Economic Analysis of Proposed Management Alternatives in Amendment 24 for the Commercial Snapper-Grouper Fishery

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Introduction

The red grouper (*Epinephelus morio*) resource within the jurisdiction of the South Atlantic Fishery Management Council (Council) has been determined to be experiencing overfishing and to be overfished (SEDAR 19 2010). A four month spawning season closure for red grouper as well as black grouper, gag, and other shallow water groupers was implemented by the NOAA Fisheries Service on July 29, 2009. The closure may be sufficient to limit landings to below the annual catch limit. However, due to the current status of the red grouper stock the Council and the NOAA Fisheries Service are required by law to implement a rebuilding plan. The primary purpose of Amendment 24 to the Fishery Management Plan for the Snapper Grouper Fishery (Amendment 24) is to implement the rebuilding plan for red grouper. The measurement actions proposed in Amendment 24 will fulfill this requirement and include a range of alternatives covering maximum sustainable yields, minimum stock size thresholds, rebuilding schedules, rebuilding strategies and acceptable biological catch levels, allocations, and annual catch limits and optimum yields.

This report describes the results of a simulation model that calculated the expected economic effects of the proposed management alternatives in Amendment 24 for the commercial snapper-grouper fishery from North Carolina through the Atlantic side of the Florida Keys. This report includes an evaluation of proposed actions involving alternative rebuilding schedules, rebuilding plans, and allocations. Results are presented as projected simulations based on trip-level logbook data from 2005-2009.

Method of Analyzing Economic Effects of Proposed Management Alternatives

Fishers 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. These logbook trip reports from 2005-2009 constitute the source of data used in this analysis.

The simulation model uses logbook trip reports to predict the short-term economic effects of proposed management alternatives.[1] 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 2005-2009, and the five-year average of simulated results is interpreted as the expected annual outcome of proposed regulations.

[1] The simulation model is described in more detail in Waters, James R. July 2008. An Economic Model to Analyze Management Alternatives Proposed for the Commercial Fishery in Amendment 16 to the Snapper-Grouper Fishery Management Plan. NOAA National Marine Fisheries Service, Southeast Fisheries Science Center, 14p.

The five-year average is used so that short-term anomalies that may have affected fishing success in any one year will be averaged out. The simulated average annual fishing income net of trip costs including labor for the proposed alternatives is compared to the no-action alternative to estimate the expected economic effects on commercial fishers. This net income calculation will henceforth be referred to as *net operating revenues*.

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, other supplies, and the opportunity cost of labor, and exclude fixed costs. Therefore, net operating revenues represent the return to fixed factors of production and the boat owner. Net operating revenues were adjusted to constant 2009 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 fishers, and are available in sufficient detail to analyze and compare the proposed alternatives. The disadvantages are that logbook data reflect fishing patterns and strategies given regulations that will no longer apply, and the model only predicts short-run behavior of fishers. In reality, fishers will likely modify their fishing patterns and strategies to minimize the effects of new regulations, but the simulation model does not account for these changes. Furthermore, long-run projections by the model are driven by changes in biological and regulatory parameters such as biomass projections and proposed annual catch limits. Therefore, the model 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 No-Action Alternative for Action 4

The objective of this analysis is to predict the change in economic effects associated with implementation of Amendment 24. It accomplishes this objective by comparing the predicted outcomes of simulations given proposed regulations for Amendment 24 with the predicted outcome of simulations for the no-action alternative. For purposes of this analysis, the no-action alternative for Action 4 (alternative rebuilding paths) is defined by

the predicted outcomes of rules specified in Amendments 13C, 15A, 16, 17A, 17B, Regulatory Amendment 10, and the Comprehensive ACL Amendment in conjunction with the preferred alternatives in Actions 5-7 of Amendment 24. The preferred alternatives from Actions 5-7 are a 45% commercial allocation (Action 5, Alternative 2, Subalternative 2e), proposed commercial and recreational ACLs equal to their respective ABCs (Action 6, Alternative 2), and no commercial sector ACT (Action 7, Alternative 2, Subalternative 2a). The no-action alternative for Action 5 (alternative sector allocations) is also defined by the predicted outcomes of rules specified in Amendments 13C, 15A, 16, 17A, 17B, Regulatory Amendment 10, and the Comprehensive ACL Amendment; however, only the preferred alternatives from Actions 6 and 7 of Amendment 24 are incorporated into the analysis. Additionally, we assume that Alternative 2 of Action 4 is implemented to simplify the comparison of different allocation strategies.

The effects of proposed regulations in Amendment 24 are compared to the simulated effects of Amendments 13C, 15A, 16, 17A, 17B, and the Comprehensive ACL Amendment (along with preferred alternatives from Amendment 24) rather than to observed fishery landings and revenues because historical data for 2005-2009 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 along with seasonal closures. Amendment 17A prohibits the harvest and possession of red snapper while Regulatory Amendment 10 rescinded proposed area closures. Amendment 17B established ACLs and AMs for nine major snapper-grouper species and established deepwater closures for deepwater snapper-grouper species. The Comprehensive ACL Amendment establishes ACLs and AMs for snapper-grouper species not listed as undergoing overfishing as well as dolphin, wahoo, and golden crab. Although this amendment has not yet been passed by the Council we utilized the preferred ACLs for black grouper in the simulation model.

Figure 1 illustrates the projected net operating revenues using simulated fishery landings for the regulatory period (2011-2020) that comprise the no-action alternative for the proposed rebuilding plans in Action 4 of Amendment 24. In the simulations for Action 4 we set the commercial allocation to 45% of the ABC. This rule represents the preferred alternatives in Actions 5-7. Table 1 shows the net present value of future cash flows of net operating revenues under the no-action alternative for Action 4 of Amendment 24 with alternative discount rates assumed for time horizons of seven and ten years.

Figure 1. Projected net operating revenues (millions of 2009 dollars) for the regulatory period (2011-2020) that comprise the no-action alternative for Action 4 of Amendment 24.

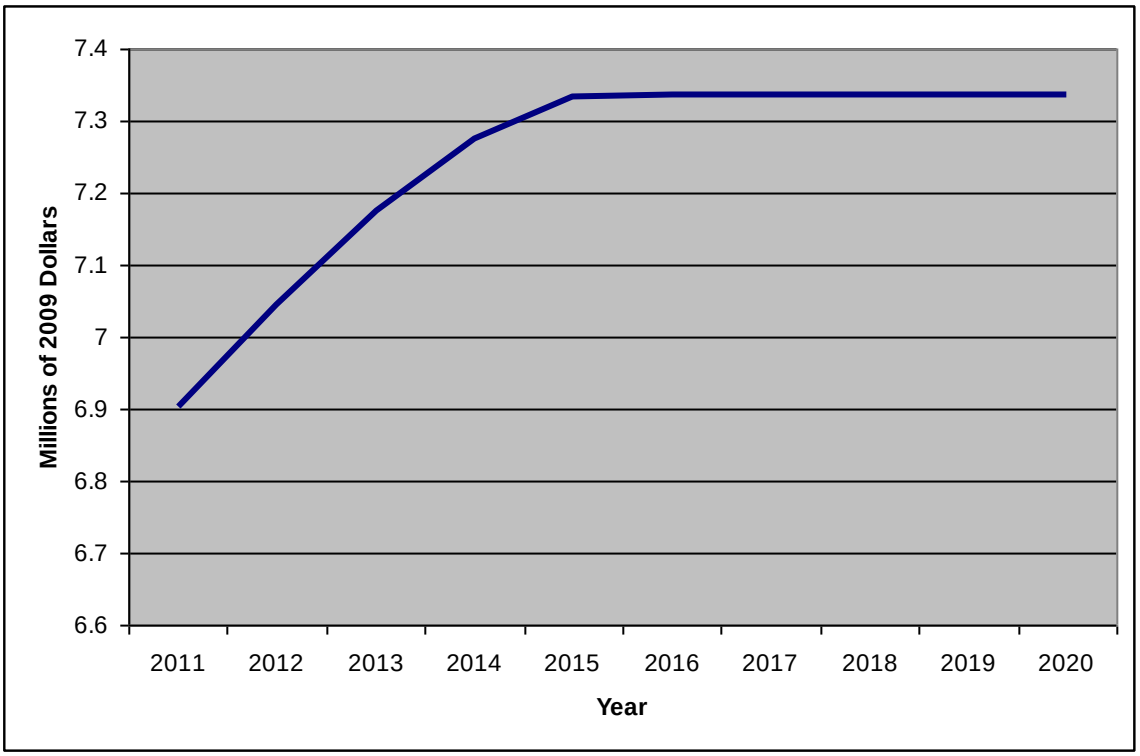

Table 1. Projected net present value (NPV) of future flows of net operating revenues (NOR) (millions of 2009 dollars) that comprise the no-action alternative for Action 4 of Amendment 24 with alternative discount rates assumed for time horizons of seven and ten years.

Time Horizon	NPV of Future Flows of NOR under Alternative Discount Rates (millions of 2009 dollars)			
	0%	3%	7%	10%
7 Years	$50.40	$44.80	$38.70	$34.91
10 Years	$72.41	$61.68	$50.68	$44.28

Economic Effects of Proposed Management Measures for Red Grouper in Action 4

Table 2 lists the management alternatives associated with Action 4 that are proposed in Amendment 24. Alternative 1 is the no-action alternative and reflects regulations currently in place for the snapper-grouper fishery along with preferred alternatives in Actions 5-7 from Amendment 24. Alternatives 2-6 all would implement a rebuilding plan for red grouper. The Council is considering a range of rebuilding strategy alternatives that define the maximum fishing mortality rate throughout the rebuilding timeframe. Each alternative is associated with a projected yield stream with a 70%

probability of rebuilding success within the allotted rebuilding time periods (i.e, seven, eight, or ten years).

Table 2. Rebuilding strategy alternatives proposed in Action 4 of Amendment 24 for the management of commercial fishing activity for red grouper. Reproduced from Draft Amendment 24 (May 2011).

Alternatives	Rebuilding strategy (F_{OY} Equal To)		ABC (lbs whole weight) *Landings and Discards*	ABC (lbs whole weight) *Landings*
	Scenario	**F rate**		
Alternative 1 (No Action)	$F_{45\%SPR}$		Not specified	Not specified
Alternative 2	$F_{REBUILD}$ (10 years)	0.181	665,000 (2011) 737,000 (2012) 806,000 (2013) 866,000 (2014)	622,000 (2011) 693,000 (2012) 762,000 (2013) 822,000 (2014)
Alternative 3	$75\%F_{MSY}$	0.166	613,000 (2011) 687,000 (2012) 759,000 (2013) 821,000 (2014)	573,000 (2011) 647,000 (2012) 718,000 (2013) 780,000 (2014)
Alternative 4	$65\%F_{MSY}$	0.144	535,000 (2011) 610,000 (2012) 683,000 (2013) 749,000 (2014)	501,000 (2011) 575,000 (2012) 648,000 (2013) 713,000 (2014)
Alternative 5	$F_{REBUILD}$ (7 years)	0.157	583,000 (2011) 657,000 (2012) 730,000 (2013) 794,000 (2014)	545,000 (2011) 619,000 (2012) 691,000 (2013) 755,000 (2014)
Alternative 6	$F_{REBUILD}$ (8 years)	0.168	620,000 (2011) 695,000 (2012) 765,000 (2013) 828,000 (2014)	580,000 (2011) 654,000 (2012) 724,000 (2013) 787,000 (2014)

The results from the economic analysis for Action 4 are summarized in Tables 3-5. The net present values of changes in net operating revenues (NOR) to the commercial sector associated with the rebuilding strategy alternatives proposed in Action 4 are presented in Table 3. Table 3 organizes these changes into two separate time horizons, seven and ten years, for a range of discount rates from zero to ten percent. The choice of the

appropriate discount rate does not change the relative ranking of the alternatives but will change the magnitude of the net present value of future NOR streams. The projected NOR streams of the ten-year rebuilding strategies (i.e. Alternatives 2-4) created by the proposed ACLs and projected biomass figures were discounted over a period of seven and ten years to populate Table 3. Alternatives 5 and 6 have proposed rebuilding horizons of seven and eight years, respectively. Thus, to derive estimates for the ten year horizon for these alternatives we assumed the same biomass projections of the ten-year plans and kept ACLs constant from the last year of the proposed rebuilding plan through the tenth year.

The analysis suggests that from an industry-wide perspective Alternative 2 is economically superior to the other rebuilding strategy alternatives presented in Action 4. Alternatives 6 and 3 provide the second and third highest economic benefits, respectively. In Table 3 if we assume a discount rate of three percent then Alternative 2 is expected to generate an additional $450,000 over the first seven years of the rebuilding schedule relative to the no-action alternative with an additional $410,000 generated in years eight through ten. Over a time horizon of ten years with an assumed discount rate of three percent Alternative 2 is expected to generate at least $220,000 more than the next two best alternatives, which are Alternatives 6 and 3. The least favorable alternative to the commercial fleet is Alternative 4 which will result in a loss of about $20,000 relative to the no-action alternative in the first seven years of the rebuilding plan assuming a discount rate of three percent (Table 3).

The anticipated economic effects of the projected increase in red grouper landings are relatively small compared to the size of the snapper-grouper fishery as a whole. Over ten years, the predicted increase in NOR due to red grouper landings relative to all landings on trips that catch at least one pound of snapper-grouper species ranges from 0.3% (Alternative 4) to 1.4% (Alternative 2) assuming a discount rate of three percent. Another interesting trend from Table 4 is the relative increase in NOR from years eight through ten are much larger than those for the first seven years of each of the rebuilding plans. This phenomenon is driven by the projected increase in biomass during those years as the ACLs are held constant after year four. This is a preliminary conclusion at best as the simulation model is best suited for short-term predictions.

Table 3. Net present value of changes in net operating revenues (NOR) to the commercial sector associated with the rebuilding strategy alternatives in Action 4 over time horizons of seven and ten years, assuming ACL=ABC, 45% commercial allocation, no commercial sector ACT, and using different discount rates. Dollar amounts are in million 2009 dollars.

Rebuilding Strategy and Discount Rate	**7-Year Horizon**					**10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Change in NOR	$0.54	$0.36	$0.01	$0.24	$0.39	$1.07	$0.78	$0.26	$0.57	$0.82
% Change in NOR	1.1%	0.7%	0.0%	0.8%	0.8%	1.5%	1.1%	0.4%	0.8%	1.1%

Rebuilding Strategy and Discount Rate	**7-Year Horizon**					**10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	$0.45	$0.29	$(0.02)	$0.19	$0.32	$0.86	$0.61	$0.17	$0.44	$0.64
% Change in NOR	1.0%	0.6%	0.0%	0.4%	0.7%	1.4%	1.0%	0.3%	0.7%	1.0%

Rebuilding Strategy and Discount Rate	**7-Year Horizon**					**10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Change in NOR	$0.36	$0.22	$(0.05)	$0.13	$0.24	$0.64	$0.44	$0.09	$0.31	$0.47
% Change in NOR	0.9%	0.6%	-0.1%	0.3%	0.6%	1.3%	0.9%	0.2%	0.6%	0.9%

Rebuilding Strategy and Discount Rate	**7-Year Horizon**					**10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Change in NOR	$0.30	$0.17	$(0.06)	$0.9	$0.19	$0.52	$0.35	$0.04	$0.23	$0.38
% Change in NOR	0.9%	0.5%	-0.2%	0.3%	0.6%	1.2%	0.8%	0.1%	0.5%	0.9%

The changes in the net present values of NOR by state of landing to the commercial sector associated with the various rebuilding alternatives in Action 4 are presented in Table 4. Table 4 organizes these changes into three separate time horizons: seven, eight, and ten years, with an assumed discount rate of three percent. The projected NOR streams of the ten-year rebuilding strategies (i.e Alternatives 2-4) created by the proposed ACLs and projected biomass figures were discounted over a period of ten year periods while NOR streams associated with Alternatives 5 and 6 were discounted over a period of seven and eight years, respectively.

The information at the state-level provides more insight into which rebuilding strategy would be preferable. In the state-level analysis each rebuilding alternative is evaluated within its proposed time frame. Alternatives 2-4 are evaluated over a period of ten years while alternatives 5 and 6 are evaluated over a time horizon of seven and eight years, respectively. Thus, the change in NOR reported in the table should not be compared across alternative since the time frames are different. However, the percentage change is comparable across rebuilding alternatives as this statistic is a relative measure of the change in NOR associated with each alternative and a comparable baseline estimate under the same time horizon.

Again, Alternative 2 is economically superior to the other alternatives due to the amount of additional NOR that is expected to be generated in a particular time horizon. Also, in all cases fishers who land their catch in North Carolina are expected to benefit the greatest relative to fishers in other states. Only fishers in South Carolina are expected to lose NOR ranging from $143,000 over a horizon of ten years (Alternative 4) to $17,000 over the same time period (Alternative 3). The only rebuilding schedule alternative that generates positive NOR over time for fishers who land their catch in South Carolina is Alternative 2 where predicted NOR is expected to increase by $54,000. This reinforces that Alternative 2 is not only globally (i.e. industry-wide) superior from an economic perspective but also regionally superior. It also suggests that at least from a geographical perspective Alternative 2 is the only *Pareto efficient* alternative. In other words, from a regional perspective it is the only rebuilding strategy that makes all constituents better off without making anybody worse off. This is strong evidence from an economic perspective about the superiority of Alternative 2 to the other alternatives. Finally, fishers in Georgia and Florida are predicted to only receive relatively minor benefits from the proposed rebuilding plans. The most generated by these fishers would be $54,000 by central south Florida boats under Alternative 2.

The changes in the net present values of NOR by primary gear type to the commercial sector associated with the rebuilding strategy alternatives proposed in Action 4 are presented in Table 5. We define the primary gear for a trip as that which produced a plurality of revenues on a trip. The vertical line sector includes all hook and line gear including handlines, electric and bandit gears, and troll lines. The diving sector includes both spears and powerhead gear. Fishers primarily using other gears (except for traps) are projected to not be affected by the red grouper legislation. The table organizes these changes into three separate time horizons, seven, eight, and ten years, with an assumed

discount rate of three percent. The projected NOR streams of the ten-year rebuilding strategies (i.e Alternatives 2-4) created by the proposed ACLs and projected biomass figures were discounted over a period of ten year periods while NOR streams associated with Alternatives 5 and 6 were discounted over a period of seven and eight years, respectively.

Table 4. Net present value of changes in net operating revenues (NOR) by state of landing to the commercial sector associated with the rebuilding strategy alternatives in Action 4 over time horizons of seven, eight, and ten years, assuming ACL=ABC, 45% commercial allocation, no commercial sector ACT, and assuming a discount rate of 3%. Dollar amounts are in thousand 2009 dollars.

Rebuilding Strategy and Discount Rate	**North Carolina – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**North Carolina - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$229	$413	$744	$579	$285	N/A	N/A
% Change in NOR	N/A	N/A	N/A	1.8%	2.9%	4.3%	3.3%	1.6%	N/A	N/A

Rebuilding Strategy and Discount Rate	**South Carolina – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**South Carolina - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$(69)	$(22)	$54	$(17)	$(143)	N/A	N/A
% Change in NOR	N/A	N/A	N/A	-0.9%	-0.2%	0.5%	-0.2%	-1.3%	N/A	N/A

Rebuilding Strategy and Discount Rate	**Georgia/NE Florida – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Georgia/NE Florida - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$17	$19	$25	$25	$24	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.4%	0.5%	0.5%	0.5%	0.5%	N/A	N/A

Rebuilding Strategy and Discount Rate	**Central and South Florida – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Central and South Florida - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$8	$11	$54	$13	$3	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.1%	0.1%	0.5%	0.1%	0.0%	N/A	N/A

Rebuilding Strategy and Discount Rate	**Florida Keys – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Florida Keys - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$4	$9	$25	$9	$5	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.0%	0.1%	0.5%	0.1%	0.0%	N/A	N/A

Table 5 suggests that most of the benefits from the rebuilding strategy alternatives will accrue to the vertical line fishers, especially those who utilize hook-and-line and bandit gears. Assuming a discount rate of three percent, Alternative 2 creates the most benefits totaling $830,000 to the vertical line sector, $22,000 to the diving sector, and $2,000 to the trap sector over a period of ten years. The rankings of the other alternatives are the same as the previous analyses above. Alternatives 3 and 6 are the next best alternatives, followed by Alternative 5. Alternative 6 accrues the least benefits.

Table 5. Net present value of changes in net operating revenues (NOR) by primary gear to the commercial sector associated with the rebuilding strategy alternatives in Action 4 over time horizons of seven, eight, and ten years, assuming ACL=ABC, 45% commercial allocation, no commercial sector ACT, and assuming a discount rate of 3%. Dollar amounts are in thousand 2009 dollars.

Rebuilding Strategy and Discount Rate	**Vertical Lines – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Vertical Lines - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$173	$409	$830	$591	$163	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.5%	1.1%	1.8%	1.3%	0.3%	N/A	N/A

Rebuilding Strategy and Discount Rate	**Diving – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Diving - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$10	$14	$22	$20	$10	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.4%	0.5%	0.6%	0.6%	0.3%	N/A	N/A

Rebuilding Strategy and Discount Rate	**Traps – 7 (Alt 5)- or 8 (Alt 6)-Year Horizon**					**Traps - 10-Year Horizon**				
	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Change in NOR	N/A	N/A	N/A	$3	$3	$2	$3	$1	N/A	N/A
% Change in NOR	N/A	N/A	N/A	0.1%	0.1%	0.1%	0.1%	0.0%	N/A	N/A

The No-Action Alternative for Action 5

Figure 2 illustrates the projected net operating revenues using simulated fishery landings for the regulatory period (2011-2020) that comprise the no-action alternative for the proposed allocation plans in Action 5 of Amendment 24. In the simulations for Action 5 we set the combined commercial and recreational allocations equal to the ABC. This rule represents the preferred alternatives in Actions 6-7. The status quo allocation rate was calculated at 44.465% to the commercial sector, which was based on historical data from the Accumulated Landings Database and was the rate used in Amendment 17B economic analyses. Additionally, for ease of comparison the *Pareto efficient* rebuilding strategy (Alternative 2) was assumed for the no-action Alternative 1 in Action 5. Table 6 shows the net present value of future cash flows of net operating revenues under the no-action alternative for Action 5 of Amendment 24 with alternative discount rates assumed for time horizons of seven, eight, and ten years.

Figure 2. Projected net operating revenues (millions of 2009 dollars) for the regulatory period (2011-2020) that comprise the no-action alternative for Action 5 of Amendment 24.

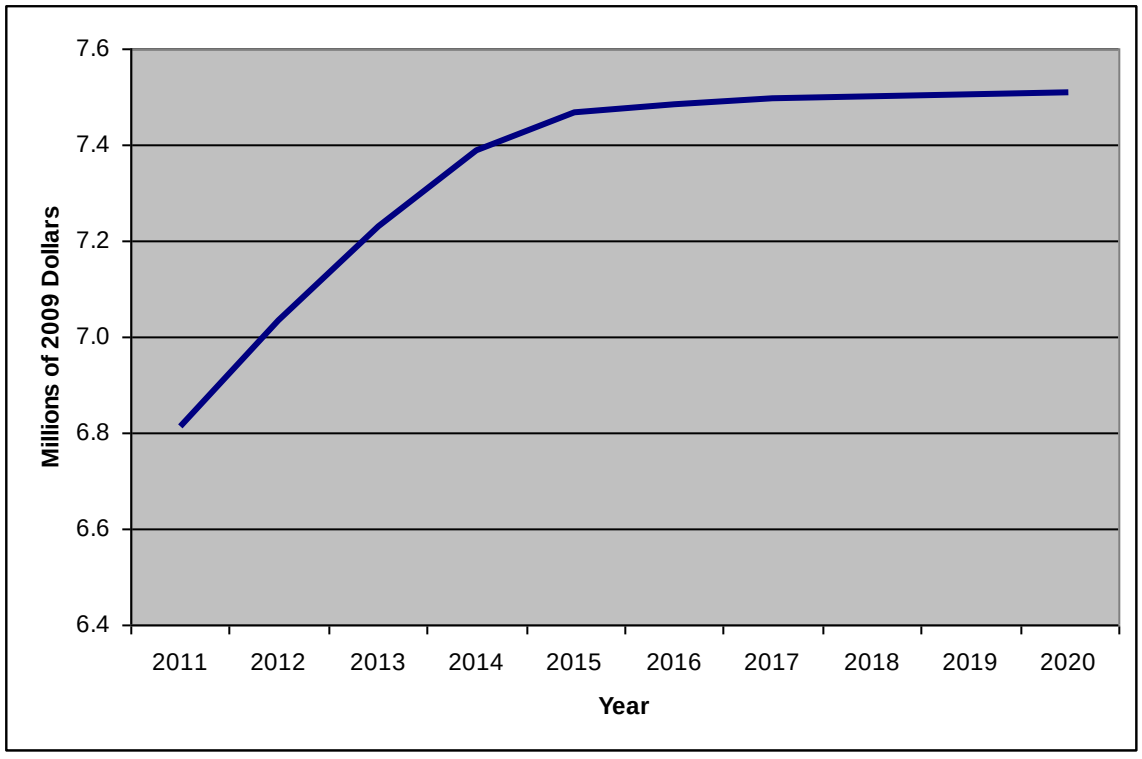

Table 6. Projected net present value (NPV) of future flows of net operating revenues (NOR)(millions of 2009 dollars) that comprise the no-action alternative for Action 5 of Amendment 24 with alternative discount rates assumed for time horizons of seven, eight, and ten years.

Time Horizon	NPV of Future Flows of NOR under Alternative Discount Rates (millions of 2009 dollars)			
	0%	3%	7%	10%
7 Years	$50.91	$45.23	$39.03	$35.19
8 Years	$58.41	$51.15	$43.39	$38.69
10 Years	$73.42	$62.48	$51.29	$44.76

The management alternatives associated with Action 5 that are proposed in Amendment 24 are listed below. Alternative 1 is the no-action alternative and reflects regulations currently in place for the snapper-grouper fishery along with preferred alternatives in Actions 6 and 7 from Amendment 24. The no-action allocation which was the implied allocation used in the analysis for Amendment 17B is 44.465% of red grouper landings to the commercial sector. Alternatives 2 and 3 propose alternative sector allocations of the red grouper ACL. Since the commercial allocations are the same for Alternatives 2 and 3 only results for Alternative 2 will be presented here.

Action 5: Allocations

Alternative 1 (No action). Do not establish a sector allocation of the red grouper annual catch limit (ACL).

Alternative 2 (Preferred). Specify allocations for the commercial and recreational sectors based on criteria as outlined in one of the following options below.

> **Subalternative 2a**. Commercial = 60% and recreational = 40% (Established by using catch history from 1986-2008).
>
> **Subalternative 2b**. Commercial = 67% and recreational = 33% (Established by using catch history from 1986-1998).
>
> **Subalternative 2c**. Commercial = 55% and recreational = 45% (Established by using catch history from 1999-2008).
>
> **Subalternative 2d**. Commercial = 43% and recreational = 57% (Established by using catch history from 2006-2008).
>
> **Subalternative 2e (Preferred)**. Commercial = 45% and recreational = 55% (Established by using 50% of catch history from 1991-2008 + 50% of catch history from 2006-2008).

Alternative 3. Specify allocations for the commercial, for-hire, and recreational sectors based on criteria as outlined in one of the following options below.

> **Subalternative 3a**. Commercial = 60%, for-hire = 28%, and recreational = 12% (Established by using catch history from 1986-2008).
>
> **Subalternative 3b**. Commercial = 67%, for-hire = 20%, and recreational = 13% (Established by using catch history from 1986-1998).
>
> **Subalternative 3c**. Commercial = 55%, for-hire = 34%, and recreational = 11% (Established by using catch history from 1999-2008).
>
> **Subalternative 3d**. Commercial = 43%, for-hire = 49%, and recreational = 8% (Established by using catch history from 2006-2008).
>
> **Subalternative 3e**. Commercial = 45%, for-hire = 28%, and recreational = 27% (Established by using 50% of catch history from 1991-2008 + 50% of catch history from 2006-2008).

Economic Effects of Proposed Management Measures for Red Grouper in Action 5

The results from the economic analysis for Action 5 are summarized in Table 7. The net present values of changes in NOR to the commercial sector associated with the allocation alternatives proposed in Action 5 are presented in table 7. Table 7 compares these changes across the rebuilding strategy alternatives proposed in Action 4 for various assumed discount rates. The projected NOR streams of the ten-year rebuilding strategies (i.e Alternatives 2-4) created by the proposed ACLs and projected biomass figures were discounted over a period of ten year periods while NOR streams associated with Alternatives 5 and 6 were discounted over a period of seven and eight years, respectively.

When the different allocation ratios are analyzed, once again Alternative 2 from Action 4 is economically superior compared to the other rebuilding strategies. It should be no surprise that predicted changes in the net present value of future NOR streams get larger as the commercial allocation increases; however, determining an optimal allocation rate is outside the scope of this analysis. Given the preferred option of Subalternative 2e, Alternative 2 from Action 4 again results in a best outcome of $50,000 NOR over ten years. This amount may not seem like much; however, the reader should be reminded that the no-action comparison assumes the implementation of the rebuilding strategy offered by Alternative 2. Essentially the negative NOR streams for the other rebuilding strategies under the preferred commercial allocation of 45% represent the relative economic superiority of the rebuilding strategy proposed in Alternative 2.

Table 7. Net present value of changes in net operating revenues (NOR) to the commercial sector associated with the various allocation alternatives in Action 5 over time horizons of seven, eight, and ten years, assuming ACL=ABC, no commercial sector ACT, and using different discount rates. Dollar amounts are in million 2009 dollars.

	Sector Allocation of Commercial ACL				
Rebuilding Strategy (years)	Subalternative 2a	Subalternative 2b	Subalternative 2c	Subalternative 2d	Subalternative 2e (Preferred)
	Comm. – 60% Rec. – 40%	Comm. – 67% Rec. – 33%	Comm. – 55% Rec. – 45%	Comm. – 43% Rec. – 57%	Comm. – 45% Rec. – 55%
	Net Present Value of Changes in NOR – 0% Discount Rate				
$F_{REBUILD}(10)$	$1.12	$1.15	$0.94	-$0.18	$0.06
$75\%F_{MSY}$	$1.07	$1.16	$0.72	-$0.47	-$0.23
$65\%F_{MSY}$	$0.68	$1.03	$0.30	-$1.00	-$0.75
$F_{REBUILD}(7)$	$0.54	$0.71	$0.31	-$0.42	-$0.27
$F_{REBUILD}(8)$	$0.78	$0.85	$0.53	-$0.32	-$0.14
	Net Present Value of Changes in NOR – 3% Discount Rate				
$F_{REBUILD}(10)$	$0.94	$0.96	$0.79	-$0.15	$0.05
$75\%F_{MSY}$	$0.89	$0.97	$0.59	-$0.39	-$0.19
$65\%F_{MSY}$	$0.56	$0.86	$0.24	-$0.84	-$0.63
$F_{REBUILD}(7)$	$0.47	$0.63	$0.27	-$0.38	-$0.24
$F_{REBUILD}(8)$	$0.67	$0.74	$0.46	-$0.28	-$0.13
	Net Present Value of Changes in NOR – 7% Discount Rate				
$F_{REBUILD}(10)$	$0.76	$0.78	$0.63	-$0.12	$0.04
$75\%F_{MSY}$	$0.71	$0.78	$0.47	-$0.32	-$0.16
$65\%F_{MSY}$	$0.44	$0.68	$0.19	-$0.69	-$0.52
$F_{REBUILD}(7)$	$0.40	$0.54	$0.23	-$0.32	-$0.21
$F_{REBUILD}(8)$	$0.56	$0.63	$0.38	-$0.23	-$0.10
	Net Present Value of Changes in NOR – 10% Discount Rate				
$F_{REBUILD}(10)$	$0.65	$0.68	$0.54	-$0.10	$0.04
$75\%F_{MSY}$	$0.60	$0.68	$0.40	-$0.27	-$0.13
$65\%F_{MSY}$	$0.37	$0.58	$0.16	-$0.60	-$0.44
$F_{REBUILD}(7)$	$0.35	$0.48	$0.20	-$0.29	-$0.18
$F_{REBUILD}(8)$	$0.49	$0.55	$0.33	-$0.20	-$0.09

Conclusions

The economic analysis presented in this paper offers evidence that the rebuilding strategy proposed in Alternative 2 in Action 4 is economically preferable to the other plans. The reasons are as follow:

- For virtually every scenario (e.g. different time frames, discount rates, and commercial allocations) Alternative 2 produces the largest benefit (i.e. net present of value of future NOR streams) when compared to the other alternatives.
- At the state-level not only does Alternative 2 produce higher benefits, but it is also the only alternative that is *Pareto efficient*. In other words, benefits accrue to fishers in all states without anyone being any worse off.
- For the preferred commercial allocation of 45% Alternative 2 is the only option that would not result in marginal reductions in future benefits when compared to the historical allocation of 44.4465%.