Length-Based Risk Analysis of Management Options for the southern Florida Mulispecies Coral Reef Fishery

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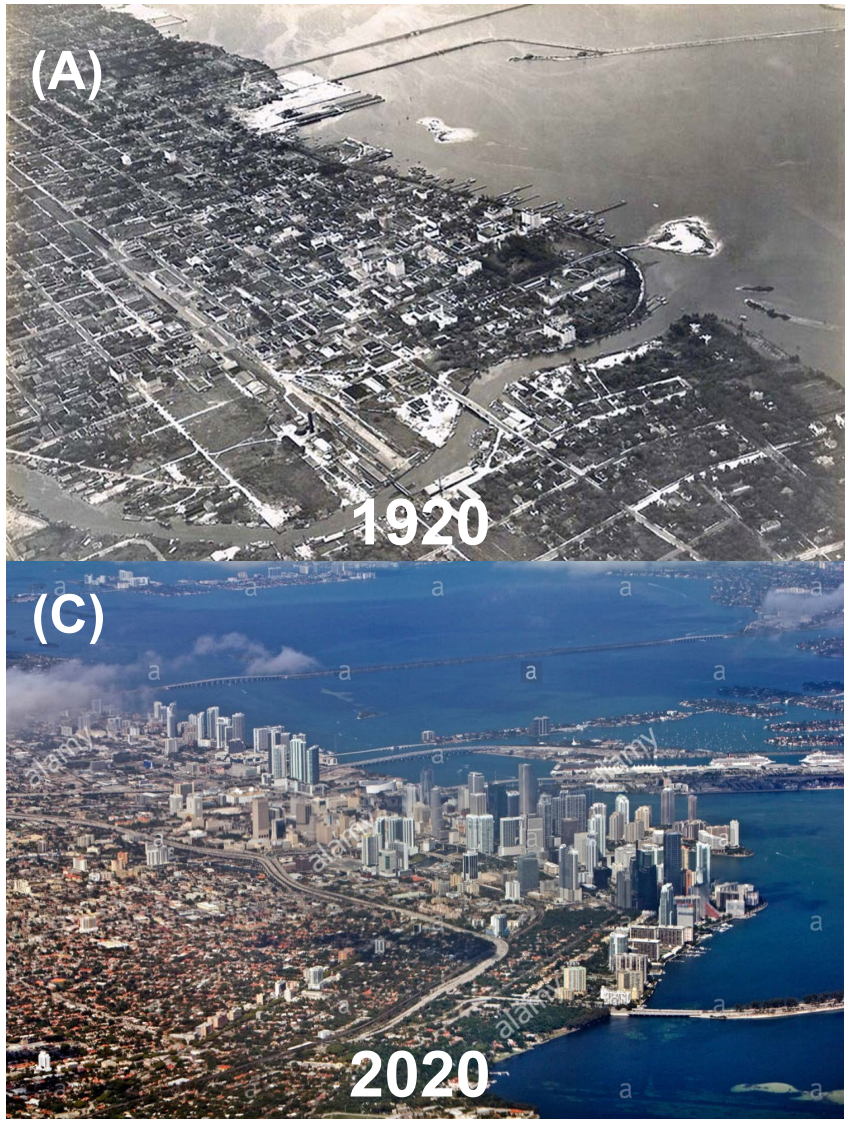
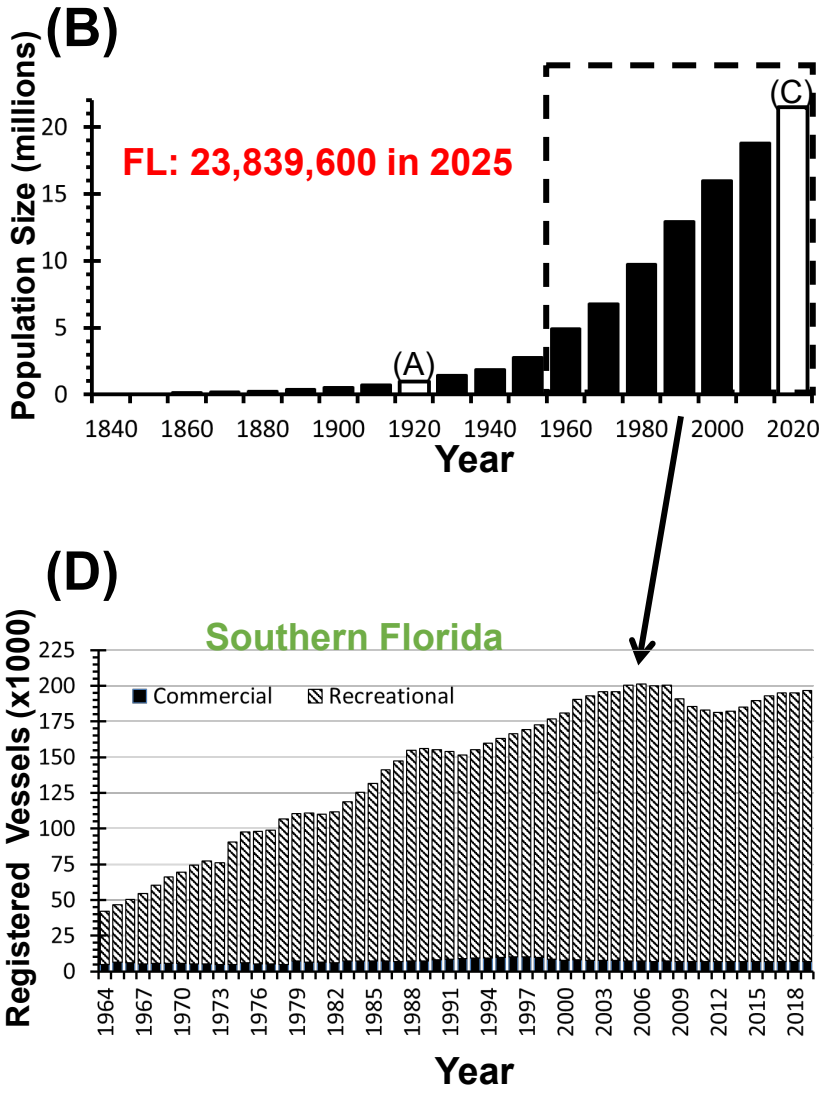
"The Times They Are a Changing!"





Recreational fleet: ↑ 410%

Commercial fleet: ↑ 45%

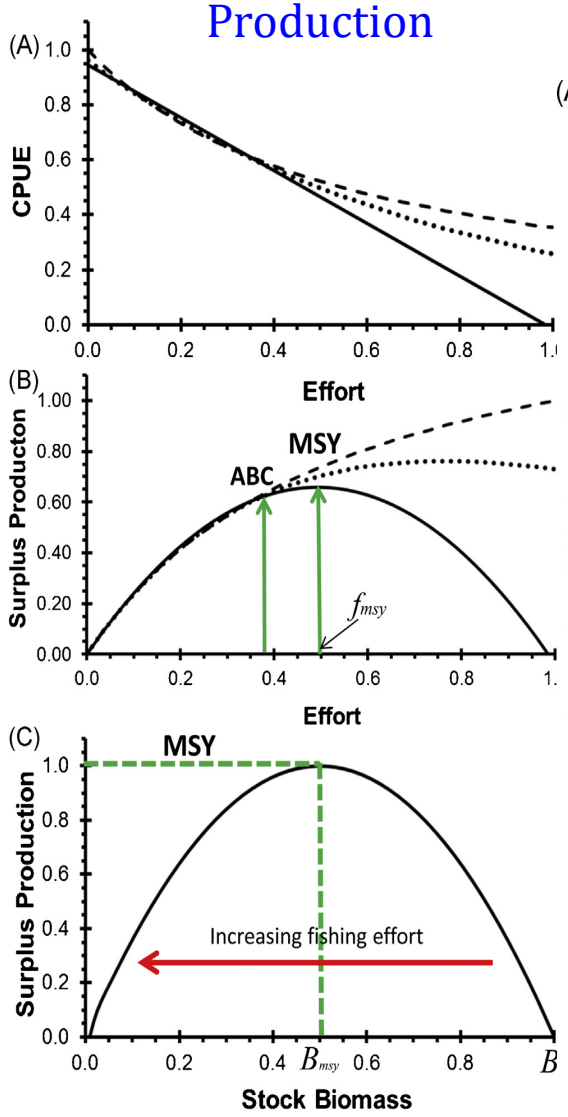
Extraordinary rise in fishing pressure with larger #s of fishers & fishing power:
GPS, fish finding acoustics, SOA vessel designs, real-time weather, communication networks, social media.

Decision Analysis with Multiple Objectives

Goal: Effectively balance resource sustainability risks with stock production to mitigate overfishing likelihoods. Increase the probability of sustainable fisheries into the indefinite future.

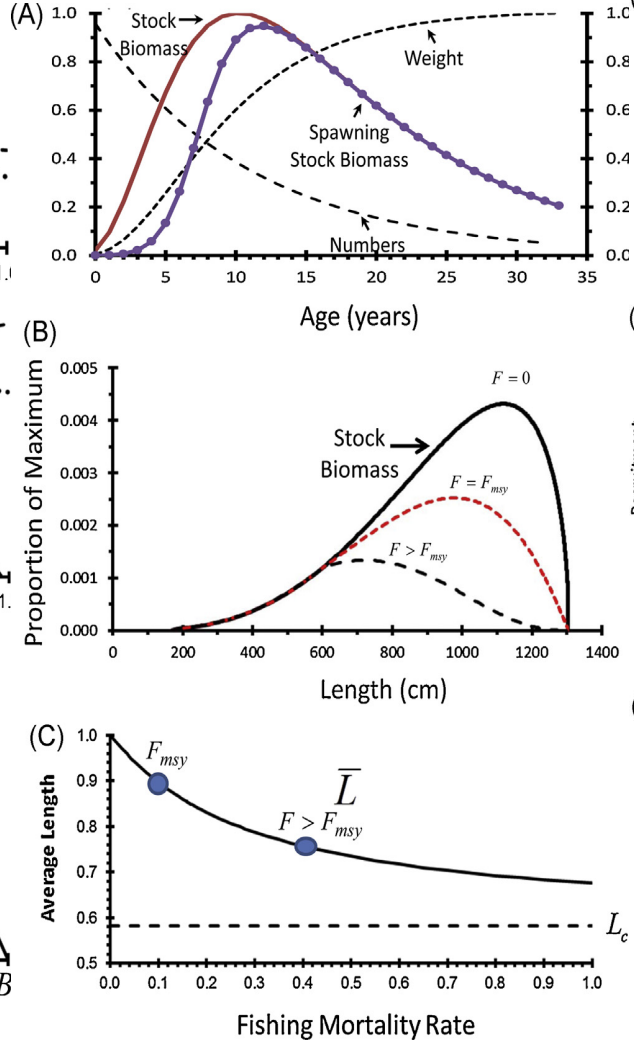
Requires assessment of risks!

Production



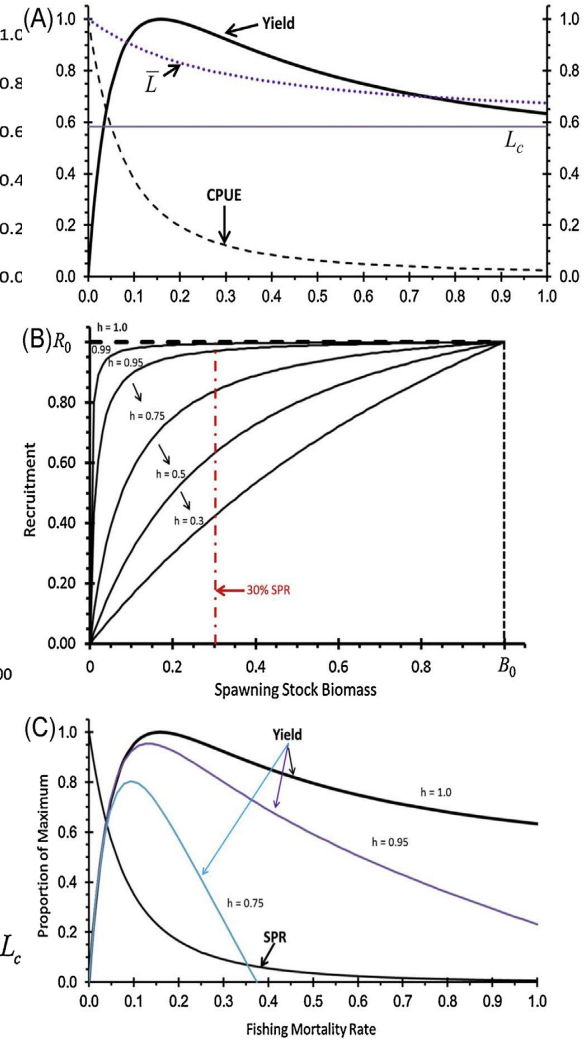
Dollar$

Sustainability



Jobs

Recruitment



Future Jobs & Dollars

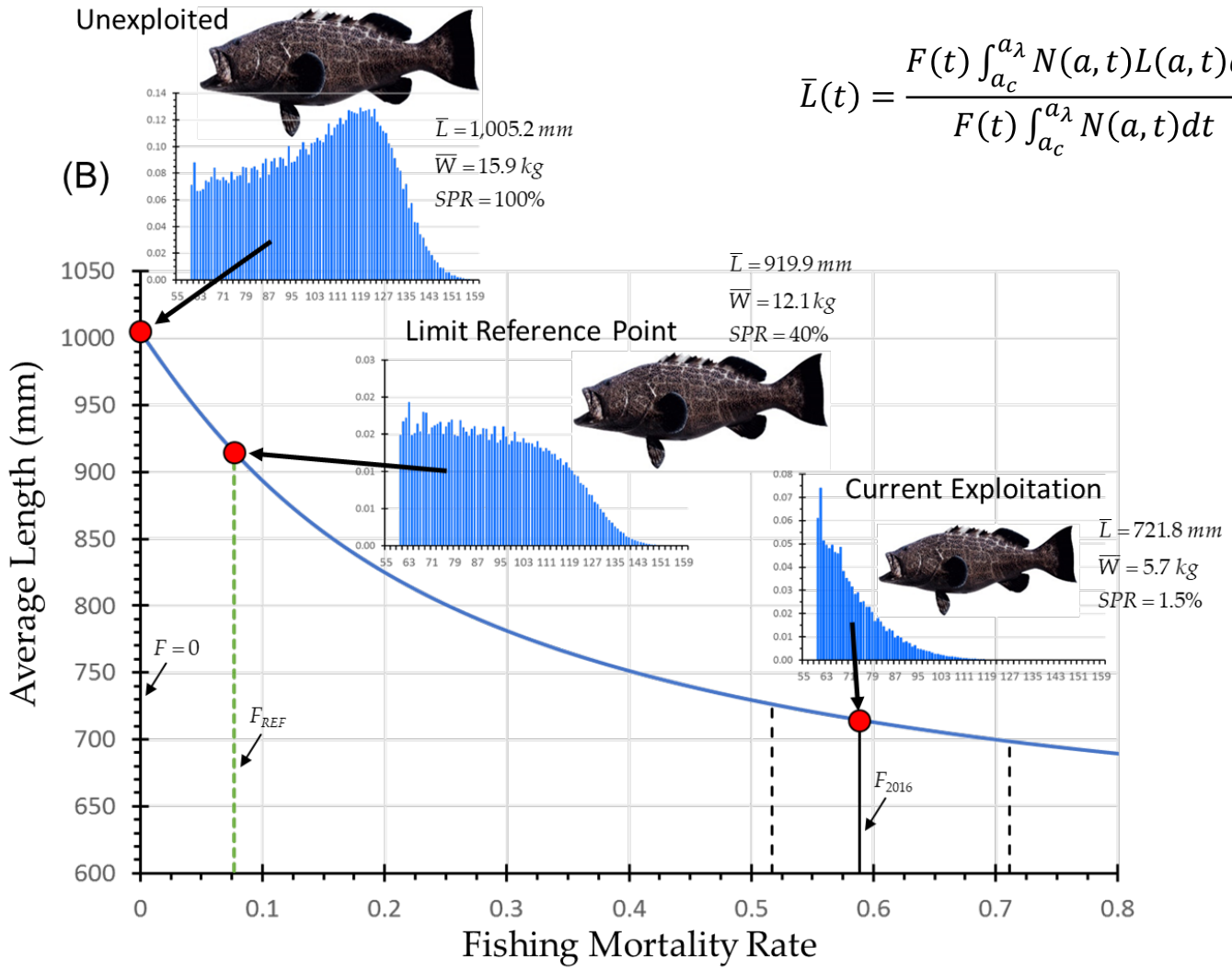
Data Sources for Multi-Stock Assessments

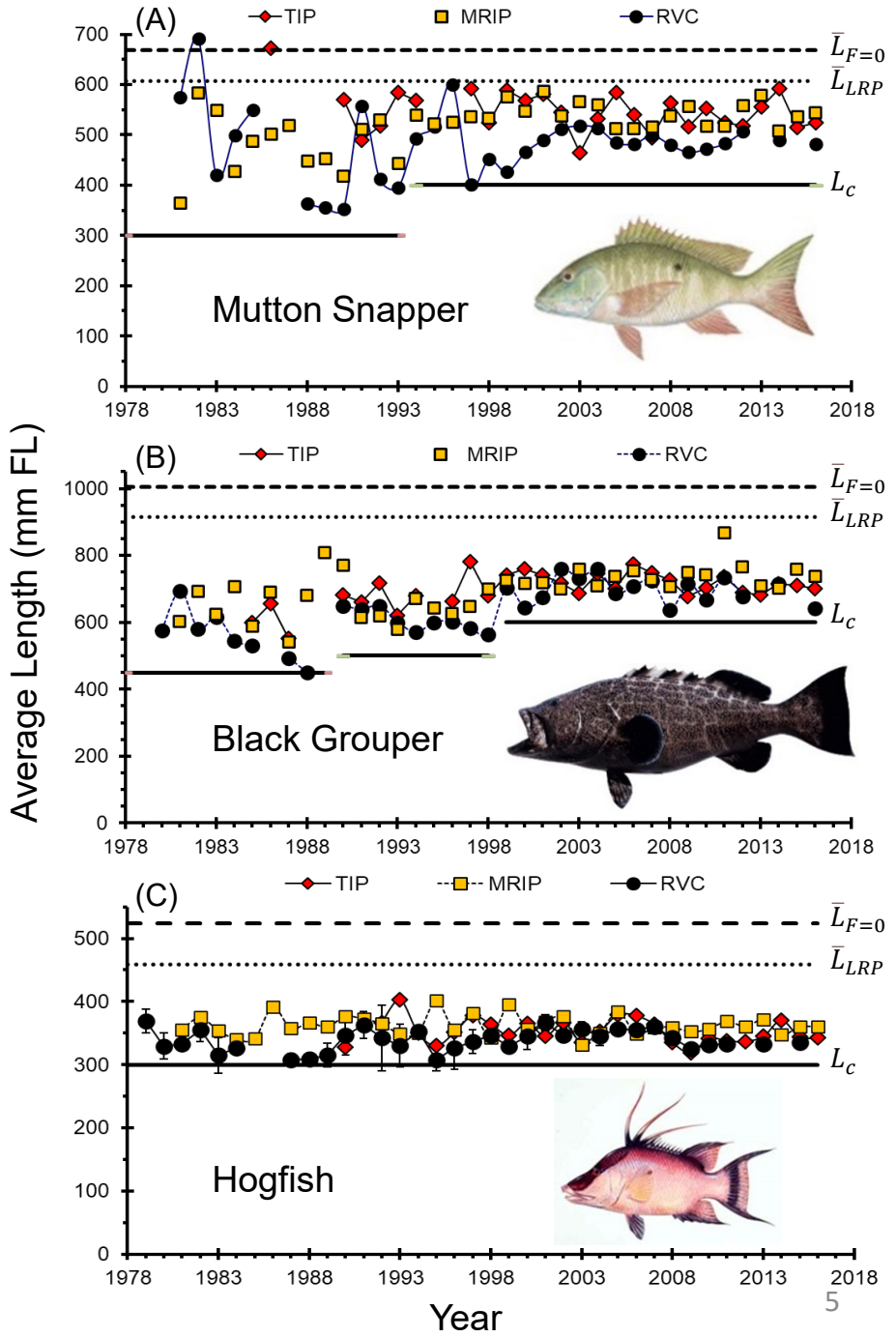
Database	Description	Years
Fishery Dependent		
TIP	Commercial Trip Intercepts	1984-2016
MRIP	Sport Trip Intercepts	1981-2016
HB	Recreational Headboats	1981-2011
Fishery Independent		
RVC	Diver Visual Surveys	1979-2016

"Data Limited" Assessment & Forecasting

(estimation – simulation framework)

$$\bar{L}(t) = \frac{F(t)\int_{a_c}^{a_\lambda} N(a,t)L(a,t)dt}{F(t)\int_{a_c}^{a_\lambda} N(a,t)dt}$$

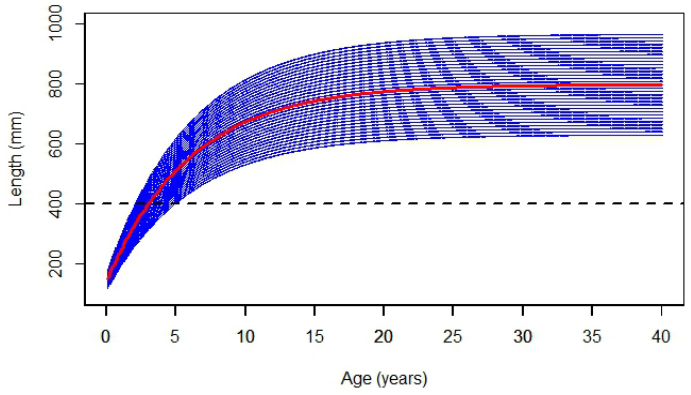




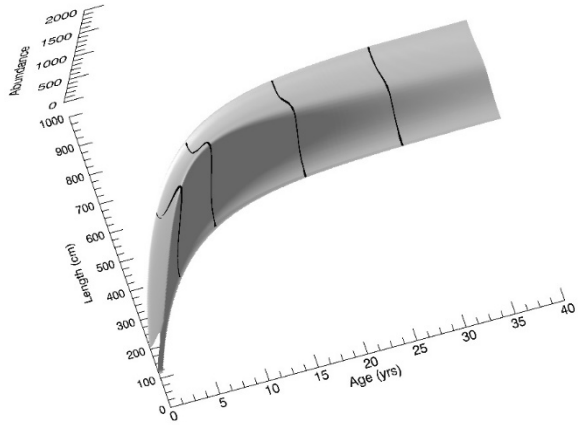
REEFS (Reef Fishery Ecosystem Exploited Fishery Simulator)

Probabilistic Lifetime Growth

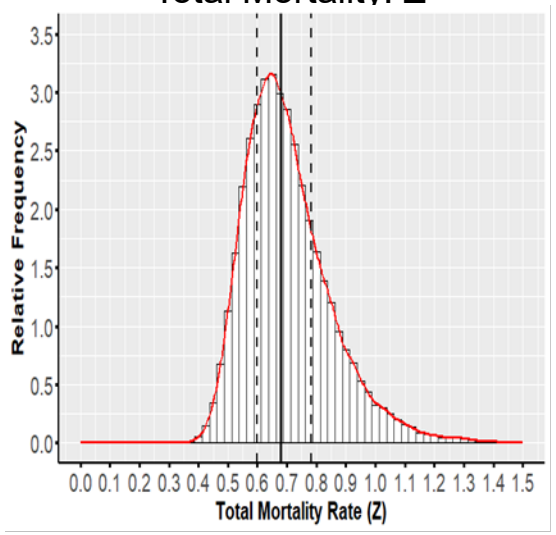
(A)



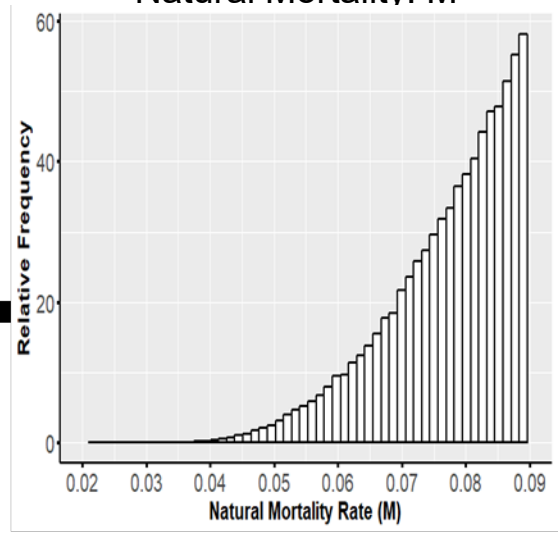
(B)



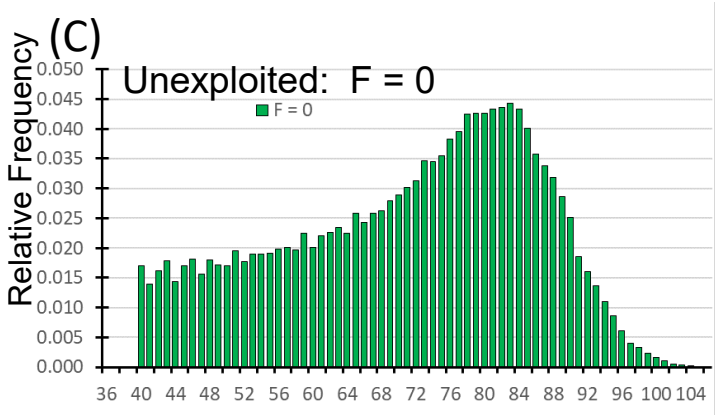
Total Mortality: Z



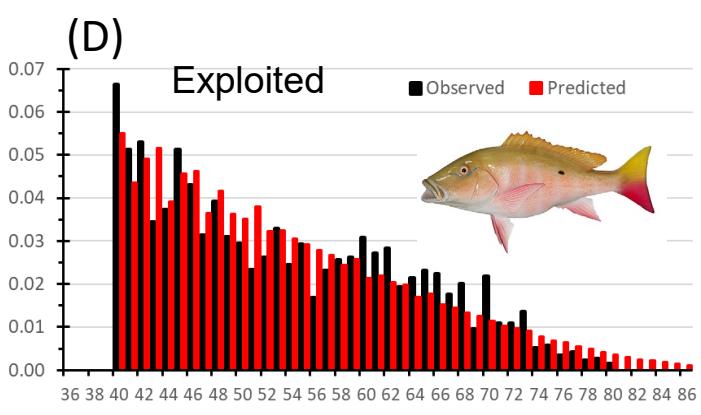
Natural Mortality: M



(C)

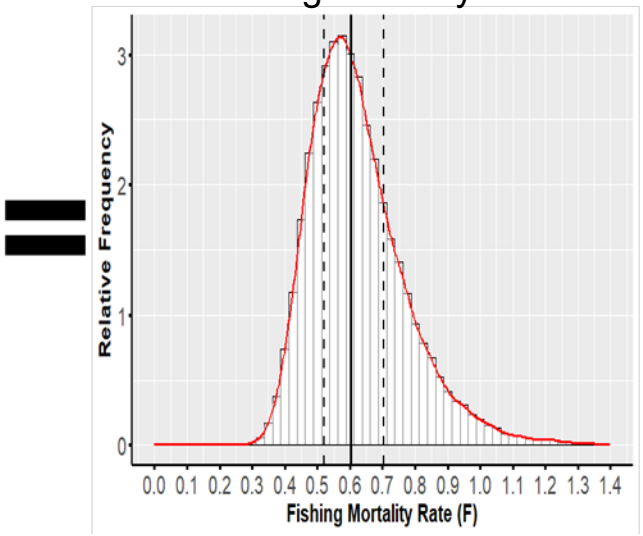


(D)

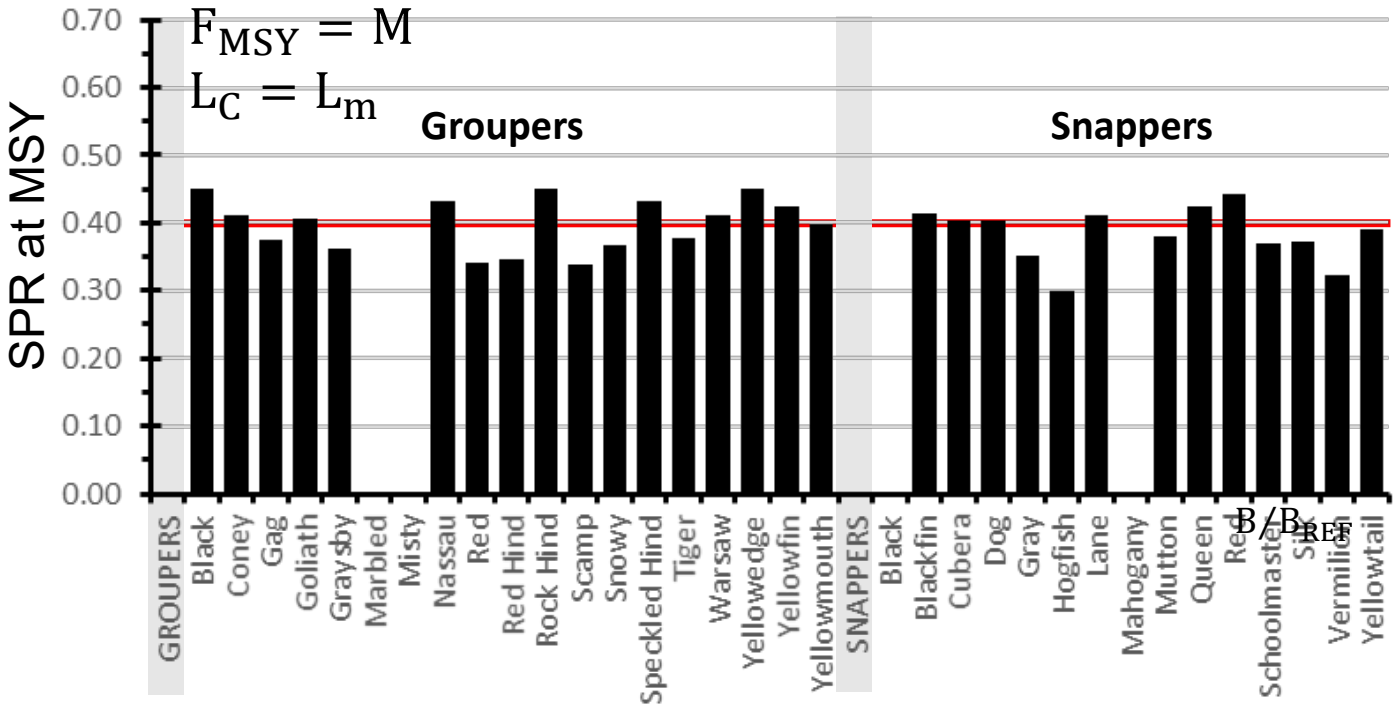


Fork Length (cm)

Fishing Mortality: F



Sustainability Reference Points



SPR ≡ spawning potential ratio: B/B_0

MSY ≡ maximum sustainable yield

Limit Reference Points (LRPs)

B/B_{REF} ≡ SPR Limit

F/F_{REF} ≡ Overfishing Limit

Management Control Variables

L_C ≡ minimum size of first capture

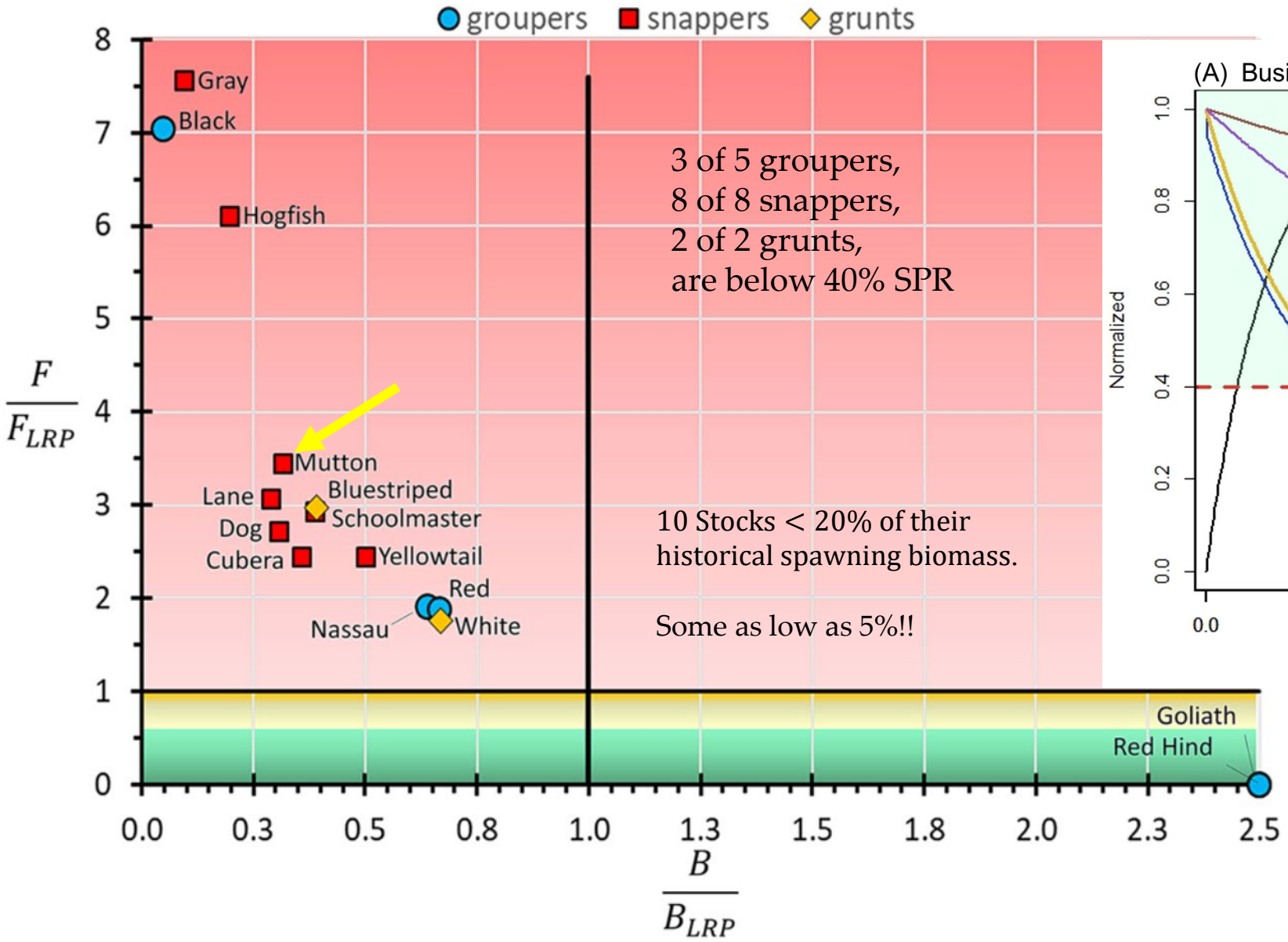
$F = qf$ ≡ fishing mortality rate

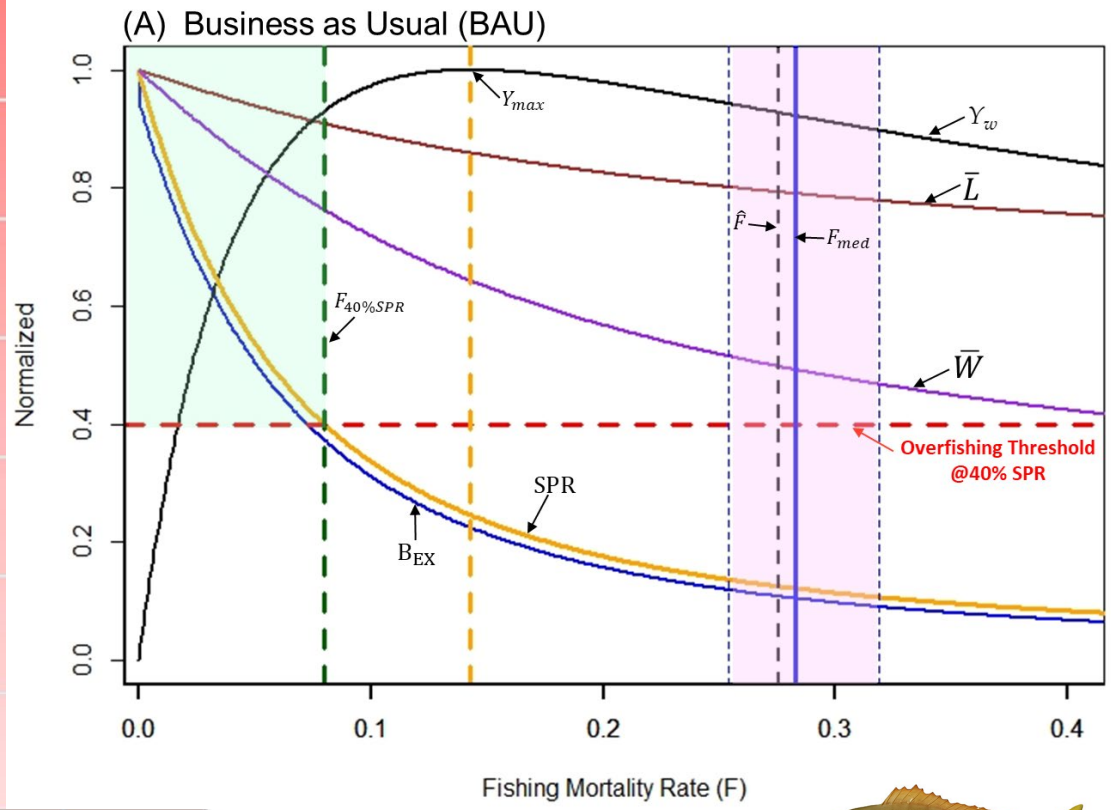
Population Dynamics

L_m ≡ length at first sexual maturity

a_λ ≡ lifespan (maximum age without fishing = M)

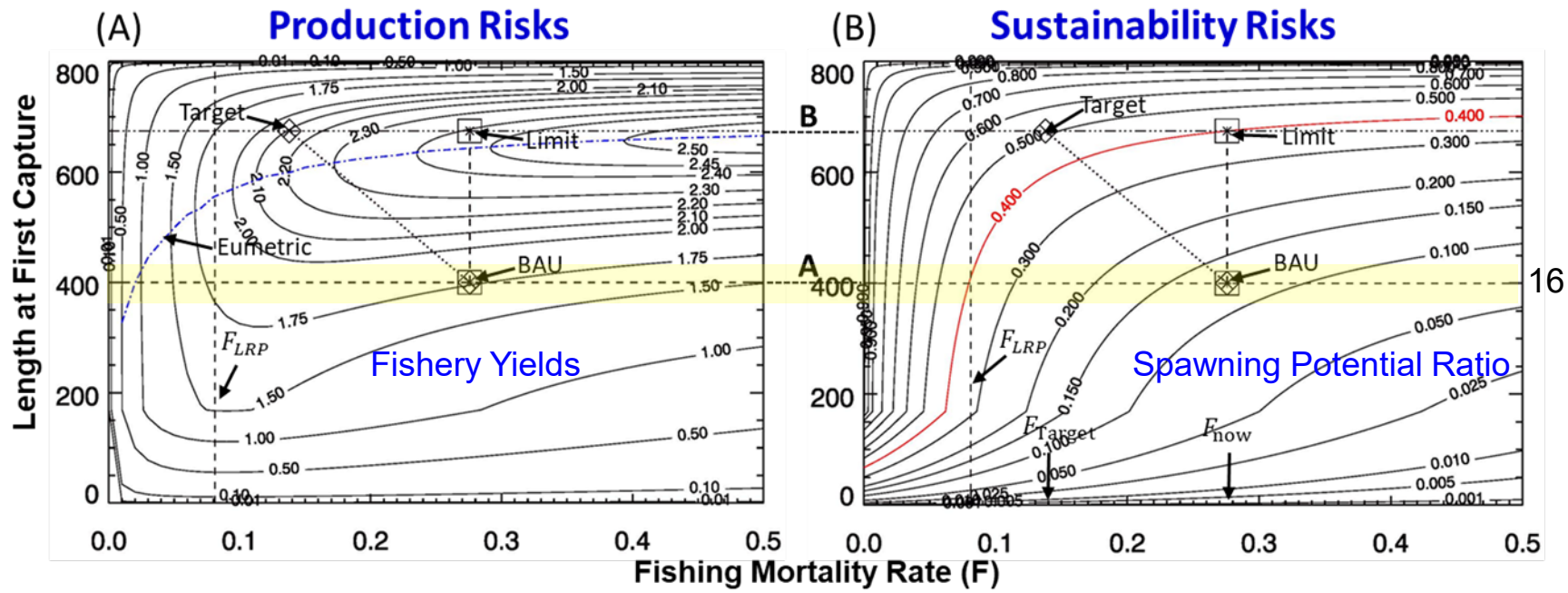
Exploitation Impacts: Kobe "control rule" plot





Mutton snapper

Global likelihoods:

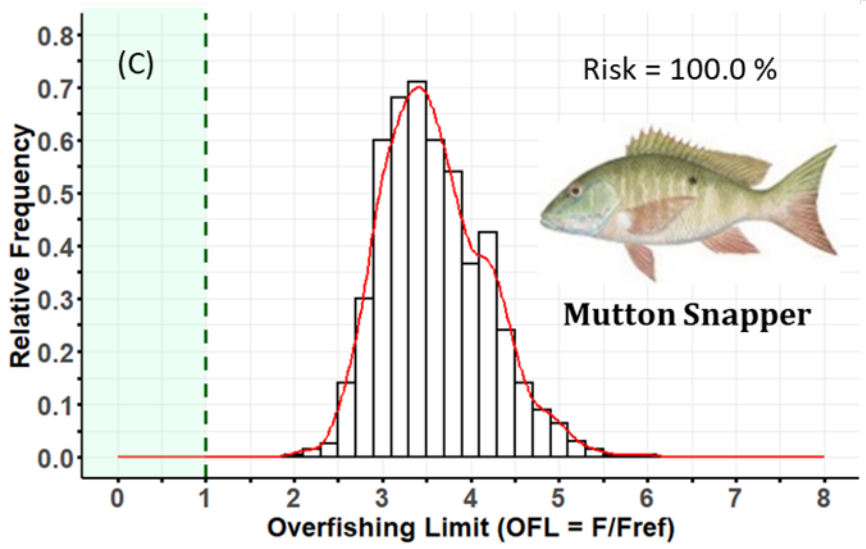


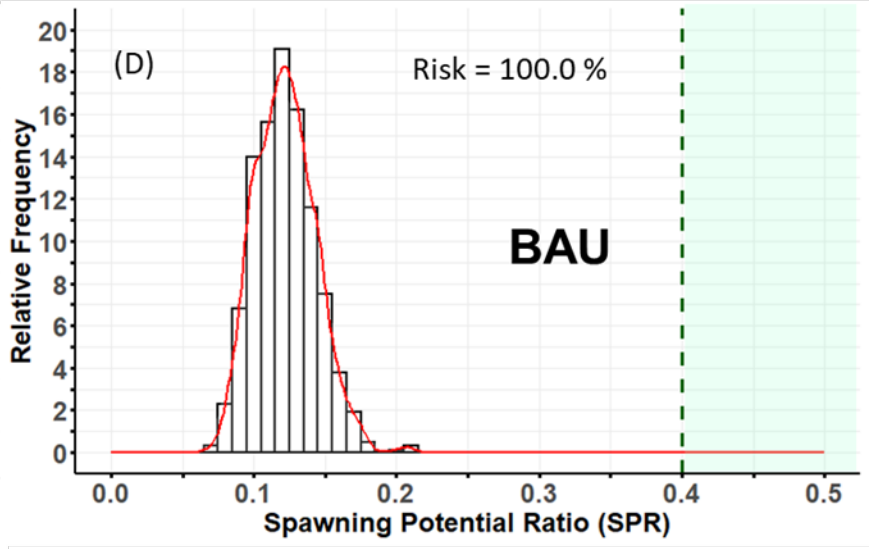
16 inches

Observed likelihoods:

$L_C = 400$ mm FL

$F = 0.2757$

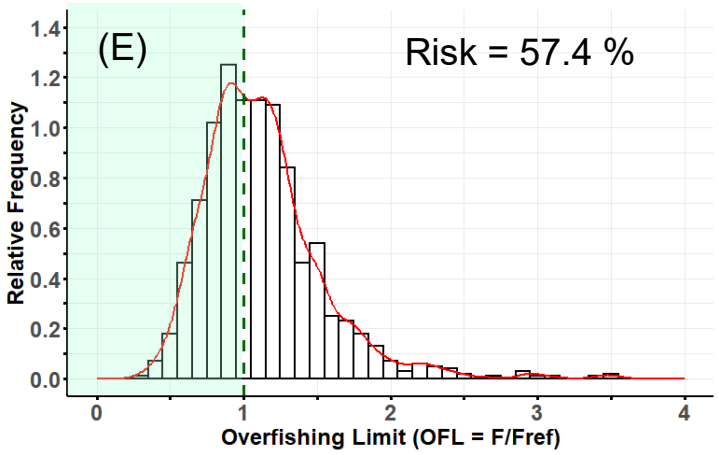


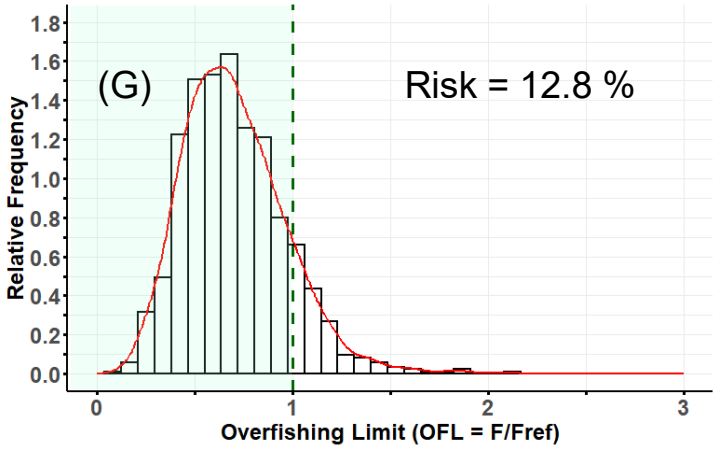


BAU Management Regulations DO NOT Achieve Sustainability Goals!

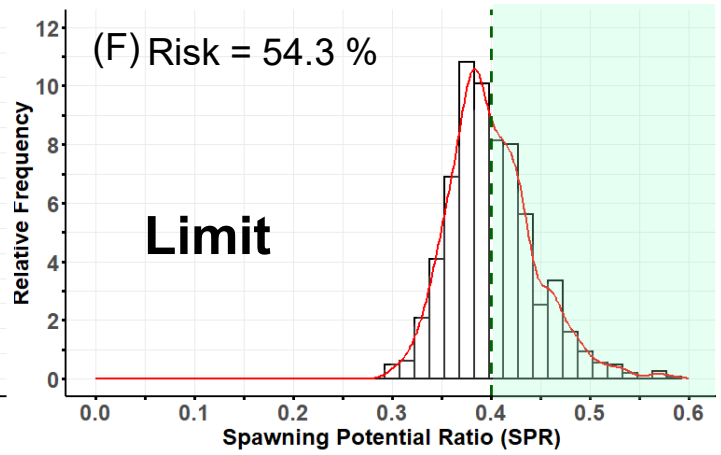
Risk Mitigation

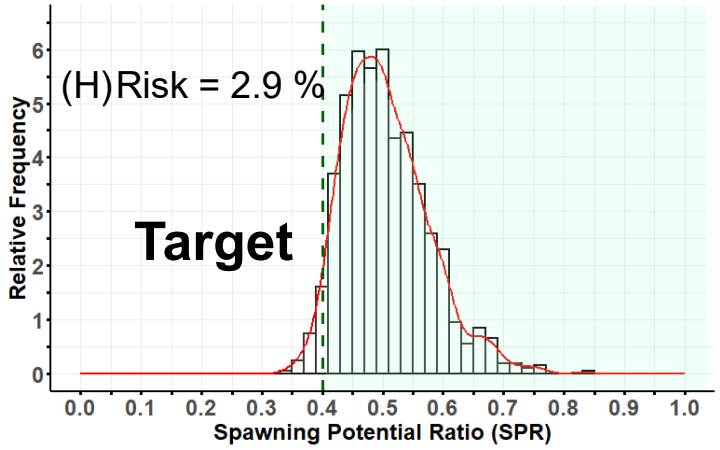
Production Risks

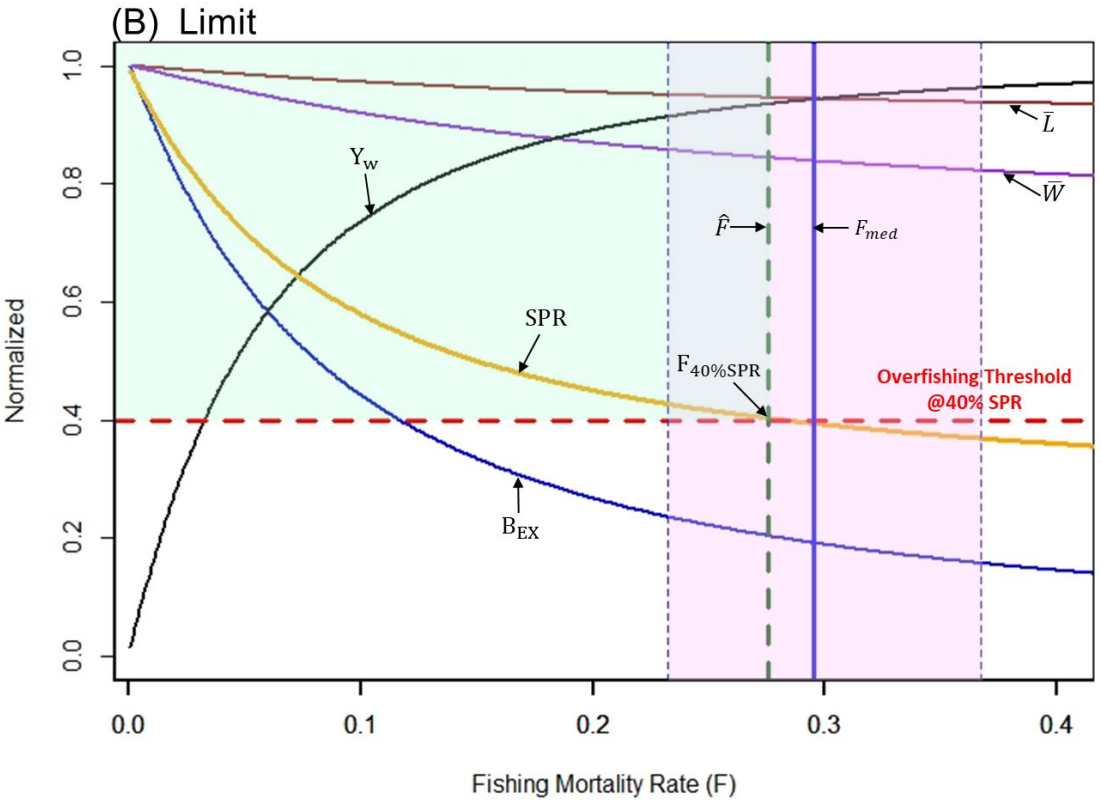




Sustainability Risks



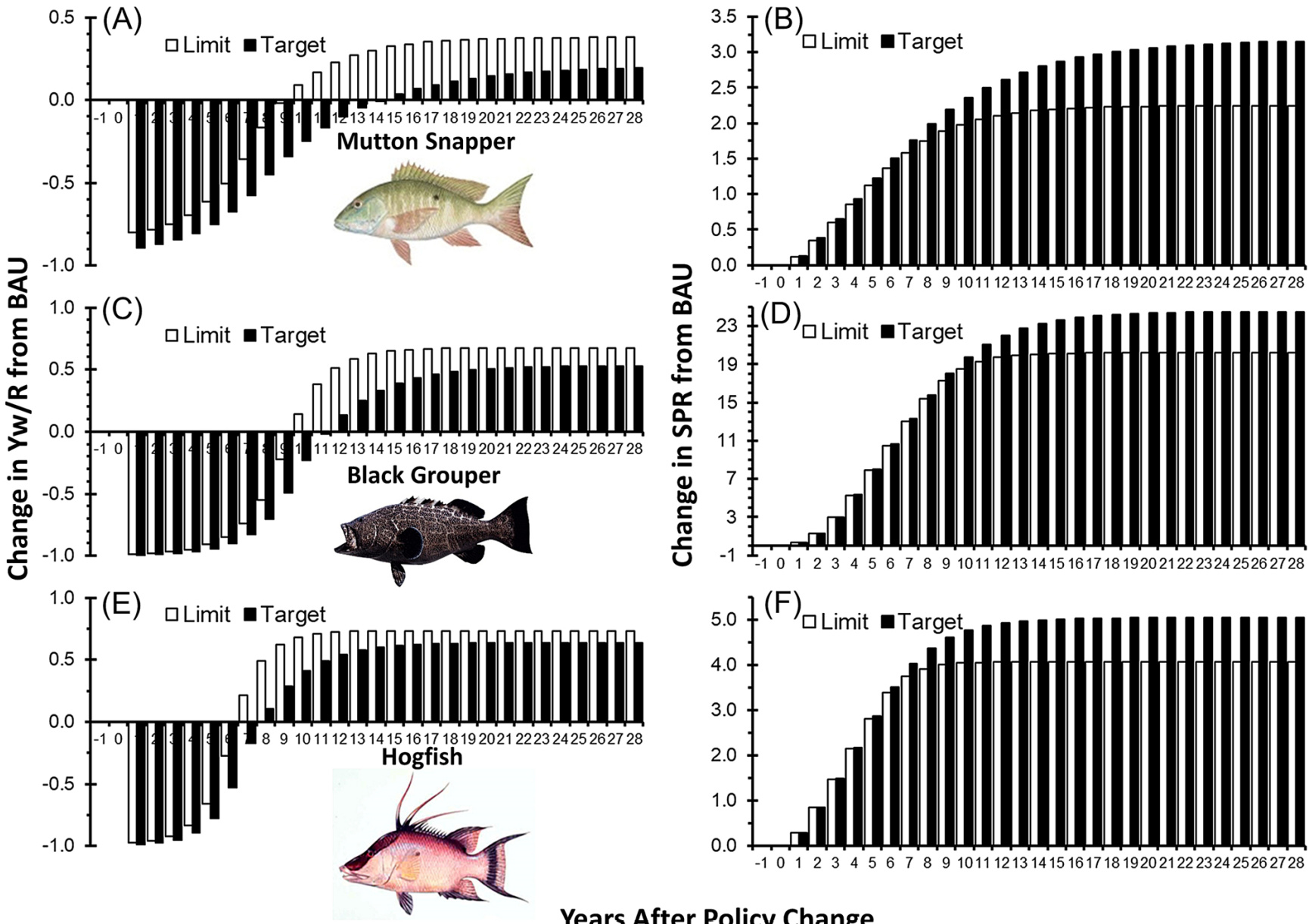




Limit: Raise $L_C = 400 \rightarrow 674.6$ mm FL (L_{REF}), but risk of overfishing still $> 50\%$.

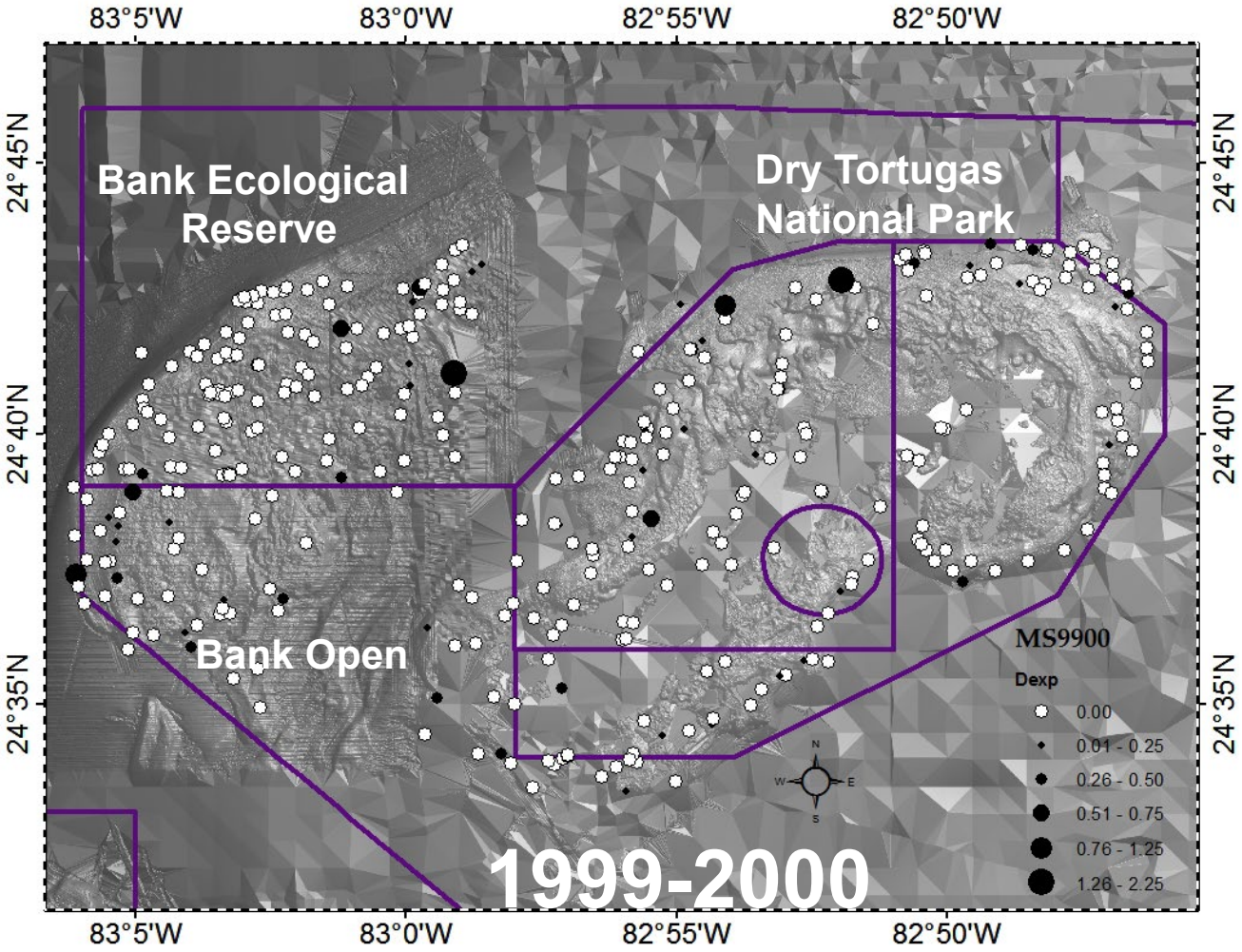
Target: Raise L_C to L_{REF} AND $F = 0.5F_{BAU} = 0.1379$.

Implementing Suggested Fishery Policy Changes

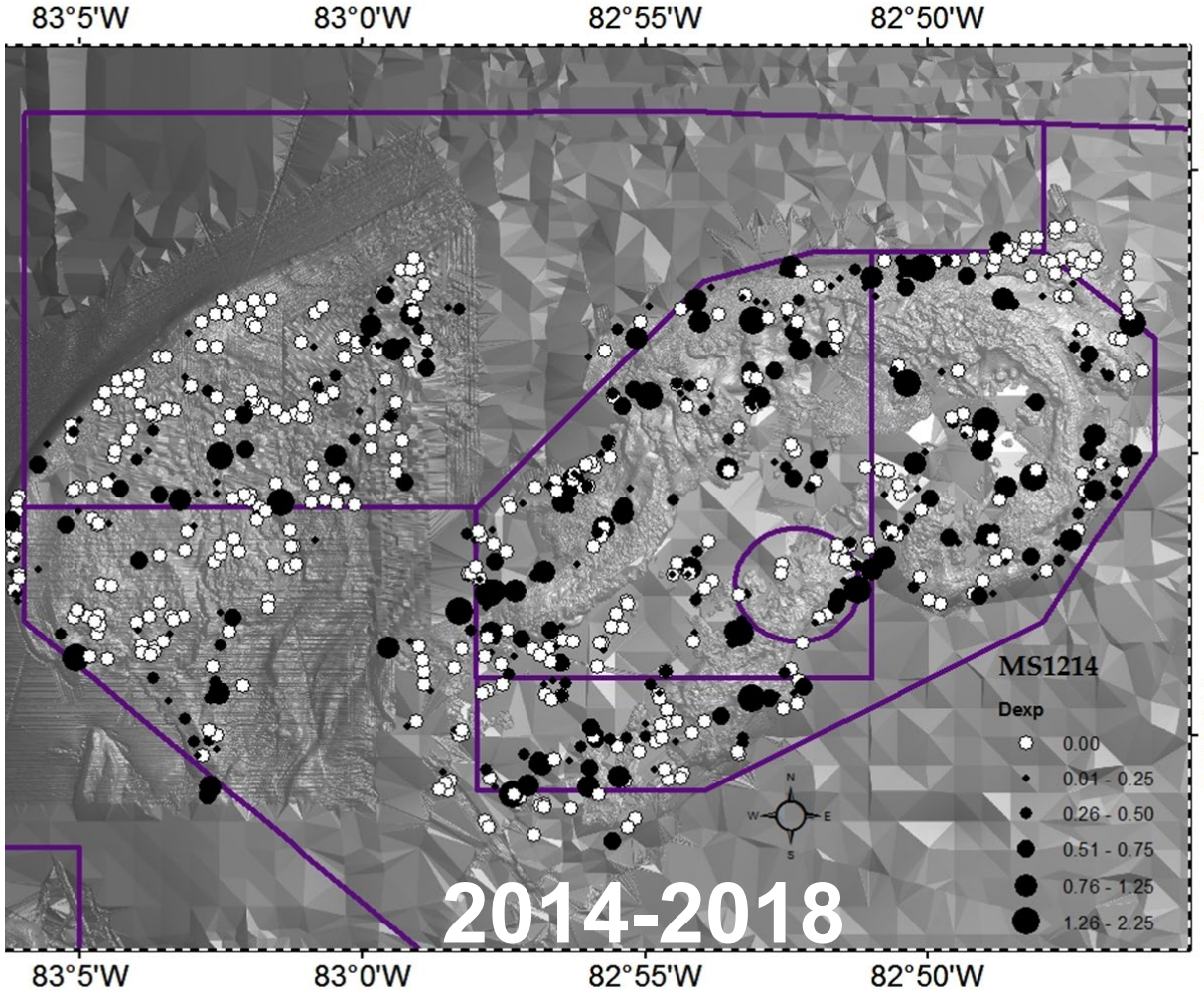


Spatial Management: Dry Tortugas "No Take" Marine Reserves

Pre-Implementation



Post-Implementation



Mutton snapper

Roles of Science & Management in Florida Keys Reef Fishery Conservation

Health is the **ability for self-renewal**. Conservation is the effort to understand and promote the capacity for self-renewal.

The **role of science** is to understand the conditions necessary for self-renewal, and the **role of management** is to use science to create conditions that promote self-renewal.

Given the long stock recovery times forecasted here, there is immediate need for management actions that combine Lc, F, area and time because BAU reminds us that doing the same thing over and over and expecting a different result is sheer folly.


Thank You