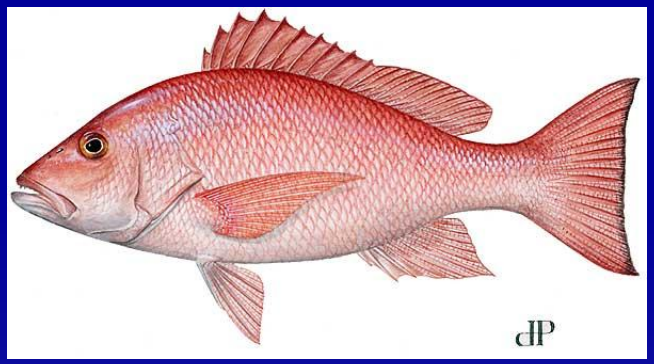
Estimating the combined effects of Amendments 13C, 16, and 17A on red snapper removals in the south Atlantic



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Outline

- Objectives and Goals
- Baseline Removals
- Amendments 13C, 16, and 17A
- Release Mortality
- Spatial Closures
- Bathymetric Closures
- Temporal Closures
- Compliance

Objectives and Goals

Objectives

- Evaluate the effects of Amendments 13C, 16, and 17A
- Explore sensitivity of model to assumptions regarding spatial and temporal distribution of the stock, release mortality, and compliance.

Goals

- To explore possible mechanisms to achieve legally-mandated reductions in red snapper fishing mortality
- To optimize the configuration and duration of closures to minimize adverse impacts on fishing communities

Baseline Removals (2005-2007)

FISHERY	L(1000)	D(1000)	R(1000)
Commercial	107.8	25.6	130.8
Recreational	258.0	351.7	398.7
Headboat	45.9	68.8	73.4
TOTAL	411.6	446.2	602.9

Sources: Commercial Logbook, MRFSS, Headboat

SAFMC current preferred 75% F_{msy} ≈ 75% $F_{40\%SPR}$ would require an ***87%*** *reduction in removals from this baseline to end overfishing.*

SUMMARY: Impacts A13C, A16, A17A

COMMERCIAL

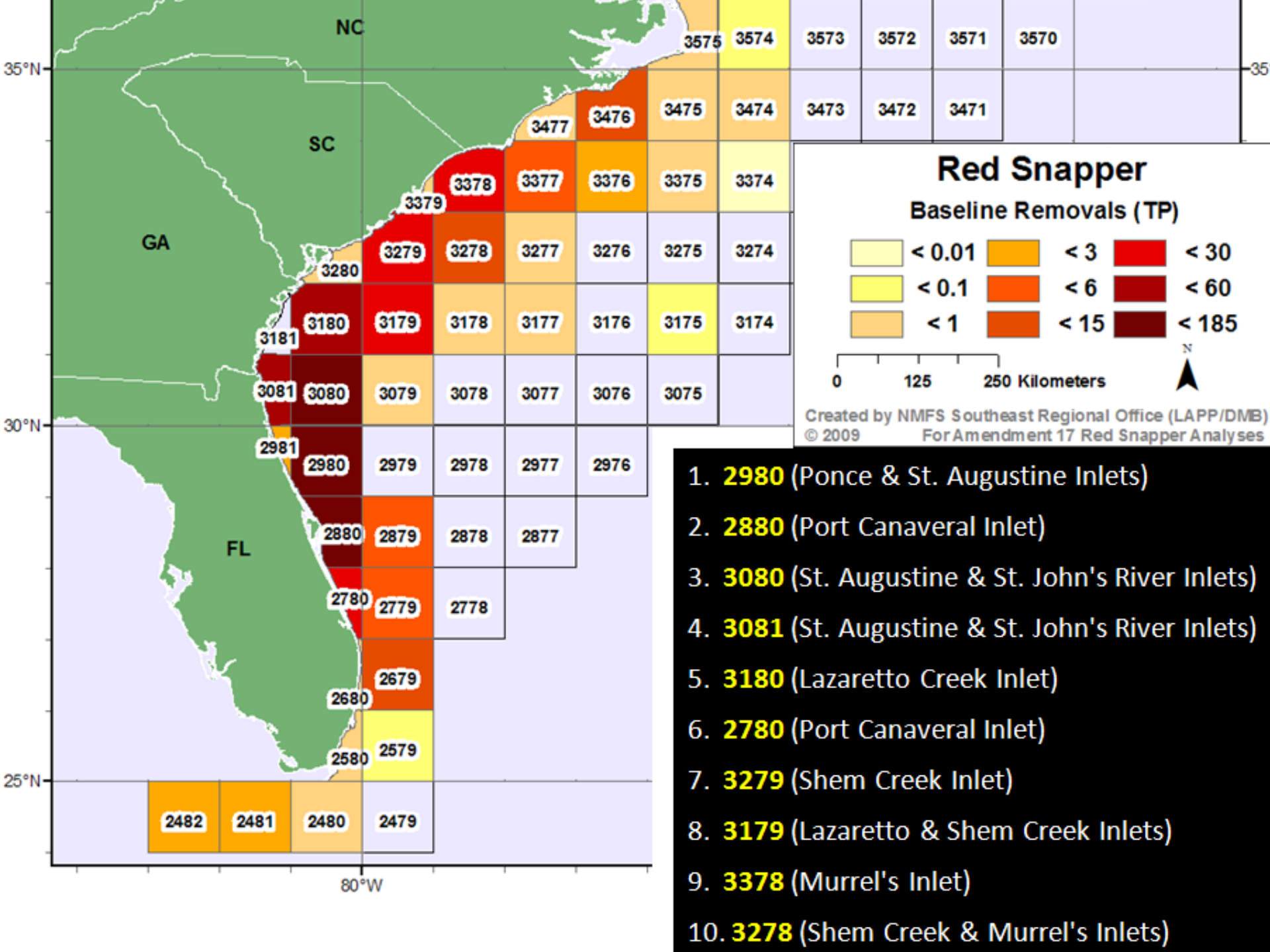
- A13C: Minimal reductions (1%)
- A16: Slight reductions (16%)
- A17A: Substantial reductions (8-88%)

HEADBOAT

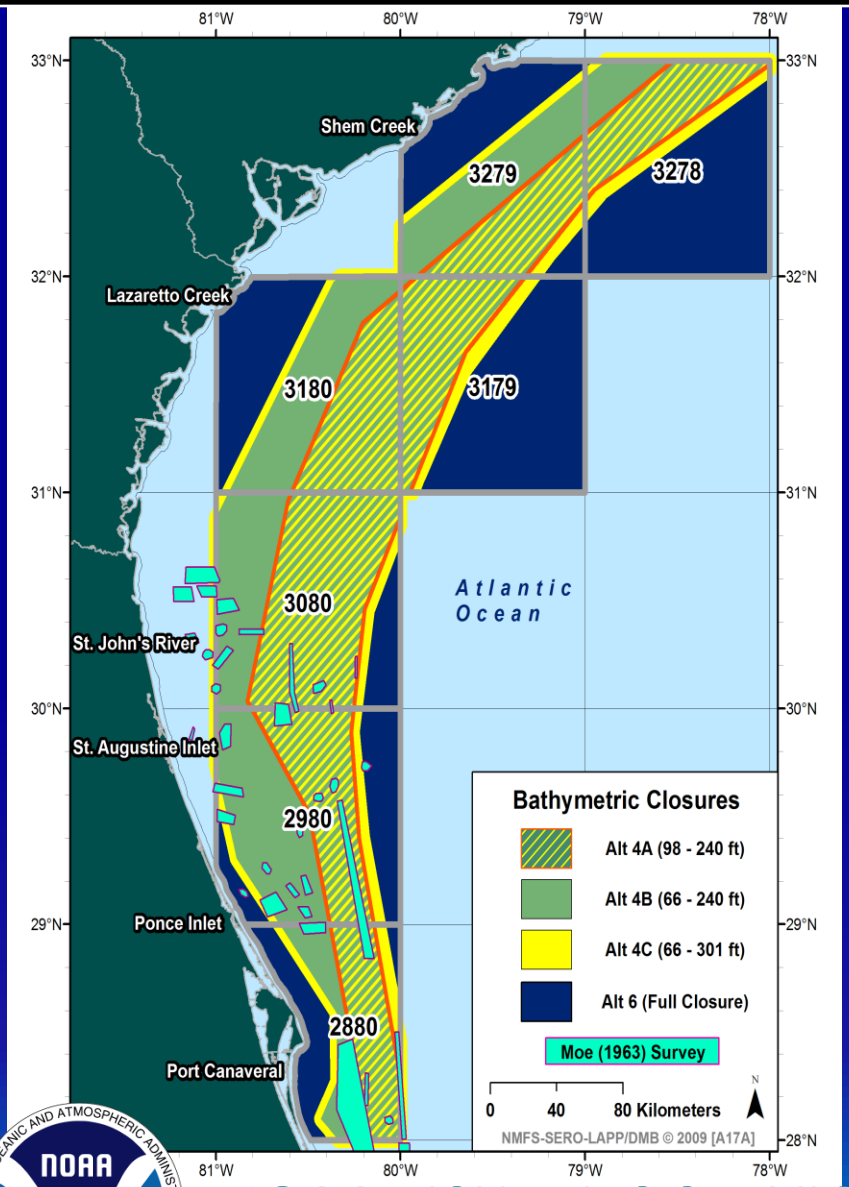
- A16: Slight reductions (1-8%)
- A17A: Substantial reductions (37-87%)

RECREATIONAL

- A16: Minimal reductions (2%)
- A17A: Substantial reductions (49-91%)



1. **2980** (Ponce & St. Augustine Inlets)
2. **2880** (Port Canaveral Inlet)
3. **3080** (St. Augustine & St. John's River Inlets)
4. **3081** (St. Augustine & St. John's River Inlets)
5. **3180** (Lazaretto Creek Inlet)
6. **2780** (Port Canaveral Inlet)
7. **3279** (Shem Creek Inlet)
8. **3179** (Lazaretto & Shem Creek Inlets)
9. **3378** (Murrel's Inlet)
10. **3278** (Shem Creek & Murrel's Inlets)



Bathymetric Closures

- Challenging to analyze:

1. Logbook (2005-2008)
   - ✓ ***Area, Depth***
   - x ***Self-reported, may be poor proxy for recreational***
2. Headboat (2005-2007)
   - ✓ ***Area (often incomplete)***
   - x ***No depth, sampling may not be representative***
3. MARMAP (1977-2008)
   - ✓ ***Area, Depth***
   - x ***Limited range of applicable sampling (South Carolina)***
4. Moe (1963)
   - x ***Only Florida, no offshore***

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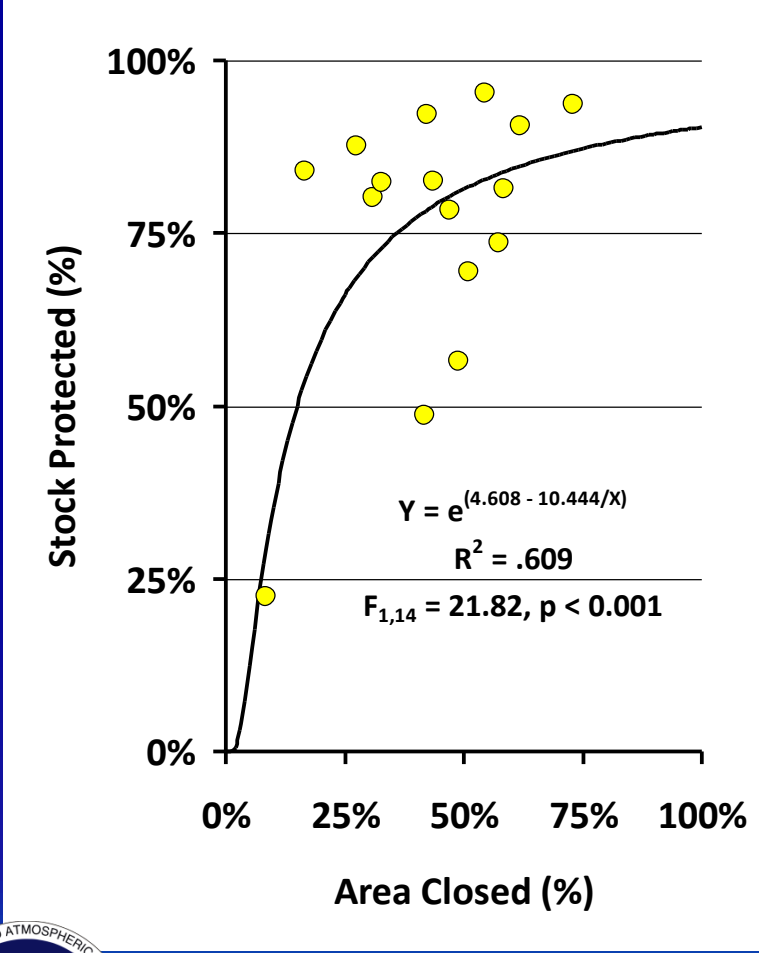
Evaluating the Bathymetric Closure: Logbook?

Year	Available Depth	Unavailable Depth	Percent Unavailable	Unrealistic Depth	Percent Unrealistic
2005	1009	333	25%	70	5%
2006	1081	73	6%	66	6%
2007	1326	0	0%	111	8%
2008	1619	1	0%	59	4%

When computing impacts of closure, percent stock protected computed directly from logbook unless:

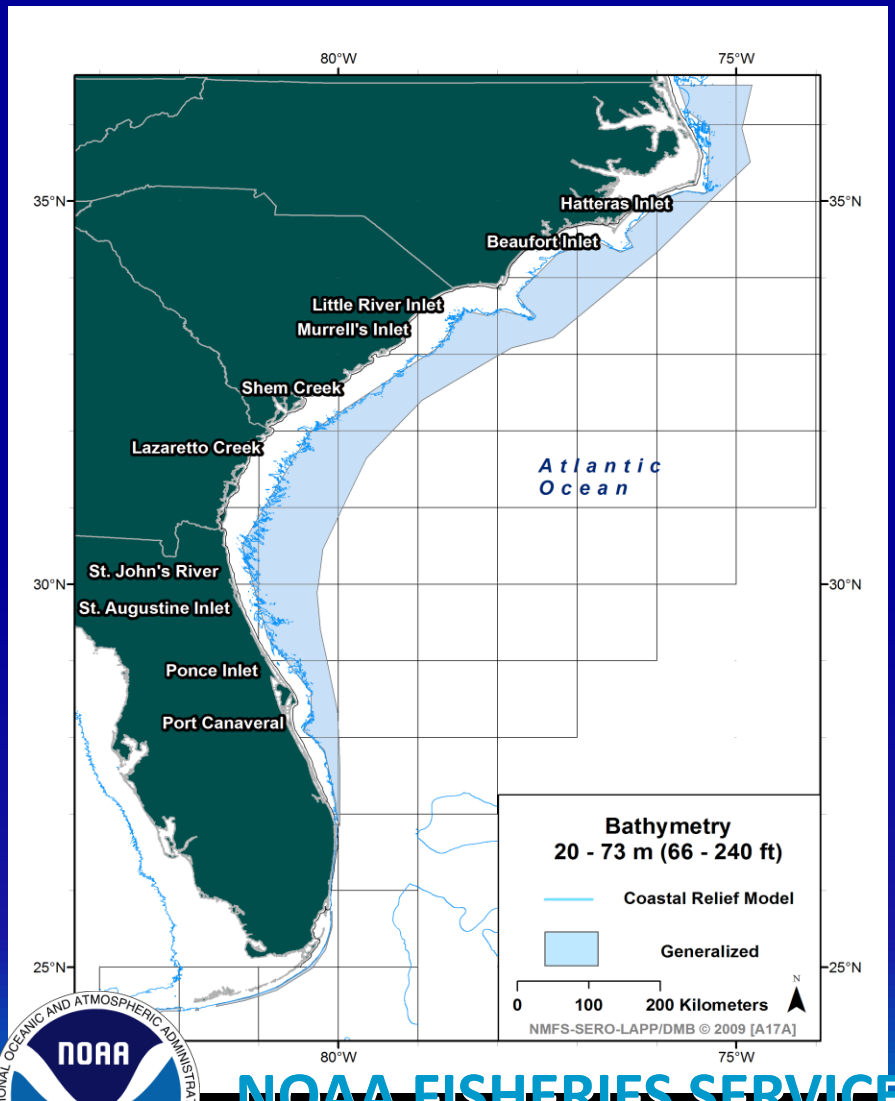
1. No red snapper landings were reported from that area
2. Red snapper were not landed both inside and outside the closure depth range (e.g., biased sample)

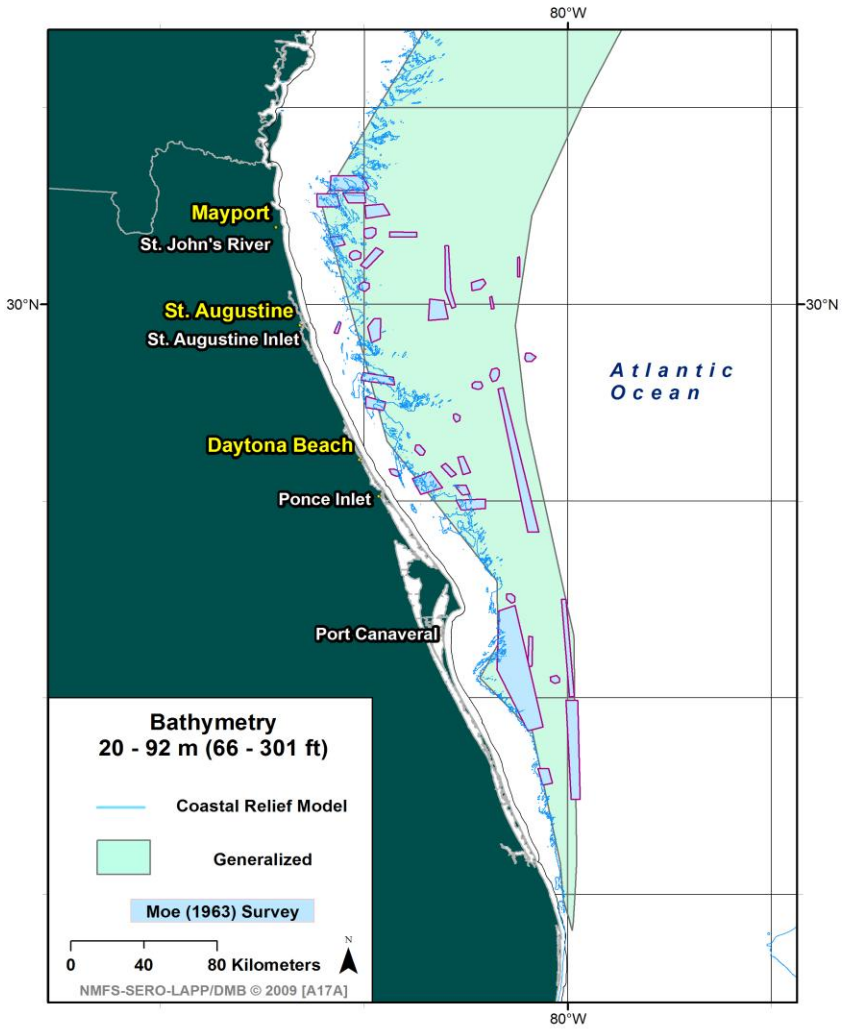
Bathymetric Closure (A): 98-240 ft



- When direct substitution not an option, regression based on landings
  - Direct substitution used for all areas in Alt3 and Alt4
- 1,241 trips outside 98-240 ft
- 3,616 trips inside 98-240 ft
- Commercial data may underrepresent inshore stock
- Recreational and headboat fisheries may operate further inshore

Bathymetric Closure (B): 66-240 ft





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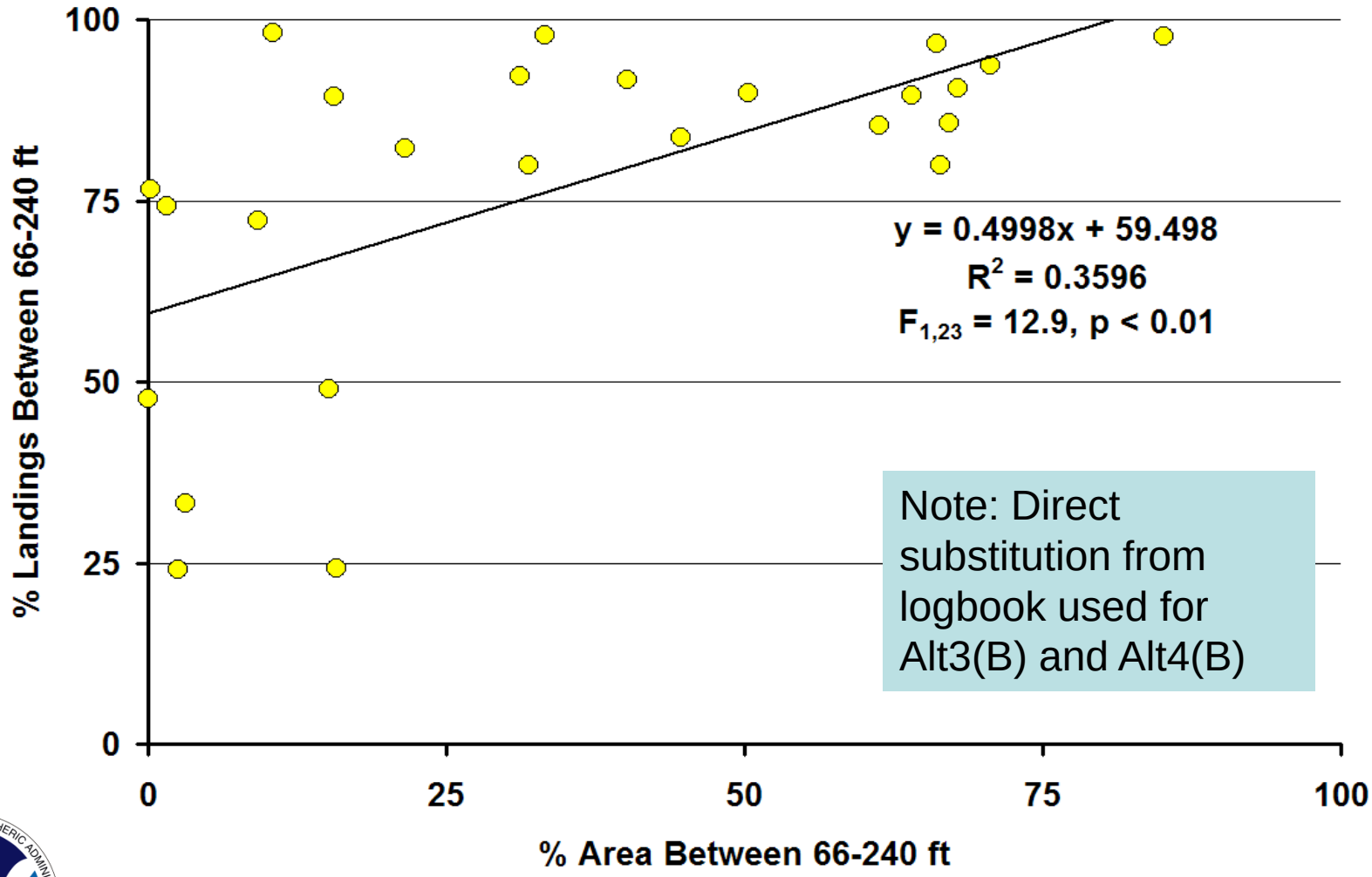
Bathymetric Closure (B): 66-240 ft



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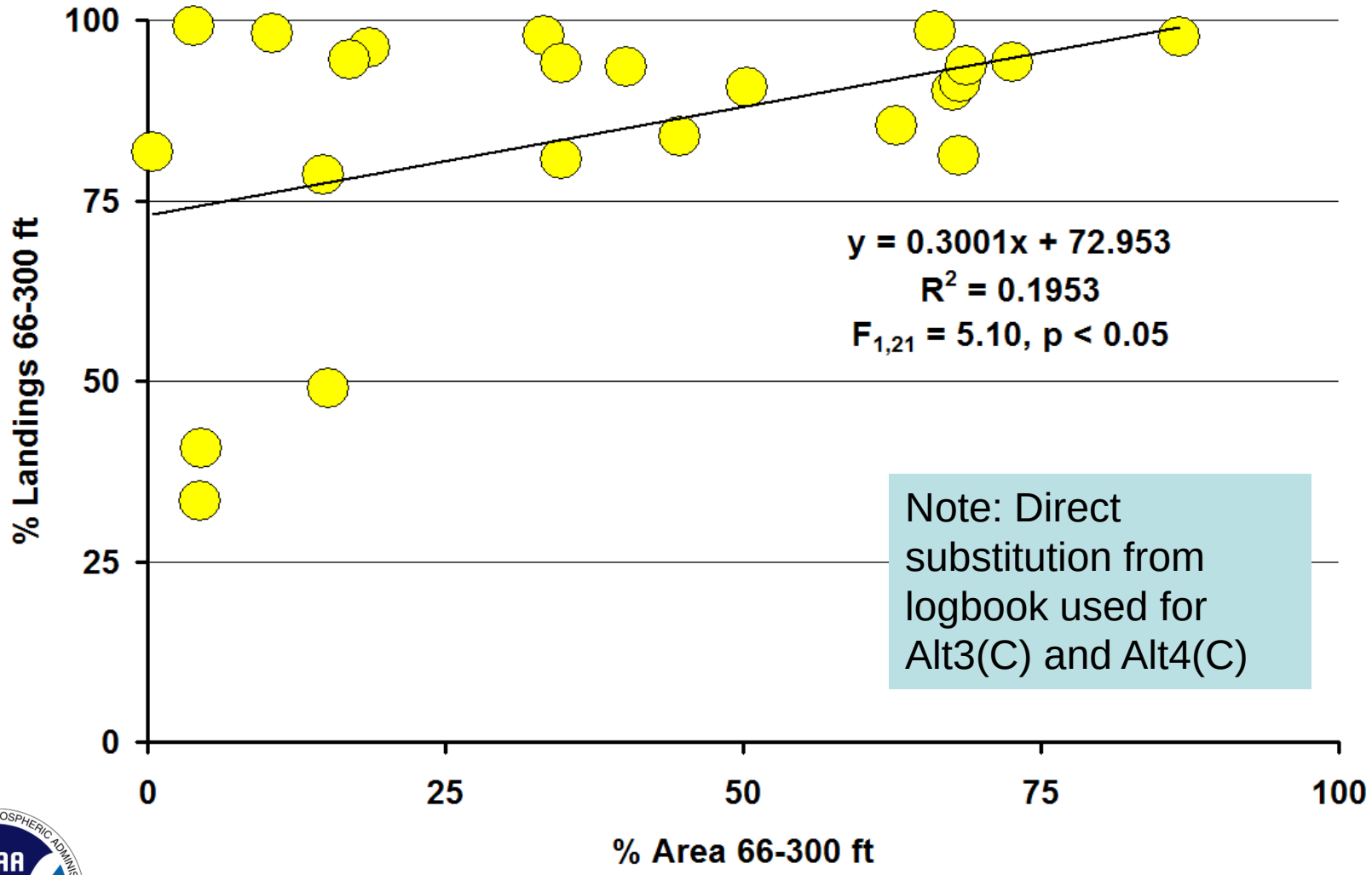
Bathymetric Closure (C): 66-300 ft



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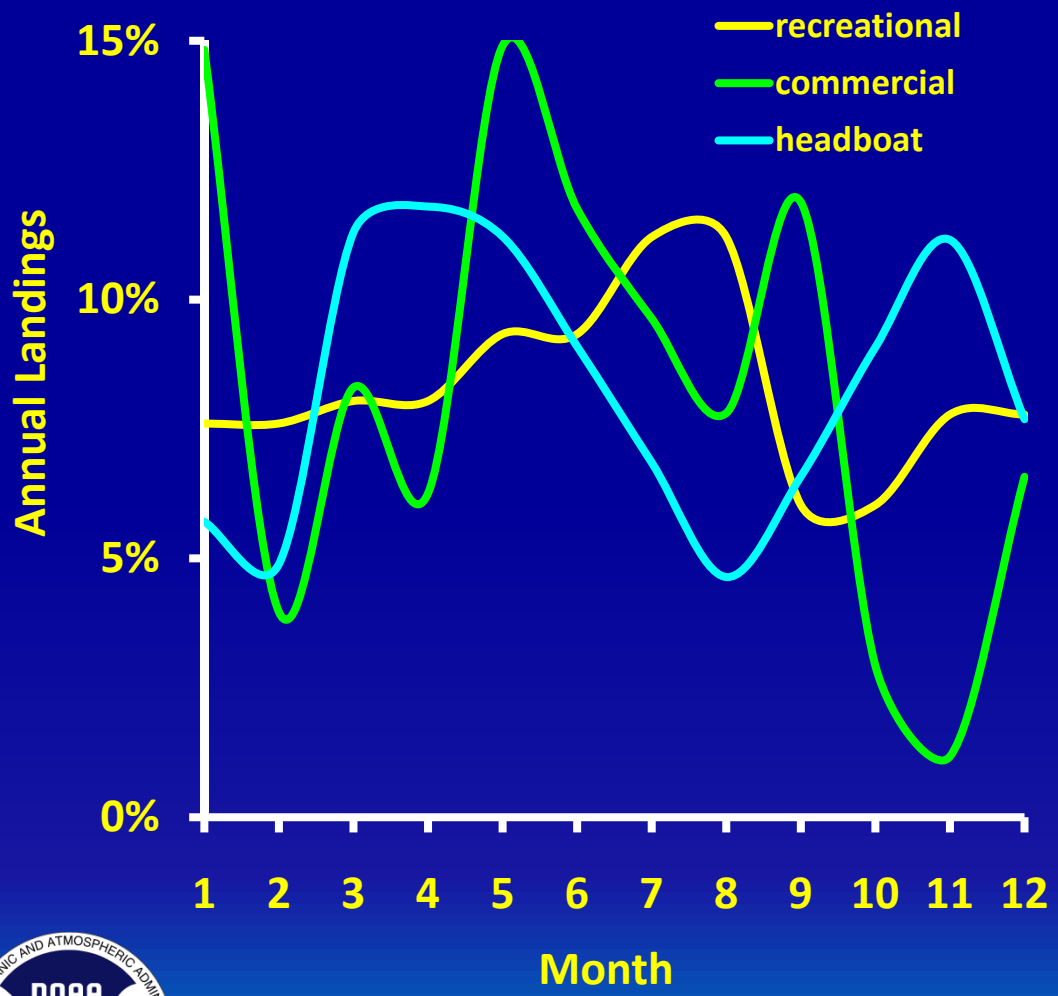
Temporal Closures



- Removals distributed temporally by month based on spatially-explicit baseline landings patterns for each fishery
- Allow for user-defined increase in effort during open periods in partially open cells

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100% Compliance?

- Even low levels of non-compliance can rapidly erode the fisheries benefits of spatial closures (Tegner 1993, Attwood et al. 1997, Gribble & Robertson 1998, Guzman & Jacome 1998, Murray et al. 1999, Fogarty *et al.* 2000, Rogers-Bennett et al. 2000; however, see Jennings et al. 1996)
- Little published data exists to estimate rates of non-compliance (Ward et al. 2001)
- A multi-year study in the Great Barrier Reef has reported high levels of intrusion into a closed area (Gribble & Robertson 1998)
- Less than 100% compliance will impact projected reductions resulting from spatial closures

Alternative 2

Close commercial, headboat, and recreational red snapper fishery.

FISHERY	R(1000)	REDUCTION
Comm	59.0	55%
Rec	187.1	53%
HB	35.5	52%
TOTAL	281.5	53%

	Fmsy proxy				F40% proxy				F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High				
Alternative 2 (F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 3 (85% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 4 (75% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 5 (65% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 6 ($F_{rebuild}$)	NO	NO	NO	NO	NO	NO	NO	NO				

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 3

Close areas 2880, 2980, 3080, 3180 between 98-240 ft to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	35.7	73%
Rec	74.3	81%
HB	17.6	76%
TOTAL	127.7	79%

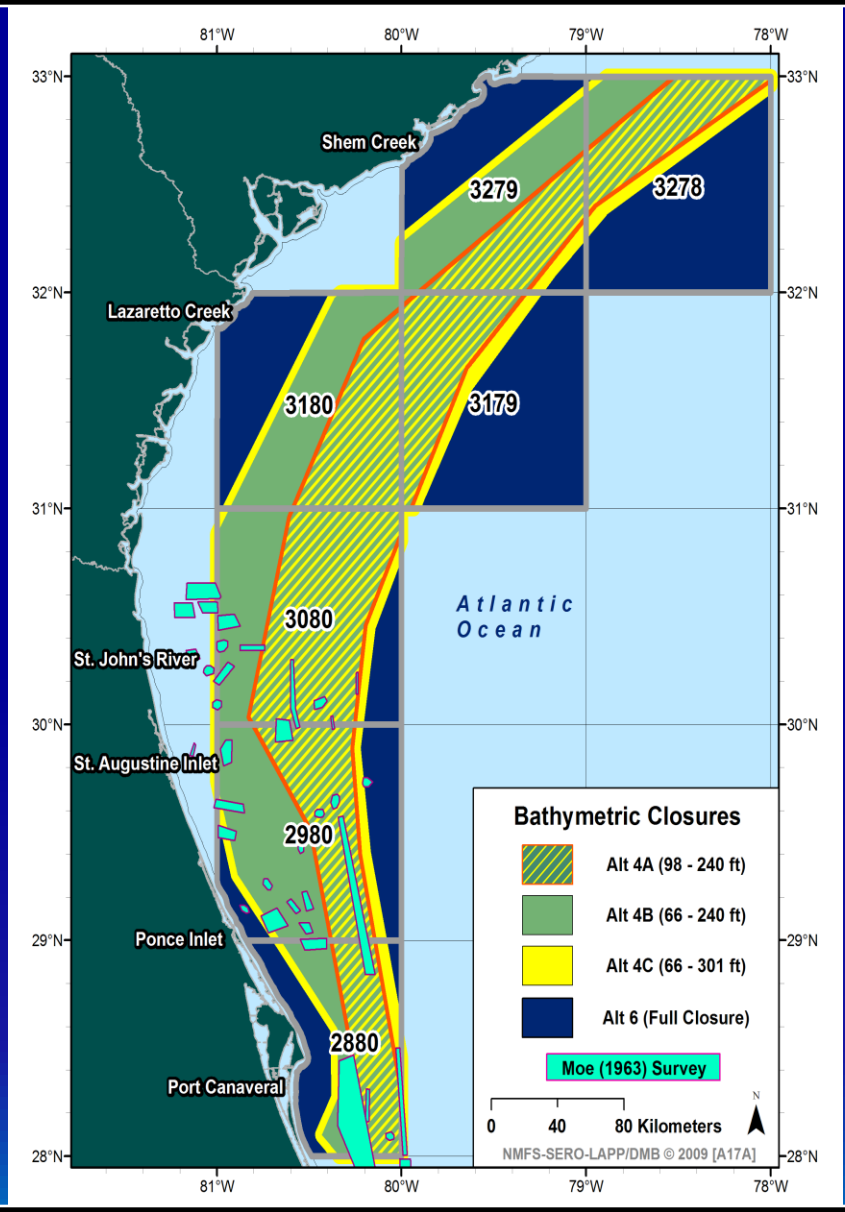
	F_{msy} proxy				F40% proxy				F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High				
Alternative 2 (F_{MSY})	NO	NO	NO	NO	NO	NO	YES	YES				
Alternative 3 (85% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 4 (75% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 5 (65% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO				
Alternative 6 ($F_{rebuild}$)	NO	NO	NO	NO	NO	NO	NO	YES				

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 4

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 to all snapper-grouper fishing between:

Closure	Depths	Area (km^2)	% Alt 6
Alt 4A	98-240 ft	23,685	35%
Alt 4B	66-240 ft	39,190	58%
Alt 4C	66-300 ft	40,573	60%
Alt 6	All	67,309	100%



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Alternative 4(A)

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 between 98-240 ft to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	35.7	73%
Rec	74.3	81%
HB	17.6	76%
TOTAL	127.7	79%

	Fmsy proxy				F40% proxy				F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High
Alternative 2 (F_{MSY})	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO	YES	YES
Alternative 3 (85% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Alternative 4 (75% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Alternative 5 (65% F_{MSY})	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Alternative 6 ($F_{rebuild}$)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 4(B)

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 between 66-240 ft to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	19.7	85%
Rec	46.7	88%
HB	11.3	85%
TOTAL	77.7	87%

	F_{msy} proxy				F40% proxy				F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High				
Alternative 2 (F_{MSY})	YES	YES	YES	YES	YES	YES	YES	YES				
Alternative 3 (85% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES				
Alternative 4 (75% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES				
Alternative 5 (65% F_{MSY})	NO	NO	NO	YES	NO	YES	YES	YES				
Alternative 6 ($F_{rebuild}$)	YES	YES	YES	YES	YES	YES	YES	YES				

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 4(C)

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 between 66-300 ft to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	19.5	85%
Rec	45.8	89%
HB	11.1	85%
TOTAL	76.4	87%

	F_{msy} proxy				F40% proxy				F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High				
Alternative 2 (F_{MSY})	YES	YES	YES	YES	YES	YES	YES	YES				
Alternative 3 (85% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES				
Alternative 4 (75% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES				
Alternative 5 (65% F_{MSY})	NO	NO	NO	YES	NO	YES	YES	YES				
Alternative 6 ($F_{rebuild}$)	YES	YES	YES	YES	YES	YES	YES	YES				

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 5

Close areas 2880, 2980, 3080, 3180 to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	32.8	75%
Rec	41.5	90%
HB	12.0	84%
TOTAL	86.4	86%

	Fmsy proxy		F40% proxy		F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High
Alternative 2 (F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES
Alternative 3 (85% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES
Alternative 4 (75% F_{MSY})	NO	NO	NO	YES	NO	YES	YES	YES
Alternative 5 (65% F_{MSY})	NO	NO	NO	NO	NO	NO	YES	YES
Alternative 6 ($F_{rebuild}$)	NO	NO	YES	YES	YES	YES	YES	YES

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Alternative 6

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 to all snapper-grouper fishing

FISHERY	R(1000)	REDUCTION
Comm	16.2	88%
Rec	36.5	91%
HB	9.3	87%
TOTAL	61.9	90%

	Fmsy proxy		F40% proxy		F30% proxy			
Recruitment	Base	High	Very High	Ext. High	Base	High	Very High	Ext. High
Alternative 2 (F_{MSY})	YES	YES	YES	YES	YES	YES	YES	YES
Alternative 3 (85% F_{MSY})	YES	YES	YES	YES	YES	YES	YES	YES
Alternative 4 (75% F_{MSY})	NO	YES	YES	YES	YES	YES	YES	YES
Alternative 5 (65% F_{MSY})	NO	NO	YES	YES	YES	YES	YES	YES
Alternative 6 ($F_{rebuild}$)	YES	YES	YES	YES	YES	YES	YES	YES

100% compliance, SEDAR 15 release mortalities, directed and targeted trips eliminated (A13C, A16, A17)

Release Mortality

- **40%** for recreational & headboat (SEDAR 15)
- **90%** for commercial (SEDAR 15)
- Factors contributing to release mortality
  - fishing depth
  - surface interval & handling
  - hook location
  - predation
  - water temperature
- Barotrauma is a major source of release mortality and is directly related to depth of capture

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See Burns et al. 2004, Rummer 2007, Campbell 2008

Changes in Release Mortality?

- Prior to closures, average depth (logbook) = 140 ft.
- Bathymetric closures (Alt3 and Alt4) only change the average depth of fishing by +/- 10 ft
  - greater emphasis is given to deep water landings outside of the bathymetric closures.
- Specifically within the cells that would be closed by Alt 6, the average depth of fishing prior to any closure is 133 ft.
- Alt 4A reduces this average depth of fishing to 85 ft (26 m)
- Alt 4B reduces this average depth of fishing to 98 ft (30 m)
- Alt 4C reduces this average depth of fishing to 61 ft (19 m)

See Burns et al. 2004, Rummer 2007, Campbell 2008, Diamond et al. (unpublished data)

Changes in Release Mortality?

- **Effort shifting into shallower water may occur following implementation of spatial closures by A17A**
- **Discard mortality may be as low as 20% if the fish is caught in waters < 20 m**
- **Difficult to predict changes in release mortality:**
  - **level and pattern of effort shifting is unknown**
  - **higher discard mortality rates will continue in open areas; logbook data suggests *average* depth of red snapper encounters may be *deeper* following closures**
  - **delayed mortality rates may be higher than estimated**
  - **Closure of fishery may reduce handling time**

See Burns et al. 2004, Rummer 2007, Campbell 2008, Diamond et al. (unpublished data)

SEDAR15: Recreational Release Mortality

- SEDAR15: "The recommended discard mortality by depth (in parentheses) for red snapper in the Gulf of Mexico stock assessment (SEDAR7) was 15% at 20-40 m to 40% at >40 m…"
- "For the recreational fisheries (MRFSS and Headboat), release mortality should be set at 40% (30 to 50% sensitivity range)."
- "The mean minimum depth in the recreational (charter boat) fishery was 43 m (range 20 to 183 m)."
- "The mean maximum depth was 58 m (24 to 274 m)."

SEDAR15: Commercial Release Mortality

- SEDAR15: “The recommended discard mortality by depth (in parentheses) for red snapper in the Gulf of Mexico stock assessment (SEDAR7) was…71% at 55 m to 88% at 83 m in the commercial fishery. ”
- “For the commercial fishery, release mortality should be set at 90% (80 to 100% sensitivity range).”
- “The commercial fishery had a mean minimum of 43 m (range 18 to 604 m).”
- “The mean maximum in the commercial fishery was 71 m (range 19 to 823 m).”

Shallow-water Release Mortality

- ***Gitschlag & Renaud (1994)*** ***short term (< 20 min diver observation) study of releases from a headboat:***
  - ***Presence of divers may have reduced post-release predation***
  - ***Delayed mortality was not accounted for.***
  - ***Immediate mortality estimates were around 1% for red snapper caught at depths < 24 m.***
- ***Burns et al. (2004)*** ***study of barotrauma related mortality in red snapper in chambers:***
  - ***No barotrauma-related mortality observed from simulated depths of 21.3 m (70 ft) and 27.4 m (90 ft).***
  - ***40% mortality from simulated depths of 42.7 m (140 ft).***

Diamond et al. (unpub.) Meta-Analysis

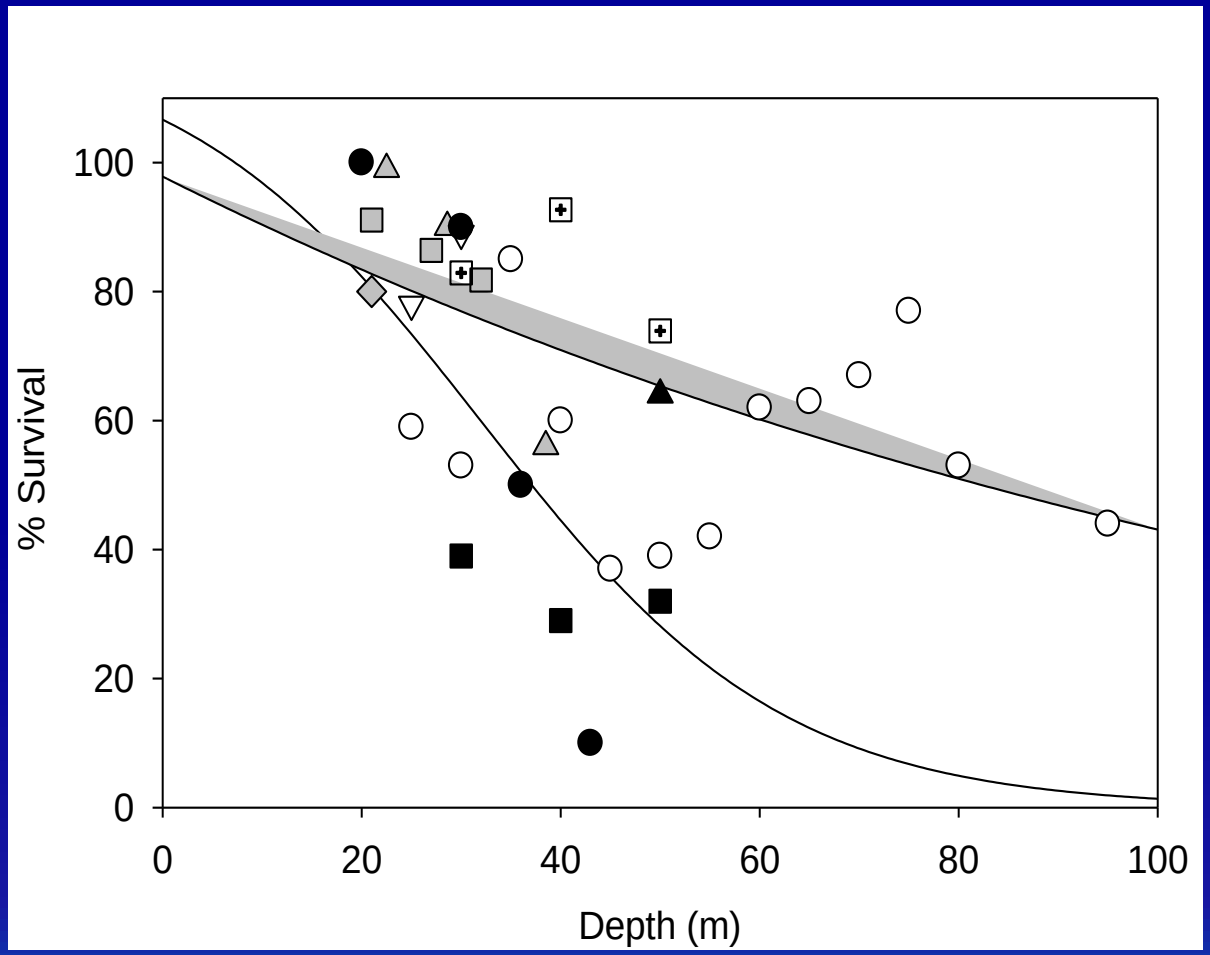
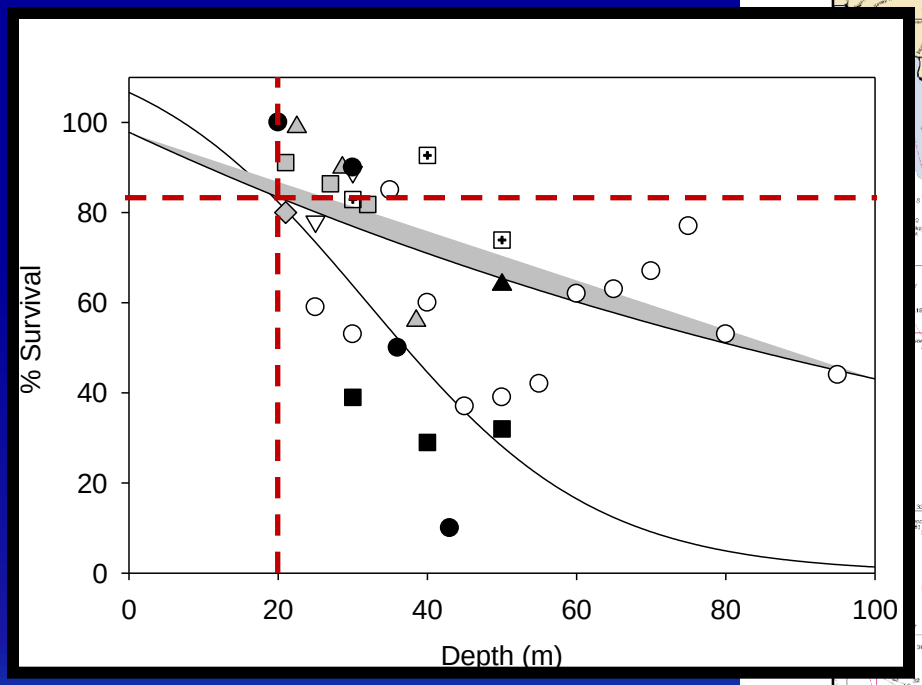
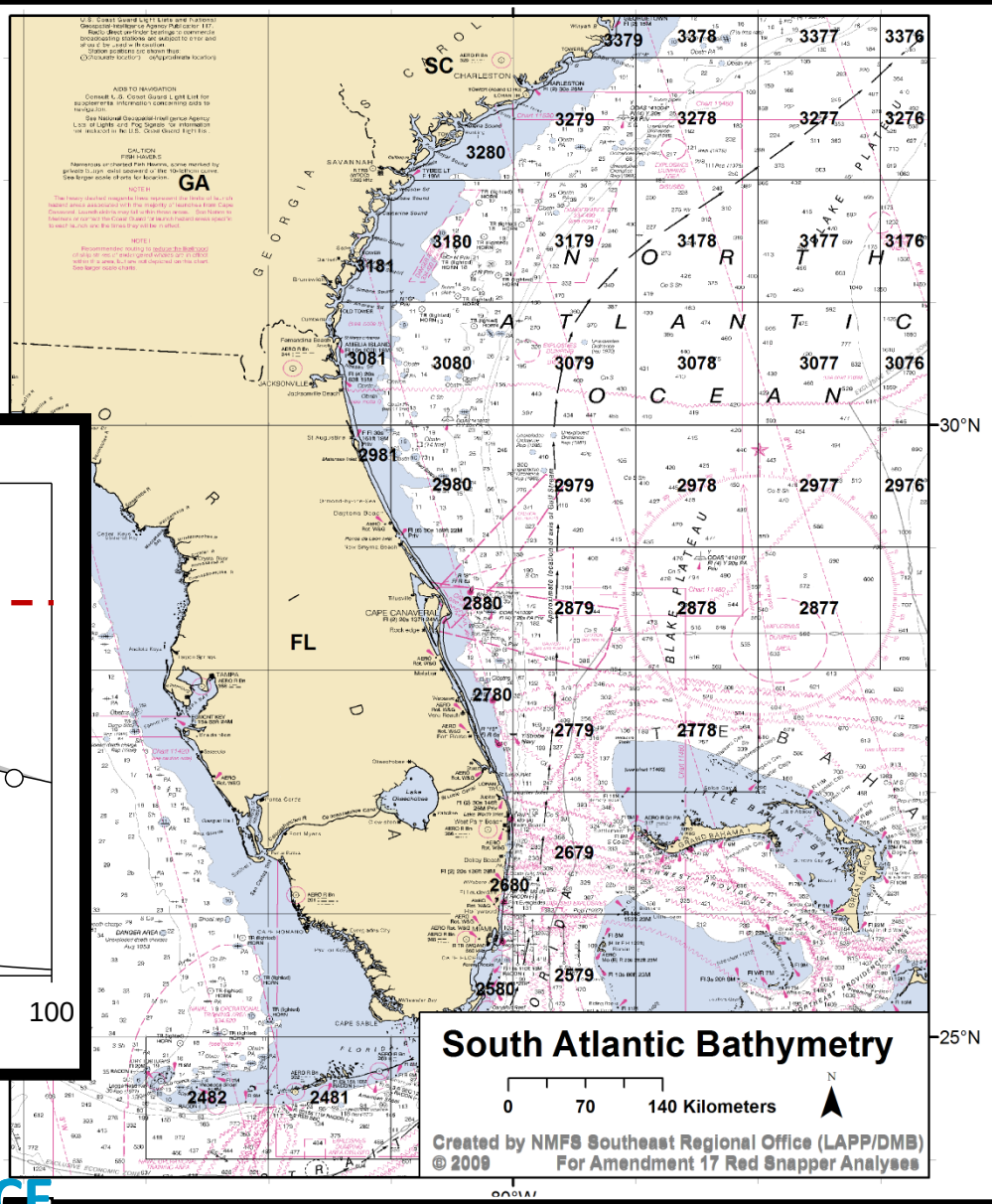


Figure 1: Immediate (open and gray symbols) and delayed (black symbols) survival by depth from literature studies. Immediate mortality estimates are taken from: Dorf (2003, open circles), Gitschlag and Renaud (1994, gray squares), Diamond and Campbell (2009, open crossed squares), Parker (1991, open triangles), Patterson et al. (2002, grey triangles), and Render and Wilson (1994, grey diamonds). Delayed mortality estimates are taken from: Gitschlag and Renaud (1994, black triangles), Diamond and Campbell (2009, black squares), and Burns et al. (2002, black circles). Points are fit to a sigmoidal curve. Immediate mortality is the flatter of the two lines.

From Diamond et al. (*unpublished*)

AREA	MAX DEPTH (FT)
3379	60
2981	63
3081	66
3181	66





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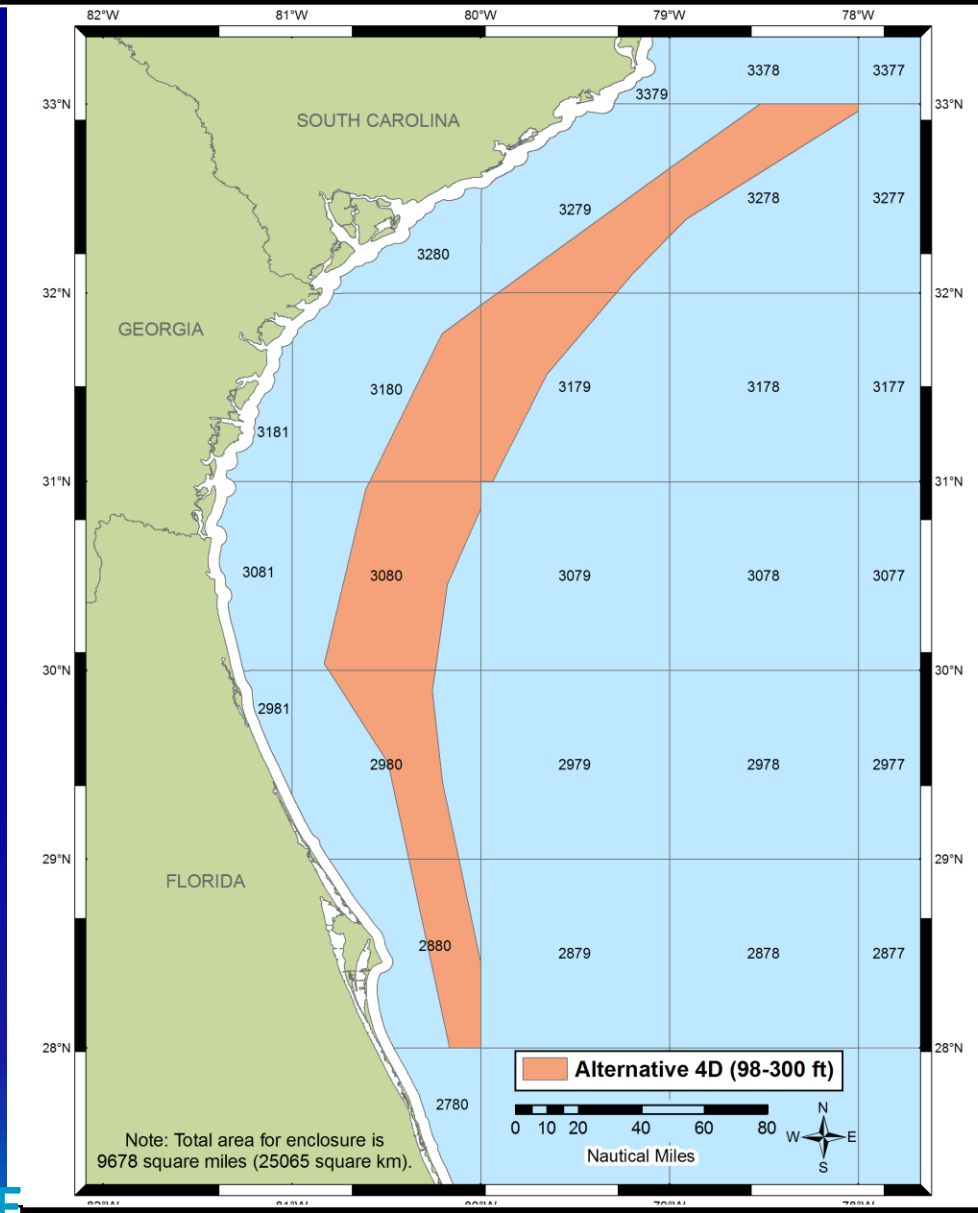
Alternative 4D

Close areas 2880, 2980, 3080, 3179, 3180, 3278, 3279 to all snapper-grouper fishing between **98 – 300 ft**

Total area closed = 9,678 miles^2 (25,065 km^2)



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Percent Reduction

ALT	Area Closed (1000 km²)	Scenario 1	Scenario 2	Scenario 3
2	0	39%	55%	60%
3A*	15	65%	77%	84%
3B*	27	70%	81%	88%
4A*	24	69%	80%	86%
4B*	39	74%	84%	91%
5	38	72%	83%	90%
6	67	77%	86%	93%

Scenario 1: No impacts A13C, A16; A17A eliminates targeted trips only; 80% compliance; 40%/90% release mortality.

Scenario 2: Directed and targeted trips eliminated by A13C, A16, A17A; 85% compliance; 40%/90% offshore release mortality; 20%/20% inshore release mortality.

Scenario 3: Directed and targeted trips eliminated by A13C, A16, A17A; 100% compliance; 40%/40% offshore release mortality; 20%/20% inshore release mortality.

TBE: To be estimated

*A=98-240 ft B=66-240 ft

Percent Reduction

ALT	Area Closed (1000 km²)	Scenario 1	Scenario 2	Scenario 3
2	0	39%	55%	60%
3A*	15	65%	77%	84%
3D*	16	66%	77%	84%
4A*	24	69%	80%	86%
4D*	25	69%	80%	86%
5	38	72%	83%	90%
6	67	77%	86%	93%

Scenario 1: No impacts A13C, A16; A17A eliminates targeted trips only; 80% compliance; 40%/90% release mortality.

Scenario 2: Directed and targeted trips eliminated by A13C, A16, A17A; 85% compliance; 40%/90% offshore release mortality; 20%/20% inshore release mortality.

Scenario 3: Directed and targeted trips eliminated by A13C, A16, A17A; 100% compliance; 40%/40% offshore release mortality; 20%/20% inshore release mortality.

TBE: To be estimated

*A=98-240 ft D=98-300 ft

Model does not consider:

1. Effort shifting from closed areas to open areas
2. Impacts of redistributed effort along closure boundaries
3. Movement of fish across closure boundaries
4. Discards due to gear exceptions in closed areas
5. Potential differences between spatial fishing patterns of private, charter, and headboat fisheries
6. Spatial heterogeneity of stock distribution within closed areas (pertains to evaluation of partial closures)

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http://www.teamgulp.co.uk/images/GrahamRedSnapper.jpg

Questions?
Guidance for Appropriate Inputs?