

INCENTIVES & BEHAVIOR
IN THE GULF RED SNAPPER
FISHERY

by

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ABSTRACT

This dissertation examines sixty years of fishing activity and more than twenty years of direct regulatory management in the Gulf red snapper fishery in order to assess the consequences of regulatory intervention in the fishery. The analysis traces the evolution of regulatory response to a commons problem, beginning with command and control regulations that successfully capped fishing output but unintentionally exacerbated overcapitalization concerns, segueing to the subsequent adjustments of the aforementioned policies applied to ameliorate the unintended consequences of regulation, and ending with a rights-based approach intended to align individuals' incentives with the fishery's. After outlining and discussing the various regulatory strategies used to manage the fishery, the analysis then replicates two previous econometric models of Gulf red snapper price in order to consider the determinants of price, including regulatory decisions. The work concludes with another pair of econometric models used to investigate the relationship between regulation and price volatility. The results provide feedback to regulators regarding the implications of fishery management policy.

DEDICATION

This thesis is dedicated to my wife, Stephanie, a keeper. And to my father, Bill, who never caught the tagged snapper.

LIST OF ABBREVIATIONS AND SYMBOLS

= Equals

+ Plus

- Minus

* Multiplied By

> Greater Than

< Less Than

2SLS Two-Stage Least Squares

ACF Autocorrelation Function

AIC Akaike Information Criterion

AR Autoregressive

ARIMA Autoregressive Integrated Moving Average

BIC Bayesian Information Criterion

BRD Bycatch Reduction Device

CFR Code of Federal Regulations

COI Certificate of Inspection

CPI Consumer Price Index

EEZ Exclusive Economic Zone

EFH Essential Fish Habitat

FMP Fishery Management Plan

FMU Fishery Management Unit

FOIA Freedom of Information Act

FR Federal Register

GARCH Generalized Autoregressive Conditional Heteroskedastic

HAPC Habitat Areas of Particular Concern

IFQ Individual Fishing Quota

ITQ Individual Tradable Quota

IVQ Individual Vessel Quota

LAPP Limited Access Privilege Program

LN Natural Log

MA Moving Average

MSFMCA Magnuson Stevenson Fishery Management and Conservation Act

MSY Maximum Sustainable Yield

NMFS National Marine Fisheries Service

NOAA National Oceanic and Atmospheric Administration

OECD Organisation for Economic Co-operation and Development

OLS Ordinary Least Squares

OY Optimal Yield

PACF Partial Autocorrelation Function

SEFSC Southeast Fisheries Science Center

SFA Sustainable Fisheries Act

SPR Spawning Potential Ratio

SSBR Stock Spawning Biomass per Recruit

TAC Total Allowable Catch

UNCLOS United Nations Convention on the Law of the Seas

U.S.C. United States Code

USCG United States Coast Guard

VAR Vector Autoregression

VMS Vehicle Monitoring System

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I. Introduction

Without a laboratory, economists turn to the natural world for data that can measure and explain observed behavior. Isolated changes in one aspect of an economic environment allow economists to study the effects of that change as if it were a natural experiment. Considering that government regulations are an obvious source of these isolated changes, it comes as no surprise that economists are prone to study the effects of such regulations. After identifying these potential natural experiments, economists can test and evaluate both the intended and unintended effects of the regulatory measures. Unfortunately, in many instances, the effects of a particular regulation may be slow to develop and difficult to evaluate. Fisheries, in contrast, offer a relatively unique opportunity to study the effects of regulation: producers are forced to alter their behavior almost immediately in response to new regulations; the behavior itself is relatively easy to quantify in terms of harvest weight; and the behavior creates measurable market effects on price (and vice-versa) and elsewhere.

The commercial Gulf red snapper fishery is an excellent candidate for this sort of natural experiment. Under the familiar commons scenario, fishery output fell precipitously during the twentieth century, bottoming out by the late 1970s with harvests at less than half of mid-century highs. Since then, the fishery has been subject to a variety of active management strategies. The relative success and futility of these strategies can be seen in the consequences, both intended and unintended, that followed.

This work will trace the evolution of the Gulf red snapper fishery from its historical origins, through early command-and-control regulations, all the way up to the most recent rights-based management innovations. Chapter II focuses on the regulatory history of the fishery, beginning with a description of the fish itself and the various metrics available to evaluate

producer behavior in the fishery. The analysis then shifts to a chronological review of regulatory history, opening with an explanation of the Federal approach to fisheries management. A summary of available pre-management fishery data sets the stage for a year-by-year analysis of the fishery under active management. The most important regulatory changes are identified and described. The effects of these regulatory changes on fishing behavior are then surmised from the available summary statistics on fishing opportunity, fishing effort, and fishing outcomes. An aggregate analysis of these statistics then suggests effects worthy of further investigation.

Chapter III begins a more in-depth econometric investigation of the fishery by summarizing the questions posed and the answers provided by previous models of Gulf red snapper price. These prior models are then updated with contemporary data and re-estimated as both annual and monthly models of Gulf red snapper price. The results suggest that the closures mandated by command-and-control regulations created negative price effects in the Gulf red snapper fishery. Strategies—such as a rights-based allocation of available quota—that kept the fishery open for longer periods appeared to reverse the price effects associated with closures.

The conspicuous volatility in the fishery's output-price relationship suggested another obvious avenue for further econometric investigation. Chapter IV therefore shifts the focus from Gulf red snapper price level to Gulf red snapper price level volatility. Two time-series models of Gulf red snapper price and price volatility are estimated in order to assess the impact of regulatory change on the conditional volatility of the Gulf red snapper price series. Not only did closure-based regulation decrease price level, it also increased price level volatility as fishing activity devolved into a series of frenzied derbies. These derby harvests lowered short-run market prices and profits, leaving little to no available resource to pursue the remainder of the

year as scarcity pushed prices back up. Once again, a rights-based management regime appeared to help: the imposition of rights-based regime reduced Gulf red snapper price volatility.

Chapter V interprets the specific policy implications of these econometric findings, suggesting that rights-based fishing is an effective complement to command-and-control output quotas. Chapter VI concludes with specific impressions on this particular regulatory process as well as with general thoughts on extensions and broader implications of the study.

II. Regulatory History

Like any other common resource, fish in the ocean are susceptible to the classic “Tragedy of the Commons” scenario Garrett Hardin outlined in his 1968 *Science* article.¹ Empirical evidence on fisheries follows Hardin's theory: data on fish and invertebrate catches from 1950 to 2003 taken from worldwide marine ecosystems that account for 83% of the global fisheries yield over the past fifty years reveal that 29% of currently fished species were considered collapsed by 2003.² As of 2006, 91% of historical species—including but not limited to fish—were considered depleted, 38% collapsed, and 7% extinct.³ While there may be numerous plausible explanations for this dire state of affairs, the primacy of one stands out: a 2001 scientific study concluded that “pollution, eutrophication, physical destruction of habitats, outbreaks of disease, invasions of introduced species, and human-induced climate change all come much later than overfishing in the standard sequence of historical events.”⁴

An analysis of the ongoing regulatory response to overfishing in the Gulf red snapper fishery and an exploration of the economic effects of this regulation is the goal of this inquiry. Study of the various regulatory strategies enacted in the Gulf red snapper fishery may then serve as a guide for other fisheries, illustrating the difference between purposeful regulations that affect incentives in intended ways and what Cass Sunstein describes as the unintended

¹ See Garrett Hardin, *The Tragedy of the Commons*, 162 *SCI.* 1243 (13 December 1968). Fish are considered a common resource because they are rival in consumption and non-excludable in nature. With benefits accruing privately and costs accruing publicly, the incentive is for each person to claim as much of the common resource as possible before another's consumption preempts this possibility.

² See Boris Worm et al., *Impacts of Biodiversity Loss on Ocean Ecosystem Services*, 314 *SCI.* 787, 788 (2006).

³ In this context, depletion is defined as a greater than 50% decline over baseline abundance, collapse is defined as a greater than 90% decline over baseline abundance, and extinction is defined as a 100% decline over baseline abundance. While a mere 14% of species recovered from collapse, these recovering species were limited to “mostly protected birds and mammals.” *Id.*

⁴ See Jeremy B. C. Jackson et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 *SCI.* 629, 635 (2001).

consequences of futile or self-defeating regulations.⁵ While management measures taken in the commercial Gulf red snapper fishery were generally effective at placing an upper limit on fish harvests, unintended consequences of these regulations included a strong incentive to overcapitalize, supply gluts that depressed price levels, and concomitant increases in output and price level volatility.⁶ The commercial and environmental resource value of the Gulf red snapper fishery demands a careful examination these regulatory strategies in order to evaluate their efficacy and elucidate the regulatory underpinnings of producer behavior.

The Gulf Red Snapper

The Gulf red snapper, *Lutjanus campechanus*, is a commercially fished species considered by some to be “the Gulf of Mexico’s most important reef fish.”⁷ These typically bottom-dwelling fish populate depths from 33 to 623 feet, usually near hard structures such as

⁵ See Cass R. Sunstein, *Free Markets and Social Justice*, at 223 (New York: Oxford University Press, 1997). Sunstein defines futile regulation as, “measures that do not bring about the desired consequences.” Self-defeating regulation is caused by, “measures that actually make things worse from the standpoint of their strongest and most public-spirited advocates.” Examples include minimum wage laws that reduce employment and campaign finance reforms that appear to entrench incumbents.

⁶ One obvious example of unintended consequences in snapper regulation can be seen in the minimum size limit: because commercial fishermen historically caught snapper at more extreme depths than recreational fishermen, the minimum size limit for commercial snapper was intentionally set below the minimum size limit for recreational snapper in order to account for increased discard mortality rates. See footnote 151 *infra*. According to Dr. Bob Shipp, Chairman of the Gulf of Mexico Fishery Management Council, a regulation intended to prevent commercial fisherman from throwing back snapper that would die anyway ended up empowering commercial fishermen to target the smaller fish in shallower waters that are coveted by restaurants: “they are targeting the smaller snapper – 2- to 4-pound snapper – because they get a higher price for it.” See Ted Venker, *Talking Red Snapper: Q & A with Dr. Bob Shipp*, 34 TIDE 48 (January/February 2010).

⁷ See Environmental Defense Fund, January-February 2007 SOLUTIONS newsletter, *Reviving Gulf Red Snapper: New Model for Fisheries*, available at: <http://www.edf.org/page.cfm?tagID=1525>. In fact, the red snapper has been the Gulf Reef Fish Fishery's second most valuable species of reef fish since 2000, with catches accounting for \$95,488,774 in nominal value (second only to the \$116,999,879 nominal value of the red grouper harvest). Harvests from the snapper complex (including red, vermilion, and yellowtail snapper among others) have accounted for over \$150,000,000 in nominal value over the same period (again, second to the over \$220,000,000 nominal value of the grouper complex which includes black, gag, red, scamp, snowy, warsaw, and yellowtail grouper among others). Data available at: http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

coral reefs, artificial reefs, or other structures with moderate to high relief.⁸ The Gulf red snapper may live as long as 57 years, following a moderate growth rate to reach a maximum length of 39.7 inches and a maximum weight of fifty pounds.⁹ Females reach reproductive maturity at a length of eleven to thirteen inches, which takes approximately two years.¹⁰

The Gulf red snapper fishery arose serendipitously in the early 1840s when a cook threw dinner scraps overboard as a fishing vessel made its way towards the port of New Orleans. The scraps attracted a crowd of red snapper, and the fishermen caught them as quickly as they could bait and cast, boating nearly 200 fish before they continued to port.¹¹ While exploitation efforts remained local at first due to shipping and spoilage issues, the commercial fishery's growth accelerated in 1872 when S.C. Cobb constructed the first processing and shipping facility devoted to red snapper in Pensacola, Florida.¹² Fishermen brought their catch from fishing grounds between Mobile, Alabama, and Cape St. George, Florida, to Pensacola's saltwater wharves. Cobb's facility allowed the fresh catch to be processed and shipped via rail to markets both near (Mobile and New Orleans) and far (New York City).¹³

As exploitation intensified, these increasingly barren fishing grounds pushed the fishery to expand: first, south towards the Florida Middle Grounds and eventually beyond Tampa and the Dry Tortugas; later, east to Texas.¹⁴ Despite the resiliency these newly discovered fishing

⁸ See Fish Watch – Red Snapper. Available at: http://www.nmfs.noaa.gov/fishwatch/species/red_snapper.htm

⁹ *Id.*

¹⁰ *Id.*

¹¹ See Clay Porch, Stephen Turner, and Michael Schirripa, *Reconstructing the Commercial Landings of Red Snapper in the Gulf of Mexico from 1872 to 1963*, 60 AMERICAN FISHERIES SOCIETY SYMPOSIUM 337, 388 (2007).

¹² *Id.*

¹³ *Id.*

¹⁴ *Id.*

grounds brought to the fishery, food preservation remained a limiting factor on growth, especially when harvesting from distant locales such as the Campeche Banks off of Mexico. The advent of low-cost ice in the early twentieth century greatly increased the capacity of the fishery: census estimates of landings surged from around five million pounds in the late nineteenth century to nearly fourteen million pounds by 1902.¹⁵ Subsequent technological breakthroughs including motorized boats and fathometers further enhanced the industry's efficiency throughout the twentieth century, allowing fisherman to find, reach, and exploit new fishing grounds as productivity fell in those barren grounds that were already overfished.¹⁶

Data on the Gulf red snapper

A number of data sources were utilized to evaluate the impact of regulatory incentives on producer behavior in the Gulf red snapper fishery. In order to assess the fishing opportunities available to Gulf red snapper fishery participants, the Federal Register was searched to determine the applicable Total Allowable Catch (TAC) quota that applied in a given fishing year.¹⁷ While other input limiting measures (including but not limited to seasonal openings, size limits, harvest limits, and trip limits) affect when a fish is caught, the TAC quota determines how many pounds of fish will be caught in a given year. Because the Gulf red snapper fishery opened and closed on different dates each year, it was also necessary to search the Federal Register in order to ascertain the opening, closing, and duration of each fishery year. This information was then converted into a monthly measure of the number of hours the fishery was open to participants.

¹⁵ *Id.* The authors point out that once U.S. vessels were able to harvest from the fertile Campeche grounds, they would continue to do so until excluded by the Mexican government in the early 1980s.

¹⁶ See Peter Hood, Andrew Strelcheck, and Phil Steele, *A History of Red Snapper Management in the Gulf of Mexico*, 60 AMERICAN FISHERIES SOCIETY SYMPOSIUM 267 (2007).

¹⁷ See e.g. 55 FR 2078

The Federal Register was also consulted in order to construct a chronological record of the passage and implementation of various regulatory adjustments.

Monthly commercial landings from 1990-2008 in the Gulf red snapper fishery are available from the National Marine Fisheries Service (NMFS), which operates under the umbrella of the National Oceanic and Atmospheric Administration (NOAA).¹⁸ This data provides a monthly accounting of the pounds gutted weight of the harvest as well as the ex-vessel nominal dollar value of the harvest. The total ex-vessel nominal dollar value of the harvest was divided by the gutted weight to yield monthly nominal dollars per pound. These nominal values were then deflated via monthly Consumer Price Index (CPI) values available through the U.S. Department of Labor's Bureau of Labor Statistics in order to provide real values.¹⁹ Additional data on pounds harvested and price received was provided by Dr. James Waters, Senior Economist for commercial fisheries with NOAA's Southeast Fisheries Science Center (SEFSC) in Beaufort, NC. This monthly data spanned from 1978-2006, offering both additional historical context to the regulatory history and a longer time series of data for subsequent econometric analysis.

Data on effort applied by fishery participants between 1993 and 2009 was obtained through a Freedom of Information Act (FOIA) request filed with NOAA. Kevin McCarthy and Steve Turner provided monthly data detailing both the total number of commercial trips (by all vessels) on which at least one pound of Gulf red snapper was claimed and the total number of unique vessels operating in the fishery each month. These records provide some insight into

¹⁸ Data available at: http://www.st.nmfs.noaa.gov/st1/commercial/landings/monthly_landings.html

¹⁹All nominal prices from the NMFS website have been deflated into real prices (January 2000 monthly prices and year 2000 yearly prices) via the CPI, available at: <http://www.bls.gov/CPI/> and <ftp://ftp.bls.gov/pub/special.requests/cpi/cpiiai.txt>

production behavior in light of the aforementioned regulatory incentives. A subsequent FOIA request yielded a breakdown on the number of vessels with a red snapper endorsement to their reef fish permit (or later, one of two varieties of red snapper licenses) reporting red snapper landings to the coastal logbook as well as the pounds gutted weight associated with those catches for the years 1993-2006.

Pre-Snapper TAC: 1950-1989

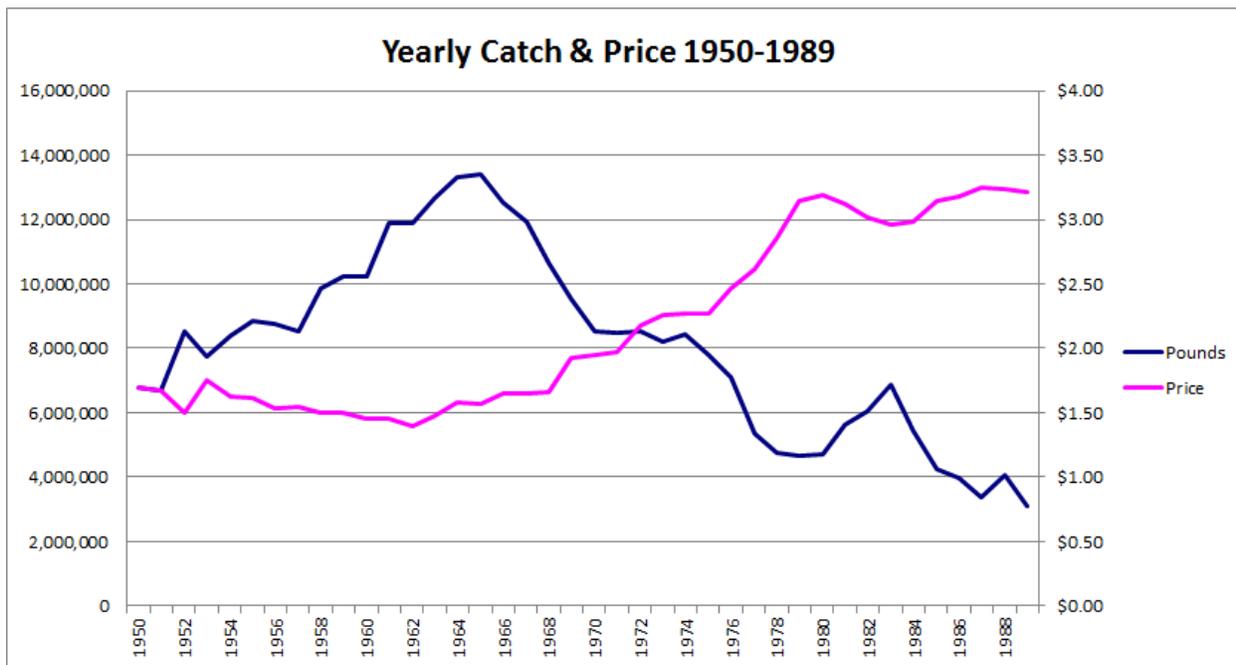


Figure 1.1 graphs the relationship between annual catch and average annual price from 1950 to 1989.

Beyond a thirteen-inch minimum size limit, the commercial harvest of the Gulf red snapper fishery was not specifically constrained by federal authority until 1990, when Amendment 1 of 1984's Fishery Management Plan (FMP) went into effect. Amendment 1 implemented, among other measures, a reef fish permit scheme and a 3.1 million pound commercial TAC limit.²⁰ According to Steve Atran, Population Dynamics Statistician at the Gulf Council, while state regulations may have been enacted at various times over this period, 1990's Amendment 1 was the first effective federal regulation of the Gulf Red Snapper Fishery.²¹ The above graph offers a visual representation of two predictable outcomes: first,

²⁰ See 55 FR 2078. See *infra* footnote 25.

²¹ Atran also pointed out two possible inconsistencies in the commercial landings statistics. First, some of the reported historical catch (particularly before the 1980s) may have been caught in waters closer to Mexico, Central America, and South America before being brought back to the United States for sale. Additionally, there are some months where harvests are reported when the fishery was ostensibly closed. These inconsistencies may be attributed to slow reporting of legitimate catches, inaccurate record-keeping practices, or illegal (out of season) catches that were subsequently seized and sold by enforcement personnel. Phone interview, Fall 2009. Dr. Waters noted that, at least for the SEFSC dataset, "prices existed in nearly all months of the year because small quantities were

Hardin's behavioral incentive to overfish expressed itself as the fishery's production peaked at 13,386,800 pounds in 1965 before falling steeply to 3,098,454 pounds (the lowest level in the NMFS database up to that time) by 1989, despite any meaningful regulation restricting domestic harvests; second, the scarcity that eventually accompanied overfishing clearly impacted price levels. Facing falling supply, price per pound began its rise in 1965 as pounds caught fell, with price per pound falling slightly in 1983 when production experienced a momentary uptick. It is also worth considering that while the pre-regulation price per pound seemed to reach and stabilize around the three dollar mark from the late 1970s through the 1980s as production fell to all-time lows, the post-regulation price per pound declined precipitously in the 1990s without any substantial increase in output once regulatory TAC limits and their concomitant derby fishing behavior reached the fishery.²²

reported to have been landed, presumably from state waters, even during closed red snapper seasons." James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS at 70 (2001).

²² See Dominique Gréboval and Gordon Munro, *Chapter 1 - Overcapitalization and Excess Capacity in World Fisheries: Underlying Economics and Methods of Control*, FAO FISHERIES TECHNICAL PAPER at 22-23 (1999). The authors point out that TACs "lead to increasingly intense competition for shares of the limited harvest... greater investment in existing vessels and gear... and predict that the amount of 'conventional' capital will be end up by being greater than it was when the TAC was first implemented... Thus, we can conclude, without hesitation or fear of contradiction, that, as far as capacity control is concerned, the TACs-only policy is an unmitigated disaster." According to Dr. Waters, this overinvestment in capital means the fishing year is "characterized by short periods of intense fishing activity, as the threat of imminent closure results in a fishing derby in which the entire year's quota is landed within a few months." These incentives, "produced market gluts... associated with a downward shift in the estimated price-quantity relationship and a decline in industry-wide dockside revenues for red snapper fishermen... dockside prices for red snapper were estimated to be about \$1.14 per pound lower in real terms when the fishery was managed with restrictive quotas, as prices fell due to difficulties marketing an entire year's catch within a short period of time." James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS at 69, 70, and 73 (2001).

1976: Fishery Conservation and Management Act of 1976

According to legal commentator Teresa Cloutier, the origins of federal fisheries management in the United States are protectionist in nature. Historically, aside from the three-mile territorial sea that fell under the jurisdiction of the states, fishermen (from all nations) were free to fish as they saw fit. And fish they did: "[t]his freedom, along with the large, efficient subsidized fleets of other nations which existed by the 1970s, resulted in a foreign fishing effort which came to be perceived as a threat to both the U.S. fishing industry and the resource itself."²³ Given that apprehension over foreign fishing effort "was a major impetus for the MSFCMA," it is not surprising that "[t]he main purpose of the act was to extend the 'exclusive fishery management' zone of the United States from 12 to 200 miles offshore."²⁴ While this planned exclusivity sufficiently limited foreign access to U.S. fisheries, Congress recognized the need to prevent Americans themselves from overfishing. In response to these domestic concerns, the FCMA created a National Fishery management program, "premised upon the conclusion of the committee of conference that fishery resources must be conserved and managed in such a way as to assure that an optimum supply of food and other fish products, and that recreational opportunities involving fishing, are available on a continuing basis and that irreversible or long-term adverse effects on fishery resources are minimized."²⁵

²³ See Teresa M. Cloutier, *Conflicts of Interest on Regional Fishery Management Councils: Corruption or Cooperative Management?* 2 OCEAN & COASTAL L.J. 101, 113-114 (1996-1997). Cloutier points out that in 1975 foreign nations took 6.4 billion pounds of the 7.0 billion pound catch from the waters 12-200 miles off the U.S. coast.

²⁴ *Id.* at 114. Cloutier refers to the Magnuson-Stevens Fishery Management Conservation and Management Act (MSFCMA), which originally passed as the Fishery Conservation and Management Act (FCMA).

²⁵ *Id.* at 116. See S. Conf. Rep. No. 711, 94th Congress, 2d Sess. 39 (1976), reprinted in 1976 U.S.C.C.A.N.

The Fishery Conservation and Management Act of 1976 became law April 13, 1976.²⁶ Importantly, the FCMA created eight regional fishery management councils (including The Gulf Council which oversees Gulf red snapper regulation) charged with preparing FMPs for those fisheries determined to be in need of active federal management. Following public hearings and revisions, FMPs were submitted to the Secretary of Commerce for approval, and then implemented through regulations published in the Federal Register.²⁷

Modifications to existing FMPs followed the same procedure: if the Secretary determines the proposed modifications are consistent with the FMP, they are published in the Federal Register for a public comment period of 15-60 days; if not, the Secretary notifies the council of the inconsistencies and provides recommendations for revision.²⁸ The Secretary may even personally prepare a FMP if the Council fails to develop, submit, or revise a plan or amendment for a fishery that requires conservation and management.²⁹ In circumstances where an emergency or overfishing requires interim measures, the Secretary may promulgate emergency regulations or interim measures necessary to address the situation.³⁰

The FCMA also originally sought to establish the aforementioned 200-mile fishery conservation zone, thereby placing marine fishery resources beyond state jurisdiction but within 200 miles of all U.S. coasts under federal jurisdiction. While this fishery conservation zone was

²⁶ The FCMA was signed into law as Public Law 94-265. FCMA regulations are located at 16 U.S.C. 1801 *et seq.*

²⁷ 16 U.S.C. 1853(c) establishes the council's obligation to submit proposed rules necessary for implementation or modification of FMPs.

²⁸ *See* 16 U.S.C. 1854(b). Final regulations are promulgated within 30 days after the end of the comment period.

²⁹ *See* 16 U.S.C. 1854(c)(1)

³⁰ *See* 16 U.S.C. 1855(c)(1). These regulations are published in the Federal Register like other FMP modifications. According to 16 U.S.C. 1855(c)(3)(B) these measures remain in effect for no more than 180 days after the date of publication, with one additional 186-day extension available if the Council is actively preparing a FMP, plan amendment, or proposed regulation to address situation permanently. 16 U.S.C. 1855(c)(3)(C) allows regulations addressing a public health emergency or oil spill to, "remain in effect until the circumstances that created the emergency no longer exist."

subsequently eliminated by amendment, the concept of extending territorial seas and declaring fishery zones lived on.

1983: Exclusive Economic Zone

On March 10, 1983, via presidential proclamation, United States President Ronald Reagan did “hereby proclaim the sovereign rights and jurisdiction of the United States of America and confirm also the rights and freedoms of all States within an Exclusive Economic Zone.”³¹ The Exclusive Economic Zone (EEZ) was defined as “a zone contiguous to the territorial sea, including zones contiguous to the territorial sea of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands (to the extent consistent with the Covenant and United Nations Trusteeship Agreement), and United States overseas territories and possessions. The Exclusive Economic Zone extends to a distance 200 nautical miles from the baseline from which the breadth of the territorial seas is measured.”³² Within this EEZ, the United States claimed “to the extent permitted by international law, [a] sovereign rights for the purpose of exploring, exploiting, conserving and managing natural resources, both living and non-living, of the seabed and subsoil and superjacent waters and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds; and [b] jurisdiction with regard to the establishment and use of artificial islands, and installations and structures having economic purposes, and the protection and preservation of the marine environment.”³³

³¹ See Presidential Proclamation 5030, Exclusive Economic Zone of the United States of America, 48 FR 10605.

³² *Id.*

³³ *Id.*

The territorial limits claimed by the U.S. mirrored those of the United Nations Convention on the Law of the Seas (UNCLOS), a product of the third United Nations Conference on the Law of the Seas.³⁴ Under UNCLOS, the territorial sea extended from a normal baseline at the low-water line along the coast up to a limit not exceeding 12 nautical miles.³⁵ Exclusive economic zones were limited to a distance, “not beyond 200 nautical miles from the baselines from which the breadth of the territorial seas is measured.”³⁶ These zones gave the coastal State, “sovereign rights for the purpose of exploring and exploiting, conserving and managing natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil.”³⁷

1984: Reef Fish Fishery Management Plan

The Gulf Council was the regional fishery management council created to manage fishery resources in the U.S. federal waters of the Gulf of Mexico, including the Gulf red snapper. The FMP for the Reef Fish Fishery of the Gulf of Mexico—submitted by the Gulf Council in August 1981, and approved by the Secretary of Commerce in June 1983—was implemented on November 8, 1984.³⁸ The FMP empowered the Gulf Council to manage the reef fish fishery and

³⁴ The Third UN Conference on the Law of the Sea began in New York on December 3, 1973. The Convention was opened for signature by all States on December 10, 1982. The Convention entered into force November 16, 1994—one year after the sixtieth state, Guyana, signed the treaty. The United States subsequently signed the agreement July 29, 1994. See Jose A. De Yturriaga, *The International Regime of Fisheries: From UNCLOS 1982 to the Presential Sea*, at 47, 91, 95, and 97 (Boston: Martinus Nijhoff Publishers, 1997).

³⁵ See International Seabed Authority, *The Law of the Sea: Compendium of Basic Documents*, at 3 (Kingston: The Caribbean Law Publishing Company, 2001). Provisions were made for alternative definitions of baselines in circumstances involving reefs, deeply indented coastlines, internal waters, river mouths, bays, ports, roadsteads, and low-tide elevations. *Id.* at 4-6.

³⁶ *Id.* at 21.

³⁷ *Id.* at 20.

³⁸ See 49 FR 39548.

was implemented through regulations at 50 CFR part 641.³⁹ This authority was granted under the auspices of the FCMA (16 U.S.C. 1801 *et seq.*).⁴⁰ The plan defined the reef fish Fishery Management Unit (FMU) so that it included red snapper, among other reef fish. Designed to rebuild declining reef fish populations, the most pertinent aspects of the FMP as it related to the Gulf red snapper fishery were: (1) prohibitions on the use of powerhead-equipped spear guns, roller trawls, or fish traps within inshore stressed areas; (2) a minimum size limit of thirteen inches total length for red snapper (with allowances for each fisherman to keep up to five undersized fish and an exemption from the application of the size limit to for-hire boats until May 8, 1986 that was subsequently extended by a final rule until May 8, 1987); and (3) prescribed data keeping and reporting requirements.⁴¹ Another final rule was issued to implement mandatory reporting requirements prescribed in the FMP and provide for "the timely collection of catch, effort, and landings data from persons using fish traps commercial vessel and headboat owners and operators, and seafood dealers and processors."⁴²

³⁹ Note 50 CFR part 622 is the current location of regulations for Fisheries of the Caribbean, Gulf, and South Atlantic. 1996's Sustainable Fisheries Act consolidated eleven CFR parts into one part (50 CFR part 622). *See* 61 FR 34930.

⁴⁰*See* 60 FR 55359.

⁴¹ *See* 49 FR 39548, at 39553-58. For final rule extending size limit exemption *see* 51 FR 19208.

⁴² *See* 52 FR 35717. Later, 52 FR 38233—after a delay to obtain the required approval from the Office of Management and Budget—established similar information collecting requirements for headboat owners and operators.

1988: A Stock Assessment

Following the first Gulf red snapper stock assessment in 1988, the Gulf red snapper was deemed to be significantly overfished; fishing mortality rate reductions of up to sixty to seventy percent were deemed necessary.⁴³ The council acknowledged the perilous rate of harvest in the fishery, noting "[t]he fishery currently has more participants than are necessary to harvest to the optimum yield," and that "additional fishing effort would lead to harvesting inefficiencies, more management constraints, and increased conservation risks."⁴⁴ Following an industry advisory panel's request to develop alternative limited access programs to curtail additional fishing efforts, the Gulf Council issued a notice of control date for anyone entering the commercial reef fish fishery in the Gulf of Mexico. In order to foster "public awareness of a potential eligibility criterion for access to the... fish resource," the notice announced that, "anyone entering the fishery... after November 1, 1989 (control date), may not be assured of future access to the reef fish resource if a management regime is developed and implemented that limits the number of participants in the fishery."⁴⁵ According to W.R. Keithly, "while not directly controlling effort... one could conclude that this announcement was the initial action taken towards the development of a limited access programme."⁴⁶

⁴³ See Fish Watch – Red Snapper, available at: http://www.nmfs.noaa.gov/fishwatch/species/red_snapper.htm. Specifically, "[t]he stock assessments for red snapper concluded that the fishery was being subjected to recruitment overfishing and that the spawning stock biomass per recruit ratio (SSBR) was likely no greater than 4.8% of the unfished level. The analysis... indicated that to restore the spawning stock to a 20 percent SSBR level, reductions in fishing mortality on the order of 60 to 70 percent would be necessary by the year 2000 for red snapper." 55 FR 2078.

⁴⁴ See 54 FR 46755-46756.

⁴⁵ *Id.*

⁴⁶ See W.R. Keithly Jr., *Initial Allocations of ITQs in the Gulf of Mexico Red Snapper Fishery*, FAO FISHERIES TECHNICAL PAPER, No. 411, at 100 (2001). Available at: <ftp://ftp.fao.org/docrep/fao/004/y2684e/y2684e09.pdf>

Historical Context from the SEFSC dataset

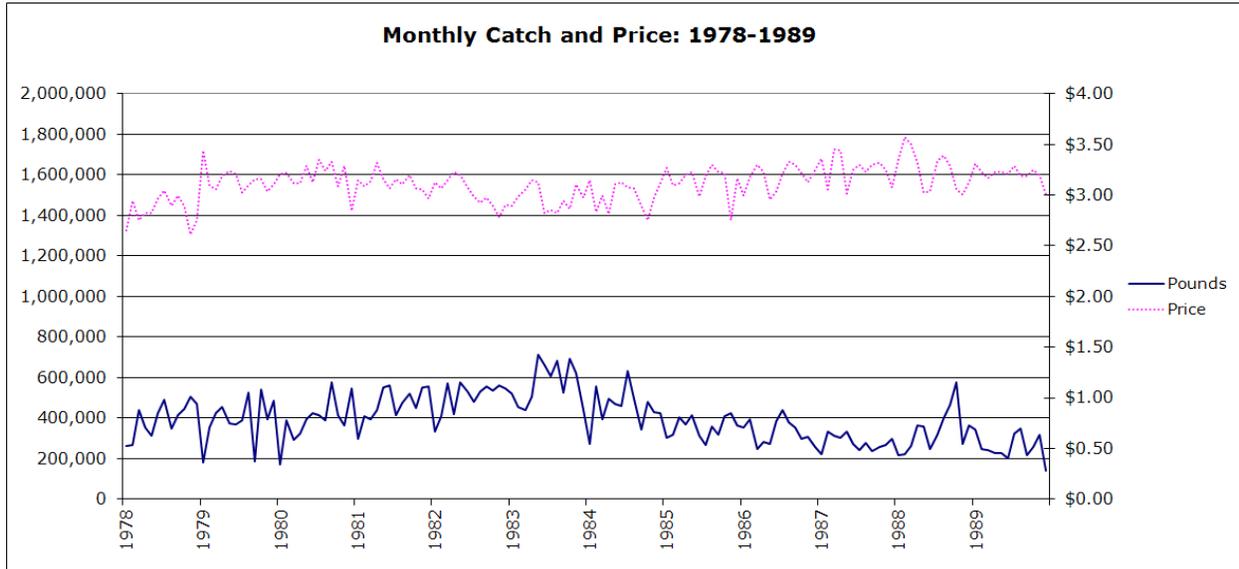


Figure 1.2 graphs the relationship between monthly catch and average monthly price from 1978 to 1989.

Monthly price and output remained fairly consistent over the twelve years of available data prior to 1990's implementation of Amendment 1 of the FMP. Average yearly price remained in a range between \$2.96 and \$3.24 from 1979-1989 (1978's average was \$2.86). Monthly prices climbed as high as \$3.57, and never fell below \$2.75 (1978 prices fell as low as \$2.61). The spread between the yearly high and low prices was never more than \$0.57, and the yearly standard deviation remained fairly constant (peaking in 1988, the same year the spread hit \$0.57). Output exhibited more variation than price, as average monthly catch hovered between 258,205 and 571,818 pounds. At least 143,094 pounds of snapper were claimed in every month, with catches as large as 712,242 pounds reported. The largest yearly spread between monthly high and low catches was 406,994 pounds in 1980; the smallest was 115,854 pounds in 1987.

Although fishing output fell to historical lows over this period, there was a relative stability in the price and output relationship that disappeared with the advent of the TAC

regime.⁴⁷ The subsequent twenty years of regulation exposed the precarious balance between the intended and the unintended consequences of regulatory adjustments. According to James Waters, "[r]egulatory adjustments... for the commercial red snapper fishery include: increases in the minimum size limit; minimum income requirements to qualify for a commercial permit; quotas followed by closures; a limit on catch per trip; a moratorium on issuance of new permits; an endorsement system with two classes of trip limits; a license limitation system with two classes of licenses and associated trip limits; a limit of one landing per boat per day; allocation of quota into spring and fall seasons; splitting seasons into a series of mini-derbies of 15 days each; and a reduction in the length of mini-derbies."⁴⁸ Ultimately, the inherent shortcomings of these input-limiting measures in a commons scenario would usher in a new regime of rights-based fishing, premised on aligning the incentives of individuals with the interests of the entire fishery.

⁴⁷ See graph on page 5.

⁴⁸ Unfortunately for long term fisheries management, "[r]egulatory adjustments may slow the overall rate of harvest by commercial fishermen, but only temporarily, because they do not alter the basic incentive to fish as intensively as possible when the fishery is open." James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS 65, at 76 (2001).

Summary Statistics for Gulf Red Snapper: Real Price from 1978-1989					
Year	Average Price	High Price	Low Price	Spread	Std. Deviation
1978	2.858441	3.04	2.61	0.43	0.14
1979	3.143592	3.44	3.03	0.41	0.11
1980	3.195644	3.35	2.85	0.50	0.14
1981	3.125448	3.32	2.97	0.35	0.09
1982	3.021419	3.23	2.78	0.45	0.14
1983	2.964956	3.15	2.83	0.32	0.12
1984	2.986062	3.14	2.75	0.39	0.14
1985	3.1398	3.30	2.76	0.54	0.15
1986	3.17425	3.33	2.95	0.38	0.12
1987	3.24298	3.45	3.01	0.44	0.14
1988	3.239174	3.57	3.00	0.57	0.20
1989	3.215279	3.31	3.01	0.30	0.07

Table 1.1 presents summary statistics on the real price of Gulf red snapper from 1978-1989

Summary Statistics for Gulf Red Snapper: Pounds Caught from 1978-1989					
Year	Average Pounds	High Pounds	Low Pounds	Spread	Std. Deviation
1978	395,089	504,105	262,791	241,314	83,687
1979	389,065	540,877	180,405	360,472	114,133
1980	391,985	578,511	171,517	406,994	106,492
1981	468,393	559,385	296,361	263,024	82,098
1982	503,661	574,384	331,173	243,211	77,784
1983	571,818	712,242	440,599	271,643	102,553
1984	454,653	631,270	274,486	356,784	92,790
1985	354,750	423,414	265,614	157,800	51,526
1986	330,429	440,218	246,015	194,203	61,671
1987	279,690	335,500	219,646	115,854	38,159
1988	338,248	577,098	215,516	361,582	106,185
1989	258,205	349,203	143,094	206,109	63,017

Table 1.2 presents summary statistics on the monthly harvest of Gulf red snapper from 1978-1989.

1990: Amendment 1

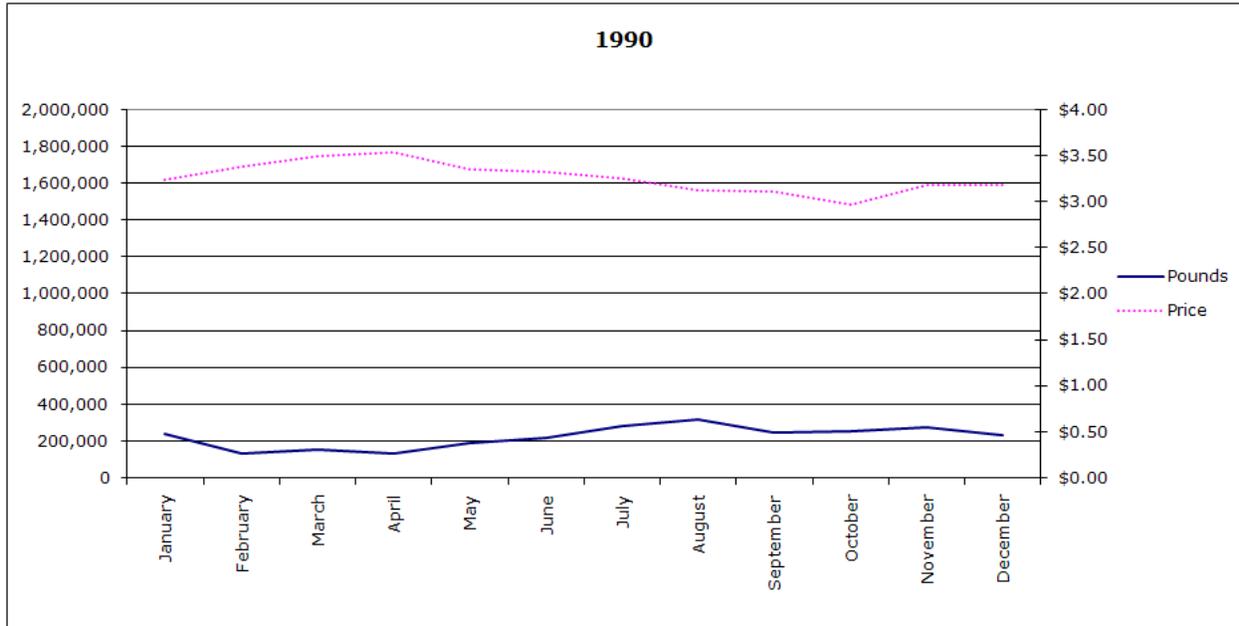


Figure 1.3 graphs the relationship between monthly catch and monthly price in 1990.

The bulk of Amendment 1 to the FMP was implemented on February 21, 1990, with a primary objective of stabilizing “the long-term population levels of all reef fish species by January 1, 2000, at a level that equaled at least 20 percent of the spawning stock biomass per recruit (SSBR) that would occur with no fishing.”⁴⁹ To this end, Amendment 1 required a permit for vessels harvesting reef fish for sale, with a requirement that fifty percent of an individual's (owner or operator) earned income “be derived from commercial, charter, or headboat fishing to qualify for an annual fishing permit.”⁵⁰ Amendment 1 established “a red snapper size limit of 13 inches total length, a recreational bag limit of 7 fish per angler per day, and a commercial quota of 3.1 million pounds that would effect a 20 percent reduction in the 1985-1987 average annual recreational and commercial catches, respectively.”⁵¹ These limits were established during the

⁴⁹ See 55 FR 2078.

⁵⁰ 55 FR 2078, 2083.

⁵¹ *Amendment Number 1 to the Reef Fish Fishery Management Plan*, August, 1989 at 13. Available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-01%20Final%201989-08-rescan.pdf>

remainder of the fishing year of implementation and were accompanied by a prohibition on the sale of snapper below the size limit as well as an end to the exemption that allowed for keeping five undersized red snapper.⁵² Closure of the commercial fishery would occur when or if the TAC quota was exhausted.⁵³

The newly installed TAC did not prove to be a binding constraint on the fishery: the annual commercial catch of 2,660,845 pounds was nearly a half million pounds (439,155 pounds according to NMFS data) below the established 3,100,000-pound quota. Because the quota was never met, the fishery remained open for the entire year (8760 hours), allowing for a relatively leisurely catch rate of 354 pounds of red snapper per hour. Price per pound peaked in April, at \$3.54, before steadily falling to a minimum of \$2.97 in October, yielding a \$0.57 spread between the yearly maximum and minimum price (with yearly average, \$3.23, effectively between the two). The largest catch occurred in August, when 318,221 pounds were caught; the smallest monthly catch—128,903 pounds—occurred in February (yearly spread was 189,318 pounds). Inspection of the above graph confirms the limited price and output volatility. Considering unimpeded efforts yielded just 3,098,454 pounds in 1989, the quota did not affect behavior.

TAC = 3.1 million pounds		Total Hours Open = 8760		Rate = 353.9 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	730	744	672	72	21.61
pounds	221,737	318,221	128,903	189,318	59,928.78
price	3.23	3.54	2.97	0.57	0.17
Beyond the first TAC quota, a 13-inch total length minimum size requirement was affirmed.					

Table 1.3 provides summary statistics for fishing activity in 1990.

⁵² *Id.*

⁵³ 55 FR at 2091.

1991: Amendment and a Final Rule

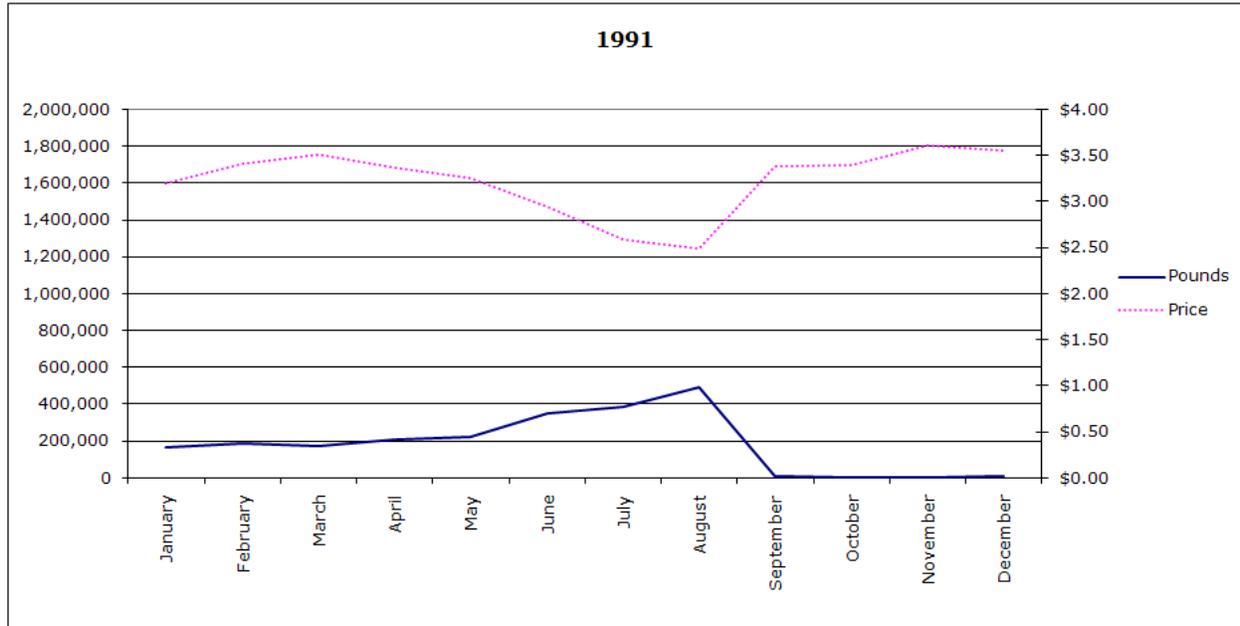


Figure 1.4 graphs the relationship between monthly catch and monthly price in 1991.

Amendment 3, implemented on July 29, 1991, increased procedural flexibility by allowing adjustment to rebuilding timeframes as scientific evidence required, "with an upper limit for the rebuilding periods not exceeding 1.5 times the generation time of the species under consideration."⁵⁴ Given an assumed red snapper generation time of fourteen years, the target date could not exceed 2011 ($14 \times 1.5 + 1990 = 2011$). Furthermore, the amendment revised the definitions of optimal yield (OY) and overfishing, replaced the twenty percent SSBR target with a target of twenty percent spawning potential ratio (SPR), and set a target date of January 1, 2007 for rebuilding the red snapper stock to twenty percent SPR.⁵⁵ Partially in response to these

⁵⁴ See 56 FR 30513.

⁵⁵ *Id.* For further discussion of SPR replacing SSBR see *Amendment 3 to the Reef Fish Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico*, February 1991. Available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-03%20Final%201991-02.pdf>

changes, a final rule effective August 19, 1991, reduced the red snapper commercial TAC to 2,040,000 pounds.⁵⁶

The newly installed 2,040,000-pound commercial quota was reached (technically, it was exceeded as the annual catch totaled 2,240,893 pounds), and the commercial fishery closed on August 24, 1991.⁵⁷ In 1991, the fishery was open for 5640 hours, or 3120 hours (130 days) less than in 1990. While the fishery shut down earlier than in the previous year, this appears to be resultant from the reduced quota as opposed to increased fishing effort (1991's catch rate of 361.70 pounds per hour was fairly similar to 1990's 353.9 pounds per hour). As the above graph shows, price fell as output increased, only to reverse this trend when output fell off significantly. Price per pound peaked in November at \$3.61, up from a yearly minimum of \$2.49 in August (a spread of \$1.12) with a yearly average, \$2.94, nearly equidistant between the two price points. Output fell in October to 1,336 pounds, off from a yearly maximum of 494,648 pounds in August (a difference of 493,312 pounds). The increase in output and price volatility as compared to 1990 is striking, whether comparing the high/low spread or the standard deviation: the price spread nearly doubled within the year and the standard deviation of the price series more than doubled; the output spread and output standard deviation both more than doubled in just one year. While it took fishermen nearly eight months to exhaust their newly reduced quota, they—if fishing behavior in the very next year is any indication—quickly adapted their behavior to the new TAC regime.⁵⁸

⁵⁶ See 56 FR 33883 and 56 FR 37606 (correcting the effective date).

⁵⁷ 56 FR 42711.

⁵⁸ Dr. Waters notes that "predicted outcomes of quota management for red snapper occurred rapidly and decisively. The first closure occurred in August 1991, and a full-scale race for fish ensued as soon as the fishery reopened in February 1992. The red snapper experience demonstrates that significantly shorter seasons, market gluts, and depressed market prices can occur almost immediately." James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS at 75-76 (2001).

TAC = 2.04 million pounds		Total Hours Open = 5640		Rate = 361.70 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	470	744	0	744	351.16
pounds	183,624.25	494,648	1336	493,312	163,461.03
price	2.94	3.61	2.49	1.12	0.37

Table 1.4 provides summary statistics for fishing activity in 1991.

1992: Amendment 4 and Three Emergency Rules

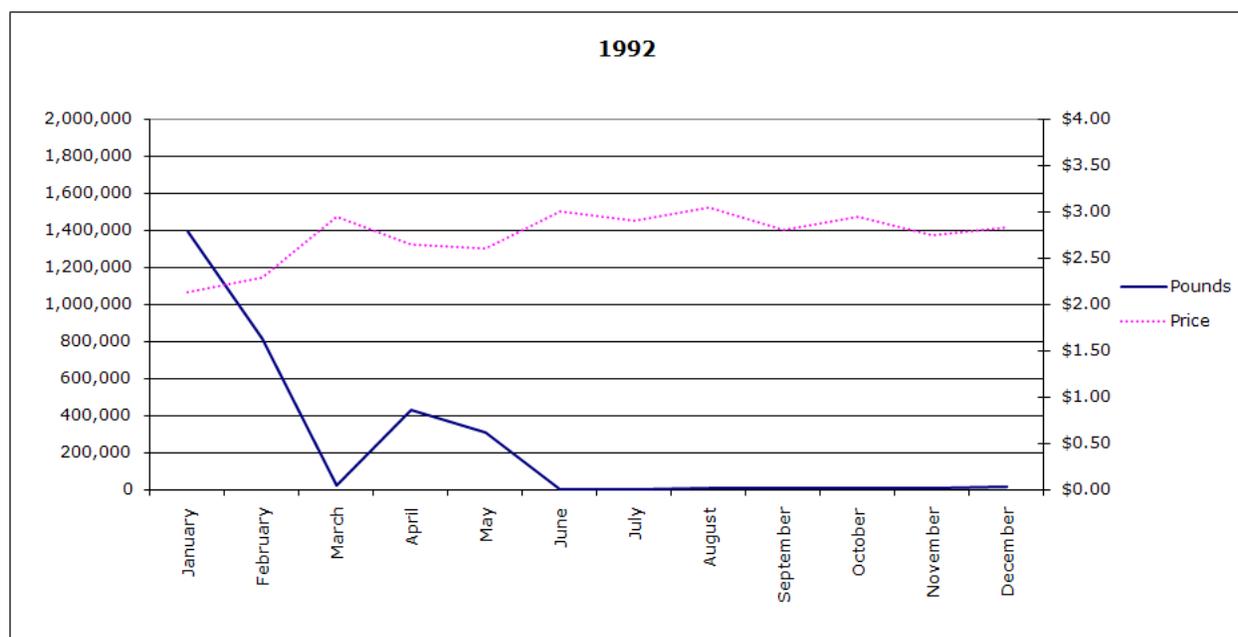


Figure 1.5 graphs the relationship between monthly catch and monthly price in 1992.

The Gulf Red Snapper Fishery reached the existing 2,040,000-pound commercial allotment just 53 days into the 1992 fishing season, forcing the fishery to close February 22, 1992.⁵⁹ An emergency rule promulgated by the Secretary of Commerce and implemented by NMFS at the request of the Gulf Council then reopened the fishery from April 3, 1992 until May 14, 1992—with a 1,000-pound trip limit—in order to “respond to economic and social emergencies in the reef fish fishery and to prevent waste of the valuable red snapper resource.”⁶⁰

⁵⁹ 57 FR 6561-6562.

⁶⁰ 57 FR 11916.

Amendment 4, effective May 8, 1992, modified the framework for implementing and changing management measures by specifying that NMFS stock and socioeconomic assessments be provided prior to August as opposed to in April.⁶¹ This allowed stock assessments to incorporate more recent landings data: an April 1992 assessment could only consider 1990 data, whereas an August 1992 assessment could consider preliminary 1991 data as well.⁶² In a move that more directly affected fishery participants, Amendment 4 attempted, “to moderate short-term future increases in fishing effort and to help stabilize fishing mortality while the Council considered a more comprehensive effort limitation program.”⁶³ The Amendment therefore, “[e]stablish[ed] a moratorium on the acceptance of additional commercial permit applications post-marked, or hand-delivered, after the effective date of implementing regulations for a maximum period of three years.”⁶⁴ Despite the moratorium, permits were transferable between vessels owned by the same permittee or between individuals when the permitted vessel was transferred.⁶⁵ Amendment 4 also made minor changes to Amendment 1's earned income requirement, allowing the "requirement to be met in either of the two years preceding permit application."⁶⁶

⁶¹ 57 FR 11914.

⁶² See *Reef Fish Amendment 4*, November 1991, at page 8, available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-04%20Final%201991-11.pdf>

⁶³ See *Reef Fish Amendment 27*, June 2007, at page 6. Available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20RF%20Amend%2027-%20Shrimp%20Amend%2014.pdf>

⁶⁴ See *Reef Fish Amendment 4*, at page 18. The moratorium was deemed necessary as “[t]he open access nature of the fishery has resulted in additional fishing effort or changes in the timing of existing effort in response to quotas and in response to actual or anticipated increases in stock levels. The additional effort and timing of the use of current effort both tend to dissipate the potential net benefits, which were originally forecast to result from earlier management actions.” *Id.* at 4.

⁶⁵ *Id.* at pages 24-25.

⁶⁶ 57 FR 11914.

A subsequent emergency rule, implemented on December 30, 1992, expanded the use of trip limits introduced during the April-May reopening by adding a red snapper endorsement issued to owners or operators of federally permitted reef fish vessels whose annual landings of red snapper reached at least 5,000 pounds in two of the three years from 1990 to 1992 to the reef fish permit.⁶⁷ This endorsement entitled permitted vessels with the endorsement a 2,000-pound possession limit of red snapper during open season; permitted vessels lacking the endorsement were limited to a 200-pound possession limit during the open season. A concurrent, related emergency rule delayed the opening of the 1993 commercial red snapper season until February 16, 1993, in order to give NMFS time to process and issue the necessary endorsements.⁶⁸

It is clear that the commercial quota affected fishing behavior in 1992. Whereas it took participants nearly nine months to exhaust the 2,040,000-pound commercial quota in 1991, in 1992, fishermen reached their limit in less than two months (1260 hours open vs. 5640). One may surmise that those who lost an opportunity to fish in late 1991 made up for their absence in early 1992, as the catch rate more than quintupled to 1619.70 pounds of fish claimed per hour. The largest harvest of the year, 1,396,046 pounds, came in January; the smallest, 2,205 pounds, arrived in July (a difference of 1,393,841 pounds). Price per pound troughed in January, the month of the largest catch, at \$2.13 per pound, and later peaked in August, the month after the

⁶⁷ 57 FR 62237. While the initial emergency interim rule was only effective through March 1993, a subsequent emergency interim rule extended the period for another 90 days, through June 28, 1993. See 58 FR 13560. W.R. Keithly described the rationale for the new rule in terms of the limitations of Amendment 4 and its predecessors: "Amendment 4, one should recognize, was general in nature and did nothing to reduce the level of effort that was being directed at the red snapper fishery at the time of its enactment nor did it restrict the movement of fishing effort from vessels fishing reef fish into the red snapper fishery. The council recognized the limitations afforded to it by the enactment of the reef fish fishery moratorium and in September 1992 requested the NMFS to implement a series of measures to extend the commercial red snapper season by emergency action. The major provisions of the emergency action were to establish a red snapper endorsement system for qualified reef fish permittees... The purpose of the trip limit was to forestall the recurrence of the 1992 derby fishery situation." W.R. Keithly Jr., *Initial Allocations of ITQs in the Gulf of Mexico Red Snapper Fishery*, FAO FISHERIES TECHNICAL PAPER, No. 411, at 101-102 (2001)

⁶⁸ 57 FR 62236.

smallest catch, at \$3.04 per pound (a spread of \$0.91). The deviation in the price series fell slightly from 1991 levels as the bulk of the catch was sold for the January and February glut-prices. Average price of \$2.29 was not only closer to the minimum; it was also 65 cents lower than the 1991 average price. The volatility in output grew substantially, with the spread and standard deviation of ex-vessel gutted weight both increasing nearly threefold.

TAC = 2.04 million pounds		Total Hours Open* = 1260		Rate* = 1619.05 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	189	744	0	744	294.75
pounds	251,775.08	1,396,046	2205	1,393,841	440,717.61
price	2.29	3.04	2.13	0.91	0.28
*Season initially closed when the TAC was met in 53 days (1260 hours) of fishing, but an emergency rule subsequently reopened the fishery for an additional 42 days (1008 hours) with a 1,000-pound trip limit. 737,572 pounds were caught, a rate of 731.72 pounds/hour. The full 2268-hour season and 3,021,301 pounds caught, set a rate of 1332.14 pounds/hour.					

Table 1.5 provides summary statistics for fishing activity in 1992.

1993: Amendment 6, an Emergency Interim Rule, a Final Rule

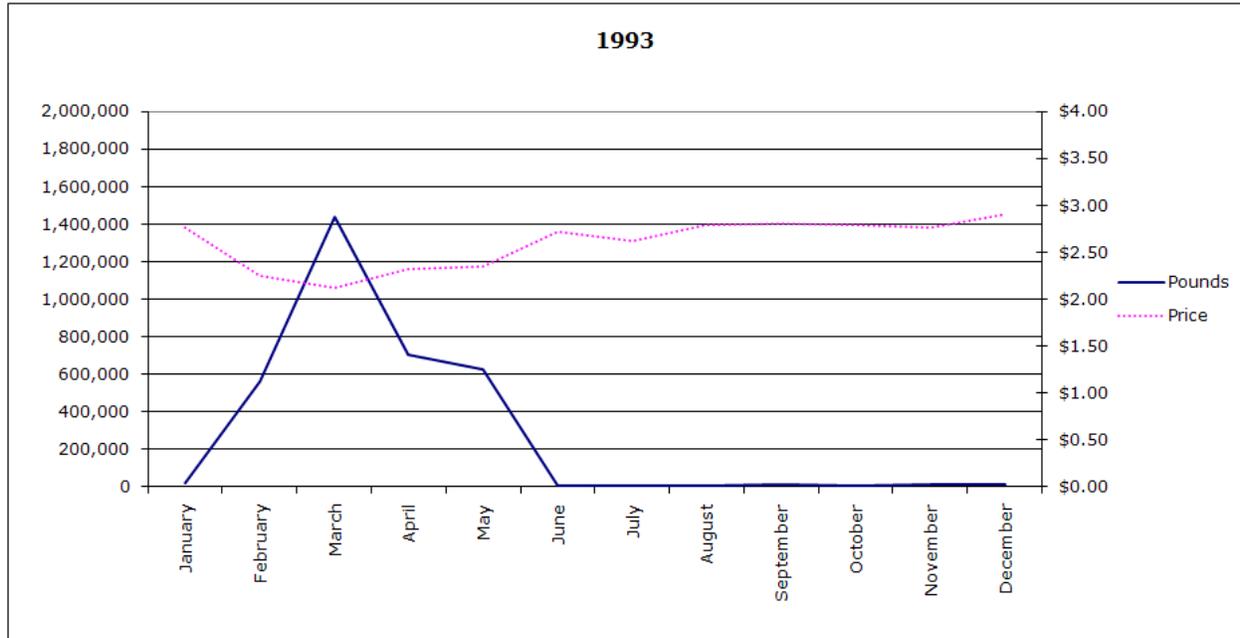


Figure 1.6 graphs the relationship between monthly catch and monthly price in 1993.

As previously mentioned, the trip limit system was extended under an emergency interim rule through June 1993.⁶⁹ A final rule, implemented March 23, 1993, increased the commercial red snapper TAC quota to 3,060,000 pounds.⁷⁰ Additionally, the final rule maintained the daily, seven red snapper recreational bag limit and pushed back Amendment 3's timeline for rebuilding the snapper stock from 2007 to 2009.⁷¹ Amendment 6, implemented on June 29, 1993, "continue[d] through December 31, 1994, the vessel trip limits for red snapper of 2,000 pounds

⁶⁹ 58 FR 13560. *See also* discussion *supra* note 54.

⁷⁰ 58 FR 16371. When the recommendation to raise the TAC of an already overfished species was questioned, the Council pointed out recent assessments indicated, "relatively strong year classes were produced in 1989 and 1990," and that a decision to extend the rebuilding target date from 2007 to 2009 brought the increased TAC within the range of the acceptable biological catch for red snapper calculated by the Council's Reef Fish Stock Assessment Panel. While the selection of appropriate TAC levels had heretofore been complicated due to bycatch of juvenile red snapper by shrimp trawls, a 1990 amendment to the FMCA specified 1994 as the earliest year for mandatory reductions in bycatch. Should anticipated reductions in bycatch "prove unattainable in (or shortly after) 1994, the Council recognizes that reductions in directed red snapper harvest may be necessary to comply with the rebuilding program." *Id.* at 16372.

⁷¹ *Id.*

for a vessel that has a red snapper endorsement on its reef fish permit and 200 pounds for a permitted vessel without such endorsement.”⁷²

With trip limits in place under the reef fish endorsement scheme, the season opening delayed until February 16 to process and issues those endorsements, and an overall TAC nearly one-third larger than the previous year, the TAC was not exhausted as rapidly as in 1992. The fishery closed May 21, 1993, providing participants with more than three months (2256 hours) of fishing in 1993 as opposed to less than 2 months (1260 hours) of fishing on the initial quota in 1992.⁷³ The trip limit system reduced the catch rate from 1992 levels (1619 pounds of fish per hour) to 1356.38 pounds per hour, but did not get anywhere close to the rates from 1990-1991. Monthly production peaked in March at 1,434,742 pounds and fell off after May, with a minimum of 3,169 pounds reported in June (a difference of 1,431,573 pounds). Price fell to its lowest level, \$2.13, as production peaked in March; price eventually topped out in December at \$2.91 (a difference of \$0.78). The deviation in both series was nearly identical to the 1992 numbers, but average price fell 6 cents further, to \$2.23 per pound (much closer to the low levels of March than the high levels reported for December).

For the first time, monthly data on the following were available: trips on which at least one-pound of red snapper was caught; total number of unique vessels harvesting snapper; and landings reported to the coastal logbook under the endorsement system. Not surprisingly, the most trips (1166) were taken in March when output peaked (1166 trips by 318 boats). A yearly high of 331 unique boats caught snapper in April, the month of the second highest harvest. For the year, 123 vessels were eligible to claim 2,000 pounds per trip with the red snapper endorsement to their reef fish permit. These vessels reported landing 2,421,466 pounds, or 86%,

⁷² See 58 FR 33025.

⁷³ 58 FR 29556.

of the 2,793,723 total pounds of snapper reported (19,686 pounds each). On the other extreme, the 529 vessels without the endorsement that reported landings to the coastal logbook accounted for the remaining 372,258 pounds of red snapper caught (703 pounds each). Intuitively, it seems overcapitalization would be necessary to accommodate a regime under which over 90% of trips (3219 of 3515) were taken in just four months (February through May). Even worse, if costs increased while engaged in this frenetic fishing behavior, the economic impact of derby-depressed average yearly prices would be exacerbated.

TAC = 3.06 million pounds		Total Hours Open = 2256		Rate = 1356.38 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	188	720	0	720	297.8
pounds	283,446.5	1,434,742	3169	1,431,573	457,157.82
price	2.23	2.91	2.13	0.78	0.26
trips	292.92	1166	31	1135	405.03
vessels	114.67	331	17	314	135.39
1993 introduced 2,000- and 200-pound red snapper endorsement system.					

Table 1.6 provides summary statistics for fishing activity in 1993.

1994: Amendment 5, Amendment 7, Amendment 9 and a Final Rule

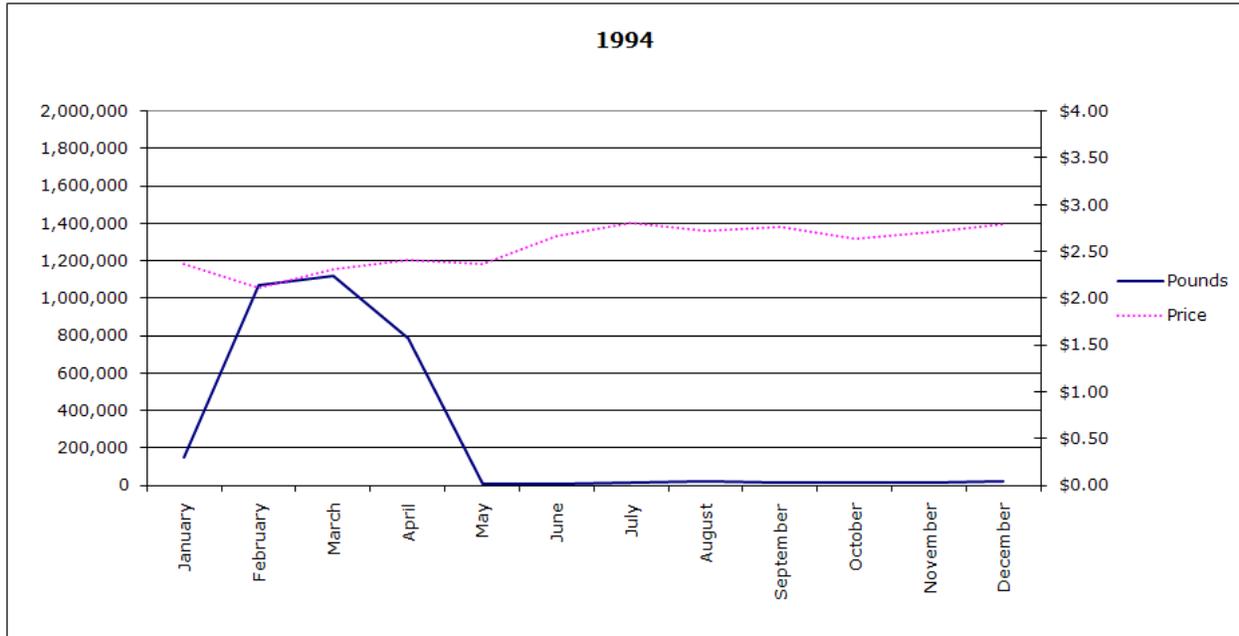


Figure 1.7 graphs the relationship between monthly catch and monthly price in 1994.

A final rule, effective January 1, 1994, postponed the beginning of the 1994 commercial red snapper fishery until February 10, 1994, in order to minimize the risk of fishing during “hazardous winter weather” and to “ensure the commercial red snapper fishery was open during Lent, when there is increased demand for seafood.” Furthermore, commercial vessels were restricted “to landing no more than one trip limit per day.”⁷⁴ Amendment 5, implemented on February 7, 1994, required all finfish to be landed with their heads and fins attached, restricted the use of fish traps in the EEZ, and introduced a three-year moratorium on new participants in the fish trap fishery via a fish trap endorsement regime with access limited to those trap fishermen who had recorded reef fish landings between January 1, 1991, and November 19, 1992.⁷⁵ Of more direct import to red snapper fishery participants, Amendment 5 established a

⁷⁴ 58 FR 68325. While this distinction may seem trivial, the council wanted to emphasize that taking two trips in one day was not a legitimate loophole around the established the 2,000 or 200 pound trip limits.

⁷⁵ 59 FR 966. Amendment 7 would, however, allow “the transfer of a fish trap endorsement with the transfer of the vessel’s reef fish permit to an immediate family member.” See 59 FR 6588.

schedule to increase the minimum size of red snapper from thirteen to sixteen inches in total length over a period of five years.⁷⁶

Amendment 7, also implemented on February 7, 1994, “require[ed] dealers who purchase from fishing vessels reef fish caught in the exclusive economic zone (EEZ) to obtain Federal permits and maintain records of such purchases.”⁷⁷ Amendment 7 gave additional flexibility to the transfer of red snapper endorsements on reef fish vessel permits, allowing transfer “upon the disability or death of a vessel owner or, in certain circumstances, an operator.”⁷⁸ Amendment 9, implemented on July 27, 1994, required collection and compilation of commercial red snapper landings and eligibility data in order to assist analysis of potential limited access fishing programs.⁷⁹ Amendment 9 also “extend[ed] the current reef fish permit moratorium... [and] the red snapper endorsement system and its associated trip and landing limits from their scheduled expiration... through as late as December 31, 1995.”⁸⁰

Following a similar opening schedule (February 10 instead of February 16) and identical TAC quota as 1993, participants exhausted the 1994 quota by April 27 (1848 hours), as opposed to the May 21 (2256 hours) closing in 1993.⁸¹ The catch rate (1655.85 pounds per hour) exceeded 1992 levels. Production peaked in March at 1,120,419 pounds, a figure nearly

⁷⁶ *Id.* at 972. The minimum size increased to fourteen inches total length through the 1995 season, with a scheduled increase to fifteen inches for the 1996 and 1997 seasons, and sixteen inches for the 1998 season forward.

⁷⁷ 59 FR 6588.

⁷⁸ *Id.*

⁷⁹ 59 FR 39301. This information was necessary “to evaluate red snapper management alternatives,” and “to identify individuals who may qualify for initial participation in a red snapper effort management regime.”

⁸⁰ *Id.* Comments accompanying the Amendment 9 proposal indicated such measures were necessary in order to “prevent speculative entry anywhere in the reef fish fishery prior to establishing a red snapper effort management system.” See *Reef Fish Amendment 9*, (March 1994), page 7, available at: <http://www.gulfcouncil.org/Beta/GMFCWeb/downloads/RF%20Amend-09%20Final%201994-03.pdf>

⁸¹ 59 FR 22760.

1,110,988 pounds higher than May’s yearly minimum of 9,431 pounds. Price per pound maxed out at \$2.81 in July, some \$0.70 higher than the yearly minimum of \$2.11 in February (the month with the second largest output). The deviation in these series was similar to—if only slightly lower than—1993 levels. Average price rose a mere four cents to \$2.27. Nearly 90% of trips were taken in February, March, and April ($2685/3104 = 86.5\%$). Not surprisingly, given the yearly high in output, March featured the most frenzied fishing: 342 vessels took 1060 trips, both yearly highs. Once again, 123 boats reported fishing under the snapper endorsement to the reef fish permit. They reported taking nearly 90% (2,482, 537 pounds) of the 2,760,228 pounds reported to the coastal logbook. 460 boats (69 fewer than in 1993) fishing with the reef fish permit alone reported catching 277,691 pounds of red snapper. Fishing behavior closely mimicked that of 1994, except that fishermen seemed to respond to the second year of an unchanged TAC quota by exhausting it more quickly.

TAC = 3.06 million pounds		Total Hours Open = 1848		Rate = 1655.85 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	154	744	0	744	285.53
pounds	270,906.58	1,120,419	9431	1,110,988	443,837.49
price	2.27	2.81	2.11	0.7	0.23
trips	258.67	1060	32	1028	388.82
vessels	96.17	342	18	324	126.44
Amendment 5 increased the minimum allowable size to 14 inches effective February 7.					

Table 1.7 provides summary statistics for fishing activity in 1994.

1995: Amendment 8, Amendment 11, a Final Rule, and a Reopening of the Fishery

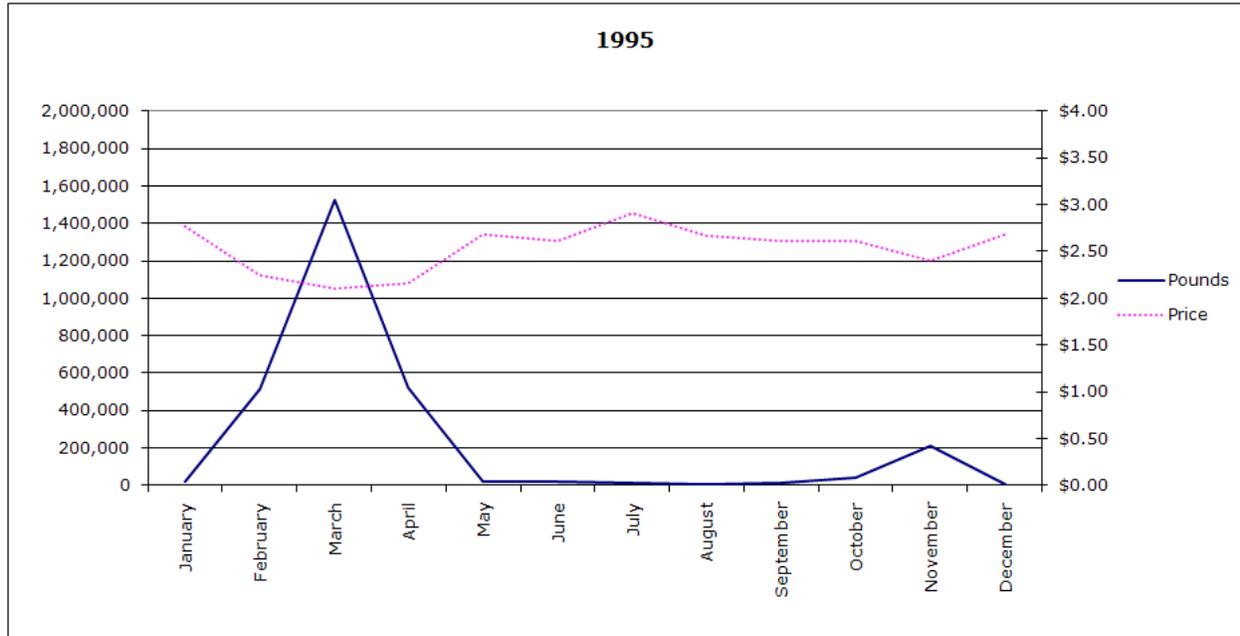


Figure 1.8 graphs the relationship between monthly catch and monthly price in 1995.

A final rule implemented on January 1, 1995, established February 24, 1995, as the opening of the commercial red snapper fishery. The rule also reduced the recreational bag limit from seven to five fish per day and, one year ahead of schedule, increased the recreational minimum size limit to fifteen inches total length.⁸² Amendment 8 proposed the implementation of an Individual Transferable Quota (ITQ) program for the red snapper fishery.⁸³ The amendment proposed rights-based fishing, with harvest allocations based on historical

⁸² 59 FR 67646. The commercial minimum size limit remained at fourteen inches total length.

⁸³ 60 FR 61200. The ITQ system was slated to begin on April 1, 1996, but Congressional action re-authorizing the FCMA via The Sustainable Fisheries Act (SFA) of 1996 imposed a moratorium on all new ITQ regimes in the U.S. with retroactive dates on the moratorium precluding implementation of a red snapper ITQ program. W.R. Keithly provides the following overview: "[a] comprehensive effort management programme... was to be implemented in the Gulf of Mexico red snapper fishery by early 1995. Due to Council delays in selecting and implementing such a programme, however, the endorsement system was extended though 1995... An ITQ system was to become operational on April 1, 1996. Because of the furlough of NMFS employees in December 1995 and a continuing resolution that provided budget funds for the Department of Commerce, however, the NMFS was unable to complete the work needed prior to implementation of the ITQ programme. The programme was originally suspended for 90 days.... Shortly thereafter, Congress, in its re-authorization of the *Magnuson Act*, placed a moratorium on all new ITQ programmes in the U.S." W.R. Keithly Jr., *Initial Allocations of ITQs in the Gulf of Mexico Red Snapper Fishery*, FAO FISHERIES TECHNICAL PAPER, No. 411, at 102 (2001). See 61 FR 7751 for details on the original suspension of the ITQ program.

participation in the fishery.⁸⁴ While the NMFS approved the proposal in 1995, a Congressional moratorium—imposed by the 1996 Sustainable Fisheries Act (SFA)—on the development or implementation of new ITQ programs until October 1, 2000, halted progress on the red snapper ITQ program.⁸⁵ The fishery was closed on April 15, 1995, based on projections made with statistics available at that time.⁸⁶ After further analysis of landings data suggested that approximately 210,000 pounds of the 1995 commercial snapper quota remained un-harvested, the Gulf Council requested the fishery be reopened, based on projected weather conditions, around November 1, 1995, so that the remainder of the quota could be harvested in late 1995 (when the economic value of the catch would be higher than in early 1996).⁸⁷ The NMFS later announced the fishery would be reopened from "12:01 a.m., local time, November 1, 1995 to 12, noon, local time, November 2, 1995."⁸⁸

Given conditions comparable to previous years—a February opening to the commercial season and an identical commercial TAC quota—fishery participants reacted in a similar

⁸⁴ See *Reef Fish Amendment 8*, at page 14. Available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-08%20Final%201995-06.pdf> ITQs seek to eliminate the common resource incentive problem in fisheries by giving participants some guaranteed percentage of the overall TAC quota. Secure in the knowledge that the fishery will not close before they have a chance to fish, participants are not forced to engage in the sort of derby-fishing behavior that crashed Gulf red snapper prices since the implementation of TAC quotas. The most far-reaching examination of worldwide IFQ impact was conducted by Costello, Gaines, and Lynham. The authors compiled a global database of fisheries institutions and catch statistics in 11,135 global fisheries from 1950 to 2003 and applied an OLS analysis to their dataset, finding that “the fraction of ITQ-managed fisheries that were collapsed was about half that of non-ITQ fisheries. This result probably underestimates ITQ benefits, because most ITQ fisheries are young.” The authors wrapped up their examination of worldwide fisheries, concluding “[i]mplementation of catch shares halts, and even reverses, the global trend toward widespread collapse.” See Costello, Gaines, and Lynham, *Can Catch Shares Prevent Fisheries Collapse?*, 321 *SCIENCE* 1678 (2008).

⁸⁵ See *Reef Fish Amendment 27*, at page 7. Available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20RF%20Amend%2027-%20Shrimp%20Amend%2014.pdf>

⁸⁶ 60 FR 19363.

⁸⁷ 60 FR 55359. While the reopening was originally scheduled to occur October 30 and 31, "weather conditions deteriorated significantly on October 29. The U.S. Coast Guard... recommended a 48 hour delay in the fishery reopening." See 60 FR 55805.

⁸⁸ 60 FR 55805.

manner. Although the 3,040,000-pound quota was not technically reached (catch totaled 2,953,751 at year's end), the bulk of the quota was exhausted in the three furious (catch rate of 2475.73 pounds per hour was the highest yet) months of fishing that predated the fishery's April 15 closure (after 1200 hours of fishing, or 648 hours less than 1994) based on projected harvests. Price bottomed out at \$2.10 in the same month, March, that production peaked at 1,522,409 pounds. The highest monthly average price, \$2.91, arose in July (a difference of \$0.81). Given the amount sold at glut prices, it is not surprising to see find yearly average price, \$2.18, much closer to low end of yearly prices. December's 7,100-pound catch was the smallest of the year (off 1,515,309 pounds from March). The standard deviations for price and output were slightly larger than the previous year.

More than 85% of the trips were taken in just three months (2222 of 2593 trips). Another 6% of trips (156 of 2593) were taken in the 36 hours during which the fishery was reopened. Once again, March hosted the most fishing activity: the 307 boats taking 1221 trips were both yearly highs. The 125 boats fishing with the red snapper endorsement claimed over 91% (2,551,845 pounds) of the 2,793,440 pounds reported to the coastal logbook. 345 boats (115 fewer than the year before) fishing without the endorsement claimed the remaining 241,595 pounds. Aside from the reopening, the pattern of behavior was strikingly similar to previous years. A slight spike in November's output and a concomitant dip in November's ex-vessel price followed the aforementioned 36-hour reopening of the red snapper fishery.

TAC = 3.06 million pounds		Total Hours Open = 1236		Rate = 2475.73 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	103	744	0	744	224.58
pounds	241,507.58	1,522,409	7100	1,515,309	447,249.98
price	2.17	2.91	2.1	0.81	0.25
trips	216.08	1221	15	1206	367.94
vessels	82.25	307	12	295	106.31

Table 1.8 provides summary statistics for fishing activity in 1995.

1996: Amendment 11, Two Emergency Interim Rules, Two Final Rules, & Amendment 13

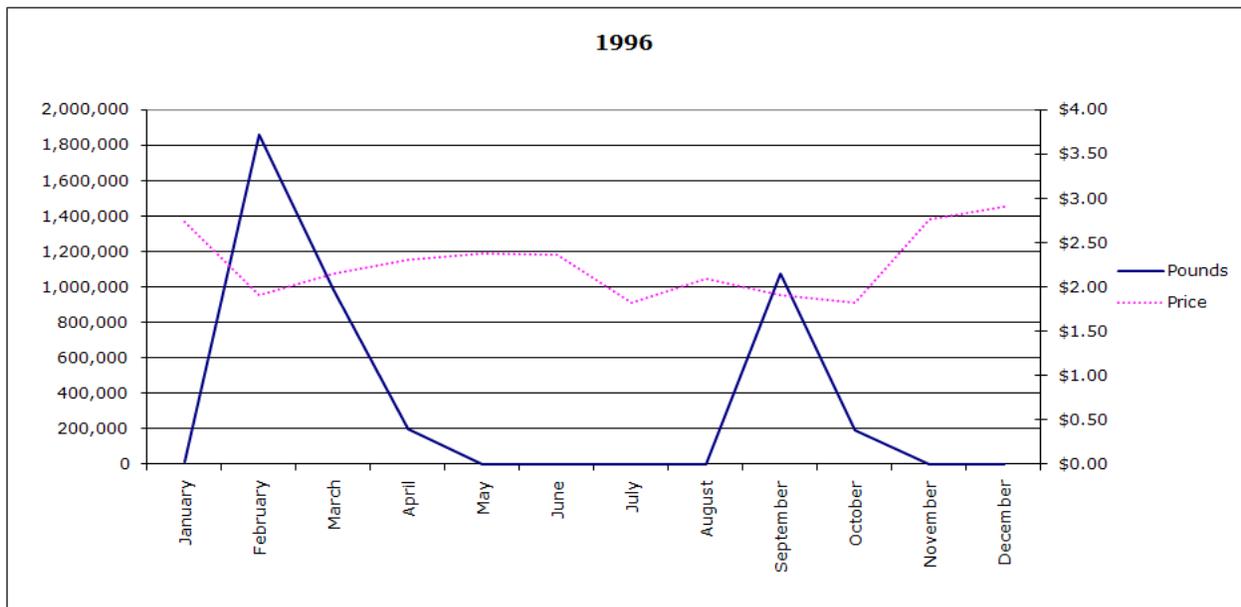


Figure 1.9 graphs the relationship between monthly catch and monthly price in 1996.

Certain elements of Amendment 11 were implemented on January 1, 1996.⁸⁹ These provisions modified the framework for adjusting management measures, restricted sale and purchase of reef fish to permitted fish vessels and dealers, required charter vessel and headboat permits, and instituted a new reef fish permit moratorium effective through December 31, 2000.⁹⁰ An emergency interim rule published in January 1996 delayed the opening of the

⁸⁹ 60 FR 64350.

⁹⁰ *Id.* at 64352-64353.

commercial fishery until February 1, established a one-million pound commercial quota for the period February 1 through March 31, 1996, and extended the red snapper endorsement system through March 31, 1996.⁹¹ A subsequent emergency interim rule halted implementation of the gulf red snapper ITQ program originally proposed by 1995's Amendment 8.⁹² The rule made the entire 3.06 million pound commercial quota available to fishery participants and extended the red snapper trip limit and endorsement regime through at least May 29, 1996.⁹³

Amendment 13, implemented on September 15, 1996, "extend[ed] the red snapper vessel permit endorsement and trip limit system until implementation of either the individual transferable quota (ITQ) system approved under Amendment 8 to the FMP or an alternate program to restrict access to the commercial red snapper fishery, such as a limited license system. If neither option is possible, the vessel permit endorsement and trip limit system terminates December 31, 1997."⁹⁴ Part of a final rule, made effective September 15, 1996, reopened the fishery to allow harvest of the newly increased commercial red snapper TAC quota of 4,650,000 pounds and—based upon new data which suggested that the life span and generation time of red snapper was longer than believed—extended the target recovery date to 2019.⁹⁵ The rest of the final rule, effective October 16, 1996, "split the 1997 commercial quota

⁹¹ 61 FR 17-18.

⁹² 61 FR 7751.

⁹³ *Id.*

⁹⁴ 61 FR 48413-48414

⁹⁵ 61 FR 48641. Dr. Waters explains the rationale for increasing the TAC: "National Marine Fishery Service (NMFS) guidelines specify an overfished stock be rebuilt within 10 years if feasible, and otherwise within 10 years plus one mean generation time (Restrepo et al. 1998), with mean generation time defined as the weighted average of spawning individuals in the population. Additional biological work about ageing revealed that red snapper was a longer-lived species than previously thought. Hence the generation time was longer than previously specified (Goodyear 1995). This result allowed the Gulf of Mexico Fishery Management Council to increase the TAC

between two seasons, the first beginning on February 1, 1997, with a quota of 3.06 million lb ... and the second beginning on September 15, 1997, with a quota equal to the unharvested balance of the annual commercial quota."⁹⁶

The February 1 opening exhausted the 3.06 million pound quota in just three months, leading the fishery to close on April 5, 1996.⁹⁷ Thanks to a subsequently increased quota (4.65 million pounds) and a reopening of the fishery, the remainder (1.59 million pounds) was made available to fishery participants as of September 15. This allocation was exhausted by October 7, when the fishery was closed again based upon projections that proved inaccurate.⁹⁸ While the two-tiered quota system was somewhat effective in providing appreciable quantities of snapper to the market in the fall, the behavior followed the pattern of previous fishing efforts—albeit on a smaller scale—as participants quickly exhausted the allocation once it became available. The catch rate of 2252.91 pounds per hour was much closer to 1995 levels than to lower historical benchmarks.

The largest harvest of the year came in February, the month of the spring opening (not coincidentally the September opening produced the second largest catch), when 1,855,507 pounds of snapper were caught. The smallest output was reported in December, when just 168 pounds of snapper were harvested (down 1,855,339 pounds from the February peak). Buoyed by the scarce output, December snapper garnered the highest price per pound, \$2.90. The fish were cheaper in July, costing just \$1.82 per pound (yielding a yearly spread of \$1.08 in the price of

because a more gradual recovery to the same biological goal was possible." James R. Waters, *Quota Management In the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS 65 at 67.

⁹⁶ 61 FR 48641.

⁹⁷ 61 FR 14683.

⁹⁸ 61 FR 52715. 4,319,361 pounds of a 4.65 million pound snapper quota were harvested in 1996.

snapper). Once again, the yearly average price, \$1.97, fell much closer to the lowest reported levels. It is worth noting that the next three lowest monthly average prices were reported in February, September, and October, when output was relatively high. The volatility of these series was clearly higher than the 1995 levels.

Nearly three-fourths ($2607/3584 = 72.7\%$) of the trips were taken in the spring season between February and April (with February hosting a yearly high of 317 boats). Over a quarter of the trips ($954/3584 = 26.6\%$) occurred during the fall season between September and October. The 131 boats fishing with the red snapper endorsement seized almost 95% (3,831,909 pounds) of the total catch (4,043,564 pounds) reported to the coastal logbook program. Another 364 boats (19 more than in 1995) reported catching the remaining 211,655 pounds. Beyond the effects of an increased and split quota providing fish into the fall, producer behavior continued to follow the already established derby pattern.

TAC = 4.65 million pounds		Total Hours Open = 2064		Rate = 2252.91 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	172	744	0	744	279.67
pounds	359,946.75	1,855,507	168	1,855,339	609,601.99
price	1.97	2.9	1.82	1.08	0.38
trips	298.67	1421	4	1417	476.34
vessels	96.25	317	3	314	121.81
Amendment 5 increased the minimum allowable size to 15 inches for the 1996 & 1997 seasons.					
For the first time, the commercial red snapper quota was split into two seasons.					

Table 1.9 provides summary statistics for fishing activity in 1996.

1997: Amendment 12, Amendment 14 and A Regulatory Amendment

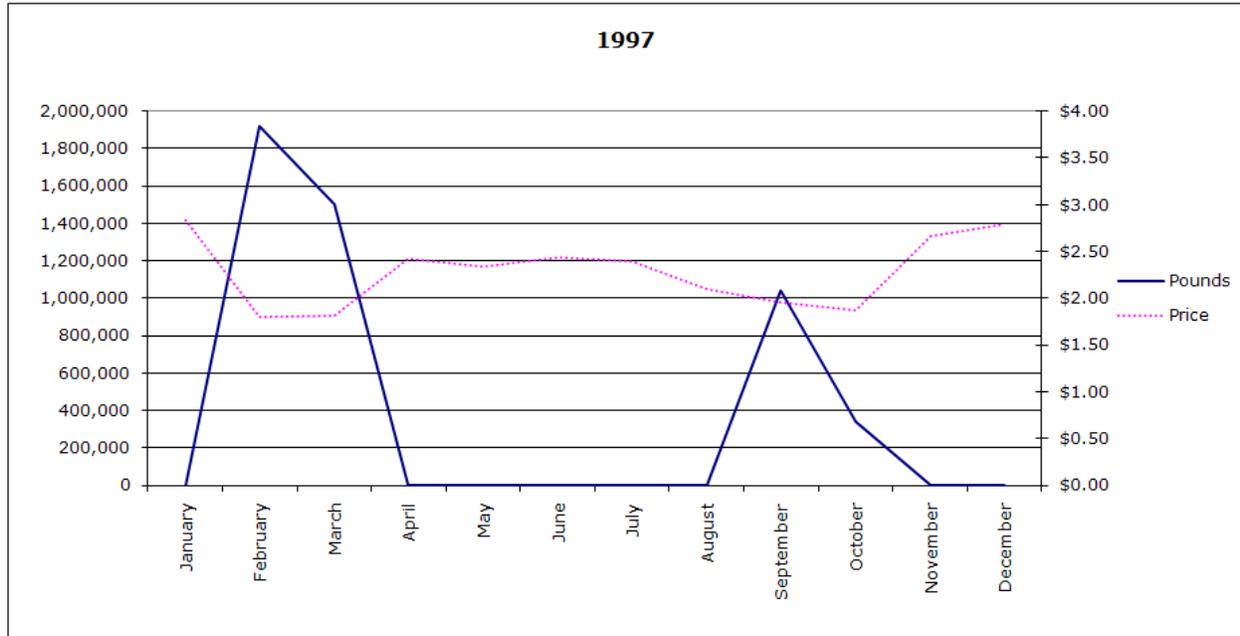


Figure 1.10 graphs the relationship between monthly catch and monthly price in 1997.

Amendment 12, implemented on January 15, 1997, proposed exempting the commercial fishery from automatic red snapper size limit increases specified by Amendment 5.⁹⁹ The NMFS did not approve these proposed provisions.¹⁰⁰ Part of a final rule, effective September 2, 1997, "change[d] the opening date of the 1997 fall commercial fishing season from September 15 to September 2... [and]... restrict[ed] the harvest of red snapper during the 1997 fall commercial season to an initial period of September 2 to September 15, and thereafter, to a period from the first to the 15th of each month until the commercial fishery is closed (all openings and closings... at noon on the date required."¹⁰¹ The rest of the final rule, effective October 6, 1997, established a quota for the recreational snapper fishery and authorized the Regional

⁹⁹ See Reef Fish Amendment 12 (December 1995), page 17, available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-12%20Final%201995-12.pdf>

¹⁰⁰ See Reef Fish Amendment 27, at page 8.

¹⁰¹ 62 FR 46677-46678.

Administrator of the Southeast Region of NMFS to close the recreational fishery when projections suggested the quota would be reached.¹⁰²

Amendment 14, implemented on March 25 and April 24, 1997, began a ten-year phase out of the reef fish trap fishery, but permitted fish trap endorsements to be transferred freely for two years, after which such transfers would be restricted to death or disability situations, “to another vessel owned by the same entity, and a one-time transfer to any of the 56 individuals who were fishing traps after November 19, 1992 and were excluded by the moratorium.”¹⁰³

In the second year of an increased TAC, participants fished to the quota faster than in the previous year. The February opening exhausted its initial quota allocation in less than two months, prompting the Gulf Council to close the spring season on March 25, 1997.¹⁰⁴ The fall season lasted just over a month, closing on October 6, 1997.¹⁰⁵ For the year, the fishery harvested the 4.65 million pounds in just 1704 hours, pushing the pounds per hour rate to 2728.87. Output peaked in February at 1,922,353 pounds (although March and September both surpassed the 1,000,000 pound plateau as well), leading price to fall to its lowest level of the year, \$1.80. Price peaked in January, at \$2.84, a full \$1.04 higher than the March low. Unfortunately, with most of the fish sold at the lower glut prices, the average price of \$1.84 was much closer to the yearly minimum. Output was low in several months, but August’s 466 pounds was the lowest—approximately 1,921,887 below the February peak. The volatility of the price and output series remained similar to 1996 levels.

¹⁰² *Id.* at 46678. The recreational fishery closed November 26, 1997. *See* 62 FR 61700.

¹⁰³ 62 FR 13983. *See* Reef Fish Amendment 14 (August 1996), pages 13 and 25, available at: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-14%20Final%201996-08.pdf>

¹⁰⁴ 62 FR 14651.

¹⁰⁵ 62 FR 52045.

Nearly 70% of the trips were taken in the spring season ($2597/3773 = 68.8\%$), with nearly 30% ($1078/3773 = 28.5\%$) following in the fall season. February was the most active month for fishing: 342 vessels made 1392 trips, both yearly highs. The 132 boats fishing with red snapper endorsements to their reef fish permits took over 92% ($4,083,426 / 4,411,084 = 92.5\%$) of the harvest reported to the coastal logbook. The 393 vessels fishing with 200-pound trip limits claimed the remainder. The initial reductions in fishing rate attributable to the red snapper endorsement and trip limit system seemed to have dissipated, as the rate increased for the fourth time in four years. The fifteen-day mini-season provided a slightly higher October catch as compared to the previous year, but otherwise the measurables of the fishery mimicked their 1996 values.

TAC = 4.65 million pounds		Total Hours Open = 1704		Rate = 2728.87 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	142	672	0	672	248.88
pounds	401,631.25	1,922,353	466	1,921,887	688,743.84
price	1.84	2.84	1.8	1.04	0.38
trips	314.42	1392	9	1383	514.94
vessels	95.08	342	9	333	131.16
Fall opening applied 15-day mini-seasons to the red snapper fishery for the first time.					

Table 1.10 provides summary statistics for fishing activity in 1997.

1998: Amendment 15, two Final Rules, and two Interim Rules

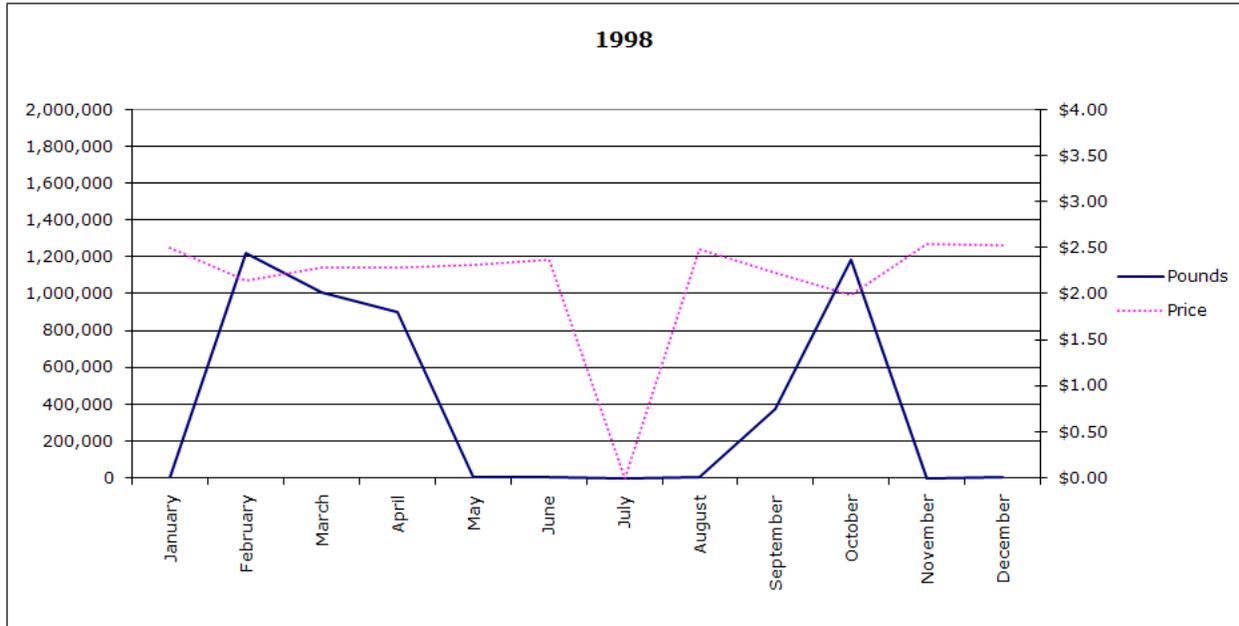


Figure 1.11 graphs the relationship between monthly catch and monthly price in 1998.

A final rule, implemented on January 1, 1998, maintained the status quo fifteen-inch minimum total length size requirement, thereby bypassing Amendment 5's provision to increase the red snapper minimum size limit to sixteen inches total length by the 1998 season.¹⁰⁶ Amendment 15, implemented on January 29, 1998, "replace[d] the current red snapper endorsement and trip limit system with a system comprised of two classes of transferable red snapper licenses and trip limits."¹⁰⁷ Endorsement holders on March 1, 1997, and historical captains received Class 1 licenses, entitling them to a 2,000-pound trip limit.¹⁰⁸ Class 2 licenses were "issued for the vessel specified by an owner or operator whose income qualified for a commercial vessel permit for reef fish that was valid on March 1, 1997, and such owner or operator was the person whose earned income qualified for a commercial vessel permit for reef

¹⁰⁶ 63 FR 443-444.

¹⁰⁷ 62 FR 67714.

¹⁰⁸ *Id.* at 67721.

fish that had a landing of red snapper during the period from January 1, 1990, through, February 28, 1997".¹⁰⁹

While these licenses were fully transferable, vessels without a Class 1 or Class 2 license were not eligible for commercial harvest of red snapper. Furthermore, the Amendment permanently divided the red snapper season into two parts, "the first commencing February 1 with two-thirds of the annual quota available and the second commencing on September 1 with the remainder of the annual quota available."¹¹⁰ Following the pattern established the previous fall, the Amendment planned to "open the red snapper commercial fishery at noon on the first of each month and close it at noon on the 15th of each month."¹¹¹ After considering a regulatory amendment, NMFS opted to instead implement an interim rule, effective April 14, 1998, which reduced the recreational bag limit to four fish and reserved 3.12 million pounds of the TAC pending an assessment of the observed efficacy of bycatch reduction devices (BRDs) applied to shrimp trawls in protecting juvenile red snapper.¹¹² An ensuing emergency interim rule released

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ *Id.*

¹¹² 63 FR 18144. Of the 9.12 million pound TAC, 3.06 million pounds had already been released to the commercial fishery (with another 1.59 million pounds to be released in the fall). The reserve meant that only 2.94 million pounds of the 4.47 million pound recreational quota would be initially available (with 1.53 million pounds reserved pending analysis of BRD efficiency). Bycatch of juvenile snapper by shrimp trawls is considered one of the unique challenges of red snapper management. Keithly notes, "the overfished status of the Gulf of Mexico red snapper fishery is the result not only of an excessive amount of effort but also a high level of bycatch mortality associated with shrimp fishing." W.R. Keithly Jr., *Initial Allocations of ITQs in the Gulf of Mexico Red Snapper Fishery*, FAO FISHERIES TECHNICAL PAPER, No. 411, at 99 (2001). Andrew Strelcheck and Peter Hood report, "[b]etween 2001 and 2003, the directed red snapper fishery discarded dead approximately 1.67 million red snapper per year (include[ing] in-season and closed season discards) and the shrimp trawl fleet discarded dead approximately 18.3 million juvenile (age-0, -1, -2) red snapper per year." Andrew J. Strelcheck and Peter B. Hood, *Rebuilding Red Snapper: Recent Management Activities and Future Management Challenges*, NOAA Fisheries Service Office, at 5, manuscript on file with author. The Gulf Council addressed this concern via Shrimp Fishery Management Plan Amendment 9, requiring use of BRDs in shrimp trawls in order to reduce the bycatch mortality of juvenile red snapper. 63 FR 18139.

the reserved TAC quota and closed the recreational snapper fishery, effective on September 30, 1998.¹¹³

The fifteen day per month commercial season seemed to impact output in the fishery, particularly in terms of volatility. The spring quota was exhausted on April 12, 1998.¹¹⁴ The fall quota was exhausted on October 15, 1998.¹¹⁵ The 1620-hour season required a catch rate of 2870.37 pounds per hour to exhaust the 4.65 million pound commercial quota. February once again reported the largest output, 1,222,119 pounds (although March, April, and October all harvested around 1,000,000 pounds). July's output of zero pounds was obviously the minimum, although November's 53-pound harvest was the minimum in a month when fishing was actually reported (yearly difference of 1,222,119 pounds counting July; difference of 1,222,066 pounds using November). Price peaked at \$2.54 amid the previously mentioned 53-pound harvest of November. The lowest price, \$1.98, came in October, the month with the second highest overall harvest (a yearly difference of \$0.56). Average price recovered somewhat from 1997 levels, climbing to \$2.16 (an average that was once again closer to yearly lows than highs). As previously mentioned, the volatility in the price and output series (both spread and standard deviation) fell from 1997 levels (with price volatility falling by approximately one-half).

With 98% of trips taken in just 5 months (with 63%, or 2581 of 4085 trips, taken in February through March; and 35%, or 1421 of 4085 trips, taken in September-October), the fishery laid effectively idle for more than half of the year. February (1000 trips by 268 boats for a reported catch of 1,222,119 pounds) and October (998 trips by 275 boats for a reported catch of 1,183,085) were the most active fishing months in terms of output, trips, and boats taking trips.

¹¹³ 63 FR 45760.

¹¹⁴ 63 FR 18147.

¹¹⁵ 63 FR 58327.

138 boats, fishing with the newly created Class 1 licenses, pulled in nearly 93% (4,136,231 of 4,463,679 pounds) of the red snapper harvest reported to the coastal logbook. 276 boats claimed 209,254 pounds under the Class 2 license. While fishing effort seemed to be on par with years prior (the fishing rate was actually the highest yet), the fifteen-day mini-seasons ensured red snapper was available in appreciable quantities in more months (the monthly standard deviation fell). This seemed to assuage some of the price volatility, which hit its lowest level since 1990.

TAC = 4.65 million pounds		Total Hours Open = 1620		Rate = 2870.37 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	135	336	0	336	167.62
pounds	426,567	1,222,119	0	1,222,119	534,380.22
price	2.16	2.54	1.98	0.56	0.18
trips	340.42	1000	6	994	430.45
vessels	109.33	275	5	270	122.93
Amendment 15 replaced the red snapper endorsement system in place since 1993 with a two-tiered licensing system whereby holders of reef fish permits & Class 1 licenses could harvest 2,000 pounds/trip, while holders of reef fish permits & Class 2 licenses could take 200 pounds/trip, and holders of reef fish permits only could not claim any red snapper. The 15-day mini-season carried over from fall 1997, serving as another tool for fishery management.					

Table 1.11 provides summary statistics for fishing activity in 1998.

1999: Two Emergency Interim Rules and a Final Rule

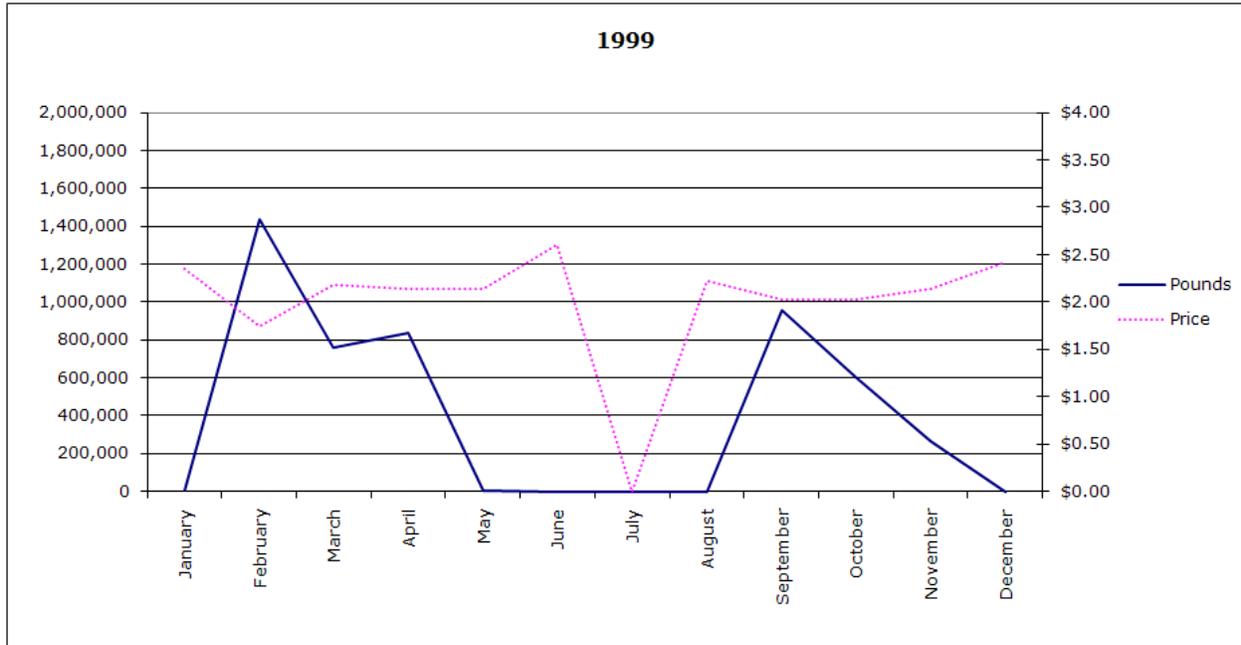


Figure 1.12 graphs the relationship between monthly catch and monthly price in 1999.

An emergency interim rule, effective January 1, 1999, maintained the daily bag limit for the recreational red snapper fishery at four fish.¹¹⁶ An emergency interim rule, effective June 8, 1999, increased the minimum size limit for red snapper from fifteen inches to eighteen inches for fisherman subject to the bag limit (those fishing recreationally).¹¹⁷ Additionally, the same rule planned an August 29 closure for the recreational red snapper fishery.¹¹⁸ A final rule, effective September 1, 1999, "change[d] the open periods of the fall red snapper commercial season from the first 15 days of each month to the first 10 days each month, beginning September 1 each year."¹¹⁹

¹¹⁶ 63 FR 72200. While the original interim rule would have expired June 29, 1999, a subsequent interim rule extended the four fish bag limit for an additional 180 days—until December 16, 1999. See 64 FR 33800.

¹¹⁷ 64 FR 30445.

¹¹⁸ *Id.*

¹¹⁹ 64 FR 47711. The rule went further, establishing a "4-fish recreational red snapper bag limit with a 0-fish bag limit for the captain (operator) and crew of a charter vessel or headboat," effective October 1, 1999. *Id.*

The spring allocation of the quota was exhausted April 15, 1999.¹²⁰ The fall allocation was exhausted November 5, 1999.¹²¹ The 4.65 million pound commercial quota lasted 1536 hours, for a fishing rate of 3027.34 pounds per hour—the highest yet. Price fell to its lowest level yet, \$1.74, in February, the month with the largest (1,436,262 pounds) harvest. Price peaked at \$2.61 in June, leaving a \$0.87 spread between yearly highs and lows. Technically, July's zero-pound harvest was the lowest of the year (a 1,436,262 spread), but the 53-pound harvest reported in December was the smallest where snapper harvests were reported (1,436,209 spread). The volatility of the outputs series fell slightly, as the ten-day fall mini-season assured six months of appreciable snapper harvests (February-April and September-October). The price volatility, on the other hand, returned to 1993-1995 levels.

More than 65% of trips (2670 of 4096) occurred in the spring; 32% of trips (1319 of 4096) were taken in the fall. February hosted the most trips (1144), boats (324), and, consequently, output. The 145 boats fishing with Class 1 licenses claimed 93% of the harvest (3,969,817 of 4,249,727 pounds reported to the coastal logbook). The 310 boats fishing with Class 2 licenses brought in another 208,753 pounds, or less than 5% of total harvest. The imposition of a ten-day fall mini-season (as opposed to the fifteen-day mini-season used in previous years) was the key innovation in management for the year. While the overall fall season was shorter than 1998 (528 hours vs. 672 hours), the 96-hour November season made fresh Gulf red snapper an option on Thanksgiving menus for the first time since 1995's reopening. And before that, you would have to go to 1990 to find the snapper fishery open this late in the year. Beyond these regulation-induced timing effects, producer behavior followed the patterns established in prior years.

¹²⁰ 64 FR 23026. The spring season opened February 1.

¹²¹ 64 FR 57585. The fall season opened September 1.

TAC = 4.65 million pounds		Total Hours Open = 1536		Rate = 3027.34 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	128	336	0	336	149.12
pounds	442,005.64	1,436,262	0	1,436,262	504,387.94
price	1.99	2.61	1.74	0.87	0.23
trips	341.33	1144	4	1140	400.08
vessels	131.92	324	4	320	129.1

The fall season was the first in which 10-day mini-seasons were applied to the fishery.

Table 1.12 provides summary statistics for fishing activity in 1999.

2000: Amendment 17, two Interim Rules, and two Final Rules

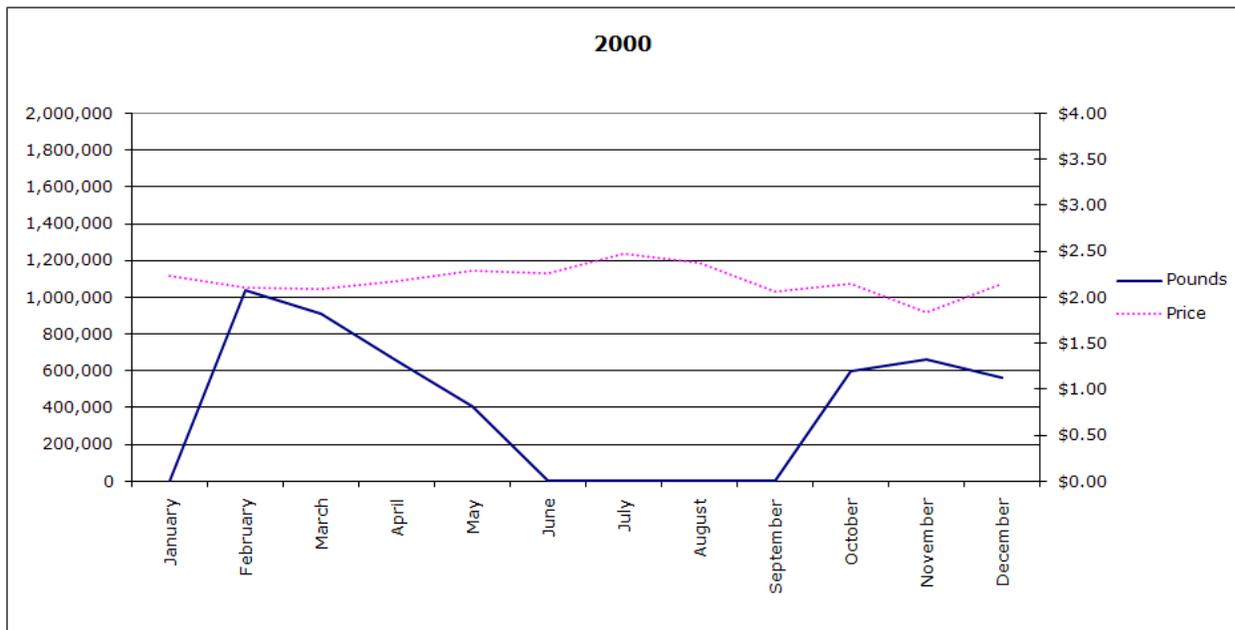


Figure 1.13 graphs the relationship between monthly catch and monthly price in 2000.

An interim rule, effective on January 19, 2000, modified the commercial and recreational fishing seasons, increased the recreational red snapper minimum size limit from fifteen inches to sixteen inches, and reinstated the four-fish bag limit for captain and crew of for-hire vessels such as charters and headboats.¹²² The commercial fishery was “closed from January 1 to noon on

¹²² 64 FR 71056. The minimum size limit for the commercial red snapper fishery remained fifteen inches. A portion of the rule effective January 1, 2000, closed the recreational fishery from January 1, 2000, until April 21, 2000, and then from November 1, 2000, until December 31, 2000. The original interim rule remained in effect until

February 1 and thereafter from noon on the 10th of each month to noon on the first of each succeeding month until the quota... [was] reached or until noon on September 1, whichever occur[red] first. From September 1 to December 1, the commercial fishery for red snapper in or from the Gulf EEZ [was] closed from noon on the 10th of each month to noon on the first of each succeeding month until the quota... [was] reached or until the end of the fishing year, whichever occur[red] first.”¹²³ A final rule, effective on September 18, 2000, made these changes to the FMP permanent.¹²⁴ A final rule, effective on June 19, 2000, modified the framework for adjusting FMPs for reef fish.¹²⁵ Amendment 17, effective August 2, 2000, extended the commercial reef fish vessel permit moratorium for five years, through December 31, 2005.¹²⁶

The spring season concluded May 8, 2000 (after 816 hours of fishing).¹²⁷ The fall season closed December 8, 2000 (after 600 hours of fishing).¹²⁸ With a 4.65 million pound quota exhausted in just 1416 available hours of fishing, the yearly pounds per hour rate surged to an all-time high of 3283.9 pounds per hour. Output peaked at 1,035,765 pounds in February, some 1,035,595 pounds above the 170-pound low reported in September. The yearly high price of \$2.47 reported in July was \$0.63 above the \$1.84 low reported in November. Once again, the average of \$2.10 was closer (by 11 cents) to the yearly low than the yearly high. Despite the

June 19, 2000. A subsequent interim rule extended the effective date of the interim rule 180 days, until December 16, 2000. *See* 65 FR 36643.

¹²³ 64 FR 71056, at 71060.

¹²⁴ 65 FR 50158.

¹²⁵ 65 FR 31831. This modification allowed for “timely addition of various stock population parameters to the appropriate FMP(s), including biomass-based estimates of minimum stock size thresholds (MSSTs), optimum yield (OY), maximum sustainable yield (MSY), stock biomass achieved by fishing at MSY (B_{MSY}), and maximum fishing mortality thresholds (MFMTs).”

¹²⁶ 65 FR 41016. The moratorium would have otherwise expired December 31, 2000.

¹²⁷ 65 FR 21377.

¹²⁸ 65 FR 70808.

increased rate of fishing, the ten-day mini-seasons spread the catch out, with seven months reporting catches of at least 400,000 pounds (up from four such months in 1998 and 1999). This appears to have moderated volatility in output and price; both series were more stable than in previous years.

More than 64% of trips (2994 of 4655) were taken between February and May; 34% came between October and December (1593 of 4655). February hosted the most trips (1013), while March saw the most unique vessels (302) taking trips that reported red snapper landings. 144 boats fishing with Class 1 licenses claimed 90% (3,982,737 of 4,427,616 pounds) of the catch reported to the coastal logbook program. 332 boats used Class 1 licenses to bring home 305,764 pounds of red snapper. The overall season was the shortest since 1995 (when the TAC was only 3.06 million pounds), but the ten-day mini-seasons assured that at least 100,000 pounds of red snapper was available in more months (seven) than any time since 1991 (when eight months saw at least 100,000 pounds caught). So while the rate of fishing suggests little, if any, change in producer behavior, the management strategies were at least effective in spacing the catch out temporally. This may be considered a step in the right direction, or at least a step away from the sorts of gluts and concomitant price drops that were associated with the fishery earlier in the decade.

TAC = 4.65 million pounds		Total Hours Open = 1416		Rate = 3283.9 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	118	216	0	216	105.59
pounds	402,897.92	1,035,765	170	1,035,595	388,830.54
price	2.1	2.47	1.84	0.63	0.16
trips	387.92	1013	5	1008	366.95
vessels	154.67	302	5	297	127.37
10-day mini-seasons became a permanent feature of the FMP.					

Table 1.13 provides summary statistics for fishing activity in 2000.

2001: No Further Actions Taken

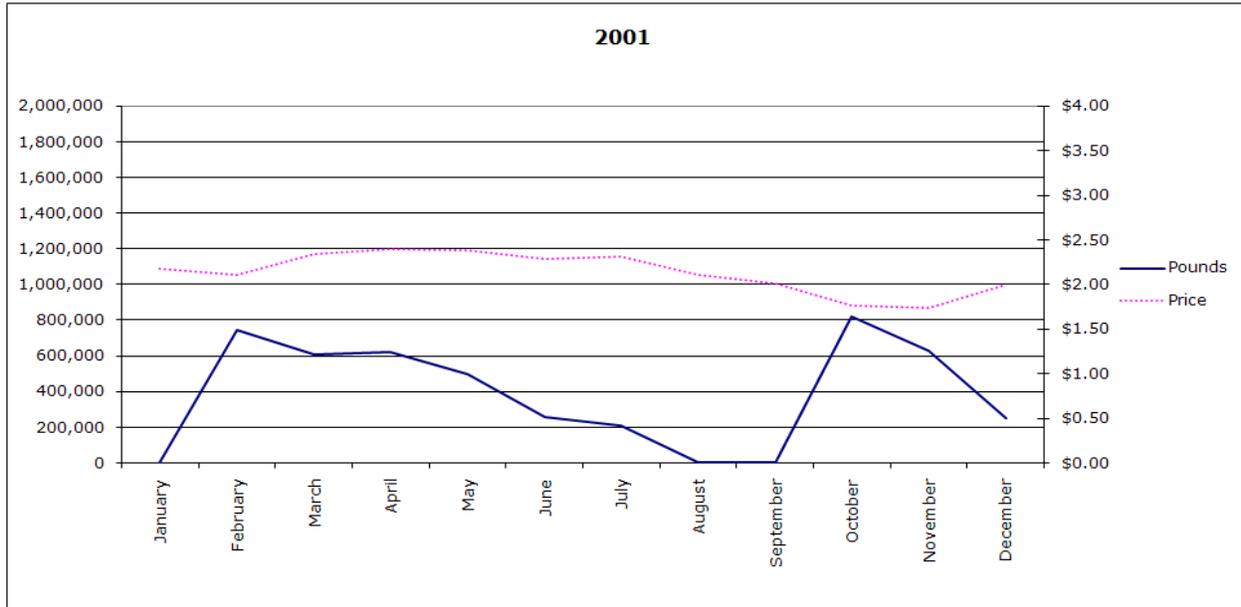


Figure 1.14 graphs the relationship between monthly catch and monthly price in 2001.

There were no adjustments to the FMP in 2001. The only actions taken that affected commercial red snapper fishery participants were closures. The spring season closed June 6, 2001.¹²⁹ The fall season closed November 10, 2001.¹³⁰ The fishery subsequently reopened from noon, local time, December 1, 2001, until noon, local time, December 3, 2001.¹³¹

The 4.65 million pound quota lasted 1680 hours, yielding a fishing rate of 2767.86 pounds per hour. While not quite as high as the previous two years, the rate was in line with production behavior throughout the late 1990s (the rate broke 2000 pounds per hour in 1995 and wouldn't fall below that level until 2005). Price bottomed out at \$1.73 in November, off \$0.67 from an April high of \$2.40. The average price, \$2.11, was only a penny higher than the

¹²⁹ 66 FR 33917.

¹³⁰ 66 FR 54723.

¹³¹ 66 FR 60161. The reopening was necessary because, "[t]he fall season was originally scheduled to be closed at noon, local time, November 10, 2001, when NMFS projected the fall quota would be reached. However, inclement weather during the November 1-10 opening limited fishing activities for red snapper in some areas of the Gulf and, therefore, the fall quota was not reached."

previous year. October saw the largest catch, at 821,743 pounds (821,577 pounds more than the 166 pounds reported in September). 2001 was the first year since derby-fishing behavior began in earnest in 1992 in which snapper harvest for the busiest month fell below a million pounds, indicating that the ten-day mini-seasons were at least somewhat effective in limiting excessive harvests. While there were three months with limited outputs, nine months saw catches of at least 200,000 pounds—the most to-date in the sample period, including 1990 (however, in 1990 all twelve months hosted catches of at least 100,000 pounds). Price volatility rose and output volatility fell from 2000 levels.

Almost 67% of trips (3057 of 4572) were taken in the spring season; 32% (1457 of 4572) occurred in the fall. February hosted the most trips (720), while April saw the most unique vessels taking trips (260, four more than 256 reported in February). 136 boats used their Class 1 licenses to claim 92% (4,063,656 of 4,410,884 pounds) of the catch reported to the coastal logbook. The 338 boats fishing Class 2 licenses brought in 265,926 pounds. As mentioned previously, the mini-seasons were effective in spreading out the catch to more months (with appreciable levels of fish reported in the most months since 1990). Behavior seemed in line with previous years managed under similar policies, and fishing rate declined for the first time since 1996 (although December's 48-hour harvest of 249,418 pounds indicated clear derby behavior as the fishing rate surged to 5196.21 pounds per hour for the month).

TAC = 4.65 million pounds		Total Hours Open = 1680		Rate = 2767.86 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	140	216	0	216	99.13
pounds	385,977.08	821,743	166	821,577	302,005.27
price	2.11	2.4	1.73	0.67	0.23
trips	381	720	9	711	269.67
vessels	163.5	260	7	253	93.84

Table 1.14 provides summary statistics for fishing activity in 2001.

2002: Amendment 19, Amendment 20, and an Emergency Rule

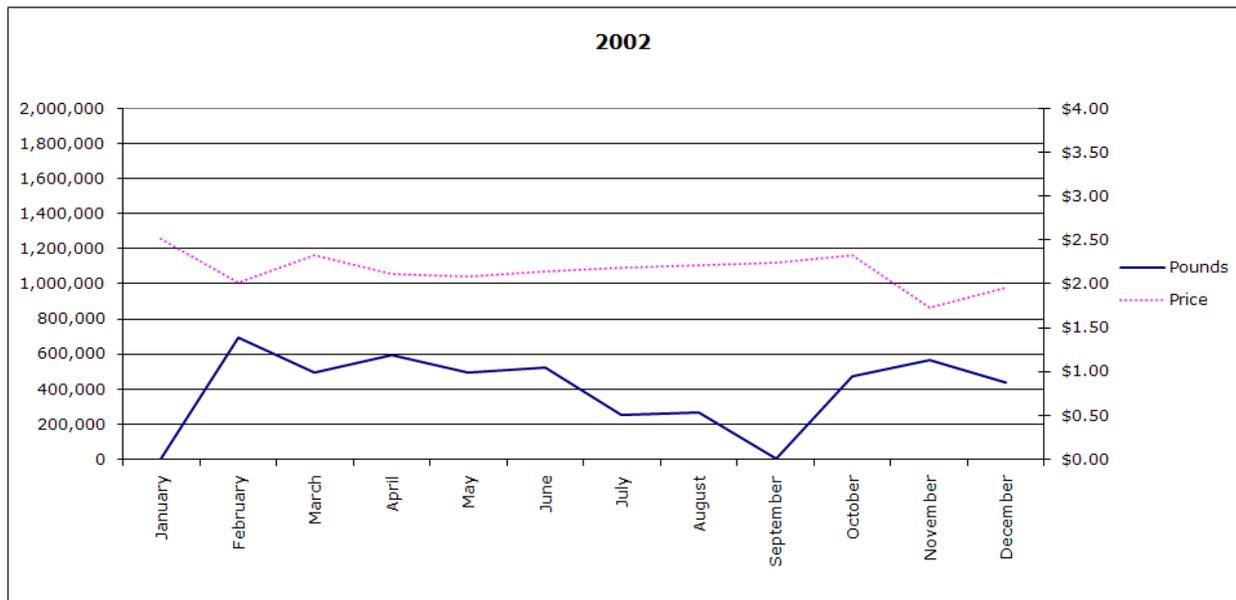


Figure 1.15 graphs the relationship between monthly catch and monthly price in 2002.

Amendment 20, effective July 29, 2002, established a 3-year moratorium on the issuance of charter vessel or headboat permits for the reef fish fishery in the Gulf of Mexico.¹³²

Amendment 19, effective August 19, 2002, established the Tortugas Marine Reserves in order to "provide enhanced protections for existing marine reserves in the vicinity of the Dry Tortugas, Florida."¹³³ The only other actions taken in 2002 were closures. The spring season closed on July 7, 2002.¹³⁴ The fishery was subsequently reopened from noon, local time, August 1, 2002, until noon, local time, August 7, 2002.¹³⁵ The fall season closed on December 7, 2002.¹³⁶

¹³² 67 FR 43558. The rule was intended "to cap the number of for-hire vessels operating in these... fisheries at the current level while the Gulf of Mexico Fishery Management Council (Council) evaluates the need for further management actions that may be needed to rebuild these fishery resources, and promote attainment of optimum yield." A subsequent emergency rule extended certain permit-related deadlines because an error in the original regulations would have prevented some entitled persons from receiving permits. The original December 26, 2002, deadline was extended until June 16, 2003. See 67 FR 77193.

¹³³ 67 FR 47467. The "regulations prohibit[ed] the fishing for any species and anchoring within the reserves."

¹³⁴ 67 FR 44569.

¹³⁵ 67 FR 50367. This reopening was necessary because "[t]he spring season was originally schedule to be closed at noon, local time, July 7, 2002, when NMFS projected the spring quota would be reached. However, inclement

The 4.65 million pound quota was exhausted in 1944 hours, for a fishing rate of 2391.8 pounds per hour. There was a \$0.78 spread between January's \$2.51 high and November's \$1.73 low, and average price fell two pennies, to \$2.09. Output peaked in February at a reported 690,817 pounds (690,359 pounds above the low of 458 pounds reported in January). Ten months saw harvests of at least 200,000 pounds, up from nine such months in 2001. The volatility of both of these series fell: price volatility stayed within recent historical norms, but output volatility fell to its lowest level since 1991. Approximately 70% (3426 of 4841) of trips were taken in the spring season; 28% (1364 of 4841) occurred in the spring season. February hosted the most trips (645), while June saw the most unique vessels (265) taking trips during which red snapper were caught, raising the possibility that some vessels opted to wait on better weather conditions before pursuing red snapper. The 140 vessels fishing with Class 1 licenses claimed over 93% (4,125,137 of 4,425,086 pounds) of the red snapper harvest reported to the coastal logbook program. The 331 boats fishing Class 2 licenses pulled in another 280,590 pounds.

TAC = 4.65 million pounds		Total Hours Open = 1944		Rate = 2391.98 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	162	216	0	216	81.95
pounds	400,264.17	690,817	458	690,359	223,307.14
price	2.09	2.51	1.73	0.78	0.2
trips	403.42	645	16	629	203.91
vessels	181.83	265	16	249	80.28

Table 1.15 provides summary statistics for fishing activity in 2002.

weather during the July 1-7, 2002, opening (abbreviated opening) and the 4th of July holiday limited fishing activities for red snapper in some areas of the Gulf and, therefore, the spring quota was not reached."

¹³⁶ 67 FR 72112.

2003: Corrected Amendment 20 and a Final Rule

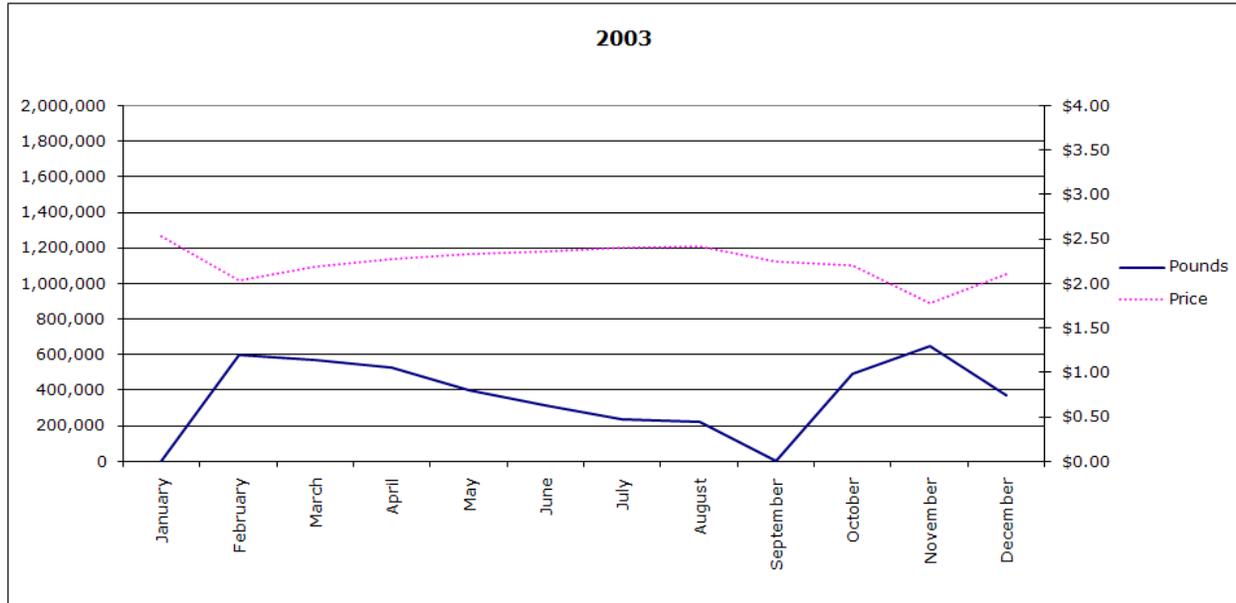


Figure 1.16 graphs the relationship between monthly catch and monthly price in 2003.

Correcting Amendment 20 was the focus of 2003 management activities. A corrected version of Amendment 20, effective June 16, 2003 revised the eligibility criteria for obtaining a charter vessel or headboat permit under the moratorium; reopened the application process for obtaining Gulf charter vessel or headboat permits extended the expiration date of valid and renewable open access permits; clarified a constraint on the acquisition of historical captain permits; and extended the expiration date of the moratorium in order to accommodate the delay in implementation.¹³⁷ Beyond these corrections, regulatory actions were limited to closures. The spring season closed on August 7, 2003.¹³⁸ The fall season ended on December 7, 2003.¹³⁹

The 4.65 million pound quota lasted 2016 hours—the longest since it was originally imposed in 1996—yielding a fishing rate of 2306.55 pounds per hour, the lowest since 1996.

¹³⁷ 68 FR 26230. A subsequent final rule added regulatory text inadvertently omitted from the aforementioned publication. See 68 FR 38232.

¹³⁸ 68 FR 47498.

¹³⁹ 68 FR 68785.

Price fell to a low of \$1.78 in November, off some \$0.75 from January's high of \$2.53. Average price climbed seven cents from 2002 levels, reaching \$2.16. Output peaked at 649,655 in November, 649,231 pounds more than January's low of 424 pounds. Once again, mini-seasons spread the harvest out: ten months witnessed harvests of at least 200,000 pounds. The volatility in both series mirrored 2002 levels. Almost 69% (3350 of 4867) trips were taken in the spring season; 30% (1481) took place in the fall. February's 627 trips led the year, but April saw seven more unique vessels taking trips (264 versus 257) than February. 144 boats fished Class 1 licenses to claim 4,003,181 pounds (or 93% of the catch); the 331 boats fishing Class 2 licenses caught 299,548 pounds.

TAC = 4.65 million pounds		Total Hours Open = 2016		Rate = 2306.55 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	168	216	0	216	83.14
pounds	365,985.92	649,655	424	649,231	218,459.17
price	2.16	2.53	1.78	0.75	0.2
trips	405.58	627	14	613	205.41
vessels	183.17	264	12	252	82.07

Table 1.16 provides summary statistics for fishing activity in 2003.

2004: Amendment 21, a Shrimp FMP Amendment, and a Final Rule

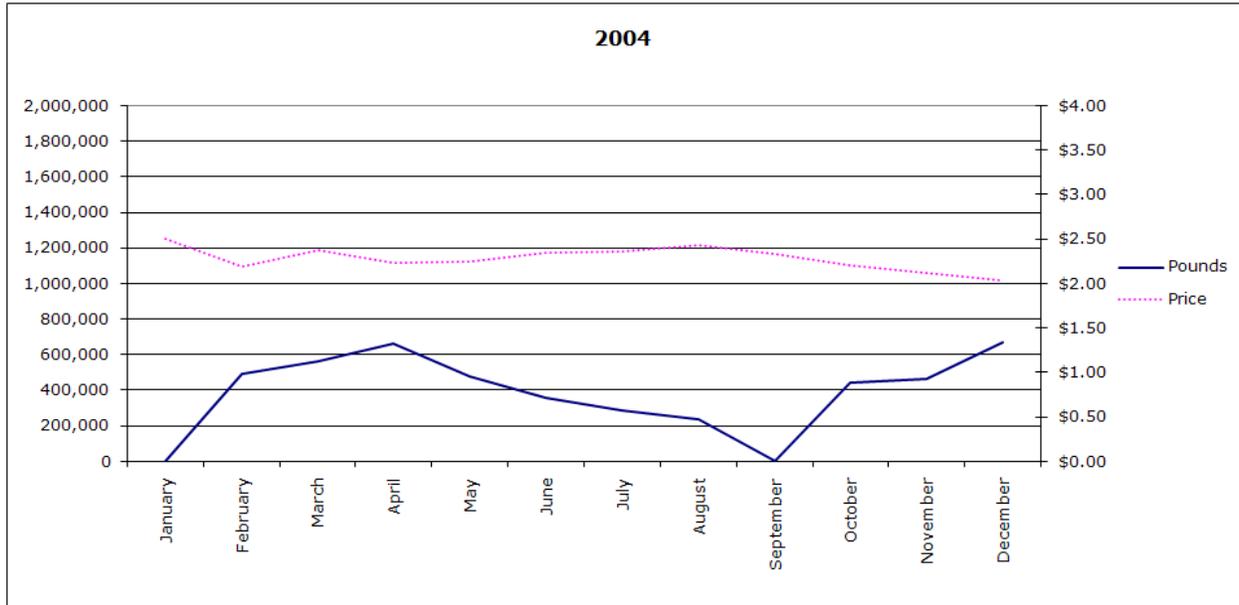


Figure 1.17 graphs the relationship between monthly catch and monthly price in 2004.

Discussion of ITQ revived when a final rule provided information regarding, "the schedule, procedures, and eligibility requirements for participating in referendums to determine whether an individual fishing quota (IFQ) program for the Gulf of Mexico commercial red snapper fishery should be prepared."¹⁴⁰ Bycatch concerns were addressed by Shrimp FMP Amendment 10, which required "with limited exceptions, the use of NMFS-certified bycatch reduction devices (BRDs) in shrimp trawls in the Gulf of Mexico exclusive economic zone (Gulf EEZ) east of 85°30' W. long. (approximately Cape San Blas, FL)."¹⁴¹ Amendment 21 modified the fishing restrictions applied "within the Madison and Swanson sites and Steamboat Lumps marine reserves in the eastern Gulf of Mexico and extend[ed] the period of effectiveness of those regulations through June 16, 2010."¹⁴² The spring season in the commercial fishery closed

¹⁴⁰ 69 FR 6921.

¹⁴¹ 69 FR 1538.

¹⁴² 69 FR 24532. Within the marine reserves the final rule prohibited "the possession of Gulf reef fish year-round, except for possession aboard a vessel in transit with fishing gear appropriately stowed."

August 10, 2004.¹⁴³ The recreational fishery closed October 31, 2004.¹⁴⁴ The fall commercial season closed December 15, 2004.¹⁴⁵

The 4.65 million pound quota lasted 2280 hours, the longest since 1991. The fishing rate, 2039.47 pounds per hour, was the lowest since 1994 (while the 2004 seasons lasted longer than the 1992-1994 seasons, lower TAC quotas made their fishing rates slightly lower than 2004). Price vacillated \$0.46 from January's \$2.50 high to December's \$2.04 low, with the average climbing seven cents from the previous year to \$2.23. Output peaked in December (contributing to the low price associated with December landings) at 666,918 pounds (666,428 more than the 490 pounds reported in September). Once again, ten months saw harvests of at least 200,000 pounds. While price volatility fell from 2003 levels, output volatility increased slightly.

More than 69% of trips (3648 of 5251) came in the spring; nearly 30% of trips (1565 of 5251) followed in the fall season. April hosted the most trips (756), but May saw seven more unique boats report trips (280) than April (273). The 139 boats with Class 1 licenses continued to dominate production, reeling in over 92% (4,003,181 of 4,323,622 pounds) of the coastal logbook's reported harvest. The 335 boats fishing Class 2 licenses caught 361,451 pounds of Gulf red snapper. The management restrictions ensured fishing activities continued until mid-December for the first time since the TAC was first established in 1990. While these measures were effective in spreading out the catch, the overcapitalization concerns remained: per hour fishing rates remained above the levels calculated for the early 1990's (1990-1994).

¹⁴³ 69 FR 53015.

¹⁴⁴ 69 FR 62818.

¹⁴⁵ 69 FR 70196.

TAC = 4.65 million pounds		Total Hours Open = 2280		Rate = 2039.47 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	207.273	336	0	336	95.16
pounds	387,378.25	666,918	490	666,428	223,038.86
price	2.23	2.5	2.04	0.46	0.13
trips	437.58	756	16	740	224.22
vessels	193.42	280	16	264	89.27

Table 1.17 provides summary statistics for fishing activity in 2004.

2005: An Emergency Rule, Amendment 22, and Amendment 24

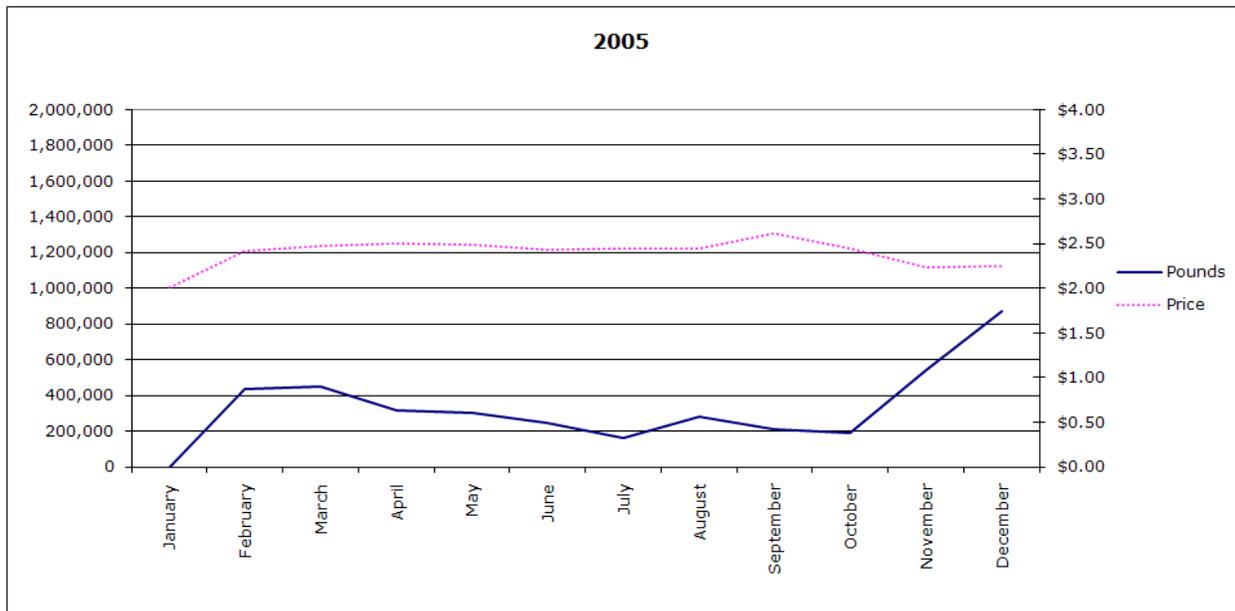


Figure 1.18 graphs the relationship between monthly catch and monthly price in 2005.

Management efforts in 2005 focused on regulating participation levels in the Gulf red snapper fishery. An emergency rule, effective April 1, 2005, through September 28, 2005, "provide[d] a limited reopening of the application process for the charter vessel/headboat permit moratorium for reef fish and coastal migratory pelagic fish in the Gulf of Mexico."¹⁴⁶

¹⁴⁶ 70 FR 16754. Intended to "eliminate adverse socioeconomic impacts on eligible Gulf charter vessel/headboat owners and operators," the reopening, "allow[ed] qualifying persons, who [could] provide documentation of economic harm as a result of inability to obtain a moratorium permit, to apply for reconsideration of moratorium permit eligibility."

Amendment 22, effective July 5, 2005, "provide[d] the regulatory authority to implement a mandatory observer program for selected commercial and for-hire (charter vessel/headboat) vessels in the Gulf of Mexico reef fish fishery."¹⁴⁷ Amendment 24, effective August 17, 2005, "establishe[d] a limited access system for the commercial reef fish fishery in the Gulf of Mexico by capping participation at the current level."¹⁴⁸

The fishery was not closed after the February spring opening in 2005, and the total catch of 3,998,453 pounds fell 651,547 pounds short of the TAC. Eleven months saw harvests of at least 100,000 pounds. It would have taken a fishing rate of 1614.58 pounds per hour to reach the TAC, but the actual fishing rate was only 1388.35 pounds per hour. Both of these rates were lower than any since 1993. Price peaked at \$2.61 in September, \$0.60 above the January low of \$2.01. Average price was up \$0.16 on the year, to \$2.39. Output peaked at 868,840 pounds in December as fishermen exploited the full month of fishing in a futile attempt to claim the remainder of 2005's TAC quota. The ensuing harvest was some 868,509 pounds more than January's 331-pound catch. The price volatility was slightly higher than in 2004, but average price was significantly closer to the yearly high (22 cents away) than the yearly low (38 cents away). Output volatility continued to decline as regulations spread the catch throughout more months.

Over 62% (2906 of 4645) of trips were taken in the spring; 37% (1739 of 4645) followed in the fall. December saw the most trips (759) by a significant margin, but the 174 different boats that took December trips was fewer than the 235 unique boats that took May trips. The 142 boats fishing Class 1 licenses claimed 91% (3,303,487 of 3,628,365) of the landings reported

¹⁴⁷ 70 FR 32266.

¹⁴⁸ 70 FR 41161. This decision permanently capped participation; it was adopted instead of the alternative option of extending the Gulf reef fish permit moratorium for a period of 5 or 10 years.

to the coastal logbook. The 335 boats fishing Class 2 permits claimed another 280,968 pounds. As previously mentioned, 2005 was the first year since the TAC was implemented in 1990 that the commercial fishery did not require closure (although the fishery was opened in January 1990 and was closed in January 2005).

TAC = 4.65 million pounds		Total Hours Open = 2880		Rate = 1614.58 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	240	720	0	720	163.42
pounds	333,204.42	868,840	331	868,509	221,543.32
price	2.39	2.61	2.01	0.6	0.16
trips	387.08	759	23	736	174.32
vessels	181.17	235	22	213	56.94

Table 1.18 provides summary statistics for fishing activity in 2005.

2006: Generic Amendment 3, Amendment 25, Amendment 18A

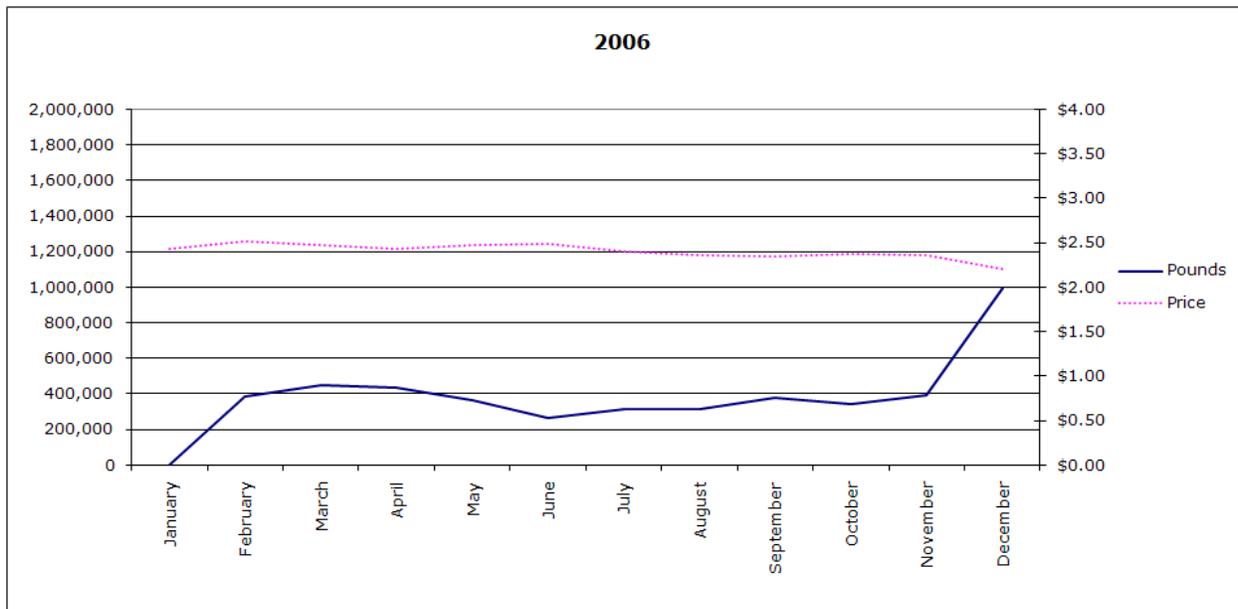


Figure 1.19 graphs the relationship between monthly catch and monthly price in 2006.

Generic Amendment 3 to the FMP of the Gulf of Mexico, effective January 23, 2006, amended the reef fish FMP, "to describe and identify essential fish habitat (EFH); minimize to the extent practicable the adverse effects of fishing on EFH; and encourage conservation and

management of EFH."¹⁴⁹ Amendment 25, effective June 15, 2006, "establishe[d] a limited access system for charter vessel/headboat (for-hire) permits for the reef fish and coastal pelagic migratory pelagic fisheries in the exclusive economic zone (EEZ) of the Gulf of Mexico and... continue[d] to cap participation at current levels."¹⁵⁰ Amendment 18A to the FMP for the Reef Fish Resources for the Gulf of Mexico, effective between September 1 and December 7, 2006, prohibited vessels from retaining fish caught under the recreational size and bag limits when commercial quantities of Gulf reef fish were on board.¹⁵¹

The fishery did not close until December 26, 2006, yielding 2760 hours of fishing before the 4.65 million pound TAC was exhausted.¹⁵² The resultant fishing rate of 1684.78 pounds per hour was slightly above the previous year's rate, but was lower than any other since 1994. Output once again peaked in December, at 994,547 pounds, as fishermen worked to claim the remainder of the 2006 quota. This figure was some 993,645 pounds above the reported 902-pound catch in January. In all, eleven months reported catches in excess of 200,000 pounds (with ten months hosting catches in excess of 300,000 pounds). Price peaked at \$2.52 in February, 32

¹⁴⁹ 70 FR 76216. The rule also established additional habitat areas of particular concern (HAPCs) and restricted fishing in such areas in order to protect EFH.

¹⁵⁰ 71 FR 28282. The rule aimed to "control increases in for-hire fishing vessels or passenger capacity while the Council determine[d] an appropriate management strategy for the for-hire fishery. Such a strategy would be in the nature of stabilizing or reducing for-hire fishing mortality for reef fish and CMP stocks that have rebuilding plans or are overfished or undergoing overfishing." *Id.* at 28283.

¹⁵¹ 71 FR 45428. 18A also, "adjust[ed] the number of persons allowed on board when a vessel with both commercial and charter/headboat reef fish permits and a U.S. Coast Guard (USCG) Certificate of Inspection (COI) [was] fishing commercially; prohibit[ed] the use of Gulf reef fish, except sandy perch or dwarf sandy perch, as bait in any commercial or recreational fishery in the exclusive economic zone (EEZ) of the Gulf of Mexico with a limited exception for crustacean trap fisheries; require[d] a NMFS-approved vessel monitoring system (VMS) on board vessels with Federal commercial permits for Gulf reef fish...; and require[d] owners and operators of vessels with Federal commercial or charter vessel/headboat permits... to comply with sea turtle and smalltooth sawfish release protocols." Additionally, annual—as opposed to biennial—permit applications were instated and the TAC framework was revised to "reflect current practices and technology." The effective date of the VMS requirements was later delayed until March 7, 2007. 71 FR 70680.

¹⁵² 71 FR 75894. 219 more trips were taken in 2006 than in 2005, with 124 more trips being taken in the month of December alone. This suggests participants were determined not to leave any excess TAC "on the table."

cents above December's low of \$2.20. The average price fell only a penny, to \$2.38, but was once again closer to the yearly high (14 cents) than it was to the yearly low (18 cents). While output volatility rose slightly on the year, price volatility fell to its lowest level yet.

Less than 60% (2887 of 4864) of trips were taken in the spring, with slightly over 40% (the remaining 1977 trips) following in the fall season. Given 600 hours of available fishing (versus the 216 hours the fishery opened in all other months), it is not surprising that December saw the most unique boats (246) taking trips, as well as the most trips (883, or 388 more than were taken April, the month with the second most trips). While fewer boats fished Class 1 licenses (130 in 2006 versus 142 in 2005), these boats caught more than 92% (3,984,674 of 4,341,154 pounds) of the catch reported to the coastal logbook. 302 boats (33 fewer than in 2003-2005) fished Class 2 licenses, claiming another 275,320 pounds of red snapper.

TAC = 4.65 million pounds		Total Hours Open = 2760		Rate = 1684.78 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	230	600	0	600	132.03
pounds	386,331.5	994,547	902	993,645	224,105.6
price	2.38	2.52	2.2	0.32	0.08
trips	405.33	883	15	868	190.25
vessels	189.08	246	15	231	59.48

Table 1.19 provides summary statistics for fishing activity in 2006.

2007: Amendment 26 and a Final Rule

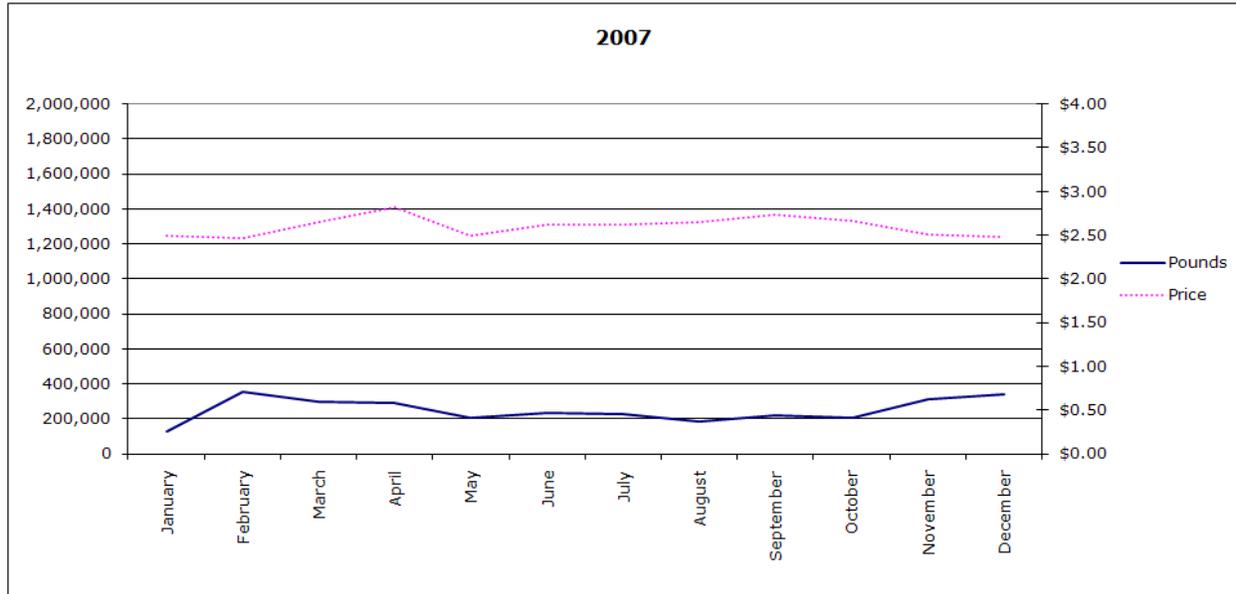


Figure 1.20 graphs the relationship between monthly catch and monthly price in 2007.

Despite the aforementioned regulatory measures, Gulf red snapper populations remained imperiled: the Gulf of Mexico breeding population was 6% of its target size.¹⁵³ The limited success of the TAC scheme led the Gulf Council, by way of Amendment 26, to implement an IFQ (individual fishing quota; also referred to as an ITQ, or individual transferable quota) program, effective January 1, 2007.¹⁵⁴ The Gulf Council described the IFQ program as “a type of limited access privilege program (LAPP), which provides individual fishermen or corporations the exclusive privilege to harvest a certain percentage of the total allowable catch of

¹⁵³ See Fish Watch *supra* note 32. The Gulf of Mexico breeding population is now 11% of its target size, but the figure was 6% before a recent update. It is worth noting that at least one fisheries biologist—Bob Shipp, head of marine sciences at the University of South Alabama—suggests Gulf red snapper are far from being overfished, and the snapper population is, in fact, exploding. Shipp argues that the primary factor controlling the size of snapper population is habitat, not fishing effort. Shipp cites 5,000 oil rigs off of Louisiana and Texas, as well as 1,200 artificial reefs off the coast of Alabama as evidence of expanded habitat. Shipp then posits that the evidence the NMFS points to as a sign of overfishing—a snapper population where the youth outnumber the older fish by a given margin—could also be caused by “a rapidly expanding population with more and more habitat... you get the same kind of signal with an expanding population that you get with an overfished population.” Ben Raines, MOBILE PRESS REGISTER, *Scientist: Snapper booming in Gulf, not overfished*, Sunday, February 22, 2009.

¹⁵⁴ 71 FR 67447.

a fishery.”¹⁵⁵ The hope is that “[b]y ensuring each program participant the opportunity to harvest a specific amount of the TAC each year, IFQ programs eliminate the need to compete for the TAC under derby-style fishing conditions and, consequently, the incentive to over-invest in fishing capacity.”¹⁵⁶ The IFQ share percentage allocated to program participants by the Gulf Council was determined based upon historical participation levels in the Gulf red snapper fishery.¹⁵⁷ A final rule effective from May 2 to September 29, 2007, “reduce[d] the commercial and recreational quotas for red snapper, reduce[d] the commercial minimum size limit for red snapper, reduce[d] the recreational bag limit for Gulf red snapper, prohibit[ed] the retention of red snapper under the bag limit for captain and crew of a vessel operating as a charter vessel or headboat, and establishe[d] a target level of reduction of shrimp trawl bycatch mortality of red snapper.”¹⁵⁸

¹⁵⁵ See GULF OF MEXICO COMMERCIAL RED SNAPPER FISHERY, IFQ Program, Frequently Asked Questions, January 2008. Article on file with author.

¹⁵⁶ *Id.*

¹⁵⁷ *Id.* IFQ shares allocated to current owners of a Class 1 license whose license was not issued based on historical captain status were derived from the ten consecutive years from 1990-2004 during which landings reported under the license were highest. Allocations to current owners of a Class 1 license issued on the basis of historical captain status were based on the seven years of landings data reported under the license between 1998 and 2004. Allocations to current owners of Class 2 license was based on any five years from 1998 to 2004 during which landings reported under the license were the highest. Because the Magnuson-Stevens Fishery Conservation and Management Act requires fishery managers to prevent IFQ shareholders from acquiring an excessive share of the TAC, an IFQ Share Cap was established at 6.023% of the TAC. See also 71 FR 67459.

¹⁵⁸ 72 FR 15617. The final rule set the commercial minimum size limit at thirteen inches and maintained the recreational minimum size limit at sixteen inches. The Council responded to comments regarding this decision as follows: “[r]educing the commercial minimum size limit from 15 to 13 inches reduces overfishing because 71-82 percent of the fish discarded by commercial fishermen do not survive. However, while reducing the recreational size limit would reduce bycatch, it would not reduce overfishing, because the discard mortality rate in the recreational fishery is relatively low (15-40 percent); therefore, a greater proportion of the fish discarded by recreational fishermen survive. Thus, reductions in the recreational size limit were not adopted in this rule.” *Id.* at 15621. The commercial quota was set at 3.315 million pounds; the recreational quota was set at 3.185 million pounds with a two-fish bag limit (in lieu of the previous four-fish limit) that did not apply to captain and crew. *Id.* at 15626. While this final rule was originally set to expire September 29, 2007, a temporary rule extended the effective date of these measures through March 28, 2008. 72 FR 54223. The temporary rule also “amend[ed] the regulations to provide an option for a special procedure for the initial calculation of Gulf of Mexico red snapper 2008 individual fishing quota allocations... based on the Council’s proposed commercial quota of 2.55 million lb.” *Id.* at 54223-54224.

The decision to reduce the TAC was based on the results of a 2005 stock assessment which concluded Gulf of Mexico red snapper populations were both overfished and undergoing overfishing, with shrimp trawl bycatch viewed as a significant source of juvenile snapper mortality.¹⁵⁹ Meanwhile, Hurricanes Katrina and Rita affected fishermen from Texas to Alabama, and the council continued to investigate the role of shrimp fishery bycatch.¹⁶⁰ In the meantime, a March 2007 District Court decision "concluded NOAA Fisheries Service violated the M-SFCMA, Administrative Procedures Act, and the National Environmental Policy Act when it approved and implemented the red snapper rebuilding plan in Amendment 22 to the Reef Fish FMP."¹⁶¹ The aforementioned final rule established interim measures as the Council's temporary solution to these concerns, until Amendment 27 could forge a more permanent response.

Thanks to the newly imposed ITQ regime, the fishery remained open the entire year. Participants did not have to worry about claiming their share of the TAC before the quota was reached. Instead, they were able to pursue their percentage share at any point during the fishing season. With the entire year available to claim a 3.315 million pound quota, it is not surprising that the fishing rate required to exhaust the quota fell to its lowest level, 378.425 pounds per hour, since 1990. Output peaked in February, at 356,585 pounds (a figure just 229,665 pounds above the 126,920 pounds reported in January). A catch of at least 100,000 pounds was reported

¹⁵⁹ Andrew J. Strelcheck and Peter B. Hood, *Rebuilding Red Snapper: Recent Management Activities and Future Management Challenges*, NOAA Fisheries Service Office, at 3, manuscript on file with author.

¹⁶⁰ *Id.* With scientific information suggesting some bycatch reduction devices (BRDs) were not meeting specified performance requirements, the Council: "establish[ed] flexible and consistent performance standards for the certification of bycatch reduction devices (BRD) for the shrimp fishery.

¹⁶¹ *Id.* at 3-4. "The Court concluded the rebuilding plan was based on flawed assumptions, and did not consider the practicability of additional bycatch reductions in the shrimp trawl fishery, and did not demonstrate a 50% probability of rebuilding red snapper by 2032... [T]he Court ordered the Secretary of Commerce/NOAA Fisheries Service to approve a revised red snapper rebuilding plan by December 12, 2007."

in every month, and at least 200,000 pounds was reported in ten months. With harvests spread so evenly throughout the year, output volatility fell to its lowest level since 1990. Average price increased more than 20 cents on the year, reaching its highest level since 1991, the year before derby fishing began in earnest. The \$0.36 spread between April's high of \$2.82 and February's low of \$2.46 was the second smallest yet for the sample period (and only 4 cents larger than the 2006 spread). While the yearly standard deviation of the monthly ex-vessel prices rose slightly on the year, this deviation was still the second smallest for the sample period.

With no spring or fall seasons constraining trips, vessels made at least 100 trips in every month. Eight months saw at least 200 trips, but none hosted as many as 300 trips. Furthermore, with fewer total trips needed to harvest the fish, pounds caught per trip increased to the highest recorded level since trip data was available in 1993. The most unique vessels, 162, operated in December, but ten other months saw at least 100 unique vessels catching red snapper (January hosted 78 unique vessels).

The incentives to overcapitalize created by a limited timeframe to catch the designated quota and the need to accommodate a substantial amount of variation in the amount of fish harvested in any given month evaporated. Fishermen were free to claim their percentage share of the quota as they saw fit, allowing them to listen to and interpret market price signals. They received more for their fish and were able to, at least theoretically, harvest these fish more efficiently as they were unencumbered from seasonal closures and trip limits.

TAC = 3.315 million pounds		Total Hours Open = 8760		Rate = 378.425 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	730	744	672	72	21.61
pounds	248,768.83	356,585	126,920	229,665	69,131.37
price	2.6	2.82	2.46	0.36	0.12
trips	215.42	274	110	164	49.4
vessels	122.83	162	78	84	21.93

Amendment 26 implemented an ITQ regime. A final rule reduced the commercial size limit from 15 to 13 inches.

Table 1.20 provides summary statistics for fishing activity in 2007.

2008: Two Final Rules, Amendment 27

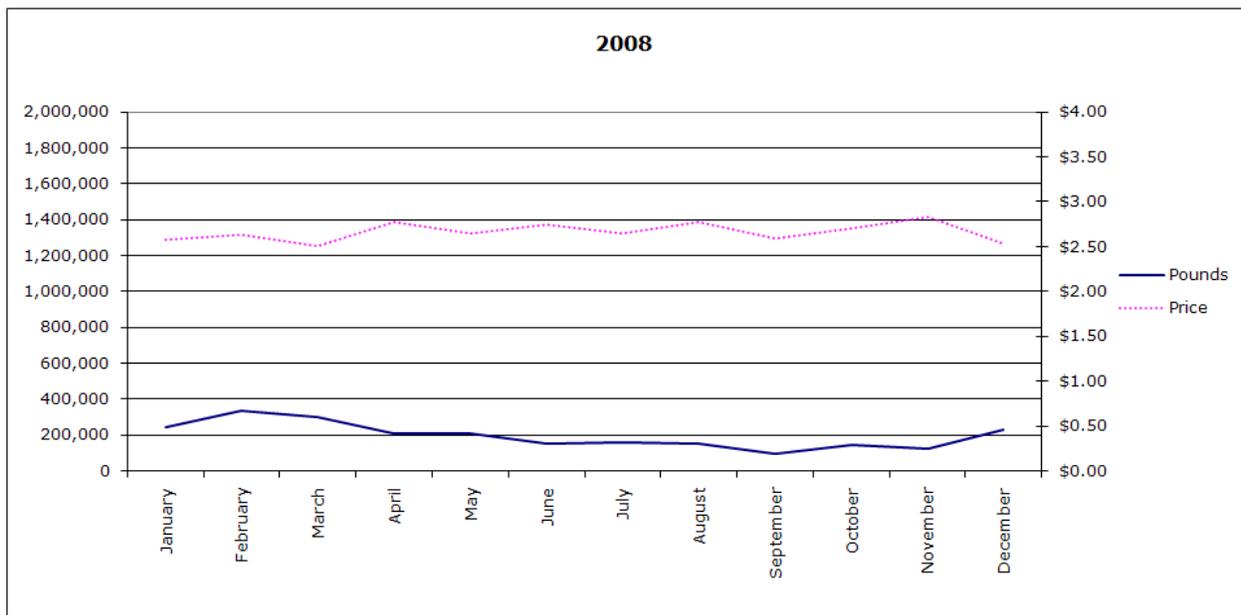


Figure 1.21 graphs the relationship between monthly catch and monthly price in 2008.

A final rule, effective January 28, 2008, revised the VMS requirements applied to the commercial reef fish fishery in the Gulf of Mexico and the allowable methods for complying with the advanced notification landing requirement in the Gulf red snapper IFQ program.¹⁶² A final rule, effective January 3, 2008, implemented clarifications for the Gulf of Mexico red

¹⁶² 72 FR 73270. The final rule, "allow[ed] commercial reef fish vessel owner or operators to reduce the frequency of VMS transmissions while in port; extend[ed] the existing power-down exemption to include reef fish vessels while in port; and add[ed] a grandfather clause to address VMS units approved for use in the Gulf reef fish fishery." It also "expand[ed] the allowable methods for communicating the required advance notification of landing."

snapper IFQ program.¹⁶³ Amendment 27, effective February 28, 2008, "reduce[d] the commercial and recreational quotas for red snapper, reduce[d] the commercial minimum size limit for red snapper, reduce[d] the recreational bag limit for red snapper, prohibit[ed] the retention of red snapper under the bag limit for captain and crew of a vessel operating as a charter vessel or headboat, establishe[d] a red snapper recreational season that [was] open from June 1 through September 30 each year, require[d] the use of non-stainless steel circle hooks when using natural baits to fish for Gulf reef fish, require[d] the use of venting tools and dehooking devices when participating in the commercial or recreational reef fish fisheries, and... provide[d] for implementing seasonal closures of the Gulf shrimp fishery to reduce red snapper bycatch based upon the 74 percent bycatch reduction target established in this final rule."¹⁶⁴ The Council responded to criticisms directed towards the decision to further lower the TAC by pointing out that the fishery remained overfished and emphasizing the interconnected nature of the red snapper and shrimp fisheries.¹⁶⁵ Inclement weather in the form of hurricanes led the

¹⁶³ 73 FR 406. Landing was defined to mean arrival "at a dock, berth, beach, seawall, or ramp." IFQ snapper could only be offloaded between 6 a.m. and 6 p.m., local time. The clarification was necessary as the rule intended to restrict offloading, but not landings, to the 6 a.m. to 6 p.m. time period.

¹⁶⁴ 73 FR 5117. Amendment 27 essentially made permanent many of the management changes instituted by a final rule originally effective May 2, 2007. *See* discussion *supra* note 145. Amendment 27 went further, however, by reducing the commercial quota to 2.55 million pounds and the recreational quota to 2.45 million pounds. *Id.* at 5128. The recreational season was subsequently closed early, on August 5, 2008. *See* 73 FR 15674.

¹⁶⁵ *Id.* at 5118. The Council noted that the red snapper population east of the Mississippi River Delta was in better condition than the western population, and that conditions in the east accounted for fishermen's impressions that fishery populations and fishing conditions were improving. The Council went on to emphasize that because both fisheries were overfished and undergoing overfishing, stronger measures were necessary to ensure both that overfishing would end by 2010 and that red snapper stocks would be rebuilt by 2032. These goals were "contingent on reducing mortality in both the directed commercial and recreational fisheries and bycatch in the shrimp trawl fishery. More restrictive management measures are needed across all of these fisheries to constrain harvest and bycatch mortality. The reduction in the directed fishery's TAC accounts for decreases in shrimp trawl effort. These decreases in shrimp trawl effort are expected to improve survival of juvenile red snapper. However... fishing mortality in the directed fishery must also be reduced to rebuild red snapper."

Council to authorize the use of paper-based forms for required IFQ functions from October 24 through December 31, 2008.¹⁶⁶

The fishery was once again open year round, but a lowered TAC decreased the fishing rate required to exhaust the quota to 290.3 pounds per hour, the lowest since a TAC was first imposed. Reduced supply and increased participant experience with the new regime pushed average price up slightly, to \$2.64. The spread between April's high of \$2.83 and the March low of \$2.50 was only 33 cents. The standard deviation of the price series continued to decrease. Eleven months saw catches of at least 100,000 pounds, while four months provided at least 200,000 pounds (with only February hosting a catch in excess of 300,000 pounds). The 226,557 spread between February's 317,841 pounds and September's 91,284 pounds was the smallest since 1990. Output volatility increased slightly on the year, but remained much closer to 1990-levels than those reported between 1991-2006.

Vessels once again took at least 100 trips in every month, with at least 200 trips reported in five months. 150 unique vessels caught red snapper in April, when 245 trips were taken (a yearly high, along with February's 245 trips). The volatility of these series remained in line with the previous year. The results from 2007 reinforce those from 2006 and suggest that the introduction of an ITQ system fundamentally changed the way producers approached the Gulf red snapper fishery.

¹⁶⁶ 73 FR 63436. The temporary rule remained effective through May 31, 2009.

TAC = 2.55 million pounds		Total Hours Open = 8784		Rate = 290.301 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	732	744	696	48	16.18
pounds	186,284.92	317,841	91,284	226,557	71,090.16
price	2.64	2.83	2.50	0.33	0.10
trips	181.67	245	121	124	47.185
vessels	108.5	150	75	75	24.51

Table 1.21 provides summary statistics for fishing activity in 2009.

2009: Temporary Rules and Amendment 29

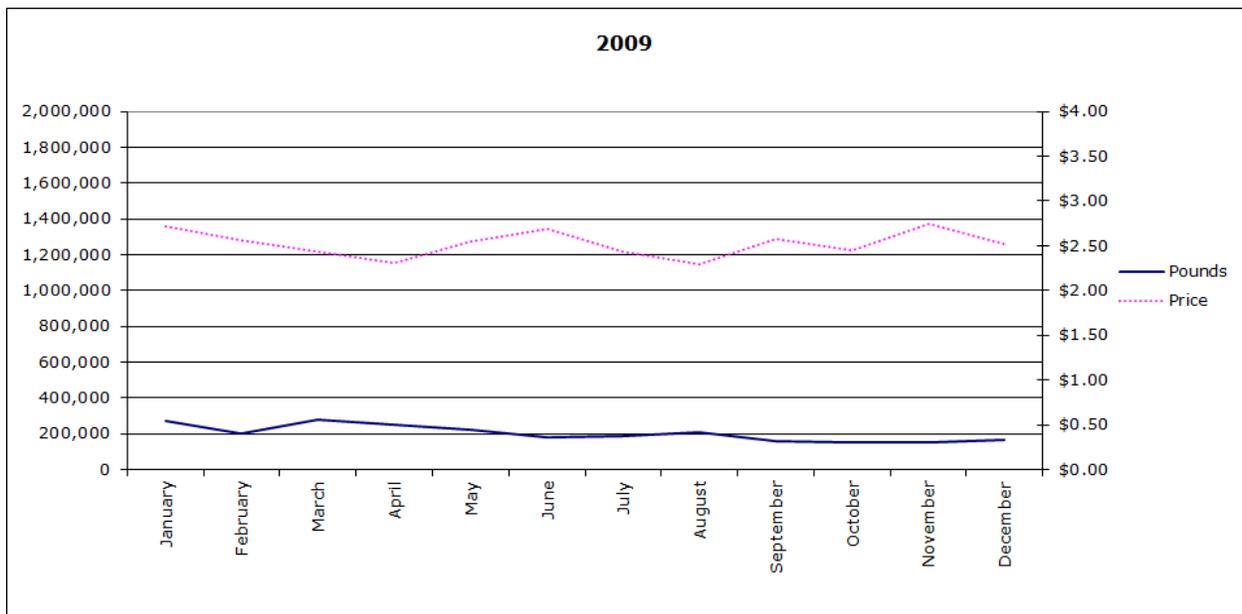


Figure 1.22 graphs the relationship between monthly catch and monthly price in 2009.

A temporary rule, effective January 1, 2009, required vessels with Federal reef fish permits to comply with Federal regulations—regardless of where reef fish were harvested—in the event that Federal regulations applicable to red snapper were more restrictive than state regulations.¹⁶⁷ A temporary rule, effective May 18 through October 28, 2009, implemented area closures on the bottom longline component of the reef fish fishery in the exclusive economic

¹⁶⁷ 73 FR 73192.

zone of the Gulf of Mexico in order to curtail incidental take and mortality of sea turtles.¹⁶⁸

Another temporary rule, effective August 15, 2009, closed the recreational red snapper fishery until June 1, 2010.¹⁶⁹ Amendment 29 to the Reef Fish FMP, effective September 30, 2009, implemented a multi-species IFQ program for grouper and tilefish.¹⁷⁰ Amendment 29 also impacted Gulf red snapper, as it modified some provisions of the Gulf red snapper IFQ program for consistency with the new final rule.

With the TAC unchanged and the fishery once again open year-round, the rate required to exhaust the quota increased imperceptibly from the previous (leap) year. Average price levels fell slightly, to \$2.51, possibly due to the effects of the general downturn in the U.S. economy. The spread between the yearly high (\$2.75) and low (\$2.29) prices also increased, to \$0.46. The standard deviation of price reflected this increased volatility. Output volatility, on the other hand, continued to decrease. The smallest month's catch (150,020 pounds) reached its highest level since 1989. The spread between high and low catch and the standard deviation of pounds harvested both fell to their lowest levels since 1987. This anecdotal evidence suggests that, despite macroeconomic conditions contributing to price volatility, the rights-based approach continued to stabilize producer behavior in the fishery.

¹⁶⁸ 74 FR 20229. The rule, “prohibit[ed] the use of bottom longline gear to harvest reef fish east of 85°30’W longitude in the portion of the EEZ shoreward of the coordinates established to approximate a line following the 50-fathom (91.4 m) contour as long as the deep-water grouper and tilefish quotas are unfilled. Once the quotas have been filled, the use of bottom longline gear to harvest reef fish in water of all depths east of 85°30’W longitude will be prohibited.” A subsequent final rule, effective October 16, 2009, made these restrictions permanent as it, “prohibit[ed] the use of bottom longline gear for the harvest of reef fish shoreward of a line approximating the 35-fathom depth contour in the eastern Gulf of Mexico and limit[ed] bottom longline vessels operating in the reef fish fishery east of longitude 85°30’W to 1,000 hooks onboard, of which only 750 may be actively fished or rigged for fishing.” 74 FR 53889.

¹⁶⁹ 74 FR 21558.

¹⁷⁰ 74 FR 44732. The rule was effective September 30 in order, “to allow for logistical operations required prior to implementation, e.g., exchange of information between NMFS and fishers and dealers, preliminary determinations of eligibility, share values, etc.” The applicability date—on which compliance was required—was delayed until January 1, 2010.

TAC = 2.55 million pounds		Total Hours Open = 8760		Rate = 291.095 pounds/hour	
(monthly)	average	high	low	spread	st dev
hours	732	744	672	72	21.61
pounds	202,408	281,796	150,020	131,776	45,689
price	2.51	2.75	2.29	0.46	0.15

Table 1.22 provides summary statistics for fishing activity in 2009.

Summary Discussion

Trends that may have been overlooked in the preceding chronological assessment of fishing regulations and outcomes become much more conspicuous when the data is aggregated across time. TAC-induced closures established incentives to overcapitalize, and the resulting market gluts created a litany of problems which become obvious when the summary statistics are presented together. First, because a system based upon closures leaves less time to harvest a given amount of fish, there is a clear incentive to overcapitalize. Any excess capital expenditures which would otherwise be unnecessary in the absence of closures limit the economic efficiency of the entire fishery. Furthermore, the output gluts created as all participants harvest their catch over the same limited timeframe translate into increased price volatility and lower average price levels. These concerns are evident in an aggregate examination of available Gulf red snapper data including those related to fishing opportunity, fishing effort, and fishing outcomes.

Gulf red snapper fishery regulations influenced producer behavior by limiting opportunities for fishermen to pursue their query. Once the yearly TAC quota was reached, the fishery shut down until a subsequent allocation was available. While other input limiting measures (such as minimum size limits and trip limits) impacted behavior, closures forced participants to concentrate their efforts over a limited time horizon in a derby-like manner.

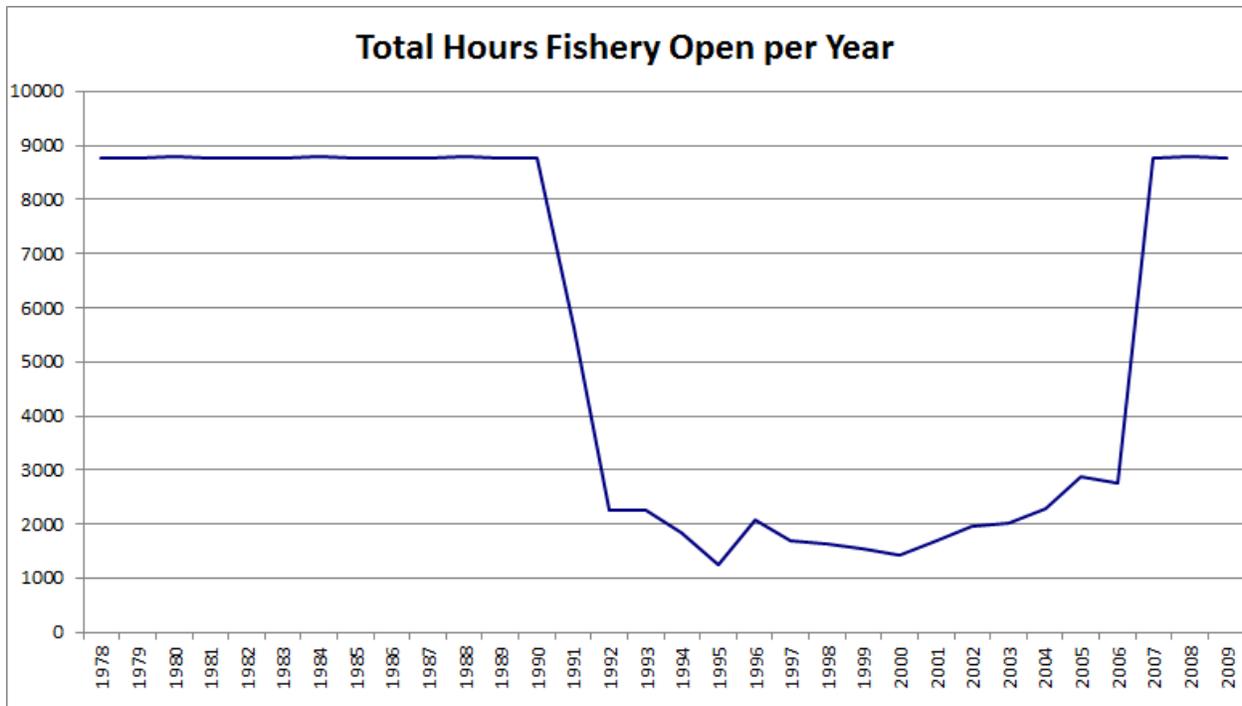


Figure 1.23 graphs the total hours the fishery was open per year from 1978-2009.

TAC adjustments conspired with seasonal closures, forcing participants to catch greater numbers of fish in shorter periods of time. This created an incentive for participants to invest in more human or physical capital in order to access the fish before the fishery closed.

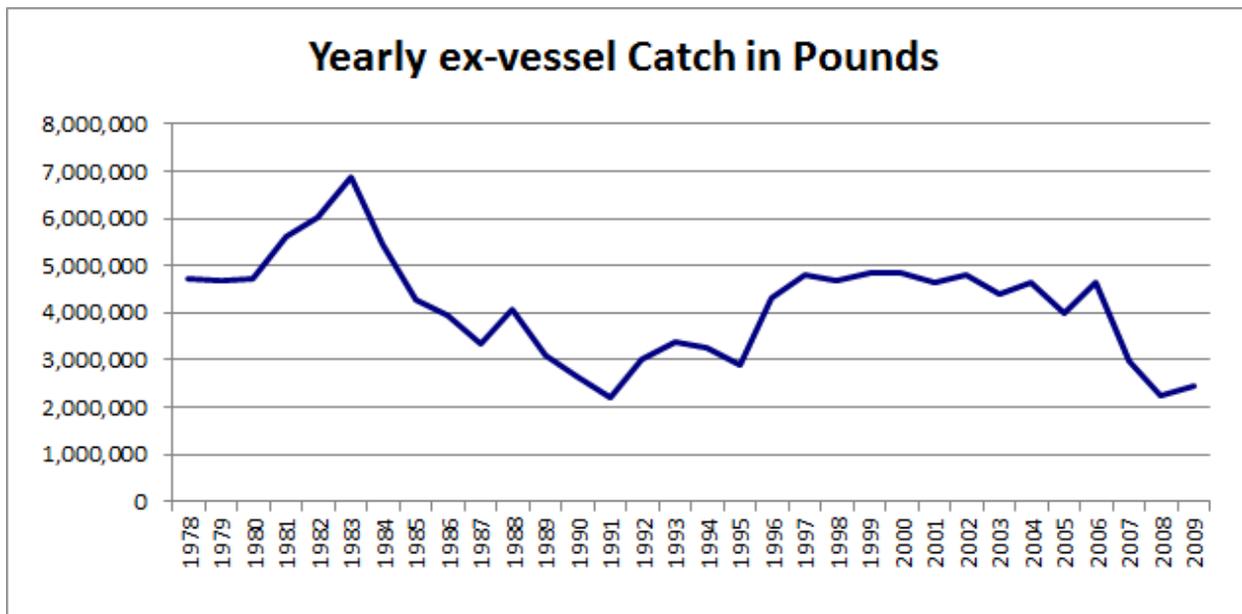


Figure 1.24 graphs the yearly ex-vessel catch in pounds from 1978-2009.

The previous graphs show how these regulations created a situation from 1992-2006 in which fishermen landed larger amounts of fish in shorter periods of time. The fishing rate required to exhaust the TAC quota (in terms of pounds of fish caught per hour of fishing time available) clearly increased as fishermen secured larger catches in less time. With multiple participants incentivized to increase capital expenditures in order to increase—or at least maintain—their relative share of the fishery quota, overcapitalization could have theoretically reduced the economic efficiency of resource extraction. Aside from creating brief periods of intense activity, these regulations may have further exacerbated the overcapitalization problem as the resources necessary for derby-competition potentially laid idle during periods of closure. Accommodation of the resultant volatility in fishing opportunity and output created yet another incentive for producers to overcapitalize.

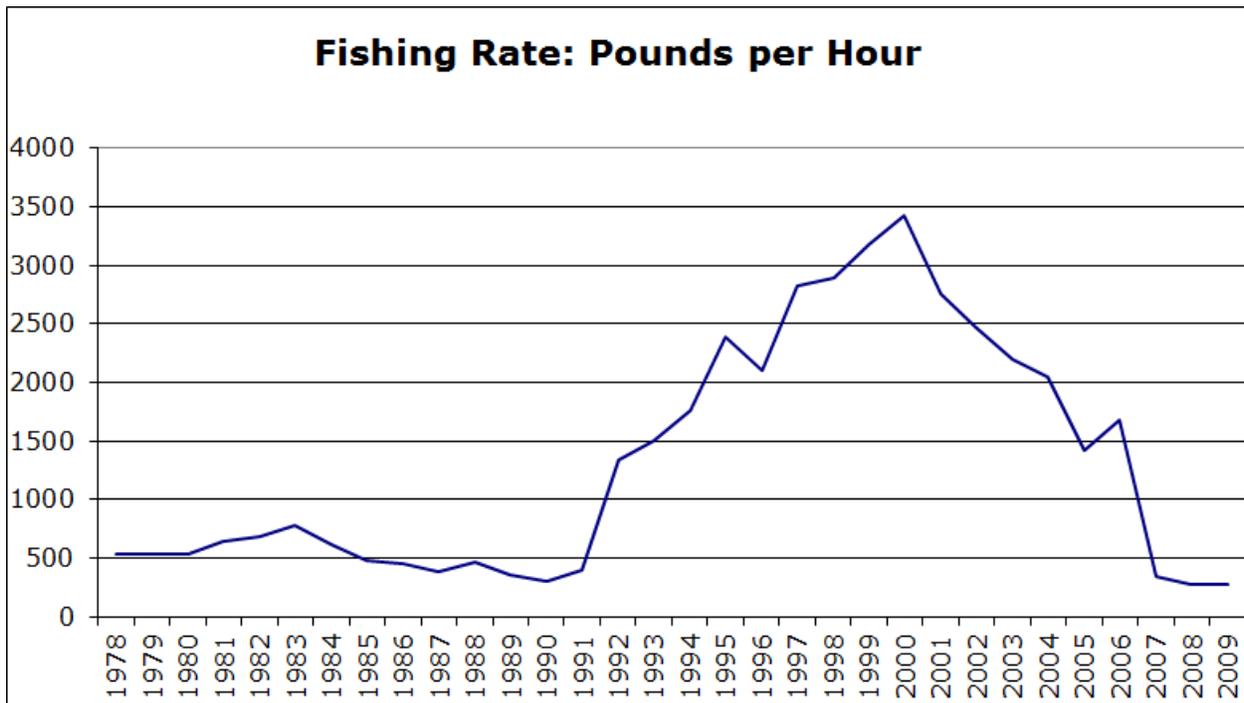


Figure 1.25 graphs the fishing rate (pounds per hour) required to exhaust the yearly TAC from 1978-2009.

These developments are certainly not unique to the Gulf red snapper fishery—critics have long lamented the problem overcapitalization presents to fisheries in general.¹⁷¹ Shi-Ling Hsu's and James Wilen's evaluation of 1996's Sustainable Fisheries Act lamented that while "the SFA contains some notable conservation advances, it does little to address the most fundamental cause of overfishing and waste—the chronic overcapitalization of fishing industries."¹⁷² Hsu and Wilen identified a number of the shortcomings of pure command and control regulations.¹⁷³ The pair concluded that these measures "focus only on the symptom of the problem and not on the cause, which is the open access nature of the resource."¹⁷⁴ IFQs, on the other hand, "attack[] the fundamental property right problem," because "[t]hey are, in effect, a property right to the potential harvest."¹⁷⁵ Because IFQs alter producer incentives, "a fisherman does not need to build a bigger boat to outfish his competitors before regulators close the season; he may fish whenever it is efficient to do so during the season."¹⁷⁶

¹⁷¹ See Shi-Ling Hsu and James E. Wilen, *Ecosystem Management and the 1996 Sustainable Fisheries Act*, 24 *ECOLOGY LAW QUARTERLY* 799, at 806 (1997).

¹⁷² *Id.*

¹⁷³ *Id.* at 807. The authors point out "reductions in season length have encouraged fishermen to build bigger, faster vessels with more short-term harvesting capacity, necessitating further reductions in season lengths. Limitations or restrictions on gear types or capacity (e.g. net size regulations) have invited substitution of other inputs that partially thwart the regulations' original purpose, leading to further attempts by regulation to contain fishing technology's impact on overall harvest levels. Even in cases where limited entry programs have been instituted to freeze capacity and prevent further entry by new boats, there has been a need for additional measures to control capacity as fishermen have continued to increase individual vessel capacity on existing boats."

¹⁷⁴ *Id.* These sentiments echo those of Waters, who opined, "[r]egulatory adjustments may slow the overall rate of harvest by commercial fishermen, but only temporarily, because they do not alter the basic incentive to fish as intensively as possible when the fishery is open. Fishermen who wait still risk losing the opportunity to harvest larger shares of the overall quota." See James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 *MARINE RESOURCE ECONOMICS* 65, at 76 (2001).

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

Waters explained that because "a known portion of the fish stock would be reserved for each fisherman with catch rights," these rights "would eliminate much of the uncertainty about the magnitude of each fisherman's catch... [t]herefore, fishermen would not be compelled to invest in extra fishing power (capital stuffing) to compete for fish on a first-come-first-served basis. They could invest in the fishing power required to minimize rather than maximize the cost of harvesting a given quantity of fish."¹⁷⁷ A 1998 study pointed out that "ITQ efficiency gains can also come from the output and revenue side of the profit equation. Maximizing prices received by value-added processing, niche marketing, and shifts in product form represent the most immediate industry output responses under ITQs."¹⁷⁸ These authors agree with the long-term forecast made of Hsu and Wilen: "[o]ver time, ITQs may lead to changes in the level of capital investment in a fishery, and in the long run alleviate overcapitalization through reduced investment or reinvestment and exit from the fishery."¹⁷⁹

Canadian fisheries experts Dominique Gréboval and Gordon Munro commented specifically on the role total allowable catch (TAC) quotas played in the overcapitalization problem, speculating, "one can go further, and predict that the amount of 'conventional' capital in the fishery will end up being greater than it was when the TAC was first implemented (Clark, 1985). The evidence presented by the OECD is overwhelming in its support of these predictions... it is virtually certain that the stock of 'conventional' capital will be built up to a

¹⁷⁷ James R. Waters, *Restricted Access vs. Open Access Methods of Management: Toward More Effective Regulation of Fishing Effort*, MARINE FISHERIES REVIEW 53(3): 1-10 (1991).

¹⁷⁸ Dale Squires, Harry Campbell, Stephen Cunningham, Christopher Dewees, R. Quentin Grafton, Samuel F. Herrick Jr., James Kirkley, Sean Pascoe, Kjell Salvanes, Bruce Shallard, Bruce Turriss, and Niels Vestergaard, *Individual Transferable Quotas in multispecies fisheries*, MARINE POLICY, Vol. 22, No. 2, 135 at 148 (1998).

¹⁷⁹ *Id.*

level far in excess of the optimal level."¹⁸⁰ Gréboval and Munro conclude "without hesitation or fear of contradiction, that, as far as capacity control is concerned, TACs-only policy is an unmitigated disaster."¹⁸¹

Waters noted a litany of problems associated with TAC-management, before identifying two troubling price-effects.¹⁸² First, whereas monthly red snapper catches were "relatively uniform" before 1991, since then, "landings changed from several hundred thousand pounds per month to nearly two million pounds per month during the spring season of 1997 and more than one million pounds during several mini-seasons. When monthly landings are plotted over time, they appear as spikes of short duration."¹⁸³ These market gluts were associated with lower dockside prices as dockside buyers found trouble marketing a full year's catch during the relatively short periods of time created by derby fishing: "[w]hen average monthly prices are plotted over time, they exhibit sharp dips that correspond to the large quantities landed during open seasons."¹⁸⁴ Whereas prices were "relatively stable" when landings took place throughout

¹⁸⁰ Dominique Gréboval and Gordon Munro, *Chapter 1 - Overcapitalization and Excess Capacity in World Fisheries: Underlying Economics and Methods of Control*, at 22, PDF on file with author.

¹⁸¹ *Id.* at 23.

¹⁸² See James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS 65, at 69-70 (2001). Waters remembered that "red snapper were caught throughout the year before restrictive quotas were implemented. Now, however, fishing effort has shifted to the regulated open seasons in the spring and fall, and the fishing year is characterized by short periods of intense fishing activity, as the threat of imminent closure results in a fishing derby in which the entire year's quota is landed in a few months." *Id.* at 69. Waters noted the concerns of small boats, as shorter seasons forced some to fish in poor weather that could have otherwise been avoided sans-derby. The greater risks of breakdowns, accidents, and injuries faced by smaller boats suggested "open seasons confer[red] an advantage on larger boats." *Id.* at 70. Waters also considered the possibility, "that the intense fishing effort associated with a sustained rush for red snapper eventually leads to fatigue that can reduce productivity and alertness, increases the likelihood of accident or injury, and increases the incidence of boat and gear breakdowns that result in higher repair costs when normal, preventative maintenance is postponed," but noted the unavailability of data to test this hypothesis. *Id.*

¹⁸³ *Id.*

¹⁸⁴ *Id.*

the year, since the introduction of restrictive quotas "average monthly prices have exhibited greater variance in response to extreme fluctuations in landings."¹⁸⁵

In addition to—or more accurately, because of—these volatility concerns, long-term average prices also suffered.¹⁸⁶ Waters estimated the magnitude of the vertical difference for dockside prices between the 1962-90 period (before quota management) and the 1992-99 period (after restrictive quotas required seasonal closures) with a single equation linear model that expressed real, average dockside prices as a function of total gulf-wide landings of red snapper; binary intercept shifters that distinguished the relevant periods from one another; snapper imports; real total disposable income; and real, average annual dockside prices for grouper as a substitute for red snapper.¹⁸⁷ Waters found that "[f]or any given quota, dockside prices for red snapper were estimated to be about \$1.14 per pound lower in real terms when the fishery was managed with restrictive quotas, as prices fell due to the difficulties of marketing an entire year's catch within a short period of time."¹⁸⁸

As previous discussion suggested and subsequent graphs will elucidate, these volatility concerns are not limited to the price series. Evidence of these effects is widespread: volatility in the hours available for fishing and the amount of fish available in those hours begat volatility in trips taken, and, subsequently, in output and price. These measures are linked with TAC-induced closures, as overcapitalization was incentivized by both the desire to claim larger quantities of fish in shorter periods of time and the need to accommodate the system-wide volatility.

¹⁸⁵ *Id.*

¹⁸⁶ *Id.* Since the first TAC-induced closure in 1991, "nominal prices have declined to their lowest levels since the mid-1980s, while real prices have declined to their lowest levels since the early 1970s. Although red snapper historically brought the highest prices among reef fishes, average, annual prices for groupers have exceeded price for red snapper since 1992 because of the effects of derby fishing on red snapper prices."

¹⁸⁷ *Id.* at 72.

¹⁸⁸ *Id.* at 73.

Fishing Opportunity: Hours Open

Once the exhausted TAC first forced an early closure in 1991, an average of approximately 200 hours of fishing was available each month from 1992-2006. The first dual spring and fall fishing seasons were introduced in 1996. The practice of limiting fishing to fifteen days per month during these seasons began in fall 1997. Mini-seasons were further restricted, to ten-day openings, in fall 1999. Openings followed this regime until 2007 ushered in the ITQ regime. The effect of the mini-seasons is evident as the standard deviation spread in the graph below clearly tightened from 1997-2004. The spread relaxed a bit from 2005-2006 as fishing continued deep into December before TACs were finally exhausted. As ITQs returned the red snapper fishery to year-round fishing, the regime significantly reduced the spreads of the yearly standard deviation in hours open per month and between the yearly high- and low-months.

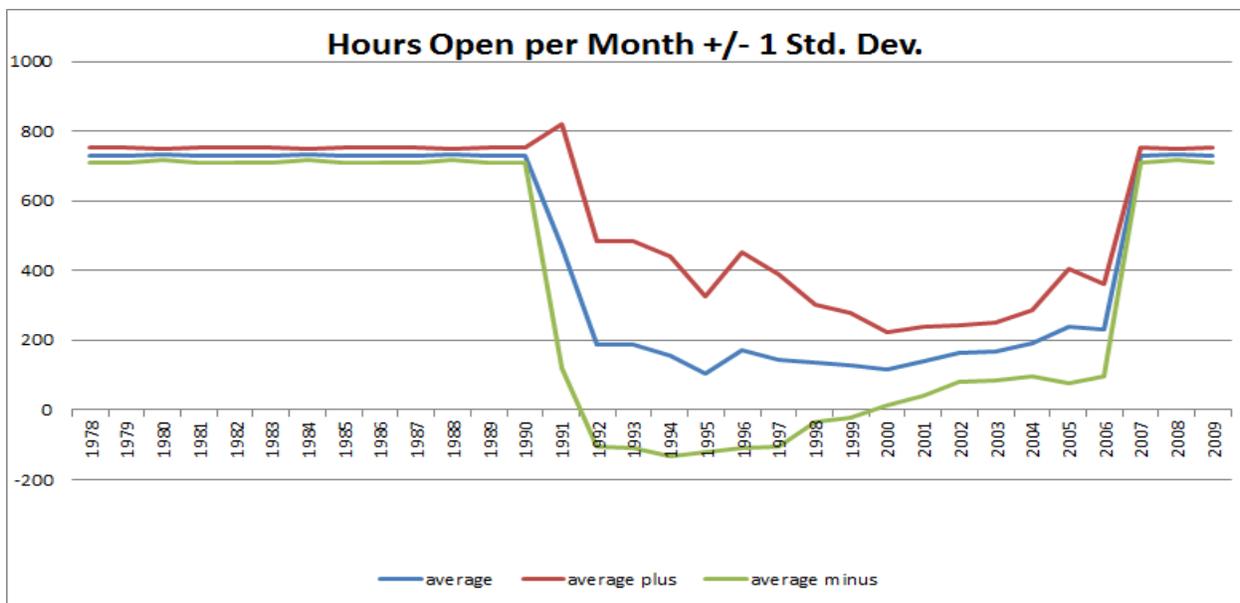


Figure 1.26 graphs the relationship between average hours open per month and the standard deviation in hours open per month.

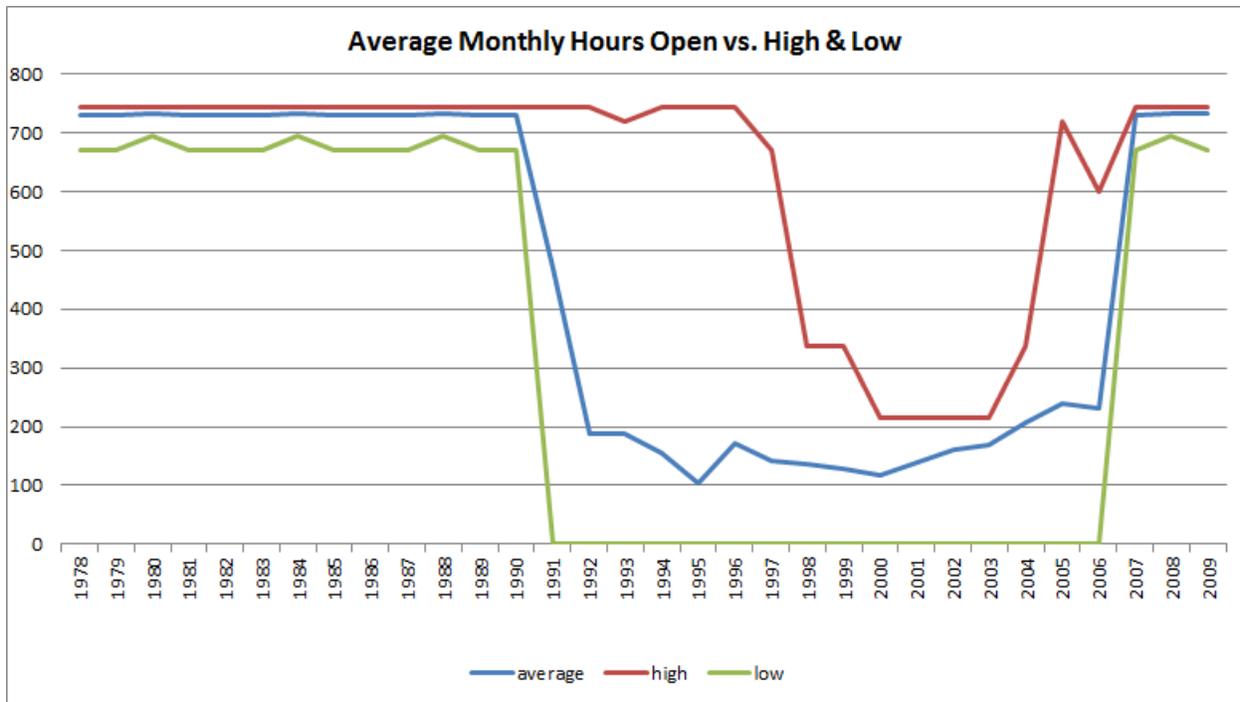


Figure 1.27 graphs the relationship between average hours open per month and the yearly high and low.

Fishing Effort: Trips Taken & Vessels Taking Trips

Faced with trip limits instituted in 1993, more vessels took more trips once the TAC increased from approximately 3 million pounds to over 4.5 million pounds in 1996. The spreads converged from then until 2002, before remaining relatively stable until the implementation of ITQ in 2007 induced another marked contraction. Unfortunately, no pre-1993 trip or vessel data is available for a comparison of how these series behaved in pre-derby conditions. Trip and vessel data both decreased as the TAC fell, first to 3.315 million pounds in 2007 and then to 2.55 million pounds in 2008.

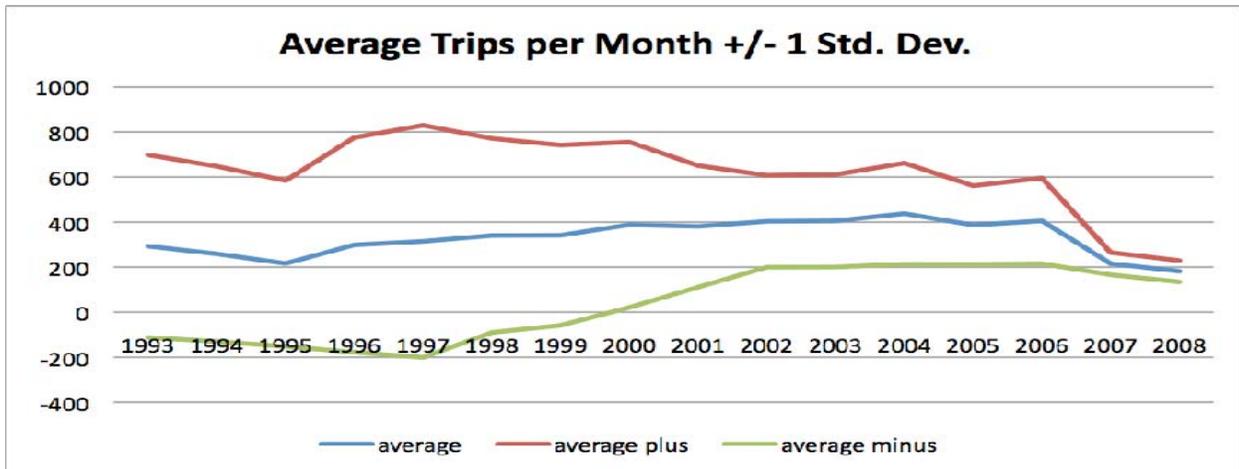


Figure 1.28 graphs the relationship between average trips taken per month and the standard deviation in trips taken per month.

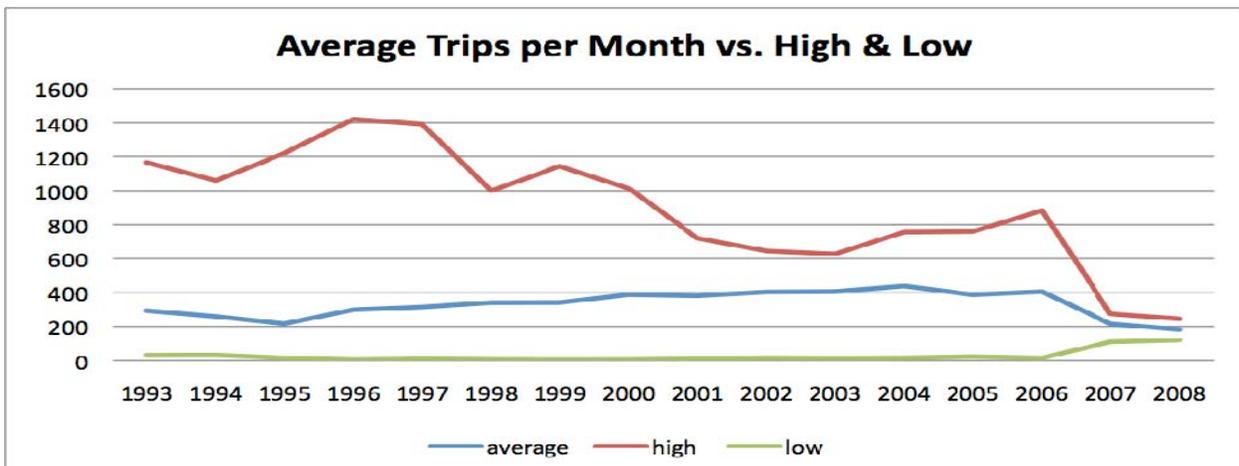


Figure 1.29 graphs the relationship between average trips taken per month and the yearly high and low.

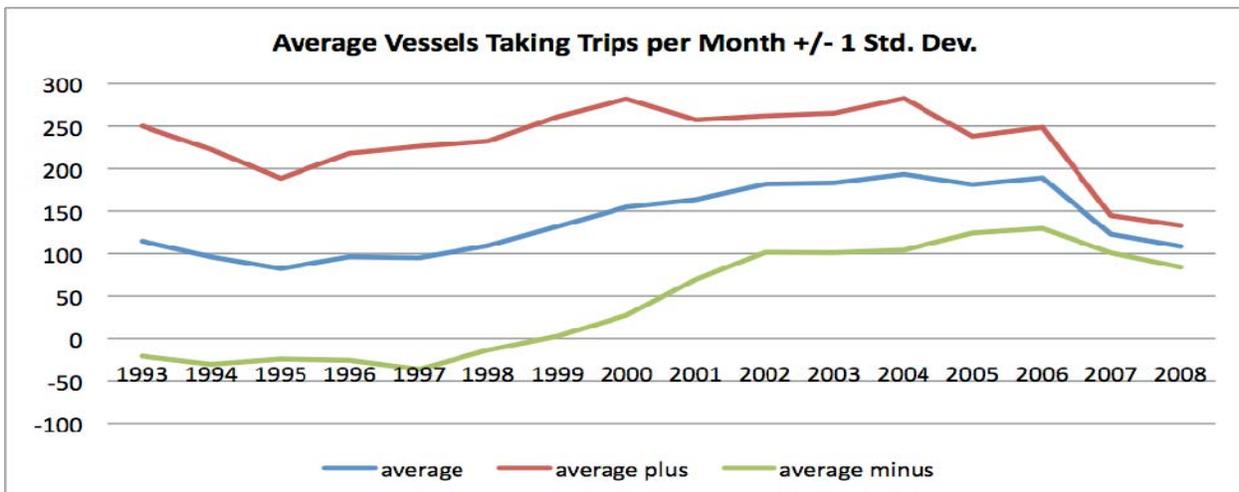


Figure 1.30 graphs the relationship between the average number of vessels taking trips per month and the standard deviation in trips taken per month.

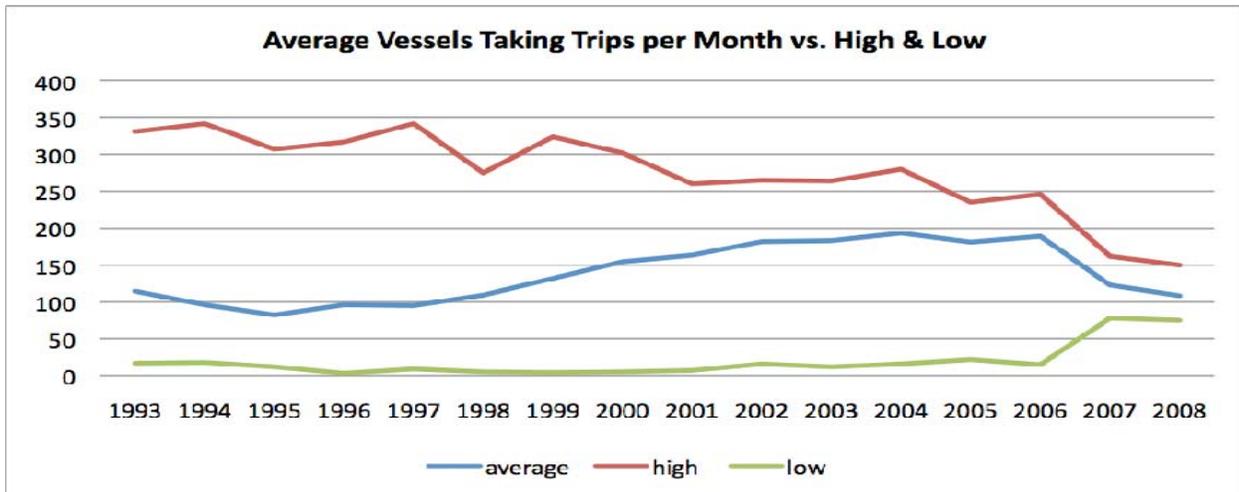


Figure 1.31 graphs the relationship between average number of vessels taking trips per month and the yearly high and low.

Fishing Outcomes: Fishing Harvest and Ex-vessel Prices

Fishing harvests mirrored the patterns evident in the fishing opportunity graphs above. The 1996 TAC increase only exacerbated the spreads between monthly output levels, as even more fish were harvested in approximately the same amount of time (about 200 hours per month, on average). While subsequent management effort and participant experience in dealing with these efforts somewhat controlled these deviations, the onset of ITQ in 2007 clearly brought further reductions in these spreads.

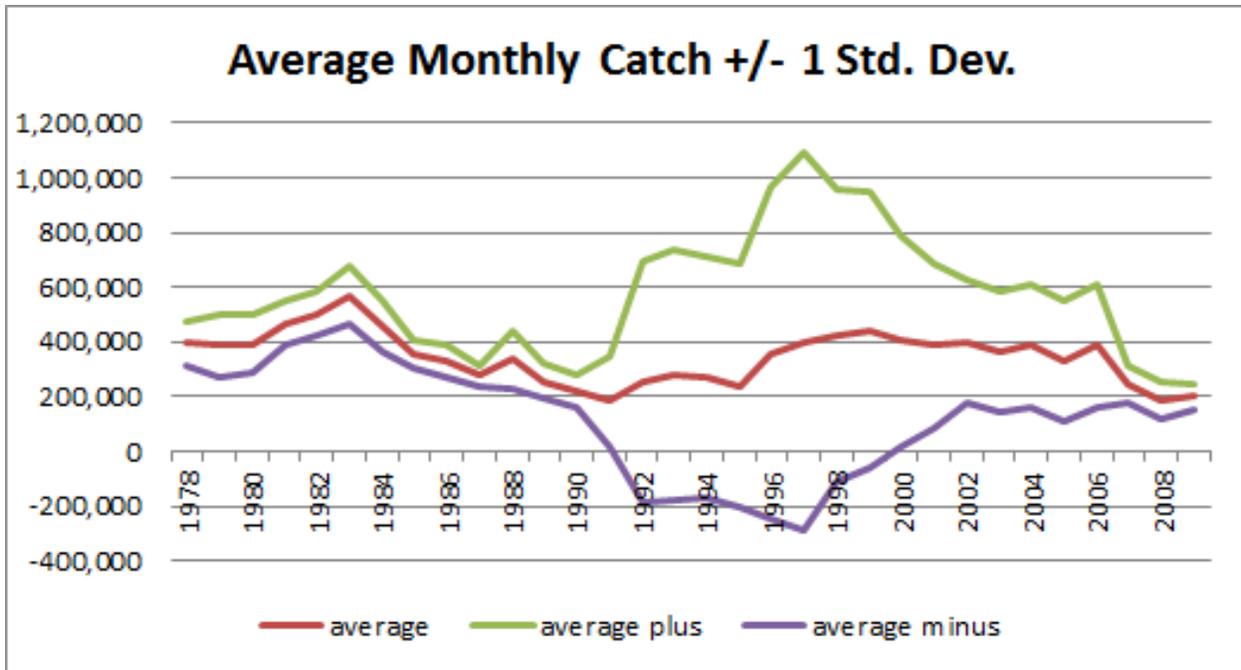


Figure 1.32 graphs the relationship between average monthly catch and the yearly standard deviation in monthly catch.

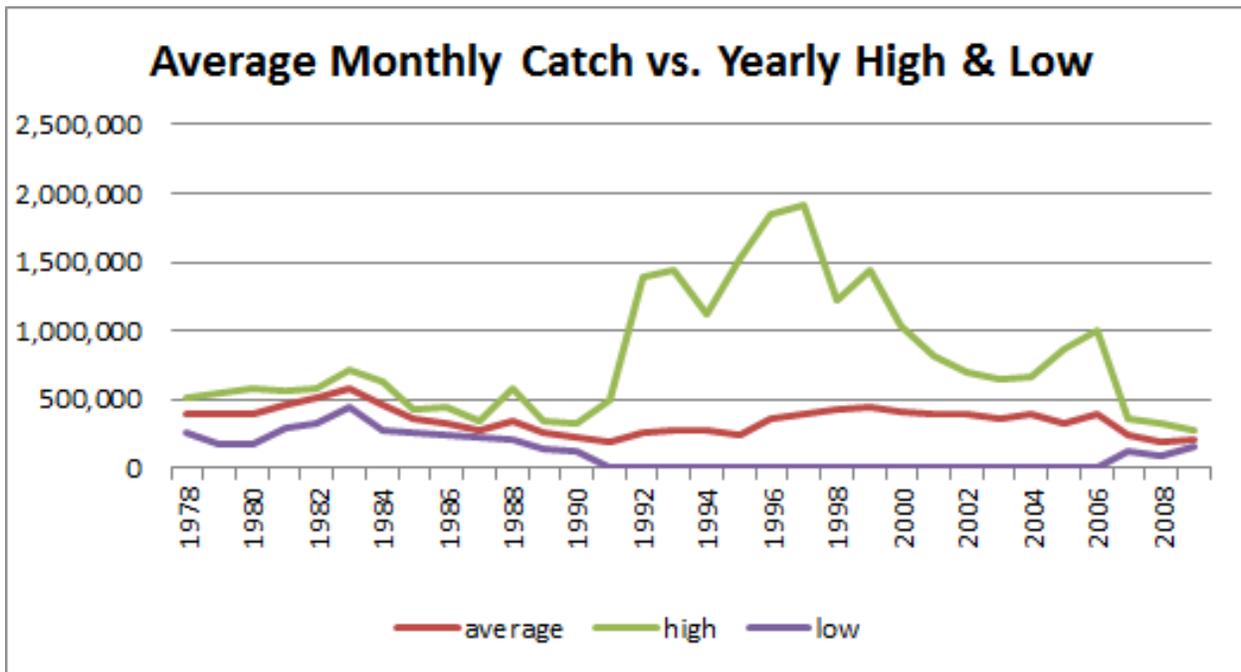


Figure 1.33 graphs the relationship between average monthly catch and the yearly high and low.

ITQs' contributions to economic efficiency went beyond merely calming volatility in these data series. By eliminating daily trip limits and allowing participants to harvest more fish

on fewer trips, ITQs made resource extraction more efficient. The next graph shows that participants caught more snapper per trip post-ITQ, allowing them to take fewer trips overall.

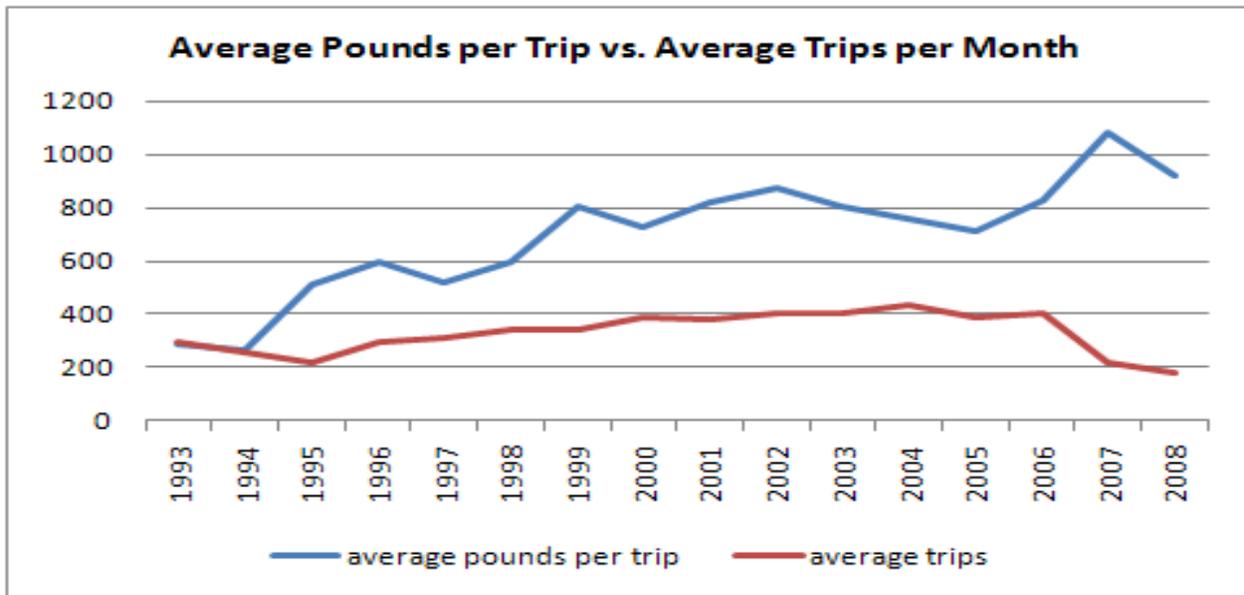


Figure 1.34 graphs the relationship between average pounds per trip and average trips per month.

Waters' concern over price volatility is evident in the graphs below. While not as striking as the volatility in the opportunity, effort, and output data series, it is clear that the price volatility Waters worried about persisted throughout the sample period. ITQs reigned in this volatility more effectively than more than fifteen years of alternative regulatory adjustments.

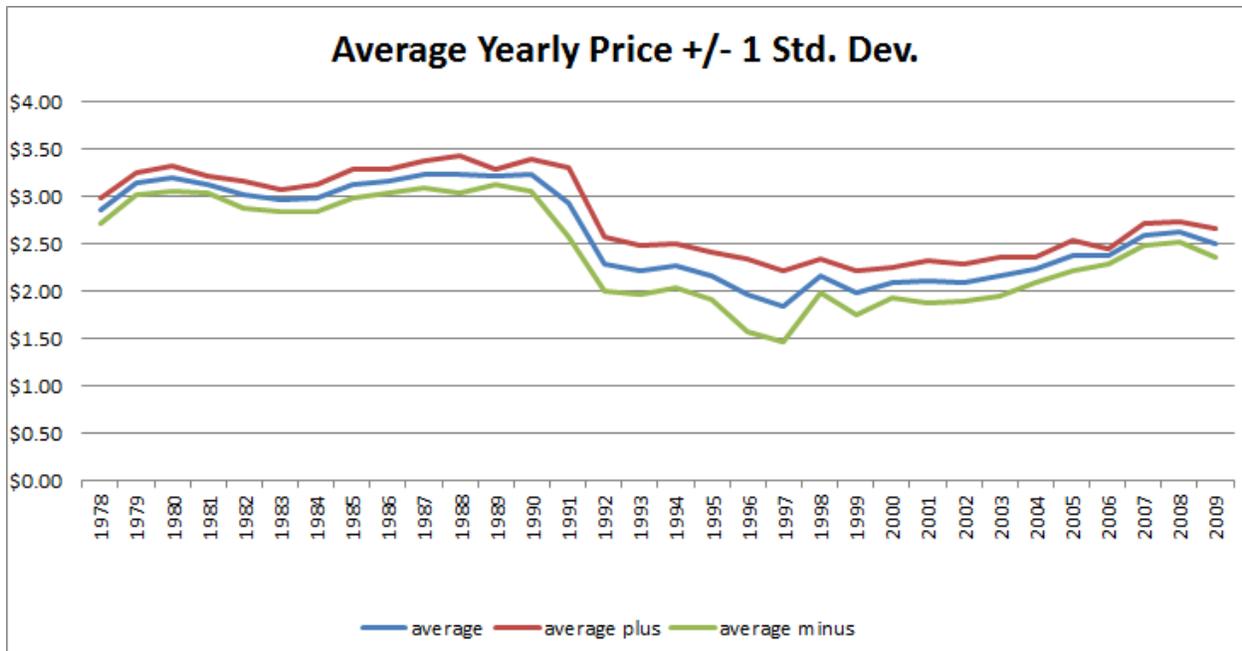


Figure 1.35 graphs the relationship between average yearly price and the standard deviation in average yearly price.

The graph below provides the most effectual depiction of the derby-fishing problem. The spread between the high and low price captures the extreme monthly price variances fishermen faced over the course of the year. But the fact that the yearly average was closer to the yearly minimum than to the yearly maximum for most (1990-mid 2000s) of the TAC-only period (whereas the average was closer to the maximum from 1978-1989) emphasizes the real problem: participants were claiming the bulk of their catch over a condensed time period, simultaneously pushing down the market price at which most of their harvest was sold. In short, they collapsed the market and then sold the majority of their output at yearly-low prices. While other management measures somewhat ameliorated this problem from the mid-2000s on, ITQ not only condensed the spreads, the system also seemed to push prices back towards their historical norms. At this point, the focus of inquiry will shift to an econometric investigation of the Gulf red snapper ex-vessel price data series.

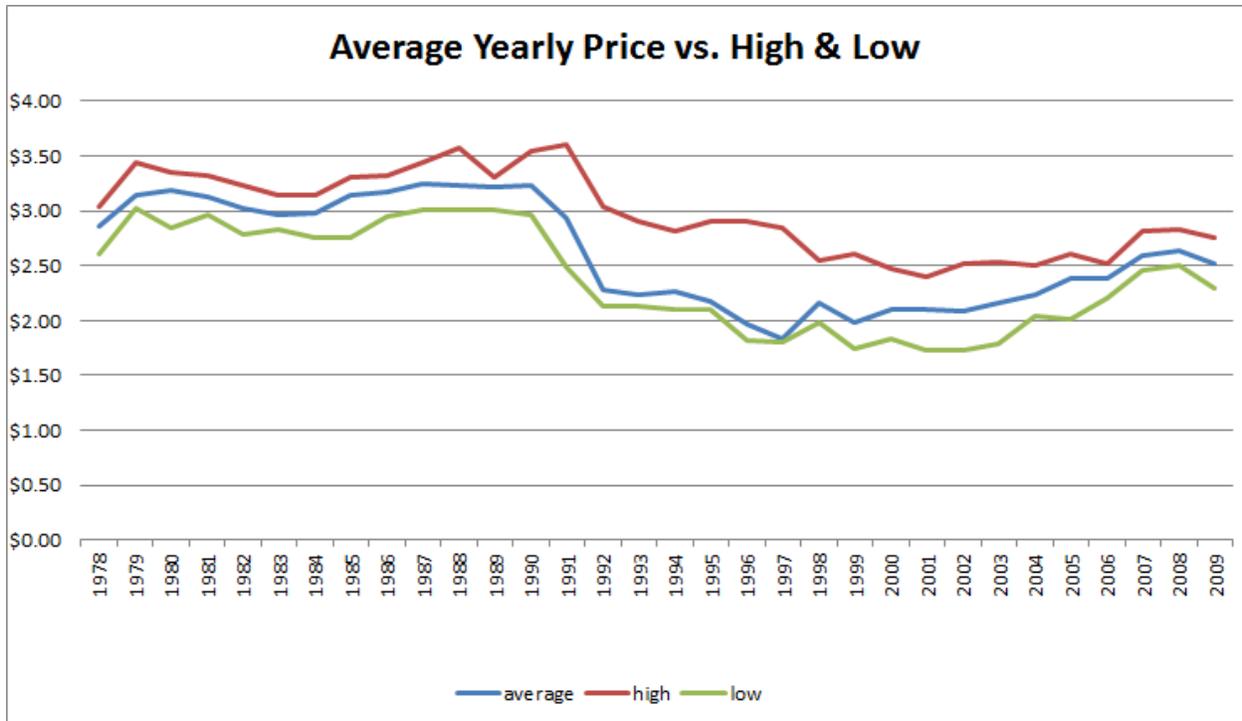


Figure 1.36 graphs the relationship between average yearly price and the yearly high and low.

III. Econometric Analysis of Price

Before assessing the empirical efficacy of ITQs' influence on ex-vessel prices in the Gulf red snapper fishery, prudence suggests an examination of related investigations of ITQ regimes in other fisheries, as well as prior appraisals of the Gulf red snapper fishery. Previous authors have generally agreed that ITQs ameliorate problems associated with TAC regimes which otherwise depend on closures to limit fishing activity. These studies looked at efficiency gains made via the elimination of excess expenditures and by way of increased the price levels attained with sufficient time to market a fresh fish product to an un-glutted market. When processors do not have the capacity to accommodate the large, sporadic harvests associated with derby fishing, product that would have otherwise been sold fresh could end up frozen. Theoretically, the ability to pick and choose which fish will be processed gives processors increased price negotiation leverage over producers.

Christopher Dewees' field work, interviews with, and mail surveys of British Columbian halibut fishermen and processors revealed "evidence of a 55% ex-vessel price gain associated with IVQs compared to the adjacent Alaska open-access fishing derby."¹⁸⁹ Scott Matulich and Michael Clark applied a welfare economics approach to gauge the share of rationalization benefits that accrued to the harvesting and processing sectors of the U.S. halibut and sablefish fisheries after the implementation of IFQ. While ex-vessel price increased for harvesters in both fisheries (103% for halibut; 96% for sablefish), up to 82% of the halibut and 96% of the sablefish processors were left worse off, leading the authors to conclude "harvest-only allocation of quota

¹⁸⁹ See Christopher M. Dewees, *Effects of Individual Quota Systems on New Zealand and British Columbia Fisheries*, 8(1) Supplement, ECOLOGICAL APPLICATIONS S133, S136 (February 1998).

redistributes the wealth from processors to harvesters."¹⁹⁰ In short, because they are less beholden to processors' ability to choose which fish will be processed, fishermen are able to negotiate better rates for their catch.

Noting that, "[n]early all of the ITQ research has focused on potential gains from eliminating a derby-style fishery and the resulting rent dissipation due to excess harvesting costs," Mark Hermann instead focused his scrutiny on the length of the season and, "price increases that the industry may receive due to the flexibility that ITQs allow in marketing the fish."¹⁹¹ Hermann used three equations to model the formation process of B.C. ex vessel price, and then applied three-stage least squares to estimate the simultaneous system.¹⁹² Comparing actual ex-vessel prices to those predicted under a ten-day season without the IVQ program, these simulations suggested that the IVQ program increased the ex-vessel price by more than 25% in 1994.¹⁹³

NOAA economist Jim Waters contributed to an econometric understanding of the Gulf red snapper fishery prices in at least two ways: first, by elucidating the negative price-effects associated with derby-fishing; and, later, by estimating the potential for revenue gains under rights-base management (ITQ). Observing that the primary consequence of TAC management "has been the incentive for individuals to fish early and intensively in each open season to maximize their shares of the overall catch before the quota is reached and the season is closed,"

¹⁹⁰ See Scott C. Matulich and Michael L. Clark, *North Pacific Halibut and Sablefish IFQ Policy Design: Quantifying the Impact on Processors*, 18 MARINE RESOURCE ECONOMICS 149, 159, 169 (2003).

¹⁹¹ See Mark Hermann, *Estimating the Induced Price Increase for Canadian Pacific Halibut with the Introduction of the Individual Vessel Quota System*, 44 CANADIAN JOURNAL OF AGRICULTURAL ECONOMICS 151, 152 (1996).

¹⁹² *Id.* at 159, 160. The equations accounted for U.S. import demand for Canadian Pacific halibut, B.C. export supply of Canadian Pacific halibut to the U.S., and Canadian Pacific halibut *ex vessel* price.

¹⁹³ *Id.* at 161. The actual 1994 price of 8.16 (C\$/kg) was 1.70 (C\$/kg) higher than the predicted price of 6.46 (C\$/kg). Hermann concludes, "the season length increase ultimately increases *ex vessel* price." *Id.* at 162.

Waters lamented that while the Gulf red snapper fishery was once open year-round, "now, however, ... the fishing year is characterized by short periods of intense fishing activity."¹⁹⁴ This led Waters to express real, average annual dockside prices for red snapper as a function of binary intercept shifters that accounted periods of varying quota management (no quota from 1962-90, a transition year in 1991, and a period of restrictive quotas requiring lengthy seasonal closures from 1992-99); gulf-wide red snapper landings; total imports of all species of snapper; real total disposable income; and real, average annual dockside prices for groupers.¹⁹⁵ Waters identified a "downward shift in the estimated price-quantity relationship and a decline in industry-wide dockside revenues for red snapper fishermen. For any given quota, dockside prices for red snapper were estimated to be about \$1.14 per pound lower in real terms when the fishery was managed with restrictive quotas."¹⁹⁶

Waters later teamed up with Quinn Weninger to estimate the revenue gains rights-based management such as ITQs would bring to the Gulf red snapper fishery by ending the derby-fishing behavior associated with seasonal closures.¹⁹⁷ The pair expressed real, average annual dockside prices for red snapper as a function of the one-period lagged price of red snapper; a trend variable; a variable formed by interacting a dummy variable (0 from 1962-89; 1 from 1990-99) for active TAC management with the numerical TAC for a given year; and a term

¹⁹⁴ See James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS 65, 69 (2001).

¹⁹⁵ *Id.* at 72.

¹⁹⁶ *Id.* at 73. Like Hermann, Waters attributed this precipitous price decline "to the difficulties of marketing an entire year's catch within a short period of time." *Id.* This analysis reinforces the "TACs-only policy is an unmitigated disaster" sentiment of Gréboval and Munro at note 172.

¹⁹⁷ See Quinn Weninger and James R. Waters, *Economic Benefits of management reform in the northern Gulf of Mexico reef fish fishery*, 46 JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT 207 (2003).

measuring the portion of the year the red snapper fishery remained open.¹⁹⁸ Results indicated that while larger harvests lowered prices, a longer season raised prices: the \$1.94 average price for 1995 resulted from a 95-day season; the model suggested a 365-day season would have yielded a price, \$2.88, nearly fifty-percent higher.¹⁹⁹ The next two sections follow in the work of Waters and Weninger, estimating annual and monthly models of Gulf red snapper ex-vessel price. Then, the focus will shift to deviations in those same price levels, investigating the influence of fishery management efforts on price level volatility.

¹⁹⁸ *Id.* at 223-24.

¹⁹⁹ *Id.* at 225.

Annual Data

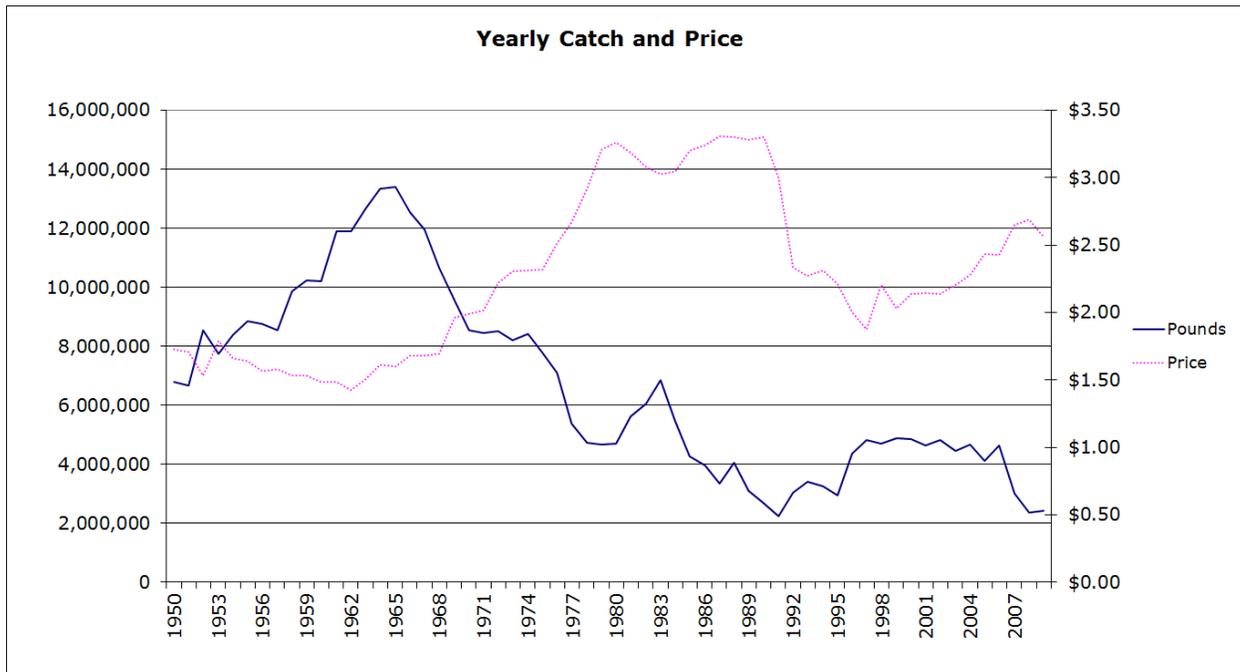


Figure 2.1 graphs the relationship between yearly catch and price from 1950-2009.

The variables of interest in the Waters (and Weninger) paper(s) included Gulf red snapper landings, lagged Gulf red snapper price, snapper imports, disposable income, grouper price, season length, trend, and assorted dummy variables. Annual data on Gulf red snapper landings and price was obtained from 1950-forward at the NMFS website.²⁰⁰ Data detailing the hours the fishery was open in a given year was collected from the Federal Register and converted into a percentage measuring the portion of the year the fishery was open. Annual disposable personal income data was obtained from the Bureau of Economic Analysis.²⁰¹ Fuel cost data was acquired from the Energy Information Association at the Department of Energy.²⁰² A trend variable was added; a dummy variable for TAC management was constructed; and the TAC

²⁰⁰ Available at: <http://www.st.nmfs.noaa.gov/st1/commercial/index.html>

²⁰¹ Available at: <http://www.bea.gov/national/nipaweb/SelectTable.asp?Selected=N>

²⁰² Because information on diesel prices was not available for the complete timeframe, the Gasoline Regular Grade Retail Price was used. Available at: <http://www.eia.doe.gov>

dummy variable was interacted with both landings and the trend variable. Unfortunately, accessible data on snapper imports and grouper price was not available until the 1990s, forcing these variables to be omitted from the annual price model. The available data was used in the following regression model:

$$\ln(s_t) = \alpha_0 + \alpha_1 \ln(s_{t-1}) + \alpha_2 \tau + \alpha_3 \text{TAC} + \alpha_4 \theta_t + \alpha_5 \ln(Y_t) + \alpha_6 \ln(F_t) + \alpha_7 \ln(Q_{rs,t}) + \alpha_8 \text{TAC} * \ln(Q_{rs,t}) + \alpha_9 \text{TAC} * \tau + \varepsilon_t \quad (1)$$

The dependent variable, $\ln(s_t)$, is the natural log of the real annual average ex-vessel price for Gulf red snapper in year t ; $\ln(s_{t-1})$ is the one-period lagged natural log of price; τ is a trend variable; TAC is an indicator variable set equal to 0 for $t < 1990$ and 1 for $t \geq 1990$; θ_t measures the portion of the year that the red snapper fishery remained open in year t ; $\ln(Y_t)$ is the natural log of real, total disposable income in year t ; $\ln(F_t)$ is the natural log of fuel price in year t ; $\ln(Q_{rs,t})$ is the natural log of Gulf red snapper landings in year t ; $\ln(Q_{rs,t})$ was interacted with the TAC; TAC was also interacted with the trend variable.

The model was estimated using an ordinary least-squares regression. Parameter estimates and standard errors are reported in the table below. All slope parameters are statistically different from zero at or above the 95% confidence interval except for the trend variable (which is statistically different from zero at the 90% confidence interval). Parameter signs are as expected. A TAC quota lowers price ($\alpha_3 < 0$) and an increase in season length raises price ($\alpha_4 > 0$). Increases in disposable income or fuel costs both raise price ($\alpha_5 > 0$; $\alpha_6 > 0$). A larger aggregate harvest leads to a lower price ($\alpha_7 < 0$). The adjusted R^2 statistic is 0.967.

Parameter estimates for ex-vessel annual price model (1951-2009)			
Variable	Parameter	Estimate	Standard error
Constant	α_0	-1.59	1.319
$\ln(s_{t-1})$	α_1	0.455***	0.103
τ (trend)	α_2	-0.013*	0.007
TAC	α_3	-3.78***	1.169
θ_t (season length)	α_4	0.157**	0.068
$\ln(Y_t)$	α_5	0.630***	0.187
$\ln(F_t)$	α_6	0.188***	0.062
$\ln(Q_{rs,t})$	α_7	-0.246***	0.051
TAC* $\ln(Q_{rs,t})$	α_8	0.271***	0.084
TAC* τ	α_9	-0.010*	0.005
There are 59 observations. A single (double) [triple] asterisk indicates parameter is significantly different than zero at or above a 90 (95) [99] percent confidence interval.			

Table 2.1 provides output from the OLS Annual Price Model.

Monthly Data

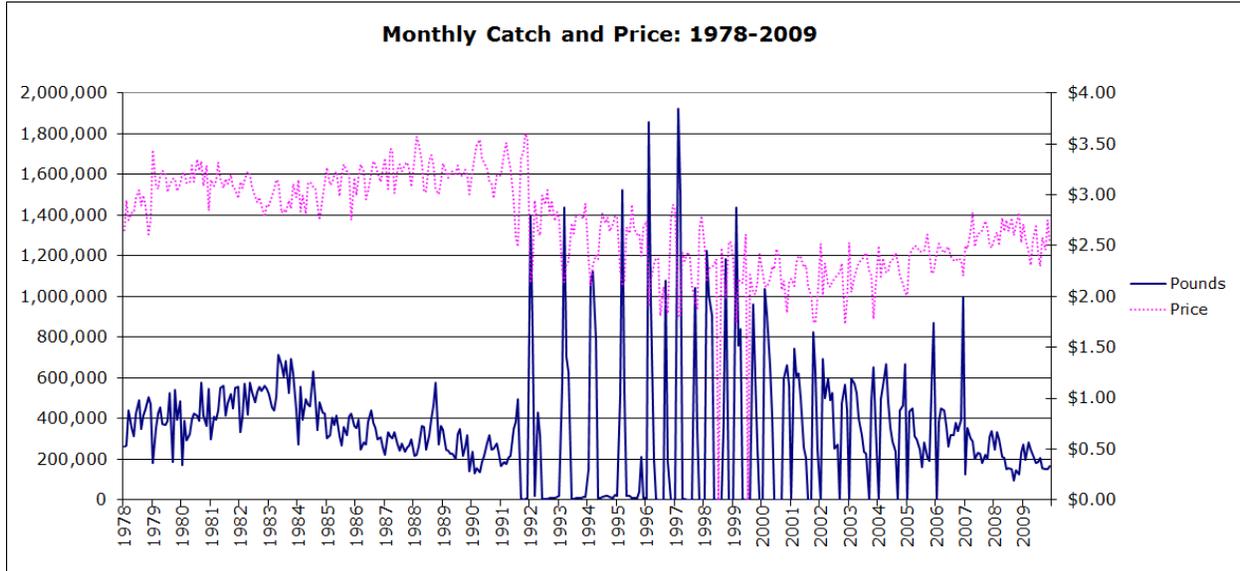


Figure 2.2 graphs the relationship between monthly catch and price from 1978-2009.

While the Waters (and Weninger) paper(s) focused on annual data, the models employed and variables chosen are adaptable for use with monthly data. Monthly data on Gulf red snapper landings and price from 1978-2006 was taken from the Waters SEFSC dataset and supplemented with 2007-09 data from the same NMFS website that provided annual data. The same NMFS website also provided the ex-vessel price of Gulf red grouper (a snapper substitute). The price of fresh, Mexican imported snapper was collected from another NMFS website.²⁰³ A monthly diesel fuel index was acquired from the Bureau of Labor Statistics.²⁰⁴ Finally, an indicator variable for ITQ management was added. The available data was used in the following regression model,

$$\ln(s_t) = \alpha_0 + \alpha_1 \ln(s_{t-1}) + \alpha_2 \ln(Q_{rs,t}) + \alpha_3 \ln(M_{fm,t}) + \alpha_4 \ln(G_t) + \alpha_5 \ln(F_t) + \alpha_6 ITQ + \alpha_7 SIN1 + \alpha_8 SIN2 + \alpha_9 COS1 + \alpha_{10} COS2 + \alpha_{11} SIN1 * TWO_SEASON +$$

²⁰³ While this dataset includes all species of fresh snapper imported from Mexico, Dr. Waters suggested that most of these imports were red snapper, making this dataset the most analogous to the Gulf red snapper data under study. Data available at: <http://www.st.nmfs.noaa.gov/st1/trade/index.html>

²⁰⁴ PPI: #2 diesel fuel; NSA. Available at: <http://www.bls.gov/ppi/ppipetroleum.htm>

$$\alpha_{12}\text{SIN2}*\text{TWO_SEASON} + \alpha_{13}\text{COS1}*\text{TWO_SEASON} + \alpha_{14}\text{COS2}*\text{TWO_SEASON} + \varepsilon_t \quad (2)$$

The dependent variable, $\ln(s_t)$, is the natural log of the real ex-vessel price for Gulf red snapper in month t ; $\ln(s_{t-1})$ is the one-period lagged natural log of price; $\ln(Q_{rs,t})$ is the natural log of Gulf red snapper landings in month t ; $\ln(M_{fm,t})$ is the natural log of fresh, Mexican imports of snapper (all species) in month t ; $\ln(G_t)$ is the natural log of the real, monthly ex-vessel price for Gulf red grouper in month t ; $\ln(F_t)$ is the natural log of the diesel price index in month t ; ITQ is an indicator variable set equal to 0 for $t < 2007$ and 1 for $t \geq 2007$; SIN1-COS2 are harmonic variables for six- and twelve-month cycles; and these harmonic variables were also interacted with an indicator variable for a two-season quota set equal to 0 for $t < 1996$ and $t > 2007$ and 1 for $1996 \leq t \leq 2006$.²⁰⁵

The model was estimated using an ordinary least-squares (OLS) regression. Parameter estimates and standard errors are reported in the table below. All slope parameters are statistically different from zero at or above the 90% confidence interval except for the harmonic variables (which control for seasonality). Parameter signs are as expected. Increases in aggregate harvest or imports both lead to lower prices ($\alpha_2 < 0$; $\alpha_3 < 0$). Increases in the price of grouper or fuel both lead to higher prices ($\alpha_4 > 0$; $\alpha_5 > 0$). The imposition of a rights-based ITQ program increases ex-vessel price ($\alpha_6 > 0$).

²⁰⁵ See Mathew T. Holt, *Risk Response in the Beef Marketing Channel: A Multivariate Generalized ARCH-M Approach*, 75 AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS 559, 563 (1993). SIN1 = $\sin(2\pi t/6)$, COS1 = $\cos(2\pi t/6)$, SIN2 = $\sin(2\pi t/12)$, COS2 = $\cos(2\pi t/12)$.

Parameter estimates for OLS ex-vessel monthly price model (July 1991 - November 2008)			
Variable	Parameter	Estimate	Standard error
Constant	α_0	0.915***	0.288
$\ln(S_{t-1})$	α_1	0.422***	0.060
$\ln(Q_{rs,t})$	α_2	-0.019***	0.003
$\ln(M_{fm,t})$	α_3	-0.046**	0.020
$\ln(G_t)$	α_4	0.205**	0.086
$\ln(F_t)$	α_5	0.052***	0.021
ITQ	α_6	0.049*	0.025
SIN1	α_7	-0.013	0.015
SIN2	α_8	0.024	0.017
COS1	α_9	0.024	0.017
COS2	α_{10}	0.013	0.016
SIN1*TWO_SEASON	α_{11}	-0.006	0.020
SIN2*TWO_SEASON	α_{12}	-0.067***	0.021
COS1*TWO_SEASON	α_{13}	-0.011	0.020
COS2*TWO_SEASON	α_{14}	-0.006	0.020
There are 221 observations. A single (double) [triple] asterisk indicates parameter is significantly different than zero at or above a 90 (95) [99] percent confidence interval.			

Table 2.2 provides output from the OLS Monthly Price Model.

Because simultaneity is a concern when working with a price system in which supply and demand jointly determine price, the landings variable was tested for endogeneity. The natural log of real, average hourly wages in manufacturing was used as an instrumental variable, along with a trend variable and a trend squared variable.²⁰⁶ The landings data was regressed on the exogenous variables in the model and these chosen IVs. The residuals from this landings regression were then added to originally estimated regression. The coefficient on the residual term from the landings regression was significant, indicating endogeneity. The model was

²⁰⁶ Wage rates taken from Federal Reserve Economic Data. Available at: <http://research.stlouisfed.org/fred2>

therefore re-estimated using two-stage least squares (2SLS). The main changes under 2SLS estimation were altered coefficient estimates, although the price of grouper no longer influenced red snapper price in a statistically significant manner.

Parameter estimates for 2SLS ex-vessel monthly price model (July 1991 - November 2009)			
Variable	Parameter	Estimate	Standard error
Constant	α_0	2.07***	0.675
$\ln(s_{t-1})$	α_1	0.344***	0.087
$\ln(Q_{rs,t})$	α_2	-0.057***	0.019
$\ln(M_{fm,t})$	α_3	-0.121***	0.045
$\ln(G_t)$	α_4	0.124	.118
$\ln(F_t)$	α_5	0.131***	0.047
ITQ	α_6	0.063*	0.034
SIN1	α_7	-0.006	0.020
SIN2	α_8	-0.40	0.038
COS1	α_9	0.005	0.024
COS2	α_{10}	-0.003	0.22
SIN1*TWO_SEASON	α_{11}	-0.047	0.033
SIN2*TWO_SEASON	α_{12}	-0.060***	0.027
COS1*TWO_SEASON	α_{13}	-0.047	0.03
COS2*TWO_SEASON	α_{14}	-0.00003	0.026
There are 221 observations. A single (double) [triple] asterisk indicates parameter is significantly different than zero at or above a 90 (95) [99] percent confidence interval.			

Table 2.3 provides output from the 2SLS Monthly Price Model.

It is important to note that the coefficient reported for ITQ only captured the contemporaneous effect of ITQ on Gulf red snapper price. For this reason, the long run effect of ITQ on price was calculated and plotted against the price series itself in the graph below.

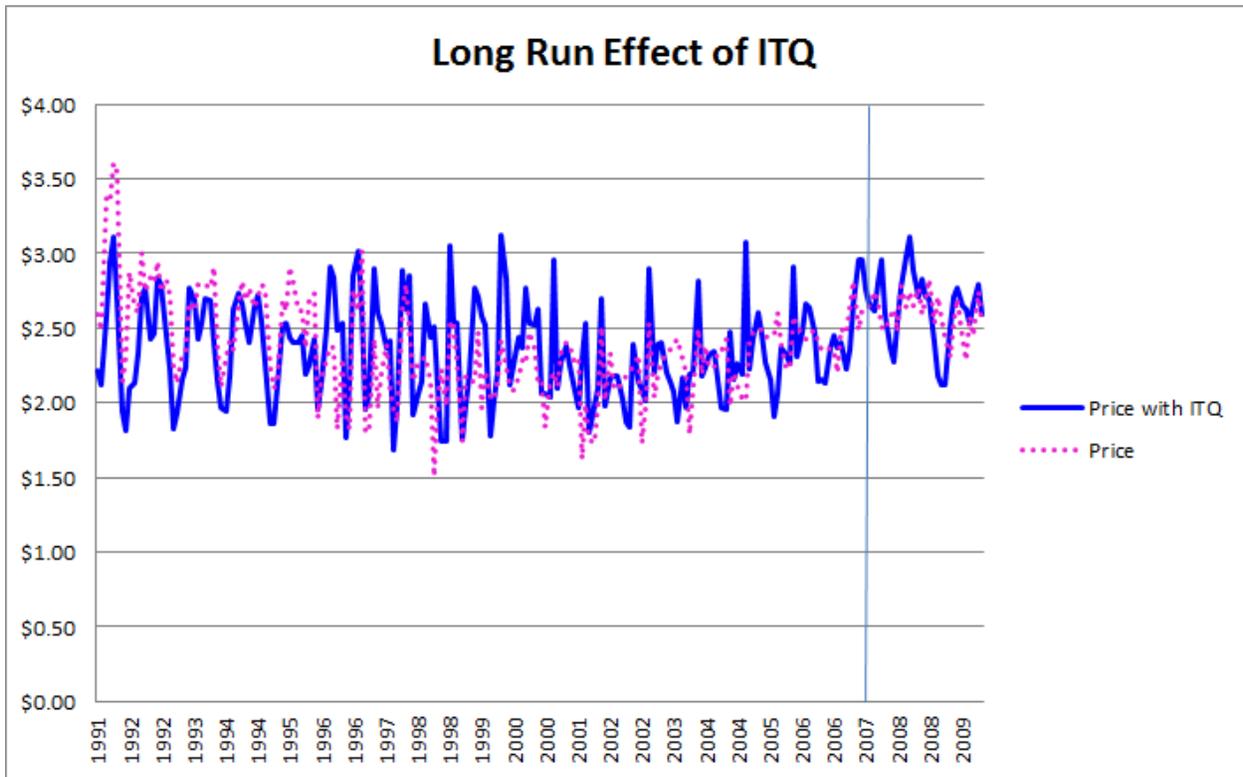


Figure 2.3 graphs the relationship between the actual price series and the projected long run effect of ITQ.

IV. Econometric Analysis of Price Volatility

In comparison to the relatively thorough econometric treatment given regulatory influence of fishery price-levels, there is a paucity of literature regarding the price-level volatility associated with derby-fishing's market gluts.²⁰⁷ Waters explained that because the short periods of intense derby-fishing associated with seasonal closures under TAC quota management produced market gluts related to lower dockside prices, "average monthly prices have exhibited greater variance in response to extreme fluctuations in landings."²⁰⁸ Treating volatility as analogous to risk underscores the importance of further research: "price uncertainty is unimportant whenever the relevant prices are reasonably predictable. However it is of paramount importance in many industries related to natural resources, where price swings of 25-40% per year are not uncommon."²⁰⁹

²⁰⁷ While no one has focused on the Gulf red snapper or its regulation-induced price volatility directly, a number of authors have applied ARCH or GARCH models to a more general assessment of fishery price volatility. *See, e.g.* Cumhur Buguk, Darren Hudson, and Terry Hanson, *Price Volatility Spillover in Agricultural Markets: An Examination of U.S. Catfish Markets*, 28 JOURNAL OF AGRICULTURAL AND RESOURCE ECONOMICS 86 (2003); Shekar Bose, *Price Volatility of South-East Fishery's Quota Species: an Empirical Analysis*, 18 INTERNATIONAL ECONOMIC JOURNAL 283 (September 2004); Atle Oglend and Marius Sikveland, *The Behavior of Salmon Price Volatility*, 23 MARINE RESOURCE ECONOMICS 507 (2008); Tu van Binh and Michel Dumont, *A Fishing Expedition in the Mekong Delta: Market Volatility and Price Substitutes for Vietnamese Fresh Water Fish*, WORKING PAPER FROM UNIVERSITY OF ANTWERP, FACULTY OF APPLIED ECONOMICS (March 2008), available at: http://www.ua.ac.be/download.aspx?c=*TEWHI&n=60625&ct=59067&e=160695

²⁰⁸ *See* James R. Waters, *Quota Management in the Commercial Red Snapper Fishery*, 16 MARINE RESOURCE ECONOMICS 65, 70 (2001).

²⁰⁹ *See* Arantza Murillas and José Manuel Chamorro, *Valuation and Management of Fishing Resources under Price Uncertainty*, 33 ENVIRONMENTAL & RESOURCE ECONOMICS 39, 41 (2006). Moreover, Oglend and Sikveland emphasize the practical implications of salmon price volatility for other researchers, cautioning: (1) "assuming normality when modelling salmon prices is not supported by our study;" and (2) "academic research applying salmon prices should account for the fact that there is persistence of volatility on the short-term dynamics." *The Behavior of Salmon Price Volatility*, 23 MARINE RESOURCE ECONOMICS at 524 (2008).

Univariate GARCH Model

In order to model the conditional volatility of ex-vessel price in the Gulf red snapper fishery it was necessary to first construct an ARIMA model of the logged monthly price series, s_t , from January 1978 through December 2009.²¹⁰ Because the logged price series indicated the presence of a unit root, the price series was differenced.²¹¹ Following Box-Jenkins methodology the series was fitted as an ARIMA((4,12), 1, 2) process based on Akaike information criterion (AIC) and Bayesian information criterion (BIC) scores as well as an evaluation of the autocorrelation and partial autocorrelation functions of the residuals.²¹² The series was then tested for conditional heteroskedasticity by squaring the residuals and then regressing the squared residuals on a constant and lags of the squared residuals.²¹³ The coefficients of these regressions were statistically different than zero, indicating generalized autoregressive conditional heteroskedastic (GARCH) effects. The model converged as a GARCH(1,1) model, meaning one lag of the squared variance ($p=1$) and one lag of the squared residual ($q=1$) were inserted into the model of the variance. An indicator variable for ITQ (set as 0 for $t < \text{January 2007}$ and 1 for $t \geq \text{January 2007}$) was added to the model of the mean and an indicator variable for DERBY behavior (set as 1 for $\text{June 1991} \leq t < \text{January 2007}$ and 0 otherwise) was added to the model of the conditional volatility (the h_t series).²¹⁴ Finally, an indicator variable,

²¹⁰ See Walter Enders, *Applied Econometric Time Series*, John Wiley and Sons, page 51, 2nd edition, 2004.

²¹¹ The autocorrelation (acf) and partial autocorrelation (pacf) plots clearly indicated the presence of a unit root. See Clive Granger and Paul Newbold, *Spurious regressions in econometrics*, 2 JOURNAL OF ECONOMETRICS 111 (1974).

²¹² See George Box and Gwilym Jenkins, *Time Series Analysis: Forecasting and Control*, San Francisco: Doubleday (1970).

²¹³ See Robert F. Engle, *Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation*, 50 ECONOMETRICA 987 (1982). See also Tim Bollerslev, *Generalized Autoregressive Conditional Heteroskedasticity*, 31 JOURNAL OF ECONOMETRICS 307 (1986).

²¹⁴ June 1991 was chosen as the beginning of the derby because this was the month when fishing activity significantly increased in anticipation of an imminent closure due to an exhausted TAC (August 1991).

DOWNTURN, was added to the model of the mean in order to account for the business cycle and its influence on demand.²¹⁵ The data were used in the following GARCH regression model,

$$s_t = a_0 + a_1s_{t-4} + a_2s_{t-12} + a_3\varepsilon_{t-1} + a_4\varepsilon_{t-2} + a_5ITQ + a_6DOWNTURN + \varepsilon_t \quad (3)$$

$$\varepsilon_t \sim (0, h_t) \quad (4)$$

$$h_t = \delta_0 + \sum_{i=1}^p \beta_i h_{t-i} + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \gamma_1 \text{DERBY} \quad (5)$$

The results of the regression are reported below. All slope parameters are significantly different than zero at or above a 95% confidence interval. Parameter signs for indicator variables were as expected. The autoregressive and moving average components of the ARIMA process were all significant above a 99% confidence interval. An ITQ regime increased price with a 95% confidence interval, while an economic DOWNTURN decreased price with a 99% confidence interval. Both the GARCH (p) term (99% confidence) and the ARCH (q) term (90% confidence) were significant in the conditional volatility model. Derby behavior increased price volatility, with a 99% confidence interval.

²¹⁵ The indicator variable was set to 1 during business cycle contractions The National Bureau of Economic Research identified as recessionary (January 1980 – July 1980; July 1981 – November 1982; July 1990 – March 1991; March 2001 – November 2001; and December 2007 – June 2009) and 0 otherwise. Data *available at*: <http://www.nber.org/cycles.html>

Parameter estimates for Univariate GARCH model (from February 1979 - December 2009)			
Variable	Parameter	Estimate	Standard error
Constant	a_0	0.0004	0.0007
S_{t-4}	a_1	-0.131***	0.051
S_{t-12}	a_2	0.232***	0.049
ε_{t-1}	a_3	-0.614***	0.053
ε_{t-2}	a_4	-0.223***	0.050
ITQ	a_5	0.004**	0.002
DOWNTURN	a_6	-0.005***	0.002
Constant	δ_0	0.0006**	0.0003
GARCH (p) term	β_i	0.582***	0.135
ARCH (q) term	α_i	0.11*	0.065
DERBY	γ_1	0.003***	0.001
There are 359 observations. A single (double) [triple] asterisk indicates parameter is significantly different than zero at or above a 90 (95) [99] percent confidence interval.			

Table 3.1 provides output from the Univariate GARCH Model.

The graph of price and conditional volatility below exhibits an unmistakable trend: price fell in the early 1990s as conditional volatility spiked; price increased again in 2007-09 as conditional volatility returned to pre-1990 levels.

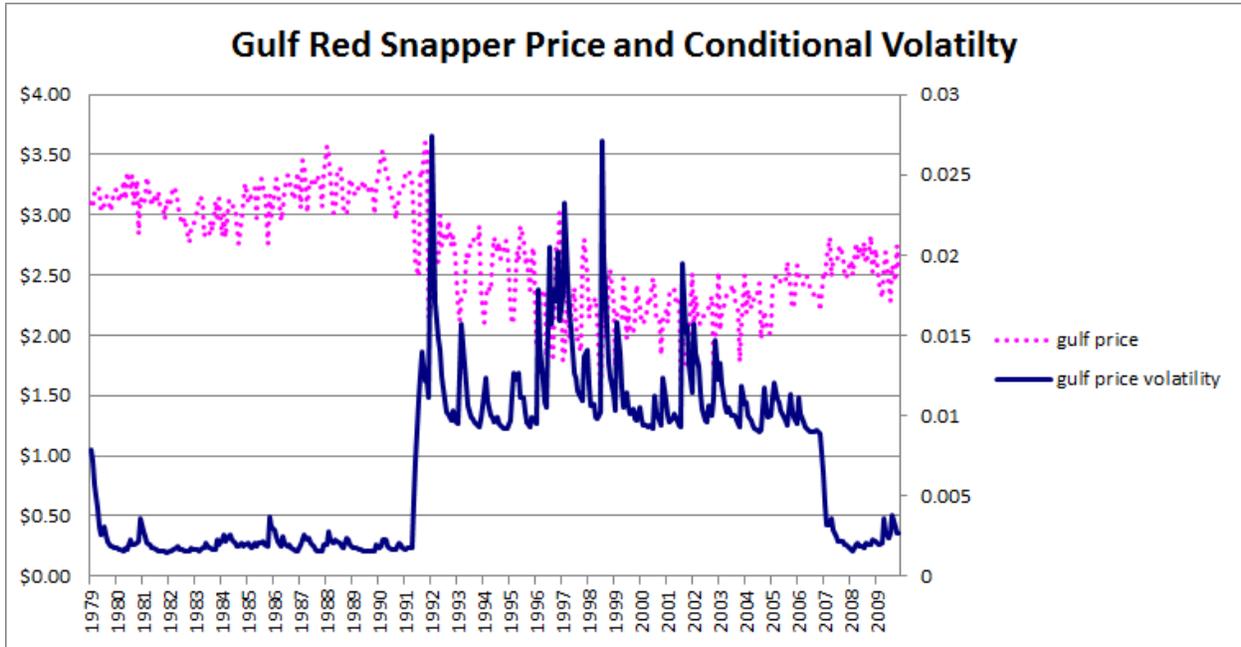


Figure 3.1 graphs the relationship between monthly price level and monthly price volatility 1979-2009.

Bivariate ARCH Model

While the univariate GARCH model confirmed that ITQ increased price level and that derby behavior increased price level volatility, it was necessary to estimate a bivariate GARCH model in order to assess the impact of ITQ on Gulf red snapper price volatility. Following the recommendation of Dr. James Waters, import data on fresh, Gulf snapper from Mexico, mt, was chosen as the second data series. This data series was available beginning in June 1991, shortening the temporal range of the regression by more than fourteen years. Both data series were logged, and because they exhibited unit roots, required differencing. Lag length selection tests for both series indicated via AIC and BIC scores that 11 lags of each differenced series were needed. The series were set up according to the following specification of the mean model:

$$s_t = \sum_{i=1}^{11} \alpha_i s_{t-i} + \varepsilon_{t,g} \quad (6)$$

$$m_t = \sum_{i=1}^{11} \beta_i m_{t-i} + \varepsilon_{t,m} \quad (7)$$

These auto-regressive equations were then grouped together and fed into a GARCH(1,1) model. The model converged using a positive definite, or BEKK parameterization. This BEKK approach, “essentially allows for a VAR process in conditional second moments, [and] ensures that conditional variances are always non-negative.”²¹⁶ The use of the BEKK formulation implies the following structure to the time-varying covariance matrix:

$$\varepsilon_t = [\varepsilon_{t,g}, \varepsilon_{t,m}]^T \mid \Omega_{t-1} \sim N(0, H_t) \quad (8)$$

$$H_t = C^T C + A^T \varepsilon_{t-1} \varepsilon_{t-1}^T A + B^T H_{t-1} B + ITQ^T ITQ \quad (9)$$

Results from the bivariate GARCH(1,1) model are reported in the table below. These results suggest that ITQ regulations reduced Gulf price volatility—an as yet undocumented contribution of the rights-based fishing program to economic efficiency. On the other hand, ITQ

²¹⁶ See Michael Haigh and Mathew Holt, *Crack Spread Hedging: Accounting for Time-Varying Volatility Spillovers in the Energy Futures Markets*, 17 JOURNAL OF APPLIED ECONOMETRICS 269 at 277 (2002).

appeared to increase the price volatility of Mexican imports. It is conceivable that the regular Gulf red snapper landings post-ITQ left Mexican red snapper more susceptible to price variances on the world market.

Parameter estimates for Bivariate GARCH model (from June 1992 - December 2009)		
Parameter	Estimate	Standard error
α_i (Lags of differenced log of gulf price)	Available upon request***	Available upon request
β_i (Lags of differenced log of Mexican price)	Available upon request	Available upon request
C(1,1) Gulf	0.092***	0.009
C(2,1) Covariance	0.009	0.018
C(2,2) Mexican	0.00000001	0.027
A(1,1)	-0.35**	0.15
A(1,2)	-0.48***	0.1
A(2,1)	-0.05	0.14
A(2,2)	-0.16*	0.1
B(1,1)	-0.16	.35
B(1,2)	0.61***	0.1
B(2,1)	0.01	0.29
B(2,2)	0.29*	.16
ITQ Gulf	-0.04***	0.009
ITQ covariance	-0.03	0.02
ITQ Mexican	0.067**	0.029
A single (double) [triple] asterisk indicates parameter is significantly different than zero at or above a 90 (95) [99] percent confidence interval.		

Table 3.2 provides output from the Bivariate GARCH Model.

Even though the graph of price and volatility below starts in 1992 instead of 1979, the same relationship between price and conditional volatility is still evident: price fell throughout the sample period as volatility spiked, only to push upward after the 2007 adoption of ITQ allowed for a conspicuous drop in Gulf price volatility.

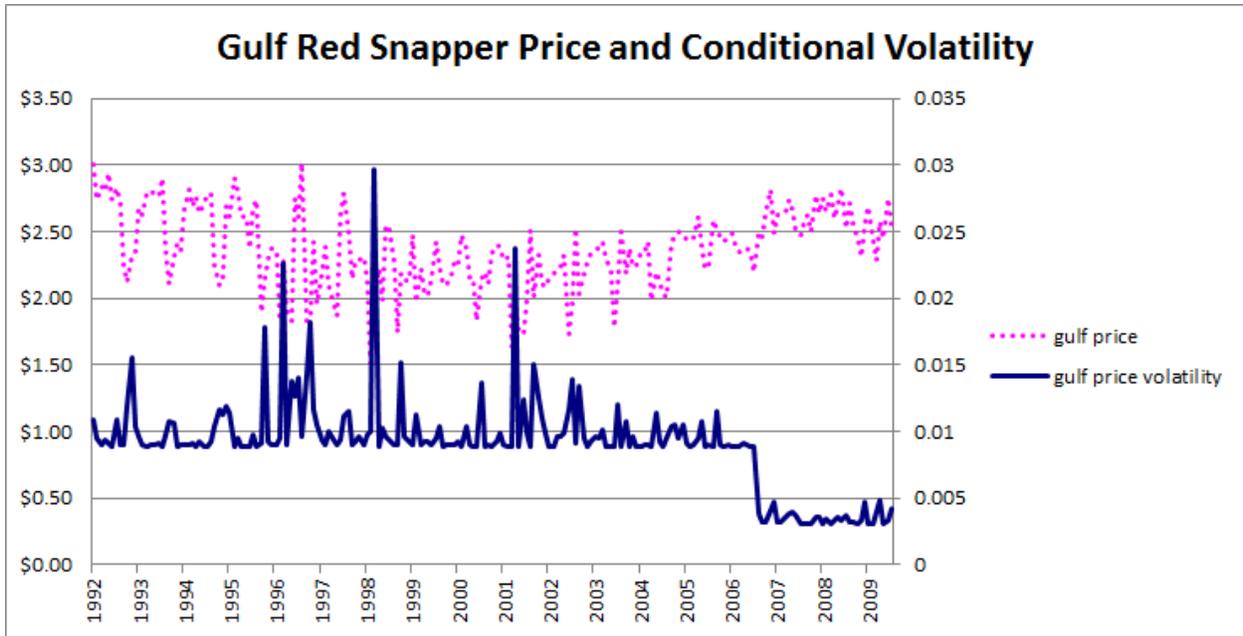


Figure 3.2 graphs the relationship between monthly price level and monthly price volatility 1992-2009.

Calculating and plotting the time-varying conditional correlation offers some insight into the impact of ITQ management on the relationship between Gulf red snapper ex-vessel price and the price of fresh, Mexican imports. The correlation of the two series was, on average, positive until 2007. After the imposition of ITQ the relationship clearly changed—the correlation became, on average, negative. The graph below emphasizes the striking change in this relationship that coincided with the implementation of an ITQ regime.

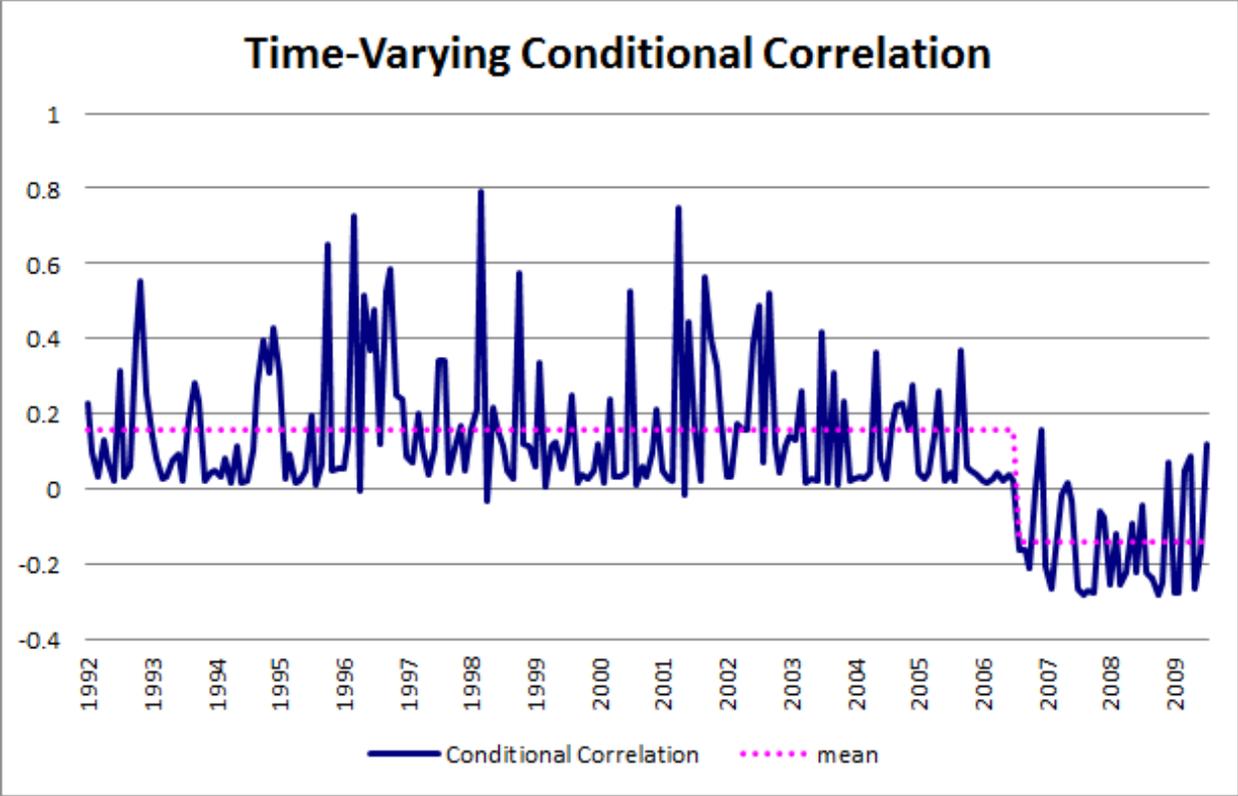


Figure 3.3 graphs the time-varying conditional correlation of the Gulf and Mexican Snapper prices series.

V. Policy Implications

The econometric results underscore the influence regulation wielded over the behavior of the Gulf red snapper price series. Even though TAC management successfully capped harvests at predetermined levels, the initial phases of regulation also created the sort of unintended consequences Cass Sunstein warned regulators about: TAC management alone exposed the fishery to a measurable decrease in price levels and quantifiable increases in price level volatility. At the very least, Sunstein would likely regard some of the management measures as futile—it is unlikely lower price levels and higher price level volatility were desired consequences of fishery management.²¹⁷ Some may even characterize the measures as self-defeating, but that judgment would likely depend on whether economic or environmental concerns were the chosen assessment criteria.²¹⁸

However, not all regulatory interventions proved futile. Certain innovations seemed to address the unintended consequences of TAC management. While TAC management lowered price levels, keeping the fishery open for a larger portion of the year generally increased prices. ITQ management is one certain way to keep the fishery open year-round and, in turn, likely increase price levels. The derby fishing behavior that followed TAC management increased the volatility of price levels, but adding an ITQ regime to the management plan returned price level volatility to historical levels. Supplementing TAC management with rights-based ITQ allocations seemed to ameliorate two of the most conspicuous problems associated with TAC management alone.

²¹⁷ See discussion footnote 5 *supra*.

²¹⁸ There is little doubt that TAC management alone worsened the economic health of the Gulf red snapper fishery. On the other hand, the TAC quota did keep commercial red snapper harvests within a scientifically based numerical constraint.

VI. General Conclusions

The Gulf red snapper fishery may be seen as regulatory parable. The initial regulatory response to a commons problem achieved a clear intended consequence by capping fishery harvests at an exogenously predetermined level. At the same time, the closure system introduced unintended consequences in terms of price level, price level volatility, and an incentive to overcapitalize. Overlaying the existing command-and-control regulations with rights-based harvest allocations addressed at least some of these concerns, allowing management authorities to address the problem at hand without creating a new series of problems that must be addressed in their own right. The limited scope of this project—both in terms of species choice and geographical locale—opens the door for a broader analysis of the role of regulation in both similar and dissimilar fisheries.

But this paper is not just about the Gulf red snapper, or even fisheries for that matter. Instead, this paper addresses one of the most important issues facing governments across the world: resource management and the relation of management measures to consequences in the field. By identifying a natural experiment, it is possible to test the intended and unintended effects of regulation in one arena. This is a first step towards developing a methodological approach appropriate for broader analysis of resource allocation and resource management. By using Gulf red snapper as a jumping off point, one can ascertain some of the regulatory problems that need to be understood and addressed in order to move towards an understanding of issues broadly significant in the world as a whole.