

Science, Service, Stewardship



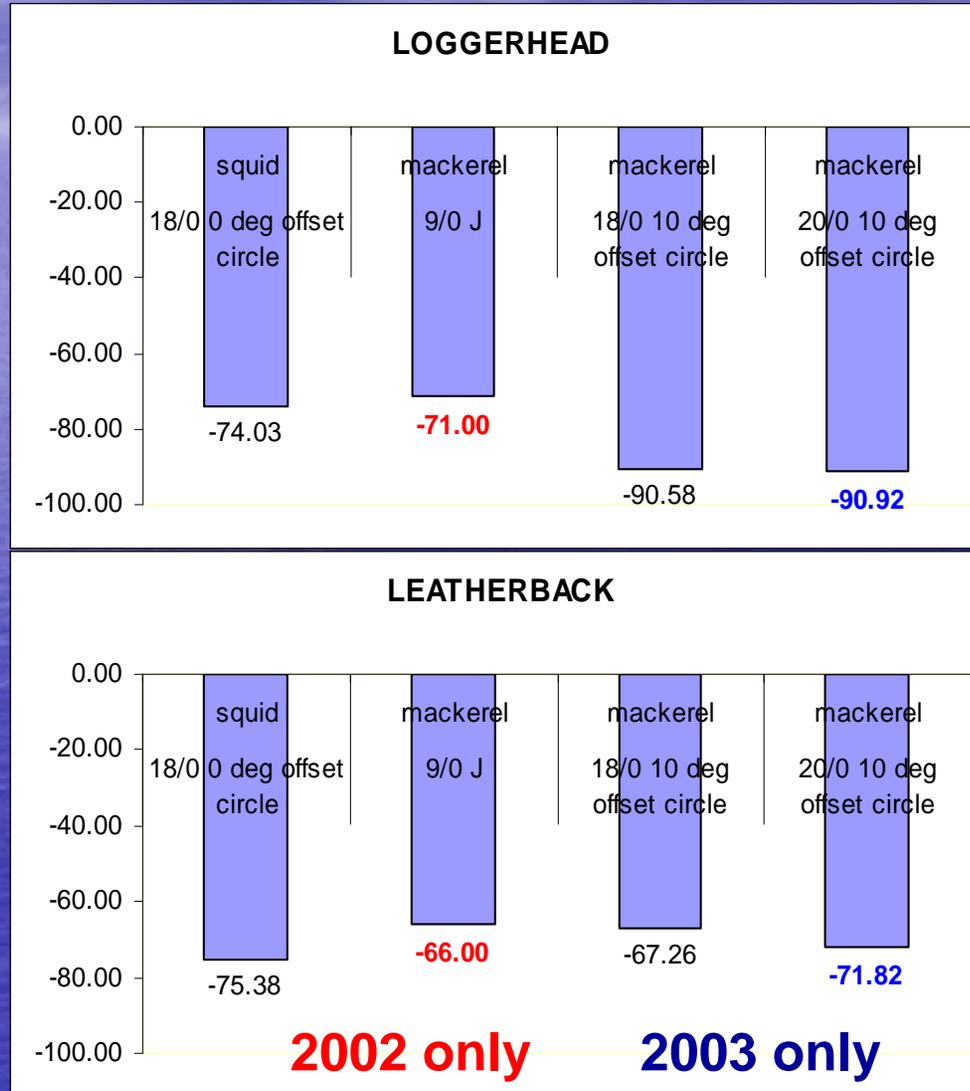
Sea Turtle Bycatch Reduction in the U.S. Atlantic Pelagic Longline Fishery – preliminary analysis

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NOAA
FISHERIES
SERVICE

NED Experiments, 2002-2003

Effect of Treatments Relative to Control



results for combined 2002-2003 NED experiments, unless noted

July 6, 2004 Final Rule

- **Within the NED**
 - 18/0 or larger circle hooks
 - offset not to exceed 10 degrees
 - Baits: whole Atlantic mackerel or squids
- **Outside the NED**
 - 16/0 or larger non-offset circle hooks
 - 18/0 or larger circle hooks with offset not to exceed 10 degrees
 - Bait: whole finfish or squids
- **All areas (Reasonable and Prudent Alternative)**
 - possess and use sea turtle release equipment
 - comply with specified sea turtle handling and release protocols

June 1, 2004 Biological Opinion

Leatherbacks: jeopardy

Other listed species: not-jeopardy

Reasonable and Prudent Alternatives (RPA)

- **Improve monitoring of the effects of the fishery,**
- Confirm the effectiveness of the hook and bait combinations that are required as part of the proposed action,
- Reduce post-release mortality of leatherbacks, and
- Take management action to avoid long-term elevations in leatherback takes or mortality

June 1, 2004 Biological Opinion

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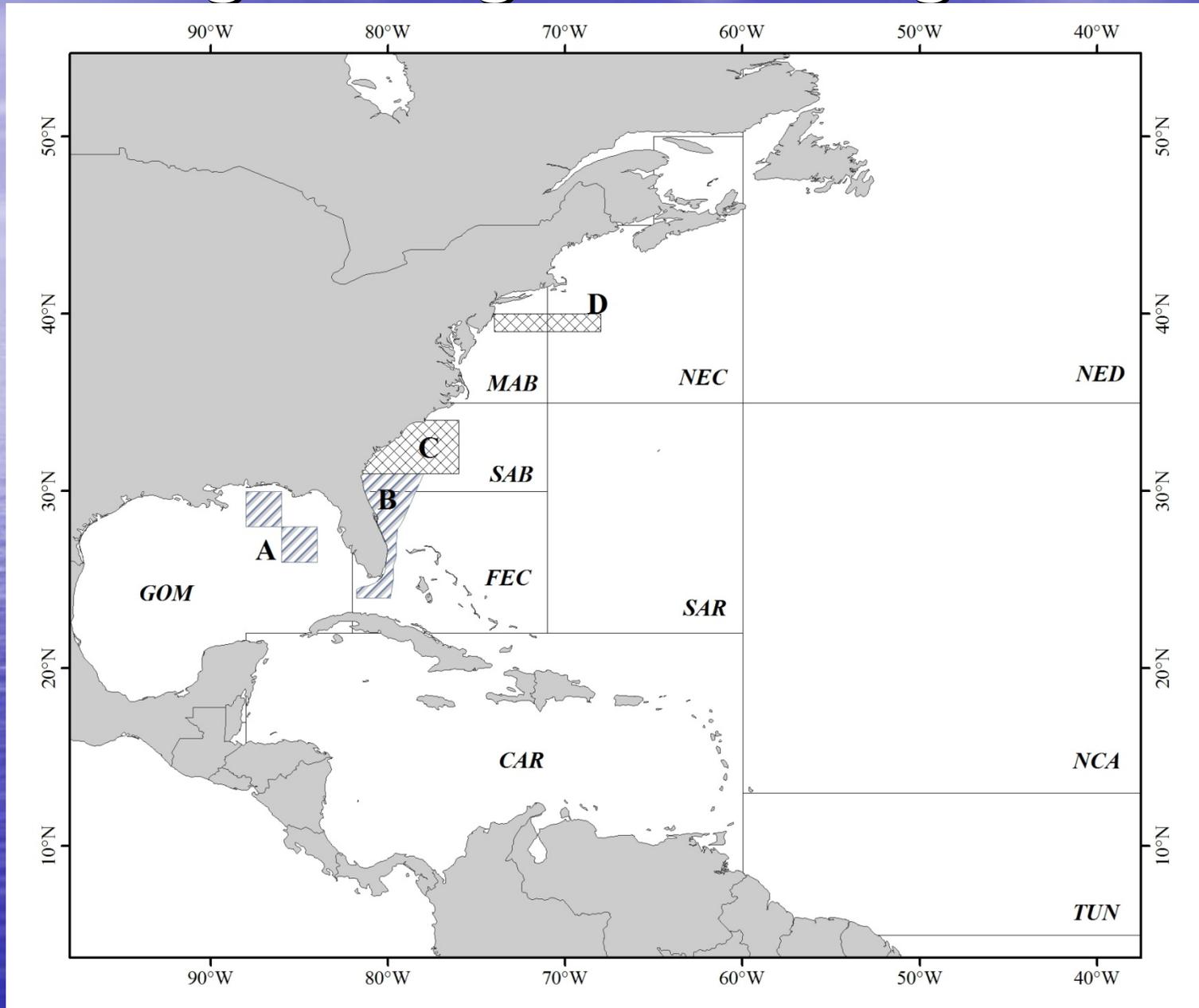
Modeling Bycatch Rates

Analysis divided into time periods:

Outside NED: 2001 – August 2004 = Before
Sept. 2004 – Sept. 2008 = After

Within NED: 1998-2000 = Before
2002-2003 = Experiment
June 2004 – Sept. 2008 = After

Pelagic Longline Fishing Areas



Fishery Changes Post-Regulation

- The fisheries used predominantly J-hooks prior to regulation. Switch to 16/0 circle hooks in the Gulf of Mexico, 18/0 hooks in the remainder of the fishery
- Some increases in use of fish bait or fish and squid bait in combination, particularly in offshore areas including the NED
- Little change in other fishery characteristics (e.g., hooks fished, mainline length) with exception of NED
- In NED, fishing in cooler water with shallower hook depths than in the pre-regulation/pre-experiment period (1998-2000)

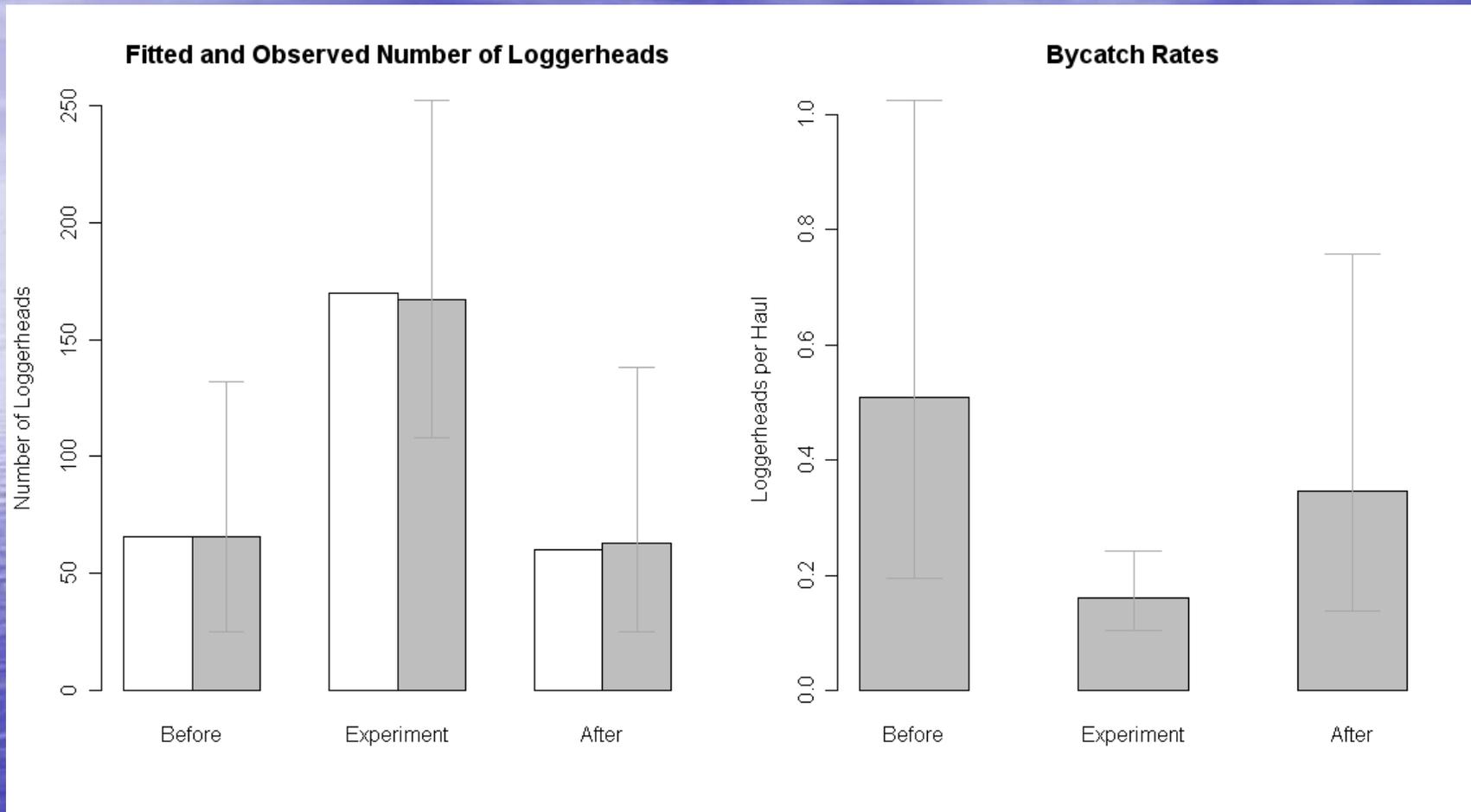
Modeling Bycatch Rates

- Modeling counts of turtles per haul as a function of gear, bait, and fishing variables
- Three alternative model forms used depending on the distributional characteristics of the data
 - Poisson* – base count model assuming variance = rate
 - Negative Binomial* – used in the presence of overdispersion
 - “Hurdle” Models* – a mixed logit and zero-truncated negative binomial in the presence of zero-inflation
- Models were evaluated for fit against observed data and predicted catch per haul was used to evaluate change in bycatch rates.
- Rates multiplied by reported effort to estimate bycatch.

Model Summaries – Loggerheads

	Gulf of Mexico	Southeast	Northeast	Caribbean/ Offshore	Northeast Distant	
Model Type	Neg. Binom.	Poisson	Neg. Binom.	Neg. Binom.	Logit	Neg. Binom.
Target - Sword	ns	ns	95.1%	-	ns	ns
Target - Mix	ns	ns	ns	-	-	ns
C-16 Hook	-67.6%	ns	ns	-	-	ns
C-18 Hook	ns	ns	ns	-68.7%	-75.1%	ns
J & C-18 Hook	-	-	-	-	-56.0%	ns
Fish Only	ns	-74.9%	ns	-	-85.9%	-92.3%
Fish and Squid	ns	ns	ns	ns	-69.3%	ns
Mainline Len. (+ 10 miles)	ns	ns	ns	-54.7%	67.4%	188.3%
Soak Duration	ns	ns	-14.0%	ns	ns	ns
Hook Depth	ns	ns	ns	ns	ns	ns
Haul Temp. (70 to 60 F)	ns	ns	ns	ns	-96.8% (lin.)	ns
# of Hooks (+ 100 hooks)	ns	ns	ns	68.4%	ns	ns
Quarter 2	356.8%	-70.9%	ns	ns	-	-
Quarter 3	ns	-91.2%	ns	-	-	-
Quarter 4	ns	ns	ns	ns	208.1%	153.5%
Other Factors	ns	ns	ns	ns	1123.1%	ns

Model Summaries – Loggerheads Northeast Distant Area

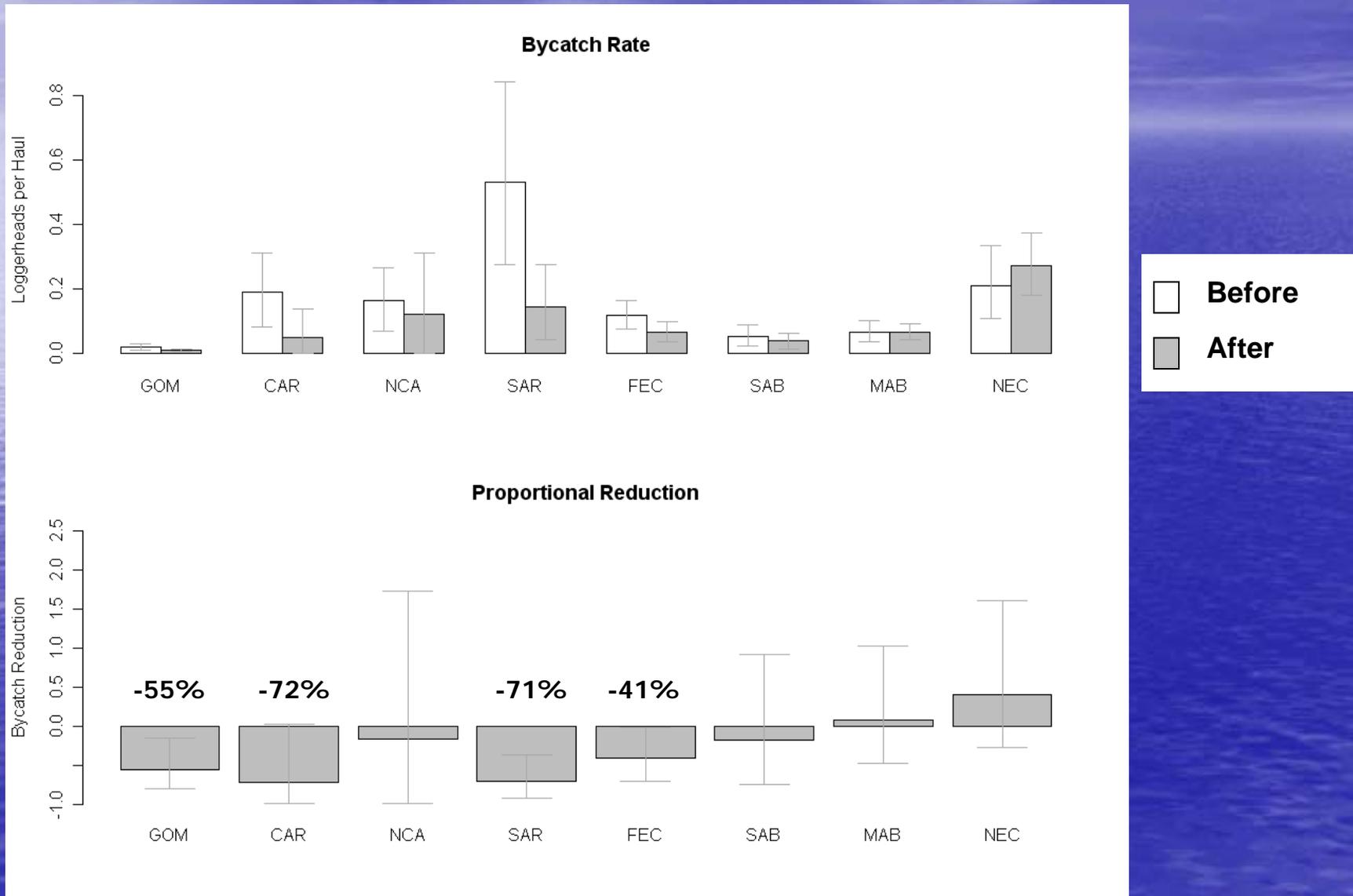


No significant reduction in rate comparing before (1998-2000) to after (2004-2008): Reduction = -18.1% (95% CI -78% to +130%)

Bycatch rates post-reg. significantly higher than expected from experiment

Model Summaries – Loggerheads

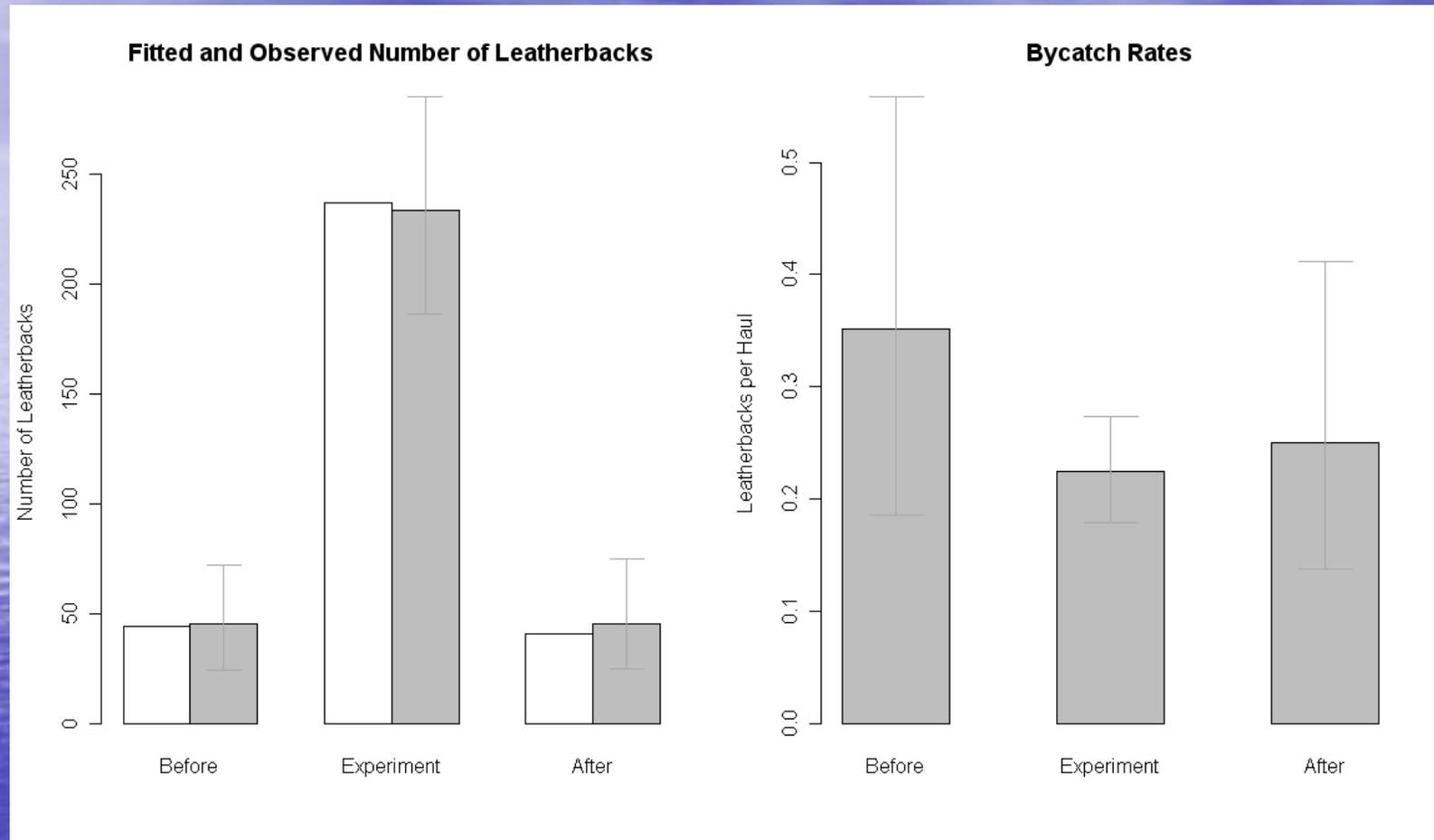
Bycatch Rates and Proportional Reductions



Model Summaries – Leatherbacks

	Gulf of Mexico	Southeast	Northeast	Caribbean/ Offshore	Northeast Distant	
Model Type	Neg. Binom.	Poisson	Poisson	Poisson	Logit	Neg. Binom.
Target - Sword	-	ns	ns	-	-	-
Target - Mix	-	ns	ns	-	-	-
C-16 Hook	213.4%	ns	ns	-	-	-
C-18 Hook	211.8%	-56.4%	ns	ns	ns	ns
J & C-18 Hook	-	-	-	-	ns	ns
Fish Only	-70.7%	ns	ns	-	-52.7%	ns
Fish and Squid	-48.2%	ns	ns	ns	ns	ns
Mainline Len. (+ 10 miles)	ns	ns	149.9%	ns	ns	ns
Soak Duration	ns	ns	ns	ns	ns	ns
Hook Depth	ns	ns	ns	ns	ns	ns
Haul Temp. (70 to 60 F)	ns	ns	-33.4% (sq.)	1130% (lin.)	-55.5% (sq.)	ns
# of Hooks (+ 100 hooks)	ns	ns	ns	86.8%	ns	ns
Quarter 2	221.9%	-13.5%	ns	ns	-	-
Quarter 3	ns	ns	ns	-	-	-
Quarter 4	300.7%	ns	ns	ns	ns	ns
Other Factors	-89.9%	ns	ns	ns	151.7%	ns

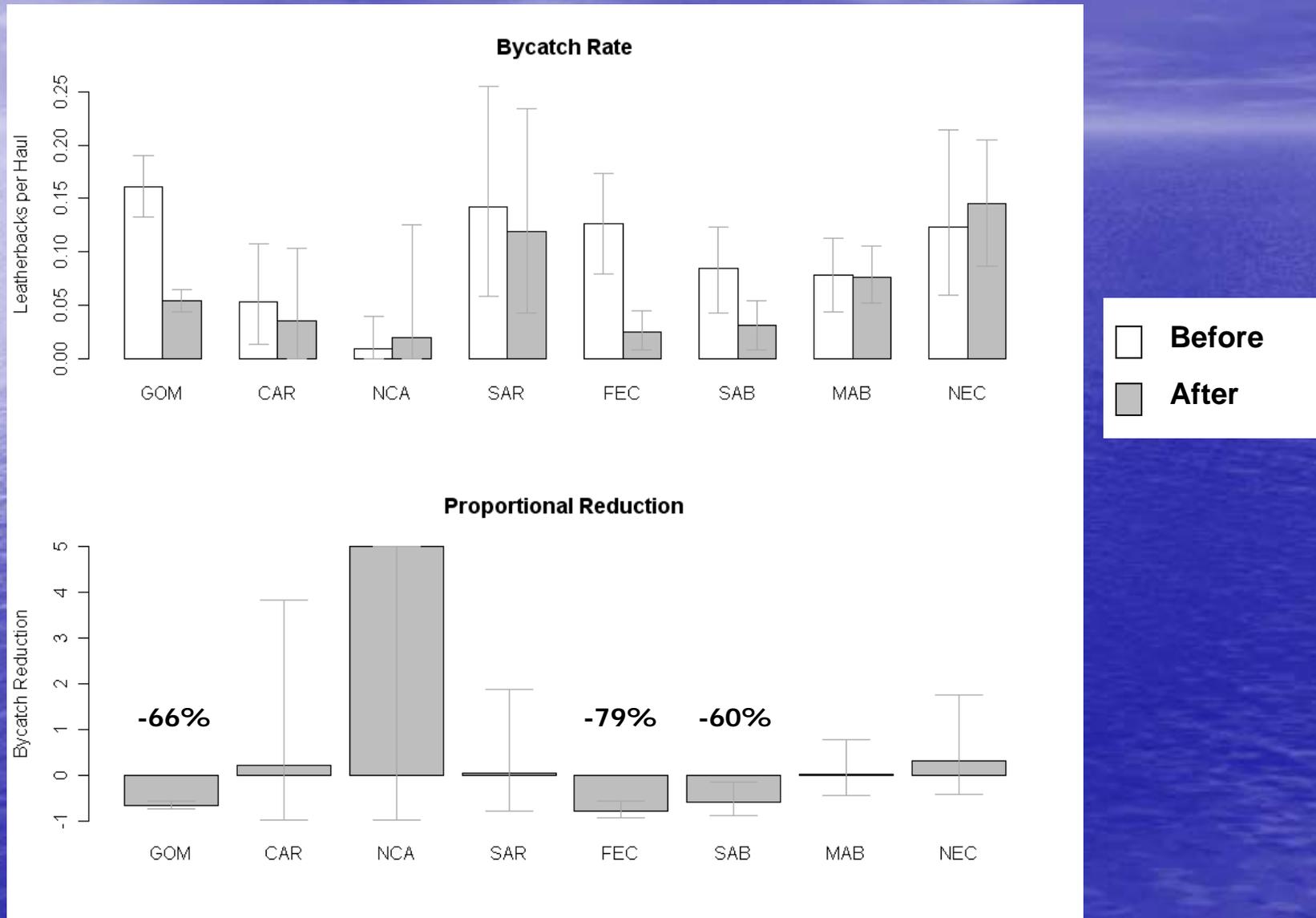
Model Summaries – Leatherbacks Northeast Distant Area



No significant reduction in rate comparing before (1998-2000) to after (2004-2008): Reduction = -22.8% (95% CI -66% to +58%)

Model Summaries – Leatherbacks

Bycatch Rates and Proportional Reductions



Bycatch Reduction

Targets are being met for both loggerhead and leatherback turtles

Loggerheads

BiOp: 575 outside NED + 60 in NED = **545**

Outside NED: Estimated = **384** (95% CI 221-583)

Within NED: Estimated = **157** (95% CI 62-344)

Leatherbacks

BiOp: 481 outside NED + 107 in NED = **588**

Outside NED: Estimated = **482** (95% CI 318-659)

Within NED: Estimated = **113** (95% CI 62-187)

June 1, 2004 Biological Opinion

Reasonable and Prudent Alternatives (RPA)

- Improve monitoring of the effects of the fishery,
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- Take management action to avoid long-term elevations in leatherback takes or mortality

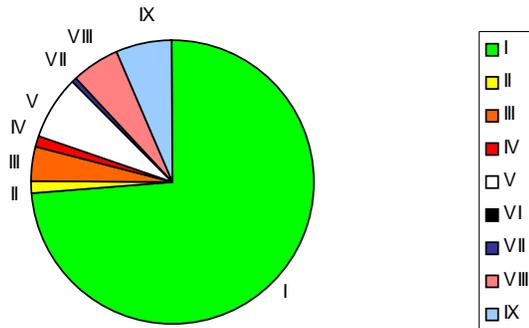
June 1, 2004 Biological Opinion

"The SEFSC must use this information [January 2004 draft post-release mortality criteria] to determine the net mortality ratio associated with the observed captures, according to the method of Epperly and Boggs (2004)"

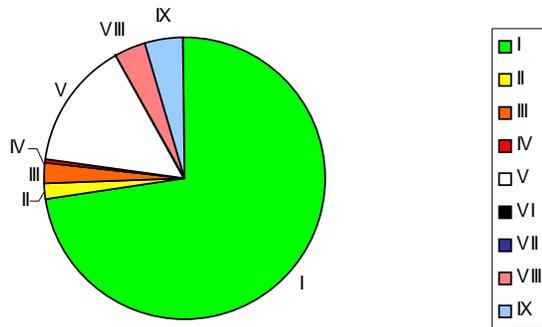
Long-Term Net Mortality Targets (beginning 2007)

- **Leatherbacks (focus of RPA)**
 - A drop in mortality ratio from 32.8% to 13.1% with RPA requiring gear removal (31.9% without RPA)
- **Loggerheads**
 - A drop in mortality ratio from 40.4% to 17.0% (21.8% without RPA)

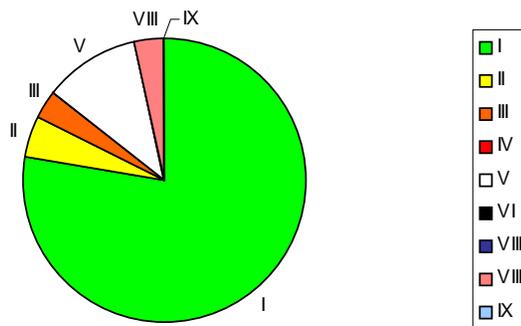
Dermochelys coriacea



Hook Location Pre-Regulation (2001-2004), n=217



Hook Location Post-Regulation (2004-2008), n=248

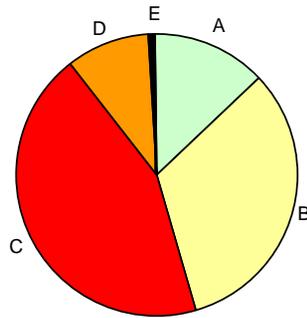


Hook Location: Circle Hooks NED 2002-2003, n=62

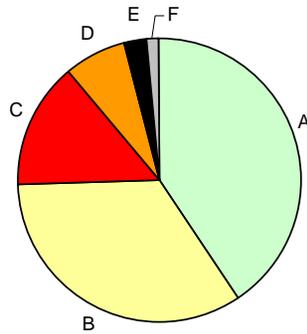
Nature of the Interaction

- I. Hooked externally or in ramphotheca
- II. Hooked in mouth, excluding glottis, roof of mouth, tongue, and jaw joint
- III. Hooked in glottis, roof of mouth, tongue, jaw joint, or cervical esophagus (hook is visible in whole or in part) or in unknown mouth location
- IV. Hooked in esophagus at or below the level of the heart (none of hook is visible)
- V. Entangled only, no hook involved
- VI. [Comatose or unresponsive but resuscitated (hooked in any location and/or entangled)]
- VII. Hooked internally in unknown location (analyzed as IV)
- VIII. Hooked, but location unknown (as IV)
- IX. Unknown if hooked (analyzed as IV)

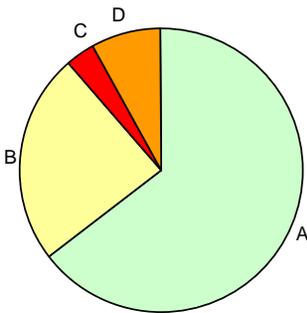
Dermochelys coriacea



Gear Removal Pre-Regulation (2001-2004), n=217



Gear Removal Post-Regulation (2007-2008), n=153

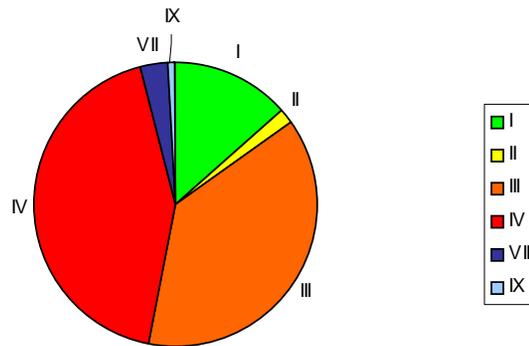


Gear Removal in NED Experiments, 2002-2003, n=62
(revision of Table 3 of Epperly and Boggs, 2004)

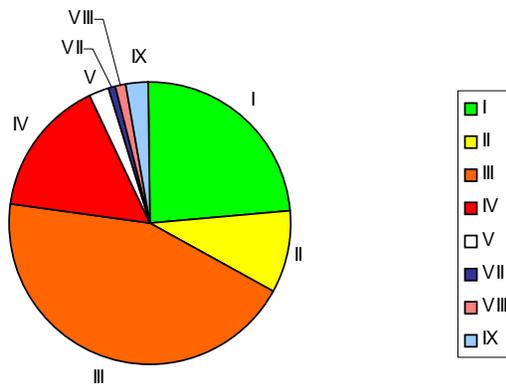
Release Situation

- A. Released with all gear removed**
- B. Released with hook and trailing line less than half the length of the carapace (turtle is not entangled) or released with hook but no trailing line**
- C. Released with hook and trailing line greater than or equal to half the length of the carapace (turtle is not entangled)**
- D. Turtle entangled at release or unknown if entangled at release**
- E. Dead/comatose/unresponsive at release**
- F. Condition at release unknown (analyzed as E)**

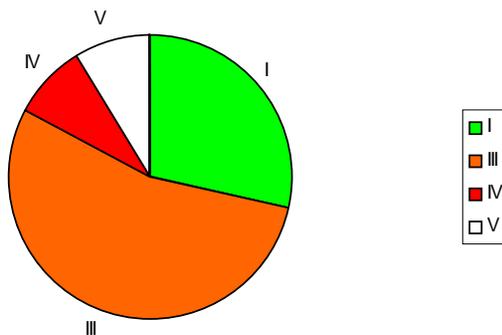
Caretta caretta



Hook Location Pre-Regulation (2001-2004), n=132



Hook Location Post-Regulation (2004-2008), n=235



Hook Location: Circle Hooks NED 2002-2003, n=35

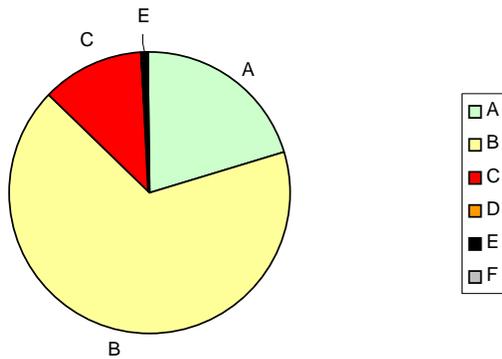
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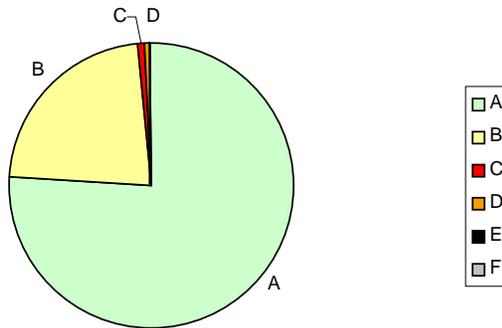
Caretta caretta

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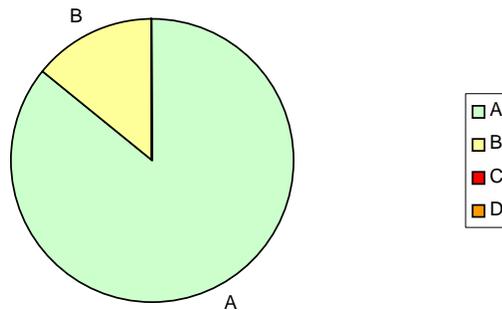


Gear Removal Pre-Regulation (2001-2004), n=132



Gear Removal Post-Regulation (2007-2008), n=149

(from revision of Table 3 of Epperly and Boggs, 2004)



Gear Removal in NED Experiments, 2002-2003, n=35

June 1, 2004 Biological Opinion Post-Hooking Mortality Ratios

- **Leatherbacks**
 - Revised NED analysis: goal is 17.0%
 - 2007-2008 fishery: 21.4%
- **Loggerheads**
 - Revised NED analysis: goal is 17.8%
 - 2007-2008 fishery: 23.7%

Summary

- Bycatch rates in the NED are higher than expected for both species for reasons that appear to be due to other factors not measured
- Reductions in bycatch were realized in the GOM, Offshore, and Southern Areas, but not in waters of the Mid-Atlantic and Northeast U.S.
- Overall bycatch reduction goals for the Atlantic pelagic longline fishery are being met
- Mortality ratio goals, based on NED experiment accomplishments (revised), are not quite being met

Summary

- Effectiveness of circle hooks was not uniform among the fisheries/areas; there are many confounding factors to consider
- Circle hooks appear to be effective in reducing loggerhead bycatch rates in directed swordfish fisheries in the NED, offshore areas, Caribbean, and in the mixed fisheries of the Gulf of Mexico and appear to be effective in reducing leatherback bycatch in the Southeast
- Circle hooks do appear to be effective in reducing the post-hooking mortality of loggerheads (via hooking locations); furthermore, the careful release protocols also are contributing to an expected lower mortality post-release in both species.
- Fish baits do appear effective, particularly in the NED (both species), the Gulf of Mexico (leatherbacks), and the Southeast (loggerheads); effectiveness of bait for loggerheads corroborated through feeding experiments (Stokes et al. 2006)

Questions?

Acknowledgements: Larry Beerkircher, Christofer Boggs, Lisa Belskis, and many pelagic longline observers.

