Appendix O

Revised and Updated Economic Analysis of Proposed Management Alternatives in Amendment 17A for the Commercial Snapper-Grouper Fishery

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Introduction

The red snapper (*Lutjanus campechanus*) resource within the jurisdiction of the South Atlantic Fishery Management Council has been determined to be severely overfished, and all management measures proposed in Amendment 17A would prohibit their harvest, possession and sale. These management measures differ in their proposed restrictions on the harvest of other species in the snapper-grouper management unit as a means of reducing the incidental catch and discard of red snapper.

This report describes the results of a simulation model that calculated the expected economic effects of the proposed management alternatives for the commercial snapper-grouper fishery from North Carolina through the Atlantic side of the Florida Keys. Its content differs from that of similar reports on the same topic that were prepared in August and November 2009 because it includes an evaluation of several new alternatives that were proposed at the Council's meeting in December 2009. Other alternatives have been reorganized and renumbered since the December Council meeting. Also, results are presented as 3-year averages based on data from 2006-2008, whereas previous reports were based on 4-year averages with data from 2005-2008. This report excludes data from 2005 because of a problem discovered in predicting commercial landings of black sea bass during the second half of the fishing year that began in 2004. The outcome is slightly higher estimates of short-term economic losses associated with the proposed alternatives because 2005 generally was a below-average year.

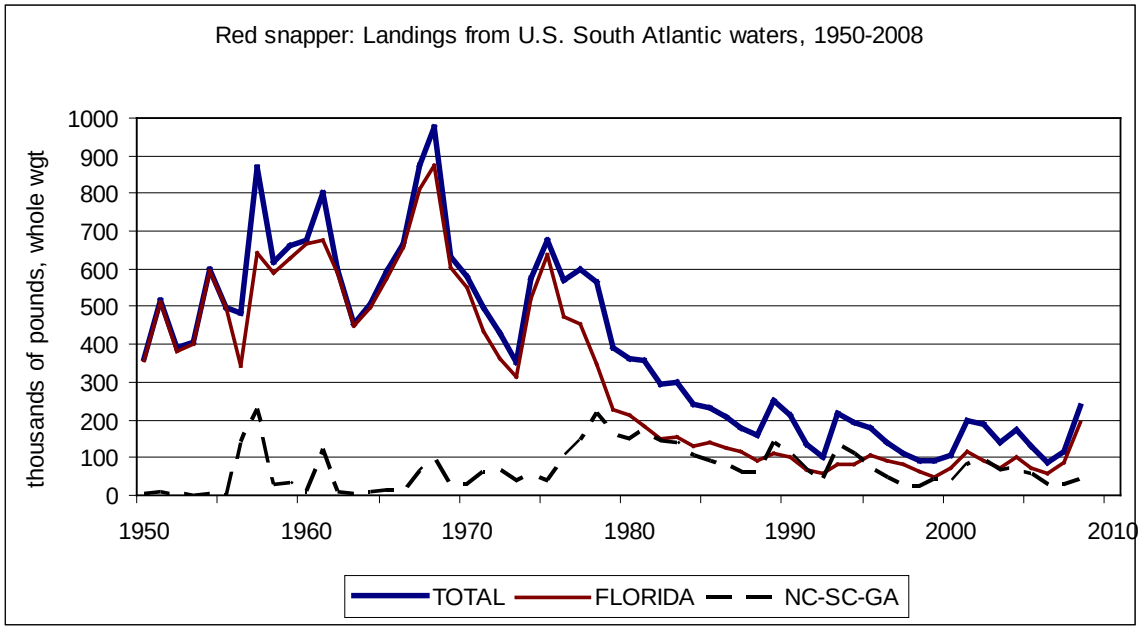
Historical Background

A small commercial fishery for red snapper along the Atlantic coast has existed at least since 1902 when 155,000 pounds were landed, primarily in Georgia.[1] The fishery continued at relatively low levels until after World War 2. Landings jumped to approximately 250,000 pounds in 1945 and 363,000 pounds in 1950. Landings fluctuated along a generally increasing trend through 1968 when they peaked at 974,000 pounds, declined to less than 100,000 pounds in 2006, and then increased in 2007 and 2008 (Figure 1). Landings in 2008 of 236,000 pounds were the highest since 1989 but remain far below historical catches prior to 1975. Commercial landings of red snapper averaged 540,000 pounds per year from 1950-1959, 678,000 pounds per year from 1960-1969, 524,000 pounds per year from 1970-1979, 259,000 pounds per year from 1980-1989, 147,000 pounds per year from 1990-2000, and 152,000 pounds per year from 2001-2008.

[1] NOAA. 1990. Historical catch statistics: Atlantic and Gulf coast states, 1879-1989. Current Fishery Statistics 9010, NMFS Fishery Statistics Division, 107p.

Fishermen along the east coast of Florida dominated the commercial fishery for red snapper until the mid-1970s, and accounted for more than 90% of landings from 1950-1975 (Figures 1 and 2). Geographic expansion of the fishery occurred during the late 1970s. Landings increased in Georgia, South Carolina and North Carolina and declined in Florida where landings averaged less than 60% of the total commercial fishery from 1978-2008 (Figure 2). Recently, however, the proportion of landings from Florida has increased from about 50% in 2002 to 80% in 2008 as landings increased in Florida and the combined landings from North Carolina, South Carolina and Georgia declined.

Figure 1. Commercial landings of red snapper from U.S. south Atlantic waters, 1950-2008.

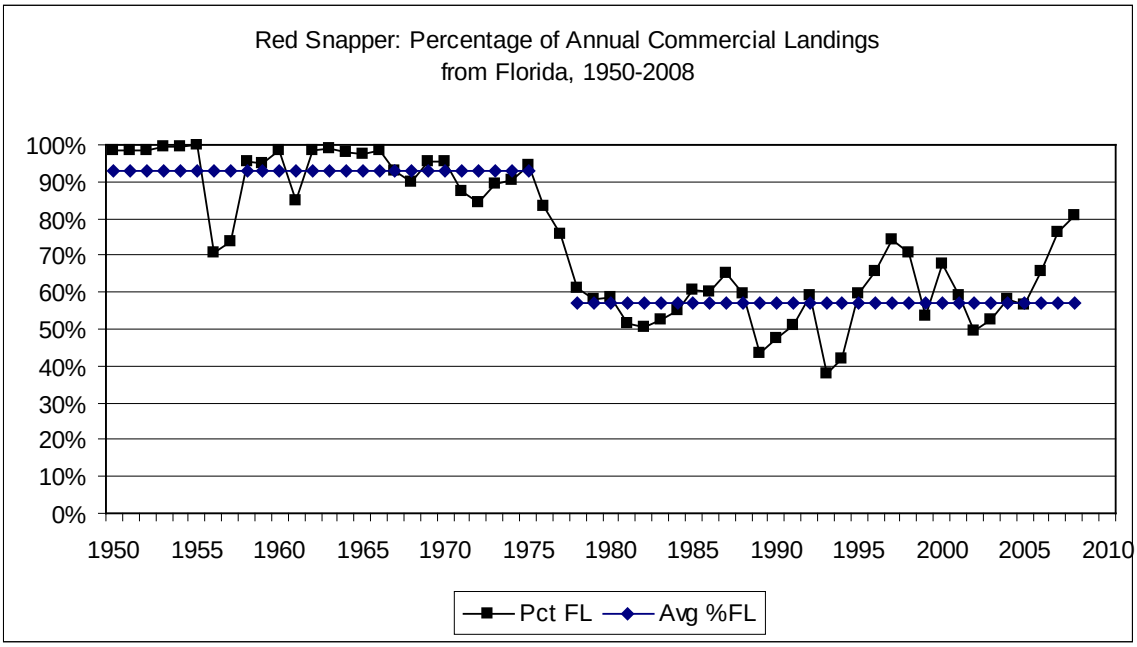


Sources: SEDAR 15 for 1950-2006, and NOAA Fisheries Southeast Fisheries Science Center Accumulated Landings System for 2007-2008.

Figure 3 displays landings and dockside revenues during the latter portion of the time series. Between 1981 and 2008, commercial landings of red snapper ranged from a high of 391,000 pounds (whole weight) worth $863,000 in current year dollars in 1981 to a low of 88,000 pounds worth approximately $292,000 in 2006. Dockside revenues increased to nearly $866,000 in 2008. In current year dollars, 2008 produced the highest revenues for red snapper since 1978. In constant 2008 dollars, dockside revenues in 2008 were the highest since 1993 after accounting for inflation with the consumer price index for all urban consumers.

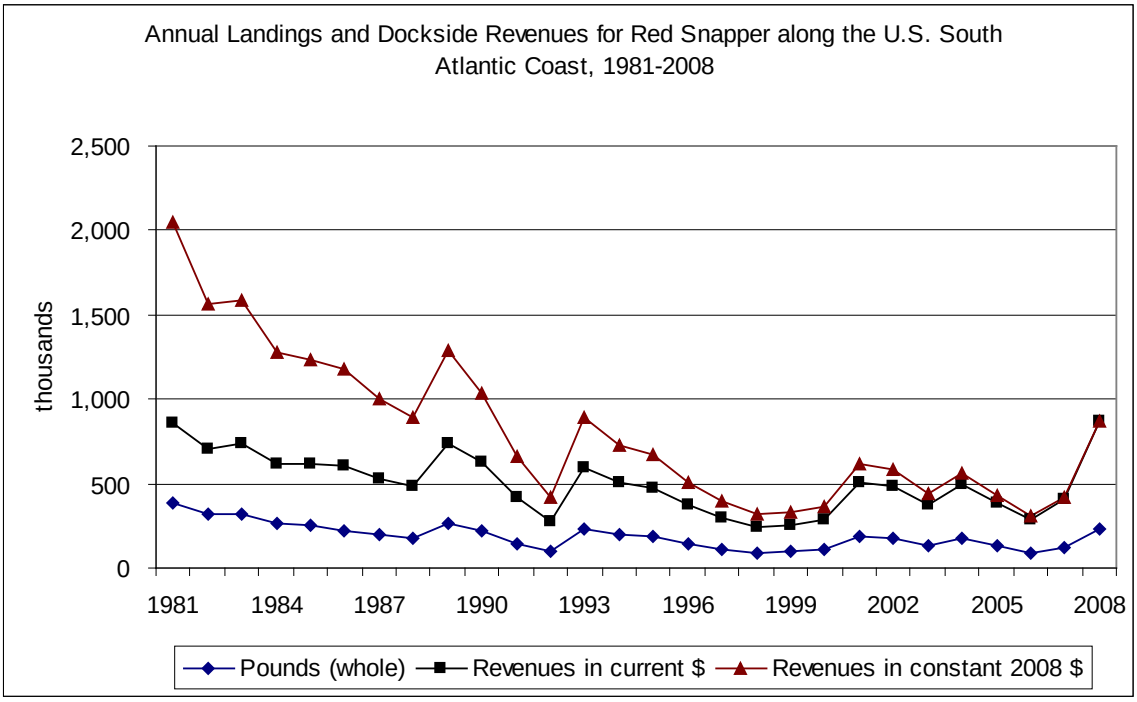
Dockside revenues and pounds landed fluctuate in the same direction (Figure 3), which suggests that ex-vessel demand is price elastic. The policy implication is that regulations that reduce industry landings in the short-term are expected to reduce dockside revenues in the short-term. Conversely, dockside revenues are expected to increase over time if regulation successfully increases biomass and landings.

Figure 2. Percentage of commercial red snapper landings from Florida, 1950-2008.



Sources: SEDAR 15 for 1950-2006, and NOAA Fisheries Southeast Fisheries Science Center Accumulated Landings System for 2007-2008.

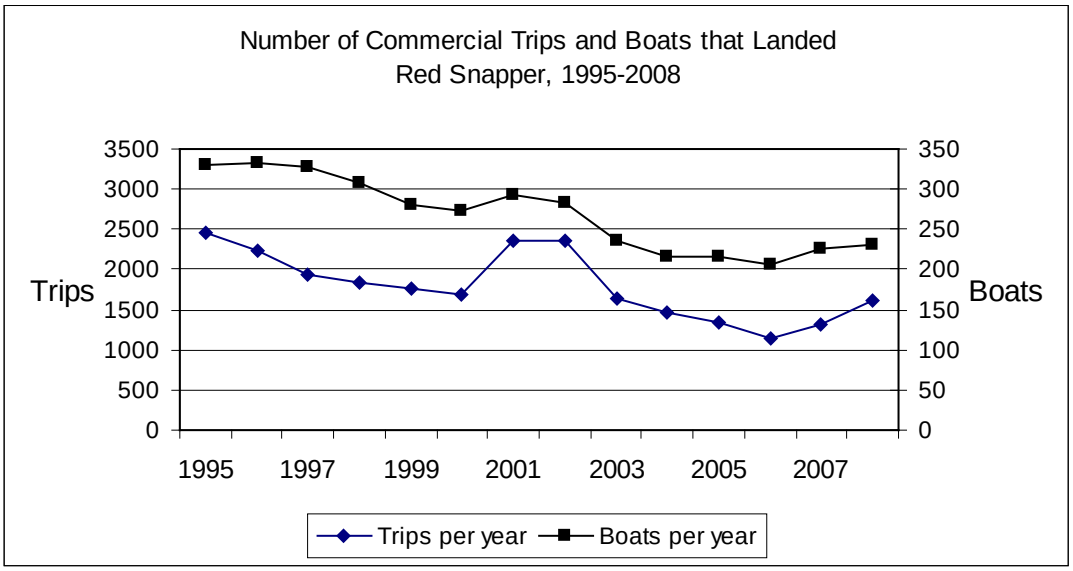
Figure 3. Annual dockside revenues from commercial red snapper landings, 1981-2008.



Source: NOAA Fisheries Service, Southeast Fisheries Science Center Accumulated Landings System as of July 8, 2009.

Logbook trip reports provide additional details about the commercial fishery for red snapper.[2] The number of vessels and trips that landed red snapper declined from 1995-2008, with a brief exception in 2001 and 2002 (Figure 4). Between 2005 and 2008 (which includes the subset of data that will be used to analyze the proposed management alternatives in Amendment 17A), an average of 220 vessels reported an average of 1,357 trips per year that landed at least one pound of red snapper (Table 1). These trips totaled an annual average of 135,000 pounds of red snapper worth $467,000 in current year dollars, and produced an average of 1.93 million pounds of other species worth $4.58 million.

Figure 4. Number of commercial trips and boats that landed red snapper in federal waters, 1995-2008.



Source: NOAA Fisheries Service, Southeast Fisheries Science Center logbook database as of June 29, 2009.

Clearly, red snapper was not the primary revenue species on most of these trips. Red snapper was the primary source of trip revenue on an average of 190 trips per year and a lesser source of revenue on 1,167 trips per year (Table 1). On average from 2005-2008, red snapper was the primary source of trip revenue on less than 15% of the total number

[2] Since 1993, snapper-grouper fishermen with a permit to fish in Federal waters have been required to submit logbook trip reports to the NMFS with information about landings by species and gear type, approximate location of trip and date of landing. Unlike the ALS (Accumulated Landings System) database, the logbook database does not include landings from trips in state waters by fishermen who do not have Federal permits. A comparison of red snapper landings from the logbook and ALS databases suggests that landings may have been underreported in the logbook database during 1993 and 1994, the first two years for mandatory logbook reporting. By 1995 landings in the two databases were relatively close, which conforms with expectations that red snapper are landed primarily in federal waters. Between 2005 and 2008, landings reported to the logbook database were about 95% of total red snapper landings as defined by the ALS database.

of trips on which they were landed. These trips accounted for approximately 40% of the total commercial harvest of red snapper, with an annual average for the entire fishery of 54,000 pounds of red snapper worth $189,000 in current dollars and 57,000 pounds of other species worth $124,000. Approximately 60% of the total commercial harvest of red snapper occurred on trips when red snapper was a secondary source of trip revenue. Trips with red snapper as a lesser source of revenue accounted for an annual average of 81,000 pounds of red snapper worth $279,000 in current dollars and 1.87 million pounds of other species worth $4.46 million.

Table 1. Average annual landings and dockside revenues on trips that landed at least one pound of red snapper, 2005-2008.[3]

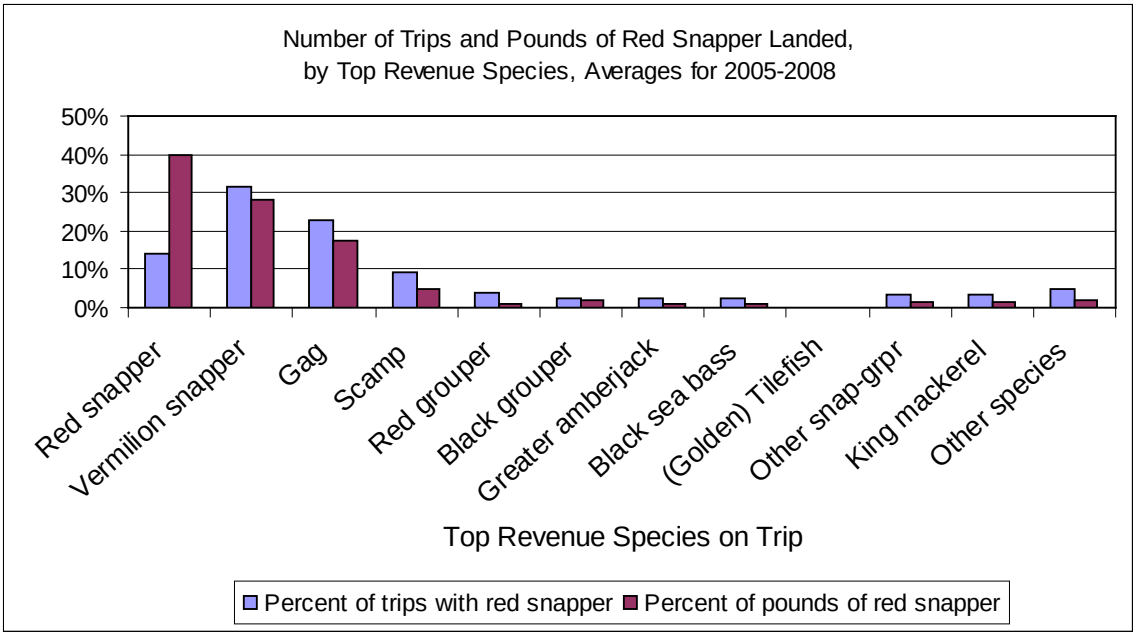
	Trips with at least one pound of red snapper	Trips with red snapper as primary source of trip revenue	Trips with red snapper as secondary source of trip revenue
	Annual averages for 2005-2008		
Number of vessels	220	67	205
Number of trips	1,357	190	1,167
Red snapper landings (thousand pounds, whole weight)	135	54	81
Dockside revenue from red snapper in current year dollars (thousands)	$467	$189	$279
Landings of other species (thousand pounds, whole weight)	1,928	57	1,871
Dockside revenue from other species in current year dollars (thousands)	$4,584	$124	$4,460

Sources: NOAA Fisheries Service, Southeast Fisheries Science Center logbook database as of June 29, 2009, and NOAA Fisheries Service, Southeast Fisheries Science Center Accumulated Landings System as of July 8, 2009. Red snapper was identified as the primary source of trip revenue if it was the top revenue species on the trip.

[3] The logbook database does not collect prices or revenues for landed fish. Trip revenues were approximated as reported landings multiplied by average prices, by species, from the NMFS Accumulated Landings System.

Red snapper were most commonly caught as a secondary revenue species on trips with vermilion snapper, gag or scamp as the primary revenue species on the trip (Figure 5). On average for 2005-2008, vermilion snapper was the primary source of trip revenue for approximately 31% of the trips that landed red snapper, and accounted for 28% of total red snapper landings. Gag was the primary source of trip revenue for 23% of trips that landed red snapper and accounted for nearly 18% of total red snapper landings. Scamp was the primary source of trip revenue for 9% of trips that landed red snapper and accounted for 5% of total red snapper landings. The top revenue species was not part of the snapper-grouper management unit for 8% of the trips with red snapper. These trips accounted for less than 2.5% of total red snapper landings.

Figure 5. Number of trips and pounds of red snapper landed, classified according to the top revenue species on each trip, averages for 2005-2008.



Sources: NOAA Fisheries Service, Southeast Fisheries Science Center logbook database as of June 29, 2009, and NOAA Fisheries Service, Southeast Fisheries Science Center Accumulated Landings System as of July 8, 2009.

Method of Analyzing Economic Effects of Proposed Management Alternatives

Fishermen with permits to fish in federal waters for species in the snapper-grouper fishery have been required since 1993 to submit trip reports of their landings by species. Logbook trip reports from 2006-2008 constitute the source of data used in this analysis. Several proposed alternatives in Amendment 17A would regulate fishing activity by depth of water where fish were caught. Logbook trip reports began collecting information about water depth in 2005.

The simulation model uses logbook trip reports to predict the short-term economic effects of proposed management alternatives. The general method of analysis is to hypothetically impose proposed regulations on individual fishing trips as reported to the logbook database, and then calculate their effects on trip catches, revenues and costs. Trip-level results are totaled by year for 2006-2008, and the three-year average of simulated results is interpreted as the expected annual outcome of proposed regulations. The three-year average is used so that short-term anomalies that may have affected fishing success in any one year will be averaged out. The average annual simulated fishing incomes net of trip costs (also referred to as *net operating revenues*) for the proposed alternatives are compared to the no-action (status quo) alternative to estimate the expected economic effects on commercial fishermen.

Net operating revenues for trip j in year t were calculated as trip revenues from all species minus predicted trip costs, which include fuel, oil, bait, ice, and other supplies, and exclude fixed costs and labor costs. Therefore, net operating revenues represent the return to fixed factors of production, labor (including crew) and boat owner. Net operating revenues were adjusted to constant 2008 dollars with the consumer price index for all items and all urban consumers.

The simulation model examines the effects of proposed management alternatives on trip revenues and trip costs. If trip revenues remain greater than trip costs plus opportunity cost of labor after accounting for the likely effects of proposed restrictions, then the trip is recorded as taken in the simulation model, and the economic effect of the proposed restriction is measured as the loss in revenues associated with the expected reduction in landings per trip. On the other hand, if the proposed alternatives would cause trip revenues to fall below the sum of trip costs and opportunity cost for labor after accounting for the likely effects of proposed restrictions on trip-level harvests, then the trip is recorded as not taken in the simulation model, and losses are measured as a reduction in net operating revenues, which included the loss in revenues from all species minus the savings of trip costs not incurred.

This method of analysis has advantages and disadvantages. The advantages are that logbook data are reported by fishermen, and are available in sufficient detail to analyze and compare the proposed alternatives. The disadvantage is that logbook data reflect fishing patterns and strategies given regulations that will no longer apply. Fishermen will modify their fishing patterns and strategies to minimize the effects of new regulations, but the simulation model does not account for these changes. Therefore, it can only approximate the true, but unknown, outcomes of proposed regulations. Nevertheless, the approach provides useful insights about the relative magnitudes of change due to proposed alternatives and the distribution of effects among subgroups within the fishery.

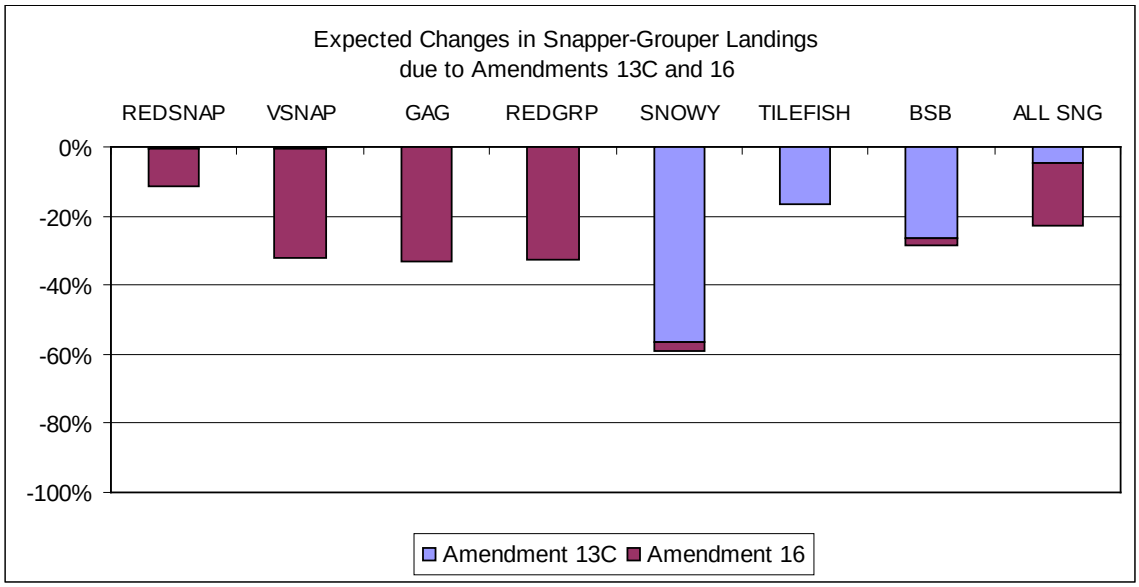
The Status Quo Alternative

The objective of this analysis is to predict the extra economic effects associated with implementation of Amendment 17A. It accomplishes this objective by comparing the predicted outcomes of simulations given proposed regulations for Amendment 17A with the predicted outcome of simulations for the status quo. For purposes of this analysis, the status quo alternative is defined by the predicted outcomes of rules specified in Amendments 13C, 15A and 16.

The effects of proposed regulations in Amendment 17A are compared to the simulated effects of Amendments 13C, 15A and 16 rather than to observed fishery landings and revenues because historical data for 2006-2008 do not reflect the effects of regulations recently implemented by these amendments. Amendment 13C to the Snapper-Grouper Fishery Management Plan was implemented in October 2006 and Amendment 15A was implemented in March 2008. Both amendments primarily regulate the harvest of deep water groupers, tilefish and black sea bass. Amendment 16 was implemented at the end of July 2009 and imposes limits on the harvest of vermilion snapper, gag and other shallow water groupers. Landings of other species, such as red snapper, in the snapper-grouper management unit could change if they are indirectly affected by regulations in Amendments 13C, 15A and 16.

Figure 6 illustrates the differences between the simulated fishery landings for the regulatory period prior to Amendment 16 and the simulated landings that comprise the status quo alternative for Amendment 17A. The light shading in Figure 6 illustrates that Amendments 13C and 15A are expected to affect landings of snowy grouper, golden tilefish and black sea bass. The dark shading illustrates that Amendment 16 is expected to affect landings of mid-shelf species such as vermilion snapper, gag and red grouper, and to a lesser extent, red snapper. The cumulative effects on landings of Amendments 13C, 15A and 16 are illustrated by the combined length of the dark and light shading on each bar in Figure 6. Amendments 13C, 15A and 16 are predicted to reduce landings of: red snapper by approximately 11 percent; gag, red grouper and vermilion snapper by approximately 32 or 33 percent each; snowy grouper by approximately 58 percent; (golden) tilefish by approximately 17 percent; and black sea bass by approximately 28 percent. The right-most bar in Figure 6 (labeled ALL SNG) illustrates that Amendments 13C, 15A and 16 are expected to reduce the aggregate total landings of all species (including species not shown in Figure 6) in the snapper-grouper management unit by approximately 23 percent compared to the simulated landings for 2006-2008 with regulatory conditions prior to Amendment 16.

Figure 6. Percentage change in pounds landed compared to the No-Action alternative for Amendment 13C after accounting for regulations implemented by Amendments 13C and 16.



Economic Effects of Proposed Management Measures for Red Snapper

Table 2 lists the management alternatives that are proposed in Amendment 17A.[4] Alternative 1 is the status quo alternative and reflects regulations currently in place for the snapper-grouper fishery. Alternatives 2, 3A, 3B, 3C, 3D, 4A, 4B, 4C and 4D all would prohibit the possession and sale of red snapper. However, red snapper often are caught while fishing for other species in the snapper-grouper management unit (Table 1). Alternatives 3A, 3B, 3C, 3D, 4A, 4B, 4C and 4D are intended to reduce the incidental catch and discard of red snapper by specifying conditions under which the possession and sale of other species in the snapper-grouper management unit would be prohibited. Alternatives 3A, 3B, 3C and 3D would prohibit snapper-grouper fishing in portions of logbook grids 2880, 2980, 3080, and 3180 off the coasts of Georgia and northeast Florida. Alternatives 4A, 4B, 4C and 4D would prohibit snapper-grouper fishing in these areas plus logbook grids 3179, 3278, and 3279 off the coast of South Carolina. Alternatives 5, 6 and 7 specify exemptions to the prohibitions listed in other alternatives. Alternative 5 would allow the use of black sea bass pots in otherwise closed areas, if the pots had the appropriate endorsement to the federal snapper-grouper permit. Alternative 6 would allow the use of bottom longline gear in waters deeper than 50 fathoms (300 feet) in otherwise closed areas. Alternative 7 would allow the harvest of snapper-grouper

[4] Alternatives were reorganized and renumbered after the December 2009 Council meeting. Alternative 3C previously was known as Alternative 3, Alternative 4C is the old Alternative 4, Alternative 3A is the old Alternative 5, and Alternative 4A is the old Alternative 6. Alternatives 3B, 3D, 4B and 4D are new. Alternatives 5, 6 and 7 previously were known as Alternatives 7, 8 and 9.

species in otherwise closed areas if taken with spearfishing gear. The Council can choose no exemptions, or one, two or all three exemptions. The exemptions do not apply to Alternative 2.

Table 2. Alternatives proposed in Amendment 17A for the management of commercial fishing activity for red snapper. Asterisks following the model name denote preferred alternatives. (Table 2 paraphrases rather than includes a verbatim statement of alternatives from Amendment 17A.)

Model Name	*Description*
A17_NO_ACTION	*Alternative 1* (Status Quo). Retain existing regulations for red snapper, including a 20 inch size limit (commercial & recreational) and a recreational 2 fish bag limit (included in the 10 snapper per person limit).
A17_RedSnap_ALT2	*Alternative 2*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ.
A17_RedSnap_ALT3A	*Alternative 3A*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, and 3180.
A17_RedSnap_ALT3B	*Alternative 3B*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, and 3180 between a depth of 66 feet (11 fathoms; 20 m) to 240 feet (40 fathoms; 73 m).
A17_RedSnap_ALT3C	*Alternative 3C*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, and 3180 between a depth of 98 feet (16 fathoms; 30 m) to 240 feet (40 fathoms; 73 m).

Model Name	*Description*
A17_RedSnap_ALT3D	*Alternative 3D*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, and 3180 between a depth of 98 feet (16 fathoms; 30 m) to 300 feet (50 fathoms; 91 m).
A17_RedSnap_ALT4A	*Alternative 4A:* Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, 3179, 3180, 3278, and 3279.
A17_RedSnap_ALT4B	*Alternative 4B*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, 3179, 3180, 3278, and 3279 between a depth of 66 feet (11 fathoms; 20 m) to 240 feet (40 fathoms; 73 m).
A17_RedSnap_ALT4C	*Alternative 4C*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, 3179, 3180, 3278, and 3279 between a depth of 98 feet (16 fathoms; 30 m) to 240 feet (40 fathoms; 73 m).
A17_RedSnap_ALT4D*	*Alternative 4D*: Prohibit all commercial and recreational harvest, possession, and retention of red snapper year-round in the South Atlantic EEZ. Prohibit commercial and recreational harvest, possession, and retention of other species in the snapper grouper FMU year-round in an area that includes commercial logbook grids 2880, 2980, 3080, 3179, 3180, 3278, and 3279 between a depth of 98 feet (16 fathoms; 30 m) to 300 feet (50 fathoms; 91 m).
A17_RedSnap_ALT5*	*Alternative 5:* Allow harvest, possession and retention of snapper-grouper species (with the exception of red snapper) in the closed area if fish were harvested with black sea bass pots with endorsements.
A17_RedSnap_ALT6	*Alternative 6*: Allow harvest, possession and retention of golden tilefish, blueline tilefish, snowy grouper, yellowedge grouper, warsaw grouper and misty grouper with bottom longline gear in waters deeper than 50 fathoms in the closed area.

Model Name	*Description*
A17_RedSnap_ALT7*	*Alternative 7*: Allow harvest, possession and retention of snapper-grouper species (with the exception of red snapper) in the closed area if fish were harvested with spearfishing gear.

The ensuing discussion focuses on a comparison of alternatives given the preferred exemptions for black sea bass pots (Alternative 5) and spearfishing gear (Alternative 7). To distinguish scenarios with gear exemptions from scenarios without gear exemptions, the number of the alternative that designates the exempted gear is added to the overall model name. For example, Model *A17_RedSnap_ALT4D57*, refers to Alternative 4D with exemptions according to Alternative 5 (black sea bass pots) and Alternative 7 (spearfishing gear). In the accompanying figures, the simulated effects of the various alternatives are presented from left to right by year, state or gear, with the status quo (No Action) alternative on the left and Alternative 4D57 on the right within each group.

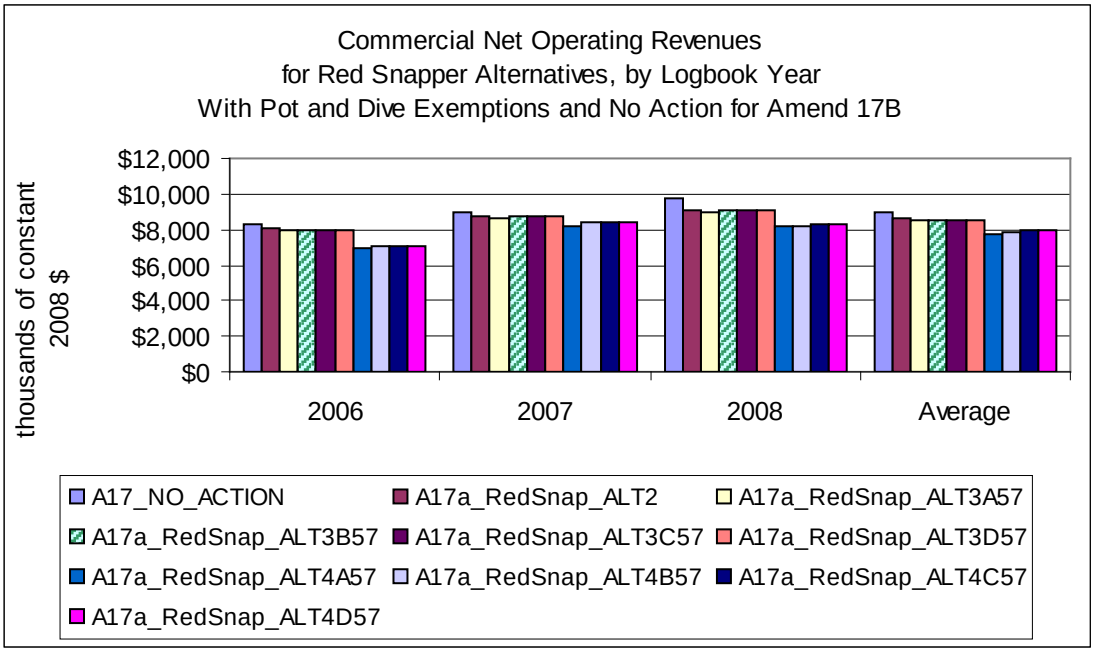
Figure 7 presents results for each year of logbook data used in the analysis. After accounting for the expected effects of Amendments 13C and 16, the simulation model predicted that the commercial fishery[5] would earn an average of approximately $9.0 million per year after deducting routine trip costs such as fuel, bait, ice, food and other supplies, but before accounting for fixed costs and labor costs. This estimate is the status quo baseline for Amendment 17A (see Model *A17_No_Action* in Figure 7), and represents income to boat owners, captains and crew members for their labor, plus income to boat owners to pay fixed costs and earn a return to capital invested in boat and equipment. This estimate is less than the average of what fishermen actually earned from 2006-2008 because it accounts for the predicted effects of Amendment 16, which was implemented in late July 2009.

The status quo baseline in Figure 7 is interpreted as follows. The simulation model uses information from the recent past as a predictor of the near future. If environmental and biological conditions in the near future most closely resemble conditions that existed in 2008, for example, then the simulation model predicts that fishermen would earn $9.8 million without the regulatory constraints that would be implemented with Amendment 17A. However, if environmental and biological conditions in the near future most closely resemble conditions that existed in 2006, then the model predicts that fishermen would earn $8.3 million. Because the future is unknown and because environmental conditions vary over time, we do not know which year is the best predictor of the near future. Therefore, the 3-year average of $9.0 million is used as the expected predictor of the status quo baseline in the near future. During the 2006-2008 period, conditions in 2008 yielded above-average economic outcomes, conditions in 2006 yielded below-

[5] The commercial fishery is defined in this analysis as consisting of all trips in the logbook database that reported landing at least one pound of any species in the snapper-grouper management unit.

average economic outcomes, and conditions in 2007 yielded average outcomes (Figure 7).

Figure 7. Predicted net operating revenues by year for the commercial snapper-grouper fishery.



The management alternatives proposed in Amendment 17A would reduce net operating revenues to commercial fishermen. Figures 8a and 8b indicate that the expected reductions would be greatest if conditions in the near future most closely resemble conditions in 2008, and usually would be the smallest if conditions most closely resemble 2007.[6] There is an inverse relationship between the predicted effects of Amendments 16 and 17A because red snapper often are caught on trips with vermilion snapper or gag that were regulated by Amendment 16 (Figure 5). The economic and biological conditions present in 2007 were conducive to the greatest economic effects in percentage terms due to Amendment 16, and the simulation model predicts the smallest additional effects on the commercial fishery due to Amendment 17A (Figures 8a and 8b). Conversely, the conditions present in 2006 and 2008 tended to yield smaller effects in percentage terms due to Amendment 16 and the largest additional effects due to Amendment 17A. Alternative 2 is the exception. The effects of Alternative 2 would be smallest if the future most closely resembles conditions in 2006.

[6] There are no changes associated with the status quo alternative, and hence no bars appear in Figures 8a and 8b for No Action. The left-most bars in each group depict the simulated effect of Alternative 2.

Figure 8a. Predicted changes in net operating revenues compared to the status quo (no action) alternative for Amendment 17A.

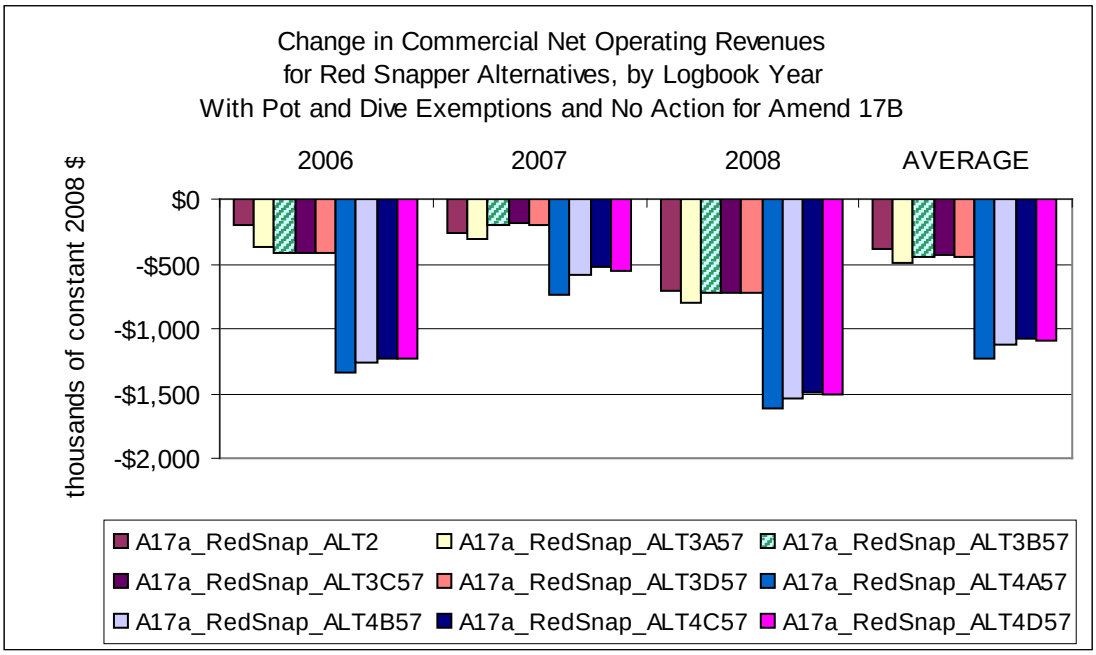
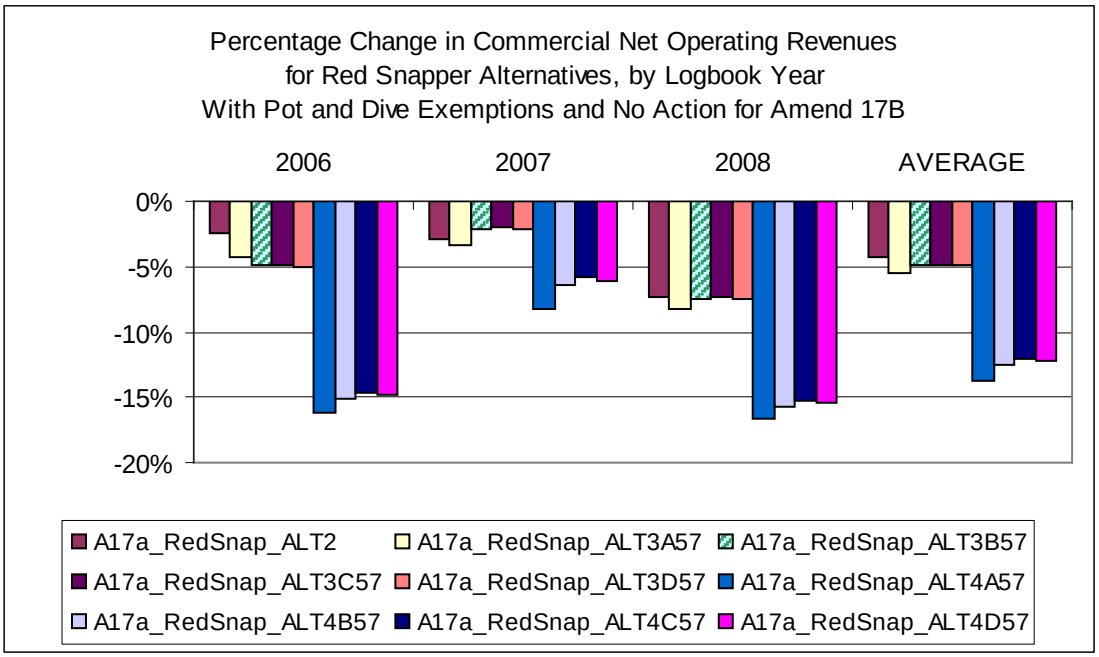


Figure 8b. Predicted percentage changes in net operating revenues compared to the status quo (no action) alternative for Amendment 17A.



Alternative 2 is the least restrictive alternative because it would prohibit the harvest of red snapper only, and is expected to reduce net operating revenues for commercial fishermen by an average of approximately $390,000, or 4.3 percent (Figures 8a and 8b). For individual years of data used in the analysis, the expected losses in net operating revenues associated with Alternative 2 ranged from $199,000 (2.4 percent) given conditions in 2006 to $709,000 (7.3 percent) given conditions in 2008. The expected losses are relatively small because red snapper is not a high-volume species in the commercial snapper-grouper fishery.

Alternatives 3A, 3B, 3C and 3D would prohibit the harvest of all species in the snapper-grouper management unit in specific depth ranges in logbook reporting areas 2880, 2980, 3080, and 3180 off the coasts of Georgia and northeast Florida, with the possibility for gear exemptions as defined by Alternatives 5-7. Alternative 3C57 would prohibit harvests between 98 and 240 foot water depths, and is expected to reduce net operating revenues by an average of approximately $438,000 (4.9 percent), with a range from $181,000 (2.0 percent) for conditions in 2007 to $723,000 (7.4 percent) for conditions in 2008 (Figures 8a and 8b). Water depths between 98 and 240 feet represent the core of the fishery, and deviations to encompass shallower depths from 66-240 feet (Alternative 3B57) or deeper depths from 98-300 feet (Alternative 3D57) would generate relatively small additional losses for fishermen, according to the depths recorded on their logbook trip reports. On average, the overall economic effects of a prohibition on fishing for snapper-grouper species in the deeper depths of 98-300 feet would be approximately equal to the effects of a prohibition in the shallower depths of 66-240 feet. Alternative 3D57 is expected to reduce net operating revenues by an average of approximately $445,000 (4.9 percent), with a range from $194,000 (2.2 percent) with conditions for 2007 to $724,000 (7.4 percent) with conditions for 2008. Alternative 3B57 is expected to reduce net operating revenues by an average of approximately $444,000 (4.9 percent), with a range from $193,000 (2.2 percent) with conditions for 2007 to $729,000 (7.5 percent) with conditions for 2008.

Alternative 3A57 would prohibit harvests in all depths, except for the use of black sea bass pots and spearfishing gear, and is expected to reduce net operating revenues for commercial fishermen by an average of approximately $489,000 (5.4 percent) (Figures 8a and 8b). Losses for individual years considered in the analysis range from $301,000 (3.4 percent) for conditions that prevailed in 2007 to $803,000 (8.2 percent) for conditions that prevailed in 2008.

Alternatives 4A, 4B, 4C and 4D would prohibit the harvest of all species in the snapper-grouper management unit off portions of South Carolina in addition to Georgia and northeast Florida. Therefore, these alternatives are expected to generate greater losses for the commercial fishery than the corresponding management choice from among Alternatives 3A, 3B, 3C and 3D because they encompass a broader range of restricted waters. The simulation results suggest that, on average, the expected losses in net operating revenues for Alternatives 4A57, 4B57, 4C57, and 4D57 would be approximately 2.5 times larger than the losses with the corresponding Alternatives 3A57, 3B57, 3C57 and 3D57.

Alternative 4C57 would prohibit harvests between 98 and 240 foot water depths, and is expected to reduce net operating revenues by approximately $1,081,000 (12.0 percent) with a range from $524,000 (5.8 percent) with conditions for 2007 to $1,495,000 (15.3 percent) with conditions for 2008 (Figures 8a and 8b). The economic effects of Alternatives 4B57 and 4D57 are expected to be larger than for Alternative 4C57 because the ranges of the restricted depths are greater. A prohibition on fishing for snapper-grouper species in the deeper depths of 98-300 feet would be slightly less costly to fishermen, on average, than a prohibition in the shallower depths of 66-240 feet. Preferred Alternative 4D57 would prohibit harvests between 98 and 300 foot water depths, and is expected to reduce net operating revenues by approximately $1,095,000 (12.1 percent) with a range from $548,000 (6.1 percent) with conditions for 2007 to $1,502,000 (15.4 percent) with conditions for 2008. Alternative 4B57 is expected to reduce net operating revenues by an average of approximately $1,125,000 (12.5 percent), with a range from $577,000 (6.4 percent) with conditions for 2007 to $1,535,000 (15.7 percent) with conditions for 2008.

Alternative 4A57 would prohibit harvests in all depths, except for the use of black sea bass pots and spearfishing gear, and is expected to reduce net operating revenues for commercial fishermen by an average of approximately $1,235,000 (13.7 percent) (Figures 8a and 8b). Losses for individual years considered in the analysis range from $736,000 (8.2 percent) for conditions that prevailed in 2007 to $1,622,000 (16.6 percent) for conditions that prevailed in 2008.

Although the overall average expected reductions in net operating revenues for all alternatives range from 4.3 percent ($390,000 with Alternative 2) to 13.7 percent ($1,235,000 with Alternative 4A57) for the entire commercial snapper-grouper fishery, the effects of Amendment 17A would be highly focused on fishermen in northeast Florida and Georgia because that region represents the center of the red snapper fishery (Figures 9a and 9b). Fishermen there would incur the largest losses in absolute and relative terms. Including the exemptions for black sea bass pots and spearfishing gear, the predicted reductions in net operating revenues for fishermen in northeast Florida and Georgia are expected to average approximately $254,000 (25.7 percent) for Alternative 2, approximately $672,000 (68.3 percent) for Alternatives 3A57 and 3B57, $670,000 (68.0 percent) for Alternatives 3C57 and 3D57, $693,000 (70.3 percent) for Alternatives 4A57 and 4B57, and $690,000 (70.0 percent) for Alternatives 4C57 and 4D57 (Figures 9a and 9b).

Fishermen in central and southeast Florida would incur smaller losses in both absolute and relative terms. The predicted reductions in net operating revenues averaged $93,000 (4.1 percent) with Alternative 2, $218,000 (9.7 percent) with Alternative 3A57, $154,000 (6.9 percent) to $163,000 (7.2 percent) with Alternatives 3B57, 3C57 and 3D57, $198,000 (8.8 percent) with Alternative 4A57, and $124,000 (5.5 percent) to $133,000 (5.9 percent) with Alternatives 4B57, 4C57 and 4D57 (Figures 9a and 9b).

Figure 9a. Predicted changes in net operating revenues by state of landing for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A.

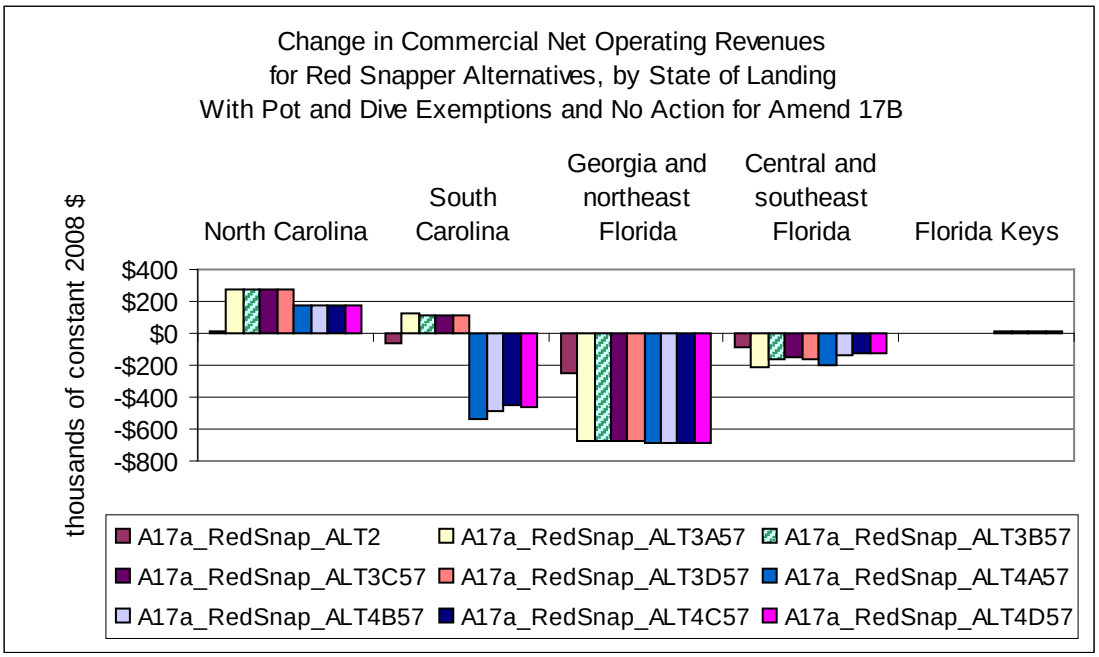
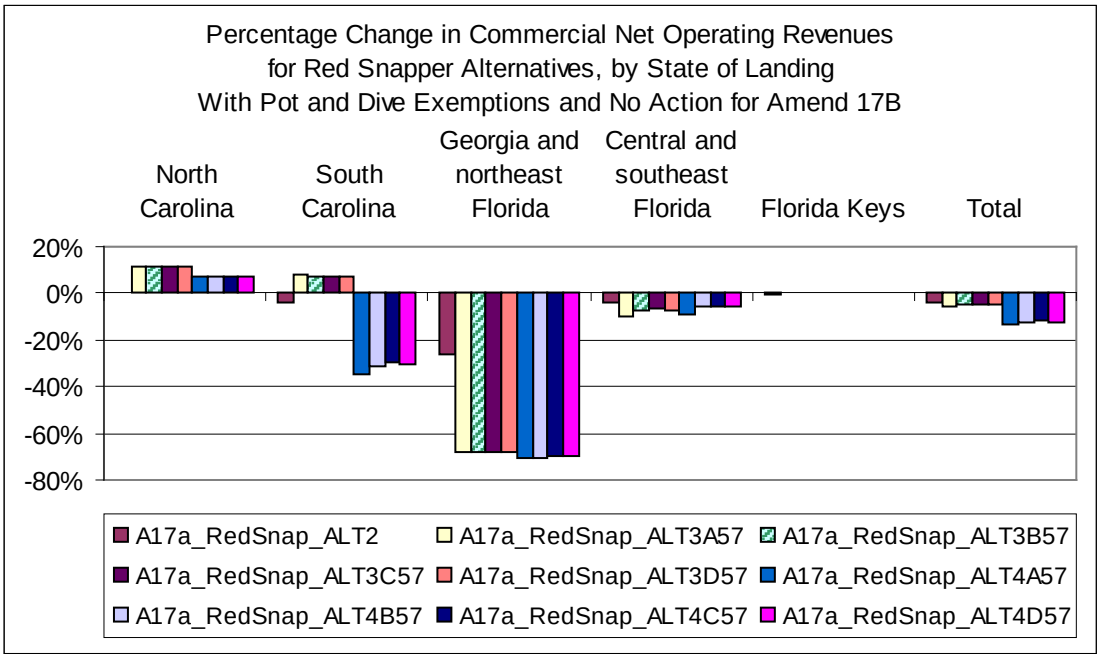


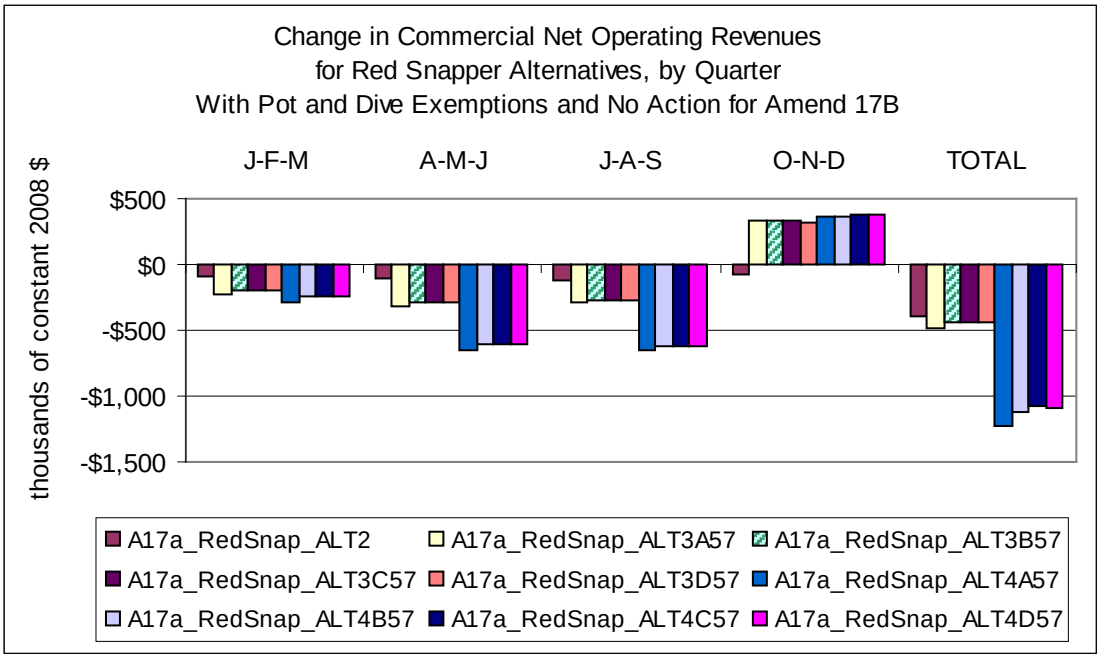
Figure 9b. Predicted percentage changes in net operating revenues by state of landing for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A.



Alternatives 3A, 3B, 3C, and 3D would limit the closures to areas off the coast of northeast Florida and Georgia, whereas Alternatives 4A, 4B, 4C and 4D also would close areas off the coast of South Carolina. Including the mitigating effects of exemptions for black sea bass pots and spearfishing gear, net operating revenues for fishermen in South Carolina are expected to decline by an average of approximately $531,000 (34.5 percent) with Alternative 4A57, $487,000 (31.6 percent) for Alternative 4B57, $456,000 (29.6 percent) with Alternative 4C57, and $463,000 (30.0 percent) for Alternative 4D57 (Figures 9a and 9b).

An unexpected finding of the simulation analysis was that proposed Alternatives 3A57, 3B57, 3C57, 3D57, 4A57, 4B57 and 4D57 would increase catches of red grouper and other species during the fourth calendar quarter of the year compared to the status quo (Figure 10). The predicted effects of Amendment 16 are included in the status quo baseline for Amendment 17A. Amendment 16 specifies a commercial quota for gag, with the additional provision that the entire shallow water grouper fishery will be closed when the quota for gag is filled. The simulation analysis for Amendment 17A predicts that the proposed restrictions on the harvest of red snapper and other species in the snapper-grouper unit, including gag, would enable the fishery for shallow water groupers to remain open longer than with Amendment 16 only. Therefore, while the commercial fishery still would land its quota for gag, landings of red grouper and other shallow water groupers and species commonly caught with them could be greater than with the status quo. One implication of this prediction is that a longer open season for shallow water groupers would partially offset the overall losses that normally would be expected from the proposed alternatives for red snapper.

Figure 10. Predicted changes in net operating revenues by calendar quarter for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A.



Fishermen in North Carolina would be the primary beneficiaries of a longer season for red grouper and other shallow water groupers. Net operating revenues for fishermen in North Carolina are predicted to increase by about 11 percent with Alternatives 3A57, 3B57, 3C57 and 3D57, and by about 7 percent with Alternatives 4A57, 4B57, 4C57 and 4D57, provided that the shallow water grouper fishery remains open longer than with the status quo alternative (Figures 9a and 9b). Net operating revenues for fishermen in South Carolina also are predicted to increase with Alternatives 3A57, 3B57, 3C57, and 3D57 because these alternatives would not close areas off the coast of South Carolina.

Net operating revenues are expected to decline for all gear types with Alternative 2, for all gear types except black sea bass pots given Alternatives 3A57, 3B57, 3C57 and 3D57, and for all gear types except black sea bass pots and spearfishing gear given Alternatives 4A57, 4B57, 4C57 and 4D57 (Figures 11a and 11b). However, trips with vertical lines would incur almost all of the expected reductions in net operating revenues because this is the primary gear used in the commercial snapper-grouper fishery.

Figure 11a. Predicted changes in net operating revenues by gear type for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A.

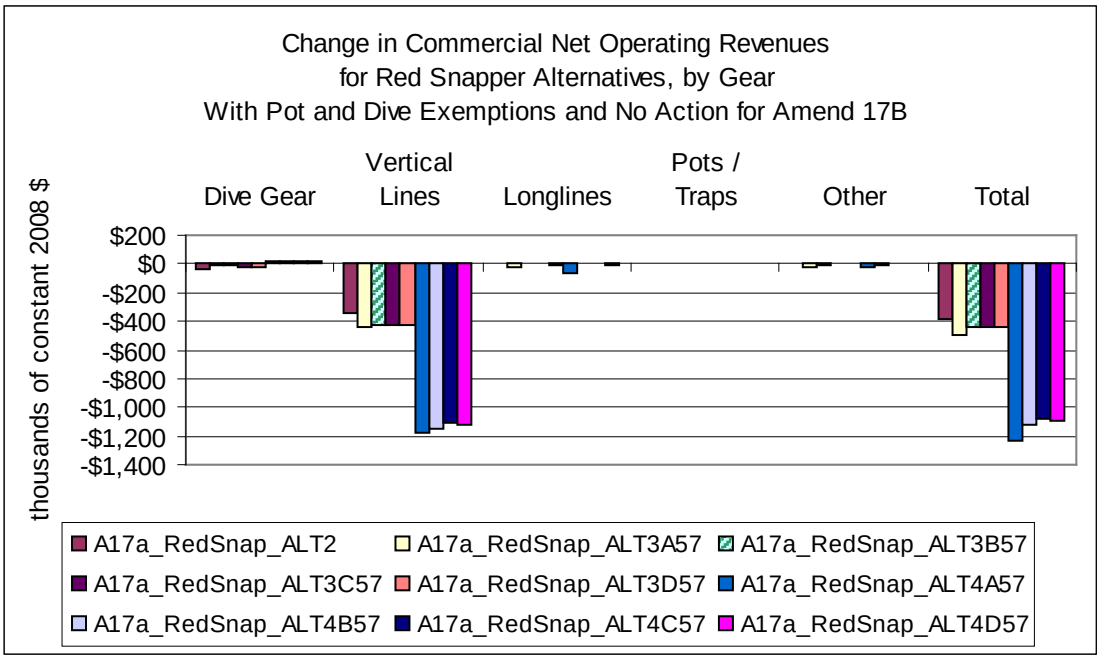
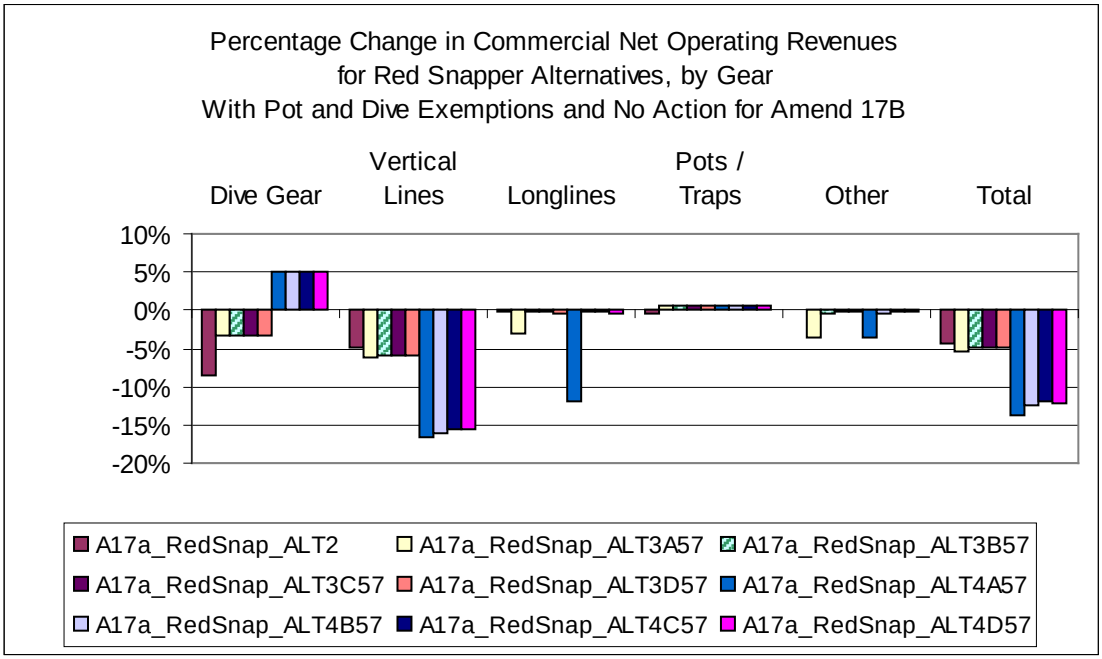


Figure 11b. Predicted percentage changes in net operating revenues by gear type for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A.



Gear exemptions are expected to mitigate the economic effects of the alternatives because some fishing activity would be exempt from the proposed closures. The exemption for black sea bass pots (Alternative 5) is small because most pot fishing occurs in fishing areas that would not be affected by the proposed closures. When compared to the effects of the same alternatives without the gear exemption, the expected benefit of an exemption for pots is approximately $14,000 for Alternatives 4A and 4B, and about $3,000 for the deeper waters associated with Alternatives 4C and 4D. When compared to the status quo alternative, the net effect of an exemption for pots is a small gain for fishermen with black sea bass pots (Figures 11a and 11b). There is virtually no benefit for Alternatives 3A, 3B, 3C or 3D because the fishery for pots primarily occurs in South Carolina and North Carolina rather than Georgia and northeast Florida.

The exemption for longlines in waters deeper than 300 feet (Alternative 6) applies only to Alternatives 3A and 4A because the other alternatives would prohibit fishing only in waters shallower than 300 feet. The simulation analysis found that an exemption for longlines could be either positive or negative for the conditions associated with individual fishing years, with the outcome dependent on whether an exemption would increase landings of tilefish quickly enough to trigger the lower 300 pound trip limit on September 1 of each year.[7] If the 300 pound trip limit is triggered, then total landings of tilefish

[7] The commercial fishery for golden tilefish is managed with an annual quota and a 4,000 pound trip limit. The trip limit is reduced to 300 pounds after 75% of the quota is taken, but only if this occurs on or before September 1.

could be less than without an exemption for longlines and the full trip limit of 4000 pounds for tilefish. This possibility occurred in the simulation analysis for Alternative 3A with conditions that prevailed in 2006. When compared to the same alternatives without the gear exemption, the expected benefit of an exemption for longlines would be approximately $14,000 for Alternative 3A and $63,000 for Alternative 4A. An exemption for longlines is not one of the Council's preferred alternatives, and trips with longlines are expected to incur reductions in net operating revenues of approximately 11.9 percent with Alternative 4A57 (Figures 11a and 11b).

The potential benefit of a gear exemption is greatest for spearfishing gear (Alternative 7), and is expected to add an average of approximately $32,000 for Alternatives 3A and 3B, and $235,000 for Alternatives 4A and 4B when compared with alternatives without gear exemptions. The potential benefit of an exemption for spearfishing gear is smaller for alternatives that restrict fishing in deeper depths where commercial diving is less common: about $19,000 for Alternatives 3C and 3D and $205,000 for Alternatives 4C and 4D. When compared to the status quo alternative, the net effect of the exemption is a small reduction in net operating revenues for spearfishing gear with Alternatives 3A57, 3B57, 3C57 and 3D57, and a small gain in net operating revenues with Alternatives 4A57, 4B57, 4C57 and 4D57 (Figures 11a and 11b). The simulation analysis found that an exemption for spearfishing gear could be either positive or negative for the conditions associated with individual fishing years, with the outcome dependent on the length of the commercial fishing season for shallow water groupers.[8] The economic effect could be negative if there was a longer open season for shallow water groupers without the exemption. This possibility occurred in the simulation analysis for Alternatives 3A, 3B, 3C and 3D with conditions that prevailed in 2007.

Summary

This report described the results of a simulation model that calculated the expected economic effects of management alternatives proposed in Amendment 17A for the commercial snapper-grouper fishery. Ten management scenarios were simulated. The status quo baseline scenario assumed management conditions that were implemented recently by Amendment 16. The proposed alternatives all would prohibit the harvest and sale of red snapper, while alternatives 3A, 3B, 3C, 3D, 4A, 4B, 4C, and 4D also would prohibit the harvest and sale of other species in the snapper-grouper management unit based on conditions defined by water depth and area fished. Alternatives were evaluated given the preferred exemptions for black sea bass pots and spearfishing gear.

The analysis suggests that the proposed alternatives would reduce net operating revenues for the entire commercial snapper-grouper fishery by an overall average of between 4.3 percent for Alternative 2 and 13.7 percent for Alternative 4A57. However, red snapper are harvested primarily in northeast Florida and Georgia, and fishermen in these areas are

[8] The entire commercial fishery for shallow water groupers, including red grouper and black grouper, is closed from January through April and when the commercial ACL for gag is filled.

expected to incur reductions in net operating revenues that range from 25.7 percent with Alternative 2 up to 70.4 percent with Alternative 4A57. Although not discussed elsewhere in this report, losses in northeast Florida and Georgia would range up to 85 percent without the preferred exemptions for black sea bass pots and spearfishing gear. The costs associated with these management scenarios would be borne primarily by fishermen who use vertical line gear because it is the most frequently used gear in the fishery.

The finding that proposed alternatives for Amendment 17A could result in a longer open season for shallow water groupers and potential increases in net operating revenues for fishermen who land shallow water groupers during the longer open season is intriguing. However, the simulation model is based on historical fishing patterns and strategies, and fishermen probably will respond to Amendments 16 and 17A by redirecting some of their fishing activity to unrestricted areas and unrestricted depths. The redirected fishing effort may not be as productive and profitable, and hence the proposed alternatives in Amendment 17A probably will slow the rate at which gag are harvested. The simulation model probably overestimates the likelihood of a significantly longer season for shallow water groupers because it does not account for changes in fishing patterns as fishermen respond to Amendments 16 and 17A. Therefore, the predicted increases in net operating revenues during the fourth quarter probably are overestimated.

Finally, alternatives for the management of red snapper could interact with additional alternatives proposed in Amendment 17B that are not considered in these analyses. In particular, the proposed alternatives considered in Amendment 17A do not include any commercial quotas for red grouper or black grouper, while Amendment 17B proposes to limit the aggregate harvest of gag, red grouper and black grouper. The expected outcome is that the likelihood of a longer open season for shallow water groupers is smaller than predicted in this analysis, and that the potential increases in net operating revenues for fishermen who land shallow water groupers during the longer open season are overstated. The effects of both amendments considered simultaneously will be greater than presented in this report.

Appendix
Joint Analysis of Proposed Management Alternatives in Amendments 17A and 17B
for the Commercial Snapper-Grouper Fishery

Snapper-grouper Amendment 17B is being developed simultaneously with Amendment 17A, and preferred alternatives have been selected to set annual catch limits (ACLs) for speckled hind and warsaw grouper, golden tilefish, and red grouper and black grouper. See Appendix Table 1.

If Amendment 17B is implemented, annual catch limits will be set to zero for speckled hind and warsaw grouper. In addition, the harvest, possession and sale of snowy grouper, yellowedge grouper, misty grouper, blueline tilefish, queen snapper, and silk snapper will be prohibited in waters deeper than 240 feet as a means of minimizing the incidental catch and discard of speckled hind and warsaw grouper. See model *A17b_SpHind_ALT4* in Appendix Table 1.

If implemented, the total allowable catch for golden tilefish will be redefined in terms of Foy rather than Fmsy. Furthermore, the commercial allocation will be formally established as 97 percent of total allowable catch. The result will be a reduction in the commercial ACL from 295,000 pounds (gutted weight) to 282,819 pounds. See model *A17b_Tilefish_alloc3_ACL2* in Appendix Table 1.

If implemented, an aggregate catch limit of 662,403 pounds (gutted weight) will be established for gag, red grouper and black grouper. The commercial fishery for shallow water groupers will be closed when either the individual ACL for gag (353,940 pounds) or the aggregate ACL for gag, red grouper and black grouper is reached. See model *A17b_RedGrouperACL_ALT2b* in Appendix Table 1.

Appendix Table 1. Preferred alternatives in snapper-grouper Amendment 17B for the management of speckled hind, golden tilefish, and red grouper. (This table paraphrases rather than includes a verbatim statement of alternatives from Amendment 17B.)

Model Name	*Description*
A17b_SpHind_ALT4	*Alternative 4 (Preferred)*: Establish an ACL = 0 for speckled hind and warsaw grouper. Prohibit all commercial and recreational fishing for, possession, and retention of speckled hind and warsaw grouper. Prohibit all fishing for, possession, and retention of snowy grouper, yellowedge grouper, misty grouper, blueline tilefish, queen snapper, and silk snapper beyond a depth of 240 feet (40 fathoms; 73 m).
A17b_Tilefish_alloc3_ACL2	*Allocation Alternative 3 and ACL Alternative 2 (Preferred)*: The total allowable catch would be determined at the Foy level of 291,566 lbs gw. The commercial ACL would be 282,819 lbs gw based on a commercial allocation of 97 percent. Prohibit harvest, possession, retention and sale of golden tilefish when the quota is met. Retain existing trip limits.
A17b_RedGrouperACL_ALT2b	*Alternative 2b (Preferred)*: Retain the current commercial ACL for gag of 353,940 lbs gw and establish an aggregate commercial ACL for gag, red grouper and black grouper of 662,403 lbs gw. The commercial fishery for shallow water groupers, including red grouper and black grouper, is closed from January through April and when the commercial ACL for gag is filled or when the aggregate ACL for gag, red grouper and black grouper is filled. Retain the existing 12 inch minimum size limit for red grouper and 24 inch minimum size limit for black grouper.

Simultaneous Effects of Amendments 17A and 17B

The predicted economic effects for the simultaneous evaluation of proposed management measures for red snapper in Amendment 17A and the preferred alternatives for Amendment 17B appear in Appendix Table 2. The *additional* reductions in net operating revenues due to the preferred alternatives for Amendment 17B range from approximately $392,000 (an extra 4.3 percent) for Alternative 4A57 to $506,000 (an extra 5.6 percent) for Alternative 3C57. The baseline was defined by average conditions from 2006-2008, given the expected effects of Amendment 16.

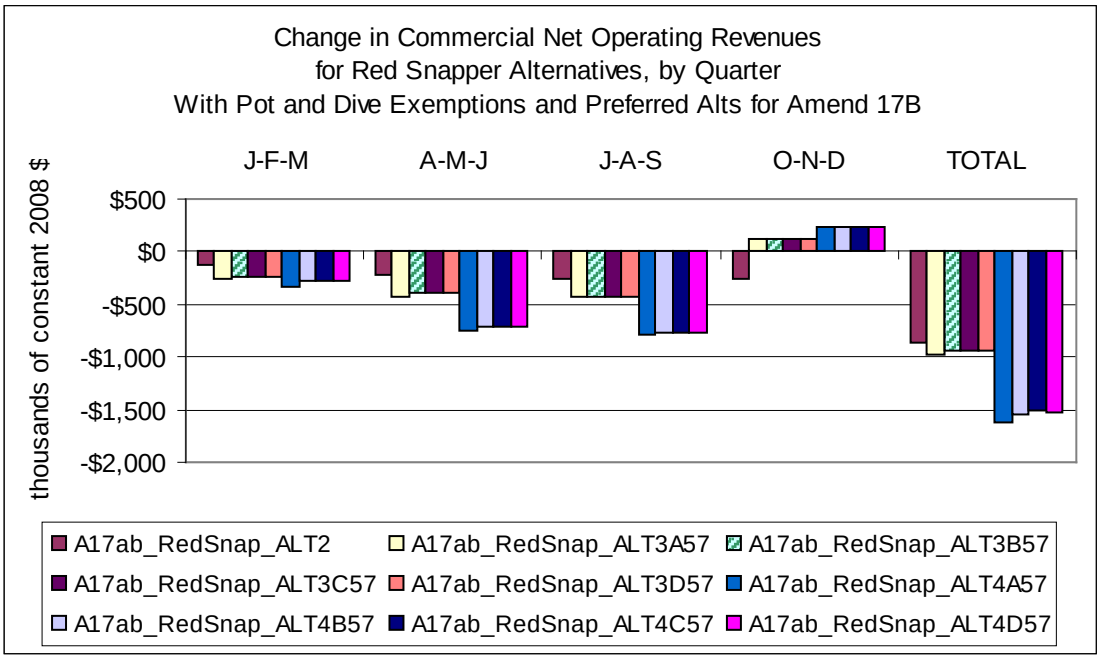
Appendix Table 2. Predicted economic effects of proposed management measures for red snapper in Amendment 17A given (a) status quo (no action) for Amendment 17B and (b) Preferred Alternatives for Amendment 17B. Economic effects are measured in terms of net operating revenues for commercial trips reported to the SEFSC fishery logbook system.

	Amendment 17A and No Action for Amendment 17B (thousands of constant 2008 $)		Amendment 17A and Preferred Alternatives for Amendment 17B (thousands of constant 2008 $)		Additional Reductions in Net Operating Revenues due to the Preferred Alternatives for Amendment 17B	
BASELINE (simulated conditions with Amendment 16)	$9,017	100%	$9,017	100%	$9,017	100%
Proposed alternative in Amendment 17A	Change from baseline	Percentage change from baseline	Change from baseline	Percentage change from baseline	Change from baseline	Percentage change from baseline
A17a_RedSnap_ALT2	-$390	-4.3%	-$859	-9.5%	-$469	-5.2%
A17a_RedSnap_ALT3A57	-$489	-5.4%	-$978	-10.9%	-$490	-5.4%
A17a_RedSnap_ALT3B57	-$444	-4.9%	-$947	-10.5%	-$503	-5.6%
A17a_RedSnap_ALT3C57	-$438	-4.9%	-$943	-10.5%	-$506	-5.6%
A17a_RedSnap_ALT3D57	-$445	-4.9%	-$947	-10.5%	-$502	-5.6%
A17a_RedSnap_ALT4A57	-$1,235	-13.7%	-$1,626	-18.0%	-$392	-4.3%
A17a_RedSnap_ALT4B57	-$1,125	-12.5%	-$1,547	-17.2%	-$422	-4.7%
A17a_RedSnap_ALT4C57	-$1,081	-12.0%	-$1,511	-16.8%	-$431	-4.8%
A17a_RedSnap_ALT4D57	-$1,095	-12.1%	-$1,521	-16.9%	-$425	-4.7%

Amendment 17B is not expected to have a large effect on commercial landings of red snapper. If Amendment 17A were never implemented, Amendment 17B would be expected to reduce landings of red snapper by an extra 1 percent compared to regulatory conditions with Amendment 16. However, the preferred alternatives in Amendment 17B would affect landings of other species in the snapper-grouper management unit, especially the shallow water groupers.

The aggregate ACL on the harvest of gag, red grouper and black grouper in Amendment 17B would dampen the prediction in the analysis of Amendment 17A of a longer season for shallow water groupers, and would limit the ability of fishermen to benefit from a longer open season by harvesting larger quantities of red grouper, black grouper and other shallow water groupers given the alternatives proposed in Amendment 17A. When Amendments 17A and 17B are considered jointly, the open season for shallow water groupers still is predicted to last longer than with Amendment 16, but would close sooner than if the ACL had not been specified in Amendment 17B. Therefore, the expected increase in net operating revenues during the fourth quarter will not be as large as was predicted in the analysis of Amendment 17A given the status quo for Amendment 17B, and the overall losses due to the alternatives in Amendment 17A will be larger than originally predicted. Compare Figure A1 with Figure 10.

Figure A1. Predicted changes in net operating revenues by calendar quarter for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A, given preferred Alternatives for Amendment 17B.



The effect of the aggregate ACL would have a greater effect on net operating revenues for Alternatives 3A57, 3B57, 3C57 and 3D57 than for Alternatives 4A57, 4B57, 4C57 and 4D57, primarily in South Carolina, North Carolina and the Florida Keys. The consideration of preferred alternatives in Amendment 17B did not appear to add significantly to the predicted economic effects of the alternatives on fishermen in northeast Florida and Georgia, and had only small effects on fishermen in central and southeast Florida. Compare Figures A2a and A2b with Figures 9a and 9b.

The snapper-grouper fishery would not be closed off the coast of South Carolina with Alternatives 3A57, 3B57, 3C57 and 3D57, but would be closed with Alternatives 4A57, 4B57, 4C57 and 4D57. Consequently, net operating revenues for fishermen in South Carolina were expected to increase by between 7.0 and 7.9 percent with Alternatives 3A57, 3B57, 3C57 and 3D57 given the status quo for Amendment 17B, and were expected to decline by between 29.6 and 34.5 percent with Alternatives 4A57, 4B57, 4C57 and 4D57. After accounting for the effects of the preferred alternatives for Amendment 17B, net operating revenues are expected to remain relatively unchanged with Alternatives 3A57, 3B57, 3C57 and 3D57, and are expected to decline by between 32.5 and 36.4 percent with Alternatives 4A57, 4B57, 4C57 and 4D57.

Based on the prediction of a longer open season for shallow water groupers, net operating revenues for fishermen in North Carolina were predicted to increase by approximately 11 percent for Alternatives 3A57, 3B57, 3C57 and 3D57 and by 7 percent for Alternatives 4A57, 4B57, 4C57 and 4D57 given the status quo for Amendment 17B. However, after accounting for the effects of preferred alternatives for Amendment 17B, net operating revenues for fishermen in North Carolina are expected to increase by approximately 1.5 percent for Alternatives 3A57, 3B57, 3C57 and 3D57, and are expected to decline by slightly more than 2 percent with Alternatives 4A57, 4B57, 4C57 and 4D57.

Similarly, fishermen in the Florida Keys were predicted to be relatively unaffected by proposed regulations in Amendment 17A. However, the proposed aggregate ACL for shallow water groupers would result in a reduction in net operating revenues of slightly less than 5 percent for Alternatives 3A57, 3B57, 3C57 and 3D57 and approximately 4 percent for Alternatives 4A57, 4B57, 4C57 and 4D57.

Amendment 17B would prohibit the harvest of snowy grouper, other deep water groupers and blueline tilefish in waters deeper than 240 feet, and would have overridden the effects of an exemption for longlines in waters deeper than 300 feet (except for golden tilefish) had it been a preferred alternative for Amendment 17A. The preponderance of economic losses due to Amendments 17A and 17B still would be incurred by fishermen that use vertical line gear because that is the most widely used gear in the fishery. However, the losses expected for fishermen with bottom longline gear are greater both in dollar and percentage terms than when the expected effects of Amendment 17B are not considered. Compare Figure A3a with Figure 11a and Figure A3b with Figure 11b.

Figure A2a. Predicted changes in net operating revenues by state of landing for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A, given preferred alternatives for Amendment 17B.

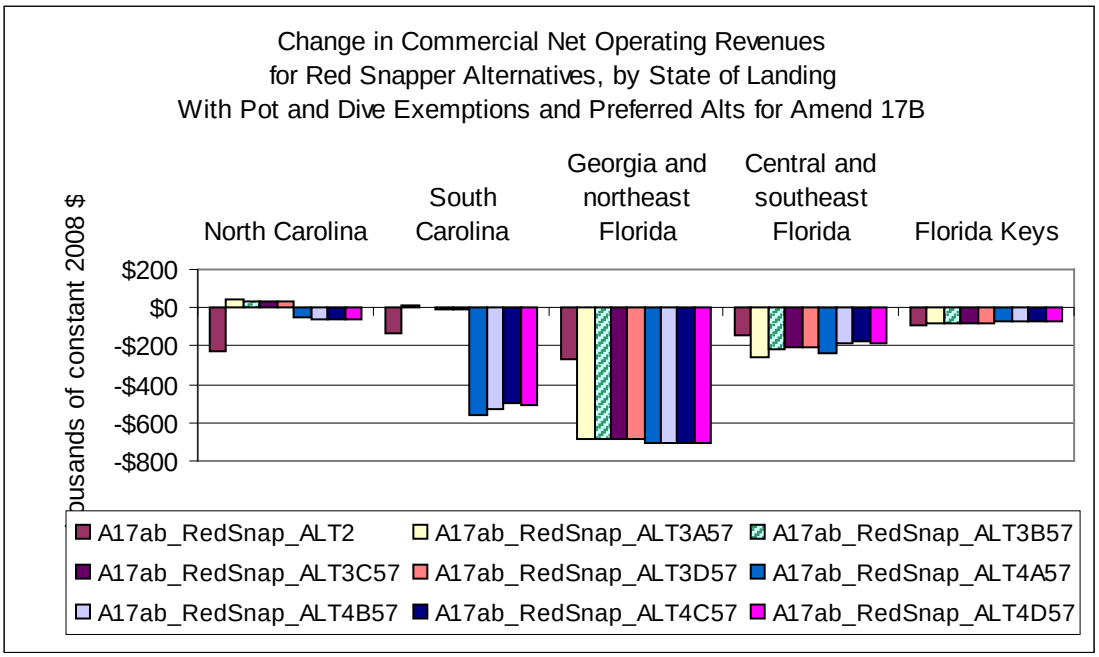


Figure A2b. Predicted percentage changes in net operating revenues by state of landing for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A, given preferred alternatives for Amendment 17B.

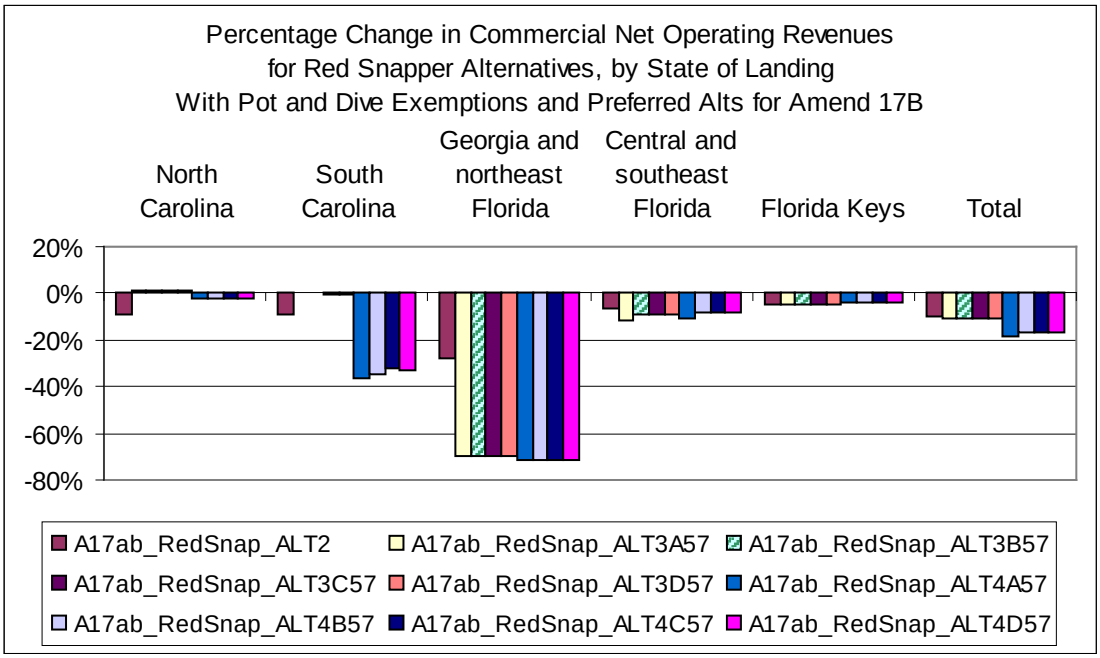


Figure A3a. Predicted changes in net operating revenues by gear type for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A, given preferred alternatives for Amendment 17B.

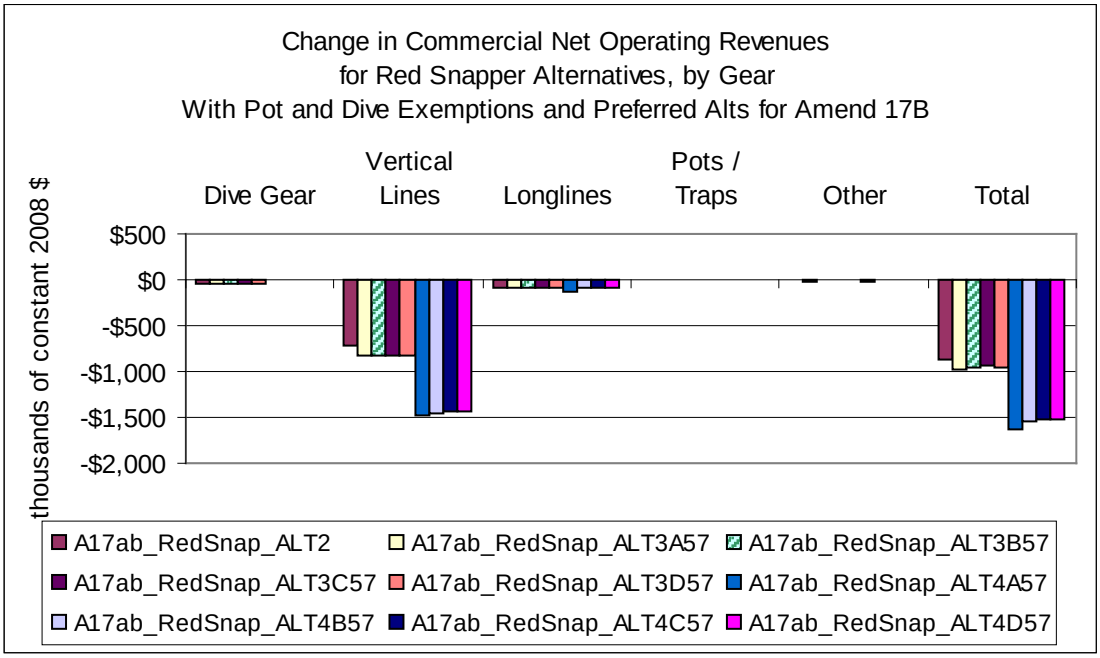
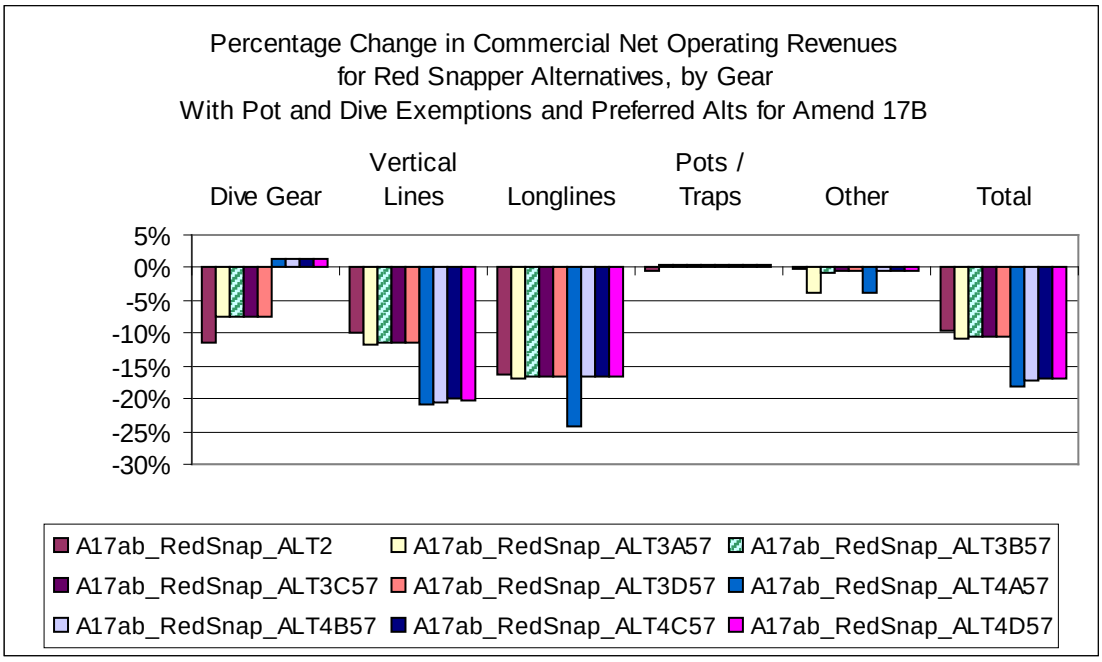



Figure A3b. Predicted percentage changes in net operating revenues by gear type for red snapper alternatives compared to the status quo (no action) alternative for Amendment 17A, given preferred alternatives for Amendment 17B.