Robust Ecosystem-based Management of the Chesapeake Bay Blue Crab Fishery

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Executive Committee Meeting
December 4, 2013

Chesapeake Bay Program
A Watershed Partnership

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Part 1

- *Rationale* #1:
  - *There is a strong need for fisheries management to be able to analyze specific policies in terms of both biological and economic outcomes*
- *Objective #1*:
  - Develop a model that includes socioeconomic considerations for ecosystem-based fishery management for the blue crab fishery in Chesapeake Bay.

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Part 2

- *Rationale #2:*
  - *While "precautionary" management is regularly used, there is a lack of objective criteria for how much precaution is appropriate.*
- *Objective #2:*
  - Develop a statistically-based approach for precautionary fisheries management and apply the approach to identify robust precautionary catch limits for the blue crab fishery in Chesapeake Bay.

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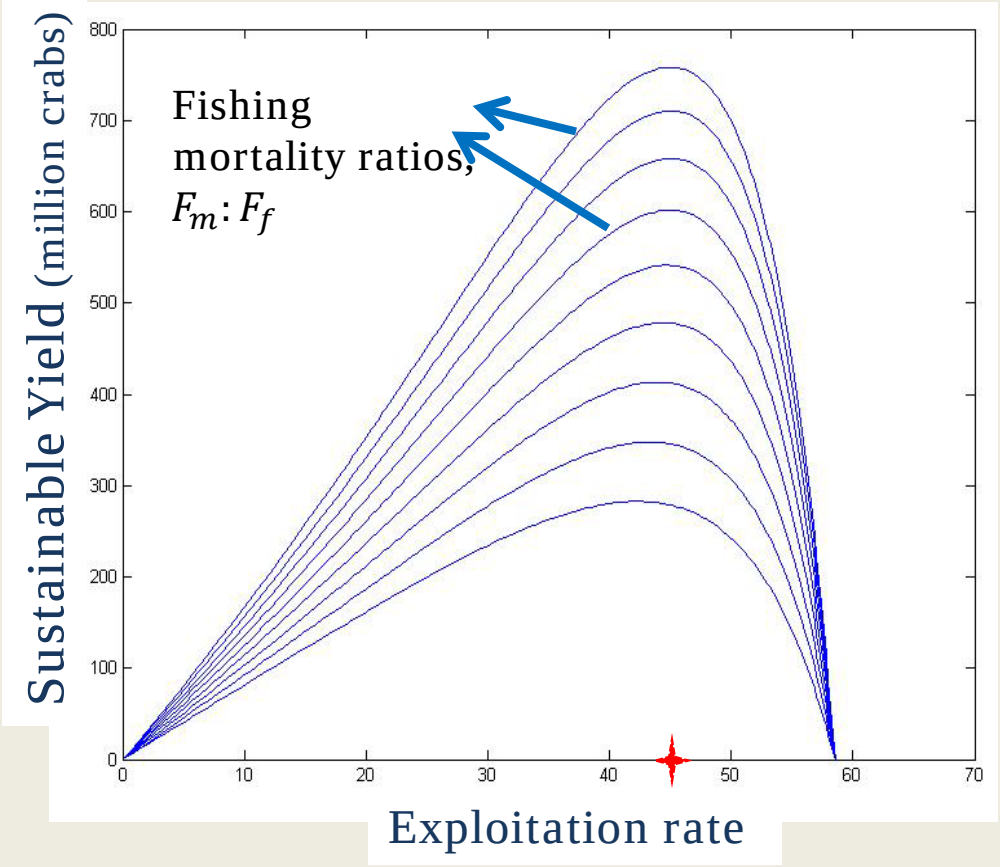
Motivation Part 1: How do we manage?



Stock Assessment (Miller et al. 2011)

What is missing?

- Economic outcome
- Exploitation rate must be controlled indirectly through fishery policies

Fishery policy

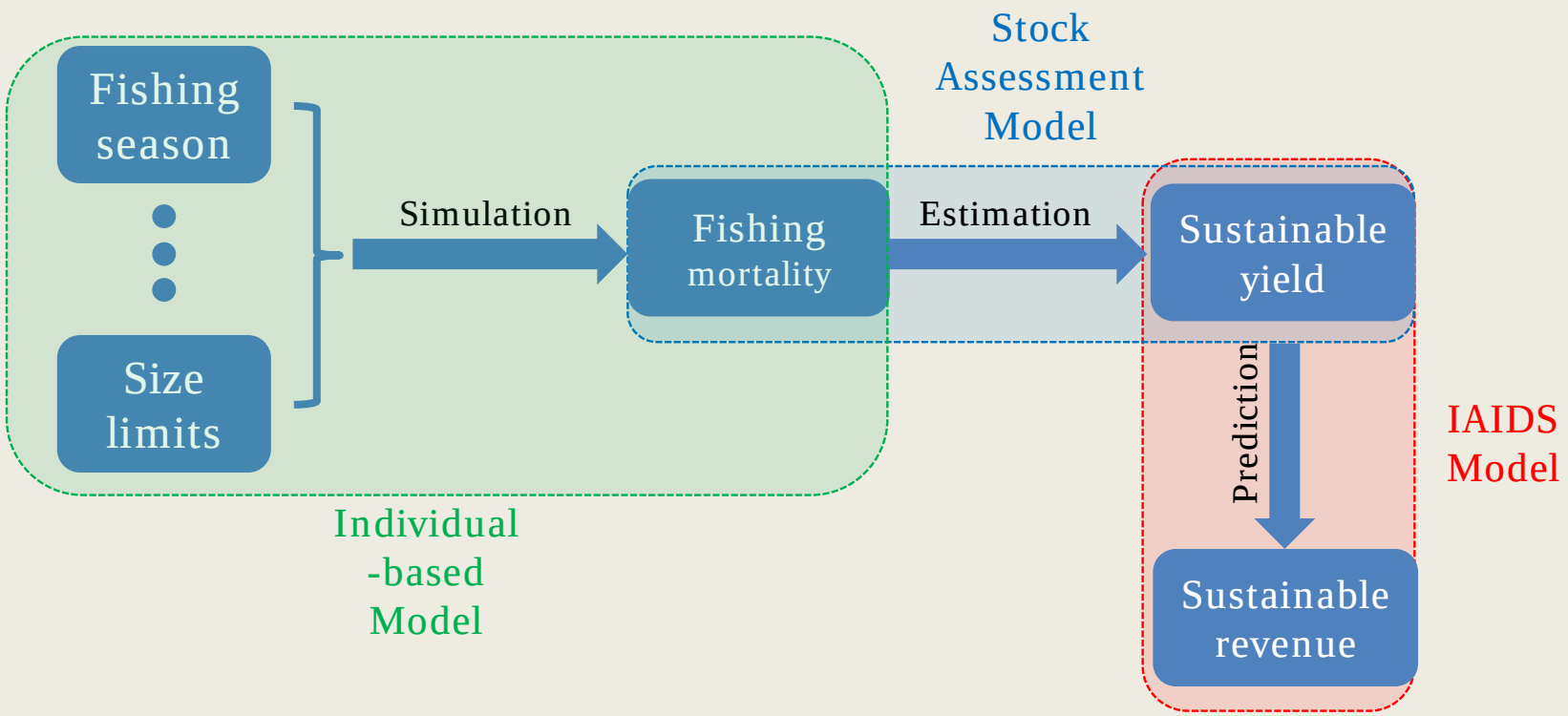
- Season length
- Season closure
- Size limits
- Spatial closures
- Vessel size limit

Part 1: An integrated model of the Chesapeake Bay Blue Crab Fishery

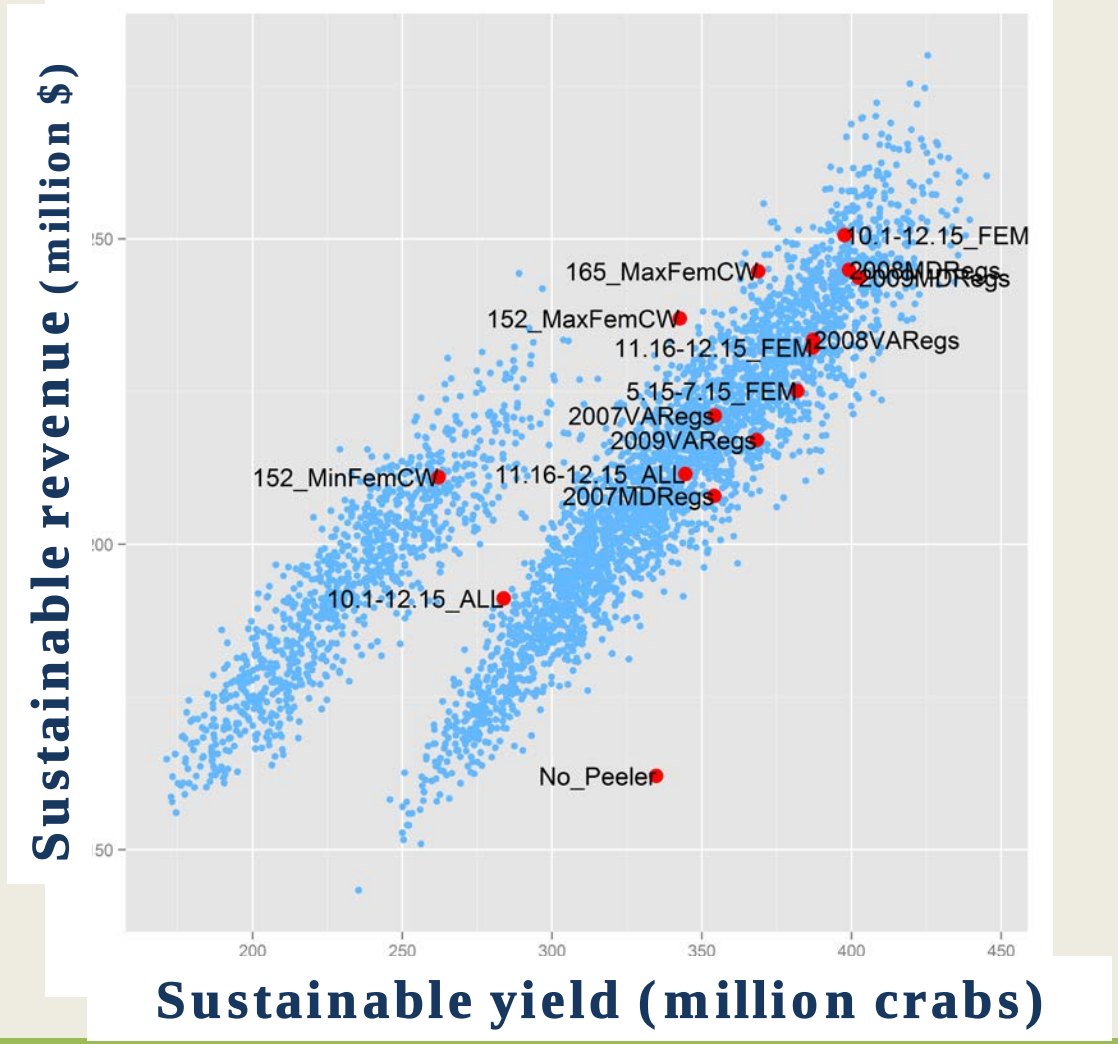
Three models are integrated:

1. An individual-based model of the blue crab fishery (Bunnell et al. 2010; Miller et al. 2011) that simulates the effects of specific policies (e.g. size limit or a closure) on harvests and stocks.
2. The 2011 stock assessment model, which predicts the sustainable harvests associated with fishing mortality.
3. A new economic demand model, that allows the prediction of prices for each blue crab market category throughout the season

The Integrated Model

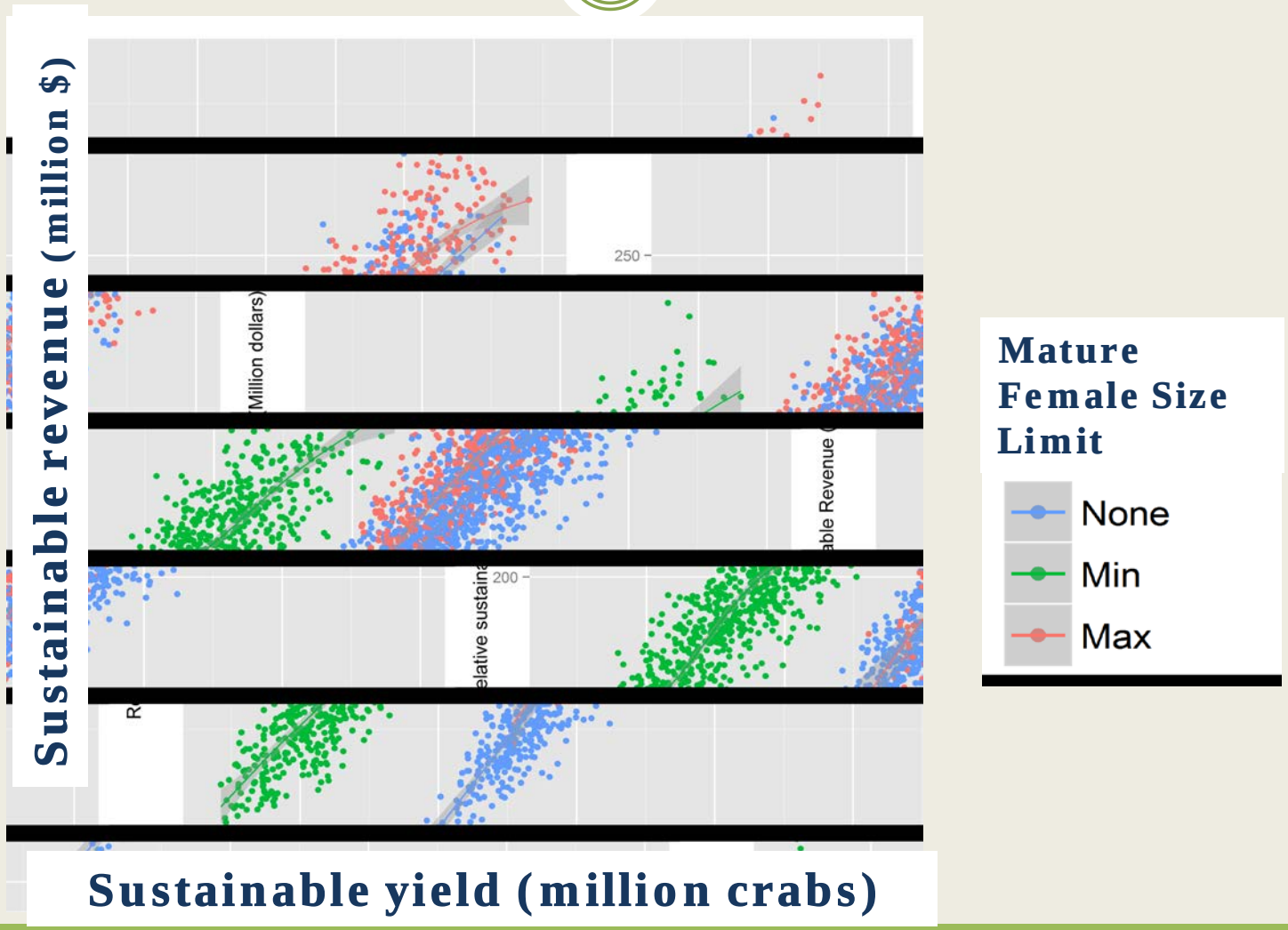


Management Scenarios



Scenarios in Bunnell et al. (2010) and 4000 simulated scenarios

What separates them?



Regression Analysis

Policy Components	Sustainable Revenue ($)	Sustainable Yield (#)
Start-Date – M (day)	0.506	1.089
Season Length – M (day)	0.743	1.418
Start-Date – F (day)	-0.175	-0.041
Season Length – F (day)	-0.317	-0.248
Closure Days – F (day)	-0.204	-0.012
Initial Min Size Lim – M & F0 (>mm)	-0.050	-1.641
Δ Min Size Lim – M & F0 (>mm)	-0.003	-1.312
Initial Min Size Lim – Peeler (>mm)	-1.514	-0.660
Δ Min Size Lim – Peeler (>mm)	-1.220	-0.515
Min Size Lim – Soft (>mm)	-0.532	-0.252
Max Size Lim – F1 (<mm)	-0.847	-0.731
Min Size Lim – F1 (>mm)	-0.794	-2.465

Note: this table only shows results associated with some selected variables.
All variables are significant at the 1% level except for the grey ones.

Regression Analysis

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Part 1:Preliminary Results

- Desirable policies
  - Shorter seasons for females
  - Longer seasons for males
  - Less restrictive minimum size limits

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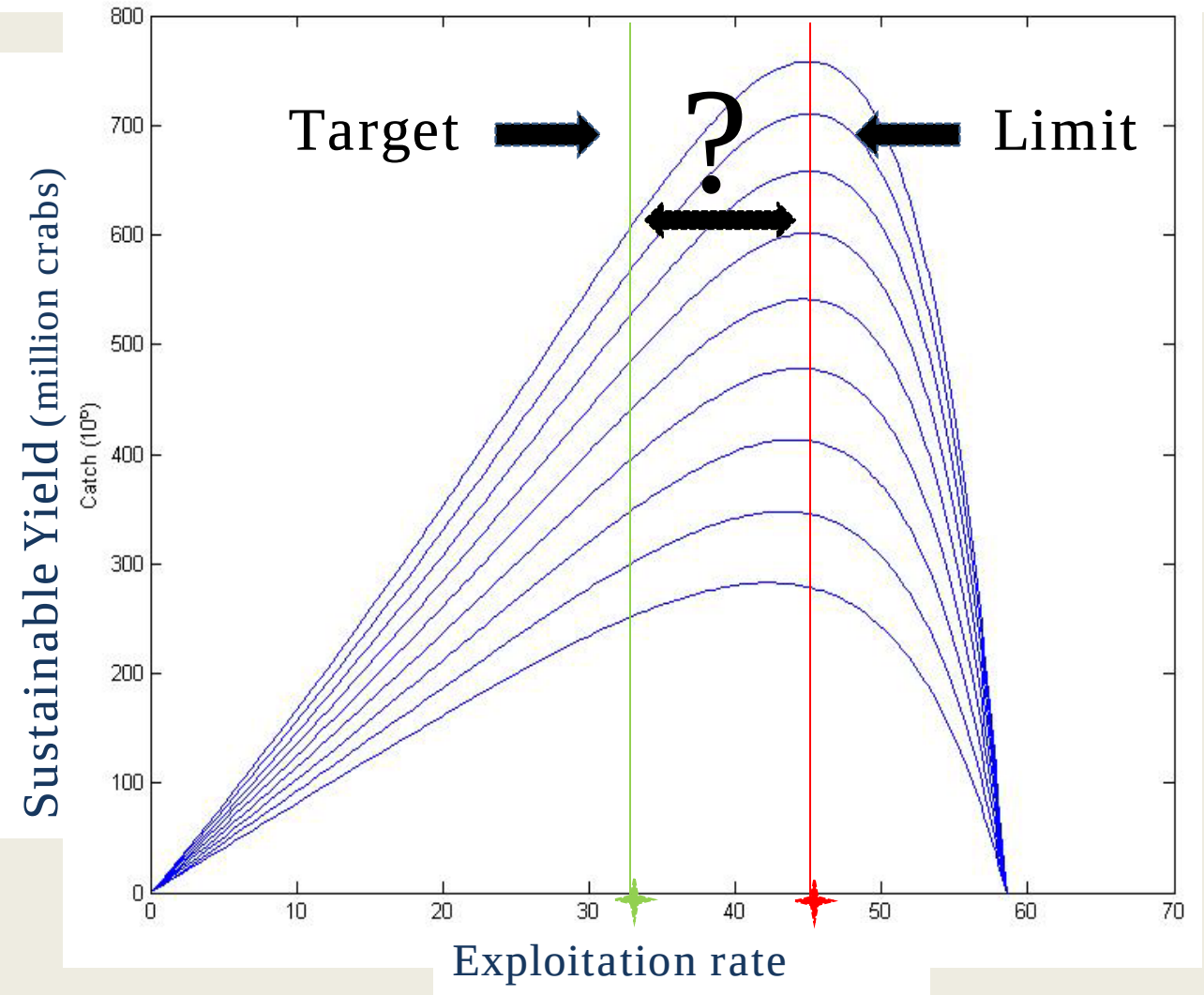
Part 2

- *Rationale #2:*
  - *While "precautionary" management is regularly used, there is a lack of objective criteria for how much precaution is appropriate.*
- *Objective #2:*
  - Develop a statistically-based approach for precautionary fisheries management and apply the approach to identify robust precautionary catch limits for the blue crab fishery in Chesapeake Bay.

Motivation Part 2: How Much Precaution?



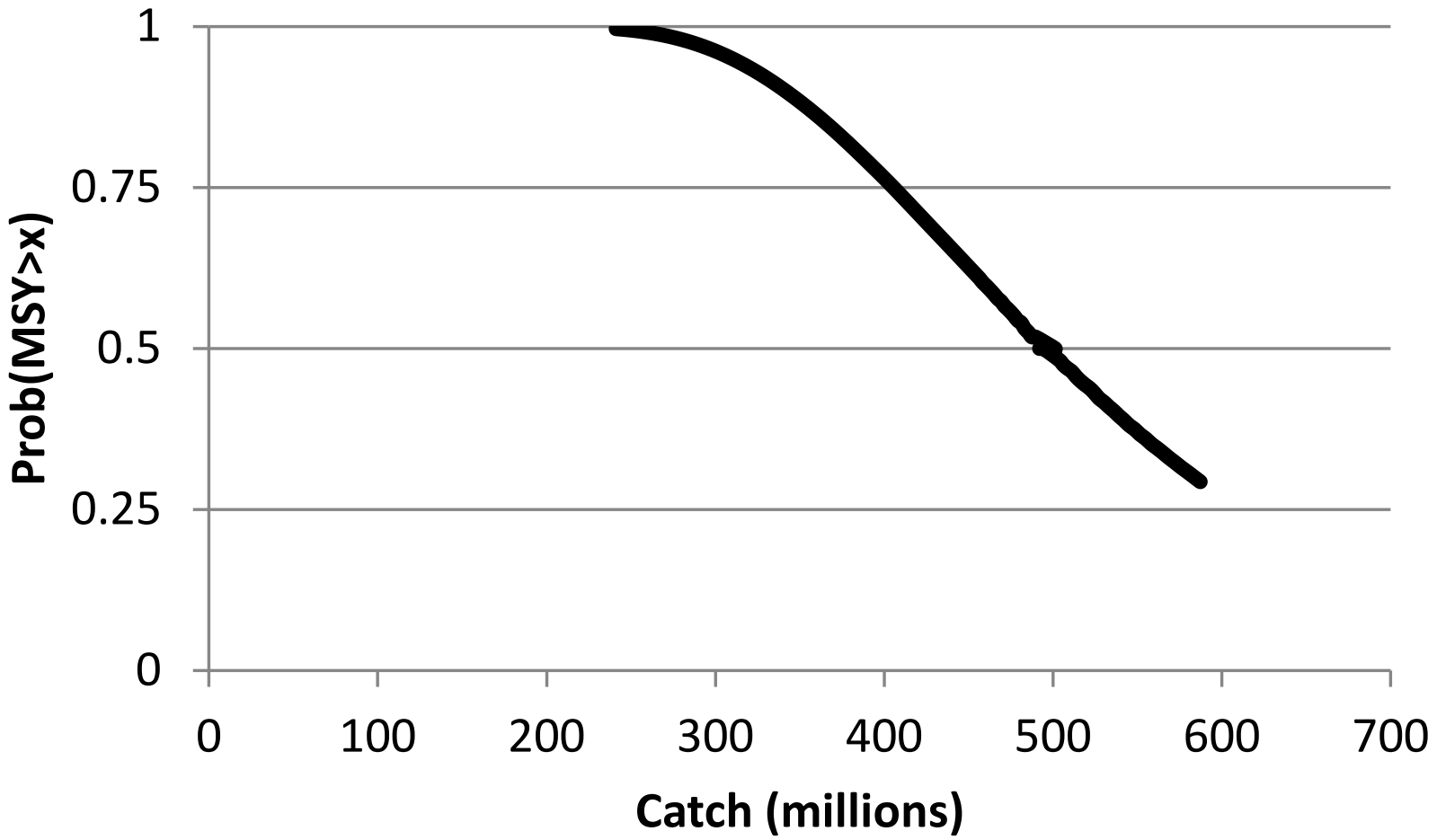
Stock Assessment (Miller et al. 2011)

Part 2: Robust harvest level advice

Robust estimates of maximum sustainable harvest:

1. Use likelihood profiling to estimate the uncertainty in Maximum Sustainable Yield.
2. Choose the appropriate confidence interval to develop “robust” catch level advice.

Robust Maximum Sustainable Yield



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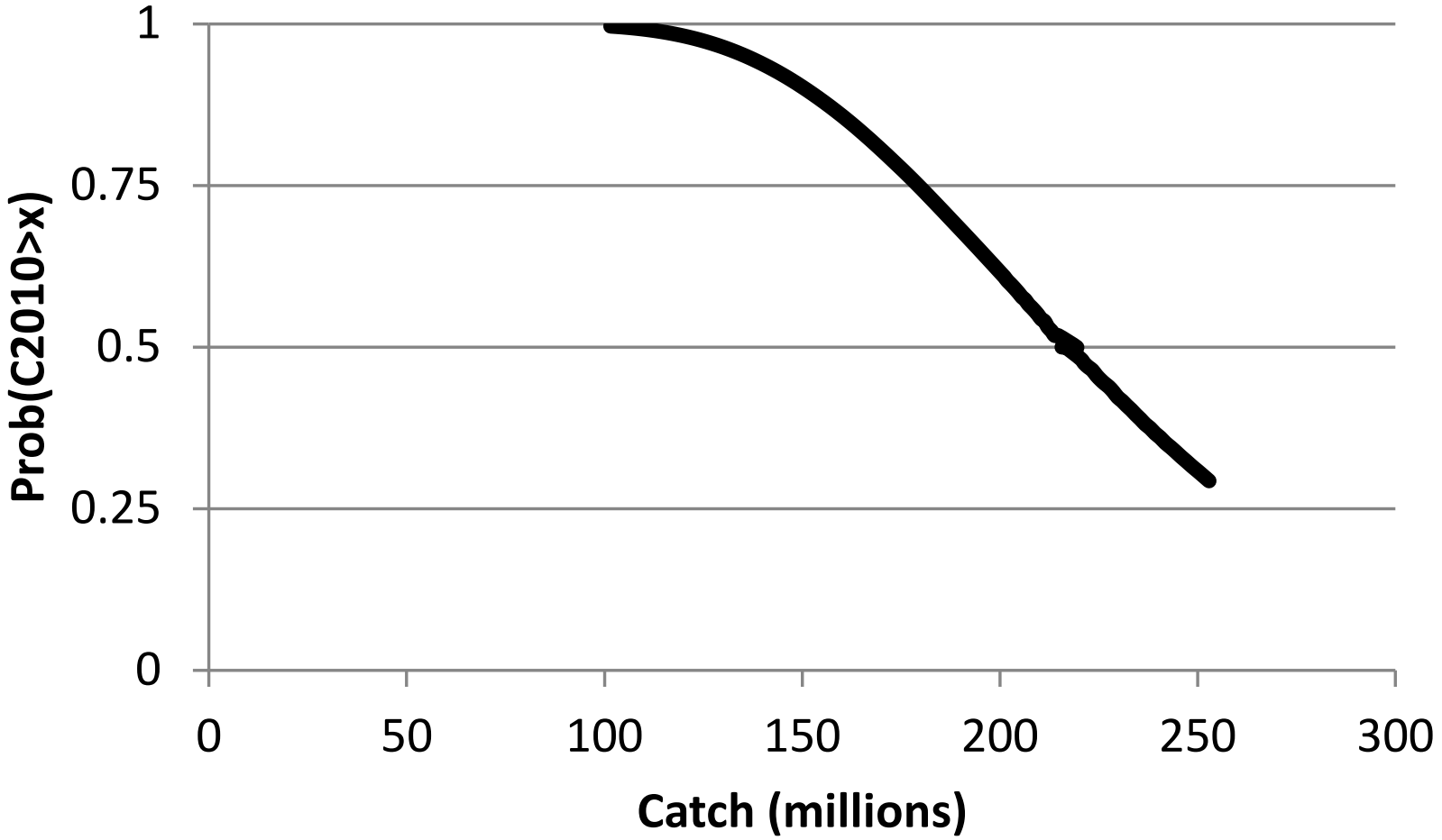

Part 2: Robust harvest level advice

CI%	C 2010	MSY	u(%)
50%	217	496	45%
75%	178	402	36%
90%	150	340	30%
95%	124	285	26%

Recommended exploitation rate target from 2011 assessment: 33%

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Part 2

- *Approach can be used to generate catch targets that are based on a desired level of precaution and the statistical uncertainty*
- *Current targets should be quite robust ~75-90th percentiles*

Acknowledgments

- *Maryland Sea Grant provided funding for this project*

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