September 23, 2015

Mr. Doug Gregory, Executive Director
Gulf of Mexico Fishery Management Council
2203 N Lois Avenue
Suite 1100
Tampa, Florida 33607 USA

Re: Minority Report Regarding the Gulf of Mexico Fishery Management Council's Approval of Amendment 28 to the Reef Fish FMP

Dear Mr. Gregory:

As voting members of the Gulf of Mexico Fishery Management Council ("Council"), the undersigned submit the enclosed minority report under Section 302(e)(4) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1852(e)(4)) to notify the Secretary of Commerce that we disagree with the Council's decision to approve Amendment 28—with Alternative 8 as the Preferred Alternative—which reallocates 2.5% of the red snapper quota from the commercial sector to the recreational sector.

This action is contrary to the provisions of the Magnuson-Stevens Fishery Conservation and Management Act and other laws and should be disapproved. We respectfully request that you transmit the enclosed minority report to the Secretary of Commerce.

Sincerely,

John R. Greene, Jr.
Representative to the Gulf Council from the State of Alabama

David Walker
Representative to the Gulf Council from the State of Alabama

Leann Bosarge
Representative to the Gulf Council from the State of Mississippi

John Sanchez
Representative to the Gulf Council from the State of Florida

Enclosure

MINORITY REPORT IN OPPOSITION TO THE GULF OF MEXICO FISHERY MANAGEMENT COUNCIL'S APPROVAL OF AMENDMENT 28 TO THE REEF FISH FMP

I. Introduction

The undersigned, as voting members of the Gulf of Mexico Fishery Management Council ("Gulf Council"), submit this minority report under Section 302(e)(4) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), in disagreement with the Gulf Council's approval of Amendment 28 to the Reef Fish Fishery Management Plan ("FMP") with Alternative 8 as the Preferred Alternative. The Gulf Council approved Amendment 28 with 12 "yes" and 5 "no" votes at the Gulf Council's August 2015 meeting.[1]

Amendment 28 as adopted by the Council reallocates 2.5 percent of the red snapper quota from the commercial sector to the recreational sector, changing the longstanding commercial/recreational allocation in this fishery from 51/49 percent to 48.5/51.5 percent.[2] The Council rejected a motion to make Alternative 1 -- No Action -- the Preferred Alternative[3] by a vote of 6 to 11.[4]

II. Executive Summary

The Secretary of Commerce should disapprove Amendment 28 for the following reasons:

1. <u>Reallocation does not promote conservation as required by National Standard 4.</u> The Southeast Fishery Science Center ("SEFSC") projects that reallocation will exacerbate the decline of the spawning stock in the Eastern Gulf of Mexico, driving the spawning potential ratio to near historical lows of around 6 percent of unfished levels. There are already signs of trouble with the stock in the Eastern Gulf, including a decade of poor recruitment and dramatic recent declines in CPUE and abundance indices. A further decline in spawning stock biomass in that region caused by reallocation will only add to these problems. Reallocation risks managing the red snapper stock in half of the Gulf of Mexico into a persistent state of depletion and jeopardizes Gulf-wide rebuilding.

2. <u>Reallocation under Preferred Alternative 8 is not intended to, nor does it, fix any purported errors in landings history over the base years used to establish the 51/49 initial allocation.</u> A gross misrepresentation peddled by some proponents of Amendment 28 is that it fixes some historical mistake in how the allocation was initially set by correcting (or "recalibrating") recreational landings data from the base years (1979-1987). Nothing in Alternative 8 purports to correct any such alleged mistake, and the National Marine

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[1] Transcript of the Gulf Council's 255th Meeting, August 2015, at 206-08.
[2] Gulf of Mexico Fishery Management Council and National Oceanic and Atmospheric Administration, Red Snapper Allocation: Final Draft for Amendment 28 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico (August 2015), *available at* http://gulfcouncil.org/council_meetings/Briefing%20Materials/BB-08-2015/B%20-%206(a)%20Amendment%2028%20Final.pdf ("Amendment 28) at x.
[3] Transcript of the Gulf Council's August 2015 meeting at 199.
[4] *Id*. at 199-201.

Fisheries Service has conceded that recreational landings data from the base years cannot be recalibrated to correspond with MRIP in any event.

3. Reallocation is not fair and equitable as required by National Standard 4 and MSA Section 303(a)(14). Reallocation unfairly penalizes the commercial sector, which is the only sector that has complied with its catch limits every year since the rebuilding plan was last revised. The recreational sector, by contrast, has routinely exceeded its catch limits, often by million of pounds. The commercial sector accordingly bore the brunt of economic impacts of harvest restrictions necessary to rebuild the stock, because the recreational sector did not comply with those restrictions. In addition, the harms to the commercial sector are not outweighed by any purported benefits to the recreational sector. This is because reallocation will not appreciably increase the length of the recreational season in federal waters, but will cost the commercial sector millions of dollars in lost IFQ share value and revenues, and will take fish away from consumers.

4. Reallocation under Preferred Alternative 8 violates MSA Section 407(d)(2) because it establishes a quota for the recreational sector that reflects that sector's overharvesting. Section 407(d)(2) requires the FMP to establish a recreational quota that reflects the allocation to the recreational sector and does "not reflect any harvests in excess of such allocations." Reallocation under Preferred Alternative 8 is justified on the basis of prior recreational overharvesting, and thus would unlawfully establish a quota that reflects recreational harvests in excess of that sector's allocations.

5. The Council's approval of Amendment 28 violated MSA Section 302(i)(6) because critical new information was not made available to the public prior to the Council taking final action. In particular, the 2014 update stock assessment report and related SEFSC working papers on recalibration were not made available to the public prior to final action. The information provided to the public, the Council and the SSC -- through SEFSC Powerpoint presentations -- was conclusory and contained no underlying data for the public to understand these methodologies and test their conclusions.

6. Amendment 28 fails to contain a reasonable range of alternatives. The Council inexplicably only considered reallocating quota from the commercial sector to the recreational sector, and not visa versa. The action alternatives were never updated as required by NEPA when the Council substantially revised the amendment's purpose and need.

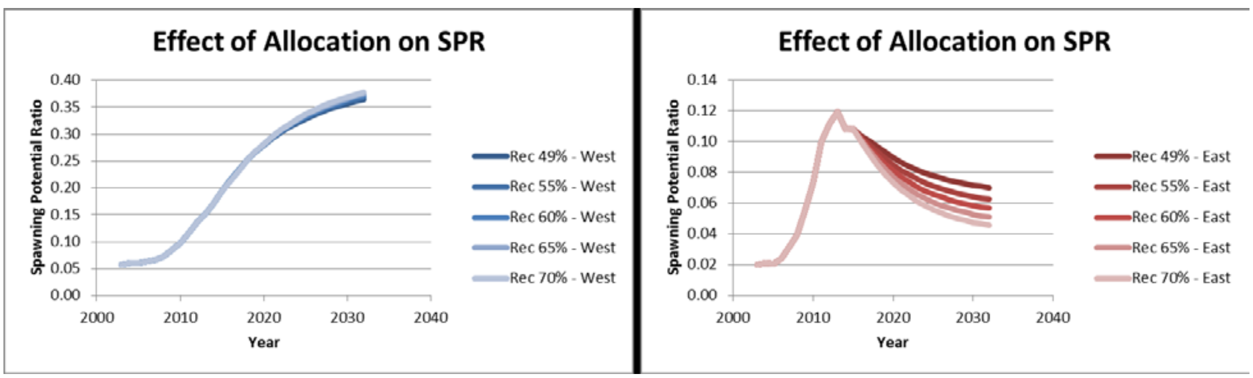
The following sections explain in more detail our rationale for voting against Amendment 28 with Alternative 8 as the Preferred Alternative. We urge the Secretary of Commerce to disapprove Amendment 28 for these reasons.

III. The Secretary Should Disapprove Amendment 28 for Numerous Reasons.

A. Reallocation Does Not Promote Conservation As Required by National Standard 4.

National Standard 4 requires that where "it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be…reasonably calculated to promote conservation." 16 U.S.C. § 1851(a)(4). Reallocation is not reasonably calculated to promote conservation because it will exacerbate the projected decline in the spawning stock in the eastern Gulf and could jeopardize stock rebuilding.

The Council's Science and Statistical Committee ("SSC") observed that the spawning potential ratio ("SPR") "in the western Gulf continues to increase, but the SPR in the eastern Gulf declines, and the decline is exacerbated by increasing allocation to the recreational sector."[5] This is because the recreational fishery is an unrestrained, open access, and expanding fishery that is prosecuted predominantly in the eastern Gulf, such that shifting more quota to the recreational sector increases fishing effort in the eastern Gulf.[6] Under Preferred Alternative 8 (recreational allocation of 51.5%), SPR in the eastern Gulf declines to about six to seven percent of an unfished condition by the end of the rebuilding period in 2032, as shown in the chart at right below.[7]



All of the management alternatives considered, including status quo, result in a crash of the spawning stock in the eastern Gulf. Yet Preferred Alternative 8, like all the other action alternatives, exacerbates the decline. At a bare minimum the Council and NMFS should refrain from taking actions that will only make the situation worse than it already is, as Amendment 28 will do.

Reallocation risks managing the resource in the eastern Gulf into a permanently, and severely, overfished state. Particularly for a stock under a rebuilding program, it does not "promote conservation" for the Council to adopt measures that will hasten depletion in half of the management unit. Moreover, depletion in the eastern Gulf evidently would be accompanied by substantial under-fishing of a fully-rebuilt resource in the western Gulf, leading to a potential failure to achieve optimum yield from either area.

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[5] Standing and Special Reef Fish SSC Report to the Gulf Council (May 20, 2015) (attached hereto as Appendix A) at p.7 (emphasis added).
[6] Amendment 28, at 53.
[7] Standing and Special Reef Fish SSC Report to the Gulf Council (May 20, 2015) (Appendix A) at p.7.

Indeed, early indications of stock depletion in the eastern Gulf are already materializing. Powerpoint slides prepared by the SEFSC in January 2015 show observed headboat red snapper catch per unit of effort ("CPUE") in the eastern Gulf falling by more than 50% between 2008–11 and 2012–13 (and by nearly 75% from the peak of 2009), while private and charter boat CPUE fell by more than 75% between 2007–08 and 2013.[8] Similarly, the video abundance surveys indicated a drop of nearly 50% between 2010–11 and 2012–13, and the larval abundance survey (indicative of the amount of spawning and hence of spawners) indicated a 67% decrease from 2010–11 to 2012.[9] These data track anecdotal reports from fishermen about what is happening on the water, as some of us and others testified about at the August 2015 meeting.[10] Given these signs of trouble in the eastern Gulf, we are very concerned about shifting even more recreational fishing effort into that region under Amendment 28.

We note that the SEFSC projected that yields actually would increase by marginal amounts as a result of reallocation. These projections, however, were based upon several "strong" (i.e., bold) assumptions that selectivity, discarding, retention and recruitment would continue unchanged into the future at levels observed in the recent past (i.e., over the period 2011-2013).[11] The SEFSC acknowledged that if any of these bold assumptions are violated, the projected yields could be "higher than those required to permit recovery of the red snapper stock by 2032."[12] This is troubling because those assumptions are contradicted by record evidence.

In particular, "selectivity," or the assumption that anglers are targeting larger fish, is conclusory; no documentation or support is provided in Amendment 28 to support the assumption that anglers are "targeting" larger fish. To the contrary, several scientists have indicated that, rather than a shift in targeting behavior, selectivity is more likely a function of anglers encountering the larger fish of strong year classes moving through the fishery, combined with recent poor recruitment in the eastern Gulf.[13] In other words, anglers could be catching larger fish not because they are targeting them, but because those fish are relatively more available. The only factual information in the record contradicts the SEFSC's conclusory assumptions about selectivity.

We are concerned that, as those strong year classes exit the fishery by around 2020, selectivity is likely to revert to smaller fish.[14] The consequences to the stock from this change could thwart stock rebuilding, as the SEFSC acknowledged.[15] At the very least, this alternative assumption about selectivity is at least as valid as the assumption the SEFSC relied upon, and projections should have been performed to test the effects on future yield streams under this

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[8] *See* NOAA Fisheries, SEFSC, 2014 Update: Gulf of Mexico Red Snapper (Jan. 26, 2015) (attached hereto as Appendix B) at 26-35.

[9] *Id*.

[10] Transcript of the Gulf Council's August 2015 meeting at 181, 189.

[11] Amendment 28, at Appendix H; SEFSC, The Effect of Alternative Allocations for the Recreational and Commercial Red Snapper Fisheries in the U.S. Gulf of Mexico (Mar. 9, 2015), at pp. 1-2.

[12] *Id*. at p. 2.

[13] *See* Trevor J. Kenchington, Ph.D., Comments on Scientific Issues Relating to Re-allocation in the Red Snapper Fisheries of the Gulf of Mexico (July 2015) (attached hereto as Appendix C) at pp. 17-18; Letter to Gulf Council from James H. Cowan, Louisiana State University, dated August 7, 2015 (attached hereto as Appendix D), at pp. 6-8.

[14] Kenchington, supra note 13 (Appendix C) at pp. 18, 20-21, 24-29, 31.

[15] Amendment 28, at Appendix H; SEFSC, The Effect of Alternative Allocations for the Recreational and Commercial Red Snapper Fisheries in the U.S. Gulf of Mexico (Mar. 9, 2015), at p. 2.

alternative assumption. We suspect such projections would show a decline in yields,[16] underscoring our concern that reallocation will not promote conservation of the stock.

Finally, Amendment 28 expressly acknowledges that "it is not clear that the proposed reallocation alternatives would promote conservation, in light of the repeated and sizeable harvest overages recorded for the recreational sector."[17] Since 2007, the recreational sector has landed approximately 1.5 pounds of fish for each pound of its allocation.[18] Thus, reallocating more quota to the recreational sector could increase the extent of overharvesting. We acknowledge that recently enacted accountability measures for the recreational sector could address these overages, but only one full year of data is available to assess their performance.

B. Reallocation Does Not Fix Any Purported Historical Error in Recreational Landings Estimates Used to Set the Initial 51/49 Allocation

Preferred Alternative 8 allocates to the recreational sector that portion of the 2015 ACL increase attributable to the effects of MRIP recalibration. Recalibration of recreational landings data showed that the stock was more productive than previously estimated and could withstand higher levels of harvest. Because the 2014 update stock assessment report had not been released when the Council took final action, however, it was not possible to ascertain the effect of the 2015 ACL increase attributable to recalibration. Accepting the conclusory statements in Amendment 28 at face value, however, it appears that MRIP recalibration resulted in a quota for 2015 that was approximately 350,000 pounds higher than it otherwise would have been for that year.[19] Preferred Alternative 8 reallocates that entire increase to the recreational sector, and locks it in going forward as a percentage of the total catch (i.e., shifting 2.5 percent of the total quota from the commercial to the recreational sector).

In voting for Preferred Alternative 8, several members of the Council appeared to be under the misimpression that they were adjusting the *initial* allocation between the sectors to reflect revised recreational landings estimates for the base years used to set that initial allocation.[20] This is incorrect. The 51/49 percent allocation set by Amendment 1 in 1990 was based on the sectors' respective landings from the base period of 1979-1987.[21] Preferred Alternative 8 had nothing to do with correcting any historical "mistake" about recreational landings estimates from those years. Indeed, Dr. Crabtree explained on the record that "some of those [base] years aren't even supported by MRIP and so you can't really recalibrate that period

[16] *See* Transcript of the Gulf Council's August 2015 meeting at 206 (indicating that ABCs go up under reallocation "largely because of the shifts selectivities that we've seen").
[17] Amendment 28, at 108.
[18] Amendment 28, at 40. Between 2007 and 2013, the recreational quota has totaled 24.7 million pounds, but the recreational sector has landed 42.0 million pounds of fish.
[19] The increased quota for 2015 is 14.3 million pounds. Preferred Alternative 8 shifts 2.5% of the quota from the commercial to the recreational sector, or 357,500 pounds of fish.
[20] *See* Transcript of the Gulf Council's August 2015 meeting at 182 (Mr. Reichers: "…this really isn't a reallocation, folks. This is a recalibration of landings."); 185 (Ms. Dana: "The way I see it, and maybe I am wrong, is that our current preferred alternative, which is Alternative 8, would be essentially be status quo…using the new science through the recalibration.").
[21] Amendment 28, at ix.

of time," and that "[t]hese alternatives [in Amendment 28] aren't based on those baseline years."[22]

Several Council members were also under the mistaken impression that it would be incongruous to rely on recalibrated MRIP landings estimates to increase the ACL (as the Council voted to do in March), but then not rely on them for purposes of reallocation.[23] These are two very different applications of MRIP recalibration, and one does not follow the other. With respect to the ACL increase, MRIP recalibration showed that the stock was more productive than previously estimated and could sustain higher levels of harvest. But those higher levels of harvest should have been split between the recreational and commercial sectors in accordance with the 51/49 percent initial allocation established by Amendment 1. This is because MRIP recalibration *could not have adjusted the landings estimates from the baseline years used to set the initial allocation*, and none of the alternatives in Amendment 28 purported to adjust the landings estimates from those baseline years. Accordingly, the sectors should have equally benefitted from the stock's newfound productivity.

All the MRIP recalibration showed was that the recreational sector overages in recent years were actually much worse than previously estimated. In essence, the Council concluded that since the recreational sector has been catching more fish in recent years, it should continue catching more fish on a going forward basis, notwithstanding the fact that landings in recent years were far out of line with the 51/49 percent split established by Amendment 1. In other words, Amendment 28 effectively rewards the recreational sector for overharvesting in recent years.

C. Reallocation is Not Fair or Equitable.

National Standard 4 requires that an allocation of fishing privileges be "fair and equitable." 16 U.S.C. § 1853(a)(4). Amendment 28 is not fair or equitable because it penalizes the commercial sector for complying with its catch limits and bearing the brunt of economic impacts associated with stock rebuilding, and rewards the recreational sector for overharvesting. Any negligible benefits to the recreational sector do not outweigh the harms to the commercial sector.

1. Reallocation penalizes the commercial sector for complying with its catch limits, and rewards the recreational sector for routinely exceeding its catch limits.

In the *Guindon v. Pritzker* case, the court held that NMFS's failure to hold the recreational sector to its quota effectuated a *de facto* reallocation that violated Section 407(d), National Standard 4, and the FMP's requirements.[24] The recent recalibration of recreational

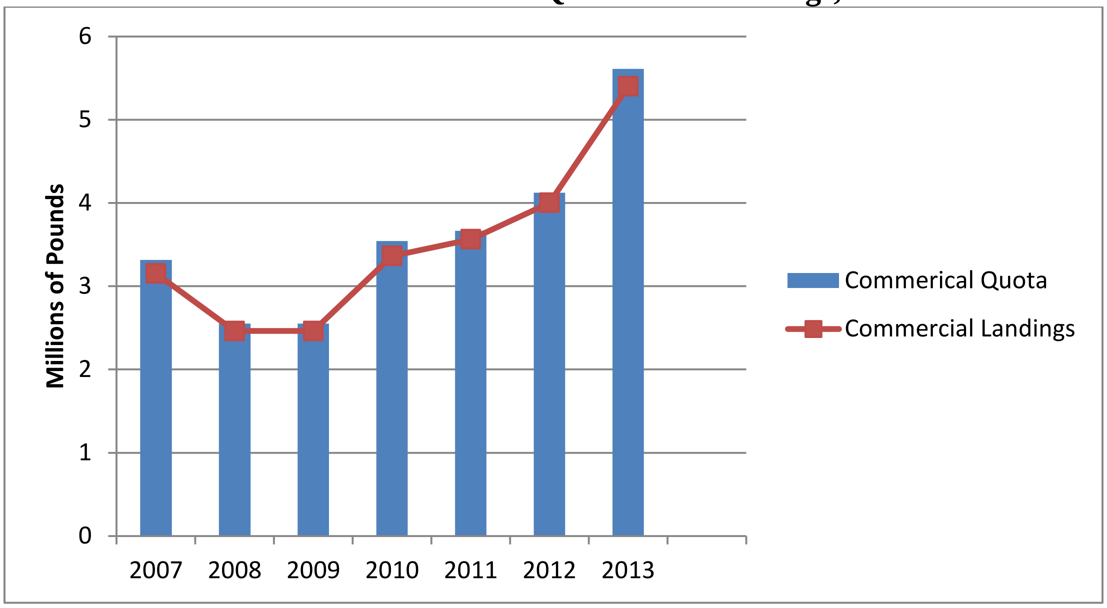
[22] Transcript of the Gulf Council's August 2015 meeting at 183, 185 (emphasis added).

[23] *See* Transcript of the Gulf Council's August 2015 meeting at 187 (Ms. Bademan: "…we just used this information to raise the quota….It's tough for me to explain why we wouldn't use the same scientific information that is the best available science to make some of these fixes to some of this past historical data where we've had issues"); 188 (Mr. Fischer: "…the quota increase that we already accepted comes from selectivity and recalibration"… "if we don't agree with this [reallocation], that means we really have to reduce our quota a few million pounds").

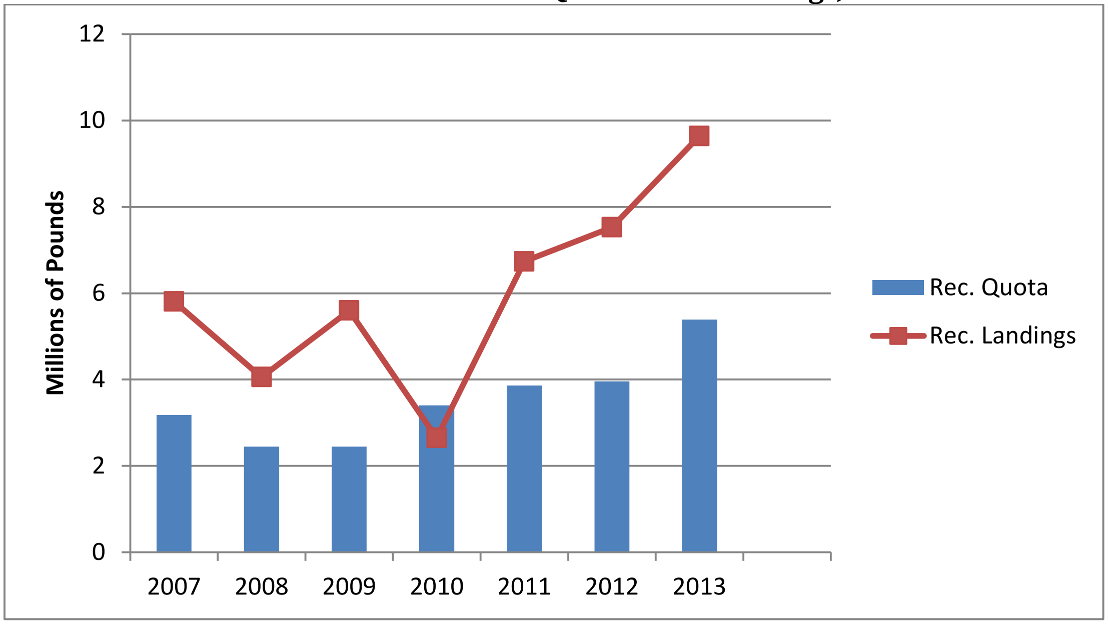
[24] *See Guindon v. Pritzker*, 31 F. Supp. 3d. 169, 193, 201 (D.D.C.2014) ("At a certain point NMFS was obligated to acknowledge that its strategy of incrementally shortening the [recreational] season was not working. Administrative

landings data only shows that this unlawful *de facto* reallocation was even more egregious than anyone previously thought. Yet the implicit justification for Amendment 28 is that the recreational sector should get more fish in the future because it has been illegally allowed to catch more fish in the recent past.

Commercial Sector Quotas and Landings, 2007-2013



Recreational Sector Quotas and Landings, 2007-2013



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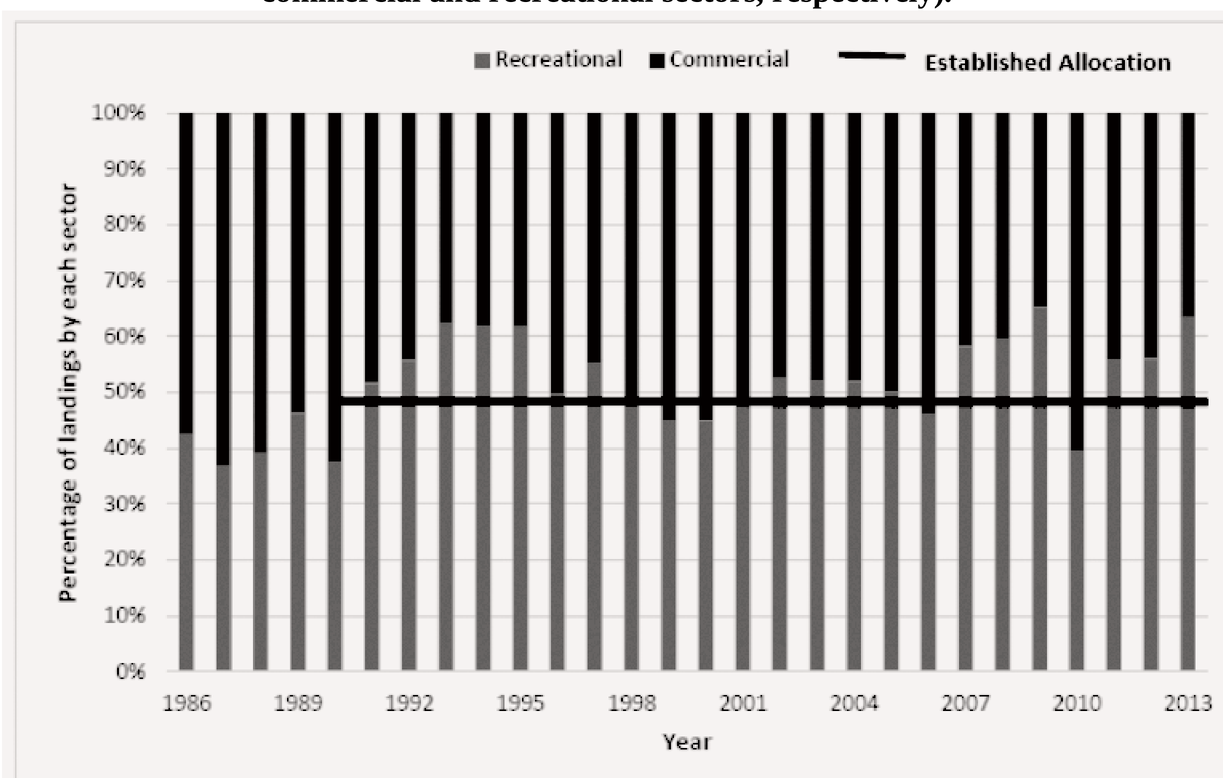
discretion is not a license to engage in Einstein's definition of folly—doing the same thing over and over again and expecting a different result…. NMFS essentially guaranteed that the actual catch allocation would skew widely from the 51/49 allocation, as indeed it did. This violated MSA Section 304(b)…. When an agency blinds itself to the high likelihood that its actions will cause overharvesting, the Court cannot characterize those actions as 'reasonably calculated to promote conservation.'" (quoting National Standard 4)).

Moreover, the purported failure to accurately estimate recreational landings, and the apparent need to retrospectively "recalibrate" those landings data, only harmed the commercial sector. To the extent that the stock withstood these higher levels of landings, the commercial sector should have been entitled to 51% of those higher levels pursuant to Amendment 1. Instead, the recreational sector caught 100% of those higher levels through an unlawful management regime. *See Guindon*, 31 F. Supp. 3d at 192-201. Thus, there is no "fair and equitable" basis for allocating the ACL increases attributable to recalibration of recreational landings estimates to the recreational sector as Alternative 8 would do, because *the recreational sector was never harmed by the error that recalibration purportedly corrects*. The allocation split may have been 49/51 percent recreational/commercial *on paper*, but the landings split was closer to 60/40 percent recreational/commercial *in practice.* This benefitted the recreational sector to an extent far greater than the 2.5 percent reallocation proposed by Preferred Alternative 8.[25]

Comparison between the proportions of red snapper landed by each sector and the commercial/recreational split of the quota (established allocation of 51% and 49% to the commercial and recreational sectors, respectively).[26]



[25] Amendment 28, at 30.
[26] Amendment 28, at 33.

Red snapper average percentages landed by the commercial and recreational sectors.[27]

Years	Recreational	Commercial
1986-2013	55.7%	44.3%
1991-2013	58.3%	41.7%
1996-2013	57.0%	43.0%
2001-2013	58.5%	41.5%
2006-2013	60.1%	39.9%

This *de facto* reallocation economically harmed commercial sector by approximately $35 million dollars in forgone direct revenues plus untold indirect revenues up the supply chain. The recreational sector evidently caught 18 million pounds of red snapper more than its catch limits allowed since 2007.[28] Based on the current 49/51 percent recreational/commercial allocations, commercial fishermen should have had access to 51% of that allocation (9.2 million pounds), valued at over $35 million dollars as set forth below.

Commercial Sector Direct Economic Losses from *De Facto* Reallocation.[29]

Year	Recreational Quota	Actual Recreational Landings	Recreational Overage	De facto Reallocation*	Average Ex-Vessel Price Per Pound**	Commercial Sector Direct Economic Losses
2007	3.185	5.809	2.654	1.35354	$4.10	$5,453,540
2008	2.45	4.056	1.606	0.81906	$4.36	$5,179,060
2009	2.45	5.597	3.147	1.60497	$4.40	$6,004,970
2010	3.403	2.651	-0.752	N/A***	N/A***	N/A***
2011	3.866	6.734	2.868	1.46268	$4.40	$5,862,680
2012	3.959	7.524	3.565	1.81815	$4.51	$6,328,150
2013	5.39	9.639	4.249	2.16699	$4.46	$6,626,990
TOTAL				**9.22539**		**$35,455,390**

[27] Amendment 28, at 30.
[28] Gulf Council, Framework Action to Adjust Recreational Charter-for-Hire Red Snapper Management Measures (Jan. 15, 2015), at Table 1.1.1. Values for quotas, landings, overages and de facto reallocation are expressed in millions of pounds.
[29] *See id. Values for quotas, landings, overages and de facto reallocation are expressed in millions of pounds. *This column assumes the catch limit could have been set at the level of total landings for that year, and that the commercial sector could have taken 51% of the total pursuant to the 51/49 commercial/recreational split established by the FMP. ** Average ex-vessel prices are taken from the 2013 Gulf of Mexico Red Snapper Individual Fishing Quota Annual Report (July 8, 2014) at p. 25. *** 2010 is excluded because of fishing disruptions caused by the Deepwater Horizon oil spill.*

2. Reallocation harms the commercial sector but will not benefit the recreational sector.

NMFS' National Standard 4 guidelines explain that an "allocation of fishing privileges may impose a hardship on one group if it is outweighed by the total benefits received by another group or groups."[30] In contravention of this standard, Amendment 28 acknowledges that reallocation will harm the commercial sector, but will provide no benefit to the recreational sector because it does nothing to solve that sector's problems.[31] Indeed, past history has proven conclusively that increasing the recreational quota provides no relief whatsoever to the problem of shortened recreational fishing seasons. The recreational quota has increased by nearly 1.5 million pounds in the last two years alone (from 4.15 million pounds in 2013 to a 5.61 million pound catch target in 2015), *an increase of 35%*, while the recreational season shortened from 42 days to 10 days (for the private angler component in 2015). A further increase of 2.5% for the recreational sector under Preferred Alternative 8 is nugatory.

Amendment 28 makes clear that shortened recreational fishing seasons in federal waters are primarily caused by Gulf states, which deliberately[32] set fishing seasons in their state waters to conflict with and undermine federal regulations. In 2014, all five Gulf states allowed additional fishing days for red snapper in state waters[33] and half of the entire recreational quota (2 million pounds of the 4.3 million pound catch target) was caught in state waters under these non-compliant regulations.[34] Amendment 28 acknowledges that reallocation will have little-to-no effect on the problem of shortened recreational fishing seasons,[35] in part because Amendment 28 does nothing to address state non-compliance. Whatever amount of quota is reallocated to the recreational sector could be absorbed completely by additional fishing in state waters from non-compliant state seasons and increased fishing effort from an unrestrained private angler component. Amendment 28 acknowledges that an "increasing proportion of the total

[30] 50 C.F.R. § 600.325(c)(3)(i)(B).
[31] Amendment 28, at p. 17 ("However, these additional opportunities [to retain red snapper] may not result in a longer fishing season in federal waters, as it would be expected that some States continue providing expanded red snapper fishing opportunities in their state waters. Thus, increases to the recreational sector's allocation may not be assumed to benefit recreational anglers Gulf-wide as an unknown amount of the reallocated quota may be caught through extended state water fishing seasons which vary by State.").
[32] "Alabama announces state red snapper/triggerfish season in July," http://www.al.com/outdoors/index.ssf/2015/05/alabama_announces_state_red_sn.html; "Red snapper debate: Gulf coast anglers at odds over new rules," http://www.gulflive.com/news/index.ssf/2015/05/red_snapper_debate_gulf_coast.html; "State Red Snapper Season Open as 'Thank You' to Recreational Fishermen," http://www.fishla.org/articles/14698/;"Louisiana red snapper limits may increase in state waters, assistant secretary says," http://www.nola.com/outdoors/index.ssf/2015/03/louisiana_red-snapper_limits_m.html; "State waters red snapper season to be 70 days," http://www.pnj.com/story/sports/outdoors/fishing/2015/04/22/red-snapper-season-days/26208513/; "Mississippi red snapper season starts Thursday; here is what you need to know," http://www.gulflive.com/sports/index.ssf/2015/07/mississippi_red_snapper_season.html; "Mississippi offers anglers a chance to harvest red snapper," http://www.gulflive.com/sports/index.ssf/2015/06/mississippi_offers_anglers_a_c.html; "Anglers may face red snapper season that lasts less than a week," http://www.chron.com/sports/outdoors/article/Anglers-may-face-red-snapper-season-that-lasts-6121498.php;
[33] Amendment 28, at 104.
[34] Amendment 28, at 104-105.
[35] Amendment 28, at 17.

recreational quota has been landed outside of the federal season under less restrictive state regulations."[36] Nothing in Amendment 28 arrests this trend.

On the commercial side, reallocation imposes millions of dollars of direct and indirect losses on the commercial sector and the seafood supply chain.[37] Under Preferred Alternative 8, direct losses to shareholders will be approximately $13 million in lost IFQ share value,[38] and about $1 million per year in foregone IFQ allocation leasing opportunities.[39] These losses only multiply up the supply chain, causing indirect economic impacts to captains, crew, wholesalers, retailers, and consumers of the red snapper harvested with that allocation. Reducing the commercial sector's allocation also risks stranding investments that were made in vessels and shoreside infrastructure based upon the rebuilding red snapper stock and the prospect for constant or increased future catches.

Indeed, because reallocation exacerbates the depletion of the spawning stock in the eastern Gulf, the commercial sector is likely to pay twice for the same regulatory action: first, a reduction of 2.5 percent in its quota now; and second, a further fishery-wide reduction in ACL once the negative impacts of reallocation in the eastern Gulf play out (*see* p. 4, *supra*). Dr. Crabtree indicated before the Council the "main tool we're using right now to rebuild this stock are the quotas themselves."[40] Reducing the quotas in the future to absorb the negative impacts of increased recreational fishing effort in the eastern Gulf will doubly harm the commercial sector.

In addition, fundamental to the MSA is the recognition that fishery resources contribute to the "food supply…of the Nation."[41] Thus, considerations of "fairness and equity" extend beyond the commercial fishing sector to seafood consumers throughout the United States as well. Amendment 28 reduces access to the fishery for these consumers, primarily to subsidize non-complaint state water seasons opened for the benefit of private anglers in those states.

Amendment 28 will harm the commercial sector, but cannot ensure any benefit for the recreational sector. This does not comport with National Standard 4.

3. The commercial sector bore the brunt of economic impacts associated with stock rebuilding.

Similar to National Standard 4, Section 303(a)(14) of the MSA requires that:

> *to the extent that rebuilding plans or other conservation and management measures which reduce the overall harvest in a fishery are necessary, [any FMP*

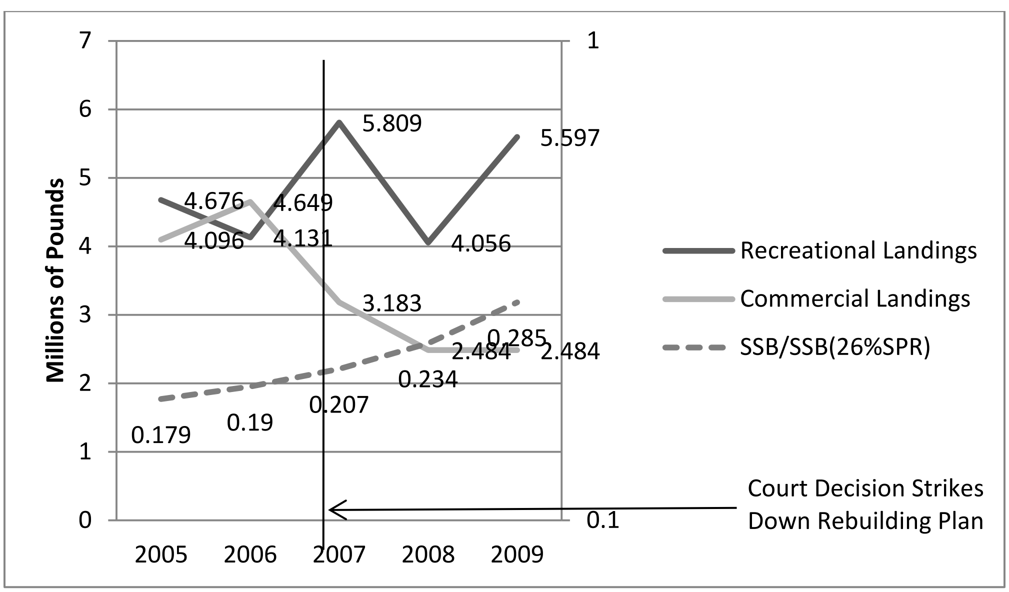
[36] Amendment 28, at 69.
[37] Amendment 28, at xii.
[38] This figure is calculated using a share price of $36.24 per pound, taken from the 2013 Annual Report on the IFQ Program (http://sero.nmfs.noaa.gov/sustainable_fisheries/ifq/documents/pdfs/2013_RS_AnnualReport.pdf) at 22, and multiplying it by 357,500 pounds (2.5% of the current quota), or $12,955,800.
[39] This figure is calculated using an allocation price of $2.98 per pound, taken from the 2013 Annual Report on the IFQ Program (http://sero.nmfs.noaa.gov/sustainable_fisheries/ifq/documents/pdfs/2013_RS_AnnualReport.pdf) at 23, and multiplying it by 357,500 pounds (2.5% of the current quota), or $1,065,350.
[40] *See* Transcript of the Gulf Council's August 2015 Meeting, at 182.
[41] 16 U.S.C. § 1801(a)(1).

shall] allocate, taking into consideration the economic impact of the harvest restrictions or recovery benefits on the fishery participants in each sector, any harvest restrictions or recovery benefits fairly and equitably among the commercial, recreational, and charter fishing sectors in the fishery.

16 U.S.C. § 1853(a)(14). Amendment 28 insufficiently analyzes the prior "economic impact of the harvest restrictions" necessary to rebuild the red snapper stock on the "fishery participants" in each sector. If that analysis was conducted, it would show that participants in the commercial sector bore almost all the economic impacts of the harvest restrictions necessary to rebuild the stock.

For example, between 2006 and 2009, when the annual quota was substantially reduced in response to a court decision striking down the prior rebuilding plan as incompatible with MSA requirements,[42] the commercial sector's landings steadily dropped from 4.649 million pounds (in 2006) to 2.484 million pounds (in 2008 and 2009).[43] This was because the commercial sector, working on conjunction with NMFS and the Council, put in the time and effort to develop and implement an accountable IFQ program. By contrast, the recreational sector did not reduce its landings at all but instead drastically exceeded its quota during this period, landing 4.131 million pounds in 2006, 5.809 million pounds in 2007, 4.506 million pounds in 2008 and 5.597 million pounds in 2009.[44]

Commercial vs. Recreational Sector Landings and SSB Increases, 2005-2009[45]
(vertical line indicates court decision invalidating rebuilding plan, requiring quota reductions)



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[42] *See Coastal Conserv. Ass'n v. Gutierrez*, 512 F. Supp. 2d 896 (S.D. Tex. 2007).
[43] Amendment 28, at 31 (Table 2.1.2).
[44] *Id*.
[45] *See* Amendment 28, at 40.

In short, the catch reductions required by the new rebuilding program had no impact on the recreational sector, because it failed to comply with those reductions. Thus, during these critical years of the rebuilding plan, when the spawning stock actually started showing signs of rebuilding,[46] it was the commercial sector alone that paid the price for rebuilding.

Moreover, persistent overharvesting by the recreational sector reduced the annual yields the stock could produce to stay on track to rebuild by 2032. To cite just one example, in 2013, the quota was reduced from 8.69 million pounds to 8.46 million pounds because of recreational overharvesting in 2012,[47] which meant that the commercial sector lost out on 115,000 pounds of quota (51% of the reduction) that year. By contrast, the recreational sector exceeded its quota that same year by over 3.5 million pounds.[48] In sum, the catch reductions the commercial sector *alone* complied with to rebuild the stock were even more severe than they otherwise would have been because of recreational overharvesting.[49]

We do not believe that reallocating quota from the commercial sector is "fair and equitable" given the economic impacts that the commercial sector has uniquely endured to rebuild the stock, during a period of time when the recreational sector routinely exceeded its quota by large amounts.

IV. Reallocation Violates MSA Section 407(d)(2).

Section 407(d) of the MSA provides that:

> *Any fishery management plan, plan amendment, or regulation submitted by the Gulf Council for the red snapper fishery after October 11, 1996, shall contain conservation and management measures that—*
> *(1) establish separate quotas for recreational fishing (which, for the purposes of this subsection shall include charter fishing) and commercial fishing that, when reached, result in a prohibition on the retention of fish caught during recreational fishing and commercial fishing, respectively, for the remainder of the fishing year; and*
> *(2) <u>ensure that such quotas reflect allocations among such sectors and do not reflect any harvests in excess of such allocations</u>.*

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[46] Amendment 28, at 289 (Figure 3).
[47] *See* 77 Fed. Reg. 64960, 64961 (Oct. 24, 2012) (explaining that the 8.69 mp quota for 2013 "was contingent upon the stock ABC not being exceeded in 2012" but that "[p]reliminary estimates indicate that the 2012 recreational red snapper quota (3.959 mp) will be exceeded by 440,000-840,000 pounds, which will result in the 2012 ABC being exceeded. As a result, the National Marine Fisheries Service Southeast Fisheries Science Center will evaluate the effect of this overharvest on the red snapper rebuilding plan."); 78 Fed. Reg. 32179, 32181 (May 29, 2013) (setting reduced 8.46mp quota).
[48] Amendment 28, at 40.
[49] In addition, in 2011 when an updated stock assessment showed that the annual quota could be increased due to early signs of rebuilding success, the Gulf Council requested and NMFS implemented an emergency action that gave the entire increase to the recreational sector, despite its persistent overharvesting and in contravention of the 49%/51% recreational/commercial split adopted by Amendment 1.*See* 76 Fed. Reg. 50143 (Aug. 12, 2011) ("the Council requested that NMFS publish an emergency rule to assign the entire 345,000 lb (156,489 kg) of additional TAC to the recreational sector and suspend the October 1 closure date of the recreational fishing season").

16 U.S.C. § 1883(d) (emphasis added).

Alternative 8 would reallocate quota to the recreational sector based on "the increase in the annual catch limit projections attributed [to] using the calibrated MRIP catch estimates to the recreational sector."[50] Those "calibrated MRIP catch estimates" indicate that the recreational sector exceeded its quota by even greater amounts than previously estimated. Specifically, "since the allocation was established in 1990, in all but five years the recreational sector's annual landings have represented a larger proportion of total landings than their [49%] allocation."[51]

The premise underlying Alternative 8 is that the recreational sector caught more fish historically than previously thought, and so that sector should be allocated more fish going forward; specifically, the amount of the increase in catch limits attributable to revised estimates of prior recreational overharvesting. Reallocation under these alternatives is thus justified on the basis of prior recreational overharvesting. Under Alternative 8, the recreational quota would thus "reflect" recreational harvests "in excess of such [recreational sector] allocations," in direct violation of section 407(d)(2).

When Congress enacted Section 407(d) in 1996, the recreational sector did not have a fixed quota like the commercial sector did, but it nevertheless had exceeded its 49 percent allocation in *every year since the Council adopted the 51/49 percent split in Amendment 1*.[52] Thus, when Congress directed the Council to establish a hard quota for the recreational sector in 1996, it evidently intended by Section 407(d)(2) that the recreational sector's quota not reflect the overharvesting that had occurred in prior years. Just as Section 407(d)(2) would have precluded the Council from setting an initial recreational quota in 1997 that exceeded that sector's 49 percent allocation, Section 407(d)(2) continues to preclude the Council from re-establishing the recreational quota in a manner that exceeds its 49 percent allocation to reflect prior recreational sector overharvesting. Yet that is precisely what Preferred Alternative 8 purports to do.

This is not to say that section 407(d)(2) would necessarily proscribe any reallocation of quota from the commercial to the recreational sectors, given a legitimate justification. But the specific manner in which the recreational quota is "established" under Alternative 8 would cause the recreational quota to "reflect" prior recreational overharvesting, which section 407(d)(2) does not allow.

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[50] Amendment 28, at x.

[51] *Id*. at 79.

[52] Amendment 28, at 36; *see also* Gulf Council, Regulatory Amendment to the Reef Fish Fishery Management Plan to Set 1997 Commercial Red Snapper Season and Authorize Recreational Quota Closures (March 1997), *available at* http://gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20RegAmend%20-%201997-03.pdf, at 11, 18, 21 ("Unlike its commercial counterpart, the recreational sector has not been subjected to closure. Instead bag and size limits have been the major tools used to keep this sector within its allocation. Since 1991, the recreational sector has been exceeding its allocation, initially by about 7 percent in 1991, 16 percent in 1992, 84 percent in 1993, 60 percent in 1994, and 42 percent in 1995. Due to these overages, additional restrictions on the recreational sector have been suggested.").

V. Adoption of Amendment 28 Violated MSA Section 302(i)(6) Because Critical New Information Was Not Made Available to the Public Prior to Final Action.

Under MSA Section 302(i)(6), interested parties "shall have a reasonable opportunity to respond to new data or information before the Council takes final action on conservation and management measures." 16 U.S.C. § 1852(i)(6) (emphasis added). Unfortunately, the Council took final action on Amendment 28 without providing the public with new information that the amendment relied upon.[53] In particular, the 2014 update stock assessment report was not publicly available, but that report was necessary to understand the extent of reallocation under Preferred Alternative 8 as well as the projected effects of reallocation on future yield streams, among other things.

For example, Preferred Alternative 8 purports to reallocate based on "the effects of revised recreational data used in the update stock assessment that led to a higher stock ACL." Amendment 28 explains that the reallocation under Preferred Alternative 8 is calculated by:

> Adding the increase in the annual catch limit projections attributed to the using the calibrated MRIP catch estimates to the recreational sector; and [then] averaging the projected increases over a 2015 to 2017 time period.

Am. 28, at x. Apparently, once this calculation is performed, the recreational sector receives 2.5% more quota. But without the information contained in the 2014 update assessment report and the SEFSC's working papers on recalibration, there is no way to understand where the figures are derived from or to independently perform this calculation. The Council -- and the public -- are evidently supposed to accept these conclusory assertions at face value. The SEFSC also apparently recalibrated recreational landings estimates back to 1950, notwithstanding NMFS's own assertions that certain of those years cannot be recalibrated.[54] Without the SEFSC's working papers, there is no way for the public to understand how this retrospective recalibration was performed or to test its methodologies.

Similarly, the SEFSC's yield stream projections under the reallocation alternatives were based on the assumption that "selectivity" observed in 2011-2013 would remain constant out to 2032. But again, without the 2014 update stock assessment report, the public has no way to understand how "selectivity" was applied in this context, how it was measured, what observations were relied upon, how this purported change in angler behavior resulted in substantial increases in the ABC/OFL levels, how those increases were calculated, or what the effects would be on yield streams if the assumption that anglers are "targeting" larger fish is wrong or changes over time.

We do not believe that taking action without providing the public access to the underlying materials -- particularly where new concepts are being applied -- is the process Congress envisioned when it enacted the MSA. This mode of operation also appears to be inconsistent with NMFS's recently revised National Standard 2 guidelines. *See* 50 C.F.R. §§ 600.315(a)(6)(iv) (stating that the MSA provides for public access "to the scientific information upon which the process and management measures are based"); 600.315(a)(6)(vi)(A) ("data and procedures used to produce the scientific information" must be "documented in sufficient detail

[53] *See* Appendix F.

[54] Transcript of the Gulf Council's August 2015 meeting at 183 ("you can't really recalibrate that period of time").

to allow reproduction of the analysis by others with an acceptable degree of precision" which is necessary "to conduct a thorough review").

VI. The Range of Alternatives in Amendment 28 Was Too Narrow

All of the action alternatives in Amendment 28 would reallocate quota from the commercial sector to the recreational sector. This may have made sense back when the purpose and need of Amendment 28 was to increase "net economic benefits," and a SEFSC study concluded that reallocating fish to the recreational sector would achieve that result. But that SEFSC study was subsequently discredited as a justification for reallocation.[55] Because the allocation within the recreational sector is not currently efficient, there is no way to ensure that net benefits will result from a reallocation of quota from the commercial to the recreational sector. *See* Amendment 28, at 107 ("policy prescriptions based on such inferences [of efficiency gains from reallocation] would not be valid, and therefore, not useful"). Yet rather than abandon Amendment 28 when its central premise was discarded, the Council instead revised the purpose and need to ensure a "fair and equitable" allocation, and forged ahead.

The problem is that, despite fundamentally changing the purpose and need of Amendment 28, the Council neglected to revisit the scope of the management alternatives. As a result, Amendment 28 is now founded upon the assumption that the <u>only</u> "fair and equitable" allocation is one that shifts more quota to the recreational sector. There is no basis for this foundational assumption, particularly given the efforts the commercial sector has put forth to develop an accountable IFQ program and comply with catch limits necessary to rebuild the stock, along with the recreational sector's persistent overages and the projected negative impacts to conservation resulting from reallocating more fish to the recreational sector. The Secretary should disapprove Amendment 28 and recommend that the Council also examine other alternatives that would shift quota from the recreational to the commercial sectors.

VII. Conclusion

For the forgoing reasons, we respectfully disagree with the Council's decision to adopt Amendment 28 and we urge the Secretary of Commerce to disapprove it pursuant to 16 U.S.C. § 1854(a)(3).

Respectfully submitted on September 23, 2015.

[55] Amendment 28, at xii, 107.

David Walker
Representative to the Gulf Council from the State of Alabama

John R. Greene, Jr.
Representative to the Gulf Council from the State of Alabama

Leann Bosarge
Representative to the Gulf Council from the State of Mississippi

John Sanchez
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List of Appendices

Appendix A: Standing and Special Reef Fish SSC Report to the Gulf Council (May 20, 2015).

Appendix B: NOAA Fisheries, SEFSC, 2014 Update: Gulf of Mexico Red Snapper (Jan. 26, 2015).

Appendix C: Trevor J. Kenchington, Ph.D., Comments on Scientific Issues Relating to Re-allocation in the Red Snapper Fisheries in the Gulf of Mexico (July 2015).

Appendix D: Letter dated August 8, 2015 from James H. Cowan, Ph.D., Louisiana State University, to the Gulf Council regarding Amendment 28.

Appendix E: Letter dated August 10, 2015 from Dr. Michael K. Orbach, Professor Emeritus of marine Affairs and Policy, Duke University Marine Laboratory, to Doug Gregory, Executive Director of Gulf Council regarding Amendment 28.

Appendix F: Letter dated August 9, 2015 from J. Timothy Hobbs, K&L Gates LLP, to Kevin Anson, Chair of the Gulf Council, regarding Amendment 28.

APPENDIX A

Standing and Special Reef Fish SSC
Meeting Summary
New Orleans, Louisiana
May 20, 2015

The meeting of the Standing and Special Reef Fish SSC was held on May 20, 2015. The agenda and the minutes of the Standing and Special Reef Fish portion of the March 10-12, 2015 Standing, Special Spiny Lobster and Special Reef Fish SSC meeting were approved as written.

Luiz Barbieri agreed to be the SSC representative at the June 8-12, 2015 Council meeting in Key West.

Analysis of Alternative F_{MSY} proxies for Red Snapper

Dr. Dan Goethel presented a review of alternative F_{MSY} proxies for red snapper. Global MSY is the highest sustainable yield that could hypothetically be taken from a stock if fishing is restricted to an optimal age class using knife-edge selectivity (no harvest above or below that age class), no discard mortality, and the relationship between spawning stock biomass (SSB) and recruitment is known. Proxies for MSY are used for red snapper because the stock-recruit function is not well-defined (Figure 1). Additionally, it is impossible to implement optimal age selectivity from a management perspective, because catch cannot be constrained to a single age class, and control of bycatch and discarding is extremely difficult. Proxies are often utilized to approximate MSY or the associated SSB at MSY, and can be based on either yield-per-recruit (YPR) or spawning potential ratio (SPR) analyses. YPR aims to approximate MSY, but SPR aims at maintaining biomass within safe biological limits with no specific goal of maximizing yield.

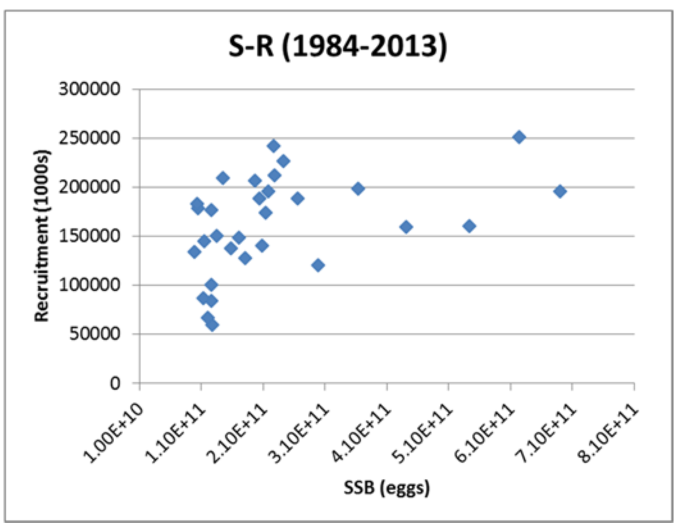

Figure 1. Red snapper spawner-recruit levels for 1984-2013. Spawning stock biomass (SSB) is in number of eggs produced. Recruitment is in abundance (1000s) of age-0 fish.

Maximum YPR (or F_{MAX}) harvest control rules maximize yield from an 'average' recruit by optimizing the time of capture (i.e., the knife-edge selectivity assumption is maintained as assumed in MSY calculations) based on the tradeoff between growth (weight) and natural mortality. YPR analysis does not account for the relationship between spawners and recruits. Maximum YPR does not result in the MSY unless there is truly no spawner-recruit relationship. If a spawner-recruit relationship does exist, maximum YPR will usually overestimate MSY causing a lower resulting SPR[1]. Recruitment overfishing can occur when maximum YPR is used as a management target if the stock is unable to replace itself (i.e., yield exceeds growth).

Due to the unrealistic assumption of knife-edge selectivity at an optimal age required for global MSY or maximum YPR, management often chooses to use a conditional MSY or YPR (depending on whether the stock-recruit relationship is known). Conditional analyses assume that existing selectivity and discard mortality patterns are maintained throughout the projections. The spawning stock biomass levels resulting from conditional MSY will be lower than global SSB_{MSY}, and the spawning stock biomass levels resulting from conditional maximum YPR will be even lower. As bycatch mortality increases, the resulting SSB tends to decrease, which can result in very low SPR values.

SPR analyses are life history-based proxies, which are dependent on the demographics of the species such as longevity, growth, and natural mortality. Yield is not an explicit consideration for SPR analysis. As with YPR, it does not account for a spawner-recruit relationship. Typical values for SPR proxies range from 20-60% of virgin spawning stock. Based on simulations (Clark, 1993), within this range of SPR levels the resulting equilibrium yield is at least 75% of MSY regardless of the true stock-recruit relationship.

Currently, a global MSY cannot be calculated for red snapper, because the spawner-recruit relationship is unknown. Additionally, global MSY or maximum YPR would be impossible to implement, because optimal selectivity is impractical to achieve. Despite the inability to achieve global MSY, the SSB associated with global MSY is still attainable if global MSY can be calculated. However, with no definitive stock-recruit relationship, the closest approximation to global MSY is true maximum yield-per-recruit (i.e., assuming a single fleet that harvests at an optimal age). The SEFSC has ongoing work attempting to calculate the true maximum YPR for red snapper, but the intricacies of the stock synthesis framework may impede the ability to determine a reliable value. Given the difficulties encountered with red snapper, the most appropriate proxy for MSY is likely to be the SSB or SPR associated with the maximum YPR, but this value has not yet been calculated.

The SEDAR 7 and 31 assessments used an alternate approximation to the global MSY referred to as 'MSY-link', which was calculated as the maximum YPR (i.e., because no stock-recruit relationship was implemented) when all sources of fishing mortality (directed, closed-season, and bycatch) were scaled up or down in the same proportion. Yield-per-recruit was then maximized by scaling the overall fishing mortality, while maintaining the ratios of relative fishing mortality by fleet. The SSB and associated SPR corresponding to the maximum yield obtained from the MSY-link scenario was then used as the SPR target proxy.

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[1] Exceptions to maximum YPR exceeding MSY do exist, most notably with gag, where the stock assessment found that F_{MAX} was a more conservative estimate of F_{MSY} that $F_{30\% SPR}$. However, this may be due to the fact that gag is a protogynous hermaphrodite.

Using the MSY-link scenario, the 2005 SEDAR 7 red snapper assessment calculated SPR_{MSY} as SPR_{MSY} = 26%. In the current analysis, the MSY-link scenario resulted in an SPR_{MSY} = 23%. The change in SPR was due to different relative fishing mortalities in the terminal year of the assessment model. However, the MSY-link scenario is not a practicable proxy because it requires scaling bycatch fishing mortality in the same proportion as directed fishing mortality. Since projections indicate that short-term yield could be increased and the SPR proxy could still be obtained in 2032, the analyses implicitly suggest that bycatch should be increased. In practice, directed and discard mortality rates are not linked.

The SEFSC was asked to examine several levels of target SPR from 40% to 20%, plus the maximum conditional yield-per-recruit and the resulting SPR. The yield streams (Acceptable Biological Catches; ABCs) to rebuild by 2032 are shown in Table 1. Many of the scenarios would result in the stock able to rebuild to the target SPR level in 10 years or less, so yield streams assuming a 10-year rebuilding plan are shown in Table 2. The conditional maximum YPR resulted in a Gulfwide SPR of 12%, but this would cause an SPR in the eastern region of 2%.

Table 1. Yield streams and equilibrium yield for several levels of target SPR and the MSY-link scenario (23% SPR) for rebuilding by 2032.

ABC (Retained Yield Million Pounds Whole Weight) – Rebuild by 2032							
YEAR	**SPR 40%**	**SPR 30%**	**SPR 26%**	**SPR 24%**	**SPR 22%**	**SPR 20%**	**MSY-LINK**
2015	6.55	11.54	14.28	15.87	17.63	19.59	15.00
2016	7.26	11.79	13.96	15.11	16.31	17.55	14.25
2017	7.91	12.02	13.74	14.61	15.45	16.28	13.72
2018	8.32	11.99	13.38	14.05	14.67	15.26	13.10
2019	8.37	11.67	12.85	13.40	13.91	14.39	12.36
2020	8.31	11.40	12.49	12.99	13.46	13.90	11.86
2021	8.24	11.24	12.29	12.78	13.23	13.64	11.56
2022	8.21	11.15	12.18	12.65	13.08	13.48	11.38
2023	8.27	11.17	12.17	12.62	13.04	13.42	11.33
2024	8.35	11.22	12.19	12.63	13.03	13.40	11.31
2025	8.41	11.25	12.21	12.63	13.02	13.37	11.30
2026	8.47	11.29	12.22	12.63	13.01	13.35	11.29
2027	8.53	11.31	12.23	12.64	13.00	13.34	11.28
2028	8.58	11.34	12.24	12.64	13.00	13.32	11.28
2029	8.62	11.36	12.25	12.64	12.99	13.31	11.27
2030	8.66	11.38	12.26	12.64	12.99	13.30	11.26
2031	8.70	11.40	12.26	12.65	12.99	13.29	11.26
2032	8.73	11.41	12.27	12.65	12.99	13.29	11.25
Equil	9.05	11.61	12.40	12.74	13.04	13.30	11.26

Table 2. Yield streams and equilibrium yield for several levels of target SPR and the MSY-link scenario (23% SPR) for rebuilding within 10 years, by 2026.

ABC (Retained Yield Million Pounds Whole Weight) – Rebuild by 2016							
YEAR	**SPR 40%**	**SPR 30%**	**SPR 26%**	**SPR 24%**	**SPR 22%**	**SPR 20%**	**MSY-LINK**
2015	4.27	9.71	12.78	14.59	16.63	18.91	15.00
2016	4.92	10.23	12.80	14.19	15.64	17.14	14.25
2017	5.54	10.67	12.84	13.92	14.98	16.01	13.72
2018	5.98	10.84	12.67	13.52	14.33	15.07	13.10
2019	6.14	10.66	12.25	12.97	13.63	14.24	12.36
2020	6.16	10.47	11.93	12.59	13.20	13.76	11.86
2021	6.13	10.34	11.75	12.39	12.98	13.51	11.56
2022	6.13	10.27	11.66	12.28	12.84	13.35	11.38
2023	6.19	10.31	11.67	12.27	12.81	13.30	11.33
2024	6.27	10.37	11.70	12.28	12.81	13.28	11.31
2025	6.34	10.42	11.72	12.30	12.81	13.26	11.30
2026	6.40	10.46	11.75	12.31	12.81	13.24	11.29
Equil	7.03	10.88	12.00	12.47	12.88	13.22	11.26

Over the long-term, fishing at target SPR levels less than 30% will result in declines in the eastern Gulf stock of red snapper, while in the west the SPR will increase at all SPR levels between 20% and 40% (Figure 2). Current (2015) SPR levels are 11% for the eastern Gulf, 19% for the western Gulf, and 16% Gulfwide.

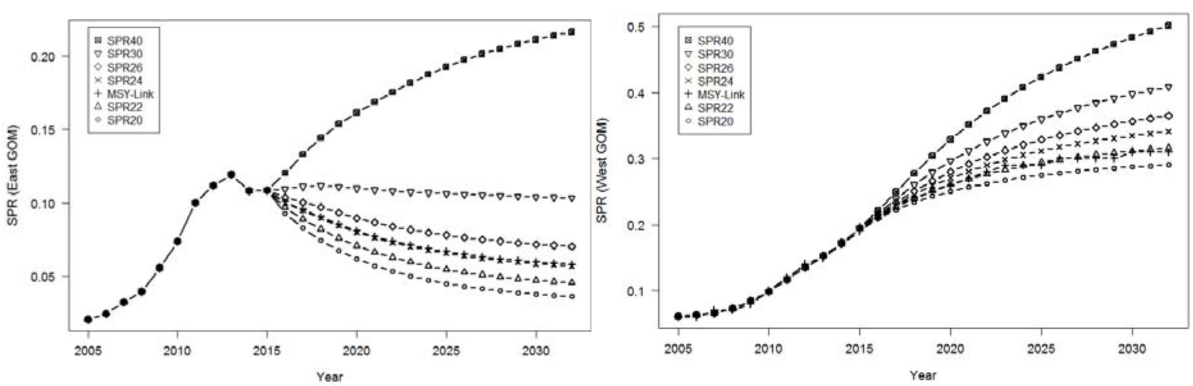


Figure 2. Regional trends in SPR when fishing for red snapper at target Gulfwide SPRs of 20% to 40% for a rebuilding target date of 2032.

Yield streams at conditional SPRs less than 26% provide short-term increases in ABC, but over the longer term target SPRs of 20% to 30% tend to converge to similar ABC levels (Figure 3).

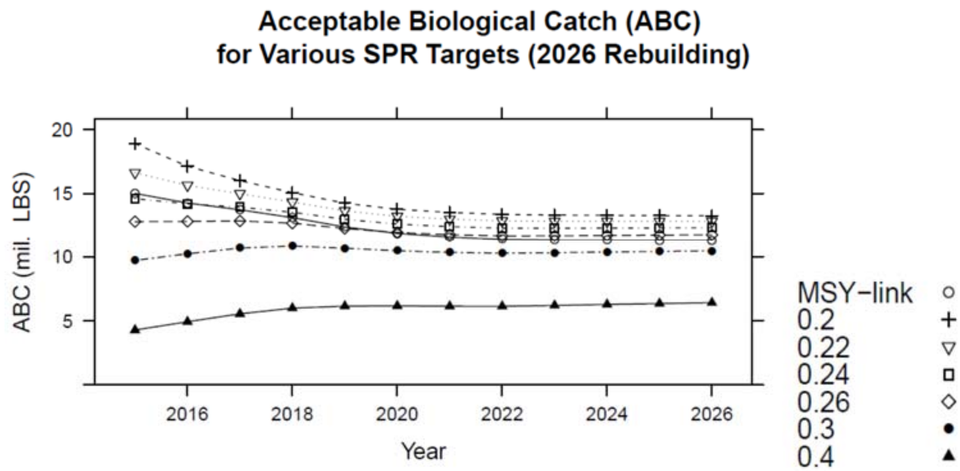


Figure 3. Trends in ABC yield streams for conditional SPR levels of 20% to 40% for a rebuilding target date of 2026.

The SSC concluded that even though the current proxy of 26% SPR was derived using the MSY-linked method, which is now considered impractical, there was little long-term benefit to changing the SPR. Additionally, lower target SPRs or conditional maximum YPR were projected to drive the stock in the eastern Gulf to very low SSB levels. The following motion was passed.

Motion: The SSC recommends, based on the latest analysis provided by the SEFSC, that there is insufficient biological evidence for a better MSY proxy than what is currently used by the Council (the yield corresponding to 26% SPR) for Gulf red snapper.
Motion carried unanimously

MRIP recalibration, selectivity changes and allocation

Dr. Shannon Cass-Calay gave two presentations on factors affecting changes in red snapper OFL and ABC projections. The first presentation reviewed the results of a series of sensitivity runs to evaluate the effect of recalibrated recreational removals and recreational selectivity on OFL and ABC projections. This analysis was previously presented to the Council. The sensitivity runs consisted of using the update assessment base model with the following projections:

- Project the annual OFLs at F26%SPR and the ABCs at FREBUILD from 2015-2032 using pre-MRIP recalibrated estimates.
- Project the annual OFLs at F26%SPR and the ABCs at FREBUILD from 2015-2032 using pre-MRIP recalibrated estimates and no new recreational selectivity block for 2011-2013

There is some evidence that recreational fishing selectivity in recent years has been shifting toward larger and older red snapper. Therefore, in these runs the model was allowed to re-estimate recreational selectivities in the most recent years (2011-2014). The OFL and ABC trends resulting from the two sensitivity runs and the base model run are shown in Figure 4.

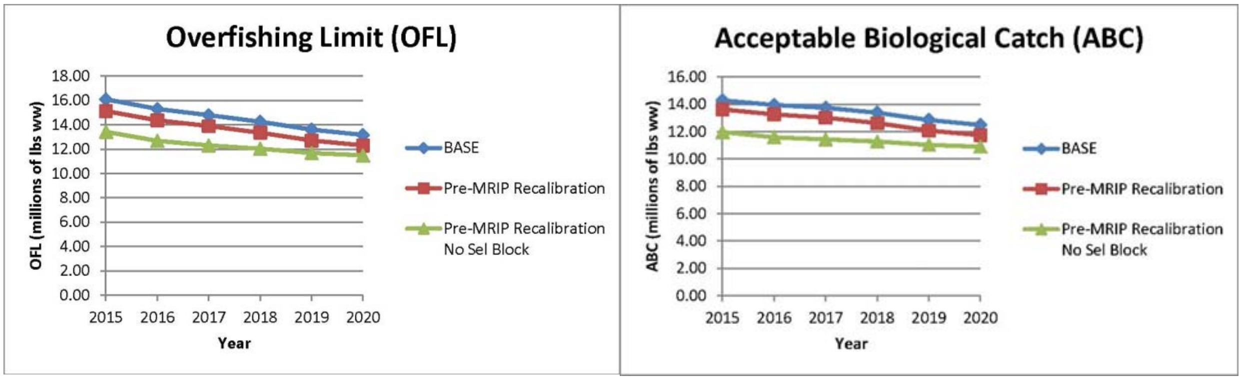


Figure 4. Trends in OFL and ABC projected by the red snapper update assessment base mode and two sensitivity runs.

The runs suggest that there are two reasons why higher OFLs and ABCs were projected in the update assessment: 1) use of the larger MRIP recalibrated estimates of recreational catch, and 2) recalibration of recreational selectivity in recent years.

The second presentation evaluated the effects of changing the commercial:recreational allocation. The recreational allocation was adjusted from the status quo 49% up to 70%. The Council has selected a recreational allocation of 48.5%. The resulting OFL and ABC yield streams are shown in Tables 3 and 4.

Table 3. Red Snapper OFL Yield streams and equilibrium yield for several allocations of recreational harvest and a target of 26% SPR by 2032.

OFL (Retained Yield Million LBS WW)						
YEAR	**Rec 49%**	**Rec 48.5%**	**Rec 55%**	**Rec 60%**	**Rec 65%**	**Rec 70%**
2015	16.10	16.35	16.70	17.19	17.69	18.17
2016	15.31	15.50	15.72	16.06	16.39	16.71
2017	14.79	14.96	15.12	15.38	15.64	15.89
2018	14.25	14.40	14.54	14.77	15.00	15.23
2019	13.60	13.73	13.87	14.09	14.31	14.52
2020	13.17	13.29	13.43	13.65	13.86	14.07
Equil	12.91	13.00	13.11	13.27	13.42	13.57

Table 4. Red Snapper ABC Yield streams and equilibrium yield for several allocations of recreational harvest and a target of 26% SPR by 2032.

ABC (Retained Yield Million Pounds Whole Weight						
YEAR	**Rec 49%**	**Rec 48.5%**	**Rec 55%**	**Rec 60%**	**Rec 65%**	**Rec 70%**
2015	14.29	14.49	14.76	15.18	15.61	16.05
2016	13.96	14.13	14.31	14.62	14.93	15.24
2017	13.75	13.89	14.04	14.29	14.53	14.78
2018	13.39	13.52	13.65	13.87	14.09	14.32
2019	12.85	12.97	13.10	13.31	13.52	13.73
2020	12.49	12.60	12.73	12.94	13.15	13.35
Equil	12.40	12.48	12.59	12.73	12.87	12.98

The OFL and ABC yields for the directed fisheries increased with increasing recreational allocation. All of the above yield streams achieve a Gulfwide stock rebuilding to 26% SPR by 2032, but with regional differences. SPR in the western Gulf continues to increase, but the SPR in the eastern Gulf declines, and the decline is exacerbated by increasing allocation to the recreational sector. At 70%, the eastern SPR decreases to 4% of unfished condition in 2032 (Figure 5).

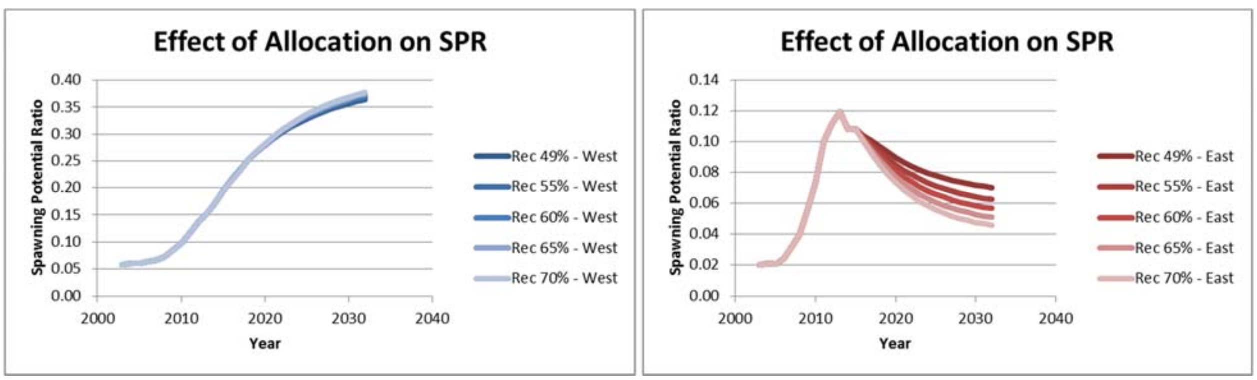


Figure 5. Regional trends in west and east red snapper SPR under various recreational allocations. Note that the graphs are drawn to different Y-axis scales.

The difference in SPR changes between the eastern and western stocks occurs because the distribution of the red snapper population and fishing effort differs. Increasing the recreational allocation disproportionately increases the fishing effort in the east (where most recreational fishing occurs) leading to an increased fraction of the population removed in the east as the recreational allocation increases. In addition, the selectivity patterns differ, with the recreational sector in the east selecting larger fish than the commercial sector.

One SSC member noted that the eastern SPR has been increasing until 2012, and asked for an explanation of why the trend changed. Dr. Cass-Calay explained that the increase until 2012 was due to reduced fishing mortality in the east and high recruitment years in the mid-2000s. However, from 2011-2014 there have been no strong recruitments observed, and some indices of abundance have suggested a decline. The projections are carried forward with average recruitment and do not assume any strong recruitment years, resulting in continued declines.

One SSC member suggested that since OFL and ABC would increase with reallocation, the existing management measures would not exceed the new OFL and ABC. Therefore, the Council would have the option to not make any changes.

Following the presentations, the SSC passed the following motion:

Motion: The SSC reviewed the changing allocation scenarios between the commercial and recreational sectors of the Gulf red snapper fisheries and concluded that if the Council changes the allocation between the two sectors, this would prompt the need to reevaluate the OFL and ABC projections.

Motion carried unanimously

Evaluation of recent trends in gag CPUE indices

Dr. Cass-Calay reviewed 7 CPUE indices for gag that were updated through 2014. The 2013 SEDAR 33 gag stock assessment had used indices through 2012. Projected trajectories from SEDAR 33 based on average recruitment have not been realized. Recreational landings per angler hour have been declining since 2010 for headboats, and since 2008 for charter boats and private vessels. Fishery-independent indices have also shown declining CPUE indices in recent years. In addition, an index of recruitment success for northeastern Gulf of Mexico gag grouper by year based on a model that uses oceanographic conditions to project larval transport model runs projects below average recruitment since 2010 (Figure 6).

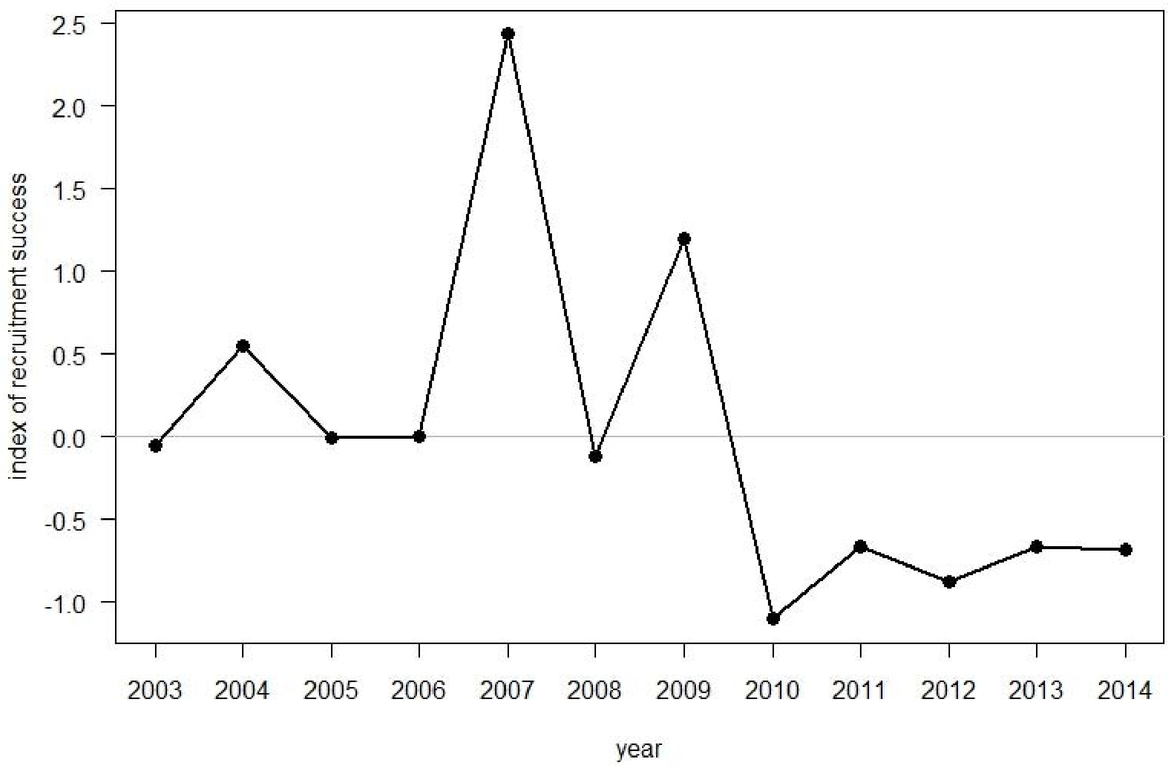


Figure 6. Expected recruitment anomalies for northeastern Gulf of Mexico gag grouper by year based solely on the effects of oceanographic conditions (update from SEDAR33-DW18).

Following presentation of the updated indices, the SSC passed the following motions.

Motion: The SSC reviewed the updated gag indices of abundances provided by the SEFSC and considers the analysis the best scientific information available LB/BG
Motion carried unanimously

Motion: The SSC recommends that, given the recent declines in fishery dependent and fishery independent indices of abundance for gag, that the Council use caution when setting ACL and ACT for 2015-2017.
Motion carried 15 to 1

Hogfish OFL and ABC

Mr. Dustin Addis (Florida FWC) presented a summary of OFL and ABC projections for the west Florida shelf hogfish stock. The SSC previously concluded that the west Florida Hogfish stock is neither overfished nor undergoing overfishing. The 2014 SEDAR 37 hogfish assessment used data through 2012. Commercial and recreational catches for 2013 and 2014 were obtained from the FWRI Trip Tickets and Discard logbook program and from MRIP and the Southeast Region Headboat Survey respectively. 2015 catches were assumed to be the average of 2013-2014. Recreational discards were left out of assessment model but were included in the projections. Projections were made using Stock Synthesis 3 and $F_{30\%\ SPR}$ as a proxy for F_{MSY}. A yield stream of OFL was produced using a P* = 0.5 and a yield stream of ABC was produced using a P* = 0.4 with a CV of 0.37. Projection results are based on year 1 = 2016 and extending through 2026.

Yields are projected to decline from 2016 (Figure 7, Tables 5 and 6) toward equilibrium values of:

OFL = 161,900 lbs. whole weight
ABC = 159,261 lbs. whole weight
OY = 151,826 lbs. whole weight

For reference, the current hogfish ACL in the Gulf of Mexico is 208,000 pounds.

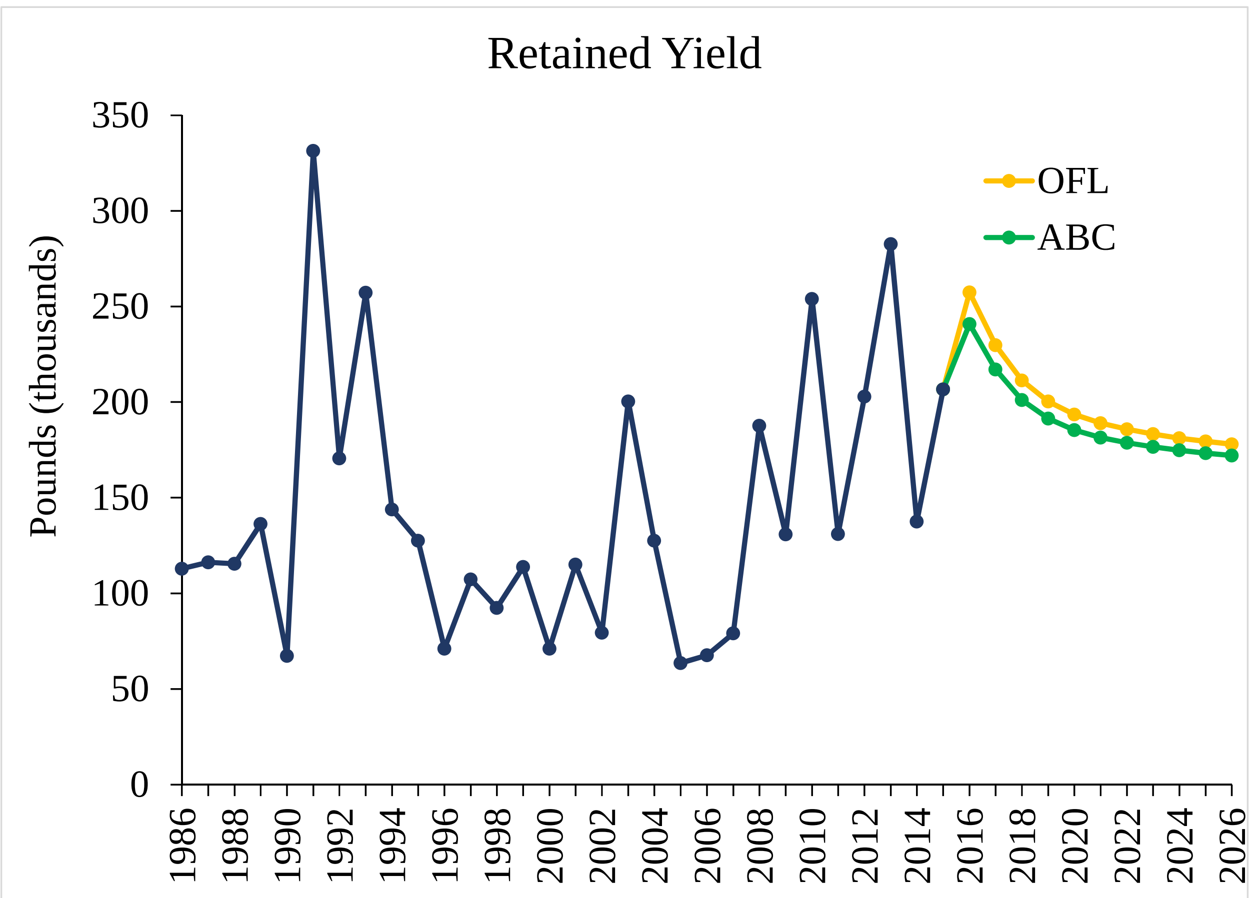


Figure 7. West Florida shelf hogfish stock OFL and ABC yield trends.

SSC members noted that declining yield streams appear to be a common feature of several stock OFL/ABC projections, and questioned if that was an artifact of Stock Synthesis. It was suggested that this was more likely the result on recent high recruitment levels being replaced by average recruitment going forward.

Table 5. Projected OFL yield stream for the west Florida hogfish stock using P* = 0.5.

West Florida Shelf Hogfish Stock Projected OFL (pounds are in whole weight)				
YEAR	**Yield (pounds)**	**Yield (numbers)**	**Discards (pounds)**	**Discards (numbers)**
2016	257,140	95,407	288	89
2017	229,432	84,073	276	84
2018	211,044	77,691	266	82
2019	200,060	74,272	257	81
2020	193,281	72,332	248	80
2021	188,783	71,125	240	80
2022	185,557	70,294	233	80
2023	183,048	69,679	227	80
2024	181,002	69,190	221	80
2025	179,277	68,777	215	80
2026	177,806	68,410	211	80

Table 6. Projected ABC yield stream for the west Florida hogfish stock using P* = 0.4 and CV = 0.37.

West Florida Shelf Hogfish Stock Projected OFL (pounds are in whole weight)				
YEAR	**Yield (pounds)**	**Yield (numbers)**	**Discards (pounds)**	**Discards (numbers)**
2016	240,081	89,252	288	89
2017	216,808	79,429	278	85
2018	200,783	73,810	269	83
2019	191,139	70,778	261	82
2020	185,193	69,061	254	81
2021	181,275	68,000	247	81
2022	178,490	67,277	241	81
2023	176,341	66,748	235	81
2024	174,601	66,333	230	82
2025	173,143	65,985	225	82
2026	171,910	65,677	221	82

SSC members noted that ABC is close to OFL, but this is similar to results obtained by the PFMC's ABC control rule when using a CV = 0.37. In keeping with recent practice and concerns about the uncertainty associated with long-range projections, the SSC recommended

OFL and ABC for just three years. In the motions below, OFL and ABC yields are rounded to four digits, also in keeping with recent practice.

Motion: The SSC recommends that the west Florida hogfish stock OFL yield stream for the years 2016 – 2018 using a P* of 0.5 be as follows:
2016 257,100 lbs. ww
2017 229, 400 lbs. ww
2018 211,000 lbs. ww
Motion carried unanimously

Motion: The SSC recommends that the ABC for the west Florida hogfish stock for the years 2016-2018 using a P* of 0.4 and a CV of 0.37 be as follows in lbs. ww:
2016 240, 400 lbs. ww
2017 216,800 lbs. ww
2018 200,800 lbs. ww
Motion carried unanimously

The SSC considered offering an alternative ABC based on a constant catch strategy. However, a motion to recommend a constant catch ABC based on the average of the 2016-2018 ABCs was withdrawn because it would have resulted in the ABC exceeding OFL in 2018. The Council, however, has the option to set a constant catch ACL at any level that does not exceed any of the annual ABCs.

SSC members felt that if the Council would like to have alternative constant catch ABC yield streams, there is a need for the SEFSC to develop a standardized method for calculating constant catch yield streams.

Dr. Luiz Barbieri discussed the South Atlantic SSC's OFL and ABC projections for the east Florida/Florida Keys hogfish stock, which is overfished and undergoing overfishing. This stock extends partially into Gulf Council jurisdictional waters, but mostly occurs in South Atlantic waters. South Atlantic SSC rebuilding projections were made at a P* = 0.275. Given that the stock occurs primarily in South Atlantic waters, the SSC felt that the South Atlantic SSC should take the lead in setting OFL and ABC.

Motion: The SSC concurs with the SAFMC SSC OFL and ABC recommendations for the FL Keys eastern Florida hogfish stock. .
Motion carried unanimously

Mutton Snapper OFL and ABC

Mr. Joe O'Hop (Florida FWC) reviewed the analysis used to project OFL and ABC for the mutton snapper stock. Mutton snapper is a single stock that crosses Gulf and South Atlantic Council jurisdictions. The SSC had previously reviewed the SEDAR 15A mutton snapper update assessment, but had not made any recommendations regarding stock status or OFL/ABC because of a lack of a quorum. The SSC decided to recommend stock status before proceeding to OFL/ABC recommendations.

Although a series of sensitivity runs produced varying results, the base model (yellow triangle in Figure 8) indicated that the fishing mortality rate was below the F_{MSY} proxy of $F_{30\%\ SPR}$, and the spawning stock biomass was above both MSST and the SSB_{MSY} proxy of $SSB_{30\%\ SPR}$.

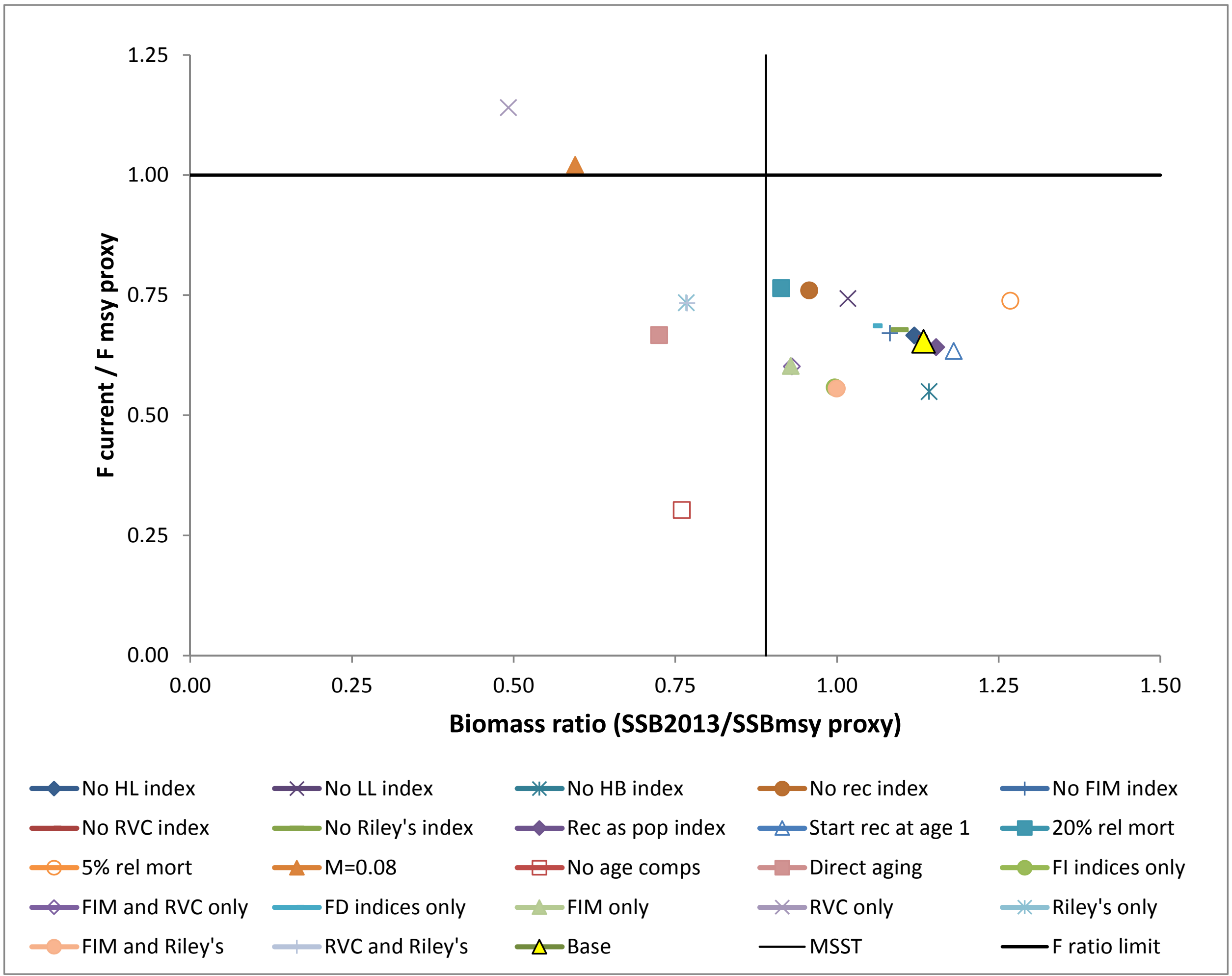


Figure 8. Summary of results of base model rum and sensitivity runs of mutton snapper in SEDAR 15A update assessment.

Motion: Based on the SEDAR 15a Mutton snapper update assessment, the SSC considers the stock neither overfished nor undergoing overfishing

Motion carried by consensus

The SSC reviewed the OFL and ABC yields recommended by the South Atlantic SSC (Table 7).

Table 7. SAFMC SSC Mutton Snapper stock status and ABC recommendations.

Criteria	Deterministic	Probabilistic		
Overfished evaluation	Not overfished: SSB/MSST=1.12			
Overfishing evaluation	Not overfishing: $F/F_{30\%SPR}$=0.65			
MFMT ($F_{30\%SPR}$)	0.18			
$SSB_{30\%SPR}$ (lbs females)	4,649,200			
MSST (lbs females)	4,137,700			
Y at $F_{30\%SPR}$ (MSY proxy, lbs)	912,500			
Y at $F_{40\%SPR}$ (lbs)	874,000			
ABC Control Rule Adjustment	20%			
P-Star	30%			
OFL RECOMMENDATION				
Year	Landed LBS	Discard LBS	Landed Number	Discard Number
2014	664,876	30,708	113,300	17,341
2015	664,877	44,496	125,245	25,215
2016	713,492	54,005	148,995	29,298
2017	751,711	55,962	164,150	29,660
2018	793,823	56,994	173,656	30,071
2019	835,318	58,170	180,716	30,430
2020	850,077	58,857	184,868	30,780
ABC RECOMMENDATION				
Year	Landed LBS	Discard LBS	Landed Number	Discard Number
2014	664,900	30,700	113,300	17,300
2015	664,900	44,800	125,800	25,400
2016	692,000	52,800	145,400	28,600
2017	717,200	53,700	157,500	28,400
2018	746,800	53,900	164,500	28,300
2019	774,400	54,400	169,300	28,300
2020	798,300	54,500	172,700	28,300

Motion: The SSC concurs with the OFL and ABC yield streams projected for Mutton snapper as adopted by the SAFMC SSC for the years 2016-2020

Motion carried 16 to 0

Other Business

The SSC is currently scheduled to elect a new Chair and Vice-chair at its next meeting (tentatively scheduled for July 2015). However, since this will be the first meeting of a reconfigured SSC, there may be several members who are new to the process. For this reason, some SSC members feel that the election should be deferred until the subsequent SSC meeting (tentatively scheduled for September 2015). This will be discussed at the first meeting of the reconstituted SSC.

SSC Members Present

Standing SSC
William Patterson, Chair
Luiz Barbieri, V. Chair
Harry Blanchet
Benjamin Blount
Shannon Cass-Calay
Bob Gill
Read Hendon
Walter Keithly
Kai Lorenzen
Jim Tolan
John Ward
Elbert Whorton

Special Reef Fish SSC
Jason Adriance
Robert Ellis
John Mareska
Brooke Shipley-Lozano

Council and Staff
Steven Atran
Assane Diagne
Karen Hoak
Ava Lasseter
Camp Matens

Others
Dustin Addis, FL FWCC
Richard Brame, CCA
Ken Brennan, NMFS/SEFSC
Dale Diaz, MS DMR
Michael Drexler, Ocean Conserv.
Dan Goethel, NMFS/SEFSC
Joe O'Hop, FL FWCC
Jessica Stephen, NMFS/SERO
Russell Underwood
Wayne Werner

APPENDIX B

NOAA FISHERIES

South East Fisheries Science Center

2014 Update Gulf of Mexico Red Snapper

Gulf of Mexico Fishery Management Council Meeting

January 26, 2015

Shannon L. Cass-Calay (SEFSC)
Clay E. Porch (SEFSC)
John F. Walter (SEFSC)
Jakob Tetzlaff

Terms of reference

1. Update the SEDAR 31 GOM red snapper assessment with data through 2013
2. Document changes or corrections made to model and input datasets…
    - **use methods from the September 2014 MRIP Calibration workshop, if possible**
3. Update estimates of stock status and management benchmarks, and provide probability of overfishing occurring at specified future harvest and exploitation levels
4. Develop a stock assessment update report to address these TORS and fully document the input data and results of the stock assessment update

Review

Model same as SEDAR 31

- 1872-2013
- 2 regions: East and West of the Mississippi River
- Flexible structure allows key parameters to change through time
  - **Recruitment of young fish to the population** – to accommodate and apparent increase in productivity in recent years (1984-2013)
  - **Selectivity** – to account for implementation of IFQ program and circle hooks
  - **Retention** – to account for changes in size limits and IFQ
  - **Discard mortality** – to account for venting

Review

Data same as SEDAR 31 (but updated through 2013)

Fisheries Dependent Data

Catch, Discards, Effort, CPUE, Age

- Com Handline
- Com Longline
- Rec Private Boat + Charter Boat
- Headboat
- Com Closed Season
- Rec Closed Season
- Shrimp Bycatch

Fisheries Independent Data

CPUE, Age composition

- SEAMAP Video
- SEAMAP Plankton
- SEAMAP Summer Trawl
- SEAMAP Fall Trawl
- NFMS bottom longline
- Artificial Reef ROV

Key Changes:

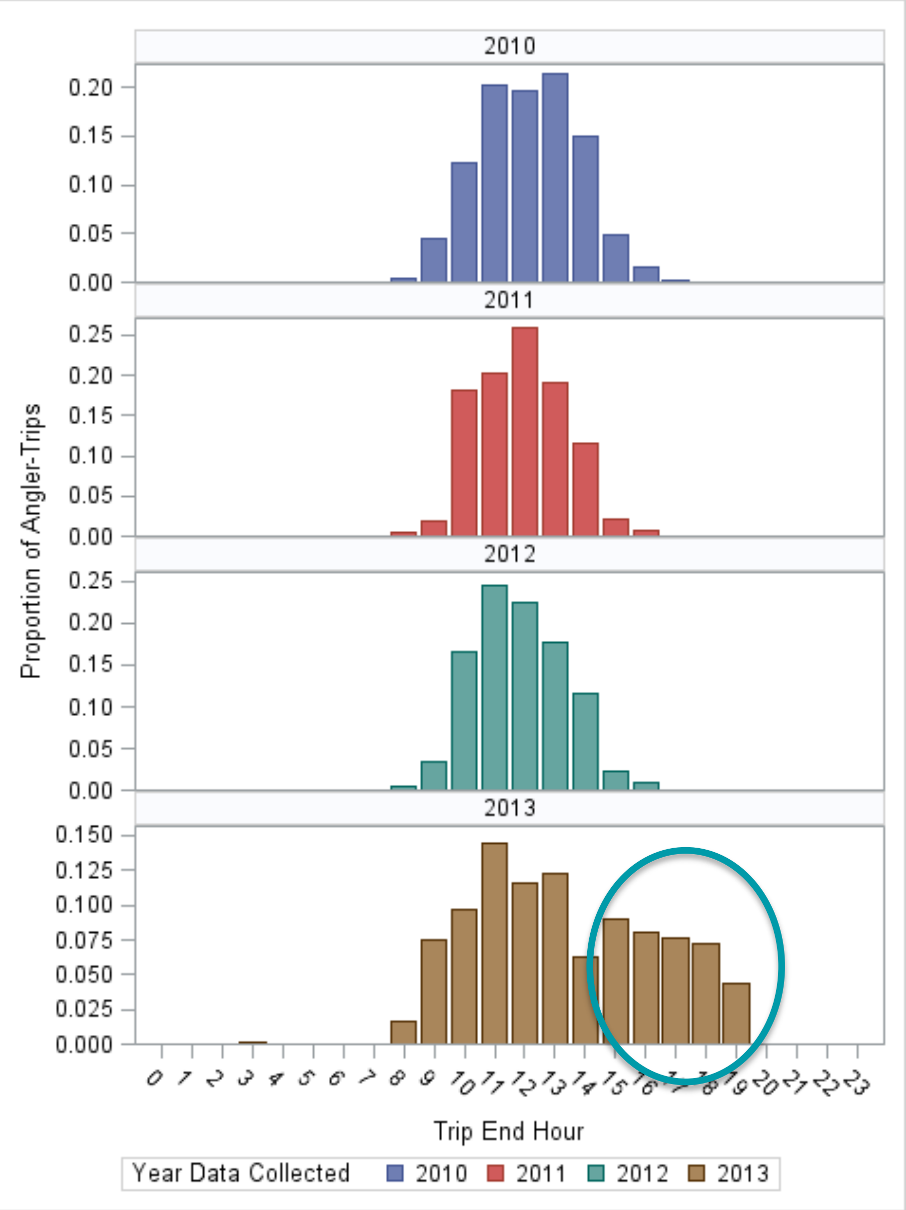
- Used recalibrated MRIP estimates
- Estimated an additional selectivity block (2011-13) for recreational fleets to accommodate recent changes in fishing behavior that appear to have led to a larger average size

"Selectivity" functions are used to model both the vulnerability of fish to the gear as well as the availability of fish. Availability can be related to the spatial distribution of fish by size or age.

MRIP Calibration workshop

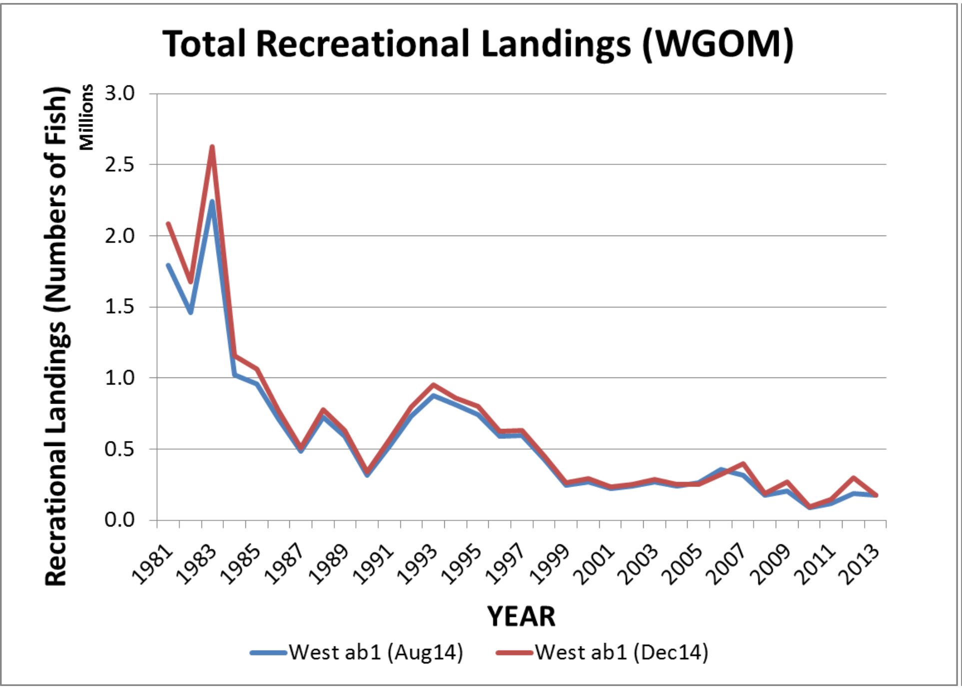
- Changes in design (implemented in 2013) led to changes in proportions of Angler-Trips by Hour
- Estimates were adjusted for possible undersampling of afternoons and evenings

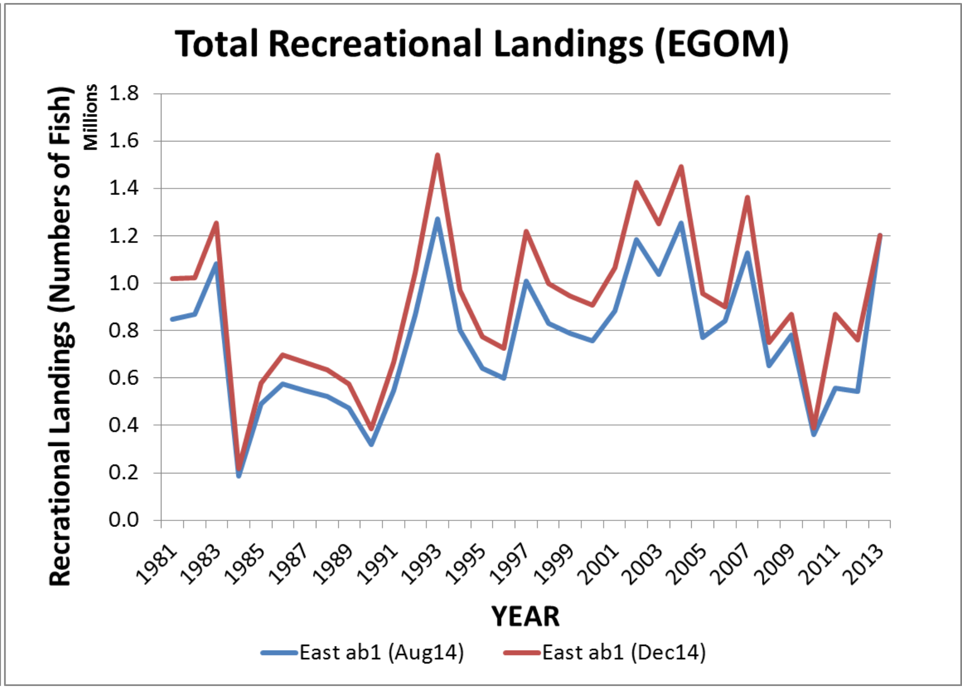
Example: Alabama Private Boat



Effect of Rescaling MRIP Estimates

- Recalibrated recreational landings (AB1) are higher throughout time series
- The increase in estimated discards is larger



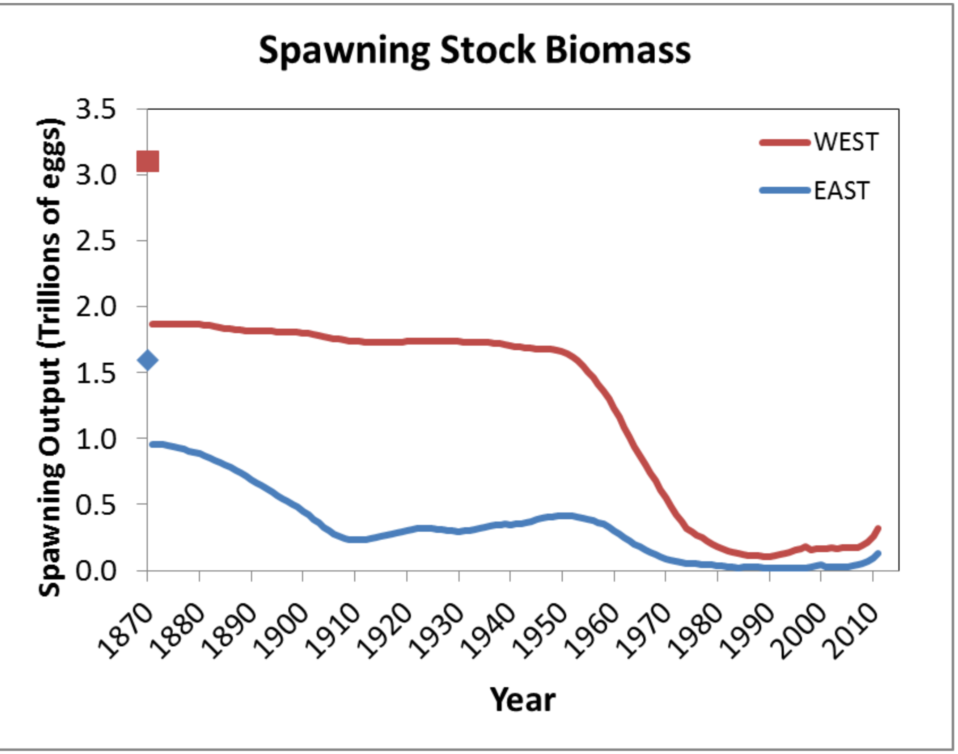


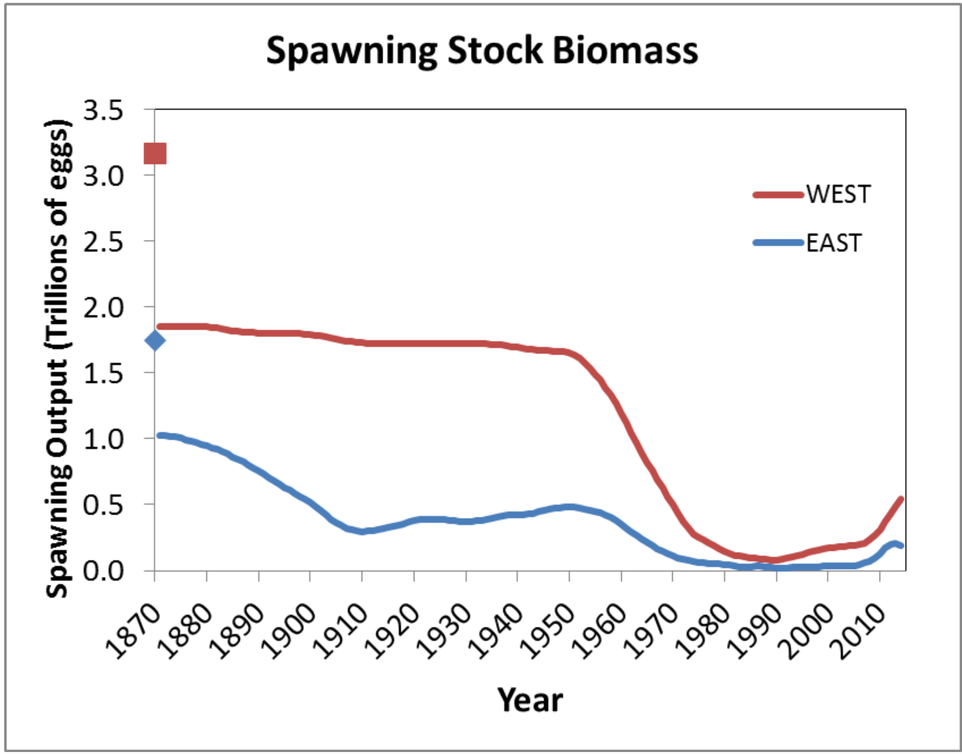
Model Results: Spawning Stock Biomass

- Regional trends in SSB nearly identical to SEDAR 31

SEDAR 31

2014 Update



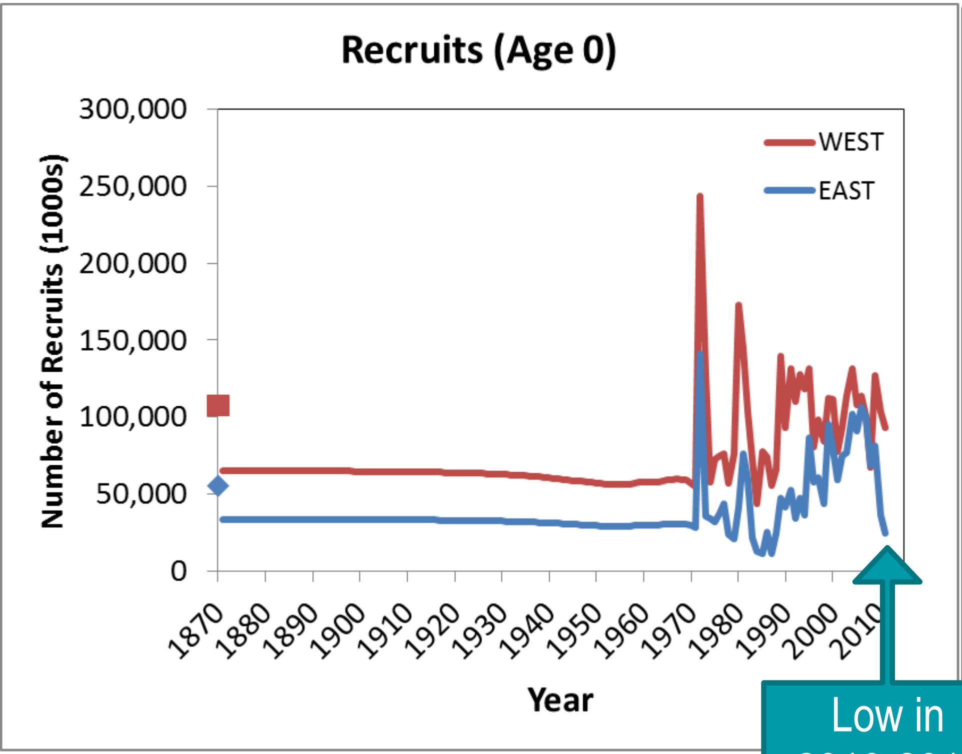


Model Results: Recruitment

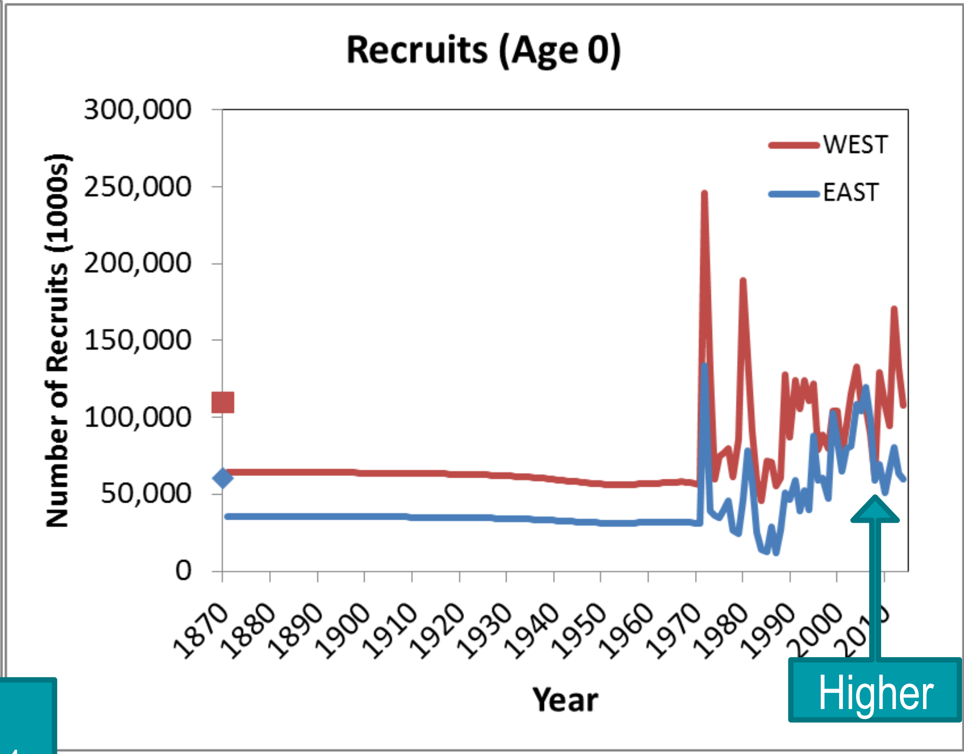
- Regional trends in recruitment similar except higher in 2010-11

SEDAR 31

2014 Update



Low in 2010-2011

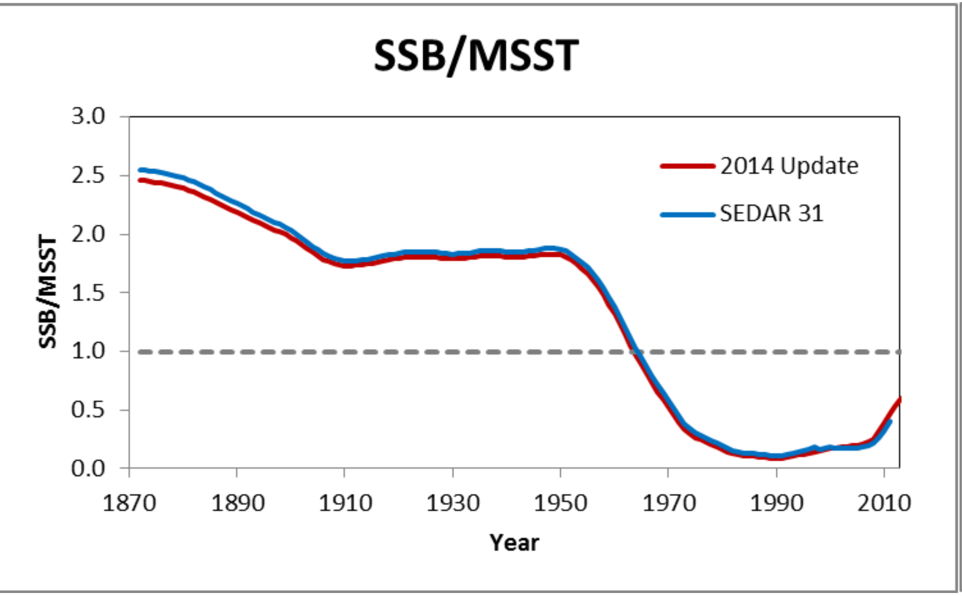


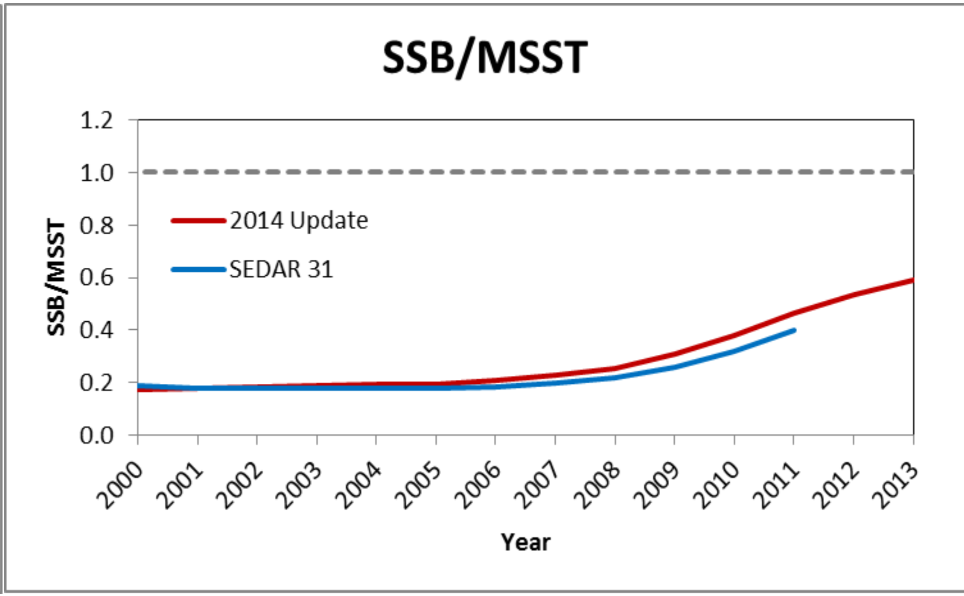
Higher

2010-11 estimates are more reliable in update due to additional age comp in 2012 and 2013

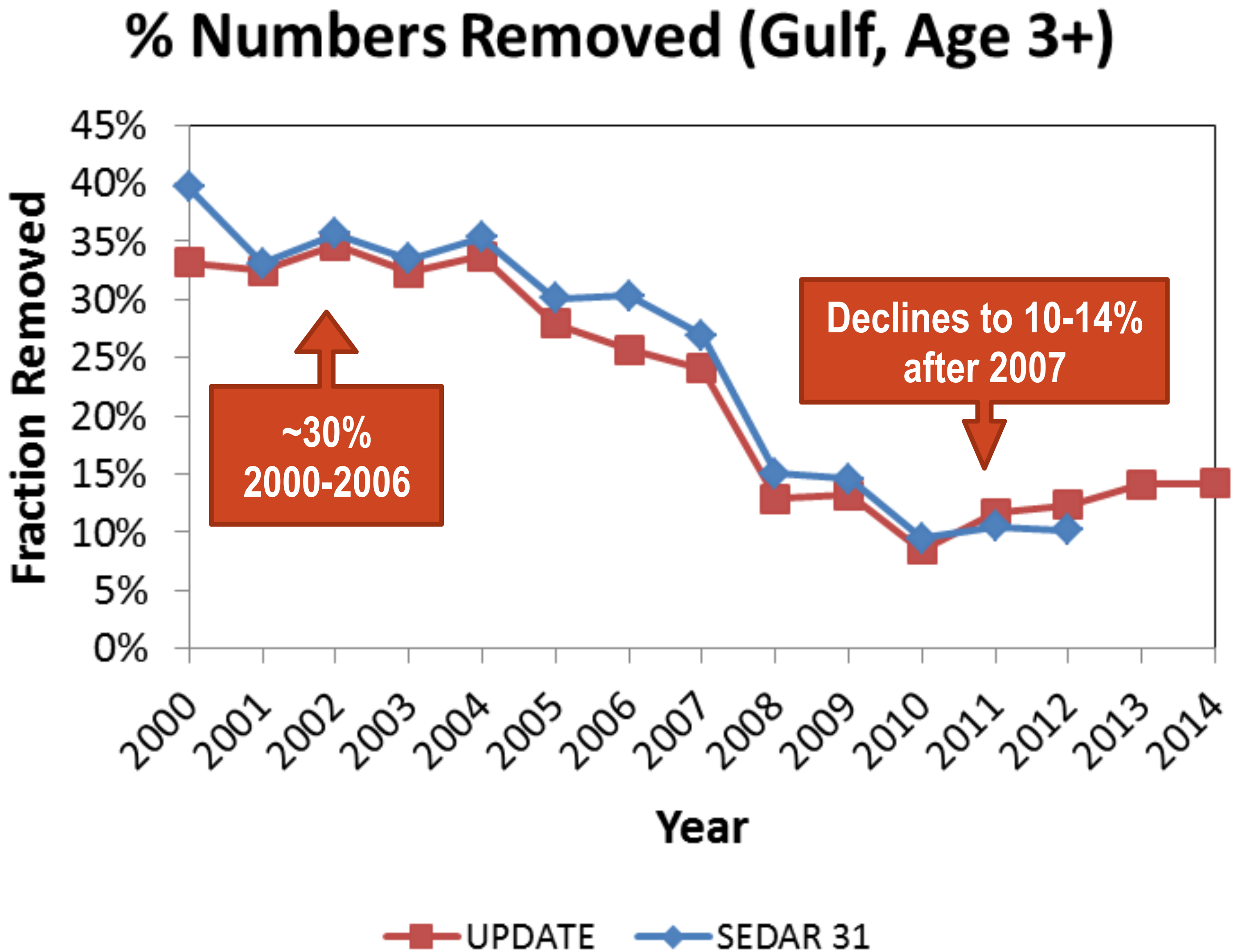
Spawning Stock Status

- Nearly identical to SEDAR 31
- MSST = (1-M)*SSB_SPR26% where M = 0.086

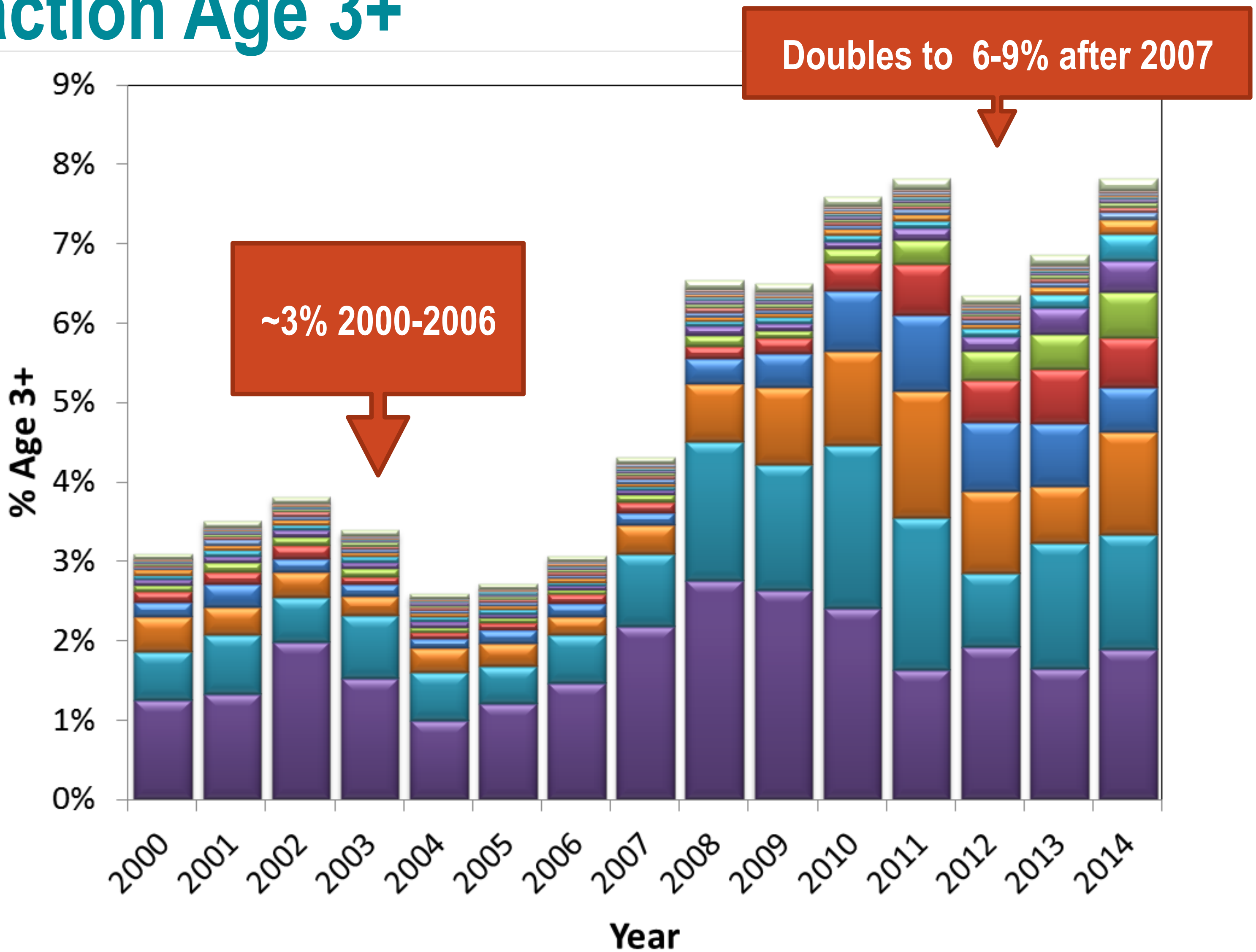




Fraction of Red Snapper Removed by Fishing



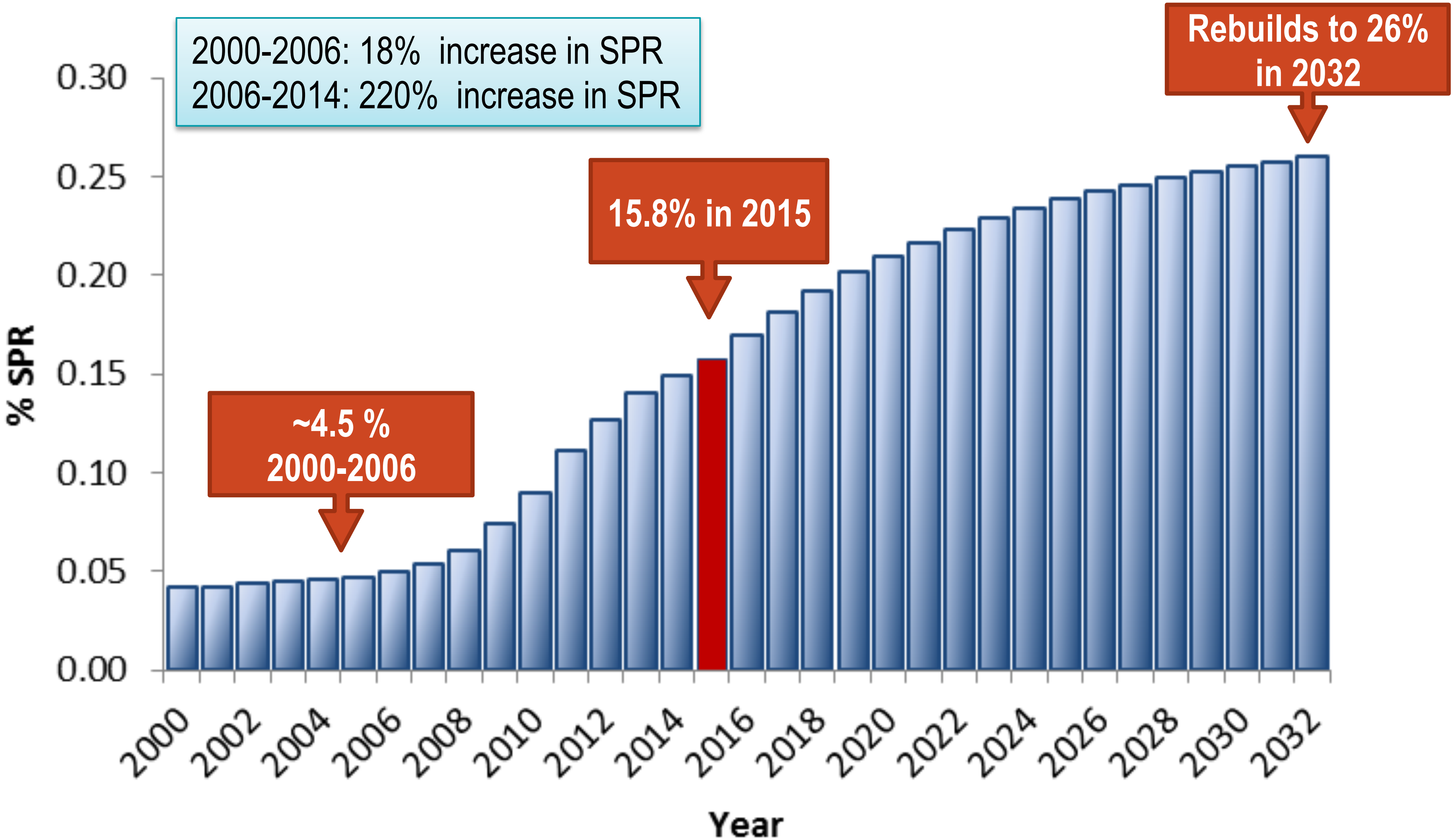
Fraction Age 3+



Projections

- Projection methods identical to SEDAR 31, except that ***SSC based management advice on base model only***
- Catch allocation between commercial and recreational fleets assumed 51:49 split
- ***2014 directed landings not yet available, therefore assumed identical to 2013 - SSC requested updated projections as soon as possible***

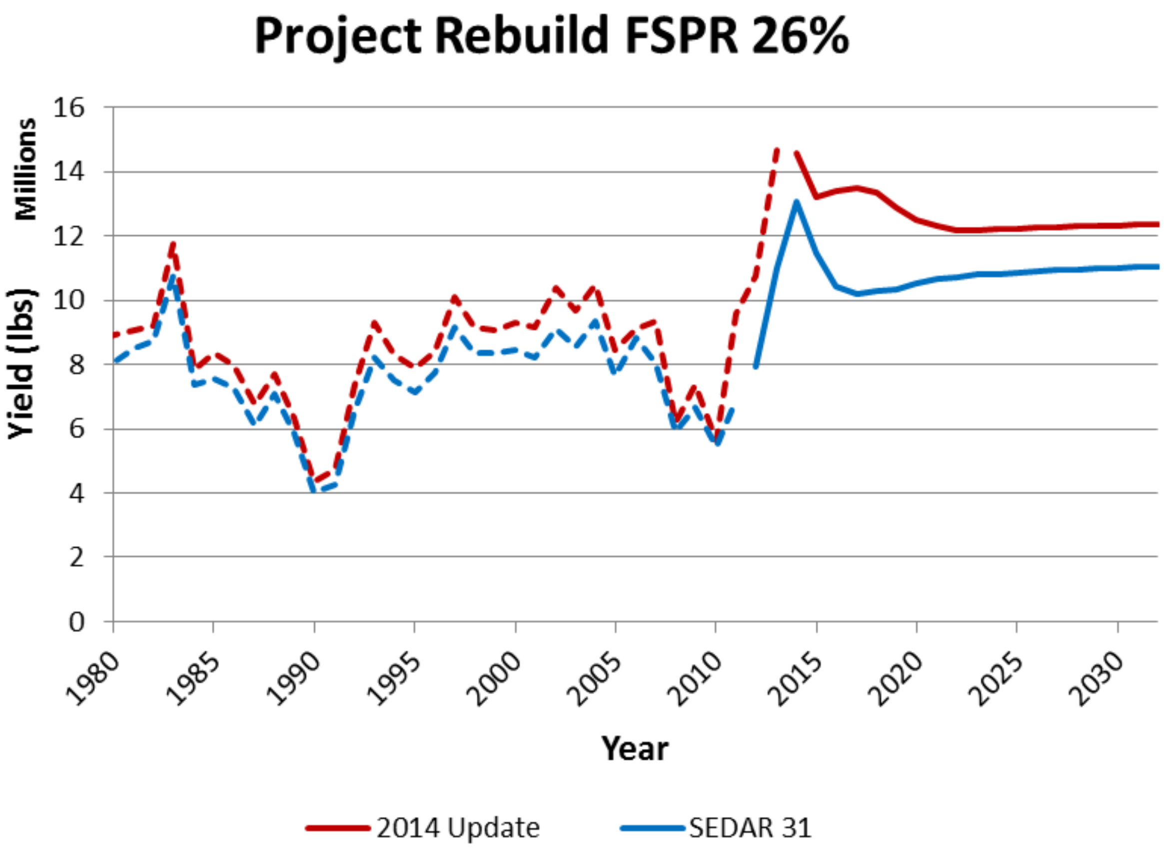
Spawning Potential Ratio: Project F Rebuild



Projected Yield: SEDAR 31 vs. 2014 Update

- MSY and retained yield higher for update than for SEDAR 31

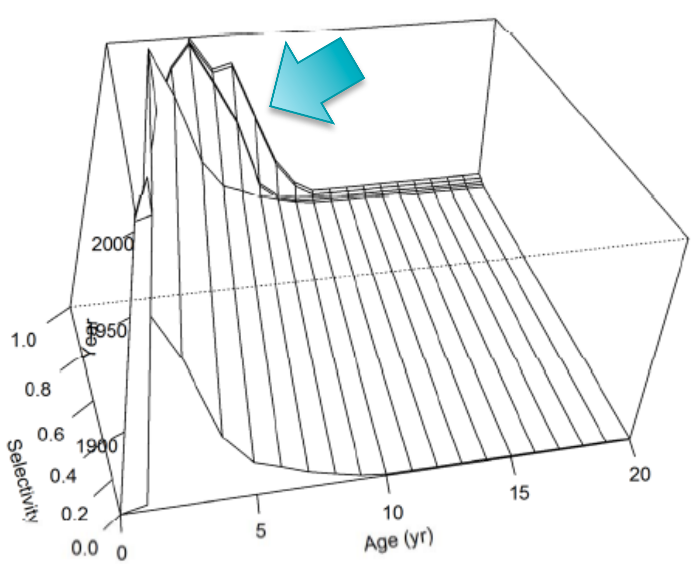
Model	MSY
SEDAR 31	11.7
BASE	12.9



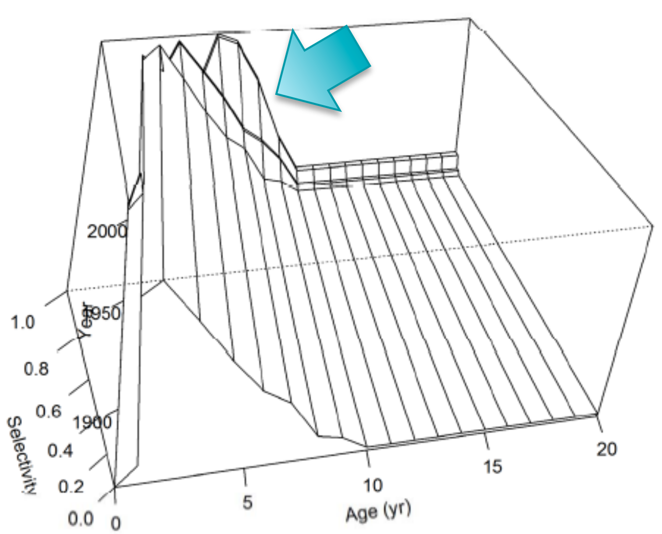
Why the increased yield?

- Increase in total removals due to MRIP recalibration
- New selectivity block for recreational fleets indicates that selectivity of those fleets has shifted to older (heavier) fish in recent years
- CB+PB and HB fisheries shows similar changes

CB+PB West



CB+PB East

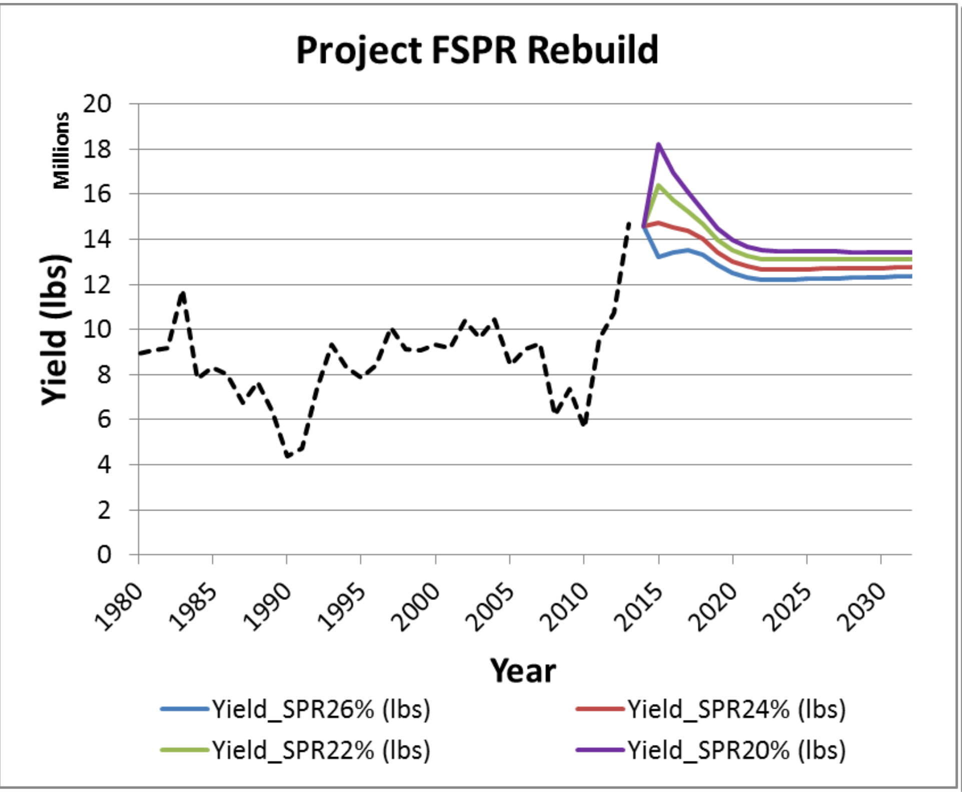


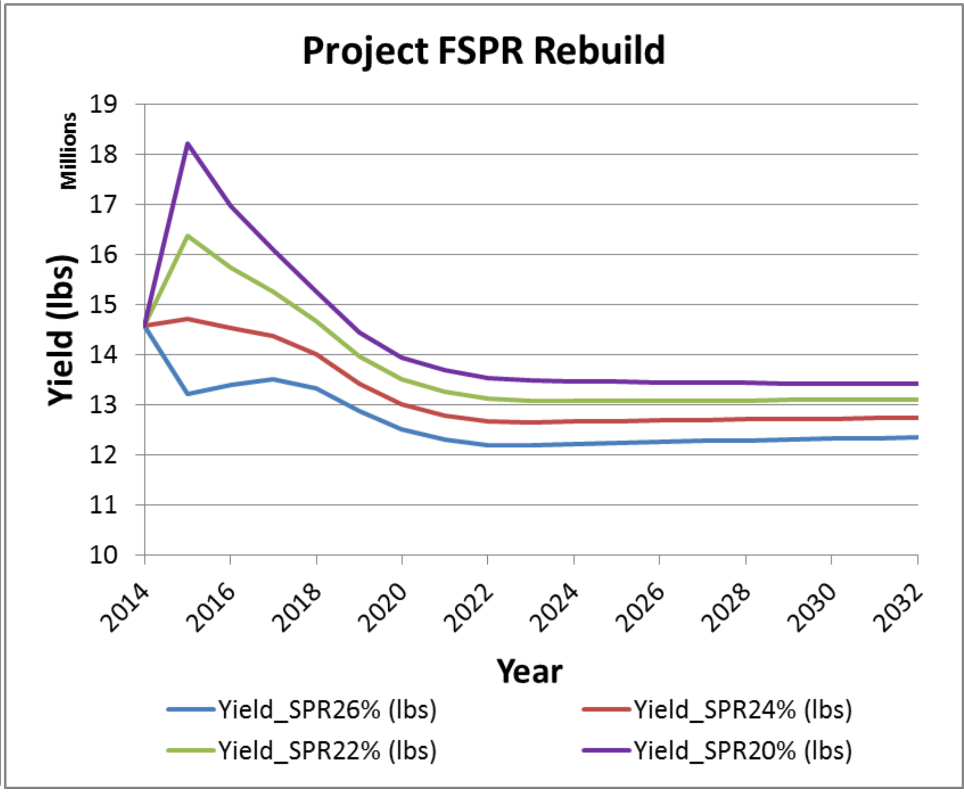
Alternative Reference Points

- At Council request, four proxies for F_{MSY} were considered during projections:
  - $F_{SPR26\%}$
  - $F_{SPR24\%}$
  - $F_{SPR22\%}$
  - F_{MAX} (~ $F_{SPR20\%}$)

Projected Yield (Retained)

- Projected constant F to achieve Rebuild Target (SSB SPR 26%, 24%, 22%, 20%) in 2032.





OFL at Specified FSPR Reference

YEAR	FSPR 26%	FSPR 24%	FSPR 22%	FMAX (SPR20%)	SEDAR 31 BASE*** (FSPR 26%)
2015	14.73	16.03	17.42	18.94	12.52
2016	14.56	15.50	16.46	17.44	11.25
2017	14.40	15.08	15.75	16.41	10.88
2018	14.02	14.54	15.03	15.49	10.92
2019	13.44	13.86	14.26	14.63	10.94
2020	13.03	13.42	13.78	14.11	11.10
Equil.	**12.87**	**13.13**	**13.37**	**13.57**	**11.69**

***** SEDAR 31 management advice developed using constant catch projections**

ABC at Specified FSPR Reference (P* = 0.427)

Assumes Rebuild Year = 2032; Will require revision if recovery plan is adjusted.

YEAR	FSPR 26%	FSPR 24%	FSPR 22%	FMAX (SPR20%)	SEDAR 31 BASE*** (FSPR 26%)
2015	13.00	14.47	16.11	17.92	11.28
2016	13.21	14.34	15.52	16.74	10.28
2017	13.32	14.19	15.05	15.89	10.04
2018	13.13	13.80	14.44	15.04	10.14
2019	12.67	13.23	13.75	14.23	10.22
2020	12.33	12.84	13.32	13.77	10.41
Equil.	**12.51**	**12.87**	**13.20**	**13.48**	**10.10**
Recovery Year F=0	**2018**	**2017**	**2017**	**2017**	**-**

*** SEDAR 31 management advice developed from constant catch projections

Effect of Provisional 2014 Landings Estimates

- REC: Provisional 2014 landings (588K) lower than 2013 (1337K)
- COM: 2014 similar to 2013
- Sensitivity: Use provisional 2014 landings, assume discards continue at 2013 levels
- Project at F Rebuild (Achieve SPR26% in 2032)

Effect of Provisional 2014 Landings Estimates

- **These estimates will require revision when final estimates are available.**

YEAR	ABC (2014 = 2013)	ABC (Provisional 2014)
2015	13.00	13.92
2016	13.21	13.77
2017	13.32	13.66
2018	13.13	13.36
2019	12.67	12.84
2020	12.33	12.48
Equil	**12.51**	**12.65**

Choice of F_{MSY} proxy

- Proxies are used when F_{MSY} cannot be estimated
- If there is TRULY no relationship between spawners and recruits (steepness = 1.0) then $F_{MAX} = F_{MSY}$
- However, at some stock size, recruitment is likely to diminish with decreasing stock size (no spawners = no recruits)
- Many scientists (and some SSC members) have proposed a biologically based FSPR proxy. A review of the literature suggests that red snapper life history characteristics are most consistent with FSPR30-40%
- F26% is a compromise which was adopted by the SSC

Choice of F_{MSY} proxy

- Lower FSPR proxies tend to produce higher yield, and “lower the bar” for recovery.
- An FSPR proxy that is too low will not rebuild the stock to the level that produces MSY in the long term.
- Rebuilding plan may need to be shortened to compensate for a lower SPR benchmark

Summary

- This model used new improved estimates of MRIP landings and discards
- 2014 Update and SEDAR 31 model results are quite similar
- Main Differences: Higher MSY and projected yields for update due to:
    - 2011-2013 recreational selectivity shifted toward larger fish
    - Higher recreational removals due to MRIP recalibration

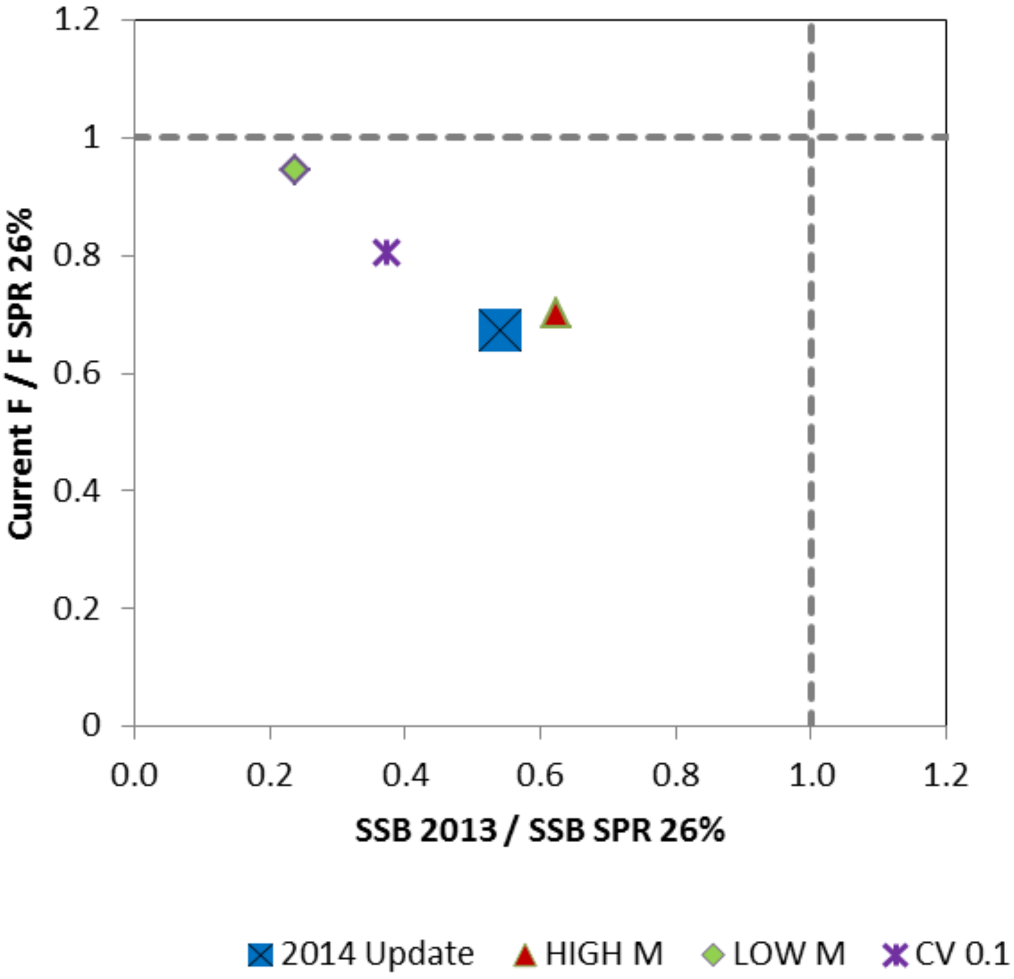
Acknowledgements

- Analytical Team
  - Shannon Cass-Calay
  - Clay Porch
  - Jakob Tetzlaff
  - John Walter
- Data Providers: To numerous to mention by name:
  - State and Academic Partners
  - NOAA SEFSC: Miami, Panama City, Pascagoula, Galveston
- Thank You!

Supplemental Slides

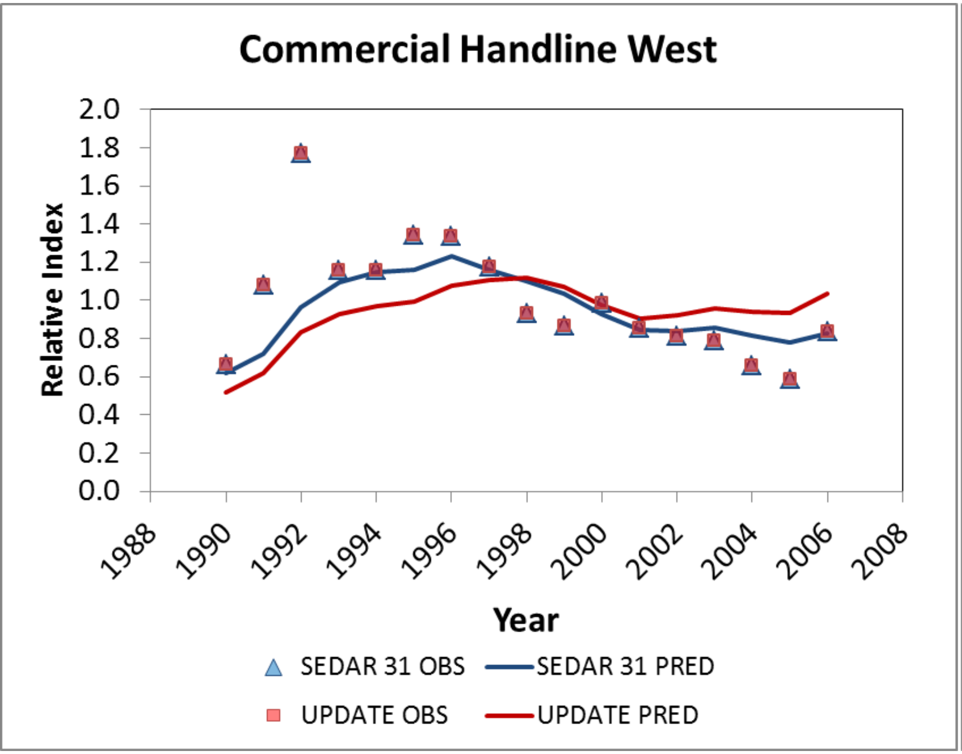
Control Rule Plot

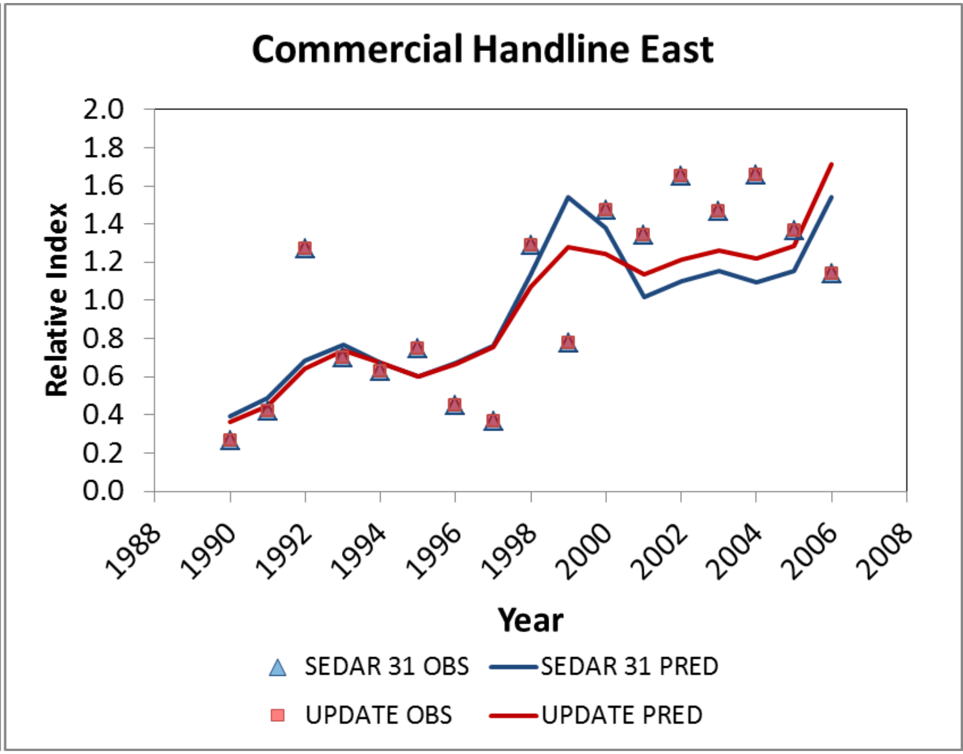
- The base and sensitivity runs examined indicate that the stock remains overfished, but that overfishing is not occurring



Fishery Dependent Indices of Abundance

- Commercial Handline

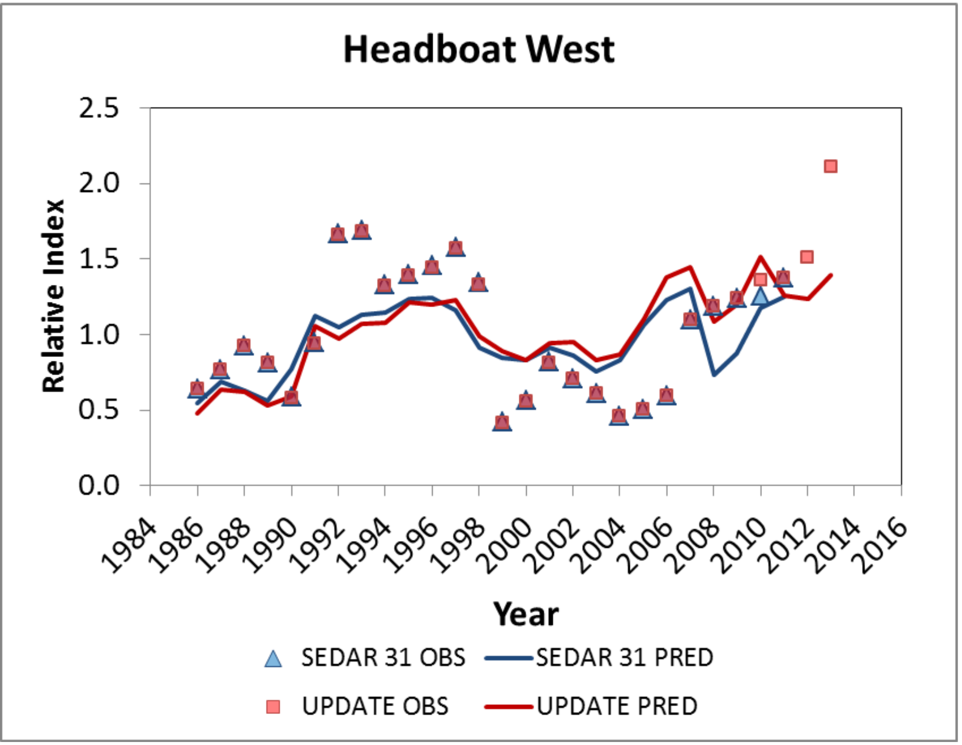


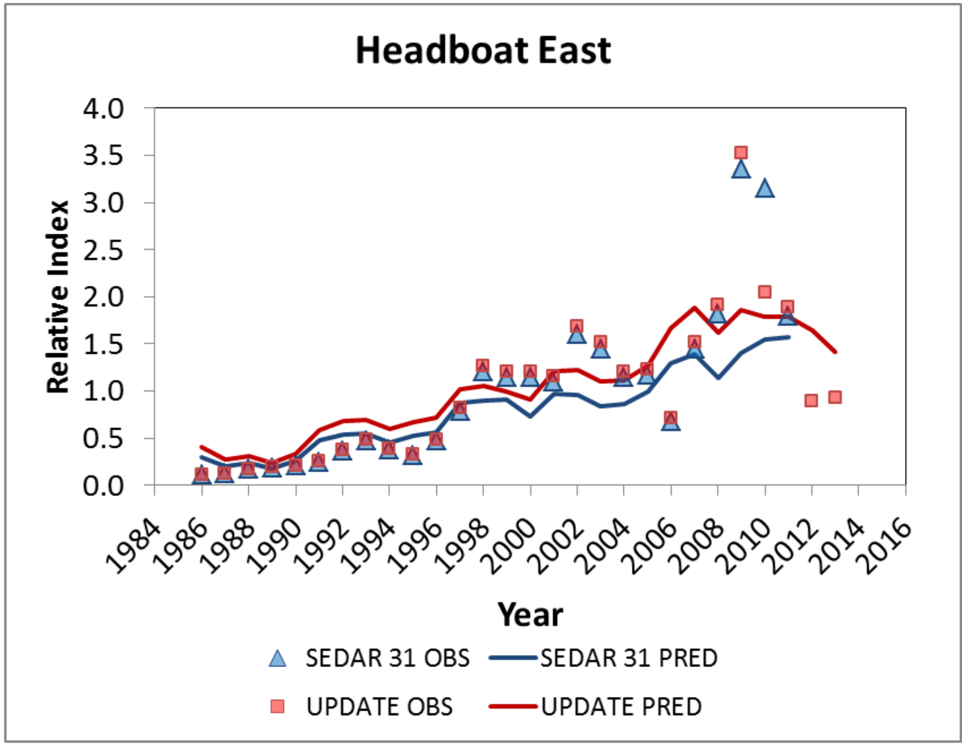


**** SCALED TO MEAN 1990-2006****

Fishery Dependent Indices of Abundance

- Recreational: Headboat

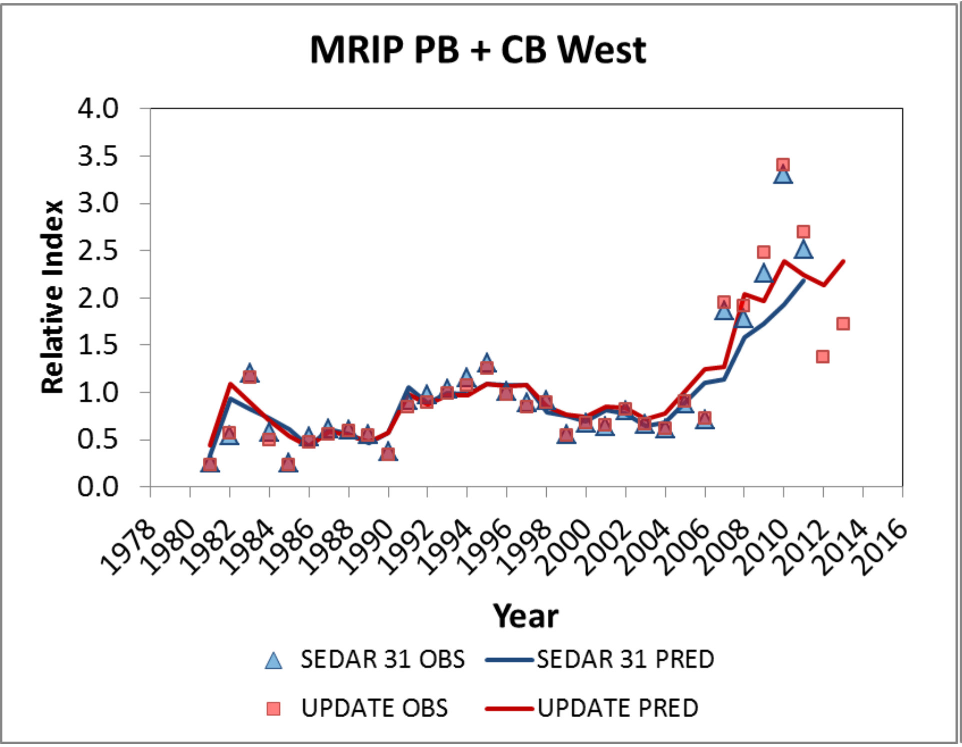


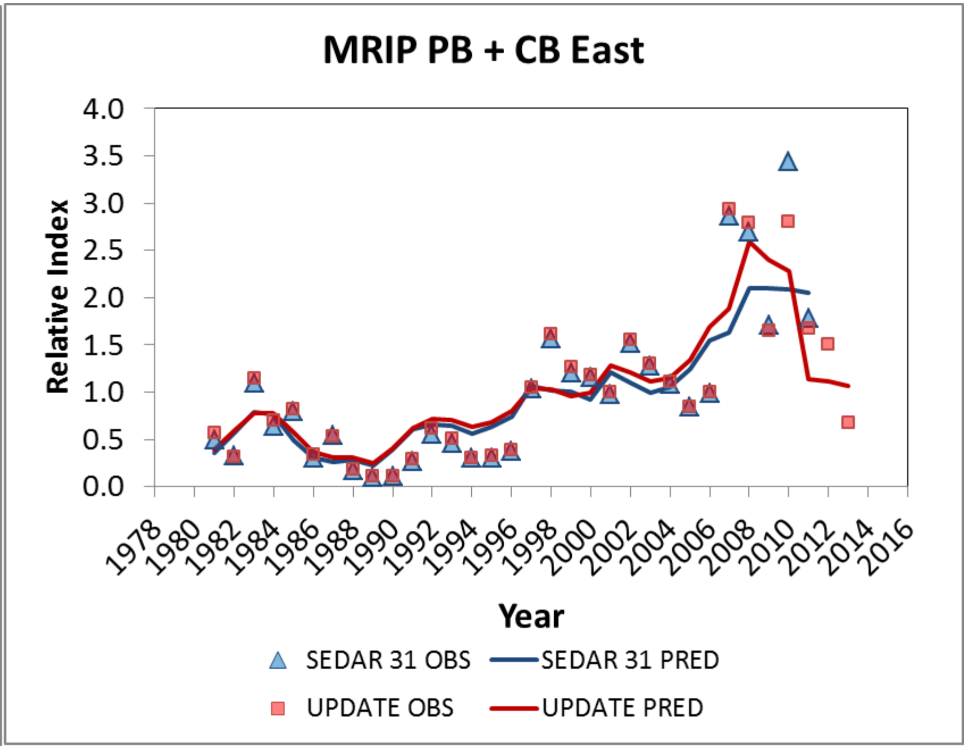


** SCALED TO MEAN 1986-2011**

Fishery Dependent Indices of Abundance

- Recreational: MRIP Charter + Private

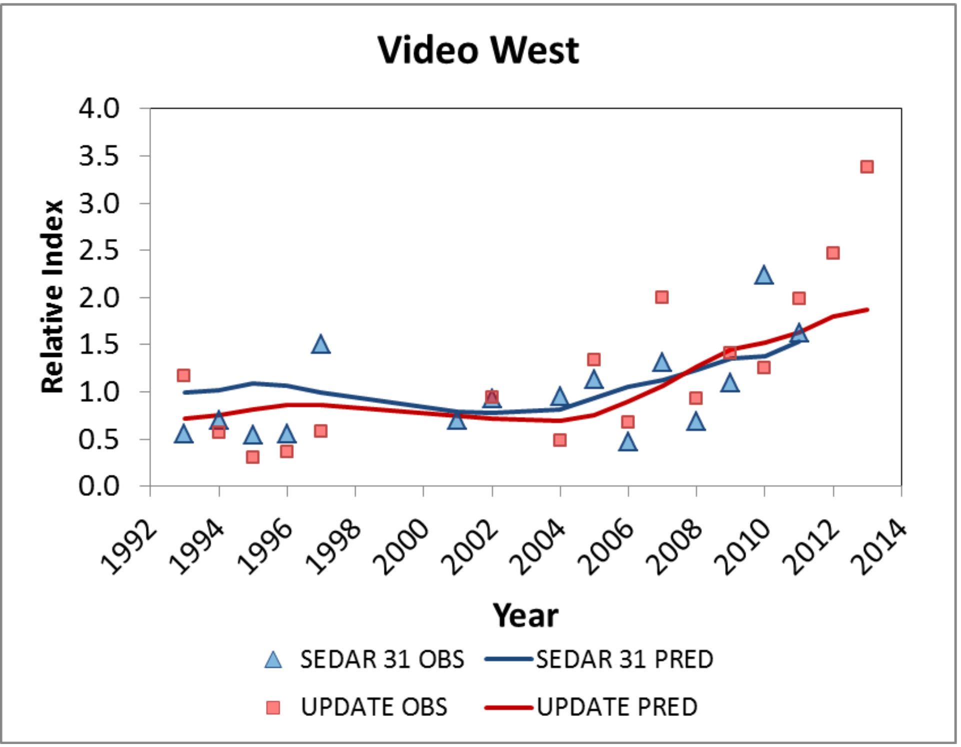


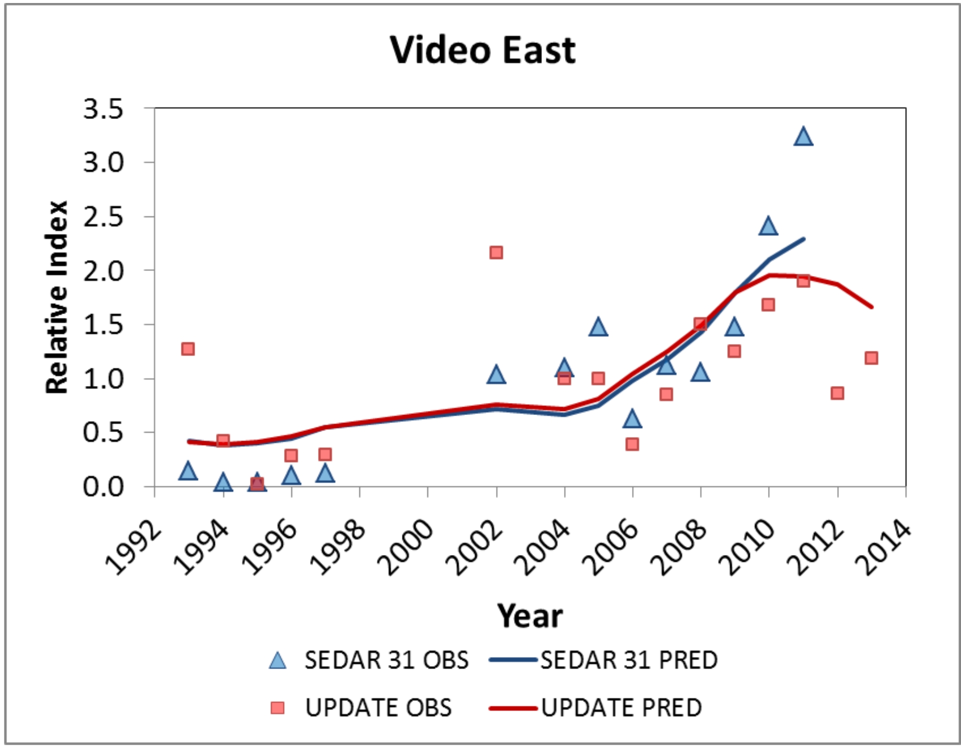


**** SCALED TO MEAN 1981-2011****

Fishery Independent Indices of Abundance

- SEAMAP Video Survey

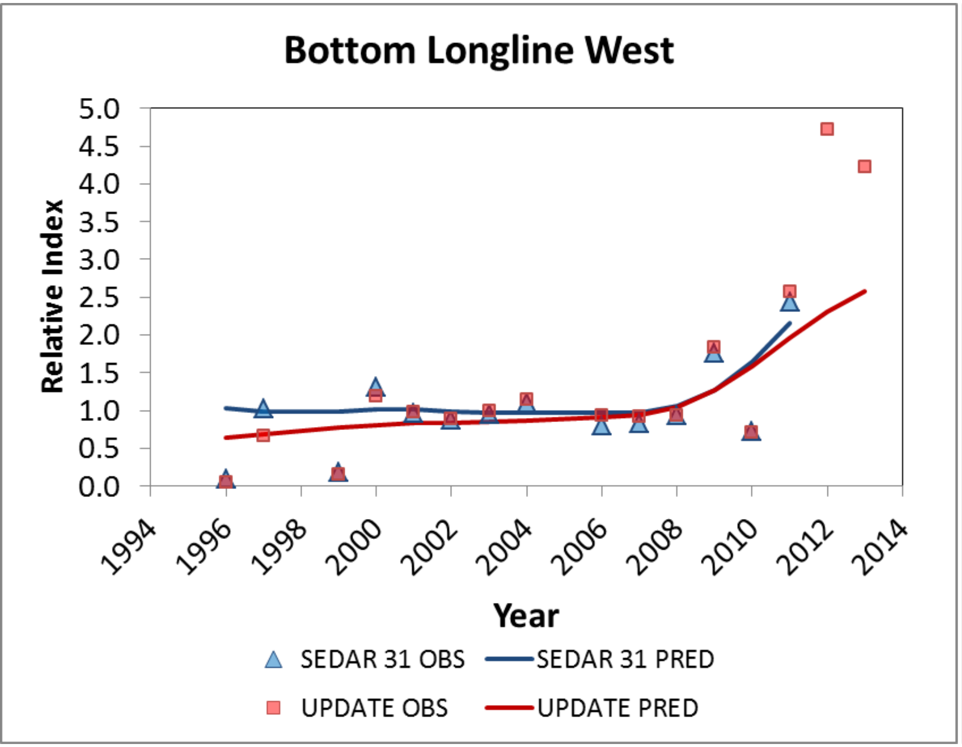


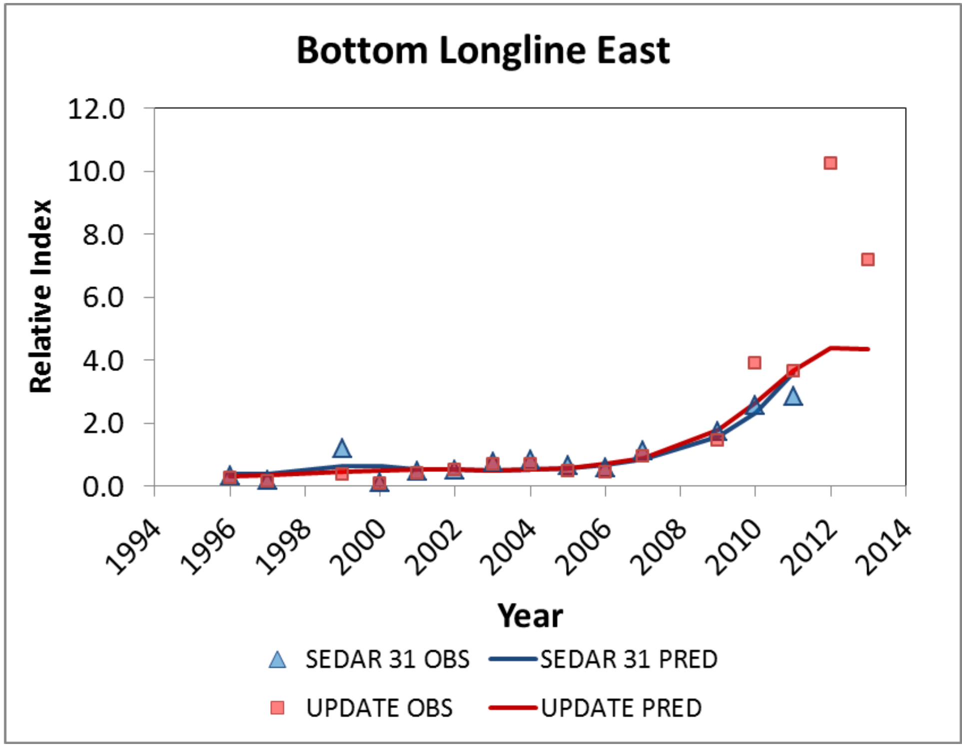


** SCALED TO MEAN 1993-2011**

Fishery Independent Indices of Abundance

- NMFS Bottom Longline

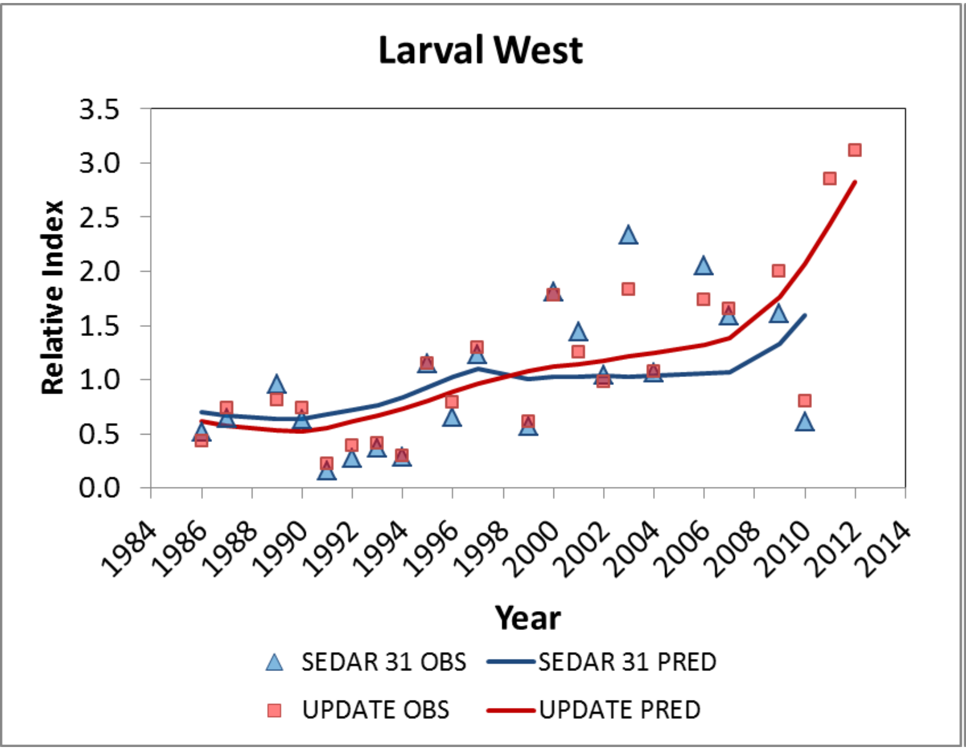


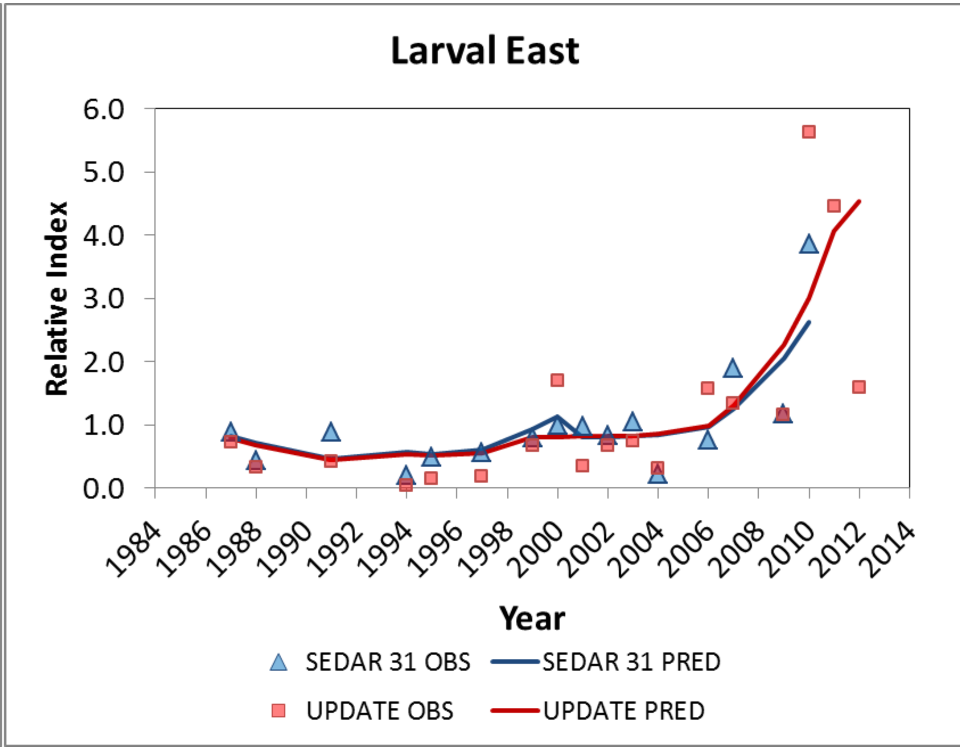


**** SCALED TO MEAN 1996-2011****

Fishery Independent Indices of Abundance

- Larval Survey: Used to Index SSB

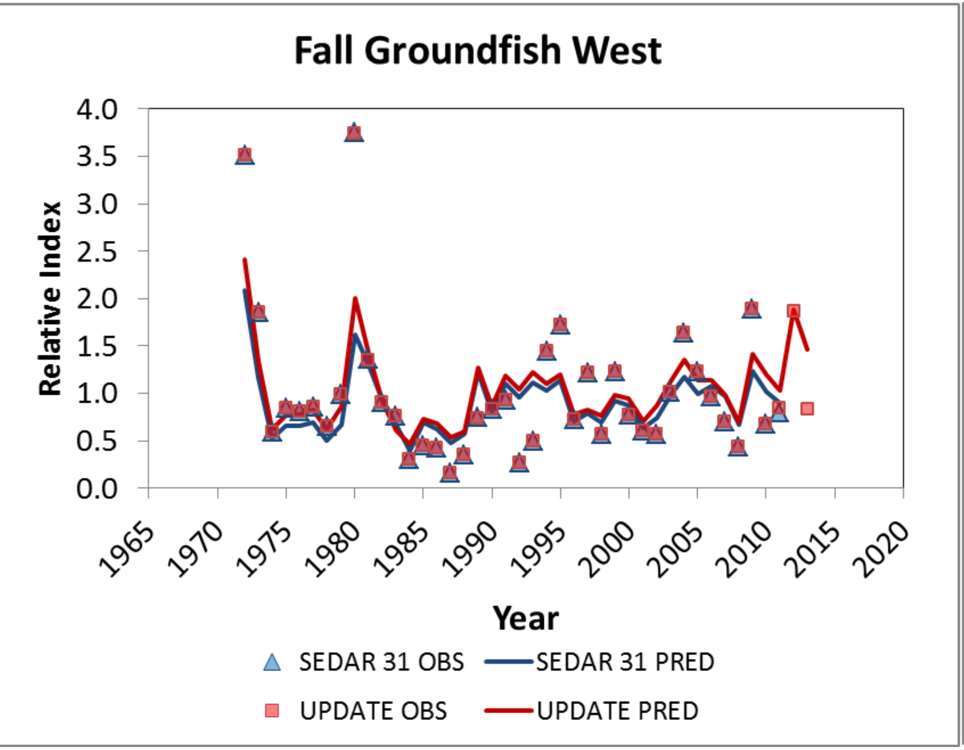


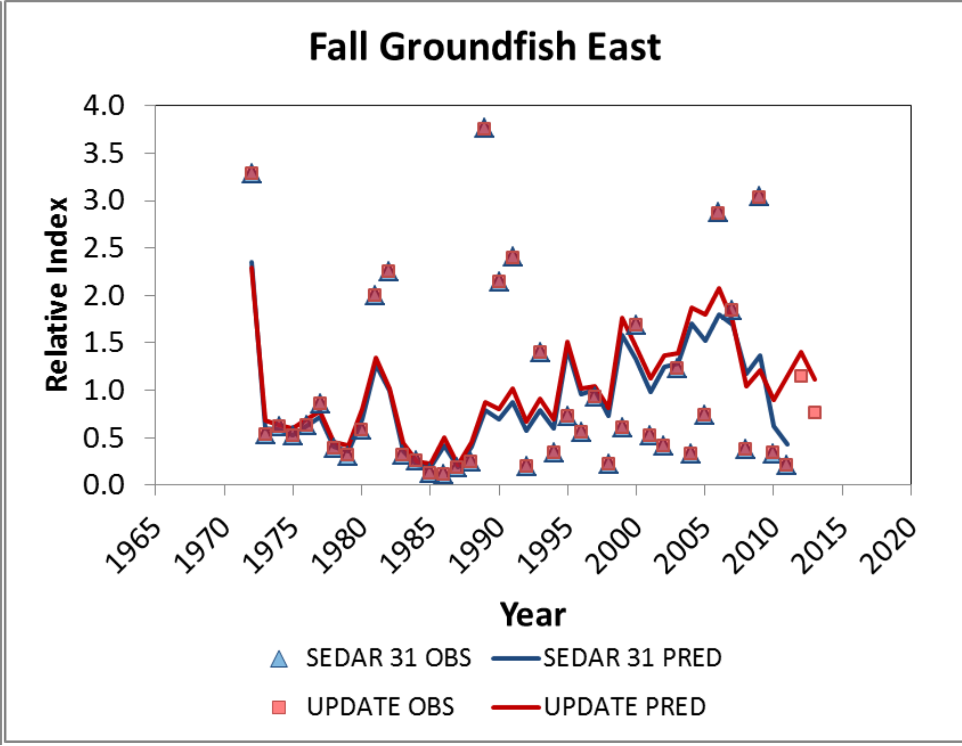


**** SCALED TO MEAN 1986-2010****

Fishery Independent Indices of Abundance

- Fall Groundfish Survey used to index recruits





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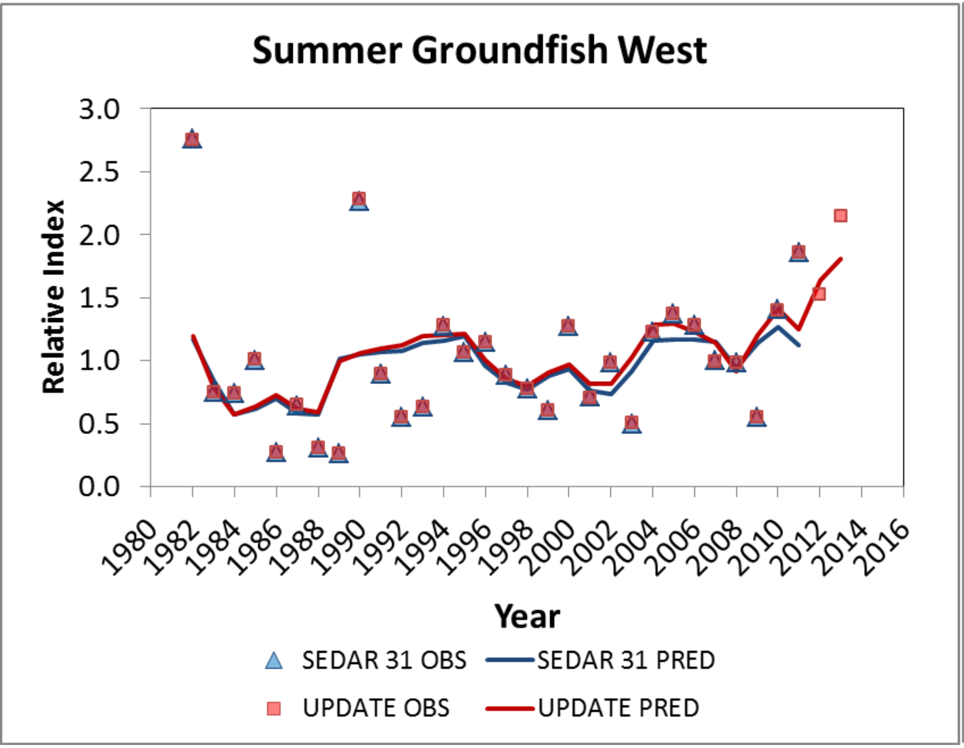
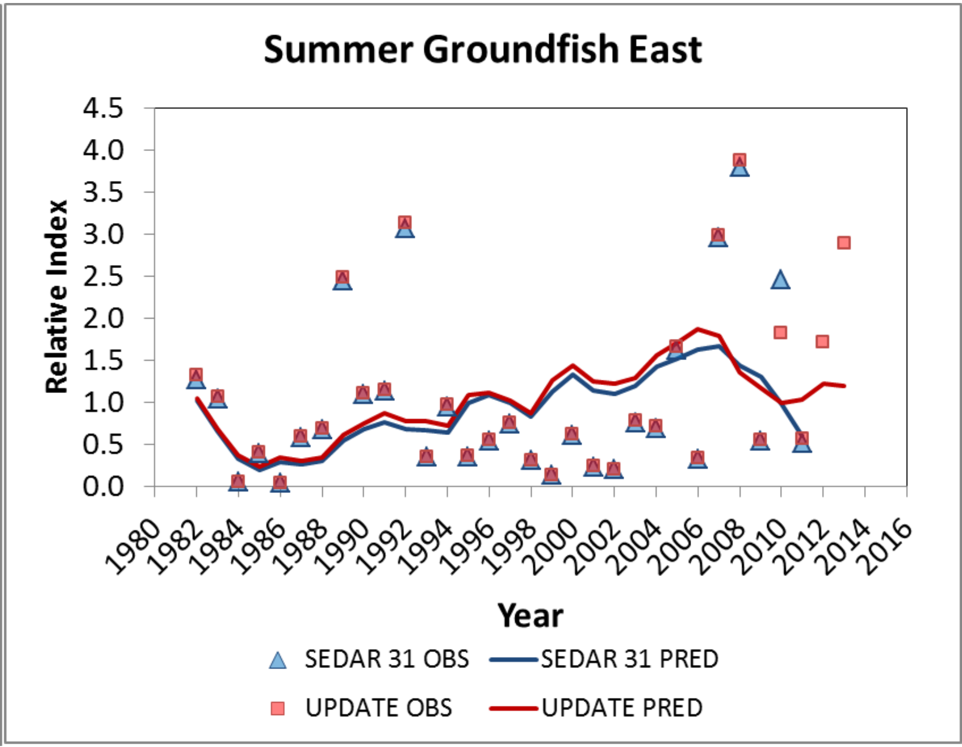
Fishery Independent Indices of Abundance

- Summer Groundfish Survey used to index recruits





**** SCALED TO MEAN 1982-2011****

APPENDIX C

Comments on Scientific Issues Relating to Re-Allocation in the Red Snapper Fisheries of the Gulf of Mexico

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Gulf of Mexico Reef Fish Shareholders' Alliance

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EXECUTIVE SUMMARY

❖ The Gulf of Mexico Fishery Management Council ("the Council") is currently considering Amendment 28 to the *Reef Fish Fishery Management Plan*, which would alter the existing allocation of Gulf red snapper (*Lutjanus campechanus*) landings from the 51% commercial and 49% recreational shares that have been in place since 1990. The 51/49 allocation was based on best available estimates of the catches by the two sectors during a base period of 1979–87. Alternative 1 of Amendment 28 would maintain *status quo*. Alternatives 2 to 7 would re-allocate arbitrary percentages of the fishery from the commercial sector to the recreational. The Amendment's *Draft Environmental Impact Statement* ("the DEIS") offers no rationale for those percentages and hence they are not amenable to scientific examination. Alternatives 8 and 9, in contrast, purport to be founded in two changes to the red snapper assessments, introduced through an update late in 2014.

The present document examines the scientific validity of that foundation, finding significant errors, flawed assumptions and critical deficiencies of the documentation. It also considers the implications of any re-allocation for the red snapper resource, key aspects of which are ignored by the DEIS.

❖ The 2014 update assessment introduced (1) re-estimated historical recreational landings (back to 1950), and (2) a supposed change, in the years from 2011 onwards, of the recreational sector's "selectivity" of red snapper, each of which led to increases in the calculated Annual Catch Limits ("ACLs"). However, that update assessment does not appear to have been written up and hence has not been peer reviewed, though it was accepted by the Council's Scientific and Statistical Committee ("SSC")

for the purpose of setting ACLs for 2015–17. Critical gaps in available documentation prevent either modification from being validated for wider use.

The increase in ACLs driven by the re-estimation of landings was utilized in developing Amendment 28's Alternative 8, while the combined effect of both assessment changes contributed to Alternative 9.

❖ The re-estimation of landings arose from a need to calibrate estimates from the 1979–2011 MRFSS to accord with those generated by its replacement, MRIP, and particularly with data from a revised MRIP protocol introduced in 2013. How the re-estimations were handled in the 2014 update assessment is obscure, being undocumented. In 2012, SEDAR developed a crude, simplistic approximation to the first calibration, though only for stock-assessment purposes. Its application to re-allocation of red snapper has never been openly discussed, far less peer reviewed. The second calibration was addressed by SEDAR in 2014, though only a "preliminary, interim approach", suggested for use in assessments conducted during winter 2014/15, was developed. That approach was apparently applied in the 2014 update assessment but whether it was the only adjustment and, if so, why it was applied to data back to 1950 remain unknown.

  In particular, the 2014 re-estimations of recreational landings during the 1979–87 base period lack any documentation, justification or even explanation. Without those, the new estimates cannot replace the figures used in Amendment 1 as the best available scientific information on the two sectors' shares of the fishery during the base period. Indeed, any suggestion that more accurate estimates could be developed, a quarter century later, borders on being absurd.

▪ Even had the update assessment used validated re-estimations of recreational landings, the logic underlying Alternatives 8 and 9 is founded in fundamental misunderstandings both of population dynamics and of the scientific advice provided to the Council. The update assessment's calculated ACLs did not rise because recreational fishermen had caught more in the past than they had been credited with. The decline and subsequent partial recovery of red snapper is not tracked by landings estimates but by CPUE and similar indicators. The assessment model generated higher ACL estimates because the higher input landings estimates indicated that the resource had sustained higher catches than previously supposed and hence must be more productive than had previously been estimated. Higher resource productivity provides science-based justification for higher catches, not re-allocation.

❖ The 2014 update assessment apparently generated indications that the "selectivity" of recreational fishing for red snapper has changed over time, and the assessment model was either presented with, or allowed to estimate, a distinct "selectivity block" for 2011–13. However, there is no available documentation showing what the "selectivity" that supposedly changed really is, nor whether it has actually changed, let alone why that may have occurred. Yet, without knowing why, it is impossible to judge whether the new "selectivity" will be maintained into the future – and it is the "selectivity" in the future, when any re-allocation would apply, that is critical to Amendment 28 decisions.

- The supposed change in "selectivity" probably (though not certainly) related to the targeting of recreational fishing effort, which is not amenable to regulation and may readily change again. In the eastern Gulf, where recreational red snapper fishing is overwhelmingly concentrated, there was a run of very strong year-classes, followed by notably weak ones from 2008 onwards. If the putative change in targeting was a short-term response to a lack of younger and smaller red snapper, while larger and older fish from the strong year-classes were still available, then recreational "selectivity" will soon revert to its pre-2011 state. It may already have done so.
- The kind of "selectivity" that is related to targeting can only be quantified as an output of stock assessment. Hence, it remains questionable whether anything changed, versus the assessment model over-estimating recent weak year-classes and offering a change in "selectivity" to explain the low recreational catches from those over-estimated year-classes.
- Even if the change in "selectivity" was real, has been estimated with reasonable accuracy, and represents the consequences of a change in the targeting of recreational fishing effort which will last into the future (none of which is certain and perhaps not even likely), there would still be two different ways in which that change contributed to the update assessment's calculation of higher ACLs. Rebuilding the snapper resource should encourage a general change towards targeting larger, older fish in deeper water. That would be positive for resource conservation, leading to higher long-term optimum yields – if its benefits are not offset by an increase in dead discards. However, in the short term and for the eastern Gulf, the supposed change in targeting within the assessment model would increase calculated ACLs by allowing the assessment model's representation of the recreational sector to harvest the remnants of the strong year-classes, instead of being confined to fishing the scarce later year-classes. That is not positive for conservation, yet its effects contribute to (and may dominate) the increases in the 2015–17 ACLs, which were one foundation for Alternative 9.

❖ Re-allocation would raise three issues in resource conservation affecting attainment of optimum yield. Changes in the loss of fish as dead discards are discussed in the DEIS, though no conclusions could be drawn. The implications of the difference in "selectivity" between the sectors and those of a change in the intra-regional spatial distribution of fishing effort are ignored by the DEIS, despite the Council having been alerted to both by its SSC.

❖ Even after its supposed recent change in "selectivity", the recreational sector still targets younger fish, on average, than the commercial sector does. Re-allocation would move fishing effort and mortality from commercial to recreational "selectivity", likely with a negative effect on conservation. Its magnitude has not been estimated but the SSC cautioned: "if the Council changes the allocation between the two sectors, this would prompt the need to reevaluate the OFL and ABC projections". That evaluation should precede Council decisions on re-allocation.

❖ The spatial biology of red snapper conflicts with the classic "stock concept" and is closer to a "meta-population". To avoid major losses in long-term yields, fishing effort must be spread across the fish, ideally so that the probability of being caught is equal for each individual. The commercial sector's effort is spread across the resource but the recreational sector is concentrated in the eastern Gulf, while most of the fish are in the west. That imbalance already has a significant, negative effect on the resource. Between 2008 and 2013, during the current rebuilding plan, multiple indicators of red snapper abundance in the eastern Gulf have dropped by one half or more. The SSC has warned that abundance and biomass are projected to drop further: to below 30% of the rebuilding target, even under the current 51/49 allocation. Projections have confirmed that the problem will be more severe with higher recreational allocations. Indeed, re-allocation risks managing the resource in the eastern Gulf into a permanently severely over-fished state, which would be accompanied by major under-fishing of a fully-rebuilt resource in the west – inevitably leading to a failure to achieve optimum yields from either area.

- ❖ The SSC has provided projections which have yet to be properly documented. Taken at face value, they suggest that that the net effect of re-allocation, including all three of the above mechanisms, would be a small increase in long-term yields and a larger one in the short term. However, those projections must be considered skeptically:

- ▪ The projection calculations included the worsening imbalance between recreational effort in the eastern Gulf and the snappers' western distribution, which must reduce optimum yield. That reduction did not emerge in the projection results, most likely because the imbalance was offset by estimates of losses of dead discards that are lower when fish are caught by the recreational sector.

- ▪ The projections used SEDAR estimates from 2013 for their rates of discarding and of discard mortality. Those estimates did not consider the higher discard mortalities inevitable with the greater depth of recreational fishing implied by the change in "selectivity" (which was itself built into the projections). The estimates do not appear to have taken account of the recent termination of the venting requirement, which was estimated to have halved recreational discard mortality rates.

- ▪ Meanwhile, independent estimates of the commercial sector's discarding (published by the Council in 2013) found that vertical-line IFQ boats in the western Gulf almost ceased discarding red snapper after 2007. Discarding continued in the east but perhaps only as long as the strong year-classes were entering the fishery, leading to unusually high numbers of small fish in the catches.

- ▪ Where SEDAR estimated nearly 633,000 dead discards of red snapper from commercial fishing (excluding shrimp trawlers) during 2007–11, the Council estimated under 430,000 total discards by the IFQ fleet, the majority of them released alive, in the same period.

Before the projections are given credence in discussions concerning long-term re-allocation, their treatment of spatial distributions of fishing effort and of discarding practices must be fully explored and subjected to meaningful peer review.

I. Introduction

For a quarter of a century, one central plank of management of the red snapper (*Lutjanus campechanus*) fisheries in the Gulf of Mexico has been an allocation of 51% of the allowable catch to the commercial sector and 49% to the recreational. That was introduced, with effect from the 1990 fishing year, by Amendment 1 to the *Reef Fish Fishery Management Plan* (hereafter: "the FMP"), the 51/49 proportions being based on the best available estimates of the catches by the two groups during a base period of 1979–87.

Constraining catches, fishing effort and fishing mortality to meet conservation goals is rarely easy, especially in mixed-species fisheries like those for the reef fish of the Gulf. Further difficulty is inevitable in fisheries that involve large numbers of small boats operating from multiple landing points, which is characteristic of the Gulf recreational reef-fish fisheries. Indeed, although essential, constraint of fishing effort is often especially challenging in recreational fisheries, not least because increased participation has been a policy goal desired by many.

Subsequent to the enhanced conservation demands introduced by the 1996 reauthorization of the Magnuson-Stevens Act ("the MSFCMA"), the Gulf of Mexico Fishery Management Council ("the Council") acted to rebuild the much-depleted red snapper resource, which is now approaching the mid-point of a 32-year rebuilding plan. Confining the recreational sector within the necessary limits of that plan has proven difficult – particularly as the resource has begun to recover, increasing catch rates. Furthermore, rebuilding of the resource required an end to overfishing (estimated to have been achieved in 2009), which meant a reduction in fishing mortality rates and hence increased survival of snapper to greater ages. Over time, that has resulted in enhanced availability of larger fish. Since the quotas are set in weight terms (as required by the MSFCMA) but the recreational sector is regulated by numbers of fish (a bag limit of two per angler since 2007, down from seven in 1990: Amendment 28 DEIS, p. 46[1]), the increase in the average size and weight of the snapper caught (from a low of 3.3 lb in 2007 to 7.1 lb in 2012 and 2013: Amendment 28 DEIS, Table 2.1.3) has driven up the weight of the recreational catch taken per unit fishing mortality.

From a year-long open season in 1996, recreational snapper fishing was gradually restricted until the season reached 194 days from 2000. Following the 2006 reauthorization of the MSFCMA, which brought in yet tighter conservation requirements, the recreational season in federal waters was cut to never more than 77 days (and in some years much less). It dropped to 42 days in 2013 and, following a shift in fishing effort into State waters consequent on the implementation of non-compliant State regulations,

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[1] For clarity, references to the *Public Hearing Draft for Amendment 28 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico Including Draft Environmental Impact Statement, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis*, of June 2015, are here given in the text as "Amendment 28 DEIS". Other reference items are cited in the conventional way and listed at the end of this document.

the season in federal waters in 2014 was cut to a mere nine days (Amendment 28 DEIS, p 2). Despite the short (and shortening) season, the recreational sector considerably exceeded its allocation of the allowable catch in every year from 2007 until 2013, except for 2010 (when the effects of the *Deepwater Horizon* explosion, and the resulting uncontrolled flow of the Macondo well, reduced fishing opportunities in the eastern Gulf). Indeed, recreational catches also exceeded quotas in nine of the years from 1990 to 2006, with a long-term average catch well above quota. Meanwhile, the commercial sector remained much closer to its assigned limits, until placed under an individual fishing quota ("IFQ") system in 2007, since when it has consistently harvested slightly less than its allocation (Amendment 28 DEIS, Figure 2.1.1). In consequence, and in marked contrast to the FMP's 51/49 allocation, recreational catches summed from 1991 to 2013 amounted to 58.3% of the total (leaving 41.7% as commercial). From 2006 to 2013 the *de facto* shares were 39.9 / 60.1, the distortion from the FMP's intent reaching a maximum, to date, of 30.7 / 69.3 in 2009 (Amendment 28 DEIS, Table 2.1.2)[2].

Rather than confront the full challenge of managing the recreational red snapper fisheries within the constraints imposed by the rebuilding requirements of the MSFCMA, in recent years the Council has considered re-allocating some of the allowable catch from the commercial sector to the recreational. Currently, it is approaching final action on Amendment 28 to the FMP, which contains a variety of proposed Alternatives from *status quo* (Alternative 1) to a fixed 41/59 allocation (meaning a near-20% reduction in the commercial allocation[3]) and yet others that would link the allocation to the allowable catches, generating allocations as imbalanced as 33.3 / 66.7 in the short term – and still greater ones as the resource continues to rebuild.

Concurrently, changes in the way that recreational landings are estimated, from the former Marine Recreational Fisheries Statistics Survey ("MRFSS") to the new Marine Recreational Information Program ("MRIP"), plus apparent trends in the targeting of recreational effort (tending to move that effort onto larger and older snapper), have contributed to a recalculation of allowable catches, through an update assessment prepared by the Southeast Fisheries Science Center ("SEFSC") late in 2014. The Council's currently preferred Alternative for Amendment 28, Alternative 8, would allocate all of the increase in the Annual Catch Limit ("ACL") for 2016 and 2017 that results from the adjustment in landings estimates to the recreational sector, resulting in a 48.5 / 51.5 allocation for those two years. Alternative 9 is similar to Preferred Alternative 8 but would grant to the recreational sector the whole increase in ACL arising from both

[2] It may be notable that the recent growth in recreational snapper landings has come from fishing on private vessels, landings from which more than doubled between 2009 and 2013 and nearly quadrupled over 2006–2013. In contrast, landings by the for-hire recreational component (including both headboats and charter boats) have been in a general slow decline for twenty years (Amendment 28 DEIS, Figure 3.4.3).

[3] While final decisions do not appear to have yet been made, the reduction in IFQs would presumably be somewhat larger than that in the commercial allocation, since the non-IFQ commercial landings are less amenable to management restriction and the re-allocation would likely be achieved through IFQ reductions alone.

the adjustments in landings estimates and the supposed changes in the targeting of recreational effort[4].

The stated purpose of the Amendment is to re-allocate the available catch "to ensure the allowable catch and recovery benefits are fairly and equitably allocated between the commercial and recreational sectors to achieve optimum yield". The need for it is stated to be "to base sector allocations on the best scientific information available and use the most appropriate allocation method to determine sector allocations, while achieving optimum yield, particularly with respect to food production and recreational opportunities, and rebuilding the red snapper stock" (Amendment 28 DEIS, p. 4). Fairness and equitability are nowhere directly addressed in the DEIS and in any case are not amenable to scientific analysis. Alternatives 2 to 7 inclusive propose transfers of allocation between the sectors by amounts that appear entirely arbitrary and are not given any justification in the DEIS. Those too are not amenable to rational analysis. In contrast, both the preferred Alternative 8 and Alternative 9 propose transfers of amounts based on the 2014 update assessment, and specifically on the changes in the outputs of that assessment that were driven by the re-calculation (sometimes misleadingly termed a "recalibration") of recreational landings data and the apparent change in targeting. Those two Alternatives can be examined for their application of the best scientific information available. That is the topic of the next section of this document.

Re-allocation would have three potentially-major implications for conservation of the snapper resource, its rebuilding and hence the achievement of optimum yield. Those are changes in, respectively, the loss of fish as dead discards, the distribution of fishing effort across the age structure of red snapper, and the spatial distribution of fishing effort within the Gulf. The first of those, the loss of fish as dead discards, is discussed at length in the DEIS, though no conclusion as to the direction of a net effect, let alone its magnitude, could be reached (Amendment 28 DEIS, pp. 73–75 & Appendix B). The latter two implications of re-allocation are not mentioned at all in the DEIS. They are addressed in the third section of this document.

II. Stock Assessment Upgrades and Alternatives 8 & 9

Amendment 28's Alternatives 8 and 9 draw the amounts of their proposed re-allocations from the outcomes of the up-date assessment prepared by SEFSC late in 2014. As stated above, two aspects of that update are utilized by the Alternatives, one being a recalculation of the estimates of historical recreational landings of Gulf red snapper and the other an adjustment to reflect what appear to have been recent changes in the targeting practices of the recreational sector when fishing for snapper. Alternative 8 uses

[4] What is proposed for years after 2017 is not entirely clear, though perhaps only because of incomplete editing of the DEIS. That states both that the 2016–17 allocation would remain in force "until changed by the Council" (Amendment 28 DEIS, p. 10) and that future allocations "would fluctuate based on the quota and on the amounts attributed to the recalibration" (Amendment 28 DEIS, p. 16) – which appears to mean that they would continue to be based on parallel stock assessments, with the commercial sector being given 51% of the ACL estimated from analyses that use unadjusted historic recreational landings.

only the first of those, while Alternative 9 uses both. From both scientific and equitability perspectives, the two assessment upgrades were quite different and they are discussed separately here.

A. Historical Recreational Landings Estimates

Development of the Revised Landings Estimates

Gathering usefully-accurate data on recreational fishing is almost always challenging. The SEDAR process utilizes estimates of Gulf red snapper recreational landings extending back to 1950 (SEFSC 2015a, Figure 1) but it was only with the advent of MRFSS in 1979 that a relatively consistent data-collection methodology emerged. While MRFSS was an advance in its day, by the turn of the century its deficiencies for modern purposes were evident. In 2006, the National Research Council released its *Review of Recreational Fisheries Survey Methods*, prepared in response to a request from NMFS, and the data collection transitioned to the new MRIP protocols during 2010–12. The methodological change means that some form of inter-calibration is highly desirable: MRIP would not provide an improvement in accuracy unless it generated different results from those produced by MRFSS, while the combination of data from two non-comparable programs would inevitably introduce errors into stock assessments. Worse, if limits on catches were predicated on MRFFS values, while actual catches were estimated using MRIP protocols, seasons could be closed to early or left open too long. Whether usefully-accurate inter-calibration is possible is another matter entirely and experience may show that the MRFSS and MRIP landing estimates have to be utilized as separate data streams, with the former treated as more uncertain, while management measures come to depend on MRIP estimates as MRFSS fades into history. For the present, however, the attempt to inter-calibrate is being pursued.

In practice, NMFS generated MRIP-compatible estimates for the years from 2004 onwards. As of 2012, the Service was seeking to extend that process back to 1998 and perhaps further, if the quality of the available MRFSS data permitted (Boreman 2012). The then-available data and estimates were examined by a 2012 SEDAR workshop, which was primarily focused on the 2004–11 period and on procedures for introducing improved landings estimates to the on-going flow of benchmark and update assessments, rather than inter-calibration *per se* (Boreman 2012). An *ad hoc* working group extended the workshop's efforts, leading to **a recommendation that simple ratios** (i.e. summed MRIP catch estimates over 2004–11 divided by the summed MRFSS estimates for the same period) **may be sufficient to adjust the pre-2004 MRFSS estimates. However, the authors of that recommendation justified their rather crude and simplistic approach through an appeal to "the relatively small differences found between MRFSS and MRIP numbers, and more importantly the anticipated small impact the revised recreational time series will have on assessment outcomes"** (Salz *et al.* 2012)[5]. Of importance to Amendment 28, **there was no suggestion that the ratio**

[5] The *ad hoc* Working Group does not appear to have considered the awkward statistical properties of ratios of variables, which could cause severe complications for assessments. The statistical complexities do affect the use of the resulting estimates in development of Alternatives 8 and 9 of Amendment 28 but will be

approach was adequate for purposes other than small adjustments to routine assessment outputs. Its application to major changes in allocations was not considered. Neither the recommendations of the workshop nor their extension by the *ad hoc* working group were peer reviewed (Boreman 2012; Salz *et al*. 2012).

In 2013 (and for onward application in subsequent years), a modification was made to the protocols of one component of MRIP, the Access Point Angler Intercept Survey ("APAIS"), which had the effect of expanding the Survey's coverage of late-afternoon and evening landings. The full consequences are rather obscure but it seems that those species which tend to be taken further from land, on longer trips that tend to return to shore late in the day, were seen to be proportionately more abundant in the surveyed landings (while species taken on shorter trips were correspondingly less abundant) than in the data from earlier years. A second SEDAR workshop was therefore held, in 2014, in order to calibrate the 2004–12 MRIP data and MRIP-compatible estimates to match the 2013 methodology – and that despite there being only the one year's data from the modified survey protocols available to work with. Unfortunately, the need to keep up with assessment obligations while avoiding distortions in the data necessitates such prompt development of preliminary calibrations, even though they cannot be considered reliable. **The 2014 workshop advised that calibration is indeed needed and offered recommendations for how it might be done, though the only concrete outcome was an explicitly "preliminary, interim approach"**, suggested for use in those assessments to be conducted during winter 2014/15. That recommendation was based on the simplest of three approaches considered by the workshop, apparently for no better reason than that the other two were not fully developed, while the simple one would be easier to explain. In its essentials, the approach finds the peak hours (within a day) of landings during a given year, determines an estimate of landings of the species of interest during those hours in the year in question, divides them by the estimated landings during the same hours in 2013 and multiples the result by the entire estimated 2013 landings – though the calculations were actually done separately for each sub-region, state and mode of fishing. **The authors of that approach stressed that their calculations assume that the ratio of peak-period to total catch has remained constant across time, which they acknowledged may not be "defensible from a scientific point of view", even over the brief period that concerned them. They recommended that "investigation continue on the remaining two methods. It is possible that one of them will be determined to be better at some future date"** (Carmichael & van Vorhees 2015).

The 2014 workshop used Gulf red snapper as an example during its deliberations and SEFSC evidently went on to re-estimate recreational snapper landings using the suggested interim approach, the new estimates then being input to the update assessment prepared late in that year. Whether that assessment has ever been written up is unclear. It is certain that nothing more than a PowerPoint presentation was available when the work was reviewed by the Council's SSC early in January 2015 and nothing more formal has been found on the SEDAR, SEFSC or Council websites. Therefore, although it was accepted by the SSC for the biennial setting of allowable catches, **the update assessment**

passed over here to avoid confusing non-technical readers with the strange properties of Cauchy distributions.

cannot be said to have been subjected to meaningful peer review, which would have required that the SSC examine a thorough report on the update's new methodology (wherever it differed from that of the last benchmark assessment).

From a later working paper prepared for the Council in support of Amendment 28, it appears that the Science Center's re-estimation of recreational landings was not confined to the post-2003 period of MRIP data and MRIP-compatible estimates, nor indeed to only the post-1978 MRFSS era. Rather, the entire series of recreational landings estimates back to 1950 was adjusted (SEFSC 2015a, Figure 1). In the absence of any proper documentation, it is impossible to know why (or indeed how) that was done. The presentation made by SEFSC to the January 2015 Council meeting emphasized the calibration developed by the 2014 workshop, which was also mentioned in the report that the SSC provided at the same time. Hence, that appears to have been the major (or perhaps sole) adjustment made to the data, though it is possible that Salz *et al.*'s (2012) ratio estimator, and potentially other adjustments too, were applied at the same time. The presentation for review, and the SSC approval, of an assessment surrounded by so much methodological uncertainty carry obvious risks of serious mistakes. However, **whatever was done to the data may not have been inappropriate for the 2014 update's intended purpose** of estimating ACLs and Over-Fishing Limits for 2015–17. That was a time-sensitive task which could not wait on better means for calibrating landings data, while the intended outputs would only be weakly affected by errors introduced into the estimates of landings from decades before. Besides, any errors could be resolved through increases or reductions in allowable catches in later years. However, **even if the update assessment's approach to estimating landings was appropriate for that particular purpose, it was not for quite different applications, such as supporting quasi-permanent changes to fundamental aspects of the FMP**.

In particular, **the update assessment's apparent extrapolation across half a century of a "preliminary, interim approach", which by its authors' own admission may not be "defensible from a scientific point of view", cannot generate reliable estimates of what the landings really were in former times – such as the 1979–87 base period**, used in setting the sector allocations in Amendment 1 to the FMP. **The 2014 workshop's critical assumption**, that the ratio of peak-period catch to total daily catch has remained constant across time, might perhaps be a reasonable approximation for the years 2004–13 but **would simply not be credible if stretched back to the 1980s. The estimates of recreational and commercial landings available when Amendment 1 was prepared**, and on which the 51/49 allocations were based, will not have been precisely accurate but there is no reason to doubt that they **represented the best scientific information available to the Council at the time. Any suggestion that a more accurate value could be developed, a quarter century later and in the absence of any new data from 1979–87, borders on being absurd**. No such suggestion has been made by the Council's scientific advisors and Amendment 28 decisions should not be distorted through any such mistake.

The Update Assessment and Sector Allocations

Even if the historical recreational landings were re-estimated appropriately for the purpose of setting ACLs for the next few years, the update assessment would not form a foundation for re-allocation. For one thing, the 2012 and 2014 calibration approaches were developed in haste, the latter when there were insufficient data available. That was necessary, if the update assessment was to be produced on schedule, but the two calibrations used crude approaches – the 2014 one, the crudest of three alternatives considered by the workshop. It is highly likely that future development of the methodology for handling the MRIP data will lead to better corrections that will be applied in later snapper assessments. It is certain that additional years of MRIP surveys will give better estimates of the ratio of peak-period catches to total catches, for projection back to pre-2013 years. It is to be hoped that, with more time for thought, SEFSC will consider the likelihood that there have been pronounced tends in the diel pattern of landings over decades, in response to such changes as declining bag limits, increasing wealth and hence the size, speed and seaworthiness of private boats, along with advances in navigational electronics, any or all of which could have led to more two-trip days, more long fishing trips that return to shore late, and/or more short trips for after-work evening fishing. All of those adjustments would lead to improved assessments over time but, **in 2015, all that anyone has are preliminary, interim methods for crude adjustments to estimates of historical recreational landings. While unavoidable for the short-term purposes of a scheduled update assessment, those are not an appropriate foundation for long-term management through discretionary action, such as a modification of an allocation that has been in place for a quarter century**.

Moreover, even if it was possible to use the update assessment as a science-based justification for a re-allocation, **the implied logic underlying Alternatives 8 and 9 is founded in a fundamental misunderstanding of population dynamics, which has led to a basic mistake**. While nowhere explicitly laid out in the DEIS, the premise of both Alternatives appears to be that, through no fault of their own, landings by recreational fishermen were underestimated. Correcting that mistake has caused the update assessment to conclude that allowable catches should be increased. Since it is extra landings by the recreational sector that have increased the allowed limits, the premise appears to be that the full increase should be allocated to recreational fishermen, leaving the commercial sector with 51% of what the allowable catch *would have been* without the correction to the recreational data. That is false logic and the misunderstanding comes from a failure to comprehend the processes by which fishery resources fluctuate and stock assessments estimate those fluctuations.

Modern assessments, such as those prepared by SEDAR for Gulf red snapper, are intricately complex and their behavior is not fully predictable, though changes that flow from revised inputs can usually be explained after the event. Nevertheless, some examination of the red snapper model's responses to the re-estimated landings is unavoidable here. To grossly over-simplify: the models use various indicators of abundance or biomass, such as indices of CPUE, to estimate relative changes in the size of the resource. The models typically use estimates of catches to estimate how much human pressure caused the resource to decline, or what decreases in catch allowed it to increase. The model then generates some sort of forecast of the future catches that would allow the resource to follow a desired trajectory, be it rebuilding towards target biomass in a specified time, maintaining long-term stability or something else. As a hypothetical example, suppose that an assessment had relied on CPUE to estimate that snapper had declined 95% from 1850 to 1995 but had since recovered to 80% of its 1850 level, all the while being subjected to catches of C_t pounds in each of the years t = 1850 to 2014. Then further suppose that it was discovered that, through no fault of any fishermen, the catches had been systematically underestimated and that the true values had been 20% higher throughout, meaning that they equal 1.2 C_t. The model would continue to estimate the 95% decline, followed by a quadrupling of the resource in recent decades, but it would also estimate that the resource had followed those trends while sustaining catches 20% higher than supposed and hence that that resource was some 20% more productive than had previously been supposed[6] – likely through higher estimates of average recruitment but perhaps with supplements from supposed faster growth, earlier maturity and/or a lower rate of natural mortality. Importantly, it would not be a matter of the resource becoming more productive through a change in the data, which would be a biological absurdity, but merely one of scientific (and hence management) perceptions of the resource changing. Projecting forward, that higher perceived productivity would translate into higher allowable catches while still achieving conservation goals.

In that hypothetical case, as in the real-world Gulf red snapper fisheries, fishermen were not responsible for the former error in estimated catches (unless they had been deliberately under-reporting). That was entirely the responsibility of the management system. But, neither in hypothetical simplicity nor in complex reality, were fishermen responsible for the greater perceived productivity and the resulting increase in allowable catches. Those stand entirely to the credit of the resource itself. It is a resource shared among all user groups and no quasi-scientific argument can justify apportioning some part of it to one group, based solely on which faulty data set was corrected in the most recent assessment update.

Fisheries can be under-fished, relative to the prevailing management targets, just as they can be over-fished. Without complex, quantitative analysis, it can be impossible to determine whether lower catches in the past would have allowed higher present landings, given the real (as distinct from perceived) productivity of the resource. In the case of Gulf red snapper, however, catches and fishing mortalities were so high for so long, and the resulting depletion of the resource so severe, relative to the targets written into the MSFCMA, while such a long and strict rebuilding plan is currently in force, that it is fully possible to declare, with complete confidence, that had historical catches been lower than they were, current restrictions on snapper fishermen could be eased from what they are today. More specifically, **if both sectors had been so constrained that their snapper landings had matched their allocations (with discards reduced in**

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[6] "Productive" in the sense of what the resource is biologically capable of producing, as distinct from what it does produce, given the history of past catches.
The relationships are curvilinear and hence the increase in the estimates of past catches would not exactly match the increase in perceived productivity.

proportion), then current allowable catches would be higher and perhaps much higher. It follows that every fish taken beyond the amount allocated was a decrement from the amounts available to be caught today. Since the recreational sector's overages, particularly in recent years when they must have a proportionately greater effect on the present resource, have been much larger than those of the commercial sector, **the net effect is that past recreational overages are detracting from future commercial landings**.

Thus, were it possible to represent fairness and equity in the mathematics of fisheries dynamics (a contention that I would not endorse), then one could write, contrary to the implied foundation of Amendments 8 and 9:

$$Eq_{RECREATIONAL} \neq ABC_{CORRECTED} - ABC_{PRE\text{-}CORRECTED}$$

But perhaps, for the short to medium term (through until the strictures of the rebuilding plan have been endured and the resource rebuilt, such that past histories of excessive landings are no longer relevant):

$$Eq_{RECREATIONAL} \approx ABC_{CORRECTED} - ABC_{CORRECTED\ OPTIMAL}$$

where: $Eq_{RECREATIONAL}$ is the portion of the allowable catch to be equitably allocated to the recreational sector before dividing the rest by the established 51/49 ratio; $ABC_{CORRECTED}$ is the allowable catch estimated by an assessment incorporating corrections to the input recreational landings data; $ABC_{PRE\text{-}CORRECTED}$ is the equivalent output from a parallel assessment that does not incorporate the landings corrections; and $ABC_{CORRECTED\ OPTIMAL}$ is the output from a calculation that used the higher resource productivity estimated by the assessment based on corrected data combined with inputs of hypothetical "landings" equal to the allocations for each year, without either over-runs or short-falls. The second expression is only an approximation because it makes no allowance for the commercial catch over-runs of the pre-IFQ era, while the calculation of $ABC_{CORRECTED\ OPTIMAL}$ should not use actual historic quotas and allocations but those which the Council would have instituted if the resource had been more abundant, in consequence of the lesser catches – the true values of which cannot be known without re-creating the Council discussions which might have occurred in past decades.

Fortunately, it is not necessary to ask SEFSC to undertake the daunting task of estimating $ABC_{CORRECTED\ OPTIMAL}$ because, although its magnitude is unknown, it is quite certain that, if it could be correctly calculated, $Eq_{RECREATIONAL}$ would be negative. That inevitability stems from the net overages of the real history of the fisheries, combined with the obvious depletion of the resource that led to present rebuilding restrictions. In other words: **if an equitable re-allocation of the red snapper resource were to be based on the assessment results alone, it would transfer a share of the allowable catch from the recreational to the commercial sector, in compensation for the effects of past over-harvesting by the former**. To re-allocate in the direction proposed by the Council, while invoking an assessment-based justification, would be to reward future recreational fishermen for the failure of management to restrain their sector in the past.

Finally, management stability would clearly be enhanced by "locking-in" future allocations at fixed values (cf. Amendment 28 DEIS, p. 10), rather than allowing them to fluctuate with each new assessment[7]. However, Alternatives 8 and 9 would lock those future long-term allocations to the short-run ACLs set for 2015–17 (Amendment 28 DEIS, p. 10). They may provide one arbitrary option for a future allocation but it cannot claim a scientific foundation. That would require long-term management measures to be based on long-run attributes of the resource and the fisheries.

In short, **the amounts of re-allocation proposed in Alternatives 8 and 9 are founded in a misunderstanding of the scientific advice provided by SEFSC. Correcting that mistake would strip away any form of apparent "science-based" justification for those Alternatives. The amounts of re-allocation that they propose are, in reality, as arbitrary as those offered by Alternatives 2 to 7**.

B. Change in Recreational "Selectivity"

According to presentations to the Council from January 2015 onwards, the SEFSC's undocumented 2014 update assessment apparently generated some (unspecified) indications that the "selectivity" of recreational fishing for red snapper has changed over time, shifting towards larger and older fish in recent years. That led to the assessment model being presented with, or perhaps being allowed to internally estimate, a distinct "selectivity block" for 2011–13 (SEFSC 2015a, Figure 2). The effects of that change in the assessment's inputs included an increase in the estimates of allowable catches over the next few years which was greater than that produced by re-calculating the recreational catches (SEFSC 2015a, Figures 6 & 7). The Council did not, however, develop an Amendment 28 Alternative that would allocate only the increase arising from the change in "selectivity" to the recreational sector (as Alternative 8 would allocate only the increase arising from the re-calculation of landings). Rather, in Alternative 9, the DEIS presents the option of allocating the increase arising from the combination of both assessment modifications (recalculated landings and new "selectivity") to the recreational fisheries. The consequence in 2016–17 would be a 42.5 / 57.5 allocation – a reduction in the commercial sector's allocation of nearly 17%.

Since, as shown above, there is no logical foundation for using the re-calculation of recreational landings to justify a re-allocation in favor of the recreational sector, Alternative 9 cannot claim any scientific foundation any more than Amendment 8 can. The apparent change in "selectivity" may, however, have different implications for fairness and equity than those of the re-calculated landings. Thus, that change merits some exploration here, even though it does not offer justification for any re-allocation at the present time.

An Apparent Change in "Selectivity"

Unfortunately, it is unclear (from the available record: no proper documentation of the analyses being publicly available) just what the "selectivity" that has changed really is. It

[7] As seems to have been intended at one point during development of the Amendment (cf. Amendment 28 DEIS, p. 16)

is even less clear why the change has occurred – the "why" being the only guide as to whether the change will continue into the future, whether the "selectivity" will now stabilize at the new level of 2011–13 or, alternatively, whether it will soon return to its former values. Meanwhile, it is the "selectivity" in the future years when any re-allocation would be applied, rather than that in the recent past, that is critical to present concerns.

For the purposes of fisheries science, "selection" and "selectivity" are sometimes narrowly defined in relation to a comparison between the fish in a catch and those that were available to the fishing operation[8]. In concept, both the free-swimming fish and those caught are subdivided into "classes", which are most often size- or age-classes. For each class, the number of fish in the catch is divided by the number available to be caught, the results of those calculations then being scaled so that the largest value for any class is 1.0. Selection, in that narrow sense, is a characteristic of the fishing gear and the way that it is deployed, though it may also be affected by such other factors as fish behavior. It is possible that the 2014 observation of an apparent change in "selectivity" in the recreational fisheries for Gulf red snapper concerned selection thus narrowly defined. However, the high "selectivity" values presented by SEFSC were rather tightly concentrated on young age-classes (SEFSC 2015a, Figure 2), whereas hooked gears usually have weak size- and age-selection. Furthermore, there has been no discussion of major and widespread changes in the gears used by the recreational reef-fish fisheries of the Gulf. I therefore conclude that it is unlikely, though not impossible, that SEFSC's "selectivity" matched the strict usage of the term.

Rather, it appears that the reported change in "selectivity", and hence the references to "selectivity" in the Amendment 28 DEIS, use the term in a related but broader sense. In essence, instead of dividing the number of fish of each class that were found in a catch by the number of fish of that class that were available to the fishing operation, the divisor used is the number of fish of the class *in the entire resource population*. The result is a value that is not only a function of the gear used and the way that it is deployed but also of where and when that deployment was made. In short, this second kind of "selectivity" is partly determined by the fishermen's targeting choices[9].

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[8] That is most easily understood in the case of bottom trawling, where the fish passing between the otter boards or those entering the mouth of the net during a single tow can be compared with those which reach the trawler's deck in the codend. In the case of hooked gear, as in the snapper fisheries, selectivity in that sense is a comparison between the fish swimming in the general (but ill-defined) vicinity of the hooks and those which are caught and hauled to the boat.

[9] There is a further complication relating to the definition of "catch". The explanation presented above invokes the literal catch – those fish brought aboard the fishing boat. For resource-conservation purposes, however, what really matters is the "removals", meaning those individuals "removed" from the resource, including dead discards and any fish killed by the gear but not brought aboard. Conversely, if the numbers of individuals in each class are estimated from landings, the "selectivity" values will also reflect fishermen's choices in selectively retaining or discarding fish, alongside the effects of gear design and those of targeting. From the available reports to the Council, it is sure that the "selectivity" which supposedly changed concern age-classes. Whether they reflect the mix of ages in the removals, the literal catches or the landings is unclear, and likely to remain so until the assessment is properly documented and made available for review.

These distinctions are not mere technicalities. Being characteristics of fishing gear, narrowly-defined selectivity can potentially be controlled by regulating gear types (e.g. hook sizes), and should not undergo changes without unless the gears used change. "Selectivity" in the broad sense, in contrast, can change quickly and unexpectedly as fishermen's targeting choices vary. Those choices cannot be stabilized by management, except perhaps through the use of closed areas.

There is a further, and more subtle, challenge in the estimation of "selectivity" values. The numbers of fish in each size-class in a single catch can be determined readily and accurately, though ageing the fish is more difficult. The equivalent numbers in the entire annual catch of a fishery can be estimated, at least relative to those in other classes – while the scaling removes any need for absolute numbers. In an experimental setting, similar relative estimates can also be made for the fish available to a particular fishing operation. Hence, selectivity in its narrow sense can be estimated empirically. In contrast, the relative abundances of the different classes in a whole fishery resource cannot be known, except as the output estimates from a stock assessment. Thus, "selectivity" in the broad sense (which is what the "selectivity" of the 2014 update assessment appears to have been) can only be estimated with all of the uncertainty carried by numbers that have been generated by complex models.

Hence, **there must be lingering doubt about whether recent events in the real recreational fisheries for red snapper have included a change in "selectivity" at all**. For one, it is clear from recent assessments that red snapper recruitment in the eastern Gulf has been depressed since the 2010 Macondo disaster (though, as yet, there is no proof that the one has been a consequence of the other). If the assessment model has underestimated the severity of that decline in recruitment, both the model and its authors could be drawn to suppose that the low recreational catches of young fish in recent years have resulted from a change in "selectivity", when in fact few young fish have been caught simply because there have been few to catch. Secondly, given the absence of documentation of the update assessment, it is unclear whether the data on the ages of fish taken by the recreational sector (and which seem to have driven the perception of a change in "selectivity") were drawn from literal catches or from landings. If the latter, it is not known whether any allowance was made for changes in size-selective discarding ("high-grading"), perhaps in response to the low bag limits. Hence, anglers may have continued to catch the same mix of fish and thrown back the younger ones. A combination of those two processes may have occurred, in the absence of any change in

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The importance of "selectivity" in this second, broader sense is that the fishing mortality imposed on each age-class (a key issue in stock assessment) can be estimated as the product of the mortality rate on the "fully recruited" age-classes (those with a "selectivity" of 1.0) and the "selectivity" of the age-class in question. That calculation is, however, only fully valid if the "selectivity" values are estimated for age-classes and for removals.

One thing that "selectivity" should not represent is the mix of fish sizes or ages in the catch. A particular gear can be highly selective for one size- or age-class but, if that 'class is scarce in the area where the gear is deployed, few individuals of the size or age in question will be found in the catch. For example, a large-mesh net deployed where there are only small juveniles will catch little but most of what it does take will be small fish.

"selectivity" or else in conjunction with a smaller change than the update assessment indicated. Without a meaningful peer review, it is impossible to know.

If there has been a change in recreational "selectivity", there is little reason to suppose that it will not swiftly revert to its previous state. In the eastern Gulf, red snapper rebuilding saw a very rapid increase in abundance resulting from a run of exceptionally strong year-classes – which is usually the way that fishery resources rebuild. From 2008 onwards, however, all of the year-classes have been notably weak (SEFSC 2015b, Figure 8). The consequence is a block of super-abundant year-classes moving through the fishery, with weak 'classes following them. If recreational fishermen had taken to targeting larger and older snapper because rebuilding has made those classes more abundant and so more attractive, the change in "selectivity" might be expected to persist and indeed progress further. However, **if the altered targeting was simply a short-term response to the progression of year-classes briefly making older-age fish more available than younger and smaller ones, recreational "selectivity" may already have reverted to its pre-2011 values and, if not, will soon do so**.

In summary, **it appears that the 2014 update assessment produced indications that something changed in the mix of age-classes taken by the recreational fisheries for Gulf red snapper. Just what those indications were, how reliable they were and indeed what really changed remain unknown, since no proper documentation of the assessment has been made public nor submitted to peer review**. The assessment responded to the apparent change through a shift in the "selectivity" values applied to the model years after 2010, relative to those used for the earlier period. In January 2015, **the Council's SSC deemed the update assessment and its documentation, including the supposed change in "selectivity", to be adequate for supporting recommendations for allowable catches for 2016 and 2017**. That may have been appropriate for such a minor, short-term and time-sensitive adjustment **but does not mean that the same analysis and assumptions, nor the mode of their presentation and the absence of formal documentation, are in any way sufficient for entirely different purposes – such as offering support for the sort of major, long-term adjustment to allocations proposed in Amendment 28**.

Conservation Effects and Assessment Outputs

If it was assumed, for the purposes of further exploration, that the change in "selectivity" (broadly understood[10]) is real, that it has been estimated with reasonable accuracy, and that it represents the age-related effects on catches of a change in the targeting of recreational fishing effort directed on Gulf red snapper (none of which postulates is by any means certain), it would still be necessary to consider two different changes in targeting, both of which likely contributed to the increase in the 2014 update assessment's estimates of allowable catches. One is a general change towards targeting larger, older fish in deeper water, and the second is specifically the targeting, in the eastern Gulf, of the strong year-classes spawned before 2008 – the same change invoked above in relation to its reversibility. The relative contributions of those two changes in

[10] Through the rest of this document, that meaning of "selectivity" (which is the one probably intended by SEFSC when reporting on its 2014 update assessment) is used exclusively.

targeting were not relevant to the update assessment's immediate purposes and they do not seem to have been explored. However, the two have very different implications for long-term management of the fishery, and specifically for re-allocation. **Until the effects of the two have been disentangled, the update assessment's results cannot provide any scientific foundation for decisions on Amendment 28**.

As to the first: the restrictions on fishing effort that have stemmed from the red snapper rebuilding plan have cut fishing mortality, supposedly down to $F_{REBUILD}$. Lower mortality rates mean higher survival of red snapper and hence, over time, a higher proportion of the population being in the older age-classes, when compared to earlier years. Most fish have some tendency to segregate by size or age, typically with larger and older individuals living in deeper water. As the effects of reduced fishing mortality work their way through the Gulf red snapper resource, therefore, it may be expected that the opportunities for catching bigger fish further offshore will improve, both in absolute terms and relative to the opportunities for catching smaller fish on the former fishing spots, closer to land. The current two-fish bag limit may also encourage anglers to seek bigger fish to fill that limit. Hence, it would not be surprising if some recreational snapper fishermen are venturing further offshore, targeting larger and older fish –thus shifting "selectivity" towards older age-classes– though, in the most recent years, the longer open seasons in state waters will have drawn fishing effort back towards the coast.

Any fishery resource has some optimal size and age of fish for harvest, such that catching all of the individuals when they reach that critical point, and none before, would (in simple theory) produce the maximal sustainable catches. That point is the age (or perhaps size) at which further increases in weight and in egg production (through continuing growth) are exactly balanced by losses to natural mortality. In practice, real fisheries must take some younger fish and some that are older than the critical point, meaning that optimal yields are necessarily lower than the theoretical maximum. How much lower depends on the "selectivities" of the age-classes, as well as on the rate of fishing mortality[11]. It is apparent from the results of red snapper assessments that the former "selectivity" of the recreational fishery was skewed so far towards young fish as to pull down the value of optimum yield. Therefore, if it was real (which is still unsure) and if it did not adversely affect the amounts of fish lost as dead discards (which is even less sure), then the change to the new "selectivity" of 2011–13 would have been positive for conservation (in the sense of efficient use of the resource), in that it would allow optimum yield to increase somewhat towards the maximum achievable.

To the extent that such a change has really happened, and if it could be shown that the trend has not been reversed (perhaps by the concentration of the recreational sector in

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[11] In a further complication, some freshwater fisheries can be managed using "slot limits" that protect both young fish (which are still growing quickly) and large, old spawners, while allowing harvesting fish of intermediate sizes and ages. Formal slot limits have rarely been used in the management of marine fisheries, but fishermen's targeting choices sometimes achieve something of the same effect by reducing the fishing mortality applied to larger, older fish. The recreational fisheries for red snapper, before 2011 at least, may be one example, though any advantage gained through protection of spawners did not outweigh the losses from the concentration of effort on young fish.

state waters) and will not be in the future, then it might provide a foundation for a scientifically supported justification for commensurate re-allocation. It would not be a matter of a past error in management being corrected (as is the re-calculation of recreational landings estimates) but rather one of a change in the recreational sector's own practices, for which that sector could equitably claim credit – if the change in "selectivity" is real, lasting and not offset by increased dead discards. Although the two sectors' allocations are set in terms of landed weight, they could perhaps be seen as shares in the production of the red snapper resource. If the recreational sector has begun to utilize its share in a way that increases the landed weight per individual killed, then the summed weight of recreational landings might fairly be seen as more than 49% of the total. In much the same way, if the IFQ program has led to the commercial sector reducing its rate of discarding, then it might equally claim an increase from 51%, based on its increased landings per individual killed. Clearly, all such efficiencies should be encouraged but they must be considered in their totality before their equitable effects on re-allocation could be determined.

The second cause of a change in targeting is specific to the eastern Gulf. As noted above, red snapper rebuilding saw an increase in abundance resulting from a run of exceptionally strong year-classes but those have been followed, from 2008 onwards, by notably weak 'classes. Before 2011, the recreational sector relied primarily on 2 and 3 year-old fish, while the fishing mortality that it exerted on ages greater than 5 was rather low. During 2011–13, that supposedly changed to a focus on red snapper of 4 to 7 years of age (SEFSC 2015a, Figure 2). SEFSC's calculations have not been documented and exactly what their outputs mean is thus uncertain. However, when the assessment model was constrained to use the pre-2011 "selectivity" for recent years and to project that into the future, its model "recreational sector" was largely confined, during model years 2016–17, to the weak 2013–15 year-classes. When, in contrast, the model "anglers" were freed to do what their real-world counterparts would do, moving their fishing effort to where the strong year-classes are, they were free to catch what remains of the earlier strong year-classes. Not surprisingly, the assessment predicted higher catches when allowed to shift the estimated "selectivity".

This second mechanism depends on the same assumption as the first: that the fishing practices of the recreational sector have changed in a more-conservative direction. The magnitude of its effect on the 2014 estimates of allowable catches, however, was not a consequence of that extra conservation but rather of the unrelated variation in year-class strengths in the eastern Gulf. That variation cannot be stable in time, each of the year-classes inevitably becoming annually one year older. Hence, even if there are new targeting practices, even if they remain unchanged henceforth, and even if their benefits are not offset by increased losses of dead discards (none of which is at all certain), **the effect on allowable catches produced by this second mechanism would still fade away by 2020, when all of the pre-Macondo disaster year-classes will be over age 10 and hence effectively out of the recreational fishery. Clearly, long-term adjustments of allocations cannot be scientifically justified by the transient effects of variable recruitment**.

What remain entirely unknown, since they have yet to be investigated, **are the relative magnitudes of the contributions of these two causes of changes in targeting to the estimated joint effect on allowable catches**. The use made of that effect in drafting Alternative 9 would be consistent with the first mechanism driving the increase, while the second was negligible. Since, however, the great majority of the recreational snapper fishery is in the eastern Gulf, the second mechanism may prove to be the predominant one. Most certainly, **until the relative effects of the two have been thoroughly examined, the change in "selectivity" cannot provide a science-based justification for re-allocation**.

Indeed, **considering the complexities of these issues and the long-term importance of decisions on allocations, it would seem best to defer their further consideration until a new benchmark assessment of Gulf red snapper**. As part of that assessment, SEDAR might usefully be charged with exploring conservation-related changes (since the 1979–87 allocation base period) in the practices of both sectors of the snapper fisheries, and the likelihood that they will be continued into the future, when any re-allocation would apply.

III. Conservation Implications of Re-Allocation

The implications of re-allocation of Gulf snapper for the loss of fish as dead discards are discussed at some length in the DEIS, though without any conclusions that can be drawn concerning even the direction, let alone the magnitude, of the overall effect on resource conservation (Amendment 28 DEIS, pp. 73–75 & Appendix B). Two other mechanisms by which re-allocation might have major effects on the attainment of optimum yield (changes in "selectivity" and in the intra-regional spatial distribution of fishing effort) were, however, ignored entirely by the DEIS, despite the Council having been alerted to both of them by its SSC.

In the report on its May 2015 meeting, the SSC offered the results of projections, abstracted from SEFSC (2015b), that purport to illustrate one aspect of the overall effect of re-allocation on resource conservation. If those could be relied on, they would show the net effect of re-allocation due to all three mechanisms (and perhaps others besides). Unfortunately, it is far from sure that the projections do reflect the likely effects of re-allocation. Those issues are addressed in this section.

A. Distribution of Fishing Mortality across Ages of Snapper

The implications of the putative recent change in "selectivity" of red snapper in the Gulf recreational fisheries have been discussed above. That change has shifted the estimated "selectivity" towards older snapper, which (if real, and if not offset by increased losses of dead discards) would have long-term benefits to resource conservation and optimum yield, provided that anglers do not revert to targeting younger fish. Even after this purported change in "selectivity", however, the recreational sector would still target younger fish, on average, than does the commercial sector. Re-allocation would therefore move a portion of $F_{REBUILD}$ from commercial to recreational "selectivity", which would probably (though not certainly) have a negative effect on conservation. The magnitude of that effect has not been estimated but could be.

During its meeting in May 2015, **the Council's SSC cautioned, through a formal and unanimous motion: "if the Council changes the allocation between the two sectors, this would prompt the need to reevaluate the OFL and ABC projections". How large the resulting changes might be, and their consequences for long-term resource conservation, cannot be known until the evaluation is undertaken. The evaluation should be undertaken before the Council reaches a decision on re-allocation**.

B. Distribution of Fishing Mortality across the Gulf of Mexico

Fisheries are necessarily managed as units, such as "Gulf of Mexico red snapper", though matters can be more complex, as when multiple jurisdictions apply contrasting management measures or fisheries exploit multiple species – both of which affect the Gulf snapper fisheries. The management units are usually selected, in part, in an attempt to reflect the biology of the resources and the fish within each unit are often referred to as a "stock", though they very rarely (if ever) conform to the formal definition of a "unit stock". Red snapper provide a classic example: There have been multiple studies, using a variety of techniques (tagging, genetic analysis and others), which have collectively shown that adult snapper have strong fidelity to a particular reef structure and yet the population intermingles over great distances. Schroepfer and Szedlmayer (2006), for example, found that tagged snapper spent almost all of their time within a circle of 200 m radius and had a median residence time on the studied artificial reef, in the northeastern Gulf, of just over a year. Topping and Szedlmayer (2011) increased the latter estimate to almost 18 months. The Gulf does not, however, harbor a multitude of independent snapper stocks, each confined to a home range of less than a kilometer across, because the adults do move between reef structures at times (some tagged individuals having gone hundreds of kilometers: e.g. Patterson *et al*. 2001; Strelcheck *et al*. 2007), while the planktonic eggs and larvae drift widely. In consequence, there appears to be genetic exchange, albeit not free exchange, among the snapper throughout the northern and western Gulf – even though some local patchiness in genetic characteristics can be observed (e.g. Gold *et al*. 2001; Saillant & Gold 2006; Saillant *et al*. 2010). Similar combinations of partial (but incomplete) localization at certain life-history stages with partial (but incomplete) intermingling at others are very common in marine fishery resources. Such population structures violate the assumptions of the "unit stock" hypothesis and are often compared to the meta-population concept of population genetics (though real fishery resources rarely, if ever, exactly conform to that abstraction either).

The problem for managers is that many of the foundations of stock assessment, and those of fishery management as a whole, were built on an assumption that the units to which assessment and management would be applied do conform to the definition of a "unit stock". One key consequence is that standard assessment approaches contain an implicit assumption that fishing effort applied anywhere within the management unit will impose an equal risk of fishing mortality for every individual in the "stock" – except in so far as the mortality rate is scaled by "selectivity", which serves to lower the rates on pre-recruits and, in some fisheries (including the recreational fisheries for snapper), also on larger and older fish that have moved outside heavily-exploited areas[12]. Clearly, no real fishery resource is as freely mixing as such assumptions suppose but for many migratory species they are adequate approximations, provided that they are used with care and not relied upon blindly. However, with a management unit that contains a resource that has a structure approximating to a meta-population, the violations of basic assumptions carry risks of severely sub-optimal fishery management.

Fortunately, commercial fishermen tend to go where the fish are, either moving their operations to a port near their resource or selecting a resource near their home, while investing in the boats and gear needed to work the grounds where the fish are plentiful. Economic pressures compel such behavior. There have been (and continue to be) massive management failures during the development phase of a new fishery, as the fleet moves from one semi-discrete aggregation of fish to the next, leading to "sequential depletion" across a management unit. However, in a mature fishery, like that for Gulf red snapper, commercial fishing tends to be spread across the fish, approximately in proportion to their local abundance. No single unit of fishing effort (a single boat-day of fishing, perhaps) can pose an equal risk to every snapper in the Gulf but the aggregate effort by the commercial fleet may adequately approximate to that assumed ideal.

Recreational fishing, in contrast, must be concentrated near the population centers where anglers reside or, in the case of fishing tourism, near sites which host an infrastructure of hotels, restaurants, tackle shops, convenient transport links to larger centers, and often holiday attractions for other family members. In many cases, recreational fishing can still be adequately spread across a resource but that is not the case for the red snapper fisheries in the Gulf. Snapper are primarily a fish of the western Gulf. The most renowned ground historically was the Campeche Bank (Carpenter 1965), from which the species draws its biological name and which is now under Mexican jurisdiction. Even without that area, **the western Gulf averages nearly 110 million recruits annually, compared to 60 million in the east** (SEFSC 2015b, Figure 8). **The recreational snapper fishery is, however, concentrated in the eastern Gulf – 70% of the landings, including 73% of those by private boats, being made in Florida or Alabama in 2012, when only 12% and 5% respectively were made in Texas, while in 2013 it was 85% to 5% for the whole recreational sector** (Amendment 28 DEIS, Tables 3.1.1 & 3.4.1.1).

That imbalance has already had a significant effect on the resource. According to the presentation made by SEFSC to the Council in January 2015, snapper spawning stock biomass in the western Gulf has been responding positively to the rebuilding plan and is increasing swiftly, though it has yet to meet its target. In the eastern Gulf, the hoped-for strong year-classes that should have rebuilt the resource did arrive in the years around and after 2000, driving an increase in biomass. That key measure, however, reached a maximum in about 2013 and has since begun to decline under heavy fishing pressure (the

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[12] When Baranov (1918) originally derived the basic equation that is still used to represent fishing mortality, he went so far as to assume that the "stock" would randomly intermingle between one trawl tow and the next. It is frequently unclear whether the same assumption is being made, implicitly, by those who use Baranov's (1918) equation.

decline being very evident in Figure 5 of the May 2015 report by the Council's SSC). Amidst the "supplemental slides" prepared by SEFSC for its January 2015 presentation, and subsequently deposited with the Council, are ones that show **observed headboat red snapper CPUE in the eastern Gulf falling by more than 50% between 2008–11 and 2012–13 (and by nearly 75% from the peak of 2009), while private and charter boat CPUE fell by more than 75% between 2007–08 and 2013, the video surveys indicated a drop of nearly 50% between 2010–11 and 2012–13, and the larval survey** (indicative of the amount of spawning and hence of spawners) **a 67% fall from 2010–11 to 2012**[13]. With a return to more typical levels of recruitment, **spawning stock biomass** (measured as the Spawning Potential Ratio or "SPR") **in the east is projected to decline swiftly and deeply, the speed and depth of the loss being progressively greater with higher assumed levels of recreational allocation. In the SSC's words: "All of the above yield streams achieve a Gulfwide stock rebuilding to 26% SPR by 2032, but with regional differences. SPR in the western Gulf continues to increase, but the SPR in the eastern Gulf declines, and the decline is exacerbated by increasing allocation to the recreational sector**. At 70%, the eastern SPR decreases to 4% of unfished condition in 2032." That is to say, **re-allocation between the sectors risks managing the resource in the eastern Gulf into a permanently severely over-fished state**.

If two discrete "unit stocks" were managed together as a single unit, it would be impossible to harvest their combined optimum yields by over-fishing the one and under-fishing the other. The curvilinear relationship between sustained fishing mortality and sustained yield means that too little fishing generates lower yields just as surely as too much fishing does, while the sum of two depressed yields cannot equal the combined optimal yield. In such a simple, hypothetical example, managed disaster could be averted by incorporating the real structure of resource biology into the assessment model. However, the calculations would then reflect the depression in yields that arose from the imbalanced distribution of fishing effort. Long term optimum yields might be achieved but they would be set far below their potential. The Gulf red snapper resource is, of course, much more complex than just two "stocks" within one management unit, but the same principle holds. **Fishing mortality must be spread approximately proportionately across the resource if rebuilding is to succeed in doing more than merely achieving a meaningless paper target and if the full optimum yield is to be taken sustainably thereafter**.

The concentration of recreational snapper fishing in the eastern Gulf has already passed the point of becoming serious. The Council's SSC has warned that simply continuing present management will cause the SPR to fall from a recent high of 0.12 to about 0.07, during a supposed rebuilding period that has a target SPR of 0.26. That would be accompanied by severe under-fishing of a fully-rebuilt resource in the west, inevitably leading to a failure to achieve optimum yields from either portion of the management unit. Measures are therefore urgently needed to reduce

[13] The groundfish surveys in the eastern Gulf have not shown a clear decline, while longline CPUE continued to increase until at least 2012 in the east – perhaps because both respond to larger, older fish and thus have yet to be greatly affected by the heavy recreational fishing pressure on recent weak year-classes.

snapper fishing in the east, preferably by encouraging the westward relocation of recreational effort. Until progress can be made on that task, it would be irresponsible to consider a transfer of allocation from the (primarily western) commercial sector to the recreational fisheries off Florida and Alabama.

C. Model Projections

While the Amendment 28 DEIS makes no mention of these issues, SEFSC and the Council's SSC have provided some projections which, taken at face value, appear to suggest that that the resulting effects of re-allocation need not be of concern – indeed, that re-allocation would lead to a small increase in long-term yields. In its May 2015 report, the SSC provided both "yield streams" for 2015–20 and long-term equilibrium values for each of a range of recreational allocations, and for both OFLs and ABCs (their Tables 3 & 4). Those were extracts from Tables 1 and 2 of SEFSC (2015b), which presented the projections out to 2032. It is the long-term equilibrium values that are of primary interest when considering a (presumably quasi-permanent) re-allocation between sectors. In units of millions of pounds retained weight of ABC, the SEFSC and SSC projected equilibrium is 12.40 for the existing 51/49 allocation, while that figure was projected to rise slowly with increasing amounts hypothetically allocated to the recreational sector, reaching 12.98 for a 30/70 allocation – a 4.7% increase. That might be said to be so near to zero change that no increase in optimum yield could be meaningfully predicted but (taken at face value) it does not suggest that re-allocation would carry a severe conservation cost.

In the short term also, the ABCs are projected to be higher under re-allocation. Indeed, the immediate benefit was estimated to be considerably greater than that over the long haul: 11.2% in 2015, if the re-allocation was already in place now (SEFSC 2015b, Table 2)[14]. **Before those projections can be accepted, however, they merit more skeptical examination than they have evidently received**. It was, after all, the same analysis which projected that a 30/70 allocation would lead to SPR in the eastern Gulf being about one third lower than under the existing 51/49 allocation, whereas there would only be a very minor increase in the west (SEFSC 2015b, Figure 4). **It is essential to reconcile those apparently-contradictory results before the management implications of either can be understood**.

According to SEFSC (2015b), the projection calculations followed the (undocumented) 2014 update assessment, other than as needed to examine the consequences of various hypothetical amounts of re-allocation, the update itself following (in most respects) the SEDAR 31 benchmark assessment of 2013. The "selectivity" used was that estimated for 2011–13 and hence the projections incorporate both the supposed 2011 change in recreational targeting (including the unsupported contention that it will be maintained into the indefinite future) and any conservation implications of the remaining difference between recreational and commercial "selectivity". The calculations further assumed that

[14] SEFSC (2015b) stated that the 2015 allocations for all projections were set at 51/49, yet the allowable catches projected for this year differed among assumed allocations. That is an anomaly which has yet to be explained.

the re-allocation would only be between the commercial IFQ fleet and the recreational fishery operating during the open red snapper season. Fishing effort by the recreational closed-season fishery and by the non-IFQ commercial fleets (including the shrimp trawlers) were assumed constant at 2013 values (SEFSC 2015b), which was obviously an unrealistic abstraction but one way of isolating the consequences of re-allocation.

As might be expected, re-allocation was projected to lead to the recreational sector causing an increased percentage of snapper deaths (including dead discards) and the commercial a lower one (SEFSC 2015b, Figures 5 & 6). **To the extent that the commercial sector's "selectivity" is closer to the theoretical ideal, that change should have reduced optimum yields**, though the effect may well be a very small one and might even be somewhat negative. Re-allocation was also projected to worsen the imbalance between the eastern and western portions of the resource. Under the existing 51/49 allocation, by 2032 fishing was projected to kill about 5% of the western red snapper biomass each year, compared to nearly 25% in the east. If there should be a 30/70 allocation, those figures would be more like 4% and 30% (SEFSC 2015b, Figure 7). **That should impose a substantial reduction in optimum yield**, unless perhaps the imbalance is so severe even under a 51/49 allocation that further losses of allowable catches resulting from re-allocation are relatively small.

Modern assessment models are highly complex, generating outputs that respond to the interactions among many inputs, rather than to simple causes. Diagnosing the behavior of such a model without undertaking multiple model runs is ultimately impossible. Nevertheless, **the only obvious mechanism that could counteract the effects of the imbalance in effort distribution and produce the reported increase in yields from re-allocation is a reduction in numbers of dead discards, as more of the fishery was transferred from the commercial to the recreational sector**.

Since the projections prepared by SEFSC (2015b) were supposedly based on the 2014 update assessment, and assumed that "selectivity", discarding and retention would continue as they were during 2011 to 2013, the values for the commercial sector were presumably taken from SEDAR 31 (with the numbers of fish discarded in 2013 being scaled to the catches that year). For the recreational sector, the projections almost certainly used the 2011–13 "selectivity block" from the update assessment but the proportions of discards released dead or dying presumably came from SEDAR 31. The numbers of fish discarded by that sector should have been those developed for the update assessment, in parallel with the re-estimation of landings. That process estimated recreational discards to have been considerably larger than had previously been supposed, particularly in recent years, though there is some confusion over just how much larger[15].

[15] In its Figure 2, the report on the SSC's January 2015 meeting provided graphs that purport to show the numbers of red snapper discarded, for each of the eastern and western Gulf, as estimated by SEDAR 31 and by the 2014 update assessment, both supposedly based on MRIP data. For some years, the latter are several times higher than the former – a point that the SSC evidently questioned and that SEFSC was unable to fully explain. From comparison with DEIS Appendix B Figure 2 (which itself appears to have mislabeled axes – see below), it seems that the SEDAR 31 discard numbers presented to the SSC were those for the open-season private-boat component of the fishery only. In the absence of proper documentation of the update assessment, it is not known whether the numbers drawn from the 2014 update assessment were also

The various values taken from the undocumented update assessment remain poorly known (outside of SEFSC) but the SEDAR 31 figures are public. Those indicated a general reduction in discard losses from the years around 2000, when more than half of fish killed by either sector were dead discards. Estimates of the proportions of catch released dead or dying were down to about 40% for the commercial sector and 25% for the recreational by 2011 (DEIS Appendix B, Table 4). Total red snapper discards by the IFQ handline fleet that year were estimated at about 100,000 in the western Gulf and several times higher in the east. The longline fleet, being much smaller, discarded only a few tens of thousands, almost all in the east, while the non-IFQ commercial fleets (presumably excluding shrimp trawlers) discarded only a few hundred snapper (DEIS Appendix B, Figure 3). The recreational sector discards considerably more red snapper than the commercial sector does: apparently about 2,000,000 in 2011 according SEDAR 31[16] and rather more than 3,000,000 by the estimates made for the 2014 update assessment[17]. However, those discarded fish are supposedly typically caught at shallower depths and are perhaps handled differently than is practical in commercial fishing. Hence, they are assumed to have higher survival rates. SEDAR 31 estimated the mortality rate of recreational discards at 10 or 11% under the venting requirement of Amendment 27 (implemented in 2007), and 21 or 22% for fish discarded without venting. In contrast, it set the mortality rates of discards by the commercial fishery very much higher – even when those fish had been handlined from shallow water. The rates varied from 55% for the non-IFQ component in the eastern Gulf when using venting to 95% for longline caught fish from the western Gulf if not vented (DEIS Appendix B Tables 2 & 3). It is not clear which, if any, of those SEDAR estimates were built into SEFSC's (2015b) projections but the likely effects are predictable: If the projection model supposed that 40% of fish killed by the commercial sector were dead discards (as estimated by SEDAR: DEIS Appendix B, Table 4), compared to 25% of those killed by the recreational sector, then re-allocation of allowable landings would reduce estimated losses to dead discarding. If the numbers were instead drawn from the update assessment, as SEFSC (2015b) claimed, then the proportion of the total recreational catch that was considered to be discarded very likely rose, though by how much is unclear in the absence of proper documentation. Hence, the projections likely incorporated recreational losses to discarding that were greater than 25% but perhaps still less than the 40% of the commercial sector. In short, while much remains in doubt, it is perhaps plausible that SEFSC's (2015b) projection model estimated that re-allocation would lead to a sufficient

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for that component alone or whether they were estimates of total recreational discards, of discards by the private-boat component for the full year, or of something else. All that can be said is that the SEDAR 31 and update-assessment discard numbers, as presented to (and reported by) the SSC, may not be directly comparable.

[16] DEIS Appendix B Figure 2 (supposedly based on SEDAR 31) suggests that recreational red snapper discards totaled only about 2,000 in 2011 (which would mean that only a few hundred were discarded dead). Yet DEIS Appendix B Table 4 provides an estimate of 220,515 recreational dead discards in 2011, based on MRIP data (and perhaps including data from the headboat survey – the Table's caption is unclear). Most likely, the axes in DEIS Appendix B Figure 2 should be labeled as reading in thousands (as are those in DEIS Appendix B Figure 3, which presents equivalent data on the commercial sector). If so, the total recreational red snapper discards were on the order of 2,000,000 fish in 2011.

[17] Drawn from Figure 2 of the report on the SSC's January 2015 meeting.

reduction in dead discarding to compensate for the exacerbated imbalance in the spatial distribution of fishing effort as allocation is passed to the recreational fisheries.

If they were used, however, **it is far from clear that the SEDAR 31 estimates of discard mortality rates are relevant to Amendment 28 questions**. For one thing, SEFSC (2015b) used the post-2010 "selectivity" estimated by the 2014 update assessment, which implies that the recreational fishery has taken to fishing deeper water in order to target larger snapper. As noted above, it is unclear whether any such change has actually happened but, if it is incorporated in the calculations, then the estimated mortality rates of recreational discards should be set higher than those of SEDAR 31 in response to the greater depths of capture. Next, the venting requirements introduced by Amendment 27 were eliminated through a framework action that became effective late in 2013 (DEIS p. 90), meaning that recreational discard mortalities should be projected at 21 and 22% – double the rate of 2011–13 from which SEFSC (2015b) supposedly drew its discard estimates.

Meanwhile, the SEDAR 31 estimates of the IFQ fleet's discarding were paralleled by a contemporary, but apparently independent, estimation prepared for the Council (GMFMC 2013). That found that discarding by vertical-line IFQ boats in the western Gulf almost ceased after 2007, as would be hoped for with a fishery under IFQ management, though discarding did continue in the east (GMFMC 2013, Figures 21 & 22) – perhaps because the strong year-classes that were entering the fishery at that time led to unusually high numbers of small fish in the catches. **Projections that use average recruitment in future years should use the targeting and discarding practices that would be generated by moderate year-classes, not values taken from particular, and potentially aberrant, past years (as was done by SEFSC 2015b)**. The IFQ longline fishery is much smaller than the vertical-line component and hence its effects on the re-allocation calculations should be negligible. In the west, however, the few longliners have continued to discard a minimal number of snapper. Those working off Florida, in contrast, generated a spike in discarding in 2007–08, which then fell back to normal levels (GMFMC 2013, Figures 21 & 22). There is some suggestion that over-quota fish were discarded (GMFMC 2013, p. 30) – a problem that was very likely resolved as the industry learnt how to utilize both its quotas and the market for additional quota. Overall, total discards by the IFQ fleet (including those released alive) were estimated at an annual average of 1,080,177 snapper during 2002–06 but only 429,671 during 2007–11 (GMFMC 2013, p. 29), in contrast to SEDAR 31's estimate of 632,686 dead discards alone in 2007–11 (DEIS Appendix B, Table 4). The latter number includes discarding by non-IFQ boats (though apparently not by shrimp trawlers) but their contribution was small. Moreover, GMFMC (2013, Table 18) found that most of the IFQ fleet's discards were released alive (surface-observed mortality rates being 17 to 43% in the vertical-line component and 14 to 44% in the longline fishery), though it must be noted that those figures do not include post-release discard-related mortality, as the SEDAR ones almost certainly do. In short, **the Council's own estimates of discarding by the IFQ fleet contradict the higher SEDAR ones, which appear to have been used in SEFSC's (2015b) projections of the conservation consequences of re-allocation, casting doubt on those results**.

As with the issue of recreational "selectivity", **what is needed here is a new SEDAR benchmark assessment and one specifically charged with examining discard rates and discard mortalities**. SEDAR 31 had the task of generating an assessment that would allow estimation of allowable catches and other measures relating to routine resource conservation through fisheries management measures. Estimating the conservation consequences of a re-allocation is a different task, needing projections across different time scales. The simplifying assumptions that are appropriate to the one may not be to the other. Uncertainties in input data deemed unimportant to the setting of allowable catches may become critical to allocation questions. In short, **full and thorough consideration of the issues at hand is needed before re-allocating but has yet to be applied in the Amendment 28 process to the scientific issues that are inevitably raised**[18].

IV. Conclusions

In its Amendment 28 DEIS, the Council has offered little justification for the proposed re-allocation in general, nor for any of the Alternatives in particular. The structure of Preferred Alternative 8 and that of Alternative 9 do, however, imply origins in **the 2014 update assessment of the Gulf red snapper resource** – an assessment that is inadequately documented and, in consequence, has yet to be subjected to a meaningful peer review. **That update assessment, however, offers only the appearance, not the substance, of scientific support for the proposed actions**.

Just what the assessment's re-calculation of historical recreational landings involved is unknown and undocumented. A calibration of MRIP estimates developed in 2014 was apparently applied but that was explicitly a "preliminary, interim approach", unfortunately necessitated by the required timelines of an assessment update but not appropriate for the production of scientific advice relating to a long-term management change. It is certain that estimates of recreational landings were amended from the values used by SEDAR in 2013 and that the changes ran all the way back to 1950 – despite MRFSS not having come on line until 1979 and having been modified

[18] Curiously, although all of SEFSC's (2015b) projections were supposedly run at $F_{REBUILD}$ and all achieved the Gulf-wide SPR target by 2032, re-allocation increased the overall rate of fishing-induced death (SEFSC 2015b, Figure 5), at least when that was calculated in biomass terms (in contradiction to the fishing mortality rate, which is defined in terms of numbers of fish). That is anomalous. Since current management targets are set safely below the theoretical F_{MSY}, by allowing mortality rates to rise in those projections that have higher assumed re-allocations, analysts would have tended to slightly increase their long-term projected allowable catches, regardless of the real effect on conservation of the more intense fishing. However, it is not certain that SEFSC (2015b) made any such error: Percentages of the snapper killed that are calculated in biomass units could increase without a change in fishing mortality (depending how that is quantified) if re-allocation altered the fishery-wide "selectivity". The expected effect of a re-allocation from commercial to recreational, however, would be the reverse – killing more smaller, and so lighter, individuals for the same mortality measured in abundance terms.
That is just one more uncertainty in the projections available to the Council that should be resolved before any reliance is placed in the numbers.

repeatedly thereafter[19]. How and why such a long run of estimates was adjusted remains obscure. **Most certainly, no argument has been advanced for why estimates of the landings during the 1979-87 base period developed (by unknown means) in 2014 should be regarded as more accurate than those used in Amendment 1, when the fisheries of that period were fresh in mind**.

Even were final and peer-reviewed estimates of historical recreational landings available, **the Council's attempt to derive a re-allocation percentage from the assessment results was founded in a fundamental misunderstanding of population dynamics**. Should the reasoning be corrected and the calculations worked through, they would show that the equitable course, in the short to medium term, would be to re-allocate in the opposite direction, from the recreational sector to the commercial sector, though the magnitude of the change cannot be known without new calculations. That stems from the long history of catch overages by the recreational sector. **To re-allocate in the direction proposed by the Council, and with the implied assessment-based justification of Alternatives 8 and 9, would be to reward future recreational fishermen for the failure of management to restrain their sector in the past**.

The nature of the putative change in the "selectivity" of the recreational sector is even less clear from the limited information available on the 2014 update assessment, though it may be that anglers chose to target their effort on larger, older fish in the years from 2011 onward. Why they did so (if indeed they did) does not seem to have been investigated and hence **there is no foundation for supposing that the change, even if real, will not soon be reversed**. Should that occur, the recreational fisheries would return to exerting high fishing pressure on young snapper, to the detriment of conservation – a detriment exacerbated by any re-allocation. Furthermore, if it is both real and lasting, the change in "selectivity" presumably arises from anglers **targeting larger red snapper in deeper water, a change that would increase the percentage of discards that die. Yet that change in discarding is not addressed in the Amendment 28 DEIS**. Even if the change in "selectivity" were to prove both real and lasting, and yet its effects were not offset by increased losses of dead discards, **the resulting short-term increases in allowable catches estimated by the update assessment have combined two different things: a long-term change resulting from the recreational sector fishing more conservatively and a short-run change** that presumably came from freeing the model "anglers" from an unrealistic focus on the scarce year-classes spawned since 2008. **The relative magnitude of those two mechanisms, and hence the extent of a possible science-justified re-allocation, cannot be known without a much more thorough examination of the assessment model and its outputs**. That examination might well be combined with consideration of those other changes that have increased the conservatism of either or both sectors, such as the IFQ fleet's reductions in discarding. **Considering the complexities and the scope for misunderstanding, the work should be incorporated into a new benchmark assessment**.

[19] As Boreman (2012) put it, in summarizing the 2012 SEDAR workshop: "MRFSS in the 1980s was not the same as MRFSS in the 1990s, and the survey continued to evolve during the 2004 to 2011 overlap period".

While the Framework's DEIS examines some effects of the proposed actions, including those on numbers of dead discards, it is deficient in its consideration of the effects on the red snapper resource. Notably, **in its DEIS, the Council has ignored the formal advice of its own SSC**, arising from the latter's May 2015 meeting, **that re-allocation would prompt a need to re-evaluate the existing OFL and ABC projections** – a change that would probably, though not certainly, move the fishery's long-term targets further away from optimum yield.

Much more seriously, the recreational sector has become (or perhaps always was) heavily concentrated in the eastern Gulf, while red snapper is primarily a species of the western Gulf. In consequence, **the rebuilding in the east that was provided by a run of strong year-classes, spawned in the years to 2007, has already been reversed by fishing pressure. Spawning stock biomass in the eastern Gulf is now projected, by the SSC, to fall to about a quarter of the target level, even under the existing allocations, leading to an inevitable and long-term failure to harvest the optimum yield in either area. Until the imbalance in the distribution of recreational fishing effort can be addressed, it would be dangerously irresponsible to re-allocate allowable catch from the (primarily western) commercial sector to the (primarily eastern) recreational sector**.

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APPENDIX D

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8 August 2015

I have been asked by several recreational and commercial fishers to provide my thoughts concerning Amendment 28 that will be before the Council for final action later this month. I have not been compensated in any way, so I offer my opinion only because I was asked to comment on this issue.

The notion that reallocation of red snapper from the commercial sector of the fishery to the recreational sector is a conservation measure is indefensible. Here's why. Red snapper live more than 50 years and long-lived species like red snapper usually are year-class dominated; i.e., they do not need to produce a strong year class every year to keep the population stable over time. As long as a good one is produced every 5 to 7 years, the population remains stable. Over the history of management of reef fish in Gulf, each time a strong year class is produced by red snapper catches are raised in response to increasing numbers and biomass. Three to 4 years later, the catch has to be reduced because overfishing resumes. If one simply looks at the history catches, they were raised then lowered as the 1989-year class moved into and through the fishery. The same thing occurred after 1995, and 1999-2000 and will happen again after 2004-2006. In the figure below, the red and green lines are relative red snapper recruitment. While the 2004 and 2006 years classes were not exceptionally high it is unusual to get good year classes separated by only a year. Recruitment from 2008-2014 has been average to low, especially in the eastern Gulf.

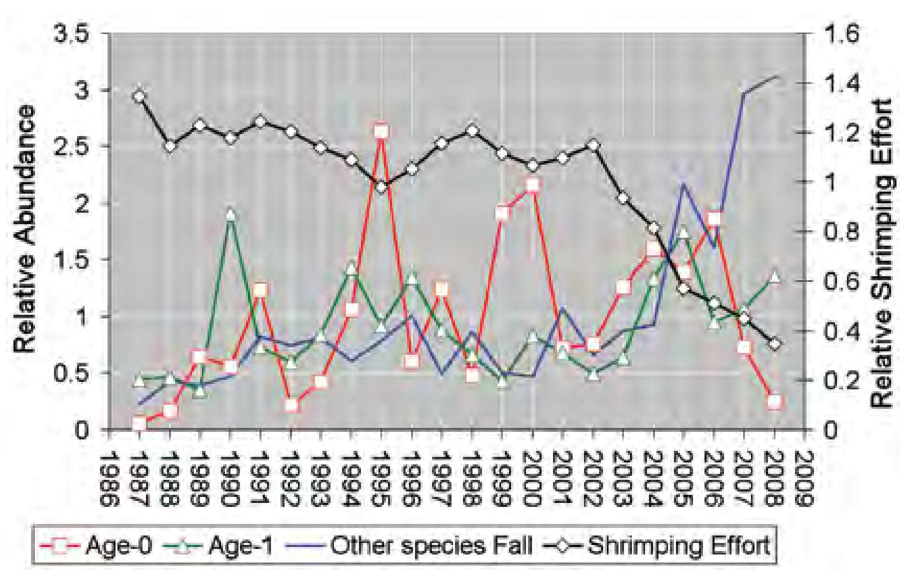
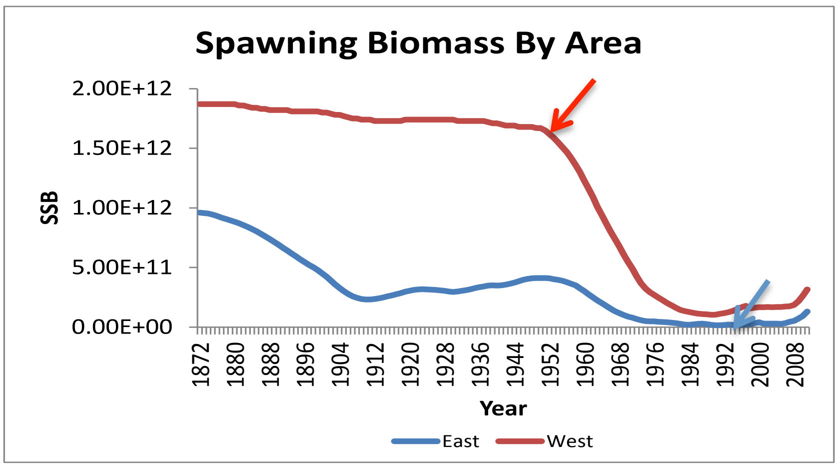


Figure 6. Relative abundance of age-0 and age-1 red snapper and total biomass of other species captured in the Southeast Area Monitoring and Assessment Program (SEAMAP) fall ground fish survey. Also shown is relative shrimping effort, which has been declining rapidly since 2002 (W. Ingram, NOAA Fisheries, Mississippi Laboratories, Pascagoula, MS).

The figure below is estimated red snapper spawning stock biomass in the Gulf as of the 2012 assessment. Basically, this shows the estimated combined weight of all of the reproductively mature red snapper females in the Gulf. As it turns out, there is considerable information available reporting that a well-established red snapper fishery in the northwestern Gulf began as early as 1892 (Carter 1965), despite what some have said to the contrary. The arrows below indicate when artificial reefs began to be deployed in large numbers. These took the form of oil and gas platforms in the western Gulf and all manner of things in the east. In either case there is no indication that artificial habitats have increased SSB because overfishing was occurring until only recently, and changed in response to the strong year classes. The artificial reef argument is not true now, nor has it been in the past.



When red snapper produced during strong year classes age to become part of the fishable biomass, everybody gets excited and fisheries governance invariably pushes to raise catches against the advice of their own advisory panels and/or the commercial and charter fishermen that generally support a more precautionary response. Unfortunately, when that happens we overexploit members of strong year classes, so there are not enough survivors that reach older ages, the importance of which explained below.

It is much easier to increase fishing pressure when times are good than it is to dial back fishing pressure when things start going south (this is called the “ratchet effect” as defined in Ludwig et al. 1992). It’s not complicated, and it happens every time a strong year class is produced. The only thing unique about the last few years is that we had two pretty good year classes separated by only one year (2004 and 2006); this had not previously been observed over the period of record, which only goes back to the early 1980s. I suspect that it has happened before, but it may not happen often.

Larger, older females (>10-12 years) devote more of their growth to reproduction, and they tend to start spawning earlier in the season than smaller fish, and they also spawn more times than do smaller females. This acts to extend the amount of time that eggs are in the water column, which increases the probability of producing strong year classes (i.e., not all of the eggs are in one basket). It is also important to recognize that despite these very high numbers of annual egg production, most females will likely not produce a survivor in any given year. This is a typical life history strategy in marine fishes. Over their lifetime, females release millions or billions of little eggs with very little investment by the female, expecting that most will die within a few days. Mortality begins to stabilize when the juveniles approach age 1. This circles back to the protracted spawning season issue. If eggs are in the water column for a longer spawning season, the probability of a strong year class increases because eggs and larvae are around to take advantage of times when conditions are just right. This life history in fishes is among the most common in nature, but can be problematic if the species stock is heavily exploited owing to the ratchet effect described above.

Red snapper is still overfished both in the eastern and western Gulf. I believe that raising the ACL, reallocation of more of the fishery to recreational sector, along with state management of the resource, will result in overfishing again within two to four years as the members of the strong 2004 and 2006 years classes exit the fishery. The new increase in catches currently is being justified by the small upturn in biomass that began in 2006 when the 2004 year-class started to show up in the landings. So, yes, biomass is higher, probably as high as it been since the 1960s; we all see this, including fisheries managers and scientists that are studying red snapper and other similar species. Unfortunately, in our work in the western Gulf, we have begun to see decreases in CPUE as these strong year classes age off deep-water oil platforms and the natural shelf edge reefs.

The table below shows the estimated instantaneous fishing mortality rate and clearly shows the impact of the strong year classes.

Year	Fishing Mortality	Standard Deviation
1988	1.31	0.18
1989	2.62	0.39
1990	1.89	0.29
1991	1.91	0.29
1992	1.59	0.20
1993	1.52	0.19
1994	1.41	0.20
1995	1.43	0.21
1996	1.05	0.14
1997	1.20	0.18
1998	1.11	0.17
1999	1.44	0.23
2000	1.70	0.29
2001	1.06	0.15
2002	1.33	0.19
2003	1.45	0.19
2004	1.43	0.17
2005	0.86	0.10
2006	0.56	0.07
2007	0.41	0.04
2008	0.18	0.02

2009	0.28	0.04
2010	0.21	0.03
2011	0.25	0.03

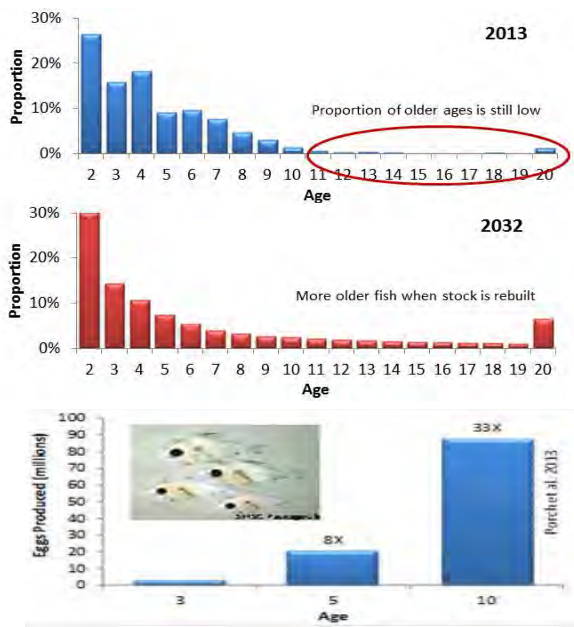
I added the yellow highlights to show that fishing mortality decreased by nearly 3-fold in 2006 when the 2004 year-class became fully vulnerable to the fishery. It dropped another 3 fold when the 2006 year-class became vulnerable in 2008. Since then, at least through 2011, rates are stable. Couple this with the figure of SSB and it's change in direction, the relationship is undeniable.

However, the figure below is the current age frequency (proportional age distribution) of adult red snapper in the Gulf based upon the most recent benchmark assessment. Fish produced in the most recent strong year classes dominate catches, but it is not clear whether enough fish are escaping to older ages. Remember that red snapper live to be 55 years old. The age frequency (proportion) in 2013 are the bars in blue, those in red represent the structure when the stock gets fully rebuilt. I also interject here that our data (LSU) support the figure from 2013.

Truncated Age Structure

- Truncated around the strong year classes 2004 and 2006
  - Less than 6 % of RS were older than 10 years
  - RS can live upwards of 50 years
- Fishing mortality
  - Selective removal of larger and older individuals
  - Overfishing leads to shifting age distributions (Hsieh et al. 2010)

Photo Credit Top Right: NMFS.gov



Why is this important? A single 7 to 9 year old red snapper female produces about 42 million eggs per year per female. Females older than 10 years produce more than 82 million eggs per fish per year, although it is hard to find fish > 10 years old, so sample size of older fish is low. But just to show you how quickly they ramp up, a 600 mm female will produce about 2 million eggs per batch, while a 650 mm female produces about 7 million eggs per batch. Red snapper spawn 30 to 40 or more times (every 4 to 7 days) each year; the older ones spawn more often because they can invest more energy in reproduction rather than somatic growth. Gonad weight at age 9 is about 175 grams, while gonads of females that are >10 -12 years old weigh about 450 grams on average. **Given these numbers, females older than age 10+ now produce about 70% of the eggs each year but this could be much higher if there were more old fish.** Because larger females devote more of their growth to reproduction, they tend to start spawning earlier in the season than smaller fish, and they also spawn more times than do smaller females. This acts to extend the amount of time that eggs are around, which increases the probability of producing a strong year class (i.e., not all of the eggs are in one basket).

More recently, members of my laboratory and I have been focused on comparing the relative value of natural versus artificial habitats for red snapper in the western Gulf off Louisiana. We sampled six standing and five toppled platforms (two of the platforms were unlit) and four of the natural shelf edge reefs off the coast of Louisiana. All of the sites are exposed to water quality that is suitable for red snapper (the standing and toppled are actually in the Louisiana Artificial Reef Planning areas). The natural reefs we sampled represent an east-west gradient in both depth of the reef crest and habitat complexity, terminating near the Flower Gardens Banks National Marine Sanctuary). Samples are being collected twice per quarter and began in 2008. To be perfectly honest, we were startled by the results. By every measure possible (i.e., tissue caloric density, liver somatic index, size and weight at age, diet complexity and nutritional quality, etc.) red snapper on the natural reefs are in better condition. The data below indicate how dramatic the differences are with respect to egg production. Recent data (June and July this year) are consistent with those reported below. All of this information has already been made available to NOAA Fisheries SEFSC.

Descriptive fecundity variables of same age female red snapper (*Lutjanus campechanus*) sampled during spawning season (June, July, August). Means N ± SD (Standard Deviation)(data provided by H. Glenn, LSU). Artificial habitat in this table refers to standing and toppled oil and gas platforms. Natural habitats are shelf-edge reefs off Louisiana (http://etd.lsu.edu/docs/available/etd-10232014-133051/)

Characteristic	Artificial Habitat	Natural Habitat
Batch Fecundity Estimate (eggs/batch)	41,878 ± 48,027	704,563 ± 693,573
Annual Fecundity Estimates (eggs/season)	1,369,334 ± 1,600,920	26,323,179 ± 26,147,495

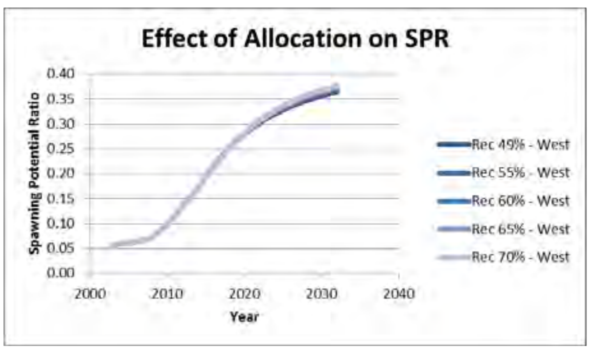
In my opinion, there appears to be no justification for a reallocation **given that the fundamental problem with the recovery of the stock is not the availability of fishable biomass, rather it is age truncation**. I am even more concerned by our results regarding reproductive potential (we are seeing this in red snapper collected from platforms in June and July 2015). We have just received funding from S-K to try to estimate the relative proportion of red snapper on artificial vs. natural reefs in the western Gulf.

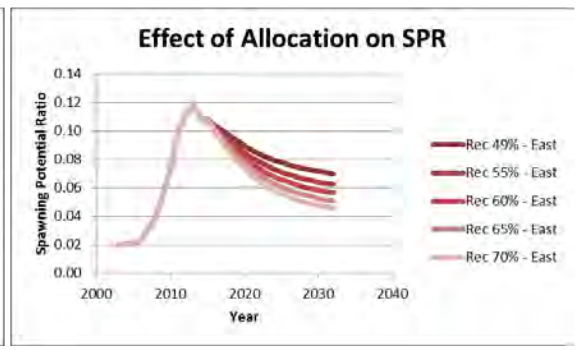
Here are my final thoughts in summary:

There appears to be no justification for a reallocation given that the fundamental problem with the recovery of the stock is not the availability of fishable biomass, rather it is age truncation. I believe that private recreational fishers on average are more likely to seek larger red snapper as a consequence of trophy hunting. Given that participation by the private recreational sector is the only sector of the red snapper fishery that is free to grow without constraint, I believe that the proposed reallocation will result in an increased risk of failure to reach the 2032 stock rebuilding target. Why?

1) If the proportion of red snapper on artificial reefs in the western Gulf is high, and those fish are reproductively constrained by poorer nutrition, then the current estimate of SSB in the west may be called to question.

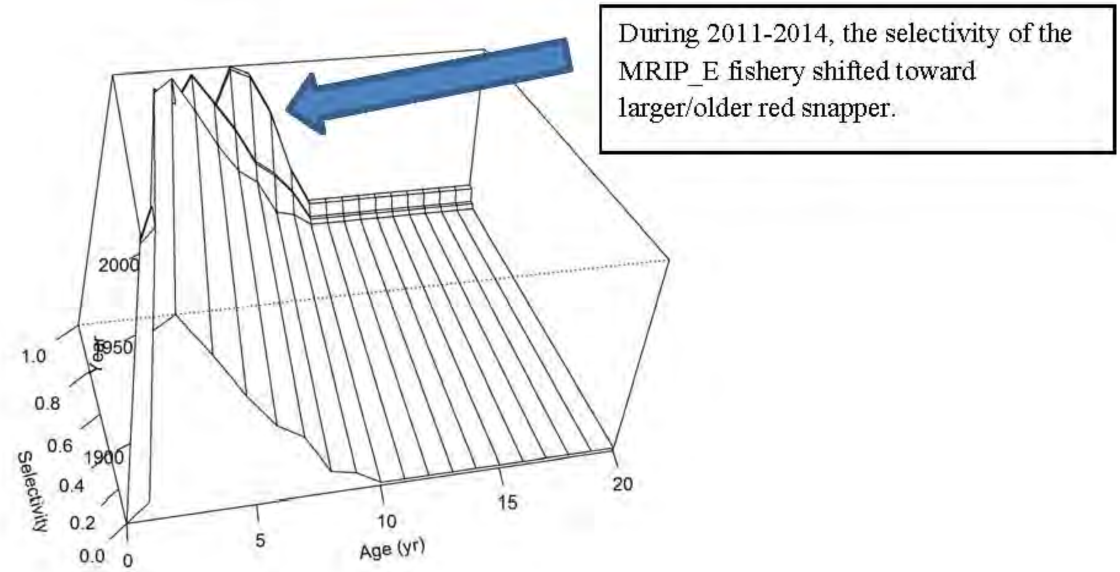
2) Information provided by NOAA Fisheries in the figures below show clearly that any change in the allocation of red snapper could cause significant declines in SPR of the snapper stock in the eastern Gulf, and under the most extreme example, collapse to levels not seen since the 1980s. If number 1 above is true, SSB in the western Gulf may not provide as strong a buffer against failure to reach the 2032 stock rebuilding target as has been previously assumed.





3) Irrespective of the recalibration due to MRIP, selectivity by the recreational sector appears to have increased substantially. I suspect that some of this is attributable to the growth of fish produced during the two aforementioned strong year classes, but there may be other consequences. The questions below addressed my concerns:

- Do we know whether the availability of larger fish caused the increase in selectivity, and if so did it result in high grading?

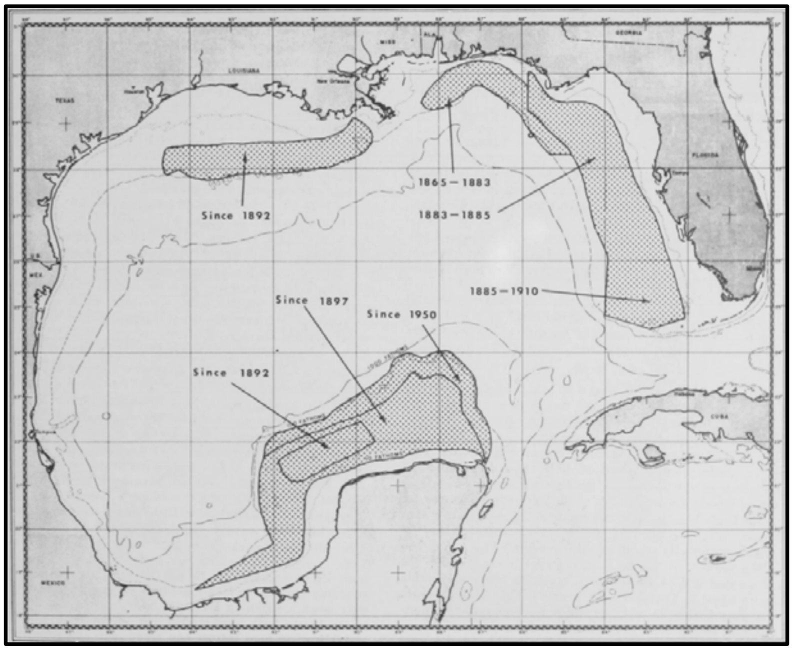


- Do we know if recreational fishers are fishing farther offshore in pursuit of trophy fishes? If so, discard mortality rates are likely to be much higher than the 10% used in the SEDAR 31. Jaxion-Harm and Szedlmayer (2015) suggest that the size distribution of red snapper increases with depth in the reef permit zones off Alabama; if this is true, are faster boats with better electronics allowing targeting of larger fish which in the past have been less vulnerable?
- Do we know how defiance of federal fishing seasons and bag limits by private recreational anglers in noncompliant states is affecting discard mortality (high grading?), and selectivity?

4). Given that a high proportion of the total recreational red snapper fishing effort occurs in the eastern Gulf, and the stock size in the east is recognized to be considerably smaller than in the western Gulf, what is to prevent effort shifting by the private recreational sector to the western Gulf as fish in the east become depleted?

5). Finally, most of the red snapper caught by the commercial sector are caught in the western Gulf. Currently, this sector of the fishery in both the east and western Gulf are fishing at a rate below F_{MSY}. In fact, the rate is likely close to F_{MEY} given the discussion provided by Punt et al. (2014) and the current estimate of $SPR_{35\text{-}40\%}$ in the western Gulf by NOAA Fisheries in the effort allocation figure above. This is considered to be risk adverse for species for which the S-R relationship is poorly known.

Personally, I will never be convinced that the steepness value for a species with a life history such as red snapper can be as high as 0.99, which effectively says that recruitment is independent of stock size. Given the history of the fishery, and the well-documented collapses that progressed eastward from Mobile-Pensacola from 1865 to 1910, culminating off south Florida, the current S-R steepness seems impossible. The commercial extinction in the eastern Gulf persisted until well after I moved to Alabama and became involved with red snapper in 1992.



From Carpenter 1965

I may be thick-headed, but I don't get it. I do know that the red snapper ITQ program seems to have had the intended affect of increased stewardship by the commercial sector, and will likely do the same for the for hire sector. Perhaps it is time for the private recreational sector to begin thinking more seriously about fishing sustainably in these days of rapidly increasing fishing power operating on a relatively small, but renewable, resource. We have demonstrated over and over again that there is sufficient fishing capacity in the US Gulf to deplete red snapper stocks. From an historical perspective red snapper has been, and is, fished by other sectors that have been around since long before recreational fishing was popular. It would not be difficult to include private recreational anglers in a dedicated access program that would end the derby conditions they face. Such a program would also greatly reduce the likelihood of quota overruns, thus the imposition of accountability measures. In the absence of such a program, it seems likely that reallocation would result in an increase in the chance that accountability measures will continue to plague private recreational anglers for the foreseeable future.

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Louisiana State University
Lifelong Recreational Angler
Award of Excellence in Fisheries Management from the American Fisheries Society 2007
Chair, Reef Fish Stock Assessment Panel 1992-2004
Member, Standing Scientific and Statistical Committee, 1995-2006
I served on both of the above are advisory panels at the behest of the Gulf of Mexico Fisheries Management Council

More information about reproductive potential in the western Gulf

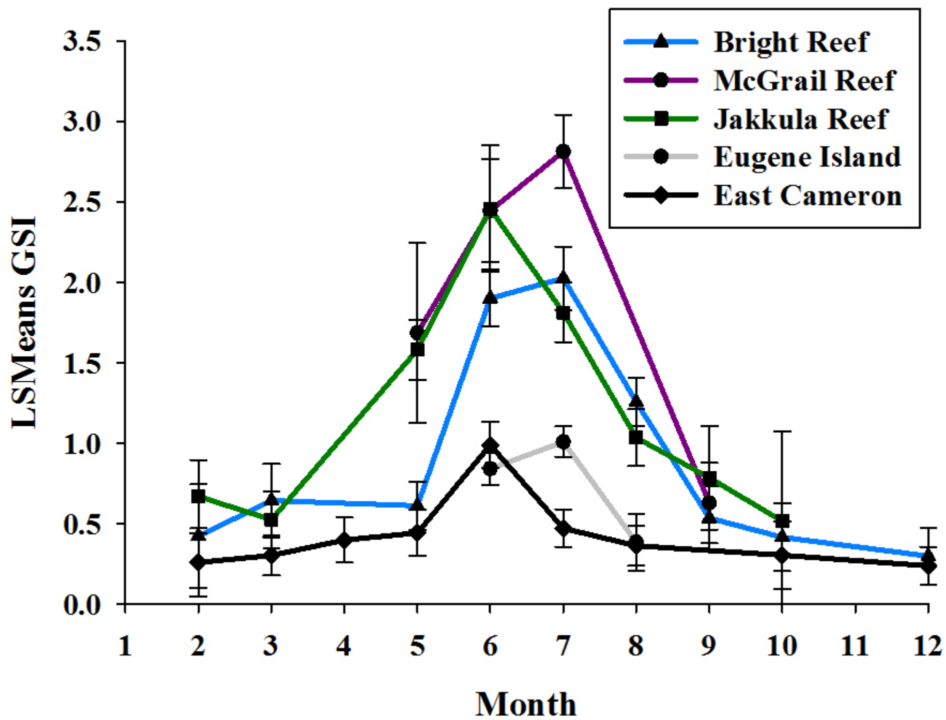

Figure 2 LSMean monthly gonadosomatic indices (GSI) for female red snapper (*Lutjanus campechanus*) at both indvidual sites (A.) and

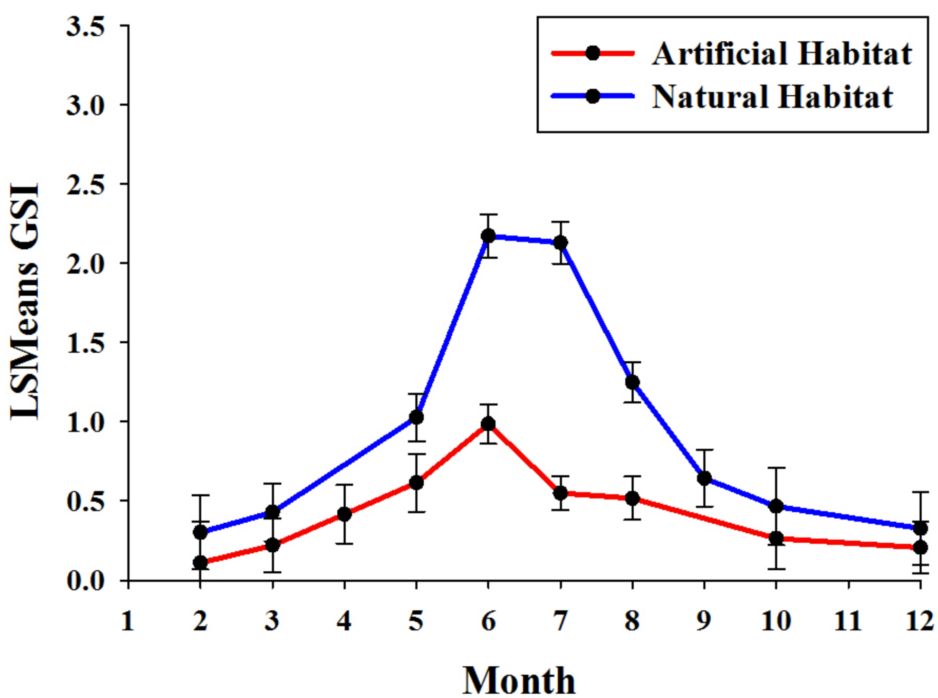

Figure 2 LSMean monthly gonadosomatic indices (GSI) for female red snapper (*Lutjanus campechanus*) at both indvidual sites (A.) and habitats (B.); vertical bars represent standard errors of monthly mean. * indicates a significant difference in mean GSI between habitats at that month (ANOVA, p<.05)

Table 5 Descriptive fecundity variables of female red snapper (*Lutjanus campechanus*) sampled during spawning season (June, July, August). Means N (% of total sample) or ± SD (Standard Deviation).

Characteristic	Artificial Habitat	Natural Habitat
Ovaries with Hydrated Oocytes	7 (5%)	2 (3%)
Postovulatory Follicles in ovaries	5 (4%)	14 (22%)
Batch Fecundity Estimate (eggs/batch)	41,878±48,027	704,563±693,573
Annual Fecundity Estimates (eggs/season)	1,369,334±1,600,920	26,323,179±26,147,495

To show that what I describe concerning truncated age structue is not restricted to red snapper, the next few sections are taken largely from Hixon et al. (2014) in a paper entitled "BOFFFFs (big old fat fecund female fish): on the importance of conserving old-growth age structure in fishery population". They state that fecundity generally increases with female age simply as a function of body size because a larger body cavity allows development of larger ovaries. In fisheries applications, the increase in fecundity with body size is accounted for by using the metric of SSB, which is an estimate of the total weight of mature female fish in the population. Application of SSB in assessment models relies on the assumption that females of different sizes produce the same number and quality of offspring per unit of body weight. Here, we do not consider the increase in fecundity with body size to be a maternal effect unless there is a difference in weight-specific or relative fecundity, the number of eggs per g of female body weight. If relative fecundity differs with maternal traits, then SSB is not an adequate metric for the reproductive potential of populations with different maternal age/size compositions.

Cooper *et al.* (2013) provide a clear example of the contrast between SSB and total egg production (TEP) with increasing age truncation (the figure below of spotted seatrout). It can clearly be seen in the figure that as F increases, the number of fish surviving to older age decreases and even modest increases in F can cause extreme reductions in total egg production. Although, I have not included the information in this brief white paper, Hixon et al. (2014) also provide a substantial review of literature showing that larger, older females usually produce eggs of higher quality than those spawned by young con-specifics.

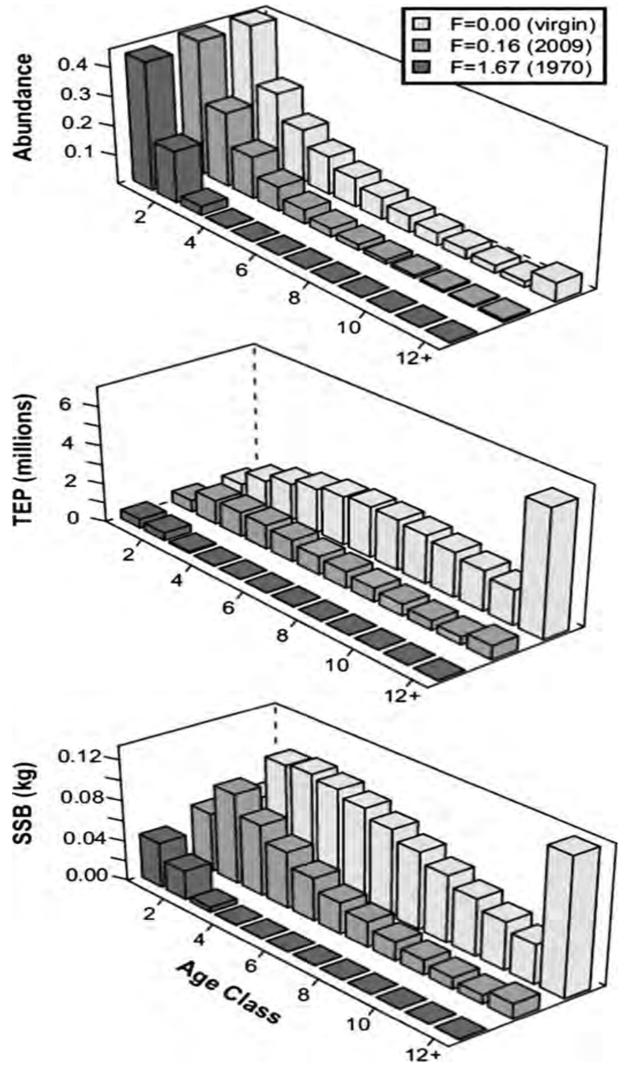

Figure 2. Modelled abundance, TEP, and SSB at three fishing mortality rates (*F*) per recruit of spotted seatrout (*Cynoscion nebulosus*). Note the extreme age truncation and decline in egg production caused by even moderate fishing (Cooper *et al.*, 2013).

While the figure above is for spotted seatrout, it is widely recognized that in long-lived species with low natural mortality, females devote increasingly more energy into reproduction than growth as they age (review by Rolf 1992). In fact, relative fecundity has been found to increase with maternal age, and most especially, size in a wide range of species (Table 1). Stock assessments are increasingly incorporating such size- and age-dependent effects on fecundity. The degree to which older females produce disproportionate numbers of eggs and larvae varies greatly among species. In a review of 41 species of rockfish (genus *Sebastes),* Dick (2009) found that some of these differences could be explained by phylogeny. For example, species in the subgenus *Acutomentum* showed limited evidence of size-related differences in relative fecundity. In contrast, species in the subgenera *Rosicoh* and *Sebastomus* demonstrated strong increasing trends with size.

Table 1. Representative teleost species with relative (weight-specific) fecundity documented to increase with female age and/or size.

Species	Reference
Clupea harengus	Oskarsson and Taggart (2006)
Clupea pallasi	Hay (1985)
Coregonus pidschian	Dupuis and Sutton (2011)
Coregonus clupeaformis	Johnston *et al.* (2012)
Dicentrarchus labrax	Mayer *et al.* (1990)
Gadus morhua	Marteinsdottir and Begg (2002)
Melanogrammus aeglefinus	Hislop (1988)
Merluccius merluccius	Mehault *et al.* (2010)
Sebastes alutus	Haldorson and Love (1991)
Sebastes brevispinis	Stanley and Kronlund (2005)
Sebastes caurinus	Dick (2009)
Sebastes chlorostictus	Haldorson and Love (1991)
Sebastes crameri	Dick (2009)
Sebastes dalli	Haldorson and Love (1991)
Sebastes diploproa	Dick (2009)
Sebastes elongatus	Haldorson and Love (1991)
Sebastes entomelas	Boehlert *et al.* (1982), Stafford (2012)
Sebastes flavidus	Sogard *et al.* (2008), Stafford (2012)
Sebastes goodei	Stafford (2012)
Sebastes melanops	Bobko and Berkeley (2004)
Sebastes melanostomus	Beyer *et al.* (in press)
Sebastes miniatus	Haldorson and Love (1991)
Sebastes mystinus	Sogard *et al.* (2008)
Sebastes ovalis	Beyer *et al.* (in press)
Sebastes paucispinis	Haldorson and Love (1991)
Sebastes rosaceus	Haldorson and Love (1991)
Sebastes rosenblatti	Haldorson and Love (1991)
Sebastes rufus	Haldorson and Love (1991)
Sebastes saxicola	Haldorson and Love (1991)
Sebastes semicinctus	Haldorson and Love (1991)
Sebastes serranoides	Haldorson and Love (1991)
Seriphus politus	DeMartini (1991)
Tilapia zillii	Coward and Bromage (1999)

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For multiple-batch spawners (fish that spawn multiple times in a season), total annual egg production depends upon the number and size of batches released each season. In fisheries applications, the common assumption is that batch number does not vary with female size or age. A thorough review by Fitzhugh *et al.* (2012) reported 21 species in which the number of batches increases with female age or size, four species that show a decrease, and nine species with no differences. Based upon modeling studies of different hake (*Merluccius)* species, Field *et al.* (2008) estimated a dramatic increase in batch number with age, from one batch per year at age 2 to fourteen batches per year at age 15. As with other aspects of maternal influences on reproduction, there is a clear trend towards BOFFFFs contributing disproportionately to future cohorts, but sufficient variability to indicate that such reproductive parameters must be evaluated on a species-by-species basis. Such interspecific variability adds further complexity to the development of management approaches that incorporate maternal effects.

In addition to exhibiting lower relative fecundity, younger, smaller females have been observed to skip spawning altogether in some years. Evidence of this effect has been observed in Atlantic cod (Rideout and Rose 2006), and the rockfish *Sebastes alums* (Hannah and Parker, 2007) and *S. aurora* (Thompson and Hannah, 2010). Rideout *et al.* (2006) demonstrated a clear relationship of reduced energy stores in the liver associated with skipped spawning, harkening back to Hjort's (1914) prescient analysis of cod. Variation in the extent of skipped spawning among years may also be associated with differences in the quality of the larval environment (Rideout *et al.* 2006; Hannah and Parker 2007). In the recent work we have done comparing natural versus artificial habitats in the western Gulf of Mexico, Glenn (2014) collected data indicating that skip spawning of same age red snapper occurred in fish collected on artificial habitats. She concluded that this was likely do the lack of energy reserves of red snapper on standing and toppled platforms compared to fish found on natural shelf edge reefs.

Finally, BOFFFFs often begin spawning earlier and/or over longer spawning seasons than smaller, younger female fish, as documented in a variety of species (Table 3 below). Additionally, in multiple-batch spawners, older fish may produce more batches of eggs over a longer period each season, as documented in drum (DeMartini and Fountain 1981), anchovy (Parrish *et al.* 1986), striped bass (Secor, 2000a), haddock (Wright and Gibb, 2005), and sardine (Claramunt *et al.,* 2007), among others. For example, individual Atlantic cod can spawn over a range of 2 - 7 weeks, and by individuals spawning at different times, a population may spawn over a range of 4 -15 weeks (Marteinsdottir and Bjornsson, 1999). This has been shown to be true for red snapper by several authors.

Table 3. Representative teleost species with the timing of annual spawning or parturition documented to be earlier and/or longer with increasing female age and/or size.

Species	**Reference**
Clupea harengus	Lambert (1987)
Engraulis encrasicolus	Millan (1999)
Gadus morhua	Hutchings and Myers (1993)
Hemiramphus balao	Berkeley and Houde (1978)
Hemiramphus brasiliensis	Berkeley and Houde (1978)
Melanogrammus aeglefinus	Wright and Gibb (2005)
Morone saxatilis	Cowan *et al.* (1993)
Pleuronectes platessa	Rijnsdorp (1994)
Sebastes crameri	Nichol and Pikitch (1994)
Sebastes entomelas	Stafford (2012)
Sebastes flavidus	Sogard *et al.* (2008)
Sebastes atrovirens	Sogard *et al.* (2008)
Sebastes melanops	Bobko and Berkeley (2004) and Sogard *et al.* (2008)
Sebastes mystinus	Sogard *et al.* (2008)
Trisopterus luscus	Alonso-Fernandez and Saborido-Rey (2011)

Reviews by Miranda and Muncy (1987), Trippel *et al.* (1997), and Wright and Trippel (2009) provide additional examples.

Based upon information already provided, it would seem obvious that mature female red snapper have the potential to produce many batches of eggs over a lifetime and that older, especially larger red snapper females, and that older females spawn more often, produce many more eggs per batch, and over a longer period of time in during the spawning season. Annual fecundity estimates (AFE) also are high. (Woods 2003; Woods et al. 2007) estimated that annual mean fecundity estimates of red snapper off Alabama to be 13,401,861 ova based upon a mean batch fecundity (BFE) (N=197 fish) of 304,996 produced by 43.9 spawns per season. One 837 mm FL, 13 year old female captured off Louisiana had an estimated BFE of more that 7.9 million ova per spawn obtained from an ovary that weighed 2,020 g wet weight. With that female included, Louisiana females (N =100) produced a mean BFE of 643,812 in 36.10 spawns per year for an AFE of 23,243,560. Excluding that female, Louisiana annual mean BFE was 552,108 and AFE was 19,932,768. On average, Louisiana red snapper annually produced 7-10 million more ova per individual that did fish collected off

Mississippi-Alabama; however, females up to 725 mm FL and 6.5 years had greater estimated annual fecundities than similar sized and aged fish collected off Louisiana (Woods 2003; Woods et al. 2007, Kulaw 2012, Glenn 2014). Similar results have been found in red snapper in the South Atlantic (White and Palmer 2004; Lowerre-Barbieri et al. 2015) and in the extreme southern Gulf of Mexico (Brulé et al. 2010).

This temporal spread of reproductive effort provides a bet-hedging life-history strategy helping to ensure that some larvae are spawned at times of favorable environmental conditions, including high food availability (Cushing 1990, as foreshadowed by Hjort 1914) and/or low predation intensity (Bailey and Houde 1989; Winemiller and Rose 1992; 1993). Additionally, BOFFFFs may spawn in different locations than younger, smaller fish (reviews by Wright and Trippel, 2009; Hsieh et al. 2010), providing spatial as well as temporal bet-hedging. Empirical evidence for bet-hedging includes settlement of plaice *(Pleuronectes platessa)* occurring over several weeks despite spawning occurring over several months (Hovenkamp 1991). Likewise, the extensive occurrence of "sweepstakes reproductive success" (Hedgecock and Pudovkin, 2011) demonstrates the rarity of each individual contributing to recruitment in any given year. Evidence for the importance of BOFFFFs in bet-hedging includes the fact that first-time, late-spawning female haddock (*Melanogrammus aeglefimis)* contribute little to recruitment (Wright and Gibb, 2005; see also the state-based model of Wright and Trippel, 2009). Other empirical examples are provided in Secor's (2007) review. Thus, there is increasing evidence that old-growth age structure is a better index of the reproductive potential of a stock than simply SSB alone (Marshall *et al.,* 2003; Lambert, 2008). Overall, age truncation due to fishing may alter the timing and duration of annual reproduction by delaying and shortening the spawning season (Scott *et al.,* 2006), contributing to the observed increase in recruitment variability for stocks comprised of only younger spawners (Marteinsdottir and Thorarinsson, 1998; Secor, 2000b; Wieland *et al.,* 2000; Hsieh *et al.,* 2006; Lowerre-Barbieri et al. 2015).

Deleterious consequences of age truncation for fisheries stability

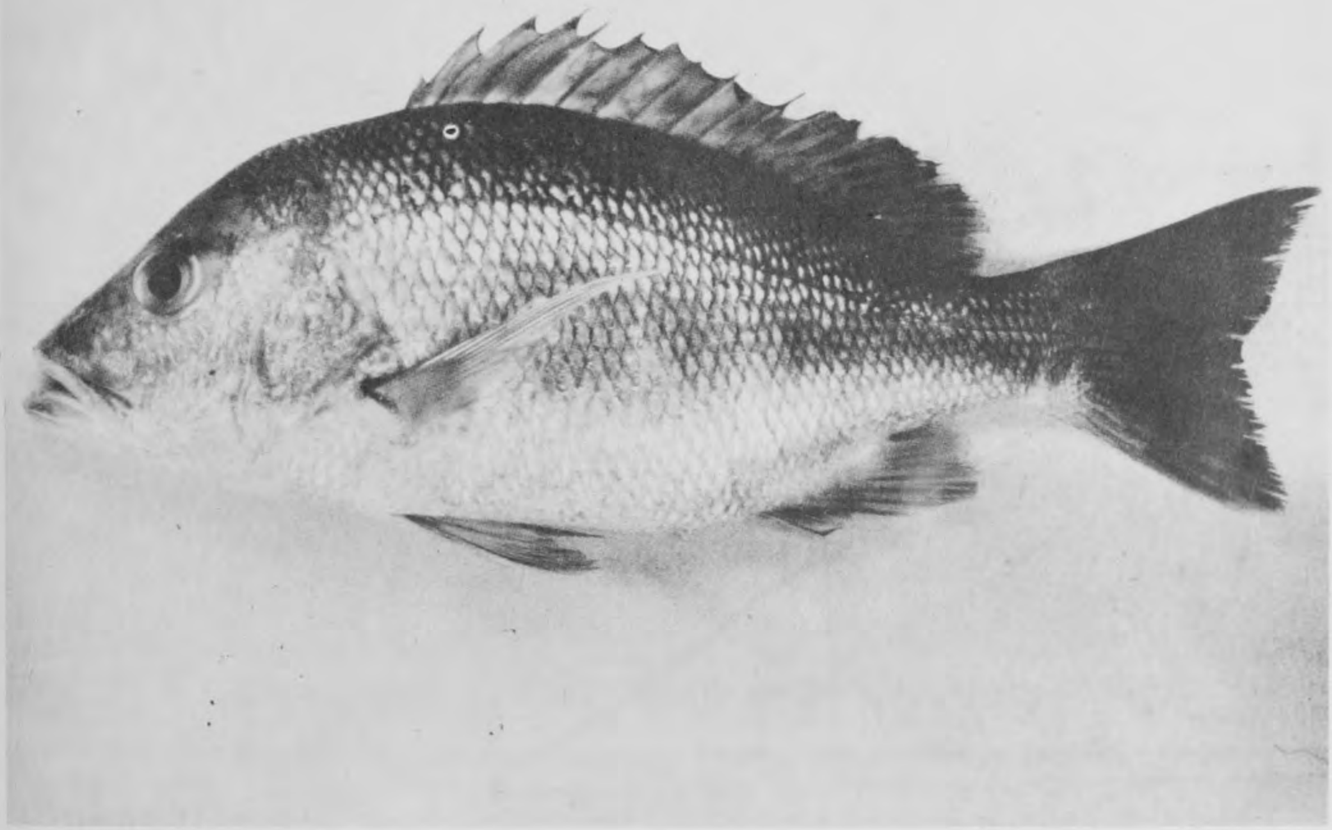
It is increasingly well documented that age-truncated fish stocks are more variable through time, and thus more susceptible to collapse, than populations with more intact age structure. This pattern is especially but not exclusively true for "periodic species" (Winemiller and Rose 1992) that exhibit relatively low early survival, late maturation, and high individual fecundity (such as cods and rockfish). In short, old-growth age structure fosters population stability, whereas age truncation often destabilizes population dynamics (Rouyer *et al.* 2012). In the most comprehensive reviews to date, Hsieh *et al.* (2006, 2008), Anderson *et al.* (2008) and Hixon et al. (2014) found that fishing significantly increased fluctuations of stocks in the southern California Current ecosystem. They used multiple species and multiple stocks of the same species Anderson *et al.* (2008) tested three likely and non-mutually exclusive mechanisms proposed to explain this pattern. First, variable fishing intensity may directly cause population variability independent of any age-truncation effects (Jonzen *et a.,* 2002). This hypothesis was falsified. Second, unlike BOFFFFs, small, young fish in age-truncated populations may not buffer environmental variability by "bet-hedging" reproductive output via a protracted spawning season (Murphy 1968; Leaman and Beamish, 1984; Longhurst 2002; Berkeley *et al.* 2004a; Hutchings and Reynolds 2004; Hsieh *et al.* 2005, 2006). Third, the demographic characteristics of age-truncated populations (in particular, the per capita population growth rate) may be prone to unstable dynamics (Dixon *et al.* 1999; Hsieh *et al.* 2005). Although both the second and third hypotheses are due to age truncation, they generate subtly different predictions: the loss-of-bet-hedging hypothesis predicts that a population will more linearly track environmental variation, whereas the demographic- alteration hypothesis predicts clearly non-linear responses. For the CalCOFI data, the demographic-alteration hypothesis provided the better fit, although there was also evidence for the loss-of-bet-hedging hypothesis (Anderson *et al.* 2008).

Age truncation also inhibits stock resilience over time-scales longer than annual production. The extremely high fecundity of teleost fish, the commonality of relatively long lifespans, and the high variability of recruitment in annual cohorts all suggest that individual reproductive success is rare and episodic (Winemiller and Rose 1992). Recent technological advances in genetics have allowed quantification of effective population size *(N_e)* and estimations of the proportion of adults that successfully contribute to subsequent generations. Hauser and Carvalho (2008) report surprisingly low N_e in a taxonomically diverse range of marine species, suggesting that a large proportion of mature adults are unsuccessful at producing surviving progeny. Based upon the evidence of maternal effects outlined above, they suggest that only older spawners ready in years of excellent recruitment may have a chance to become rare “sweepstake winners”. For a 28-year time-series of pelagic juvenile rockfish surveys, Ralston *et al.* (2013) found a striking pattern of increased individual size, coherent among the ten most common *Sebastes* species, in years of high abundance. This result suggests that, in environmentally favorable years, larvae released earlier in the reproductive season had particularly high survival. Because older, larger rockfish females tend to release larvae earlier than younger, smaller females (Nichol and Pikitch 1994; Bobko and Berkeley 2004; Sogard *et al.* 2008), it is likely that much of the production in high- recruitment years came from BOFFFFs. Likewise Gold and Saillant (2007) and Saillant and Gold (2010) provide evidence that red snapper N_e in the eastern Gulf of Mexico is 10 to 100 fold lower than in the west; more recent results suggest that the effective population size off Mississippi-Alabama is very low (Gold, pers. comm.). In contrast, when environmental conditions were not favorable for early spawners, much of the production was likely derived from younger females, with reduced offspring abundance despite the presumably greater amount of SSB compared with older females.

Repeated spawning over many years increase the likelihood that an individual’s offspring will encounter a favorable environment in at least one of those years. In a recent paper focused on red snapper from the Florida east coast and the Carolinas, Lowerre-Barbieri et al. (2015) referred to this as reproductive resilience and infers that fishing practices that cause and perpetuate age truncation should be avoided, despite the observation that red snapper can occasionally produce strong year classes when spawning stock biomass is low. In short, old-growth age structure fosters population stability, whereas age truncation often destabilizes population stability and increases the probability of collapse.

I have concluded: 1) there is no justification for lowering the red snapper rebuilding target to $F_{20\%SPR}$ in the absence or management measures to lessen age-truncation, 2) benchmarks based upon biomass alone for long-lived species like red snapper, are necessary but insufficient for successful management, 3) management benchmarks should devised to include a measure of age truncation (AT) rather than on simple spawning stock biomass (SSB). This is essentially what Phil Goodyear tried to tell us with SPR in his early publications. Ideally, it would best to combine the two (SSB and AT) into a single benchmark (like a much smarter P*), but this will be difficult to do; and 4) changes to reduce derby (very short seasons) conditions in the for-hire and private recreational fisheries should be made via development of a dedicated access program as was done for the commercial red snapper fishery in 2007. It is time to admit that red snapper are still overfished (but may be starting to recover) and that fishing power now is higher now than anytime in the history of the fishery.

A Review of the Gulf of Mexico Red Snapper Fishery



UNITED STATES DEPARTMENT OF THE INTERIOR

U.S. FISH AND WILDLIFE SERVICE

BUREAU OF COMMERCIAL FISHERIES

Circular 208

Cover photo. -- The red snapper, *Lutjanus aya*.

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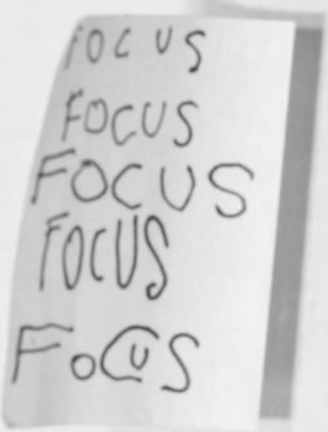
A Review of the Gulf of Mexico Red Snapper Fishery

By

JAMES S. CARPENTER

Circular 208

Washington, D.C.
August 1965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A Review of the Gulf of Mexico Red Snapper Fishery

By
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ABSTRACT

The developments of the fishery (fourth most valuable fishery in the Gulf) are shown by the following comparisons:

Vessels.-From a relatively small fleet of sail-driven schooners with live-wells for keeping fish to numerous diesel powered boats using ice for preserving the catch.

Fishing grounds.-From areas lying close to the mainland (inside 40 fathoms) off Florida and the "Middle Grounds" southeast of Pensacola to the "Western Grounds" off Texas and the Campeche Banks off Mexico.

Gear, equipment, and fishing methods.-From cotton handlines using the hand over hand technique to stainless steel lines with reels and improved terminal gear. From dead-reckoning and sounding techniques for navigation and locating fishable bottoms to modern electronic equipment, complete and accurate charts, and celestial navigation. From the generally ineffective cod gill nets, longlines, hoop nets, and fish traps for catching snapper to the highly successful modified otter trawls.

Handling and marketing.-From unsatisfactory fish handling techniques, resulting in poor quality fish, to greatly improved methods. From almost exclusive use of railroads for shipping fish iced in barrels to the predominant use of trucks for shipping boxes of iced fish.

Production.-From good catches made per boat by the relatively small snapper fleet, producing moderate total landings, to decreased catches per boat for a much increased fleet, making greater total production.

INTRODUCTION

The existing literature contains only few and incomplete descriptions of the red snapper fishery. Comprehensive descriptions have been made at various times by Stearns (1885); Jarvis (1935); and Camber (1955). There is, however, no up-to-date description. Since so many innovations in vessels, gear, and methods have been made in the past few years, and because the Bureau of Commercial Fisheries has received numerous requests for information on the snapper and grouper fishery, it is necessary to redescribe the fishery to include these changes.

HISTORY

The Gulf of Mexico red snapper fishery, pioneered by New Englanders, had its origin off the northwestern coast of Florida some 15 or 20 years before the Civil War. During this period, catches, taken by handlines from live-well smacks[1] and chings[2] that fished only the inshore waters, were either shipped to New Orleans "where they sold like hot cakes" (Collins, 1887) or were sold in Mobile (Warren, 1898). Some catches were sold in Pensacola for local consumption. "The existence of red snapper grounds in Florida waters and the potentialities of the waters offshore were unknown to the local people. In the early seventies of the last century the grounds fished were within the forty fathom line, between Mobile, Ala., and Fort Walton, Fla. The lack of experience as deep sea fishermen, as well as the absence of correct soundings, contributed further to the delay in the discovery of the red snapper banks off the Gulf coast." (Camber, 1955).

Not until after the Civil War (1872) was the fishery really started on a large scale (Warren, 1898). At this time, a New Englander built a fish house for handling and shipping red snapper and imported fishermen and live-well smacks from the North. In the following few years, with the organization of new companies and partnerships, the red snapper fishery in Pensacola became more firmly established. The Texas red snapper fishery developed in the 1880's (Camber, 1955), and at about this same period Mobile became one of the principal snapper centers. In 1932, two companies in Pensacola worked about 70 smacks and produced half the U.S. red snapper catch (Jarvis, 1935).

In the early fishery, live-well chings and smacks were used exclusively. These vessels were constructed to hold live fish in tanks or wells. Fish could be kept alive only for a relatively short period of time; therefore, fishing was confined mostly to grounds lying short distances from home ports.

A revolution in the red snapper fishery had its beginning when schooners brought ice from Maine. Fish dealers found that ice-packed red snapper remained in good condition for long periods. Although natural ice was available as early as 1868 (Collins, 1887), it soon became too expensive to use because of increased shipping costs.

[1] "Smacks" are large schooners of 50 to 60 tons, carrying 8 to 12 men. They spend at least 17 and up to 32 days at sea.

[2] "Chings" are small sailing vessels over 5 but not exceeding 20 tons, carrying 3-7 fishermen. They spend a maximum of 10 days at sea.

In 1895, ice manufacturing plants began producing ice at a reasonable price. With disappearance of prejudice among fishermen against the use of ice for preserving fish, live-wells were eventually abandoned (Camber, 1955). With vessels modified or constructed to carry ice, fishing ranges were extended, and, as a result, much larger catches were landed.

After the turn of the century, most snapper grounds from Texas to Florida and along the entire Bank of Campeche had been fished. Several years later, vessels began to fish off the coast of Mexico. Major areas initially fished off Mexico were directly south of the Rio Grande River and east-southeast of Vera Cruz, Mexico. Some vessels would make the complete circuit and fish the entire Mexican coast from the United States-Mexico border to the Yucatan peninsula. Now, U.S. vessels fish on all known snapper grounds in the Gulf.

In the past few years, with only a few vessels lost or retired and numerous vessels constructed, the size of the commercial fleet has increased tremendously. More boats were built in the past 12 months than in the previous 12 years. In the early fishery, a minute fleet of sail-driven smacks and chings fished out of one port (Pensacola) in northwestern Florida; today a vast fleet of diesel powered vessels fish regularly from numerous ports along the Gulf coast.

VESSELS

The early live-well chings and smacks had holding tanks or "wells", which were made by installing two watertight bulkheads. The tanks or wells occupied about one-third of the total length of the vessel. Water was supplied to the wells through several hundred auger holes bored in the hull (Jarvis, 1935). When ice was used to preserve fish on vessels, the wells had to be modified to keep ice. Later, new vessels were built with ice boxes. The number and size of ice boxes or bins vary as do their insulative properties. Chings usually have four boxes, each of which holds 500 to 3,000 pounds of fish. The larger smacks have six to eight boxes, each with a capacity of 3,000 to 5,000 pounds. The smaller chings do not make lengthy cruises, so their holds and ice boxes are poorly insulated, having only tar paper tacked to the bulkheads and thin layers of cork and sheathing elsewhere. Conversely, smacks are well insulated with tar paper, 4- to 6-inch cork slabs, and sheathing (Jarvis, 1935). Styrofoam slabs, 4- to 6-inches thick, are used in place of cork. The entrance to each ice box is closed off from the hold with 3/4- by 6- by 30-inch shifting boards and bottom and top doors.

The smaller vessels or chings that fished for snapper were usually of the schooner design; however, some were nondescript with numerous variations in hulls and riggings. Chings were 30 to 40 feet long and between 10 and 20 tons, with most less than 15 tons. They had a 3- to 7- man crew, and trips were seldom more than a week. Chings could never handle more than 5,000 pounds of fish; usual catches ranged from 500 to 3,000 pounds. In 1885, snapper boats increased in size to more than 20 tons net (Stearns, 1885). Later, with the introduction of the larger schooners or smacks of the 26- to 50- ton class, a definite size distinction became obvious (Camber, 1955).

The larger two-masted schooners or smacks which were 50 to 100 feet long carried 8 to 12 men, and fishing trips were 2 to 4 weeks (figs. 1 and 2). The increased size of these vessels, compared with chings, enabled them to make longer cruises and to explore offshore grounds.

A boost was given to the fishery after the turn of the century when sail-rigged smacks were powered with auxiliary gasoline engines; in the early 1920's diesel engines provided a further boost. With motor-powered vessels, fishermen were not as dependent on weather as they had been when only sails were used. Freed from dedependence on winds, the boats needed less time for passage to and from fishing grounds and more time was spent in the actual fishing operation.

In 1923, over half the vessels operating from Florida ports were auxiliary-powered sailing vessels. In 1939, the first modern diesel engines were installed in snapper boats. By 1945, most snapper vessels had converted from auxiliary-powered sailing vessels to diesel

Figure 1.--The Buccaneer, built in 1925, is a 105-gross ton, 103-foot two-masted schooner of the type used in the early fishery. A few are still in use today.

Figure 2.--The Star Queen, built in 1953, is a 71-gross ton, 68-foot motor sailboat.

powered vessels (Camber, 1955). Some diesels were installed during World War II; however, the ready availability of surplus engines after the war was probably the main factor that contributed to complete dieselization. Although the adoption of diesel engines has changed the mode of locomotion, sails are still used on boats for stabilization. The main engine, together with the steadying effect of the mainsail ("spanker"), is used to maintain position on fishing grounds, where winds and currents are variable.

As a result of the varying profitability of the fishery, the size of the commercial red snapper fleet has fluctuated considerably in the past. From 1935 to 1955 only 3 to 4 new boats were added to the snapper fleet; however, during the past several years new and more modern vessels have been built -- about 15 vessels are under construction. The new vessels have a modified schooner design that incorporates features of the New England schooner and of the deep water shrimp trawlers.

These vessels have schooner bows and use a ''spanker'' or mainsail. Most new vessels are 65 to 80 feet long and have larger horsepower engines than were previously installed on the older smacks. Also, there has been a reduction in the amount of sail (fig. 3).

The arrangement of all superstructure is the prerogative of the captain for whom the boat is built. Probably the greatest variations in new vessels are in the positions of the galley and mast, whether they are placed forward or aft of the pilothouse.

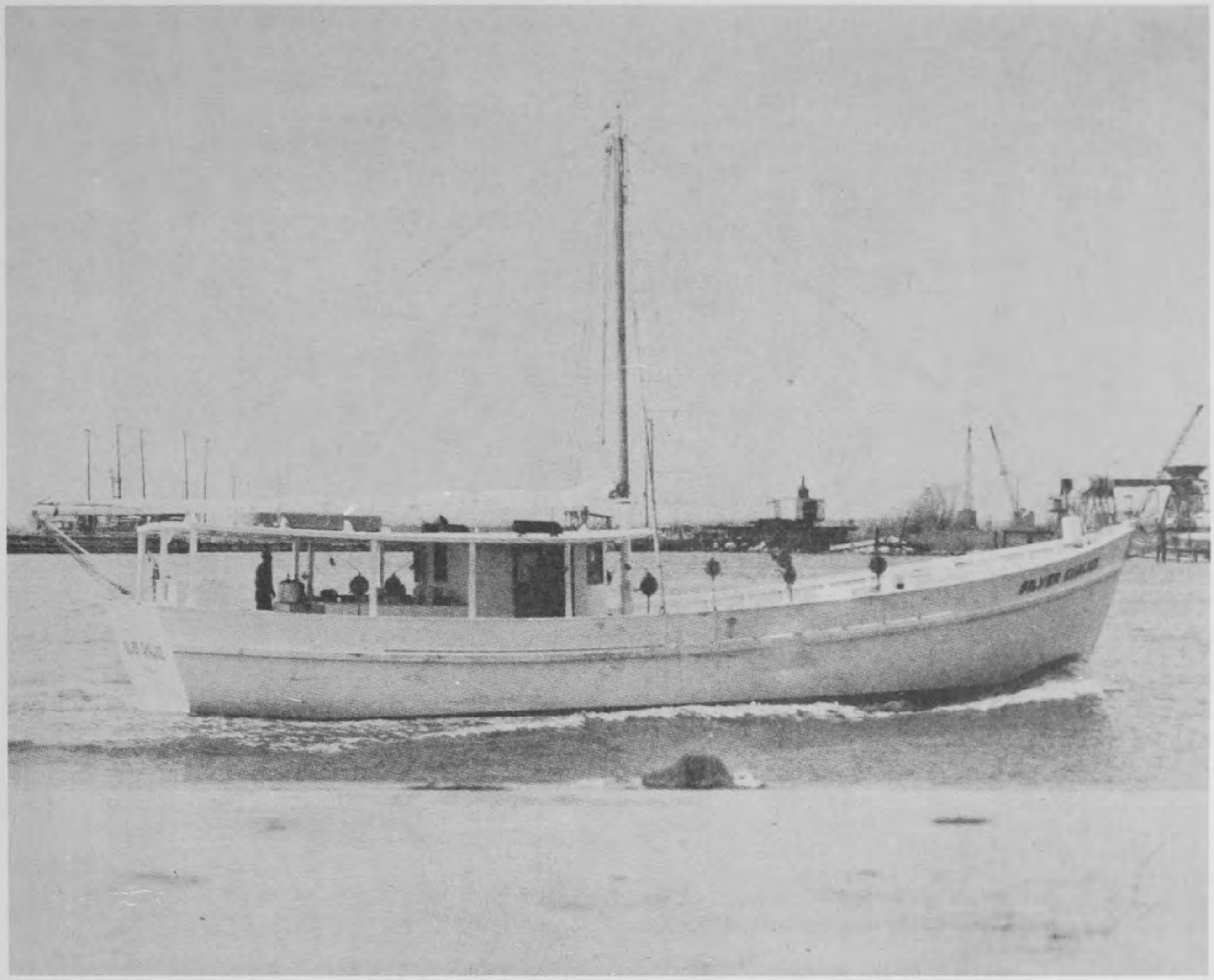

Figure 3.--The Silver Chalice, built in 1964, is a 63-gross ton, 72-foot snapper boat.

Figure 4.--The Ten Kids, built in 1964, is a 58-gross ton, 70-foot combination vessel that can be used to fish for snapper and trawl for shrimp.

Some of the new boats are constructed so that they can be used as combination vessels to fish for snapper and shrimp (fig. 4).

Statistics compiled by the Bureau of Commercial Fisheries for 1962[3] list 420 snapper and grouper vessels in the Gulf of Mexico. Also, N.L. Pease (personal communication) said that 546 vessels fish the Gulf waters for snapper and grouper. Although these totals are documented, they appear high and probably do not represent the actual size of the commercial fleet that consistently fishes for snapper and grouper. Evaluation of information gained through interviews with industry members (fish company officials, vessel captains, and fishermen) indicates that shrimp and sport fishing vessels, which fish on only a part-time basis, form the greatest part of the above values. The size of the commercial fleet (smacks and chings), which fishes only for snapper and grouper, probably does not exceed 300 vessels.

[3] 1962 statistics of the number of vessels fishing for snapper and grouper in the Gulf of Mexico, compiled by the Branch of Statistics, have not yet been published and are, therefore, unofficial.

FISHING GROUNDS

During the early period of the fishery, chings fished only inside the 40-fathom curve between Mobile Bay, Ala., and Cape St. George, Fla. (fig. 5). Because of its proximity to the grounds and other advantages, such as communications, transportation, and harbor facilities, Pensacola became the red snapper center. "Before 1880 it was common for smacks to make weekly trips, and they were seldom compelled to go far for good fishing" (Warren, 1898). In 1883-84, however, heavy fishing pressure on the waters parallel to the edge of the continental shelf caused the area off Pensacola to become less productive. Consequently, vessels had to sail 200 miles southeast of Pensacola to an area called the "Middle Grounds" (fig. 5). In due time, the increased fishery on the "Middle Grounds" resulted in rapid declines in catches (Stearns, 1883).

With discovery in 1885 of new snapper grounds between Tampa and the Dry Tortugas by the U.S. Fish Commission research vessel Albatross (Collins, 1885), and discovery of excellent snapper grounds (Galveston "Lumps" or "Western Grounds") off Texas in the 1880's (Camber, 1955), new centers were established, and the fishery gradually spread out from Pensacola. These centers, Tampa, Carrabelle, Apalachicola, Panama City, and Niceville, Fla.; Pascagoula, Miss.; and Freeport and Brownsville, Tex., were supplied with fish caught by smaller vessels on grounds that had been abandoned earlier by the larger vessels (Camber, 1955). New ports that have developed as snapper centers in recent years are Bayou La Batre and Gulf Shores, Ala.; and Corpus Christi, Port Arthur, and Aransas Pass, Tex.

Not until about 1890 did smacks begin to fish for snapper on the Campeche Banks. Although fish could be taken from that area on a year round basis, the heaviest fishing pressure was generally during times of the year of adverse weather (winter) on the U.S. side of the Gulf. During winter, good catches could not be made on the Florida and Texas coasts.

By 1897, with continued emphasis on the Campeche Banks, numerous smacks from Pensacola, Mobile, and Galveston fished on a year round basis. At the turn of the century the areas fished (Arcas Cay, Triangle Cay, Arenas Cay, and Alacran Reef) were confined easterly by the Tortugas at lat. 24° N., long. 83° W. and extended westerly across the banks to lat. 20° N., long. 93° W. (Camber, 1955) (fig. 5).

With snapper schooners compelled to sail 400 to

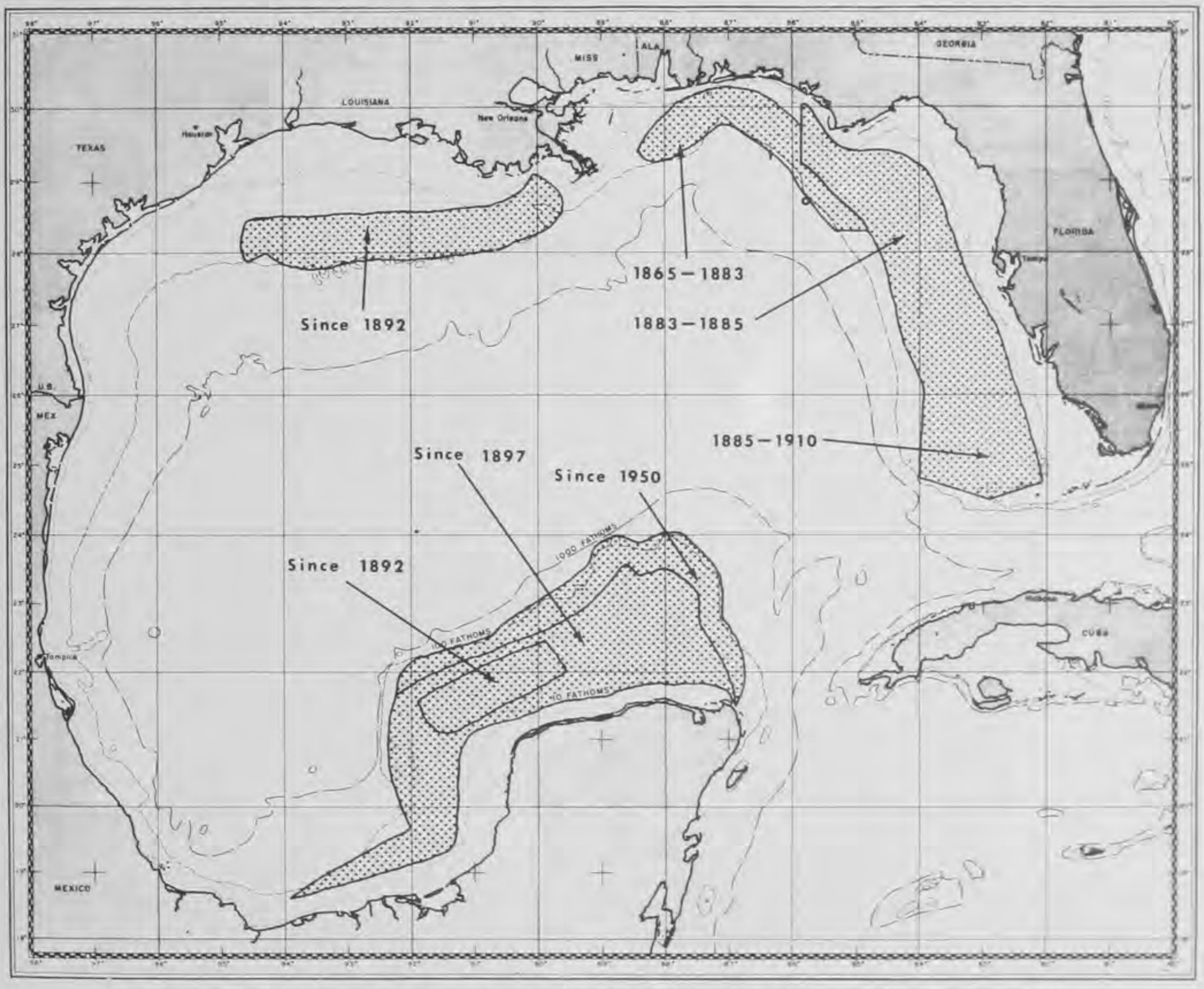

Figure 5.--Major sources of snapper in the Gulf of Mexico since 1865 (Camber, 1955).

700 miles to reach the Campeche Banks, the average fishing trip was about 23 days, of which 8 were allotted for the outward and homeward passage.

Through the years, even with ever increasing fishing pressure, Campeche Banks have remained the most important snapper area in the Gulf. Jarvis (1935) estimated that 75 percent of all snapper taken in 1933 were from the Campeche Banks. Company officials of the larger snapper companies in Pensacola and Mobile have agreed with this estimate of 75 percent of the snapper and grouper catch coming from the Campeche Banks (personal communications). In 1935, however, about 50 percent of the total catch came from U.S. waters. This reduction in Campeche's contribution can probably be attributed to increased fishing activities on the "Western Grounds", an area from a few miles south-southwest of the Mississippi River Delta to Galveston, Tex., at depths of 10 to 100 fathoms (fig. 5). Areas fished in 1933 were from the eastern limit in about lat. 21° 20′ N., long. 86° 40′ W., with the northern limit about 400 miles from Pensacola (Jarvis, 1935).

In 1935, vessels from Pensacola and Mobile took their fares from all portions of the Campeche Banks while Galveston schooners fished from the Triangle Reefs northward. The Tampa and Panama City fleets usually worked only the eastern area of the banks. At this time, Mexican and Cuban schooners were also fishing that area (Jarvis, 1935).

Camber (1955) states that about 40 vessels fished the Campeche Banks between 1937 and 1951 and lists the areas as follows:

a. "The Eastern Grounds"--a triangular area formed by a line running along the 25 fathom curve from Cape Catoche to Alacran Reef, then running northeast along the 60 to 65 fathom line to longitude 88° W. and latitude 23° 30′ N., and from there back to Cape Catoche.

b. "Between the Reefs"--a rectangular area between the Alacran Reef and Arcas Cay, bounded seaward by the 65 to 70 fathom line, and inshore by the 15 fathom line.

c. "Arcas Grounds"--an area between the 18 and 55 fathom lines, confined in the north by a line running from Arcas Cay inshore and tapering off in the southwest toward Vera Cruz, Mexico.

"In 1950-51 fishing commenced on new grounds consisting of an area formed between the former most northerly and westerly seaward limits of the fishing area and the 140 fathom line." (Camber, 1955) (fig. 5).

Between 100 and 150 commercial snapper vessels, sailing out of about 15 Gulf coast ports, fish all portions of the Campeche Banks (inside the 100-fathom curve from the eastern edge of the bank southwest toward Vera Cruz, Mexico) and the "Western Grounds" off Texas. Also, U.S. vessels fish off the Mexican coast from an area east-southeast of Vera Cruz, referred to as the "Mountains" up to the United States-Mexico border. An estimated 200 or more pleasure boats, from the Florida west coast to Texas, make occasional trips to the inshore snapper banks. In addition, an unknown number of commercial shrimp boats occasionally fish for snapper.

The Campeche Banks are considered the most important snapper area in the Gulf. An estimated 30 to 60 U.S. vessels can be seen on the Banks at any time of the year. Captains of snapper vessels fishing the Campeche Banks have stated (personal communications) that most fishing effort is concentrated near Arcas, Obispo, The Triangles, and Nuevo. In the past few years not much fishing has been done in the Arenas, Alacran, "The Eastern Grounds", and "Northern Shelves" areas; however, boats are gradually shifting back to these areas, especially to the "Northern Shelves" and "The Eastern Grounds", down to an area near Cape Catoche. Depths fished range from 20 to 100 fathoms with heaviest concentration of effort in 25 to 60 fathoms.

Concentrations of red snapper are usually found only over certain types of bottoms. Irregular hard bottom formation (submarine elevations or lumps and depressions or gullies) of rock or limestone covered with live coral and grass are especially preferred by snapper. However, as stated by Camber (1955), "The number of such habitats is relatively small." Fish schools are usually located several feet off the bottom of lumps and gullies where food material brought in by eddying current settles out. The Gulf of Mexico snapper lumps are usually small in area (less than a mile), although a few snapper banks are known to extend for several miles. Hard bottoms are the preferred habitat for snapper and grouper, yet good catches have often been made from mud and sand bottoms.

Red snappers have been reported from Brazil to Massachusetts and have been taken from waters of less than 10 fathoms out to 140 fathoms.

From 1950 to 1960, U.S. Fish and Wildlife Service exploratory vessels fished for snapper at several hundred locations in the Gulf. Results of fishing operations from areas known to the snapper fishermen, as well as exact positions of productive areas discovered by exploratory vessels, were provided the industry.

In 1956, an uncharted rock "ridge" was found by the R/V Oregon. The ridge, which was 50 to 100 yards wide and 2 to 8 fathoms above the surrounding bottom, originated near lat. 27° 57′ N., long. 94° 55′ W. and extended several miles in an east-southeasterly direction along the 50-fathom curve. Echo recorder tracings showed good indications of fish along the entire ridge. A series of handline stations made at various points along its length yielded about 1,600 pounds of red snapper and 300 pounds of grouper in 1 day's fishing (R/V Oregon Cruise Report No. 38, 1956). All information gathered by the Oregon was passed on to the snapper fishery. As a result of this disclosure, vessels from Texas and Florida started fishing this ridge and caught 200,000 pounds of snapper and grouper in 1 month. Although not documented, further reports on the ridge revealed that 500,000 pounds of fish were taken in a 3- to 4-month period after its discovery.

Considerable changes have been made in navigational techniques since the snapper fishery began. In early years fishermen knew little about celestial navigation but relied entirely on dead reckonings and soundings. Although smacks were able to sail all areas of the Gulf, errors in navigation resulted in loss of time and fuel. Upon reaching the fishing grounds, fishermen used sounding methods to locate actual fishing spots. The first mate used a sounding line with baited hooks attached to try to locate both hard bottom and snappers. Almost invariably when hard bottom was found, one and sometimes two snappers were hooked. At this time, all hands, including the skipper and cook, would join in the fishing operation (Wallace, 1923). Inasmuch as snappers are scarce on soft bottoms and hard bottoms were often difficult to locate, many hours were spent in searching. When a "hot spot" was located, vessels were either anchored or allowed to drift across the area. A more productive fishery evolved as information was accumulated on positions of snapper banks (gained through years of fishing experiences), and complete and accurate charts depicting depths and bottom types were introduced. But not until the introduction of modern navigational instruments were fishermen able to "pinpoint" latitudes and longitudes. With radios, depth recorders, and lorans as standard equipment, fishermen have little difficulty in locating and staying over fishable bottoms. Once a vessel reaches a fishing area, the depth and topography of the bottom (recorded by depth devices) determine the anchorage spot where the actual fishing will commence.

A fish finder, "which utilizes an oscilloscope to electronically portray the bottom composition and fishes present under the boat" (Moe, 1963) was tested by the R/V Oregon. This device was found to be promising in locating concentrations of snapper. "Good correlations of trial handline catches were found with indications of fish on the fish finder, conversely, no fish or few fish were hooked over good appearing rocky bottom where it failed to show fish" (R/V Oregon Cruise Report No. 19, 1953). Such fish finders are most often used as additional instruments on board vessels equipped with recording fathometers (Moe, 1963).

Depth sounding devices of several types are used in the fishery. The Recorder Type records the depths graphically by stylus tracings which correlate actual depths and topographies. Permanent recorded tracings or markings on paper can be retained for future reference. One of this type, "the white line recorder," has been introduced and used with great success in the fishery. It records graphically the seabed, its consistency, and fish concentrations on or above the bottom. With this instrument fishermen can locate gullies and lumps and actually distinguish between hard and soft bottoms. The Indicator Type has a flashing light viewed on the calibrated screen of a cathode ray tube. This second type of depth sounding device is not commonly used.

Figure 6.--Fisherman retrieving fish with hand reel.

FISHING METHODS AND GEAR

Today's fishing operations are basically similar to those in the past; i.e., a line with baited hooks is suspended about 1 to 3 feet above the bottom. When a bite is felt, the hook is set by a sharp jerk and the fish is brought up, unhooked, and thrown aside. Today a hand reel (fig. 6) is used to bring up the fish, while in the past the "hand over hand" technique was used.

Baits most commonly used in the fishery are ladyfish, Spanish mackerel, blue runners, mullet, cigarfish, menhaden, shrimp, and squid. Most bait is bought in a frozen condition rather than fresh as it was in the early fishery. Bait is placed in wooden or steel barrels aboard vessels and salted on the outward passage to the fishing grounds. Salting hardens the bait and subsequently makes it more difficult for fish to strip it from the hooks. After the fishing area is reached, the thawed and salted bait is cut into small strips and threaded on the hooks. Fishermen consider ladyfish and squid to be most effective in catching fish. Squid are imported from the Atlantic and Pacific coasts, while ladyfish are bought from Florida dealers.

Jarvis (1935) said the handlines are "made of no. 12 tarred cotton line and average about 100 fathoms in length. When not in use the lines are coiled down in small wooden tubs. A pear-shaped 'patent' lead is used by most fishermen. These leads come in several different weights, but the usual weight is 3¾ pounds. A short brass rod, ending in an eye with a box swivel, projects at an angle from the lower end of the lead. To this are fastened two, sometimes three, 3-foot gangings, each with a no. 4 Mustad japanned hook."

Changes in snapper gear, as noted by Camber (1955), have been in the use of untarred hard lay net twine for handlines and Kirby Nos. 3, 4, and 5 hooks rather than Mustad japanned hooks. In recent years there has been a change from hard lay net twine to 3/64-inch stainless steel line on reels. Also, fishermen have returned to the use of japanned or "tuna circle hooks", Nos. 6 to 9. Fishermen claim that these hooks do not have to be set, since the fish will hook themselves. Nos. 5 and 6 hooks are most widely used in the fishery. From 5 to 15 of these hooks are secured to a line. Off the Texas coast ("Western Grounds"), snapper are located in shallower waters and are predominantly smaller in size. In this area, up to 40 No. 9 hooks are strung out on a single line. Instead of the 3¾-pound pear-shaped lead, window sash weights are used as sinkers. A rather new apparatus in the fishery is the rubber shock or "rubber snubber". This device, molded of rubber with brass eyes on each end, is about 12 to 18 inches long. The swiveled end of the stainless steel line is attached to one end of the "rubber snubber" and a heavy duty (test) monofilament line with gangings (snoods), swivels, and hooks is secured to the opposite end. When fish take the baited hooks, the elasticity of the "rubber snubber" prevents sudden, strong tension on the line; consequently, fewer fish are lost from gear breakage or tearing loose from the hooks. Increased reliability is another advancement of today's gear; i.e., all lines, monofilament nylon and stainless steel, are fastened to accessories by a crimping process using a micropress and sleeves.

Other advances in snapper gear have been in developing electric and gasoline powered reels, which were introduced in 1950 and 1952 by the Warren Fish Company and E.E. Saunders Fish Company. These reels were found to be effective in catching snapper. Because of high costs and complexity, however, these reels were soon found to be impractical and only a few were installed on boats. "Electric reels were used with considerable success" during Cruise No. 9 by the U.S. Fish and Wildlife Service exploratory vessel Oregon (R/V Oregon Cruise Report No. 9, 1951). Later, the Warren Fish Company introduced a simpler reel which consisted of a bicycle coaster brake and a large hand-drive wheel with stainless steel line (Camber, 1955) (fig. 7). In 1949, a fleet of 14

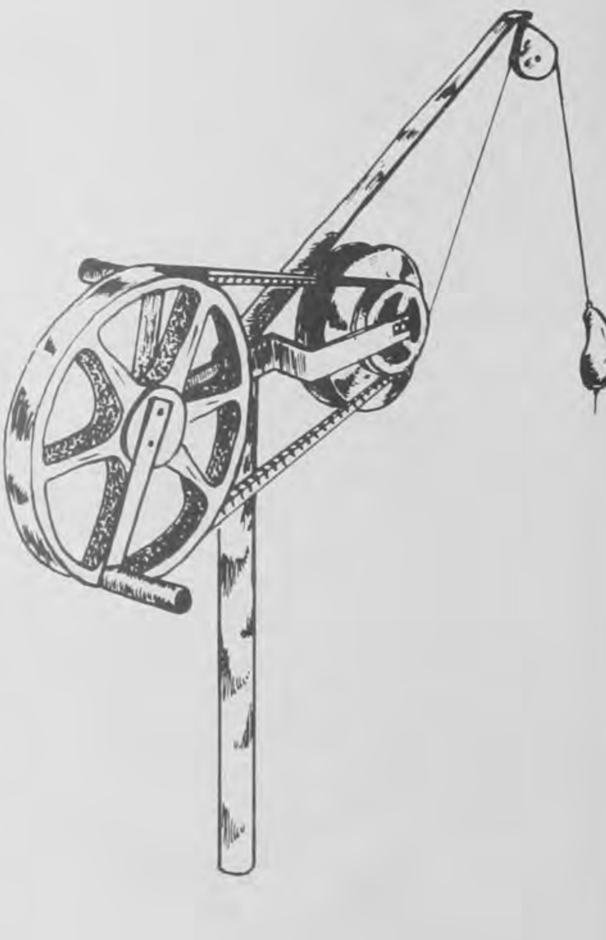

Figure 7.--Hand reel with bicycle coaster brake and a large hand-drive wheel.

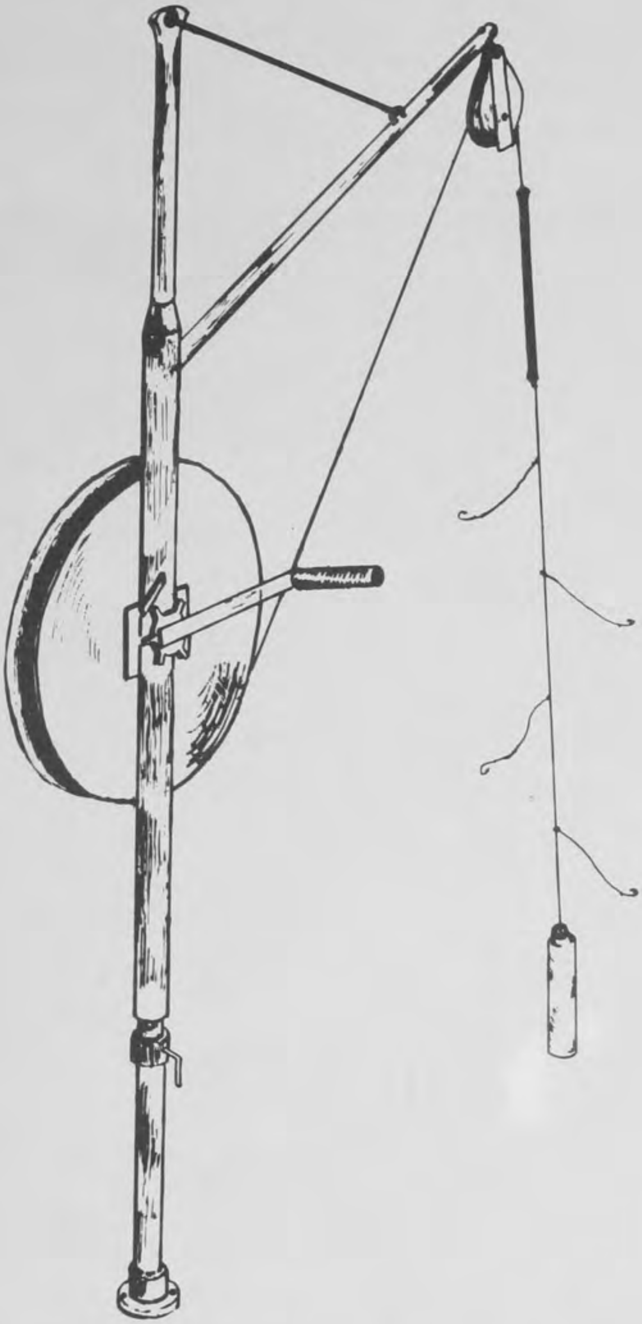

Figure 8.--Direct-drive high speed hand reel.

red snapper vessels was equipped with high-speed manual reels of the direct drive type as seen in figure 8 (Siebenaler and Brady, 1952). With hand reels, which were relatively inexpensive and easy to install, fishermen could fish greater depths much faster than they could with handlines. As a result, catch rates increased considerably.

Most snapper vessels have changed from handlines to manual reels with steel line, of the types seen in figures 7 and 9. Depending on the number of fishermen, each boat has 4 to 12 of these reels, which are mounted on steel posts along the starboard and port weather rails.

Although through the years handlines have been the traditional gear in taking snapper, continual efforts have been made to find more efficient gear and methods.

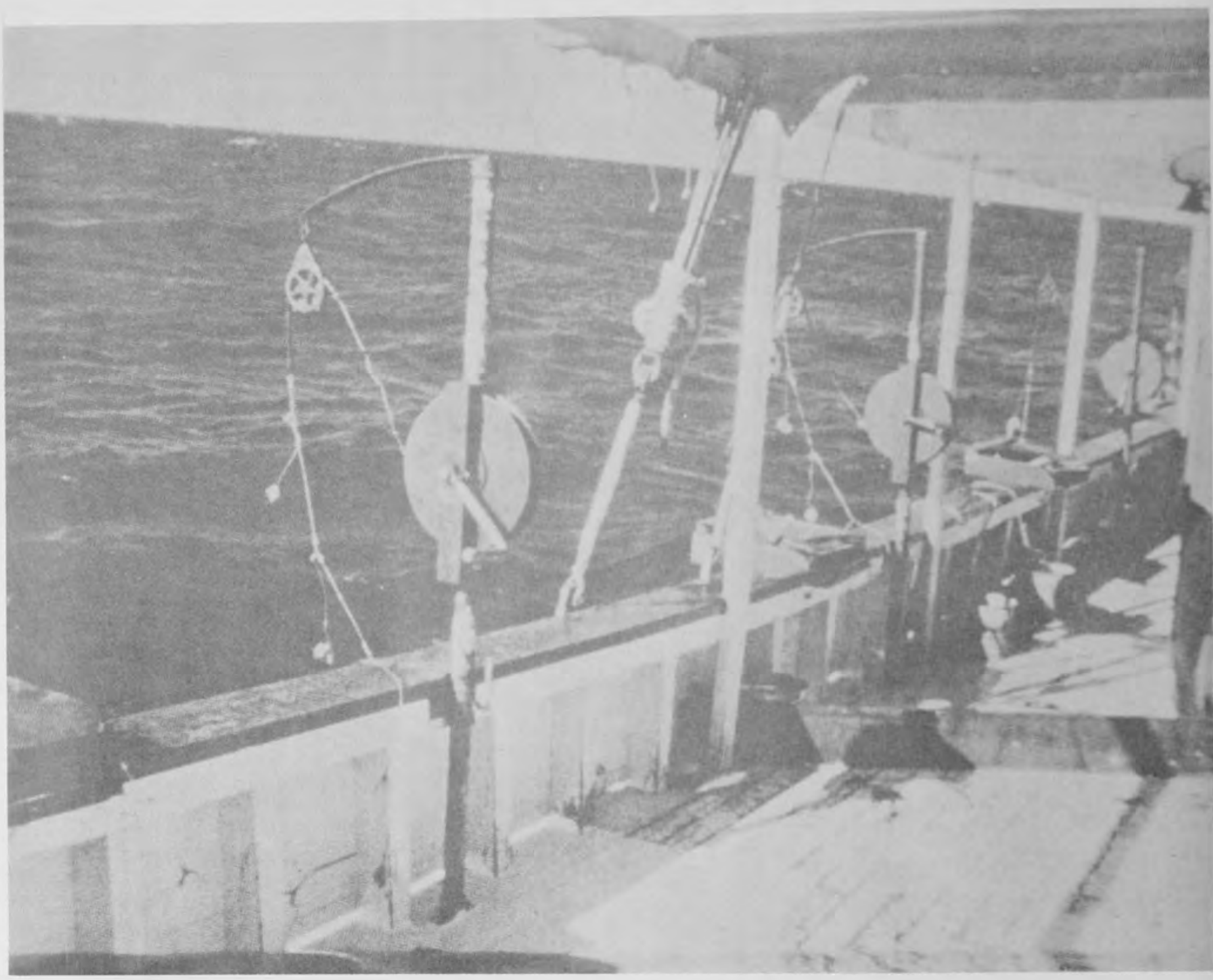

Figure 9.--Modified direct-drive high-speed hand reels of the type now used on most vessels.

Developments in this gear are as follows:

a. Cod gill nets that were brought from Boston in 1884 proved inefficient and impractical in the Gulf. Stearns (1885b) states--"the fishermen did not understand hauling them and were indifferent as to their success."

b. Longlines or trawllines were generally unsuccessful in catching commercial quantities of snapper (Jarvis, 1935; Whiteleather and Brown, 1945). The ineffectiveness of this gear, in many instances, stemmed from inadequate materials, strong currents, and rough bottoms. As a result, considerable gear was damaged or lost. Jarvis (1935) believed that longlines may be more successful for catching grouper than snapper.

c. Hoop nets were tested and compared with handlines by Smith (1948). He found that with all factors being equal (except gear used) handlines caught more fish than hoop nets.

d. Fish traps of the type used in the West Indies were successful in catching commercial quantities of snapper. Jarvis (1935) states "that this apparatus can be used successfully, especially by chings fishing near shore." Experiments on the effectiveness of traps made by the R/V Oregon showed trap capture rates to be low in comparison with handline fishing (R/V Oregon Cruise Report No. 9, 1951). Also, more recent trap tests by the Oregon in March 1964 were unsuccessful.

e. Modified otter trawls (fish trawls rigged with roller gear) have been tested on 21 cruises by the U.S. Fish and Wildlife Service exploratory vessels Silver Bay (fig. 10) and Oregon. Conclusions on the effective-

Figure 10.--Mixed catch of snapper, porgies, and triggerfish taken with modified otter trawl by BCF-chartered exploratory vessel Silver Bay.

ness of this gear by Captiva and Rivers (1960) are as follows:

1. Modified otter trawls can be used as effective commercial means of catching red snapper, grouper, and other species in the Gulf of Mexico.

2. Broken and rough bottom areas, previously considered untrawlable, can be worked economically with gear properly designed and constructed.

3. Additional species of marketable snapper, not generally caught with handlines, are available to trawl gear.

4. Release of undersize snapper is accomplished effectively by large mesh trawls and cod ends.

5. Daily trawl catches often surpass those of handline vessels when the two methods are used simultaneously in one area—especially when the fish are apparently not feeding or during heavy seas.

6. Trawl gear, suitable for use by present Gulf of Mexico shrimp vessels, can be adopted by the industry either on a full-scale or as a supplementary operation during periods of low shrimp catches.

A commercial fisherman out of Pensacola demonstrated the commercial applicability of roller-rigged fish trawls for catching snapper. While fishing in 40 fathoms off Pensacola, he caught 500 to 1,500 pounds of fish per day. Catches were made in an area where handline operations were not producing fish. Recently, 8,000 pounds of snapper and grouper were taken in a 3-day period by this same fisherman. Several Florida trawlers are fishing with roller-rigged fish trawls. Five more trawlers are either being constructed or planned.

Figure 11.--Pile of fish accumulated on deck.

HANDLING AND MARKETING

Improvements in methods of handling snapper have been in eviscerating and carefully packing them in ice. In the past, snapper were often allowed to remain too long on deck and were not eviscerated, but packed round. Fishermen's erroneous objections to gutting fish were that gutted fish decomposed more rapidly. Gutting required too much time during the fishing operation, and gutted or dressed fish were hard to pack (Jarvis, 1935). Also, in the past, ice bins were often overloaded, and, as a result, pressure exerted on the fish prohibited air circulation and, therefore, the cooling effect, and many inferior or spoiled fish were brought in and unloaded at the fish house. With better handling methods, the quality of snapper is considered to be much improved. The fish are gutted and packed usually within an hour after they are landed. Fish are prevented from "drying out" on deck by dousing them regularly with water from either a bucket or a hose.

Since emphasis on quality of fish is stressed continually, more time is spent in the actual drawing and washing operation. Fish are prepared for drawing by making an incision toward the head on the lower side (almost vertically) between the pectoral and ventral fins and running the knife at an angle to the vent. Care is exercised in removing the viscera so that the white membrane (peritoneum) lining the abdominal cavity is not damaged (Jarvis, 1935).

Vessels fishing out of Texas have even a bigger job in cleaning their catch. Texas requires that all fish must not only be gutted but also gilled--the so-called G & G Law.

Upon accumulation of a good size pile of fish on deck, the fish are drawn and washed and tossed into the hold to be packed in ice (figs. 11 and 12). The first hand or icer, responsible for icing the fish, remains in the hold for considerable lengths of time, adding ice and stacking fish. About 6 inches of ice are shoveled into the bottom

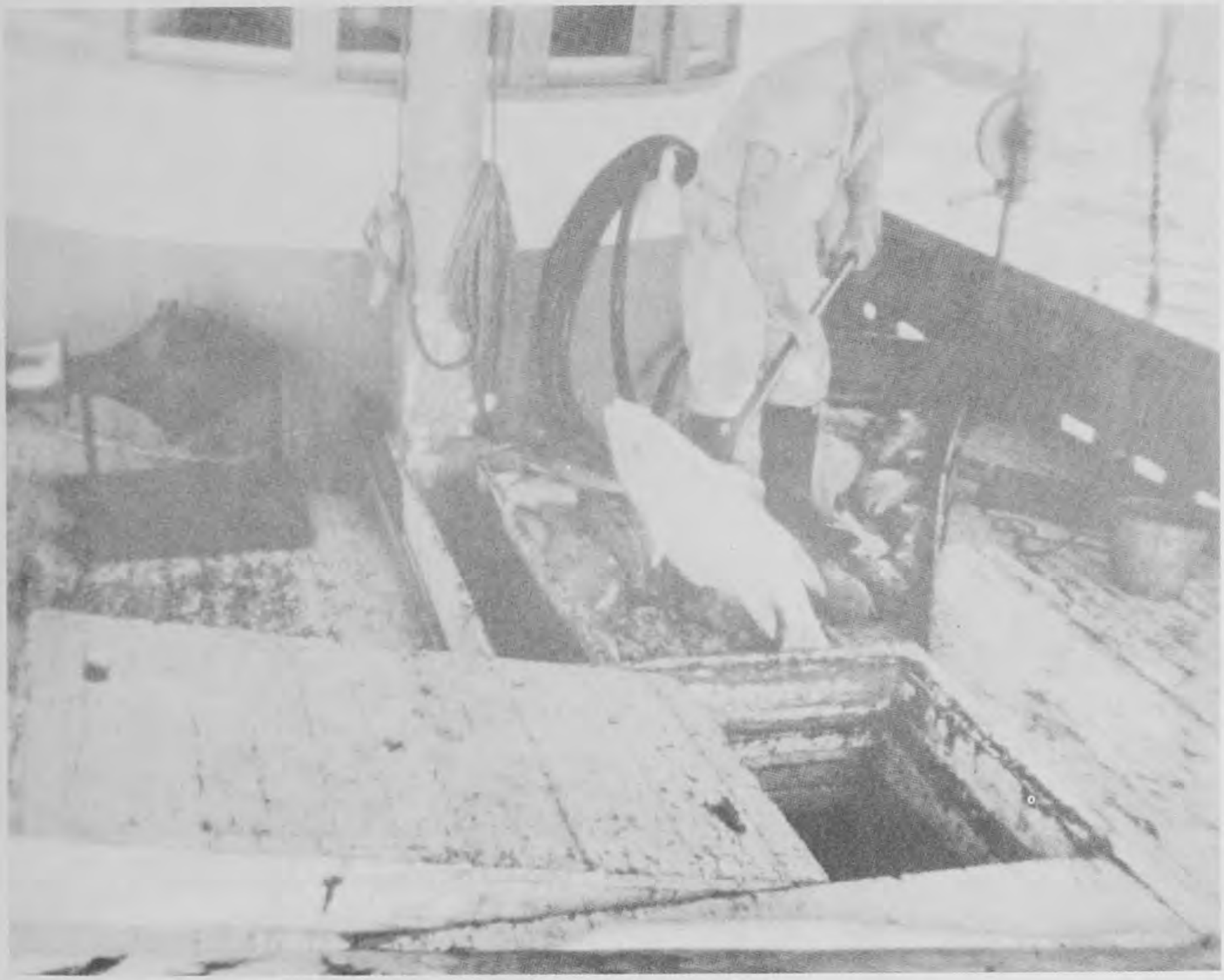

Figure 12.--Fish being thrown into icebox.

of an icebox, then fish are added. Fish are stacked with their drawn sides down to permit drainage. Crushed ice, dispersed evenly to a 2-inch thickness, separates rows of fish. Usually, small fish (1 to 2 pounds) are stacked three and four layers deep before a layer of ice is added. Larger fish are stacked in only one or two layers, then ice is added. After an icebox has been filled or "topped off", a thicker layer of ice is added to the top and in the space between the shifting boards and the doors. If properly cared for, fish caught during the first part of a fishing trip can be kept in ice for 3 weeks and when unloaded will be almost as fresh as fish taken during the latter part of the trip. If the vessel is still over the fishing area when fish are drawn, the entrails are not discarded overboard, but are retained in buckets so that sharks will not be attracted to the area.

In summer fish are re-iced three and four times a day, but during winter only one or two re-icings per day are required. The first hand's job is lightened somewhat now, because most vessels no longer carry block ice which must be chipped with a pick or chisel--they carry machine-crushed ice provided at the fish house. Ice is added to

Figure 13.--Fish being unloaded from vessel by large-capacity steel bucket.

the boxes by a blower system which is attached to the crusher. Many fish houses have their own plants in which they make ice.

It has been known for a long time that fish spoilage results from chemical decomposition and bacterial action. In the past few years many fish companies have made antiseptic ice by adding a bacteriostatic chemical to the water before freezing. (This chemical retards growth of bacteria.) Fish companies are discontinuing the use of antiseptic ice because they claim that little difference can be detected between fish packed with treated ice and those packed in untreated ice. Also, it seems that fishermen are relying on antiseptic ice alone to keep fish in a fresh condition, rather than on a combination of ice and good handling techniques.

Only a few changes have been made in the overall processing operation in today's red snapper fishery as compared with processing methods of the past fishery.

Fish companies attempt to arrange vessel arrivals so that landings will be made about the time the fish supply on hand is exhausted. The arrivals, however, cannot always be scheduled properly and, subsequently, a glut may occur. Excess supplies of fish for which the producer does not have an immediate market are frozen and in most cases are sold within a week after storage.

At port, the catches are unloaded from fishing vessels by means of a large-capacity steel bucket (figs. 13 and 14). Each bucket is raised and lowered by an

Figure 14.--Fish being unloaded from hold of vessel.

electric hoist and when fully loaded weighs about 400 to 500 pounds. In the past, each bucket load of fish was weighed before it was unloaded and the weight was checked by the fish house and a member of the vessel crew. Now, fish are not weighed at the beginning of the processing operation but after they have been sorted and graded.

Figure 15.--Fish being dumped into hopper.

Figure 16.--Fish leaving hopper on conveyor belt.

Unloading techniques used by various fish companies in transporting fish from vessels to the fish house are as follows:

a. Fish are dumped from the bucket to a chute and hopper system and then are moved into the fish house via a conveyor belt (figs. 15 and 16). As the fish move along the belt, they are sorted and graded.

b. Fish are dumped directly from the bucket onto the dock adjoining the fish house. Then fish house employees pew or gaff the fish and separate them into baskets (fig. 17). The fish are pewed or gaffed only in the head.

Figure 17.--Fish being sorted and weighed.

The newer fish companies use the hopper and conveyor method for moving fish, while the older companies retain the old direct handling method.

Regardless of the unloading methods used, the fish are sorted and graded according to species, size, and quality and then are weighed on platform scales (fig. 17).

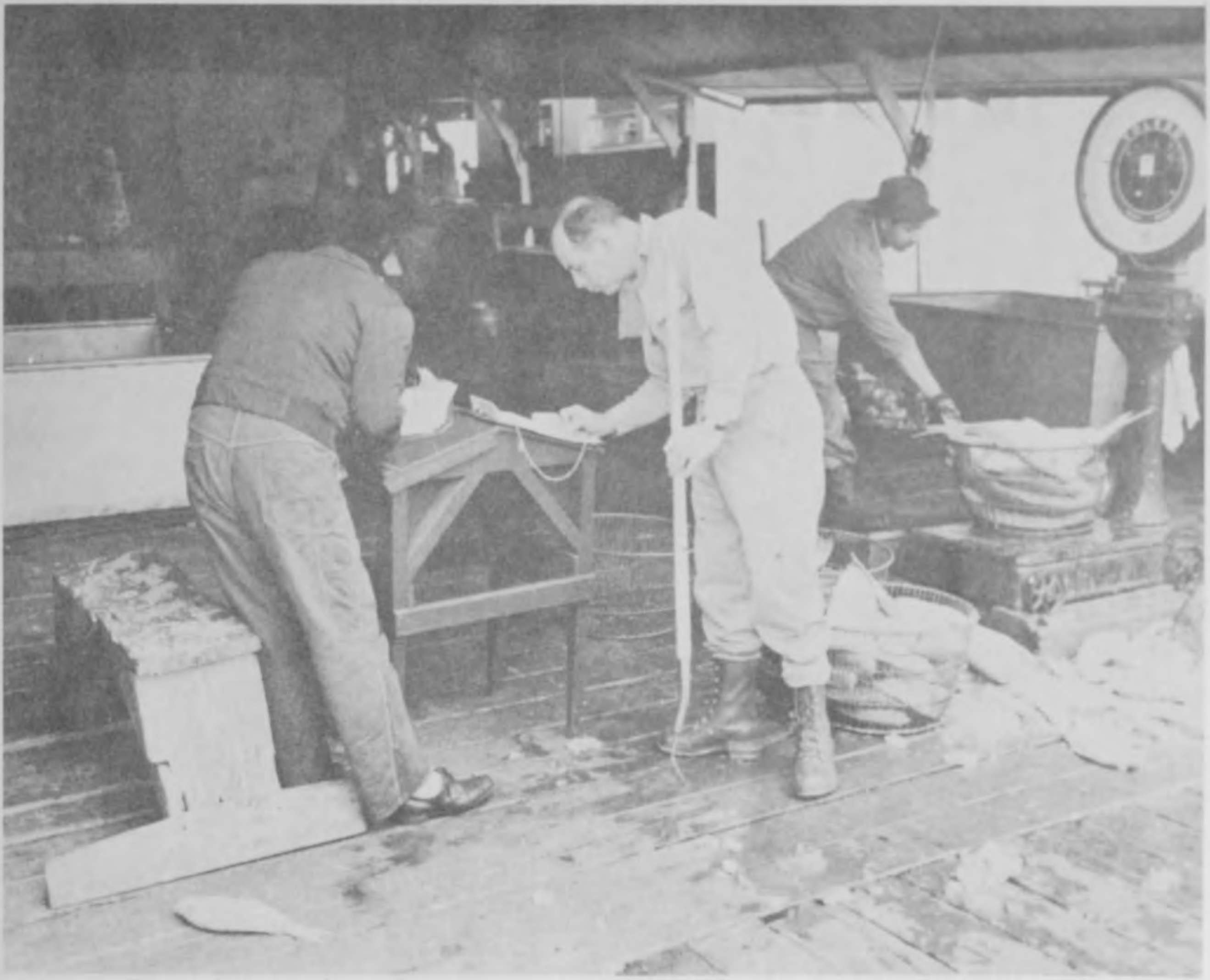

Figure 18.--Weight of catch being recorded by fisherman (left) and fish house employee (right).

A careful record of weights is kept by the fish house and by a fisherman representing the fishing vessel (fig. 18).

Inferior or spoiled fish are discarded; fish not in prime condition are headed and sold as "headless" fish. However, fish other than those of a lower quality are also headed; i.e., about half of all fish landed are shipped as headless fish. One of the greatest changes in processing is that whole fish (uneviscerated) are no longer shipped. All fish, including grouper, are shipped drawn, drawn and gilled, or headless and drawn.

A considerable demand has been built up for tenderloins (steaks) and fillets. About 10 to 25 percent of all grouper landed are made into steaks. In addition, a small amount of grouper and snapper is cut as fillets.

Figure 19.--Heads being removed from snapper and grouper.

Steaks and fillets are packed and frozen in small lots with most being sold to restaurants, hotels, hospitals, and public institutions.

Fish houses differ in their ways of processing fish for shipment. Fish that are to be headed go to dressing tables where heads are removed with an axe (fig. 19) or with an electric saw. Red snapper heads are then moved to another table where small pieces of flesh, roughly triangular in shape, are cut away from the side of the head. This meat, referred to as "snapper throats", actually is snapper cheeks and is said to be the richest and most delicately flavored part of the fish; it is sold in bulk to some markets. Whole fish are either dumped into large tanks containing iced water (where they are washed) (fig. 20) or they are moved directly to the packing area. In the latter case, fish are washed while in the hopper before they enter the fish house.

Wooden boxes and barrels are used for shipping fish. In the past, barrels were used almost exclusively and nearly all catches were shipped by rail express. The reasons barrels were preferred to boxes, as given by Jarvis (1935), are: "first, that most shipments are small and made to wayside stations, and undergo considerable rough handling before reaching the buyer. In such shipments barrels are said to be more easily handled and less liable to breakage en route. Expressmen are said to prefer

Figure 20.--Snappers being washed before they are packed in ice.

barrels for larger shipments because of ease of handling. Second, customers are said to request barrels, believing that the fish arrive in better condition with less meltage of ice. In the third place, barrels also have a reuse value and are preferred by customers for this reason."

Now the trend is reversed. Most shipments (in excess of 75 percent of the production) are made by truck in 100-pound boxes (fig. 21). Some of the older companies

Figure 21.--Boxes of fish being loaded on truck.

continue to send snapper and grouper in barrels by express, mainly to the larger southern cities (fig. 22).

Most fish sales are made by telephone orders from customers in the larger northern and eastern cities. Shipments are sent via truck to distribution centers, such as Chicago, Detroit, Cleveland, St. Louis, Cincinnati, and New York. Although the snapper fishery is quite competitive, fish houses cooperate with one another in making arrangements whereby trucks owned or rented by a certain company will pick up and deliver fish for another company. This system is advantageous for both, since at times one company will not have a large enough supply of fish to supply customers' needs. Also, trucks which are not fully loaded and are heading for certain cities will go out of their way to pick up fish from other companies that have orders for the same places. In addition to normal retail outlets, fresh fish are sold to independent fish merchants (commonly referred to as fish "peddlers"), who in turn distribute the fish to markets, public establishments, and individuals within about a hundred mile radius of the coast.

Boxes used for shipping snapper and grouper are the standard 100-pound capacity type. Crushed ice is shoveled into the bottom of the packing box, and the fish

Figure 22.--Barrels of fish being loaded on express truck for delivery to railroad.

are carefully packed by alternating heads and tails to secure an even layer. Crushed ice is added to separate layers of fish. After 100 pounds of fish are added, a heavy scoop of ice is placed on top (fig. 23). At one time, it was a practice to "top off" a box with a heavy block of ice. The box was then covered with burlap and wired down. Now, however, because of the expediency of truck delivery, block ice is not added and boxes are seldom covered. Snapper shipments made by truck reach their destinations in 1 to 2 days. If most of the ice melts en route, the driver repacks the boxes with crushed ice, which is carried in the truck.

Barrels used for shipping fish are usually of two sizes: the larger holds 200 pounds of fish and about 150 pounds of ice, the smaller holds 150 pounds of fish and about 100 pounds of ice. Barrels are packed by first placing a 20- to 25-pound block of ice on the bottom and then adding crushed ice to fill in around the block. Fish are packed in layers, in the same way as for boxes. Barrels are "topped off" by adding enough crushed ice to form a mound and then placing an ice chunk on top. Barrels are then covered with bonded burlap paper, which is held in place by wooden hoops that are tacked to make a tight fit. The burlap covers are secured so that expressmen can remove them when re-icings are required.

Figure 23.--Boxes of snappers being iced for shipment.

SPECIES TAKEN

Although commercial landings of snapper fleets do not consist entirely of the red snapper, Lutjanus aya (also called L. blackfordi and perhaps L. campechanus), this species is the predominant one taken (cover photo). Camber (1955) states, "Producers never separate red snappers according to species. As a result, the reported landings include not only the principal species (L. aya), but also other fish marketed as red snapper." The following species (arranged in order of importance) are caught in the Gulf and marketed as red snapper:

- Lutjanus aya -- red snapper
- Lutjanus vivanus -- yelloweye, golden eye, or silk snapper
- Lutjanus analis -- mutton snapper or kingfish
- Lutjanus synagris -- Lane or Mexican snapper
- Lutjanus griseus -- mangrove or gray snapper
- Lutjanus campechanus -- Caribbean red snapper
- Lutjanus buccanella -- gunmouth, hambone, or blackfin snapper
- Lutjanus apodus -- schoolmaster snapper
- Rhomboplites aurorubens -- vermilion, mingo, or bastard snapper
- Ocyurus chrysurus -- yellowtail snapper
- Etelis oculatus -- queen snapper
- Holocentrus ascensionis -- squirrel fish
- Pristipomoides macrophthalmus -- wenchman

In addition to the above species, the deep sea wenchman (Pristipomoides andersoni) has been taken in large numbers off the Texas coast by the Bureau's exploratory vessel Oregon and probably is also taken by commercial handline vessels.

The red snapper is most abundant in 20 to 60 fathoms. The yelloweye snapper is the predominant species in 90 to 120 fathoms. The numbers of red snapper and yelloweye snapper appear to be more equally distributed in about 80 fathoms than in other depths (personal communications with snapper boat captains and fishermen).

Studies by Jarvis (1935) and Camber (1955) show that at least 90 percent of the total Gulf of Mexico snapper production throughout the years has been composed of red snapper, while grouper and additional forms of snapper (mainly yelloweye) constitute the remainder of the catches.

In addition to snappers, the Gulf of Mexico supports a large grouper fishery. Most groupers taken by snapper vessels are incidental to snapper catches and are considered a byproduct of the fishery; however, some vessels off the western coast of Florida fish only for grouper. The red grouper (Epinephelus morio) is the most important of the groupers because of its abundance and excellent flavor. Also, the black grouper (Mycteroperca bonaci) is commonly taken. Also marketed are other species of grouper, the speckled hind (Epinephelus drummondhayi), the yellowfin grouper (Mycteroperca venenosa), the gag (Mycteroperca microlepis), and the scamp (Mycteroperca phenax). The scamp is considered by many to be the finest flavored fish of the group; however, it is taken in relatively small numbers and is usually reserved by the fishermen for their own use (Jarvis, 1935). Little is known of the life history and habits of red snapper and grouper. Numerous examinations of gonads indicate that the red snapper spawns between July and September and groupers spawn in early spring (Jarvis, 1935; Camber, 1955; Moe, 1963).

PRODUCTION

Because many factors have affected production of snapper and grouper, these fisheries have fluctuated tremendously since their beginning. As pointed out by Camber (1955), some of the non-biological factors that have affected production are market conditions, war, size and efficiency of the fishing fleet, labor-management relations, labor shortage, and weather.

Red snapper production increased continually from 1880 to 1902 and then apparently stabilized until 1929. Because of the economic depression from 1929 to 1935, catches declined sharply. From 1935 to 1939, a period of economic recovery, catches increased, but not to the predepression levels. Catches decreased again from 1939 to 1945 because of the disrupting effect of World War II. Catches began to increase after the war, and by 1952 production had again approached the 1929 level. Except for a few sporadic years, production increased continually from 1952 to 1963.

Statistics on red snapper and grouper have been collected since 1880 by the U.S. Bureau of Fisheries, the U.S. Fish and Wildlife Service, and the Bureau of Commercial Fisheries (table 1). From 1880 to 1963, the reported Gulf production of red snapper (round weight) has been 313 million pounds, valued at $48 million, and the production of grouper has been 174 million pounds, valued at $13 million. Statistics are, unfortunately, lacking for some extensive periods of years. Estimates of production for these years are provided, based on production in years immediately before and after the missing ones and on partial landings. I estimate that more than 612 million pounds of snapper and 239 million pounds of grouper, valued at $67 million and $19 million, respectively, have been taken. This is, roughly, a yearly average of 10 million pounds of both species, valued at $1 million, for the past 83 years from the Gulf of Mexico, or a total of 853 million pounds worth over $86 million. In 1963, 12,600,676 pounds of snapper were taken from the Gulf of Mexico. This production value almost reached the all time high. The best year for snapper production was in 1902. Alexander (1905) and Radcliffe (1921) reported 13,608,553 pounds and 13,995,660 pounds, respectively, for that period (Camber, 1955) (table 1).

Since the early 1900's, the Campeche Banks have been the most productive area for red snapper and also an excellent source for grouper. I estimate that 50 percent of the snapper, or more than 300 million pounds, valued at over $30 million, of the total Gulf production has come from the Campeche Banks and coast of Mexico. This is an average of over 3.5 million pounds a year, valued at over $350,000.

Table 1.--Total production of snapper and grouper by U.S. fishing vessels from the Gulf of Mexico for various years, 1880-1963

	Snapper		Grouper			Snapper		Grouper	
Year	Weight	Value	Weight	Value	Year	Weight	Value	Weight	Value
	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars		Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars
1880	2,750	---	---	---	1939	7,899	615	6,864	230
1888	3,525	102	390	11	1940	6,523	577	5,184	206
1889	3,793	---	393	---	1945	4,782	1,011	8,790	1,026
1890	4,481	134	376	---	1948	6,216	1,352	7,574	905
1897	6,114	200	751	---	1949	7,888	1,864	8,397	835
1902	13,609	410	1,112	15	1950	6,788	1,643	5,622	515
1908	12,546	603	1,430	---	1951	6,670	1,720	5,862	592
1918	9,430	609	5,223	---	1952	8,547	2,016	4,613	536
1923	11,729	864	4,639	121	1953	7,728	2,142	4,290	432
1927	11,899	974	4,720	148	1954	8,386	2,174	4,945	554
1928	10,372	860	4,241	131	1955	8,863	2,265	4,898	501
1929	9,969	816	4,352	134	1956	8,770	2,165	6,063	604
1930	7,113	595	3,346	101	1957	8,541	2,204	6,661	664
1931	6,093	415	2,774	72	1958	9,859	2,532	4,393	490
1932	6,359	315	3,300	67	1959	10,219	2,639	6,180	712
1934	5,856	323	3,570	85	1960	10,215	2,606	6,341	722
1936	7,320	458	5,247	156	1961	11,888	3,061	6,798	694
1937	7,522	516	5,547	175	1962	11,600	2,927	6,600	660
1938	8,110	586	4,814	151	1963	12,676	3,381	7,324	740
Totals for reported years						312,648	47,674	173,624	12,985
Estimated totals for all years since 1880						612,735	67,357	239,924	19,399

Table 2.--Production of red snapper in round weights from the Gulf of Mexico for 1954-63 by U.S. snapper fleet.

	Total production U.S. vessels (all waters)		Production U.S. vessels (international waters off Mexico, including Campeche Banks)		Percent of total weight from international waters off Mexico, including Campeche Banks
Year	Weight	Value	Weight	Value	
	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars	Percent
1954--	8,386	2,174	5,000	1,296	59.62
1955-	8,863	2,265	5,400	1,380	60.93
1956-	8,700	2,165	1/	1/	1/
1957-	8,541	2,204	4,400	1,135	51.52
1958-	9,859	2,532	3,000	700	30.43
1959-	10,219	2,639	3,600	930	35.23
1960-	10,215	2,606	3,017	770	29.54
1961-	11,888	3,061	4,300	1,107	36.17
1962-	11,600	2,927	4,200	1,060	36.21
1963-	12,600	3,162	5,900	1,481	46.83
	100,941	25,735	38,817	9,859	42.94

1/ No data

Table 3.--Production of grouper in round weights from the Gulf of Mexico for the years 1954-63

Year	Total production U.S. vessels		Production U.S. vessels (international waters off Mexico, including Campeche Banks)		Percent of total weight from international waters off Mexico, including Campeche Banks
	Weight	Value	Weight	Value	
	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars	Percent
1954-	4,945	554	1/	1/	1/
1955-	4,898	501	1/	1/	1/
1956-	6,063	604	1/	1/	1/
1957-	6,661	664	1/	1/	1/
1958-	4,393	490	200	22	4.55
1959-	6,180	712	200	23	3.24
1960-	6,341	772	316	36	4.98
1961-	6,798	694	900	92	13.24
1962-	6,600	660	1,000	10	15.15
1963-	6,400	640	1,200	12	18.75
	59,279	6,291	3,816	195	9.98

1/ No data

Complete statistics of snapper and grouper landed from the Campeche Banks and off Mexico's coast have been collected by the U.S. Fish and Wildlife Service for the past 9 and 6 years, respectively (tables 2 and 3). An average of 43 percent of the snapper or 38,817,000 pounds, valued at $9,859,000, and 10 percent of the grouper or 3,816,000 pounds, valued at $195,000, of the total Gulf production for 1952-63 has come from the Campeche Banks and off the Mexican coast.

FLUCTUATION OF EFFORT ON THE CAMPECHE BANKS

For 1929-51, accurate records of the number of trips made to the Campeche Banks by each vessel is available for a portion of the total fleet. Camber (1955) presents data including the average number of trips to Campeche per month by 28 vessels owned by the Warren Fish and E.E. Saunders Fish Companies of Pensacola, and the Star Fish and Oyster Company of Mobile, during 1929-36 and 1938 (fig. 24). The effort decreased from an average high of 24 trips per month in March to an average low of 17 trips per month in September, and then increased again in October. Figure 25 also shows the average number of trips to Campeche made by 15 vessels owned by E.E. Saunders Fish Company during 1937 and 1939-51. Again, these data show that the Campeche Banks effort is high in March and low in September. Two reasons can be advanced for this pattern: First, hurricanes are most active in the Gulf of Mexico during fall, with September having most hurricanes. Therefore, vessels of any kind avoid getting too far away from home port during this time. Also, snapper and grouper fishing is good and can be done in favorable weather during summer, but during winter the weather is adverse and the northern Gulf is plagued with "Northers" (cold fronts which pass through with considerable velocity at times, causing hazards to unwary fishermen).

These factors tend to explain the concentration of effort on the Campeche Banks from October to April and the decrease in effort during the remaining months. It is evident that this general pattern of effort along the coast of Yucatan would apply to almost any period of years or any one year.

PRODUCTION PROBLEMS

Many problems that confronted the snapper industry in the past exist today, and more problems have arisen, some of which are as follows:

1. Production.-The old problem of catching sufficient quantities of snapper and grouper to make a worthwhile trip still exists. Although there has been considerable advancement in vessels and fishing equipment (diesel engines, depth recorders, radios, and electric and hand reels) during the last few years, the average vessel fare has decreased. Total production, of course, is greater than it was in previous years. The main reason for production declines per vessel is that the numerous vessels are exerting heavy pressure on snapper populations.

2. Production costs.-Operation and maintenance of snapper vessels are expensive. Also, construction costs of new vessels are high. Since all work aboard vessels is done by hand, operations are slow and tedious.

3. Competition from other seafood products.-Production costs for other sea foods are usually much less than for snapper, so they are sold more cheaply at retail. The promotion of new types of sea foods has given consumers a wider variety, which competes with snappers. In the past, red snappers had much less competition. Sea food markets were generally localized in areas where catches were brought in and fish were sold in fresh condition. With development of modern refrigeration and new methods of processing, packaging, freezing, and canning, all types of sea foods are distributed nationwide.

4. Location and retainment of vessel captains. With the increased number of new snapper vessels in the Gulf, fish houses are experiencing difficulty in finding and retaining competent captains. In an effort to obtain captains, a type of competition which rarely existed in the early fishery is becoming quite common among fish houses today; i.e., companies continue to advance the attractiveness of employment with their company by offering the captaincy position to the better captains on the newer and better vessels. Also, some fish companies are having vessels constructed according to specifications of their captains within certain limitations, such as size and horsepower. Another problem facing the industry is an overall shortage of fishermen.

SUMMARY

The red snapper fishery in the Gulf of Mexico was started about 1850 off Pensacola, Fla. During early years, live-well vessels fished inside the 40-fathom curve between Mobile, Ala., and Cape St. George, Fla. As the fishery expanded it gradually exploited the grounds off Texas to the Rio Grande and the banks along the west coast of Florida to the Dry Tortugas. In 1890, vessels began to fish for snapper and grouper on the Campeche Banks. At first, efforts on the Banks were sporadic; however, by 1895 live-wells were abandoned when artificial ice became available at a reasonable price. The Campeche Banks became regularly fished with vessels constructed or modified to carry ice. Through the years, the Campeche Banks have remained the most important snapper grounds in the Gulf of Mexico.

From 1935 to 1955, only three to four boats were added to the snapper fleet; however, in the past few years, only a few vessels have been lost or retired and numerous modern vessels have been constructed. Consequently, the size of the commercial fleet has increased tremendously. More vessels were built in the past 12 months than in the previous 12 years; about 15 vessels are under construction.

From the masted schooners of early years, the red snapper fishery changed to vessels rigged with sail and powered with auxiliary gasoline engines. Later, diesel engines were introduced, and by 1945 most of the snapper fleet had transformed to diesel powered vessels.

Throughout the years, efforts have been made find more efficient types of gear for taking snapper. Of the types of gear developed and tested, the modified otter trawl has proved to be the most promising method of capturing fish. Five trawlers which will be outfitted with roller-rigged fish trawls for snapper fishing are either under construction or in the planning stage.

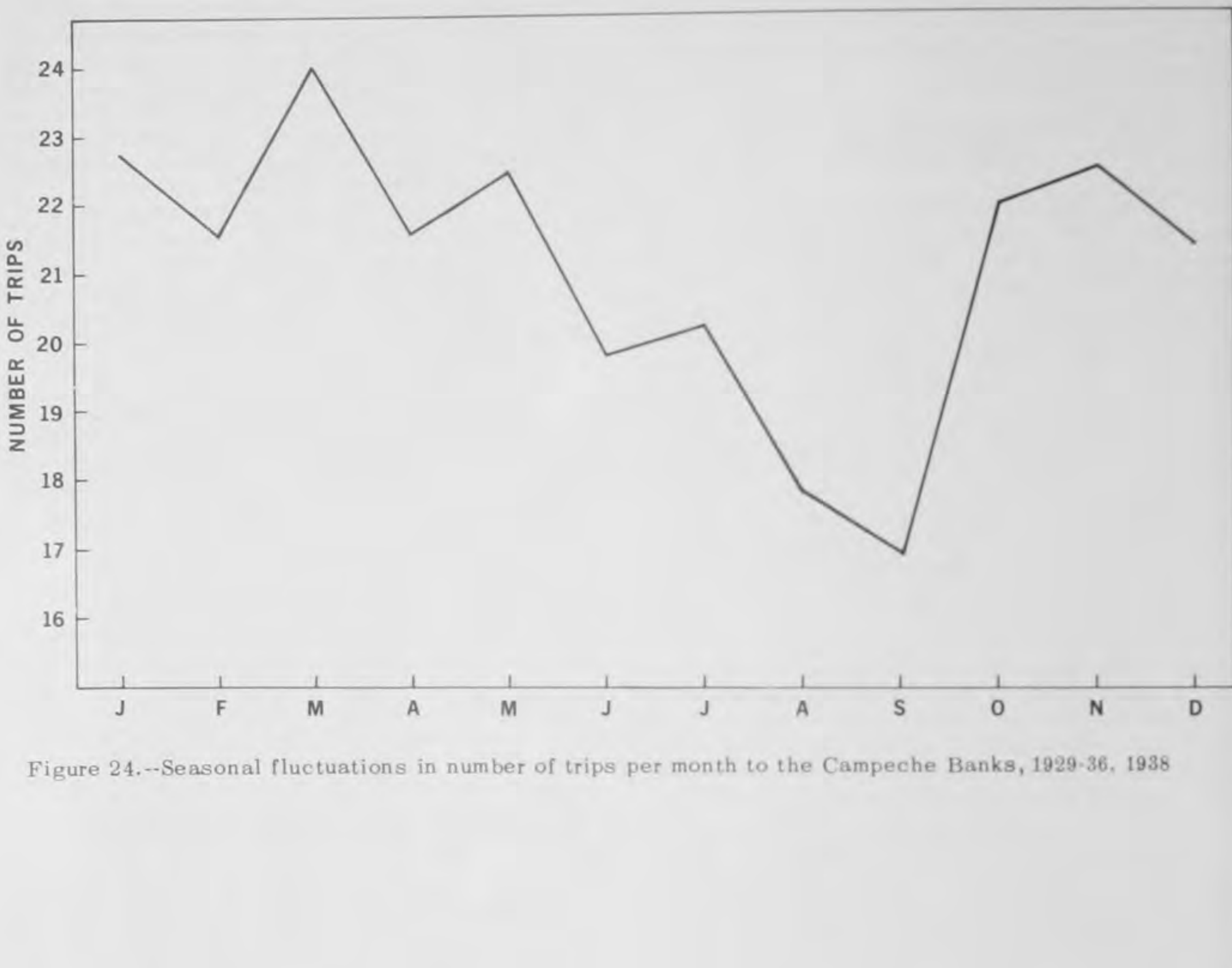

Figure 24.--Seasonal fluctuations in number of trips per month to the Campeche Banks, 1929-36, 1938

Recent advances in fishing gear have included the introduction and use of power and hand driven reels and stainless steel lines, rather than the traditional cotton handlines of the past. Also, improvements have been made in terminal gear (hooks, swivels, and rubber shocks), and superior techniques were devised for fastening this gear to the mainline. In addition, accurate charts, depth recorders and electronic navigational aids have helped the fishery immensely.

The red snapper (Lutjanus aya) is the predominant snapper taken in the Gulf of Mexico. This species has contributed more than 90 percent of the total Gulf production throughout the years. Producers never separate fish according to species, and, as a result, about 13 species of snapper and other fish are marketed as red snapper. Species of snapper other than L. aya and about six species of grouper make up the remaining 10 percent of the total production.

From 1880 to 1963, the total reported Gulf production of snapper and grouper was 313 and 174 million pounds, respectively. I estimate that total Gulf of Mexico production from 1880 to 1963 was more than 612 million pounds of snapper and more than 239 million pounds of grouper. In 1963, 12,600,676 pounds of snapper were taken from the gulf of Mexico. This production value almost reached the alltime high of over 13 million pounds caught in 1902. An average of 43 percent of the total Gulf production, or 38,817,000 pounds, was taken from the Campeche Banks and off the coast of Mexico during the past 9 years, while 10 percent or 3,816,000 pounds of grouper was produced from this area during the past 6 years.

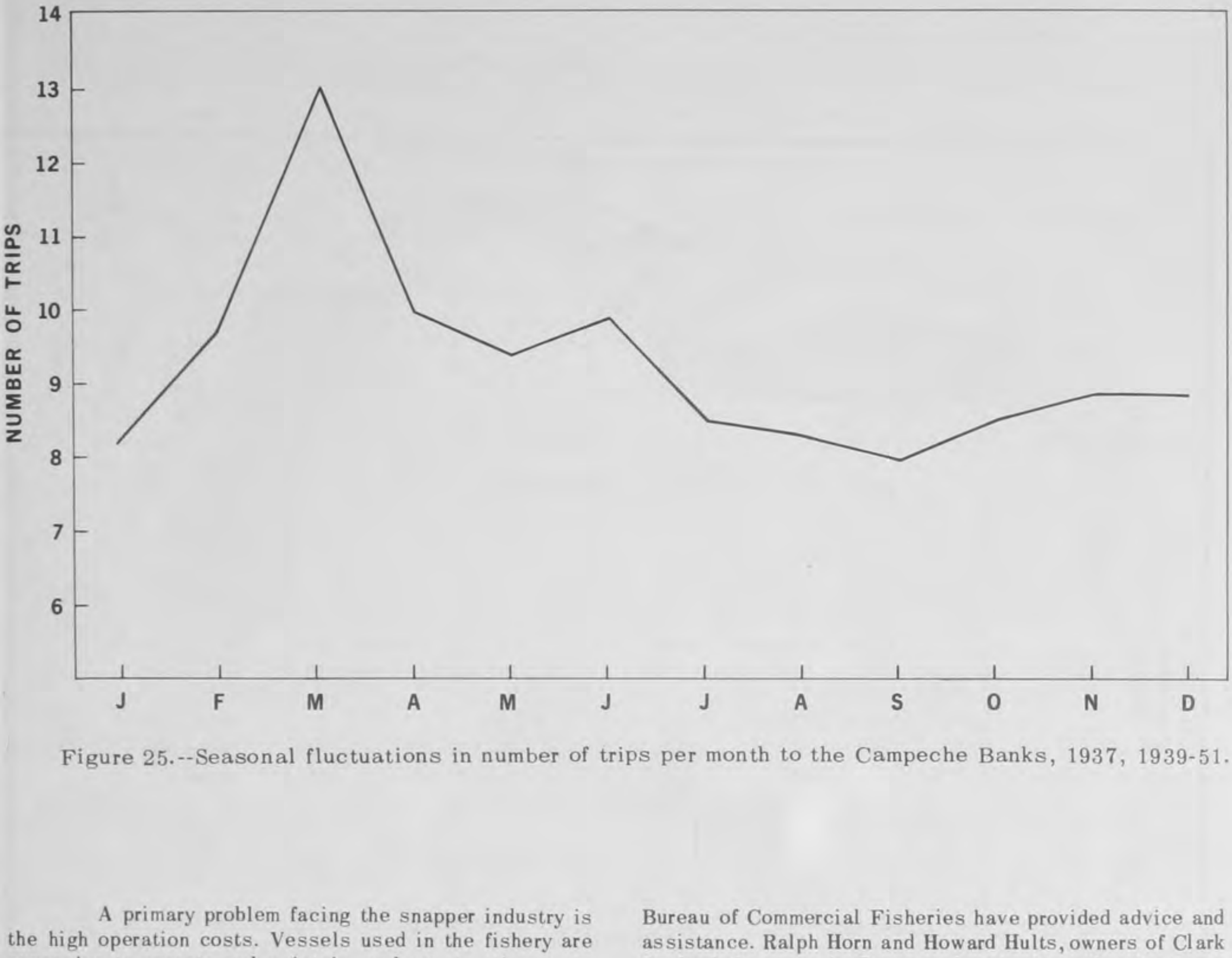

Figure 25.--Seasonal fluctuations in number of trips per month to the Campeche Banks, 1937, 1939-51.

A primary problem facing the snapper industry is the high operation costs. Vessels used in the fishery are expensive to operate and maintain, and construction costs of new vessels are high. The red snapper fishery must also compete with other fisheries that produce fish for considerably less. Although the total catch is greater than in previous years because of the increased number of vessels fishing for snapper, the average catch per boat has decreased.

ACKNOWLEDGMENTS

Personnel of the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries have provided advice and assistance. Ralph Horn and Howard Hults, owners of Clark Seafood Company in Pascagoula, the Gonzales Brothers, owners of the Star Fish and Oyster Company of Mobile, T.E. Welles, owner of the E.E. Saunders Fish Company of Pensacola, and Francis William Taylor, owner of Warren Fish Company of Pensacola, all cooperated. Vessel captains William Kolbush and Victor Williams and their crews gave me their cooperation, as did retired and active captains and fishermen from Pensacola, Mobile, Bayou La Batre, and Pascagoula.

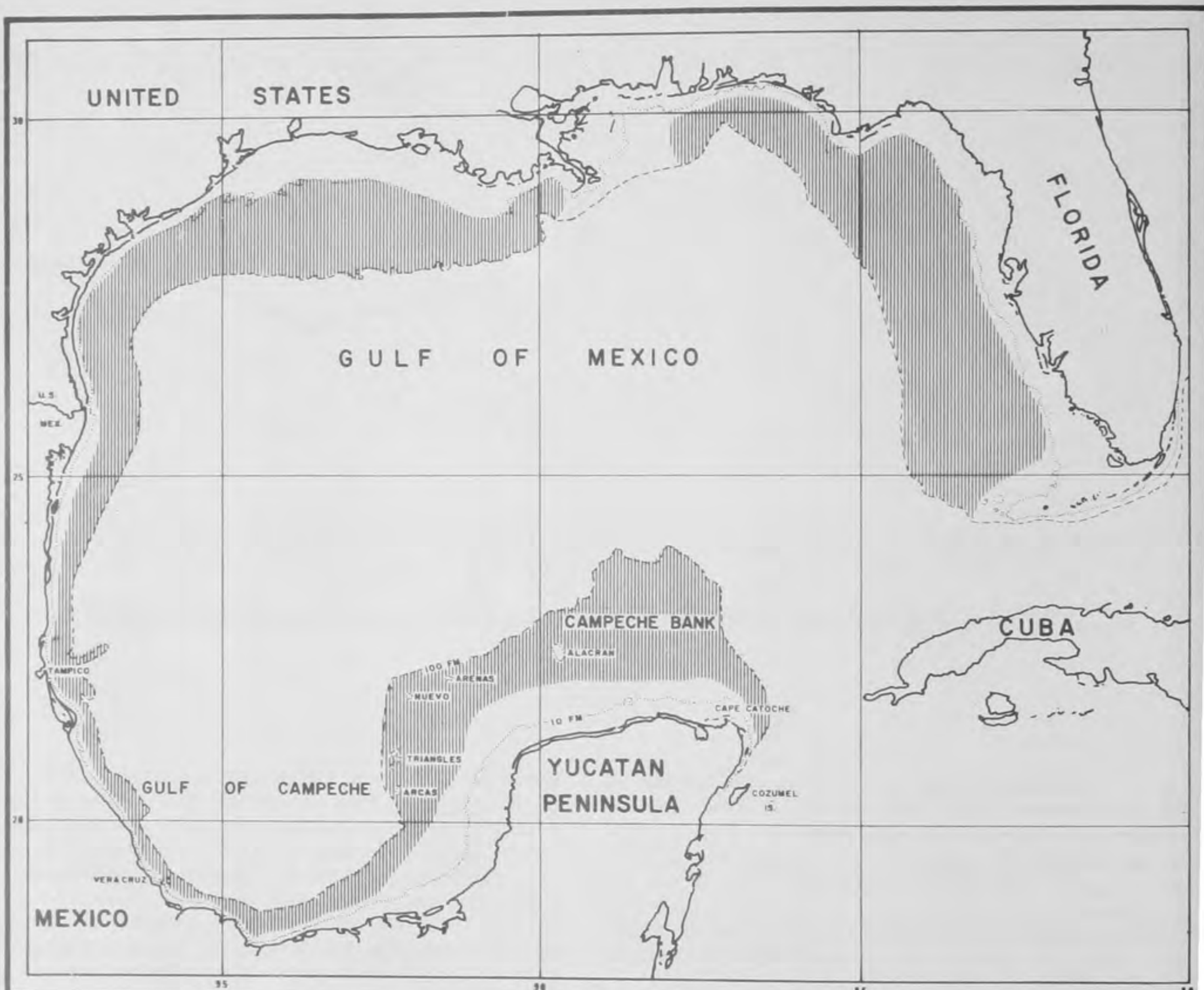

Figure 26.--Areas fished by the commercial snapper fleet in the Gulf of Mexico.

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MS #1436

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APPENDIX E

NICHOLAS SCHOOL OF THE ENVIRONMENT AND EARTH SCIENCES

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DUKE UNIVERSITY MARINE LABORATORY

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August 11, 2015

Doug Gregory
Executive Director
Gulf of Mexico Fishery Management Council

Dear Greg,

I would like to comment on the allocation alternatives in Draft Amendment 28 of the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico, June 2015. In the spirit of full disclosure, I was employed as a contractor by the GMFMC in the late 1980s and early 1990s as a facilitator for the development of the original Red Snapper IFQ proposal which was approved by the GMFMC but which was subsequently held up for over a decade by Congressional action. When the IFQ program was finally approved and implemented, it was in approximately the same form in which we had originally designed it. That design was the product of over 30 consensus-building workshops which I moderated and which were held in ten locations around the Gulf of Mexico over a two year period. I am also a member of the Board of Directors of the Ocean Conservancy which, through our New Orleans office, worked with the Council to pass and implement the IFQ program in the last decade, and also plays a role in the restoration planning in the wake of the Deepwater Horizon oil spill.

When we were developing the commercial IFQ program in the early 1990s, there was discussion of the possibility of some form of limited access for the recreational sector in the Red Snapper fishery, everything from license limitation to some form of recreational IFQ. Even then there was the potential for over-runs of recreational harvest due to insufficient and lax management of that sector, including by the individual Gulf states. Our conclusion then was that we should focus on the commercial sector, because that was the sector that had the most to gain from IFQ management in support of the overall goals of the Reef Fish Plan. It was clear that the issues of the recreational fishery would have to be addressed in the long run.

However, the current allocation alternatives in Draft Amendment 28 again raise the question of both the effectiveness of the management of the recreational sector, including by the states, and of the appropriate allocation between the commercial and recreational sectors. There is, of course, no perfect allocation formula, and allocations will always have to be made on the basis of judgments based on biophysical and socioeconomic data, standards such as "fairness and equity", and political values and interactions at both the state and federal levels. However, I would like to make two points.

First, it would be difficult to justify a reallocation of harvest from the commercial to the recreational sector on the basis of "fairness and equity" when the recreational sector has a significant history of over-runs of their historical allocation and in light of reluctance to engage in appropriate management by the Gulf states. Both of these factors are referenced in the amendment and supporting documents. This would essentially be rewarding the recreational sector and the states for mismanagement of the recreational harvest of the Red Snapper resource. This same comment applies to the objective of increasing the allocation to the recreational sector to in essence justify that sector's over-runs.

In addition, the shift in draft Amendment 28 from the "net economic benefit" to the "fairness and equity" standard is a productive one, because it emphasizes the point that the issue is not just dollars, but the "value" of those dollars to the different human communities in which they circulate. Commercial fishing communities are dependent on economic benefits in a very different way from recreational fishing communities, and those differences must be taken into account in allocation decisions under the M-SFCMA.

Second, this situation will ultimately not be resolved until the recreational sector is brought under clearly understood, monitorable, accountable and responsible management. That is what the IFQ system did – with the participation of commercial fishermen -- for the commercial sector. I believe that the Council has not fully considered alternatives for such management of the recreational sector.

For example, one of the most successful examples of the restoration of a fishery with both significant commercial and recreational components is that of the Atlantic Striped Bass fishery. In that case, stimulated by the plans of the Atlantic States Marine Fisheries Commission (ASMFC), the Commission and many of the individual states adopted a "tag" program for the recreational fishery wherein a limited number of "tags" were issued for each recreational fish allowed to be taken. This provided both a clear, accountable record of the number of fish taken by the recreational sector, and a means to limit that harvest in accordance with the prescribed quota. This system worked well because of the unique state-federal partnership formed under the Atlantic Coastal Fisheries Cooperative Fisheries Management Act (Atlantic Coastal Act), under which the federal government provides 'back-up' authority for the ASMFC in enforcing uniform state-federal management functions (that is, neither the states nor the federal government can manage such resources effectively on their own). I do understand that the situation in the Gulf is different from that of the Atlantic, owing to the absence of a Gulf of Mexico equivalent of the Atlantic Coastal Act, and that fish "tags" may or may not be the appropriate mechanism in the case of Red Snapper. However, advantage should be taken of examples such as Striped Bass to inform more effective management of the Gulf of Mexico Red Snapper fishery.

Thank you for your consideration of these comments.

Sincerely,

Michael K. Orbach
Professor Emeritus of Marine Affairs and Policy

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APPENDIX F

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August 9, 2015

Kevin Anson, Chair
Gulf of Mexico Fishery Management Council
2203 North Lois Avenue, Suite 1100
Tampa, FL 33607

Re: Lack of Access to Scientific Information Supporting Amendment 28

Dear Mr. Anson:

This law firm represents several commercial red snapper IFQ holders in the Gulf of Mexico and their associated entities who have long been engaged in management of the red snapper fishery.[1] The Gulf of Mexico Fishery Management Council ("Council") is scheduled to take final action on Amendment 28 at its upcoming meeting. Amendment 28 is legally and substantively flawed, as explained in various letters and public comments submitted by our individual clients and others. The purpose of this letter, however, is to advise the Council that it is procedurally barred from taking final action on Amendment 28 because critical scientific information supporting that amendment has not been made available to the public.

The Magnuson-Stevens Act ("MSA") provides that "[i]nterested parties shall have a reasonable opportunity to respond to new data or information before the Council takes final action on conservation and management measures." 16 U.S.C. § 1852(i)(6) (emphasis added). In addition, NMFS's National Standard Two guidelines explain that the MSA "provides broad public and stakeholder access to the fishery conservation and management process, including access to the scientific information upon which the process and management measures are based." 50 C.F.R. § 600.315(a)(6)(iv) (emphasis added). Data collection methods "are expected to be subjected to appropriate review before providing data used to inform management decisions." *Id*. § 600.315(a)(6)(v). The "data and procedures used to produce the scientific information" must be "documented in sufficient detail to allow reproduction of the analysis by others with an acceptable degree of precision. External reviewers of scientific information require this level of documentation to conduct a thorough review." *Id*. § 600.315(a)(6)(vi)(A).

These requirements have not been met with respect to the scientific information supporting Amendment 28. In particular, Amendment 28 explains (at p. x) that:

[1] *See* plaintiffs listed in the Complaint for Declaratory and Injunctive Relief, *Guindon, et al. v. Pritzker*, No. 14-cv-45 (D.D.C. Jan. 10, 2014).

> Preferred Alternative 8 and Alternative 9 would base reallocation on the effects of revised recreational data used in the [2014] update stock assessment that led to a higher stock ACL. These revisions included calibrated Marine Recreational Information Program (MRIP) catch estimates in the recreational sector and changes in the recreational size selectivity due to recreational fishermen targeting larger fish.

Unfortunately, although Alternatives 8 and 9 are based upon the 2014 update stock assessment, the written report of that assessment is not publicly available. Amendment 28 explains (at p. viii, note 2) that "[t]he written report for the 2014 red snapper update assessment is in preparation." The public is instead directed to "[a] version of the PowerPoint presentation describing the assessment [that] was presented to the Council at its January 2015 meeting." But the report itself, including a description of the assumptions relied upon and the underlying data and methodologies, all of which are necessary to test its conclusions, is nowhere to be found.

Apart from the legal requirement to provide this new information "before the Council takes final action"[2] on Amendment 28, its absence is troubling because the 2014 update assessment evidently relied upon two newly applied methodologies -- "recalibration" and "selectivity" -- to support its findings that catch limits could be raised. Those methodologies are now the driving force behind Amendment 28 and Alternatives 8 and 9, but the way in which they were implemented lacks publicly available documentation and raises conservation concerns.

First, it appears that the Southeast Fisheries Science Center ("SEFSC") "recalibrated" recreational landings estimates going back over half a century to 1950, apparently based upon a "preliminary, interim approach" developed by a working group using <u>one year of data</u> from 2013 and assumptions that they admit are subject to "substantial criticisms" and <u>may not be "defensible from a scientific point of view</u>."[3] While the working group's report is available,[4] the SEFSC's working papers showing how it applied the working group's methodology to recalibrate 60+ years of landings estimates are not available. Without the 2014 update stock assessment report and the SEFSC's working papers, there is no way for the public to understand the underlying assumptions and methodologies, or to reproduce the findings. Alternatives 8 and 9 of Amendment 28 are thus based entirely upon conclusory and undocumented assertions about recalibration and its effects upon the 2014 update stock assessment.

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[2] 16 U.S.C. § 1852(i)(6). The 2014 update assessment report is being prepared by Southeast Data, Assessment and Review ("SEDAR"), which "is a Council process, governed by the rules and regulations of the [Councils]." *See* http://sedarweb.org/docs/page/SEDAR%20FAQs_J3_updateJB_2.26.2015.pdf. Accordingly, the 2014 update assessment report constitutes "new information" from a "Council advisory body" under § 1852(i)(6).
[3] *See* Carmichael and Van Vorhees, MRIP Calibration Workshop II - Final Report (Mar. 24, 2015), at p. 19 (emphasis added).
[4] *See id*.

Similarly, Alternative 9 is also based upon "selectivity," or the assumption that recreational anglers are targeting larger fish and the effects of that assumption on the 2014 update stock assessment. Alternative 9 presumes that there have been "changes in the recreational size selectivity due to recreational fishermen targeting larger fish,"[5] but again no support is provided for the conclusory assertion that recreational anglers are "targeting" larger fish. This is particularly troubling because that assumption about anglers' *behavior* apparently triggered a substantial increase in stock yields under the 2014 update assessment. The SEFSC acknowledged that if this "strong" (i.e., bold) assumption about anglers' behavior (among other "strong assumptions" it relied upon) is wrong, projected yields after reallocation could be "higher than those required to permit recovery of the red snapper stock by 2032."[6]

A recent analysis by Dr. Trevor Kenchington concluded that this perceived "selectivity" might not be a behavioral change at all, but simply a reflection of anglers encountering the older fish from a few prior strong year classes moving through the fishery, coupled with recent poor recruitment in the eastern Gulf where the recreational fishery is focused.[7] In other words, anglers were catching larger fish because they were relatively more available, and the catch makeup could change as those strong year classes exit the fishery. Dr. Jim Cowan with Louisiana State University has raised similar concerns.[8] Moreover, even if this perceived behavioral change is in fact real, a shift back to anglers' targeting behavior of just a few years ago could have severe negative implications for the stock,[9] as the SEFSC also acknowledged.[10]

Before potentially exacerbating these problems by reallocating more fish to the recreational sector, which the SEFSC projects will only hasten the depletion of the spawning stock in the eastern Gulf to near record lows,[11] the Council and the public need a more thorough understanding of "selectivity." Neither Amendment 28 nor any other document we can find adequately explains how "selectivity" was applied in this context, how it was measured, what observations were relied upon, how this purported change in angler behavior resulted in substantial increases in the ABC/OFL levels, how those increases were calculated, or what the effects would be if the assumption that anglers are "targeting" larger fish is wrong or changes over time.

---

[5] Amendment 28 at p. x (emphasis added).
[6] NMFS, Southeast Fisheries Science Center, Selectivity Runs to Evaluate the Effect of Recalibrated Recreational Removals and Recreational Selectivity on Estimates of OFL, ABC and MSY for Gulf Red Snapper (Mar. 9, 2015), at p. 2.
[7] *See* Dr. Trevor J. Kenchington, Comments on Scientific Issues Relating to Re-Allocation in the Red Snapper Fisheries of the Gulf of Mexico (Aug. 2015), at p. 16.
[8] *See* Letter from Dr. Jim Cowan to Gulf Council dated August 9, 2015 at pp. 6-8.
[9] *See* Kenchington, *supra* note 7, at pp. 18-20, 24-30.
[10] *See* NMFS, SEFSC, *supra* note 6, at p. 2.
[11] *See* Standing and Special Reef Fish SSC Meeting Summary, New Orleans, Louisiana (May 20, 2015), at Figure 5, p. 7 (showing that the SSB in the eastern Gulf declines to just 4-6% of unfished levels under the reallocation alternatives).

"[T]o meet their statutory and regulatory mandate, [NMFS] must have a 'fairly high level of confidence' the regulatory provisions they recommend will rebuild red snapper stocks within the statutorily required period." *Coastal Conserv. Ass'n v. Gutierrez*, 512 F. Supp. 2d 896, 901 (S.D. Tex. 2007) (quoting *Natural Res. Defense Council v. Daley*, 209 F.3d 747, 754 (D.C. Cir. 2000)). This requisite "fairly high level of confidence" cannot be achieved given the significant doubts about "selectivity" as applied in the 2014 update assessment and by the SEFSC in projecting the impacts to the stock from reallocation.

* * * * *

NMFS's National Standard Two guidelines define "emergent science" as "relatively new knowledge that is still evolving and being verified, [and] therefore, may potentially be uncertain and controversial." 50 C.F.R. § 600.315(a)(4). Emergent science must accordingly "be considered more thoroughly." *Id*. There is no question that "recalibration" and "selectivity," as they were invoked in the update assessment, constitute "emergent science" and thus deserve more thorough documentation and review before being relied upon to make permanent management changes in this fishery that would cause significant harm to the commercial sector and potentially to the stock.

Indeed, as courts have recognized, "it is not consonant with the purpose of a rule-making proceeding to promulgate rules on the basis of inadequate data, or on data that, to a critical degree, is known only to the agency." *American Radio Relay League, Inc. v. FCC*, 524 F.3d 227, 237 (D.C. Cir. 2008) (internal quotations & alterations omitted). Similarly, courts do not uphold agency actions that are "based on speculation," nor do courts "defer to an agency's conclusory or unsupported suppositions." *Nat'l Shooting Sports Foundation, Inc. v. Jones*, 716 F.3d 200, 214 (D.C. Cir. 2013) (internal citations and quotations omitted). The MSA reflects these basic principles of administrative law in requiring that "[i]nterested parties shall have a reasonable opportunity to respond to new data or information before the Council takes final action on conservation and management measures." 16 U.S.C. § 1852(i)(6) (emphasis added).

Apart from the legal and substantive flaws with Amendment 28, the Council is procedurally barred from taking final action on Amendment 28 unless and until the public is provided access to and a reasonable opportunity to comment upon at least the following scientific information:

1) The written report of the 2014 update stock assessment;
2) The SEFSC's working papers showing the methods, assumptions and calculations used to recalibrate recreational landings data back to 1950, with sufficient detail to allow reproduction of the analysis by others with an acceptable degree of precision; and
3) To the extent not contained within #1, a quantifiable description and analysis of the apparent recent changes in "selectivity" purportedly observed in the recreational

sector, the effects of such "selectivity" on the 2014 update stock assessment, and the potential effects on stock rebuilding if assumptions about "selectivity" are wrong.

We ask that this letter be included in the administrative record for Amendment 28. Thank you for your attention to this matter.

Sincerely,

J. Timothy Hobbs

cc:
Dr. Roy Crabtree, Southeast Regional Administrator, National Marine Fisheries Service
Mara Levy, NOAA General Counsel
Gulf of Mexico Fishery Management Council Members