A Retrospective Bioeconomic Assessment of Florida's Commercial Reef Fisheries

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Issues

Florida reef ecosystem worth billions of dollars

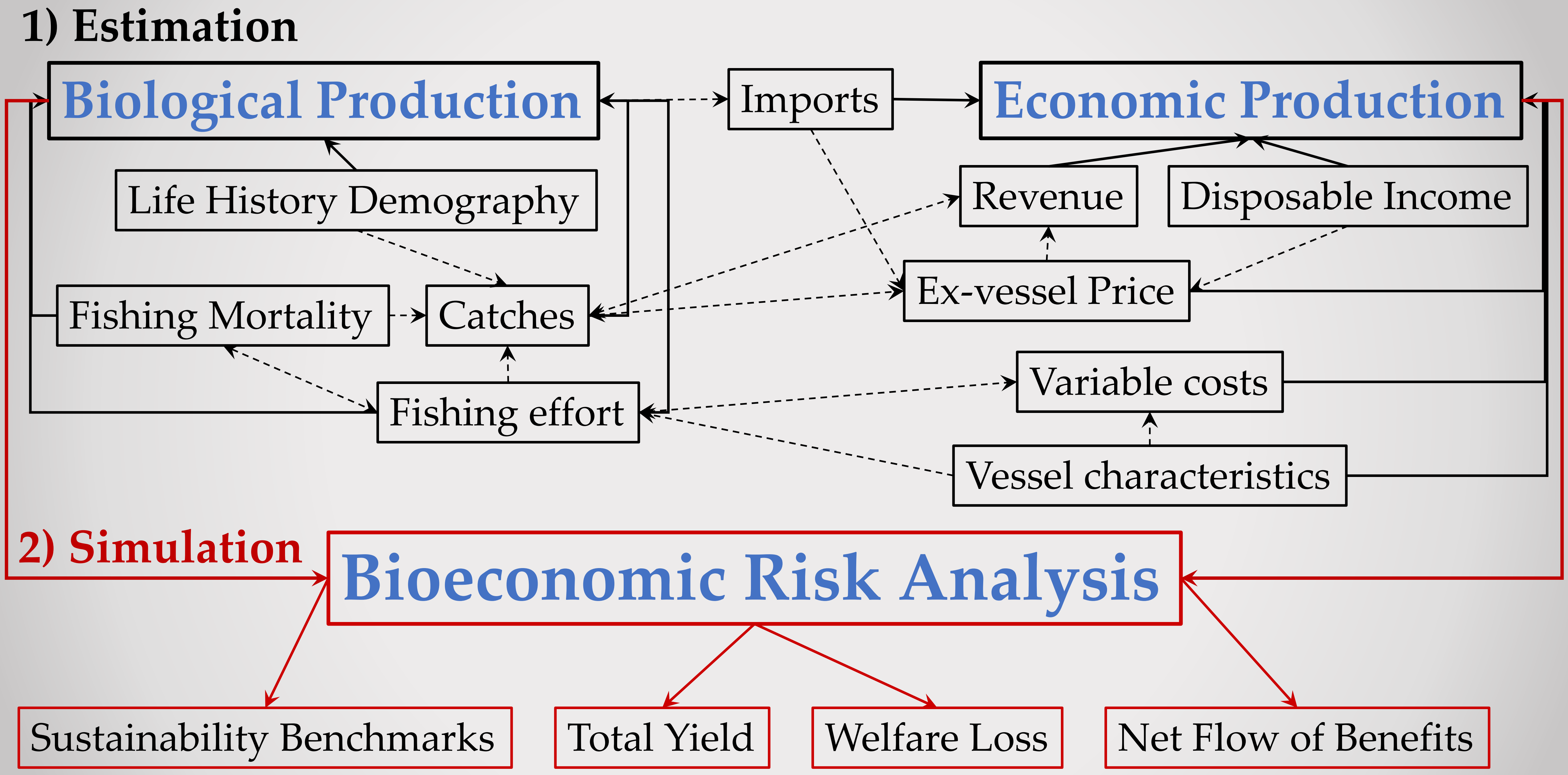
Threats from rapidly increasing Florida population, and demands for tourism & seafood

Florida reef fish (groupers, snappers) overfished

Goals

Assess efficacy of Florida reef fish management strategies relative to biological and economic consequences

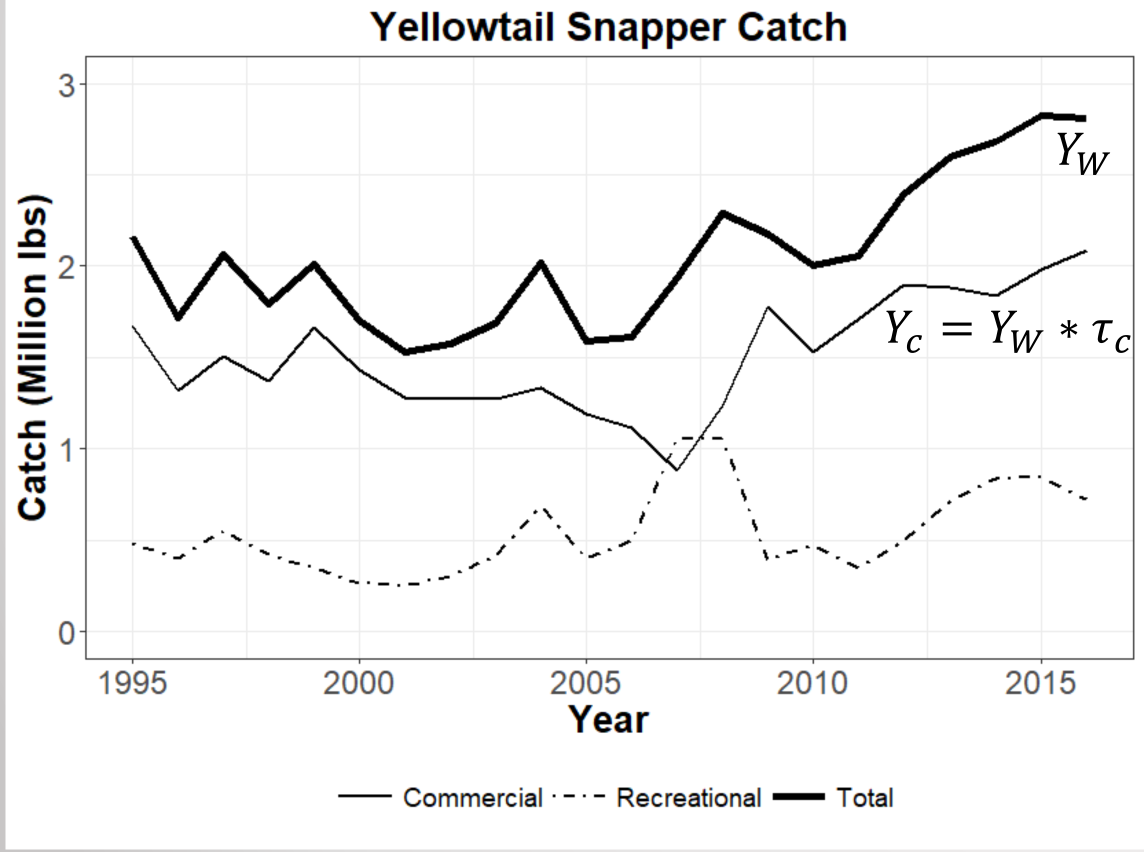
Explore optimal bioeconomic management regimes

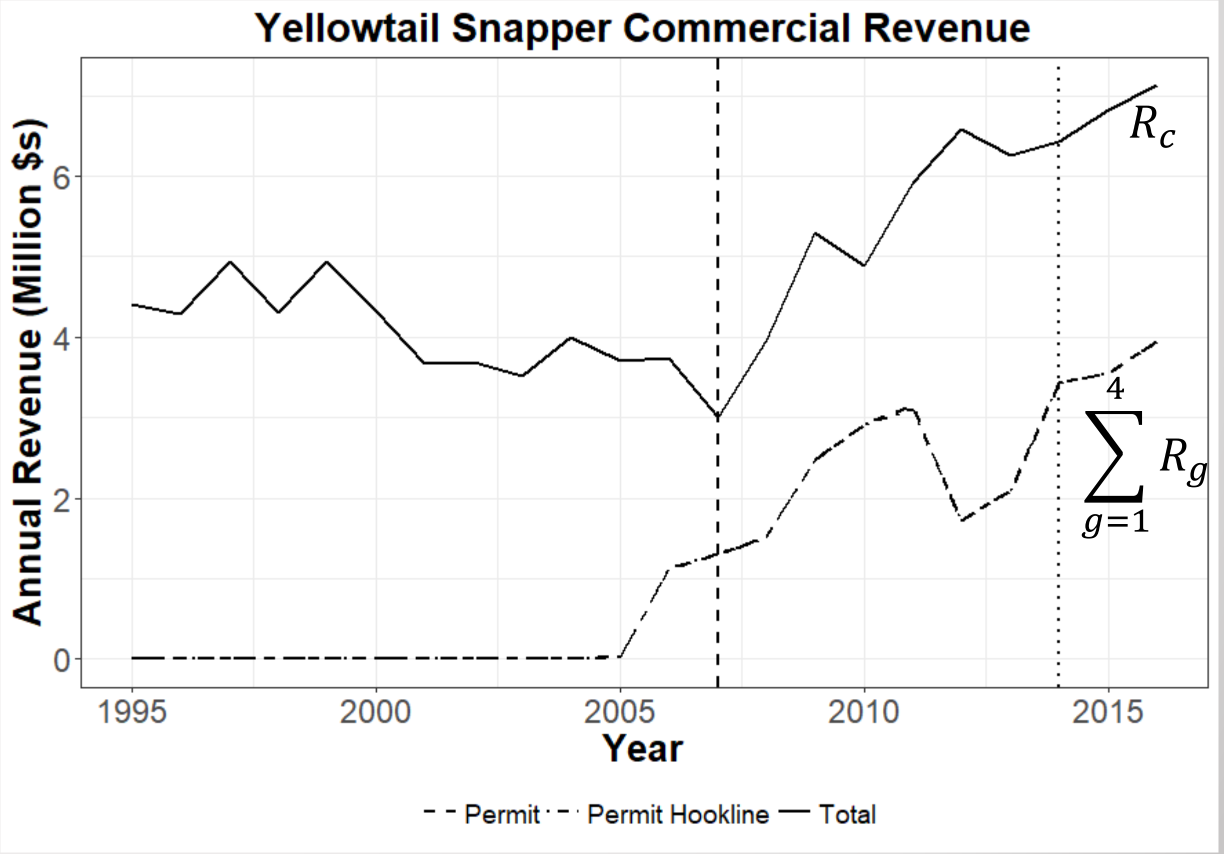

1) Estimation
Biological Production
Imports
Economic Production
Life History Demography
Revenue
Disposable Income
Ex-vessel Price
Fishing Mortality
Catches
Variable costs
Fishing effort
Vessel characteristics
2) Simulation
Bioeconomic Risk Analysis
Sustainability Benchmarks
Total Yield
Welfare Loss
Net Flow of Benefits

Yellowtail Snapper Catch & Revenue

Hook and line federal permit types (g):

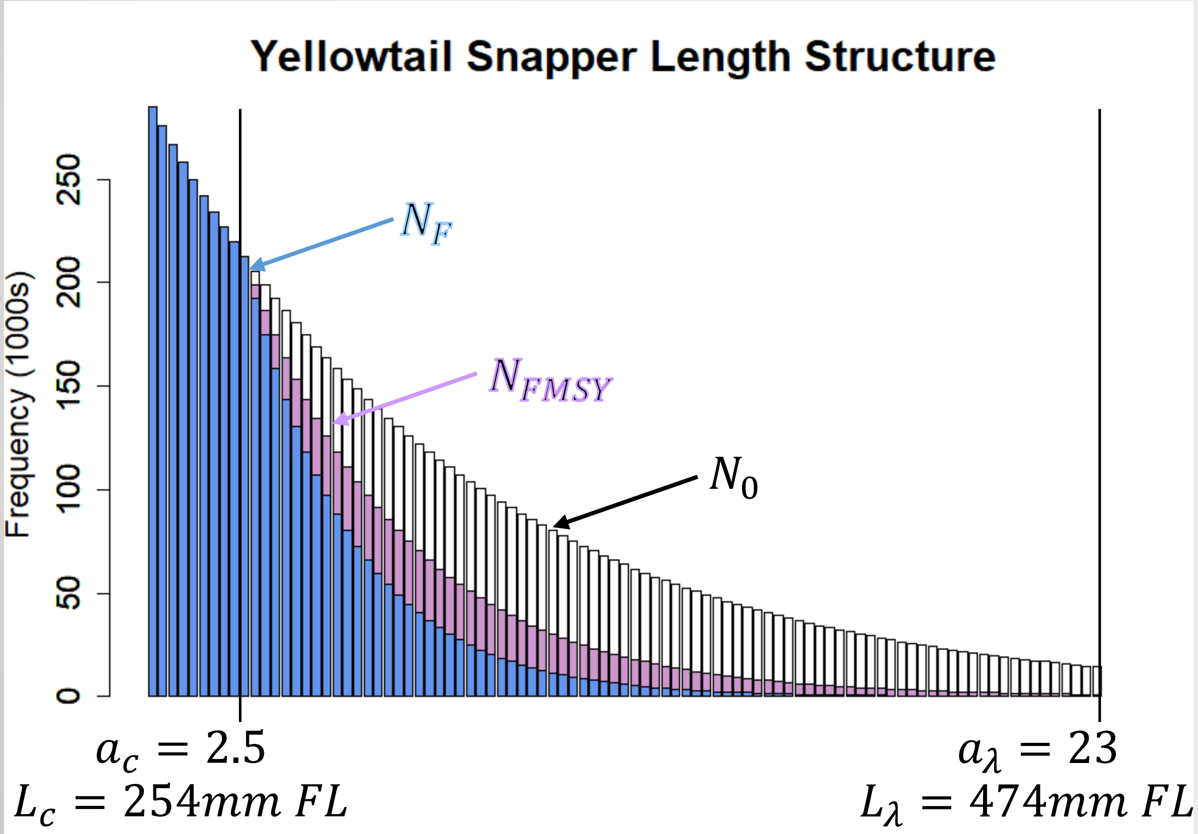
(1) South Atlantic Snapper-Grouper Unlimited Trip (SG1) ; (2) South Atlantic Snapper-Grouper 225lb Trip Limit (SG2) ; (3) Gulf of Mexico Reef Fish (RR) ; (4) South Atlantic Unlimited Trip and Gulf of Mexico Reef Fish (RRSG1)

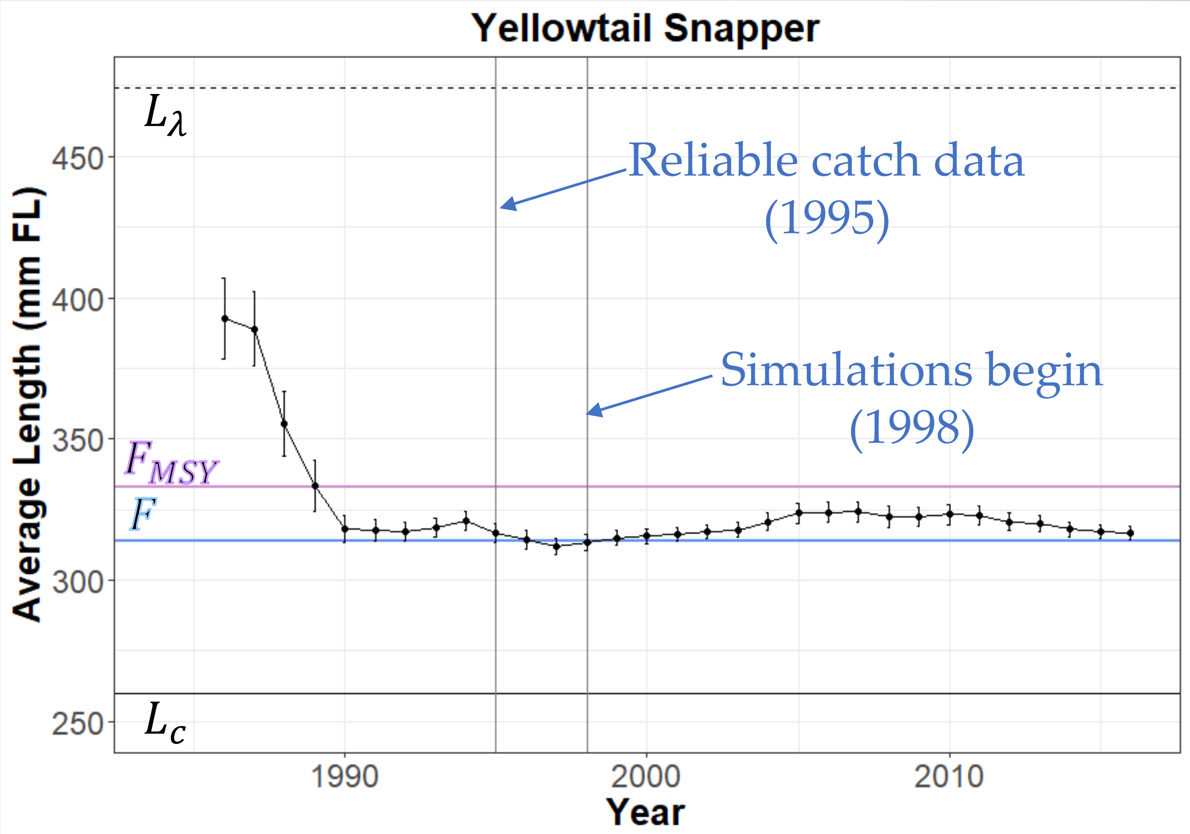




Indicator Variables of Sustainability

Average length of the exploited phase → $\bar{L}(t) = \dfrac{\int_{a_c(t)}^{a_\lambda} F(t) * N(a,t) * L(a,t)\, da}{\int_{a_c(t)}^{a_\lambda} F(t) * N(a,t)\, da}$

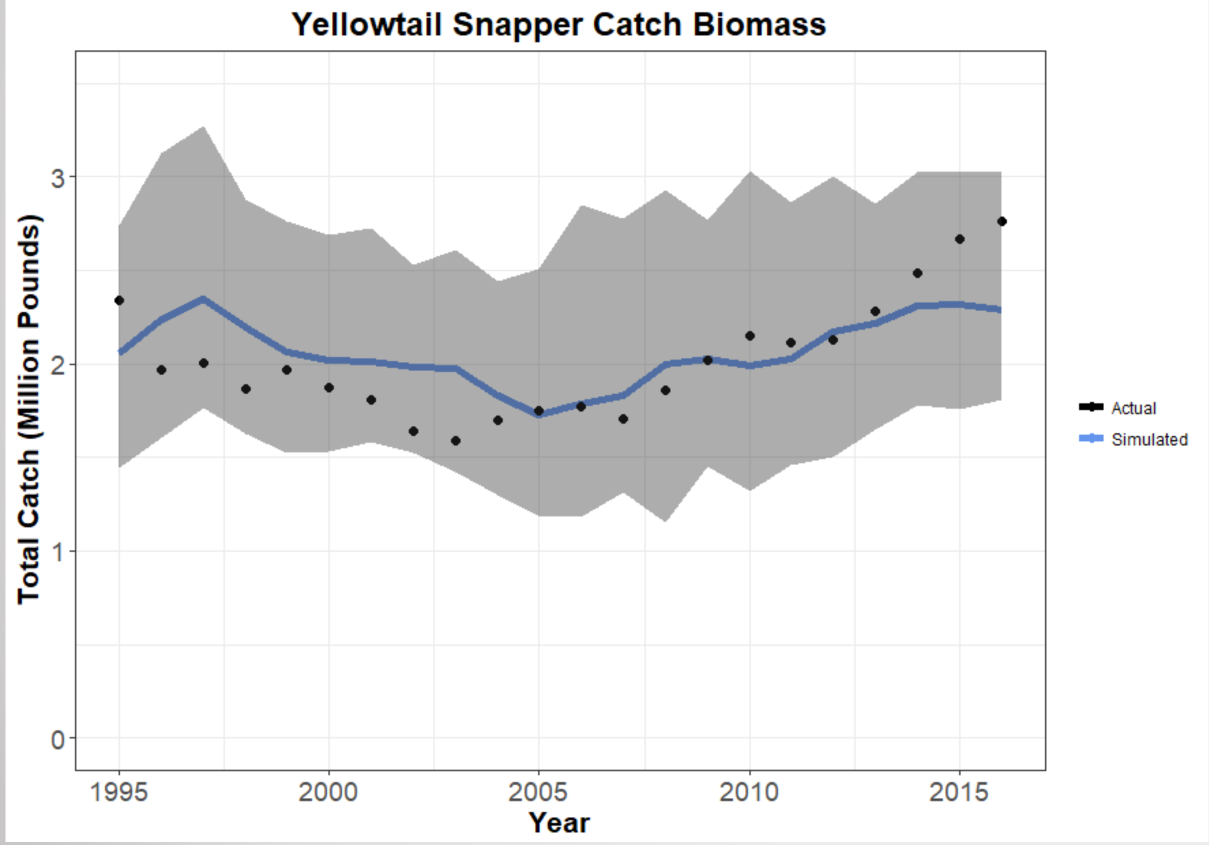




Ehrhardt, N.M. & Ault, J.S. 1992. Analysis of two length-based mortality models applied to bounded length frequencies. *Transactions of the American Fisheries Society* 121(1): 115-122.

Numerical Cohort-Based Simulation Model

- Adjusted recruitment, $N(0,t)$, to minimize difference between observed & simulated catch, $Y_W(t)$



Exponential mortality model

$$N(a+1,t+1) = \begin{cases} N(a,t)e^{-M} & \text{if } a(t) < a_c(t) \\ N(a,t)e^{-[F(a,t)+M]} & a(t) \geq a_c(t) \end{cases}$$

Conversion to biomass

$$L(a) = L_\infty\left[1 - e^{-K(a-a_0)}\right] \qquad W(a) = \alpha L(a)^\beta$$

Catch estimation

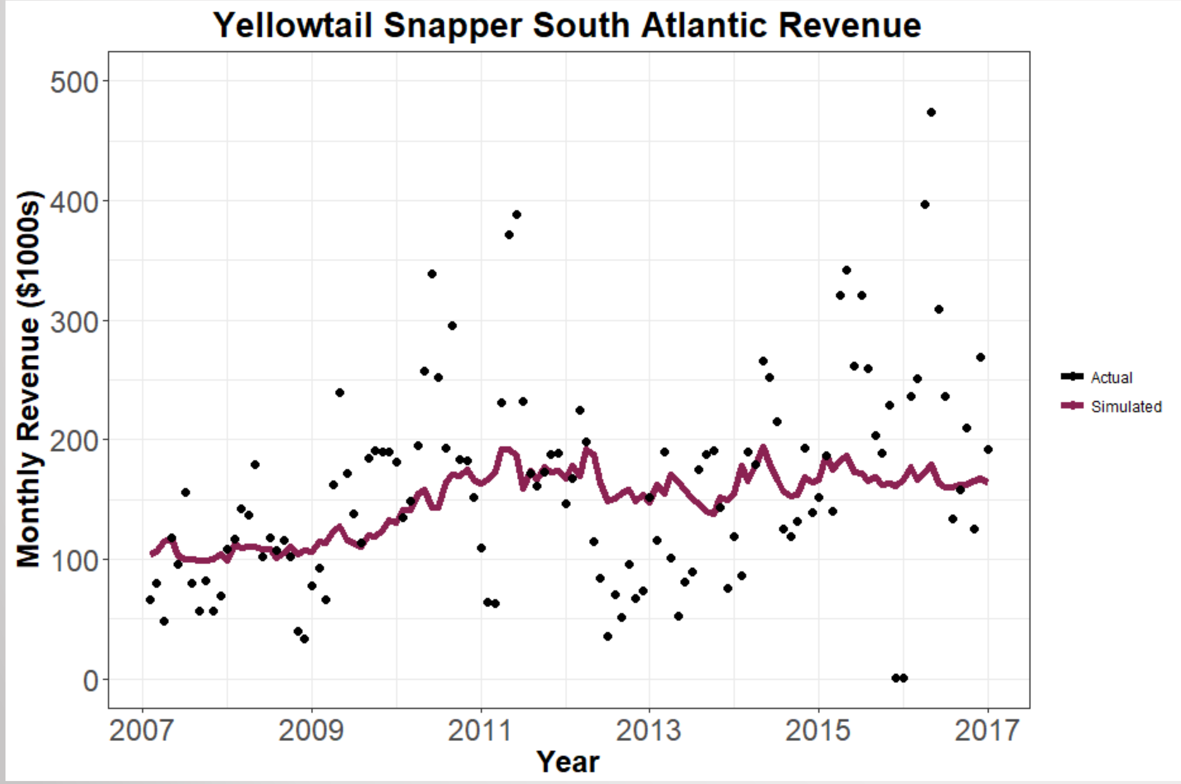
$$Y_W(t) = \sum_{a=a_c(t)}^{a_\lambda} F(a,t) * \frac{N(a,t) * W(a)}{[F(a,t)+M]}\left[1 - e^{-(F(a,t)+M)}\right]$$

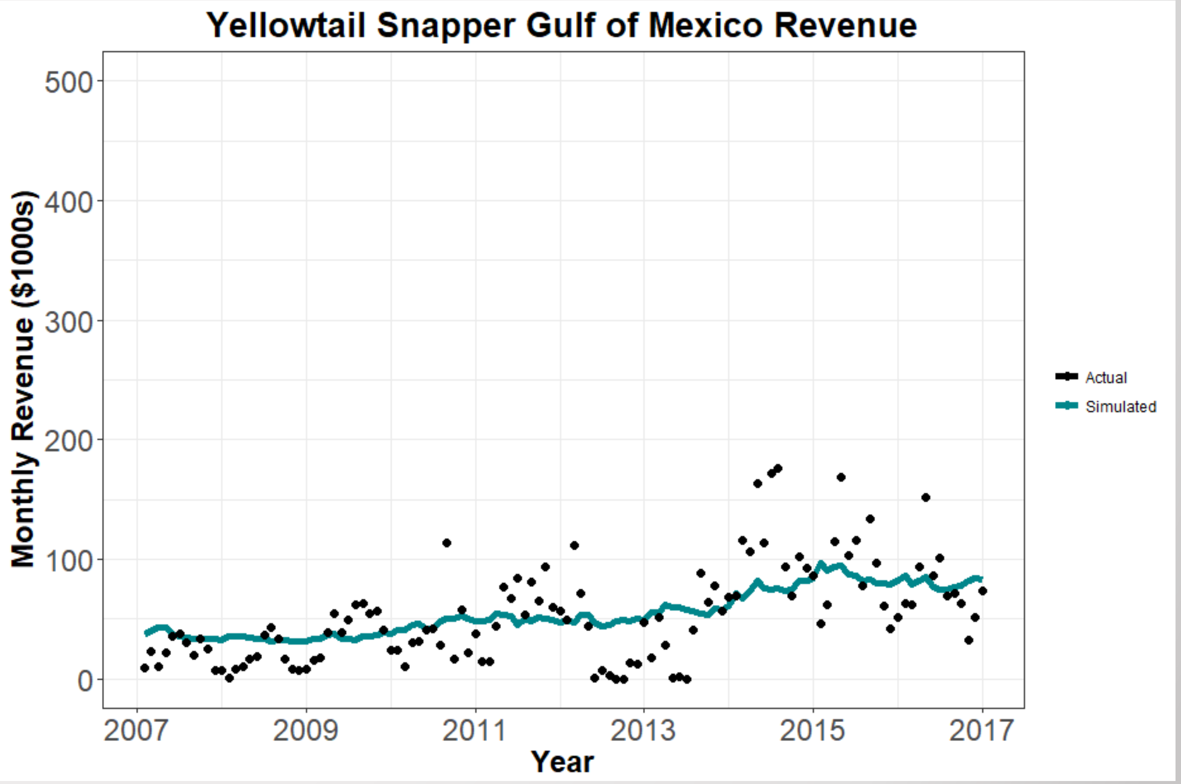
Yellowtail Snapper Fleet Revenue

Inverse Demand Function $p(t) = \beta_0 + \beta_j x_j(t + k_j) + \varepsilon(t)$

x_j = yellowtail commercial landings ($k = -1$), snapper import price, disposable income

Commercial Revenue Function $R_g(t) = p[t, Y_c(t + k)] * Y_c(t) * \tau_g(t)$



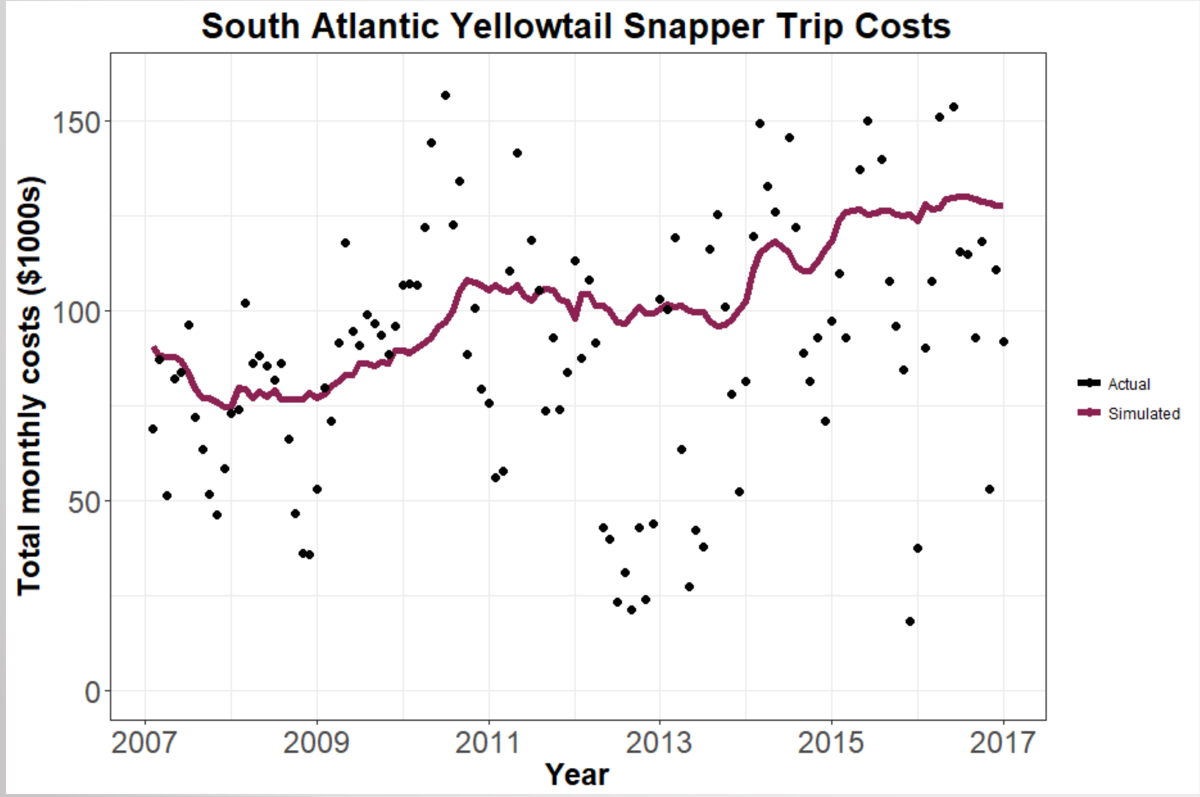


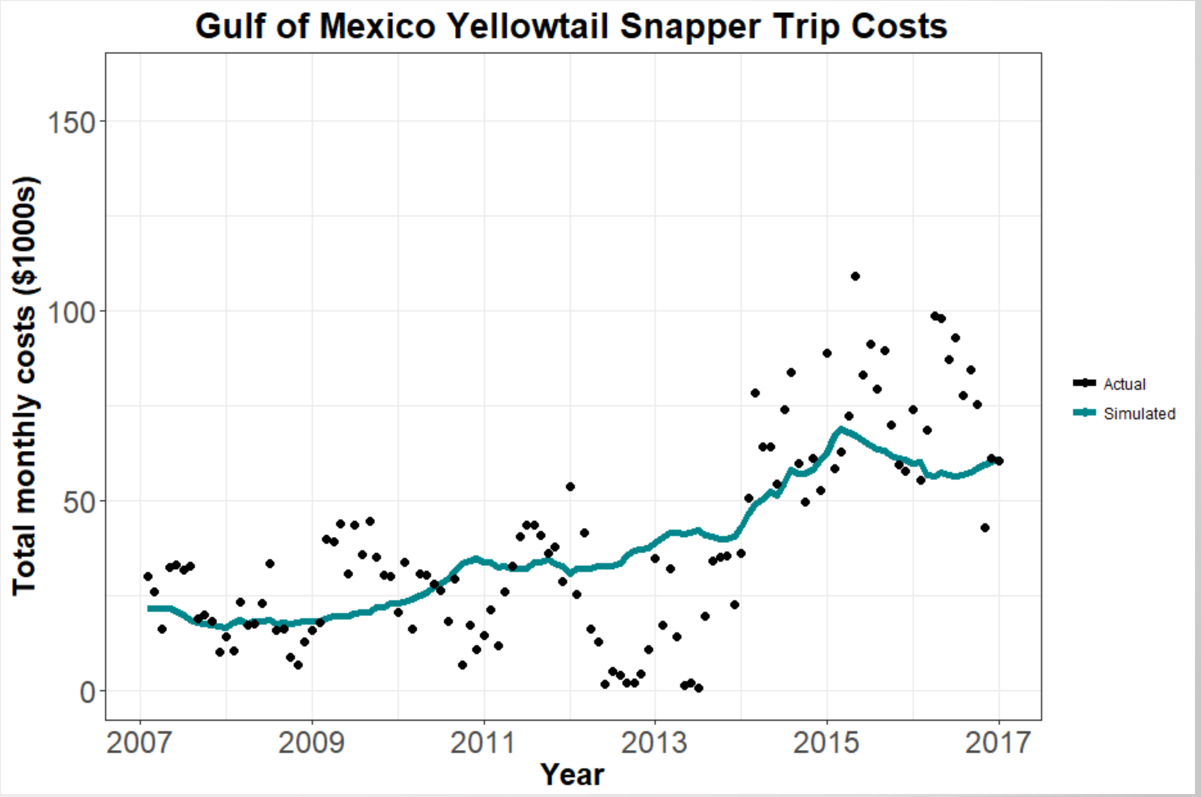
Yellowtail Snapper Fleet Costs

Cost per trip = $C_g(\gamma) = \sum_{l=1}^{6} y_{gl}(\gamma)$, y_l =Fuel, bait, ice, miscellaneous, tackle, grocery per trip γ

Predicted cost per trip $= \sqrt{C_g(\gamma)} = \beta_{g0} + \beta_{gr}\varphi_{gr}(\gamma) + \varepsilon_g(\gamma)$, φ_r= Vessel length, days fished per trip γ

Cost per month $= C_g(t) = [C_g(\gamma)]^2 * f_g(t)$, $f_g(t)$ simulated trips by fleet g in month t

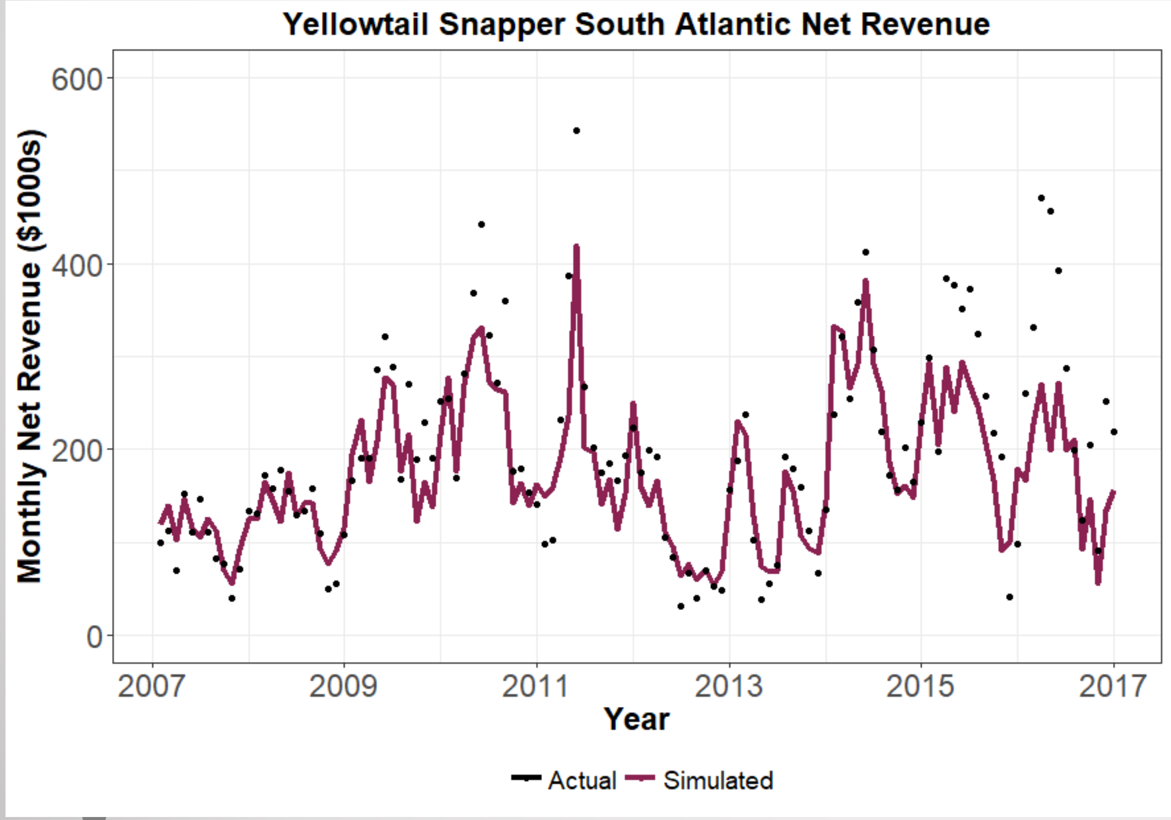


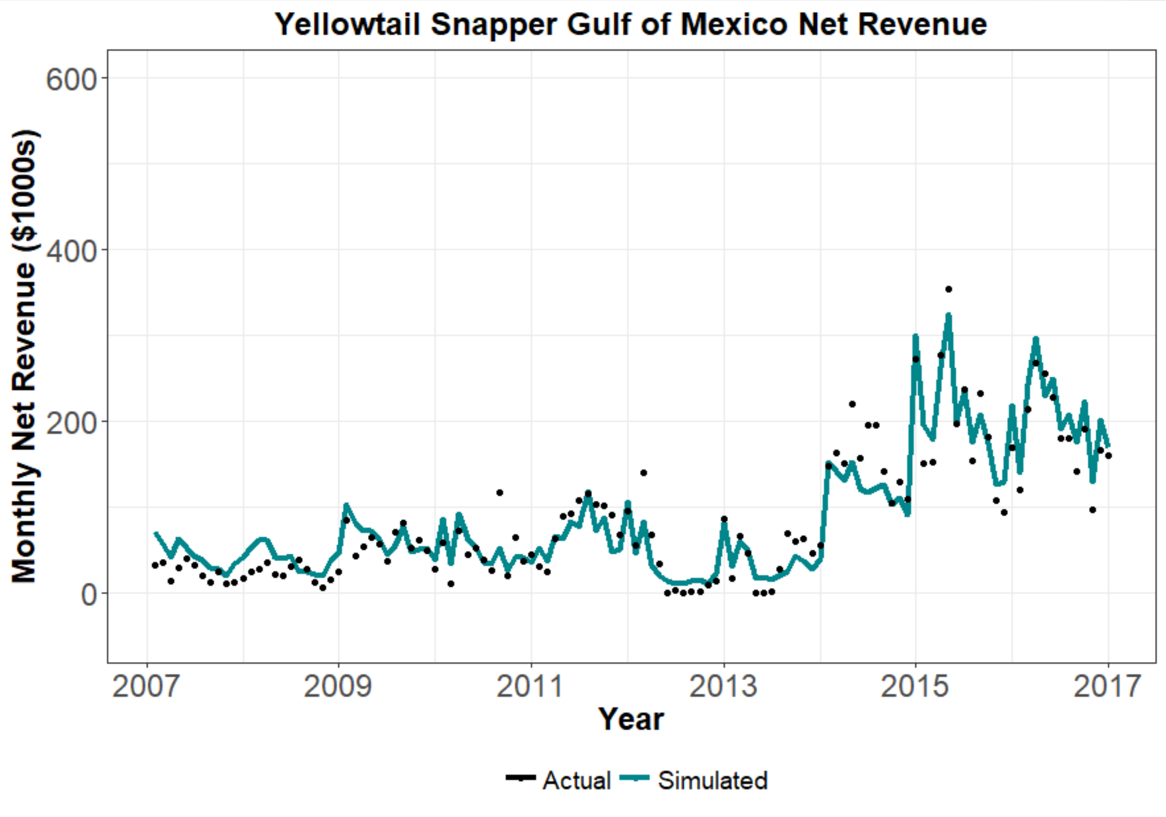


Yellowtail Snapper Fleet Net Revenue

- Assumed revenue from nontarget species (NT_g) remained constant

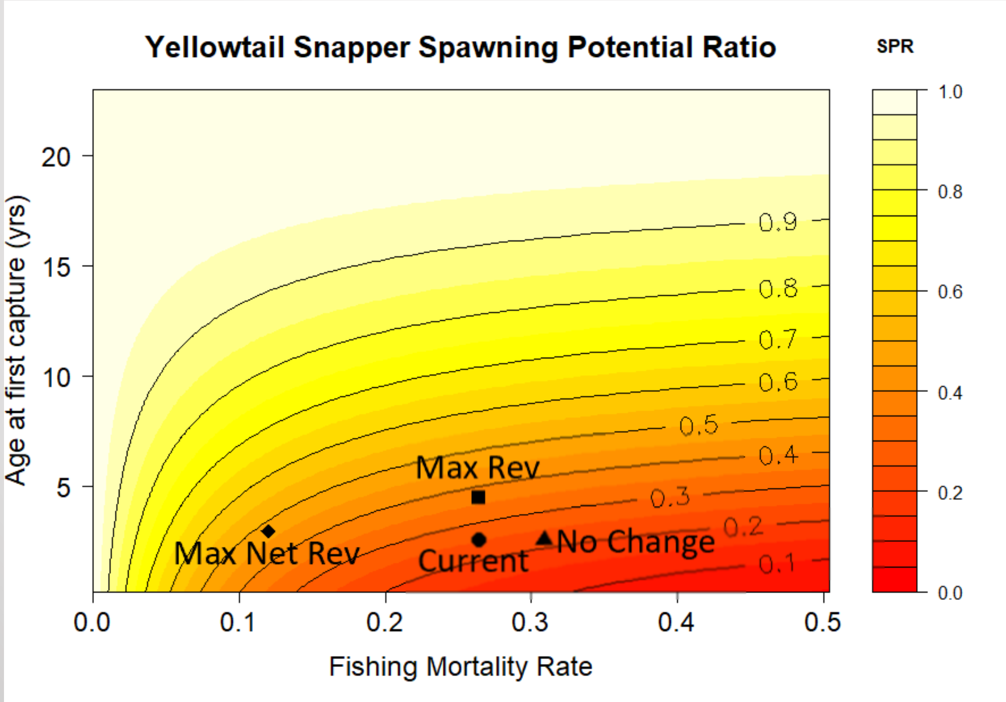
$$NR_g(t) = R_g(t) + NT_g - C_g(t)$$

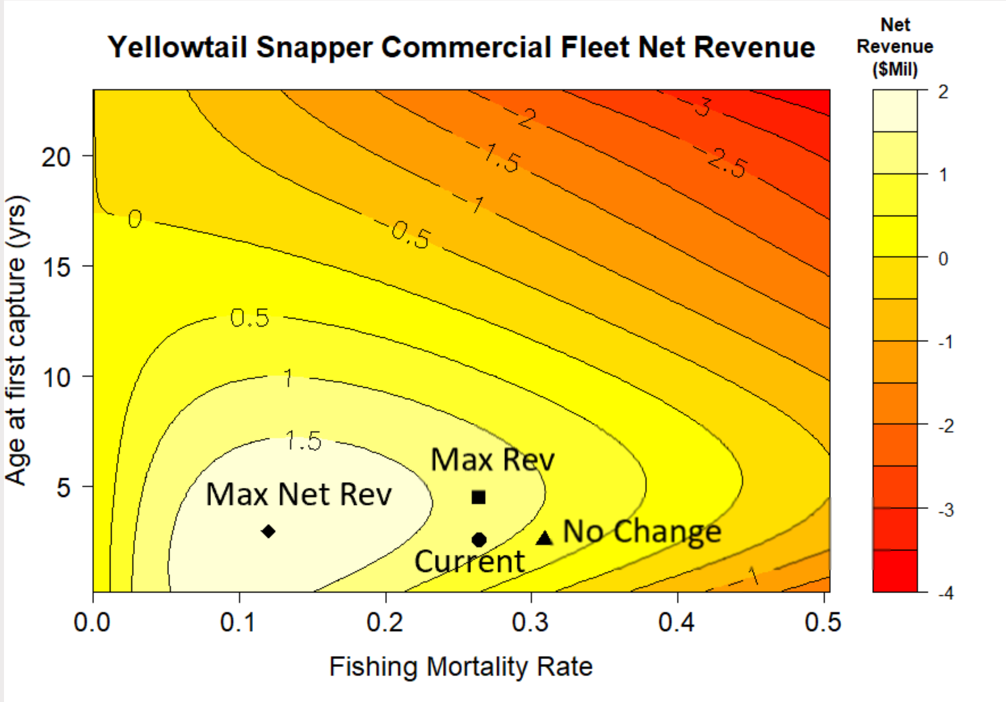




Management Simulations

Simulation	*F*	a_c (yrs)	Population (Million lbs)	SPR	Net Revenue ($Million)
No change from 1998	0.312	2.58	9.6	22.0%	$0.77
Current	0.264	2.58	10.7	25.3%	$1.15
Max Revenue	0.264	4.50	14.9	36.9%	$1.30
Max Net Revenue	**0.120**	**3.00**	**18.6**	**47.5%**	**$1.90**





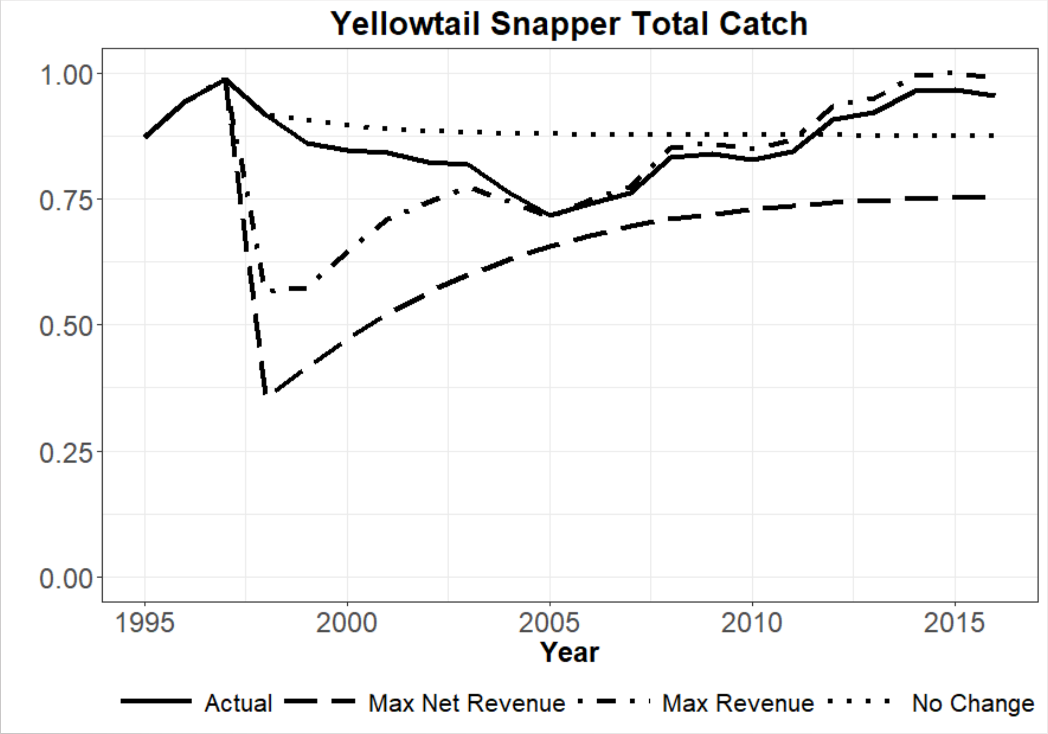
Management Simulations

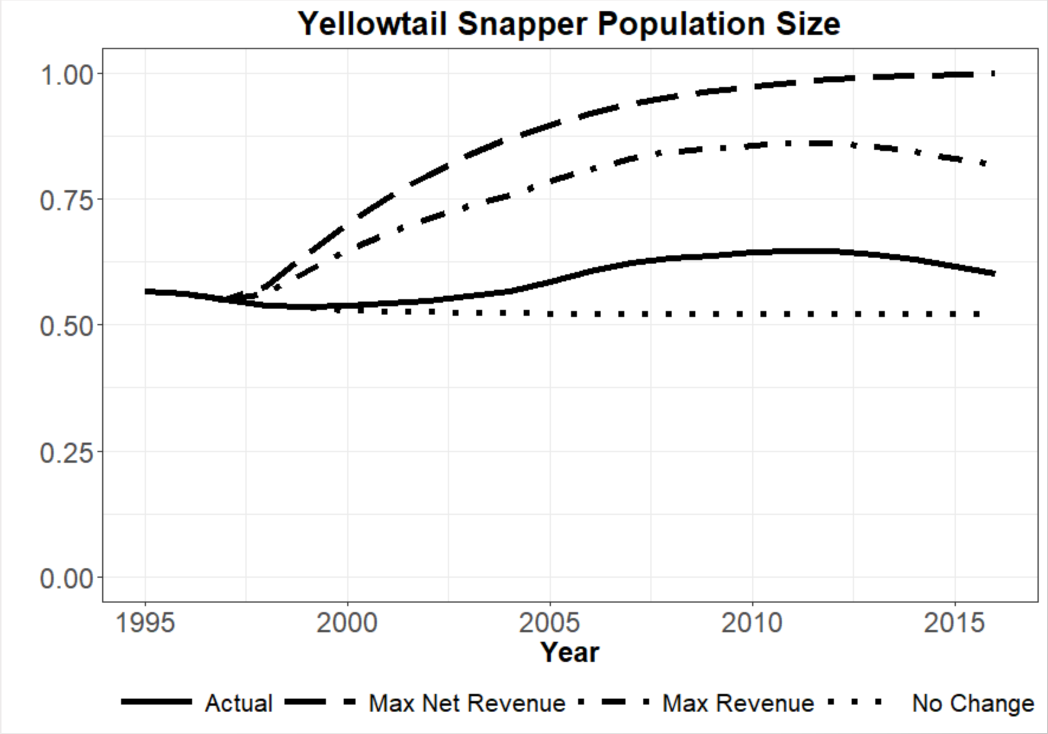
(1) No change from 1998

(2) Actual regulations

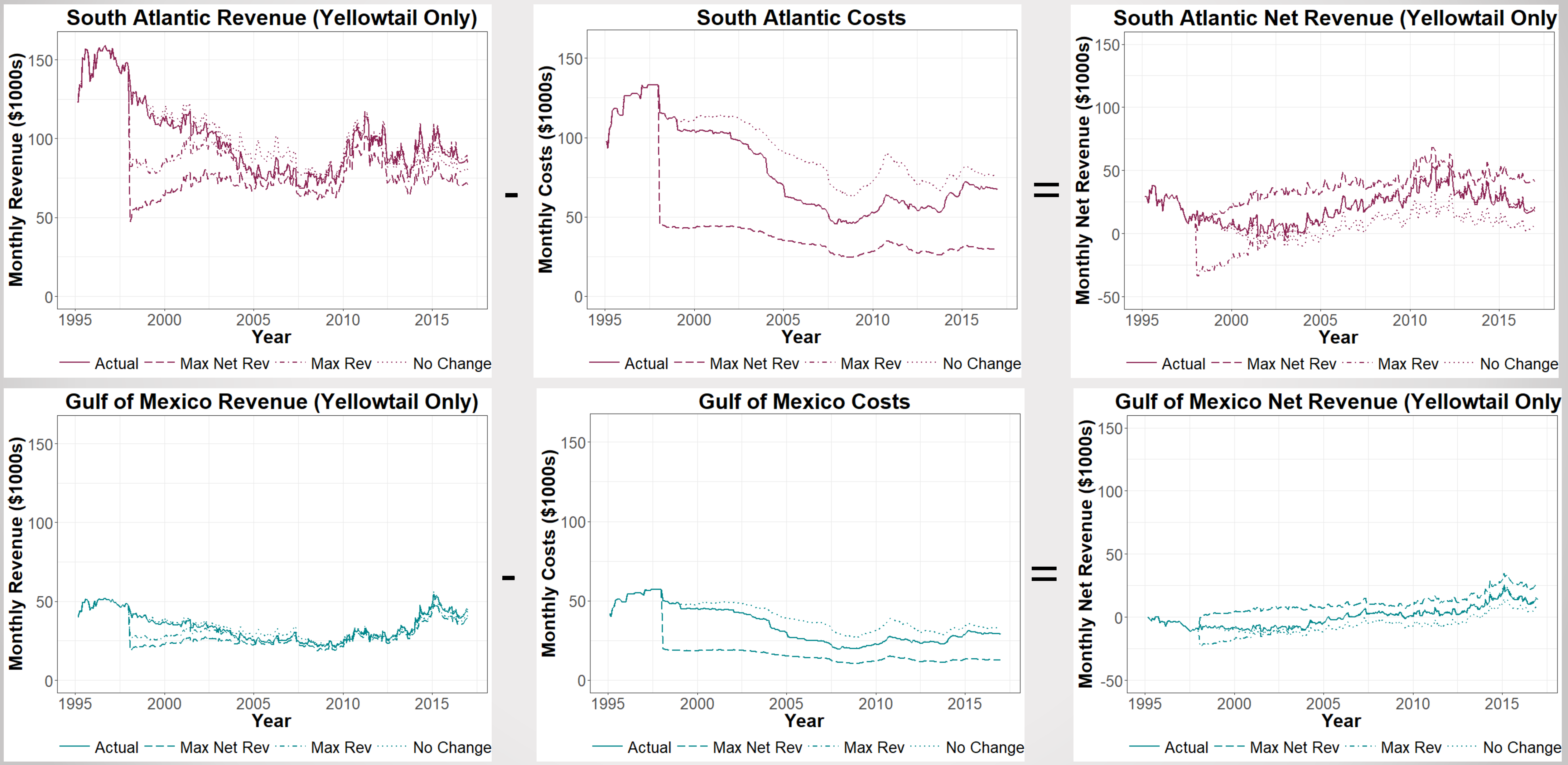
(3) Maximum revenue under current F

(4) Maximum yellowtail snapper net revenue





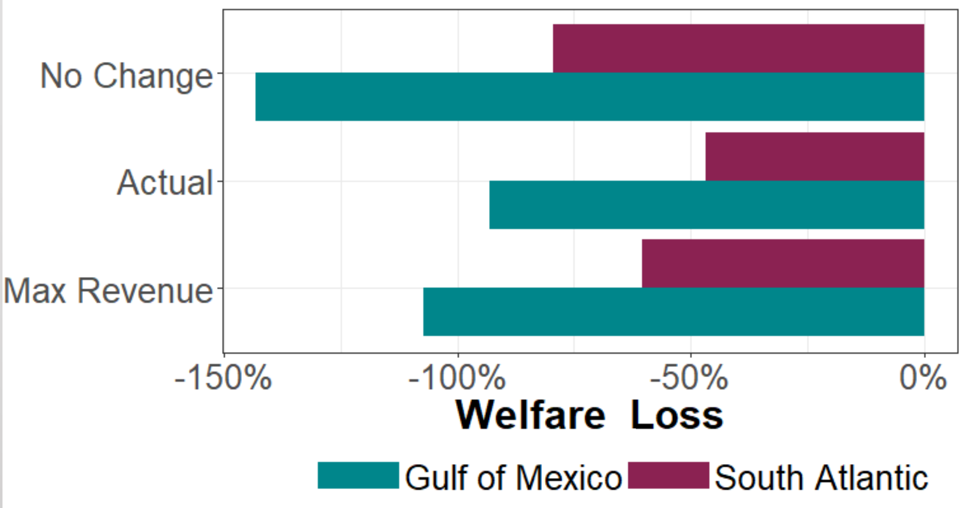
Yellowtail Snapper Net Revenue

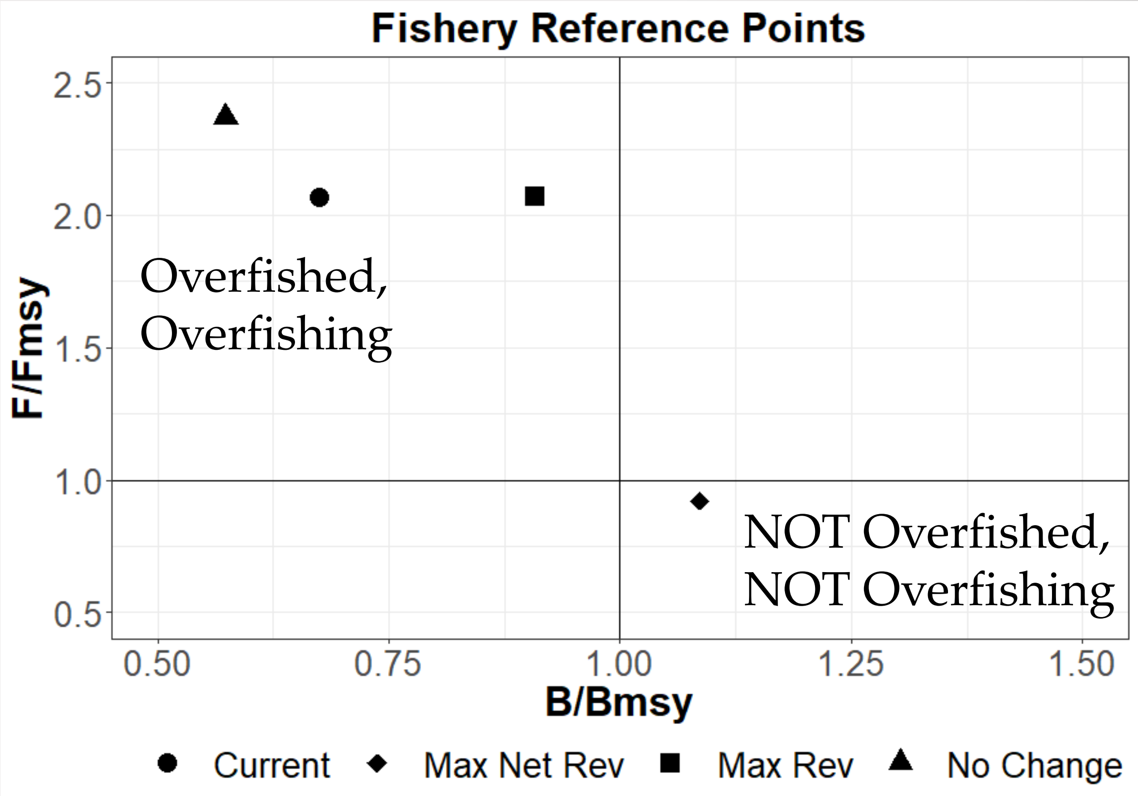


Economic and Biological Benchmarks

Net Present Value (Millions)

Strategy	South Atlantic	Gulf of Mexico
No Change	$1.80	-$1.16
Actual	$4.65	$0.18
Max Revenue	$3.45	-$0.20
Max Net Revenue	**$8.72**	**$2.69**





Conclusions and Future Work

- Reduction of fishing effort is an efficient way to maximize profits
  - Tradeoffs of reduced F
- Recreational effort more difficult to contain
  - Marine Protected Areas?
- For species with $L_c > L_m$ (yellowtail), increasing L_c is less effective
- Analyze more reef fishes to define fleet wide benefits of reduced F

Thank you!

Funding Sources

NOAA Southeast Fisheries Science Center

National Coral Reef Conservation Program

Florida RESTORE Act

University of Miami RSMAS