Successes and Failures of Regulatory Requirements to Rebuild Depleted Stocks in U.S. Fisheries

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Legal Basis for Management of U.S. EEZ Fisheries

Finding that "[c]ertain stocks of fish have declined to the point where their survival is threatened," **Congress enacted the MSA in 1976 to "conserve and manage fishery resources" and to "achieve and maintain, on a continuing basis, the optimum yield from each fishery."**

In order to achieve these ends the MSA established eight regional Fishery Management Councils, which could set the TAC for each fish species in different fishing zones.

The FMP's, and amendments thereto, do not become effective, however, until they are approved by the Secretary. The Secretary has delegated this responsibility to the NMFS, which only promulgates the regulation after ensuring the FMP's and amendments are consistent with the MSA's ten National Standards, and after a period of public comment. Fishermen's Finest v. Locke (2009)

Key Elements of the MSA

- Section 301—National Standards
- Section 303—Requirement to end overfishing and rebuild overfished stocks
- Section 304—Timing to Rebuild Overfished Stocks

MSA Section 301—National Standards

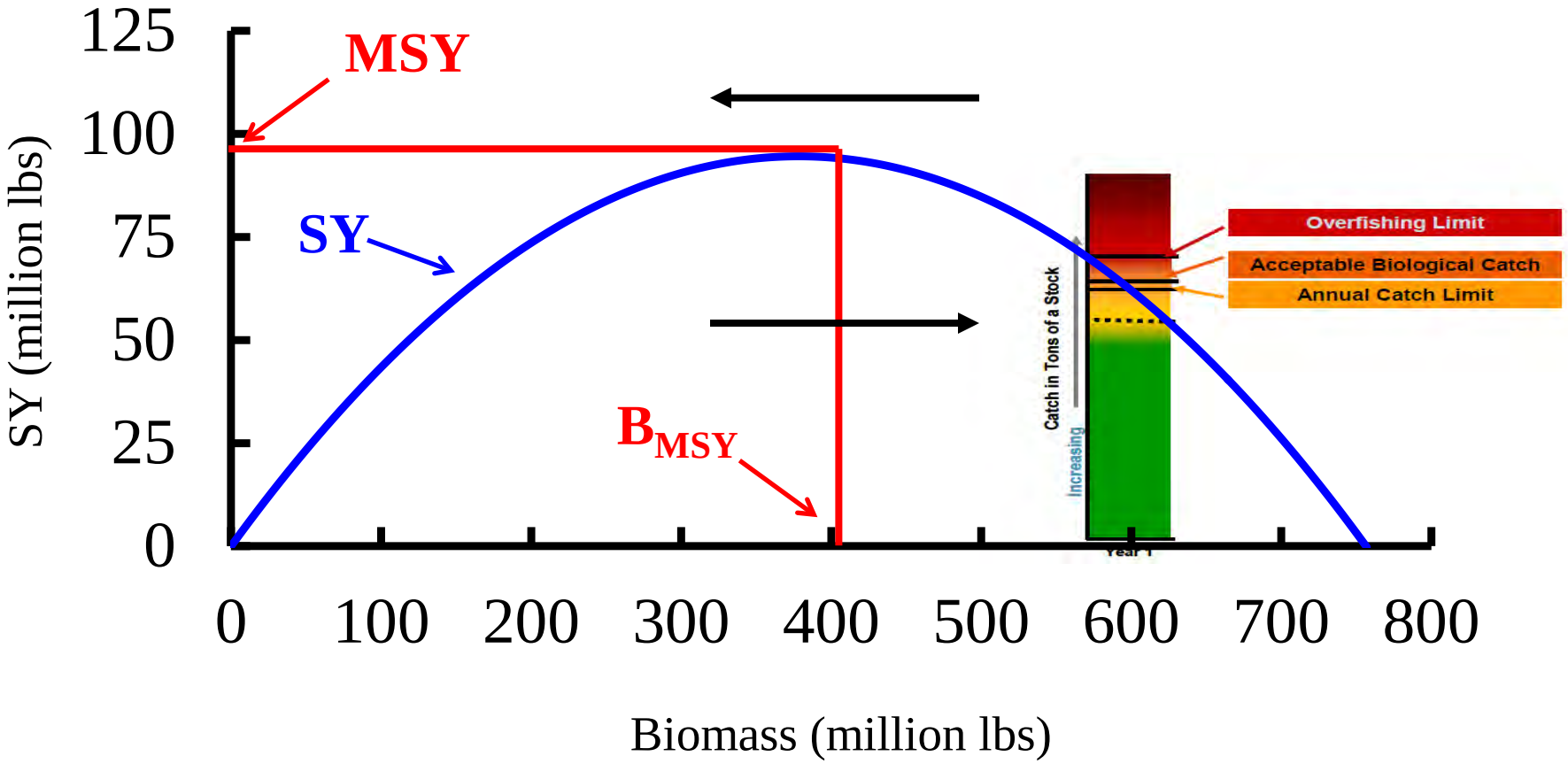
1. Conservation and management measures shall **prevent overfishing while achieving, on a continuing basis, the optimum yield** from each fishery for the United States fishing industry.
2. Conservation and management measures shall be based upon the **best scientific information available**.
3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and **interrelated stocks of fish shall be managed as a unit** or in close coordination.
4. **Conservation and management measures shall not discriminate between residents of different States**. If it becomes necessary to allocate or assign fishing privileges among various USA fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

Sustainable Yields

E.g.

$$B_t = \beta_1 B_{t-1} - \beta_2 B_{t-1}^2 - h_{t-1}$$

$$h_{sy} = (\beta_1 - 1) B - \beta_2 B^2$$

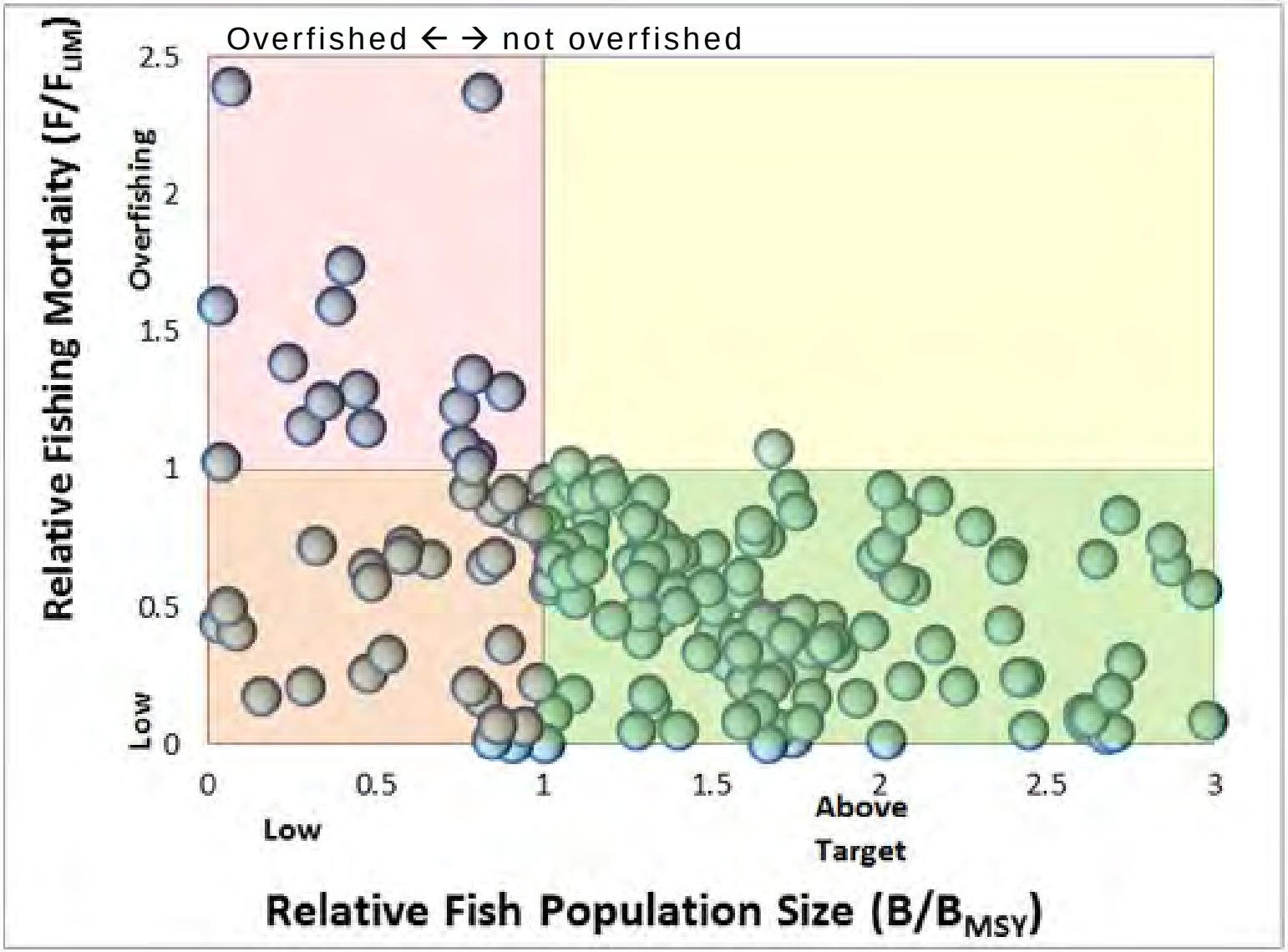


MSFCMA Section 303(a)

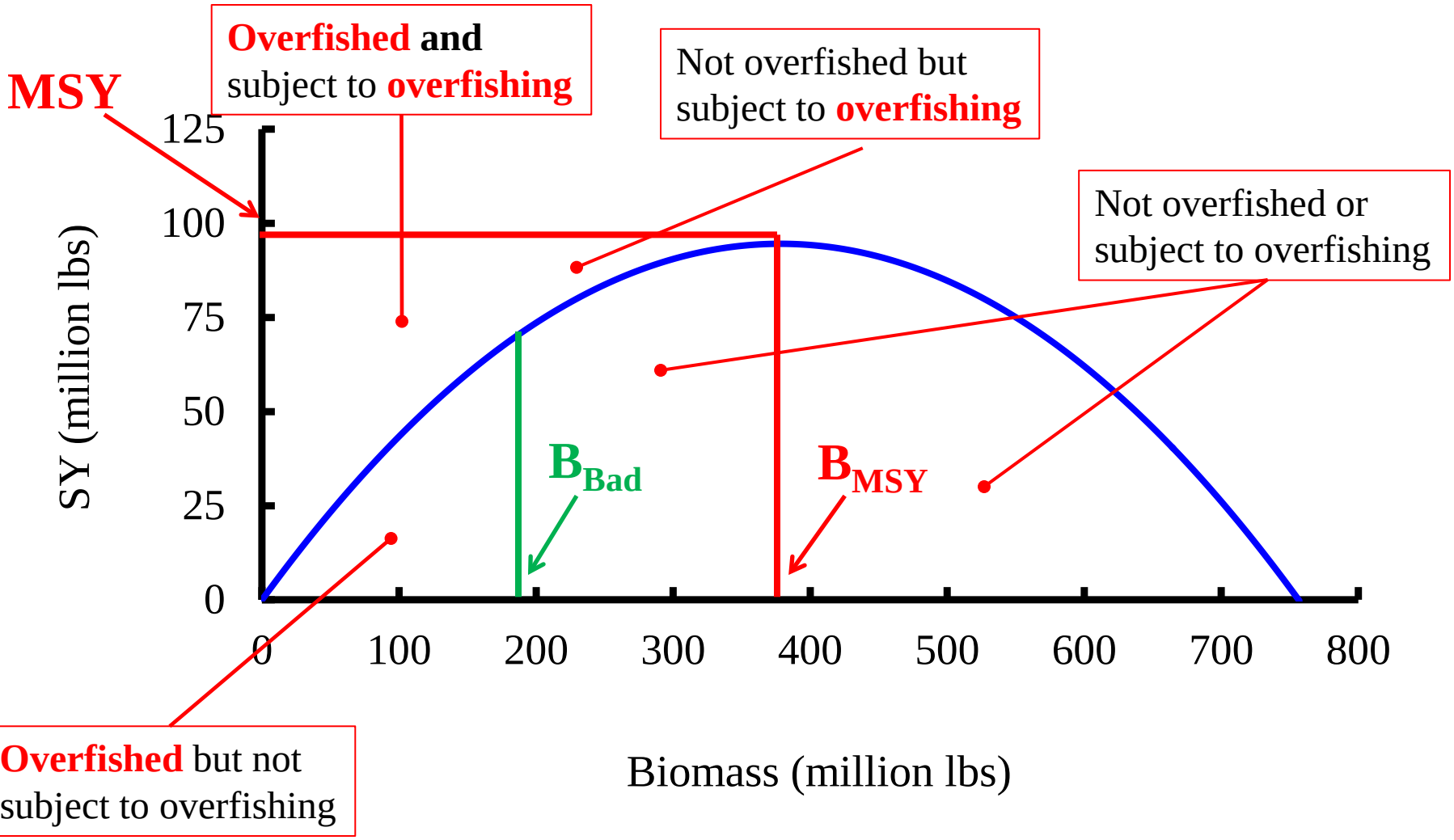
Any fishery management plan (FMP) … shall

(1) contain the conservation and management measures, …, which are (A) necessary and appropriate for the conservation and management of the fishery **to prevent overfishing and rebuild overfished stocks**, and to protect, restore, and promote the long-term health and stability of the fishery;

Status of US (Commercial) Fish and Shellfish Stocks—Idealized



Sustainable Yields



Optimum Sustainable Net Benefits

$$\text{Max}\left(Wellbeing\right) = \sum_{t=t_0}^{T} \delta^t \left(NB_{use}, NB_{option}, NB_{nonuse} \right)$$

Social Preferences

$$\text{subject to } x_t = f\left(x_{t-k}, \mathbf{X}_{t-k}, \mathbf{Y}_{t-k}\right) - h_{t-1} + \boldsymbol{\varepsilon}_t$$

Stock dynamics

$$h_t = \phi\left(\mathbf{X}_t, \mathbf{Y}_t, \ldots\right) + \boldsymbol{\upsilon}_t$$

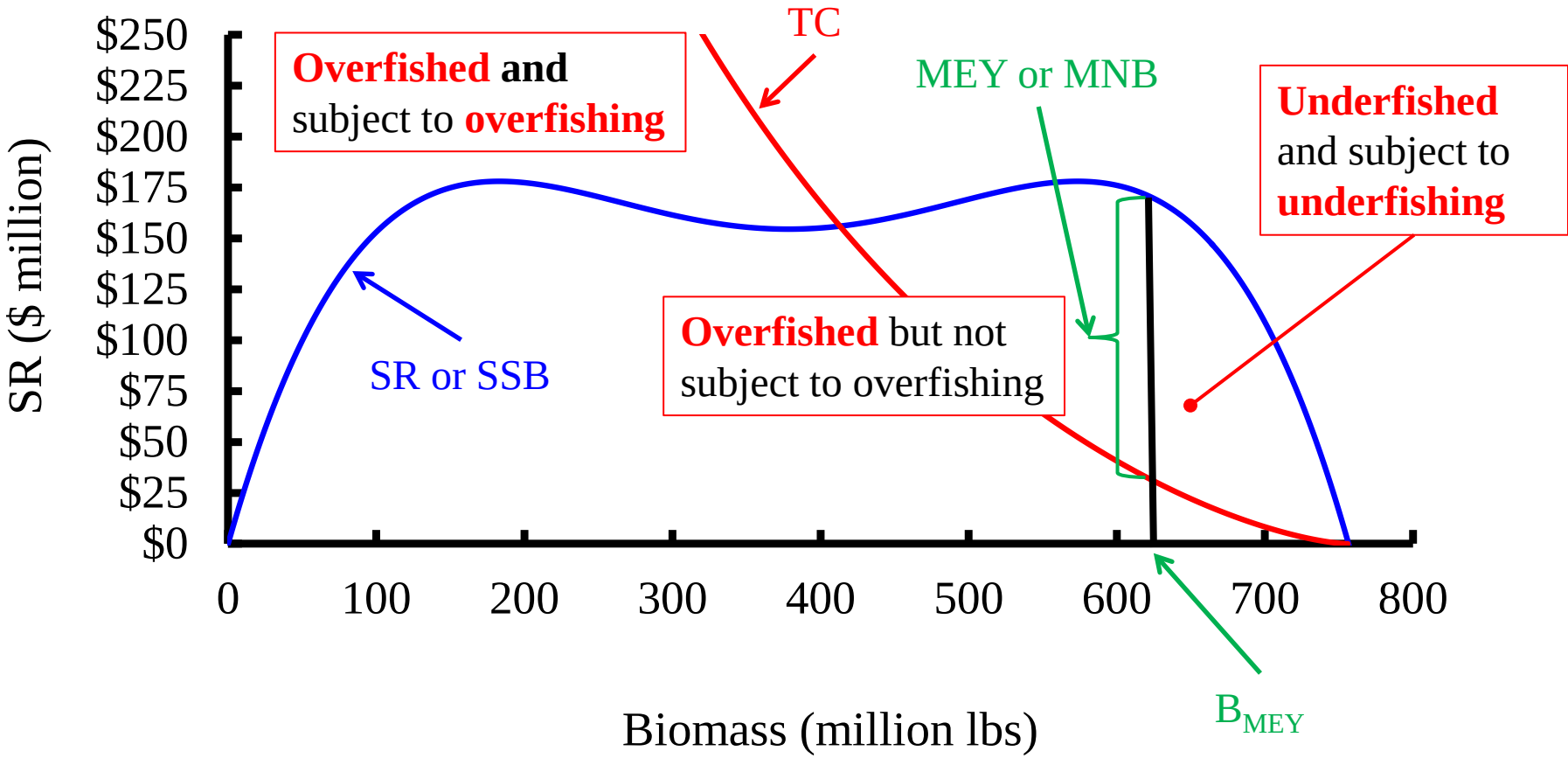
Harvest control rule

$$x_t \geq h_t \geq 0 \quad \frac{\partial x_t}{\partial x_{t-1}} > 0, \quad \frac{\partial^2 x_t}{\partial x_{t-1}^2} < 0, \quad \frac{\partial x_t}{\partial h_{t-1}} < 0$$

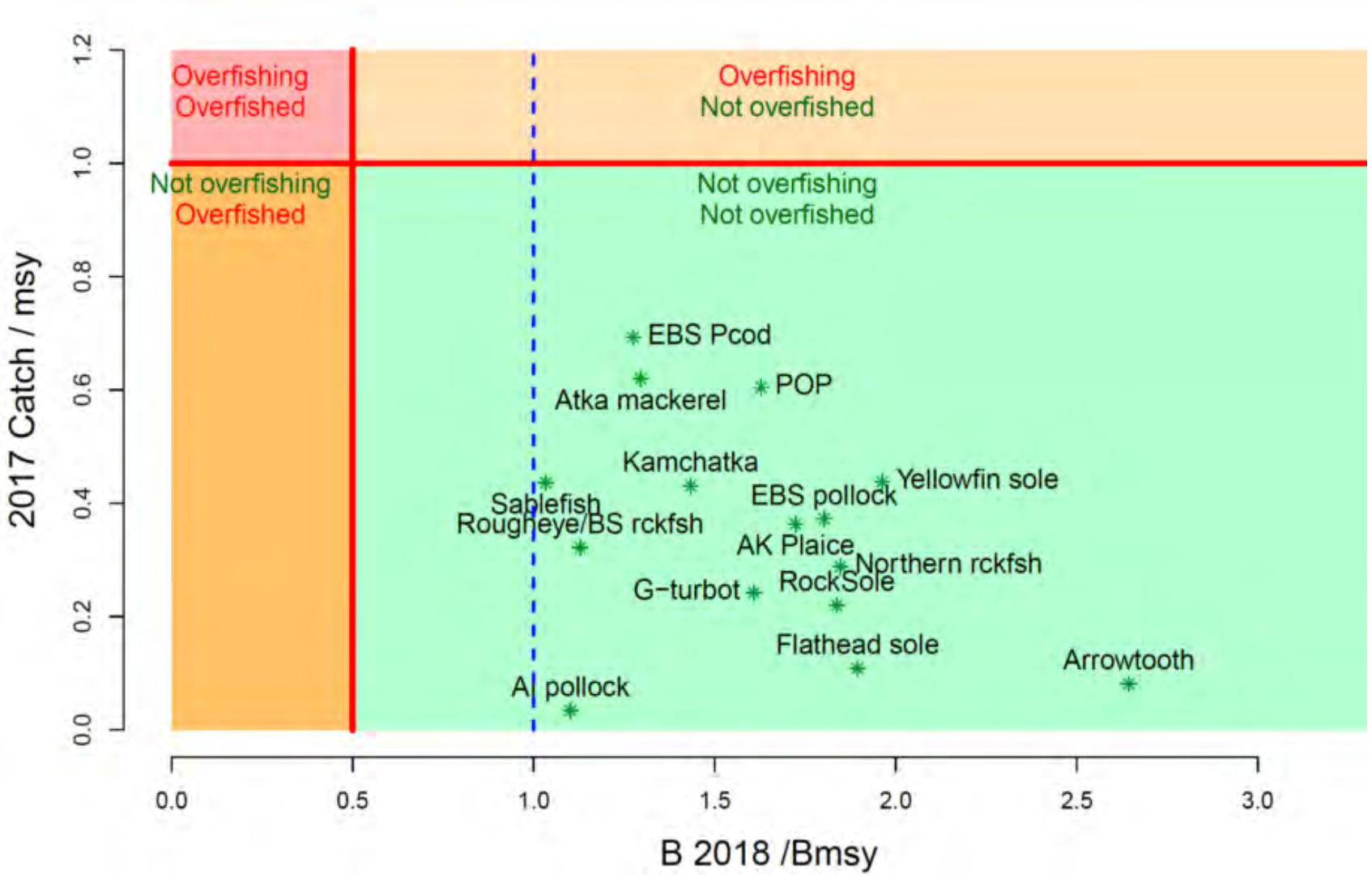
Feasibility

$$\text{For sustainability: } \frac{\partial Wellbeing}{\partial t} \geq 0$$

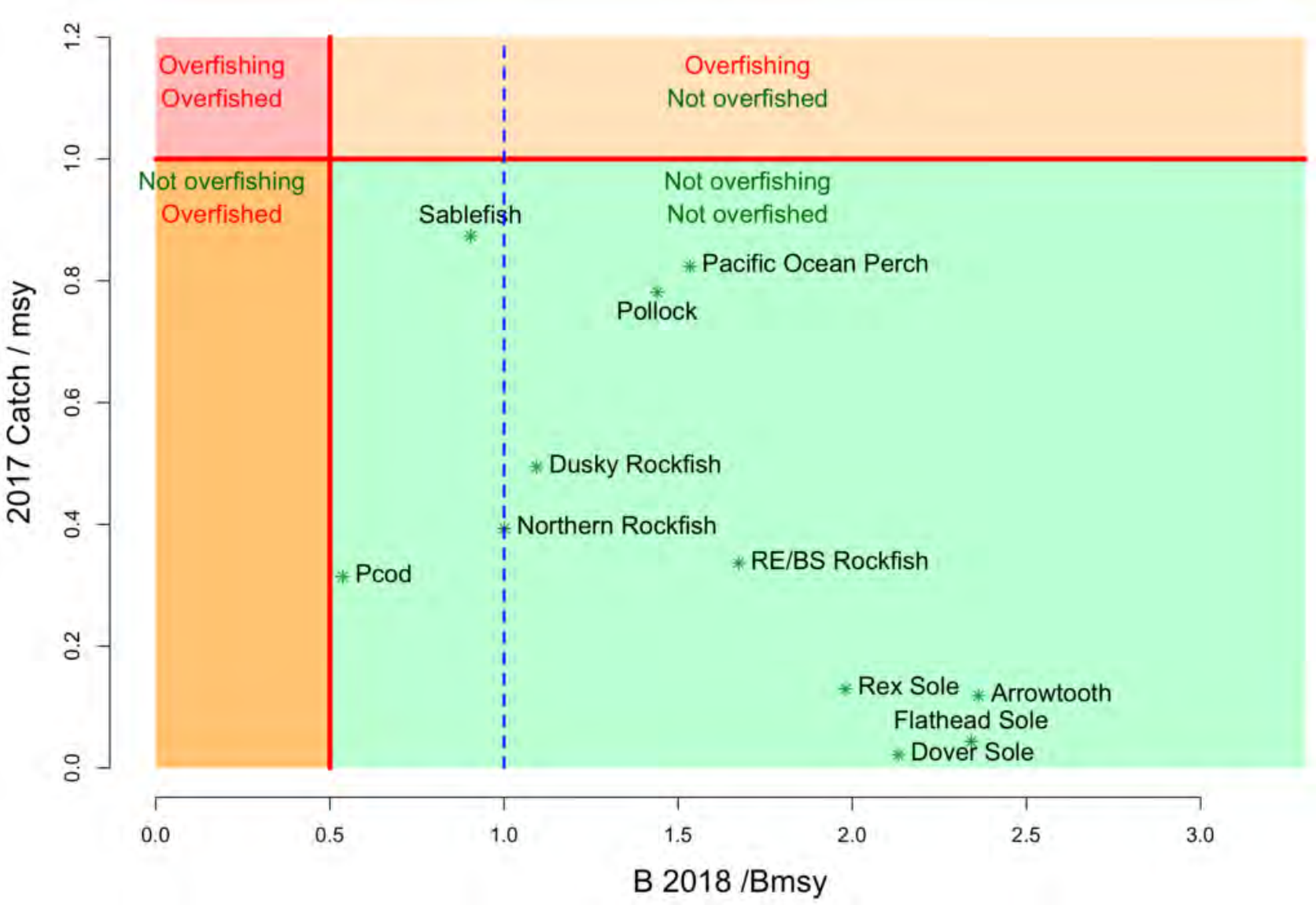
Revenues, Costs, and Wellbeing



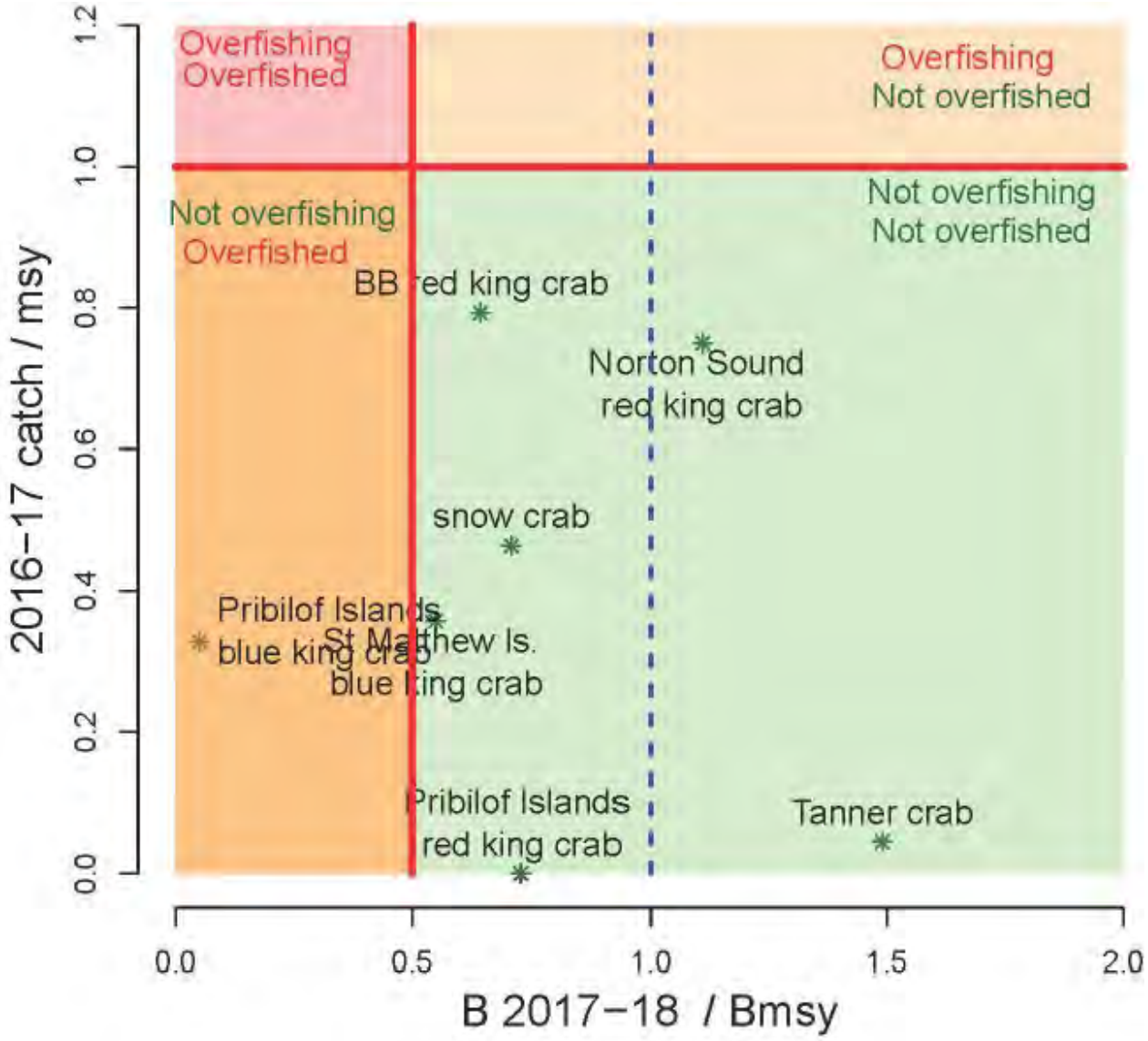
Status of BSAI Groundfish



Status of GOA Groundfish

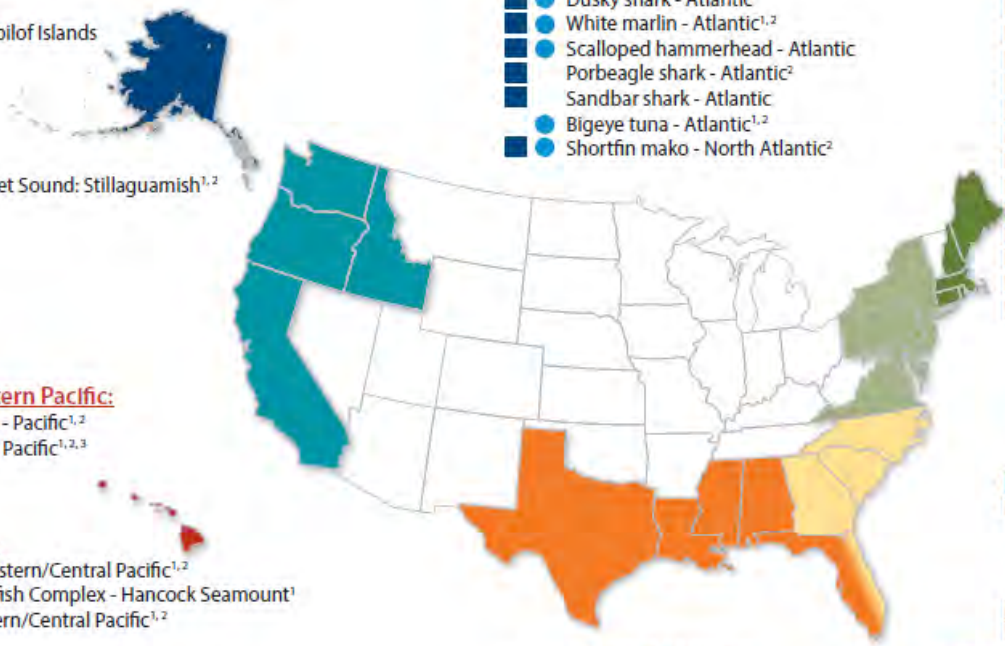


Status of BSAI Crab



Note: this only represents FMP stocks for which status is assessed

NOAA FISHERIES
Stock Status as of December 31, 2017



North Pacific:
- Blue king crab - Pribilof Islands

Pacific:
- Coho salmon - Puget Sound: Stillaguamish[1,2]

Pacific and Western Pacific:
- Pacific bluefin tuna - Pacific[1,2]
- Swordfish - Eastern Pacific[1,2,3]

Western Pacific:
- Striped marlin - Western/Central Pacific[1,2]
- Seamount Groundfish Complex - Hancock Seamount[1]
- Bigeye tuna - Western/Central Pacific[1,2]

Highly Migratory Species:
- Blacknose shark - Atlantic
- Blue marlin - Atlantic[1,2]
- Dusky shark - Atlantic
- White marlin - Atlantic[1,2]
- Scalloped hammerhead - Atlantic
- Porbeagle shark - Atlantic[2]
- Sandbar shark - Atlantic
- Bigeye tuna - Atlantic[1,2]
- Shortfin mako - North Atlantic[2]

Gulf of Mexico:
- Greater amberjack
- Gray triggerfish

New England:
- Atlantic cod - Georges Bank
- Atlantic cod - Gulf of Maine
- Windowpane - Gulf of Maine/Georges Bank
- Witch flounder
- Yellowtail flounder - Cape Cod/Gulf of Maine
- Yellowtail founder - Georges Bank
- Yellowtail flounder - S. New England/Mid-Atl
- Thorny skate - Gulf of Maine
- Atlantic halibut
- Atlantic salmon[1]
- Atlantic wolffish
- Ocean pout
- Winter flounder - Southern New England
- Red hake - Southern Georges Bank/Mid-Atl

Mid-Atlantic:
- Summer Flounder

South Atlantic:
- Hogfish - Southeast Florida
- Red snapper - South Atlantic
- Blueline tilefish
- Speckled hind
- Warsaw grouper
- Red porgy
- Snowy grouper
- Tilefish - South Atlantic
- Red Grouper - South Atlantic

Caribbean:
- Goliath grouper[1]
- Nassau grouper[1]
- Queen conch
- Triggerfishes and Filefishes Complex - Puerto Rico
- Caribbean spiny lobster - Puerto Rico

Legend
- On Overfished List: 35 stocks
- On Overfishing List: 30 stocks

1. Non-FSSI stock
2. Stock is fished by US and International fleets
3. The geographic boundary of this stock extends from Mexico south and west to the Palmyra Atoll.

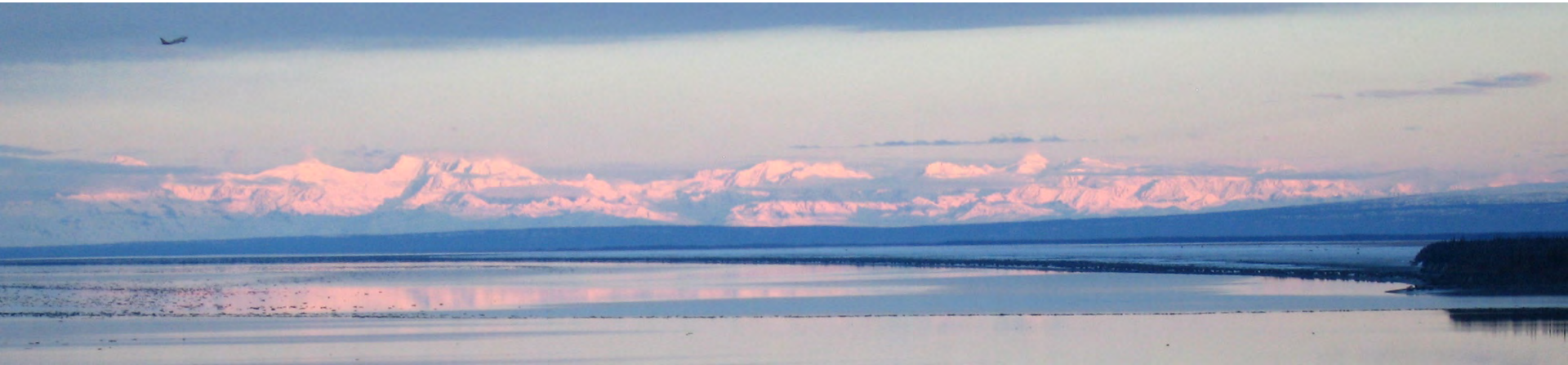
MSFCMA Section 304(e)

For a fishery that is overfished, any FMP, … shall

(A) specify a **time** period **for ending overfishing and rebuilding the fishery that shall**

(i) be as short as possible, …; and

(ii) **not exceed 10 years**, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;



Time to Rebuild Overfished Stocks

If $T_{min} \leq 10$ years, $T_{max} = 10$ years.

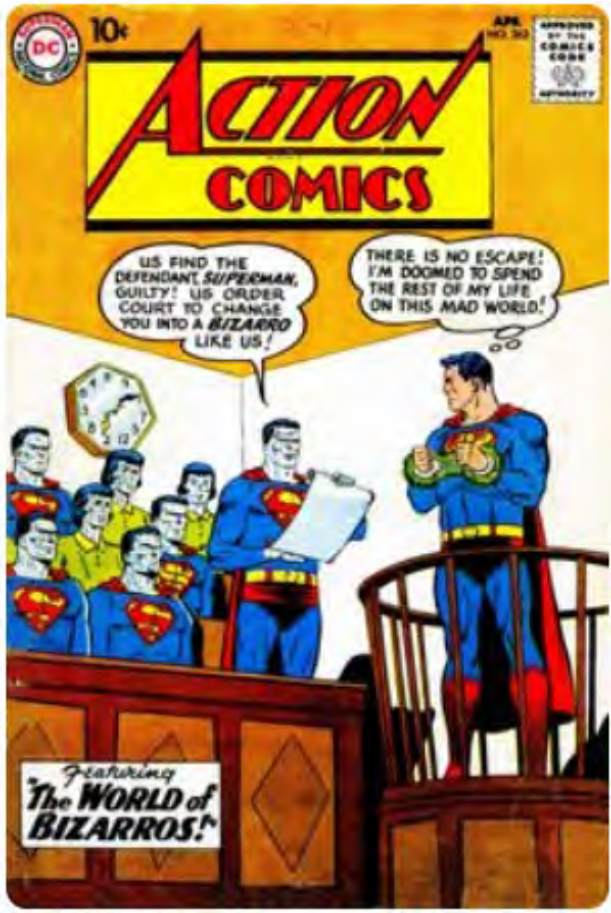
If $T_{min} > 10$ years, $T_{max} = T_{min}$ + mean generation time

T_{target} must be as short as possible, taking into account the status and biology of the overfished stock, the needs of fishing communities, recommendations by international organizations, and the interaction of the stock within the marine ecosystem.

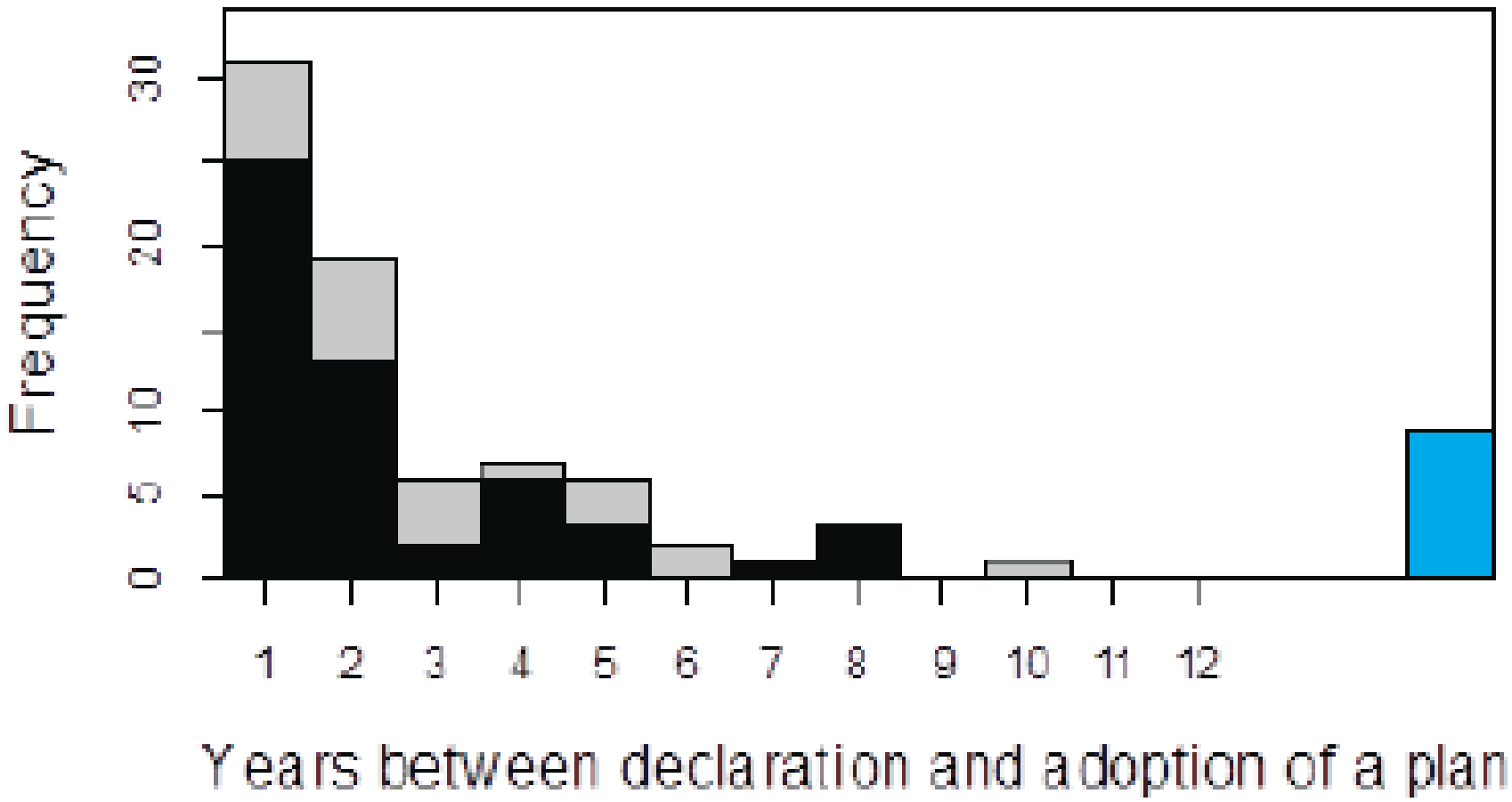
The DC Circuit court has held that:

$$P(\text{rebuild} \mid T_{target}) > 20\%$$

Only in Superman Comics' Bizarro world, where reality is turned upside down, could the Service reasonably conclude that a measure that is at least four times as likely to fail as to succeed offers a "fairly high level of confidence."



Years Between Overfished Declaration and the Adoption of a Rebuilding Plan



NRC (2013) Evaluating the Effectiveness of Fish Stock Rebuilding Plans in the US

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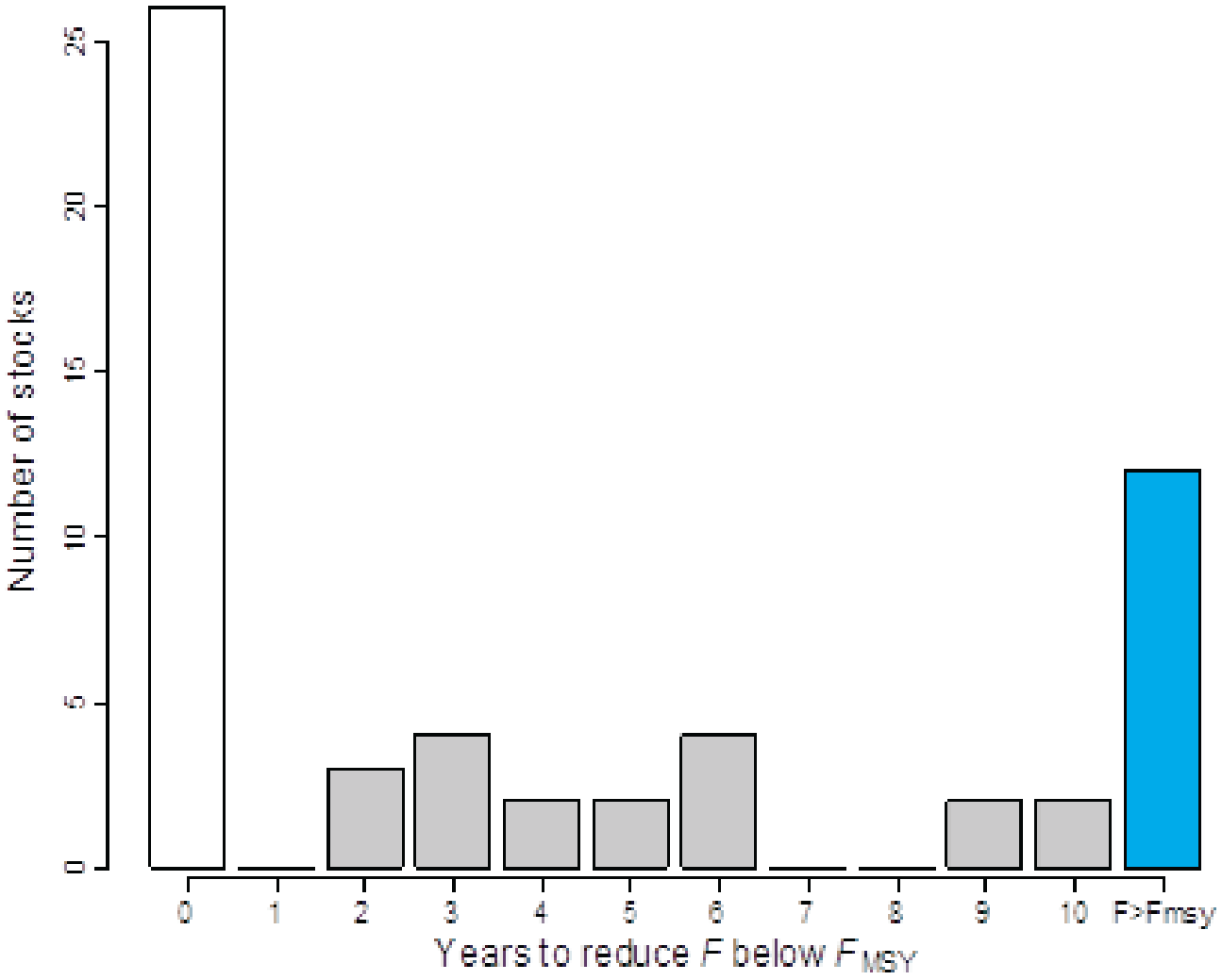

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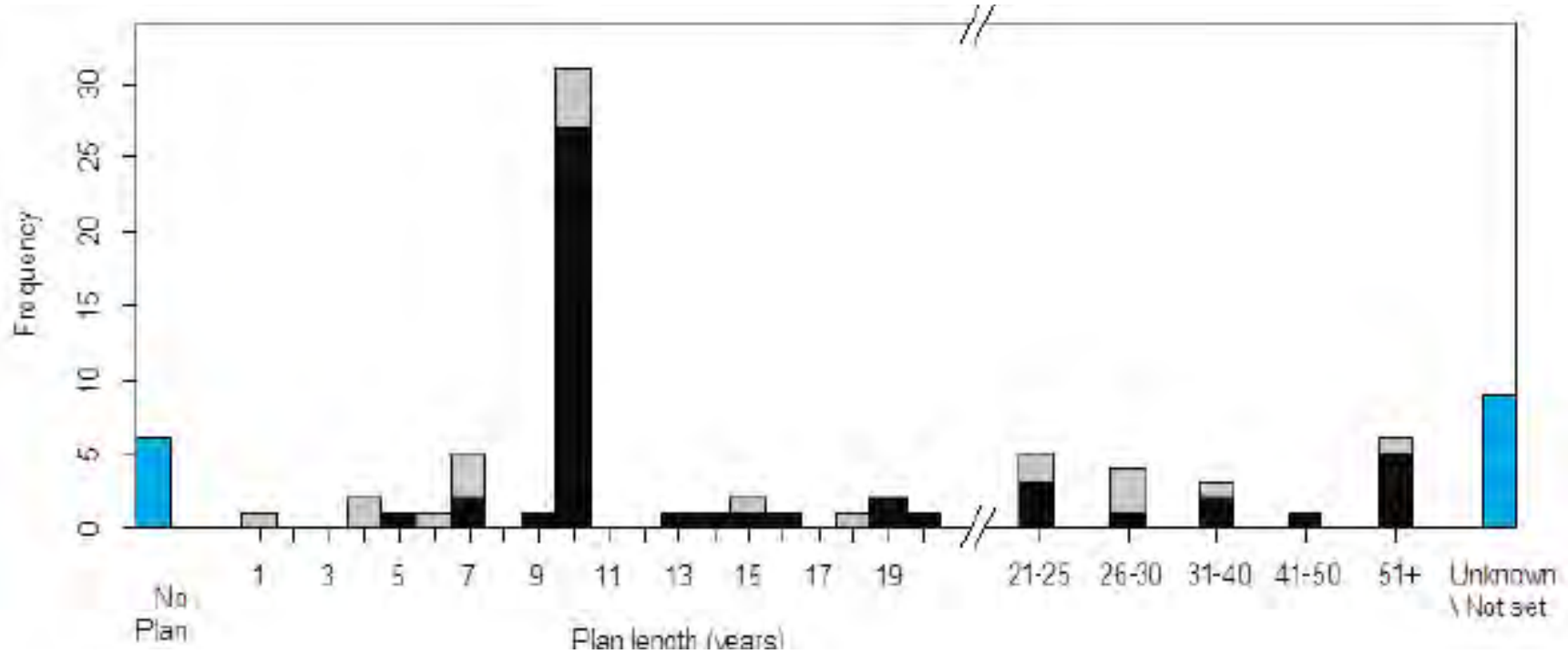
Rebuilding Schedule (T_{target})



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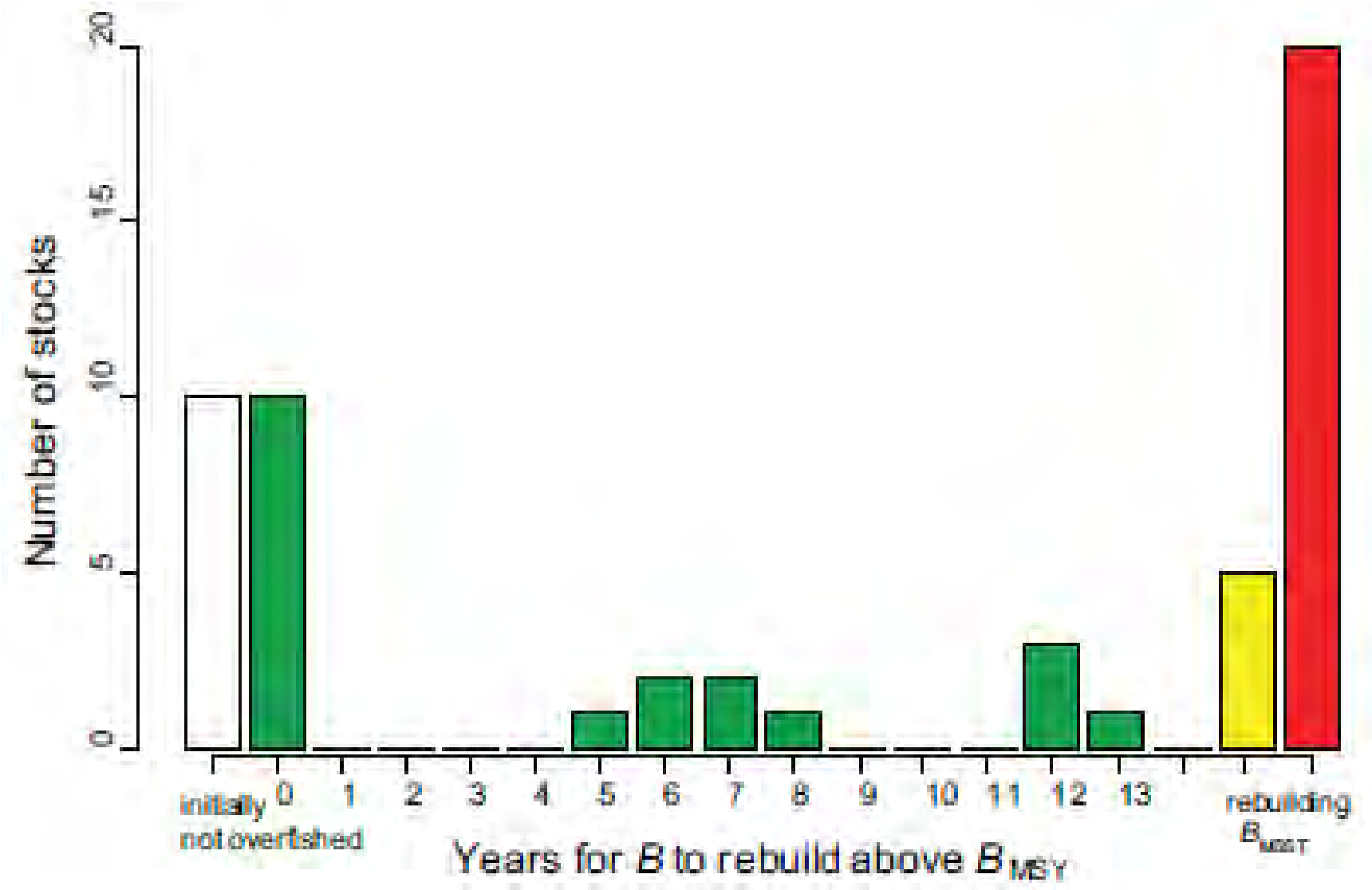
Time to Rebuild



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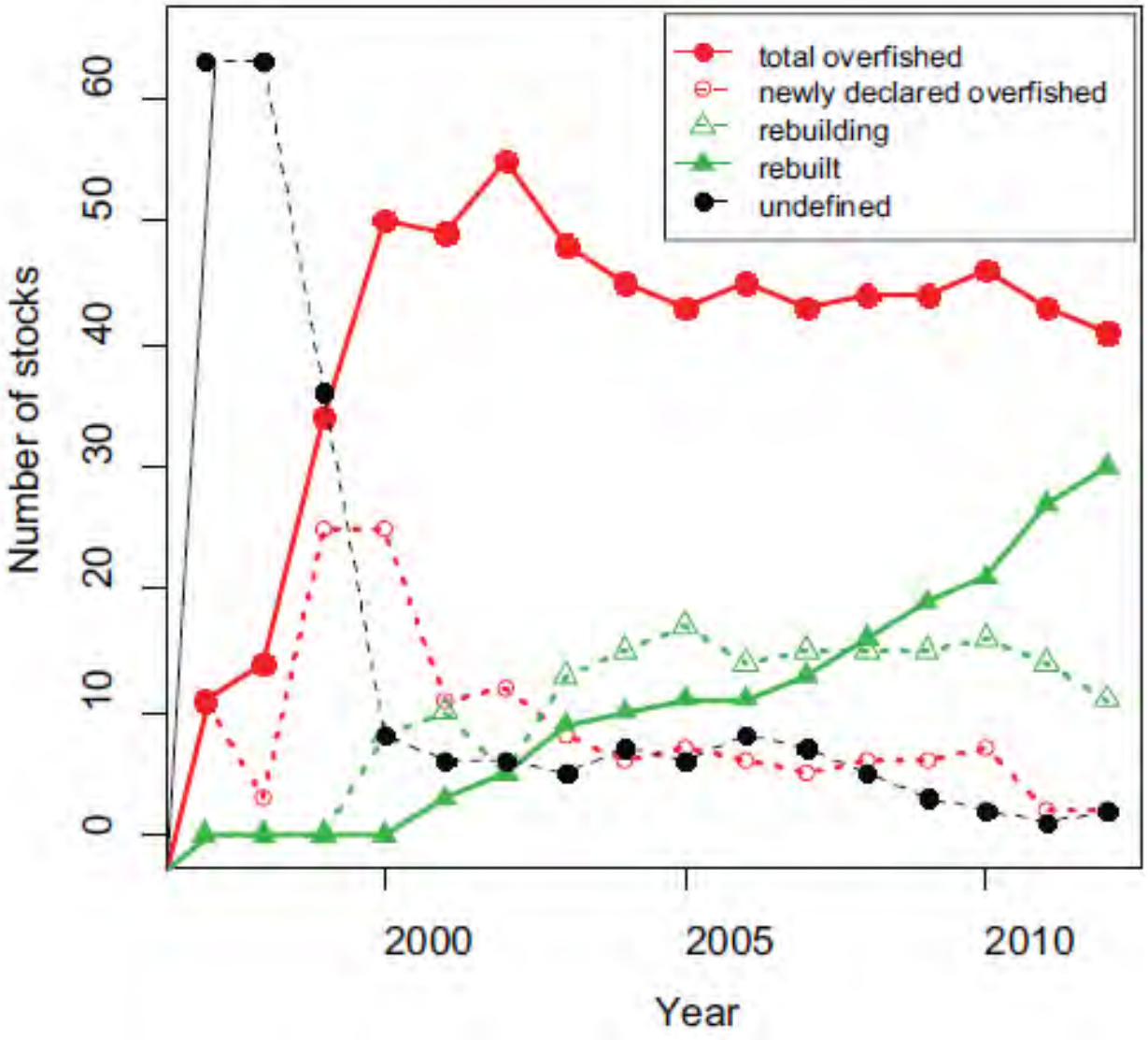
Number of Stocks Overfished or Rebuilt



NRC (2013)
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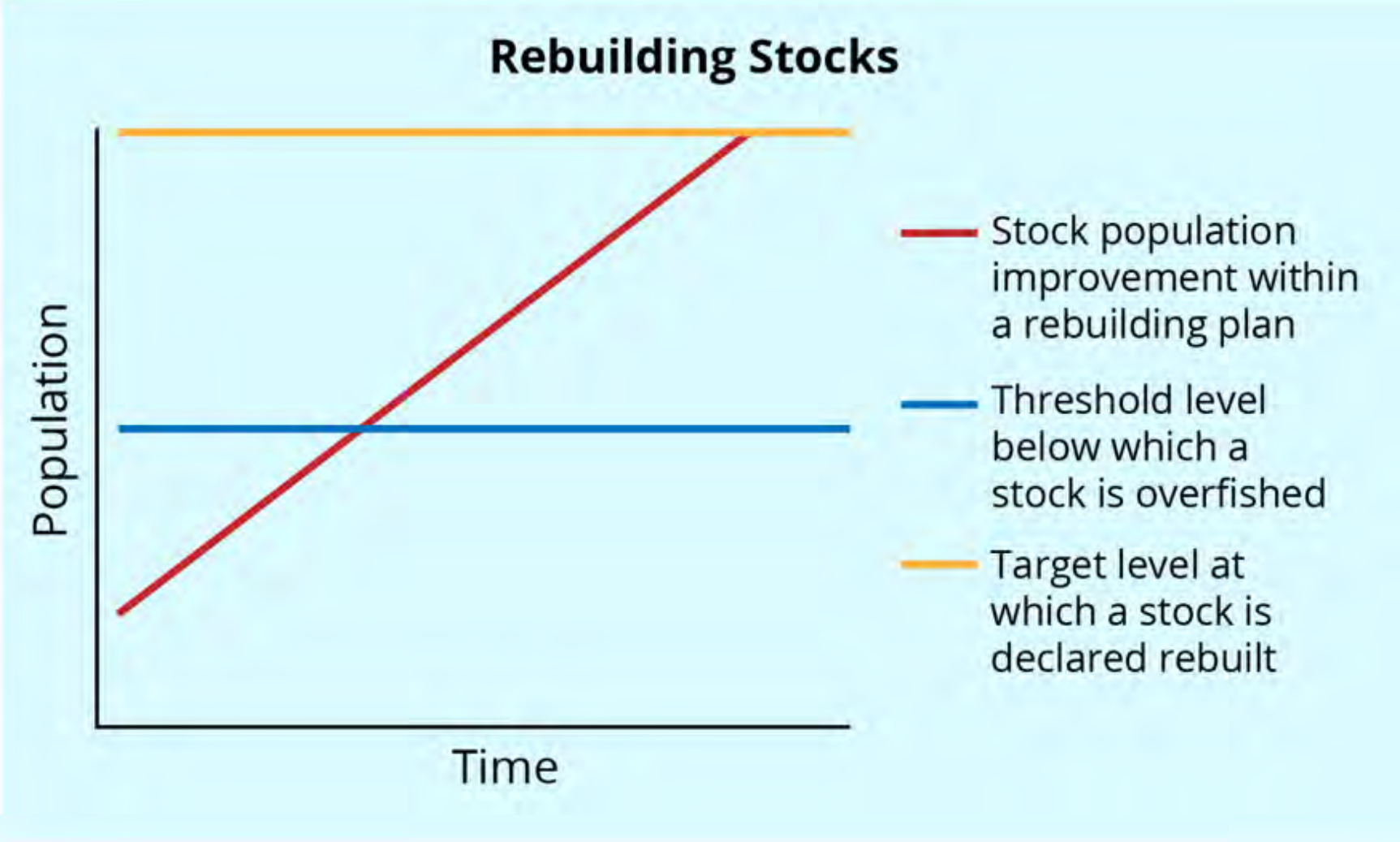
Rebuilding Strategy



Classical Bioeconomics (Clark & Munro)

The population dynamics of the fishery resource is modeled by the equation

$$(2.1) \qquad \frac{dx}{dt} = F(x) - qEx, \quad x(0) = x^0,$$

where $x(t)$ is population biomass at time t, $F(x)$ is the natural growth function, q is the catchability coefficient (constant), and $E(t)$ is fishing effort at time t. Regarding the natural, or biological, growth function $F(x)$, we shall assume that

$$(2.2) \qquad F(0) = F(\bar{x}) = 0, \quad F(x) > 0, \quad F''(x) < 0 \quad \text{for} \quad 0 < x < \bar{x}.$$

In equation (2.1) the rate of harvest $h(t)$ is of the form

$$(2.3) \qquad h(t) = qE(t)x(t);$$

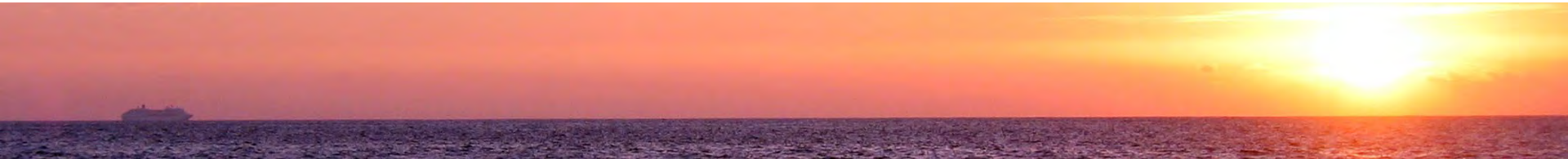
The optimal approach to x^* from a non-optimal initial biomass level $x^0 \neq x^*$ is the "most rapid" [**18**] or "bang-bang" [**8**] approach:

$$(3.8) \qquad E(t) = \begin{cases} E_{\max} & \text{whenever} \quad x(t) > x^*, \\ E_{\min} & \text{whenever} \quad x(t) < x^*, \end{cases}$$

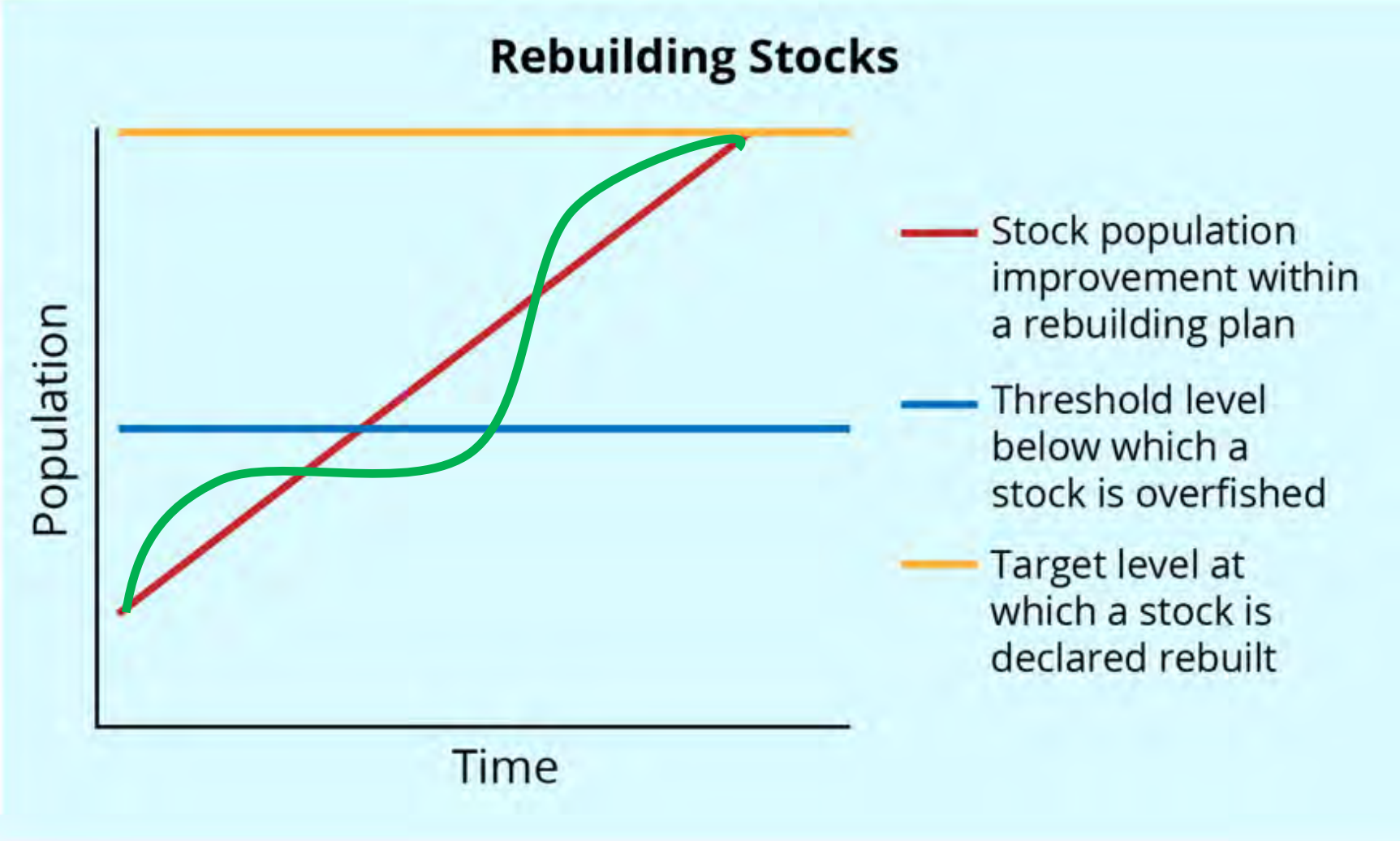
where in our present model $E_{\min} = 0$ and $E_{\max}$ is an ad hoc upper bound.

MSA Section 301—National Standards

5. Conservation and management measures shall, where practicable, **consider efficiency in the utilization of fishery resources**; except that no such measure shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and **allow for variations among, and contingencies in, fisheries, fishery resources, and catches.**
7. Conservation and management measures shall, where practicable, **minimize costs and avoid unnecessary duplication**.
8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), **take into account the importance of fishery resources to fishing communities** by utilizing economic and social data that meet the requirements of paragraph (2), in order to (A) **provide for the sustained participation of such communities**, and (B) to the extent practicable, **minimize adverse economic impacts on such communities**.



Rebuilding Strategy



Ruminations

- Default triggers for rebuilding, e.g., MSST = ½ B_{MSY}, are ***arbitrary***
  - ➢Triggers should reflect social and economic considerations
- Default targets for stock rebuilding, e.g., B_{MSY}, are ***arbitrary***
  - ➢Targets should reflect OY (MEY or MNB) rather than MSY
- Default rebuilding target times are ***ad hoc***
  - ➢Rebuilding target times should be based on explicit consideration of social and economic wellbeing

Questions?

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