2011	116	18%
2012	213	28%
2013	215	35%
2014	325	38%

GG	N	%
2010	150	16%
2011	303	24%
2012	631	36%
2013	705	41%
2014	1,015	45%

[12] Fishermen would be expected to lose money and be worse off if they pay more for the allocation than the price they receive for their landed fish, which is not consistent with economically rational behavior, all other things being equal.

2015	282	31%
2016	285	30%
2017	250	32%
2018	296	36%

2015	847	46%
2016	1,017	47%
2017	574	39%
2018	439	49%

RG	N	%
2010	153	14%
2011	482	31%
2012	746	39%
2013	827	47%
2014	1,337	58%
2015	1,331	54%
2016	1,391	47%
2017	898	51%
2018	668	49%

SWG	N	%
2010	75	12%
2011	117	21%
2012	279	31%
2013	354	39%
2014	443	44%
2015	529	49%
2016	870	55%
2017	545	48%
2018	474	47%

TF	N	%
2010	35	13%
2011	62	19%
2012	93	24%
2013	88	30%
2014	153	36%
2015	186	37%
2016	202	39%
2017	171	36%
2018	189	45%

GT-IFQ	N	%
2010	481	14%
2011	1,080	25%
2012	1,962	34%
2013	2,188	41%
2014	3,273	48%
2015	3,175	47%
2016	3,765	46%
2017	2,438	43%
2018	2,066	42%

RS	N	%
2007	155	19%
2008	152	22%
2009	283	34%
2010	344	20%
2011	476	22%
2012	781	31%
2013	1,068	39%
2014	1,382	48%
2015	1,562	46%
2016	1,891	51%
2017	1,982	54%
2018	2,051	55%

Table 2.1.7. GT-IFQ allocation transfer reason counts.

Allocation Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	167	98	101	28	32	19
Barter trade for shares	14	19	35	9	10	45
Gift	139	126	80	113	128	179
No comment	2,276	3,145	3,484	4,850	5,406	4,377
Package deal	60	77	23	41	22	22
Transfer to related account	1,075	1,043	1,211	1,409	1,671	1,838
Sale to another shareholder	1,549	2,317	1,879	1,764	2,031	2,127

Table 2.1.8. GT-IFQ pounds of allocation transferred for each transfer reason.

Allocation Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	175,545	175,545	214,922	38,546	42,186	24,505
Barter trade for shares	56,675	56,675	292,573	7,054	8,312	42,549
Gift	81,314	81,314	38,276	202,270	177,616	157,690
No comment	5,362,270	5,362,720	6,196,445	11,990,710	12,297,855	10,101,566
Package deal	467,153	467,153	107,961	80,734	37,519	43,034
Transfer to related account	2,651,134	2,651,134	3,819,045	4,043,051	3,936,138	5,584,058
Sale to another shareholder	3,763,044	3,763,044	4,469,944	4,331,621	5,281,279	4,733,629

Table 2.1.9. RS-IFQ allocation transfer reason counts.

Allocation Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	41	21	28	33	13	23
Barter trade for shares	3	4	8	6	2	3
Gift	38	28	37	20	31	41
No comment	1,374	1,560	1,854	2,305	2,227	2112
Package deal	6	22	7	2	5	2
Transfer to related account	411	323	485	468	551	640
Sale to another shareholder	878	902	968	846	872	881

Table 2.1.10. RS-IFQ pounds of allocation transferred for each transfer reason.

Allocation Transfer Reason	2013	2014	2015	2016	2017	2018
Barter trade for allocation	93,371	13,031	60,320	83,812	20,083	38,353
Barter trade for shares	6,854	9,950	63,794	16,692	784	4,051
Gift	91,734	16,887	39,124	15,891	22,248	23,483
No comment	2,802,597	3,088,708	5,638,898	5,809,143	5,448,860	4,831,546
Package deal	11,450	51,792	32,703	1,906	13,650	20,001
Transfer to related account	1,281,863	823,707	1,321,814	856,367	1,021,521	1,409,156
Sale to another shareholder	1,473,599	1,545,478	2,097,881	1,745,663	1,770,663	1,639,936

Unlike for share transfers, there were no high prices associated with the transfer reason "Package deal"; in fact, most of the prices were $0/lb. When "No comment" was provided as the transfer reason, the price ranged from $0/lb to $10/lb (the maximum the system allows), the same range as seen for all transfer reasons. Therefore, transfer reasons were not as helpful in explaining variability in allocation prices as they were with explaining variability in share prices.

Mitchell (2016) identified two data gaps with respect to the collection of ownership data in the GT-IFQ and RS-IFQ programs. Accurate estimates of market concentration are critical with respect to determining whether markets are competitive. This is true for allocation and share markets as well as product (seafood) markets. Based on his conclusion that market concentration is most accurately represented at the affiliated entity level, as opposed to the individual IFQ account or Lowest Known Entity (LKE) level, Mitchell recommended that the collection of detailed ownership data (i.e., the percentage ownership by each individual in every business that participates in the reef fish fishery) be expanded from entities with commercial Gulf reef fish permit holders, IFQ shares, and annual allocation to dealers as well in order to determine the degree of vertical integration in these markets. Vertical integration exists when one business controls multiple levels of production, such as when a seafood dealer or processor owns an ice house or tackle/bait shop, vessels, a dock, and a retail market). The lack of such data may lead to underestimating concentration in the shares, allocation, and product markets and thus overestimating the degree of competition in these markets. In turn, current assessments of whether existing share and allocation caps are performing as intended may be inaccurate. Federally permitted dealers only recently have been required to provide detailed ownership data in the Southeast Region. Additional research is needed to use the dealer ownership data in combination with vessel and IFQ account ownership data to determine the extent to which vertical integration may exist in the RS-IFQ and GT-IFQ programs.

In addition, detailed ownership data is not collected for "joint" owners (e.g., two or more members of a family own a permit or account but have not formally created a partnership or corporation) of reef fish permits and IFQ accounts. Instead, NMFS' current protocol is to assume the individuals own equal percentages of the business and thus the accounts held by the business. Although likely true in some cases, the validity of this assumption cannot currently be discerned. To the extent the assumption is inaccurate, assessments of market concentration and competition and the performance of share and allocation caps will also be inaccurate.

The findings in Mitchell (2016), Keithly (2017), and Asche (2020) suggest that analyses of market concentration, competition, and demand/economic value are currently hampered by the lack of retail level price data (i.e., scanner data) regarding fish harvested in the IFQ programs. Specifically, confidence in the accuracy of these types of analyses would be greatly enhanced if retail price data and data regarding the final point of sale (e.g., restaurants, grocery stores, export markets, etc.) were available as they would help better define the boundaries of relevant markets, determine the products that consumers consider to be "good" substitutes for the seafood harvested through the IFQ programs, and thereby better discern the effects of the IFQ programs on consumers and others in the product distribution chain as well as program participants. Scanner data is typically very costly to obtain. Nonetheless, NMFS is currently investigating options to obtain scanner data for a variety of seafood products.

Another data gap area identified is with reporting of IFQ violations. While the NMFS receives information regarding violations and seizures from federal agents, not all state agencies supply this information to NMFS. This commonly occurs when state regulations match federal regulations, and violations are enforced on the state level rather than federal.

2.2 Reporting Burden

The estimate of the reporting burden for the RS-IFQ and the GT-IFQ programs is updated every 3 years. Nearly all information for the program is collected electronically through the web-based system and satellite-linked vessel monitoring systems. Additionally, there is a 24-hour call line for landing notifications, and paper form submissions for landing corrections, account applications, and landing transactions under catastrophic conditions. The time to fill out the various forms is between 1 minute and 6 minutes. The IFQ account application, which is filled out for any shareholder account that is not associated with a permit, occurs every 2 years and takes about 15 minutes.

Landings data are also collected through the Southeast Fisheries Science Center's (SEFSC) Coastal Logbook (CLB) program and state trip tickets (dealer reports). Any fisherman whose vessel has a federal Gulf commercial reef fish permit must submit a trip report form (coastal logbook) within 7 days after each trip on which Gulf reef fish were caught. The coastal logbooks collect information on all caught species, regardless of whether it is landed or federally managed. Each logbook record contains information about the vessel, the operator, trip dates (start and unload), days at sea, crew, offload location, dealer, state trip ticket number, gear and effort information, and catch. Information regarding trip expenses (e.g., cost of ice, bait, groceries, and labor), price and quantity of fuel used, trip revenue (ex-vessel value), and whether the trip was taken by a hired captain or owner-operator is also collected for a sample of trips each year. Any dealer who purchases fish managed by the Reef Fish Fishery Management Plan (Reef Fish FMP) is required to report electronically through their state's trip ticket program on a weekly basis. The state trip tickets report information about the trip (trip start date, vessel logbook number, gear, area fish caught) and the landings (landing date, landing location, dealer, species landed, amount, size, and condition), and ex-vessel value. State trip tickets and vessel logbooks collect more information than is collected through the IFQ landing transactions, but also collect some of the same information collected through the IFQ program, specifically with respect to the landing of IFQ species (e.g., pounds landed, ex-vessel price and value, vessel ID, dealer, landing date, etc.). As a result, these data collection programs result in duplicative reporting for the fishermen (coastal logbook and IFQ) and dealers (trip ticket and IFQ). However, some overlap in the data collection programs may be desirable as it allows analysts to compare data provided from multiple sources and determine which data are the most accurate and therefore would lead to the most accurate estimates.

Timeliness is key in the IFQ programs, as deductions in allocation for landings occur in near real time. Delaying the input of that information may lead to inaccurate account balances prior to fishing trips, which in turn could lead to increased violations for insufficient allocation.

2.3 Conclusions

This analysis shows that there is a distinct data gap when collecting share and allocation price information. While the program has made great strides in collecting a higher percentage of valid data, there is still room for improvement. The addition of the transfer reasons for both share and allocation transfers has helped explain why prices may vary so widely in the program.

A possible avenue to improve price information in share and allocation transfers is to allow the system to further limit the prices placed on each transaction, perhaps in coordination with the reason selected. Alternatively, a mechanism that allows the price to be entered but warns the user it is outside of a typical range may be a better option. This would allow higher prices to be entered, as often happens when a transfer is part of a larger package deal involving the sale of additional assets (e.g., vessel, gear, etc.), but would remind the user of the benefits of the transfer price information. Any such mechanism to limit or warn the user would require constant monitoring to ensure the values are consistent with market conditions.

The Southeast Regional Office (SERO) and the SEFSC are aware of the duplicative reporting between the IFQ, the coastal logbooks, and the trip ticket programs. All three programs are run on different operating systems for different purposes, which makes the elimination of duplicative reporting difficult. The IFQ system needs real-time reporting of IFQ species to deduct allocation from the accounts in a timely manner, but it does not collect any other additional information. In 2012, IFQ staff sought public opinion on including some additional information in the IFQ landing transaction, such as primary gear, coastal logbook number, and trip ticket number. The idea was to compare the three data sets more comprehensively, but overwhelming opinion from constituents is that this would be unnecessarily duplicative and time-consuming. Therefore, an optional trip ticket number was added to the IFQ program landing transaction form, as well as a method to enter the trip ticket number at a later time, and mandatory reporting of trip ticket numbers on IFQ landing transactions was not pursued. The SEFSC is still looking into methods to better reconcile the differences in data among these three data sources. Once that has been analyzed, both SERO and SEFSC will re-visit possible means to reducing duplicative reporting. Before the information can be combined into one database, there must be an understanding of why information is not reported exactly the same between data sources. Differences in values reported may be due, but not limited, to different understandings about reporting catch sold back to the crew, how seizures are processed, and accounting for fish that spoiled and therefore were not sold to a dealer. Until these reasons are better understood and reporting more standardized, it may not be beneficial to reduce the duplicative reporting, as comparing these records highlights areas for improvement.

CHAPTER 3. ENVIRONMENT

3.1 Biological Environment

Reef fish are widely distributed in the Gulf of Mexico (Gulf), occupying both pelagic and benthic habitats during their life cycle. Habitat types and life history stages can be found in more detail in the final Generic Essential Fish Habitat Amendment to multiple fishery management plans (FMP) of the Gulf of Mexico (GMFMC 2004a) and the final Generic Essential Fish Habitat Amendment 3 to multiple FMPs of the Gulf of Mexico (GMFMC 2005) including the FMP for Reef Fish Resources of the Gulf of Mexico (Reef Fish FMP). These amendments are hereby incorporated by reference.

In general, both eggs and larval stages of species in the Gulf's grouper-tilefish and red snapper individual fishing quota (GT-IFQ and RS-IFQ) programs are planktonic. Larval fish feed on zooplankton and phytoplankton. Juvenile and adult reef fish are typically demersal, and are usually associated with bottom topographies on the continental shelf (less than 328 feet [100 meters]) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. Juvenile red snapper are common on mud bottoms in the northern Gulf, particularly from Texas to Alabama. Also, juvenile red snappers and some groupers (e.g., red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 2004a, 2005).

3.1.1 Stock Status

Stocks are evaluated as to whether they are undergoing overfishing or if they are overfished (Table 3.1.1.1). An overfished status means the population is too low and an undergoing overfishing status means too many fish are being harvested. In years when a stock is assessed, the stock is subject to overfishing if fishing mortality (F) exceeds the maximum fishing mortality threshold (MFMT). In years when the stock is not assessed, the stock is subject to overfishing if landings exceed the overfishing limit (OFL). Because overfishing is now re-evaluated each year instead of only in years when there is a stock assessment, this status could change on a year-to-year basis. In years when a stock is assessed, an overfished determination is made when the population is driven below the maximum sustainable yield derived reference point for that stock. Prior Reef Fish Amendments have set overfished status determination criteria (SDC) for IFQ species red snapper, red grouper, gag grouper, and black grouper. In 2018, Reef Fish Amendment 44 (GMFMC 2017) revised the overfished SDC for seven reef fish species, including IFQ species red snapper, red grouper, and gag, which changed the overfished status for red snapper and the potential overfished status for red grouper. Reef Fish Amendment 48 is under review by the Secretary of Commerce and if approved would specify the overfished SDC for other reef fish species that do not currently have a minimum stock size threshold (MSST), including the rest of the IFQ species.

Table 3.1.1.1. Stock status of IFQ-managed species grouped by family and complex.

Common Name	Scientific Name	Stock Status Overfishing	Stock Status Overfished	Most recent assessment or SSC workshop
Family Malacanthidae – Tilefishes				
tilefish (golden)	*Lopholatilus chamaeleonticeps*	N	N	SEDAR 22 2011b
blueline tilefish	*Caulolatilus microps*	Unknown	Unknown	
goldface tilefish	*Caulolatilus chrysops*	Unknown	Unknown	
Family Serranidae – Groupers				
SWG				
red grouper	*Epinephelus morio*	N	N	SEDAR 61 2019
gag	*Mycteroperca microlepis*	N	N	SEDAR 33 Update 2016
black grouper	*Mycteroperca bonaci*	N	N	SEDAR 19 2010
yellowmouth grouper	*Mycteroperca interstitialis*	N	Unknown	SEDAR 49 2016
scamp	*Mycteroperca phenax*	Unknown	Unknown	
yellowfin grouper	*Mycteroperca venenosa*	Unknown	Unknown	
DWG				
snowy grouper	*Hyporthodus niveatus*	N	Unknown	SEDAR 49 2016
speckled hind	*Epinephelus drummondhayi*	N	Unknown	SEDAR 49 2016
yellowedge grouper	*Hyporthodus flavolimbatus*	N	N	SEDAR 22 2011a
warsaw grouper	*Hyporthodus nigritus*	N	Unknown	
Family Lutjanidae – Snapper				
red snapper	*Lutjanus campechanus*	N	N	SEDAR 52 Update 2018

Red Snapper

Red snapper is not considered overfished or undergoing overfishing, although it is in a rebuilding plan. The National Marine Fisheries Service (NMFS) conducted assessments of Gulf red snapper almost every year from the late 1980s to 1999. In 1999, it was determined more time was needed between assessments to better assess trends in stock size and fishing mortality. The first assessment was conducted in 1986 (Parrack and McClellan 1986) and concluded red snapper was overfished and undergoing overfishing. Additional assessments conducted in the 1990s and in the 2000s; all reached the same conclusions - too many fish were being harvested by directed fisheries and too many juvenile fish were caught as bycatch in the shrimp fishery. However, following the implementation of the RS-IFQ program in 2007 and the completion of Southeast Data Assessment and Review (SEDAR) 31 benchmark assessment (2013), the Scientific and Statistical Committee (SSC) concluded as of 2009, overfishing was no longer occurring, but the stock was still considered overfished. A SEDAR 31 update assessment (2015), determined that although the spawning stock biomass had increased and the stock was not undergoing overfishing, it was still considered overfished. Additionally, it concluded that red snapper overfishing had not been occurring since 2009. With the implementation of Reef Fish Amendment 44 (GMFMC 2017) and the revised MSST formula to calculate an overfished status, the Gulf red snapper stock was reclassified as not overfished but still rebuilding (Table 3.1.1.1). Biomass estimates from the most recent red snapper assessment (SEDAR 52 2018), showed the western Gulf population continues to rebuild, while the eastern Gulf population has leveled off over the last few years (boundary Mississippi River). Even though the number of older fish present in the stock has increased Gulf-wide, the stock is not expected to be rebuilt until 2032. The Great Red Snapper Count, which estimates the absolute abundance of red snapper in the Gulf, should be completed in 2020. This information will help inform the assessment for red snapper planned begin in late 2020 (SEDAR 74).

Groupers

Red Grouper

Currently, red grouper is not considered overfished or undergoing overfishing. The first assessment of the Gulf red grouper was conducted in 1991 (Goodyear and Schirripa 1991). This assessment evaluated and interpreted trends in data sources, evaluated recent regulatory changes, and estimated mortality through catch curve analysis. A subsequent assessment conducted in 1993 (Goodyear and Schirripa 1993) did not find much change in mortality and stock status. However, a review conducted in 1994 (Goodyear 1994) found sampling bias was introduced into the stock assessments due to catch ages being determined from growth models based on data from length-stratified sampling, size-selective gears, or fisheries restricted by minimum sizes. It was determined that all previous assessments were invalid. Major analysis revisions, in addition to more sampling indices, were included in the next assessment in 1999, prepared by Schirripa, Legault, and Ortiz (1999). Both models used in the 1999 assessment suggested that the stock was overfished and overfishing was occurring in 1997, the terminal year of data used. A Reef Fish Amendment was begun to address rebuilding the stock, but due to timing, the ten-year rebuilding plan was put in place with Secretarial Amendment 1 (GMFMC 2004b). During development of Secretarial Amendment 1, an updated assessment was reviewed in September, 2002 (NMFS 2002). It was believed at this time that the stock was showing some signs of recovery, as the stock was no longer overfished and suggested that overfishing was no longer occurring. In 2006, red grouper was first assessed under the umbrella of the SEDAR process (SEDAR 12 2006). Based on SEDAR 12, the SSC concluded the stock was not overfished and was not experiencing overfishing. Subsequent assessments reached the same conclusion and the stock has not been considered overfished or undergoing overfishing since. However, after SEDAR 42 (2015), fishermen testified to the Gulf of Mexico Fishery Management Council (Council) in 2018 that red grouper were harder to catch and that they thought the acceptable biological catch (ABC) was too high. They expressed concern that the stock condition may be declining in light of fewer legal-size and larger individuals throughout the species' range on the West Florida shelf. In addition, the severe red tide conditions that occurred in summer and fall of 2014 and 2018 off the Florida west coast could have adversely affected the red grouper stock.[13,14] SEDAR 61 (2019), which used data through 2017, incorporated the latest red tide data and assumed the 2018 event was similar to the 2005 red tide event when determining the OFL. This assessment determined the stock was currently not undergoing overfishing or overfished due to the revised MSST formula to calculate an overfished status implemented with Reef Fish Amendment 44 (GMFMC 2017; Table 3.1.1.1). However, the spawning stock biomass continues to be below the target and the terminal year biomass was at an all-time low. Furthermore, the stock was only not considered overfished due to the revised formula. The stock would have been considered overfished under the previous MSST value.

[13] Florida Fish and Wildlife Conservation Red Tide Webpage: http://myfwc.com/research/redtide/
[14] Red Tide in Florida and Texas, National Ocean Service Webpage: https://oceanservice.noaa.gov/news/redtide-florida/

Gag Grouper

While gag grouper is not currently considered overfished or undergoing overfishing, there are concerns about the status of the stock as below average recruitment has been occurring since 2010. The gag stock was first assessed in 1997 when the stock assessment concluded that gag, although not overfished, may be undergoing overfishing (Schirripa and Legault 1997). In 2006, gag grouper was first assessed under the umbrella of the SEDAR process (SEDAR 10 2006). The SSC reviewed SEDAR 10 and a subsequent 2007 reanalysis with corrected dead discard estimates (NMFS 2007) and concluded that the gag stock was undergoing overfishing. An update assessment (SEDAR 10 Update 2009) indicated the gag stock size had declined since 2005. A large part of the decline was attributed to an episodic mortality event in 2005, most likely associated with red tide. The update assessment, as interpreted by the SSC, also indicated the Gulf gag stock was both overfished and undergoing overfishing. Reef Fish Amendment 32 (GMFMC 2011a) subsequently established a formal rebuilding plan for gag not to exceed 10 years. A benchmark assessment for gag completed in 2014 (SEDAR 33 2014) indicated that the gag stock was no longer overfished or undergoing overfishing, and had rebuilt to above its maximum sustainable yield level. However, a major red tide event occurred off of the Florida west coast in the region of greatest gag abundance beginning in 2014. SEDAR 33 Update (2016) included the 2014-2015 red tide event in the analysis and the SSC still determined the stock was not overfished or undergoing overfishing (Table 3.1.1.1). Despite this, the biomass was not increasing as optimistically as predicted by projections from SEDAR 33. An index of recruitment success for northeastern Gulf gag grouper by year used in the update projected below average recruitment since 2010. The SSC felt that there was considerable uncertainty with the results from the update assessment and cautioned the Council to take a conservative management approach. Because of concerns about the condition of the stock, the Council has maintained the annual catch limit (ACL) that has been in place since 2015. An operational assessment is planned for gag grouper in 2021 (SEDAR 72).

Black Grouper

Black grouper is not considered overfished or undergoing overfishing. Based on genetic studies, black grouper is considered a single stock in southeast U.S. waters. Because of this, the black grouper stock is assessed between the Gulf and South Atlantic regions and the ACL is split between both regions. Before 2010, black grouper had not had a formal stock assessment where all of the data and the model had undergone outside review. Previous growth parameters and mortality had been estimated, however, in some cases the analysis was biased due to misidentification of the species. In 2010, black grouper was first assessed under the umbrella of the SEDAR process in (SEDAR 19 2010). The assessment found that the stock was neither overfished nor undergoing overfishing (Table 3.1.1.1). SEDAR 48 (2017) was supposed to update the black grouper stock status, however, there were concerns regarding uncertainty in the commercial landings history due to misidentification with gag grouper and uncertainty in the recreational estimates as well. The assessment process was suspended until such a time that these issues can be resolved, or alternative assessment methods investigated.

Yellowedge Grouper

The first assessment of yellowedge grouper was completed in 2002 (Cass-Calay and Bahnick 2002), but was inconclusive regarding the status of the stock. With the improvements in the information content for yellowedge grouper since the first assessment, a new assessment was completed in 2011. The SSC reviewed the first assessment conducted under the SEDAR process (SEDAR 22 2011a) and concluded the stock was neither overfished nor undergoing overfishing (Table 3.1.1.1).

Snowy Grouper, Speckled Hind, and Yellowmouth Grouper

SEDAR 49 (2016) utilized the Data-Limited Methods Toolkit to try and assess eight species including GT-IFQ species snowy grouper, speckled hind, and yellowmouth grouper. However, before SEDAR 49 was completed, yellowmouth grouper was removed from consideration due to low catch levels, concerns about misidentification, and data confidentiality. Later, it was determined speckled hind and snowy grouper could not be assessed due to shifts in the fishery, that prevented analyses using indices of abundance or length data (Table 3.1.1.1).

Tilefishes

Golden Tilefish

Tilefish was not assessed prior to SEDAR 22 (2011b). SEDAR 22 provided information to set an OFL and ABC, but the SSC determined the assessment did not capture the dynamics of the Gulf tilefish stock and was therefore, not adequate for management decisions (Table 3.1.1.1).

Non-Assessed Species

Scamp, Yellowfin Grouper, Warsaw Grouper, Blueline Tilefish, and Goldface Tilefish

These species have not been assessed at this time. Therefore, their overfished and overefishing stock status is unknown (Table 3.1.1.1). An assessment is currently ongoing for scamp (SEDAR 68).

3.1.2 Catch Levels

Red Snapper

Since the RS-IFQ program began in 2007, the total ACL has increased from 5 million pounds whole weight (mp ww) to over 13 mp ww as the stock has been rebuilding (Table 3.1.2.1). By 2012, the total ACL had increased to 8.080 mp ww (GMFMC 2012). A scheduled total ACL increase in 2013 to 8.690 mp ww was cancelled due to an overharvest in 2012 by the recreational sector. After analysis to see if the overharvest of red snapper impacted the rebuilding plan, the 2013 total ACL was increased to 8.460 mp ww (GMFMC 2013a). In July 2013, the Council reviewed SEDAR 31 (2013), which showed that the red snapper stock was rebuilding faster than projected, partly due to strong recruitment in some recent years. After incorporating a buffer to reduce the possibility of an overage, the Council increased the 2013 ACL to 11.0 mp ww (GMFMC 2013b). After the Council reviewed SEDAR 31 Update (2015), ACLs were set for 2015-2017+ (GMFMC 2015). The commercial sector is allocated 51% of the total ACL with the distributed shares (quota) equaling the commercial ACL allocation. Since 2012, the commercial sector has harvested on average 98.7%, or almost all of the commercial quota (Table 3.1.2.1). From 2012-2018, the average weight per fish harvested has been 4.2 mp gutted weight (gw) (Table 3.1.2.2). Average weights were estimated using data from the Southeast Fisheries Science Center's (SEFSC) Trip Interview Program (TIP). TIP is a shore-based sampling program to collect detailed data for individual trips with samplers placed strategically throughout the Southeast. Fishing trips are selected to be representative of each region with every effort to sample from as many vessels and gear types as possible. A random subsample of fish measurements is obtained in roughly the same proportion for each species comprising the entire landings. These data include weight and/or length data of individual fish intercepted during dock-side intercepts of commercial fishers, and all data were converted to pounds gutted weight using standardized conversion factors and equations used in SEDAR 52 (2018).

Table 3.1.2.1. Red snapper total ACL, commercial quota, commercial landings, percent (%) commercial quota caught, and averages of each during fishing years 2012-2018.

Fishing Year	Total ACL (lbs ww)	Commercial Quota (lbs gw)	Commercial Landings (lbs gw)	% Commercial Quota caught
2012	8,080,000	3,712,613	3,636,395	97.9
2013	11,000,000	5,054,054	4,908,598	97.1
2014	10,400,000	5,054,054	5,016,056	99.2
2015	14,300,000	6,570,270	6,472,261	98.5
2016	13,960,000	6,097,297	6,057,498	99.3
2017	13,740,000	6,312,613	6,287,083	99.6
2018	13,740,000	6,312,613	6,285,704	99.6
Average	12,174,286	5,587,645	5,523,371	98.7

Source: SERO IFQ database. Assessed May 14, 2020.

Table 3.1.2.2. Average commercial landed weight per GT-IFQ and RS-IFQ species, sample standard deviation, and number of samples (2012-2018).

Common Name	Scientific Name	Average Weight per Species (lbs gw)	Standard Deviation	Number of Samples
Family Malacanthidae – Tilefishes				
tilefish (golden)	*Lopholatilus chamaeleonticeps*	4.9	4.3	8,701
blueline tilefish	*Caulolatilus microps*	5.1	2.0	1,190
goldface tilefish	*Caulolatilus chrysops*	1.8	1.5	43
Family Serranidae – Groupers				
SWG				
red grouper	*Epinephelus morio*	6.9	3.6	76,802
gag	*Mycteroperca microlepis*	13.7	7.3	20,114
black grouper	*Mycteroperca bonaci*	34.0	18.9	1,093
yellowmouth grouper	*Mycteroperca interstitialis*	5.0	2.0	517
scamp	*Mycteroperca phenax*	5.2	2.7	21,999
yellowfin grouper	*Mycteroperca venenosa*	12.4	6.1	92
DWG				
snowy grouper	*Hyporthodus niveatus*	10.2	7.9	2,718
speckled hind	*Epinephelus drummondhayi*	12.6	8.5	1,783
yellowedge grouper	*Hyporthodus flavolimbatus*	10.5	5.8	17,951
warsaw grouper	*Hyporthodus nigritus*	38.8	21.7	237
Family Lutjanidae – Snapper				
red snapper	*Lutjanus campechanus*	4.2	3.1	208,581

Source: SEFSC TIP data. Accessed April 28, 2020.

Groupers

Red Grouper

In 2012, the total ACL was raised from 7.72 to 7.93 mp gw with scheduled sector quota increases through 2015 (GMFMC 2011a; Table 3.1.2.3). Based on catch advice from the SSC after reviewing SEDAR 42 (2015), the Council raised the ACL to 10.77 mp gw for 2016+ (GMFMC 2016; Table 3.1.2.3). The commercial sector is allocated 76% of the total ACL with the distributed shares (quota) equaling the commercial ACL allocation. Since 2012, an average of 70% of the quota has been landed. In recent years, less than 50% of the program's quota has been landed per year (Table 3.1.2.3). In 2017, this could have been a result of hurricanes that impacted the Gulf, as well as a large red grouper quota increase, which was implemented late in 2016. Furthermore, severe red tide conditions that occurred in summer and fall of 2014 and 2018 off the Florida west coast could have adversely affected not only red grouper landings, but the stock as well. As shown in Table 3.1.4, commercial quotas for red grouper have remained unchanged between 2016 and 2018, but the percentage of quota landed continued to decrease. The average weight per fish harvested from 2012-2018 has been 6.9 lbs gw (Table 3.1.2.2). Average weights were estimated using data from SEFSC TIP. All data were converted to pounds gutted weight using standardized conversion factors and equations used in SEDAR 42 (2015).

Gag Grouper

In 2012, the total ACL was reduced from 3.82 mp gw to 2.02 mp gw with scheduled sector quota increases through 2015 (GMFMC 2011a; Table 3.1.2.3). However, due to uncertainty in discards and the low amount of commercial quota in the beginning of the rebuilding plan set with the Amendment 32, the commercial quotas were reduced an additional 14% per year (GMFMC 2011a). The SEDAR 33 Update (2016) included the 2014-2015 red tide event in the analysis and still determined the stock was not overfished or undergoing overfishing. However, the biomass was not increasing as optimistically as predicted with SEDAR 33 (2014). The SSC suggested that there was considerable uncertainty with the results of the gag update assessment and cautioned the Council to take a conservative approach. While the stock is considered to be rebuilt, there are still concerns about the condition of the stock, and the Council has maintained the total ACL and commercial quota that has been in place since 2015. The commercial sector is allocated 39% of the total ACL with the distributed shares (quota) equaling the commercial ACL allocation. Since 2012, an average of 70% of the gag quota has been landed. In recent years, less than 50% of the gag quota has been landed per year (Table 3.1.2.3). These lower landings could have been a result of hurricanes that impacted fishing in the Gulf, as well as severe red tide conditions that occurred in summer and fall of 2014 and 2018 off the Florida west coast. As shown in Table 3.1.4, commercial quotas for gag have remained unchanged since 2015, but the percentage of quota landed has steadily decreased. The average weight per fish harvested from 2012-2018 has been 13.7 lbs gw (Table 3.1.2.2). Average weights were estimated using data from SEFSC TIP. All data were converted to pounds gutted weight (lbs gw) using standardized conversion factors and equations used in SEDAR 33 Update (2016).

Deep-Water Grouper (DWG) – yellowedge, snowy, warsaw, and speckled hind

In 2012 the total ACL was raised from 1.02 mp gw to 1.216 mp ww with scheduled decreases through 2016 (GMFMC 2011b; Table 3.1.2.3). There is not a defined allocation for the deep-water grouper complex, however, there is approximately a 7% buffer between the commercial quota and the total ACL to allow for recreational harvest (Table 3.1.2.3). Deep-water groupers are found at depths and distances from shore beyond the capability of most recreational vessels. Consequently, these species are infrequently targeted for recreational harvest. On average, 84% of the DWG commercial quota has been landed since 2012, and has remained fairly constant per year (Table 3.1.2.3). From 2012-2018, the composition of DWG complex landings consisted mostly of yellowedge grouper (65.4%) with snowy, warsaw and speckled hind comprising ~10% or less per species (Table 3.1.2.3). The average weight per deep water grouper species from 2012-2018 has ranged from 10.2 lbs gw to 38.8 lbs gw, with warsaw being the largest and the other species average weights being similar around 10 lbs gw (Table 3.1.2.2). Average weights were estimated using data from SEFSC TIP. All data were converted to pounds gutted weight using standardized conversion factors and equations used in SEDAR 49 (2016) for snowy and speckled hind, SEDAR 22 (2011a) for yellowedge, and from FishBase.org for warsaw.

Other Shallow Water Grouper (SWG) - scamp, black, yellowfin, and yellowmouth

In 2012, the total ACL was raised from 0.570 mp gw to 0.688 mp gw with scheduled increases through 2015 (GMFMC 2011b). In addition, red hind and rock hind were removed from the other shallow water grouper complex. There is not a defined allocation for the other shallow water grouper complex, however, there is approximately a 25% buffer between the commercial quota and the total ACL to allow for recreational harvest. While these species are targeted more frequently by the recreational sector, the buffer is sufficient to allow the historical recreational fishery to continue. Since 2012 an average of 54% of the other SWG quota has been landed. However, in recent years, less than 50% of the program's quota has been landed per year (Table 3.1.2.3). This could have been a result of hurricanes and red tide events that occurred in the Gulf. As shown in Table 3.1.2.3, the commercial quotas have remained unchanged since 2015, but the percentage of quota landed has decreased since 2016. From 2012-2018, the composition of other SWG complex landings consisted mostly of scamp (39%) with black comprising ~10%, and yellowfin and yellowmouth comprising less than 1% (Table 3.1.2.3). The average weight per other shallow water grouper species harvested has ranged from 5 lbs gw to 34 lbs gw, with black being the largest (Table 3.1.2.2). Average weights were estimated using data from SEFSC TIP. All data were converted to pounds gutted weight using standardized conversion factors and equations used in SEDAR 19 (2010) for black and SEDAR 49 (2016) for yellowmouth. Scamp and yellowfin were based on black grouper conversion factors and equations used.

Table 3.1.2.3. Red, gag, deep water grouper complex, and other shallow water grouper complex total ACLs, commercial quotas, commercial landings, percent commercial quota caught, and averages of each during fishing years 2012-2018.

Fishing Year	Total ACL (lbs gw)	Commercial Quota (lbs gw)	Commercial Landings (lbs gw)	% Commercial Quota Landed
Red Grouper				
2012	7,720,000	5,370,000	5,217,205	97.2
2013	7,720,000	5,530,000	4,594,672	83.1
2014	7,720,000	5,630,000	5,497,993	97.7
2015	7,720,000	5,720,000	4,784,992	83.7
2016	10,770,000	7,780,000	4,631,388	59.5
2017	10,770,000	7,780,000	3,377,210	43.4
2018	10,770,000	7,780,000	2,404,300	30.9
Average	9,027,143	6,512,857	4,358,251	70.8
Gag Grouper				
2012	2,020,000	567,000	525,066	92.6
2013	2,451,000	708,000	579,664	81.9
2014	2,830,000	835,000	689,513	82.6
2015	3,120,000	939,000	554,941	59.1
2016	3,120,000	939,000	777,190	82.8
2017	3,120,000	939,000	443,156	47.2
2018	3,120,000	939,000	451,914	48.1
Average	2,825,857	838,000	574,492	70.6
DWG Complex: yellowedge grouper, snowy grouper, warsaw grouper, speckled hind				
2012	1,216,000	1,127,000	963,835	85.5
2013	1,207,000	1,118,000	912,923	81.7
2014	1,198,000	1,110,000	1,048,142	94.4

Fishing Year	Total ACL (lbs gw)	Commercial Quota (lbs gw)	Commercial Landings (lbs gw)	% Commercial Quota Landed
2015	1,189,000	1,101,000	911,339	82.8
2016	1,105,000	1,024,000	867,040	84.7
2017	1,105,000	1,024,000	821,899	80.3
2018	1,105,000	1,024,000	817,452	79.8
Average	1,160,714	1,075,429	906,090	84.2
Yellowedge Grouper			**Snowy Grouper**	
Year	**Landings**	**% Quota**	**Landings**	**% Quota**
2012	667,785	59.2	168,759	15.0
2013	673,349	60.2	108,689	9.7
2014	773,621	69.7	159,857	14.4
2015	735,218	66.8	108,980	9.9
2016	709,349	69.3	94,830	9.3
2017	677,926	66.2	87,587	8.5
2018	677,310	66.1	89,416	8.7
Average	702,080	65.4	116,874	10.8
Warsaw Grouper			**Speckled Hind**	
Year	**Landings**	**% Quota**	**Landings**	**% Quota**
2012	86,212	7.6	43,344	3.8
2013	103,074	9.2	34,922	3.1
2014	75,426	6.8	72,241	6.5
2015	55,502	5.0	55,550	5.0
2016	44,635	4.3	41,151	4.0
2017	44,362	4.3	51,061	5.0
2018	35,976	3.5	60,618	5.9
Average	63,598	5.8	51,270	4.8
Other SWG Complex: scamp, black grouper, yellowfin grouper, yellowmouth grouper				
2012	688,000	509,000	300,367	59.0
2013	700,000	518,000	307,846	59.4
2014	707,000	523,000	263,251	50.3
2015	710,000	525,000	282,338	53.8
2016	710,000	525,000	358,163	68.2
2017	710,000	525,000	239,046	45.5
2018	710,000	525,000	224,161	42.7
Average	705,000	521,429	282,167	54.1
Scamp			**Black Grouper**	
Year	**Landings**	**% Quota**	**Landings**	**% Quota**
2012	249,320	49.0	47,537	9.3
2013	242,170	46.8	56,750	11.0
2014	167,840	32.1	60,555	11.6
2015	182,108	34.7	54,831	10.4
2016	284,987	54.3	48,788	9.3

Fishing Year	Total ACL (lbs gw)	Commercial Quota (lbs gw)	Commercial Landings (lbs gw)	% Commercial Quota Landed
2017	162,435	30.9	37,032	7.1
2018	142,787	27.2	34,806	6.6
Average	204,521	39.3	48,614	9.3
Yellowfin Grouper			**Yellowmouth Grouper**	
Year	**Landings**	**% Quota**	**Landings**	**% Quota**
2012	739	0.1	506	0.1
2013	856	0.2	959	0.2
2014	568	0.1	1,285	0.2
2015	442	0.1	1,046	0.2
2016	709	0.1	754	0.1
2017	152	0.03	390	0.1
2018	440	0.1	260	0.05
Average	558	0.1	742	0.1

Source: SERO IFQ database. Assessed May 14, 2020.

Tilefishes: Golden, Blueline, and Goldface

In 2012 the total ACL was raised from 0.440 mp gw to 0.608 mp gw (GMFMC 2011b). No tilefish in the stock complex have had an accepted stock assessment, so the ACL and commercial quota have remained unchanged. There is not a defined allocation for the tilefish complex, however, there is approximately a 5% buffer between the commercial quota and the total ACL to allow for recreational harvest (Table 3.1.2.4). Like deep water groupers, species in the tilefish complex are found at depths and distances further than what most recreational fishermen go to, so recreational landings are typically low. Therefore, the buffer is sufficient to allow the historical recreational fishery to continue. On average, 80% of the commercial quota has been landed since 2012 with the percentage of quota landed remaining fairly constant per year (Table 3.1.2.4). From 2012-2018, the composition of tilefish complex landings consists mostly of golden tilefish (~69%), with blueline comprising ~11%, and goldface comprising less than 1% (Table 3.1.2.4). The average weight for golden tilefish and blueline from 2012-2018 has been around 5 lbs gw, while goldface has been less than half of that (Table 3.1.2.2). Average weights were estimated using data from SEFSC TIP. All data were converted to pounds gutted weight using standardized conversion factors and equations used in SEDAR 22 (2011b) for golden tilefish. Goldface were based on golden tilefish conversion factors and equations used. Gulf blueline were based on South Atlantic blueline conversion factors and equations used in SEDAR 50 (2017).

Table 3.1.2.4. Tilefish complex (golden, blueline, goldface) total ACL, commercial quota, landings, percent of commercial quota caught, and averages of each during fishing years 2012-2018.

Fishing Year	Total ACL (lbs gw)	Commercial Quota (lbs gw)	Commercial Landings (lbs gw)	% Commercial Quota Landed
Tilefish Complex				
2012	608,000	582,000	451,121	77.5
2013	608,000	582,000	440,091	75.6
2014	608,000	582,000	517,268	88.9
2015	608,000	582,000	537,512	92.4
2016	608,000	582,000	429,003	73.7
2017	608,000	582,000	484,895	83.3
2018	608,000	582,000	386,138	66.3
Average	608,000	582,000	463,718	79.7
Golden Tilefish			**Blueline Tilefish**	
Year	**Landings**	**% Quota**	**Landings**	**% Quota**
2012	366,763	63.0	82,025	14.1
2013	383,132	65.8	49,454	8.5
2014	442,992	76.1	74,221	12.7
2015	483,779	83.1	53,681	9.2
2016	380,125	65.3	47,898	8.2
2017	423,054	72.7	61,808	10.6
2018	318,133	54.7	66,936	11.5
Average	399,711	68.7	62,289	10.7
Goldface Tilefish				
Year	**Landings**	**% Quota**		
2012	2,333	0.4		
2013	7,505	1.3		
2014	55	0.01		
2015	35	0.01		
2016	212	0.04		
2017	33	0.01		
2018	1,069	0.2		
Average	1,606	0.3		

Source: SERO IFQ database. Assessed May 14, 2020.

3.2 Economic Environment

Additional details on the economic environment of the RS-IFQ and GT-IFQ programs are provided in Reef Fish Amendment 36A (GMFMC 2017). Recent descriptions and performance information related to the GT-IFQ and RS-IFQ programs are included in the 5-year review of the

GT-IFQ program (GMFMC and NMFS 2018), the Gulf of Mexico 2019 Red Snapper Individual Fishing Quota Annual Report (NMFS 2020a), and the Gulf of Mexico 2019 Grouper-Tilefish Individual Fishing Quota Annual Report (NMFS 2020b).

3.2.1 Permits

Any fishing vessel that harvests and sells any of the reef fish species, including red grouper, managed under the reef fish FMP from the Gulf EEZ must have a valid Gulf commercial reef fish permit. The commercial sector of the reef fish fishery has been managed under a limited access program since 1992, which in turn capped the number of commercial reef fish permits. Therefore, new entrants must buy a permit in order to participate in the commercial sector. As shown in Table 3.2.1.1, the number of permits that were valid or renewable in a given year has continually decreased in the years after the RS-IFQ program was implemented in 2007. This decline continued after the GT-IFQ program was implemented in 2010, but at a slower rate, particularly after 2015. As of February 27, 2020, there were 834 valid or renewable commercial reef fish permits, 763 of which were valid. A renewable permit is an expired limited access permit that cannot be actively fished, but can be renewed for up to one year after expiration.

Table 3.2.1.1. Number of valid or renewable commercial reef fish permits, 2008-2019.

Year	Number of Permits
2008	1,099
2009	998
2010	969
2011	952
2012	917
2013	895
2014	882
2015	868
2016	852
2017	850
2018	845
2019	842

Source: NMFS SERO SF Access permits database.

A single permit is attached to a single vessel and many businesses only own one vessel. However, some businesses hold or own multiple permits and vessels. Multiple vessels owned by a single business are often referred to as a "fleet." Although each vessel is often legally organized under an individual corporate or other business name, for economic purposes, the fleet is treated as a single business because the same, or mostly the same, individuals are determining how those vessels operate.

As illustrated in Table 3.2.1.2, at the end of 2018, which is essentially equivalent to Jan. 1, 2019, 94 businesses owned two or more valid or renewable reef fish permits. Although these businesses represented only 14.8% of the businesses with permits, they held 35.5% of the permits, which illustrates some degree of concentration in the ownership of permitted vessels. The maximum number of permitted vessels held by a single business was 16.

Table 3.2.1.2. Vessels and businesses with a commercial reef fish permit, EOY 2018.

No. of Vessels Owned by a Business	No. of Businesses	No. of Total Permitted Vessels	% of Businesses	% of Permitted Vessels
1	543	543	85.2%	64.5%
2	60	120	9.4%	14.3%
3	15	45	2.4%	5.3%
4	8	32	1.3%	3.8%
5-6	3	17	0.5%	2.0%
7-10	6	53	0.9%	6.3%
15-16	2	32	0.3%	3.8%
Total	637	842	100%	100.0%

Source: NMFS SERO PIMS and IFQ databases, March 23, 2020.

Although all permitted vessels may harvest non-IFQ reef fish species (e.g., vermilion snapper), not all permitted vessels are eligible to harvest IFQ species. A permitted vessel must be linked to an active IFQ account in order to be eligible to harvest IFQ species.[15] Thus, because some vessels are not linked to an active IFQ account, fewer permitted vessels are eligible to harvest IFQ species and, in turn, fewer businesses may accrue revenue from the harvest of IFQ species.

Table 3.2.1.3 shows that, at the end of 2018, only 713 permitted vessels were linked to an IFQ account, and these vessels were owned by 532 businesses. Thus, 129 permitted vessels were not eligible to harvest IFQ species and 105 businesses with reef fish permits could not accrue revenue from the harvest of IFQ species. The degree of concentration among IFQ-eligible permitted vessels is slightly greater than with all permitted vessels, as businesses owning multiple IFQ-eligible vessels represent only 15.4% of the businesses, but hold 36.9% of the permitted vessels that can harvest IFQ species.

As the number of permits have changed over time, so has the market value of these permits.[16] Specifically, as shown in Table 3.2.1.4, the market value of a commercial reef fish permit was relatively stable from 2006 through 2011, though minor increases were seen in 2009 before the GT-IFQ program was established. The market value increased somewhat from 2011-2013, remaining stable through 2015. However, after 2015, the price of these permits has steadily increased as the number of permits stabilized, with the price being 164% higher on average in 2019 compared to 2015. Partial year data for 2020 indicates that the price has continued to

[15] The vessel account must have a valid permit and be linked to an active IFQ account. The vessel account must also have annual allocation in it in order for the permitted vessel to harvest IFQ species. Vessel accounts are considered active when a permit is valid. A renewable permit status is not an active status. An IFQ account status is active if the account holder submitted an affirmative answer to the bi-annual citizenship requirement.

[16] The median was used to represent the market price of permits rather than the mean because the distribution of the data was somewhat skewed and because the price data had to be filtered to eliminate a relatively large number of reported values that included the sales value of other permits and/or the vessel, as well as reported values that likely represented the "lease" value rather than the sales value of the permit.

increase, with the current market value being at least $18,000 and some permits selling for $20,000.

Table 3.2.1.3. IFQ eligible vessels and businesses with a commercial reef fish permit, EOY 2018.

No. of Vessels Owned by a Business	No. of Businesses	No. of Total Permitted Vessels	% of Businesses	% of Permitted Vessels
1	450	450	84.6%	63.1%
2	52	104	9.8%	14.6%
3	13	39	2.4%	5.5%
4	6	24	1.1%	3.4%
5-6	3	17	0.6%	2.4%
7-10	6	48	1.1%	6.7%
15-16	2	31	0.4%	4.3%
Total	532	713	100%	100.0%

Source: NMFS SERO PIMS and IFQ databases, March 23, 2020.

Table 3.2.1.4. Average market value of commercial reef fish permits, 2006-2019 (2019$).

Year	Average Market Value of Permit
2006	$4,956
2007	$4,859
2008	$4,766
2009	$5,913
2010	$4,676
2011	$4,580
2012	$5,617
2013	$6,624
2014	$6,501
2015	$6,433
2016	$8,749
2017	$13,842
2018	$15,266
2019	$17,000

Source: NMFS SERO permits database, Feb, 26, 2020.

3.2.2 IFQ Accounts

As of February 19, 2020, there were 684 IFQ accounts with shares in one or more share categories. The total percentage of shares held in these accounts does not sum to 100% in Table 3.2.2.1 because a small percentage of shares in each category were reclaimed under Reef Fish

Amendment 36A (GMFMC 2017).[17] On average (mean), each of these accounts holds 0.146% of the shares in each category. As discussed in Amendment 36A, the distribution of shares within all categories is highly skewed. In other words, some accounts have a relatively high percentage of the shares in a category while others have no or a very low percentage of the shares. The largest or maximum percent of shares held by a single account in each category ranges from 2.33% for gag (GG) to 4.265% for red grouper (RG), 4.433% for other shallow-water grouper (SWG), 4.487% for red snapper (RS), 12.212% for tilefish (TF), and 14.704% for deep water grouper (DWG). The account that has the highest percentages of DWG and TF shares are at the share cap for those categories. The account that has the highest percentage of RG shares is near the 4.331% share cap for RG. Thus, in percentage terms, these estimates indicate there are some relatively large shareholders in the DWG and TF categories in particular. This finding is consistent with findings in GMFMC and NMFS (2018) which indicate the concentration of shares is greatest in the TF and DWG categories and least in the GG category. Even though the concentration of shares is relatively high for TF and DWG, concentration levels in those and other categories, as well as for all categories combined, are still considered to be "unconcentrated" and thus quota share markets are considered to be competitive (i.e., no business or other entity has the ability to exercise market power by controlling an "excessive" amount of the shares and thereby share prices).[18]

Table 3.2.2.1. Quota share statistics (in percent) for all IFQ accounts, February 19, 2020.

Statistic	DWG Shares	RG Shares	GG Shares	SWG Shares	TF Shares	RS Shares
Maximum	14.704	4.265	2.330	4.433	12.212	4.487
Total	99.978	99.900	96.825	99.550	99.953	99.929
Mean	0.146	0.146	0.146	0.146	0.146	0.146

Source: NMFS SERO IFQ database accessed 2/19/2020.

As with permitted vessels, although it is common for a single IFQ account with shares to be held by a single business, some businesses have multiple IFQ accounts with shares. The 684 IFQ accounts are owned by 595 businesses.

Further, although some IFQ accounts are linked to a single permitted vessel, others are linked to multiple permitted vessels or are not linked to a permitted vessel at all. The latter accounts are held by businesses that are likely to sell their annual allocation rather than harvest it. Of the 684 IFQ accounts with shares, 369 accounts were linked to one or more permitted vessels, while 315 accounts were not linked to a permitted vessel. The 369 accounts were linked to a total of 453 permitted vessels and these accounts and vessels were owned by 329 businesses. Most

[17] Shares were reclaimed from accounts that had never been activated since the start of the IFQ program. These shares are currently held in an NMFS IFQ account, not a standard IFQ account.

[18] These conclusions hold regardless of the measure of concentration (e.g., the Herfindahl-Hirschman Index (HHI), C5, or C3) or the unit of analysis (e.g., IFQ account, lowest known entity (LKE), and affiliated accounts/businesses). The Horizontal Merger Guidelines from the US Department of Justice and the Federal Trade Commission identify markets with an HHI below 1,500 to be Unconcentrated (no concerns over the exercise of market power), HHI between 1,500 and 2,500 to be Moderately Concentrated (possible concern with market power being exercised given a sufficient increase in concentration), and above 2,500 to be Highly Concentrated (exercise of market power is likely, particularly if concentration increases further).

businesses only own one or two accounts and permitted vessels. But, one business has 13 accounts and there are 3 businesses that own 10 or more permitted vessels. The 315 accounts that were not linked to a vessel were owned by 266 businesses and the vast majority of these businesses only held one or two accounts with shares.

As shown in Table 3.2.2.2, the 329 businesses that own permitted vessels hold the vast majority of shares in all share categories, ranging from a low of almost 75% of the RS shares to a high of almost 96% of the TF shares. On average, each of these 329 businesses own between 0.23%-0.29% of the shares in each category. The maximum percentage of shares owned by a business varies considerably, ranging from about 5.14% of the SWG shares to 19.72% of the DWG shares. Share caps are applied and monitored at the account and LKE level, not the business level as defined here. Thus, it is possible for one or more businesses to own or control shares in excess of the cap in each category.

As shown in Table 3.2.2.3, the 266 businesses that own shares, but do not own permitted vessels, own a much lower percentage of the shares in total compared to the businesses that own permitted vessels. Specifically, the percentage of shares owned by these businesses ranges from a low of about 4.1% of the TF shares to a high of about 25.25% of the RS shares. Each business owns between about 0.02% and 0.09% of the shares in each category on average. The maximum percentage of shares owned by one of these businesses varies somewhat, ranging from about 1.14% of the TF shares to 3.66% of the RS shares.

Table 3.2.2.2. Quota share statistics (in percent) for businesses with shares and permitted vessels, February 19, 2020.

Statistic	DWG Shares	RG Shares	GG Shares	SWG Shares	TF Shares	RS Shares
Maximum	19.719	6.262	5.485	5.136	14.743	5.501
Total	87.565	84.194	82.406	85.069	95.851	74.683
Mean	0.266	0.256	0.250	0.259	0.291	0.227

Source: NMFS SERO IFQ database accessed 2/19/2020.

Table 3.2.2.3. Quota share statistics (in percent) for businesses but no permitted vessels, February 19, 2020.

Statistic	DWG Shares	RG Shares	GG Shares	SWG Shares	TF Shares	RS Shares
Maximum	1.991	1.745	2.330	1.536	1.136	3.661
Total	12.414	15.706	17.419	14.481	4.103	25.246
Mean	0.047	0.059	0.065	0.054	0.015	0.095

Source: NMFS SERO IFQ database accessed 2/19/2020.

In general, the information in Tables 3.2.2.2 and 3.2.2.3 can be used to determine the distribution of annual allocation, the market value of shares, the market value of annual allocation, and the potential ex-vessel value of annual allocation if used for harvesting between businesses with shares that own permitted vessels and businesses with shares that do not own permitted vessels.

However, ex-vessel value would not accrue to businesses that do not possess a permit because a permit is needed to harvest IFQ species.

The amount of annual allocation (quota pounds) that an account holder receives each year is not only conditional on the percentage of shares held in a category, but also the commercial quota applicable to that category. The 2019 quotas for each share category were as follows: 6,937,838 pounds gutted weight (lb gw) for RS, 3 million lb (mp) gw for RG, 1.024 mp gw for DWG, 582,000 lbs gw for TF, and 525,000 lbs gw for SWG. Table 3.2.2.4 presents statistics regarding annual allocation to shareholder accounts based on the share statistics in Table 3.2.2.1 and these quotas. Based on this information, the average account holder received about 19,000 lbs gw of allocation in 2019 across all share categories.

Table 3.2.2.4. Annual allocation statistics for all IFQ accounts, February 19, 2020.

Statistic	DWG Allocation	RG Allocation	GG Allocation	SWG Allocation	TF Allocation	RS Allocation
Maximum	150,572	127,945	21,879	23,275	71,076	311,299
Total	1,023,778	2,996,996	937,355	522,637	581,728	6,932,877
Mean	1,497	4,382	1,370	764	850	10,136

Source: NMFS SERO IFQ database accessed 2/19/2020.

Table 3.2.2.5 provides statistics regarding the amount of allocation held by the 329 businesses that possess shares and are associated with a permit. Information in this table reflects that these businesses control almost 80% of the total allocation in the two IFQ programs, or around 10.38 mp gw, with 50% of that amount coming from the possession of RS allocation and 29% coming from RG allocation. The largest amount of allocation controlled by a single business with a permit is almost 936,000 lbs gw, while the average amount of allocation held by a business with a permit is almost 31,600 lbs gw.

Table 3.2.2.5. Annual allocation statistics for businesses with shares and permitted vessels, February 19, 2020.

Statistic	DWG	RG	GG	SWG	TF	RS
Maximum	201,920	187,868	51,506	26,965	85,803	381,673
Total	896,662	2,525,825	773,793	446,614	557,851	5,181,354
Mean	2,725	7,677	2,352	1,357	1,696	15,749

Source: NMFS SERO IFQ database accessed 2/19/2020.

Table 3.2.2.6 provides statistics regarding the amount of allocation held by the 266 businesses that possess shares but are not associated with a permit. Information in this table reflects that these businesses control about 20% of the total allocation in the two IFQ programs, or around 2.61 mp gw, with 67% of that amount coming from the possession of RS allocation and 18% coming from RG allocation. The largest amount of allocation controlled by a single business without a permit is around 363,000 lbs gw, while the average amount of allocation held by a business without a permit is about 9,800 lbs gw.

Table 3.2.2.6. Annual allocation statistics for businesses with shares but no permitted vessels, February 19, 2020.

Statistic	DWG	RG	GG	SWG	TF	RS
Maximum	20,386	52,359	21,879	8,064	6,613	253,967
Total	127,116	471,171	163,561	76,024	23,877	1,751,523
Mean	478	1,771	615	286	90	6,585

Source: NMFS SERO IFQ database accessed 2/19/2020.

Shares have value in multiple ways. First, shares have value because they are an asset. The asset value of each account's shares is determined by the market price of the shares and the amount of shares it contains. Statistics regarding the value of the shares held by IFQ accounts are in Table 3.2.2.7. The total value of all shares held by IFQ accounts is more than $329 million (2019$), with the bulk of that value coming from ownership of RS shares, which accounts for almost 87% of the combined total value. This is also true for the average IFQ account that holds shares. The average value of an account that holds shares is slightly more than $481,000. The account with the largest asset share value is worth about $13.8 million, with RS shares representing the bulk of that value (about 93%). Compared to conditions in 2015, RG shares represented a far smaller percentage of a share account holder's IFQ asset portfolio in 2019 (around 5%) compared to 2015 (29%). The same is true for the other GT share categories, and thus RS shares now dominate that portfolio.

Table 3.2.2.7. Quota share value statistics for all IFQ accounts (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$1,376,230	$728,007	$208,945	$130,804	$675,221	$12,816,182	$13,831,668
Total	$9,357,329	$17,052,906	$8,951,736	$2,937,222	$5,526,415	$285,426,564	$329,252,173
Mean	$13,680	$24,931	$13,087	$4,294	$8,080	$417,290	$481,363

Note: Share value estimates are based on average 2019 share prices per pound.
Source: NMFS SERO IFQ database accessed 2/11/2020.

Table 3.2.2.8. Average share prices by share category, 2012-2019 (2019$).

Year	RS	RG	GG	DWG	SWG	TF
2012	$39.04	$9.01	$29.11	$12.11	$8.76	$9.24
2013	$40.60	$14.53	$34.68	$13.89	$9.16	$9.32
2014	$37.26	$14.16	$32.72	$14.14	$7.98	$9.49
2015	$36.07	$13.80	$23.58	$13.67	$7.23	$9.85
2016	$32.56	$10.74	$15.18	$13.25	$6.20	$10.64
2017	$36.27	$5.39	$16.55	$13.16	$9.06	$9.07
2018	$36.90	$4.17	$9.95	$11.11	$4.96	$10.89
2019	$41.17	$5.69	$9.55	$9.14	$5.62	$9.50

Source: NMFS SERO IFQ database accessed 2/11/2020.

The information in Table 3.2.2.7 reflects the asset value of shares based on 2019 share prices in Table 3.2.2.8. The average RS share price decreased after 2013 through 2016, but subsequently increased by about 14% and reached its highest level in 2019. The average TF share price has been relatively stable from 2012 through 2019. On the other hand, while generally increasing from 2012 to 2014, average share prices for other share categories have continuously declined since 2014, as illustrated in Table 3.2.2.8. Specifically, RG and GG share prices have declined by 59% during this time. Compared to conditions in 2015, RG shares represented a far smaller percentage of a share account holder's IFQ asset portfolio in 2019 (around 5%) compared to 2015 (29%). The same is true for the other GT share categories, and thus RS shares now dominate that portfolio.

Table 3.2.2.9 provides statistics regarding the value of the shares held by the 329 businesses that possess shares and one or more permits. Information in this table reflects that these businesses control around 76% of the total value of shares in the two IFQ programs, with 85% of that value coming from the possession of RS shares. The largest share value controlled by a single business without a permit is worth just over $16.8 million, while the average value of shares held by a business without a permit is just over $763,000.

Table 3.2.2.9. Quota share value statistics for businesses with shares and permitted vessels.

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$1,845,546	$1,068,972	$491,878	$151,544	$815,125	$15,713,492	$16,823,978
Total	$8,195,486	$14,371,942	$7,389,724	$2,509,969	$5,299,584	$213,316,346	$251,083,053
Mean	$24,910	$43,684	$22,461	$7,629	$16,108	$648,378	$763,170

Note: Share value estimates (in $2019) are based on average 2019 share prices per pound.
Source: NMFS SERO IFQ database accessed 2/11/2020.

Table 3.2.2.10 provides statistics regarding the value of the shares held by the 266 businesses that possess shares but are not associated with a permit. Information in this table again reflects that these businesses control about 24% of the total value of shares in the two IFQ programs, with 87% of that value coming from the possession of RS shares. The largest share value controlled by a single business without a permit is worth just over $13.6 million, while the average value of shares held by a business without a permit is just over $347,000.

Table 3.2.2.10. Quota share value statistics for businesses with shares but no permitted vessels, February 19, 2020 (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$186,331	$297,923	$208,945	$45,319	$62,823	$10,455,838	$10,455,838
Total	$1,161,843	$2,680,963	$1,562,012	$427,253	$226,831	$72,110,218	$78,169,120
Mean	$4,368	$10,079	$5,872	$1,606	$853	$271,091	$293,869

Note: Share value estimates are based on average 2019 share prices per pound.
Source: NMFS SERO IFQ database accessed 2/11/2020.

In addition to their asset value, shares have value because they result in annual allocation, which can either be sold or used for harvesting purposes (i.e., landings). Annual allocation that is sold results in revenue for the business holding the allocation. This revenue likely represents an equivalent amount of profit as the business does not pay cost recovery fees when selling allocation and any other monetary costs associated with selling allocation are likely trivial. Statistics regarding the potential market value associated with the annual allocation for each account with shares are provided in Table 3.2.2.11.

Table 3.2.2.11. Potential market value of annual allocation in 2020 for all IFQ accounts (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$158,101	$75,488	$18,597	$13,732	$51,175	$1,148,694	$1,239,345
Total	$1,074,967	$1,768,227	$796,751	$308,356	$418,844	$25,582,318	$29,949,463
Mean	$1,572	$2,585	$1,165	$451	$612	$37,401	$43,786

Note: Annual allocation market value estimates are based on average 2019 allocation prices.
Source: NMFS SERO IFQ database accessed 2/11/2020.

The average market value of annual allocation should approximate the expected net revenue or economic profit of the annual allocation in the short-term (i.e., in a given year). Thus, if all of the annual allocation held by IFQ accounts was harvested, economic profit from those landings would be expected to be more than $29.9 million, with the bulk of those profit (85%) arising from the harvest of RS. Although one account would be expected to earn about $1.2 million in short-term profit if all allocation was either sold and/or used for harvesting, the average short-term profit per account would only be expected to be a little more than $44,000.[19] However, while complete or nearly complete utilization of the RS commercial quota and thus annual allocation is typical, that has not been the case for quotas and annual allocation in the GT-IFQ program. For example, in 2019, quota utilization rates in the GT categories ranged from 35% to 93%, with an overall average of 68%. Thus, realized total annual profit would more likely be slightly less in the future (about $28.4 million), and annual profit per account would be slightly lower at around $41,700.

The information in Table 3.2.2.11 reflects the market value of allocation based on 2019 allocation prices as shown in Table 3.2.2.12. Allocation prices for all share categories were generally stable from 2012 through 2014, except for SWG, which decreased by 39%. However, with the exception of RS allocation, allocation prices for other share categories have declined over the past 5 years, as illustrated in Table 3.2.2.12. Specifically, RG and GG allocation prices have declined by 49% and 58% during this time. The declines for DWG and TF allocation prices have been less, but are still noticeable. If these trends continue, then the estimate in Table 3.2.2.11 may overestimate the market value of these allocations in 2020. TF share prices have been relatively steady, while RS share prices have increased by about 14%, with most of that increase occurring in 2019. Thus, if the upward trend in RS allocation prices continues, the estimated market value of RS allocation in Table 3.2.2.11 may underestimate actual market value in 2020. Compared to conditions in 2015 (GMFMC 2017b), RG allocation currently represents a far smaller percentage of a share account holder's allocation portfolio (about 6%), which was around 29% at that time. The same is true for the other GT share categories, and thus RS allocation now dominates that portfolio.

[19] "Accounts" do not actually harvest landings and thus do not earn profits *per se*; rather, vessels and the businesses that own them do. Further, annual allocation is often transferred, so the actual distribution of short-term profits would likely differ from the potential distribution of short-term profits based on the distribution of annual allocation at the beginning of the year. The purpose of these estimates is to characterize the distribution of annual allocation and its value across accounts and businesses in the short-term.

Table 3.2.2.12. Average allocation prices by share category, 2012-2019 (2019$).

Year	RS	RG	GG	DWG	SWG	TF
2012	$3.37	$0.88	$2.55	$1.33	$1.29	$0.74
2013	$3.29	$1.07	$2.65	$1.26	$0.92	$0.74
2014	$3.28	$1.06	$2.21	$1.21	$0.79	$0.78
2015	$3.31	$1.15	$2.03	$1.26	$0.64	$0.83
2016	$3.41	$0.95	$1.47	$1.23	$0.59	$0.71
2017	$3.46	$0.44	$1.51	$1.23	$0.60	$0.75
2018	$3.46	$0.33	$1.03	$1.01	$0.54	$0.73
2019	$3.69	$0.59	$0.85	$1.05	$0.59	$0.72

Source: NMFS SERO IFQ database accessed 2/11/2020.

Similar to shares, annual allocation tends to be "unconcentrated" across accounts. According to GMFMC and NMFS (2018), concentration is low across all share categories combined and for most share categories, with the exception of TF which is typically "moderately concentrated." Also, concentration of annual allocation is the lowest at the beginning of each year, when it is based on the distribution of shares. Concentration in all categories is seasonal and increases as the year progresses or stabilizes in the 3rd or 4th quarter, but the markets are still largely "unconcentrated" with the exception of TF. Even with moderate levels of concentration, there is no evidence of market power being exercised in any of the markets for annual allocation (i.e., markets for annual allocation are competitive).

Table 3.2.2.13 provides statistics regarding the value of the allocation held by the 329 businesses that possess shares and one or more permits. Information in this table again reflects that these businesses control just around 76% of the total value of allocation in the two IFQ programs, with 84% of that value coming from the possession of RS allocation. The largest allocation value controlled by a single business with a permit is worth just over $1.5 million, while the average value of allocation held by a business without a permit is more than $69,500. Again, realized value in the form of actual annual revenue and profits is likely less from allocation in the GT-IFQ program as quota utilization is typically well below 100% in those categories. Thus, annual profit for these businesses from the use or sale of allocation is more likely to be around $21.8 million in total and $66,300 per business on average.

Table 3.2.2.13. Allocation value statistics for businesses with shares and permitted vessels, February 19, 2020 (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$212,016	$110,842	$43,780	$15,909	$61,778	$1,408,375	$1,506,226
Total	$941,495	$1,490,237	$657,724	$263,502	$401,653	$19,119,196	$22,873,807
Mean	$2,862	$4,530	$1,999	$801	$1,221	$58,113	$69,525

Note: Allocation value estimates are based on average 2019 allocation prices per pound.
Source: NMFS SERO IFQ database accessed 2/11/2020.

Table 3.2.2.14 provides statistics regarding the value of the allocation held by the 295 businesses that possess shares but are not associated with a permit. Information in this table again reflects that these businesses control around 24% of the total value of allocation in the two IFQ programs, with 91% of that value coming from the possession of RS allocation. The largest allocation value controlled by a single business without a permit is worth around $937,000, while the average value of allocation held by a business without a permit is $26,600. Again, realized value in the form of actual annual revenue and profits is likely less from allocation in the GT-IFQ program as quota utilization is typically well below 100% in those categories. Thus, annual profit for these businesses from the sale of allocation is more likely to be around $6.76 million in total and $25,400 per business on average.

Table 3.2.2.14. Allocation value statistics for businesses with shares but no permitted vessels, February 19, 2020 (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$21,406	$30,892	$18,597	$4,758	$4,761	$937,140	$937,140
Total	$133,472	$277,991	$139,027	$44,854	$17,191	$6,463,121	$7,075,657
Mean	$502	$1,045	$523	$169	$65	$24,297	$26,600

Note: Allocation value estimates are based on average 2019 allocation prices per pound.
Source: NMFS SERO IFQ database accessed 2/11/2020.

The same general findings regarding the market value of annual allocation also apply to the potential ex-vessel value of that annual allocation. The markets for landed product largely have the same characteristics as the markets for annual allocation (i.e., unconcentrated overall and for most categories, except landings of TF which are "moderately concentrated"). Thus, markets for landed product of IFQ species are thought to be competitive. Even if market power is not detected in these markets, the Council may have distributional or "fairness" concerns as the distributions of shares, allocation, landings, and revenue in the Gulf IFQ programs are highly unequal. In fact, they are the most unequal of any catch share program in the U.S. (GMFMC and NMFS 2018).

The information in Table 3.2.2.15 reflects the potential ex-vessel value of allocations in 2020 based on 2019 ex-vessel prices and commercial quotas in 2020. Again, realized ex-vessel value will likely be less for RG and other species in the GT-IFQ program as quota utilization rates are typically well below 100%. Only businesses with IFQ accounts that are linked to a permit are allowed to harvest IFQ species. Therefore, estimates of ex-vessel value are not germane to businesses that do not possess permits.

As illustrated in Table 3.2.2.16, with the exception of TF, and RS to some extent, ex-vessel prices at the share category level have steadily increased from 2015 through 2019. For example, ex-vessel prices for gag, SWG, DWG, and TF have increased by 11%, 12%, 13%, and 13%, respectively. This increase is also seen at the individual species level within the DWG, SWG, and TF categories, with the exception of yellowmouth grouper in the SWG category, which declined by 9%, and goldface tilefish in the TF category, which declined by 10% (see Table 6.3.2). The ex-vessel price for RS has only increased by 2%, and that increase almost entirely occurred in 2019. The ex-vessel price for RG has increased by almost 26%. These trends are nearly the opposite of the trends for allocation prices, suggesting that it is likely becoming relatively more profitable for those with shares to harvest their allocation rather than sell it, all other things being equal.[20]

Table 3.2.2.15. Potential ex-vessel value of annual allocation in 2020 for all IFQ accounts (2019$).

Statistic	DWG	RG	GG	SWG	TF	RS	All
Maximum	$844,710	$675,549	$132,149	$129,408	$204,699	$1,643,659	$2,075,597
Total	$5,743,393	$15,824,137	$5,661,622	$2,905,864	$1,675,376	$36,605,593	$68,415,986
Mean	$8,397	$23,135	$8,277	$2,449	$4,248	$53,517	$100,023

Note: Potential ex-vessel value estimates are based on 2019 average ex-vessel prices.
Source: NMFS SERO IFQ database accessed 2/11/2020.

Table 3.2.2.16. Average ex-vessel prices by share category, 2012-2019 (2019$).

Year	RS	RG	GG	DWG	SWG	TF
2012	$4.99	$3.61	$5.27	$4.56	$4.86	$2.55
2013	$4.92	$3.91	$5.41	$4.75	$4.95	$2.85
2014	$5.15	$4.09	$5.24	$4.81	$4.88	$2.83
2015	$5.18	$4.23	$5.44	$4.96	$4.95	$3.11
2016	$5.17	$4.26	$5.45	$4.91	$4.92	$3.12
2017	$5.18	$4.45	$5.47	$4.93	$4.96	$3.10
2018	$5.19	$4.83	$5.76	$5.17	$5.30	$2.87
2019	$5.28	$5.31	$6.04	$5.61	$5.56	$2.88

Source: NMFS SERO IFQ database accessed 2/11/2020.

3.2.3 Vessels

The information in Table 3.2.3.1 describes the landings and revenue for vessels that harvested IFQ species in each year from 2012 through 2018, as well as their revenue from Gulf non-IFQ species, and South Atlantic fisheries. Although a majority of these vessels' gross revenue came from harvesting IFQ species, a significant portion came from harvesting non-IFQ species in the Gulf, with a minor amount coming from harvests in the South Atlantic.

[20] Preliminary information suggests that the recent pandemic has caused ex-vessel prices for most IFQ species to decline, thus reversing the previous trend. As effects on allocation prices have not yet been determined, whether it is currently more profitable for IFQ account holders to sell or use allocation for landings purposes is unknown.

Table 3.2.3.1. Landings and revenue statistics for vessels harvesting IFQ species by year, 2012-2018 (2019$).

Year	Number of Vessels	Statistic	IFQ Revenue	Gulf Non-IFQ Revenue	South Atlantic Revenue	Total Revenue
2012	473	Maximum	$898,413	$252,437	$127,087	$958,319
		Total	$44,483,377	$10,826,558	$621,606	$55,931,540
		Mean	$94,045	$22,889	$1,314	$118,248
2013	447	Maximum	$2,040,920	$238,288	$90,743	$2,045,225
		Total	$51,457,151	$8,193,246	$478,106	$60,128,503
		Mean	$115,117	$18,329	$1,070	$134,516
2014	473	Maximum	$2,384,939	$300,104	$125,063	$2,387,842
		Total	$58,778,434	$9,296,600	$766,602	$68,841,636
		Mean	$124,267	$19,655	$1,621	$145,543
2015	484	Maximum	$2,708,555	$304,970	$112,904	$2,715,183
		Total	$62,689,496	$8,489,181	$697,198	$71,875,875
		Mean	$129,524	$17,540	$1,440	$148,504
2016	487	Maximum	$2,259,525	$242,494	$99,390	$2,339,708
		Total	$60,892,137	$9,141,918	$621,715	$70,655,771
		Mean	$125,035	$18,772	$1,277	$145,084
2017	513	Maximum	$2,336,305	$216,904	$149,465	$2,358,048
		Total	$54,815,660	$8,913,904	$606,509	$64,336,072
		Mean	$106,853	$17,376	$1,182	$125,411
2018	502	Maximum	$2,091,909	$190,863	$107,512	$2,110,894
		Total	$51,186,656	$7,475,362	$440,279	$59,102,297
		Mean	$101,965	$14,891	$877	$117,734

Sources: NMFS SERO IFQ database accessed 2/19/2020 and SEFSC Socioeconomic Panel (Version 10)

Some important trends can be seen in Table 3.2.3.1. In general, vessel participation in the IFQ programs tends to be very fluid. However, the number of vessels that harvested IFQ species in each year from 2014 through 2016 was relatively stable, ranging between 473 and 487 vessels. Vessel participation increased by more than 5% in 2017 to 513 vessels, likely in response to the upward trend in IFQ revenue from 2011 through 2015 (GMFMC 2017b), but declined slightly in 2018 to 502 vessels. These 502 vessels were owned by 394 businesses. In 2018, the maximum gross revenue from commercial fishing for a single business was $4.69 million (2019$), while the average gross revenue was approximately $150,000 per business.[21]

[21] Only revenues from commercial harvesting are accounted for in these estimates and thus do not account for revenues the business may have earned from selling annual allocation.

After steadily increasing from 2012 through 2014, IFQ revenue peaked in 2015 and remained relatively stable in 2016. However, it declined in 2017 and 2018 by more than 18% from its peak in 2015. Not only has IFQ revenue for the IFQ vessels decreased in recent years, revenue from non-IFQ species in the Gulf also declined by about 18% from 2016 to 2018, with most of the decrease occurring in 2018. Although revenue from South Atlantic landings does not make up a significant portion of the IFQ vessels' total revenue, it continually declined after 2014 through 2018, by almost 43% during that time. As a result, total revenue for the IFQ vessels declined by almost 18% from 2015 through 2018.

These declines occurred even though the RG commercial quota increased from 5.63 mp gw in 2014 to 7.78 mp gw by late 2016, and remained at that level through 2018. Also, the RS commercial quota increased from approximately 5.054 mp gw in 2014 to 6.312 mp gw through mid-2017, and remained at that level through 2018. Given that ex-vessel prices were also increasing for most IFQ species during this time, landings and revenue would be expected to increase, likely significantly, with such quota increases under stable biological and economic conditions. Thus, it appears that biological and/or economic conditions for at least some IFQ species are not stable.

Based on information in NMFS (2019a), conditions in the RS-IFQ program appear to be stable or improving. Conversely, as suggested in NMFS (2019b), conditions in the GT-IFQ program are not stable as landings in all share categories have been trending down, and the percentage of the commercial quota harvested in each category has therefore also been declining. Specifically, while 92% of the combined commercial quotas in the GT-IFQ program was harvested in 2014, only 39% was harvested in 2018, with RG experiencing the most precipitous declines in absolute and relative terms. A recent stock assessment for RG indicates that the red grouper stock is in decline (SEDAR 61). However, other GT species may also be in decline based on the information in NMFS 2019b. These findings reflect the interdependency between species harvested in the RS-IFQ and GT-IFQ programs (i.e., biological or economic factors that affect the commercial harvest of one species can and often do affect the commercial harvest of other species). That interdependency likely extends to non-IFQ reef fish species. For e.g., if those species are harvested concurrently with IFQ species (i.e., they are complements in the production process), then declines in the harvest and/or profitability of IFQ species would be expected to lead to declines in the harvest of non-IFQ reef fish species. On the other hand, if those species are substitute target species, declines in the harvest and/or profitability of IFQ species would be expected to increase the harvest of non-IFQ reef fish species.

The maximum annual gross revenue earned by a single vessel from commercial fishing during this time was almost $2.72 million (2019$) in 2015, though the average gross revenue per vessel was only about $148,500 that year. Similar to the trends in total revenue for the IFQ vessels, these values decreased to $2.11 million and slightly less than $118,000 by 2018, representing a 21% decline in average total revenue per vessel from 2015 through 2018. Average IFQ revenue per vessel also decreased from $129,524 per vessel to $101,965, similarly decreasing by about 21% during this time. In general, practically all of the gains in total revenue and IFQ revenue that IFQ vessels experienced from 2012 through 2015 were erased by 2018.

Estimates of economic returns have not been available historically for the commercial sector of the Gulf reef fish fishery. Recent reports (Overstreet, Perruso, and Liese 2017, Overstreet and Liese 2018a, and Overstreet and Liese 2018b) provided the first such estimates. These estimates are specific to economic performance in 2014, 2015 and 2016, respectively. Overstreet and Liese (2018b) also provides average estimates of economic returns across 2014-2016, which are the most useful for current purposes, and thus findings from that report are summarized below. Given the declines in landings and revenue for IFQ vessels discussed above, it is quite likely that economic returns were likely different by 2018 than they were in 2016, and thus the estimates below should be used with some caution. However, some of the findings for 2014-2016 seem to be consistent with the results above for 2014-2016.

Estimates in these reports are based on a combination of Southeast Coastal logbook data, a supplemental economic add-on survey to the logbooks, and an annual economic survey at the vessel level. The economic surveys collect data on gross revenue, variable costs, fixed costs, as well as some auxiliary economic variables (e.g., market value of the vessel). The report provides estimates of critical economic variables for the commercial sector of the Gulf reef fish fishery as a whole, but also provides estimates by "subsets" within this sector. These subsets are referred to as Segments of Interest (SOI). Subsets are generally defined at the individual species (e.g., red snapper), species group (e.g., Jacks), and/or gear-level (e.g., longline). In addition, estimates are provided at the trip level and the annual vessel level for each SOI. For current purposes, the most important results are those for vessels that harvested IFQ species.

From an economic returns perspective, the two most critical results at the trip level are the estimates of trip net cash flow and trip net revenue. Trip net cash flow is trip revenue minus the costs for fuel, bait, ice, groceries, miscellaneous, hired crew, and purchases of annual allocation from other allocation holders. Thus, this estimate represents the amount of cash generated by a typical reef fish trip over and above the cash cost of taking the trip (i.e., variable costs of the trip) and is a proxy for producer surplus at the trip level. Trip net revenue is trip revenue minus the costs for fuel, bait, ice, groceries, miscellaneous, hired crew, and the opportunity cost of owner's time as captain. By including opportunity cost of the owner's time and excluding purchases of annual allocation, trip net revenue is a measure of the commercial fishing trip's economic profit.

Table 3.2.3.2 illustrates the economic "margins" generated on IFQ trips, i.e., trip net cash flow and trip net revenue as a percentage of trip revenue. As shown in this table, 33%, 15%, and 20% (or 62% in total) of the average revenues generated on IFQ trips were used to pay for crew costs, fuel/supplies costs, and purchases of annual allocation, while the remaining 38% was net cash flow back to the owner(s). The margin associated with trip net revenue was higher than the margin for net cash flow at 52%. Thus, trip cash flow and trip net revenue were both positive on average from 2014 through 2016, generally indicating that IFQ trips were profitable during this time.

Table 3.2.3.2. Economic Characteristics of IFQ Trips 2014-2016 (2019$).

	2014	2015	2016	Average
Number of Observations	1,154	1,656	1,775	
Response Rate (%)	80%	85%	94%	
SOI Trip				
Owner-Operated	71%	64%	67%	67.3%
Fuel Used per Day at Sea (gallons/day)	46	46	40	44
Total Revenue	100%	100%	100%	100%
Costs (% of Revenue)				
Fuel	6.6%	4.8%	4.1%	5.2%
Bait	3%	3.2%	3.4%	3.2%
Ice	1.4%	1.5%	1.7%	1.5%
Groceries	2.4%	2.3%	3.1%	2.6%
Miscellaneous	2.5%	2.4%	3%	2.6%
Hired Crew	28.1%	25.7%	27%	26.9%
IFQ Purchase	14.8%	27.2%	19%	20.3%
OC Owner-Captain Time	6.2%	5.8%	7%	6.3%
Trip Net Cash Flow	41%	33%	39%	38%
Trip Net Revenue	50%	54%	51%	52%
Labor - Hired & Owner	34%	32%	34%	33.3%
Fuel & Supplies	16%	14%	15%	15%
Input Prices				
Fuel Price (per gallon)	$3.74	$2.68	$2.15	$2.86
Hire Crew Wage (per crew-day)	$349	$292	$267	$305
Productivity Measures				
Landings/Fuel Use (lbs/gallon)	13.5	12.7	11.8	13
Landings/Labor Use (lbs/crew-day)	222	206	170	199

Table 3.2.3.3 provides estimates of the important economic variables at the annual level for all vessels that had IFQ landings in each year from 2014 through 2016. Similar to the trip level, the three most important estimates of economic returns are net cash flow, net revenue from operations,[22] and economic return on asset value. Of these measures, net revenue from operations most closely represents economic profits to the owner(s). Net cash flow is total annual revenue minus the costs for fuel, other supplies, hired crew, vessel repair and maintenance, insurance, overhead, loan payments, and purchases of annual allocation. Net revenue from operations is total annual revenue minus the costs for fuel, other supplies, hired crew, vessel repair and maintenance, insurance, overhead, and the opportunity cost of an owner's

[22] Net revenue from operations accrues to the vessel owner and, when applicable, the IFQ shareholder, who may not be the same entity.

time as captain as well as the vessel's depreciation. Economic return on asset value is calculated by dividing the net revenue from operations by the vessel value.

Net cash flow and net revenue from operations at the annual vessel level were both positive from 2014-2016, generally indicating that IFQ vessels in the commercial sector were profitable, though some vessels earned much greater profits than others. More specifically, net cash flow and net revenue from operations averaged 26% and 35%, respectively, while the economic return on asset value was approximately 54% during this time. For purposes of this Review, it is also worth noting that the average market value of IFQ vessels declined by almost 30% from 2014 to 2016, with the average value over this time being about $109,000.

Table 3.2.3.3. Economic characteristics of IFQ vessels from 2014-2016 (2019$).

	2014	2015	2016	Average
Number of Observations	81	101	117	
Response Rate (%)	63%	78%	84%	
SOI Vessel				
Owner-Operated	76%	70%	79%	75%
For-Hire Active	6%	15%	16%	12%
Vessel Value	$128,923	$106,972	$90,726	$108,874
Total Revenue	100%	100%	100%	100%
Costs (% of Revenue)				
Fuel	8%	6%	6.6%	6.9%
Other Supplies	9.7%	9.2%	10.7%	9.9%
Hired Crew	27.1%	25.5%	24.3%	25.6%
Vessel Repair & Maintenance	7.6%	6.6%	8.5%	7.6%
Insurance	1%	0.8%	1%	0.9%
Overhead	5%	5.4%	4.9%	5.1%
Loan Payment	0.8%	1.4%	1.3%	1.2%
IFQ Purchase	11.5%	24.4%	14.3%	16.7%
OC Owner-Captain Time	5.6%	5.3%	6.6%	5.8%
Net Cash Flow	29%	21%	28%	26%
Net Revenue for Operations	32%	38%	34%	35%
Depreciation	3.7%	3%	3.2%	3.3%
Fixed Costs	14%	13%	14%	14%
Labor - Hired & Owner	33%	31%	31%	32%
Fuel & Supplies	18%	15%	17%	17%
Economic Return (on asset value)	43.8%	64.4%	53.9%	54%

Source: Overstreet and Liese (2018b)

Overstreet and Liese (2018b) only provide estimates of economic returns from 2014 through 2016, and thus it cannot be used to assess how economic returns and related measures have changed since the implementation of the IFQ programs. However, Liese (pers. comm., Nov. 22, 2017) has conducted an analysis that compares economic returns and related measures in 2006 and 2014, and thus examines how they have changed since the implementation of the GT and RS-IFQ programs. Because of the years chosen, the changes in economic performance indicated by these results can only, at best, be attributed to the combination of the two IFQ programs as opposed to one or the other. Also, his results apply to all trips that landed Gulf reef fish species as opposed to landings of species managed under one or both of the IFQ programs. Further, as these results are preliminary, only a generally qualitative overview can be provided.

First, effort in the commercial sector of the fishery has decreased significantly according to multiple measures. Specifically, the number of vessels, trips, and days at sea decreased by 31%, 38%, and 28%, respectively, between 2006 and 2014. At the same time, landings of Gulf reef fish were relatively unchanged, decreasing by about 4% during that time. Thus, output per unit of input (one measure of productivity) has increased significantly since the IFQ programs were implemented. Further, even though landings have remained about the same, the average ex-vessel price of Gulf reef fish landings increased by 20% during this time, resulting in a 16% increase in total annual revenues from these landings.

Because productivity increased, costs decreased. Specifically, crew costs decreased by 6%, other variable costs (supplies, fuel, etc.) decreased by 33%, and fixed costs decreased by 19%. The decrease in crew costs was driven by a decrease in crew days of 26%, as crew compensation per day actually increased by 24% (i.e., the amount of labor used decreased somewhat significantly, but "wages" increased somewhat significantly as well). Similarly, even though fuel prices increased by 25%, a 49% decrease in fuel usage was the primary driver of the decline in other variable costs. In addition, the opportunity costs associated with the owner's labor time and capital invested in the vessel decreased by 16% and 31%, respectively.

Because costs decreased, significantly lower percentages of the total revenues had to be used to cover these costs, in turn resulting in much higher economic returns and margins. Net cash flow to the owner(s) increased by more than 300% while net revenue from operations increased by more than 400%. Trip net revenue as a percentage of total trip revenue increased by 94% while, at the vessel level, net revenue from operations as a percentage of total revenues increased by 180%. While such increases may appear to be exorbitant, it must be kept in mind that, in 2006, net cash flows were only slightly above the break-even point and net revenues from operations were negative (i.e., commercial reef fish were earning economic losses on average).

3.2.4 IFQ Dealers

The information in Table 3.2.4.1 illustrates the purchasing activities of dealers that bought IFQ landings from vessels from 2012 through 2018.[23] Like vessels, dealer participation in the IFQ programs is fluid and not all of these dealers were active in one or both IFQ programs in each year during this time. Information on the number of dealers active in each of the two programs in a specific year is provided in the annual reports (NMFS 2019a, 2019b). After increasing from 2012 through 2014, the number of dealers that purchased IFQ landings has been relatively stable since 2014, with an average of 135 dealers purchasing IFQ landings each year.

[23] The number of IFQ dealers and the value of their IFQ landings purchases are slightly different in Table 3.2.4.1 than in the IFQ programs' annual reports. The estimates in this table are based on Accumulated Landings System (ALS) data, which tends to produce different estimates of ex-vessel landings and value for IFQ species, and thus the number of IFQ dealers as well, due to waterbody code assignment issues in the Keys.

Although most dealers that purchase IFQ landings rely heavily on those purchases, purchases of non-IFQ species in the Gulf and the South Atlantic are also important, i.e., the purchasing portfolios of Gulf IFQ dealers are generally more diversified than landings portfolios of Gulf IFQ vessels. As a result, Gulf IFQ dealers are much more reliant on purchase of non-IFQ landings in the Gulf and landings from the South Atlantic compared to IFQ vessels. Further, dependency on Gulf IFQ purchases as opposed to purchases of non-IFQ species in the Gulf and South Atlantic varies considerably by dealer.

Table 3.2.4.1. Dealer statistics for dealers that purchased IFQ landings by year, 2012-2018. All dollar estimates are in 2019$.*

Year	Number of Dealers	Statistic	IFQ Purchases	Gulf Non-IFQ Purchases	South Atlantic Purchases	Total Purchases
2012	118	Maximum	$4,371,884	$10,468,012	$2,859,711	$11,227,050
		Total	$43,852,346	$58,209,794	$10,634,782	$112,696,922
		Mean	$371,630	$493,303	$90,125	$955,059
2013	122	Maximum	$6,220,161	$10,498,756	$3,263,800	$11,465,044
		Total	$51,567,209	$58,162,444	$13,285,983	$123,015,636
		Mean	$422,682	$476,741	$108,902	$1,008,325
2014	135	Maximum	$6,909,731	$12,329,746	$4,128,319	$13,219,673
		Total	$58,661,601	$57,835,600	$17,309,170	$133,806,371
		Mean	$434,530	$428,412	$128,216	$991,158
2015	143	Maximum	$7,737,859	$7,633,810	$3,406,249	$8,917,566
		Total	$60,490,346	$50,830,595	$13,859,068	$125,180,008
		Mean	$423,009	$355,459	$96,917	$875,385
2016	124	Maximum	$9,873,563	$8,079,619	$3,848,256	$10,541,374
		Total	$59,760,150	$57,242,048	$16,839,568	$133,841,765
		Mean	$481,937	$461,629	$135,803	$1,079,369
2017	135	Maximum	$8,060,928	$9,275,039	$5,151,898	$10,312,813
		Total	$53,568,612	$57,619,322	$23,723,845	$134,911,779
		Mean	$396,805	$426,810	$175,732	$999,347
2018	136	Maximum	$7,956,983	$7,373,814	$4,403,264	$8,581,393
		Total	$49,914,258	$56,754,758	$20,546,417	$127,215,433
		Mean	$367,017	$417,314	$151,077	$935,408

Source: SEFSC Fishing Communities Web Query Tool (Version 1).

In addition, although the trend in purchases of IFQ landings by dealers necessarily mimics the trend in IFQ vessel revenues, the trends in purchases of non-IFQ species in the Gulf and South Atlantic do not mirror the trends for vessels. For example, purchases of non-IFQ landings in the

Gulf by IFQ dealers have remained relatively constant from 2014 through 2018, whereas IFQ vessels' landings of non-IFQ species in the Gulf declined noticeably in 2018. Further, although landings of South Atlantic species by IFQ vessels consistently declined during this time, IFQ dealers generally increased their purchases of South Atlantic landings from 2012 through 2018, particularly in 2017 and 2018, which allowed them to compensate for the decline in purchases of IFQ landings. Thus, the aforementioned diversity in their portfolios has allowed IFQ dealers to be more flexible and adaptive to changes in the IFQ fisheries. As a result, after increasing from 2012 through 2014, the total value of seafood purchases by IFQ dealers, and the average value of those purchases per dealer, has remained relatively constant from 2014 through 2018, unlike IFQ vessels that experienced noticeable declines in their revenues after 2016.

3.2.5 Imports

Imports of seafood products compete in the domestic seafood market and have in fact dominated many segments of the seafood market. Imports aid in determining the price for domestic seafood products and tend to set the price in the market segments in which they dominate. Seafood imports have downstream effects on the local fish market. At the harvest level for IFQ species, imports affect the returns to fishermen through the ex-vessel prices they receive for their landings. As substitutes to domestic production of IFQ species, imports tend to cushion the adverse economic effects on consumers resulting from a reduction in domestic landings. The following describes the imports of fish products which directly compete with domestic harvest of red grouper. All monetary estimates are in 2019 dollars.

Total imports of snapper were relatively stable at around 33-34 mp from 2012 through 2014. However, snapper imports increased significantly (36%) from 2014 through 2016, increasing from about 33 mp product weight (pw) to 45 mp pw during this time. Snapper imports declined slightly thereafter to about 43 mp pw in 2018. Revenue from snapper imports followed a similar pattern, ranging from $104-$106 million from 2012 through 2014, increasing to $136 million in 2016, but then falling to about $134 million in 2018. Although the average price per pound decreased slightly from 2012 through 2014 and fluctuated somewhat between 2014 and 2018, moving inversely to volume, it generally vacillated around $3.05/lb. Imports of fresh snapper increased steadily from 22.7 mp pw in 2012 to 31.2 mp pw in 2017, before declining slightly to 31.2 mp pw in 2018. Total revenue from fresh snapper imports increased from $73.6 million in 2012 to an all-time high of $98.5 million in 2018. The average price increased slightly from 2012 to 2014, from $3.24/lb to $3.32/lb, but then declined significantly to $3/lb by 2017 as volume increased, and rose to $3.21/lb in 2018 when volume declined. Imports of fresh snappers primarily originated in Mexico, Panama, and Nicaragua, and entered the U.S. through the port of Miami. Imports of frozen snapper were substantially less than imports of fresh snapper from 2012 through 2018. Frozen snapper imports were 11.4 mp pw worth $32.7 in 2012 but then decreased to a low of 9.3 mp pw worth $26.5 million in 2014, increasing thereafter to 14.4 mp pw worth $40.2 million in 2018. The average price fluctuated around $2.84/lb during this time. Imports of frozen snapper primarily originated in Brazil. The majority of frozen snapper imports entered the U.S. through the ports of Miami and New York.

Total imports of grouper increased significantly (64%) from 10.4 mp pw in 2012 to 17.1 mp pw in 2018. Total revenue from grouper imports also increased significantly (60%) from $37.8

million to $60.3 million during this time period. Revenue from grouper imports did not increase quite as much as the volume due to a small decrease in the average price per pound of grouper imports. Imports of frozen grouper were minimal from 2012 through 2016, increasing from 1.3 mp pw in 2012 to 1.75 mp pw in 2014, then falling to only 0.81 mp pw in 2016. However, frozen grouper imports increased significantly in 2018, up to 4.6 mp pw. As a result, frozen grouper composed 27% of total grouper imports in 2018 compared to only 12% in 2012. Further, after increasing from $2.15/lb in 2012 to $2.67/lb in 2015, the average price per pound of frozen grouper imports decreased significantly, to only $1.27/lb, by 2018. Similarly, total revenue from frozen grouper increased from $2.7 million in 2012 to $3.8 million in 2014, then decreased significantly to $1.5 million in 2016, and subsequently increased to $5.8 million in 2018. The decline in the average price of frozen grouper in combination with frozen product making up a higher proportion of total imports explains why revenue from grouper imports, frozen and in total, did not increase as significantly as volume from 2014 through 2018. The volume and revenue from fresh grouper imports generally increased from 2012 through 2018, ranging from a low of 8.6 mp pw and $38.5 million in 2014 to a high of 12.5 mp pw and $54.5 million in 2018. Average price was only $3.81/lb in 2012 but increased and then remained relatively stable at around $4.38/lb from 2014 through 2018. Thus, the price premium attached to fresh grouper relative to frozen grouper is much greater than the premium attached to fresh snapper compared to frozen snapper. The bulk of fresh and frozen grouper imports originated in Mexico and entered the U.S. through Miami and Tampa.

3.2.6 Economic Impacts of the Gulf IFQ Fisheries

The commercial harvest and subsequent sales and consumption of fish generates business activity as fishermen expend funds to harvest the fish and consumers spend money on goods and services, such as IFQ species purchased at a local fish market and served during restaurant visits. These expenditures spur additional business activity in the region(s) where the harvest and purchases are made, such as jobs in local fish markets, grocers, restaurants, and fishing supply establishments. In the absence of the availability of a given species for purchase, consumers would spend their money on substitute goods and services. As a result, the analysis presented below represents a distributional analysis only; that is, it only shows how economic impacts may be distributed through regional markets and should not be interpreted to represent the impacts if these species are not available for harvest or purchase.

In addition to these types of impacts, economic impact models can be used to determine the sources of the impacts. Each impact can be broken down into direct, indirect, and induced economic impacts. “Direct” economic impacts are the results of the money initially spent in the study area (e.g., country, region, state, or community) by the fishery or industry being studied. This includes money spent to pay for labor, supplies, raw materials, and operating expenses. The direct economic impacts from the initial spending create additional activity in the local economy, i.e., “indirect” economic impacts. Indirect economic impacts are the results of business-to-business transactions indirectly caused by the direct impacts. For example, businesses initially benefiting from the direct impacts will subsequently increase spending at other local businesses. The indirect economic impact is a measure of this increase in business-to-business activity, excluding the initial round of spending which is included in the estimate of direct impacts. “Induced” economic impacts are the results of increased personal income caused by the direct and indirect economic impacts. For example, businesses experiencing increased revenue from the direct and indirect impacts will subsequently increase spending on labor by hiring more employees, increasing work hours, raising salaries/wage rates, etc. In turn, households will increase spending at local businesses. The induced impact is a measure of this increase in household-to-business activity.

Table 3.2.6.1. Average annual economic impacts of IFQ species in the commercial sector of the Gulf reef fish fishery. All monetary estimates are in thousands of 2018 dollars[24] and employment is measured in full-time equivalent jobs.

Industry sector	Direct	Indirect	Induced	Total
Harvesters				
Employment impacts	1,204	187	248	1,639
Income impacts	29,125	5,407	13,076	47,609
Total value-added impacts	31,046	19,468	22,374	72,887
Output Impacts	53,945	43,889	43,433	141,267
Primary dealers/processors				
Employment impacts	251	100	174	525
Income impacts	9,503	8,758	8,283	26,544
Total value-added impacts	10,130	11,175	15,595	36,900
Output impacts	30,587	23,038	30,484	84,110
Secondary wholesalers/distributors				
Employment impacts	116	26	113	255
Income impacts	5,661	1,684	5,954	13,299
Total value-added impacts	6,035	2,824	10,171	19,030
Output impacts	15,164	5,529	19,779	40,472
Grocers				
Employment impacts	499	57	111	666
Income impacts	11,646	3,870	5,845	21,361
Total value-added impacts	12,414	6,235	9,896	28,545
Output impacts	19,904	10,127	19,428	49,459
Restaurants				
Employment impacts	3,107	207	508	3,822
Income impacts	46,716	14,168	26,759	87,644
Total value-added impacts	49,797	25,326	45,086	120,209
Output impacts	91,055	39,632	88,968	219,655
Harvesters and seafood industry				
Employment impacts	5,177	577	1,153	6,907
Income impacts	102,652	33,887	59,918	196,457
Total value-added impacts	109,422	65,028	103,121	277,571
Output impacts	210,655	122,215	202,093	534,963

[24] The commercial economic impact model has not been updated yet to produce estimates in 2019$.

Estimates of the U.S. average annual business activity associated with the commercial harvest of IFQ species in the Gulf were derived using the model developed for and applied in NMFS (2018)[25] and are provided in Table 3.2.6.1. Specifically, these impact estimates reflect the expected impacts from average annual gross revenues generated by landings of IFQ species from 2012 through 2018. This business activity is characterized as jobs (full- and part-time), income impacts (wages, salaries, and self-employed income), value-added impacts (the difference between the value of goods and the cost of materials or supplies), and output impacts (gross business sales). Income impacts should not be added to output (sales) impacts because this would result in double counting.

The results provided should be interpreted with caution and demonstrate the limitations of these types of assessments. These results are based on average relationships developed through the analysis of many fishing operations that harvest many different species; specifically reef fish in this case. Separate models for individual species are not available. Between 2012 and 2018, landings of Gulf IFQ species resulted in approximately $53.95 million (2018$) in gross revenue on average. In turn, this revenue generated employment, income, value-added, and output impacts of 6,907 jobs, $196.5 million, $277.6 million, and $535 million per year, respectively, on average.

3.3 Social Environment

Recent descriptions of the RS-IFQ and GT-IFQ programs are contained in annual reports produced by NMFS (2019a and 2019b) and in Amendment 36A (GMFMC 2017a), and are incorporated here by reference. These reports and amendment include detailed information on IFQ program participants, program activity, quotas, landings, price information, enforcement, commercial engagement, regional quotient, local quotient, vulnerability indices, and top red snapper and grouper-tilefish communities.

3.3.1 Permits

The majority of commercial reef fish permits are issued to individuals residing in a Gulf state (average of 99.3% from 2012-2019, Table 3.3.1.1), with the greatest proportion residing in Florida (average of 80.6%), followed by Texas (8.1%), Louisiana (5.1%), Alabama (4.6%), and Mississippi (0.7%).

[25] A detailed description of the input/output model is provided in NMFS (2011).

Table 3.3.1.1. Number of Gulf commercial reef fish permits by state, 2012-2019.

State	2012	2013	2014	2015	2016	2017	2018	2019
AL	44	42	41	40	38	37	38	39
FL	729	721	715	706	690	686	677	677
LA	53	48	44	43	42	42	43	41
MS	11	9	9	8	7	6	7	7
TX	74	69	67	67	70	72	74	72
Other	6	6	6	4	5	7	6	6
Total	**917**	**895**	**882**	**868**	**852**	**850**	**845**	**842**

Source: NMFS SERO SF Access permits database.

As of February 17, 2020, a total of 833 commercial reef fish permits were valid, renewable, or transferable (SERO Permit Office). Commercial reef fish permits are held by entities with mailing addresses in a total of 242 communities. Communities with the most commercial reef fish permits are located in Florida and Texas (Table 3.3.1.2). The community with the most Gulf commercial reef fish permits is Panama City, Florida (approximately 8.2% of commercial reef fish permits, Table 3.3.1.2).

Table 3.3.1.2. Top communities by number of Gulf commercial reef fish permits.

State	Community	Permits
FL	Panama City	69
FL	Key West	39
FL	St. Petersburg	30
FL	Destin	23
FL	Largo	22
TX	Galveston	22
FL	Pensacola	20
FL	Cortez	19
FL	Seminole	19
FL	Tampa	16
FL	Clearwater	14
FL	Hudson	11
FL	Naples	11
TX	Houston	11
FL	Apalachicola	10
FL	Lecanto	10
FL	Lynn Haven	10
FL	Steinhatchee	10
FL	Tarpon Springs	10
FL	Winter Springs	10

Source: NMFS SERO permit database accessed 2/17/20.

3.3.2 Landings

Red Snapper

The greatest proportions of the commercial red snapper catch are landed along the west coast of Florida (average of approximately 38.9% from 2012-2019, Table 3.3.2.1) and in Texas (36.6%). Louisiana (average of 18.1%, Table 3.3.2.1) also includes a sizable amount of the commercial red snapper catch. Other Gulf states are also involved in commercial red snapper fishing, but these states represent a much smaller percentage of the total commercial landings.

Table 3.3.2.1. Percentage of total commercial red snapper landings by state for 2012-2019.

Year	AL/MS	FL	LA	TX
2012	4.6%	47.5%	19.6%	28.4%
2013	5.0%	40.8%	21.6%	32.6%
2014	5.2%	39.0%	13.4%	42.3%
2015	5.8%	40.3%	15.9%	37.9%
2016	7.2%	35.4%	16.7%	40.6%
2017	9.2%	37.1%	18.1%	35.6%
2018	7.6%	37.4%	20.1%	34.9%
2019	7.6%	37.4%	20.1%	34.9%

NMFS SERO IFQ database accessed 2/12/20.

Grouper Tilefish

When all share categories of group tilefish are aggregated, the majority of the GT-IFQ catch is landed along the west coast of Florida (average of approximately 90.9% of all GT-IFQ share category landings from 2012-2019, Table 3.3.2.2). Other Gulf states are also involved in commercial grouper tilefish fishing, but these states represent a much smaller percentage of the total commercial landings.

Table 3.3.2.2. Percentage of total commercial grouper tilefish landings by state for 2012-2019.

Year	AL/MS	FL	LA	TX
2012	0.1%	93.3%	2.4%	4.2%
2013	0.1%	90.9%	3.0%	6.0%
2014	0.1%	92.7%	2.0%	5.2%
2015	0.1%	91.1%	2.0%	6.8%
2016	0.1%	90.8%	2.0%	7.1%
2017	0.1%	88.6%	3.4%	7.9%
2018	0.1%	89.0%	5.4%	5.5%
2019	0.1%	87.7%	5.1%	7.1%

Source: NMFS SERO IFQ database accessed 2/12/20.

3.3.3 IFQ Participants

IFQ Accounts

To land IFQ-managed species, fishermen need a permitted vessel and sufficient IFQ allocation in the vessel's account to land the fish. Some accounts are held in the name of an individual, or more than one individual, while others form business entities and open accounts in the name of the business. This makes it more difficult to talk about the social environment, because we don't always know who is behind the account, and whether the holders of an account reside in the same area. In the following analysis, accounts are described at the state and community level based on the mailing address of the individual; business; or primary entity which equates to the primary individual listed on the account, if the account is held by more than one individual.

Also called shareholder accounts, an IFQ account is required to hold shares and allocation. The number of accounts is used here as a proxy to represent the number of participants.

Shareholders
As of February 19, 2020, a total of 683 IFQ accounts held shares in either the RS-IFQ program or GT-IFQ program, or both programs (IFQ database; includes active and suspended accounts). The majority of accounts with shares have a mailing address in Florida (76.9% of accounts with shares, Table 3.3.3.1), followed by Texas (9.5%), Alabama (4.5%), and Louisiana (4.2%). Accounts with mailing addresses in Mississippi and in other states (Arkansas, Georgia, Iowa, Michigan, North Carolina, New York, Ohio, Oregon, South Carolina, Tennessee, Utah, and Wyoming) also hold shares, but these states represent a smaller percentage of the total number of accounts with shares.

The greatest proportion of shares in all share categories including deep-water grouper (DWG), red grouper (RG), gag (GG), other shallow-water grouper (SWG), tilefish (TF), and red snapper (RS) are held in accounts with mailing addresses in Florida, followed by Texas, and Louisiana (Table 3.3.3.1). Accounts in other Gulf states also hold shares, but these states represent a smaller percentage of shares in each share category. Accounts in other states hold a sizable percentage of shares for many of the share categories (for example, 8.826% DWG, 8.439% RG, and 8.693% TF).

Table 3.3.3.1. Number of IFQ accounts with shares by state, including the percentage of shares by state by share category.

State	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
AL	31	1.015	0.870	1.647	1.981	0.492	4.412
FL	525	51.245	84.268	89.385	77.309	42.369	46.890
LA	29	5.817	0.005	0.372	2.748	10.230	8.399
MS	10	0.445	0.143	0.218	0.668	0.154	2.424
TX	65	32.630	6.175	4.386	12.584	38.015	35.031
Other	23	8.826	8.439	3.817	4.260	8.693	2.772
Total	**683**	**99.978**	**99.900**	**99.825**	**99.550**	**99.953**	**99.929**

Source: NMFS SERO IFQ database accessed 2/19/20. Note: Includes active and suspended accounts.

IFQ accounts with shares are held by people with mailing addresses in a total of 233 communities (IFQ database accessed 2/19/20). Communities with the most accounts with shares are located in Florida and Texas (Table 3.3.3.2). The community with the most accounts with shares is Panama City, Florida (7.3% of accounts with shares), followed by Key West, Florida (3.7%), and Largo, Florida (3.1%).

Table 3.3.3.2. Top communities by number of IFQ accounts with shares, including the percentage of shares by community by share category.

State	Community	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
FL	Panama City	50	12.803	4.912	17.952	12.262	7.867	11.863
FL	Key West	25	0.204	0.519	0.238	1.513	0.848	0.008
FL	Largo	21	2.216	8.511	5.891	2.614	0.514	0.470
FL	St. Petersburg	18	2.077	4.472	2.316	2.443	0.775	0.089
FL	Destin	17	2.589	0.177	1.084	1.076	4.186	6.288
FL	Cortez	16	4.083	6.342	1.714	2.213	3.454	0.024
FL	Pensacola	15	1.260	0.038	0.577	1.883	4.082	2.795
TX	Galveston	14	7.561	0.487	0.805	2.818	18.245	14.337
FL	Steinhatchee	13	0.061	2.126	2.894	1.371	0.029	0.524
FL	Tallahassee	13	0.001	0.540	1.227	0.124	0.002	1.151
FL	Tampa	12	0.172	0.548	1.746	1.157	0.020	0.013
FL	Apalachicola	11	3.112	3.159	7.532	4.698	3.024	0.558
TX	Houston	11	19.783	4.864	1.506	5.265	14.743	4.577
FL	Clearwater	10	0.591	6.754	4.286	1.943	0.638	0.014
FL	Seminole	10	1.665	3.163	1.418	1.900	2.692	0.024
FL	Tarpon Springs	10	1.045	2.102	2.623	1.199	0.306	0.077

Source: NMFS SERO IFQ database accessed 2/19/20.

The largest or maximum percent of shares held in a community ranges from 8.511% for RG, 12.262% for SWG, 14.337% for RS, 17.952% for GG, 18.245% for TF, and 19.783% for DWG (IFQ database accessed 2/19/20). The percentage of shares by community varies widely by share category and a large number of accounts with shares may not necessarily correlate to a large percentage of shares in a particular category (Table 3.3.3.2). Some communities with a relatively smaller number of accounts may have a larger percentage of shares in a particular share category or categories. The community of Panama City, Florida includes the greatest percentage of shares for GG and SWG; Galveston, Texas for TF and RS; Houston, Texas for DWG; and Largo, Florida for RG.

Shareholders with Permits

As of February 19, 2020, a total of 369 IFQ accounts held shares in at least one share category and were also associated with a commercial reef fish permit (IFQ database; includes active and suspended accounts). The majority of accounts with shares that are also associated with a permit have a mailing address in Florida (78% of accounts with shares that are associated with permits, Table 3.3.3.3), followed by Texas (10.3%), Louisiana (4.6%), and Alabama (4.3%). Accounts with mailing addresses in Mississippi and in other states (Arkansas, Georgia, New York, and South Carolina) also hold shares and are associated with permits, but these states represent a smaller percentage of the total number of accounts with shares that are also associated with permits.

Table 3.3.3.3. Number of IFQ accounts with shares that are associated with permits by state, including the percentage of shares by state by share category.

State	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
AL	16	0.444	0.845	1.375	1.623	0.405	3.558
FL	288	41.148	62.204	67.238	63.112	36.581	31.609
LA	17	4.605	0.001	0.214	1.785	10.145	6.551
MS	4	0.251	0.141	0.186	0.405	0.147	0.058
TX	38	15.541	4.107	3.812	11.083	19.566	25.415
Other	6	4.437	1.844	0.463	1.454	2.618	1.454
Total	**369**	**66.425**	**69.140**	**73.287**	**79.462**	**69.462**	**67.978**

Source: NMFS SERO IFQ database accessed 2/19/20. Note: Includes active and suspended accounts.

The total percentage of shares held by accounts that are associated with permits ranges from 66.425% for DWG, 67.978% for RS, 69.140% for RG, 69.462% for TF, 73.287% for GG, and 79.462% for SWG (Table 3.3.3.3). The greatest proportion of shares that are associated with permits are held by accounts with mailing addresses in Florida, followed by Texas, and Louisiana. Accounts in other Gulf states also hold shares and are associated with permits, but these states represent a smaller percentage of shares in each share category. Accounts in other states hold a somewhat sizable percentage of shares for some of the share categories (for example, 4.437% DWG and 2.618% TF).

IFQ accounts with shares that are also associated with permits have mailing addresses in a total of 152 communities (IFQ database accessed 2/19/20). Communities with the most accounts with shares that are associated with permits are located in Florida and Texas (Table 3.3.3.4). The community with the most accounts with shares that are associated with permits is Panama City, Florida (7.3% of accounts with shares that are associated with permits), followed by Cortez and Key West, Florida (each with 4.1%). The largest or maximum percent of shares held in a community by accounts that are associated with permits ranges from 6.719% for RG, 10.821% for SWG, 10.945% for RS, 11.777% for DWG, 12.045% for TF, and 12.768% for GG (IFQ database accessed 2/19/20). The percentage of shares by community varies widely by share category and a large number of accounts may not necessarily correlate to a large percentage of shares in a particular category (Table 3.3.3.4). Some communities with a relatively smaller number of accounts may have a larger percentage of shares in a particular share category or categories. The community of Panama City, Florida includes the greatest percentage of shares for DWG, GG, and SWG; Galveston, Texas for TF and RS; and Largo, Florida for RG.

Table 3.3.3.4. Top communities by number of IFQ accounts with shares that are associated with permits, including the percentage of shares by community by share category.

State	Community	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
FL	Panama City	27	11.777	4.183	12.768	10.821	6.578	10.772
FL	Cortez	15	4.026	5.744	1.629	2.138	3.414	0.023
FL	Key West	15	0.046	0.253	0.121	1.139	0.003	0.000
FL	Largo	11	1.329	6.719	4.739	2.208	0.206	0.042
FL	St. Petersburg	11	1.779	4.121	2.309	1.919	0.775	0.089
TX	Galveston	9	6.840	0.118	0.320	1.888	12.045	10.945
TX	Houston	9	5.078	3.179	1.506	5.265	2.530	4.309
FL	Apalachicola	8	3.108	3.078	7.441	4.308	3.024	0.557
FL	Destin	8	2.421	0.029	0.842	0.942	4.185	5.801
FL	Seminole	8	1.662	3.046	1.418	1.899	2.688	0.024
FL	Steinhatchee	7	0.061	1.670	2.419	1.336	0.028	0.496
FL	Tampa	7	0.170	0.447	1.735	0.157	0.020	0.011
FL	Fort Walton Beach	6	0.378	0.152	0.423	0.607	0.043	0.976
FL	Naples	6	0.060	1.043	0.515	0.846	0.000	0.010
FL	Pensacola	6	0.822	0.018	0.303	1.008	4.053	1.647
FL	Tarpon Springs	6	1.044	2.015	2.477	1.109	0.304	0.077

Source: NMFS SERO IFQ database accessed 2/19/20.

Shareholders without Permits

As of February 19, 2020, a total of 314 IFQ accounts held shares in at least one share category and did not hold a commercial reef fish permit (IFQ database; includes active and suspended accounts). The majority of accounts with shares, but that are not associated with permits have a mailing address in Florida (75.5% of accounts with shares, but without permits, Table 3.3.3.5), followed by Texas (8.6%), Alabama (4.8%), Louisiana (3.8%), and Mississippi (1.9%). Accounts with mailing addresses in other states (Georgia, Iowa, Michigan, North Carolina, New York, Ohio, Oregon, South Carolina, Tennessee, Utah, and Wyoming) also hold shares without permits and cumulatively these states represent a sizable percentage of the total number of accounts with shares, but without permits (5.4%).

Table 3.3.3.5. Number of IFQ accounts with shares, but without permits by state, including the percentage of shares by state by share category.

State	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
AL	15	0.571	0.025	0.272	0.358	0.087	0.854
FL	237	10.097	22.064	22.147	14.197	5.788	15.281
LA	12	1.212	0.004	0.158	0.963	0.085	1.848
MS	6	0.194	0.002	0.032	0.263	0.007	2.365
TX	27	17.090	2.069	0.574	1.501	18.449	9.616
Other	17	4.389	6.595	3.354	2.806	6.075	1.987
Total	**314**	**33.553**	**30.759**	**26.537**	**20.088**	**30.492**	**31.951**

Source: NMFS SERO IFQ database accessed 2/19/20. Note: Incudes active and suspended accounts.

The total percentage of shares held by accounts that are not associated with permits ranges from 20.088% for SWG, 26.537% for GG, 30.492% for TF, 30.759% for RG, 31.951% for RS, and 33.553% for DWG (Table 3.3.3.5). The greatest proportion of shares that are not associated with permits are held by accounts with mailing addresses in Florida and Texas. Accounts in other Gulf states also hold shares and are not associated with permits, but these states represent a smaller percentage of shares in each share category. IFQ accounts in other states that are not associated with permits hold a sizable percentage of shares for some of the share categories (for example, 6.595% RG and 6.075% TF).

IFQ accounts with shares, but without permits have mailing addresses in a total of 154 communities (IFQ database accessed February 19, 2020). Communities with the most accounts with shares that are not associated with permits are located in Florida and Texas (Table 3.3.3.6). The community with the most accounts with shares, but without permits, is Panama City, Florida (7.3% of accounts with shares, but without permits, Table 3.3.3.6), followed by Key West, Largo, and Tallahassee, Florida (each with 3.2%).

The largest or maximum percent of shares held in a community by accounts that are not associated with permits ranges from 1.944% for SWG, 4.562% for RS, 5.073% for RG, 5.184%

for GG, 12.212% for TF, and 14.704% for DWG (IFQ database accessed 2/19/20). The percentage of shares by community varies widely by share category and a large number of accounts may not necessarily correlate to a large percentage of shares in a particular category (Table 3.3.3.6). Some communities with a relatively small number of accounts may have a larger percentage of shares in a particular share category or categories (for example, three accounts in Mt. Pleasant, South Carolina hold 6.072% of TF shares). The community of Houston, Texas (not shown in Table 3.3.3.6) includes the greatest percentage of shares for DWG and TF; Lecanto, Florida (not shown in Table 3.5.2.6) for RG and SWG; Panama, Florida for GG; and Lynn Haven, Florida for RS.

Table 3.3.3.6. Top communities by number of IFQ accounts with shares, but without permits, including the percentage of shares by community by share category.

State	Community	Accounts	DWG Shares (%)	RG Shares (%)	GG Shares (%)	SWG Shares (%)	TF Shares (%)	RS Shares (%)
FL	Panama City	23	1.025	0.729	5.184	1.441	1.290	1.091
FL	Key West	10	0.158	0.266	0.117	0.374	0.845	0.008
FL	Largo	10	0.887	1.791	1.152	0.407	0.308	0.429
FL	Tallahassee	10	0.000	0.433	0.766	0.057	0.000	0.390
FL	Destin	9	0.168	0.148	0.242	0.134	0.001	0.487
FL	Pensacola	9	0.438	0.019	0.273	0.875	0.029	1.148
FL	Lynn Haven	7	0.008	0.197	0.669	0.343	0.000	4.562
FL	St. Petersburg	7	0.298	0.351	0.007	0.524	0.000	0.000
FL	Steinhatchee	6	0.000	0.456	0.475	0.035	0.000	0.028
FL	Clearwater	5	0.353	1.018	2.427	0.010	0.292	0.000
FL	Hudson	5	0.557	0.940	0.770	0.277	0.561	0.000
FL	Madeira Beach	5	0.849	0.573	0.357	0.478	0.458	0.025
FL	Tampa	5	0.002	0.101	0.011	1.001	0.000	0.002
TX	Galveston	5	0.721	0.369	0.485	0.930	6.199	3.392
FL	Palm Harbor	4	0.207	0.830	1.097	0.397	0.001	0.022
FL	Panacea	4	0.000	0.065	0.185	0.002	0.000	0.000
FL	Riverview	4	0.000	0.547	0.003	0.000	0.000	0.000
FL	Tarpon Springs	4	0.000	0.087	0.146	0.090	0.002	0.000

Source: NMFS SERO IFQ database accessed 2/19/20.

Account Holders without Shares

As of February 19, 2020, a total of 331 IFQ accounts were activated or suspended without shares (IFQ database accessed 2/19/20, includes activated and suspended accounts without shares in any RS-IFQ or GT-IFQ share category). Activated accounts include those that have logged in. Suspended accounts can be re-activated after citizenship requirements have been completed. However, these accounts may be related to accounts with shares. The majority of accounts without shares have mailing addresses in Florida (78.9% of activated or suspended accounts without shares, Table 3.3.3.7), followed by Texas (6.9%), Alabama (6%) and Louisiana (4.2%). Account holders without shares also have mailing addresses in Mississippi and other states (Connecticut, Iowa, Illinois, Kentucky, Massachusetts, Maryland, North Carolina, Ohio, South Carolina, and Wisconsin), but these states represent a smaller percentage of the total number of activated or suspended accounts without shares.

Table 3.3.3.7. Number of IFQ accounts without shares by state.

State	Accounts
AL	20
FL	261
LA	14
MS	3
TX	23
Other	10
Total	**331**

Source: NMFS SERO IFQ database accessed 2/19/20. Note: Includes active and suspended accounts.

IFQ accounts without shares have mailing addresses in a total of 145 communities (IFQ database accessed 2/19/20). Communities with the most accounts without shares are located in Florida, Texas, and Alabama (Table 3.3.3.8). The community with the most accounts without shares is Panama City, Florida (7.3% of activated or suspended accounts without shares, Table 3.3.3.8), followed by St. Petersburg, Florida (4.5%), and Galveston, Texas (4.5%).

Table 3.3.3.8. Top communities by number of IFQ accounts without shares.

State	Community	Accounts
FL	Panama City	24
FL	St. Petersburg	15
TX	Galveston	15
FL	Key West	11
FL	Destin	9
FL	Largo	9
FL	Seminole	9
FL	Fort Myers	8
FL	Cape Coral	7
FL	Clearwater	7
FL	Pensacola	7
AL	Dauphin Island	6
FL	Hudson	6
FL	Madeira Beach	6

Source: NMFS SERO IFQ database accessed 2/19/20.

IFQ Dealers

The majority of GT-IFQ and RS-IFQ dealers are located in Florida (average of 74.8% of Gulf IFQ dealers for 2012-2019, Table 3.3.3.9), followed by Louisiana (9.1%), Alabama and Mississippi (8.5%), and Texas (7.6%).

Table 3.3.3.9. Number of Gulf IFQ dealers by state for 2012-2019.

Year	AL/MS	FL	LA	TX
2012	6	79	8	8
2013	5	76	10	9
2014	8	94	9	10
2015	9	98	10	9
2016	9	90	10	8
2017	16	90	17	11
2018	14	94	12	9
2019	14	95	11	9

Source: NMFS SERO IFQ database accessed 2/12/20.

Gulf IFQ dealer facilities are located in a total 105 communities (IFQ database accessed 2/12/20, includes Gulf IFQ dealers with landings 2012-2019). Communities with the most Gulf IFQ dealer facilities are located in Florida, Texas, Alabama, and Louisiana (Table 3.3.3.10). The community with the most Gulf IFQ dealer facilities is Key West, Florida (approximately 6% of Gulf IFQ dealer facilities, Table 3.3.3.10), followed by Panama City, Florida (approximately 3.6% of Gulf IFQ dealer facilities) and Madeira Beach and Tarpon Springs, Florida (each with approximately 2.8% of Gulf IFQ dealer facilities).

Table 3.3.3.10. Top communities by number of Gulf IFQ dealer facilities with landings during 2012-2019.

State	Community	*Dealer Facilities
FL	Key West	17
FL	Panama City	10
FL	Madeira Beach	8
FL	Tarpon Springs	8
FL	Destin	7
FL	Pensacola	7
FL	St. Petersburg	7
TX	Galveston	7
FL	Fort Myers	6
FL	Panacea	6
FL	Steinhatchee	6
AL	Bayou La Batre	5

State	Community	*Dealer Facilities
AL	Bon Secour	5
FL	Bokeelia	5
FL	Crystal River	5
FL	Fort Myers Beach	5
FL	Hudson	5
FL	Matlacha	5
FL	Naples	5
FL	St. James City	5
LA	Golden Meadow	5
LA	Venice	5
FL	Apalachicola	4
FL	Clearwater	4
FL	Miami	4
FL	Tampa	4

Source: NMFS SERO IFQ database accessed 2/12/20.
*Multiple dealers can use the same facility and a dealer can operate at multiple facilities.

3.3.4 Catch Share Performance Indicators

In a national report on community participation in catch share programs (Colburn et al. 2017), a series of performance indicators were developed to provide an overview of catch share programs and the communities participating in those regional programs. The report focuses specifically on the trends of catch share programs within U.S. fishing communities in the broadest sense rather than as defined under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and presents a set of community-level catch share performance metrics aimed at understanding changes in social vulnerability and fisheries' participation. The following metrics for the RS-IFQ program and GT-IFQ program were included in that report and are presented here separately and combined together as the Gulf IFQ programs as part of the social environment. Data are updated to 2018, when possible and adapted accordingly.

The metrics developed include two categories of objective community-level indicators that monitor community dependence on catch share species. The first set of indicators is intended to measure commercial fishing engagement by a community. The index is created through a principal components factor analysis (PCFA) of variables that are thought to contribute to (or detract from) community engagement in commercial fishing activities. The results of the PCFA were used to construct individual index scores for each community, using the regression method and normalized to have a mean of zero. Communities were chosen if they had an index score (standard deviation) of 1.0 or higher at least one year during the time series. Other indicators include the Regional Quotient (RQ) and the Local Quotient. The second set of indicators includes community-specific measures of social vulnerability and gentrification pressure vulnerability, based on those developed in Jepson and Colburn (2013). Together, these four metrics (see Table 3.3.4.1) form the community catch share performance indicators as developed by Colburn et al. (2017).

Table 3.3.4.1. Definitions of catch share performance indicators for communities involved with the Gulf IFQ Programs, RS-IFQ Program, and GT-IFQ Program.

Performance Indicator	Definition	Timeframe
Engagement Index	Index consisting of pounds and value of IFQ species, number of permitted reef fish vessels, number of IFQ species dealers within a community	2012-2018
Regional Quotient (pounds and value)	Community landings of IFQ species divided by total landings of IFQ species in the region	2012-2018
Catch Share Program Local Quotient (pounds and value)	Community landings IFQ species divided by total landings (all species) in community	2012-2018
Community Social Vulnerability Indicators (CSVIs)	**Social Vulnerability Indicators:** Poverty Index, Population Composition Index, Personal Disruption Index, Housing Characteristics Index, Labor Force Structure Index **Gentrification Pressure Vulnerability Indicators:** Housing Disruption Index, Retiree Migration Index, Urban Sprawl Index	2012-2016 American Community Survey 5-year Estimate

Gulf IFQ Programs: Commercial Engagement

The program-specific commercial Fishing Engagement Index scores for the Gulf IFQ Program, including red snapper and grouper-tilefish are presented in Table 3.3.4.2. The index is an indicator of the importance of IFQ red snapper and grouper-tilefish fishing in a community relative to other communities. It is a measure of the presence of IFQ red snapper and grouper-tilefish fishing activity including pounds and value of red snapper and grouper-tilefish, number of reef fish permits, and number of reef fish dealers within the community. There are 22 communities in Table 3.3.4.2 that were highly engaged (1.0 standard deviation or more above the mean) in the Gulf IFQ Program fishery for at least one year from 2012 through 2018.

Table 3.3.4.2. Fishing Engagement Index scores of communities highly engaged in the Gulf IFQ Program for one or more years from 2012 through 2018.

Community	2012	2013	2014	2015	2016	2017	2018
Madeira Beach, FL	9.154	9.407	9.523	9.047	8.723	8.177	7.722
Galveston, TX	3.429	5.550	6.254	6.939	7.508	7.403	7.606
Panama City, FL	7.366	6.943	6.235	5.863	6.062	6.764	7.068
Destin, FL	4.745	4.194	3.652	4.263	3.747	3.710	3.528
Key West, FL	3.411	3.659	3.635	3.782	4.030	3.321	3.270
Apalachicola, FL	3.241	2.259	2.431	2.435	2.469	2.658	2.800
Golden Meadow, LA	1.845	1.853	1.362	1.760	1.563	2.570	2.771
Cortez, FL	2.972	1.717	2.002	2.054	2.397	2.247	2.149
Tarpon Springs, FL	3.239	3.150	3.350	2.609	2.545	2.176	2.096
Pensacola, FL	1.672	1.996	1.903	1.712	1.667	1.371	1.621
St. Petersburg, FL	1.624	1.069	1.016	0.957	1.163	1.584	1.459
Houma, LA	0.267	1.060	0.160	0.551	0.469	1.172	1.351
Indian Shores, FL	0.398	0.600	1.095	1.082	0.932	1.237	1.325
Venice, LA	0.735	1.081	0.958	1.038	1.043	0.968	1.110
Bon Secour, AL	0.466	0.013	0.142	0.144	0.753	0.775	1.071
Redington Shores, FL	0.980	1.214	1.451	1.527	1.306	1.099	0.969
Clearwater, FL	1.112	1.064	0.925	0.796	0.583	0.741	0.930
Fort Myers Beach, FL	1.061	0.791	1.180	1.506	0.945	0.995	0.913
Steinhatchee, FL	1.447	0.791	1.217	1.351	1.325	1.017	0.875
Bayou La Batre, AL	0.210	0.351	0.255	0.405	0.507	1.005	0.749
Crystal River, FL	1.205	0.915	0.973	0.930	0.836	0.678	0.702
Fort Myers, FL	0.391	0.225	0.401	0.541	1.005	0.935	0.547

Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.

Note: Highlighted cells indicate high engagement. Communities are in order of 2018 engagement scores.

The majority of highly engaged communities are in Florida, with Galveston, Texas and Golden Meadow, Louisiana the only two communities outside the state that were highly engaged throughout the time series. Other communities, like Redington Shores and Steinhatchee, Florida, have been highly engaged five out of the seven time periods. Indian Shores and Venice, FL were both highly engaged for four out the seven years. The communities of Houma, LA and Fort Myers Beach, FL have been highly engaged for at least three out of the seven time periods.

Of the 22 communities found in Table 3.3.4.2, the communities that were highly engaged for all years from the 2012 through 2018 are depicted in Figure 3.3.4.1. The engagement scores for those highly engaged communities display some fluctuation, but tend to be fairly stable for most communities. Galveston, Texas demonstrated the most fluctuation with a large increase in Gulf IFQ engagement over time. The community of Madeira Beach, Florida has remained at the top throughout the time series, but has demonstrated a decrease in engagement in recent years. For those communities at the bottom, engagement has fluctuated. For example, Tarpon Springs, Florida has demonstrated a decrease in engagement; whereas Golden Meadow, Louisiana has demonstrated an increase.

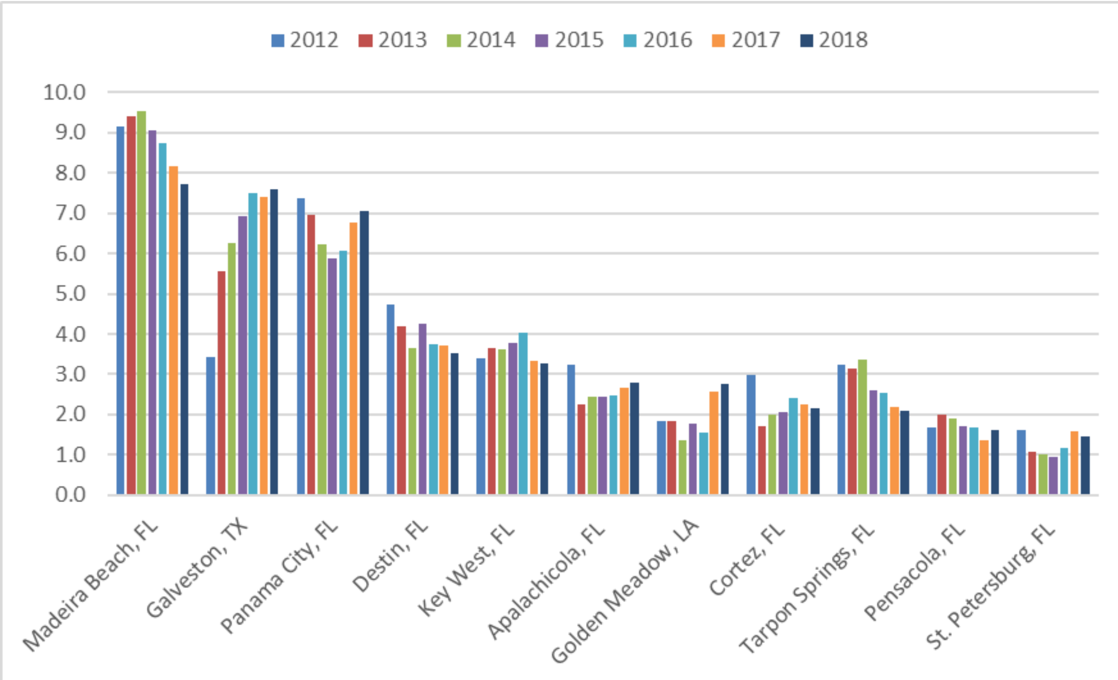

Figure 3.3.4.1. Fishing Engagement Index scores of communities highly engaged in the Gulf IFQ Program for all years, from 2012 to 2018.
Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.

Gulf IFQ Programs: Regional Quotient

Another measure of a community's involvement in the IFQ fishery is its RQ. RQ is the proportion of IFQ red snapper and grouper-tilefish landed within a community out of the total amount of IFQ red snapper and grouper-tilefish landed within the Southeast region. It is an indicator of the percent contribution in pounds or value of IFQ red snapper and grouper-tilefish landed within that community relative to the regional fishery. The RQ is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. All other communities that landed IFQ red snapper and grouper-tilefish are grouped as "Other Communities." Figure 3.3.4.2 and Figure 3.3.4.3 show the RQ both in pounds and value, respectively from 2012 to 2018.

The dominant IFQ red snapper and grouper-tilefish communities for pounds landed included the Florida communities of Madeira Beach, Florida; Galveston, Texas; and Panama City, Florida (Figure 3.3.1.2). Of the three leading communities, Galveston, Texas has seen the largest increase in RQ over the time period. The community of Madeira Beach, Florida has seen a decrease over time. Most communities that were highly engaged for all years, saw some fluctuation in their RQ, but overall trends in RQ for pounds seem to be fairly stable for most communities.

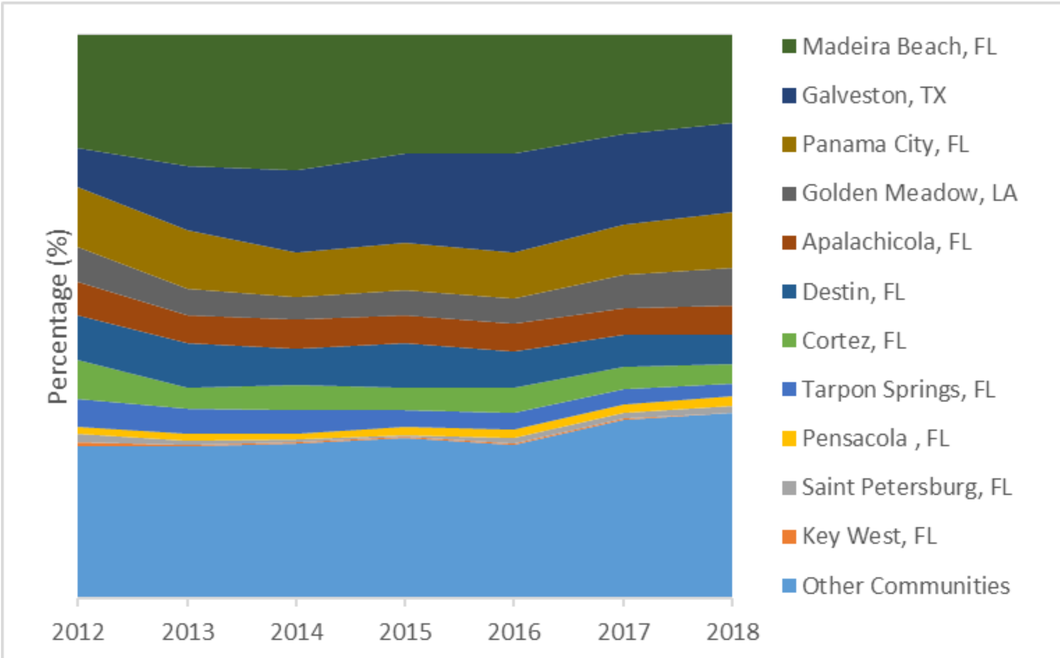

Figure 3.3.4.2. Regional Quotient (pounds) for communities highly engaged in the Gulf of Mexico IFQ Program for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

The dominant Gulf IFQ communities for value landed are roughly the same as for pounds landed (Figure 3.3.4.3). Most communities saw similar fluctuation in their RQ for value to that for pounds. One change was that the communities of Golden Meadow, Louisiana and Destin, Florida switched rankings in terms of value when compared to pounds in the RQ. However, they are very close on both measures. The category of “Other Communities” makes up a sizable proportion of the total RQ (an average of 29% of pounds and 28% of value from 2012 to 2018) and that proportion has increased over time for both pounds and value.

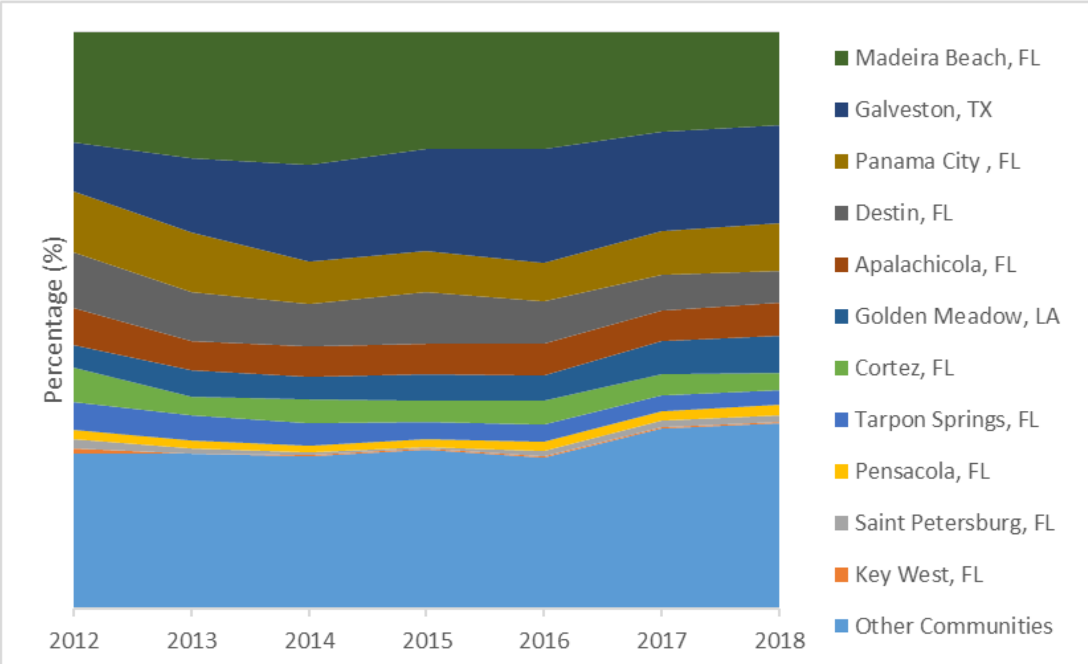

Figure 3.3.4.3. Regional Quotient (value) for communities highly engaged in the Gulf IFQ Programs for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

Gulf IFQ Programs: Local Quotient

The community Local Quotient is the percentage of Gulf IFQ programs, including red snapper and grouper-tilefish landed within a community out of the total amount of all species landed within that community. It is an indicator of the contribution in pounds or value of IFQ red snapper and grouper-tilefish to the overall landings in a community. The Local Quotient is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. Figure 3.3.4.4 and Figure 3.3.4.5 show the Local Quotient both in pounds and value from the 2012 to 2018.

The Local Quotient for pounds landed for most communities fluctuated from 2012 through 2018 (Figure 3.3.4.4). The communities of Panama City, Apalachicola, Destin, Tarpon Springs, and St. Petersburg, Florida and Galveston, Texas all saw considerable fluctuation over time in their Gulf IFQ Local Quotient for pounds landed. Apalachicola, Florida and Galveston, Texas saw a substantial increase in their Local Quotient, while St. Petersburg, Florida saw a considerable decrease. The Local Quotient for Madeira Beach, Florida consistently contributed over 65% of total pounds landed in the community. The Local Quotient for Panama City, Apalachicola, and Destin, Florida and Galveston, Texas often contributed to over 25% of total pounds landed in these communities.

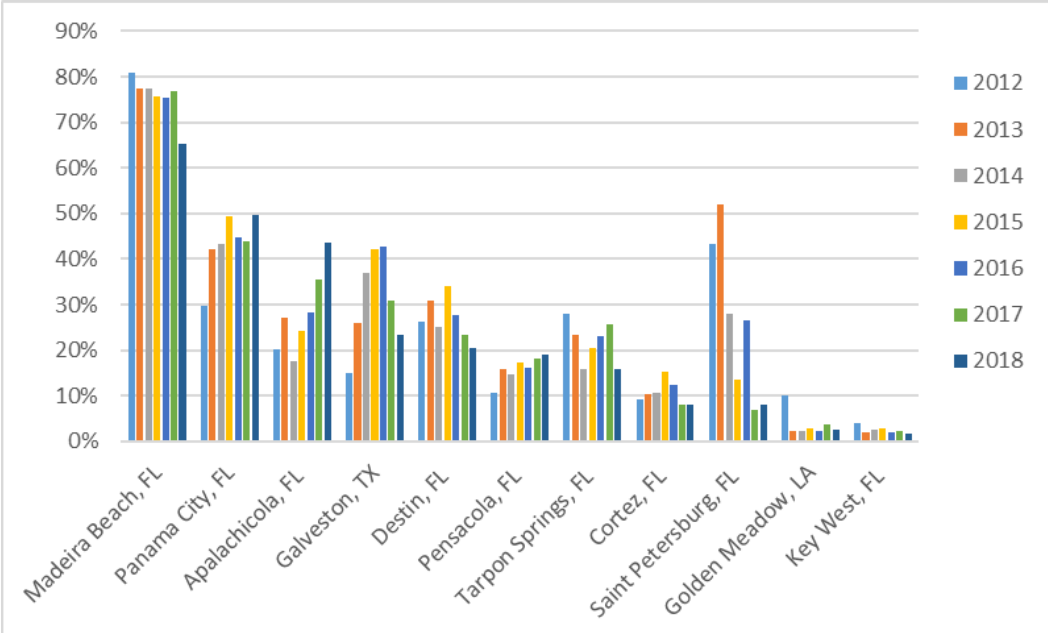

Figure 3.3.4.4. Local Quotient (pounds) for communities highly engaged in the Gulf IFQ Programs for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

The trend for Gulf IFQ Local Quotient for value landed is that the value makes up a higher percentage of total species value than pounds landed within most communities (Figure 3.3.4.5). Many communities switched rankings in terms of value as compared pounds in the LQ. The Local Quotient for Destin, Florida consistently contributed over 85% of total value landed in the community.

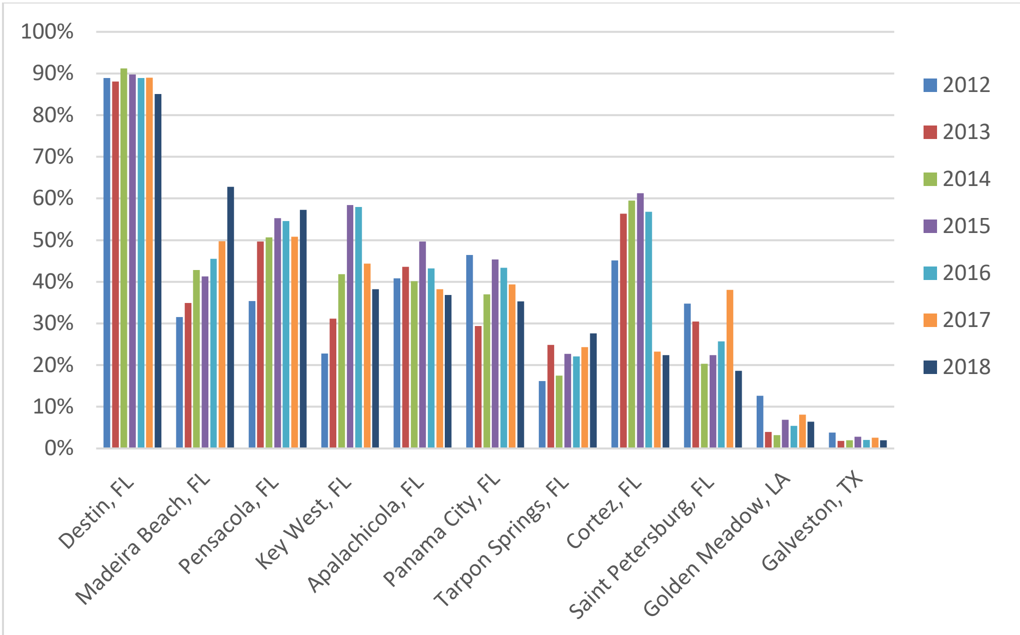

Figure 3.3.4.5. Local Quotient (value) for communities highly engaged in the Gulf IFQ Programs for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

RS-IFQ Program: Commercial Engagement

The program-specific commercial Fishing Engagement Index scores for the Gulf RS-IFQ Program are presented in Table 3.3.4.3. The index is an indicator of the importance of IFQ red snapper fishing in a community relative to other communities. It is a measure of the presence of RS-IFQ fishing activity including pounds and value of red snapper, number of reef fish permits, and number of reef fish dealers within the community. There are 13 communities in Table 3.3.4.3 that were highly engaged (1.0 standard deviation or more above the mean) in the Gulf RS-IFQ Program fishery for at least one year from 2012 through 2018.

Table 3.3.4.3. Fishing Engagement Index scores of communities highly engaged in the RS-IFQ Program for one or more years from 2012 through 2018.

Community	2012	2013	2014	2015	2016	2017	2018
Galveston, TX	7.287	9.395	12.169	11.349	12.488	11.198	11.371
Panama City, FL	8.064	6.805	5.008	5.116	4.815	6.380	6.579
Destin, FL	9.207	8.233	6.826	7.432	6.170	5.605	4.774
Golden Meadow, LA	3.893	2.819	2.361	2.606	2.496	3.151	3.298
Madeira Beach, FL	1.205	1.803	1.755	1.947	1.766	2.046	2.698
Apalachicola, FL	1.756	1.550	1.703	2.138	1.790	2.446	2.383
Houma, LA	0.654	2.930	0.357	1.161	1.004	2.475	2.380
Key West, FL	2.073	2.220	2.188	2.291	2.264	2.252	2.217
Pensacola, FL	1.993	1.733	1.549	1.546	1.446	1.520	1.589
Freeport, TX	1.791	1.738	1.067	1.396	1.084	1.628	1.329

Community	2012	2013	2014	2015	2016	2017	2018
Matagorda, TX	1.046	1.065	0.875	1.106	1.015	1.231	1.238
Tarpon Springs, FL	1.572	1.474	1.237	1.207	1.151	1.121	1.229
Port Bolivar, TX	1.182	1.184	1.007	1.249	0.924	1.101	1.094

Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.
Note: Highlighted cells indicate high engagement. Communities are in order of 2018 engagement scores

Highly engaged communities are located in Texas, Florida, and Louisiana. Matagorda, Texas was highly engaged for 6 of the 7 years. Other communities, like Houma, Louisiana and Port Bolivar, Texas, have been highly engaged five out of the seven time periods.

Of the 13 communities found in Table 3.3.4.3, the communities that were highly engaged for all years from the 2012 through 2018 are depicted in Figure 3.3.4.6. For those communities at the top of the scale, RS-IFQ engagement has fluctuated. Though the community of Galveston, Texas did not start at the top at the beginning of the time series, it rose to the top during the second year of the time series and remained at the top for the remainder of the time series. The community of Destin, Florida has demonstrated a decrease in RS-IFQ engagement in recent years. The engagement scores for those highly engaged communities at the middle and bottom of the scale display some fluctuation, but tend to be fairly stable for most communities.

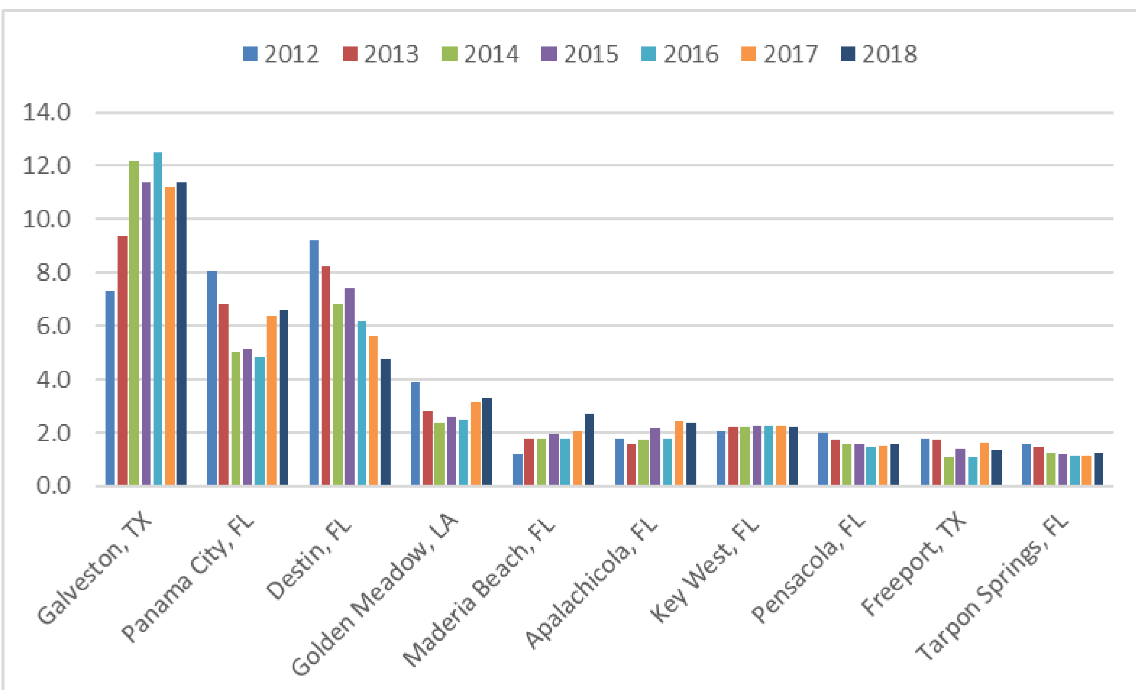

Figure 3.3.4.6. Fishing Engagement Index scores of communities highly engaged in the RS-IFQ Program for all years, from 2012 to 2018.
Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.

RS-IFQ Program: Regional Quotient

RQ is the proportion of IFQ red snapper landed within a community out of the total amount of RS-IFQ landed within the southeast region. It is an indicator of the percent contribution in pounds or value of RS-IFQ landed within that community relative to the regional fishery. The RQ is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. All other communities that landed RS-IFQ are grouped as "Other Communities." Figure 3.3.4.7 and Figure 3.3.4.8 show the RQ both in pounds and value, respectively from 2012 to 2018.

The dominant IFQ red snapper communities for pounds landed included the communities of Galveston, Texas, Destin, Florida, and Panama City, Florida (Figure 3.3.4.7). Of the three leading communities, Galveston, Texas has seen the largest increase in RQ over the time period and the community of Destin, Florida has seen the largest decrease over time.

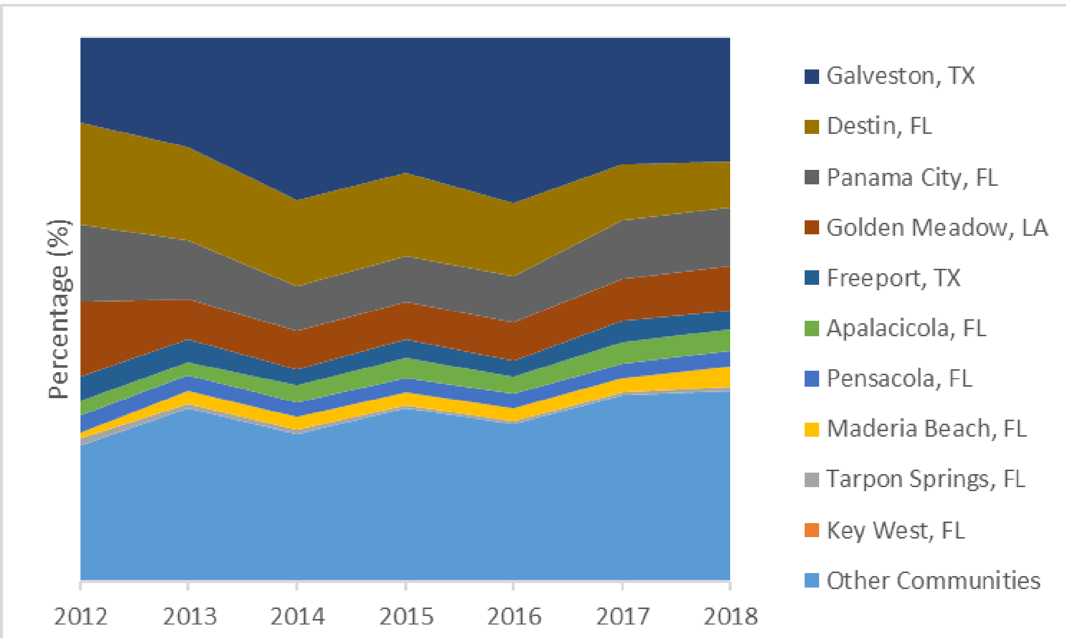

Figure 3.3.4.7. Regional Quotient (pounds) for communities highly engaged in the RS-IFQ Program for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

The dominant IFQ red snapper communities for value landed are roughly the same as for pounds landed (Figure 3.3.4.8). Most communities saw similar fluctuation in their RQ for value to that for pounds. The category of "Other Communities" makes up a sizable proportion of the total RQ (an average of 30% of pounds and 29% of value from 2012 to 2018) and that proportion has increased over time for both pounds and value.

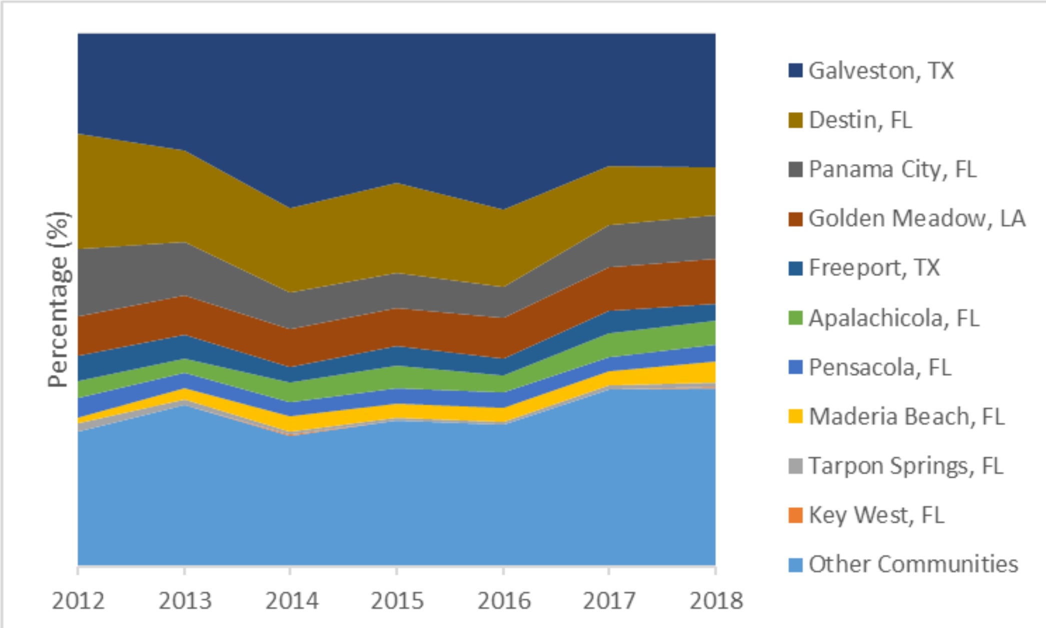

Figure 3.3.4.8. Regional Quotient (value) for communities highly engaged in the RS-IFQ Program for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

RS-IFQ Program: Local Quotient

The community Local Quotient is the percentage of IFQ red snapper landed within a community out of the total amount of all species landed within that community. It is an indicator of the contribution in pounds or value of IFQ red snapper to the overall landings in a community. The Local Quotient is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. Figure 3.3.4.9 and Figure 3.3.4.10 show the Local Quotient both in pounds and value from 2012 to 2018.

The Local Quotient for pounds landed for most communities fluctuated from 2012 through 2018 (Figure 3.3.4.9). The communities of Freeport and Galveston, Texas; Panama City, Apalachicola, and Destin, Florida; and Golden Meadow, Louisiana all saw considerable fluctuation over time in their red snapper Local Quotient for pounds landed. Freeport, Texas, Panama City, Florida, and Apalachicola, Florida saw a substantial increase in their Local Quotient, while Galveston, Texas and Destin, Florida saw a considerable decrease.

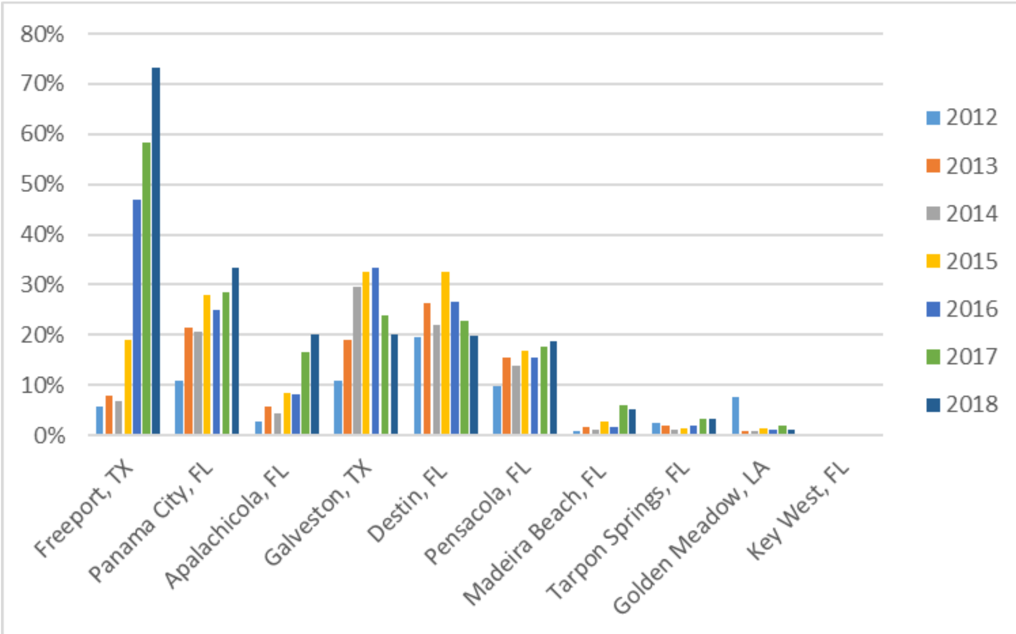

Figure 3.3.4.9. Local Quotient (pounds) for communities highly engaged in the RS-IFQ Program for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

The trend for red snapper Local Quotient for value landed is similar for the top two communities of Freeport, Texas and Panama City, Florida; however, many of the remaining communities switched rankings in terms of value as compared pounds in the LQ (Figure 3.3.4.10). For most communities, the value makes up a higher percentage of total species value than pounds landed.

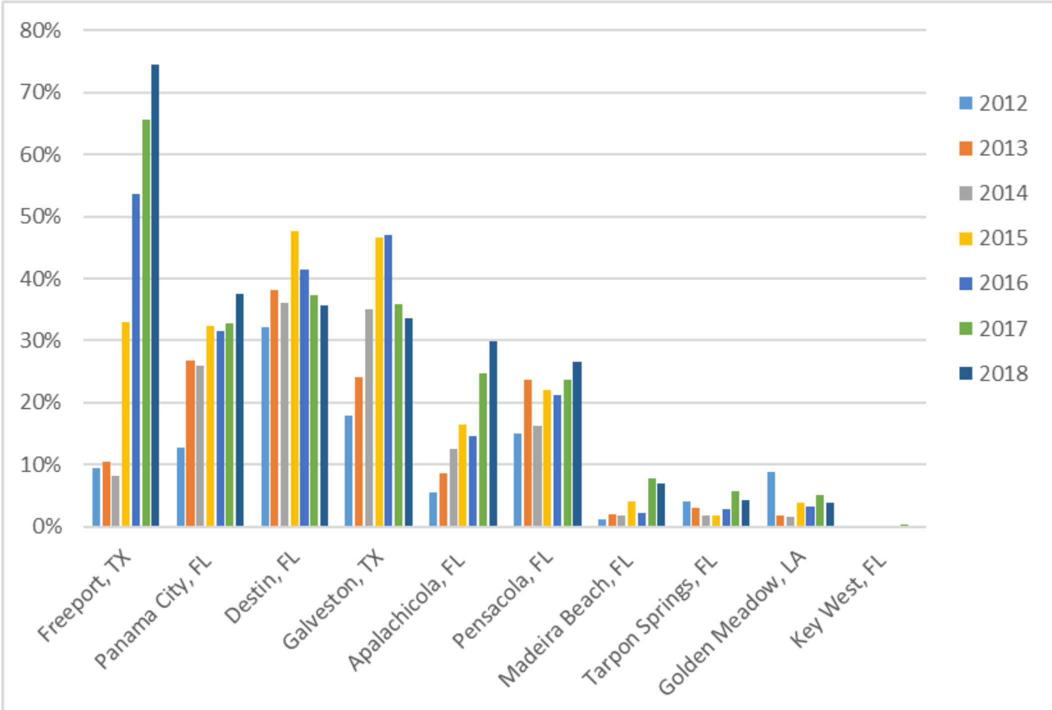

Figure 3.3.4.10. Local Quotient (value) for communities highly engaged in the RS-IFQ Program for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

GT-IFQ Program: Commercial Engagement

The program-specific commercial Fishing Engagement Index scores for the Gulf GT-IFQ Program are presented in Table 3.3.4.4. The index is an indicator of the importance of IFQ grouper-tilefish fishing in a community relative to other communities. It is a measure of the presence of GT-IFQ fishing activity including pounds and value of grouper-tilefish, number of reef fish permits, and number of reef fish dealers within the community. There are 20 communities in Table 3.3.4.4 that were highly engaged (1.0 standard deviation or more above the mean) in the GT-IFQ Program fishery for at least one year from 2012 through 2018.

Table 3.3.4.4. Fishing Engagement Index scores of communities highly engaged in the GT-IFQ Program for one or more years from 2012 through 2018.

Community	2012	2013	2014	2015	2016	2017	2018
Madeira Beach, FL	10.884	11.535	11.618	11.774	11.502	11.478	11.267
Panama City, FL	6.378	6.234	5.829	5.323	5.660	5.800	6.218
Key West, FL	3.524	3.772	3.700	3.841	4.127	3.419	3.382
Galveston, TX	1.580	3.026	2.598	3.151	3.354	3.695	3.276
Cortez, FL	3.501	2.100	2.448	2.911	3.032	3.124	3.138
Apalachicola, FL	3.427	2.372	2.424	2.323	2.600	2.511	2.867
Tarpon Springs, FL	3.503	3.530	3.697	3.011	2.929	2.637	2.548
Destin, FL	2.545	1.961	1.704	1.692	1.714	1.755	1.801

Community	2012	2013	2014	2015	2016	2017	2018
Saint Petersburg, FL	1.647	1.121	1.039	1.020	1.316	1.842	1.763
Redington Shores, FL	1.198	1.514	1.836	2.055	1.785	1.590	1.611
Indian Shores, FL	0.452	0.649	1.166	1.312	1.096	1.451	1.588
Golden Meadow, LA	0.793	1.037	0.607	0.783	0.636	1.395	1.558
Clearwater, FL	1.178	1.142	0.977	0.927	0.648	0.829	1.315
Pensacola, FL	1.298	1.668	1.619	1.323	1.298	0.923	1.100
Bokeelia, FL	0.351	0.351	0.386	0.432	0.625	0.660	1.065
Fort Myers Beach, FL	1.235	0.939	1.279	1.432	1.061	1.111	1.017
Steinhatchee, FL	1.491	0.797	1.252	1.352	1.334	0.984	0.851
Crystal River, FL	1.352	1.055	1.091	1.032	0.899	0.741	0.757
Venice, FL	0.651	1.007	0.842	0.775	0.793	0.738	0.731
Fort Myers, FL	0.438	0.271	0.449	0.586	1.196	1.161	0.725

Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.
Note: Highlighted cells indicate high engagement. Communities are in order of 2018 engagement scores

The majority of highly engaged communities are in Florida, with Galveston, TX the only community outside the state that was highly engaged throughout the time series. Communities, like Pensacola, FL and Fort Myers Beach, FL have been highly engaged for six of the seven time periods. The community of Indian Shores, FL has been highly engaged for five of the seven time periods. Other communities, like Steinhatchee, FL and Crystal River, FL, have been highly engaged four out of the seven time periods. The communities of Golden Meadow, LA and Clearwater, FL have been highly engaged for at least three out of the seven time periods.

Of the 20 communities found in Table 3.3.4.4, the communities that were highly engaged for all years from the 2012 through 2018 are depicted in Figure 3.3.4.11. The GT-IFQ engagement scores for those highly engaged communities display some fluctuation, but tend to be fairly stable for most communities. The community of Madeira Beach, FL has remained at the top throughout the time series.

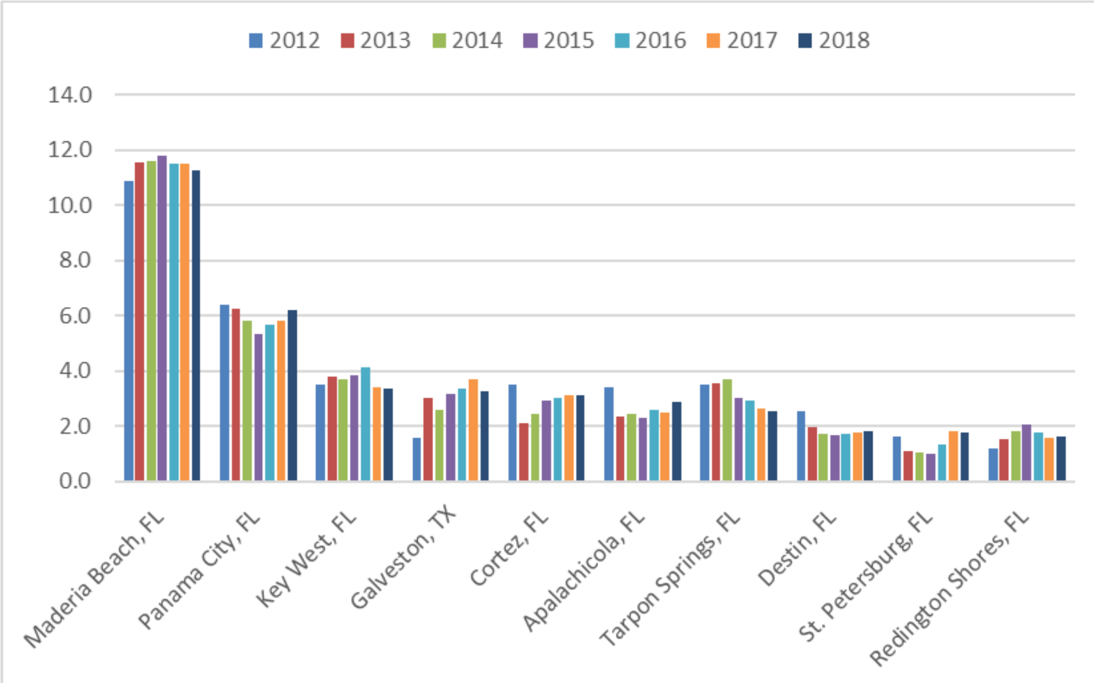

Figure 3.3.4.11. Fishing Engagement Index scores of communities highly engaged in the GT-IFQ Program for all years, from 2012 to 2018.
Source: PIMS, SERO Community ALS, and IFQ database accessed 2/19/20.

GT-IFQ Program: Regional Quotient

RQ is the proportion of IFQ grouper-tilefish landed within a community out of the total amount of IFQ grouper-tilefish landed within the Southeast region. It is an indicator of the percent contribution in pounds or value of IFQ grouper-tilefish landed within that community relative to the regional fishery. The RQ is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. All other communities that landed IFQ grouper-tilefish are grouped as "Other Communities." Figure 3.3.4.12 and Figure 3.3.4.13 show the RQ both in pounds and value, respectively from 2012 to 2018.

The dominant IFQ grouper-tilefish communities for pounds landed included the Florida communities of Madeira Beach, Panama City, and Cortez, Florida (Figure 3.3.4.12). Of the three leading communities, Madeira Beach, FL has seen an increase in RQ over the time period. Most communities that were highly engaged for all years, saw some fluctuation in their RQ, but overall trends in RQ for pounds seem to be fairly stable for most communities.

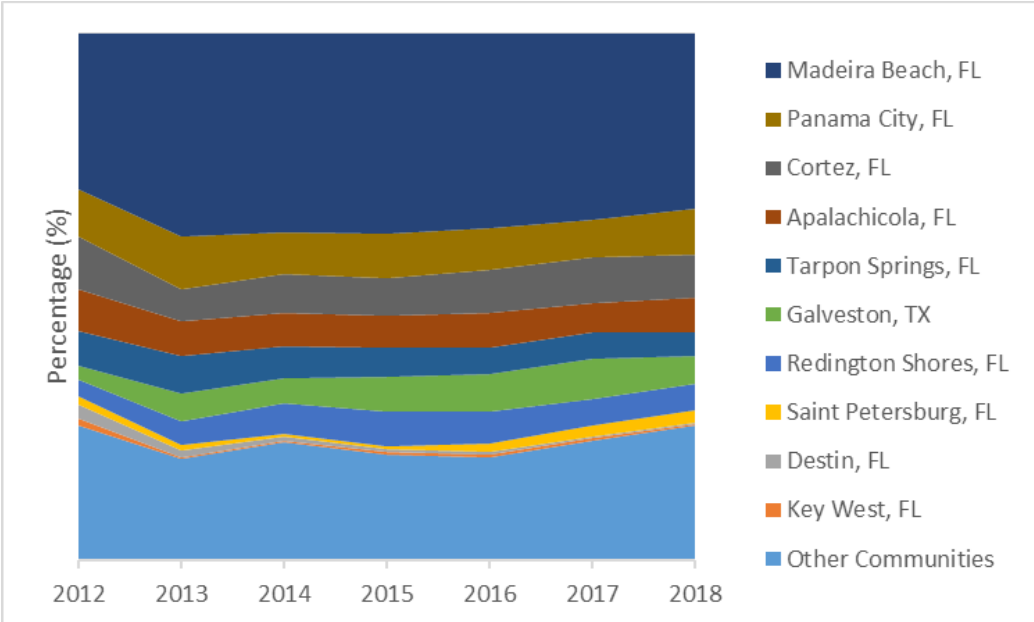

Figure 3.3.4.12. Regional Quotient (pounds) for communities highly engaged in the Gulf of Mexico GT-IFQ Program for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

The dominant GT-IFQ communities for value landed are roughly the same as for pounds landed (Figure 3.3.4.13). Most communities saw similar fluctuation in their RQ for value to that for pounds. Again, the overall trend in RQ value seems to be fairly stable for most communities. The category of "Other Communities" fluctuates somewhat throughout the time series, but is roughly the same RQ for both pounds and value at the beginning and end of the time series.

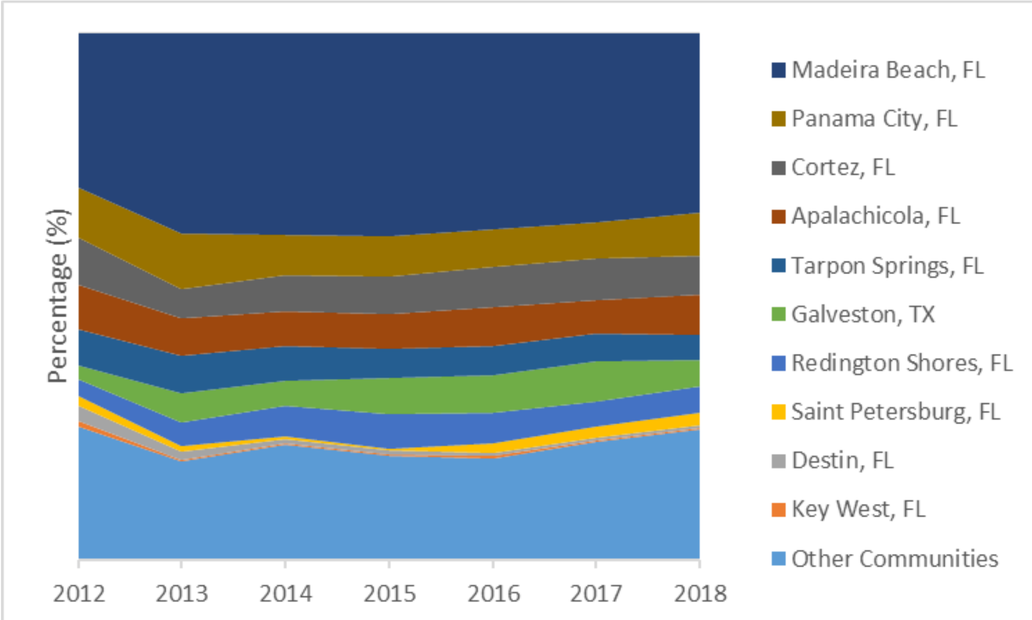

Figure 3.3.4.13. Regional Quotient (value) for communities highly engaged in the Gulf of Mexico GT-IFQ Program for all years from 2012 through 2018.
Source: IFQ database accessed 2/12/20.

GT-IFQ Program: Local Quotient

The community Local Quotient is the percentage of IFQ grouper-tilefish landed within a community out of the total amount of all species landed within that community. It is an indicator of the contribution in pounds or value of IFQ grouper-tilefish to the overall landings in a community. The Local Quotient is reported individually only for those communities that were highly engaged for all years from 2012 through 2018. Figure 3.3.4.14 and Figure 3.3.4.15 show the Local Quotient both in pounds and value from 2012 to 2018.

The Local Quotient for pounds landed for several communities fluctuated from the 2012 through 2018 (Figure 3.3.4.14). The communities of Madeira Beach, Redington Shores, Tarpon Springs, St. Petersburg, and Destin, Florida all saw considerable fluctuation over time in their grouper-tilefish Local Quotient for pounds landed. The communities of Madeira Beach and Redington Shores, FL saw a substantial decrease in their Local Quotient; however, the Local Quotient for both communities consistently contributed approximately 50% and over of total value landed in each community.

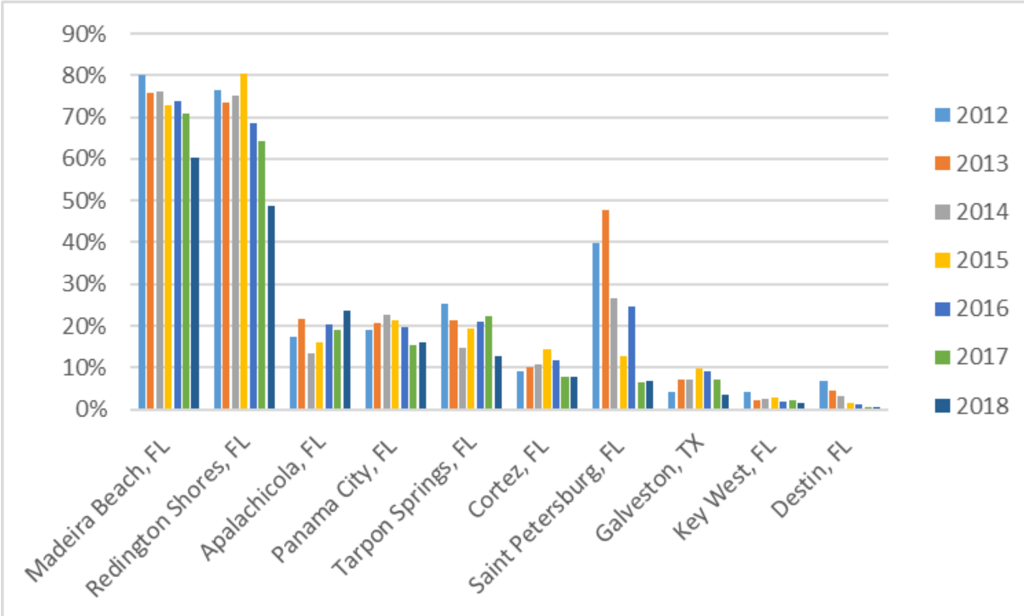

Figure 3.3.4.14. Local Quotient (pounds) for communities highly engaged in the GT-IFQ Program for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

Most communities switched rankings in terms of value as compared pounds in the Local Quotient (Figure 3.3.4.15). The Local Quotient for value fluctuated for most communities from 2012 to 2018. For the top two communities of Tarpon Springs and St. Petersburg, Florida, the Local Quotient consistently contributed over 50% of total value landed in the community; however, both communities saw a decrease in Local Quotient over time. The community of Galveston, Texas saw a substantial decrease in grouper-tilefish Local Quotient value.

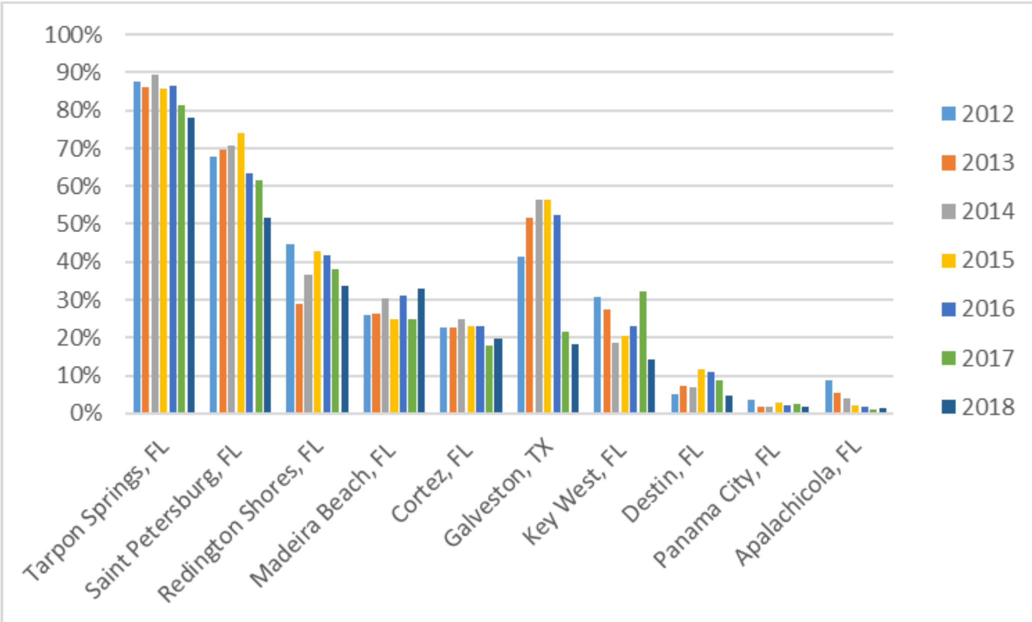

Figure 3.3.4.15. Local Quotient (value) for communities highly engaged in the GT-IFQ Program for all years from 2012 through 2018.
Source: SERO, Community ALS 2012-2018.

Community Social Vulnerability Indicators (CSVIs)

The two categories of CSVIs discussed below include social vulnerability and gentrification pressure vulnerability. The Social Vulnerability Indicators represent social factors that can shape either an individual's or community's ability to adapt to change (poverty, personal disruption, labor force structure, housing characteristics, and population composition vulnerability). The Gentrification Pressure Vulnerability Indicators characterize factors that over time may indicate a threat to the viability of a vibrant commercial working waterfront including property and businesses (urban sprawl, housing disruption and retiree migration).

The Social Vulnerability Indicators for communities that were highly engaged in the Gulf IFQ Programs, RS-IFQ Program, and/or the GT-IFQ Program for at least one year from 2012 to 2018 are included in Table 3.3.4.5. Communities highly engaged for all years in any program are highlighted. These communities have a wide range in populations. Bokeelia, Cortez, Crystal River, Fort Myers Beach, Fort Myers, Panama City, Steinhatchee, Tarpon Springs, and Venice, Florida have high vulnerabilities in relation to other Florida communities. The communities in Alabama, Louisiana, and Texas have higher vulnerabilities for the most part than the communities in Florida. Almost every community that was highly engaged for all years in any program has high vulnerabilities related to housing characteristics except Destin, Key West, Madeira Beach, and Redington Shores.

Table 3.3.4.5. Community Social Vulnerability Indicators for communities highly engaged in the Gulf IFQ Programs, RS-IFQ Program, and/or GT-IFQ Program for one or more years from 2012 through 2018.

Community	Population Size (2016)	Personal Disruption	Population Composition	Poverty	Labor Force Structure	Housing Characteristics
Bayou La Batre, AL	2532	High	High	High	Medium	Med High
Bon Secour, AL	650	Med High	Low	High	High	N/A
Apalachicola, FL	2219	Medium	Low	Medium	Medium	Med High
Bokeelia, FL	1430	Low	Low	Low	High	High
Clearwater, FL	111747	Medium	Low	Medium	Medium	Med High
Cortez, FL	4004	Low	Low	Low	High	High
Crystal River, FL	3073	Med High	Low	High	High	Med High
Destin, FL	13312	Low	Low	Low	Low	Medium
Fort Myers Beach, FL	6801	Low	Low	Low	High	Medium
Fort Myers, FL	71051	Med High	Med High	Med High	Medium	Med High
Indian Shores, FL	1498	Low	Low	Low	High	Medium
Key West, FL	26039	Low	Medium	Low	Low	Low
Madeira Beach, FL	4343	Low	Low	Low	Med High	Medium
Panama City, FL	36654	Med High	Medium	Med High	Medium	Med High
Pensacola, FL	53250	Medium	Low	Medium	Low	Med High
Redington Shores, FL	2136	Low	Low	Low	Med High	Low
St. Petersburg, FL	253585	Medium	Low	Medium	Low	Med High
Steinhatchee, FL	920	Med High	Low	Low	High	N/A
Tarpon Springs, FL	24244	Medium	Low	Medium	Med High	Med High
Venice, FL	21722	Low	Low	Low	High	Med High
Golden Meadow, LA	1827	Med High	Low	Med High	Med High	High
Houma, LA	34052	Medium	Medium	Med High	Medium	Med High
Venice, LA	214	Med High	Low	High	Low	N/A
Freeport, TX	12122	High	High	High	Low	Med High
Galveston, TX	49443	Med High	Medium	Med High	Low	Med High
Matagorda, TX	434	Low	Low	Medium	Medium	N/A

Source: SERO, Community Social Vulnerability Indicators Database 2018 (American Community Survey 2012-2016). Note: Highlighted cells indicate high engagement for all years from 2012-2018.

The Gentrification Pressure Vulnerability Indicators characterize factors that over time may indicate a threat to the viability of a vibrant commercial working waterfront (urban sprawl, housing disruption and retiree migration). Gentrification Pressure Vulnerability Indicators for communities that were highly engaged in the Gulf IFQ Programs, RS-IFQ Program, and/or the GT-IFQ Program for at least one year from 2012 to 2018 are included in Table 3.3.4.6. Communities highly engaged for all years in any program are highlighted. Over half of the communities that were highly engaged for all years scored as highly vulnerable for at least one indicator. The communities of Cortez, Fort Myers Beach, Madeira Beach, and Redington Shores showed high gentrification vulnerability for two indices. The Urban Sprawl Index did demonstrate a trend, with most communities registering low vulnerabilities and none above medium.

Table 3.3.4.6. Gentrification Pressure Vulnerability Indicators for communities highly engaged in the Gulf IFQ Programs, RS-IFQ Program, and/or GT-IFQ Program for one or more years from 2012 through 2018.

Community	Housing Disruption	Retiree Migration	Urban Sprawl
Bayou La Batre, AL	Medium	Low	Low
Bon Secour, AL	N/A	High	N/A
Apalachicola, FL	Medium	Medium	Low
Bokeelia, FL	Low	High	Low
Clearwater, FL	Medium	Medium	Low
Cortez, FL	Med High	High	Low
Crystal River, FL	Low	High	Low
Destin, FL	Medium	Low	Low
Fort Myers Beach, FL	Med High	High	Low
Fort Myers, FL	Med High	Medium	Low
Indian Shores, FL	Low	High	Medium
Key West, FL	Med High	Low	Low
Madeira Beach, FL	High	Med High	Medium
Panama City, FL	Medium	Low	Low
Pensacola, FL	Low	Low	Low
Redington Shores, FL	High	Med High	Medium
St. Petersburg, FL	Medium	Low	Low
Steinhatchee, FL	N/A	High	N/A
Tarpon Springs, FL	Medium	Med High	Low
Venice, FL	Medium	High	Low
Golden Meadow, LA	Low	Low	Low
Houma, LA	Medium	Low	Low
Venice, LA	N/A	Low	N/A
Freeport, TX	Med High	Low	Low
Galveston, TX	Med High	Low	Low
Matagorda, TX	Low	Med High	Low

Source: SERO, Community Social Vulnerability Indicators Database 2018 (American Community Survey 2012-2016).
Note: Highlighted cells indicate high engagement for all years from 2012-2018.

CHAPTER 4. ELIGIBILITY AND PARTICIPATION

Section 303A(c)(1)(D) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) indicates that eligibility requirements must be established for participation in limited access privilege programs (LAPP). Eligibility requirements determine who is allowed to hold shares or allocation (e.g., owner on board provisions, etc.). This section will determine if any existing restrictions on eligibility are inhibiting or precluding the achievement of the program's goals and objectives, or if any additional restrictions are necessary to achieve particular objectives.

4.1 Eligibility

For the first 5 years of both the red snapper individual fishing quota (RS-IFQ) program (2007-2012) and the grouper-tilefish (GT) IFQ program (2010-2015), only those entities that possessed a valid commercial Gulf of Mexico (Gulf) reef fish permit and were a U.S. citizen or resident alien were eligible to participate in the program under the shareholder role. A shareholder account is an IFQ account that may hold shares and/or allocation, and includes accounts that only hold allocation. Initial recipients of shares were not required to maintain their commercial reef fish permit during the first 5 years of the program in order to retain their shares during that time. A shareholder account that no longer had a valid commercial Gulf reef fish permit could maintain or decrease their shares or allocation, but could not obtain additional shares or allocation, nor harvest IFQ species.

A shareholder account, vessel account, and valid commercial reef fish permit are needed to harvest IFQ species. The Southeast Regional Office (SERO) Permits office and the IFQ online system utilize the same database. Therefore, shareholder accounts were established with the same criteria as the Permits office uses to record permit ownership. This allowed the IFQ on-line system to be linked in real-time to permits and permit validity. Each shareholder account is composed of a unique set of entities (single or combination of individuals and/or business) and no two accounts may be composed of the same set of entities. A unique entity may be a single person or business, or a combination of people and/or businesses. For any business that is part of a shareholder account, National Marine Fisheries Service (NMFS) collects the owner information for that business (e.g., shareholders) and the percentage owned by each individual. If a business is owned in part or in total by another business, NMFS collects the ownership information of all parent companies. Owners of a business and the percentage held by such an individual may change over time. Any time a change (e.g., ownership, percentage owned, address) is made in ownership within a business, the business must inform NMFS. NMFS tracks business ownership throughout time using start and end dates for each change submitted to NMFS. An entity may be associated with more than one IFQ shareholder account. IFQ shareholder accounts with at least one entity in common are called related accounts (RL). While no two IFQ accounts have the same set of entities, one entity may be associated with multiple IFQ accounts. For example, John Smith may hold an account, and John Smith and Jane Smith may hold another account. These accounts are considered related as John Smith is involved in both accounts. Similarly, if John Smith is an owner of John Smith, Inc., that account is also related to the John Smith account and the John Smith and Jane Smith account. Likewise, an account may be held by John Smith, Inc. and another account is held by Smith LLC. Both John Smith, Inc. and Smith LLC may have one or all owners in common, and therefore are related accounts. Due to the change in business ownership, relations between accounts may change over time. For example, John Smith may have held shares in ABC, Inc. in 2010, but not in 2014. That would mean that the ABC, Inc. account was related to the John Smith account in 2010, but not in 2014. For the purpose of this discussion, RL accounts are determined by the owners of each account at the end of the fishing year.

4.2 Participation Changes

Throughout the program, the total number of shareholder accounts in both the RS-IFQ and GT-IFQ programs has decreased each year (Table 4.1.1). The number of accounts with shares varied by share category. Shallow water grouper (SWG) and gag grouper (GG) always had the greatest number of accounts with shares, while tilefish (TF) always had the least number of accounts with shares. All share categories also showed a decreasing trend in the number of accounts with shares over time. Accounts with shares can be classified by the volume of shares held: small (less than 0.05%), medium (0.05%-1.49999%), and large (greater than or equal to 1.5%). In all share categories, the majority of accounts with shares were classified as small shareholders, while the fewest number of accounts held a large volume of shares. The decreasing trend in the number of shareholder accounts with shares does not mean that there were no new participants each year or accounts that newly acquired shares. Within any share category, there were between 6 and 38 accounts that acquired shares for the first time (new shareholder account) in that category (Table 4.1.2). New shareholder accounts occur in the program for a variety of reasons: participant entering the program, transferring to a related account due to a permit name change[26], or managing related accounts from one account.[27] Participants in the IFQ program often hold shares in more than one category (Table 4.1.3). The majority of the participants held shares in at least three categories. The percentage of accounts holding shares in one or two share categories has been increasing since 2012, and have reached 13 and 8%, respectively, in 2018.

Table 4.1.1. Number and volume of shareholder accounts with shares by share category.

DWG	Small	Medium	Large	Total
Initial	299 (2%)	169 (58%)	12 (40%)	480
2010	300 (2%)	148 (54%)	13 (44%)	461
2011	275 (2%)	143 (53%)	13 (45%)	431
2012	253 (2%)	134 (49%)	14 (49%)	401
2013	238 (2%)	131 (49%)	13 (49%)	382
2014	224 (2%)	129 (45%)	15 (53%)	368
2015	220 (2%)	131 (48%)	15 (50%)	366
2016	215 (2%)	127 (44%)	17 (54%)	359

GG	Small	Medium	Large	Total
Initial	415 (6%)	330 (88%)	3 (6%)	748
2010	424 (5%)	290 (85%)	5 (10%)	719
2011	391 (4%)	263 (81%)	7 (15%)	661
2012	355 (4%)	249 (80%)	8 (16%)	612
2013	342 (4%)	244 (78%)	9 (18%)	595
2014	333 (4%)	233 (78%)	9 (18%)	575
2015	328 (4%)	238 (80%)	8 (16%)	574
2016	328 (4%)	232 (75%)	11 (21%)	571

[26] IFQ accounts are established based on the name(s) of the Gulf commercial reef fish permit holder. If the name(s) of the permit holder change (e.g., adding/removing a spouse), a new IFQ account must be established to link to the permit.
[27] Some IFQ participants are associated with more than one IFQ account (e.g., John Smith vs. John and Jane Smith, incorporating each vessel under a different company name), and therefore may shift all their shareholding to one account for ease of management.

2017	221 (2%)	123 (43%)	17 (55%)	361
2018	208 (2%)	118 (41%)	18 (57%)	344

2017	331 (4%)	227 (73%)	12 (23%)	570
2018	288 (4%)	223 (73%)	12 (23%)	523

RG	Small	Medium	Large	Total
Initial	435 (5%)	248 (77%)	9 (18%)	692
2010	421 (4%)	237 (80%)	7 (16%)	665
2011	377 (3%)	227 (81%)	6 (16%)	610
2012	349 (3%)	212 (77%)	8 (20%)	569
2013	339 (3%)	200 (72%)	11 (25%)	550
2014	327 (3%)	192 (71%)	11 (26%)	530
2015	332 (3%)	186 (67%)	12 (30%)	530
2016	332 (3%)	185 (65%)	13 (32%)	530
2017	345 (3%)	190 (65%)	13 (32%)	548
2018	303 (3%)	190 (66%)	12 (31%)	505

SWG	Small	Medium	Large	Total
Initial	467 (6%)	275 (68%)	10 (26%)	752
2010	460 (5%)	250 (65%)	11 (30%)	721
2011	421 (5%)	242 (65%)	11 (30%)	674
2012	384 (4%)	234 (65%)	11 (31%)	629
2013	364 (4%)	227 (65%)	13 (31%)	604
2014	351 (4%)	218 (64%)	13 (32%)	582
2015	346 (4%)	223 (67%)	12 (29%)	581
2016	345 (4%)	221 (68%)	11 (28%)	577
2017	347 (4%)	219 (70%)	10 (26%)	576
2018	295 (4%)	216 (70%)	10 (26%)	521

TF	Small	Medium	Large	Total
Initial	171 (2%)	100 (36%)	16 (62%)	287
2010	185 (2%)	85 (30%)	17 (68%)	287
2011	164 (1%)	79 (28%)	17 (71%)	260
2012	155 (1%)	76 (27%)	15 (72%)	246
2013	144 (1%)	72 (25%)	16 (74%)	232
2014	143 (1%)	69 (26%)	15 (73%)	227
2015	143 (1%)	63 (24%)	16 (75%)	222
2016	138 (1%)	54 (19%)	19 (80%)	211
2017	142 (1%)	54 (20%)	18 (79%)	214
2018	134 (1%)	52 (18%)	19 (80%)	205

Total GT-IFQ Shareholders	
Initial	766
2010	743
2011	699
2012	665
2013	644
2014	628
2015	645
2016	653
2017	667
2018	616

RS	Small	Medium	Large	Total
Initial	415 (5%)	125 (59%)	14 (37%)	554
2007	368 (4%)	112 (50%)	17 (46%)	497
2008	346 (4%)	111 (49%)	17 (48%)	474
2009	313 (3%)	108 (48%)	18 (49%)	439
2010	297 (3%)	109 (47%)	19 (50%)	425
2011	284 (3%)	116 (49%)	18 (49%)	418
2012	273 (3%)	117 (50%)	17 (47%)	407
2013	261 (3%)	120 (48%)	18 (49%)	399
2014	236 (3%)	125 (50%)	17 (48%)	378
2015	238 (3%)	131 (50%)	17 (47%)	386
2016	230 (3%)	125 (47%)	19 (50%)	374
2017	233 (3%)	126 (48%)	19 (50%)	378
2018	199 (3%)	125 (52%)	17 (46%)	341

Note: Small accounts hold <0.05%; medium accounts hold 0.05% - 1.49999%; large accounts hold $\geq$ 1.5% shares.

The number of accounts with shares is classified by volume of shares held. The number in parentheses indicates the percentage of all accounts with shares within that year and share category.

Table 4.1.2. Number of accounts acquiring shares for the first time by share category.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
DWG	17 (9.26%)	25 (3.06%)	18 (2.21%)	13 (0.46%)	12 (2.28%)	27 (10.62%)	15 (2.10%)	13 (0.71%)	12 (2.13%)
GG	16 (4.07%)	25 (2.81%)	18 (4.62%)	21 (1.97%)	11 (1.53%)	34 (9.43%)	24 (2.03%)	24 (2.86%)	20 (1.83%)
RG	18 (2.95%)	23 (3.46%)	19 (5.81%)	20 (5.28%)	11 (2.79%)	36 (16.01%)	27 (4.12%)	38 (2.66%)	24 (5.44%)
SWG	13 (5.09%)	25 (3.35%)	17 (2.06%)	17 (1.47%)	13 (1.15%)	32 (7.44%)	24 (2.63%)	18 (1.45%)	19 (4.57%)
TF	18 (16.22%)	13 (2.03%)	14 (0.94%)	6 (1.88%)	10 (1.48%)	21 (10.95%)	8 (3.24%)	12 (0.62%)	8 (2.24%)
RS	28 (4.41%)	22 (1.51%)	27 (5.85%)	19 (1.35%)	12 (1.92%)	31 (8.32%)	20 (1.64%)	26 (4.06%)	16 (3.68%)

Table 4.1.3. Number of accounts that hold shares in one or more share categories.

Share Categories	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	18 (2%)	22 (3%)	34 (5%)	33 (5%)	37 (6%)	55 (9%)	68 (10%)	81 (12%)	82 (13%)
2	34 (5%)	39 (6%)	42 (6%)	48 (7%)	51 (8%)	58 (9%)	59 (9%)	62 (9%)	52 (8%)
3	258 (35%)	239 (34%)	225 (34%)	214 (33%)	206 (33%)	208 (32%)	213 (33%)	207 (31%)	182 (30%)
4	172 (23%)	176 (25%)	156 (23%)	153 (24%)	145 (23%)	142 (22%)	142 (22%)	142 (21%)	134 (22%)
5	261 (35%)	223 (32%)	208 (31%)	196 (30%)	189 (30%)	182 (28%)	175 (26%)	175 (26%)	166 (27%)
Total Accounts	743	699	665	644	628	645	653	667	616

Prior to 2015, a valid commercial Gulf reef fish permit was initially required to open a IFQ shareholder account, but the account could continue to hold shares and allocation without maintaining a reef fish permit. Accounts without a reef fish permit could neither acquire more shares or allocation nor harvest IFQ species, but could transfer those shares or allocation to another shareholder account. Even in the early years of the IFQ program, there were accounts with shares that no longer held permits (Table 4.1.4). The number of accounts with shares, but without a permit has decreased in the RS-IFQ program and increased in the GT-IFQ program since 2012. In 2018, however, the number of shareholders without a permit decreased considerably, particularly in the GT-IFQ program, due to Amendment 36A which reverted shares in 28 accounts back to NMFS. The shares held in these accounts were nominal (0.0788%). The volume of shares held by non-permitted shareholders has been increasing, but has remained relatively stable since 2012 for RS, and since 2015 in most GT-IFQ share categories. Both of these coincided with the implementation of public participation in each respective program. However, there was a slight increase in the volume of shares held by non-permitted shareholders in GT-IFQ share categories in 2018. Again, this change could be a result of Amendment 36A. As of 2018, between 16 and 31% of shares were held by non-permitted accounts in the GT-IFQ program, and 32% of shares were held by non-permitted accounts in the RS-IFQ program. The overall increase in percentage of shares held by accounts without a permit may be due to a variety of reasons. There are many accounts within the IFQ system that are related to another account through a common entity. This increase in accounts without permits holding shares may be influenced by business practices among these related accounts. Participants with multiple accounts (e.g., each vessel is incorporated separately) may transfer all the shares to one account and later transfer the permit to another vessel. This allows for a separation of the shares from the vessels. Discussions with industry representatives indicated that this separation of assets may be a growing business practice.

Table 4.1.4. Number of accounts that hold shares by permit status.

DWG	Permit N (share %)	No Permit N (share %)
2010	449 (99%)	12 (1%)
2011	392 (96%)	39 (4%)
2012	359 (97%)	42 (3%)
2013	323 (95%)	59 (5%)
2014	296 (93%)	72 (7%)
2015	275 (87%)	91 (13%)
2016	262 (85%)	97 (15%)
2017	252 (85%)	109 (15%)
2018	239 (69%)	105 (31%)

GG	Permit N (share %)	No Permit N (share %)
2010	690 (99%)	29 (<1%)
2011	578 (98%)	83 (2%)
2012	513 (97%)	99 (3%)
2013	475 (94%)	120 (6%)
2014	433 (94%)	142 (6%)
2015	404 (87%)	170 (13%)
2016	390 (85%)	181 (15%)
2017	379 (83%)	191 (15%)
2018	359 (80%)	164 (19%)

RG	Permit N (share %)	No Permit N (share %)
2010	641 (99%)	24 (<1%)
2011	537 (98%)	73 (2%)
2012	479 (98%)	90 (2%)
2013	440 (96%)	110 (4%)
2014	402 (95%)	128 (5%)
2015	369 (80%)	161 (20%)
2016	360 (79%)	170 (21%)
2017	362 (80%)	186 (20%)
2018	339 (79%)	166 (21%)

SWG	Permit N (share %)	No Permit N (share %)
2010	692 (99%)	29 (<1%)
2011	591 (97%)	83 (3%)
2012	527 (96%)	102 (4%)
2013	479 (94%)	125 (6%)
2014	433 (92%)	149 (8%)
2015	404 (85%)	177 (15%)
2016	390 (85%)	187 (15%)
2017	380 (85%)	196 (15%)
2018	352 (83%)	169 (16%)

TF	Permit N (share %)	No Permit N (share %)
2010	282 (99%)	5 (<1%)
2011	238 (98%)	22 (2%)
2012	224 (98%)	22 (2%)
2013	200 (96%)	32 (4%)
2014	187 (95%)	40 (5%)
2015	167 (89%)	55 (11%)
2016	155 (87%)	56 (13%)

GT-IFQ	Permit	No Permit
2010	714	29
2011	612	87
2012	556	109
2013	507	137
2014	465	163
2015	441	204
2016	430	223

2017	154 (89%)	60 (11%)
2018	151 (79%)	54 (21%)

2017	424	243
2018	398	218

RS	Permit N (share %)	No Permit N (share %)
2007	421 (86%)	76 (14%)
2008	354 (87%)	120 (13%)
2009	319 (86%)	120 (14%)
2010	304 (85%)	121 (15%)
2011	298 (82%)	120 (18%)
2012	288 (79%)	119 (21%)
2013	273 (76%)	126 (24%)
2014	258 (72%)	120 (28%)
2015	252 (70%)	134 (30%)
2016	247 (70%)	127 (30%)
2017	246 (70%)	132 (30%)
2018	240 (68%)	101 (32%)

An IFQ account holder obtains allocation either from shares (distributed at the beginning of the year and any in-season quota increases) or through transfer from another account holder. Accounts that hold allocation are termed allocation holders. Allocation holders may also hold shares. The number of allocation holders is typically greater than the number of shareholders. In 2012, there were 812 allocation holders in the GT-IFQ program and 599 allocation holders in the RS-IFQ program (Table 4.1.5). In the GT-IFQ program, allocation holder accounts decreased in number until 2015 when the program was opened to public participants. Since then, the number has been steadily increasing. The RS-IFQ program saw a similar trend in that the number of allocation holders has been increasing since 2012, when the RS-IFQ program became open to public participation. In both programs, the majority of allocation holders have also held shares. In 2012, 73% of RS-IFQ allocation holders also held RS-IFQ shares, and 86% of GT-IFQ allocation holders also held GT-IFQ shares. The distribution of allocation holders that also held shares has since decreased in both programs, but still remain the majority. The number of allocation holders that also held shares for all share categories also followed similar trends. The continued decrease in allocation holders with shares may be a result from a variety of factors. For example, a shareholder may manage shares in related accounts,[5] may be unable to buy shares (e.g., availability or price), and/or may change their harvesting behavior.

The RS-IFQ and GT-IFQ programs have a large amount of overlap; 75-89% of the vessels that landed at least one pound of GT-IFQ species also landed at least one pound of RS-IFQ species each year and 72-93% of the vessels that landed at least one pound of RS-IFQ species also landed at least one pound of GT-IFQ species (Table 4.1.6). The multi-species harvest overlap observed in the reef fish complex likely contributes to the increased number of allocation holders in some share categories, as fishermen seek to reduce their bycatch and discards through allocation transfers. Quota increases may also allow allocation to be indirectly distributed among more participants through transfers. As the quota increases, those with shares receive a larger amount of allocation than previously. If the allocation received by the fisherman is more than needed to land within that share category, they might transfer the allocation to another account that does not have shares, rather than land the allocation themselves.

Table 4.1.5. Allocation holders by share status.

DWG	N	With Shares	With Transfer
2010	512	472 (92%)	40 (8%)
2011	521	445 (85%)	76 (15%)
2012	498	416 (84%)	81 (16%)
2013	465	384 (83%)	81 (17%)
2014	457	365 (80%)	92 (20%)
2015	464	351 (76%)	113 (24%)
2016	462	349 (76%)	113 (24%)
2017	455	342 (75%)	113 (25%)
2018	477	345 (72%)	132 (28%)

GG	N	With Shares	With Transfer
2010	789	740 (94%)	49 (6%)
2011	767	694 (90%)	73 (10%)
2012	743	645 (87%)	98 (13%)
2013	716	595 (83%)	121 (17%)
2014	726	580 (80%)	146 (20%)
2015	753	560 (74%)	193(26%)
2016	752	560 (74%)	192 (26%)
2017	767	556 (72%)	211 (28%)
2018	756	556 (74%)	200 (26%)

RG	N	With Shares	With Transfer
2010	744	690 (93%)	54 (7%)
2011	739	675 (91%)	64 (9%)
2012	715	605 (85%)	110 (15%)
2013	683	563 (82%)	120 (18%)
2014	689	544 (79%)	145 (21%)
2015	716	522 (73%)	194 (27%)
2016	723	543 (75%)	180 (25%)
2017	750	525 (70%)	225 (30%)
2018	755	543 (72%)	212 (28%)

SWG	N	With Shares	With Transfer
2010	762	725 (95%)	37 (5%)
2011	760	687 (90%)	73 (10%)
2012	737	644 (87%)	93 (13%)
2013	720	602 (84%)	118 (16%)
2014	722	578 (80%)	144 (20%)
2015	742	555 (75%)	187 (25%)
2016	738	555 (75%)	183 (25%)
2017	749	551 (74%)	198 (26%)
2018	745	548 (74%)	197 (26%)

TF	N	With Shares	With Transfer
2010	299	271 (91%)	28 (9%)
2011	309	263 (85%)	46 (15%)
2012	292	243 (83%)	49 (17%)
2013	282	230 (82%)	52 (18%)
2014	279	217 (78%)	62 (22%)
2015	287	212 (74%)	75 (26%)
2016	273	207 (76%)	66 (24%)
2017	264	196 (74%)	68 (26%)
2018	286	199 (70%)	87 (30%)

GT-IFQ	N	With Shares	With Transfer
2010	816	765 (94%)	51 (6%)
2011	833	756 (91%)	77 (9%)
2012	812	701 (86%)	111 (14%)
2013	786	659 (84%)	127 (16%)
2014	795	639 (80%)	156 (20%)
2015	835	620 (74%)	215 (26%)
2016	842	655 (78%)	187 (22%)
2017	872	644 (74%)	228 (26%)
2018	878	656 (75%)	222 (25%)

RS	N	With Shares	With Transfer
2007	596	554 (93%)	42 (7%)
2008	547	497 (91%)	50 (9%)
2009	530	474 (89%)	56 (11%)
2010	598	461 (77%)	137 (23%)
2011	589	439 (75%)	150 (25%)
2012	599	438 (73%)	161 (27%)
2013	598	421 (70%)	177 (30%)
2014	606	399 (66%)	207 (34%)
2015	635	397 (63%)	238 (37%)
2016	639	385 (60%)	254 (40%)
2017	639	388 (61%)	251 (39%)
2018	650	377 (58%)	273 (42%)

Table 4.1.6. Vessel overlap between RS-IFQ and GT-IFQ programs.

Year	Percentage of GT-IFQ Vessels landing RS	Percentage of RS-IFQ Vessels landing GT species
2010	78%	72%
2011	75%	91%
2012	77%	93%
2013	81%	91%
2014	83%	90%
2015	85%	91%
2016	87%	89%
2017	86%	87%
2018	89%	90%

The number of dealers participating in the GT-IFQ program is determined through the landings processed by the dealers. Dealers that did not process IFQ species were not included in an analysis even if they had opened an IFQ dealer account. The total number of dealers processing IFQ species has increased each year (Table 4.1.7). Dealer size is determined by the percentage of annual IFQ species landed with the dealer: small dealers processed less than 1% of IFQ landings, medium dealers between 1-3% of annual IFQ landings, and large dealers greater than 3% of annual IFQ landings. The number of larger dealers has remained relatively stable since 2012, and in recent years, has been at 10 dealers for both the GT-IFQ and RS-IFQ programs. The number of medium size dealers has decreased from 16 to 10 dealers in that same time frame in the GT-IFQ program, but has remained relatively stable at 8 dealers in the RS-IFQ program as of 2018. The number of small dealers has increased over time, and in 2018, 82 and 84% of the dealers were classified as small in the GT-IFQ and RS-IFQ programs, respectively. The increase in small-sized dealers may be due to fishermen obtaining a dealer permit. Some fishermen may choose to obtain a dealer permit in order to eliminate the middleman, reduce costs, and increase profits. Personal communication with industry representatives indicated that there are fishermen who also own dealer permits, but these were not limited to just small-sized dealers. Direct comparison of all shareholder and dealers accounts is currently not possible, as there is incomplete information on dealer ownership information for a business.

Table 4.1.7. Dealers landing IFQ species.

GT-IFQ	Total	Small <1% of landings	Medium 1-3% of landings	Large >3% of landings
2010	85	63 (74%)	15 (18%)	7 (8%)
2011	94	75 (80%)	12 (13%)	7 (7%)
2012	97	73 (75%)	16 (16%)	8 (8%)
2013	96	75 (78%)	11 (11%)	10 (10%)
2014	112	94 (84%)	7 (6%)	11 (10%)
2015	114	97 (85%)	7 (6%)	10 (9%)
2016	107	89 (83%)	8 (8%)	10 (9%)
2017	113	95 (84%)	8 (7%)	10 (9%)
2018	114	94 (82%)	10 (9%)	10 (9%)

RS-IFQ	Total	Small <1% of landings	Medium 1-3% of landings	Large >3% of landings
2007	75	56 (75%)	8 (11%)	11 (15%)
2008	67	48 (72%)	9 (13%)	10 (15%)
2009	66	44 (67%)	11 (17%)	11 (17%)
2010	77	57 (74%)	13 (17%)	7 (9%)
2011	82	64 (78%)	10 (12%)	8 (10%)
2012	82	67 (82%)	7 (9%)	8 (10%)
2013	81	66 (81%)	7 (9%)	8 (10%)
2014	96	77 (80%)	11 (11%)	8 (8%)
2015	105	88 (84%)	8 (8%)	9 (9%)
2016	96	79 (82%)	7 (7%)	10 (10%)
2017	109	91 (83%)	7 (6%)	11 (10%)
2018	111	93 (84%)	8 (7%)	10 (9%)

Note: Dealer size determined by percentage of annual IFQ landings by each dealer and may include multiple facilities. The percentage refers to proportion percentage of landings processed.

4.3 Operational Changes

This section discusses the effects of the Gulf limited access privilege programs on the operations of the commercial fleet participating in the RS-IFQ and GT-IFQ programs. For the evaluation of operational changes, a vessel is considered a part of the fleet if it landed at least one pound of RS or GT species in the Gulf during the time interval covered by the evaluation. The discussion provided in this section summarizes a study on fleet capacity dynamics in the IFQ fisheries completed by Agar, Horrace, and Parmeter (*under review*). A draft of the study is included in Appendix A for reference. The study examined the performance of Gulf of Mexico IFQ programs under two arrangements. The first arrangement considered the Gulf RS IFQ fishery by itself, and the second arrangement combined the RS with GT species into the Gulf reef fish IFQ fishery.

The new assessment evaluated changes in technical efficiency, excess capacity, and overcapacity in these programs employing a stochastic output distance frontier setup that allowed to account for both vessel-specific heterogeneity and time constant vessel inefficiency. The theoretical underpinnings of the model, its specification, distributional assumptions, and estimation are discussed in Appendix A. The model used detailed trip-level landings and fishing effort from the Logbook program and information on vessel characteristics from the PIMS database. Of note is that Gulf RS IFQ model only considered the vertical line fleet since it accounts for most of the RS landings, whereas the Gulf reef fish IFQ model considered both the vertical line and longline fleets.

Results from the RS (only) IFQ model suggest that time-varying technical efficiency increased by 6% post-IFQ and that excess capacity and overcapacity remain high in the fishery. Consistent with the initial findings of Solis, del Corral, Perruso and Agar (2015), the new assessment finds that about 20% of the vertical line fleet (operating at full efficiency) could have harvested the entire quota. The authors of the new assessment also note that a larger number of shorter trips ensures fresher and more valuable product, which is what has historically been demanded. Fewer trips landed at the same time, could lead to market gluts and reduced prices.

Results from the Gulf reef fish IFQ model indicate that time-varying technical efficiency improved by 5% post-IFQ. On a fleet basis, the average technical efficiency moved up by almost 4 percentage points for vertical line vessels post-IFQ while it moved just over 9 percentage points for longline vessels during the same period. The model also found evidence of excess capacity; however, the estimation of overcapacity proved challenging because the fleet did not catch the entire quota. Nonetheless, it found that between 2011 and 2016, 57% Gulf reef fish IFQ fleet (had it had operated at full efficiency) could have harvested the entire quota

Overall, the fleet dynamics study discussed in this section finds that technical efficiency (input use) improved following the implementation of the Gulf IFQ programs and that overcapacity in the RS fishery remains high. Excess capacity is present in both the RS and Gulf reef fish IFQ programs. As noted in the first 5-year RS IFQ review, the program has had limited success reducing overcapacity; therefore, additional management interventions may be necessary to balance the harvesting capacity of the fleets with the productivity of the stocks (Agar et al 2014).

4.5 Social Effects

This section integrates and updates the social effects sections in the individual program reviews, which incorporated the results of several studies conducted among program participants and a discussion of social effects in other IFQ programs that may be occurring within the Gulf region. The initial RS-IFQ Program Review incorporated the results of a survey among RS-IFQ program account holders (Boen and Keithly 2012). The subsequent GT-IFQ Program Review incorporated the results of several studies focused on examining impacts of the GT-IFQ program on program participants (QuanTech 2015), fishing communities (Griffith et al. 2016), captains and crew (LaRiviere 2016), and dealers and processors (Keithly and Wang 2016). The SEFSC is currently developing a crew survey which could further inform on the combined social effects of the RS-IFQ and GT-IFQ programs, but the results are not available at this time. Additional studies were not conducted for this combined review.

The respective RS-IFQ and GT-IFQ programs' initial 5-year reviews found that progress had been made towards achieving the broad, related goals of each program: the reduction of overcapacity and addressing the problems with derby fishing. Nevertheless, the IFQ programs fundamentally changed the way fishing was prosecuted, leading to new issues that are largely social in nature. These issues principally relate to the distribution of benefits for fishery participants, particularly those directly engaged in the activity of fishing (Ropicki et al. 2018; Griffith et al. 2016). Such concerns were noted among the potential impacts of implementing the RS-IFQ program, including "the fairness of initial allocations that would result in windfall profits to a select few" and "the costs new fishermen would have to pay to gain entry" (GMFMC 2006). These concerns may have been compounded through the provision included for each program, which opened the sale of shares to the public after the initial 5 years thereby expanding participation to any U.S. citizen or permanent resident. The Council is currently evaluating this provision and will determine whether to require some or all shareholders to possess a commercial reef fish permit.[28]

Reduction of Overcapacity

In terms of the goal to reduce overcapacity, the effects have likely been both positive and negative. In terms of number of vessels and trips, there has been a reduction in vessels and a reduced number of trips since implementation of both programs. The number of vessels landing RS each year has increased again in recent years, while the number of vessels landing GT species has remained more consistent since the initial decrease following implementation of the GT-IFQ program. However, whether these trends can be solely attributable to the IFQ programs is unclear. The absolute number of commercial vessels landing RS and GT has declined, suggesting some reduction in capacity is possible, although the number has increased again in recent years. The social impacts of such a reduction can be both positive and negative. In terms of reducing overcapacity for the red snapper component of the fishery, there are positive effects; those remaining vessels have fewer competitors. Yet, for those who chose or were forced to

[28] Public Hearing Draft Amendment 36B: Modifications to Commercial Individual Fishing Quota Programs. Under development. Most recent draft available at: https://gulfcouncil.org/wp-content/uploads/B-9b-2020-Oct-RF-36B-PHDraft-10-15-2020.pdf

leave the red snapper component of the reef fish fishery as a result of the RS-IFQ program there were likely negative effects. In the first year of the RS-IFQ program, 13% of the former Class 2 RS endorsement holders and 7% of the former Class 1 RS endorsement holders exited the fishery by selling all their shares, resulting in a 10% decrease in shareholders. The number of vessels landing red snapper also decreased upon implementation of the program, from an average of 485 vessels over the 5 years prior to the program to 309 vessels during the first year of the program, representing a 36% decrease in the number of vessels landing at least one pound of red snapper. The RS-IFQ quota also decreased substantially between 2006 and 2007, when the RS-IFQ program began. With the exit of the vessels associated with those shareholders, there was also a concurrent change in catch composition for many reef fish vessels, as RS is part of a multi-species fishery. With the ability to use RS allocation at any time of the year, the incentive to land as much RS as possible during the short mini-seasons was no longer incentivized, which led to some fishermen targeting other reef fish alongside red snapper, spreading out the use of their RS allocation throughout the year (Table 12 in NMFS 2019a). Therefore, there has been a change in the composition of species landed by commercial reef fish vessels because of the RS-IFQ program. Whether there was a concurrent loss of employment as reported in other IFQ programs (AECOM 2010) is unknown.

Prior to implementation of the GT-IFQ Program, there was not a corresponding endorsement for fishermen targeting grouper and tilefish and there were fewer closures to harvest resulting from quotas being met compared to red snapper. Nevertheless, some reduction to capacity occurred in the grouper-tilefish component of the fishery as vessels were now required to possess allocation to land species managed under the GT-IFQ Program. The number of vessels landing grouper and/or tilefish decreased upon implementation of the program, from an average of 630 vessels over the 5 years prior to implementation of the program to 452 vessels during the first year of the program, representing a 28% decrease in the number of vessels landing at least one pound of any share category of the GT-IFQ Program.

Crew sizes have changed since implementation of the RS-IFQ program. Over the 5-year averages for pre and post-RS-IFQ Program implementation, fishermen took slightly fewer trips with smaller crew sizes, but the trips became longer. The number of days fished and crew size decreased by 3% and 7%, respectively but the average length of the trips increased from 2.6 to 4.3 days (approximately 66%). Average crew sizes decreased marginally from 3.0 to 2.8 between these 5-year intervals (GMFMC and NMFS 2013). According to Boen and Keithly (2012), there has been a reduction in crew size since implementation. Their respondents reported a statistically significant reduction in the number of crew that was more prominent in the western Gulf and among smaller and medium-sized operations (Boen and Keithly 2012). However, the number of captains and crew who were forced to exit the fishery due to either program as a direct result of reduced capitalization remains unknown. While there has been a reduction in crew size, there was also a significant change in the ability to hire and keep stable crew, especially in the western Gulf, a change that most respondents indicated has been positive. It is likely that these changes to crew size occurred following implementation of the IFQ programs, although the decrease in the number of vessels landing GT-IFQ Program species was not as large as under the RS-IFQ Program. The decrease in the red snapper quota in the initial year of that program further confounds the ability to assess the impact of adopting the IFQ Program on capacity reduction. Information is unavailable to measure direct impacts from any reductions in overcapacity at the community level.

Elimination of the Derby Fishery

The primary effects of eliminating the derby fishery for the RS-IFQ program, and mitigating problems associated with derby fishing (GT-IFQ program) have most likely been positive; see Chapter 8 for a discussion of safety at sea. The commercial harvest of red snapper is open year-round and fishermen can utilize their allocation at any time. Fishermen no longer race to catch fish during the first 10 days of each month, as occurred with red snapper prior to implementation of the RS-IFQ program, which defined derby fishing. The opportunity to fish at any time has certainly reduced the likelihood that fishermen will fish during bad weather or in unsafe conditions. Furthermore, eliminating the derby fishery has added more flexibility to the yearly fishing seasons, allowing participants to land IFQ program species when most convenient and profitable. According to Boen and Keithly (2012), elimination of the derby fishery was one of the most positive impacts of the RS-IFQ program (mean response of 1.92, between (1) strongly agree and (2) agree [Boen and Keithly 2012]). With regard to eliminating the derby fishery, the Council concurred that this goal of the program has been met and could be removed as a program goal.[29] As discussed in Chapter 8, safety at sea has also improved.

New Participation Roles

Another result of IFQ programs is the emergence of new participation roles, such as the development of socioeconomic classes of individuals that control access to the fisheries and those that depend on these individuals for access to the fisheries (Wingard 2000). The structure of the programs has allowed for the appearance of a new participation role of brokers, those that buy and sell allocation, but do not land IFQ managed species. Brokers may or may not hold shares and were present during the initial 5 years of each program, as some initial shareholders did not maintain their permit while keeping their shares for the purpose of selling the allocation associated with the shares. Others who buy and sell allocation without a permit include dealers. Dealers, who may or may not have shares, use the allocation for vessels that sell to them.

Through the first 5 years of each program, a Gulf reef fish permit was required to purchase shares or allocation, but not to retain shares already held. Beginning in 2012 for the RS-IFQ Program and 2015 for the GT-IFQ Program, any U.S. citizen or permanent resident is able to participate in the IFQ programs by trading (i.e., buying and selling) shares and allocation. Because a commercial reef fish permit continued to be required to land the allocation associated with shares, this new public participation in the programs is limited to buying and selling shares and allocation. This reflects a point of dissatisfaction with the GT-IFQ program expressed by respondents in the Griffith et al. (2016) research, who were concerned with the Gulf of Mexico Fishery Management Council's (Council) decision to allow the requirement that shareholders possess a reef fish permit to expire. Many participants felt it was unfair that individuals who own shares and/or transfer allocation, but do not participate directly in the fishery, do not assume any of the physical or economic risks of being on the water while commercial fishing (Griffith et al. 2016), nor do they bear the expense of cost recovery fees, which are charged to the fishermen.

[29] Public Hearing Draft Amendment 36B: Modifications to Commercial Individual Fishing Quota Programs.

Although this new role of "virtual fishermen" (Macinko 1997) has been raised as a potential problem, it is unclear the extent to which this type of ownership has become pervasive within the Gulf IFQ programs to date. The number of accounts that are only trading red snapper allocation has increased from 24% (n = 144) in 2007 to 27% (n = 176) in 2018 (accounts only trading allocation/accounts with allocation, Table 6 in NMFS 2019a). Similarly in the GT-IFQ Program, the number of accounts that are only trading allocation has remained within 3% from 2010 through 2018 for each share category (Table 12 in NMFS 2019b). Although the increase in the number of accounts only trading allocation is not substantial, it highlights an apparent shift in how people participate in the program. Relatedly, there has been a shift toward a greater proportion of landings made through accounts that do not hold shares. These accounts would have had to procure the allocation from another participant, including brokers, or from a related account. For red snapper, while only 9% of landings were made through accounts without shares in 2007, that had increased to 47% in 2018 (Table 7 in NMFS 2019a). The proportion of landings made through accounts without shares in the GT-IFQ program has increased similarly: landings of gag increased from 4% to 41%; red grouper from 4% to 52%; SWG from 2% to 44%; DWG from 4% to 53%; and tilefish from 1% to 55% (Table 11 in NMFS 2019b).

Identifying a broker within the data on allocation transfers is difficult, as accounts only trading allocation may be related to another account with an associated vessel account or represent dealers who are securing allocation for vessels to sell fish to them. While price data is collected on allocation transfers, not all transferors complete this field or complete it with invalid data. Both the related accounts and price data may make it difficult to determine how many accounts are transferring allocation to make a profit. There is also evidence of IFQ shareholders being "gatekeepers" for accessing allocation. Non-shareholding fishermen have complained of having to go through particular shareholders, i.e., gatekeepers, to obtain allocation and expressed fear of criticizing the program, lest they be denied access to buying allocation (Griffith 2018).

The accounts that are only trading allocation may also include both small and large shareholders. Small shareholders may trade all their allocation because it is not sufficient to harvest profitably, whereas large shareholders may trade all their allocation to related account(s) or if they can no longer harvest IFQ-managed species (e.g., do not own a Gulf reef fish permit, vessel is being repaired). Therefore, it remains unknown whether or not accounts that only sell allocation are doing so for the sole purpose of profit and are not otherwise engaged in fishing activity. Nevertheless, it does seem clear that a category of accounts that only trade allocation has emerged, although the amount of allocation that is being transferred to related or unrelated accounts remains unknown.

Fairness, Equity, and Issues of Distribution

The issue of fairness in the initial allocation of catch shares has been framed as a social equity issue (Macinko 1997) that may at times be in conflict with economic benefits (McCay et al. 1998; Matulich and Sever 1999). Amendment 26, which established the Gulf's RS-IFQ program (GMFMC 2006), acknowledged that "many people are concerned about the fairness of initial allocations that would result in windfall profits to a select few." In their review of the literature, Griffith et al. (2016) also point to the fairness of the initial allocation as a source of controversy for many IFQ programs. This concern was echoed in the National Research Council's report (1999), requested by Congress following the 1996 reauthorization of the MSA.

A related criticism of catch share programs is that the first generation of quota holders are considered to have been "gifted" their shares, while future entrants must purchase shares or transfer allocation to participate in the program (Macinko 1997). Furthermore, some have considered "distributing the initial quota allocation for free is a mistake because it produces a windfall for recipients and allows them to transfer without adding any value or innovation to the process" (Griffith et al. 2016). Research conducted for the initial GT-IFQ Program 5-year Review found these views were expressed in all Gulf regions as some participants questioned both NMFS's right to allocate a public resource to private citizens and how initial allocations were established (Griffith et al. 2016).

Griffith (2018) reported complaints by fishermen regarding the threshold for eligibility to participate in the referendum to implement the GT-IFQ program, which excluded many fishermen from participating if their historical landings were below the threshold. Fishermen with the highest landings were allowed to vote, i.e., those who were considered to have substantially fished, and were also the ones who received the most shares. The complaints centered on how NMFS defined "substantially fished." Further, Griffith (2018) argued that by distributing more shares to fishermen who had fished the hardest, those fishermen who most contributed to creating the derby-like fishing conditions that brought about the decision to move to an IFQ program were rewarded. In contrast, those fishermen who had a diversified fishing strategy in which many species were harvested had lower landings of the grouper tilefish species and thus, received little to no shares. However, subsequent to the program, a multi-species fishing strategy became the practice by those who received the most shares and were now targeting an array of species, using their quota when necessary, and building up landings histories for other species that may one day be put under an IFQ program (Griffith 2018). Yet, the multi-species strategy fishermen pre-program implementation were now required to buy allocation to continue harvesting the smaller quantities of grouper tilefish they had previously landed (Griffith 2018). Griffith further argues that the IFQ program converts historical participation into an economic commodity that incentivizes fishermen to behave as businessmen, and that participation under the IFQ program is no longer representative of historical participation.

While Griffith et al. (2016) did not provide a breakdown of responses by participation role (e.g., crew member, hired captain, shareholder, etc.) in their report, Boen and Keithly (2012) found that in the RS-IFQ program, smaller shareholders, or those who did not receive shares through the initial distribution, express the strongest views of inequity in the distribution of IFQs, while the large shareholders expressed the most satisfaction. Most shareholders also agreed that it is now harder for others to enter the fishery. There are claims that some shareholders now charge their hired crew for the purchase of allocation on the shareholder's vessel, which has increased the costs per trip born by crew. This practice has been reported in other fisheries as well (AECOM 2010). While we have no empirical evidence, the perception among respondents is that entry into the fishery has become increasingly more expensive and difficult, and some believe current hired captains and crew are having more difficulty surviving economically (Boen and Keithly 2012). Pinkerton and Edwards (2009) found similar results in the British Columbia halibut fishery, as did McCay and Brandt (2001) within the Mid-Atlantic surf clam and ocean quahog ITQ program.

Other related social issues pertaining to the initial allocation of harvest privileges identified in the literature include an increase in “social divisiveness ... between [the] haves and have-nots” and that crew were not included in the initial allocation, despite their contribution to the fish that earned permit holders their shares (Macinko 1997; Copes and Charles 2004; Griffith 2018). From the perspective of fishery management, crew were essentially “invisible;” most received no tangible benefits from implementation of the IFQ program, as landings histories were associated with a permit and benefits went to the permit holders. Shares were conferred on permit holders based on the landings associated with their permit and not the fishermen who caught the fish. Although the state trip tickets record the number of crew on a trip, the data collection systems that monitor commercial landings in the reef fish fishery do not record information about crew which would be sufficient for an initial distribution of catch shares (i.e., identifying information such as names). Nor does crew receive any benefits if the permitholder who received those shares sells them, or transfers the allocation to other vessels (Copes and Charles 2004). Griffith et al. (2016) found mixed results with some participants suggesting that the IFQ program gave more power to the dealers, while others said the fishermen gained more power because of the program.

In summary, the social effects on the eligibility and participation in the IFQ programs are similar to effects identified in other IFQ-type programs. These effects center on social equity concerns beginning with the initial distribution of shares, social changes in how people participate, the provision that allows for public participation in the programs, and changes in relationships that are tied to ownership of capital (i.e., shares).

Participant Satisfaction

This section summarizes some of the results of surveys conducted prior to each of the initial IFQ program 5-year reviews, as more recent surveys are not available. According to Boen and Keithly’s 2012 study on the RS-IFQ program, overall satisfaction with the program was tepid, with respondents, on average, expressing just above neutral satisfaction with the program. Broken down geographically, those in the western Gulf were more likely to be satisfied, and respondents in the eastern Gulf were more likely dissatisfied. A marked difference between large shareholders and those with fewer shares was also reported with those categorized as large shareholders reporting that they were significantly more satisfied with the program and small shareholders reporting dissatisfaction. Similar results were reported by Tokotch et al. (2012) who surveyed GT-IFQ participants and found that larger commercial operators were more inclined to agree with managers and academics that the GT-IFQ program would produce several benefits for both their operations and the fisheries, in contrast to the smaller operators. They also found that GT-IFQ program fishermen and dealers were more skeptical of the alleged overall benefits of the program than those not associated with the RS-IFQ program (Tokotch et al. 2012).

Crosson (2011) found that among North Carolina fishermen, loss of flexibility was the primary reason other forms of management were preferred to IFQs. Loss of flexibility referred to the ability to switch targeted species; in an IFQ program, fishermen must obtain allocation to be able to land an IFQ-managed species. This loss of flexibility may be reflected in a decrease in the number of targeted IFQ species reported by captain and crew, as quota is either unavailable or too expensive for harvesting IFQ-managed species (QuanTech 2015).

QuanTech's (2015) survey of GT-IFQ program participants in 2014 found that support among program participants had increased over time as 45% of respondents indicated that they supported the GT-IFQ in 2014, while only 38% supported the program at the time of implementation. However, when explicitly asked if they were satisfied with the GT-IFQ in 2014, only 39% agreed while 48% exhibited some level of dissatisfaction. Thus, there are approximately 6% of participants that support the GT-IFQ but were not satisfied with the program 5 years after implementation. QuanTech (2015) also found that 39% of respondents thought that the profitability of their business increased due to increasing ex-vessel prices while only 23% thought an increase in profits was due to decreased operating expenses. Also, there was majority agreement that the GT-IFQ program provided more flexibility in timing trips (54%), reduced derby-fishing conditions (67%), and decreased crowding on fishing grounds (52%). Only 18% of respondents agreed that the GT-IFQ program had reduced the loss of fishing gear.

In a survey of captains and crew for the GT-IFQ Program 5-year Review, LaRiviere (2016) reported similar modest decreases in satisfaction since IFQ program implementation. It is unclear what caused this decrease. The satisfaction results are most similar to responses from decreased ability to earn a large income. Captains and crew also reported a lack of perceived fairness that ownership under the program was not linked to active fishing participation. In sum, captains and crew reported a decreased availability of work and a decreased ability to move among vessels. Conditional on working there is less choice and flexibility to move across vessels. It is important to note that these labor outcomes by their nature also implicitly reflect local market conditions: if there was a wide variety of well-paying jobs locally, it is likely that labor would have more bargaining power in the GT fishery.

Dealers and Processors

Keithly and Wang (2016) administered a survey among GT dealers and processors regarding their opinions on various aspects of the program for the initial GT-IFQ program 5-year review. Keithly and Want report almost 40% of dealers indicated opposition to the GT-IFQ program prior to implementation, 30% voiced support for the program and 30% of the respondents were 'neutral' or had 'no opinion.' Approximately 5 years after implementation of the GT-IFQ program, almost 40% of the respondents continued to voice opposition to the program while support for the program increased to almost 50%. Much of this increase may reflect a change among those who expressed 'no opinion' of the program prior to its implementation, potentially because they were not involved in the fishery.

Investigating further, those operations expressing 'no opinion' either prior to implementation of the GT-IFQ or after its implementation were deleted from consideration leaving 52 observations. Based on this smaller sample, approximately 20% of the responding dealers were 'strongly opposed' to the GT-IFQ program at the time of its implementation with the percentage increasing only marginally (from 21% to 23% approximately five years later). The proportion 'opposed' to the program, by comparison, fell from 23% to 15%. Those expressing 'strong support' for the program increased from 17% to 29% while those expressing 'support' for the program equaled 21% both at the implementation of the program and approximately 5 years after the program was implemented.

Among those respondents considering their operation to be primarily that of commercial fishing (15 in total), almost one-half of them indicated that they were opposed to the program prior to its implementation compared to one-third of them who expressed support for the program. At the time the survey was conducted in 2016, the proportion among this type of operation who expressed support for the GT-IFQ program had increased to two-thirds (i.e., 10 out of 15) while those expressing opposition had fallen to a third.

Among those respondents considering their operation to be primarily that of a dealer/distributor, 9 of the 28 (or about a third of the total) expressed opposition to the program prior to its implementation while 11 of the 28 (about 40%) expressed support for the program. In 2016, more than 50% of the dealers/distributors (15 of 28) voiced support for the GT-IFQ program, while 10 of the 28 dealers/distributors expressed opposition to the program. A large number of dealers/distributors (5 of the 28) expressed 'no opinion' with respect to the GT-IFQ program prior to its implementation in 2010 and this number fell to zero in 2016.

4.6 Conclusions

Vessels participating in the Gulf IFQ programs operate with significant overlap between the programs. Between 2010 and 2018, the annual percentage of vessels that landed at least one pound of GT-IFQ species and also landed at least one pound of red snapper ranged from 75% to 89%. During the same time interval, the annual percentage of vessels that landed at least one pound of red snapper and also landed at least one pound of GT-IFQ species fluctuated between 72% and 93%. The overlap between IFQ program participants supports the decision to review the IFQ programs jointly.

Fishing capacity can be defined as the maximum harvest over a period by a fishing fleet that is fully utilizing inputs given current levels of fixed inputs, available technology, and existing biomass level. Overcapacity is defined as the difference between actual capacity output and a desirable sustainable catch level such as a quota. Capacity Utilization indicates the proportion of capacity that is effectively utilized. The rest is considered as excess capacity. A study on fleet dynamics conducted by Agar, Horace, and Parmeter (under review) evaluated the performance of the Gulf IFQ programs under two model arrangements, a RS-IFQ model and a Gulf reef fish IFQ model. Results from the RS-IFQ model suggest that time-varying technical efficiency increased by 6% following the implementation of the RS-IFQ program and that excess capacity and overcapacity remain high in the fishery. As indicated by the findings of Solis, del Corral, Perruso and Agar (2015), the RS-IFQ model suggests that about 20% of the vertical line fleet (operating at full efficiency) would be sufficient to harvest the totality of the RS-IFQ commercial quota. Results from the Gulf reef fish IFQ model suggest that time-varying technical efficiency improved by 5% post-IFQ program implementation. For the reef fish fleet, the average technical efficiency moved up by almost 4 percentage points for vertical line vessels post-IFQ while it increased just over 9 percentage points for longline vessels during the same period. The Gulf reef fish IFQ model also indicates the presence of excess capacity. It also suggests that between 2011 and 2016, 57% Gulf reef fish IFQ fleet (assuming it had operated at full efficiency) could have harvested the totality of the quota.

CHAPTER 5. ALLOCATIONS, TRANSFERABILITY, AND CAPS

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires initial allocations to be fair and equitable under all limited access privilege programs (LAPP). Section 303A(c)(7) of the Magnuson-Stevens Act requires a Council to establish a policy and criteria for the transferability of limited access privileges (shares and allocation). Transferability is generally thought to improve technical efficiency and thus aid in achieving economic efficiency in a fishery (i.e., National Standard 5). Restrictions on transferability may serve to meet other objectives, such as equity (i.e., National Standard 4), providing for the sustained participation of and minimizing adverse economic effects on fishing communities (i.e., National Standard 8), or reducing adverse effects on particular types of habitat. Section 303A(c)(5)(D) of the Magnuson-Stevens Act requires Councils and the National Marine Fisheries Service (NMFS) to establish limits or caps to prevent the excessive accumulation of harvesting privileges. The accumulation of excessive shares is thought to potentially create market power in the product market, input markets (e.g., gear, bait, labor, etc.), and/or the markets for shares and allocation. Market power creates economic inefficiency, and excessive shares should be avoided for equity/distributional reasons. One of the anticipated effects of limits and caps is to limit the degree of consolidation within the fleet. Consolidation would typically be expected to result in a reduction in capacity and overcapacity, which is a goal of most catch share programs (CSP).

Since allocation between entities in the program, transferability, and caps are explicitly linked together and changes in one may have potential changes in the others, they are reviewed together in this section. Sector allocations are not analyzed in this section or in this review because the Gulf of Mexico Fishery Management Council (Council) is: 1) reviewing sector allocations for red grouper in Reef Fish Amendment 53, 2) planning to review sector allocations for red snapper in Reef Fish Amendment 52, and 3) planning to review sector allocations for other IFQ species separately by April 2026 under its allocation triggers review policy. Further, the Council is developing guidelines for its allocation reviews. Thus, this section will review:

- allocations between individuals or entities within the program and the allocations between subgroups within the program
- if the equity/distributional impacts of existing caps and the impacts those caps have had on the creation of market power by affected entities
- whether existing transferability provisions are conducive to achieving the specified objectives, keeping in mind that trade-offs often exist between objectives.

Shares are fully transferable within the grouper-tilefish individual fishing quota (GT-IFQ) program and red snapper individual fishing quota (RS-IFQ) program. Share transfers are a two-step process, with the transferor initiating the process and the transferee completing the process by accepting or rejecting the share transfer. Therefore, share transfers may start on one day and not be completed until another day.

Allocation can be transferred from a shareholder account to their own vessel account(s), another shareholder account, or another shareholder's vessel account. Only allocation transfers between shareholder accounts (shareholder account to another shareholder's account or shareholder account to another shareholder's vessel account) were analyzed. Within account transfers were not analyzed as these transfers simply result from a shareholder moving allocation between their own shareholder account and any associated vessel accounts. The transferor initiates the allocation transfers and the transfer is completed immediately upon submission, with no action from the transferee. This process was created to allow allocation to be transferred to vessel accounts while the vessels were still at sea with limited internet availability. Allocation units cannot be individually tracked in the system as each pound of allocation is not uniquely identified. The system tracks the amount of allocation being transferred between accounts. All allocation transfers record the transferor, transferee, share category, pounds transferred, and price. Allocation prices are analyzed as a price per pound.

5.1 Share Transfers

Shares were distributed at the start of the program to participants based on landings history and can only be increased or decreased in an account through share transfers. The number of share transfers has decreased since 2012 in the GT-IFQ program as well as within all GT-IFQ share categories, while the total amount of shares transferred has remained relatively stable (Table 5.1.1). In the RS-IFQ program, however, the number of share transfers and the total amount of shares transferred remained similar between 2012 and 2018, with some variability. In both IFQ programs, the number of share transfers and the total amount of shares transferred were greatest in 2015, which coincides with public participation becoming available in the GT-IFQ program. Between 15-38% of the shares were transferred in each share category during that year. Thereafter, the total amount of shares transferred decreased to 3- 21%. The average amount of shares transferred was less than 1%.

Table 5.1.1. Number and volume of share transfers, and average shares per transfer.

DWG	N	Total Shares	Average Shares
2010	161	25.80	0.16
2011	96	7.00	0.07
2012	78	9.30	0.12
2013	53	7.30	0.14
2014	62	12.60	0.20
2015	85	32.70	0.38
2016	56	9.60	0.17
2017	31	3.00	0.10
2018	34	11.60	0.34

GG	N	Total Shares	Average Shares
2010	256	24.00	0.09
2011	138	18.80	0.14
2012	129	14.80	0.12
2013	88	5.50	0.06
2014	106	19.20	0.18
2015	153	24.70	0.16
2016	84	7.90	0.09
2017	67	7.10	0.11
2018	63	4.80	0.08

RG	N	Total Shares	Average Shares
2010	267	24.30	0.09
2011	168	13.50	0.08

SWG	N	Total Shares	Average Shares
2010	195	25.60	0.13
2011	104	8.40	0.08

2012	202	17.20	0.08
2013	145	13.70	0.09
2014	144	14.20	0.10
2015	214	32.90	0.15
2016	118	13.10	0.11
2017	117	5.00	0.04
2018	84	12.30	0.15

2012	97	6.90	0.07
2013	82	12.20	0.15
2014	63	10.60	0.17
2015	97	21.60	0.22
2016	56	7.30	0.13
2017	45	3.50	0.08
2018	55	12.30	0.22

TF	N	Total Shares	Average Shares
2010	91	31.60	0.35
2011	59	9.00	0.15
2012	44	11.80	0.27
2013	29	5.50	0.19
2014	34	16.30	0.48
2015	57	38.20	0.67
2016	34	21.10	0.62
2017	24	3.20	0.13
2018	20	6.80	0.34

GT-IFQ	N	Total Shares	Average Shares
2010	970	131.30	0.14
2011	565	56.62	0.10
2012	550	59.97	0.11
2013	397	44.34	0.11
2014	409	72.94	0.18
2015	606	150.17	0.25
2016	348	59.04	0.17
2017	284	21.70	0.08
2018	256	47.84	0.19

RS	N	Total Shares	Average Shares
2007	108	10.74	0.10
2008	42	4.82	0.11
2009	75	6.02	0.08
2010	79	8.47	0.11
2011	78	5.10	0.07
2012	81	7.56	0.09
2013	76	4.74	0.06
2014	91	5.56	0.06
2015	120	15.31	0.13
2016	93	5.85	0.01
2017	116	8.68	0.02
2018	98	6.42	0.01

QuanTech (2015) reported that 76 (28%) program participants responding to the survey purchased GT-IFQ shares spending an average of $162,686 with median cost listed as $50,000 while 33 (12%) program participants reported selling GT-IFQ shares receiving an average of $59,817 with median revenue listed as $50,000.

5.3 Allocation Transfers

In 2012, there were 5,700 allocation transfers in the GT-IFQ program and 2,551 allocation transfers in the RS-IFQ program (Table 5.2.1). The number of transfers has increased to over 3,500 transfers in the RS-IFQ program in recent years, but has been more variable in the GT-IFQ program. The number of allocation transfers in the GT-IFQ program was highest in 2016 for all share categories. This could be a result of the GT-IFQ program becoming open to the public the year before, and also as a result of a large red grouper (RG) quota increase during that year. Allocation transfers can exceed the quota because the allocation can be transferred multiple times before being used for landings. As expected, the average pounds per transfer were greater in share categories that had higher quotas. The number of allocation transfers and amount of allocation transferred increased from 2012 to 2015 in all share categories, but has remained relatively stable since. The overall increase since the early part of the program, however, could not be simply correlated to increases in quota, as the amount of allocation transferred increased even at times when the quota decreased. More likely, the amount of allocation being transferred increased as networks between participants increased allowing for more access to the allocation across the Gulf of Mexico (Gulf).

Table 5.2.1. Number of allocation transfers, total pounds (gutted weight) of allocation transferred, average amount transferred, and percentage of quota transferred.

DWG	N	lbs	Avg. lbs	% quota
2010	490	1,027,477	2,097	101%
2011	632	1,447,229	2,290	142%
2012	764	1,524,618	1,996	135%
2013	608	1,762,344	2,899	158%
2014	846	2,370,757	2,802	214%
2015	898	3,240,557	3,609	294%
2016	947	2,438,566	2,575	238%
2017	780	2,153,472	2,761	210%
2018	820	2,297,499	2,802	224%

GG	N	lbs	Avg. lbs	% quota
2010	945	743,266	787	53%
2011	1,250	332,049	266	77%
2012	1,745	503,899	289	89%
2013	1,718	621,594	362	88%
2014	2,232	1,236,126	554	148%
2015	1,847	1,255,383	680	134%
2016	2,183	1,391,053	637	148%
2017	1,485	848,718	572	90%
2018	1,274	704,654	553	75%

RG	N	lbs	Avg. lbs	% quota
2010	1,065	3,217,048	3,021	56%
2011	1,550	4,260,483	2,749	81%
2012	1,906	4,736,612	2,485	88%
2013	1,752	5,579,299	3,185	101%
2014	2,317	7,187,959	3,102	128%
2015	2,480	8,654,733	3,490	151%
2016	2,978	15,069,366	5,060	194%
2017	1,758	8,905,708	5,066	114%
2018	1,373	8,391,173	6,112	108%

SWG	N	lbs	Avg. lbs	% quota
2010	616	315,042	511	77%
2011	568	272,816	480	67%
2012	900	365,563	406	72%
2013	911	493,144	541	95%
2014	1,000	506,556	507	97%
2015	1,084	576,714	532	110%
2016	1,595	662,269	415	126%
2017	1,147	504,162	440	96%
2018	999	463,479	464	88%

TF	N	lbs	Avg. lbs	% quota
2010	268	489,585	1,827	111%
2011	328	765,586	2,334	174%
2012	385	685,980	1,782	118%
2013	291	933,105	3,207	160%
2014	430	1,255,737	2,920	216%
2015	504	1,411,779	2,801	243%
2016	515	1,133,932	2,202	195%
2017	472	1,073,241	2,274	184%
2018	422	864,755	2,049	149%

GT-IFQ	N	lbs	% quota
2010	3,384	5,792,418	64%
2011	4,328	7,078,163	94%
2012	5,700	7,816,672	96%
2013	5,280	9,389,486	111%
2014	6,825	12,557,135	145%
2015	6,813	15,139,166	171%
2016	8,218	20,695,186	191%
2017	5,642	13,485,301	124%
2018	4,888	12,721,560	117%

RS	N	lbs	Avg. lbs	% quota
2007	808	1,686,218	2,087	57%
2008	683	1,371,100	2,007	60%
2009	843	1,539,479	1,826	67%
2010	1,719	3,065,736	1,783	96%
2011	2,155	3,639,394	1,689	110%
2012	2,551	3,741,966	1,467	101%
2013	2,752	5,762,456	2,094	114%
2014	2,860	5,549,553	1,940	110%
2015	3,387	9,254,534	2,732	141%
2016	3,682	8,537,474	2,319	140%
2017	3,701	8,297,809	2,242	138%
2018	3,702	7,966,526	2,152	126%

Accounts transferring allocation were categorized by the account's actions (e.g., landing and transferring allocation). Some accounts only transfer allocation and do not have landings. There are a variety of reasons why an account holder may only transfer allocation: account holder could not harvest allocation (e.g., no permit, vessel inoperative), allocation was transferred to a related account, account holder had insufficient allocation to harvest (e.g., shares resulted in only a few pounds of allocation), and/or greater profit could be earned from selling than harvesting the allocation. Accounts without a reef fish permit may not land IFQ species. Therefore, these accounts can only transfer allocation to another account.

Even in the first year of the RS-IFQ and GT-IFQ programs, there were accounts that only transferred allocation (Table 5.2.2). The highest percentages of accounts only transferring allocation occurred in the tilefish (TF) share category, where nearly half of the accounts with allocation were only transferring allocation. RG, gag grouper (GG), and shallow water grouper (SWG) all had lower percentages (23-30%) of accounts only transferring allocation. The percentage of accounts only transferring allocation was elevated in 2012 but has remained similar or decreased slightly between 2012 and 2018, with minor fluctuations (no more than 6-

7%), within each share category over time. Since 2012, there has been a drop in the number of these accounts with shares and a permit. Still, the majority of all shareholder accounts (65%) hold permits (Table 4.1.4), with only a small decrease in the number of shareholder accounts (Table 4.1.1). Additionally, there was a decrease in accounts landing IFQ species that held shares (Table 5.2.3). Therefore, the changes in participation are most likely due to a combination of changes in activities and cannot be attributed to one specific change.

Table 5.2.2. Accounts only transferring allocation, by share and permit status.

		Shares		No Shares	
DWG	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2010	182 (36%)	148	7	27	NA
2011	212 (41%)	142	30	40	NA
2012	209 (42%)	147	30	32	NA
2013	182 (39%)	126	24	32	NA
2014	186 (41%)	128	29	29	NA
2015	203 (44%)	114	35	43	11
2016	206 (45%)	110	46	43	7
2017	176 (39%)	83	48	35	10
2018	186 (39%)	81	56	36	13

		Shares		No Shares	
GG	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2010	183 (23%)	156	14	13	NA
2011	223 (29%)	164	35	24	NA
2012	215 (29%)	156	37	22	NA
2013	174 (24%)	123	33	18	NA
2014	199 (27%)	137	38	24	NA
2015	210 (28%)	110	47	41	12
2016	214 (28%)	111	61	31	11
2017	194 (25%)	81	63	39	11
2018	184 (24%)	79	62	31	12

		Shares		No Shares	
RG	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2010	174 (23%)	144	12	18	NA
2011	211 (29%)	156	37	18	NA
2012	191 (27%)	136	34	21	NA
2013	180 (26%)	122	31	27	NA
2014	187 (27%)	127	39	20	NA
2015	208 (29%)	110	46	36	16
2016	193 (27%)	98	60	24	11
2017	199 (27%)	77	61	46	15
2018	197 (26%)	75	68	39	15

		Shares		No Shares	
SWG	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2010	203 (27%)	172	14	17	NA
2011	227 (30%)	162	36	29	NA
2012	214 (29%)	155	37	22	NA
2013	190 (26%)	121	34	35	NA
2014	190 (26%)	126	39	25	NA
2015	208 (28%)	106	44	46	12
2016	214 (29%)	109	60	35	10
2017	202 (27%)	86	59	46	11
2018	195 (26%)	76	60	46	13

		Shares		No Shares	
TF	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2010	132 (44%)	105	3	24	NA
2011	164 (53%)	111	20	33	NA
2012	146 (50%)	105	18	23	NA
2013	136 (48%)	97	11	28	NA

		Shares		No Shares	
RS	**N**	**Permit**	**No Permit**	**Permit**	**No Permit**
2007	144 (24%)	117	21	6	N/A
2008	110 (20%)	63	36	11	N/A
2009	131 (25%)	75	49	7	N/A
2010	139 (23%)	75	48	16	N/A
2011	159 (27%)	92	47	20	N/A
2012	172 (29%)	101	52	19	0
2013	165 (28%)	89	52	21	3

2014	142 (51%)	98	18	26	NA
2015	144 (50%)	82	25	30	7
2016	132 (48%)	74	32	22	4
2017	116 (44%)	55	30	23	8
2018	124 (43%)	62	27	28	7

2014	163 (27%)	76	66	17	4
2015	180 (28%)	80	68	22	10
2016	184 (29%)	65	90	14	15
2017	182 (28%)	66	94	14	8
2018	176 (27%)	68	85	12	11

Note: N indicates the number of accounts only transferring allocation. The percentage next to the N is the percentage of accounts only transferring allocation from all accounts with allocation.

Table 5.2.3. Pounds landed by accounts with and without shares.

DWG	With Shares		Without Shares	
2010	602,749 lb	96%	22,013 lb	4%
2011	701,273 lb	90%	78,246 lb	10%
2012	806,041 lb	84%	157,794 lb	16%
2013	562,498 lb	62%	350,425 lb	38%
2014	576,636 lb	55%	471,506 lb	45%
2015	458,548 lb	50%	452,791 lb	50%
2016	392,801 lb	45%	474,239 lb	55%
2017	390,545 lb	48%	431,354 lb	52%
2018	383,801 lb	47%	433,651 lb	53%

GG	With Shares		Without Shares	
2010	473,362 lb	96%	20,576 lb	4%
2011	286,560 lb	90%	33,577 lb	10%
2012	436,556 lb	83%	88,510 lb	17%
2013	470,701 lb	81%	108,963 lb	19%
2014	450,465 lb	65%	239,048 lb	35%
2015	356,593 lb	64%	198,348 lb	36%
2016	495,483 lb	64%	281,707 lb	36%
2017	276,519 lb	62%	166,637 lb	38%
2018	264,948 lb	59%	186,966 lb	41%

RG	With Shares		Without Shares	
2010	2,800,064 lb	96%	113,794 lb	4%
2011	4,397,093 lb	92%	385,101 lb	8%
2012	4,513,535 lb	87%	703,670 lb	13%
2013	3,688,461 lb	80%	906,211 lb	20%
2014	3,609,728 lb	66%	1,888,265 lb	34%
2015	2,943,654 lb	62%	1,841,338 lb	38%
2016	2,619,630 lb	57%	2,011,758lb	43%
2017	1,760,921 lb	52%	1,616,289 lb	48%
2018	1,151,522 lb	48%	1,252,778 lb	52%

SWG	With Shares		Without Shares	
2010	155,091 lb	98%	3,143 lb	2%
2011	170,156 lb	91%	16,079 lb	9%
2012	256,643 lb	85%	43,724 lb	15%
2013	242,464 lb	79%	65,382 lb	21%
2014	193,570 lb	74%	69,681 lb	26%
2015	193,160 lb	68%	89,178 lb	32%
2016	221,279 lb	62%	136,884 lb	38%
2017	144,564 lb	60%	94,482 lb	40%
2018	126,056 lb	56%	98,105 lb	44%

TF	With Shares		Without Shares	
2010	246,987 lb	99%	2,721 lb	1%
2011	330,997 lb	86%	55,137 lb	14%
2012	350,670 lb	78%	100,451 lb	22%
2013	219,869 lb	50%	220,222 lb	50%
2014	214,600 lb	41%	302,668 lb	59%
2015	214,554 lb	40%	322,958 lb	60%
2016	181,045 lb	42%	247,958 lb	58%
2017	196,264 lb	40%	288,631 lb	60%
2018	173,916 lb	45%	212,222 lb	55%

RS	With Shares		Without Shares	
2007	2,598,649 lb	91%	265,738 lb	9%
2008	1,958,999 lb	88%	276,420 lb	12%
2009	1,735,818 lb	78%	498,196 lb	22%
2010	2,220,185 lb	73%	835,859 lb	27%
2011	2,060,719 lb	64%	1,177,616 lb	36%
2012	2,522,817 lb	69%	1,113,578 lb	31%
2013	2,972,769 lb	61%	1,935,829 lb	39%
2014	3,035,667 lb	61%	1,980,389 lb	39%
2015	3,567,377 lb	55%	2,904,884 lb	45%
2016	3,302,781 lb	55%	2,754,717 lb	45%
2017	3,314,326 lb	53%	2,972,757 lb	47%
2018	3,355,481 lb	53%	2,930,223 lb	47%

5.4 Distributions of Landings, Revenues, and Shares

One of the explicit objectives of both the RS-IFQ and GT-IFQ programs was to reduce overcapacity. If overcapacity is reduced by reducing capacity as opposed to increasing the target level of catch (e.g., the quota or sector annual catch limit (ACL)), one of the expected effects is a reduction in the number of vessels, fishermen, and businesses participating in the fishery. This reduction in the number of participants may or may not change how landings and revenues are distributed across vessels and participants remaining in the fishery. However, if certain types of vessels or participants exit the fishery upon or after implementation of the program, then changes in the distributions of landings and revenues are likely to occur. Similarly, the distribution of shares and thus the annual allocations of quota would also be expected to change over time.

For example, economic theory suggests that less efficient and typically smaller businesses are expected to leave the fishery either as a result of receiving an insufficient amount of quota or because they cannot compete with their larger and more efficient counterparts. Regardless, their shares are expected to be bought by those with the greatest willingness to pay, which again are expected to be those operating at the lowest cost with the highest profits. In turn, those larger, more efficient entities will also accrue the landings and revenues associated with those shares. If this actually occurs, then the distributions of landings, revenues, and shares would be expected to become less equal over time.

The Gini coefficient is commonly used to measure distributional changes over time. The value of the Gini coefficient ranges between 0 and 1. A Gini coefficient of 0 indicates that all entities in the program have an equal or the same percentage of what is being measured (e.g., landings, revenues, shares, etc.), while a Gini coefficient of 1 indicates that a single entity possesses or controls 100% of what is being measured, which in market structure terms is commonly known as a monopoly. Thus, if the Gini increases over time, the distribution is becoming more unequal; if the Gini decreases over time, the distribution is becoming more equal.

The level at which the analysis is conducted (i.e., the unit of analysis) can be at the vessel, lowest known entity (LKE), account, business, or some other level. It is advisable to analyze distributional changes at various levels to ensure that choosing a particular level or unit of analysis does not obscure distributional effects that are actually occurring and may be of importance to fisheries managers. It is also advisable to look at changes in the distribution of multiple economic performance indicators (e.g., landings, revenues, and shares) as their distributional changes may differ in magnitude or direction over time.

The most commonly used unit of analysis for this purpose has been the vessel. However, some additional data regarding business ownership and structure started to be collected when the RS-IFQ program was implemented. Complete data of this nature was not collected until the GT-IFQ program was implemented. Further, vessels do not possess shares, and so it is not feasible to look at the distribution of shares at the vessel level.

As illustrated in Table 5.3.1, NMFS has produced a suite of Gini coefficient estimates that provide some indication of how certain distributions have changed since 2012 (J. Agar, 2021, pers. comm.). Specifically, for landings and revenue of all species in the GT program, the Gini coefficient at the vessel level increased by about 7% from 2012-2018. So, although the distribution of landings and revenue in the GT-IFQ program was already highly unequal at the vessel level, it has become even more so during this time. Most of this change was due to the distribution of RG and particularly GG landings at the vessel level becoming more unequal after 2012.

Similar trends are seen in the Gini coefficient estimates for landings and revenue at the LKE level in each GT share category. However, the increases in most GT share categories are less pronounced. Further, the Gini coefficient estimates for DWG landings and revenue at the LKE level declined by about 2.5% from 2012 through 2018. Thus, these distributions have become less unequal during this time, though they are still highly unequal. In general, the distributions of landings and revenue at the LKE level are highly unequal in each share category, but are the most unequal in the DWG and TF share categories, followed by RG, with GG and SWG being the least unequal.

Table 5.3.1. Gini Coefficients for landings, revenue, and shares at the vessel or LKE level in the GT-IFQ and RS-IFQ programs, 2012-2018.

	2012	2013	2014	2015	2016	2017	2018
GT landings, vessel	0.734	0.759	0.769	0.760	0.760	0.765	0.786
GT revenue, vessel	0.729	0.754	0.765	0.759	0.758	0.761	0.780
RS revenue, vessel	0.785	0.789	0.805	0.802	0.816	0.801	0.791
RG revenue, vessel	0.735	0.770	0.774	0.748	0.773	0.758	0.785
GG revenue, vessel	0.669	0.679	0.685	0.746	0.747	0.705	0.736
SWG revenue, vessel	0.689	0.702	0.709	0.747	0.715	0.709	0.701
DWG revenue, vessel	0.828	0.861	0.847	0.864	0.863	0.839	0.822
TF revenue, vessel	0.865	0.891	0.915	0.880	0.891	0.886	0.859
RS landings, LKE	0.828	0.817	0.834	0.827	0.838	0.822	0.802
RG landings, LKE	0.781	0.800	0.790	0.795	0.822	0.810	0.828
GG landings, LKE	0.713	0.730	0.751	0.787	0.773	0.746	0.748
SWG landings, LKE	0.720	0.729	0.751	0.769	0.742	0.747	0.738
DWG landings, LKE	0.832	0.837	0.837	0.865	0.848	0.834	0.813
TF landings, LKE	0.720	0.729	0.751	0.769	0.742	0.747	0.738
RS revenue, LKE	0.818	0.821	0.836	0.831	0.841	0.823	0.805
RG revenue, LKE	0.779	0.797	0.789	0.794	0.821	0.809	0.830
GG revenue, LKE	0.717	0.735	0.750	0.790	0.775	0.749	0.751
SWG revenue, LKE	0.715	0.726	0.745	0.767	0.739	0.742	0.738
DWG revenue, LKE	0.838	0.845	0.847	0.870	0.854	0.840	0.816
TF revenue, LKE	0.832	0.843	0.877	0.850	0.852	0.847	0.824
RS shares, LKE	0.861	0.858	0.850	0.846	0.842	0.838	0.824
RG shares, LKE	0.836	0.835	0.841	0.847	0.848	0.848	0.832
GG shares, LKE	0.792	0.789	0.792	0.791	0.796	0.796	0.778

	2012	2013	2014	2015	2016	2017	2018
SWG shares, LKE	0.826	0.818	0.821	0.814	0.817	0.816	0.797
DWG shares, LKE	0.877	0.877	0.876	0.868	0.868	0.867	0.871
TF shares, LKE	0.889	0.889	0.897	0.895	0.894	0.893	0.893

In general, the Gini coefficients for landings and revenue at the LKE level are about the same within each GT share category. Further, the Gini coefficients for revenue are consistently higher at the LKE level compared to the vessel level estimates in each share category, which is to be expected because multiple vessels can be owned, at least in part, by a single LKE.

The noticeable exception to these general findings is in the TF share category. For example, the Gini coefficient for TF revenue is slightly lower at the LKE level compared to the vessel level estimate. More importantly, the Gini coefficient for TF landings at the LKE level is significantly lower (about 16%) than the Gini coefficient for TF revenue at the LKE level. Thus, TF revenue appears to be more unequally distributed than TF landings. The most likely explanation for this result is based on the fact that the TF category is composed of species with very different ex-vessel prices. Although the price differential has declined from 2012-2018, golden TF commands a much higher ex-vessel price than blueline TF, ranging from 37-46% higher depending on the year (NMFS 2020). Further, and related, recent research suggests that some vessels may be highgrading when harvesting TF species. This highgrading behavior is partly due to the price difference between golden and blueline TF, but is also driven by the higher price that larger size fish typically command in the market (Pulver and Stephen 2019). The difference in the Gini coefficient for revenue and landings at the LKE level suggests that some entities are better at targeting fish that, either due to species or size, command a higher ex-vessel price. As a result, those entities are responsible for a higher percentage of the TF revenue than the TF landings.

With respect to the distribution of shares at the LKE level, again, the distributions are highly unequal in every share category, but are the most unequal in the DWG and TF share categories, followed by RG, with GG and SWG being the least unequal. However, unlike landings and revenue, the Gini coefficients for shares were mostly stable from 2012-2018 in most share categories. The coefficient for SWG shares decreased by about 3.5%, indicating SWG shares became slightly more equally distributed during this time.

The distributions of RS landings, revenue, and shares are similar to those for GT in general and in each GT share category, though there are differences. As with GT and its share categories, the distribution of RS revenue and landings are highly unequal at the vessel level and/or the LKE level. However, although RS revenue at the vessel level was more unequally distributed than GT revenue in 2012, there was little difference between them by 2018 because the distribution of GT revenue became even more unequal during this time while the distribution of RS revenue was essentially unchanged. Further, unlike most GT share categories, the distributions of RS landings and revenue at the LKE level became more equal from 2012-2018, with the Gini coefficients decreasing by about 2-3%. Similarly, unlike shares in most GT share categories, the distribution of RS shares at the LKE level also became more equal from 2012-2018, with the Gini coefficient declining by 4%.

To provide additional context for these estimates, Brinson and Thunberg (2016) estimated Gini coefficients for the distribution of revenues at the vessel level for all U.S. catch share programs. Although there was some variability in the effect each program's implementation had on the distribution of revenue and thus the Gini coefficients, the effects of implementing the GT-IFQ program as well as the RS-IFQ program did not differ significantly from the effects seen in most other catch share programs. Interestingly, the distributions in some programs actually became more rather than less equal over time, including in the RS-IFQ program to a very limited degree (Gini coefficient was 0.81 in the baseline period and 0.79 in 2013). However, the most striking result in their analysis is how unequal the revenue distributions across vessels were in the baseline period for the GT-IFQ and RS-IFQ programs relative to the other fisheries managed by catch shares. For all other fisheries in their analysis, the Gini coefficient averaged 0.45 in the baseline period, ranging from 0.25 to 0.62. Depending on whether you compare these programs with the GT-IFQ as a whole, or with certain species categories in the program, the Gini coefficients in the GT-IFQ program were 58%-84% higher in the baseline period compared to the other U.S. fisheries. Thus, the distributions of revenues across vessels in the GT and RS fisheries were considerably more unequal when the IFQ programs were implemented relative to all other U.S. fisheries where catch share programs have been put in place. Because the effect of the RS-IFQ and GT-IFQ programs' effects were not significantly different from most other programs, the revenue distributions at the vessel level are still much more unequal in the RS-IFQ and GT-IFQ programs compared to their distributions in other U.S. catch share programs.

5.5 Market Concentration and Market Power

5.5.1 Landings Market

When estimates of marginal cost are available, it is generally a straightforward matter to determine if market power exists, i.e., if price exceeds marginal cost, market power exists. However, the marginal cost estimates necessary for this type of analysis were not available when Mitchell (2016) conducted his analyses of concentration and market power in the GT-IFQ and RS-ITQ programs.[30]

An alternative way to detect market power is to examine the structure of the industry. Industries that are more concentrated, or situations with a large dominant firm, have some individual suppliers for whom elasticity is low due to a lack of competitive activity. Low elasticity allows for the exercise of market power. One commonly used measure of concentration is the Herfindahl-Hirschman Index (HHI). Other measures include C5 and C3, the share of the market controlled by the top five or three suppliers, respectively. A sufficiently large share for the largest supplier can also indicate potential market dominance.

According to joint guidance from the Department of Justice and the Federal Trade Commission, a market with an HHI above 2,500 is considered "highly concentrated" (exercise of market power is likely, particularly if concentration increases further)," a market with an HHI between 1,500 and 2,500 is considered "moderately concentrated" (possible concern with market power

[30] Mitchell's full analysis can be found at: https://gulfcouncil.org/wp-content/uploads/Analysis-of-Market-Power.pdf

being exercised given a sufficient increase in concentration)," and a market with an HHI below 1,500 is considered "unconcentrated" (no concerns over the exercise of market power). Further, a regulatory action raises potential "significant competitive concerns" if it produces an increase in the HHI of more than 100 points in a moderately concentrated market or between 100 and 200 points in a highly concentrated market. A regulatory action is presumed "likely to enhance market power" if it produces an increase in the HHI of more than 200 points in a highly concentrated market.

Mitchell's analysis measured concentration at three levels: the IFQ account, LKE, and the affiliated business/entity level. The affiliated business/entity (supplier) level is the closest approximation of units of independent economic control and the basis for the analysis of market power.[31] Affiliation exists when one business controls or has the power to control another or when a third party (or parties) controls or has the power to control both businesses. Control may arise through ownership, management, or other relationships or interactions between the parties. This level of analysis is most consistent with the Small Business Administration's (SBA) regulations for assessing ownership affiliation, which stipulate that control or the power to control should be presumed if one entity owns 50 percent or more of another entity (see 13 CFR 121.103(c)). Ownership percentages were based on ownership data for IFQ accounts provided by NMFS (J. Stephen, pers. comm., Jan. 13, 2016). In the case of "joint" IFQ account holders, for which ownership percentage data is not collected, the joint owners of the IFQ account were assumed to control equal percentages of the account in accordance with SERO's internal practices.

Mitchell also provided concentration estimates at the individual IFQ account level and the LKE level. At the LKE level, ownership is aggregated across IFQ accounts for each individual. The LKE (individual) level underestimates actual concentration because it ignores the ability of individuals to exercise control over a business' operations when they have a majority or substantial minority ownership interest. The IFQ account level underestimates actual concentration even more than the LKE level because it does not account for affiliated ownership at all. Thus, estimates at the LKE level come closer than estimates at the IFQ account level to approximating the appropriate measure of concentration for assessing market power. But unlike estimates at the affiliated business/entity level, estimates at the LKE level do not account for control of affiliated businesses that do not have a single common owner (e.g., where the same individual is not the sole owner of multiple businesses but does have a majority ownership interest in multiple businesses).

Based on the multiple measures of market concentration (e.g., HHI, C3, and C5), market concentration was found to be low in all species groups' markets for landings, with the exception of TF, and DWG to a much lesser degree, suggesting markets are likely competitive. More specifically, the market for red snapper (RS) landings has been Unconcentrated since the start of the IFQ program, with the largest supplier (i.e., the largest group of affiliated individuals and businesses) garnering no more than 11.5 percent of RS landings in any year, and the largest five

[31] NMFS has not been able to apply Mitchell's algorithms for determining affiliated entities and therefore is working on alternative methods to make such determinations. For e.g., see the discussion of "businesses" in sections 3.2.1 and 3.2.2. Thus, at this time, estimates of HHIs at the LKE level are the most appropriate for assessing market power.

suppliers garnering less than one third of the RS landings in any year. Similarly, the market for red grouper and gag grouper combined (RGG),[32] the market for DWG, and the market for SWG are also Unconcentrated and without any dominant suppliers or group of suppliers. Concentration decreased in the market for TF landings from 2010 to 2012, and then increased during 2013 and 2014 to a level of Moderate Concentration in both years, along with potentially dominant shares controlled by a small group of suppliers every year, especially in 2010 and 2014.[33] However, an examination of monthly average prices for all of the species groups revealed no relative upward trend for either of those species groups during these years. In fact, TF had a relative price increase between 2010 and 2012, during which concentration was declining and output was increasing. Absent a strong argument why prices should have been declining in 2013 and 2014, the stability in prices indicates that the increased concentration did not create market power.

A firm producing multiple substitutable products faces lower aggregate demand elasticity (i.e., has more opportunity to exercise market power) than the individual elasticity for each product. This means that a single entity accounting for large shares of multiple species groups would be more of a concern than if different entities produced the largest shares of each different species group. For example, in 2013 and 2014, the entity that produced the highest RS landings also produced the most DWG and TF landings. However, concentration in terms of revenue across all Gulf reef fish is quite low, and no firm produced as much as 8 percent of the total revenue in any given year.

NMFS estimated HHIs at the LKE level for landings and revenue to check some of Mitchell's results and update his findings through 2018 using current data (J. Agar, 2021, pers. comm.). Those results are presented in Table 5.4.1. These results are qualitatively similar to Mitchell's, with a few exceptions. For example, although Mitchell determined the market for TF landings became moderately concentrated in 2014, these results suggest that market continued to be unconcentrated based on the HHIs for TF landings and revenue. Further, NMFS' HHI estimates for landings are consistently lower for TF, RS, DWG and, to a lesser degree, SWG from 2012-2014, likely due to revisions in the ownership data since Mitchell conducted his analysis. Like the Gini coefficients, the HHI estimates for TF revenue are noticeably higher than those for TF landings, presumably for the same reasons discussed in Section 5.3.1. Regardless, the updated HHI estimates do not reflect any significant changes to the degree of market concentration in any of the landings markets, and all landings markets are unconcentrated.

Based on these findings, there is no evidence that market power exists in any of the relevant markets for landings. However, market power can also be created through collusive activity between presumably competing suppliers (e.g., such as was apparently the case between the major producers of canned tuna in recent years). Identifying specific conduct that only makes sense as cooperative activity to increase prices, and not as individual profit-maximizing behavior, would demonstrate the existence of market power. Collusive activity would be unlikely to have much effect unless the market was moderately or highly concentrated. NMFS'

[32] Mitchell chose to combine RG and GG into a single market because of multi-use allocation.

[33] Based on new analyses, it was determined that Mitchell's HHI estimates for 2013 and 2014 were likely too high as it was based on incomplete data. Therefore, it is unlikely the TF landings market was in fact moderately concentrated in these years.

updated analysis does not indicate that any of the landings markets are moderately or highly concentrated and Mitchell's analysis found no evidence of collusion in any of the markets for landings and shares.

Table 5.4.1. HHIs for landings, revenue, and shares at the LKE level in the GT-IFQ and RS-IFQ Programs, 2012-2018.

	2012	2013	2014	2015	2016	2017	2018
RS landings, LKE	268	225	225	194	208	187	169
RG landings, LKE	140	156	138	149	169	160	176
GG landings, LKE	94	105	116	145	137	118	129
SWG landings, LKE	102	108	105	132	113	114	116
DWG landings, LKE	263	378	440	517	538	466	468
TF landings, LKE	473	595	772	619	650	641	585
RS revenue, LKE	200	254	243	213	228	201	184
RG revenue, LKE	136	153	137	148	167	157	176
GG revenue, LKE	95	108	113	146	138	119	131
SWG revenue, LKE	96	103	101	133	109	111	114
DWG revenue, LKE	278	424	494	533	574	485	461
TF revenue, LKE	526	657	922	680	719	733	672
RS shares, LKE	213	214	217	208	204	203	203
RG shares, LKE	121	114	121	124	130	130	124
GG shares, LKE	77	78	81	78	86	85	85
SWG shares, LKE	142	114	121	117	118	119	114
DWG shares, LKE	338	366	397	371	375	376	382
TF shares, LKE	390	412	505	489	506	507	508

5.5.2 Annual Allocation and Shares Markets

With respect to estimating concentration in the markets for annual allocation and shares, the approach used in Mitchell's analysis was to measure allocation held at the beginning of each quarter, specifically January 1 (which is the same as measuring the concentration of shares), April 1, July 1, and October 1. Distribution of allocation occurs on January 1 according to the percentage of shares held and the amount of quota for each species group. The holder of allocation can transfer, use, or acquire allocation. Occasional mid-year increases in quota can also result in new distributions of allocation.

With respect to shares, the largest producers (i.e., the largest groups of affiliated individuals and businesses) in every species group had landings that were almost always higher than the volume associated with the cap on shares. This means that they were able to obtain sufficient allocation through market transactions such that their landings were not only above their initial shares/annual allocation but also above the share cap for each species group.

Landings can exceed the volume related to share caps because the regulatory constraints on accumulating allocation during the year are looser than the share caps. Specifically, there is no cap on the accumulation of RS allocation, while the cap on GT allocation restricts the level of allocation aggregated across all species to approximately 6 percent of the aggregate total GT allocation on an annual basis. For example, the annual allocation cap in 2013 was 529,300 lbs, and the total GT allocation across all species groups was 8,456,000 lbs. So, the annual allocation cap was 6.25% of the quota for all GT-IFQ species. An aggregated GT-IFQ market with 16 firms that have just a bit above a 6% market share would have an HHI of 625, which would be Unconcentrated. It would be even less concentrated if RS-IFQ was part of the market.

Mitchell's analysis concludes that the existing GT-IFQ allocation cap does not effectively control concentration in a manner that is meaningful for the relevant markets of IFQ landings and allocation for the following reasons. First, it matters how a supplier spreads their production across species groups. For example, the 2013 quotas were 6,238,000 lbs for RG, 1,118,000 lbs for DWG, 518,000 lbs for SWG, and 582,000 lbs for TF. Given an allocation cap of 529,300 lbs, if a supplier held the aggregate cap all in one species group, which is currently allowable, then the supplier could hold about 8.5% of the quota for RG, 48% of DWG quota, over 100% of the SWG quota, or 92% of the TF quota.

Second, the ability of a single entity to potentially control multiple IFQ accounts means that, if the allocation and share caps are effectively applied at the IFQ account or the LKE level, it is possible for concentration to exceed what the caps allow. For example, in 2013, each of the entities responsible for the largest share of production in each of the GT-IFQ species groups, which was a different entity for each group, landed a total amount of GT-IFQ production well below the allocation cap of 529,300 lbs. In fact, the combined production of those four different entities was under 520,000 lbs, which is just below the cap. The allocation cap would not have constrained any of these entities from increasing their production. If these entities were affiliated, only a small increase from each would have put their combined production over the allocation cap.

Finally, the GT-IFQ allocation cap does not include RS-IFQ. It is possible that there is a broad market including both GT and RS, as well as other reef fish species, but there is no indication that a relevant market exists for the specific group delineated by the cap (i.e., all GT regulated species excluding RS). Only a cap on all IFQ species would address the relevant market for all IFQ species or all Gulf reef fish. The largest aggregate supplier of IFQ species in 2013, also a combination of multiple permit holders, produced over 800,000 lbs across all species groups (about 6.8% of all IFQ landings that year), including over 500,000 lbs of RS, or about 10% of all RS landings that year.

According to Mitchell (2016), allocation and shares at the LKE level are much less concentrated than landings at the LKE level. Three of the species groups (RS, RG, and SWG) as well as the aggregate quantity of all species groups has always been Unconcentrated. Also, the largest suppliers have always had small shares not consistent with market dominance. Market share has usually been less than 20%, though rising above 30% in a few recent years for species groups that constitute less than 5% of the total IFQ landings (i.e., TF and DWG). The only species group with concentration measures above those consistent with an Unconcentrated market in multiple years, TF, is the same species group that had higher concentrations for landings. This appears not to be a concern for market power based on the price movements occurring during these periods of increased concentration.

DWG allocation had a notable increase in concentration in the second half of 2010. This is mostly due to a large increase in holdings by a particular market participant caused by a small number of low-price transactions (i.e., transactions that were priced considerably below the average price of the other transactions in the data for DWG that year), and failure to use or transfer all of those holdings as the season progressed. This conduct could be consistent with an attempt to exercise market power. However, the modest rise in prices for DWG in 2010 is not substantially different from price fluctuations at other times, nor was there any noticeable impact on allocation prices. Absent any effect on prices, it is evident that either this was not an attempt to exercise market power, or, if it was, then there was no market power to exercise because of competition from substitute products.

There is a more consistent pattern of concentration for TF. Notably, the allocation market for TF starts out Unconcentrated at the beginning of each year and becomes more concentrated during the year, becoming Moderately Concentrated in July 2010, October 2013, and April, July and October 2014. These concentration patterns occur with a mixture of different suppliers in different years and, absent any evident price effect downstream and given the allocation prices were about average, appear to be more consistent with a small number of harvesters chasing a relatively small amount of fish that likely is not by itself a relevant market, rather than an attempt to exercise market power.

NMFS estimated HHIs at the LKE level for shares to check some of Mitchell's results and update his findings through 2018 using current data (J. Agar, 2021, pers. comm.). Those results are presented in Table 5.4.1. In this case, NMFS' estimates are nearly identical to Mitchell's from 2012-2014. Thus, consistent with Mitchell's results, these findings demonstrate that shares at the LKE level are much less concentrated than landings at the LKE level. Further, there have been no appreciable changes to the HHIs for shares at the LKE level since 2014. Most importantly, all of the share markets continue to be unconcentrated based on these estimates.

Absence of market power may mean that the existing share and allocation caps have been effective in preventing market power or may be due to strong competition between industry participants and from products in adjacent markets (e.g., non-IFQ Gulf reef fish and South Atlantic snapper-grouper). There is no evidence of market power even when participants (or, strictly speaking, groups of individuals and businesses with affiliated ownership) accumulate large and concentrated shares of allocation or landings. However, concentration levels may be underestimated if there is vertical integration in the industry (i.e., one business controls multiple levels of production, such as when a seafood processor owns an ice house or tackle/bait shop, vessels, a dock, and a retail market). Federally permitted dealers only recently have been required to provide detailed ownership data and processors are not permitted in the Southeast Region. Additional research is needed to use the dealer ownership data in combination with vessel and IFQ account ownership data to determine the extent to which vertical integration may exist in the RS-IFQ and GT-IFQ programs.

The analysis also shows that the share caps are not constraining landings, as there have consistently been some entities (groups of affiliated individuals and businesses) harvesting a percentage higher than prescribed by the existing share caps (e.g., up to as much as 7-11% for red snapper, 6-8% for red/gag grouper, 8-12% for deep-water grouper, 5-8% for other shallow water grouper, and 14-20% for tilefish). Section 3.2.2 provides additional evidence that certain business operations (i.e., affiliated entities) have been able to exceed the share caps because they are only applied at the IFQ account and LKE levels. For all Gulf IFQ reef fish, the largest producer each year has only been responsible for 3-8% of the landings revenue since 2010. These findings suggest that, while some small sets of commonly controlled entities may dominate landings in certain species categories, landings are substantially more dispersed when looked at from the perspective of the IFQ program(s) as a whole. The higher levels of concentration at the species category level suggest certain businesses specialize in harvesting particular species, which should result in improved technical efficiency (i.e., lower average costs per unit of output). Further, there is no evidence that allocation caps are necessary at this time to prevent the exercise of market power in the landings markets or markets for allocation.

5.6 Social Effects

The social effects resulting from provisions related to allocations, transferability, and caps are related to program eligibility and participation. See Section 4.3 above for further discussion of these effects and results from stakeholder surveys.

Transferability of shares and allocation is generally viewed as a positive component of IFQ programs as it allows for quota to move to where it is needed most. However, Griffith et al. (2016) point out that in the early stages of development, IFQ markets can retard trading or transferability. Because the RS-IFQ and GT-IFQ programs are closely tied through common participants (Table 4.1.6), the market established through the RS-IFQ program likely mitigated many delays or negative impacts of market development when the GT-IFQ program was implemented 3 years later. Transferability allows for allocation to be bought by another fisherman when needed to land IFQ managed species. The IFQ online system records these transactions as allocation transfers between accounts. The online system requests the price paid (if any) for the transferred allocation. However, the online transaction merely formalizes the private agreement between the two account holders. Much of the allocation is transferred at a price agreed upon by the buyer and seller and is called “leasing” by fishermen.

Many holders of transferred or purchased allocation do pass on at least a portion of that cost to hired captains and crew. Griffith et al. (2016) found many participants complained about vessel owners who own shares, but require their hired captains and crew to transfer the allocation associated with those shares. These participants found this practice to be highly unfair, especially when prior to implementation of the IFQ program, the hired captains and crew bore none of those costs and in many cases, caught the fish for which the permit holder received the shares (Griffith 2018). The participant study conducted by QuanTech (2015) did not inquire about this practice, but only asked about whether the expense of buying allocation was passed on to the captain and crew. According to QuanTech, 69% of respondents reported that allocation expenses were deducted “from revenue before paying the captain,” who receives a share of total revenue. It is not clear if the survey respondent reported sharing in the cost of buying allocation.

This has been labeled a "usury fee," adding that passing this cost on to crew further increased "the divisions between those who own and those who work" (Macinko 1997). Even with higher prices for their fish, it is unclear that the increase would offset these new costs borne by the captain and crew. This may be why QuanTech (2015) found decreases in satisfaction from fishing and a decreased ability to earn a large income. There was also a large percentage of those surveyed who saw their share of revenue decrease since implementation of the GT-IFQ Program. This has been documented in other IFQ-type programs (Copes and Charles 2004; Pinkerton and Edwards 2009; Olson 2011). Notably, Pinkerton and Edwards (2009) found that the cost of buying allocation has actually decreased economic efficiency and worsened wealth inequities in the British Columbia halibut fishery.

Social Impacts from Share Consolidation

The consolidation of IFQ shares after initial implementation of a program has occurred in many IFQ programs, often leading to concern that consolidation may affect the objectives of the plan (Copes and Charles 2004; Gibbs 2007). During the first year of the RS-IFQ Program, it appears consolidation occurred as 11% of shares were transferred during the first year with an average of 7% transferred annually since (Table 5.1.1), and the number of accounts holding shares decreased from an initial 554 accounts that received shares to 497 accounts by the end of 2007 (NMFS 2019a). Consolidation also occurred during the first year of the GT-IFQ Program, with fewer shares transferred thereafter. A total of 766 accounts received shares in at least one share category at the beginning of 2010, while at the end of 2010, 743 accounts held shares (NMFS 2019b). There was no change in the number of accounts holding shares for the TF share category during the initial year of the program.

Share transfers have remained relatively stable across years, with the exception of the timing for public participation, i.e., when an account could be opened and shares purchased without holding a commercial reef fish permit. The year with the greatest number of share transfers and total amount of shares transferred across both programs occurred in 2015 when public participation became available in the GT-IFQ program (Table 5.1.1), having previously opened for the RS-IFQ Program in 2012. In 2012, there was one less account that held RS shares but no permit compared to 2011, although this increased by 6% the following year. Upon both programs having public participation, the RS-IFQ Program saw a 32% increase in the number of share transfers in 2015 compared to the previous year, while the GT-IFQ Program saw a 48% increase in the number of share transfers. Also in 2015 compared with the previous year, the number of accounts with shares but not a permit increased by 12% in the RS-IFQ Program (from 120 to 134 accounts) and 25% in the GT-IFQ Program (from 163 to 204 accounts) (NMFS 2019a, 2019b).

Overall, the number of accounts that hold shares has decreased from an initial 554 in 2007 to 341 in 2018 for the RS-IFQ Program (NMFS 2019a), and from 766 in 2010 to 616 for the GT-IFQ Program (NMFS 2019b). While some consolidation may be expected in both the fleet and shares, over-consolidation was one of the concerns during the development of the program. Therefore, provisions were included to place a cap on share ownership to prevent an individual entity from possessing an excessive share of the total. While this provision prevents individual entities from exceeding the cap, it is not possible to determine whether the cap is circumvented by having others purchase shares on their behalf, as has been reported in other IFQ programs

(Carothers 2013). The majority of respondents in Boen and Keithly's (2012) survey agreed that consolidation had occurred in the RS-IFQ Program. Some public comment has indicated that any further consolidation may be a barrier to access for others and have negative impacts for some communities. Alongside public participation, over-consolidation may not be the concern, but rather, the increased cost and reduced access to shares for fishermen as shares become investment instruments for entities without other ties to the fisheries. Griffith et al.'s (2016) informants referred to this as not having "skin in the game."

5.7 Conclusions

Market concentration measures, i.e., the Herfindhal-Hirschman index, and the concentration ratios at the three and five-firm levels, suggest that market concentration was low for most species groups' markets for landings; therefore indicating that markets are likely competitive. For example, the market for red snapper landings has been characterized as "Unconcentrated" since the beginning of the RS-IFQ program.

To update market concentration measures for the IFQ shares market from previous studies (Mitchell 2016), NMFS estimated Herfindhal indices through 2018. NMFS' estimates are consistent with previous estimates and indicate that all the shares markets continue to be classified as "unconcentrated." Furthermore, there were no notable changes to market concentration for IFQ shares since 2014. However, more research combining dealer ownership data with vessel and IFQ account ownership data to evaluate the extent to which vertical integration may exist in the Gulf IFQ programs.

CHAPTER 6. PRICE ANALYSIS

Share, allocation, and ex-vessel price information is important for evaluating the economic performance of catch share programs, particularly when estimates of profitability are not available (Holland et al. 2014). Theoretically, allocation prices should reflect the expected annual profit from landing one pound of quota, whereas share prices should reflect the net present value of the expected profit from landing one pound of quota in the long-run. In addition, economic theory suggests that, when fishermen no longer have to engage in a "race for fish" or "derby fishing," they will adjust their operations to better take advantage of weather and market conditions. Market gluts are expected to be reduced and product quality is expected to improve. As a result, ex-vessel prices are expected to increase, resulting in higher gross revenues and profits. Markets for landed product are also expected to be more stable. Specifically, if market gluts are reduced, landings would be expected to be more evenly dispersed over the course of the year, which in turn would be expected to result in more stable ex-vessel prices over the year (i.e., less variability from week to week, month to month, etc.). Further, if profits increase, operators will likely be willing to pay higher prices for shares and allocation, which in turn would be expected to result in higher share and allocation prices. All inflation-adjusted values in the analysis below were calculated based on the Gross Domestic Product (GDP) deflator.[34] The GDP deflator was chosen as the measure of inflation because it includes prices for all domestically produced goods and services and so is broader than other indexes.

Reporting of share transfer prices was not required until mid-2010, when a minimum transfer price of $0.01 was required for all share transfers. Share transfers report a value for the total share transfer, not a value per equivalent pound. Allocation transfer prices are collected on a per pound basis, but are not required to complete a transfer. Each year, there are share and allocation transactions that are either missing price information or have under-reported price information (e.g., $0.01/lb). Transactions that had reported low or no value could be due to, but not limited to, any of the following: entering a price per pound equivalent[35] instead of transaction price (only applicable to share transfers), reluctance to enter price information, gifts, transferring to a related accounts, part of a package deal (e.g., sale of shares with a permit, vessel, and/or other equipment), and/or unrecorded bartering of shares or allocation within the grouper-tilefish individual fishing quota (GT-IFQ) or red snapper individual fishing quota (RS-IFQ) programs. This misreporting of prices led to a 2012-2013 mail survey to participants about share prices. The survey was mailed to both the transferor and transferee for all past transfers where information was incomplete or possibly incorrect. Participants were asked to verify or correct the price information and select one of seven share transfer reasons: "Barter trade for allocation," "Barter trade for shares," "Gift," "Transfer to a related account," "Sale to another shareholder," "Package deal," and "No comment." Beginning in 2013, a submission of one of

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[34] http://www.bea.gov/national/index.htm#gdp

[35] A price per pound equivalent is the share percentage that would equal one pound for that particular period. The exact share percentage that is equivalent to one pound depends on the total commercial quota and will change as the quota changes from year to year or within a year for any quota increases.

these transfer reasons was required to complete every share and allocation transfer to better monitor the performance of the program.

For share price analysis, the data were limited to share transfers with "valid" price per pound equivalents. From 2013 onward, when prices differed between the transferor and transferee, a final price was decided based on the more representative total price entered. For example, a total price was selected over a value that was more representative of a price per pound. For the allocation price analysis, the data were limited to "valid" prices. All allocation statistics were computed by weighting pounds transferred and not on a transactional basis. All values for share and allocation were weighted by the pounds instead of on a transactional basis.

While ex-vessel prices are required to complete a landing transaction, prices have been variable, with prices as low at $0.01/lb reported. They may also be under-reported for a variety of reasons: to minimize cost recovery fees and/or capital gains, contractual arrangements between dealers and shareholders, and deductions for transferred allocation, goods (e.g., bait, ice, fuel), and/or services (e.g., repairs, machinery replacement). In June of 2011, regulations modified the definition for ex-vessel price and explicitly prohibited the deduction of allocation, goods, and/or services when reporting the ex-vessel price. For the ex-vessel price analysis in the annual reports, the data were limited to valid ex-vessel prices. All statistics were weighted by pounds rather than on a transactional basis. All ex-vessel prices prior to the start of the program were calculated using the Southeast Fisheries Science Center (SEFSC) Accumulated Landings System (ALS) database. After the start of the individual fishing quota (IFQ) program, ex-vessel prices are reported to both the ALS and IFQ systems, but IFQ submitted prices are used in this analysis.

6.1 Share Prices

Reporting of share transfers reasons reveals that most share transfers in both the GT-IFQ and RS-IFQ programs are considered a sale to another shareholder account, both in number of transfers and amount of shares transferred (Tables 2.1.2 - 2.1.5). The large number of transfers to a related account illustrates the complicated nature of accounts in the IFQ program. The other share reasons with a larger number of transfers and amount of shares transferred was "No Comment."

Obtaining representative share prices has been a challenge, with only 51-69% of the transfers being reported with representative prices since 2012 (Table 6.1.1). Despite these low numbers, the percentage of representative share prices has improved over time, particularly in recent years. These improvements are likely due to outreach efforts that highlight the need and usefulness of share price data. Additional discussion of share price trends over time can be found in Section 3.2.2.

Table 6.1.1. Statistics for share transfer prices.

DWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	53	33%	$8.19	$9.00	$9.41
2011	44	46%	$11.35	$12.02	$12.77

GG	N	%	Avg.	Median	Inf.-adj. avg.
2010	107	42%	$5.35	$6.00	$6.14
2011	47	34%	$24.24	$25.00	$27.27

2012	34	44%	$10.78	$12.00	$11.90
2013	30	57%	$12.58	$12.00	$13.65
2014	38	61%	$13.04	$13.00	$13.88
2015	40	47%	$12.74	$13.00	$13.42
2016	37	66%	$12.48	$12.75	$13.00
2017	23	74%	$12.63	$12.80	$12.92
2018	15	44%	$10.92	$13.25	$10.92

2012	68	53%	$25.91	$30.00	$28.60
2013	52	59%	$31.41	$30.02	$34.08
2014	78	74%	$30.18	$30.02	$32.13
2015	94	61%	$21.97	$22.00	$23.15
2016	55	65%	$14.29	$15.00	$14.89
2017	42	63%	$15.88	$16.00	$16.24
2018	39	62%	$9.78	$10.00	$9.78

RG	N	%	Avg.	Median	Inf.-adj. avg.
2010	111	42%	$3.73	$3.30	$4.28
2011	76	45%	$6.24	$5.97	$7.02
2012	124	61%	$8.02	$8.00	$8.85
2013	106	73%	$13.16	$13.70	$14.28
2014	107	74%	$13.06	$13.00	$13.91
2015	150	70%	$12.86	$13.00	$13.55
2016	81	69%	$10.11	$10.00	$10.54
2017	90	77%	$5.17	$5.00	$5.29
2018	53	63%	$4.10	$4.20	$4.10

SWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	76	39%	$6.91	$6.49	$7.94
2011	42	40%	$9.93	$11.99	$11.17
2012	41	42%	$7.80	$7.99	$8.61
2013	49	60%	$8.30	$7.25	$9.00
2014	33	52%	$7.36	$7.50	$7.84
2015	62	64%	$6.74	$6.00	$7.10
2016	26	46%	$5.84	$5.97	$6.09
2017	25	56%	$8.69	$11.00	$8.89
2018	27	49%	$4.87	$4.50	$4.87

TF	N	%	Avg.	Median	Inf.-adj. avg.
2010	38	42%	$3.11	$2.15	$3.57
2011	24	41%	$5.77	$5.14	$6.49
2012	14	32%	$8.22	$9.00	$9.07
2013	13	45%	$8.44	$8.00	$9.16
2014	17	50%	$8.75	$8.50	$9.32
2015	33	58%	$9.18	$9.00	$9.67
2016	21	62%	$10.02	$10.00	$10.44
2017	16	67%	$8.70	$9.00	$8.90
2018	6	30%	$10.70	$10.25	$10.70

GT-IFQ	N	%
2010	385	40%
2011	233	41%
2012	281	51%
2013	250	63%
2014	273	67%
2015	379	63%
2016	220	63%
2017	196	69%
2018	140	55%

RS	N	%	Avg.	Median	Inf.-adj. avg.
2007	21	19%	$11.04	$12.51	$13.18
2008	22	52%	$11.56	$10.50	$13.53
2009	38	51%	$20.64	$20.00	$23.98
2010	36	46%	$19.84	$21.50	$22.79
2011	28	36%	$28.77	$26.03	$32.37
2012	36	44%	$34.75	$35.00	$38.36
2013	47	62%	$36.77	$42.00	$39.89
2014	47	52%	$34.37	$34.00	$36.59

2015	62	52%	$33.62	$35.43	$35.42
2016	58	62%	$30.66	$35.00	$31.95
2017	84	72%	$34.80	$35.75	$35.59
2018	53	54%	$36.26	$36.50	$36.26

6.2 Allocation Prices

The most commonly selected reasons for allocation transfers were “No comment”, “Sale to another shareholder”, and “Transfer to a related account.” These reasons were substantially greater than all other reasons by an order of magnitude (Table 2.1.7 – 2.1.10). The greatest amount of pounds were also transferred under these same three reasons. As with the share transfers, the large number of transfers and amount of pounds transferred under the “transfer to a related account” illustrates the analysis of allocation transfers can be complicated.

Obtaining representative allocation prices has also been a challenge, with only 34-48% of the transfers being reported with representative prices since 2012 (Table 6.2.1). Just as has been seen with share transfers, the percentage of representative allocation prices has increased over time, and is likely due to outreach efforts that highlight the need and usefulness. Additional discussion of allocation price trends over time can be found in Section 3.2.2.

Table 6.2.1. Statistics for allocation transfer prices.

DWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	68	14%	$1.32	$1.50	$1.51
2011	116	18%	$1.36	$1.40	$1.53
2012	213	28%	$1.19	$1.25	$1.31
2013	215	35%	$1.14	$1.15	$1.24
2014	325	38%	$1.11	$1.10	$1.19
2015	282	31%	$1.18	$1.25	$1.24
2016	285	30%	$1.16	$1.20	$1.21
2017	250	32%	$1.18	$1.25	$1.20
2018	296	36%	$0.99	$1.00	$0.99

GG	N	%	Avg.	Median	Inf.-adj. avg.
2010	150	16%	$1.18	$1.00	$1.35
2011	303	24%	$1.74	$1.50	$1.96
2012	631	36%	$2.27	$2.25	$2.51
2013	705	41%	$2.40	$2.50	$2.60
2014	1,015	45%	$2.04	$2.00	$2.17
2015	847	46%	$1.90	$2.00	$2.00
2016	1,017	47%	$1.38	$1.25	$1.44
2017	574	39%	$1.45	$1.50	$1.48
2018	439	49%	$1.01	$1.00	$1.01

RG	N	%	Avg.	Median	Inf.-adj. avg.
2010	153	14%	$0.92	$1.00	$1.05
2011	482	31%	$0.54	$0.50	$0.61
2012	746	39%	$0.79	$0.75	$0.87
2013	827	47%	$0.97	$1.00	$1.05
2014	1,337	58%	$0.97	$1.00	$1.04
2015	1,331	54%	$1.07	$1.00	$1.13
2016	1,391	47%	$0.89	$0.95	$0.93
2017	898	51%	$0.42	$0.40	$0.43

SWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	75	12%	$1.15	$1.00	$1.32
2011	117	21%	$1.25	$1.40	$1.41
2012	279	31%	$1.15	$1.00	$1.27
2013	354	39%	$0.83	$0.75	$0.90
2014	443	44%	$0.73	$0.60	$0.78
2015	529	49%	$0.60	$0.50	$0.63
2016	870	55%	$0.56	$0.50	$0.58
2017	545	48%	$0.58	$0.60	$0.59

2018	668	49%	$0.32	$0.20	$0.32

2018	474	47%	$0.53	$0.50	$0.54

TF	N	%	Avg.	Median	Inf.-adj. avg.
2010	35	13%	$0.65	$0.50	$0.74
2011	62	19%	$0.67	$0.70	$0.75
2012	93	24%	$0.66	$0.65	$0.73
2013	88	30%	$0.67	$0.65	$0.73
2014	153	36%	$0.72	$0.75	$0.77
2015	186	37%	$0.77	$0.75	$0.82
2016	202	39%	$0.66	$0.75	$0.69
2017	171	36%	$0.72	$0.75	$0.73
2018	189	45%	$0.72	$0.75	$0.72

GT-IFQ	N	%
2010	481	14%
2011	1,080	25%
2012	1,962	34%
2013	2,188	41%
2014	3,273	48%
2015	3,175	47%
2016	3,765	46%
2017	2,438	43%
2018	2,066	42%

RS	N	%	Avg.	Median	Inf.-adj. avg.
2007	155	19%	$1.97	$2.00	$2.35
2008	152	22%	$2.31	$2.25	$2.70
2009	283	34%	$2.69	$2.75	$3.13
2010	344	20%	$2.88	$3.00	$3.31
2011	476	22%	$2.96	$3.00	$3.33
2012	781	31%	$3.00	$3.00	$3.31
2013	1,068	39%	$2.98	$3.00	$3.23
2014	1,382	48%	$3.03	$3.00	$3.23
2015	1,562	46%	$3.09	$3.25	$3.25
2016	1,891	51%	$3.21	$3.25	$3.35
2017	1,982	54%	$3.32	$3.35	$3.40
2018	2,051	55%	$3.40	$3.50	$3.40

6.3 Ex-Vessel Prices

The majority of ex-vessel prices submitted through the IFQ system are thought to be representative of actual market prices, with greater than 84% of the transactions having representative prices (Table 6.3.1). Overall, ex-vessel prices have either remained stable or increased since 2012 in all share categories. Increases were greatest for RG ($1.26/lb) and DWG ($0.60/lb) from 2012 to 2018. Since ex-vessel share category prices are averages of the species caught in that share category, ex-vessel prices were also analyzed by species, which can reveal if one species is driving the average ex-vessel price (Table 6.3.2). When ex-vessel prices were calculated at the species level rather than the landing share category, there were slight differences for species that can be landed in multiple categories (i.e., RG or GG multi-use, DWG and SWG flexibility measures) when compared to the category average prices. In the DWG share category, yellowedge grouper had the greatest ex-vessel price in all years. In SWG, the specie with the greatest ex-vessel price varied annually, but typically consisted of either black grouper or scamp. In the TF share category, typically golden tilefish had the greatest ex-vessel price. Additional discussion of ex-vessel price trends over time can be found in Section 3.2.2.

Table 6.3.1. Statistics for ex-vessel prices by share category.

DWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	1,529	94%	$3.61	$3.70	$4.15
2011	1,961	96%	$3.80	$3.75	$4.28
2012	2,450	96%	$4.06	$4.00	$4.48
2013	2,006	97%	$4.30	$4.50	$4.66
2014	2,090	97%	$4.44	$4.50	$4.73
2015	1,762	97%	$4.62	$4.95	$4.87
2016	1,825	97%	$4.62	$4.95	$4.81
2017	1,601	97%	$4.73	$4.85	$4.84
2018	1,494	99%	$5.08	$5.25	$5.08

GG	N	%	Avg.	Median	Inf.-adj. avg.
2010	3,226	99%	$4.27	$4.25	$4.90
2011	2,811	98%	$4.59	$4.75	$5.16
2012	3,562	98%	$4.69	$4.75	$5.18
2013	3,509	99%	$4.90	$5.00	$5.32
2014	3,940	98%	$4.83	$5.00	$5.14
2015	3,179	97%	$5.07	$5.25	$5.34
2016	3,505	98%	$5.13	$5.25	$5.35
2017	2,914	99%	$5.25	$5.25	$5.37
2018	2,746	99%	$5.66	$5.75	$5.66

RG	N	%	Avg.	Median	Inf.-adj. avg.
2010	3,803	99%	$3.05	$3.00	$3.50
2011	4,563	99%	$3.15	$3.24	$3.54
2012	4,587	99%	$3.21	$3.25	$3.54
2013	4,383	100%	$3.54	$3.55	$3.84
2014	4,891	99%	$3.77	$3.80	$4.01
2015	5,009	98%	$3.94	$4.00	$4.15
2016	5,123	98%	$4.01	$4.05	$4.18
2017	4,455	99%	$4.27	$4.25	$4.37
2018	3,983	99%	$4.75	$4.79	$4.75

SWG	N	%	Avg.	Median	Inf.-adj. avg.
2010	2,282	98%	$4.06	$4.10	$4.66
2011	2,782	97%	$4.14	$4.00	$4.66
2012	3,273	97%	$4.33	$4.25	$4.78
2013	2,954	98%	$4.48	$4.50	$4.86
2014	3,188	98%	$4.50	$4.50	$4.79
2015	3,046	96%	$4.61	$4.50	$4.86
2016	3,413	98%	$4.63	$4.50	$4.82
2017	2,849	98%	$4.76	$5.00	$4.87
2018	2,769	99%	$5.21	$5.25	$5.21

TF	N	%	Avg.	Median	Inf.-adj. avg.
2010	357	100%	$2.07	$2.11	$2.38
2011	411	100%	$2.31	$2.40	$2.60
2012	529	99%	$2.27	$2.25	$2.51
2013	447	98%	$2.58	$2.75	$2.80
2014	512	94%	$2.61	$2.80	$2.78
2015	531	97%	$2.90	$3.00	$3.05
2016	470	99%	$2.94	$3.15	$3.06

RS	N	%	Avg.	Median	Inf.-adj. avg.
2007	2,455	92%	$3.74	$3.75	$4.38
2008	2,023	85%	$4.06	$4.25	$4.72
2009	1,963	79%	$4.13	$4.25	$4.74
2010	2,319	71%	$4.17	$4.25	$4.79
2011	2,985	77%	$4.26	$4.25	$4.79
2012	3,319	84%	$4.44	$4.50	$4.90
2013	3,716	90%	$4.46	$4.75	$4.84
2014	3,660	84%	$4.75	$5.00	$5.06
2015	4,045	84%	$4.83	$5.00	$5.09
2016	4,428	84%	$4.87	$5.00	$5.07

2017	492	99%	$2.97	$3.20	$3.04
2018	477	99%	$2.82	$3.00	$2.82

2017	4,518	86%	$4.97	$5.00	$5.08
2018	4,242	84%	$5.10	$5.20	$5.10

Note: N indicates the number of representative ex-vessel transactions and prices are based on the category under which a species was landed. Under flexibility measures, when a species is landed under its secondary category, the price is captured for that category (e.g., red grouper landed under gag multi is counted in the GG price per pound).

Table 6.3.2. Statistics for ex-vessel prices by species.

Cat.	Species	2010	2011	2012	2013	2014	2015	2016	2017	2018
DWG	Snowy Grouper	$3.61	$3.97	$3.96	$4.26	$4.46	$4.81	$4.95	$5.10	$5.58
	Speckled hind	$3.49	$3.65	$3.74	$4.07	$4.27	$4.61	$4.51	$4.72	$5.56
	Warsaw grouper	$2.99	$3.10	$3.57	$4.12	$4.31	$4.51	$4.47	$4.67	$4.88
	Yellowedge grouper	$4.40	$4.61	$5.01	$5.19	$5.35	$5.46	$5.43	$5.52	$5.92
GG	Gag	$4.92	$5.27	$5.39	$5.64	$5.72	$5.90	$5.88	$6.04	$6.49
RG	Red grouper	$3.49	$3.62	$3.69	$4.07	$4.34	$4.53	$4.57	$4.88	$5.44
SWG	Black grouper	$4.57	$4.78	$4.98	$5.17	$5.41	$5.62	$5.66	$5.87	$6.25
	Scamp	$4.70	$4.82	$5.05	$5.23	$5.25	$5.36	$5.32	$5.58	$6.11
	Yellowfin grouper	$3.91	$3.63	$4.12	$4.76	$5.08	$4.64	$4.31	$4.74	$4.38
	Yellowmouth grouper	$4.51	$4.46	$5.09	$4.24	$4.63	$4.70	$5.59	$4.70	$4.41
TF	Blueline tilefish	$1.08	$1.30	$1.52	$1.72	$1.55	$1.81	$2.04	$1.99	$2.18
	Golden tilefish	$2.48	$2.84	$2.86	$3.12	$3.24	$3.49	$3.55	$3.62	$3.47
	Goldface tilefish	$2.91	$1.61	$2.78	$2.75	$1.15	$2.15	$2.31	$3.45	$2.54
RS	Red snapper	$4.79	$4.79	$4.90	$4.84	$5.06	$5.09	$5.07	$5.08	$5.10

6.4 IFQ Program Effects on Prices

Additional research has been conducted to determine whether implementation of the RS-IFQ and GT-IFQ programs has affected prices, particularly ex-vessel prices, and, if so, to what extent. As discussed in Section 5.2, Mitchell (2016) hypothesized that increases in market concentration could lead to market power (i.e., the ability of some producers to increase prices above marginal cost). Because all quota share markets were found to be unconcentrated, market power does not exist in these markets and thus cannot explain the changes in quota share prices that have occurred since the IFQ programs were implemented. In the aggregate, markets for annual allocation were also found to be unconcentrated. On the other hand, the market for DWG annual allocation was moderately concentrated for part of the year in 2010 and the market for TF annual allocation has been moderately concentrated throughout most of the 2010-2014 time period.

However, prices for annual allocation did not increase as concentration levels increased, and thus market power does not explain changes in the prices of annual allocation that have occurred since the IFQ program was implemented. With the exception of TF in 2014, all markets for RS and GT landings were also found to be unconcentrated and thus market power cannot explain changes in ex-vessel prices since the IFQ program was implemented.

Although economic theory suggests that IFQs and catch share programs in general will increase ex-vessel prices, and thereby gross revenues, Birkenbach et al (2020) found mixed evidence to support that hypothesis. In general, they attempted to control for all other factors that could have potentially explained changes in ex-vessel prices after the implementation of a catch share program in order to isolate the effect of the program. Their study assessed changes in ex-vessel prices for all U.S. catch share fisheries using differences-in-differences and synthetic control methods. Their empirical findings provide mixed results, with ex-vessel prices increasing, decreasing, or remaining unchanged depending on the species and program. In general, species experiencing ex-vessel price increases were found to supply higher-value fresh product markets that discouraged market gluts (i.e., catch shares ended or at least slowed the race to fish). For species experiencing ex-vessel price decreases, the economic benefits from catch shares management accrued in the form of improvements in technical efficiency (i.e., cost reductions) as season length increased. Species experiencing no change in ex-vessel price were found to supply frozen or canned product markets, and so the timing of within-season landings did not influence ex-vessel price.

With respect to the Gulf of Mexico (Gulf) IFQ programs, implementation of the RS-IFQ program was found to cause a statistically significant and rather sizable increase in the ex-vessel price of red snapper, though the effect was perhaps not as large as expected. The mitigated effect of the program on the ex-vessel price of red snapper was likely caused by the shift to 10-day monthly mini-seasons in the years just prior to the RS-IFQ program's implementation. Further, the analysis suggests that at least part of the ex-vessel price increase could be attributed to a 30% reduction in the commercial quota that was implemented concurrently with implementation of the RS-IFQ program.

Their analysis also found that implementation of the GT-IFQ program did not cause a statistically significant increase in the ex-vessel price for any species in the GT-IFQ program. In fact, the ex-vessel price of red grouper decreased slightly as a result of the IFQ program even though the season length did increase to some extent and landings predominantly enter a fresh product market. They hypothesize that their findings were confounded by effects from the *Deepwater Horizon* MC252 oil spill. Though the evidence is not conclusive, their findings are consistent with stated preference evidence of consumer concerns regarding seafood contamination following the spill. Further, for four out of the five of GT species groups, initial price increases following catch share implementation on January 1, 2010, were followed by sharp reversals after the oil spill began on April 20.

Results in a study by Keithly (2017) support Birkenbach et al's findings regarding changes in ex-vessel prices in the GT-IFQ program. While many catch share programs are initiated only after the "race for fish" has developed and continued or worsened in a fishery over a period of time, Keithly finds this was generally not the situation in the GT fishery. With the exception of two short seasonal closures for RG and several seasonal closures for DWG, the GT fishery was a year-round fishery prior to the IFQ program being introduced.[36] Thus, reasons cited in the literature for why ex-vessel prices are often depressed in a regulated open-access fishery may not be totally applicable in the GT fishery.[37]

Studies that have empirically examined the influence of an IFQ system on ex-vessel prices have traditionally done so using a set of structural equations with relevant market clearing prices to estimate demand and supply functions for the species being examined. Given the large number of species in the GT fishery in conjunction with the paucity of literature associated with the markets for these species, which may differ among species, Keithly specified a complete demand system to examine whether introduction of the GT-IFQ program resulted in higher ex-vessel prices.

Keithly's analysis used seven species or species groups: 1) grouper imports, 2) snapper imports, 3) dolphin imports, 4) Gulf red grouper, 5) Gulf "Other" groupers, 6) Gulf red snapper, and 7) Gulf and South Atlantic dolphin. Grouper imports are an obvious substitute for Gulf grouper. Snapper and dolphin were considered to be the other most likely substitutes for grouper and thus were also included in the analysis. Both of these species have significant imports and therefore imports and local harvest of both species were included.[38] Given its relatively large landings, Gulf red grouper was treated separately in the model, while other grouper species (black, warsaw, yellowedge, and gag) were aggregated.[39] The raw data indicates a large increase in prices, in general, among all species for both domestic and imported product. This strong increase likely reflects, at least in part, a recovering economy after a steep recession. Though there are no studies which examine the final outlet, the seafood products being considered in this study are likely largely consumed in the away-from-home market which is heavily influenced by the general state of the economy.[40]

The model results indicate there is little seasonality in the demand for either the imported products or the domestic products. There appears to be a small increase in demand, and thus a higher price for Gulf red snapper in February likely associated with Lent. Somewhat unexpectedly though, the demand for Gulf red grouper appears to be relatively low in February and March, possibly because of the higher demand for red snapper in February. In addition, there appears to be no seasonal changes in the demand for any of the imported products.

Consistent with Birkenbach et al's findings, Keithly's results indicate that the GT-IFQ program did not appear to have influenced the ex-vessel prices of Gulf grouper species. This is not

[36] Temporal closures by species or species group can be found at: https://www.fisheries.noaa.gov/southeast/gulf-mexico-historical-commercial-landings-and-annual-catch-limit-monitoring

[37] A recent analysis by Keithly and Wang (2017) found no appreciable changes in product form and market outlets when comparing dealer/processor activities both before and after introduction of the GT-IFQ program.

[38] Commercial harvest of red snapper in the South Atlantic has largely been prohibited in recent years and thus was not included.

[39] TF were not included given their relatively small contribution to landings in the fishery, particularly in relation to domestic harvest and imports of groupers, snappers, and dolphin. Further, their price trends generally follow those for Gulf red grouper and other groupers.

[40] A recent analysis by Keithly and Wang (2017) suggests that more than a third of Gulf GT sales by dealers are directed to the restaurant trade.

unexpected given that, unlike analyses in other catch share programs, the "race to fish" and related shortened seasons were not the primary reason for implementing the GT-IFQ program. Keithly expanded the analysis by including "habit formation" into the static model to determine if it produced different results.[41] However, the inclusion of habit formation did not affect the conclusion that the introduction of the GT-IFQ program has had no appreciable effect on ex-vessel prices for Gulf groupers.

On the other hand, monthly ex-vessel prices appear to have become more stable during the period after the GT-IFQ program was implemented. This can be seen by examining data for Gulf red grouper. Specifically, average monthly red grouper harvests during the 2005-2009 period ranged from a low of 191,000 lbs, or 4.2% of the annual landings, in March to 536,000 lbs, or 11.8% of the annual landings, in June. Further, ex-vessel price ranged from a low of $2.63 per pound (gutted weight) to $3.04 per pound with a rather definite negative relationship between average monthly landings and the ex-vessel price per pound. Further, during the 5-year period after the introduction of the GT-IFQ program, the percentage of landings by month fell in a much more narrow range (i.e., from 6.1% in August to 10.5% in December) and the ex-vessel price also fell in a much more narrow range (i.e., from $3.25 per pound in February to $3.47 in April). To the extent that the GT-IFQ program caused monthly landings to be more stable, the program has also resulted in more stable ex-vessel prices.

Asche (2020) examined the effect of implementing the RS-ITQ program specifically on the market for red snapper and more generally on markets for multiple snapper species. With respect to the effect of the program on the ex-vessel price for red snapper, his findings are consistent with those in Birkenbach et al (2020). His findings are also consistent with Mitchell (2016) with respect to the market structure for red snapper and other reef fish species.

Specifically, Asche concludes there is not a market specific to domestically harvested red snapper because there are domestic landings of other snapper species and significant imports of fresh and frozen. Asche examined competition in the snapper market by estimating an inverse demand system with five snapper products: red snapper, vermilion snapper, other domestic snappers, imported fresh snapper and imported frozen snapper. Asche finds that total purchases of snapper in general and of red snapper specifically have increased significantly since the RS-ITQ program was implemented, which suggests a strong increase in demand.

The analysis also determined that the demand for all snapper species is inflexible (i.e., demand is price elastic). Further, it did not find that implementation of the RS-ITQ program led to a shift in demand between the different snapper species. Thus, he concluded the increase in demand for domestic red snapper was likely driven by an increase in the total demand for snapper in general. However, while the demand flexibilities for snapper imports did not change after implementation of the program, the price flexibility for domestic red snapper significantly increased after implementation, causing the demand to become less price sensitive. As a result, the reduction in ex-vessel price for domestic red snapper was noticeably less than would have been otherwise expected given the increase in harvests that occurred in subsequent years.

[41] Habit formation is based on the idea that current consumption is based on past consumption.

Asche also conducted a market integration analysis using the data noted above. Although the market integration analysis indicates all snapper species and products compete in the same market, the analysis also shows that vermilion and other domestic snappers are imperfect substitutes for domestic red snapper. Conversely, the analysis fails to conclude that fresh and frozen snapper imports are imperfect substitutes for domestic red snapper. Therefore, even though the import data does not distinguish between different snapper species, it is highly likely that snapper imports are predominantly red snapper. Further, the analysis also finds that, not only is the ex-vessel price for domestic red snapper more stable after implementation of the program, similar to Keithly's (2017) findings for species in the GT-IFQ program, but prices were also more stable for the other domestic snappers and imports.

Given that domestic red snapper and fresh and frozen imports are close substitutes, the analysis also examined whether the RS-IFQ program led to an increase in the ex-vessel price of domestic red snapper relative to the two import products. The analysis concludes that the program increased the ex-vessel price of domestic red snapper by about 12% relative to the import price, or by about $0.35/lb. This price increase is in addition to the 40% price premium for domestic red snapper relative to imports before the IFQ program was implemented. As a result, domestic red snapper commands a price premium of about $1.54/lb on average relative to imported snapper.

Finally, these findings also suggest that domestic red snapper has value to U.S. consumers beyond the costs of production and its market value (i.e., consumer surplus is positive). This finding is consistent with other research showing that product differentiation can create consumer surplus even in highly competitive markets. Production differentiation can occur because of physical attributes, such as fresh product being preferred to frozen, or credence attributes, such as domestic product being preferred to imported product. Further research is needed to specifically estimate consumer surplus for domestic red snapper.

With respect to accurately assessing the effects of these programs on prices in the future, Holland et al (2014) made several recommendations with respect to the collection of price data in IFQ programs. First, information on sale price and/or other compensation received should be collected on all arm's-length share and annual allocation transfers, and systems should be implemented to validate and correct the data. In addition to price information when applicable, other characteristics of transfers should be collected including: whether the transfer is internal to a company; whether there is in-kind compensation for the transfer and what that compensation is; and if there is some contractual form of compensation and what it is (e.g., a proportion of the landed value of the fish once it is sold). Second, information on ownership ties between different quota account owners should be collected so that arm's-length transactions can be differentiated from transfers between related business entities. Third, if dealers/processors provide annual allocation to fishermen, care should be taken to ensure that ex-vessel prices and annual allocation prices reported do not reflect discounts associated with an agreement to deliver fish to that processor/buyer. Fourth, share and annual allocation prices should be evaluated to determine whether they appear to reflect reasonable values and are useful for informing policymaking (i.e., care should be taken when calculating average prices to exclude transactions with prices that appear to be misreported or errors). Fifth, Councils, stakeholders and fishery managers should be made aware of the potential value of catch share market information, particularly share and annual allocation prices, and Councils should be asked to consider making provision of annual allocation and share price information mandatory when transfers are made. Finally, to the extent sufficient non-confidential information about prices and volume of activity in quota markets is available, it should be made readily accessible to the public, preferably online and updated regularly. Information should be provided in as disaggregated a form as possible without compromising confidentiality of individuals' transactions (e.g., monthly rather than annual average prices and prices by Sector and/or area if applicable), and information should be as rich as possible (e.g., report median prices and measures of dispersion as well as averages (means)).

The findings of this review suggest that the RS-IFQ and GT-IFQ programs have dealt with the first four recommendations. For example, share price data has been required for those transferring shares in these programs since mid-2010. Share price data from those receiving transferred shares has been required since 2013. Also, entities transferring or receiving transferred shares or annual allocation have been required to provide a reason for the transfer since 2013. Provision of allocation transfer price data only became required in December 2020. As a result, though issues still exist with respect to some respondents not providing "credible" price information, the GT-IFQ and RS-IFQ programs most likely have the best annual allocation and share price data and thus the most accurate price estimates in U.S. catch share programs. Further, the annual reports for both programs play a major role in addressing the last two recommendations.

On the other hand, estimates of share and annual allocation prices are only provided to the public in the annual reports. As these reports come out several months after the conclusion of the previous calendar year, they are not "real-time" estimates and thus may be somewhat outdated and of limited use to participants in the program when they become available. The feasibility of providing estimates on a more "real-time" basis has not been evaluated yet.

6.5 Conclusions

With respect to the goals and objectives of the programs, although derby fishing has been eliminated in both programs (i.e., all species have a 365-day fishing season), derby fishing was not a major issue for most GT species or species groups prior to implementation of the IFQ program. Further, the findings above suggest that the GT-IFQ program has not led to a statistically significant increase in the ex-vessel prices of GT species. Conversely, the findings demonstrate there has been a statistically significant increase in the ex-vessel price for red snapper since the RS-IFQ program was implemented. Because landings have been more evenly distributed over time within a year, ex-vessel prices have been more stable under the GT-IFQ program relative to the years just prior to its implementation. The ex-vessel price for domestic red snapper has also been more stable, as have prices for all domestic and imported snapper products, since implementation of the RS-IFQ program.

CHAPTER 7. CATCH AND SUSTAINABILITY

Section 303(a)(15) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires the Councils and National Marine Fisheries Service (NMFS) to establish mechanisms for specifying annual catch limits (ACLs), as well as accountability measures (AM) to ensure those ACLs are not exceeded, for most federally managed species in their fishery management plans (FMPs). ACLs must be set at a level that prevents overfishing from occurring. This section will review if the grouper-tilefish individual fishing quota (GT-IFQ) and red snapper IFQ (RS-IFQ) programs have helped to keep harvests/landings within applicable limits, are encouraging full utilization of the quota, and also if the programs describe and analyze changes in the status of stocks within the IFQ programs. The section will also review if changes in bycatch and discard mortality are consistent with National Standard 9.

Each share category has one or more commercial quotas that may be adjusted annually or during the fishing year, based on stock assessments and other new information (Table 1.3.3.1). The IFQ program tracks landings in pounds of gutted weight and landings are reported in this report as such. Some share categories had in-season quota increases within a year. In-season increases occurred as early as January and as late as November. The quotas have generally increased for deepwater grouper (DWG), tilefish (TF), shallow water grouper (SWG), and red snapper (RS). Both red grouper (RG) and gag (GG) quotas decreased in 2011, followed by gradual increases each year thereafter.

The GT-IFQ program has several built-in flexibility measures to accommodate the multi-species nature of the commercial reef fish fishery and to reduce bycatch. Two share categories, GG and RG, have a multi-use provision that allows a portion of the red grouper quota to be harvested under the gag allocation, or vice versa. The three remaining categories (SWG, DWG, and TF) are multiple-species categories designed to capture species complexes that are commonly caught together (Table 1.3.2.1). Three grouper species (scamp, warsaw grouper, and speckled hind) are found in both the shallow and deep-water complexes. Flexibility measures in the GT-IFQ program allow these species to be landed under both share categories. Scamp are designated as a SWG species, but may be landed using DWG allocation once all SWG allocation in an account has been harvested. Warsaw grouper and speckled hind are designated as DWG species and may be landed using SWG allocation after all DWG allocation in an account has been harvested.

The multi-use provision for GG and RG allows a portion of the gag or red grouper allocation to be reserved each year for multi-use allocation, which may be used to land either gag or red grouper. The multi-use provision is to ensure that there may be allocation to use if either gag or red grouper are landed as incidental catch. The percentage of multi-use may change each year and may even be zero (Table 7.1). Since 2013, the red grouper multi-use (RGM) and gag multi-use (GGM) allocation was based on formulas (see below) utilizing the commercial quota and the annual catch limits for gag and red grouper. If either stock is under a rebuilding plan, the percentage of the other species multi-use allocation will equal zero. Multi-use allocation cannot be used until all the species-specific allocation has been landed or transferred, including allocation in shareholder and all associated vessel(s) accounts. For example, gag may not be landed under GGM or RGM unless there is no GG allocation remaining in the shareholder and associated vessel(s) accounts. Similarly, multiuse allocation may only be transferred after landing or transferring all the corresponding species-specific allocation in the shareholder and associated vessel(s) accounts. There was no RGM allocation from 2011-2014, because gag was under a rebuilding plan.

Table 7.1. Red grouper and gag multi-use allocations.

Year	GGM	RGM
2010	8%	4%
2011	8%	NA
2012	8%	NA
2013	70%	NA
2014	47%	NA
2015	33%	5%
2016	33%	5%
2017	44%	4%
2018	44%	4%

$$RGM\ allocation = 100 * \frac{(Gag\ ACL - Gag\ Commercial\ Quota)}{Red\ Grouper\ Commercial\ Quota}$$

$$GGM\ allocation = 100 * \frac{(Red\ Grouper\ ACL - Red\ Grouper\ Commercial\ Quota)}{Gag\ Grouper\ Commercial\ Quota}$$

The GT-IFQ and RS-IFQ programs additionally have a built-in 10% overage measure to allow a once-per-year allocation overage per share category for any IFQ account that holds shares in that share category. For shareholder accounts with shares, a vessel can land 10% more than their remaining allocation on the vessel once during the year. NMFS deducts this overage from the shareholder’s allocation in the following fishing year. Because overages need to be deducted in the following year, IFQ accounts without shares cannot land an excess of their remaining allocation in that share category and IFQ accounts with shares are prohibited from selling shares that would reduce the account’s shares to less than the amount needed to repay the overage in the following year.

7.1 Landings and Quota Utilization

The percentage of the quota landed varies yearly for each share category (Table 7.1.1). Between 2012 and 2015, the GT-IFQ program had over 80% of the program’s entire quota landed. Since 2016, however, the GT-IFQ program has landed less than 65% of the entire quota, and was likely a result of an increase to the RG quota by more than 2 million pounds (mp) gutted weight (gw) as well as the strong hurricane season that took place in the Gulf of Mexico (Gulf) that year. The RS-IFQ program has had more than 97% of the quota landed since 2012, and has neared 100% in recent years.

Table 7.1.1. IFQ annual landings (pounds [gw] and percentage of quota).

Cat.	2010	2011	2012	2013	2014	2015	2016	2017	2018
DWG	624,762 (61%)	779,519 (76%)	963,835 (86%)	912,923 (82%)	1,048,142 (94%)	911,339 (83%)	867,040 (85%)	821,899 (80%)	817,452 (80%)
GG	493,938 (35%)	320,137 (74%)	525,066 (93%)	579,664 (82%)	689,513 (83%)	554,941 (59%)	777,190 (83%)	443,156 (47%)	451,914 (48%)
RG	2,913,858 (51%)	4,782,194 (91%)	5,217,205 (97%)	4,594,672 (83%)	5,497,993 (98%)	4,784,992 (84%)	4,631,388 (60%)	3,377,210 (43%)	2,404,300 (31%)
SWG	158,234 (30%)	186,235 (45%)	300,367 (59%)	307,846 (59%)	263,251 (50%)	282,338 (54%)	358,163 (68%)	239,046 (46%)	224,161 (43%)
TF	249,708 (57%)	386,134 (88%)	451,121 (78%)	440,091 (76%)	517,268 (89%)	537,512 (92%)	429,003 (74%)	484,895 (83%)	386,138 (66%)
GT-IFQ	4,440,500 (49%)	6,454,219 (86%)	7,457,594 (91%)	6,835,196 (81%)	8,016,167 (92%)	7,071,122 (80%)	7,062,784 (65%)	5,366,206 (49%)	4,283,965 (39%)
RS-IFQ	3,056,044 (96%)	3,238,335 (98%)	3,636,395 (98%)	4,908,598 (97%)	5,016,056 (99.2%)	6,472,261 (98.5%)	6,057,498 (99.4%)	6,287,083 (99.6%)	6,285,704 (99.6%)

Three of the share categories (DWG, SWG, and TF) contain multiple species. One species within each of these categories comprises the majority of the landings for that share category (Figure 7.1.1). Landings may be strongly influenced by social and economic factors, such as share price, allocation price, allocation availability, market desirability, and ex-vessel price for these species within the IFQ program. All the species in a category use the same shares and allocation, although landings and ex-vessel prices may differ among these species. Differences in ex-vessel price among species within the same share category may influence the fishing behavior as fishermen target species that receive a higher ex-vessel price (e.g., SWG and TF). While this may occur in non-catch share fisheries, this behavior may be magnified due to allocation costs and availability. If fishermen have limited allocation available, they may change effort to harvest the fish with a higher ex-vessel price to maximize their profits.

The DWG share category contains four species: snowy grouper, speckled hind, warsaw grouper, and yellowedge grouper. During the years under the GT-IFQ program, yellowedge grouper accounted for 69-80% of the DWG landings, followed by snowy grouper which accounted for 10-17% of the landings (Table 7.1.2; Figure 7.1.1). Both warsaw grouper and speckled hind landings were typically between 3-11% each year.

The SWG share category contains four species: black grouper, scamp, yellowfin grouper, and yellowmouth grouper. During the years under the GT-IFQ program, scamp accounted for 73-87% of the SWG landings, followed by black grouper with 12-26 % of the landings, while yellowfin grouper and yellowmouth grouper are each less than 1% of the landings (Table 7.1.2; Figure 7.1.1).

The TF share category contains three species: golden tilefish, blueline tilefish, and goldface tilefish. During the program golden tilefish accounted for 81-90% of the TF landings, followed by blueline tilefish with 9-18%, and goldface tilefish with less than 1% to 7% (Table 7.1.2, Figure 7.1.1).

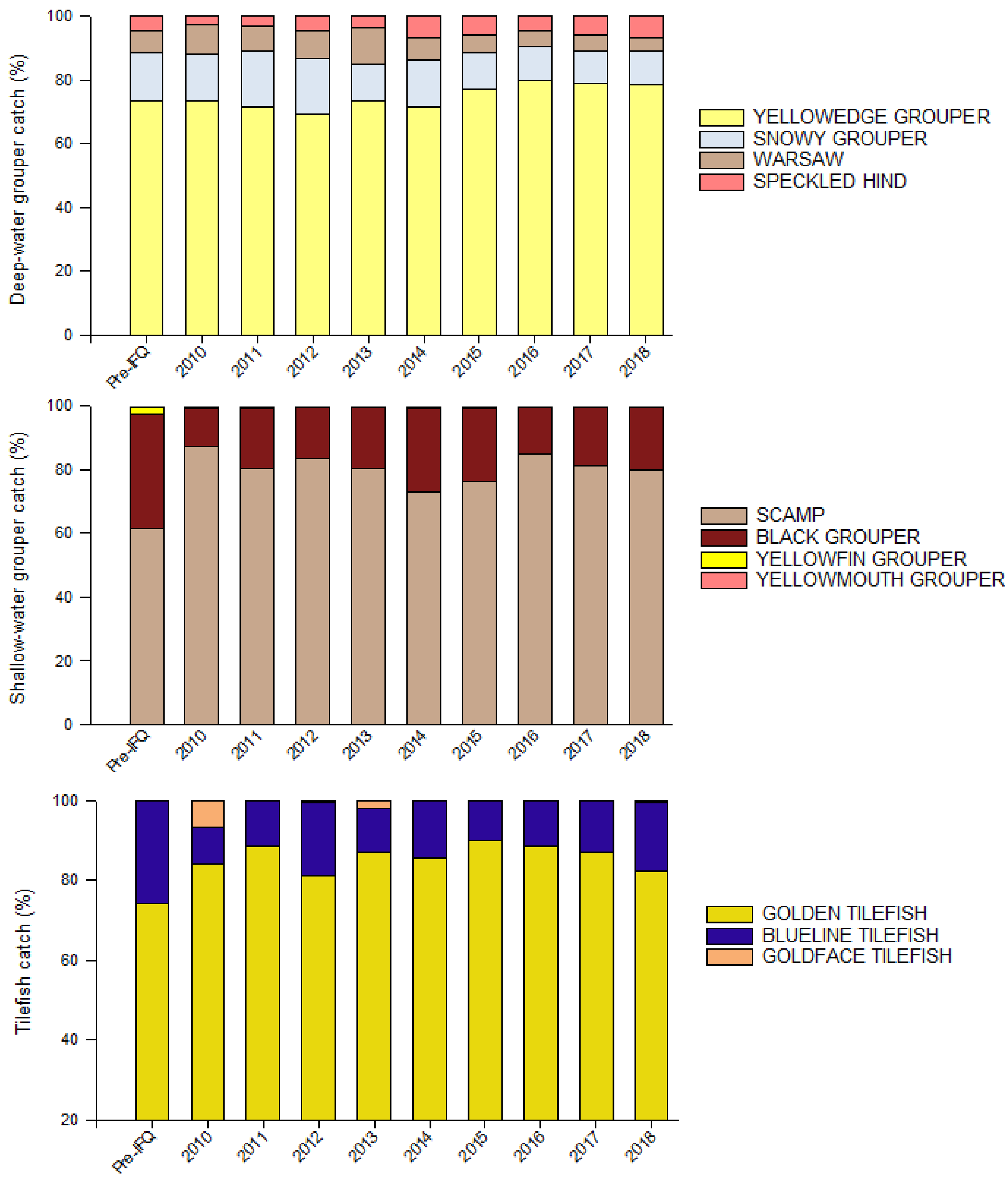

Figure 7.1.1. Species landings within share categories.

Table 7.1.2. Landings by IFQ-managed species.

Cat.	Species	Pre-IFQ[1]	2010	2011	2012	2013	2014	2015	2016	2017	2018
DWG	Snowy Grouper	161,175	90,180	132,971	168,759	108,689	159,857	108,980	94,830	87,587	89,416
	Speckled hind	47,913	15,359	24,925	43,344	34,922	72,241	55,550	41,151	51,061	60,618
	Warsaw grouper	74,476	56,496	61,661	86,212	103,074	75,426	55,502	44,635	44,362	35,976
	Yellowedge grouper	792,055	443,887	558,908	667,785	673,349	773,621	735,218	709,349	677,926	677,310
GG	Gag	952,555	496,826	318,663	523,138	575,335	586,377	542,774	910,996	492,095	492,934
RG	Red grouper	3,910,083	2,910,970	4,783,668	5,219,133	4,599,001	5,601,905	4,797,159	4,497,582	3,328,271	2,363,280
SWG	Black grouper	156,778	20,905	34,970	47,537	56,750	60,555	54,831	48,788	37,032	34,806
	Scamp	266,193	153,533	149,286	249,320	242,170	167,840	182,108	284,987	162,435	142,787
	Yellowfin grouper	10,122	1,394	945	739	856	568	442	709	152	440
	Yellowmouth grouper	466	85	548	506	959	1,285	1,046	754	390	260
TF	Blueline tilefish	123,072	22,555	44,841	82,025	49,454	74,221	53,681	47,898	61,808	66,936
	Golden tilefish	352,080	209,641	341,260	366,763	383,132	442,992	483,779	380,125	423,054	318,133
	Goldface tilefish[2]	NA	16,559	33	2,333	7,505	55	35	212	33	1,069

[1] Pre-IFQ data were averaged over 3 years: 2007-2009. Data from the SEFSC Coastal Logbook records are as of 5/7/2019 and therefore may not contain the complete 2018 data.

[2] Goldface tilefish were grouped with unclassified tilefish prior to the start of the GT-IFQ program.

[3] Pounds are by species and not the share category the species of landing.

Between 2012 and 2014, the only multi-use category was GGM (Table 7.1.3). In the GGM category, gag accounted for the majority of the landings (65-99%). Since 2015, both RGM and GGM categories were available for multi-use. In 2015, RGM was most commonly used to land red grouper, while GGM were most commonly used to land gag. Since 2016, gag have been landed most often using both multi-use categories.

Table 7.1.3. Multi-use landings.

Year	RGM		GGM	
	Red Grouper	**Gag**	**Red Grouper**	**Gag**
2010	73% (13,833 lbs)	27% (5,091 lbs)	28% (2,203 lbs)	72% (5,654 lbs)
2011	NA	NA	14% (1,474 lbs)	86% (8,700 lbs)
2012	NA	NA	6% (1,928 lbs)	94% (32,230 lbs)
2013	NA	NA	1% (4,329 lbs)	99% (376,528 lbs)
2014	NA	NA	35% (103,151 lbs)	65% (188,950 lbs)
2015	82% (98,466 lbs)	18% (20,998 lbs)	26% (33,165 lbs)	74% (92,661 lbs)
2016	8% (11,441 lbs)	92% (135,471 lbs)	1% (1,665 lbs)	99% (220,088 lbs)
2017	11% (6,145 lbs)	89% (51,137 lbs)	2% (2,198 lbs)	98% (116,163 lbs)
2018	4% (1,656 lbs)	96% (41,364 lbs)	0.3% (344 lbs)	99.7% (114,984 lbs)

Any remaining allocation in an account expires on December 31. In the GT-IFQ program, between 70% and 90% of the accounts had at least one pound of GT-IFQ allocation remaining (Table 7.1.4). Within share categories, the percentage of accounts with remaining allocation was highest in SWG, followed by RG and GG, with more than 50% of the accounts having remaining allocation. DWG typically has the lowest allocation remaining, with 20% or less seen throughout the program. Remaining allocation increased particularly in 2017 in the GT-IFQ program, which was likely a result of the quota increase for RG as well as the strong hurricane season that took place in the Gulf that year. Of the accounts with remaining GT-IFQ allocation, 60% of those accounts were active (landed or transferred allocation), and these accounts contained the majority of the remaining allocation. Accounts that were deemed inactive (did not land or transfer allocation) held the rest of the remaining allocation. In contrast, the number of accounts with remaining RS-IFQ allocation, and the proportion of the quota that expired each year, has generally declined since 2012. Roughly 30% of the accounts had unused RS-IFQ allocation that represented less than 1% of the total quota. This decrease in remaining RS-IFQ allocation occurred in both active and inactive accounts.

Table 7.1.4. Remaining allocation in IFQ shareholder accounts.

DWG	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	395,615	390	39	64,601	169
2011	240,703	283	24	15,731	140
2012	163,126	235	14	11,177	103
2013	205,088	253	18	14,192	115
2014	62,405	195	6	5,406	103

GG	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	916,034	706	65	114,277	257
2011	109,780	531	26	17,991	259
2012	41,981	425	7	11,808	221
2013	128,169	467	18	21,471	217
2014	145,486	418	17	17,536	196

2015	189,347	238	17	8,411	109
2016	156,744	228	15	11,209	107
2017	202,191	250	20	24,698	131
2018	206,622	264	20	44,402	139

2015	384,151	519	41	51,875	232
2016	162,234	463	17	37,993	220
2017	495,728	556	53	72,492	250
2018	487,166	573	52	100,678	262

RG	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	2,835,405	666	49	343,665	235
2011	448,926	501	9	64,216	184
2012	152,249	356	3	38,159	167
2013	935,526	441	17	62,605	171
2014	132,651	317	2	46,907	153
2015	935,240	478	16	58,501	190
2016	3,148,565	582	40	194,289	191
2017	4,403,288	571	57	463,690	221
2018	5,376,103	607	69	681,565	242

SWG	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	251,503	630	61	33,961	277
2011	223,743	513	55	22,514	261
2012	208,450	441	41	22,711	220
2013	210,129	493	41	20,999	233
2014	259,689	461	50	20,948	208
2015	242,619	499	46	26,732	223
2016	166,837	476	32	25,570	212
2017	285,942	538	54	50,372	243
2018	405,047	600	77	75,174	274

TF	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	190,857	219	43	59,798	101
2011	53,920	142	12	5,343	77
2012	130,903	130	22	5,951	59
2013	141,968	148	24	11,614	70
2014	64,855	113	11	2,380	54
2015	44,613	122	8	4,410	64
2016	153,031	121	26	14,684	61
2017	97,149	133	17	10,317	76
2018	195,955	157	34	43,906	82

GT-IFQ	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2010	4,589,414	750	51	453,584	245
2011	1,077,088	667	14	96,463	260
2012	696,709	596	9	75,785	254
2013	1,620,880	608	19	110,513	244
2014	665,086	561	8	85,800	232
2015	1,795,970	635	20	109,014	251
2016	3,787,411	692	35	238,076	251
2017	5,484,298	695	51	529,912	276
2018	6,566,771	723	61	861,310	298

RS	Lbs	Accts	% Quota	Inactive lbs	Inactive Accts
2007	122,311	327	4	78,543	173
2008	59,515	292	3	50,338	168
2009	61,318	242	3	41,680	137
2010	133,104	306	4	53,151	122
2011	65,406	236	2	50,743	102
2012	75,626	216	2	55,274	94
2013	148,767	257	3	79,810	96
2014	37,223	178	0.7	27,981	74
2015	97,625	267	1.5	37,794	77
2016	39,447	194	0.6	14,717	67
2017	27,733	220	0.5	11,803	58

2018	25,681	193	0.4	11,857	64

7.2 Discards

These analyses focus on discards from 2012 through 2018 since the initial reviews compared discards before and after each respective IFQ program's implementation. Prior to implementation of each respective program, discards were primarily due to size limits, trip limits, and seasonal closures. Six species in the programs currently have minimum size limits: gag, red grouper, black grouper, scamp, yellowfin grouper, and red snapper. After the implementation of each respective program, trip limits and seasonal closures were eliminated except for the restriction of longline gear inside the 35-fathom contour from June through August in the eastern Gulf. However, fishers are now constrained by the allocation they possess. Fishers without sufficient amounts of allocation must either discard IFQ species when the allocation in their account is exhausted, or obtain additional allocation from other allocation holders to continue to harvest that IFQ species. The GT-IFQ program's built-in multi-use provisions and flexibility measures were intended to reduce discards. Despite these measures, discards may still occur due to minimum size limits, high-grading for a species, or grading among a species group (share category). High-grading refers to selective harvesting by fishers for a species usually influenced by price differences based on fish size, i.e., increased discards of less valuable fish sizes. Grading within a species group is often due to price differentials between species in multi-species GT-IFQ categories, i.e., retaining more valuable species and discarding less valuable ones. Data from recent stock assessments through the Southeast Data Assessment and Review (SEDAR) process, the Southeast Fisheries Science Center's (SEFSC) Reef Fish Observer Program (RFOP), and the Supplemental Discard Logbook (self-reported discard information) were used to evaluate discards associated with the GT-IFQ and RS-IFQ programs.

Only recent assessments since the previous reviews were included to minimize redundant information. The mandatory RFOP began in mid-2006, and the data for these analyses included longline (LL) and vertical line (VL) gear (primarily handlines and bandit reels, but also includes buoy and spearfishing effort). For the RFOP, vessels were randomly selected quarterly each year to carry an observer (NMFS 2016). Sampling effort was stratified by quarter and gear in the eastern and western Gulf based on annually updated vessel logbook data (Scott-Denton et al., 2011). Beginning in February 2009, increased observer coverage levels were directed at the bottom longline fishery in the eastern Gulf due to concerns regarding sea turtle interactions. Additionally, in 2011, increased funding allowed enhanced coverage of both the vertical line and bottom longline fisheries through 2014. RFOP observer coverage levels were not consistent throughout the years (< 1 to ~5% by sea day). Despite these variations in coverage levels, RFOP data (accessed May 2019) are the best data available representative of the fishery. The Supplemental Discard Logbook database (accessed May 2019) contains self-reported discard reports from a 20% sub-sample (by region and gear fished) of all commercial vessels with federal fishing permits (SEFSC 2016).

7.2.1 Grouper-Tilefish IFQ Program

Discard estimates for red grouper from SEDAR 61 (2019) were available from 1993 through 2017 (Table 7.2.1.1). SEDAR 61 was the first assessment to use a new methodology to estimate discards. Previously, commercial red grouper discards for vertical line and longline gears were calculated based on observed discard and kept rates from the NMFS Observer Program database. The estimated commercial discards received considerable attention as they were substantially higher than previous assessments, but were maintained at the time due to anecdotal information supporting high numbers of discards. In SEDAR 61 the same general approach for estimating discards was used utilizing catch per unit effort (CPUE) from the coastal observer program and total fishing effort from the commercial reef logbook program to estimate total catch. The main difference in SEDAR 61 was identifying an unbiased effort variable. Logbook effort metrics were recorded at the trip level, whereas observer effort metrics were recorded at a finer scale (usually individual 'sets' within a trip). A suite of effort metrics recorded on commercial logbooks and collected by onboard observers were evaluated to identify unbiased and consistent effort variables between the two programs for carrying out the catch expansion. For vertical line, the trip fishing time ("fishing day") was found to be unbiased and selected as the most appropriate effort variable for logbook and observer data, and was computed as the cumulative daily fishing time from first hook in to last hook out (including active fishing and transit time). For longline, the number of sets per trip was found to be unbiased and selected as the most appropriate effort variable for logbook and observer data.

Table 7.2.1.1. Red grouper commercial discards (number of red grouper) by gear from 1993-2017. Shading in gray denotes years prior to the GT-IFQ program.

Year	Vertical Line	Longline	Total
1993	79,662	514,033	593,695
1994	94,368	668,159	762,527
1995	49,123	302,219	351,342
1996	112,944	667,938	780,882
1997	132,132	878,497	1,010,629
1998	127,683	718,051	845,734
1999	140,955	754,469	895,424
2000	142,683	633,778	776,461
2001	146,668	652,257	798,925
2002	151,052	579,902	730,954
2003	158,908	596,105	755,013
2004	151,788	567,853	719,641
2005	133,793	440,858	574,651
2006	146,203	506,568	652,771
2007	150,881	405,702	556,583
2008	127,661	480,530	608,191
2009	219,006	153,431	372,437
2010	198,729	177,525	376,254
2011	290,423	346,979	637,402
2012	178,703	402,936	581,639

Year	Vertical Line	Longline	Total
2013	96,399	209,867	306,266
2014	59,449	324,659	384,108
2015	86,568	195,727	282,295
2016	96,899	242,272	339,171
2017	71,658	216,046	287,704

Source: SEDAR 61 (2019).

Estimated red grouper discards annually for both gears from 2012 through 2017 were some of the lowest of the time series (Table 7.2.1.1). The number of discards dropped substantially beginning in 2013 with vertical line discards estimated under 100,000 fish through 2017. The lowest total number of discards in the entire time series was recorded in 2015. Some of the reduction in estimated discards from 2012 through 2017 is likely due to the reduction in the commercial minimum size limit from 20 to 18 inches total length (TL) in May 2009. The RFOP had red grouper as the most common IFQ species observed with a relatively high percentage (35%) of discards occurring compared to other IFQ species (Table 7.2.1.2). Data from the RFOP was used to calculate the discard ratio (number discarded: one landed) stratified by year and gear (Table 7.2.1.3). A larger value indicates that more fish are being discarded, however, a value less than one indicates more fish are being harvested than discarded. The RFOP discard ratios are less than one fish being discarded for each fish being retained for almost all the time series, except in 2017 for longline and 2018 for both gears.

Table 7.2.1.2. The number of captures and percentage for each disposition observed by the RFOP from 2012-2018 for IFQ species.

Species or Complex	Number Observed	Kept	Discarded	Unknown
Red Grouper	283,879	64.9%	35.1%	0.0%
Gag Grouper	14,570	79.8%	20.2%	0.0%
Shallow-water Grouper				
Scamp	11,344	94.5%	5.5%	0.0%
Black Grouper	298	87.6%	12.4%	0.0%
Yellowmouth Grouper	83	91.6%	8.4%	0.0%
Yellowfin Grouper	11	90.9%	9.1%	0.0%
Deep-water Grouper				
Yellowedge Grouper	19,672	98.7%	1.3%	0.0%
Snowy Grouper	3,268	98.7%	1.3%	0.0%
Speckled Hind	1,205	88.0%	12.0%	0.0%
Warsaw Grouper	205	100%	0.0%	0.0%
Tilefish				
Golden Tilefish	20,701	81.3%	18.7%	0.0%
Blueline Tilefish	6,256	56.6%	43.4%	0.0%
Goldface Tilefish	104	39.4%	60.6%	0.0%
Red Snapper	154,319	82.7%	17.0%	0.3%

Source: SEFSC RFOP (2019).

Table 7.2.1.3. The discard ratio (number discarded: one landed) for red grouper, gag grouper, and red snapper for vertical line (VL) and longline (LL) gear by year.

Red Grouper	VL	LL
2012	0.44	0.88
2013	0.42	0.50
2014	0.25	0.55
2015	0.41	0.52
2016	0.54	0.51
2017	0.57	1.11
2018	1.29	1.19
2012-18 Average	**0.56**	**0.75**

Gag Grouper	VL	LL
2012	0.47	0.44
2013	0.23	0.52
2014	0.15	0.05
2015	0.16	0.01
2016	0.17	0.04
2017	0.19	0.04
2018	0.34	0.01
2012-18 Average	**0.24**	**0.16**

Red Snapper	VL	LL
2012	0.28	3.62
2013	0.13	1.89
2014	0.10	1.21
2015	0.10	0.62
2016	0.12	0.70
2017	0.21	1.01
2018	0.14	0.45
2012-18 Average	**0.14**	**1.36**

Source: SEFSC RFOP (2019).

In addition to the number of self-reported discards per trip, the discard logbook attempts to quantify the reason why discarding occurs using four categories: 1) not legal size, 2) other regulation, 3) market conditions, and 4) out of season. For IFQ species other regulation could refer to lack of allocation. Using these categories, the discard logbook reported 97% of the self-reported discards of red grouper were due to the minimum size limit from 2012-2018 (Table 7.2.1.4). Length data collected by the RFOP supports that the current minimum size limit is the principal reason discards were occurring from 2012-2018, although a small amount of discarding may have occurred due to lack of allocation (Figure 7.2.1.1).

Table 7.2.1.4. The number of discards and percentage for each discard reason out of the total number of each species reported to the Supplemental Discard Logbook from 2012-2018 for IFQ species.

Species or Complex	Number Reported	Not Legal Size	Other Regulations	Market Conditions	Out of Season
Red Grouper	344,400	97.0%	2.7%	0.2%	0.1%
Gag Grouper	22,914	54.3%	44.2%	0.8%	0.7%
Shallow-water Grouper					
Scamp	2,084	89.2%	9.5%	0.8%	0.5%
Black Grouper	1,093	46.4%	52.1%	0.1%	1.5%
Deep-water Grouper					
Yellowedge Grouper	606	53.3%	35.8%	10.9%	0.0%
Snowy Grouper	124	68.5%	12.1%	19.4%	0.0%
Speckled Hind	41	4.9%	95.1%	0.0%	0.0%
Warsaw Grouper	10	50.0%	30.0%	20.0%	0.0%
Tilefish					
Golden Tilefish	1,496	52.1%	22.3%	25.5%	0.0%
Blueline Tilefish	3,250	1.5%	30.2%	68.3%	0.0%
Red Snapper	288,601	28.7%	60.8%	9.3%	1.3%

Source: SEFSC Supplemental Discard Logbook (2019).

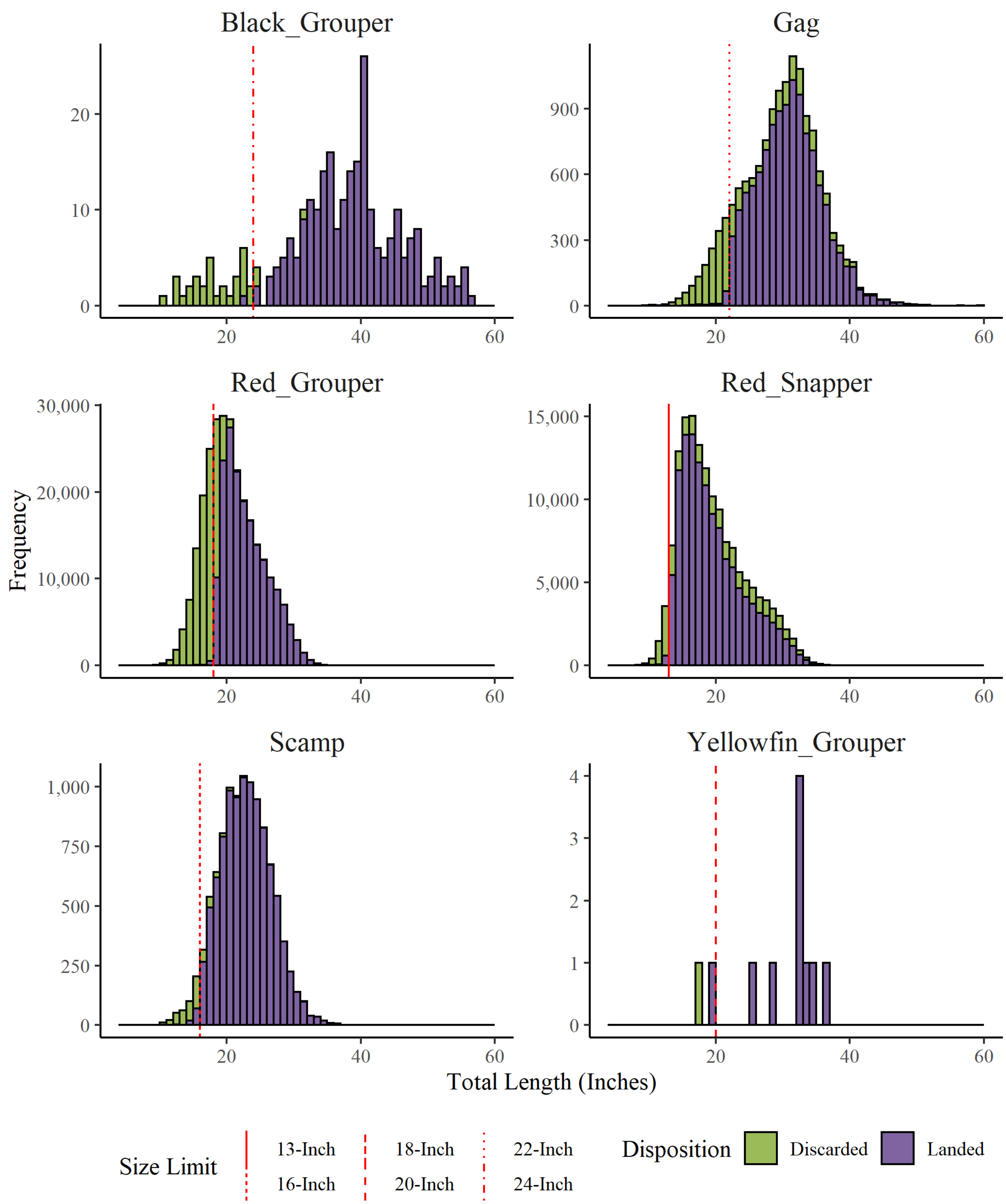

Figure 7.2.1.1. Size frequency distribution for IFQ species that have a minimum size limit with the size limit denoted by a red line.
Source: SEFSC RFOP (2019).

No updated assessment information was available for updating estimated total GT-IFQ discards for other species since the last review. Only discard information from the RFOP and Supplemental Discard Logbook datasets were used to examine trends from 2012-2018. The RFOP had gag grouper with a relatively moderate percentage (20%) of discards occurring compared to other IFQ species (Table 7.2.1.2). The RFOP gag grouper discard ratios have less than one fish being discarded for each fish being retained for the entire time series (Table 7.2.1.3). The discard ratios were highest in 2012 and have generally decreased since then. The higher discard ratios in 2012 were likely due to a substantial decrease in the quota from 1,410,000 lbs in 2010 to 430,000 lbs in 2011. Following 2011, the gag grouper quota was increased annually back up to 835,000 lbs in 2014. In March 2012, the minimum size limit was reduced from 24 inches TL to 22 inches TL to reduce discard mortality. The minimum size limit for gag was then raised back to 24 inches TL in July 2018 to be consistent with other sector's regulations and improve the abundance of the spawning stock. Based on RFOP length and discard disposition data, the size limit is likely a major reason discards are occurring (Figure 7.2.1.1). A small number of discards above the size limit were still occurring from 2012-2018 and based on the previous review is likely due to lack of allocation (GMFMC 2018). From 2012-2018, the discard logbook recorded 54% of discards were due to the minimum size limit, but other regulations were selected 44% of the time as discard reason (Table 7.2.1.4). It is likely the other regulation selected in the discard logbook refers to limited allocation available to fishers, especially during years with reduced quotas.

Three of the shallow-water groupers have a minimum size limit. From 2012 through 2018, the minimum size limit for black grouper was 24 inches TL, scamp had a 16-inch TL minimum size limit, and yellowfin grouper had a 20-inch TL minimum size limit. According to the RFOP data from 2012-2018, greater than 90% of three of the four shallow-water grouper species were kept (Table 7.2.1.2). Only black grouper had greater than 10% of captures discarded (12.4%), but black grouper also had a relatively small number (298) of observations. No yellowmouth or yellowfin groupers were reported discarded by commercial fishers from 2012-2018 (Table 7.2.1.4). Commercial fishers cited the minimum size limit as the dominant reason for scamp discards (Table 7.2.1.4). Both the minimum size limit and other regulations were the most common reasons discarding occurs for black grouper from 2012-2018 (Table 7.2.1.4). It is unknown if the other regulation refers to limited allocation available. Allocation limitations may not be likely since at most 68% of the shallow-water grouper quota was harvested annually from 2012-2018, and in many years, greater than half of the quota remained uncaught (SERO 2019). Therefore, allocation should have been available to fishers. If the species were discarded due to lack of allocation, the discarding could be due to multiple reasons such as a lack of knowledge on how to contact participants with allocation available, a lack of knowledge of the allocation price, or they did not intend to capture the species. On a per trip basis, fishers may have done an internal cost-benefit analysis and determined it wasn't worth their time to figure out the details if they hadn't planned on catching these species and the catches were relatively small. The discarding was likely not due to the cost of allocation alone, which was on average less than $1.00 per pound since 2012 while ex-vessel prices were typically around $5.00 per pound, thus still profitable (SERO 2019). Length data collected by the RFOP supports that the minimum size limit is likely the principal reason discards were occurring from 2012-2018 for scamp and black grouper, although some discarding may have occurred due to lack of allocation (Figure 7.2.1.1).

According to RFOP data, very little discarding of yellowedge, snowy, and warsaw grouper occurred from 2012-2018 with more than 98% of captures retained (Table 7.2.1.2). Fishery observers did record a higher percentage (12%) of speckled hind being discarded. There is currently no commercial minimum size limit for any of the deep-water grouper species. But from 2012-2018, fishers self-reported the minimum size limit as the reason why 68% and 53% of the snowy and yellowedge grouper were discarded, respectively (Table 7.2.1.4). Fishers reported other regulations as the dominant reason (95%) speckled hind were discarded from 2012-2018 (Table 7.2.1.4). It is unknown if the other regulation refers to limited allocation available for speckled hind. Speckled hind may be landed under shallow-water or deep-water IFQ allocation and such flexibility should reduce discards of that species. Investigations by Pulver and Stephen (2019) revealed that size selection (high grading) was occurring for speckled hind. The study revealed fishers were choosing to only retain larger sized fish due to price differentials causing the increased discards of smaller speckled hind.

RFOP data recorded almost 19% of the observed golden tilefish and over 43% of blueline tilefish as discarded from 2012-2018 (Table 7.2.1.2). There is currently no commercial minimum size limit for golden tilefish, but fishers self-reported the minimum size limit as the most common discard reason (52%) followed by market conditions from 2012-2018 (Table 7.2.1.4). Length data collected by the RFOP confirms smaller fish were discarded at a higher rate with over 33% of golden tilefish under 24 inches TL being discarded (Figure 7.2.1.2). Price data collected from 2012-2016 for golden tilefish in the mid-Atlantic revealed higher prices for larger size categories (MAFMC 2017). The small category for golden tilefish averaged $2.77 per pound compared to $4.23 per pound for the large category. Similar dynamics may be present in the Gulf causing the increased discards of smaller golden tilefish due to price differentials, but price information by size is not available. For blueline tilefish, other factors may be influencing discarding since fishers self-reported market conditions as the discard reason 68% of the time from 2012-2018 (Table 7.2.1.4). Additionally, no pattern was present in the size frequency distribution of discards observed by the RFOP for blueline tilefish indicating little size selection of discards was occurring. Anecdotal evidence from fishers suggests multi-species quota discarding may be occurring since the ex-vessel price for golden tilefish is nearly twice the price for blueline tilefish for most of the period from 2012-2018 (SERO 2019). Thus, fishers are choosing to use their allocation on the higher valued tilefish species in the same GT-IFQ category.

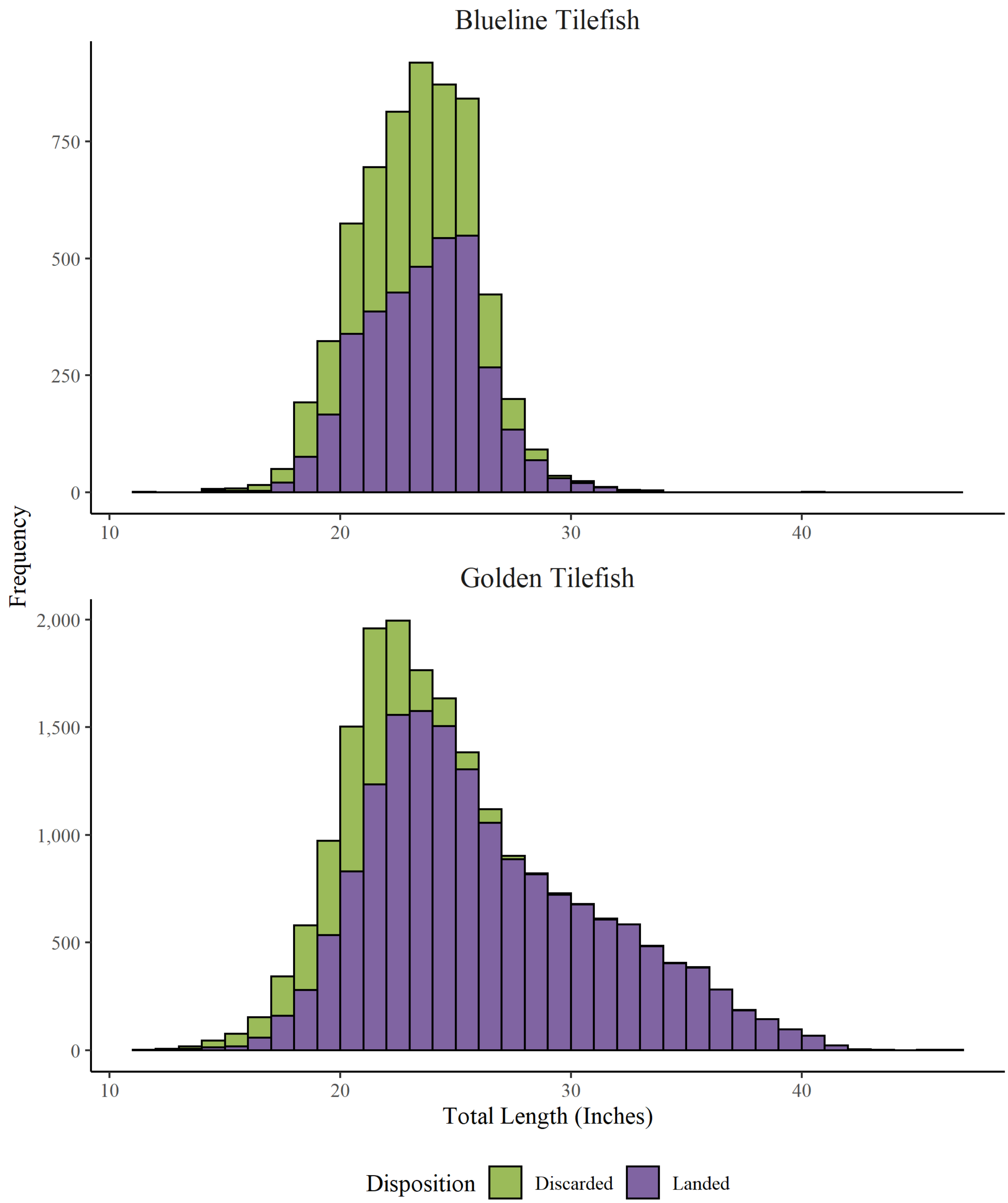

Figure 7.2.1.2. Size frequency distribution for blueline and golden tilefish with disposition. Gears were combined since the majority (>97%) were captured on longline gear.
Source: SEFSC RFOP (2019).

7.2.2 Red Snapper IFQ Program

Commercial discard estimates for red snapper from SEDAR 52 (2018) were available, but consultation with the SEFSC suggested estimates presented with the improved methodology from SEDAR 61 (2019) at the January 2020 Gulf Council meeting to be more appropriate. The updated commercial red snapper discards from 2007 through 2018 are summarized by year, gear, and the spatial region (eastern and western Gulf of Mexico) in Table 7.2.2.1. Annual discard estimates for both gears and spatial regions fluctuated considerably, but the overall trend since the RS-IFQ program began in 2007 is flat. Vertical line discards in the eastern Gulf were fairly low from 2012 through 2015, but increased in 2016 and 2017. A similar trend is present with the eastern Gulf longline fishery with increased discards beginning in 2016. On January 1, 2012, the RS-IFQ program opened to the general public allowing any U.S. citizen or permanent resident alien to establish an RS-IFQ account to transfer shares and allocation. Public participation was expected to reduce discards as fishers could now obtain allocation and reduce bycatch.

Table 7.2.2.1. Red snapper commercial discards (number of red snapper) by gear from and spatial strata from 2007-2018.

Year	Vertical Line		Longline	
	East	West	East	West
2007	151,768	48,004	7,141	7,188
2008	76,902	75,168	2,648	2,395
2009	118,990	60,911	3,191	257
2010	53,861	91,500	5,598	415
2011	100,144	96,270	8,601	139
2012	77,814	46,676	9,322	542
2013	60,604	79,306	7,533	1,866
2014	88,595	32,631	5,222	2,223
2015	50,795	69,839	8,871	2,152
2016	118,071	26,451	10,082	1,920
2017	138,396	22,594	5,425	2,740
2018	81,931	95,587	18,375	2,749

Source: GMFMC (2020).

RFOP data recorded 17% of the observed red snapper as discarded from 2012-2018, which is a relatively low percentage among all IFQ species (Table 7.2.1.2). Additionally, the discard ratio for red snapper captured on vertical line gear is lower than red and gag grouper for most years (Table 7.2.1.3). However, red snapper captured on longline gear had higher discard ratios compared to red and gag grouper for most years (Table 7.2.1.3). The general trend of red snapper discards ratios from 2012 through 2018 is a decrease, especially for longline gear (Table 7.2.1.3). In the discard logbook, fisher's indicated other regulations as the most common discard reason (61%), followed by the minimum size limit (29%) (Table 7.2.1.4). An examination of the RFOP length frequency from 2012-2018 revealed red snapper of all sizes being discarded (Figure 7.2.1.1). The current red snapper minimum size limit of 13 inches TL has been in place since 2007. It is likely the other regulation selected in the discard logbook refers to limited allocation available to fishers and may apply more to fishers in the eastern Gulf and vessels using longline gear.

7.2.3 Discard Mortality

The reported discard mortality estimates for IFQ species ranges from very low (<10%) to as high as 100% (Campbell et al. 2014; Overton et al. 2008; Pulver 2017; Rudershausen et al. 2007; Sauls 2014; Stephen and Harris 2010; Wilson and Burns 1996). Discard mortality estimates can be affected by a number of different stressors, such as hooking trauma, barotrauma, handling time, and temperature (Campbell et al. 2014; Curtis et al. 2015; Jarvis and Lowe 2008). A variety of tools are available to help increase survival of released reef fish, including venting tools, which release the gasses from the fish's abdominal cavity, and descender devices, which lower the fish to a depth at which the effects of barotrauma are reduced and the fish can swim away. At the beginning of 2008, fishers were required to use a venting tool on swim bladders for released reef fish captures to reduce the effects of barotrauma; however, the venting requirement was rescinded in 2013 due to questions regarding its effectiveness (GMFMC 2013). Recently, the Council held a release mortality symposium in October 2019 with the objectives of creating a roadmap plan to promote the use of barotrauma mitigation tools, data collection efforts for discard mortality by fleet and species, and incorporate the results into stock assessments and management.

IFQ species with information available for discard mortality estimates recommended in the most recent assessment are summarized in Table 7.2.3.1. The deep-water species that have been assessed had a recommended discard mortality estimate of 100%, except for blueline tilefish captured using longline gear that had an estimate of 95%. For red grouper, discard mortality estimates were recommended in SEDAR 61 (2019) by gear using data through 2017. The commercial vertical line recommendation was based on research by the Florida Fish and Wildlife Conservation Commission using mark-recapture data to model relative survival in the recreational charter fishery with the methods described by Sauls (2014). A discard mortality point estimate of 19% was estimated using the model's predicted rate for depths that the commercial VL fishery operates. The value assumes fishing methods and handling procedures between the recreational hook-and-line and commercial vertical fisheries are similar.
For the commercial longline fishery, data from the RFOP was used to estimate discard mortality. The RFOP currently determines immediate discard mortality through surface observations of individual fish after discard. For the discarded fish, the alive or dead determination was based on surface observation of individual fish. Some fish were recorded with an unknown discarded disposition due to the difficulty in observing discards attributed to poor lighting, high seas, or other factors. Short-term survival was assumed if the fish was able to descend, either rapidly or slowly, and immediate mortality was classified when the fish floated on the surface or floated on the surface then slowly descended (not swimming). Individual fish recorded as dead upon arrival were included in the analyses since the goal was to examine total discard mortality. The immediate mortality percentage was determined using the number discarded dead out of those released as either alive or dead. The panel recommended a LL point estimate of 44% for the IFQ period using the assumption that 100% of floaters suffered immediate mortality and 20% latent mortality for discards that re-submerge.

Similar to red grouper vertical line gear, the gag grouper discard mortality was estimated at 27% in SEDAR 33 (2014) using the depth mortality function from Sauls (2014). For Gulf red snapper, a meta-analysis was used in SEDAR 52 (2018) to model depth-dependent discard mortality rates (Campbell et al. 2014). Data used in the meta-analysis were compiled from 11 studies that produced 70 distinct estimates (some studies produced estimates for multiple fishing depths and/or seasons). Separate discard mortality relationships were developed for each sector (i.e., commercial and recreational) and for vented and unvented fish. The results from the meta-analysis model were used to select appropriate discard mortality rates for each fishery, based on the average depth fished, over different time periods. An average seasonal effect was assumed in the relationships. For the commercial sector, average depths at which discards occurred for each gear (vertical line or longline), region (eastern or western Gulf), and season (open or closed) were calculated using commercial observer program data. Consistent with how commercial discards have been treated in other parts of the assessment, discards from trips with IFQ allocation were considered open season discards, while discards from trips with no IFQ allocation were considered equivalent to closed season discards. The red snapper discards mortality estimates were higher for longline compared to vertical line gear and in the western Gulf compared to the eastern Gulf.

Table 7.2.3.1. Commercial discard mortality (DM) estimates from the most recent stock assessment for IFQ species. Note: Red snapper estimates for the eastern and western Gulf of Mexico assume venting and an open season.

IFQ Species	Gear	DM	Source
Red Grouper	Longline	44%	SEDAR 61 (2019)
Red Grouper	Vertical Line	19%	SEDAR 61 (2019)
Gag	Combined	27%	SEDAR 33 (2014)
Speckled Hind	Combined	100%	SEDAR 49 (2016)
Yellowedge Grouper	Combined	100%	SEDAR 22 (2011)
Snowy Grouper	Combined	100%	SEDAR 49 (2016)
Blueline Tilefish	Longline	95%	SEDAR 50 (2017)
Golden Tilefish	Vertical Line	100%	SEDAR 22 (2011)
Red Snapper	Longline (East)	64%	SEDAR 52 (2018)
Red Snapper	Longline (West)	81%	SEDAR 52 (2018)
Red Snapper	Vertical Line (East)	56%	SEDAR 52 (2018)
Red Snapper	Vertical Line (West)	60%	SEDAR 52 (2018)

Using RFOP data from 2012-2018, the immediate discard mortality estimate with 95% confidence intervals (Wilson score interval with continuity correction) for IFQ species were calculated (Table 7.2.3.2). The RFOP estimates presented here likely represent minimum discard mortality estimates since latent or delayed mortality is not included. Red grouper discarded in the longline fishery had an immediate mortality estimate of 29.7% that was nearly twice the vertical line mortality estimate of 13.8%. A study by Pulver (2017) using logistic regression to examine RFOP data found increasing depths, seasons associated with warmer water temperatures, external evidence of barotrauma, and increasing size were positively correlated with red grouper discard mortality. Although submergence ability as a proxy for mortality is problematic since it does not account for any long-term effects, similar studies have shown when other factors, such as hook trauma or barotrauma, are included, it can be used as a reasonably accurate method for inferring mortality rates (Patterson et al. 2002; Rudershausen et al. 2014).

Comparing RFOP discard mortality data, gag had lower immediate mortality for each gear than red grouper and for vertical line discards a very low mortality estimate (5%) was observed. Using tag-recapture to estimate long-term mortality for gag grouper, Sauls (2014) determined venting was associated with increased mortality, but noted the increased mortality may have been affected by other confounding factors besides venting. For example, Sauls (2014) reported vented gag groupers were typically both larger and caught at greater depths than non-vented fish. Other than venting additional factors; e.g., increased handling time, could have affected discard mortality. The RFOP recorded high discard mortality (>73%) for scamp captured with longline gear, but discard mortality was much lower (23%) for vertical line gear (Table 7.2.3.2). For the deep-water groupers and tilefish, the RFOP recorded immediate discard mortality of greater than 88% for both tilefish species and yellowedge grouper discarded in the longline fishery (Table 7.2.3.2). Red snapper had similar immediate mortality for each gear (Table 7.2.3.2). Red snapper vertical line discard mortality estimates are higher when compared to red and gag grouper discard mortality, likely due to the deeper capture depths of red snapper when compared to both those species.

Table 7.2.3.2. The immediate discard mortality (DM) estimate with 95% confidence interval (CI) and the number of observation (N) by gear for IFQ species with >100 observations from 2012-2018.

IFQ Species	Gear	DM	95% CI	N
Red Grouper	Longline	29.7%	29.4–30.0%	76,554
Red Grouper	Vertical Line	13.8%	13.4–14.3%	21,734
Gag	Longline	31.7%	28.8–34.7%	979
Gag	Vertical Line	5.0%	4.1–6.1%	1,952
Scamp	Longline	73.4%	66.2–79.7%	177
Scamp	Vertical Line	23.0%	19.2–27.2%	440
Yellowedge Grouper	Longline	94.3%	90.1–96.9%	212
Blueline Tilefish	Longline	88.7%	87.4–89.9%	2,562
Golden Tilefish	Longline	90.8%	89.8–91.7%	3,661
Red Snapper	Longline	27.3%	26.4–28.3%	8,448
Red Snapper	Vertical Line	24.6%	23.9–25.2%	17,409

Source: SEFSC RFOP (2019).

7.3 Conclusions

As expected following the establishment of an IFQ program, the GT-IFQ and RS-IFQ programs have been successful in providing year-round fishing opportunities to participating commercial fishermen. Closures have not been recorded post-IFQ; for all IFQ species included in the program, there is a 365-day season.

During the review period of 2012-2018, annual GT-IFQ landings across all share categories varied considerably, with landings typically at 80% and above of the respective quotas, with the exception of SWG which was consistently below 60%., and following 2017 for most share categories following a strong hurricane season in the Gulf and an increase to the RG quota by more than 2 mp gw.

In addition to the five share categories established by the GT-IFQ program, commercial fishermen can rely on GGM and RGM allocation to land GT-IFQ species. GGM and RGM convert a portion of the gag and red grouper quotas into multi-use allocation that can be used to land either gag or red grouper. Multi-use allocation was expected to add flexibility and contribute to reducing discards by balancing catch and quota ownership. Multi-use allocation may not have been used as intended due to a variety of factors. When a large percentage of the allocation is converted to multi-use, the majority of the multi-use allocation is used for the primary species (e.g., see 2013 when 70% of gag was converted to gag multi-use and 99% of gag multi-use was used to land gag). In addition, factors that affect how fishermen utilize multi-use allocation include the red grouper and gag quotas, catchability of each species, and the allocation and ex-vessel prices. There are built in systematic provisions that limit the ability of multi-use for the non-primary species. For example, in order to use gag multi-use allocation for red grouper landings, the associated shareholder account must be depleted of all red grouper and red grouper multi-use allocation. In 2018, the red grouper quota was nearly 7mp larger than the gag quota, red grouper landings were only 31% of the quota (2.4 mp gw), and the red grouper ex-vessel price was nearly $0.50 lower than the gag ex-vessel price. Consequently, accounts with low amounts of gag allocation may be more likely to use red grouper multi-use allocation to land gag. The multi-use provision should be re-evaluated in comparison to single species allocation, as well as the formula used to calculate the multi-use allocations.

The evaluation of the estimated number of discards by gear type suggests that the GT-IFQ and RS-IFQ program have successfully met their objectives with the RFOP discard ratios of less than one fish being discarded for each fish being retained for almost all the time series. Length data supports that the current minimum size limit is the principal reason discards were occurring from 2012-2018, although a small amount of discarding may have occurred due to lack of allocation.

CHAPTER 8. SAFETY AT SEA

Data from the government agencies such as the U.S. Coast Guards (USCG) and Bureau of Labor (BLS) have shown that commercial fishing is one of the most dangerous occupations in the U.S. There are various contributing factors, which are rather unique in commercial fishing such as harsh weather, long hours, laborious work, and dangerous work conditions. In the U.S., the 2018 death rate in the commercial fishing industry is significantly above the average fatal occupational injury rate: 77.4 deaths per 100,000 full-time equivalent (FTE) workers for fishers and related fishing workers as compared to the national average of 3.5 per 100,000 FTE. The rate of fatal occupational injury in commercial fishery is only second to logging at 97.6 per 100,000 per FTE in 2018 (BLS 2018).

Several legislative USCG changes are likely to have affected the level of occupational injuries in fisheries. The Commercial Fishing Industry Vessel Safety Act of 1988 was the first legislation specifically dealing with commercial fishing vessel safety. Later, enforcement of the 1991 Commercial Fishing Industry Vessel Regulations is believed to have reduced the rate of casualties. Then, a USCG regulatory change known as the Coast Guard Authorization Act of 2010 imposed stronger regulations requiring training of commercial fishing vessel operators as well as design, construction, and maintenance standards for new vessels. The USCG has used several strategies to mitigate safety risks in commercial fishing, including training, vessel structural considerations, operational factors, and equipment issues.

Reviews of the red snapper (RS) and grouper-tilefish individual fishing quota (GT-IFQ) programs concluded that the Gulf of Mexico (Gulf) IFQ programs promoted efficiency and successfully ended fishing derbies, thereby reducing the rate of commercial fishing accidents and fatalities (Southeast Regional Office 2019a, 2019b). The underlying intuition is that when fishermen operate with personal quota allocations on one hand, and with significantly more time on the other, they do not need to rush out to sea, but rather can be selective and choose to fish during the most favorable weather and market conditions. In contrast to the common quota regime, fish not caught today can still be caught later during the year, making it less costly to postpone a trip when weather conditions are poor. Furthermore, the transferability of IFQ allocation may also have contributed to a lower rate of accidents, as operators of smaller vessels have been able to sell or transfer their allocation to operators of larger, but not necessarily safer, vessels. However, while larger vessels can withstand larger waves and stronger winds, they also tend to stay at sea for longer periods of time, not only increasing the likelihood of running into foul weather, but also inducing more fatigue among crewmembers.

Reductions in the rate of injuries and fatalities enhances fishermen's welfare. To assess the benefit of social regulation by government agencies in dealing with issues such as environmental and product safety, economists often use value of statistical life (VSL) and value of statistical injury (VSI) methods. While there are no studies of the value of statistical life or injury for reef-fish fisheries, findings from a study of shrimp fishery in the Gulf may shed light on important choices commercial fishermen often face in their occupation. When deciding whether to make a trip, commercial fishermen must evaluate expected benefits, namely revenues, and costs, which include the risk of fatality or injury. Variation in daily revenues and the risk of fatality or injury provide the opportunity to examine how individuals trade-off more money for greater physical risk. Marvasti (2020) applies a two-stage Heckman model to the captain's decision to fish and estimates the marginal rate of substitution between risk of fatality (injury) from commercial shrimp fishing and economic reward, which is used to estimate the value of statistical life and the value of statistical injuries. The author's analysis of the trade-offs between safety risk in the Gulf shrimp fishery and monetary rewards suggests that the upper-bound of the value of statistical life for fatality is \$6.14 million, compared with \$1.26 million for the value of statistical injuries, in 1982 dollars. Correcting for the sample selection bias, his estimated value of statistical life is \$1.86 million and value of statistical injury is \$0.36 million, in real terms. The result indicates that shrimp fishermen are not risk-lovers as some have argued. This study also concludes that the VSL and VSI estimates for the Vietnamese group are significantly lower than the rest of the population, which can be considered in policy evaluations. The source of this heterogeneity may reflect inadequate English proficiency skills among the Vietnamese population. As a result, one may extrapolate that certain ethnic populations, such as the Vietnamese, face different job market opportunities than the rest of the working population. On the other hand, if the risk valuation differentials are attributed to discrimination, it is considered a market failure and the risk differential valuations have no policy implications.

A few recent occupational studies have addressed safety in commercial fisheries in the Gulf, particularly focusing on the effect of IFQ programs. For example, Marvasti and Dakhlia (2017) use time series fatality injuries data from the Centers for Disease Controls in a Heckman two-step model to establish a link between a captain's decision to take a red snapper/grouper-tilefish commercial fishing trip and the likelihood of a fatal injury incident. The authors introduce a group of control variables capturing geographic, market, and regulatory-specific factors such as wind speed, unemployment rate, and quota levels, as well as price lag and vessel-specific factors. Marvasti and Dakhlia find that the probability of taking a trip after the introduction of the RS-IFQ program, all else the same, is approximately 0.06 lower than over the period prior to the introduction of the RS- IFQ program. This is consistent with the fact that the institution of the RS-IFQ and GT-IFQ programs led to a faster drop in the number of trips than in the number of registered vessels. The effect of introducing the GT-IFQ program is more significant (7.0 fatalities per 100,000 FTE) than the effect of introducing the RS-IFQ program, perhaps in part due to its overlap with the introduction of the Coast Guard Authorization Act of 2010, which imposed regulations requiring training of commercial fishing vessel operators as well as design, construction, and maintenance standards for new vessels. The coefficients of the interaction effects between weather conditions and the two IFQ programs have opposite signs, suggesting that after the introduction of the RS-IFQ program, the probability of taking a commercial fishing trip during poor weather fell, whereas after the introduction of the GT-IFQ program, the probability of taking a commercial fishing trip during poor weather rose. The authors argue that since the Gulf IFQ programs have allowed captains to make trip decisions without a seasonality constraint, they are expected to take fewer risks with respect to poor weather conditions. Their regression results show that the RS-IFQ program reduced the number of fatalities by 1.25 per 100,000 FTE. The authors also experiment with an alternative set of models, in which they separated the dataset used in the study into two groups: pre- and post-RS-IFQ program implementation. They then followed the same process to estimate the parameters for the trip decision and fatal injuries equations. An intriguing result from the trip decision equation is the response to poor weather conditions. Comparing the size of the coefficient across the models suggests that captains give more weight to wind speed in making their trip decision after the IFQ than they did before the IFQ. This implies that their attitude towards risk associated with poor weather conditions has changed. Also, in the sub-sample of injuries data after the IFQ program implementation, the role of poor weather conditions in causing fatal accidents is significantly reduced.

Another study of the effects of IFQ programs on safety of commercial fisheries in the Gulf, Marvasti (2018) applies the difference-in-difference approach to commercial fishery panel of fatal and non-fatal injuries data from the USCG. His cross-sectional variable is represented by the red snapper and grouper-tilefish fisheries as treatment groups and the shrimp fishery as the control group. The results suggest that, in most cases, there has been a widespread improvement in safety among the commercial fisheries of the Gulf during the study period. This study's most favourable results for safety improvements that can be linked to the IFQ programs come from estimates of the effect of the GT-IFQ program on non-fatal injuries. The limited effectiveness of the RS-IFQ program in improving safety in this study is due partly to the economies of scope stemming from the multispecies nature of the reef fish fishery in the Gulf. In the presence of economies of scope and interrelatedness of products produced by a firm, response to regulations is more complex and will be more effective when all products are subject to regulations. In other words, the addition of the GT-IFQ program in 2010 expanded the scope of the IFQ programs in the reef fish fisheries, enhancing their effectiveness in reducing occupational injuries. Other studies of the effectiveness of the IFQ programs in multi-species fisheries also point out that IFQ programs are more effective in influencing behavior (choices) such as level of effort, capacity, and timing of departure for trips, when they are imposed on all species targeted by a fleet (Clark et al. 1979; Squires and Kirkley 1996; Felthoven et al. 2009).

In another study, Marvasti (2019) examines the effect of several government regulations on the severity of commercial fishing injuries in the Gulf using two alternative dependent variables in the ordered-response model based on the treatment of missing persons in the USCG data. Treatment of the missing persons as dead is perhaps more appropriate than dropping these observations. Generally, the results from these alternative models are qualitatively similar. Using several control variables including vessel attributes, weather, and job market conditions in the model also provides an opportunity to consider the effect of other variables with potential policy implications. Estimates from ordered probit models find no statistically significant effect for the 2010 dummy variable, regardless of whether it represents the USCG regulatory change or the introduction of the GT-IFQ program by NMFS. However, the estimated coefficient for the fishery-specific observer program estimates suggests that having a NMFS observer on commercial fishing vessels in the Gulf appears to have reduced the severity of injuries during the study period. Since the NMFS observer programs require USCG certification and the USCG regulations regarding certifications are voluntary, the effectiveness of NMFS observer programs might also be attributed to the effectiveness of USCG certification process. The results also show that poor weather conditions are a critical factor contributing to the severity of injuries. Fatal injuries are significantly more likely when a crew member has fallen overboard. As expected, when the wind speed is high, the detrimental effect of overboard accidents is amplified. Marvasti also finds that when wind speed is high, vessels that are older, shorter, or made of steel are more likely to experience fatal injuries. However, it is not clear whether the higher rate of fatality among vessels made of steel is due to the operation of the vessel or the composition of the hull. There is also some evidence from this analysis that some vessel characteristics are likely to affect the severity of injuries independent of weather conditions. For example, injuries in older vessels tend to be less severe, though the relation between vessel age and the severity of injuries seems to be nonlinear. If vessel age is correlated with captain's years of experience, the results show a positive, though diminishing, effect of captain's experience in reducing the severity of injuries. The findings regarding the effects of safety-enhancing vessel attributes could potentially be used in the future design and build of new commercial fishing vessels.

Dakhlia and Marvasti (2020) focus on the impact of the IFQ-induced structural change on occupational safety. They argue that tradability of quota rights has led to some fleet consolidation, along with a shift to larger vessels, which may have also affected safety. To estimate the impact of changing fleet composition on safety, the authors simulated a counterfactual scenario, in which they ask what weather conditions fishermen would brave if quota privileges were not tradable and thus could not lead to market concentration. Using data from the reef-fish fishery in the Gulf to calibrate their model, the authors find that fleet consolidation would occur, with the most efficient vessel size categories', which are made of mid-size vessels, catching most of the quota. This consolidation would also contribute positively to safety: especially when operators internalize the crew's occupational risk and when the total allowable catch (TAC) is not excessively large (in which case industry concentration would be limited). On the one hand, the remaining active vessels are larger, and larger vessels are inherently more dangerous: They travel farther, so rescue efforts take longer; they acquire rights to a larger share of the TAC and therefore operate more often, which makes it more difficult to avoid adverse weather; and they take longer trips, which leads to crew fatigue. On the other hand, greater efficiency leads to a reduction in the fleet-wide number of fishing trips and thus less exposure to risk. Dakhlia and Marvasti find that the second effect dominates the first. Actual fleet data suggest, however, that while there has been a contraction in the total number of vessels that have pursued reef fish species after the introduction of IFQ regimes in 2007 and 2010, the composition by vessel size has so far not changed dramatically. While one can only speculate about the reasons behind the ineffectiveness of price signals to bring about a more complete fleet consolidation so far, the results from this study suggest that any additional future consolidation should help further reduce the high rate of fatal accidents.

8.1 Conclusions

As stated in the purpose and need for Reef Fish Amendment 29 (GMFMC 2009), which established the GT-IFQ program, the transition from a traditional command and control management approach to the establishment of an incentive-based management system such as the GT-IFQ and the RS-IFQ programs was expected to result in significant safety-at-sea improvements for commercial fishermen in the Gulf. A study conducted by Marvasti and Dakhlia (2017) suggests that the introduction of the RS-IFQ and GT-IFQ programs have afforded fishermen the flexibility to select more favorable weather conditions to schedule fishing trips. This study also indicates that the role of adverse weather conditions as a cause of fatalities was lessened following the implementation of IFQ programs in the Gulf. Overall, this study shows that while both IFQ programs have improved safety in the Gulf, the GT-IFQ program effect on reduction in fatalities rates has been much larger than the effect of the RS-IFQ program. However, the 2010 GT-IFQ program dummy variable captures the presence of both IFQ programs, which is consistent with the findings by Marvasti (2018). A follow up study by Marvasti (2017) using a different statistical method concludes that, because of the multi-species nature of the reef fish fishery in the Gulf, the addition of the GT-IFQ program has resulted in a significant decrease in the rate of non-fatal injuries. Also, since the Gulf IFQ programs allow fishermen to avoid taking trips under poor weather condition, evidence suggests that, not only has the rate of injuries been reduced, but also the severity of injuries has diminished (Marvasti 2019).

The safety enhancing effects found in these studies are consistent with survey responses provided by captains and crewmembers, where it is concluded that the GT-IFQ program has successfully met its objectives relative to improving the safety-at sea of participating commercial fishermen (Southeast Regional Office 2018).

CHAPTER 9. NEW ENTRANTS

Since 1990, the Gulf of Mexico Fishery Management Council (Council) has required vessels to have a federal commercial permit for reef fish to harvest commercial quantities of any species managed under the reef fish fishery management plan (Amendment 1; GMFMC 1989). A moratorium on the issuance of new commercial reef fish permits was initially implemented in 1992 (Amendment 4) and subsequently extended in 1994 (Amendment 9), 1996 (Amendment 11), and in 2000 (Amendment 17). The Council then established an indefinite limited access system for commercial reef fish permits in 2005 (Amendment 24; GMFMC 2005). Existing permits may be transferred to another vessel, but there are no new permits available. This means that the number of commercial vessels targeting reef fish cannot be increased.

The red snapper individual fishing quota program (RS-IFQ) was established January 1, 2007, and required a vessel to have IFQ annual allocation in addition to a valid commercial reef fish permit to harvest red snapper. Initial shares were distributed to permit holders based on historical landings. The universe of potential initial participants in the RS-IFQ program, as measured by the number of Class 1 and Class 2 licenses, included 136 Class 1 and 480 Class 2 licenses (GMFMC 2006). Because some entities owned multiple licenses, 554 initial accounts were established at the inception of the RS-IFQ program, representing 554 vessels.

The grouper-tilefish individual fishing quota (GT-IFQ) program was established January 1, 2010, and like the RS-IFQ program, required a vessel to have IFQ annual allocation in addition to a valid commercial reef fish permit to harvest grouper and tilefish species. Initial shares were distributed to permit holders based on historical landings. The universe of potential initial participants in the GT-IFQ program, as measured by the number of valid or renewable commercial reef fish permits as of August 31, 2008, was estimated at 1,028. Because the vessels of some permit holders did not harvest grouper or tilefish to qualify for the initial distribution of shares, 766 permit holders received GT-IFQ shares during the initial apportionment for that program.

Share and allocation transferability provisions included in the IFQ programs contribute to improving access to RS and GT allocation for those who did not receive initial distributions, and also have allowed for participation in the programs by non-fishing entities, which may affect access to RS and GT shares and allocation by those who fish. During the first 5 years of each program, only U.S. citizens or permanent residents with a valid commercial reef fish permit could acquire IFQ shares or annual allocation through transfer. After the first 5 years, any US citizen or permanent resident could acquire IFQ shares and annual allocation without possession of a commercial reef fish permit, although a commercial reef fish permit continued to be required for the harvest and landing of IFQ species. Thus, beginning January 1, 2012 (RS-IFQ), and January 1, 2015 (GT-IFQ), respectively, any U.S. citizen or permanent resident became eligible to open a shareholder account and acquire shares and allocation without a commercial reef fish permit, and are termed "public participants." Without a commercial reef fish permit, public participants cannot engage in the activity of fishing; their participation is restricted to buying, selling, and trading shares and allocation.

For the commercial reef fish fishery, a commercial reef fish permit and IFQ allocation is required for the commercial harvest of IFQ-managed reef fish. Because no new permits are available, and IFQ shares and allocation must likewise be obtained by transfer, the discussion of new entrants generally pertains to replacement fishermen. Although new entrants are generally assumed to refer those directly engaged in the activity of fishing such as captains and crew, those engaged directly in fishing may not hold a permit or shareholder account. Rather, fishing activity is monitored through the entities holding commercial reef fish permits and shareholder accounts, representing entities that may or may not fish.

New entrants can opt for long term participation in the program by acquiring shares and receiving the corresponding annual allocation yearly or participate on a short-term basis by purchasing annual allocation as needed. Although the numbers of accounts acquiring shares for the first time, allocation holders with transfers and, pounds of IFQ species landed by accounts without shares are partially determined by activity in related accounts, they also suggest that the programs have experienced a sustained level of new entrants.

Although improvements in new entrants' access may be a part of the long-term performance of successful IFQ programs, significant new entries (well above replacement fishermen) may run counter to the reduction of overcapitalization, one of the main objectives of the IFQ program. Additional assistance, in the form of loan programs and quota banks, would allow potential new entrants to participate in the IFQ programs. A national loan program currently in development is expected to offer opportunities to Gulf fishermen. The Council is also developing management measures to distribute shares collected from inactive actions to new entrants and/or fishermen with limited IFQ holdings. Although the Council has previously considered quota banks, quota bank initiatives in the Gulf are currently limited to private organizations.

Barriers to new entrants, referring to those engaged directly in the fishing activity, has long been a recurring problem within IFQ programs (Copes 1997; GAO 2004; Carothers et al. 2010; Szymkowiak and Himes-Cornell 2015). Griffith et al. (2017) noted that it is most often the second generation of fishermen who bear the burden of significant barriers to entry. These sentiments were reinforced in their research of the GT-IFQ program where most of those interviewed saw an aging population of fishermen with few younger ones to take their place. Most of those interviewed said that the barriers to entry include "…costs of leasing allocation, high share prices, the inability to purchase shares, the costs of purchasing a boat, reef [fish] permit, vessel monitoring system (VMS) equipment, and recovery fees relative to ex-vessel prices, among others, would prevent younger fishers from entering the fishery" (Griffith et al. 2017). While transferability of shares and allocation does offer some flexibility within the market, most innovative markets have low entry barriers, which is not often the case with IFQ programs. This can have disproportionate effects in rural areas where there are fewer economic opportunities for fishermen and fishing may be critical to community identity (Griffith et al. 2017; Langdon 2008).

The Council has made modifications to the IFQ programs (Amendment 36A; GMFMC 2017) and is exploring further modifications (Amendments 36Band 36C), which may affect new entrants. Amendment 36A included an action that returned RS and GT shares held in non-activated IFQ accounts to NMFS, which was effective on July 12, 2018. These shares are currently held in an account by NMFS until the Council determines how to distribute the shares or the allocation associated with those shares, currently under consideration in Amendment 36C. However, these shares represent a relatively small amount of annual allocation for each share category (Table 9.1) and could potentially be combined with additional shares or allocation to address a Council goal of assisting new entrants.

Table 9.1. Amount of shares held by NMFS that were reclaimed from non-activated accounts following implementation of Amendment 36A.

Share category	Reclaimed Shares	2019 Quota (lbs)	2019 Allocation (lbs)	# Accounts with shares ≤ 500 lbs
DWG	0.028405%	1,024,000	291	207
RG	0.106974%	3,000,000	3,209	178
GG	0.182621%	939,000	1,715	291
SWG	0.451821%	525,000	2,372	336
TF	0.055081%	582,000	321	139
RS	0.078800%	6,937,838	5,467	111

Amendment 36B considers the provision for allowing entities without a commercial reef fish permit to hold shares. The Council is considering alternatives to allow some or all existing shareholders to retain shares already held without a permit, and to require all future shareholders to first obtain a commercial reef fish permit. This action could potentially benefit new entrants in the future. However, it is also possible that existing shareholders who would like to possess IFQ shares would obtain a permit in order to comply with the requirement, but not use the permit for fishing, which could then reduce the availability of permits for transfer to a new vessel.

The Council is considering additional modifications to the IFQ programs through Amendment 36C, which may affect new entrants. The method and recipients of the shares reclaimed through Amendment 36A will be addressed. The Council may distribute the shares to existing shareholders; distribute the shares to a specified group of program participants; or authorize NMFS to hold the shares and distribute on the annual allocation associated with the shares to a specified group of participants. The Council may establish a quota bank for the purpose of assisting new entrants. The Council would specify the amount of shares and/or allocation to add to the quota bank, the recipients eligible to receive allocation, how much allocation to make available to each recipient, and how the allocation would be distributed.

9.1 Conclusions

A goal shared by most limited access privilege programs is to reduce overcapacity in the fishery. Thus, the concept of new entrants may seem to be in conflict with this goal. However, new entrants do not refer to expanding capacity, but rather to the next generation of fishermen. New entrants are often already participants in the fishery, and may be crew, hired captains, or captains of owner-operated vessels who do not own shares but would buy allocation to cover their landings. Therefore, facilitating access to the program by considering provisions for new entrants would be consistent with the program objectives. For potential new entrants, the access to shares and allocation generally constitutes a major challenge. The Council could consider loan programs (including national programs), redistribution of portions of the commercial quotas, and the establishment of quota banks to ease potential new entrants' access to IFQ shares and allocation. Due to the public participation provision included in both Gulf IFQ programs, new entrants also include those who buy and sell shares and allocation but do not otherwise engage in fishing activity. The Council is currently evaluating whether to continue this type of participation.

CHAPTER 10. MONITORING AND ENFORCEMENT

According to Section 303A(c)(1)(H) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), each limited access privilege program (LAPP) must include "an effective system for enforcement, monitoring, and management of the program, including the use of observers or electronic monitoring systems." Widespread non-compliance can adversely affect the ability of other catch share program (CSP) attributes to achieve their desired goals and objectives. This section assesses whether the current enforcement provisions and activities, including resources for conducting the latter, are sufficient to ensure a high rate of compliance with program requirements.

10.1 Discussion

Effective law enforcement is a crucial component of the individual fishing quota (IFQ) programs. Special agents and officers from the National Oceanic and Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS) Office of Law Enforcement (OLE) Southeast Division, the U.S. Coast Guard (USCG) and state wildlife officers and game wardens under authority of state law, or operating under the authority of joint enforcement agreements (JEA) with OLE, enforce the regulated activities mandated under the Gulf of Mexico (Gulf) IFQ programs through a variety of mechanisms. These mechanisms include at-sea and dockside inspections, offload monitoring, investigations of potential violations, and the seizure of illegally caught fish.

Commercial vessels harvesting RS-IFQ or GT-IFQ species are required to have a valid Gulf reef fish permit and a functioning vessel monitoring system (VMS) prior to fishing. VMS units transmit and store information relating to the vessel identification, date, time, latitude/longitude, course and speed, and are able to provide position accuracy to within 33 feet (100 m). VMS units are required to be turned on and properly functioning 24 hours a day, 7 days a week (unless a power down exemption has been approved), even when docked. VMS units provide hourly position transmission and can provide "real time" position when polled. The VMS protocol contains a requirement that vessels declare their fishing activity and gear type before leaving port (declaration; 'hail out') via the VMS terminal or the NMFS call service center. The VMS units improve the efficiency of enforcement efforts by providing a means to remotely monitor offshore restricted areas and to quickly and accurately locate vessels for law enforcement or search and rescue.

Prior to returning to port, all vessels landing any commercial reef fish species are required to notify NMFS between three hours to 24 hours[42] in advance of the time of landing to indicate where and when the landing will occur, the dealer who will be purchasing the fish, and an estimation of the pounds being landed. (Amendment 36A expanded this requirement from applying to RS-IFQ or GT-IFQ species to all reef fish.) Before a landing notification is

[42] Until 2013, the pre-landing notifications needed to be made between 3 to 12 hours in advance of the time of landing. An administrative rule based on results the Red Snapper IFQ 5-Year review extended this time period to 24 hours.

submitted, the vessel account must contain sufficient allocation for the fish onboard. Landing notifications can be made through the VMS unit, the IFQ online website, or through the call service center. Each time a landing notification is received, law enforcement and dispatch personnel are notified via e-mail. The advance notice allows law enforcement personnel to be present when the vessel lands to inspect the catch. Vessels landing any reef fish species, including RS-IFQ or GT-IFQ managed species, can only land at approved landing locations. Establishing approved landing sites aids in enforcing the landing and offloading aspects of the IFQ programs. All landing locations need to be publicly accessible by land and their geographic location must be specifically identifiable. Landing sites must be pre-approved by NOAA OLE to ensure agents and officers can find and access the sites. Landing (arriving at a dock, berth, beach, seawall, or ramp) may occur at any time, provided that a landing notification has been given, but fish may only be offloaded between 6 a.m. and 6 p.m., local time. Offloading is defined as the removal of any IFQ species from the vessel. A landing transactions report is completed by the IFQ dealer and validated by the fisherman. The landing transaction includes the date, time, and location of transaction; weight and actual ex-vessel value of fish landed and sold; and the identity of shareholder account, vessel, and dealer. All landings data are updated in a real-time basis as the landing transaction is processed.

VMS technicians have the ability to monitor all IFQ trips. Monitoring begins by checking to see if a proper declaration was made for all IFQ trips. Trip level monitoring permits tracking of the vessel from port to port, and checking that the VMS positioning does not stop or have significant gaps in reporting. Vessel landing locations can be confirmed to match the location reported via the vessel's IFQ pre-landing form (hail-in). If the vessel makes an unauthorized landing or lands at a landing location other than the site listed on the IFQ pre-landing, the VMS technicians can notify OLE or state law enforcement personnel for follow up. IFQ vessels' tracks can be matched with logbook reporting to confirm the accuracy of the declaration as well as reported IFQ catch. In addition, VMS staff work closely with the Southeast Regional Office's Permits Office to confirm that all reef fish permit holders have an active and positioning VMS unit onboard prior to their permit being issued.

Enforcement of the IFQ program regulations includes all of the enforcement options and activities present in all of NOAA's enforcement work. Law enforcement personnel from OLE, the USCG, and state JEA partners conduct at-sea and dockside patrols and inspections designed to educate the regulated community about the program and detect and deter violations. In addition, OLE conducts follow up investigations in the event of more complicated violations such as the undocumented landing and sale of IFQ species and the trafficking of illegally landed red snapper or grouper-tilefish in interstate or foreign commerce. If the USCG or JEA partners detect a violation related to the IFQ programs, they can provide compliance assistance to fix the violation on the spot such as educating fishermen on the use of the technology used to monitor the programs (VMS and IFQ notification systems), or, if the violation is of a more serious nature, they can forward the case to OLE for additional action. OLE's enforcement options include a wider range of actions including compliance assistance, written warnings, summary settlements,[43] referral to NOAA's Office of General Counsel, Enforcement Section, for

[43] Summary settlements are offers issued by OLE to settle violations listed on the Office of General Counsel, Enforcement Section's Summary Settlement Schedules. The summary settlement program is designed to provide a mechanism to resolve relatively low-level violations quickly, efficiently, and without the more formal procedures

consideration of a civil penalty, or referral to the Department of Justice for prosecution of a criminal offense.

Major violations detected by law enforcement since the implementation of the IFQ programs include false reporting of species landed and under reporting of total weights landed. More typical violations include landing prior to the 3-hour minimum landing notice, landing at an unspecified or unapproved location, insufficient allocation, transporting IFQ species without an approval code, completing a landing transaction without a landing notification, and offloading after approved hours. Typical dealer violations include misreporting IFQ species, failure to provide a current dealer permit and/or IFQ dealer endorsement, and failure to report IFQ species landed.

The seizure of illegal catch is also an enforcement option, although OLE usually reserves this option for the most egregious violations. As the program has matured, the number of federal IFQ related cases that have resulted in seizures has decreased, with the greatest number of seizures occurring in 2011 (Table 10.1.1). It should be noted that these estimates are only based on seizures by federal agents and officers and do not include seizures completed by state law enforcement. As more states change state regulations to match federal regulations, there may be a decrease in the number of federal seizures and violations, as they are prosecuted under state regulations.

Table 10.1.1. Number of enforcement cases resulting in seizure of fish.

Year	Total IFQ Cases	RS-IFQ Seizures	GT-IFQ Seizures	Total Pounds Seized
2007	20	7	-	7,678
2008	17	6	-	1,622
2009	20	2	-	250
2010	9	4	2	3,549
2011	10	6	7	25,742
2012	6	5	4	10,748
2013	6	3	3	5,961
2014	4	3	3	5,240
2015	1	1	0	1,088
2016	3	2	2	3,817
2017	15	0	0	0
2018	19	0	0	0
Total	130	43	33	65,695

involved when the Office of General Counsel assesses a civil penalty. Up until 2019, previous settlement schedules only included penalties for red snapper violations and did not contain IFQ specific violations. In June of 2019, the Southeast Region summary settlement schedule added penalties for IFQ specific violations. OGC/Enforcement. The schedule now includes provisions for violating IFQ regulations relating to transport on land, landing notifications, arrival times, offloads, landing locations, and sufficient allocation. Fees begin at $1,000 for each first offense and increase by $500 for each subsequent second and third offense. See https://www.gc.noaa.gov/gces/2019/SE-SSS-Final-6-27-19.pdf

Catch Share administrative staff regularly audit pre-landing notifications and landing transactions, connecting each notification and landing transaction. Currently, fishers and dealers are notified via phone call of outstanding transactions, while in past years they were notified via audit letters. The online system requires dealers submitting a landing transaction to select a landing notification from within the last 96 hours. The majority of notifications and transactions are linked through this process. Occasionally, dealers may be unable to link landings to notifications because it does not appear in the list of available notifications. This may be due to a system delay (e.g., VMS system is delayed in connection to the IFQ system), late reporting of the landing transaction (e.g., past 96 hours from the notification date/time), or because no notification was submitted to the system. In these situations, dealers must select "No Notification Meets Criteria," and Catch Share staff link the notification and transactions after the fact. Likewise, during the daily audit, Catch Share staff may see a notification with no matching landing transaction. In these instances, Catch Share staff reaches out to the dealer listed in the notification, to verify if a landing did occur. When Catch Share staff continues to have difficulty resolving outstanding pre-landing notification, the dealer and vessel are referred to NOAA OLE for further investigation.

In two surveys of GT-IFQ program stakeholders, account holders reported similar levels of satisfaction with enforcement of IFQ program. Program participants (i.e., owners of share and allocation accounts) reported satisfaction at 46% (QuanTech 2015), and dealers/processors reported satisfaction at 47% (Keithly and Wang 2016). About 19% of participants reported dissatisfaction with enforcement (QuanTech 2015) while 20% of dealers/processors were dissatisfied (Keithly and Wang 2016). The remainder of respondents in both surveys were either neutral towards program enforcement or had no opinion.

10.2 Conclusions

Together, the multiple actions and activities undertaken by NMFS Sustainable Fisheries, NOAA's Office of General Counsel, and law enforcement personnel from OLE, the USCG, and JEA partner states, result in an effective system for enforcement, monitoring, and management of the IFQ programs. Law enforcement made good use of VMS to monitor and track vessels and applied the full range of available enforcement options, including compliance assistance, written warnings, summary settlements and referral of appropriate cases for civil or criminal prosecution to promote compliance, deter would-be violators, and level the playing field for law-abiding fishers. Law enforcement continued to make adjustments to improve its enforcement activities as demonstrated by the addition of IFQ violations to the summary settlement schedule for lower-level offenses and the modification of annual JEAs to specifically address IFQ-related violations.

CHAPTER 11. ADMINISTRATION AND COST RECOVERY

According to Section 303A(c)(1)(H) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), each limited access privilege program (LAPP) must include "an effective system for enforcement, monitoring, and management of the program, including the use of observers or electronic monitoring systems." This section will review if the total administrative costs are being minimized to the extent practicable, which is consistent with National Standard 7. It is likely there will be trade-offs in the various types of administrative costs.

11.1 Cost Recovery

The Magnuson-Stevens Act requires the Secretary of Commerce (Secretary) to adopt regulations implementing a cost recovery program to recover the actual costs of managing, administering, and enforcing the Gulf of Mexico (Gulf) individual fishing quota (IFQ) programs. Monitoring costs are the costs associated with determining how many fish are harvested, when harvest occurs, where harvest occurs, issuing quota, transferring quota, etc. The administrative costs are the costs associated with IFQ personnel, customer service, equipment, travel, call service contracts, and mail outs. The enforcement costs are the costs associated with ensuring the harvesting vessels and fish buyers are in compliance with the existing regulations governing the harvest. The cost recovery fee established for IFQ program is currently 3% of the actual ex-vessel value of IFQ species. IFQ allocation holders who complete a landing transaction with a dealer are responsible for payment of the fee. The dealer who receives the IFQ species is responsible for collecting and submitting the fee on a quarterly basis. Monies collected are also used for the maintenance and upkeep of the online system and software, enforcement of the IFQ program, and scientific research.

Task codes are used to track salaries and benefits, contracts, travel, and equipment, supplies, and materials for the cost recovery expenses, as well as research activities and law enforcement activities directly related to the IFQ program. Additional funding for law enforcement and program administration is provided through the general National Oceanic and Atmospheric Administration (NOAA) catch shares annual funding. Expenses summarized here include only those expenses incurred between January 1, 2010, and December 31, 2018. Additionally, some expenses (i.e., observers/research, law enforcement) are jointly associated with one another and cannot be distinguished for tracking between the red snapper (RS)-IFQ program and the grouper-tilefish (GT)-IFQ program. The total value reported for each program each year was used to apportion expenses (Table 11.1.1).

In the IFQ programs, the bulk of the cost recovery expenses were used to fund enforcement and salaries/benefits of staff working on the program, followed by science and research, supplies and materials, contracts, and travel (Figure 11.1.1). Cost recovery fees have been fully funding the program. A total of $8.04 million was spent on administering and enforcing the program between 2010 and 2018, with $4.74 million spent between 2014 and 2018, which is being considered for this review. The money spent between 2014 and 2018 represents 1.74% of the total ex-vessel value of IFQ-managed fish reported in the programs. However, because not all expenses exceeding the 3% cost recovery were tracked, including costs to migrate and upgrade the online system to a new platform, expenses likely were greater than those provided here. When setting cost recovery fees, the following factors need to be considered: projected ex-vessel value of the catch, costs directly related to the management and enforcement of the program, projected balance from year to year, and expected non-payment of fees. Some expenses, such as hardware and software replacement, only occur every 3-7 years, versus expenses such as labor, enforcement, and supplies which are annual. Monies remaining in the Limited Access System Administration Fund (LASAF) at the end of the fiscal year are rolled over to the next year to allow for the large expenses that occur every 3-7 years.

Table 11.1.1. The proportion of expenses associated with both IFQ programs attributed to each program.

Year	% GT-IFQ	% RS-IFQ
2010	58%	42%
2011	65%	35%
2012	64%	36%
2013	55%	45%
2014	58%	42%
2015	49%	51%
2016	51%	49%
2017	44%	56%
2018	40%	60%

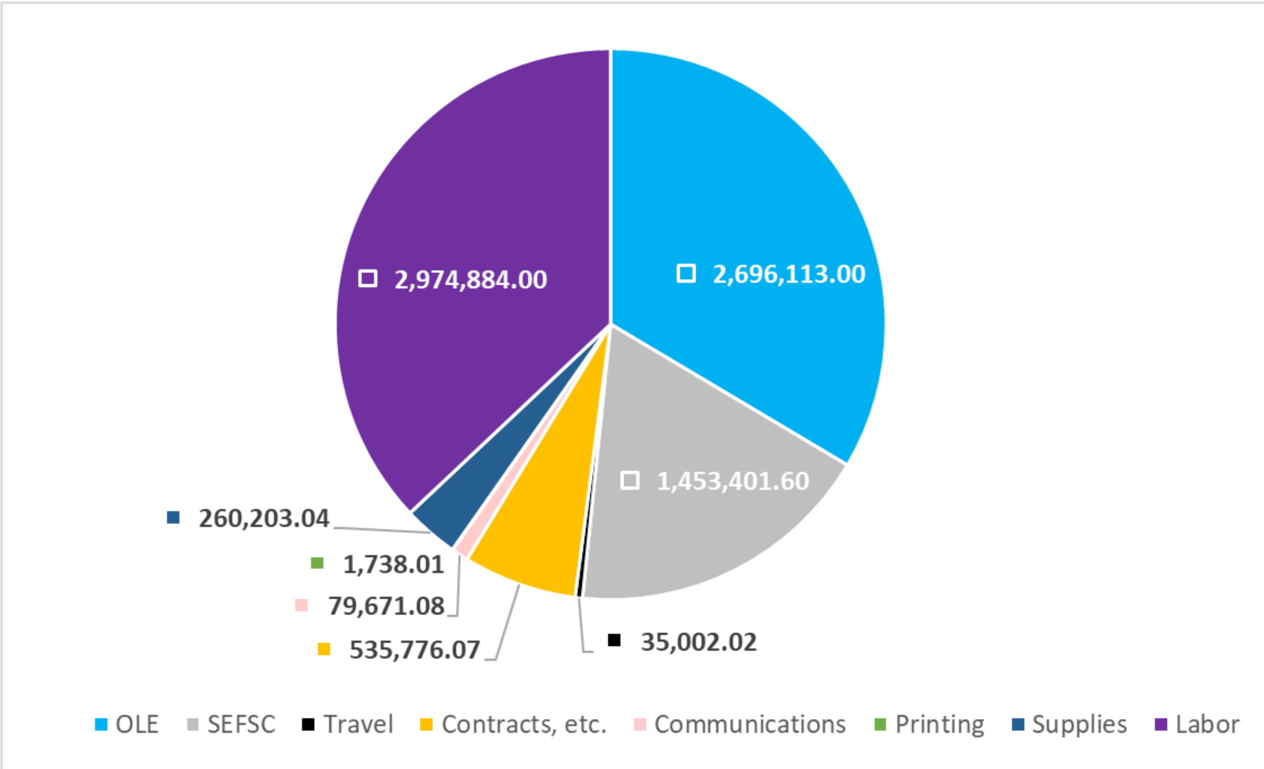

Figure 11.1.1. Aggregated IFQ program expenses, 2010-2018.

11.2 Administration

Administration of the IFQ program includes maintaining the online system and database, auditing transactions, and customer support and outreach. Updates are continuously made to the Catch Share system based on input from users, the National Marine Fisheries Service's (NMFS) Southeast Regional Office (SERO) and Information Technology staff, as well as for any regulatory changes.

Since 2012, several administrative rules have been implemented to improve the regulatory functioning of the IFQ program. The first of these changes was to allow allocation to be held in either a vessel or linked shareholder account at the time a landing notification is submitted. Another change was to extend the reporting window for landing notifications from 12 to 24 hours. In addition to this, a rule was implemented requiring vessels land within an hour after the arrival time given in the landing notification.

Administrative improvements have also been made to the IFQ program to improve NMFS's ability to manage and analyze the program's performance. Such improvements have included the addition of a comment field for SERO IFQ managers to use in landing notifications to inform enforcement, the ability for SERO IFQ managers to close an IFQ account, the development of procedures for when there has been a death of an IFQ shareholder, a requirement that mandates the selection of a landing notification for each landing transaction, the addition of transfer reasons for all share and allocation transfers, the requirement that both the transferor and transferee enter the share price during a share transfer, and finally, an update to the dealer endorsements that reflects the new Gulf and South Atlantic Dealer permits.

Improvements were also incorporated into the IFQ program and the IFQ online system to improve the user experience for participants. The login procedure was simplified, which included removing the need to fill in the user role, removing the requirement to accept the Terms of Use, and the ability to view the PIN during login. Print options on confirmation screens when performing allocation or share transfers were added to the online system, and a new share and allocation calculator was added to the home page. GIS interactive maps of dealer and landing locations were added on the public home page. So that IFQ participants could better monitor their activity, landings ledgers for shareholders and dealers were added to the online system, as well as the ability for account holders to update the trip ticket number in landing transactions. Most recently, numerical VMS codes were assigned to each dealer and landing location so new dealers and landing locations can be added to the VMS lists more efficiently.

There have also been several instances when the Catch Share online system has been upgraded for performance improvements. Specifically, in 2012, the IFQ database was transitioned onto SQL Server software, which has since been upgraded to SQL Server 16. Currently, the catch share system is undergoing a migration to a more modern platform. The existing software will no longer be supported after 2020. This presented an opportunity for NMFS to not only migrate the system, but to incorporate new features into the online system, including the ability to work on mobile platforms and to structure the program to have cloud-based operations.

Finally, some improvements to assist with the enforcement of the Catch Share program were made. Law enforcement is a crucial component of the IFQ programs. Special agents and officers from NOAA/NMFS Office of Law Enforcement (OLE) Southeast Division, the U.S. Coast Guard (USCG) and participating Joint Enforcement Agreement (JEA) states enforce the regulated activities mandated under the Gulf IFQ programs. In order to reduce the efforts required to enforce the programs, summary settlements were established for IFQ related violations. Such violations typically include underreporting of total weights landed, landing prior to the 3-hour minimum landing notice, landing at an unspecified or unapproved location, insufficient allocation, transporting IFQ species without an approval code, offloading after approved hours, misreporting IFQ species, failure to provide a current dealer or reef fish permit and/or IFQ dealer endorsement, and failure to report IFQ species landed.

Catch Share support staff also create and maintain several useful documents for participants including: Frequently Asked Questions, Trouble-shooting Guide, Annual Reports, Commercial Quotas and Landings document, IFQ common terms, IFQ fishing guide, IFQ flexibility measures, and IFQ Proposed Quotas. Catch Share support staff also assist customers with questions about the program, creating a new account, and closing an account.

NMFS is responsible for maintaining Catch Share programs customer service. Customer service staff are available from 8 a.m. to 4:30 p.m. EST Monday through Friday. Four staff members assist in answering phone calls, auditing and correcting IFQ data, preparing IFQ annual reports, conducting workshops and meetings, and preparing IFQ materials for dissemination to constituents. One to two additional Information Technology staff work full or part-time to maintain and upgrade the IFQ online data collection system. Additionally, NMFS contracts out phone-based IFQ landing notifications to an after-hours call service. The call service typically answers 600-1,000 minutes of phone calls each month.

One aspect of the administrative duties is to provide outreach opportunities for participants in the program. Outreach activities include visiting dealers for face-to-face meetings, public meetings to address IFQ participants, bulletins to inform participants about changes, and posting messages on the IFQ website (Table 11.2.1). In 2012, Catch Share support staff held four public meetings across the Gulf in order to address the administrative rule changes being considered. In 2018, the Catch Share support staff explored the applicability and interest for a newsletter as an outreach avenue for not only stakeholders, but any public entities interested in learning about the catch share programs.

Table 11.2.1. Number of outreach activities by type.

Type	2010	2011	2012	2013	2014	2015	2016	2017	2018
Dealer Visits	5	7	16	0	11	12	4	9	41
Important Messages	20	34	42	36	33	36	21	18	17
Bulletins	4	7	4	1	4	1	2	5	7
Newsletter	-	-	-	-	-	-	-	-	4

11.3 Conclusions

NMFS is migrating the Catch Share online system to keep the system up to modern standards. The bulk of the administrative changes have been to improve the stakeholder experience, the performance of the system, and the ability to analyze future changes (to the system).

The Catch Share support team has been working to improve outreach efforts through the exploration of new methods to communicate to constituents. Since 2018, the Catch Share support team has been producing short newsletters to address stakeholder requests (e.g., in-season price and landings data) and to demonstrate critical system functions to the catch share community.

CHAPTER 12. PROGRAM DURATION

Limited access privileges such as individual fishing quota (IFQ) shares are considered by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as a revocable permit. IFQ shares do not constitute a right and therefore, do not entitle recipients to compensation should the privilege be revoked, as was done with shares in non-activated accounts through Amendment 36A (GMFMC 2017), or modified. According to Section 303A(f) of the Magnuson-Stevens Act, IFQ shares are not issued in perpetuity. For limited access privilege programs established after January 12, 2007, their lifespan is limited to 10 years, though they will be renewed if not revoked, limited, or modified. In effect, limited access privileges are considered to be issued under rolling conditional permanence (Anderson and Holliday 2007).

In designing the red snapper (RS) and grouper-tilefish (GT)-IFQ programs, the Gulf of Mexico Fishery Management Council (Council) did not include additional duration provisions and therefore, the privileges granted are currently valid for successive 10-year time intervals. For a predetermined share of the commercial quota for a species included in the IFQ programs (e.g., 1% of the gag commercial quota), a fixed commercial quota for that species would grant the shareholder the privilege to harvest the same amount of annual allocation each year. Therefore, given a fixed commercial quota for an IFQ-managed species, a shorter program duration would be expected to result in a smaller potential aggregate harvest from the species considered. Because the value of an asset is equivalent to the net present value of the stream of income expected to be generated from the asset, a shorter program duration would result in a lower asset value. Compared to programs with a shorter duration, the duration of the Gulf IFQ programs, along with the transferability provisions implemented, is conducive to the development of a well-functioning market for IFQ shares. For a program with limited duration, incentives to acquire shares through trading would diminish as the end date of the program approaches. In addition, because IFQ programs provide participants a long-term stake in the fishery, which has been assumed to confer a vested interest in conservation measures, limited duration would lessen or negate any incentives to support and engage in conservation measures in the long run.

The Council has recently made some modifications to the IFQ programs (Amendment 36A) and is considering further modifications to the programs (Amendments 36B and 36C) relative to the limited access privileges for holding IFQ shares. Amendment 36A (GMFMC 2017) authorized NMFS to revoke shares from non-activated IFQ accounts. These accounts had never been accessed by the accountholder, resulting in the allocation associated with those shares remaining unused. Table 9.1 provides the amount of shares that were revoked for each share category. Amendment 36A also authorized NMFS to withhold a portion of the annual allocation from distribution at the beginning of a year in which a quota reduction is anticipated. These provisions became effective on July 12, 2018. The Council is currently considering additional changes to both the RS-IFQ and GT-IFQ programs through Amendments 36B and 36C. Amendment 36B evaluates the program provision that allows any U.S. citizen or permanent resident to participate in the IFQ programs by obtaining shares and allocation. Amendment 36C will develop a method for distributing the shares revoked through Amendment 36A, or potentially, distributing only the annual allocation associated with those shares through a quota bank. Additional actions pertain to the establishment of a quota bank.

While shares are a revocable privilege, shares are usually revoked only for reasons noted above or for egregious violations of regulations. Common critiques of typical catch share programs focus on the initial distribution of shares, one-time only distribution of shares, cost of shares and allocation after the program has been in place for multiple years, difficulty for new or replacement entrants to join the programs, and absentee ownership of shares and/or allocation.

An alternative to typical catch share programs is an adaptive catch share program, which uses adaptive management to address many of these concerns over time. An adaptive catch share program is designed to reclaim and redistribute a portion of the shares at pre-determined periods, centered on three main components: cycle length, reclamation process, and redistribution process. Initial shares are distributed based on criteria chosen for the program. Once the program is implemented, within any cycle the program functions similar to a non-adaptive catch share. It is at the end of the cycle, where an adaptive catch share program differs from a non-adaptive program. Once a cycle is completed, based on criteria set forth by management, a portion of shares are reclaimed from all accounts and then redistributed to participants. The goal of an adaptive catch share program is to continuously redistribute shares to those participants who have harvested fish. Depending on how the adaptive catch share program is designed, it may be an appropriate choice if one or more of the following conditions are met:

- Initial share distribution may no longer be representative of the fishery.
- A need exists to reduce barriers to new/replacement fishermen.
- Absentee ownership is a concern.
- Number of latent permits is unknown.
- Prior landings history is unknown.

The structure of the adaptive catch share program would depend on the degree of need for adaptation in the program. For programs that have been in place for many years, the driving need is for the ability to have replacement fishermen (new entrants) join the fishery without undue burden. An adaptive catch share program could be structured to allow for the long-term replacement of existing fishermen with incoming fishermen as the fleet ages.

The first stage in an adaptive catch share program is setting a pre-determined cycle length (one or more years), where fish are landed using annual allocation. During the cycle, fishing proceeds as it would during a non-adaptive catch share program, with harvest and transferability of allocation or shares allowed as set by the program’s regulations. Some shareholders will harvest all of the allocation associated with their shares each year, while others will not. At the end of the first cycle, the reclamation process of an adaptive catch share program reclaims a percentage of shares from all shareholders. While shares are reclaimed from all shareholders, each shareholder has an opportunity to have a greater, smaller, or equal percentage of shares returned to them through the redistribution process. Reclaiming only a portion of the shares is intended to allow for the participants to form a business plan based on a known minimum number of shares they would have for the next fishing year. The proportion of shares reclaimed each cycle can be set or progressive. During the redistribution process, the reclaimed shares are distributed to those accounts that landed fish during the cycle. Shares can be redistributed equally or proportionally among those participants with landings. Redistributing shares proportionally based on landings would result in those participants who landed a greater amount of fish receiving a greater amount of redistributed shares than those who landed less fish. Redistribution keeps the shares in the hands of those participants that are actively fishing the resource.

The minimum time for a cycle is one fishing season (typically one year) but could be longer. Cycles may be for a set length of time (e.g., one year in perpetuity) or progressively lengthened over time until a constant cycle length is achieved. Possible impacts of cycle length and the effect on the fishery should be considered when setting a cycle length. Cycle durations would impact how quickly the shares are redistributed to represent the current fishery, the stability of the market for shares and allocation, and the ability and timeliness for new or replacement entrants to acquire shares. Effects of the duration of a cycle may also be magnified by localized events (e.g., red tides, hurricanes) and personal events (e.g., health or vessel problems). Short durations are beneficial when there is a need for rapid adaptive management, as it would allow changes in the distribution of shares to occur more frequently. Longer cycle durations provide for more stability in business planning and may minimize localized effects. Conversely, a longer cycle duration may have a negative impact on new or replacement entrants, because it will take longer to receive shares through redistribution.

Reclamation with redistribution provides a way for new or replacement entrants to earn shares through participation. The percentages of shares to be reclaimed can be set from 0% (i.e., functions like a non-adaptive program) to 100% (i.e., full redistribution each cycle). The goal is to determine what reclamation percentages will best accomplish the program's goals (e.g., a representative share distribution, aids to new or replacement entrants), without creating a barrier to business practices (e.g., the ability to predict allocation available for future trips). Impacts from different reclaimed share percentages should be considered when designing such a program. The participants would need to retain enough shares within their accounts to continue with this business practice. Although reclaiming a high percentage of reclaimed shares each cycle would allow the program to move more rapidly towards representative distribution, it might also create instability in trip planning. Conversely, reclaiming a low percentage of shares each cycle may provide stability but may not redistribute enough shares to address the program's goals in a reasonable time frame. Allocation transfers must be allowed for this adaptive management program to work for new or replacement entrants. The new or replacement entrants would obtain allocation through transfers and land within a cycle. Once these participants have recorded landings, they would be eligible to receive reclaimed shares in the next cycle. While the annual allocation associated with these redistributed shares may not initially be sufficient to support their business practices, it would reduce the amount of allocation to be obtained and result in a reduction in cost. In this manner, an adaptive catch share program may aid new entrants and should be considered when investigating privilege durations and any subsequent redistribution.

12.1 Conclusions

The duration of the RS-IFQ and GT-IFQ programs, which are not restricted beyond Magnuson-Stevens Act requirements, is consistent with the objectives of the IFQ programs because the programs have fostered longer term planning and investment in the fisheries. However, to further promote the full utilization of the available quotas, the Council recently elected to revoke

IFQ shares from accounts that had never been activated and thus, remained unused. Amendment 36A (GMFMC 2017) defined non-activated accounts as those accounts possessing shares, but the account had not been logged into since 2010. This means that none of the shares or annual allocation associated with the shares in those accounts had been landed or transferred to another account. The method for distributing these revoked shares will be determined in Amendment 36C, which is currently under development by the Council. Other IFQ programs in the U.S. such as the wreckfish ITQ program and the Pacific halibut/sablefish IFQ program include rules specifying the conditions under which shares from inactive accounts may be revoked.[44]

[44] For example, see the rules to revoke inactive QS in the wreckfish ITQ program (https://www.federalregister.gov/articles/2012/09/26/2012-23731/fisheries-of-the-caribbean-gulf-of-mexico-and-south-atlantic-snapper-grouper-fishery-off-the) and the Pacific halibut/sablefish IFQ program (https://www.govinfo.gov/content/pkg/FR-2012-05-18/pdf/2012-12153.pdf)

CHAPTER 13. CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

13.2 Recommendations

13.2.1 Scientific and Statistical Committees Recommendations

13.2.2 Ad Hoc Red Snapper and Grouper-Tilefish IFQ Advisory Panel

13.2.3 Council Recommendations

CHAPTER 14. REFERENCES

Asche, Frank. Supply chains and markets for red snapper. Report prepared for NOAA. July 2, 2020. 21 pp.

Agar, J. J., Strelcheck, A. & Diagne, A. 2014. "The Gulf of Mexico Red Snapper IFQ Program: The first five years,' *Marine Resource Economics* 29(2): 177–198.

Birkenbach A., David J. Kaczan, Martin D. Smith, Greg Ardini, Daniel S. Holland, Min-Yang Lee, Doug Lipton, and Michael D. Travis. Revenue Margins and Market-Based Regulation: Evidence from U.S. Fisheries. Submitted to Journal of the Association of Environmental and Resource Economists, Aug. 2020.

Bureau of Labor Statistics (BLS). 2018. https://www.bls.gov/iif/oshcfoi1.htm#2018.

Campbell, M.D., Driggers III, W.B., Sauls, B., Walter, J.F. 2014. Release mortality in the red snapper fishery (*Lutjanus campechanus*) fishery: a meta-analysis of 3 decades of research. Fisheries Bulletin, 112:283–296.
Clark, C.W., Clarke, F. H., and Munro, G. R. 1979. The Optimal Exploitation of Renewable Resource Stocks: Problems of Irreversible Investment. *Econometrica* 47(1): 25-47.

Cass-Calay, S. L. and M. Bahnick. 2002. Status of the yellowedge grouper fishery in the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory, Miami Sustainable Fisheries Division Contribution Sustainable Fisheries Division Contribution No. SFD-02/03-172.

Colburn, Lisa L., Michael Jepson, Amber Himes-Cornell, Stephen Kasperski, Karma Norman, Changhua Weng and Patricia M. Clay. 2017. Community Participation in U.S. Catch Share Programs. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-F/SPO-179, 136 p.

Curtis, J.M., Johnson, M.W., Diamond, S.L., Stunz, G.W. 2015. Quantifying delayed mortality from barotrauma impairment in discarded red snapper using acoustic telemetry. Marine and Coastal Fisheries, 4:434–449.

Dakhlia, S., and Marvasti, A. Forthcoming. Regulatory Change, Industry Structure, and Fatalities: the Case of a Gulf of Mexico Fishery. *The Review of Industrial Organization*.

Felthoven, R., Horrace, W. and Schnier, K. 2009. Estimating Heterogeneous Capacity and Capacity Utilization in a Multi-Species Fishery. *Journal of Productivity Analysis* 32(3): 173–189.

GMFMC. 2004a. Final environmental impact statement for the generic essential fish habitat amendment to the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of

Mexico, stone crab fishery of the Gulf of Mexico, coral and coral reef fishery of the Gulf of Mexico, spiny lobster fishery of the Gulf of Mexico and South Atlantic, coastal migratory pelagic resources of the Gulf of Mexico and South Atlantic. Gulf of Mexico Fishery Management Council. Tampa, Florida. 682 pp. https://gulfcouncil.org/wp-content/uploads/March-2004-Final-EFH-EIS.pdf

GMFMC. 2004b. Secretarial Amendment 1 to the fishery management plan for the reef fish resources of the Gulf of Mexico: Set a 10-year rebuilding plan for red grouper, with associated impacts on gag and other groupers. NOAA, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida. 367 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Secretarial-Amendment-1-RF.pdf

GMFMC. 2005. Final generic amendment number 3 for addressing essential fish habitat requirements, habitat areas of particular concern, and adverse effects of fishing in the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, United States waters, red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico, coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council. Tampa, Florida. 106 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/GENERIC/FINAL3_EFH_Amendment.pdf

GMFMC. 2011a. Final reef fish amendment 32 – gag grouper – rebuilding plan, annual catch limits, management measures, red grouper – annual catch limits, management measures, and grouper accountability measures. Gulf of Mexico Fishery Management Council. Tampa, Florida. 406 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Final%20RF32_EIS_October_21_2011[2].pdf

GMFMC. 2011b. Final generic annual catch limits/accountability measures amendment for the Gulf of Mexico fishery management council's red drum, reef fish, shrimp, coral and coral reefs fishery management plans, including environmental impact statement, regulatory impact review, regulatory flexibility analysis, and fishery impact statement. Gulf of Mexico Fishery Management Council. Tampa, Florida. 378 pp. http://gulfcouncil.org/wp-content/uploads/Final-Generic-ACL-AM-Amendment-September-9-2011-v.pdf

GMFMC. 2012. Final regulatory amendment to the fishery management plan for the reef fish resources of the Gulf of Mexico: Revise fall recreational fixed closed season and set 2012 and 2013 quotas for red snapper. Gulf of Mexico Fishery Management Council. Tampa, Florida. 68 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Final%20Red%20Snapper%20Fall%20Season%20and%20Quota%20RegAmend%20-%2003-20-2012.pdf

GMFMC. 2013. Framework action to set the annual catch limit and bag limit for vermilion snapper, set annual catch limit for yellowtail snapper, and modify the venting tool requirement.

Gulf of Mexico Fishery Management Council, 4107 West Spruce Street Suite 200, Tampa, FL 33607.

GMFMC. 2013a. Framework action to set the 2013 red snapper commercial and recreational quotas and modify the recreational bag limit. Gulf of Mexico Fishery Management Council. Tampa, Florida. 89 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Red%20Snapper%20Framework%20Action%20to%20Set%202013%20Quotas.pdf

GMFMC. 2013b. Framework action for red snapper 2013 quota increase and supplemental recreational season. Gulf of Mexico Fishery Management Council. Tampa, Florida. 95 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Final%20Red%20Snapper%20Framework%20Action%20Set%202013%20Quotas.pdf

GMFMC. 2015. Framework action for red snapper quotas for 2015-2017+. Gulf of Mexico Fishery Management Council. Tampa, Florida. 74 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Final%20Red%20Snapper%20Framework%20Action%20Set%202015-2017%20Quotas.pdf

GMFMC. 2016. Framework action to adjust red grouper allowable harvest. Gulf of Mexico Fishery Management Council. Tampa, Florida. 117 pp. https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/Red%20Grouper%20Allowable%20Harvest%20Framework%20Action%20060716%20final.pdf

GMFMC. 2017. Final amendment 44 to the fishery management plan for the reef fish resources of the Gulf of Mexico: Minimum stock size threshold (MSST) revision for reef fish stocks with existing status determination criteria, including environmental assessment and fishery impact statement. Gulf of Mexico Fishery Management Council. Tampa, Florida. 124 pp. http://gulfcouncil.org/wp-content/uploads/Final-Amendment-44-revised-MSST-GOM-Reef-Fish-update-2.pdf

GMFMC. 2017. Final amendment 36A to the fishery management plan for the reef fish resources of the Gulf of Mexico: Modifications to commercial individual quota programs. Gulf of Mexico Fishery Management Council. Tampa, FL.192pp. http://gulfcouncil.org/wp-content/uploads/RF36A-Post-Final-Action-5-25-2017-with-bookmarks.pdf

GMFMC and NMFS. 2018. Grouper-tilefish individual fishing quota program 5-year review. Gulf of Mexico Fishery Management Council and NMFS Southeast Regional Office. Tampa and St. Petersburg, FL. 168 pp. https://portal.southeast.fisheries.noaa.gov/reports/cs/Grouper-Tilefish-IFQ-Review.pdf

GMFMC. 2020. Commercial Discards in Numbers and Pounds for Red Snapper in the U.S. Gulf of Mexico. Gulf of Mexico Fishery Management Council, 4107 West Spruce Street Suite 200, Tampa, FL 33607. https://gulfcouncil.org/meetings/council/january-council-meeting-2020/

Goodyear, C. P. 1994. Biological reference points for red grouper: uncertainty about growth. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. MIA 93/94-60. 26 pp.

Goodyear, C. P. and M. J. Schirripa. 1991. The red grouper fishery of the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. MIA 90/91-86.

Goodyear, C. P. and M. J. Schirripa. 1993. The red grouper fishery of the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. MIA 92/93-75. 122 pp.

Jarvis, E.T., Lowe, C.G. 2008. The effects of barotrauma on the catch-and-release survival of southern California nearshore and shelf rockfish (Scorpaenidae, Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences, 65:1286–1296.

Jepson, M. and L.L. Colburn. 2013. Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S. Southeast and Northeast Regions. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-F/SPO-129, 64 p.

MAFMC. 2017. Golden Tilefish Advisory Panel Information Document. Mid-Atlantic Fishery Management Council, 800 North State Street, Suite 201, Dover, DE 19901. Available from: www.mafmc.org/s/Tilefish-AP-Info-February-3-2017-9xfw.pdf

Marvasti, A. 2017. Occupational Safety in Fisheries of the Gulf of Mexico: A Difference-In-Difference Approach, Western Economic Association International, San Diego, 2017.

Marvasti, A. 2018. Occupational Safety in Fisheries of the Gulf of Mexico: A Difference-In-Difference Approach. Working Paper.

Marvasti, A. 2019. Effect of the Safety Regulations on the Severity of Injuries in the Gulf of Mexico Commercial Fisheries. *Applied Economics* 51(38): 4164-4175.

Marvasti, A. 2020. Value of Life and Injury: Evidence from a U.S. Fishery. *Contemporary Economic Policy*. https://doi.org/10.1111/coep.12472

Marvasti, A., and Dakhlia, S. 2017. Occupational Safety and the Shift from Common to Individual Fishing Quotas in the Gulf of Mexico. *Southern Economic Journal*, 83(3): 705-720.

NMFS. 2002. Draft status of red grouper in United States waters of the Gulf of Mexico during 1986-2001. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida. 65 pp.

NMFS. 2007. Final model for Gulf of Mexico gag grouper as recommended by the SEDAR Grouper Review Panel: revised results and projections. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida. 34 pp.

NMFS. 2011. A Users Guide to the National and Coastal State I/O Model. www.st.nmfs.noaa.gov/documents/commercial_seafood_impacts_2007-2009.pdf.

NMFS. 2016. Characterization of the U.S. Gulf of Mexico and southeastern Atlantic otter trawl and bottom reef fish fisheries. Observer Training Manual. NMFS, Southeast Fisheries Science Center, Galveston Lab., Galveston, Texas. Available from: https://www.fisheries.noaa.gov/southeast/fisheries-observers/gulf-mexico-reef-fish-and-shrimp-observer-program.

NMFS. 2018. Fisheries Economics of the United States, 2016. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-187, 243 p.

NMFS. 2019a. 2018 Gulf of Mexico red snapper individual fishing quota annual report. SERO-LAPP-2019-3. NMFS Southeast Regional Office. St. Petersburg, FL. https://portal.southeast.fisheries.noaa.gov/reports/cs/RS_AnnualReport_SEROfinal.pdf

NMFS. 2019b. Gulf of Mexico 2018 grouper-tilefish individual fishing quota annual report. SERO-LAPP-2019-4. NMFS Southeast Regional Office. St. Petersburg, FL. https://portal.southeast.fisheries.noaa.gov/reports/cs/GT_AnnualReport_SEROFinal.pdf

NMFS. 2020a. Gulf of Mexico red snapper individual fishing quota annual report. SERO-LAPP-2020-2. NMFS Southeast Regional Office. St. Petersburg, FL.

NMFS. 2020b. Gulf of Mexico grouper-tilefish individual fishing quota annual report. SERO-LAPP-2020-3. NMFS Southeast Regional Office. St. Petersburg, FL.

Overstreet, E., L. Perruso, and C. Liese. 2017. Economics of the Gulf of Mexico reef fish fishery - 2014. NOAA Technical Memorandum NMFS-SEFSC-716. 84 pp.

Overstreet, E. and C. Liese. 2018a. Economics of the Gulf of Mexico Reef Fish Fishery -2015. NOAA Technical Memorandum NMFS-SEFSC-724. 78 pp.

Overstreet, E. and C. Liese. 2018b. Economics of the Gulf of Mexico Reef Fish Fishery -2016. NOAA Technical Memorandum NMFS-SEFSC-725. 116 pp.

Overton, A.S., Zabawski, J., Riley, K.L. 2008. Release mortality of undersized fish from the snapper-grouper complex off North Carolina. North American Journal of Fisheries Management, 28(3):733–739.

Parrack, N. C. and D. B. McClellan. 1986. Trends in Gulf of Mexico red snapper population dynamics, 1979-85. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory, Miami CRD 86/87-4.

Patterson III, W.F., Ingram Jr., Q.W., Shipp, R.L., Cowan, J.W. 2002. Indirect estimation of red snapper (*Lutjanus campechanus*) and gray triggerfish (*Balistes capriscus*) release mortality. Gulf and Caribbean Fisheries Institute, 53:526–536.

Pulver, J.R. 2017. Sink or swim? Factors affecting immediate discard mortality for the Gulf of Mexico commercial reef fish fishery. Fisheries Research, 188:166–172.

Pulver, J. and J. Stephen. 2019. Factors that influence discarding in the Gulf of Mexico commercial grouper-tilefish IFQ reef fish fishery. Fisheries Research, vol. 218, pp. 218-228. https://doi.org/10.1016/j.fishres.2019.05.018

Rudershausen, P.J., Buckel, J.A., Williams, E.H. 2007. Discard composition and release fate in the snapper and grouper commercial hook-and-line fishery in North Carolina, USA. Fisheries Management and Ecology, 14(2):103–113.

Rudershausen, P.J., Buckel, J.A., Hightower, J.E. 2014. Estimating reef fish discard mortality using surface and bottom tagging: effects of hook injury and barotrauma. Canadian Journal of Fisheries and Aquatic Sciences, 71:514–520.

Sauls, B. 2014. Relative survival of gags *Mycteroperca microlepsis* released within a recreational hook-and-line fishery. Application of the Cox Regression Model to control for heterogeneity in a large-scale mark-recapture study. Fisheries Research, 150:18–27.

Schirripa, M. J. and C. M. Legault. 1997. Status of the gag stocks of the Gulf of Mexico: Assessment 2.0. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory, Miami.

Schirripa, M. J., Legault C. M., and M. Ortiz. 1999. The red grouper fishery of the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory, Miami Sustainable Fisheries Division Contribution SFD-98/99-56.

Scott-Denton, E., P. F. Cryer, J. P. Gocke, M. R. Harrelson, D. L., Kinsella, J. R. Pulver, R. C. Smith, and J. A. Williams. 2011. Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data. Marine Fisheries Review, 73(2):1–26.

SEDAR 10. 2006. Stock assessment of Gulf of Mexico gag grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 250 pp. http://sedarweb.org/docs/sar/S10SAR2%20GOM%20Gag%20Assessment%20Report.pdf

SEDAR 10 Update. 2009. Update stock assessment report of SEDAR 10 Gulf of Mexico gag grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 171 pp. http://sedarweb.org/docs/suar/Gag_2009_Assessment_Update_Report.pdf

SEDAR 12. 2006. Stock assessment of Gulf of Mexico red grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 358 pp. http://sedarweb.org/docs/sar/S12SAR1%20Gulf%20Red%20Grouper%20Completev2.pdf

SEDAR 19. 2010. Stock assessment of Gulf of Mexico and South Atlantic black grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 661 pp. http://sedarweb.org/docs/sar/Black_SAR_FINAL.pdf

SEDAR 22. 2011a. Stock assessment of Gulf of Mexico yellowedge grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 423 pp. http://sedarweb.org/docs/sar/YEG_final_SAR.pdf

SEDAR 22. 2011b. Stock assessment of Gulf of Mexico tilefish. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 467 pp. http://sedarweb.org/docs/sar/tilefish_SAR_FINAL.pdf

SEDAR 31. 2013. Stock assessment of Gulf of Mexico red snapper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 1103 pp. http://sedarweb.org/docs/sar/SEDAR%2031%20SAR-%20Gulf%20Red%20Snapper_sizereduced.pdf

SEDAR 31 Update. 2015. Update stock assessment report of SEDAR 31 Gulf of Mexico red snapper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 242 pp. http://sedarweb.org/docs/suar/SEDARUpdateRedSnapper2014_FINAL_9.15.2015.pdf

SEDAR 33. 2014. Stock assessment of Gulf of Mexico gag grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 609 pp. http://sedarweb.org/docs/sar/SEDAR%2033%20SAR-%20Gag%20Stock%20Assessment%20Report%20FINAL_sizereduced.pdf

SEDAR 33 Update. 2016. Update stock assessment report of SEDAR 33 Gulf of Mexico gag grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 123 pp. http://sedarweb.org/docs/suar/GagUpdateAssessReport_Final_0.pdf

SEDAR 42. 2015. Stock assessment of Gulf of Mexico red grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 612 pp. http://sedarweb.org/docs/sar/S42_SAR_0.pdf

SEDAR 48. 2017. Stock assessment of southeastern U.S. black grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. http://sedarweb.org/sedar-48

SEDAR 49. 2016. Stock assessment of Gulf of Mexico data-limited species. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 618 pp. http://sedarweb.org/docs/sar/SEDAR_49_SAR_report.pdf

SEDAR 50. 2017. Atlantic blueline tilefish

SEDAR 52. 2018. Stock assessment of Gulf of Mexico red snapper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 434 pp. http://sedarweb.org/docs/sar/S52_Final_SAR_v2.pdf

SEDAR 61. 2019. Stock assessment of Gulf of Mexico red grouper. Southeast Data, Assessment, and Review. North Charleston, South Carolina. 285 pp. http://sedarweb.org/docs/sar/S61_Final_SAR.pdf

SEFSC. 2016. Supplemental discard and gear interaction report. NMFS, Southeast Fisheries Science Center, Galveston Lab., Miami, Florida. Available from: https://www.fisheries.noaa.gov/southeast/resources-fishing/southeast-recordkeeping-and-reporting-forms.

Solis, D., del Corral, J., Perruso, L. & Agar, J. J. 2015. "Individual fishing quotas and fishing capacity in the US Gulf of Mexico red snapper fishery," *Australian Journal of Agricultural and Resource Economics* 59(2): 288–307.

Southeast Regional Office. 2019a. Gulf of Mexico Grouper-Tilefish Individual Fishing Quota Annual Report, National Marine Fisheries Service: https://portal.southeast.fisheries.noaa.gov/cs/.

Southeast Regional Office. 2019b. Gulf of Mexico Red Snapper Individual Fishing Quota Annual Report, National Marine Fisheries Service: https://portal.southeast.fisheries.noaa.gov/cs/.

Southeast Regional Office. 2018. Grouper-Tilefish Individual Fishing Quota Program 5-year Review, National Marine Fisheries Service: https://gulfcouncil.org/wp-content/uploads/B-9a-Grouper-Tilefish-Review-March-2018.pdf.

Squires, D., Kirkley, J. 1996. Individual Transferable Quota in a Multiproduct Common Property Industry. *Canadian Journal of Economics*, 29(2): 318–42.

Stephen, J.A., Harris, P.J. 2010. Commercial catch composition with discard and immediate release mortality proportions off the southeastern coast of the United States. Fisheries Research, 103:18–24.

Wilson Jr., R.R., Burns, K.M. 1996. Potential survival of released groupers caught deeper than 40 m based on shipboard and in-situ observations, and tag-recapture data. Bulletin of Marine Science, 58(1):234–247.

APPENDIX A. FLEET CAPACITY DYNAMICS

FLEET CAPACITY DYNAMICS IN THE GULF OF MEXICO RED SNAPPER FISHERY: 12 YEARS AFTER THE IFQ

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ABSTRACT. We study impacts of individual fishing quota programs on overcapacity and the technical efficiency of the Gulf of Mexico red snapper and grouper-tilefish fisheries. We deploy generalized panel data stochastic frontier methods, which allow us to decompose time invariant heterogeneity into both vessel specific heterogeneity and persistent inefficiency. This type of decomposition has recently seen interest in a variety of applied production settings but marks the first use in fishery studies. Our main findings show that roughly 20% of red snapper fleet size could have harvest the entire red snapper quota and that the time-varying technical efficiency of the red snapper fleet grew by 6% post-IFQ. When we examined the Gulf reef fish IFQ fishery (red snapper combined with grouper-tilefish) we found that between 2011 and 2016, 57% of the fleet could had harvested the quota, had it operated at full efficiency, and that the time-varying technical efficiency of the fleet rose by 5% post-IFQ.

"The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect those of NOAA or the Department of Commerce."

1. Introduction

The Magnson-Stevens Act (MSA) mandates recurring evaluations of the performance of US catch shares programs. Comprehensive evaluations are required every 5 to 7 years. In January 2007, the Gulf of Mexico (Gulf) Fishery Management Council (Council) implemented Amendment 26 to the Fishery Management Plan for Reef Fish Resources of the Gulf of Mexico (GOMRF FMP), which established an individual fishing quota (IFQ) program for the commercial red snapper fishery. The purpose of the program was to reduce overcapacity and, to the extent possible, lessen the incentive to out-compete other fishermen for a share of the total allowable quota. The initial 5-year review of the IFQ program indicated that

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the program had been successful mitigating derby fishing conditions but the harvesting potential of the fleet remained significantly above the reproductive potential of the resource. Solís, del Corral, Perruso & Agar (2015) estimated that about 1/5 of the fleet could harvest the entire commercial quota. In 2010, Amendment 29 to GOMRF FMP implemented the grouper-tilefish IFQ program to mitigate derby-fishing conditions and reduce overcapacity in the commercial grouper and tilefish fishing fleets. The 5-year review of this latter program also showed that it had been successful mitigating derby-fishing conditions, but overcapacity remained high.

This study examines the on-going performance of these programs towards reducing overcapacity and augmenting technical efficiency. To this end, we consider two scenarios. The first scenario considers the red snapper IFQ as a fishery unto itself; whereas the second scenario considers it part of the Gulf reef fish IFQ fishery (red snapper plus grouper-tilefish) because most of the fleet lands both red snapper and grouper-tilefish species. SERO (2019*a*) reports that the proportion of grouper-tilefish vessels landing red snapper rose from 78% in 2010 to 91% in 2018.

To contribute to the Council's decision-making, this study takes advantage of novel econometric developments that account for vessel-specific heterogeneity, which helps generate improved technical efficiency (TE) and overcapacity measures. Accounting for vessel specific heterogeneity is important beyond academic interest because TE estimates can vary widely depending on whether transient inefficiency, persistent inefficiency, or both, are modeled explicitly; thus, failing to understand the implications of these sources of inefficiency could result in policies that have unintended consequences (Kumbhakar & Lien 2018).

Our study follows several recent papers focusing on IFQs more generally, both in the Gulf of Mexico (Solís, del Corral, Perruso & Agar 2014, Solís, Agar & del Corral 2015, Solís, del Corral, Perruso & Agar 2015) and elsewhere.[1] For example Schnier & Felthoven (2013), using the vessel exit model of Tsionas & Papadogonas (2006) study the impact of

[1]Solís, Agar & del Corral (2015) provide an overview of empirical studies examining capacity in fisheries.

IFQs and exit decisions due to the implementation of IFQs in the Bering Sea and Aleutian Island fisheries in Alaska while Mainardi (2019) (who also develops a selection model to pair with a stochastic frontier framework) studies IFQ impacts in the Falkland/Malvinas Islands. Reimer, Abbott & Haynie (2017) provide a detailed discussion of the policy implications of studying IFQs in a pre-post setting. We also connects with the large literature studying TE in fisheries around the globe: Sharma & Leung (1998, the Hawaiian long-line fishery), Kirkley, Squires & Strand (1998, mid-Atlantic sea scallop fishery), Squires & Kirkley (1999, Pacific Coast trawl fishery), Binh, D'Haese, Speelman & D'Haese (2010, Mekong River Delta fishery), Guttormsen & Roll (2011, Norwegian groundfish fishery) and Álvarez, Couce & Trujillo (2020, Gran Canaria artisanal fishery), to name a few. There are many interesting hypotheses that can be investigated with knowledge of vessel level inefficiency. For example, both Kirkley, Squires & Strand (1998) and Alvarez & Schmidt (2006) study the "good captain hypothesis". A key finding from Alvarez & Schmidt (2006) is that the level of data aggregation (using trip level versus season or year averaged level) plays a role in how much "luck" (noise) or "skill" (technical efficiency) reveals itself. This result has important implications for the level of data aggregation as it pertains to the ratio of variances between noise and efficiency.

A common feature of many of the studies of TE of vessels that have access to panel data is that they do not include vessel specific fixed effects. Some notable exceptions include Reimer, Abbott & Haynie (2017) who use Greene's (2005) "true" fixed effects stochastic panel data frontier model to estimate a hyperbolic distance function and Huang, Ray, Segerson & Walden (2018) who include vessel specific fixed effects in a multi-output stochastic production frontier. To our knowledge, there has yet to be an attempt in the fisheries literature to decompose unobserved vessel specific heterogeneity into idiosyncratic heterogeneity and time-invariant (persistent) technical efficiency (Kumbhakar, Lien & Hardaker 2014).

A final important aspect of empirical specification of the fishing technology, and one that we will speak to, is the ability to measure excess capacity in limited access privilege programs, such as IFQs (Reimer, Abbott & Wilen 2017).[2] The estimation of excess capacity is one that requires delicacy; as noted by Kirkley, Paul & Squires (2004, pg. 272) "Effectively dealing with excess capacity in a given fishery, however, requires both establishing the extent of the problem by estimating the magnitude of excess capacity, and determining how particular boats in the fleet contribute to this capacity, rather than arbitrarily imposing a particular capacity reduction."The setting of arbitrary levels (which quotas are) is fraught with issues pertaining to measurement of capacity. Certainly for any given quota, it is an easy exercise to assess how many fewer vessels could meet such quota if they increased inputs, days at sea or technical efficiency. However, what an analysis of this sort misses is how best to measure capacity to maximize the value of the quota relative to prices that vessels face when they offload their catch. This is, to our knowledge, an unexplored issue in the assessment of capacity utilization literature but one that deserves further attention.

This analysis re-evaluates the efficacy of the red snapper and grouper-tilefish IFQ programs to reduce overcapacity which have been in place since 2007 and 2010, respectively. Using recently developed generalized panel data stochastic frontier methods, we estimate an output-oriented distance function to measure both time-varying and time-constant vessel efficiency for both the red snapper and grouper-tilefish fisheries of the Gulf of Mexico from 2002-2018.

There are several major findings from our analysis. First, fleet capacity increased by by 35% in the red snapper fishery and by 7% in the Gulf reef fish IFQ fishery, post-IFQ. Second, we estimated that 20% of the red snapper fleet could have harvested the red snapper quota, and that, between 2011 and 2016, 57% of the Gulf reef fish IFQ fleet could have harvested the combined red snapper and grouper-tilefish quotas. Third, time varying technical efficiency increased post-IFQ. In the case of the red snapper fishery it grew by 6% and in the case of the Gulf reef fish fishery it increased by 5%. Finally, the fleet as a whole has enjoyed increasing

[2]Earlier work studying excess capacity include Pascoe & Coglan (2000), Felthoven (2002), Felthoven, Horrace & Schnier (2009) and Horrace & Schnier (2010).

returns to scale throughout the sample period with a noticeable improvement after the IFQ was in place.

2. Gulf Red Snapper and Grouper-Tilefish Fisheries

There are two IFQ programs in the Gulf of Mexico. The red snapper program and the grouper-tilefish program, which has five share categories: red grouper, gag, other shallow-water groupers, deep-water groupers, and tilefishes (SERO, 2019*a*, 2019*b*). In 2018, the commercial fleet landed about 6.3 million pounds (gutted weight) of red snapper worth $30 million in dockside revenues and 4.3 million pounds of grouper-tilefish worth $20.4 million in dockside revenues (SERO, 2019*a*, 2019*b*). Red grouper makes about half of the grouper-tilefish landings and revenues. Although there is considerable overlap in the fleets participating in these programs, vertical line vessel account for most of the red snapper landings and longlines vessels account for most of the grouper-tilefish landings, particularly red grouper. Most vessels jointly catch species from both programs.

The contemporary federal commercial management history can be divided into a "command and control" period and an IFQ (or catch share) period. Detailed accounts of the management history of the red snapper fishery can be found in Waters (2001), Hood, Strelcheck & Steele (2007), Agar, Strelcheck & Diagne (2014), and SERO (2019*b*). The management history of the Gulf grouper-tilefish fishery is found in SERO (2019*a*). The command and control period (1984-2006) began with the adoption of the GOMRF FMP in 1984. This FMP aimed to attain the greatest overall benefit to the nation by increasing the yield of the reef fish fishery, minimizing user conflicts in near shore waters, and protecting juvenile reef fish and their habitats (Waters 2001). The early measures intended to protect the red snapper stock included minimum size limits and quotas; however, stock assessments concluded that the stock was in worse condition than expected, resulting in tighter regulations. These more stringent regulations included quota reductions, new reef fish permit moratoriums, and red snapper trip limit endorsements (200 or 2,000 lbs. depending on the vessel's catch history).

Despite these new regulations, fishing derby conditions developed and quotas began to be met progressively sooner. Subsequently, the Council extended the resultant fishing season by splitting the quota into 2 seasons (Spring and Fall) and establishing 10/15-day fishing mini-seasons. Waters (2001) reports that these management measures were not only biologically ineffective because of quota overages and high discard rates but also were economically wasteful because they resulted in excessive capital investments (i.e., overcapacity), short fishing seasons, market gluts, depressed prices, higher harvesting costs, and unsafe fishing practices.

The catch share period (2007-present) began on January 1, 2007. The intent of the IFQ program was to reduce overcapacity and to eliminate, to the extent possible, the problems associated with derby fishing in the red snapper commercial fishery. The 5-year review of the IFQ program concluded that the program had mixed success. The program successfully mitigated derby-fishing behavior and prevented quota overages, but overcapacity remained high as one-fifth of the fleet could harvest the commercial quota. The 5-year review also suggested that further policy interventions may be required to curb overcapacity and to reduce discarding in the eastern Gulf (even though overall discarding had decreased) because of insufficient allocation (leased quota) due to the recovery (and eastern expansion) of the red snapper resource (Agar et al. 2014). In 2010, Amendment 29 to GOMRF FMP implemented the grouper-tilefish IFQ program to mitigate derby-fishing conditions and reduce overcapacity in the commercial grouper and tilefish fishing fleets. The 5-year review of this latter program also indicated that the program had been successful at mitigating derby fishing conditions but additional work was required to curb overcapacity and reduce discard mortality.

3. Methodology

3.1. **Empirical Model.** To assess characteristics of the production process of the IFQ fleet, we deploy a stochastic output distance frontier (ODF). The ODF measures the maximum amount by which an output vector can be proportionally expanded holding an input vector fixed. One of the most common empirical forms for the ODF is the translog (TL) functional form. The TL represents a global second order approximation to the true ODF and is represented as:

$$\ln D_{it} = \beta_0 + \sum_{m=1}^{M} (\beta_m + \rho_m t) \ln y_{mit} + 0.5 \sum_{p=1}^{M} \sum_{m=1}^{M} \beta_{mp} \ln y_{mit} \ln y_{pit}$$
$$+ \sum_{k=1}^{K} (\delta_k + \nu_k t) \ln x_{kit} + 0.5 \sum_{k=1}^{K} \sum_{l=1}^{K} \delta_{kl} \ln x_{kit} \ln x_{lit} + \sum_{m=1}^{M} \sum_{k=1}^{K} \gamma_{mk} \ln y_{mit} \ln x_{kit}, \quad (1)$$

where D_{it} is the output distance, y_{mit} is the m^{th} output level and x_{kit} is the k^{th} input level for vessel i fishing in period t for $i = 1, \ldots, n$ and $t = 1, \ldots, T$. Axiomatically, the ODF is homogeneous of degree 1 which allows normalization by one output. The ODF is also symmetric in the cross terms such that $\beta_{mp} = \beta_{pm}$ and $\delta_{kl} = \delta_{lk}$. Once the normalizations have been taken into account, and rearranging, we have

$$-\ln y_{1it} = \beta_0 + \sum_{m=2}^{M} (\beta_m + \rho_m t) \ln \tilde{y}_{mit} + 0.5 \sum_{p=2}^{M} \sum_{m=2}^{M} \beta_{mp} \ln \tilde{y}_{mit} \ln \tilde{y}_{pit}$$
$$+ \sum_{k=1}^{K} (\delta_k + \nu_k t) \ln x_{kit} + 0.5 \sum_{k=1}^{K} \sum_{l=1}^{K} \delta_{kl} \ln x_{kit} \ln x_{lit}$$
$$+ \sum_{m=2}^{M} \sum_{k=1}^{K} \gamma_{mk} \ln \tilde{y}_{mit} \ln x_{kit} - \ln D_{it}, \quad (2)$$

where $\tilde{y}_{mit} = y_{mit}/y_{1it}$. In the empirical literature $D_{it} \leq 1$ so that $\ln D_{it} \leq 0$. This implies that we can set $u_{it} = -\ln D_{it}$. Adding in a stochastic noise term, v_{it} along with vessel specific heterogeneity, τ_i, we have our final, panel stochastic ODF:

$$\begin{aligned}
-\ln y_{1it} = \beta_0 + & \sum_{m=2}^{M} (\beta_m + \rho_m t) \ln \tilde{y}_{mit} + 0.5 \sum_{p=2}^{M} \sum_{m=2}^{M} \beta_{mp} \ln \tilde{y}_{mit} \ln \tilde{y}_{pit} \\
& + \sum_{k=1}^{K} (\delta_k + \nu_k t) \ln x_{kit} + 0.5 \sum_{k=1}^{K} \sum_{l=1}^{K} \delta_{kl} \ln x_{kit} \ln x_{lit} \\
& + \sum_{m=2}^{M} \sum_{k=1}^{K} \gamma_{mk} \ln \tilde{y}_{mit} \ln x_{kit} + \kappa \boldsymbol{z}_{it} + v_{it} + u_{it} + \alpha_i, \qquad (3)
\end{aligned}$$

where $\boldsymbol{z}_{it}$ is a set of controls that also impact the distance frontier. This has all the makings of a standard stochastic cost frontier: for a fixed level of outputs $\tilde{y}_{2it}, \ldots, \tilde{y}_{Mit}$ and inputs, time-varying vessel inefficiency decreases how much output can be produced. Note this happens radially, so that all outputs are decreased by the same relative amount.

For the red snapper IFQ model, we have four outputs (red snapper, other snappers, grouper-tilefish species, and a miscellaneous or residual group), one quasi-fixed input (vessel length) and two variable inputs (days fished and crew size). Here $\boldsymbol{z}_{it}$ includes quarter dummies ($Q4$ is the baseline), regional landing location (county-level) dummies, biomass estimates for red snapper, red grouper, gag and yellowedge grouper as well as IFQ implementation dummies for red snapper (2007-2018) and grouper tilefish (2010-2018). For the Gulf reef fish IFQ model (i.e., red snapper with grouper-tilefish) we employ a similar model with the exception that instead of four species groupings we only have three: red snapper with grouper-tilefish, other snappers and the residual group.

We enhance the model by allowing for both vessel specific heterogeneity as well as time constant vessel inefficiency. This is achieved by writing $\alpha_i = c_i + \tau_i$, where c_i captures vessel heterogeneity and τ_i captures time invariant, or persistent, inefficiency. Recognizing this distinction in unobservable heterogeneity is important as it is likely that there exist differences across vessels participating in the IFQ that do not vary over time (like innate skipper skill) as well as persistent habits that vessels may exhibit which lead to lower catch rates than otherwise expected. We assume that $\tau_i \geq 0$ to capture this. Given that our time span covers 17 years for the red snapper fishery data learning is likely to occur (e.g., 17 years in the red snapper IFQ fishery). This is captured in u_{it}. Here if $u_{it} \leq u_{it+1}$ $\forall t$ then time-varying inefficiency is decaying over time, and one reason for this can be learning on behalf of the skipper. τ_i has no time component so this acts to quantify unobservable skill in fishing, i.e. persistent inefficiency.

3.2. **Estimation.** Assuming that x_{kit} and α_i are uncorrelated, the OLS estimator applied to the empirical model in (3) is consistent, but inefficient. Further, while OLS estimation is simple, it does not offer the ability to recover estimates of unobserved heterogeneity or output efficiency. A simple, multi-step procedure originally proposed in Kumbhakar et al. (2014) is available to estimate the stochastic ODF for specification given in (3), known as plug-in likelihood estimation (see Andor & Parmeter 2017). To aid in describing how we recover estimates of inefficiency (both time-varying and persistent) we first rewrite the normalized stochastic ODF as

$$\begin{aligned}
-\ln y_{1it} = \beta_0^* &+ \sum_{m=2}^{M}(\beta_m + \rho_m t)\ln \tilde{y}_{mit} + 0.5\sum_{p=2}^{M}\sum_{m=2}^{M}\beta_{mp}\ln \tilde{y}_{mit}\ln \tilde{y}_{pit} \\
&+ \sum_{k=1}^{K}(\delta_k + \nu_k t)\ln x_{kit} + 0.5\sum_{k=1}^{K}\sum_{l=1}^{K}\delta_{kl}\ln x_{kit}\ln x_{lit} \\
&+ \sum_{m=2}^{M}\sum_{k=1}^{K}\gamma_{mk}\ln \tilde{y}_{mit}\ln x_{kit} + \varepsilon_{it}^* + \alpha_i^*. \qquad (4)
\end{aligned}$$

where $\beta_0^* = \beta_0 + E[\tau_i] + E[u_{it}]$; $\alpha_i^* = c_i + \tau_i - E[\tau_i]$; and $\varepsilon_{it}^* = v_{it} + u_{it} - E[u_{it}]$. With this specification both α_i^* and ε_{it}^* are zero mean and constant variance random variables. Additionally, we will assume that v_{it} is i.i.d. $N(0, \sigma_v^2)$ and u_{it} is i.i.d. $N_+(0, \sigma_u^2)$ while c_i is i.i.d. $N(0, \sigma_c^2)$, τ_i is i.i.d. $N_+(0, \sigma_\tau^2)$. The parameters of the model are estimated in three steps. We discuss estimation of this model under the random effects (RE) framework.

Step 1: Estimate the parameters of the stochastic ODF in (4) using a random effects panel data estimator. These estimates are then used to generate predicted values of α_i^* and ε_{it}^*, denoted by $\widehat{\alpha}_i^*$ and $\widehat{\varepsilon}_{it}^*$. No distributional assumptions are required to estimate the parameters of the output distance function.

Step 2: Time-varying technical inefficiency, u_{it}, is estimated using the information contained in $\hat{\varepsilon}_{it}^*$ from Step 1. We have $\varepsilon_{it}^* = v_{it} + u_{it} - \sqrt{2/\pi}\,\sigma_u$ under the assumption of half-normality. The parameters for the distributions of v and u can be estimated using maximum likelihood or method of moments. Doing so produces predictions of the time-varying technical inefficiency component u_{it}, $E\left[e^{-u_{it}}|\varepsilon_{it}^*\right]$, which Kumbhakar, Parmeter & Zelenyuk (2018) term relenting technical efficiency (RTE).

Step 3: Estimate τ_i following a similar strategy as in Step 2. For this we use $\widehat{\alpha}_i^*$ from Step 1. Again, based on the common distributional assumptions, $\alpha_i^* = c_i + \tau_i - \sqrt{2/\pi}\,\sigma_\tau$ can be estimated using maximum likelihood. Estimates of the persistent technical inefficiency (PTE) component, can be obtained from $E\left[e^{-\tau_i}|\alpha_i^*\right]$. Overall technical efficiency (OTE) is then constructed as the product of PTE and RTE, OTE = PTE×RTE.

An alternative multi-step approach based on corrected OLS (COLS) follows from Kumbhakar & Lien (2018). Rather than performing maximum likelihood estimation in steps 2 and 3, method of moments are deployed to recover estimates of the unknown distributional parameters. A benefit of this approach is that a modified likelihood function is not needed and these estimators can be constructed with a few lines of code in any matrix oriented statistical software. To see this, note that under the assumption of normal-half normal for either α_i or ε_{it}, the variance parameters can be constructed using the second and third moments of these terms. That is, for the second and third moments of, say, $\widehat{\zeta}_{it}$:

$$\widehat{m}_2(\widehat{\zeta}) = (nT)^{-1} \sum_{i=1}^{n} \sum_{t=1}^{T} \widehat{\zeta}_{it}^2 \tag{5}$$

and

$$\widehat{m}_3(\widehat{\zeta}) = (nT)^{-1}\sum_{i=1}^{n}\sum_{t=1}^{T}\widehat{\zeta}_{it}^3, \tag{6}$$

the variance components can be estimated via:

$$\widehat{\sigma}_u^2 = \max\left\{0, \left[\sqrt{\frac{\pi}{2}}\left(\frac{\pi}{\pi-4}\right)\widehat{m}_3(\widehat{\varepsilon}^*)\right]^{2/3}\right\} \tag{7}$$

$$\widehat{\sigma}_v^2 = \widehat{m}_2(\widehat{\varepsilon}^*) - \left(\frac{\pi-2}{\pi}\right)\widehat{\sigma}_u^2. \tag{8}$$

For estimation of the variance components of the time-constant components we would have

$$\widehat{\sigma}_\tau^2 = \max\left\{0, \left[\sqrt{\frac{\pi}{2}}\left(\frac{\pi}{\pi-4}\right)\widehat{m}_3(\widehat{\alpha}^*)\right]^{2/3}\right\} \tag{9}$$

$$\widehat{\sigma}_c^2 = \widehat{m}_2(\widehat{\alpha}^*) - \left(\frac{\pi-2}{\pi}\right)\widehat{\sigma}_\tau^2. \tag{10}$$

As in standard cross-sectional settings, if either $\widehat{\alpha}_i^*$ or $\widehat{\varepsilon}_{it}^*$ have the wrong skew, then the variance estimate of the corresponding inefficiency term will be zero (Olson, Schmidt & Waldman 1980). It is also possible to obtain negative variance estimates (what Olson et al. (1980) term a type 2 error) for the normally distributed components, c_i and v_{it}, but this is rare empirically.

The three-step approach just described is inefficient relative to full maximum likelihood, yet is straightforward to implement. Previous research has shown that similar step-wise estimation strategies perform nearly identical to maximum likelihood in small samples (Olson et al. 1980, Coelli 1995, Andor & Parmeter 2017). This suggests that concerns over loss of efficiency in applying step-wise or corrected procedures may be overstated.

4. Capacity, Overcapacity and Utilization

Before discussing the findings of this study it is useful to review the definitions of harvesting capacity, excess capacity and overcapacity. Following NMFS guidelines harvesting capacity is defined as the "maximum amount of fish that the fishing fleets could have reasonably expected to catch or land during the year under the normal and realistic operating conditions of each vessel, fully utilizing the machinery and equipment in place, and given the technology, the availability and skill of skippers and crew, the abundance of the stocks of fish, some or all fishery regulations, and other relevant constraints" (Terry, Walden & Kirkley 2008). Further, NMFS defines excess capacity as the difference between harvesting capacity and estimated catch or landings and overcapacity as the difference between harvesting capacity and a short-term target catch level such as an annual catch limit or proxy (Terry et al. 2008).

This study adopts the definition of fishing capacity as the potential (maximal) output that a fishing fleet could harvest given the current stock of capital and other fixed inputs, the state of the technology and the available biomass (FAO 1998). With the notion of maximal output, estimation of capacity requires us to work with a stochastic production frontier (Parmeter & Kumbhakar 2014).

A standard approach to measuring capacity is, at the vessel level, determining maximum attainable output with the full utilization (unrestricted use) of variable inputs given the existing capital and other fixed factors of production. Felthoven et al. (2009) look at days at sea in their estimation of capacity.

To that end, several alternative approaches have been proposed to estimate capacity, including: (i) identifying the maximum observed variable input levels of all vessels with similar fixed input endowments (for instance comparing catch rates across vessels of the same length); (ii) identifying the theoretically maximum variable input usage levels; and (iii) increasing the observed variable input levels by an *ad hoc* amount, such as an increase of 25 or 50%. Here our approach to estimate capacity is more focused and, we believe, consistent with Terry et al. (2008). We hold inputs fixed at observed levels and ask what each vessel could catch if they were to eliminate both persistent and time-varying inefficiency. In some sense we are moving vessels in the output direction radially to calculate capacity whereas other approaches move the vessels in the input direction to calculate capacity.

5. Data and Model Specification

The data used in this study were obtained from the National Marine Fisheries Service (NMFS) Southeast Coastal Fisheries Logbook Program and the Permits Information Management Systems (PIMS) databases. The logbook database contains detailed trip-level information on landings and fishing effort, and the PIMS database contains information on vessel characteristics.

To avoid potential biases due to heterogeneous fishing technologies, we modeled the vertical line and longline fleets separately. For the red snapper IFQ model we only included vertical line vessels that landed at least one pound of red snapper during the year, because this gear lands more than 80% of the red snapper in the entire database. For the Gulf reef fish IFQ model we included vertical line and longline vessels that landed at least one pound of red snapper or grouper-tilefish species during the year.

In the next two sections, we present the results of the red snapper and reef fish IFQ models.

6. Red Snapper IFQ Model: Empirical Findings

6.1. **Characteristics of the Technology.** Following Solís, del Corral, Perruso & Agar (2015) we study the five years prior to the implementation of the IFQ (2002-2006) along with the corresponding 12 years after (2007-2018). Those observations for which missing or incomplete input and/or output data were also excluded from the analysis resulting in an unbalanced panel data of 94,595 observations on 1306 distinct vessels.[3]

We did not aggregate to the quarter level as was done in Solís, del Corral, Perruso & Agar (2015) as this has the potential to obscure important trip information that can be hidden in the aggregation. For example, fisherman may make several trips in a quarter and in one trip may catch a substantial amount relative to their other trips. In sum their quarter level fishing may appear more robust given this one highly productive trip. By focusing on the

[3]For reference, there were a total of 114,685 complete observations that reported red snapper landings regardless of fishing gear so limiting our analysis to vertical line covers roughly 82% of the trips where red snapper was caught.

trip level we can more aptly characterize performance for all trips taken by a vessel. By not aggregating we are left with the situation where some trips produced zero catch for a particular species. Those trips by vessels within a season that did not land red snapper were coded as landing 1 lb such that the subsequent logarithmic transformation was 0.[4]

Table 1 presents summary statistics for our inputs, outputs and biomass variables that are used to estimate the stochastic ODF for those vessels which landed red snapper caught with vertical lines. We can see immediately that for these vessels red snapper landings are, on average, more than double the catch of any other species. The largest vessel is 78 feet in length while the average vessel is roughly 40 feet in length with a crew size of three (exclusive of the captain). The vast majority of trips are under four days with an average of 3.4 days away. In general the characteristics of the fleet and fishery are similar to the snapshot of the fleet provided in Solís, del Corral, Perruso & Agar (2015) even when we extend those data to 2018.

Table 1. Descriptive statistics for the red snapper IFQ model.

		Mean	St. Dev.	Min	Max
Red Snapper (lbs.)	y_1	763.6	1,700.655	0	33,735
Other Snapper (lbs.)	y_2	317.8	808.485	0	12,038
Grouper/Tilefish (lbs.)	y_3	356.5	655.675	0	18,089
All Other Species (lbs.)	y_4	249.8	646.5	0	26,460
Vessel Length (ft.)	x_1	37.7	9.7	18	78
Days Away	x_2	3.4	2.7	1	14
Crew	x_3	2.7	1.2	1	8
Red Snapper Biomass (mt.)	z_1	68,957.8	17,255	51,939.4	101,071
Gag Biomass (mt.)	z_2	10,844	3,516.1	4,947	16,315
Red Grouper Biomass (mt.)	z_3	20,747	4,522.8	11,340	27,873
Yellowedge Grouper Biomass (mt.)	z_4	5,730.5	187.5	5,524.7	6,095.7

Solís, del Corral, Perruso & Agar (2015) assumed that the ODF technology and TE were homogeneous for the fleet across the implementation of the IFQ. To test this we split our

[4]Certainly this empirical practice, while common in many applied production domains, is tenuous at best, but lacking a formal selection model, the other option is to focus our attention exclusively on those landings that reported red snapper. In this case we have 63,260 trip records, roughly two-thirds of our initial sample.

sample between pre- and post-IFQ and estimate separate stochastic ODF. We then use a heteroskedastic robust Wald test to assess if there are statistically meaningful differences between the two periods. We find at all conventional levels of significance that the pre- and post-IFQ periods do indeed display different technological features. Given this we assess the ODF in Equation (3) for the pre- and post-IFQ separately.

As translog model parameter estimates are notoriously difficult to interpret directly, model assessment typically relies on other alternatives. Table 2 presents input and output elasticities across the entire period along with returns to scale (RTS). We do not present the raw estimates from the translog ODF as any given parameter lacks direct economic interpretation. Rather, we focus on meaningful quantities that have direct economic relevance. We see that red snapper (y_1) and grouper-tilefish (y_3) have larger (in magnitude) output elasticities than the other categories, which is intuitive. Moreover, the output elasticity for red snapper decreased in magnitude between the pre- and post-IFQ periods by nearly 20%. Agar et al. (2014) report that after the adoption of IFQs, red snapper fishermen increased the duration of their trips and diversified their catch composition largely because of the elimination of trip limits and fishing mini-seasons.

Several other interesting features of the technology for the fleet are the fact that returns to scale are above one, suggesting the ability to scale up (by increasing crew size and days at sea). We do note that our estimates of RTS are lower than those reported in Solís, del Corral, Perruso & Agar (2015, Table 4) as we treat vessel length as a quasi-fixed input whereas they treat it as a variable input. It appears here that the elasticity of vessel length (with respect to output) has decreased across the pre/post-IFQ split, although the last five years have seen a rise of the elasticity of vessel length quite close to one. This could be reflective of adaptation to the IFQ. It may capture the dramatic increase in red snapper quota during that period and the relative higher 'red snapper' share of total landings (see Table 11 on page 19 and Table 16 on page 24 of SERO (2019*b*)). Additionally, catch responsiveness to changes in days at sea is twice as high as for changes in crew size. This is intuitive. Bringing additional

Table 2. Partial distance input/output elasticities and RTS pre- and post-IFQ: Assumes different technology pre- and post-IFQ for red snapper IFQ model. 1000 Bootstrap standard errors appear beneath each estimate in parentheses.

	Whole Sample	Pre-IFQ	Post-IFQ	2007-2011	2012-2018
Output Elasticities					
Red Snapper	−0.275	−0.313	−0.250	−0.194	−0.280
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Other Snapper	−0.187	−0.185	−0.189	−0.185	−0.191
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Grouper/Tilefish	−0.315	−0.279	−0.339	−0.376	−0.320
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Other Species	−0.222	−0.224	−0.221	−0.244	−0.209
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Input Elasticities					
Vessel Length	1.066	1.228	0.957	0.881	0.997
	(0.024)	(0.032)	(0.035)	(0.041)	(0.038)
Days Away	0.971	0.872	1.037	1.053	1.029
	(0.006)	(0.01)	(0.008)	(0.01)	(0.009)
Crew	0.403	0.401	0.403	0.470	0.368
	(0.01)	(0.018)	(0.012)	(0.016)	(0.014)
RTS	1.374	1.274	1.441	1.522	1.398
	(0.012)	(0.02)	(0.015)	(0.019)	(0.017)

crew will have less impact on the catch of a given trip than staying at sea for additional days. Given the fixed length of the vessel, additional crew could lead to overcrowding.

We deploy bootstrap sampling of the errors to assess the statistical significance of all of our estimates of returns to scale and input/output elasticities. We use a wild bootstrap algorithm with 1,000 resamples. For each resample we reestimate the random effects model, again splitting the sample into pre- and post-IFQ periods, allowing the technology to differ. These standard errors are presented beneath each estimate in parentheses in Table 2. As is clear our measure of average elasticities of the fleet and scale are quite precise. We are dealing with nearly 100,000 observations so this is not surprising.

There is also a substantial impact of the IFQ on trip duration. The trip duration elasticity rose from 0.872 in the pre-IFQ period to 1.037 in the post-IFQ period probably because of the relaxation regulations such as trip limits and mini-seasons from the command and control period. All told, Table 2 suggests that there was a significant change in fleet behavior after the implementation of the IFQ program. The null hypothesis that technical inefficiency does not exist ($H_0 : \sigma_u = 0$) is rejected at the 1 per cent level favoring the adoption of a stochastic distance frontier over a standard distance function. The ratio of the standard deviation of u to that of v, λ, equals 1.887 prior to the implementation of the IFQ and 2.797 afterwards, indicating that skill (efficiency) is more important than random shocks in explaining production differences across fishing vessels.

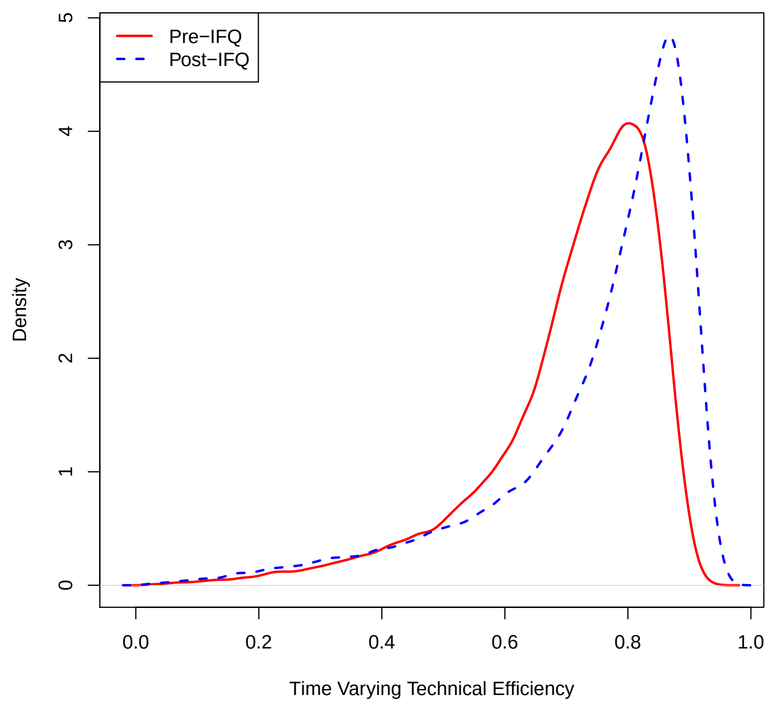
To better assess the ability of vessels to increase red snapper landings we investigate time-varying inefficiency of the fleet in the pre- and post-IFQ periods. Figure 1 presents the kernel density plot of estimated time-varying inefficiency across the implementation of the IFQ. We see a rightward shift in the full distribution and a movement in the mean time-varying efficiency of roughly four percentage points (0.711 to 0.751).

Table 3 breaks down overall technical efficiency (OTE) by year as well as into its separate components: time-varying and persistent inefficiency (TVE and PE, respectively). Consistent with Figure 1 the fleet became more efficient over time. One empirical issue we encountered is that for the pre-IFQ sample, the random effects did not display appropriate skewness, so persistent efficiency was not identified; more specifically, the variance parameter is estimated to be zero, suggesting that there does not exist persistent inefficiency, the natural conclusion of which is that persistent efficiency is 1.[5] The common approach in this instance is to claim that persistent inefficiency is at or very near to 0, so time-varying and overall technical inefficiency are the same (Olson et al. 1980).

6.2. **Capacity of the Fleet.** Table 4 details a year by year break down of estimated capacity of the red snapper IFQ fleet. There are several striking features. First, consistent with Solís,

[5]This is a common issue in empirical work that typically results in researchers seeking alternative specifications to have the ability to present estimates on inefficiency. Another alternative is to use bootstrap bagging methods to construct confidence intervals for each vessel in each period.

Figure 1. Density plot of time-varying technical efficiency for Gulf of Mexico vessels, pre- and post-IFQ for the red snapper IFQ model.



del Corral, Perruso & Agar (2015), pre-IFQ red snapper catch totals are higher than post-IFQ catch totals up to 2011 (the year their analysis ended). Landings rose because of increased quota levels in the last few years of the program (2014 and onwards; Table 5). We also see capacity levels of the fleet are higher than catch totals and quota levels by a wide margin, indicating the presence of overcapacity.

Looking over the pre-IFQ period, the red snapper C^{OTE} is roughly 150% higher than reported catch rates, while for the second half of the post-IFQ the same measure is 178%. Table 5 presents the observed fleet size and number of trips taken (vertical line only) and the smallest (fully efficient) fleet size and the minimum number (most productive) of trips that could have harvested the entire quota, had the fleet operated at full efficiency (OTE).

Table 3. Technical efficiency scores for the red snapper fleet pre- and post-IFQ.

	OTE	TVE	PE
2002	0.712	0.712	1.000
2003	0.714	0.714	1.000
2004	0.710	0.710	1.000
2005	0.714	0.714	1.000
2006	0.707	0.707	1.000
2007	0.593	0.742	0.799
2008	0.606	0.759	0.798
2009	0.599	0.753	0.796
2010	0.600	0.754	0.796
2011	0.598	0.752	0.795
2012	0.605	0.755	0.802
2013	0.610	0.758	0.804
2014	0.605	0.753	0.804
2015	0.597	0.744	0.803
2016	0.601	0.753	0.798
2017	0.598	0.749	0.798
2018	0.597	0.746	0.800
$Entire$	0.645	0.735	–
$Pre-IFQ$	0.711	0.711	–
$Post-IFQ$	0.601	0.751	0.800
$2007-2011$	0.599	0.752	0.797
$2012-2018$	0.602	0.751	0.802

Table 5 also shows the predicted (anticipated) quota utilization (i.e., catch/quota) had the observed fleet operated at OTE.

Tables 4 and 5 provides convincing evidence of the presence of excess capacity and overcapacity. Consistent with the initial findings of Solís, del Corral, Perruso & Agar (2015) we find that many vessels left the fishery after the implementation of the IFQ and that about 20% of the vertical line fleet (operating at full efficiency) could have harvested the entire quota. We note that a larger number of shorter trips ensures fresher product, which is what has historically been demanded, promoting higher prices. Fewer trips means more product being landed at the same time, which can also lead to gluts and reduced prices.

Table 4. Annual red snapper fleet capacity measures pre- and post-IFQ

	Actual Catch	C^{OTE}	C^{TVE}
2002	4,225	6,497	6,497
2003	4,083	6,174	6,174
2004	3,714	5,641	5,641
2005	3,334	4,880	4,880
2006	3,999	6,053	6,053
2007	2,580	4,869	3,981
2008	2,079	3,490	2,906
2009	2,088	3,973	3,262
2010	2,742	5,070	4,158
2011	2,937	5,172	4,305
2012	3,391	6,225	5,230
2013	4,311	7,392	6,224
2014	4,548	8,235	6,836
2015	5,874	10,843	8,970
2016	5,501	9,726	8,083
2017	5,748	10,098	8,422
2018	5,656	10,182	8,509
Entire	4,251	7,286	6,352
$Pre-IFQ$	3,871	5,849	5,849
$Post-IFQ$	4,410	7,885	6,562
2007 − 2011	2,485	4,515	3,722
2012 − 2018	5,785	10,292	8,590

7. Gulf Reef Fish IFQ Model: Empirical Findings

Here we present the Gulf reef fish IFQ model, which combines the reported landings for red snapper and grouper-tilefish into a single species group category. We also include both longline and vertical line vessels. Excluding observations with missing fields resulted in an unbalanced panel data of 144,960 observations on 2,090 distinct vessels.

Table 6 presents summary statistics for inputs, outputs and biomass variables that are used to estimate the stochastic ODF for those vessels which landed either red snapper or grouper-tilefish with long or vertical lines. This table shows that, on average, IFQ species landings are more than four times higher than those from other species groupings. The largest vessel is 87 feet in length while the average vessel is roughly 38 feet in length with a

Table 5. Annual red snapper fleet size measures.

Year	Quota	Fully Efficient Vessels	Total Vessels	Fully Efficient Trips	Total Trips	% Vessels	% Trips	Quota Utilization Actual	Quota Utilization Predicted
2002	4,189,189	111	430	1,297	8,217	0.258	0.158	1.051	1.551
2003	4,189,189	115	425	1,332	8,134	0.271	0.164	1.025	1.474
2004	4,189,189	116	439	1,443	8,035	0.264	0.180	0.991	1.347
2005	4,189,189	127	432	1,690	6,863	0.294	0.246	0.864	1.165
2006	4,189,189	109	394	1,390	6,672	0.277	0.208	1.021	1.445
2007	2,297,297	68	291	203	3,844	0.234	0.053	0.960	2.119
2008	2,297,297	77	279	351	3,928	0.276	0.089	0.974	1.519
2009	2,297,297	57	286	229	4,014	0.199	0.057	0.974	1.729
2010	2,297,297	44	334	176	3,639	0.132	0.048	0.958	2.207
2011	3,190,991	75	319	367	4,259	0.235	0.086	0.981	1.621
2012	3,300,901	45	316	252	4,294	0.142	0.059	0.979	1.886
2013	3,712,613	49	313	270	4,174	0.157	0.065	0.971	1.991
2014	5,054,054	62	346	362	4,581	0.179	0.079	0.992	1.629
2015	5,054,054	49	345	269	5,023	0.142	0.054	0.985	2.145
2016	6,097,297	63	352	448	5,152	0.179	0.087	0.993	1.595
2017	6,312,613	67	369	488	5,172	0.182	0.094	0.996	1.600
2018	6,312,613	68	376	431	4,513	0.181	0.096	0.996	1.613

crew size of three (exclusive of the captain). The vast majority of trips are under four days with an average of 3.9 days away.

Table 6. Descriptive statistics for Gulf reef fish IFQ fishery.

		Mean	St. Dev.	Min	Max
Red Snapper/Grouper/Tilefish (lbs.)	y_1	1,261.6	2,042.5	0	39,352
Other Snapper (lbs.)	y_2	221.1	683.4	0	12,038
All Other Species (lbs.)	y_3	301.3	753.8	0	51,794
Vessel Length (ft.)	x_1	37.7	9.6	18	87
Days Away	x_2	3.9	3.3	1	14
Crew	x_3	2.6	1.1	1	8
Red Snapper Biomass (mt)	z_1	66,582.3	16,443.2	51,939.4	101,071
Gag Biomass (mt.)	z_2	10,473.5	3,495.5	4,947	16,315
Red Grouper Biomass (mt.)	z_3	20,955.4	4,243.9	11,340	27,873
Yellowedge Grouper Biomass (mt.)	z_4	5,705.9	178.2	5,524.7	6,095.7

TABLE 7. Partial distance input/output elasticities and RTS pre- and post-IFQ for the Gulf reef fish IFQ fishery: Assumes different technology pre- and post-IFQ as well as across gear type.

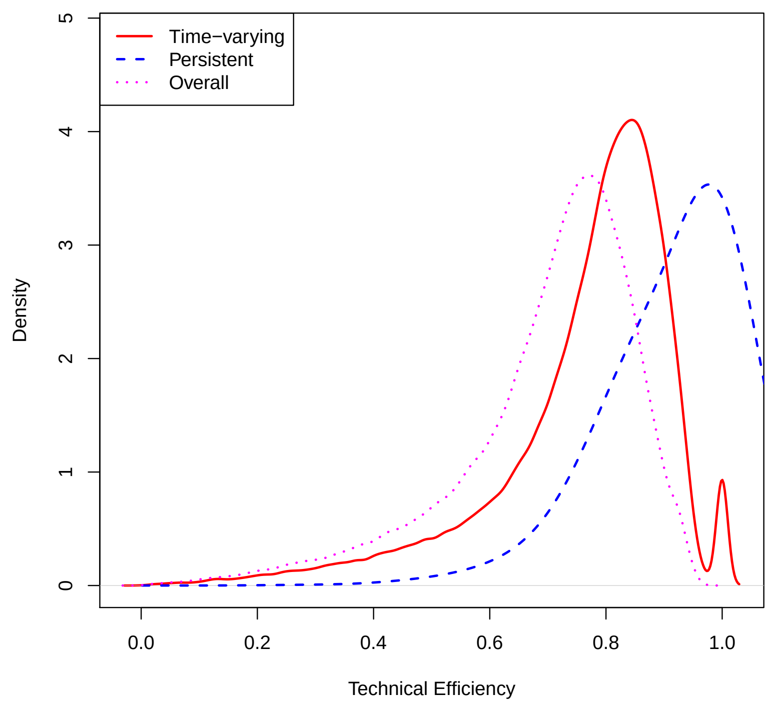
	Whole Sample	Pre-IFQ	Post-IFQ	2010-2014	2015-2018
Output Elasticities					
Red Snapper/Grouper/Tilefish	−0.517	−0.511	−0.527	−0.509	−0.546
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Other Snapper	−0.248	−0.267	−0.220	−0.232	−0.209
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
All Other Species	−0.234	−0.222	−0.252	−0.259	−0.246
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Input Elasticities					
Vessel Length	0.974	0.913	1.066	0.944	1.185
	(0.019)	(0.025)	(0.026)	(0.025)	(0.035)
Days Away	0.853	0.822	0.899	0.944	0.856
	(0.005)	(0.006)	(0.006)	(0.006)	(0.008)
Crew	0.366	0.363	0.371	0.368	0.374
	(0.008)	(0.01)	(0.01)	(0.011)	(0.013)
RTS	1.220	1.185	1.271	1.312	1.230
	(0.009)	(0.012)	(0.011)	(0.013)	(0.015)

Similar to our earlier analysis we allow the fishing technology to differ across the pre- and post-IFQ periods, using the 2010 grouper-tilefish IFQ as our cutoff. We also allow the technology to differ between longline and vertical line vessels.

Table 7 presents input and output elasticities across the entire period along with returns to scale. We do not present the raw estimates from the translog ODF as any given parameter lacks economic interpretation. Again, we focus on measures that have direct economic relevance. We see that red snapper/grouper-tilefish (y_1) have larger (in magnitude) output elasticities than the other categories, which is intuitive. Moreover, the output elasticity for red snapper/grouper-tilefish increased in magnitude between the pre- and post-IFQ (in this case we use the year 2010 as that is when IFQs exists for all three species groups) but only minimally so.

Figure 2 presents the kernel density estimate of estimated technical efficiency both overall and in its constituent components: time-varying and persistent for the Gulf reef fish IFQ fleet. For the entire fleet over the full time period, we see that average persistent technical inefficiency is low (suggesting little time constant inefficiencies which pervade the fleet) while time-varying technical efficiency is lower than that for persistent technical efficiency. The spike that occurs at one occurs because we have several vessels that are found to be approximately fully efficient.

Figure 2. Density plot of overall technical efficiency and its components for the Gulf reef fish IFQ fleet.



We also investigated a more nuanced depiction of time-varying technical efficiency of the Gulf reef fish fleet. Figure 3 presents the kernel density plot of estimated time-varying efficiency across gear type and pre/post adoption of the IFQ. We see a rightward shift in the estimated kernel densities for both vertical and longline fleets after the 2010 IFQ was implemented. The average technical efficiency moved up by almost 4 percentage points for vertical line vessels post-IFQ while it moved just over 9 percentage points for longline vessels.

Moreover, the longline fleet appears to be more technically efficient than the vertical line fleet regardless of the IFQ.

FIGURE 3. Density plot of time-varying technical efficiency for Gulf reef fish IFQ fleet, pre- and post-IFQ by line type.

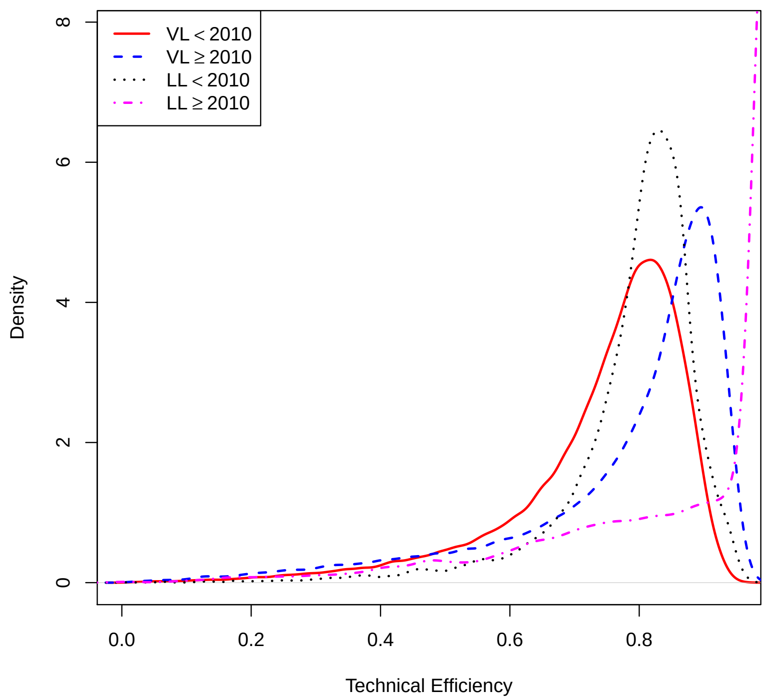


Table 8 breaks down overall technical efficiency by year and into its separate components, time-varying and persistent. Consistent with Figure 2 the fleet became more efficient over time. One empirical issue we encountered is that for the pre-IFQ sample, the random effects did not display appropriate skewness, so persistent efficiency was not identified for the vertical line fleet. We did find persistent inefficiency in the longline fleet however.

7.1. **Capacity of the Fleet.** Table 9 details a year by year break down of estimated excess capacity of the Gulf reef fish IFQ fleet. There are several striking features. First, reported landings had a near continuous decline from 2002 through 2010, rebounding after the IFQ went into effect. These reported landings again declined for the last two years for which

Table 8. Technical efficiency scores pre- and post-IFQ for full fleet and by gear type.

	Full Fleet			Vertical Line			Long Line		
	OTE	TVE	PE	OTE	TVE	PE	OTE	TVE	PE
2002	0.733	0.745	0.986	0.737	0.737	1.000	0.711	0.797	0.892
2003	0.735	0.747	0.985	0.741	0.741	1.000	0.703	0.787	0.894
2004	0.737	0.749	0.985	0.742	0.742	1.000	0.707	0.791	0.894
2005	0.733	0.747	0.983	0.738	0.738	1.000	0.708	0.790	0.896
2006	0.735	0.749	0.982	0.740	0.740	1.000	0.711	0.791	0.899
2007	0.739	0.752	0.984	0.745	0.745	1.000	0.709	0.789	0.898
2008	0.731	0.744	0.985	0.734	0.734	1.000	0.715	0.793	0.902
2009	0.730	0.736	0.992	0.733	0.733	1.000	0.694	0.769	0.903
2010	0.627	0.778	0.804	0.608	0.767	0.793	0.808	0.886	0.912
2011	0.649	0.798	0.812	0.626	0.784	0.799	0.829	0.905	0.916
2012	0.647	0.789	0.817	0.625	0.776	0.804	0.815	0.889	0.917
2013	0.656	0.799	0.820	0.638	0.789	0.808	0.803	0.876	0.916
2014	0.648	0.794	0.815	0.632	0.787	0.804	0.788	0.862	0.915
2015	0.636	0.778	0.816	0.616	0.765	0.805	0.822	0.899	0.915
2016	0.641	0.786	0.814	0.621	0.774	0.803	0.813	0.891	0.912
2017	0.639	0.784	0.814	0.623	0.775	0.804	0.803	0.880	0.913
2018	0.636	0.780	0.813	0.615	0.767	0.802	0.831	0.910	0.914
$Entire$	0.697	0.763	0.916	0.691	0.754	0.918	0.741	0.821	0.902
$Pre-IFQ$	0.734	0.746	0.985	0.739	0.739	1.000	0.708	0.790	0.896
$Post-IFQ$	0.642	0.787	0.814	0.623	0.776	0.803	0.811	0.887	0.915
$2010-2015$	0.646	0.792	0.814	0.626	0.781	0.802	0.809	0.884	0.915
$2015-2018$	0.638	0.782	0.814	0.619	0.770	0.804	0.817	0.895	0.913

we have full data (2017/2018). Second, looking over the pre-IFQ period, full fleet C^{OTE} is roughly 45% higher than reported landings, while for the second half of the post-IFQ the same measure is 62%. This level of excess capacity post-IFQ is consistent throughout the period (whether we look initially after the IFQ was implemented, 2010-2014, or later, 2015-2018). Finally, even though the average annual catch was *higher* prior to IFQ implementation, the fully efficient catch potential is roughly 7% higher after the IFQ goes into effect. This increased predicted catch potential is primarily driven by the last four yeas of catch data.

Table 10 shows that since 2011, on average, 2.3 of the fully efficient fleet (or 49% of the fully efficient trips) could have harvested the reported landings (i.e., 84% of the quota). This table

Table 9. Annual fleet capacity measures pre- and post-IFQ for the Gulf reef fish IFQ fishery.

	Actual Catch	C^{OTE}	C^{TVE}
2002	13,374	19,545	18,803
2003	12,525	18,469	17,724
2004	13,043	18,971	18,142
2005	12,030	17,676	16,916
2006	11,236	16,060	15,417
2007	8,692	12,285	11,783
2008	9,225	13,250	12,692
2009	7,544	11,190	10,868
2010	6,446	11,277	9,578
2011	8,630	13,723	11,887
2012	9,900	16,173	13,988
2013	10,112	15,825	13,777
2014	10,916	17,715	15,385
2015	11,262	19,084	16,386
2016	11,021	17,458	15,065
2017	9,556	15,138	13,054
2018	8,701	13,877	11,955
Entire	10,248	15,748	14,319
Pre − IFQ	10,959	15,931	15,293
Post − IFQ	10,541	17,073	14,740
2010 − 2014	9,201	14,943	12,923
2015 − 2018	10,135	16,389	14,115

also shows that between 2011 and 2016 overcapacity existed in the fishery since, on average, 57% of the fleet, had it operated fully efficiently, could have harvested the entire quota. However, beginning in 2017, the number of fully efficient vessels/trips needed to harvest the full quota rose to 100%. This is due to difference in the reported quota utilization of 60-70% relative to the predicted quota utilization (either with fully efficiency vessels or fully efficient trips) of only 80-90%.

8. Conclusions

This study assessed the impact of the IFQ program on the TE and overcapacity of the red snapper IFQ and Gulf reef fish IFQ fisheries. Drawing on recent econometric developments

Table 10. Annual fleet size measures

Year	Quota	Fully Efficient Vessels	Total Vessels	Fully Efficient Trips	Total Trips	% Vessels	% Trips	Quota Utilization Actual	Quota Utilization Predicted
2010	12,220,991	482	482	5,046	5,046	1.000	1.000	0.613	0.923
2011	10,830,901	222	470	1,450	5,921	0.472	0.245	0.895	1.267
2012	11,867,613	223	461	1,350	5,944	0.484	0.227	0.935	1.363
2013	13,510,054	261	445	1,917	5,643	0.587	0.340	0.869	1.171
2014	13,734,054	224	479	1,482	6,233	0.468	0.238	0.949	1.290
2015	15,437,270	265	469	1,854	6,387	0.565	0.290	0.877	1.236
2016	16,947,297	390	464	3,813	6,465	0.841	0.590	0.774	1.030
2017	17,162,613	494	494	6,213	6,213	1.000	1.000	0.679	0.882
2018	17,162,613	486	486	5,538	5,538	1.000	1.000	0.616	0.809

that account for vessel-specific heterogeneity, we find that time-varying TE improved after the adoption of IFQ. In the red snapper fishery, time-varying TE rose by almost 6% (from 0.711 pre-IFQ to 0.751 post-IFQ) and in the Gulf reef fish fishery it increased by 5% (from 0.746 pre-IFQ to 0.787 post-IFQ). In contrast, overall TE declined post-IFQ in both fisheries; however, this result was affected by the inability of the model to capture persistent TE in the pre-IFQ periods.

The study also found that, in the red snapper fishery, post-IFQ fishing capacity increased between 13% and 34% depending on the capacity metric considered (existing practices vs fully efficient practices). In contrast, in the Gulf reef fish fishery, post-IFQ fishing capacity decreased by 4% when using existing practices but rose by 7% when assumed that best practices were employed.

We estimated that less than 20% of the red snapper IFQ fleet could harvest the entire red snapper quota. The estimation of overcapacity in the Gulf reef fish IFQ fishery was more challenging because the fleet did not catch the entire quota. Nonetheless, we found that, on average, hat between 2011 and 2016 57% Gulf reef fish IFQ fleet, if it had operated at full efficiency, could have harvested the entire quota.

In short, this study found evidence that input use improved after the adoption of the IFQ program and that overcapacity remains high in the red snapper IFQ fishery. It also found evidence of excess capacity in both the Gulf red snapper and Gulf reef fish IFQ fishery.

To conclude, we note that further methodological improvements can be made for these types of studies since in both the red snapper and reef fish IFQ models, data spanning over 17 years is quite lengthy to believe that substantial persistent inefficiency levels remain. Alternative panel data stochastic frontier models that model this persistent efficiency as a function of various vessel specific (time constant) information may prove useful (Amsler & Schmidt 2019). Additionally, the reliance on the translog functional form could also be relaxed in future work (Parmeter & Zelenyuk 2019) and time-varying inefficiency could be modeled completely independent of distributional assumptions (Zhou, Parmeter & Kumbhakar 2020).

References

Agar, J. J., Strelcheck, A. & Diagne, A. (2014), 'The Gulf of Mexico Red Snapper IFQ Program: The first five years', *Marine Resource Economics* **29**(2), 177–198.

Álvarez, A., Couce, L. & Trujillo, L. (2020), 'Does specialization affect the efficiency of small-scale fishing boats?', *Marine Policy* **113**, 103796.

Alvarez, A. & Schmidt, P. (2006), 'Is skill more important than luck in explaining fish catches?', *Journal of Productivity Analysis* **26**(1), 15–25.

Amsler, C. & Schmidt, P. (2019), 'Separating different individual effects in a panel data model', *The Econometrics Journal* **22**(2), 173–187.

Andor, M. & Parmeter, C. F. (2017), 'Pseudolikelihood estimation of the stochastic frontier model', *Applied Economics* **49**, 5651–5661.

Binh, T., D'Haese, M., Speelman, S. & D'Haese, L. (2010), 'The influence of changes in the market environment on economic production characteristics of Pangasius farming in the Mekong Delta (Vietnam)', *Marine Resource Economics* **25**, 293–307.

Coelli, T. J. (1995), 'Estimators and hypothesis tests for a stochastic frontier function: A Monte Carlo analysis', *Journal of Productivity Analysis* **6**(4), 247–268.

Felthoven, R. G. (2002), 'Effects of the American Fisheries Act on capacity, utilization and technical efficiency', *Marine Resource Economics* **17**(3), 181–205.

Felthoven, R. G., Horrace, W. C. & Schnier, K. E. (2009), 'Estimating heterogeneous capacity and capacity utilization in a multi-species fishery', *Journal of Productivity Analysis* **32**(3), 173–189.

Greene, W. H. (2005), 'Fixed and random effects in stochastic frontier models', *Journal of Productivity Analysis* **23**(1), 7–32.

Guttormsen, A. G. & Roll, K. H. (2011), 'Technical Efficiency in a Heterogeneous Fishery: The Case of Norwegian Groundfish Fisheries', *Marine Resource Economics* **26**(4), 293–307.

Hood, P. B., Strelcheck, A. J. & Steele, P. (2007), A history of red snapper management in the Gulf of Mexico, *in* W. F. Patterson, III, J. H. Cowan, Jr., G. R. Fitzhugh & D. L. Nieland, eds, 'Red Snapper Ecology and Fisheries in the U.S. Gulf of Mexico', American Fisheries Society, Bethesda, MD, pp. 267–284.

Horrace, W. C. & Schnier, K. E. (2010), 'Fixed-effect estimation of highly mobile production technologies', *American Journal of Agricultural Economics* **92**(5), 1432–1445.

Huang, L., Ray, S., Segerson, K. & Walden, J. (2018), 'Impact of collective rights-based fisheries management: Evidence from the New England groundfish fishery', *Marine Resource Economics* **33**(2), 177–201.

Kirkley, J., Paul, C. J. M. & Squires, D. (2004), 'Deterministic and stochastic capacity estimation for fishery capacity reduction', *Marine Resource Economics* **19**(3), 271–294.

Kirkley, J., Squires, D. & Strand, I. E. (1998), 'Characterizing managerial skill and technical efficiency in a fishery', *Journal of Productivity Analysis* **9**(2), 145–160.

Kumbhakar, S. C. & Lien, G. (2018), 'Yardstick regulation of electricity distribution – disentangling short-run and long-run inefficiencies', *The Energy Journal* **38**, 17–37.

Kumbhakar, S. C., Lien, G. & Hardaker, J. B. (2014), 'Technical efficiency in competing panel data models: A study of Norwegian grain farming', *Journal of Productivity Analysis* **41**(2), 321–337.

Kumbhakar, S. C., Parmeter, C. F. & Zelenyuk, V. (2018), Stochastic frontier analysis: Foundations and advances, *in* S. Ray, R. Chambers & S. C. Kumbhakar, eds, 'Handbook of Production Economics', Springer. Forthcoming.

Mainardi, S. (2019), 'Access fees and efficiency frontiers with selectivity and latent classes: Falkland Islands fisheries', *Marine Resource Economics* **34**(2), 163 – 195.

Olson, J. A., Schmidt, P. & Waldman, D. A. (1980), 'A Monte Carlo study of estimators of stochastic frontier production functions', *Journal of Econometrics* **13**, 67–82.

Parmeter, C. F. & Kumbhakar, S. C. (2014), 'Efficiency Analysis: A Primer on Recent Advances', *Foundations and Trends in Econometrics* **7**(3-4), 191–385.

Parmeter, C. F. & Zelenyuk, V. (2019), 'Combining the virtues of stochastic frontier and data envelopment analysis', *Operations Research* **67**(6), 1628–1658.

Pascoe, S. & Coglan, L. (2000), 'Implications of differences in technical efficiency of fishing boats for capacity measurement and reduction', *Marine Policy* **24**(4), 301–307.

Reimer, M., Abbott, J. & Wilen, J. (2017), 'Fisheries production: Management institutions, spatial choice, and the quest for policy invariance', *Marine Resource Economics* **32**(2), 143–168.

Reimer, M. N., Abbott, J. K. & Haynie, A. C. (2017), 'Empirical models of fisheries production: Conflating technology with incentives?', *Marine Resource Economics* **32**(2), 169–190.

Schnier, K. E. & Felthoven, R. G. (2013), 'Production efficiency and exit in rights-based fisheries', *Land Economics* **89**(3), 538–557.

SERO (2019*a*), Gulf of Mexico 2018 grouper-tilefish individual fishing quota annual report, Technical report, National Marine Fisheries Service.

SERO (2019*b*), Gulf of Mexico 2018 red snapper individual fishing quota annual report, Technical report, National Marine Fisheries Service.

Sharma, K. R. & Leung, P. (1998), 'Technical efficiency of the longline fishery in Hawaii: An application of a stochastic production frontier', *Marine Resource Economics* **13**(4), 259–274.

Solís, D., Agar, J. J. & del Corral, J. (2015), 'IFQs and total factor productivity changes: The case of the Gulf of Mexico red snapper fishery', *Marine Policy* **62**, 347 – 357.

Solís, D., del Corral, J., Perruso, L. & Agar, J. J. (2014), 'Evaluating the impact of individual fishing quotas (IFQs) on the technical efficiency and composition of the US Gulf of Mexico red snapper commercial fishing fleet', *Food Policy* **46**, 74–83.

Solís, D., del Corral, J., Perruso, L. & Agar, J. J. (2015), 'Individual fishing quotas and fishing capacity in the US Gulf of Mexico red snapper fishery', *Australian Journal of Agricultural and Resource Economics* **59**(2), 288–307.

Squires, D. & Kirkley, J. (1999), 'Skipper skill and panel data in fishing industries', *Canadian Journal of Fisheries and Aquatic Sciences* **56**(11), 2011–2018.

Terry, J., Walden, J. & Kirkley, J. (2008), National assessment of excess harvesting capacity in federally managed commercial fisheries, Technical report, U.S. Department of Commerce. NOAA Tech. Memo. NMFS-F/SPO-93, 368.

Tsionas, M. G. & Papadogonas, T. (2006), 'Firm exit and technical inefficiency', *Empirical Economics* **31**(2), 535–548.

Waters, J. R. (2001), 'Quota management in the commercial red snapper fishery', *Marine Resource Economics* **16**(1), 65–78.

Zhou, J., Parmeter, C. F. & Kumbhakar, S. C. (2020), 'Nonparametric estimation of the determinants of inefficiency in the presence of firm heterogeneity', *European Journal of Operational Research* **286**, 1142–1152.