Applying a bioeconomic model to recreational fisheries management in the Northeast U.S.: the good, the bad, and the just plain ugly

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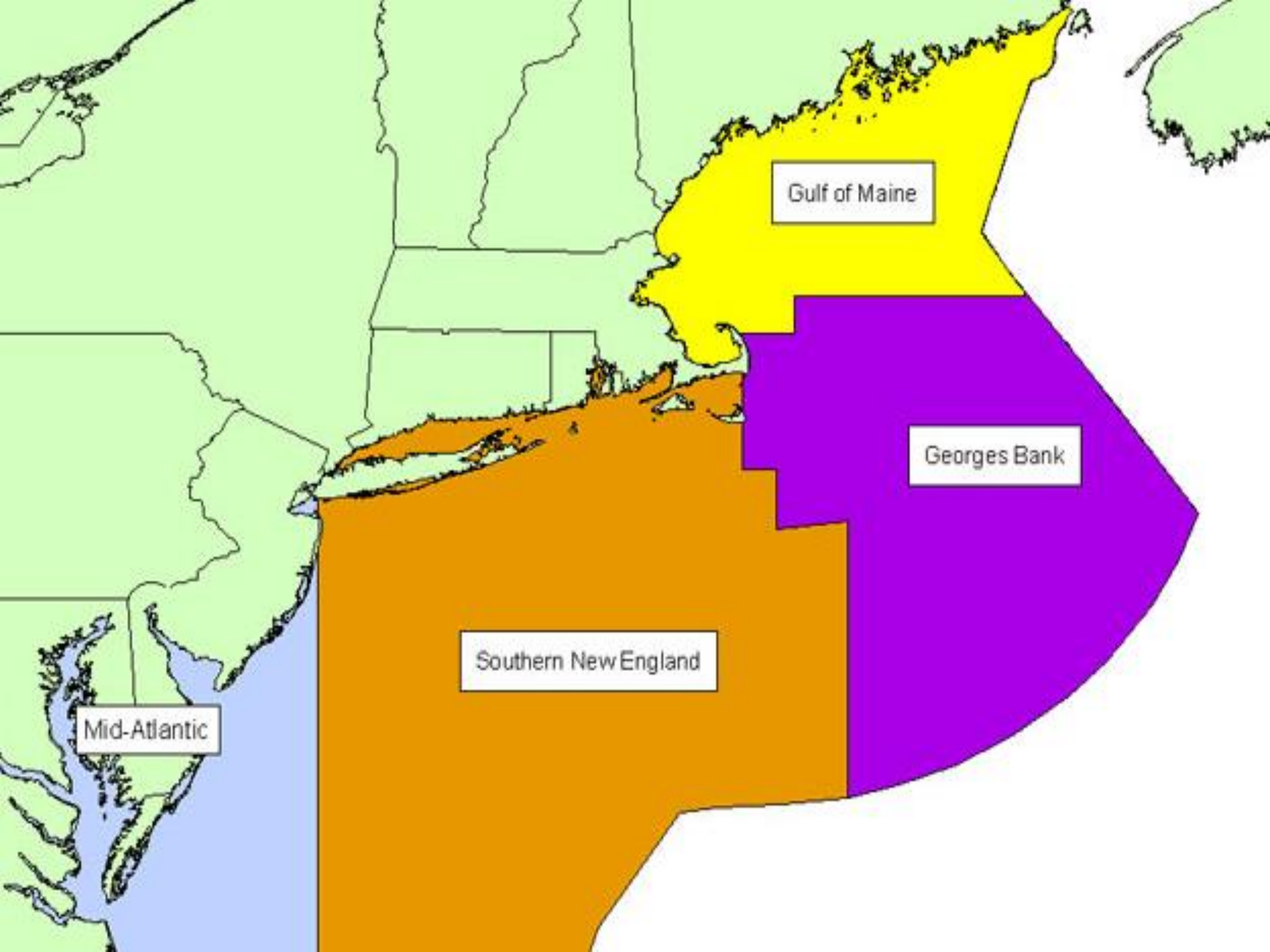
Policy/Research Objectives

Gulf of Maine cod and haddock

- How will changes in management measures alter:
  1) angler fishing effort
  2) recreational fishing mortality
  3) angler welfare
  4) stock levels of Atlantic cod and haddock in the Gulf of Maine

Model

- Joint Mid-Atlantic and New England Council SSC review conducted in 2012
- Used to set recreational measures for GOM cod and haddock each year since 2013
- Lee, Min-Yang, Scott Steinback, Kristy Wallmo. 2017. “Applying a Bioeconomic Model to Recreational Fisheries Management: Groundfish in the Northeast United States.” *Marine Resource Economics 32:2*.


Gulf of Maine
Georges Bank
Southern New England
Mid-Atlantic

Management of Gulf of Maine Cod and Haddock

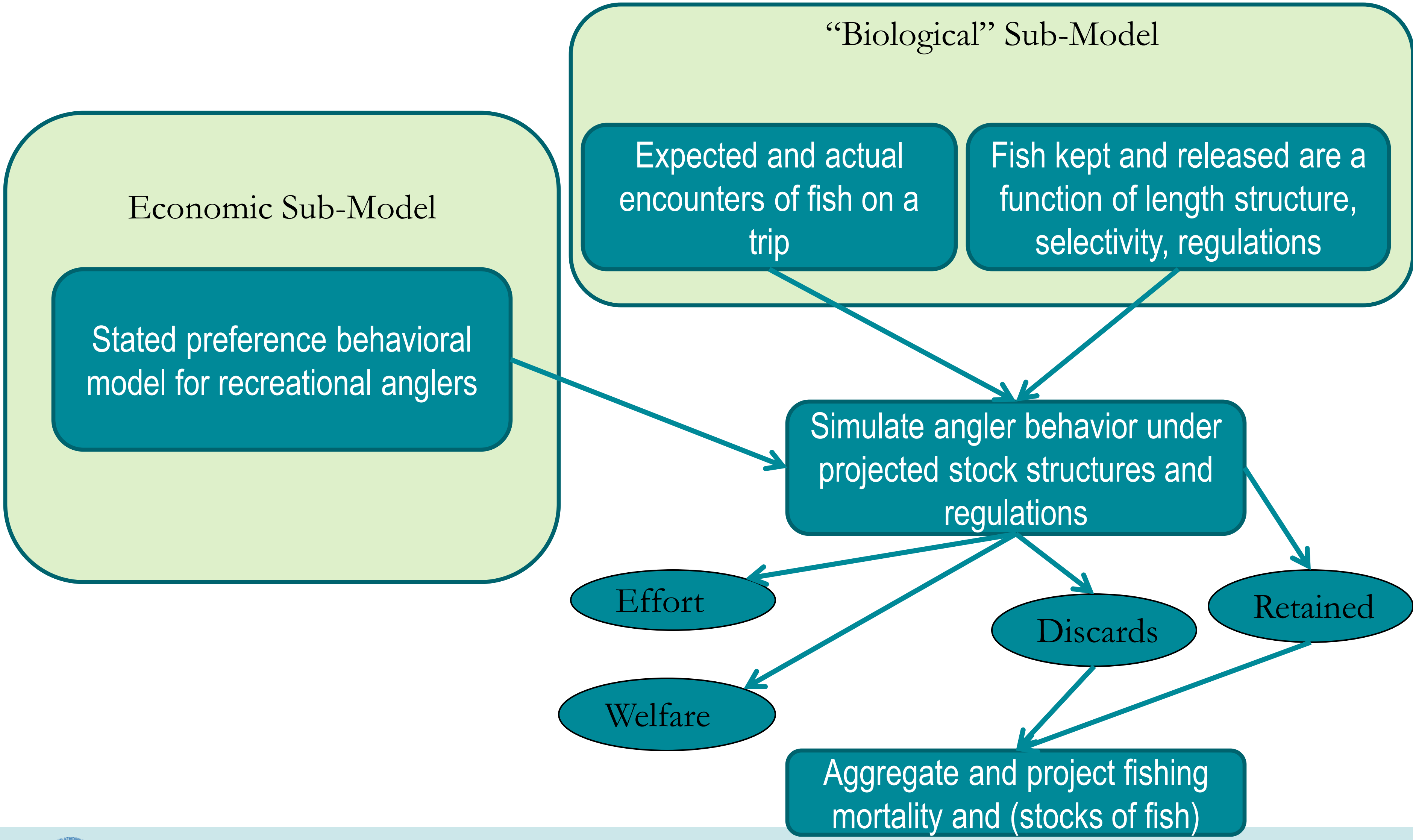
Management

- Open-access recreational fishery
  - Private and for-hire boats
- Separate ACLs for cod and haddock
  - Possession, size, and seasonal closures
- No observer monitoring and minimal enforcement

Annual Goal

- Achieve but not exceed ACLs

Model Overview

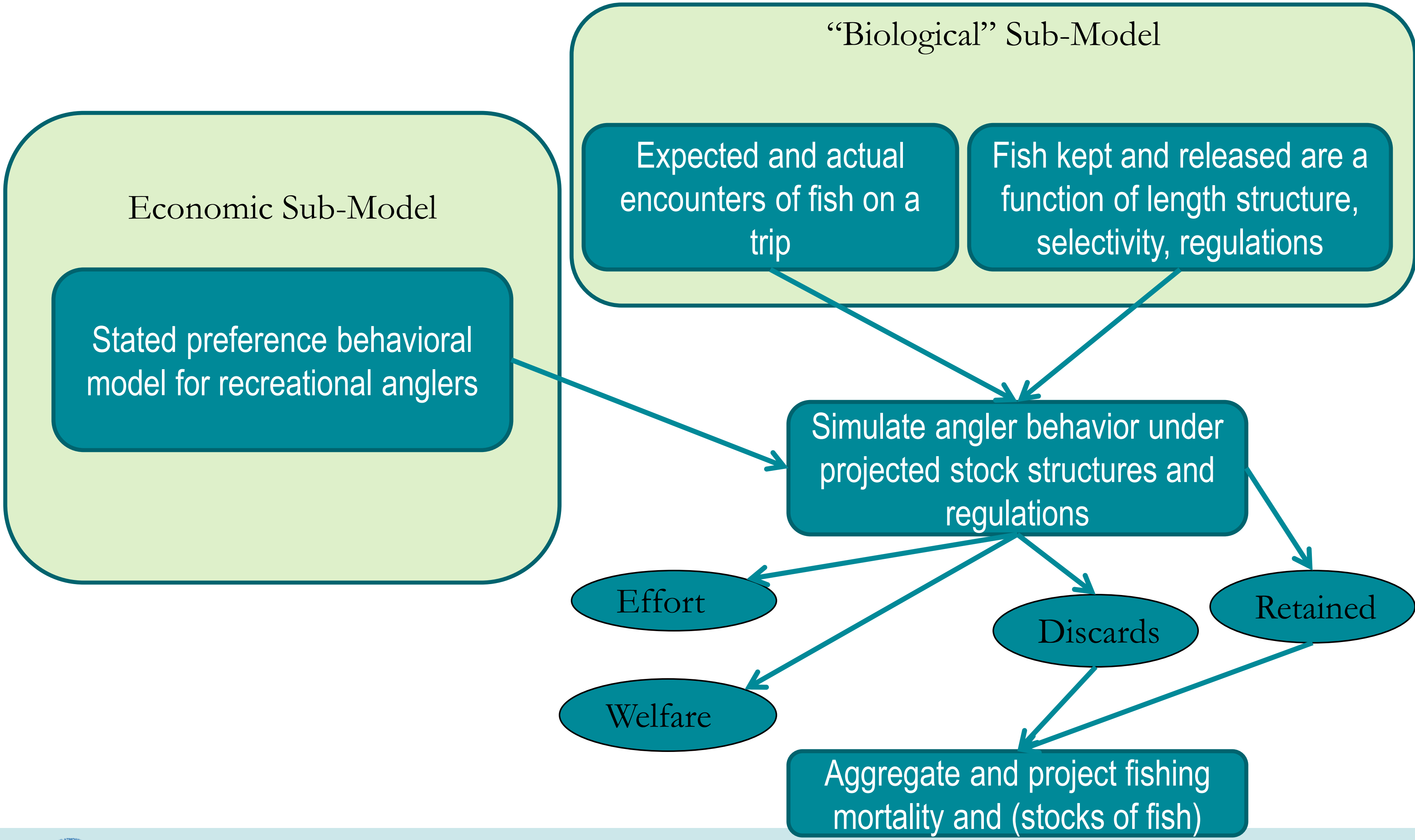


Behavioral Model Parameters (Mixed Logit)

Utility Function Parameter	Estimate (standard error)	Standard Deviation Parameter (standard error)	
$\sqrt{cod\ landed}$	0.33858***	0.1848	
	(0.03822)	(0.20135)	
$\sqrt{cod\ discarded}$	0.11128***	0.19278	
	(0.02701)	(0.15005)	
$\sqrt{haddock\ \ landed}$	0.33558***	.26932*	
	(0.03444)	(0.15797)	
$\sqrt{haddock\ discarded}$	0.09624***	0.10108	
	(0.03008)	(0.22859)	
trip length * for hire	0.02593	0.00603	
	(0.02611)	(0.05179)	
(trip length)2 * for hire	-3.51E-005	0.00428	
	(0.00211)	(0.00352)	
opt-out	-1.67608***	2.55826***	
	(0.38518)	(0.47826)	
trip cost	-.00581***	N/A	
	(0.00031)	N/A	
No. Obs.	4,966	McFadden's LRI	0.2871
Log-likehood (LL)	-4,908	AIC	9,846
LL(0)	-6,884		

***, **, * Indicate Significance at 1%, 5%, 10% level respectively

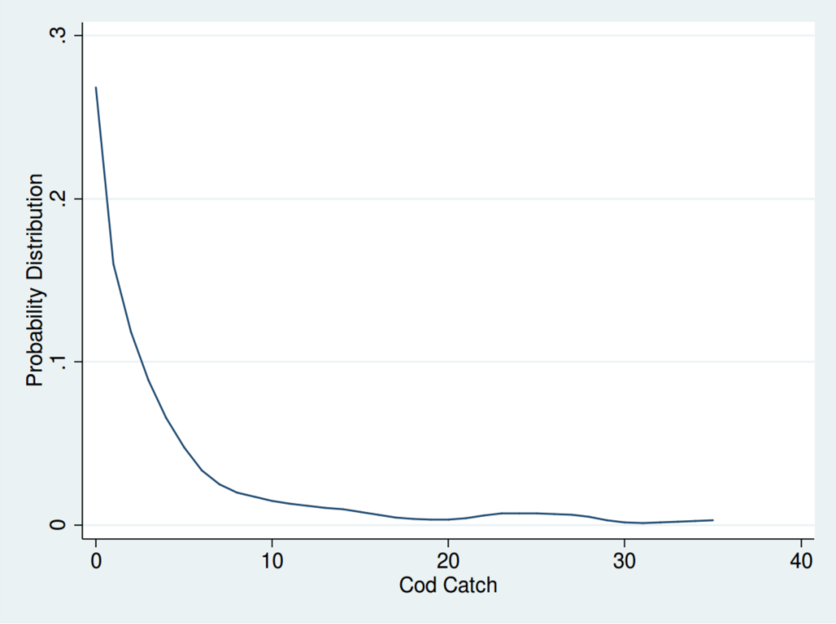
Model Overview

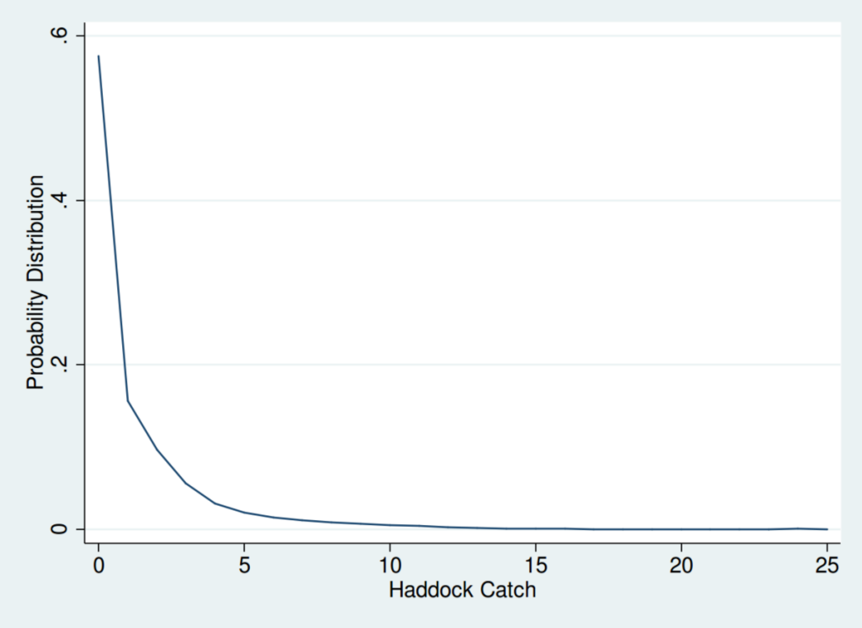


In the “Biological” Sub-Model:

- Generate expectations about catch:
  - Encounters-per-trip
  - Length of encounters-per-trip

Encounters-Per-Trip





- The distribution of encounters-per-trip derived from MRIP (2014)
  - Encounters=Kept+ Discard
  - Trips that targeted or caught GOM cod or haddock
- Lots of zeros
  - Approx 25% of trips do not encounter a cod
  - Nearly 60% of trips do not encounter a haddock

Length Distribution of Encounters-Per-Trip

- What is the length-distribution of fish encountered by recreational anglers?

Pair with bag, size limits to determine how many fish are kept and released.

- Not the same as:
  - Length distribution of stock

    Doesn't account for selectivity

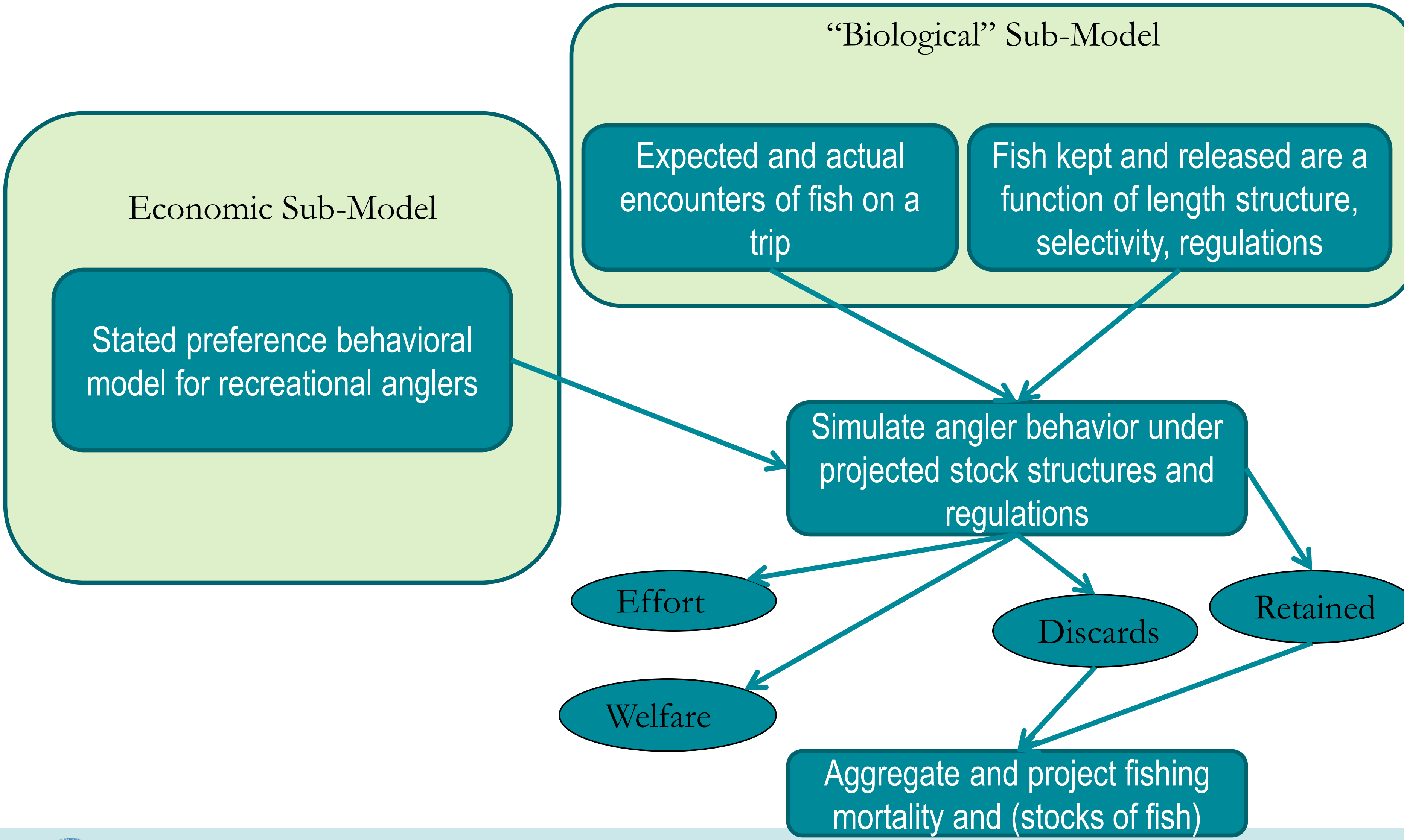
  - Length distribution of historical catch

    Doesn't account for changing stock conditions

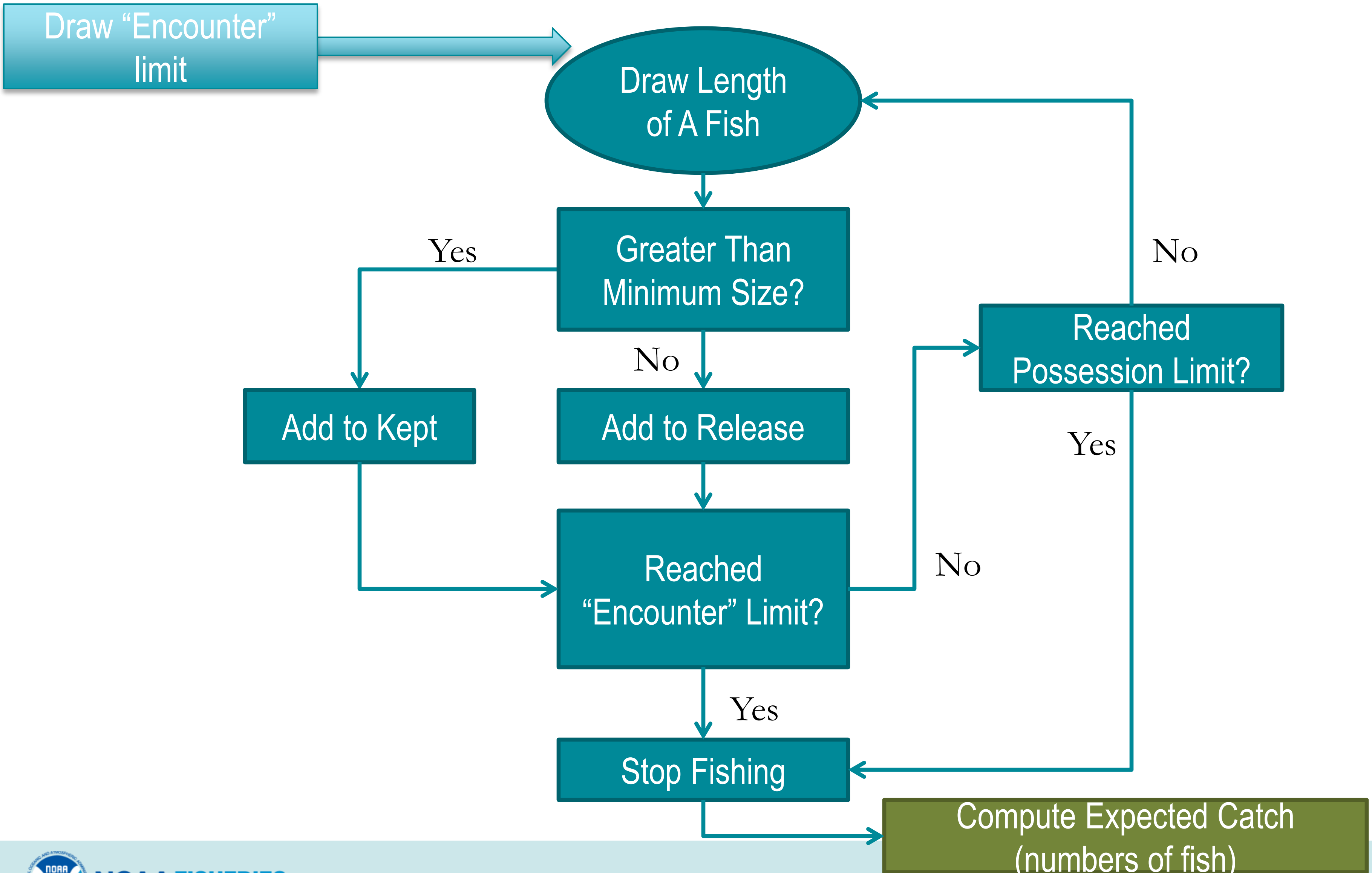
Combining Stock Assessment and Recreational Catch data

- Combine
  - Numbers-at-age projections
  - Bottom trawl age-length data
  - MRIP Catch-at-length
- Project recreational CPUE-at-length for the next fishing year

Model Overview



Simulating *Expected Catch* for a Trip



Simulating Trip Probabilities

Computed Expected Catch on Trip (number kept and released)

Other Trip Characteristics (costs, mode, length of trip)

Behavioral Model

Probability that a trip (choice occasion, *k*) will occur and the WTP corresponding to that trip

Simulating Predicted Trips and Catch

- Following Train (2003)

$$\boldsymbol{Predicted\ Trips} = \sum_{k=1}^{K} \hat{p}_k$$

$$\boldsymbol{Cod\ Landed}_l = \sum_{k=1}^{K} \hat{p}_k * number\ of\ length\ l\ cod\ landed_k$$

- Calibrate by setting *K* so that

$$\boldsymbol{Predicted\ Trips} = estimated\ MRIP\ trips\ from\ previous\ year$$

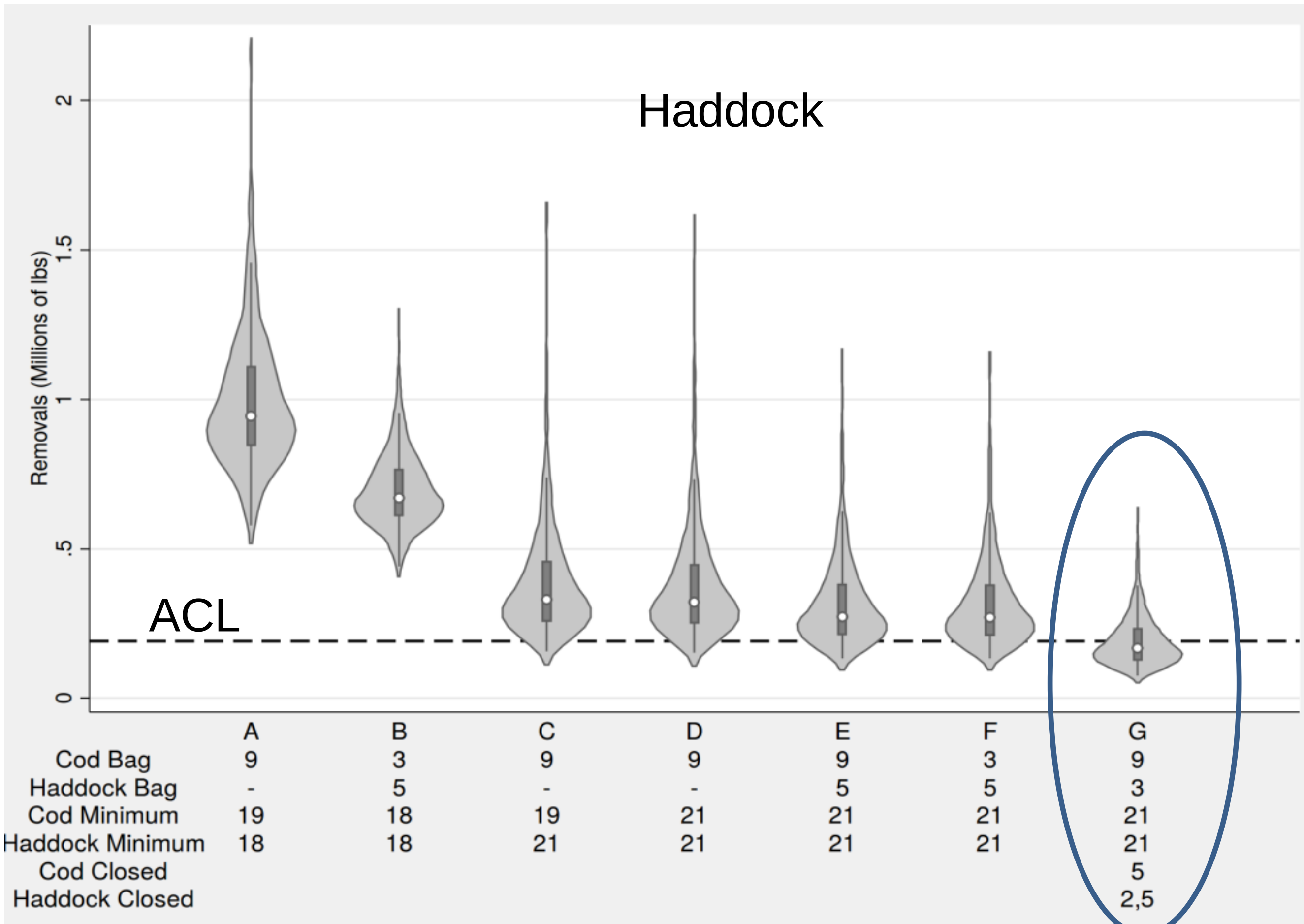
Calibrate to Match MRIP Trip Estimates

- Enter

1) 2016 possession and size limits
2) 2016 biological projections

	MRIP FY2016	Model Predictions FY2016	Difference
Choice Occasions (*K*)	N/A	259,000	
Angler Trips	171,785	171,349	
Cod Landings (lbs)	197,523	*208,469*	+6%
Cod Discard Mortality (lbs)	473,023	473,777	+0.2%
Total Cod Mortality (lbs)	670,546	682,246	+2%
Had Landings (lbs)	1,655,394	1,500,994	-9%
Had Discard Mortality (lbs)	749,751	833,498	+11%
Total Had Mortality (lbs)	2,405,145	2,334,492	-3%

FY 2014 Policy Setting



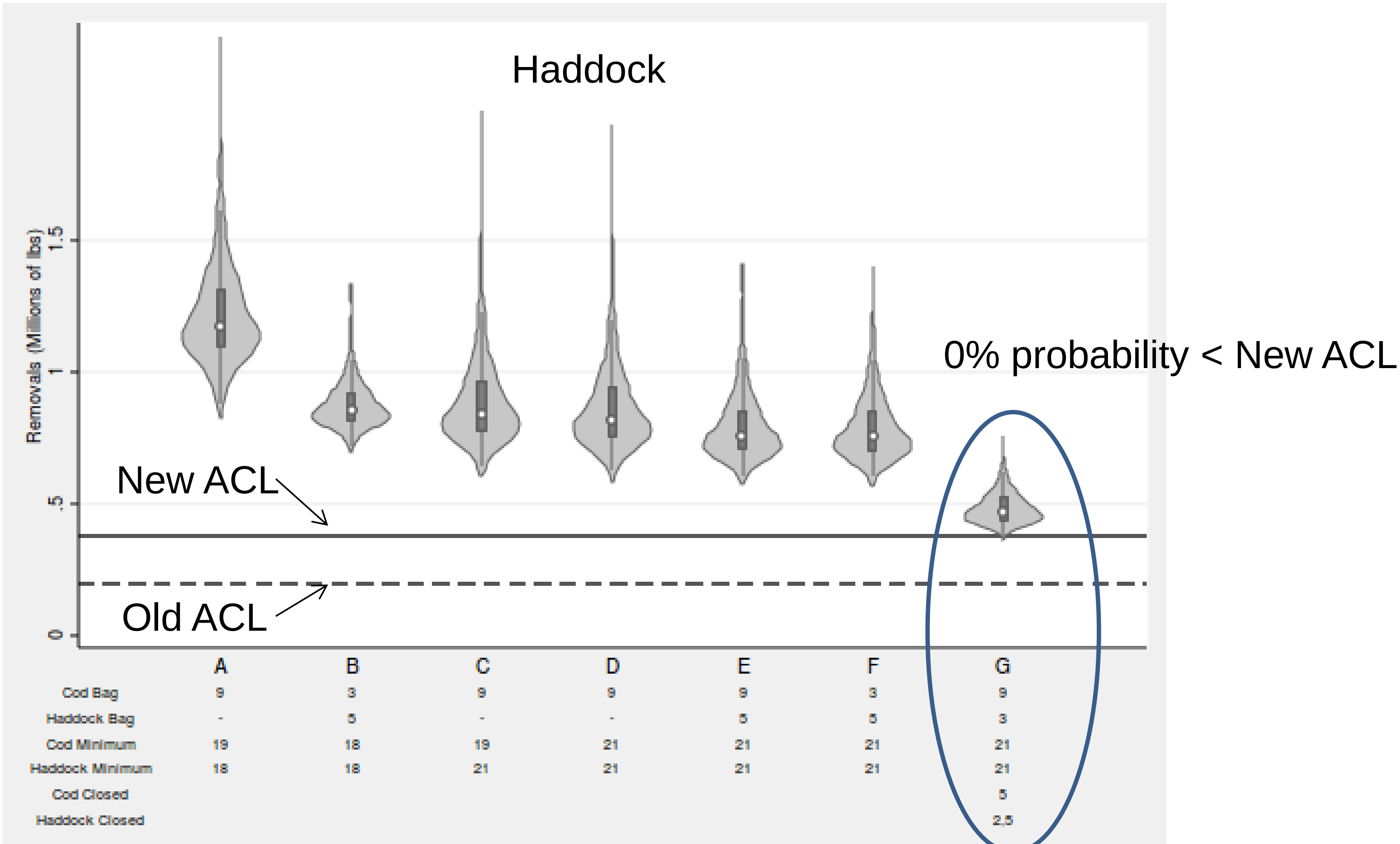
52% probability < ACL

FY 2014 Policy Setting Continued

Revised haddock stock assessment released in August

- Biomass about 6 times higher
    - Large increase in age 3 and 4 fish
- ACL doubled
- Discard mortality rate changed from 0% to 50%

FY 2014 Policy Setting Continued



FY 2017 Policy Setting

January

- Cod measures: 78% probability < ACL
- Haddock measures: 50% probability < ACL

February

- Updated catch data released for Nov-Dec
  - Haddock catch much higher than previous Nov-Dec
  - Updated model runs
    - Proposed haddock measures insufficient

Modeling Constraints

Data limitations and model uncertainty

Model mortality projections derived from…..

- Uncertain numbers-at-age estimates: 2, 3, even 4 years out from terminal year
- Incomplete and preliminary MRIP catch & effort data
  - Annual MRIP variability
- Annual noncompliance variability
- Misspecified behavioral model?

The Good, the Bad, the Just Plain Ugly

Good

- Integrates "economics" into the fishery management process
- Potentially a way to improve stock projection models

Bad

- Simulations based on:
  - Incomplete and preliminary MRIP data
  - Outdated biological projections

Just Plain Ugly

- Policy setting process is institutionally challenging
  - Little time for stakeholder input
  - Undermines effective fishery management

Questions?

One of the authors?