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# South Atlantic Bight and Florida East Coast Pelagic Longline Time-Area Closure Research: 2008-2010

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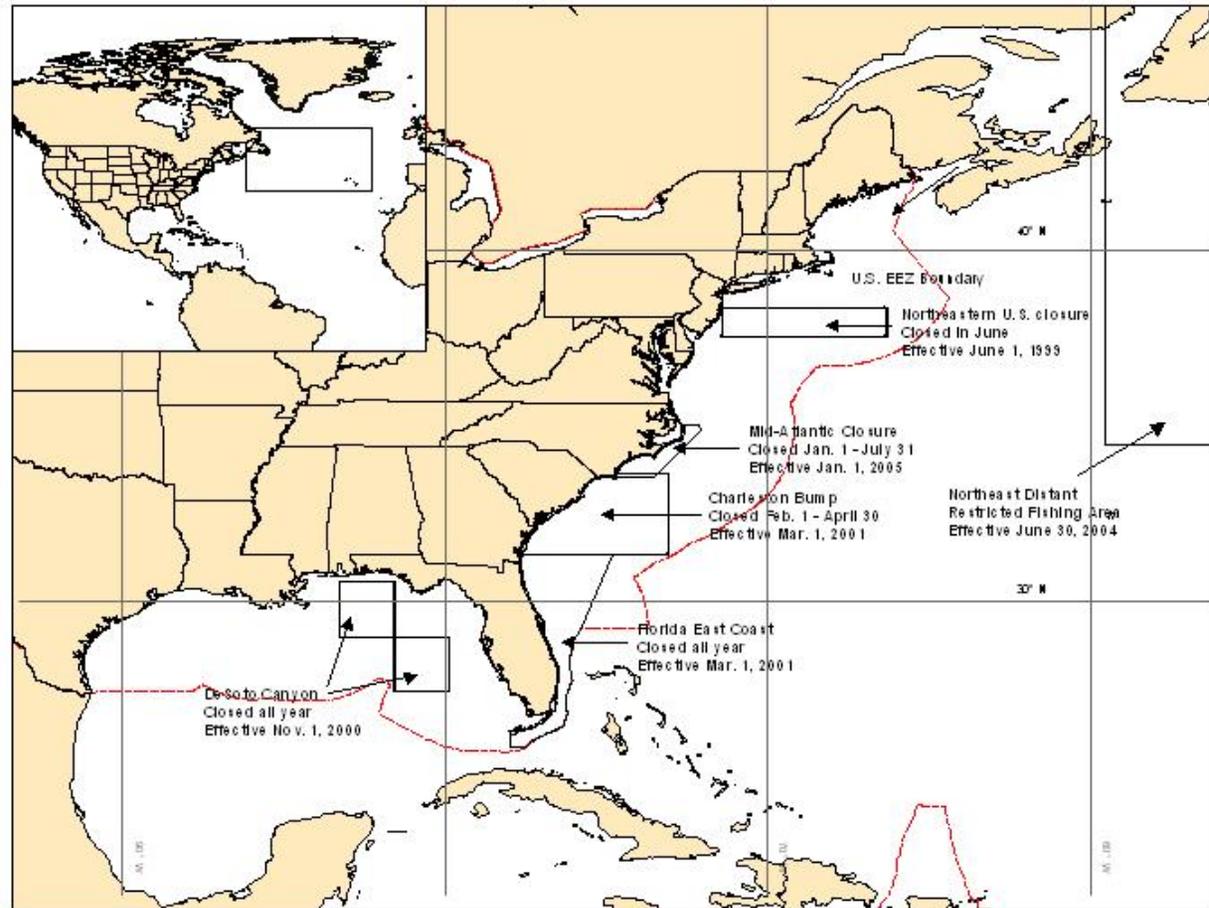
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Presentation to the HMS Advisory Panel

April 6, 2011



## Current Time-Area Closures





## Research Project History

- Original discussions for such a project began in 2006
- Bluewater Fishermen's Association proposed to allow 13 vessels into time-area closures, but opposition eventually resulted in denial of EFP request in July 2007
- Discussion continued with resulting smaller-scale proposal of two vessels, with Federal Register publication of Environmental Assessment by NOAA in November 2007



## Research Project Goals

- 1) **Comparison of catch rates between open and closed (experimental portions) areas;**
- 2) *Comparison of historical and contemporary catch rates between open and closed (experimental portions) areas; and*
- 3) *Comparison of historical and contemporary catch rates of hooks*



## Research Project Objectives

- Evaluate the catch rates of target and bycatch species within the Charleston Bump and Florida Coast East time-area closures to PLL gear.
- Evaluate bycatch reduction potential for 18/0 non-offset circle hook on swordfish directed bycatch species.
- Evaluate the effectiveness of line cutters and de-hookers for releasing bycatch species.
- Collect data on the spatial and temporal relationship between target and bycatch species.
- Evaluate “immediate” mortality using non-offset 18/0 circle hooks.
- Evaluate bycatch reduction potential for non-offset 18/0 hook on all swordfish-directed fishery bycatch species.



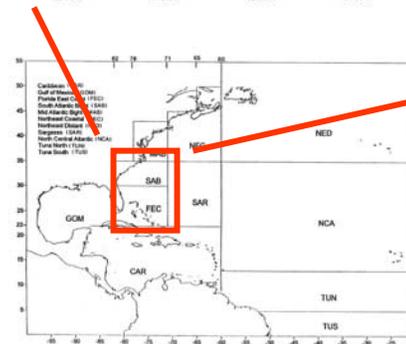
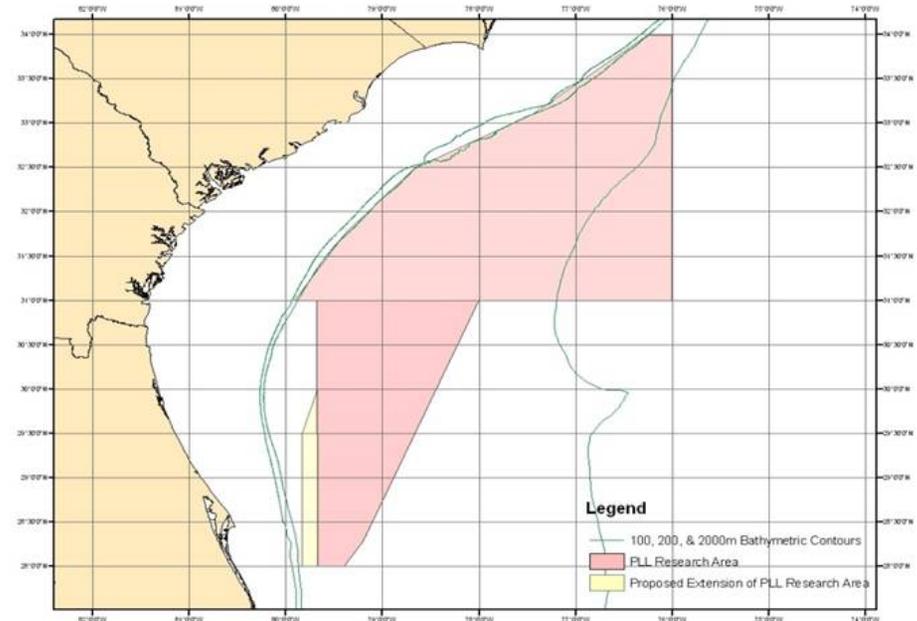
## Project EFP Details

- Vessels and captains required to go through (thorough) background check for prior NOVAs – several interested vessels/captains/owners did not pass
- Original proposal by BWFA called for 13 vessels, but NMFS limited participation to three on the EFP at any one time, and no more than two fishing simultaneously
- All vessels carried NMFS POP, POP contractor, or POP-trained fisheries observer for standardized data collection – most sets by NSU OC graduate students



## Project EFP Details: Area

- Original experimental areas in pink
- Based on concerns that the lower part of the EFC closure could not be adequately fished, a small experimental area in southern end was extended (yellow) in 2009 EFP renewal





## Project Methods

- Ports included Dania (FL), Pompano Beach (FL), Cape Canaveral (FL), and Cherry Point (SC)
- Project did not include any compensation to any participating vessel; even hooks had to be provided by the vessel

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## Project Methods: Operations

- The vessel operator is responsible for all matters relating to safety of personnel, the vessel, and equipment operation.
- The vessel Captain and crew will work cooperatively with and assist the observer to ensure the fullest potential data collection.
- Research vessels will adhere to all gear requirements under current HMS regulations.
- All legally harvested fish catch may be retained by the vessel for sale.
- Research vessels will take precautions to reduce gear and/or fishing grounds conflicts.



## Project Methods: Gear Configurations

- Branch lines must be at least 110% of the float line length.
- Hook spacing must be uniform within a set.
- Vessel may deploy up to 500 hooks per set within the closed areas. Vessels may deploy additional hooks at their discretion when fishing outside the closed areas, but must still allow observer access to examine any caught animals.
- All vessels will employ NOAA-specified line cutters, de-hookers, and mouth gags and openers, and must attempt to release alive all non-target bycatch species.



## Project Methods: Gear Configurations

When targeting swordfish, all vessels must:

- Only non-offset 18/0 circle hooks: either Mustad #39960D or the L-P model
- Use leaded swivels on every leader, placed 2.5 fathoms above the hook
- Use 5 hooks between each set of floats
- No requirement that the first gangion be on the float
- 7 or 10 fathom drops and 12 fathom leaders, uniform within a set

All float, poly ball, and beeper buoy drops must be consistent within a set.



## Project Methods: Gear Operations

- The vessel crew will assist the observer in collecting data on section location, water temperature, and time of section set and haul, including positions of beeper buoys and high-flyers.
- Following each fishing set, the Captain and Observer will determine the accurate number of hooks fished, to be included in the Observer's daily report.
- The fishery observer or experiment coordinator will be given access to the fish at the point of sale to record weight data by carcass



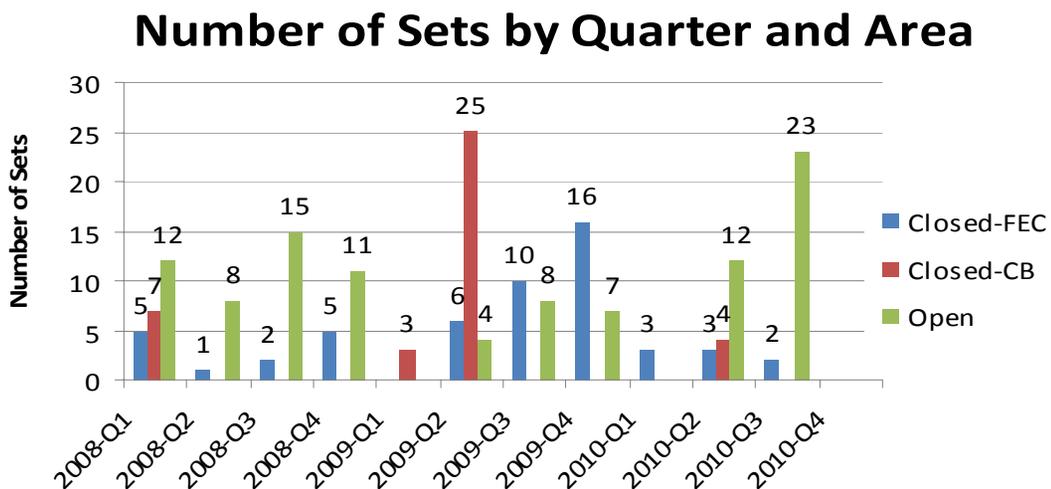
## Project Methods: Gear Operations

- Vessels will conduct normal longline fishing operations inside and outside of each time-area closure
- “Outside” the closure area includes areas within the SAB area (Charleston Bump) and FEC area (East Florida Closure), even outside the U.S. EEZ
- Vessels will attempt – as much as practicable – to divide fishing effort on each trip equally between both sides of the closure lines



## Total Effort: Vessels

- 34 trips completed:  
14 in 2008; 13 in 2009; 7 in 2010
- 192 sets completed:  
39 in CB (seasonal) closed area; 53 in FEC closed area; 100 in open areas
- 5 participating vessels; however, 73% of all sets aboard F/V *Kristin Lee*



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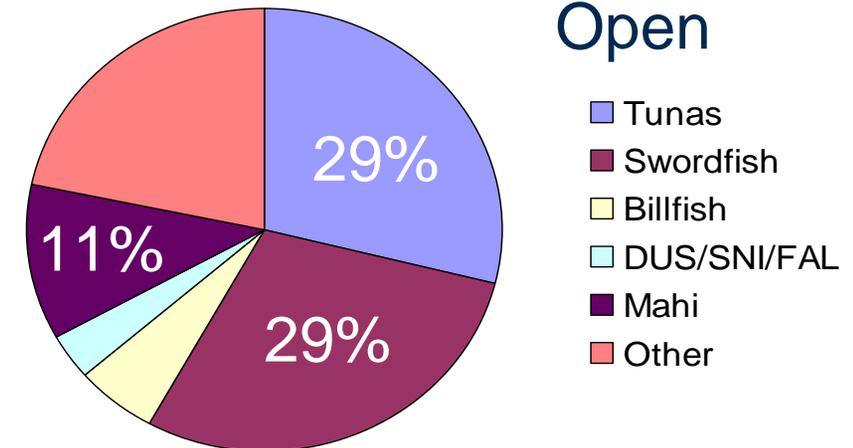
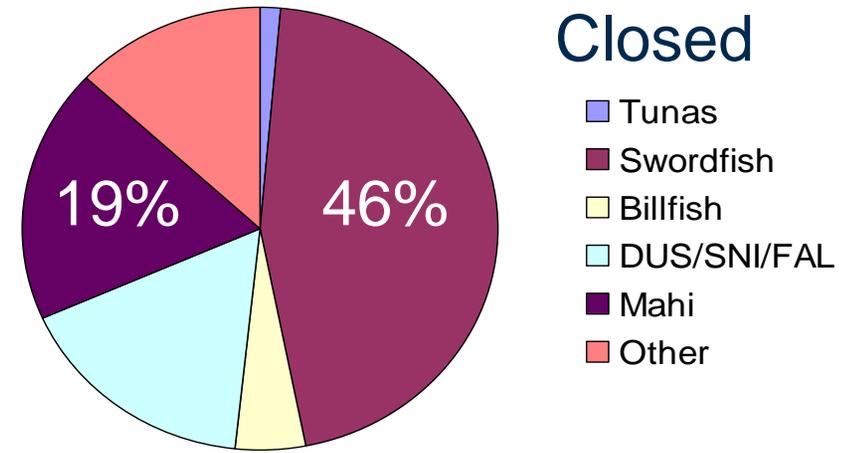
## Total Effort: Individual Research Sets

		Q1	Q2	Q3	Q4	
2008	open	17	11	16	6	50
	closed	7	7	--	4	18
2009	open	--	5	28	17	50
	closed	--	32	--	1	33
2010	open	3	12	17	na	32
	closed	--	7	2	na	9
		27	74	63	28	192

- Original proposal called for 256 experimental sets over one, 12-month period – using statistical power estimation tools and historical CPUE data, such work would have provided a minimum power of  $(1 - \beta) = 0.90$
- Final sets totaled 192, with 60 within the closed area(s) and the remainder in open areas and/or open seasons – 10 sets not fully observed, so not included in catch rate analyses



## Total Catches: All Species





## Catches: Swordfish Lengths

- **Total swordfish (both TAC combined):**
  - 1156 open:  $141.0 \text{ cm} \pm 31.3$ ; 994 closed:  $135.8 \text{ cm} \pm 26.1$
  - $t=4.23$ ;  $\text{Pr}>|t| < 0.0001^{**}$



## Catches: Tunas and Mahi Lengths

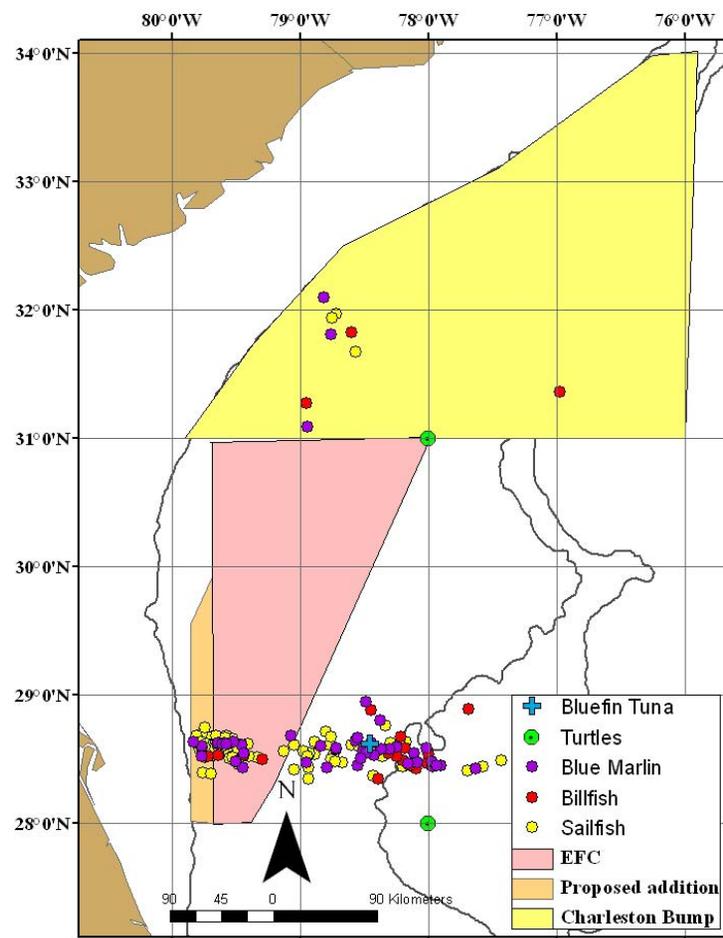
- **Bigeye tuna:**
  - 310 open:  $108.6 \text{ cm} \pm 20.5$ ; 16 closed:  $94.8 \text{ cm} \pm 14.4$
  - $t=2.66$ ;  $\text{Pr}>|t| = 0.0082^*$
- **Yellowfin tuna:**
  - 97 open:  $122.2 \text{ cm} \pm 20.6$ ; 10 closed:  $100.3 \text{ cm} \pm 12.6$
  - $t=3.05$ ;  $\text{Pr}>|t| = 0.0029^*$
- **Bluefin tuna:** only one caught, in open area during 2010
- **Mahi:**
  - 116 open:  $110.9 \text{ cm} \pm 17.9$ ; 731 closed:  $98.5 \text{ cm} \pm 14.9$
  - $t=7.07$ ;  $\text{Pr}>|t| < 0.0001^{**}$  (Satterthwaite for uneq. var.)

# Catches: Bycatch Species Mortality



## Billfish:

- Blue marlin: 84 total  
(14 dead, 10 alive predicted)
  - 19 dead, 65 alive
  - $\chi^2=25.19$ , Pr: <0.0001\*\*
- White marlin: 11 total  
(13 dead, 9 alive predicted)
  - 4 dead, 7 alive
  - $\chi^2=0.82$ , Pr: 0.3657
- Sailfish: 187 total  
(11 dead, 20 alive predicted)
  - 56 dead, 131 alive
  - $\chi^2=30.08$ , Pr <0.0001\*\*



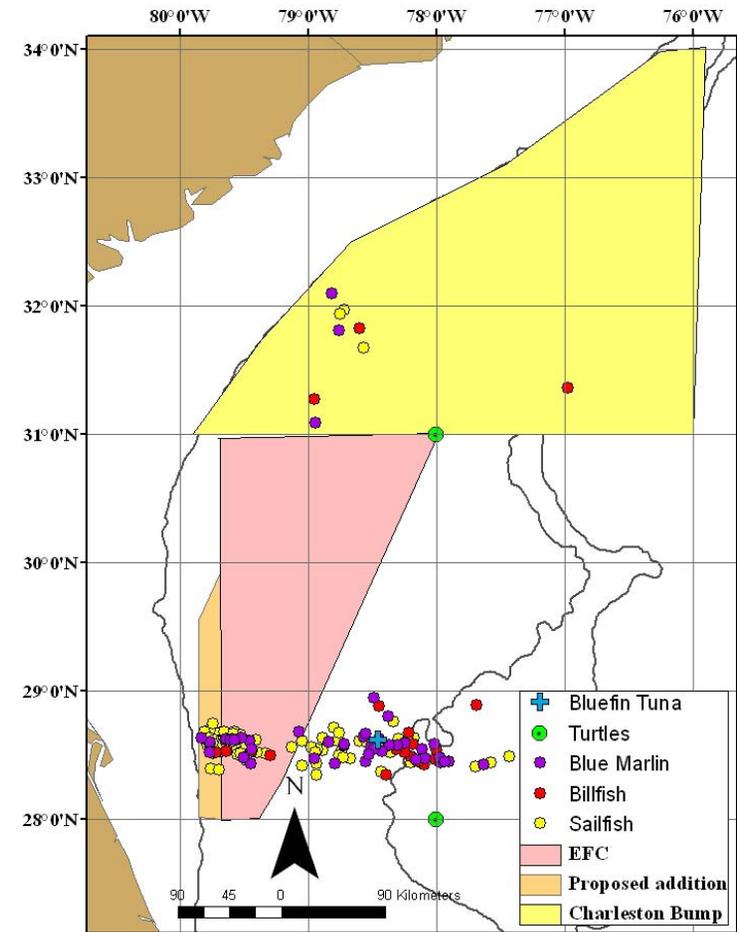
# Catches: Bycatch Species Mortality



## Sea Turtles:

- Under “worst-case” scenario published in FR notice, 2 leatherback and 6 loggerhead turtle interactions would result
- Actual results were 3 leatherbacks and 2 loggerheads, all released alive without trailing fishing gear

**No seabird interactions occurred during any part of this study.**





# Catches: Bycatch Species Mortality

## Silky Shark

- 377 total: 175 dead, 201 alive;  $\chi^2=1.79$ , Pr: 0.1800

## Night Shark

- 595 total: 394 dead, 196 alive;  $\chi^2=66.45$ , Pr: <0.0001\*\*

## Tiger Shark

- 160 total: 3 dead, 156 alive;  $\chi^2=147.22$ , Pr: <0.0001\*\*



## Testing for Scientific Error

In a hypothetical example of a patient being tested for HIV, statisticians approach it like this: Begin with the null hypothesis, that the patient *does not* have the disease; the alternative hypothesis is that HIV is present. If the null hypothesis is rejected when it is in fact true (the patient tests positive for infection when the patient is well), this is a **Type I error** or “false positive.” If the null hypothesis is not rejected when it is in fact false (the patient tests negative when the patient is infected), this is a **Type II error** or “false negative.”

Type I error probability is assessed with statistical significance tests.

Type II error probability is assessed with statistical power tests.

Statistical power is conventionally expressed as  $(1 - \beta)$ , and power values of greater than 0.8 are generally considered sufficient to avoid Type II errors.



## Catch Rate Comparisons

- CPUEs expressed as: [catch] per 1000 hooks
- All CPUEs log-transformed with  $\log(x+1)$  for normality and assessed for area and quarter effects using PROC GAM in SAS (v. 9.2)
- Statistical power calculated *post hoc* for all comparisons using Cohen's  $d$  and G\*Power (v.3.1.2). Generally, values of  $(1 - \beta) > 0.8$  are considered adequate power.

Note: Charleston Bump time-area closure is only seasonal; therefore, sets in this area during open seasons lumped with rest of open areas for analyses



## Catch Rates: All Swordfish

- **All years, all quarters:**
  - closed: mean= $36.8 \pm 29.2$  (range: 0-112)
  - open: mean= $19.77 \pm 15.2$  (range: 0-84.4)
- **GLM results: All swordfish**
  - area:  $F=12.36$ ,  $Pr>F$  0.0006\*
  - quarter:  $F=1.91$ ,  $Pr>F$  0.1288
  - area\*quarter:  $F=4.72$ ,  $Pr>F$  0.0034\*

Power ( $1 - \beta$ ) = **0.8644**



## Catch Rates: Retained Swordfish

- **All years, all quarters:**
  - closed: mean= $25.4 \pm 19.9$  (range: 0-72)
  - open: mean= $15.3 \pm 12.3$  (range: 0-65.3)
- **GLM results: Retained Swordfish Only**
  - area:  $F=2.18$ ,  $Pr>F$  0.1411
  - quarter:  $F=1.02$ ,  $Pr>F$  0.3832
  - area\*quarter:  $F=3.57$ ,  $Pr>F$  0.0152\*

**Power ( $1 - \beta$ ) = 0.6931**



## Catch Rates: Swordfish Discards

- **All years, all quarters:**
  - closed: mean= $11.1 \pm 11.5$  (range: 0-44)
  - open: mean= $4.3 \pm 4.6$  (range: 0-24.4)
- **GLM results: Discarded Swordfish Only**
  - area:  $F=19.18$ ,  $Pr>F < 0.0001^{**}$
  - quarter:  $F=4.60$ ,  $Pr>F 0.0039^*$
  - area\*quarter:  $F=4.74$ ,  $Pr>F 0.0033^*$

Power  $(1 - \beta) = \mathbf{0.9574}$

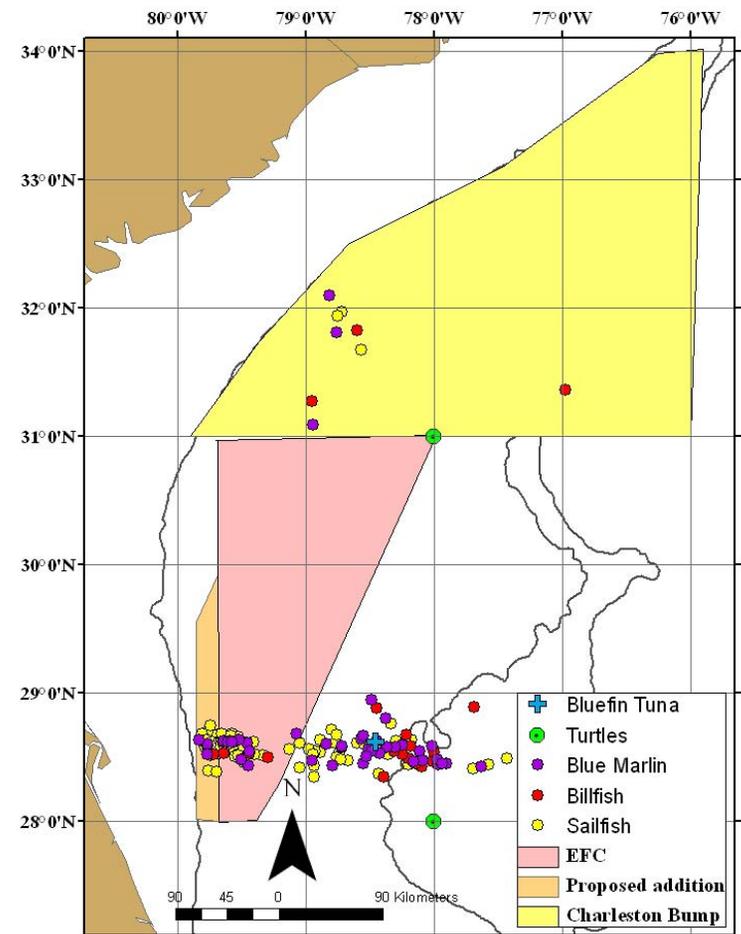


# Catch Rates: Billfish Bycatch

## Blue Marlin

- All years, all quarters:
  - closed: mean= $0.69 \pm 0.18$   
(range: 0-0.69)
  - open: mean= $0.18 \pm 0.27$   
(range: 0-1.07)
- GLM results:
  - area:  $F=0.30$ ,  $Pr>F$  0.5872
  - quarter:  $F=0.34$ ,  $Pr>F$  0.7983
  - area\*quarter:  $F=0.63$ ,  $Pr>F$  0.5937

$$\text{Power } (1 - \beta) = 0.0673$$

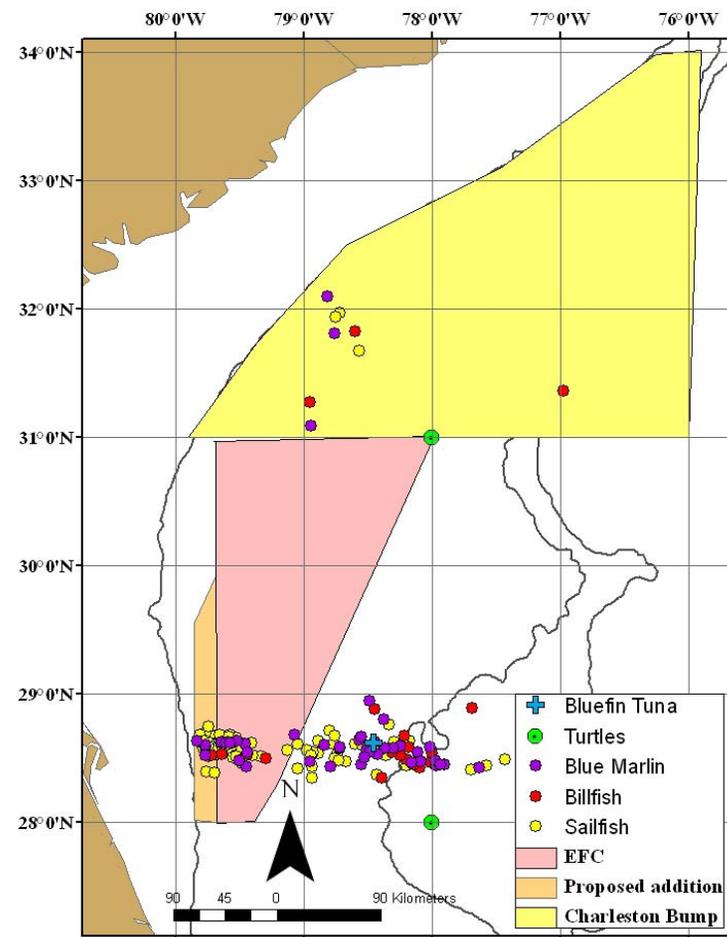




## Catch Rates: Billfish Bycatch

### Sailfish

- All years, all quarters:
    - closed: mean= $0.04 \pm 0.14$   
(range: 0-0.69)
    - open: mean= $0.37 \pm 0.40$   
(range: 0-1.33)
  - GLM results:
    - area:  $F=18.27$ ,  $Pr>F < 0.0001^{**}$
    - quarter:  $F=9.89$ ,  $Pr>F < 0.0001^{**}$
    - area\*quarter:  $F=2.05$ ,  $Pr>F 0.1088$
- Power  $(1 - \beta) = 0.8644$**

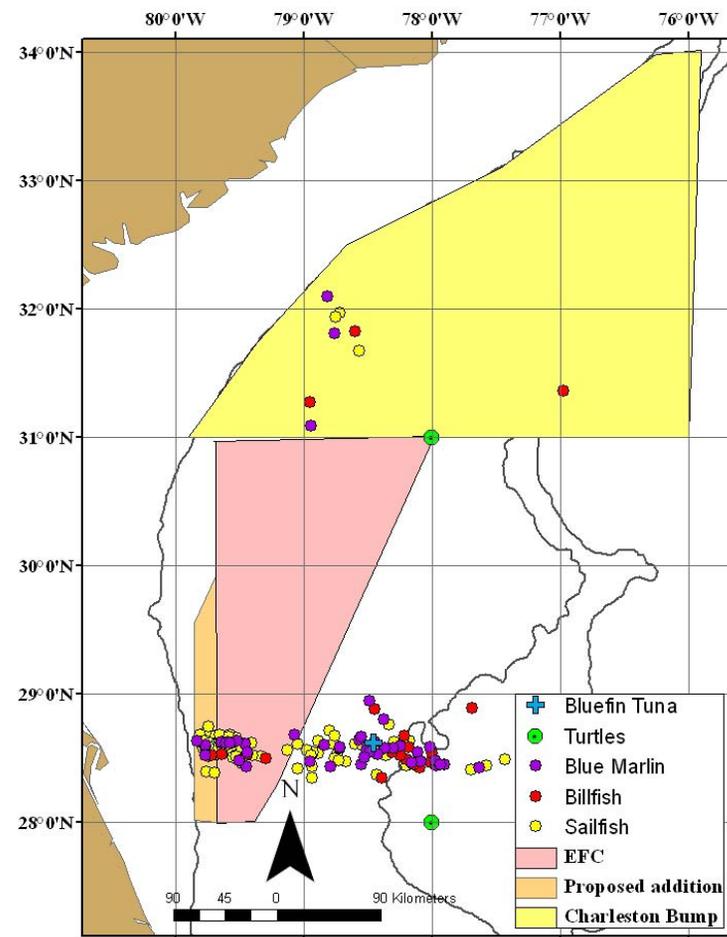




# Catch Rates: Billfish Bycatch

## All Billfish Combined

- All years, all quarters:
    - closed: mean= $0.15 \pm 0.26$   
(range: 0-0.71)
    - open: mean= $0.50 \pm 0.43$   
(range: 0-1.47)
  - GLM results:
    - area:  $F=43.57$ ,  $Pr>F < 0.0001^{**}$
    - quarter:  $F=19.75$ ,  $Pr>F < 0.0001^*$
    - area\*quarter:  $F=1.74$ ,  $Pr>F 0.1613$
- Power  $(1 - \beta) = 0.9906$**





# Catch Rates: Shark Bycatch

## Silky Shark

- All years, all quarters:
  - closed: mean= $38.17 \pm 97.86$   
(range: 0-562.5)
  - open: mean= $1.31 \pm 2.81$   
(range: 0-22.22)
- GLM results:
  - area:  $F=50.97$ ,  $Pr>F <0.0001^{**}$
  - quarter:  $F=8.22$ ,  $Pr>F <0.0001^{**}$
  - area\*quarter:  $F=9.98$ ,  $Pr>F <0.0001^{**}$

**Power ( $1 - \beta$ ) = 0.9986**

## Night Shark

- All years, all quarters:
  - closed: mean= $7.84 \pm 13.01$   
(range: 0-64.0)
  - open: mean= $0.51 \pm 1.47$   
(range: 0-8.33)
- GLM results:
  - area:  $F=80.43$ ,  $Pr>F <0.0001^{**}$
  - quarter:  $F=3.48$ ,  $Pr>F 0.0172^*$
  - area\*quarter:  $F=16.01$ ,  
 $Pr>F <0.0001^{**}$

**Power ( $1 - \beta$ ) = 0.9999**



## Conclusions: Project

- Requirements for EFP resulted in few participating vessels – many more were willing, but did not qualify
- Unwillingness (or inability, due to EFP requirements) for vessels to conduct year-round sampling in CB
- Zero interactions with any recreational vessel



## Conclusions: Catches

- Overall billfish mortality\* minimal, as was sea turtle bycatch and bluefin tuna incidental catch
- Significantly higher catch rates of all swordfish and swordfish discards within closed areas
- Unknown effects of using non-offset 18/0 circle hooks versus fleet-standard offset 18/0 circle hooks or non-offset size 16/0 circle hooks

\* Defined as “mortality at haulback”



## Last Project Steps?

- Completing comparisons of historical and contemporary catch rates (Goal #2); however, some issues:
  - “apples and oranges” comparison question between hook types and changes in baseline CPUE?
  - available data are on basis of single hook types within a set; i.e., not standard, paired-hook scientific comparisons
  - also, standard POP observer protocol is only to record animal disposition (alive or dead), not other, potentially useful data such as hooking location



## Next Steps?

- Need to do comparisons of hook types, but little data available for public use (e.g., FRI project and NED project data are still not publicly available). However, some of these data are scheduled to be presented (Congress-willing!) at the upcoming Circle Hook Symposium next month in Miami.



## Management Considerations?

- Locations of target and bycatch species catches might allow more specific area targeting of closed areas
- Significant interaction effects of area\*quarter in most species-level analyses might allow more time-specific targeting of closed areas

However, both suggestions are under the presumption that neither alternative strategy would increase bycatch nor result in any other undesirable outcome.



## Other Research?

- Swordfish diet in FL Straits
- Mesopelagic teleost life-history
- Pelagic stingray life-history
- Cetacean habitat modeling
- Conventional tagging!
  - 29 swordfish
  - 11 blue and white marlin
  - 19 sailfish
  - 74 various sharks, with two tag recoveries (night, s/f mako)

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January 21, 2010

Congratulations! We have received recapture information on a shark tag that was issued to you. We are sincerely grateful to those fishermen who assist our research by tagging sharks. The information you provide is vital to our studies on migrations, age and growth, and other aspects of the biology of sharks. Thank you for your participation in the Cooperative Shark Tagging Program and for helping to make this research possible.

**Tag Number**  
324243

**Silky shark (sickle)**

**Female**





Data are preliminary and subject to revision.

	Release	Recapture
Date	04/02/2009	01/07/2010
Location	31° 37' N 78° 14' W	23° 03' N 82° 45' W
Size	84 cm measured fork length	120 cm estimated total length 12 kg estimated weight
Caught By	Biologist	Recreational Fisherman
Using	Longline	Handline
Distance Traveled		894 nm southwest †
Time at Liberty		280 days, 9.2 months, 0.8 years
		† distance traveled calculated using waypoints around Florida



## Acknowledgements

- NSU OC graduate student fisheries observers: Shannon Bayse, Cheryl Cross, Heidi (DaSilva) Keller, Mike Tousignant, Matt Dancho, and Sohail Khamesi
- Matt Dancho, Rachel Hickey, and Sohail Khamesi for species-level data assistance
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- NMFS HMS staff for EFP assistance
- BWFA for support and vessel assistance
- Vessels, crews, and captains of the F/V *Carol Ann*, F/V *Kristin Lee*, F/V *Shady Lady*, F/V *Southern Lady*, and F/V *Dakota*



NSU OC graduate student Cheryl Cross aboard the F/V *Shady Lady* in 2009