Allocation Sharing and Accountability Measures for the Gulf of Mexico Migratory Group of King Mackerel

Options Paper
Draft Amendment 29
to the Fishery Management Plan for the Coastal Migratory Pelagics Fishery of the Gulf of Mexico and Atlantic Region

June 2016

This is a publication of the Gulf of Mexico Fishery Management Council Pursuant to National Oceanic and Atmospheric Administration Award No. NA15NMF4410011.

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ENVIRONMENTAL ASSESSMENT COVER SHEET

ALLOCATION SHARING AND ACCOUNTABILITY MEASURES FOR THE GULF OF MEXICO MIGRATORY GROUP OF KING MACKEREL

Draft Amendment 29 to Fishery Management Plan for Coastal Migratory Pelagic Resources in the Gulf of Mexico and South Atlantic Region addressing modifications to the management of king mackerel within the coastal migratory pelagic zones.

Type of Action

( ) Administrative
(X) Draft
( ) Legislative
( ) Final

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ABBREVIATIONS USED IN THIS DOCUMENT

ABC	acceptable biological catch
ACL	annual catch limit
ACT	annual catch target
ALS	Accumulated Landings System
AMs	accountability measures
AP	Advisory Panel
APA	Administrative Procedures Act
ASMFC	Atlantic States Marine Fisheries Commission
CFDBS	Commercial Fisheries Data Base System
CLM	commercial landings monitoring system
CMP	coastal migratory pelagics
Council	Gulf of Mexico and South Atlantic Fishery Management Councils
CS	consumer surplus
CZMA	Coastal Zone Management Act
DQA	Data Quality Act
EA	environmental assessment
EEZ	exclusive economic zone
EFH	essential fish habitat
EIS	environmental impact statement
EJ	environmental justice
ESA	Endangered Species Act
F	instantaneous rate of fishing mortality
FLEC	Florida east coast
FMP	Fishery Management Plan
Gulf	Gulf of Mexico
Gulf Council	Gulf of Mexico Fishery Management Council
GMFMC	Gulf of Mexico Fishery Management Council
GSMFC	Gulf States Marine Fisheries Commission
HAPC	habitat area of particular concern
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MFMT	maximum fishing mortality threshold
Mid-Atlantic Council	Mid-Atlantic Fishery Management Council
MMPA	Marine Mammal Protection Act
mp	million pounds
MRFSS	Marine Recreational Fisheries Survey and Statistics
MRIP	Marine Recreational Information Program
MSST	minimum stock size threshold
MSY	maximum sustainable yield
NEFSC	New England Fisheries Science Center
NEPA	National Environmental Policy Act
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	net operating revenue

OFL	overfishing level
OY	optimum yield
PS	producer surplus
RFA	Regulatory Flexibility Act of 1980
RIR	Regulatory Impact Review
RQ	regional quotient
SAFMC	South Atlantic Fishery Management Council
SBA	Small Business Administration
SCS	small coastal sharks
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment, and Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
South Atlantic Council	South Atlantic Fishery Management Council
SSB	spawning stock biomass
SSC	Scientific and Statistical Committee
SPR	spawning potential ratio
SRHS	Southeast Regional Headboat Survey
TLR	trip limit reduction
TPWD	Texas Parks and Wildlife Department
USCG	United States Coast Guard
VOC	volatile organic compound
ww	whole weight

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CHAPTER 1. INTRODUCTION

What Actions Are Being Proposed?
Options in Amendment 29 to Fishery Management Plan (FMP) for Coastal Migratory Pelagic Resources (CMP) in the Gulf of Mexico and South Atlantic Region (Amendment 29) address issues associated with sector allocation sharing and associated accountability measures for the Gulf of Mexico (Gulf) migratory group of king mackerel.

Who Is Proposing the Action?
The Gulf and South Atlantic Fishery Management Councils (Councils) are proposing the actions. The Councils develop the regulations and submit them to the National Marine Fisheries Service (NMFS) who ultimately approves, disapproves, or partially approves the actions in the amendment on behalf of the Secretary of Commerce. NMFS is an agency in the National Oceanic and Atmospheric Administration.

Who's Who?

- ***Gulf of Mexico*** and ***South Atlantic Fishery Management Councils*** – Develop the range of actions and alternatives and select preferred alternatives that are submitted to the National Marine Fisheries Service.
- ***National Marine Fisheries Service*** and ***Council staffs*** – Assist in the development of alternatives based on guidance from the Councils, and analyze the environmental impacts of those alternatives.
- ***Secretary of Commerce*** – Approves, disapproves, or partially approves the amendment as recommended by the Councils.

Why Are The Councils Considering Action?
In 2014, a stock assessment of the Atlantic and Gulf migratory groups of king mackerel was completed (SEDAR 38), and indicated that neither migratory group was overfished or experiencing overfishing.

Historically, the recreational sector in the Gulf has not landed its sector allocation of the king mackerel ACL (currently 68%), while the commercial sector has either met or exceeded its allocation (32%). In an effort to manage Gulf king mackerel such that the maximum benefit of the resource is extracted without harming the population, the Councils have decided to evaluate sharing of allocation between the recreational and commercial sectors of Gulf king mackerel.

1.1 Background

Initially, the CMP FMP (GMFMC/SAFMC 1982) treated king mackerel as one stock. The present management regime in the FMP recognizes two migratory groups: the Gulf migratory group and the Atlantic migratory group. Each migratory group is primarily managed by the respective Council. Gulf and Atlantic migratory groups of king mackerel are also divided into zones and/or subzones for management purposes. This amendment considers changes to management measures for the Gulf migratory group of king mackerel. For the purposes of this

amendment, the Gulf migratory group will be referred to as *Gulf king mackerel* and the Atlantic migratory group will be referred to as *Atlantic king mackerel*.

The two migratory groups were historically thought to mix seasonally off the east coast of Florida and in Monroe County, Florida. The SEDAR 38 stock assessment revised this winter mixing zone to be in the exclusive economic zone south of US Highway 1 in the Florida Keys from November 1 – March 31. The Councils approved an amendment to the CMP FMP (Amendment 26) to revise the stock boundary between the Councils to the Dade/Monroe County line, with the Gulf of Mexico Fishery Management Council (Gulf Council) managing the mixing zone year-round (Amendment 26 to the CMP FMP will be transmitted for Secretarial review in late spring, 2016). For management and assessment purposes, the boundary between the migratory groups of king mackerel will be specified at the Dade/Monroe County line (Figure 1.1.1).

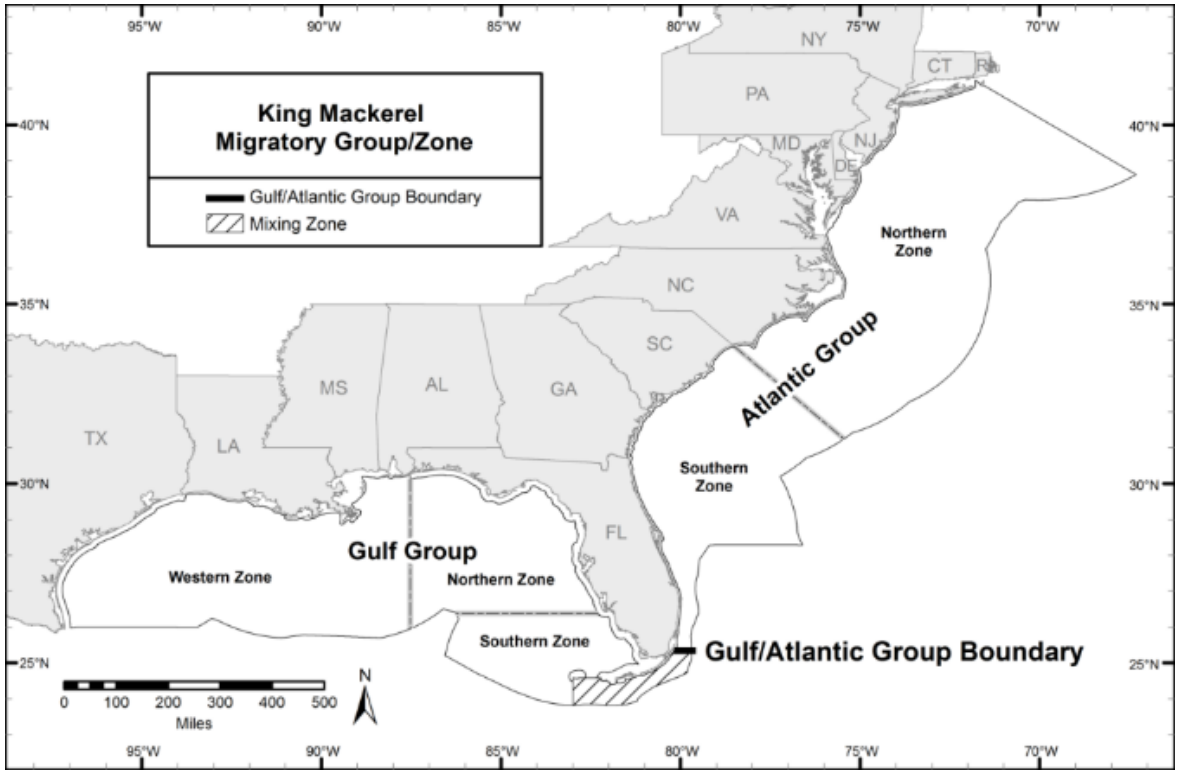

Figure 1.1.1. Boundary between Atlantic and Gulf migratory groups of king mackerel, as proposed by SEDAR 38 (2014) and Amendment 26 to the CMP FMP (GMFMC and SAFMC 2016).

The Councils are considering modifying the sector allocations for Gulf king mackerel. Over the past decade, the commercial sector has regularly met or exceeded the commercial ACL while the recreational sector has landed low proportions of the recreational ACL. At the March and November 2015 Gulf CMP Advisory Panel (Gulf AP) meetings, members recommended that the Councils abstain from reallocating any king mackerel from the recreational sector to the commercial sector. The Gulf AP subsequently recommended an increase for the Gulf recreational bag limit as a way to potentially increase utilization of the recreational ACL

(preferred by the Councils in CMP Amendment 26). The Councils did not make any changes to the sector allocations in CMP Amendment 26; however, they did direct staff to begin an amendment to examine how to utilize underages in the landings of Gulf king mackerel, along with any necessary accountability measures (AMs).

1.2 Purpose and Need

Purpose for Action

The purpose of this amendment is to review and consider changes to the recreational and commercial allocations and associated accountability measures for Gulf migratory group king mackerel.

Need for Action

The need for this amendment is to achieve optimum yield while ensuring overfishing does not occur in the coastal migratory pelagics (CMP) fishery, thereby increasing social and economic benefits of the CMP fishery through sustainable and valuable harvest of king mackerel in accordance with provisions set forth in the Magnuson-Stevens Fishery Conservation and Management Act.

1.3 History of Management

The CMP FMP, with Environmental Impact Statement (EIS), was approved in 1982 and implemented by regulations effective in February 1983 (GMFMC/SAFMC 1982). The management unit includes king mackerel, Spanish mackerel, and cobia. The FMP treated king and Spanish mackerel as unit stocks in the Atlantic and Gulf. The following is a list of management changes relevant to this amendment. A full history of CMP management can be found in Amendment 18 to the CMP FMP (GMFMC and SAFMC 2011), and is incorporated here by reference.

Amendment 1, with EIS, implemented in September 1985, recognized separate Atlantic and Gulf migratory groups of king mackerel. The Gulf commercial allocation for king mackerel was divided into Eastern and Western Zones for the purpose of regional allocation, with 69% of the allocation provided to the Eastern Zone and 31% to the Western Zone.

Amendment 5, with environmental assessment (EA), implemented in August 1990, extended the management area for Atlantic migratory groups of mackerels through the Mid-Atlantic Council's area of jurisdiction; provided that the South Atlantic Council will be responsible for pre-season adjustments of total allowable catch and bag limits for the Atlantic migratory groups of mackerels while the Gulf Council will be responsible for Gulf migratory groups; and continued to manage the two recognized Gulf migratory groups of king mackerel as one stock until management measures appropriate to the eastern and western migratory groups could be determined.

Amendment 6, with EA, implemented in November 1992, allowed for Gulf migratory group king mackerel stock identification and allocation when appropriate.

Amendment 7, with EA, implemented in November 1994, equally divided the Gulf commercial allocation in the Eastern Zone at the Dade-Monroe County line in Florida. The sub-allocation for the area from Monroe County through Western Florida was equally divided between commercial hook-and-line and net gear users.

Amendment 8, with EA, implemented in March 1998, provided the South Atlantic Council with authority to set vessel trip limits, closed seasons or areas, and gear restrictions for Gulf migratory group king mackerel in the North Area of the Eastern Zone (Dade/Monroe to Volusia/Flagler County lines); and modified the seasonal framework adjustment measures.

Amendment 9, with EA, implemented in April 2000, created north and south subzones on the Florida west coast and reallocated the commercial portion of the total allowable catch among the Gulf zones.

Amendment 18, with EA, implemented in January 2012, established ACLs and accountability measures for Gulf and Atlantic migratory groups of king mackerel. The ACLs for the Gulf and South Atlantic migratory groups of king mackerel were 10.8 million pounds (mp) and 10.46 mp, respectively.

Amendment 20A, with EA, implemented in July 2014, prohibited sale of recreationally caught king mackerel, with an exception for sale of fish caught on for-hire trips on dual-permitted vessels in the Gulf region, and an exception for sale of fish caught in state-permitted tournaments in both regions.

Amendment 20B, with EA, implemented in March 2015, revised Gulf king mackerel hook and line trip limits in the Florida West Coast zone Northern and Southern subzones and modified the Northern subzone fishing year; created a transit provision for areas closed to king mackerel; and established Northern and Southern zones with commercial quotas for Atlantic king mackerel.

Amendment 23, with EA, implemented in August 2014, was part of the joint Gulf and South Atlantic Dealer Reporting Amendment, and required CMP fishermen to sell to a federally permitted dealer.

South Atlantic CMP Framework Action 2013 with EA, implemented in December 2014, modified king mackerel trip limits in the Gulf Florida East Coast subzone.

Amendment 26, with EA, approved by the Councils in March and April of 2016, modified the stock boundary between the Gulf and Atlantic migratory groups of king mackerel to be at the Dade/Monroe County Line in southeastern Florida, with the Gulf Council managing king mackerel to that line year-round. For the 2016/17 fishing year, the ABC for Gulf king mackerel was set at 9.21 mp. Commercial zone allocations of the commercial king mackerel ACL in the Gulf were changed as follows: Western Zone: 40%; Northern Zone: 18%; Southern Zone Handline: 21%; and Southern Zone Gillnet: 21%. Lastly, the recreational bag limit was

increased from two fish per person per day to three fish per person per day. This amendment is in the process of being transmitted for Secretarial review.

CHAPTER 2. PROPOSED MANAGEMENT ALTERNATIVES

2.1 Action 1 – Gulf Migratory Group King Mackerel Quota Sharing

Alternative 1: No Action – Do not establish a quota sharing system. Maintain the current recreational and commercial allocations for Gulf of Mexico migratory group king mackerel (68% recreational, 32% commercial).

Alternative 2: Conditionally transfer a certain percentage (*Options 2a-2d*) of the stock annual catch limit (ACL) to the commercial sector until such a time that recreational landings reach a predetermined threshold (*Options 2e-2g*). If this threshold is met, the recreational and commercial allocations will revert to 68% for the recreational sector and 32% for the commercial sector at the beginning of the following recreational fishing year.

Conditional Quota Transfer (MUST CHOOSE ONE):

Option 2a: Transfer 5% of the stock ACL to the commercial sector.

Option 2b: Transfer 10% of the stock ACL to the commercial sector.

Option 2c: Transfer 15% of the stock ACL to the commercial sector.

Option 2d: Transfer 20% of the stock ACL to the commercial sector.

Recreational ACL Threshold (MUST CHOOSE ONE):

Option 2e: Revert to the status quo sector allocations if 80% of the adjusted recreational sector ACL is landed.

Option 2f: Revert to the status quo sector allocations if 90% of the adjusted recreational sector ACL is landed.

Option 2g: Revert to the status quo sector allocations if 100% of the adjusted recreational sector ACL is landed.

Alternative 3: If the stock ACL is not met in a fishing year, establish a "carry-over credit" derived from the difference between the total pounds of king mackerel landed in both sectors and the stock ACL for that same fishing year. In the following fishing season, the credit would transfer to the ACL for the sector which met or exceeded its ACL from the ACL for the sector which did not. This carry-over credit would only apply if a minimum percentage of the stock ACL was not harvested in a given fishing year (*Options 3a-3c*), and only a certain percentage of the unharvested ACL from the previous fishing year would make up the carry-over credit (*Options 3d-3f*). The carry-over credit would only be valid for a single fishing year.

Remaining Stock ACL Threshold (MUST CHOOSE ONE):

Option 3a: At least 15% of the stock ACL remains unharvested.

Option 3b: At least 20% of the stock ACL remains unharvested.

Option 3c: At least 25% of the stock ACL remains unharvested.

Percentage of Remaining ACL to Transfer (MUST CHOOSE ONE):

Option 3d: The carry-over credit will be equal to 20% of the unharvested stock ACL.

Option 3e: The carry-over credit will be equal to 30% of the unharvested stock ACL.

Option 3f: The carry-over credit will be equal to 40% of the unharvested stock ACL.

Alternative 4: If the stock ACL is not met in a fishing year, the Scientific and Statistical Committee (SSC) will be convened to consider increasing the acceptable biological catch (ABC) for the following fishing year only. If the SSC recommends increasing the ABC, the amount of the increase would be added to the ACL of the sector which met its ACL in the previous fishing year. Consideration of an ABC adjustment by the SSC would only be requested if a minimum percentage of the stock ACL was not harvested in a given fishing season (*Options 4a-4c*). If one of Options 4a-4c is not chosen as preferred, and the stock ACL has not been landed, then the SSC will consider raising the ABC by default:

Remaining Stock ACL Threshold (MUST CHOOSE ONE):

Option 4a: At least 15% of the stock ACL remains unharvested.

Option 4b: At least 20% of the stock ACL remains unharvested.

Option 4c: At least 25% of the stock ACL remains unharvested.

Alternative 5: Establish a sunset provision for any modifications in the sector allocations. After the predetermined time period, any modifications in sector allocations would revert back to the status-quo sector allocations (68% recreational and 32% commercial).

Option 5a: Sunset any change in sector allocations after a five year period (2017-2021).

Option 5b: Sunset any change in sector allocations after a ten year period (2017-2026).

Option 5c: Sunset any change in sector allocations after a fifteen year period (2017-2031).

Discussion:

Over the past ten years, the commercial sector of the Gulf of Mexico (Gulf) king mackerel fishery has consistently landed near the commercial annual catch limit (ACL) while the recreational sector has landed low proportions of the recreational ACL. Recent landings of Gulf king mackerel are shown in Table 2.1.1 and Figure 2.1.1. The fishing year for king mackerel is July 1 – June 30.

Table 2.1.1. Proportion of sector ACLs landed and proportion of total ACL landed for Gulf king mackerel, including those landings attributed to the former Florida East Coast Zone (FLEC). The FLEC landings are included here since there is not a recreational allocation specifically for the former FLEC Zone.

Fishing Year	Total TAC/ACL	Comm Sector ACL	Comm Landings	Rec Sector ACL	Rec Landings	% of Sector ACL Landed		% of Total ACL Landed
						Comm[1]	Rec[2]	
2001/02	10.2 mp	3.264 mp	2.902 mp	6.936 mp	3.669 mp	88.9%	52.9%	64.7%
2002/03	10.2 mp	3.264 mp	3.186 mp	6.936 mp	2.816 mp	97.6%	40.6%	59.3%
2003/04	10.2 mp	3.264 mp	3.094 mp	6.936 mp	3.211 mp	94.8%	46.3%	62.7%
2004/05	10.2 mp	3.264 mp	3.215 mp	6.936 mp	2.532 mp	98.5%	36.5%	56.4%
2005/06	10.2 mp	3.264 mp	2.983 mp	6.936 mp	2.996 mp	91.4%	43.2%	58.9%
2006/07	10.8 mp	3.456 mp	3.231 mp	7.344 mp	3.305 mp	93.5%	45.0%	60.5%
2007/08	10.8 mp	3.456 mp	3.459 mp	7.344 mp	2.629 mp	100.1%	35.8%	56.3%
2008/09	10.8 mp	3.456 mp	3.833 mp	7.344 mp	2.350 mp	110.9%	32.0%	57.6%
2009/10	10.8 mp	3.456 mp	3.674 mp	7.344 mp	3.525 mp	106.3%	48.0%	68.0%
2010/11	10.8 mp	3.456 mp	3.522 mp	7.344 mp	2.181 mp	101.9%	29.7%	53.0%
2011/12	10.8 mp	3.456 mp	3.428 mp	7.344 mp	2.438 mp	99.2%	33.2%	54.3%
2012/13	10.8 mp	3.456 mp	3.539 mp	7.344 mp	2.710 mp	102.4%	36.9%	57.9%
2013/14	10.8 mp	3.456 mp	3.055 mp	7.344 mp	2.916 mp	88.4%	39.7%	55.3%
2014/15[3]	10.8 mp	3.456 mp	3.591 mp[3]	7.344 mp	4.576 mp	103.9%	62.3%	75.6%

[1]Commercial allocation = 32% [2]Recreational allocation = 68%

[3] Commercial landings are incomplete for 2014/15

Source: SERO

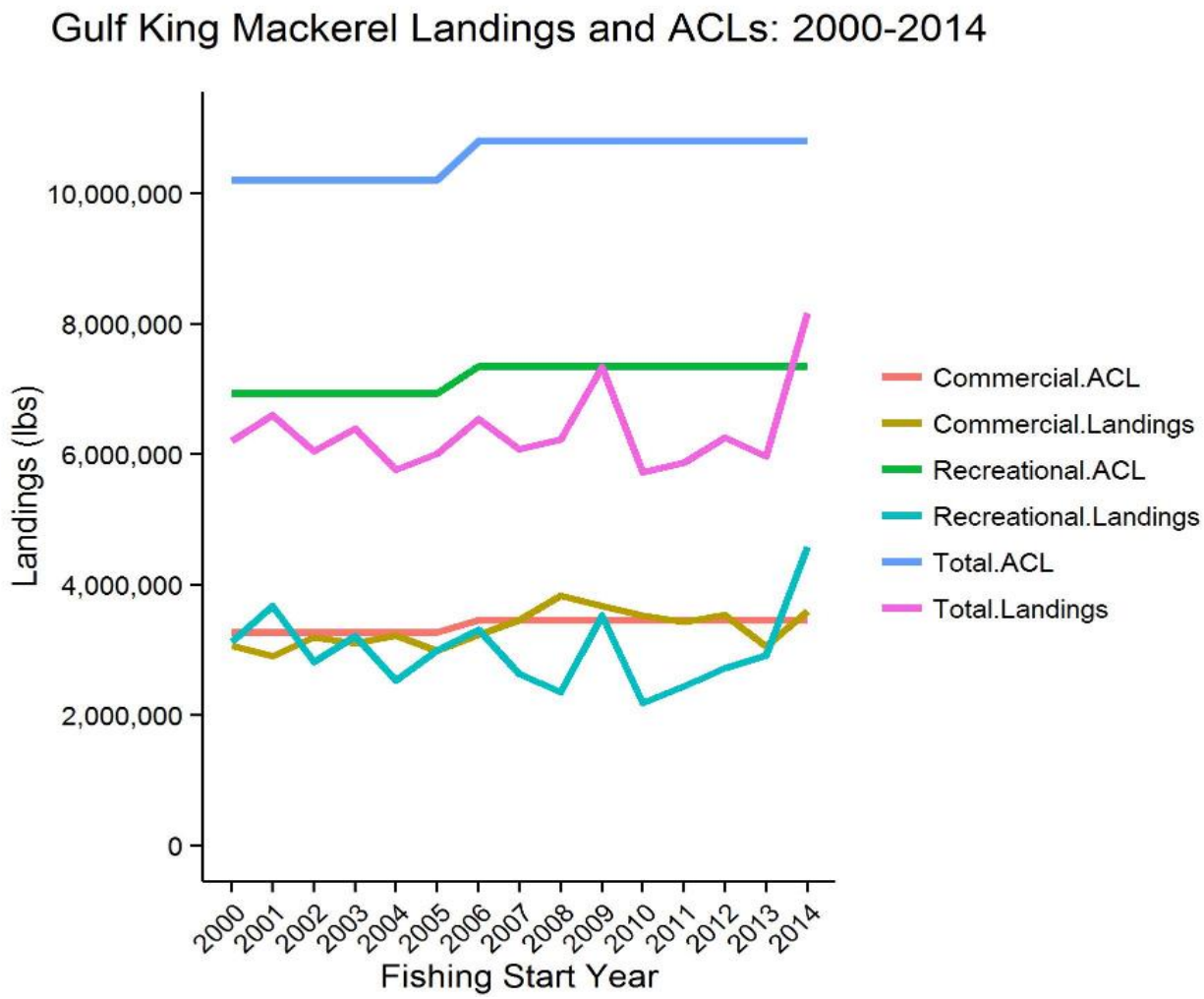

Figure 2.1.1. Trends in Gulf king mackerel landings by sector for the 2000-01 to the 2014-15 fishing seasons. Landings are in pounds.

Alternative 1 would maintain the current recreational and commercial sector allocations of 68% and 32% respectively, which were established in the original Fishery Management Plan (FMP) for Coastal Migratory Pelagic Resources (CMP) in February 1983. Over the last decade, the recreational sector has not landed its sector ACL, while the commercial sector has typically met or exceeded its ACL. Closures for the commercial sector are facilitated by the National Marine Fisheries Service (NMFS), which provides notice to fishermen prior to closing each commercial zone to fishing when that zone's quota is projected to be reached. This trend would be expected to continue, at least in the short term under **Alternative 1**.

Alternative 2 would conditionally transfer a certain percentage of the stock ACL to the commercial sector until such a time that the landings under the recreational sector ACL reach a predetermined threshold. If the recreational ACL threshold is met, then the recreational and commercial sector ACLs would revert to the status quo allocation of 68% for the recreational sector and 32% for the commercial sector at the beginning of the following recreational fishing year. The Gulf of Mexico (Gulf) and South Atlantic Fishery Management Councils (Councils) proposed four options for transferring quota to the commercial sector: 5% (**Option 2a**), 10%

(**Option 2b**), 15% (**Option 2c**), and 20% (**Option 2d**). The resultant sector allocations for each option under **Alternative 2** are shown in Table 2.1.2. The proposed recreational ACL thresholds would revert to the status quo sector allocations if 80% (**Option 2e**), 90% (**Option 2f**), or 100% (**Option 2g**) of the adjusted recreational sector ACL is landed. In order for **Alternative 2** to function as designed, the Councils must choose one option from **Options 2a – 2d** and one option from **Options 2e – 2g**.

Table 2.1.2. Resultant allocations based on alternatives and options presented in Alternative 2 of Action 1.

Alternative 2	Commercial Allocation	Recreational Allocation
Option 2a	37%	63%
Option 2b	42%	58%
Option 2c	47%	53%
Option 2d	52%	48%

Alternative 3 would establish a "carry-over credit" of a percentage of the difference between the total pounds of king mackerel landed by both sectors and the stock ACL for that same fishing year. The credit would apply to the following fishing season's sector ACL for the sector which met or exceeded its ACL from the sector which did not. This credit would only apply if a certain percentage of the stock ACL was not harvested in a given fishing year (if at least 15% [**Option 3a**], 20% [**Option 3b**], or 25% [**Option 3c**] of the stock ACL remains), and only a certain percentage of the unharvested ACL from the previous fishing year would be credited to the aforementioned sector's ACL in the following fishing year (credit 20% [**Option 3d**], 30% [**Option 3e**], or 40% [**Option 3f**] of the remaining stock ACL). This credit would only be valid for the single fishing year for which the credit was applied. In order for **Alternative 3** to function as designed, the Councils must choose one option from **Options 3a – 3c** and one option from **Options 3d – 3f**. The percentages in **Options 3a – 3c** were chosen by considering three factors: natural mortality of Gulf king mackerel (17%; SEDAR 38 2014); mean proportional standard error of recreational landings for the previous five fishing seasons (2010/11 – 2014/15: 11.63%); and the mean remaining quota from the stock ACL for the past five fishing seasons (2010/11 – 2014/15: 40.78%). Table 2.1.3 demonstrates how **Alternative 3** would function (*provided as an example only*). In the example, the carry-over credit is based initially on the landings from the 2016/17 fishing season. After that season, each successive season's sector ACLs are altered based on the carry-over credit.

Table 2.1.3. Functional example of Alternative 3 in Action 1. ACLs and catch are in millions of pounds (mp). The stock ACL is assumed to be equal to the ABC for the listed fishing years (2016/17 = 9.21 mp, etc.; Alternative 2 of Action 6 in CMP Amendment 26). This example assumes that Options 4a (≥15% of ACL remaining) and 4e (30% of remaining ACL credited) of Alternative 4 are preferred, with the "mp to be Added to Comm ACL" representing the millions of pounds of king mackerel that would be added to the commercial sector's ACL from the recreational sector's ACL in the following fishing year.

Fishing Year	Stock ACL	Comm Sector ACL	Comm Catch[1]	Rec Sector ACL	Rec Catch[2*]	Total Catch	% of Stock ACL Remaining	mp of Stock ACL Remaining	mp to be Added to Comm ACL
2016/17[3]	9.21	2.947	2.947	6.263	3.409	6.356	31%	2.854	0.856
2017/18	8.88	3.698	3.698	5.182	3.981	7.679	14%	1.201	0.000
2018/19	8.71	2.787	2.787	5.923	3.205	5.992	31%	2.718	0.815
2019/20	8.55	3.551	3.551	4.999	3.492	7.043	18%	1.507	0.452

[1] Assumes the commercial sector will land their ACL every year.

[2] Varies recreational catch randomly by 20%, based on variance of the previous five fishing year's recreational landings. *Based on estimated 2016/17 recreational sector landings (see note 3).

[3] Combines MRIP waves 1 – 3 from the 2014/15 fishing season with waves 4 – 6 from 2015/16 fishing season for 2016/17 "Rec Catch". Source: SERO ACL Monitoring website: April 13, 2016

The example of **Alternative 3** in Table 2.1.3 shows how variations in recreational catch could affect the availability of a carry-over credit in the following fishing year. Proportionally lower recreational catch compared to the recreational sector ACL in the 2016/17 fishing year yielded a credit; however, because recreational catch increased in 2017/18, a credit was not available to the commercial sector in the following fishing year.

Alternative 4 states that if the stock ACL is not met in a fishing year, the Gulf Council will convene the SSC to consider increasing the ABC for the following fishing year only. If the SSC recommends increasing the ABC, the amount of the increase would be added to the ACL of the sector which met its ACL in the previous fishing year. The Council would only request consideration of an ABC adjustment by the SSC if a minimum percentage of the stock ACL was not harvested in a given fishing season: at least 15% of the stock ACL remains unharvested (**Option 4a**); at least 20% of the stock ACL remains unharvested (**Option 4b**); and at least 25% of the stock ACL remains unharvested (**Option 4c**). If one of **Options 4a-4c** is not chosen as preferred, and the stock ACL has not been landed, then the SSC will consider raising the ABC by default. For example:

> *During the 2018-2019 fishing year, the commercial sector lands its allocation of king mackerel, while the recreational sector does not. The remaining stock ACL that went unharvested equals 2 mp of the total stock ACL of 10 mp (20%: **Option 4a** or **4b**). The Council convenes the SSC to consider increasing the ABC for the following fishing year only. The SSC determines that the ABC for the following fishing year can be increased by 500,000 lbs. This results in the commercial ACL for the 2019-2020 fishing season equaling 3.7 mp, while the recreational ACL would equal 6.8 mp. This increase would be valid for the 2019-2020 fishing season only.*

In the above example, the sector allocations for Gulf king mackerel are still 68% recreational to 32% commercial. The 500,000 lb increase for the 2018-2019 fishing year would be added to the commercial sector's ACL, while the recreational sector's ACL would go unchanged. For the 2018-2019 fishing year, the stock ACL would then equal 10.5 mp, as opposed to the 10.0 mp ACL from the previous fishing year.

Alternative 5 would establish a sunset provision for any modifications in the sector allocations for Gulf king mackerel. After the predetermined time period, any modifications in sector allocations would revert back to 68% for the recreational sector and 32% for the commercial sector. Options for time periods after which any sector allocation modifications would end include five years (**Option 5a**), ten years (**Option 5b**), and fifteen years (**Option 5c**). If the Councils prefer one of the options in **Alternative 5**, the prescribed sunset period would begin in the fishing year of the implementation of the regulations. The modifications in sector allocations would revert after the conclusion of the last fishing season in the time period chosen from the options in **Alternative 5**.

The main differences between **Alternatives 2 – 4** are in how unused allocation would be shared with the sector historically using its allocation, and for how long that allocation will be shared. **Alternatives 2** and **3** both conditionally transfer some amount of allocation, and limit the temporal longevity of any allocation sharing. **Alternative 2** does this through the use of the "threshold trigger", and **Alternative 3** does this by limiting the availability of the "carry-over credit" to a single fishing season. However, **Alternatives 2** and **3** differ in another important way. If the threshold trigger is met in **Alternative 2**, then the reversion back to the status-quo allocations is thereafter permanent unless or until it is addressed by the Councils in a future action. **Alternative 3** is more fluid with time, meaning that if a credit is not available in one year, it may still be available in a following year, depending on sector-specific landings in relation to the stock ACL. **Alternative 4** is similar to **Alternative 3** in that any allocation sharing would only persist for a single year, but differs in that the status-quo allocations would not change as they would in **Alternatives 2** and **3**. **Alternative 5** could still be selected in conjunction with **Alternatives 2 – 4**, should the Councils prefer to adopt a sunset provision. If one of **Alternatives 2 – 4** is chosen as preferred by the Councils, the CMP framework procedure for modifying ACLs as prescribed by the preferred alternative will be updated.

Council Conclusions:

2.2 Action 2 – Adjust the Recreational Accountability Measure (AM) for Gulf Migratory Group King Mackerel

Alternative 1: No Action – Retain the in-season recreational AM. If recreational landings reach or are projected to reach the recreational ACL (as adjusted in Action 1), the bag limit will be reduced to zero for the remainder of the fishing year.

Alternative 2: Replace the current in-season AM with a post-season AM. If the recreational ACL as adjusted in Action 1 is exceeded, the bag limit will be reduced to two fish per person per day for the following fishing year only. After the following fishing year, if the ACL was not exceeded again, the bag limit of three fish per person per day will be reinstated.

Alternative 3: Replace the current in-season AM with a post-season AM. If the recreational ACL as adjusted in Action 1 is exceeded, the length of the following fishing season will be reduced by the amount necessary to ensure the landings do not exceed the ACL.

Discussion:

Action 2 proposes replacing the current in-season AM (**Alternative 1**) with a post-season AM (**Alternative 2** or **3**), which would be applicable after the conclusion of the fishing season. If a recreational ACL overage were to occur in a given year, it would essentially result in a fishing closure in the same season in which the overage occurred (**Alternative 1**). Given that the recreational sector has not met its sector ACL in the last 10 years, it is unlikely that this AM would be triggered. However, should some proportion of the recreational sector ACL be shifted to the commercial sector ACL, it is possible that the adjusted recreational sector ACL could be met. Thus, by replacing the recreational in-season AM with a post-season AM (**Alternatives 2** or **3**) the sector allocation adjustment proposed in Action 1 would be allowed to occur without the risk of shutting down the recreational harvest of king mackerel in that year, by reducing the bag limit to zero. Thus, an additional protection is provided to the recreational sector in the event the allocation adjustment is large enough that the adjusted recreational sector ACL is exceeded.

Alternative 1 would retain the current in-season AM, which would close the recreational sector to king mackerel harvest by reducing the bag limit to zero if the recreational ACL was met or projected to be met for the duration of the fishing year.

Alternative 2 would institute a post-season AM in place of the in-season AM in **Alternative 1**, whereby if the recreational ACL as adjusted in Action 1 is exceeded, the bag limit would be reduced to two fish per person per day for the following fishing year only. The recreational sector has been fishing under a two fish per person per day bag limit for over a decade, during which the recreational sector has not landed its ACL (Table 2.1.1). The recreational bag limit was recently recommended to be raised to three fish per person per day by the Councils in Amendment 26 to the CMP FMP (GMFMC and SAFMC 2016), which was approved by the Councils in April 2016. Reducing the bag limit to two fish per person per day in the event of a previous fishing year's recreational ACL overage for the following fishing year only would

allow NMFS to determine whether the previous year's overage reflected a change in fishing effort, or was more anomalous in nature. After the following fishing year, if the recreational ACL was not exceeded again, the bag limit of three fish per person per day would be reinstated.

Alternative 3 would institute a post-season AM in place of the in-season AM in **Alternative 1**, whereby if the recreational ACL as adjusted in Action 1 is exceeded, the length of the following fishing season would be reduced by the amount necessary to ensure the recreational landings do not exceed the recreational ACL. This type of post-season AM would preserve the three fish per person per day bag limit preferred by the Councils in Amendment 26 to the CMP FMP (GMFMC and SAFMC 2016).

Council Conclusions:

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APPENDIX A. SUMMARIES OF PUBLIC COMMENTS RECEIVED

Gulf of Mexico Scoping Workshop Comments

These comments were received with respect to Amendment 26 to the CMP FMP, and have been limited to those comments received with pertain to the proposed management alternatives in Action 1.

SCOPING WORKSHOPS
Coastal Migratory Pelagics
Amendment 26
King Mackerel Allocations & Mixing Zone Delineation

Biloxi, Mississippi
March 31, 2015

Meeting Attendees:
Rufus Young

Gulf King Mackerel Sector Allocation

Should the Gulf Council adjust the commercial and recreational allocations for king mackerel?

- There should be a hard shift of 10% of the allocation from the recreational to commercial sector. Anything to give the commercial side more and keep the season open longer.

Saint Petersburg, Florida
April 13, 2015

Meeting Attendees:
Richard Sergent
Stewart Hehenberger

Gulf King Mackerel Sector Allocation

Should the Gulf Council adjust the commercial and recreational allocations for king mackerel?

- The fish that are under harvested by the recreational sector should be given to the commercial sector.

Key West, Florida
April 19, 2015

Meeting Attendees:
George Niles
Daniel Padron
Bill Kelly

Gulf King Mackerel Sector Allocation

Should the Gulf Council adjust the commercial and recreational allocations for king mackerel?

- There has to be some way to use the fish that aren't being harvested.
- Recreational fish already go against commercial quota because they can sell the fish they catch.
- Give the commercial fishermen quota from the recreational sector until the recreational sector is landing 80% of its quota.
- The three million pounds of fish being left in the water by the recreational sector is not being caught, and using a "use it or lose it" for a million of those pounds over 5 years doesn't make sense.

How should the king mackerel annual catch limit be allocated?

- The recreational sector should lend portion of their quota to commercial sector because they're not using it and fish are being wasted. Try lending program for a year and see how it works.
- Attendees in favor of proportional allocation, where the Western Zone would get 45.53%; the Northern Zone, 7.61%; and each component of the Southern Zone, 23.43%.
- The allocation in the northern areas doesn't make sense. Those areas were never where the heart of the fishery was.

Galveston, Texas
April 27, 2015

Meeting Attendees:
Shane Cantrell

Gulf King Mackerel Sector Allocation

Should the Gulf Council adjust the commercial and recreational allocations for king mackerel?

- More recreational input is needed before a decision on allocation is made. We should have more information on why the recreational sector isn't harvesting their allocation. They shouldn't necessarily be penalized for under harvesting.

How should the king mackerel annual catch limit be allocated?

- A bag limit analysis and research on mortality rate of king mackerel releases should be performed to inform this decision.

Grand Isle, Louisiana
April 28, 2015

Meeting Attendees:
Dean Blanchard
Kelty Readenour
Michael Frazier
Abigail Frazier
Brian Hardcastle

Sector Reallocation of Gulf King Mackerel

Should the Gulf Council adjust the commercial and recreational allocations for king mackerel?

- Do not move recreational allocation to commercial sector. You don't want to mess with those guys, or you'll never hear the end of it.

APPENDIX B. ECONOMIC ANALYSIS OF REALLOCATION SCENARIOS FOR GULF MIGRATORY GROUP KING MACKEREL

July 6, 2015

Social Science Research Group and Sustainable Fisheries Division
NOAA Southeast Fisheries Science Center

This communication addresses the request to conduct an economic analysis of Gulf of Mexico king mackerel reallocation proposals in support of Amendment 24 to the Fishery Management Plan for the Coastal Migratory Pelagic Resources in the Gulf of Mexico and Atlantic Region. The request solicited an analysis of alternatives that could redistribute 2%, 5%, 10%, or 20% of the king mackerel quota from the recreational sector to the commercial sector. Table 1 shows the current allocation and proposed alternatives.

Table 1. Status quo and allocation alternatives

		Percent from Recreational to Commercial			
Sector	SQ	2%	5%	10%	20%
			--Allocation in Percent--		
Commercial	32%	34%	37%	42%	52%
Recreational	68%	66%	63%	58%	48%
			--Allocation in million lbs--		
Commercial	3.456	3.672	3.996	4.536	5.616
Recreational	7.344	7.128	6.804	6.264	5.184

The methods and data used in the short-run allocation economic analysis are documented in the Appendices A and B. Table 2 summarizes the main results of the analysis. The short-run analysis suggests that the largest (20%) reallocation proposal could increase the welfare of the commercial sector and the nation by almost $1 million dollars per year. Any reallocation to the commercial sector would increase the amount harvested and decrease recreational and commercial catch rates because the recreational sector does not harvest their entire annual catch limit (ACL). Because in the short-run the reduction in commercial and recreational catch rates is likely to be minor, commercial harvesting costs and the quality of the recreational experience are not expected to be impacted. However, in the medium and long-run, large reallocations could lead to significant catch rate reductions, particularly in the recreational sector, which could reduce the welfare of this sector because anglers value catching and releasing king mackerel. Presently, the long-run impacts of these reallocation proposals cannot be estimated. Preliminary estimates from the king mackerel stock assessment model suggests that reductions in catch rates could be significant if a large portion of the surplus (un-harvested) recreational ACL is reallocated to the commercial sector (Appendix B and C). Additional research is necessary to compare the longer-term economic costs of recreational catch rate reductions with the economic benefits of reallocating to the commercial sector.

Table 2. Inflation-adjusted annual net benefits from quota reallocation proposals (2014=100).

Reallocation Alternative	Anticipated annual added benefits ($) to the commercial sector	Anticipated annual losses ($) to the recreational sector	Annual net benefit ($) from the reallocation alternative
2%	92,532	Negligible	92,532
5%	231,331	Negligible	231,331
10%	462,664	Negligible	462,664
20%	925,328	Negligible	925,328

*This short-run analysis assumes that the quality of the fishing experience is not diminished by potentially lower catch rates.

Appendix B-A. Commercial Sector Analysis

Overview

King mackerel (*Scomberomorus cavalla)* is a migratory coastal pelagic species that supports important commercial and recreational fisheries in the Gulf of Mexico and South Atlantic regions. In the Gulf of Mexico the recreational sector is assigned 68% of the overall quota and the commercial sector is assigned the remaining 32%. The recreational sector typically harvests less than half of their allocation of the Gulf of Mexico king mackerel quota whereas commercial sector harvests have consistently been at or above their quota allocation. Consequently, the Gulf the Mexico Fishery Management Council is considering policies that would redistribute 2%, 5%, 10%, or 20% the king mackerel quota from the recreational sector to the commercial sector.
In the 2013/14 fishing season, the commercial fleet landed over 2.5 million pounds (mp) of king mackerel gutted weight (gw) worth $5.6 million in revenues in the Gulf of Mexico. Handlines, trolls and to a lesser extent gillnets are the main fishing gear used. The Gulf king mackerel commercial fishery is managed with limited entry, area and gear specific quotas, fishing seasons, trip limits and minimum size limits. Issuance of new king mackerel vessel permits is under a moratorium, but existing permits are transferable. The harvest of king mackerel using gillnet in the Florida west coast subzone requires a gillnet endorsement. Table 1 provides an overview of the main regulations affecting the commercial sector.

Table 1. Main commercial regulations for the Gulf of Mexico king mackerel fishery.

Zones	Subzone	Gear Sector	Quota (lbs)	Trip limit (lbs)	Fishing year
Western			1,071,360	3,000	Jul 1-Jun 30
Eastern	East Coast		1,102,896	50/75 fish[1]	Nov 1-Mar31
	Northern		178,848	1,250/500 (H&L)	Jul 1-Jun 30
	Southern	Hook and line	551,448	1,250/500	Jul 1-Jun 30
		Gillnet	551,448	25,000	MLK(Feb)[2]-Jun 30

[1]The average weight for a king mackerel in the South Atlantic region is about 9.8 lbs. (John Walter, pers. comm.). The conversion ratio from gutted weight to whole weight is 1.04.
[2] Martin Luther King (MLK) holiday.

Conceptual Model

To investigate the potential economic gains of quota redistribution proposals to the commercial sector, we assume that commercial fishermen that land king mackerel want to maximize net benefits subject to the king mackerel trip limit (i.e., trip quota). Therefore, when king mackerel landings make up the majority of the trip landings, we posit that fishermen maximize net benefits by minimizing their harvesting costs because they face an exogenously set trip limit (i.e., revenues are fixed). Conversely, when king mackerel landings do not account for the majority of the trip landings we assume that fishermen maximize net benefits over the entire catch mix, not

only king mackerel.[1] In other words, fishermen maximize profits by controlling both harvesting costs and the catch composition. This profit maximizing behavioral assumption implicitly assumes that when fishermen reach their king mackerel trip limit they stop fishing. King mackerel acts a constraint on the trip level harvesting process. Hence, the economic value of a king mackerel at the trip limit is the added net revenue obtained from the entire catch mix obtained by relaxing the king mackerel trip limit by one unit (i.e., its shadow price). If the trip limit is not binding then the marginal benefit from easing the trip limit is zero.

Under the cost minimizing behavioral model, we assume that fishermen can only select the optimal input or factor mix since they face an exogenously determined king mackerel trip limit. Mathematically,

$$\text{Min C}(w, y) = \sum_{j=1}^{m} w_j x_j(w, y) \tag{1}$$

where C is the restricted (short-run) cost function, y is harvest of king mackerel, w_j is the price of input j, and x_j is the amount of input j used. As is customary in production analyses, we presume that the cost function is non-decreasing in input prices and output, linearly homogenous in input prices and concave and continuous in input prices.

Differentiating the cost function with the respect to the fixed (or regulated) output (i.e., king mackerel) we obtain the marginal cost function

$$\frac{\partial C}{\partial y} = MC(w, y). \tag{2}$$

The marginal cost function captures the cost of harvesting an additional unit of king mackerel. The net benefit of harvesting an additional unit of king mackerel is the difference between the king mackerel dockside price and the marginal cost. Mathematically,

$$\lambda_1^c = \text{p}_1 - \frac{\partial C(w, y)}{\partial y}. \tag{3}$$

Note that because we cannot directly observe marginal costs, we need to recover the marginal cost function from the estimates of the system of input demand functions, which are obtained by applying Shepard's lemma. Mathematically,

$$\frac{\partial C}{\partial w_j} = x_j(w, y). \tag{4}$$

Input demand functions describe the optimal adjustment of inputs in response to changes in input prices given an exogenously determined output level.

[1] For analytical purposes, we (arbitrarily) assumed that "the majority of the landings" rule applies when king mackerel makes up 85% or more of the overall trip landings. This assumption lends greater confidence to the cost minimization assumption.

Now, when king mackerel landings do not make up the majority of the trip landings, we assume that fishermen maximize profits by selecting the economically optimal input use and catch mix and subject to the king mackerel trip limit. Mathematically,

$$Max\ \ \pi(p,w;q) = \sum_{i=1}^{n} p_i y_i - \sum_{j=1}^{m} w_j x_j + \lambda(q - y_1) \tag{5}$$

were π is the restricted (short-run) profit function, y_i is harvest of species i (i=1 king mackerel), w_j is the price of input j, x_j is the amount of input j used and q is the king mackerel trip limit. The marginal net benefit (or 'shadow price') of an additional king mackerel is given by the added profit from harvesting over the entire harvest mix when the king mackerel trip limit is relaxed by one additional unit. The shadow price of relaxing the king mackerel trip limit by one unit is simply found by differentiating the profit function with respect to the regulated output (king mackerel)

$$\frac{\partial \pi}{\partial q} = \lambda_1^p . \tag{6}$$

As in the case of the cost minimization model, we cannot directly observe the shadow price so we need to recover it from the estimates of the jointly estimated system of input demands and output supply.

Differentiating the profit function with the respect to input prices we obtain input demand functions

$$\frac{\partial \pi}{\partial w_j} = -x_j . \tag{7}$$

Applying Hotelling's lemma, we obtain the output supply for species $i \neq 1$

$$\frac{\partial \pi}{\partial p_i} = y_i . \tag{8}$$

The input demand and output supply functions describe the optimal adjustment of outputs and inputs in response to changes in output and input prices.

Data

Detailed trip-level data on landings, gear, fishing effort, landing and fishing location, crew size, vessel characteristics, dockside prices and variable costs for those vessels that landed at least one hundred pounds of king mackerel (one thousand pounds for gillnets) were obtained from the National Marine Fisheries Service. The analysis was limited to hook and line (i.e., handline and troll) and gillnet vessels because they were responsible for the majority of the landings. The

analysis focused on the last three complete fishing years (2011/12 through 2013/14) to mitigate potential confounding effects from the Deepwater Horizon oil spill.

The empirical model specified two inputs and one (or two) outputs depending on the behavioral model. The two outputs (species) were king mackerel and a residual or miscellaneous group. The price of the residual species was obtained by dividing the total gross revenue by the total landings (excluding king mackerel). The two inputs included energy (fuel consumption) and labor (crew size). Annual dummies were used to control for king mackerel resource abundance. Fishing year 2013/14 was defined as the base year. Because fuel consumption information is only collected on a subset of the fleet, we imputed fuel consumption for the remaining vessels as a function of vessel characteristics and trip duration. Diesel #2 prices were obtained from the US Energy Information Administration.

The return to the labor was measured by its opportunity cost. The crew's opportunity cost was set equal to wages of production employees, whereas captains received an arbitrary 20% premium over regular crew's earnings (Squires, 1988; Walden *et al.*, 2014). The labor earnings were obtained from the U.S. Bureau of Labor Statistics. The opportunity cost of captain and crew were aggregated into a single wage rate. All output and input prices were adjusted by the GDP deflator (2014=100). Table 4 summarizes the descriptive statistics.

Table 2. Descriptive statistics of the commercial fleet.

Variable	Units	Mean	Minimum	Maximum	Std. Deviation
King mackerel landings	lbs gw/trip	376.07	0.96	38,813.46	1,048.69
Other species landings	lbs gw/trip	127.89	0.01	11,995.00	515.24
Diesel # 2 price	$/gallon	3.24	2.86	3.55	0.16
Captain and crew wage	$/trip	226.24	165.06	2,642.99	150.03
Price of king mackerel	$/lbs gw	2.50	0.63	4.59	0.62
Price of other species	$/lbs gw	0.95	0.01	51.13	1.70

*All prices and wages are deflated using the GDP deflator (2014=100)

Empirical model

Broadly, we estimate the added benefits from redistributing quota to the commercial sector by assuming that the commercial sector is made up of cost minimizing and profit maximizing fishing vessels. Due to the multiplicity of area and gear specific quotas, we estimated indirect, trip-level cost and profit functions for the main area-gear combinations. Both cost minimizing and profit maximizing behavior were modelled using a generalized Leontief flexible function form.

The indirect restricted cost function is given by

$$C(w,y) = y(\sum_{i=1}^{2}\sum_{k=1}^{2}\beta_{ik}(w_i^{1/2}w_k^{1/2}) + \sum_{i=1}^{2}\sum_{l=1}^{2}\delta_{il}w_i D_l) \quad (9)$$

where w_i are input prices (fuel and labor), y is the king mackerel landings and *D is* a dichotomous variable to account for annual changes in king mackerel abundance. Symmetry is imposed by setting $\beta_{ik}=\beta_{ki}$ for $k \neq i$.

Applying Shepard's lemma, we obtain the factor demand which we divide by the output level to reduce the potential for heteroscedasticity (Parks, 1971). Mathematically,

$$\frac{1}{y}\frac{\partial C(w, y)}{\partial w_i} = -\frac{x_i}{y} = \sum_{i=1}^{2}\beta_{ik}\left(\frac{w_k}{w_i}\right)^{1/2} + \sum_{l=1}^{2}\delta_{il}D_l \; . \quad (10)$$

Using the parameters estimated above, we recover the marginal cost function which is given by

$$\frac{\partial C(w, y)}{\partial y} = MC(w, y) = \sum_{i=1}^{2}\sum_{k=1}^{2}\beta_{ik}(w_i^{1/2}w_k^{1/2}) + \sum_{i=1}^{2}\sum_{l=1}^{2}\delta_{il}w_i D_l \; . \quad (11)$$

Then, we obtain the net benefit from harvesting an additional unit by subtracting the king mackerel dockside price from the marginal cost. Mathematically,

$$\lambda_1^c = p_1 - \frac{\partial C(w, y)}{\partial y} \; . \quad (12)$$

The indirect restricted profit function captures the difference between dockside revenues and variable costs (fuel and labor) and is given by

$$\pi(p, y) = y_1(\sum_{i}\sum_{j}\beta_{ij}(p_i^{1/2}p_j^{1/2}) + \sum_{i}\sum_{l}\delta_{il}p_i D_l) \quad (13)$$

where π is the profit function, p_i are input and output prices, *D* is a dichotomous yearly dummy to control for changes in king mackerel abundance and y_1 is the fixed output, king mackerel. King mackerel was modeled as a fixed output because is subject to an exogenously determined trip limit. The fishing year 2013/14 is set as the base year. Symmetry is imposed by setting $\beta_{ij}=\beta_{ji}$ for $i \neq j$.

Applying Hotelling's lemma, we obtain the associated output supply for $i \neq 1$

$$\frac{1}{y_1}\frac{\partial \pi}{\partial p_i} = y_i = (\beta_{ii}E + \sum_{j \neq i}\beta_{ij}\left(\frac{p_j}{p_i}\right)^{1/2} + \sum_{l}\delta_{il}D_l) \quad (14)$$

and input demand equations

$$\frac{1}{y_1}\frac{\partial \pi}{\partial p_j} = -x_j = (\beta_{jj}E + \sum_{i \neq j}\beta_{ij}(\frac{p_i}{p_j})^{1/2} + \sum_l \delta_{jl}D_l) \quad . \tag{15}$$

These supply and demand functions describe the optimal adjustment of outputs and inputs in response to changes in output and input prices.

Differentiating the profit function with respect to the fixed output (y_1) we obtain the shadow price

$$\frac{\partial \pi}{\partial y_1} = \lambda_1^p = (\sum_i \sum_j \beta_{ij}(p_i^{1/2} p_j^{1/2}) + \sum_i \sum_l \delta_{il} p_i D_l) \tag{16}$$

To assess the economic consequences of reallocating quota to the commercial sector, we make the following additional assumptions. First, we conjecture that the quota increase would materialize in the form of trip limit increases (in proportion to the proposed quota change) since the length of the fishing season is not binding (while quota is available). Second, following Holzer and McConnell's (2014) recommendation we utilize the mean marginal WTP as proxy of net benefits since the current management regime does not ensure that fishermen who value the resource the most will have preferential access to it. In addition, we posit that fishermen would exhaust the added quota as long as the dockside revenue exceeds the marginal cost of harvesting under the cost minimization behavioral model. We also assume that the proportion of the landings that meet or exceed a given trip limit would be the same for the various reallocation proposals under the profit maximizing behavioral model.[2] These last two assumptions become more tenuous for the larger reallocation proposals (5%-20%).

Finally, we estimate the net benefit to the commercial sector for a given reallocation proposal by weighing the lambdas from equations (12) and (16) by the share of current quota taken by each benefit maximizing strategy (cost minimization vs. profit maximization) and multiply them by the proposed quota increase.

$$\Delta \text{ Net Benefit} = \lambda_1^c(\frac{h_t^{\text{cost min}}}{Quota_t})\ \Delta\text{Quota} + \lambda_1^p \quad (\frac{Quota_t - h_t^{\text{cost min}}}{Quota_t})\Big|_{\text{king mackerel trip landings} \geq \text{king mackerel trip limit}} \Delta\text{Quota} \quad . \tag{17}$$

Note that because of the profit maximizing behavioral assumption we only multiply the shadow price by the harvest of those trips that met or exceeded the trip limit (i.e., binding constraint).

[2] For clarity, in the analysis we adopt the higher trip limit available, when multiple trip limits exist in one management area.

Results

As noted earlier because we only had information on fuel consumption for about 20% of the fleet, we imputed fuel consumption for the remaining fleet using fishing effort and vessel characteristics as explanatory variables. The fuel consumption equations were estimated using ordinary least squares (OLS). The R^2 for the fuel equations ranged from 0.01 to 0.73. The system of input demand and output supply functions were jointly estimated using iterated seemingly unrelated regression (ITSUR).[3] The generalized R^2 for the system of equations ranged from 0.09 to 0.41.[4] Marginal cost estimates range from \$0.12/lbs gw to \$1.50/lbs gw whereas king mackerel shadow prices range from \$2.02/lbs gw to \$33.54/lbs gw. Some of the shadow price estimates are high and should be viewed with caution (e.g., Western zone, Eastern zone, Northern subzone).

The preliminary analysis suggests that increasing the commercial quota by 2% would result in an increase in net benefits (i.e., quasi-rent or revenues minus fuel costs and the opportunity cost of labor) of \$92,532 to the commercial sector whereas a 20% increase would result in a larger net increase of \$925,328 (Table 3).

Table 3. Inflation-adjusted net benefits from quota reallocation proposals (2014=100).

Zones	Subzone	Gear Sector	Added net benefits ($) from increasing the baseline quota by			
			2%	5%	10%	20%
Western			35,214	88,035	176,070	352,140
Eastern	East Coast		29,935	74,839	149,677	299,356
	Northern		7,917	19,792	39,586	79,171
	Southern	Hook and line	7,907	19,767	39,535	79,069
		Gillnet	11,559	28,898	57,796	115,592
Grand Total			92,532	231,331	462,664	925,328

[3] Due to the multiplicity of area-gear combinations, we do not report parameter estimates; however, these are available from the authors.

[4] The generalized R^2 was estimated as 1- exp[2(Lo - Lm)/N], where Lo (Lm) is the sample maximum of log-likelihood when all slope coefficients equal zero (unconstrained) and N is the sample size.

Appendix B-B. Recreational Sector Analysis

Research suggests that anglers value both keeping and releasing king mackerel (Carter and Liese, 2012). Therefore, the recreational sector would forgo economic benefits if un-harvested (or "surplus") quota is reallocated to the commercial sector because the quality of the fishing experience could be diminished by the lower catch rates. The timing and significance of this "stock effect" could vary depending on the amount of the surplus recreational ACL that is reallocated and harvested by the commercial sector. We do not expect that the stock effect to be strong enough in the initial years following any of the alternative reallocations to result in a reduction in recreational catch rates. Consequently, there would be little, if any, loss in economic value to the recreational sector in the first year following even the largest (20%) proposed reallocation to the commercial sector.

Potential Longer Term Effects of Reallocation Policies

We do not have the information at present to calculate the long-term foregone economic value in the recreational sector associated with reallocation policies. However, the current king mackerel stock assessment model (SEDAR 38) can be used to simulate the potential change in catch rates.[5] The two cases we simulate are purely illustrative and are not directly related to any of the reallocation policies currently under consideration. The first case is the situation where none of the current recreational ACL surplus is reallocated to the commercial sector and the second case considers the situation where all of the current recreational ACL surplus is reallocated to the commercial sector. The simulations are described in Appendix C.

The simulated king mackerel catch rates results for the two cases from 2016 to 2022 are shown in Figure 1. The graph shows that the catch rates for both recreational fishing fleets are expected to be lower if the surplus recreational ACL is reallocated to the commercial sector. The difference between catch rates for the two cases grows for about seven years and then stabilizes in equilibrium at around 20%. The difference in catch rates widens over time because the fish not reallocated to the commercial sector are left to accumulate in the water so that fishing is more effective.

Note that the results from the stock assessment model simulations cannot readily be used to calculate potential changes in economic value to the recreational sector that are comparable with the estimates calculated for the commercial sector. The commercial sector results are based on changes from the existing king mackerel ACL and the geographic definition of the stock structure (i.e., the mixing zone) used in the previous stock assessment. The simulations performed for the analysis of the recreational sector catch rates used the most recent stock assessment model (SEDAR 38) that uses an updated stock structure and the ACL stream. The results of SEDAR 38 have not yet been used to set new ACLs or to redefine the stock structure for regulator purposes.

[5] The SEDAR 38 king mackerel stock assessment model is documented at: http://sedarweb.org/sedar-38.

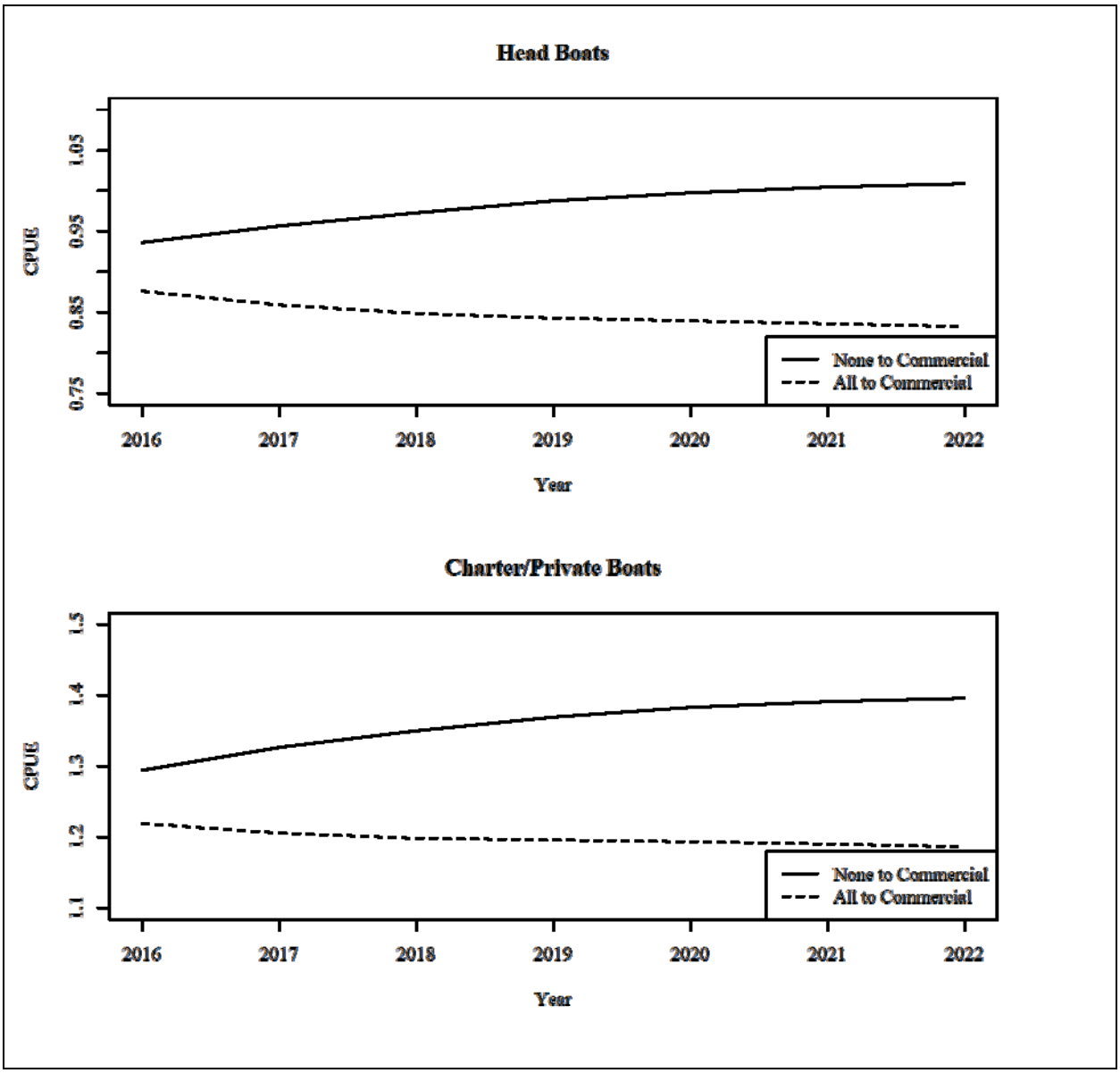

Figure 1. Catch rates (CPUE) when all or none of the surplus recreational ACL is reallocated to the commercial sector.

Appendix B-C. Effects on recreational CPUE of reallocation of the recreational of Gulf of Mexico king mackerel under-age to commercial sector

In recent years (fishing years 2011-2013, http://sero.nmfs.noaa.gov/sustainable_fisheries/acl_monitoring/) the recreational fishery for king mackerel in the Gulf of Mexico has only caught ~38% of its annual catch limit. Projections of the SEDAR 38 assessment assume that the recreational fishery will catch its ACL (Status quo scenario, in this analysis). However, there is the potential that the recreational underage could be reallocated to the commercial handline and gill net fishery (Reallocation scenario). This analysis evaluates the estimated impact on recreational catch per unit effort (CPUE) if such a reallocation occurs.

The analysis was conducted by projecting the population forward in time to year 2030 and then estimating the difference in expected recreational CPUE under the status quo allocation of landings and under the reallocation scenario. The analysis proceeded as follows:

1. Project the SEDAR 38 Base model forward to 2030 at F_{SPR30} to obtain the equilibrium (after all transient cohort effects have passed) allocation of landings by weight. The resulting allocation is 40:60 commercial:recreational

2. Assume that the recreational fleet only catches 38% of their allocation (0.60*0.38=23%). Reallocating the remainder of the retained biomass to the commercial fleet's results changes the allocation to this sector to 77%. This reallocation is achieved in the projections by assigning the commercial (handline and gillnet) and recreational (headboat and charter/private) to separate allocation groups and projecting a 77:23 reallocation. This reallocation achieves the same total ACL as the base projections but reallocates the retained yield.

3. Calculate the expected CPUE for the two recreational fleets under the status quo and reallocation scenarios.

4. The expected CPUE for each scenario was obtained by multiplying numbers at age *x* selectivity at age *x* catchability

Comparison between the Stock Assessment Status Quo and the Reallocation Scenarios

Under the Reallocation scenario, the expected equilibrium CPUE was ~0.7%higher for the headboat fleet (Figure 1.A) and ~1.3% higher for the charter/private fleet (not shown). This was due to the higher projected numbers of vulnerable fish (Figure 1.B). Note that the decline, under both scenarios, in the numbers, of vulnerable fish reflects the fishing down of the population currently above the B_{MSY} proxy towards the target level. This reduces the total fish available to each fleet, reducing the expected CPUE.

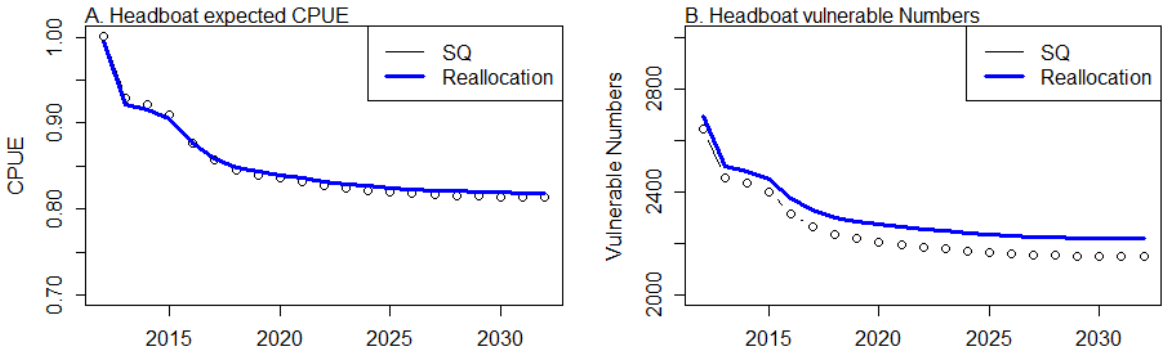

Figure 1. Projected CPUE (A) and vulnerable numbers (B) for headboat fleet under the status quo and reallocation scenarios.

The differences in expected CPUE are very minor and unlikely to be detectable. The major reason that the differences are very minor are that the selectivities for the different fleets are relatively similar (Figure 3) indicating that reallocation between the recreational and commercial fleets results in little change in the overall pattern of fishing mortality at age or size. Furthermore, while the recreational fishery has slightly higher levels of dead discards per landed fish than the commercial fishery, the reallocation does not greatly alter the total levels of discards. What minor differences exist between the two scenarios is likely a result of a very slightly higher level of SSB (Figure 3.A) as a result of a small the reduction (~15,000 per year) reduction in dead discards (Figure 3.B).

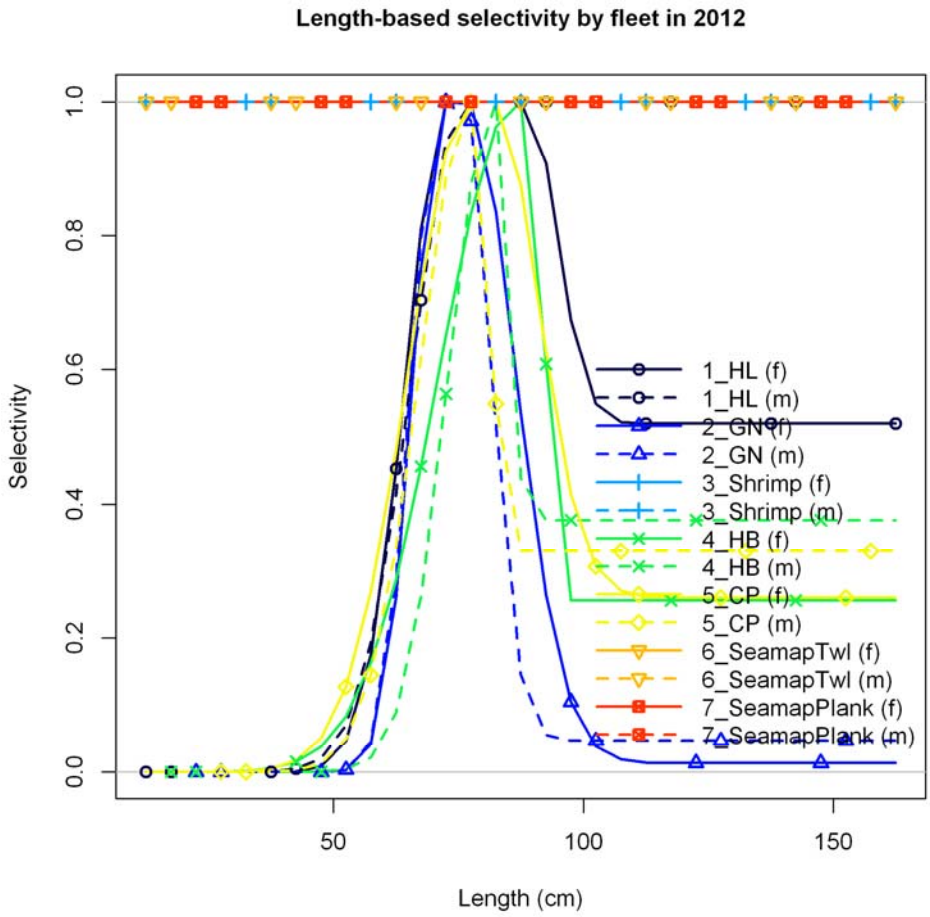

Figure 2. Estimated length-based selectivities for the each fleet from SEDAR 38 base model for Gulf of Mexico

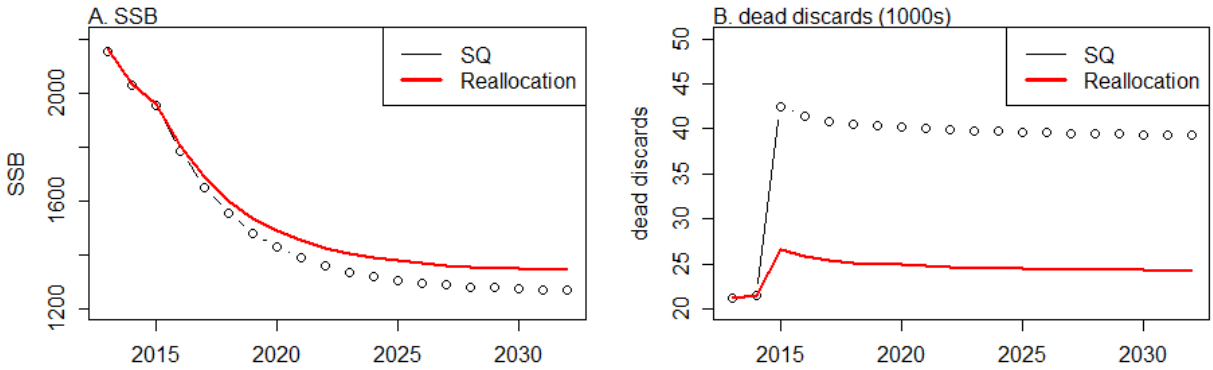

Figure 3. Estimated SSB (A) and dead discard (B) trends for the status quo and reallocation scenarios

Comparison between the Current Underage and the Reallocation Scenarios

If the current recreational fleet underage was perpetuated into the future then the overall ACL would not be caught. This would allow the population to remain at higher than target levels (Figure 4) into the future and impact CPUE. To evaluate the impact on CPUE the recreational underages were projected into the future by reducing the equilibrium fishing mortality rates for each recreational fleet to 38% of their original value and projecting forward with the following levels of fixed F.

	Handline	Gillnet	Shrimp	Headboat	Charter/Private
Equilibrium F	0.069	0.060	0.133	0.014	0.239
Rec reduced by 38%	0.069	0.060	0.133	0.005	0.091

This resulting equilibrium CPUE values were 21% (headboat) and 25% (private recreational, not shown) higher than expected values under the status quo scenario (Figure 4).

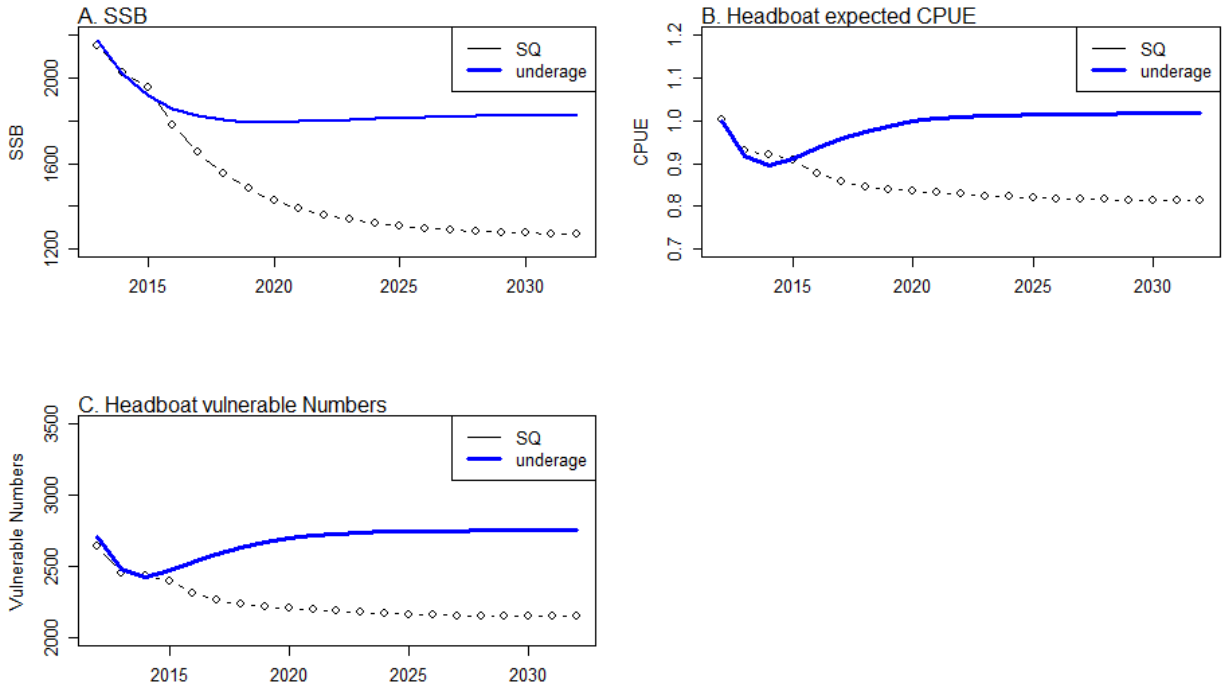

Figure 4. Projected SSB (A) CPUE (B) and numbers (C) for headboat fleet under the status quo and under the recreational underage scenario.

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