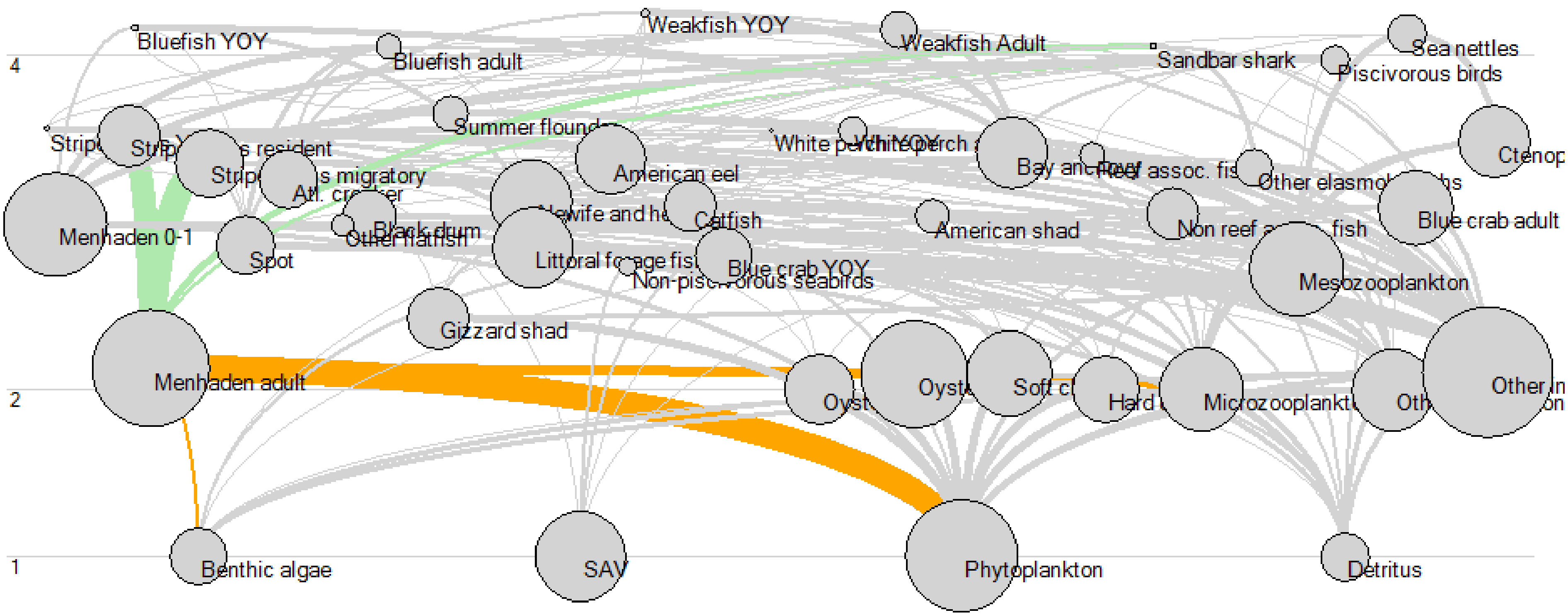
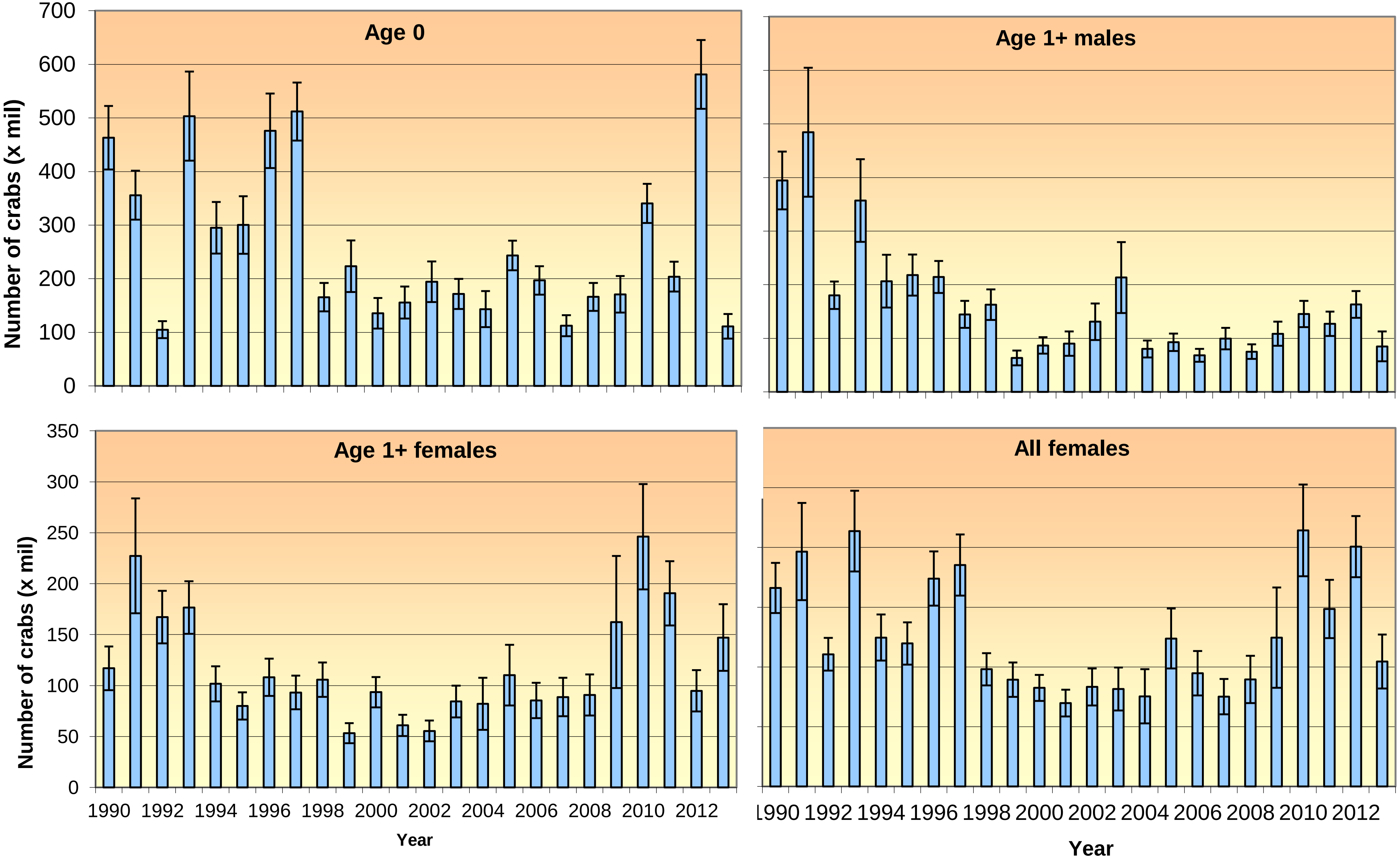

WHEN THE 'HAND OF GOD' SAVED A SHETLAND CREW
o 'give fishermen more say'
ITQs
Alaska studies seabed 'damage
Anchovy —just a few ton
of a great catch
Man gets suspended term, fined for killing of turtl
Some very fishy busi
Shark! Fishermen haul in a whopper and make a packet
Abalone price sl
Assault on the Reefs
'No black fish on the Humber'
Canada boats set for herring rush
IS COD DEAD?
JAPAN FACING A FISH FAMINE
The rape of the sea
Sandeel fishery
Scraping the bottom
'KING COD' LOSES HIS CROWN
BIGGEST-EVER US ANCHOVY QUOTA
Peru tightens anchovy rules
...UK 'black' fish problem
The Grim Sweepers
Fisherman fights off shark in diving drama
Figures allay armada
Fishing industry to bring in $100m in '95: Minis
Norway cod quota cut for trawler
Farmers of the Sea
Seychelles tuna deal
JAPAN
The Scottish herring processing industry fears a complete collapse
MICKY'S 'ULTIMATE' WHELK POT!
Paradise lost to pirates
Splashes of Hope
More countries agree 'We must have high seas deal'
Canada in high seas arrest
Peru closes more meal plants
ALBAC
t quota-h
y tells Bonino
RILL



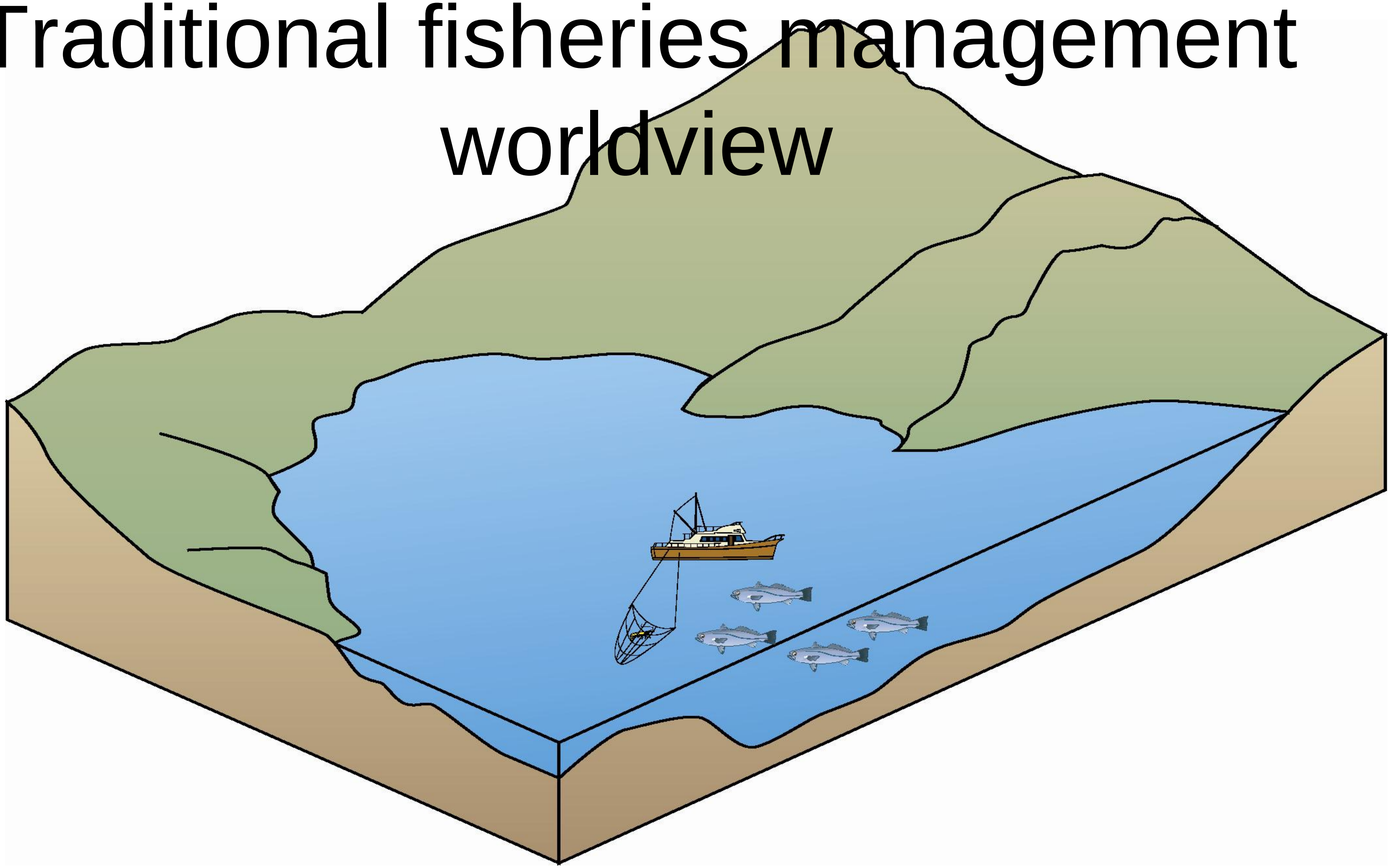
4
2
1
Bluefish YOY
Bluefish adult
Weakfish YOY
Weakfish Adult
Sandbar shark
Sea nettles
Piscivorous birds
American eel
Catfish
American shad
Blue crab adult
Mesozooplankton
Gizzard shad
Menhaden adult
Menhaden 0-1
Spot
Benthic algae
SAV
Phytoplankton
Detritus

Blue crab



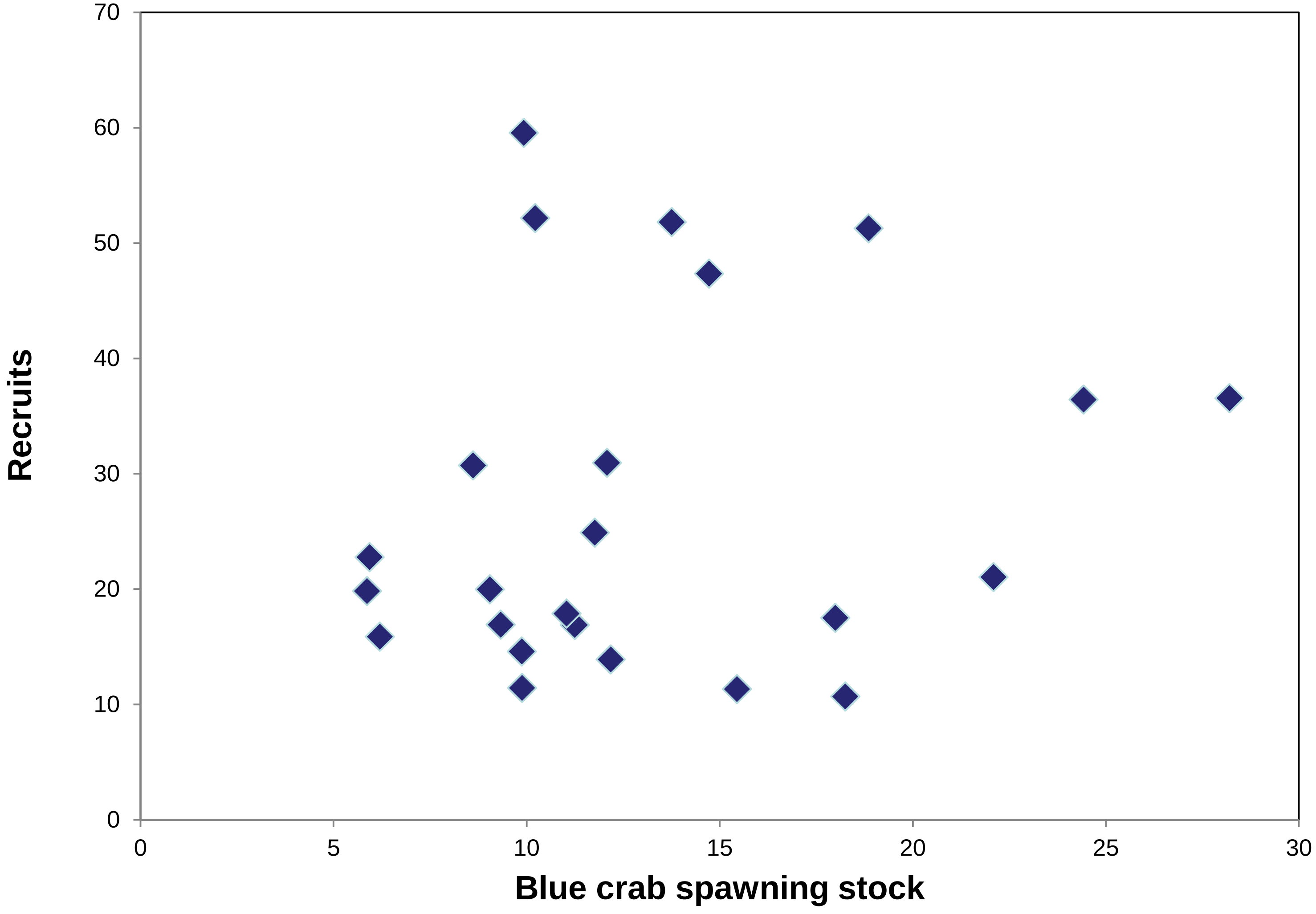
Age 0
Age 1+ males
Age 1+ females
All females
Number of crabs (x mil)
Number of crabs (x mil)
0
100
200
300
400
500
600
700
0
50
100
150
200
250
300
350
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012
Year
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012
Year

Traditional fisheries management worldview



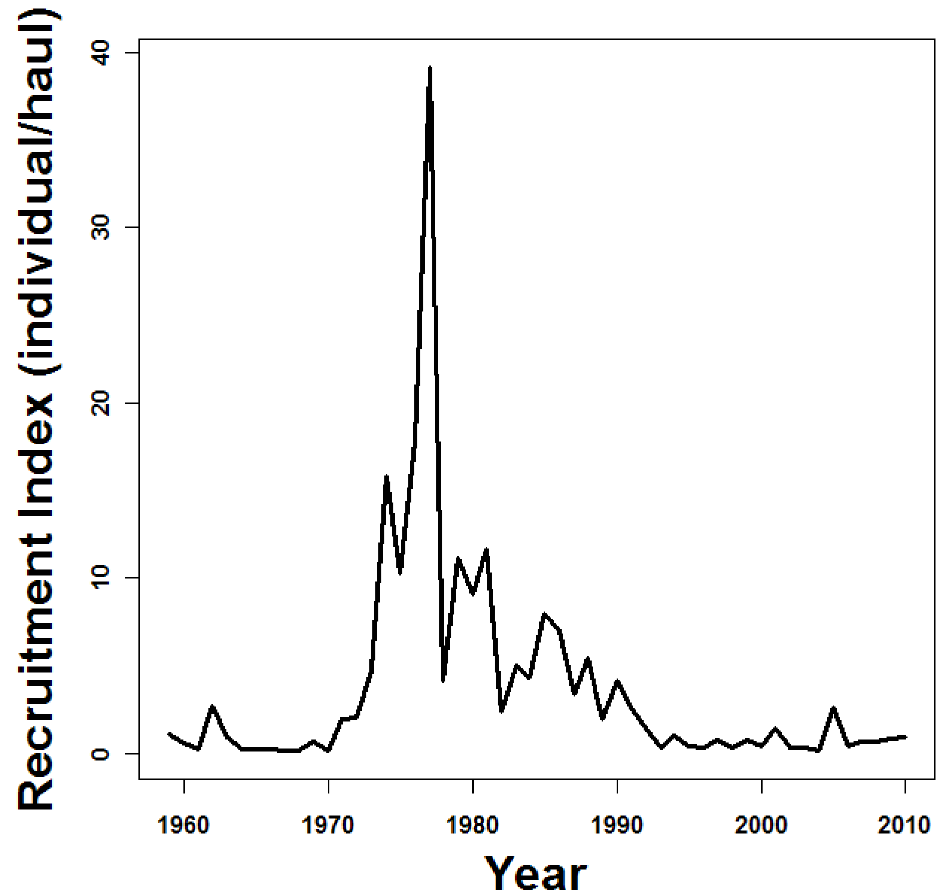
$$B_{t+1} = G + R - F - M$$

Recruitment variation



Recruitment variation

- Recruitment is the most stochastic of all processes
  - In forage fish, like Atlantic menhaden 10-100x variation not uncommon
- Physical and biological processes important



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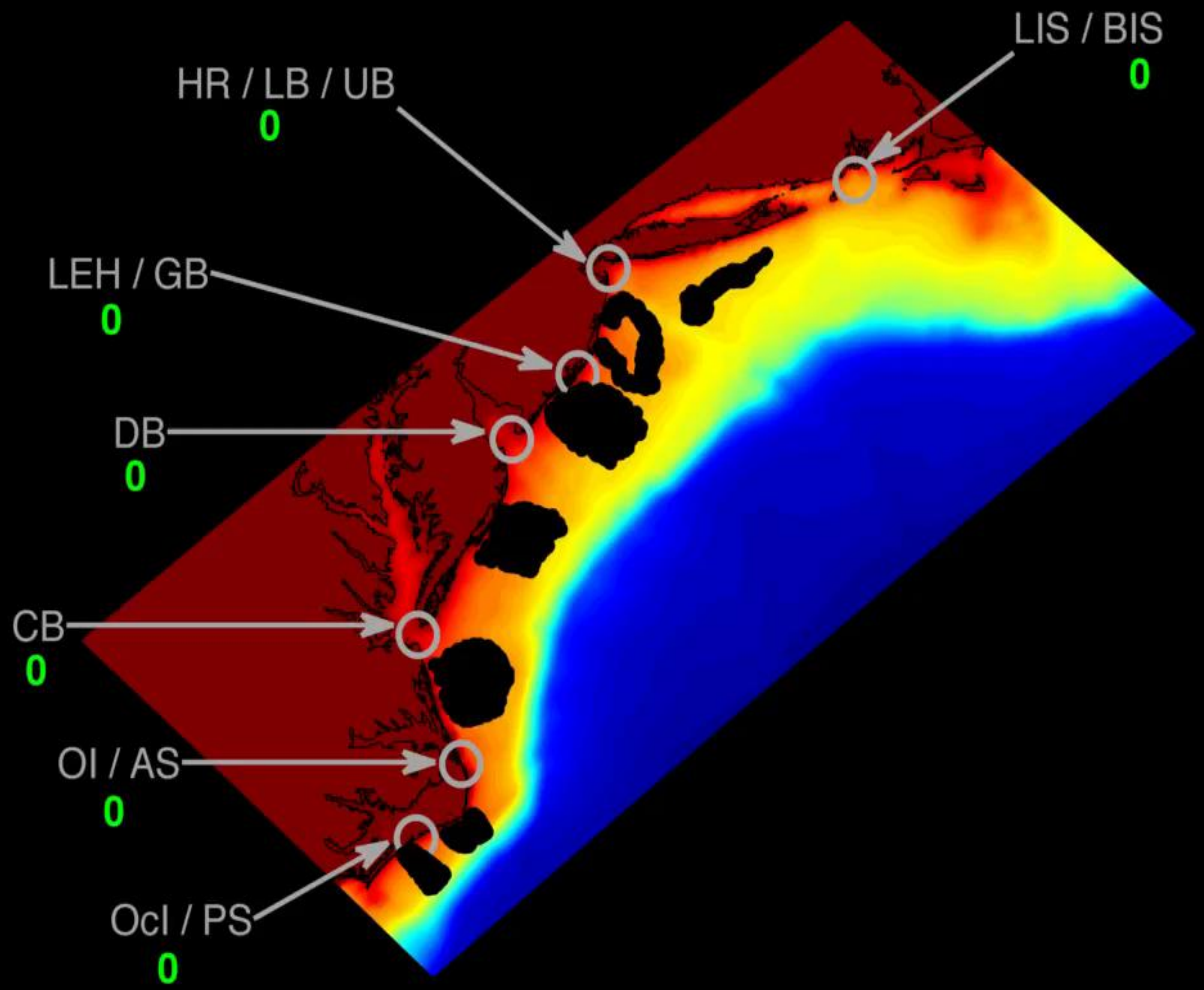
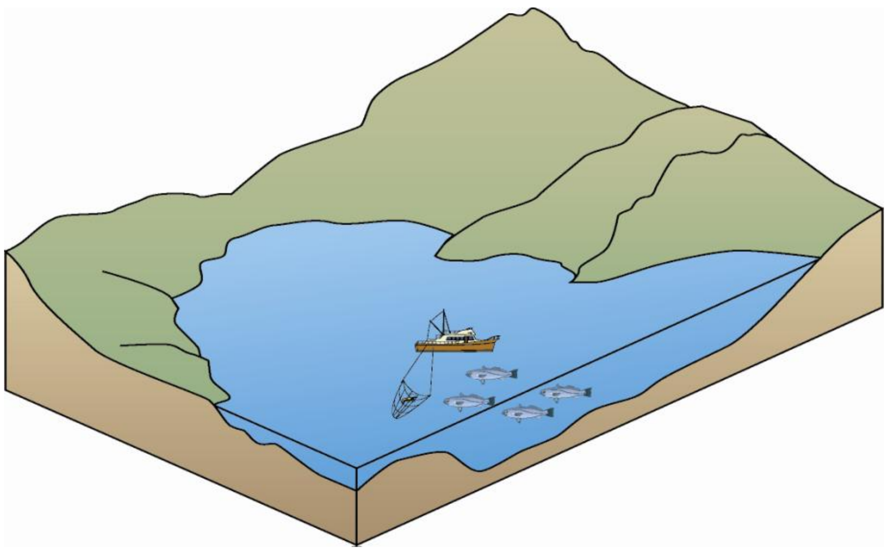


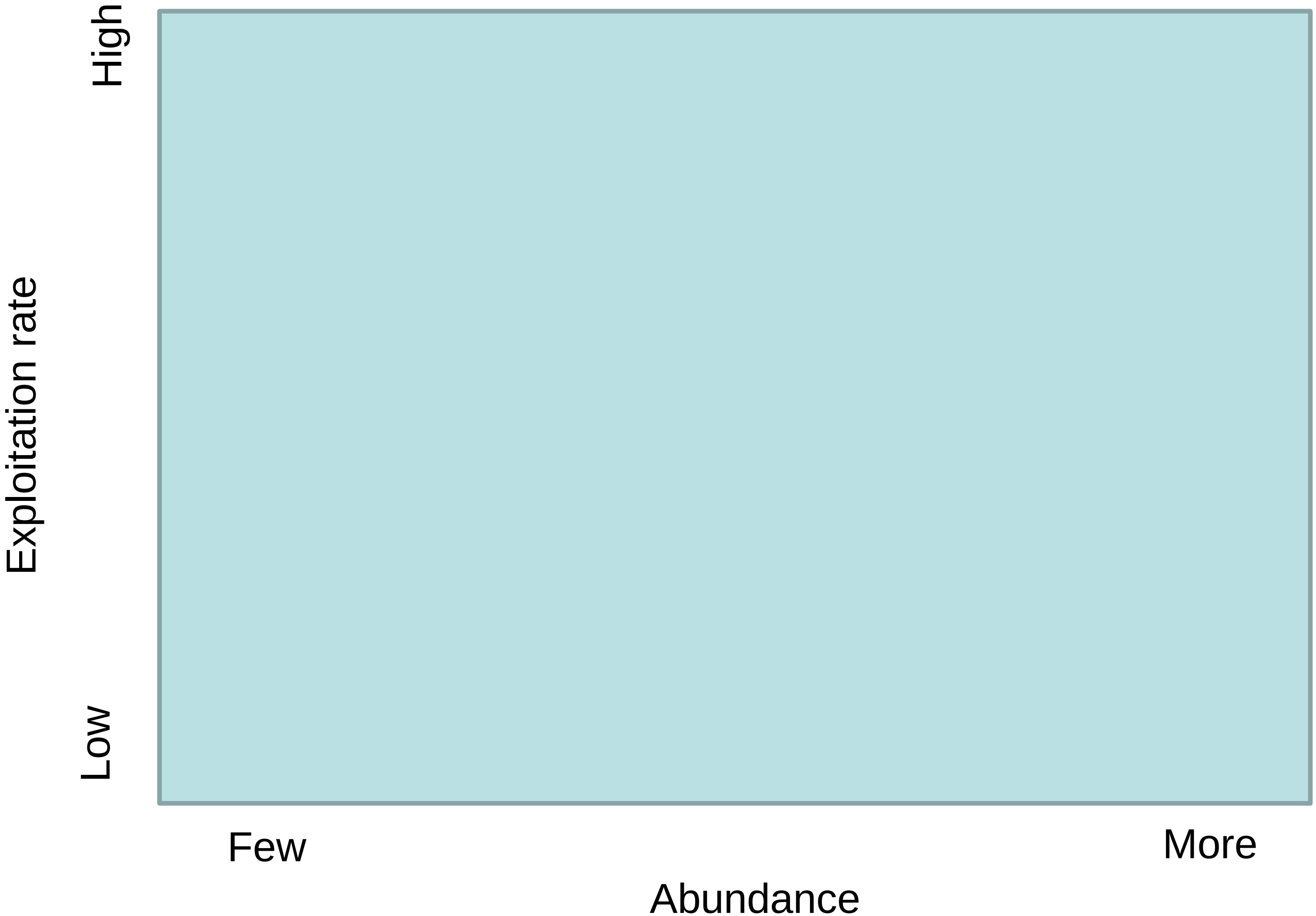
Traditional approach to fisheries management



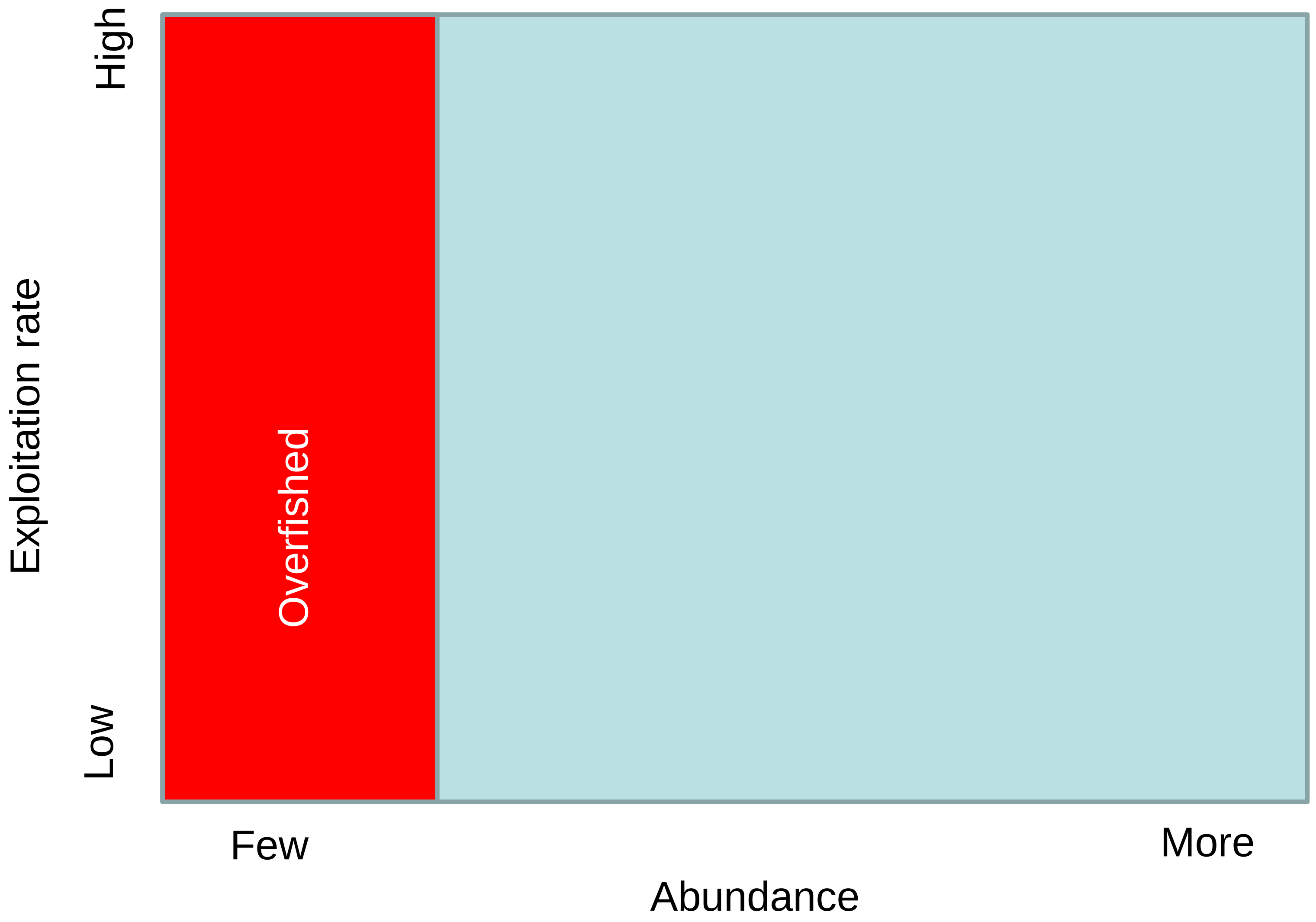
$$B_{t+1} = G + R - \boxed{F} - M$$

- Original US federal fisheries legislations focused purely on regulation of F to obtain optimum yield, under the assumption that all “surplus production” was really surplus
- Stakeholders limited to
  - Commercial fishery interests
  - Managers (protecting societal interest)
- Assessment approach is to establish a control rule that account for uncertainty (ACLs)

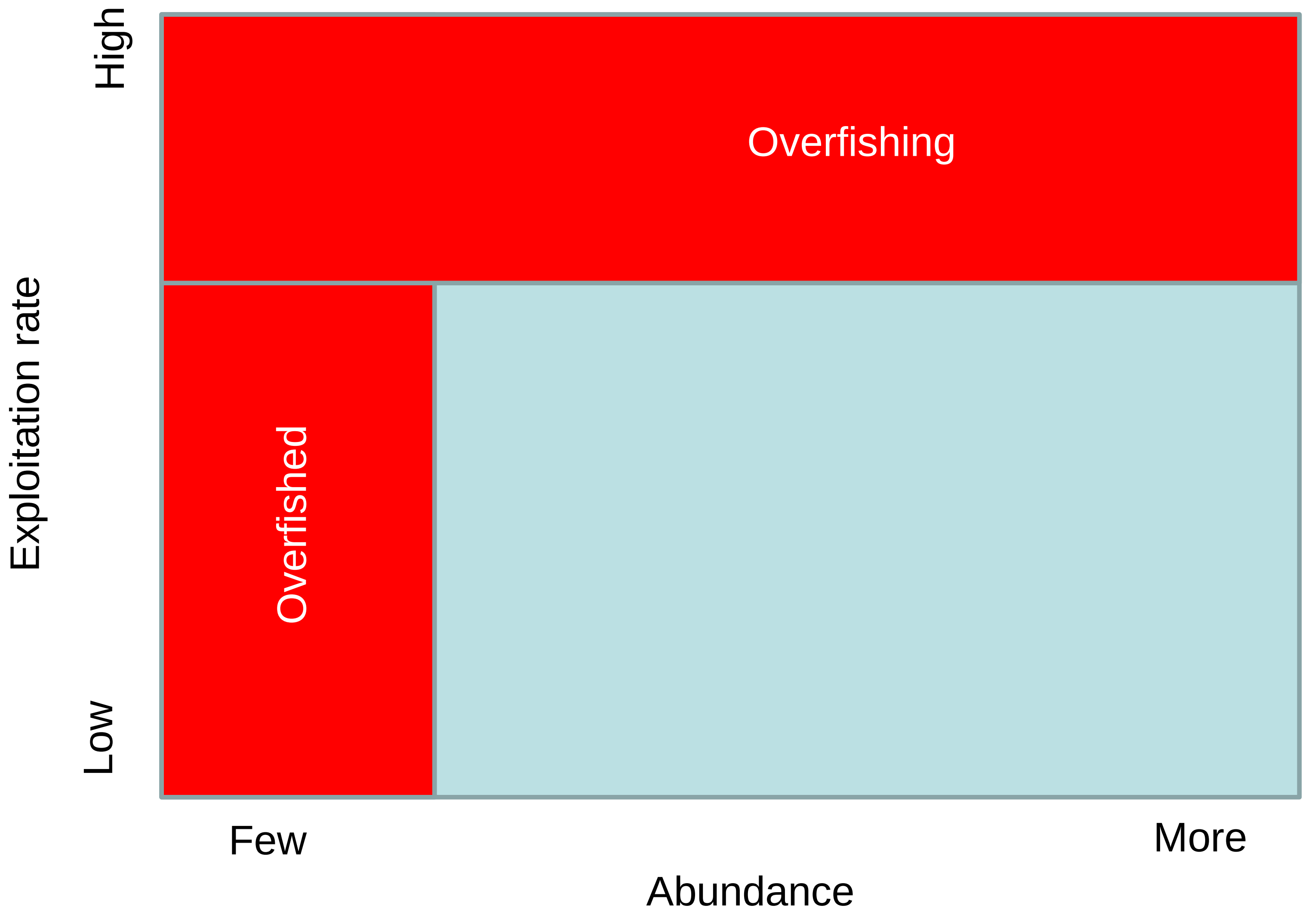
Control rule



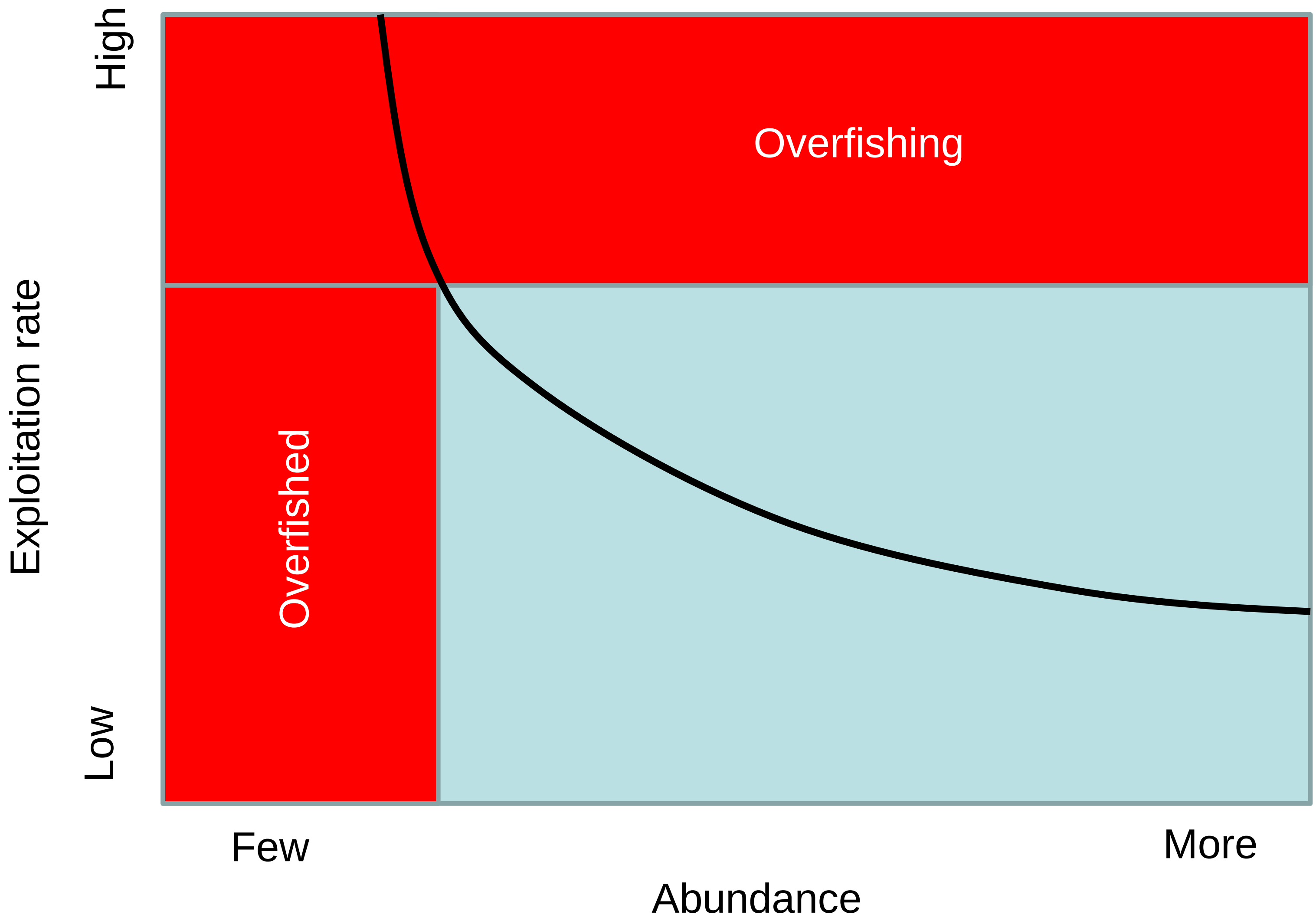
Control rule



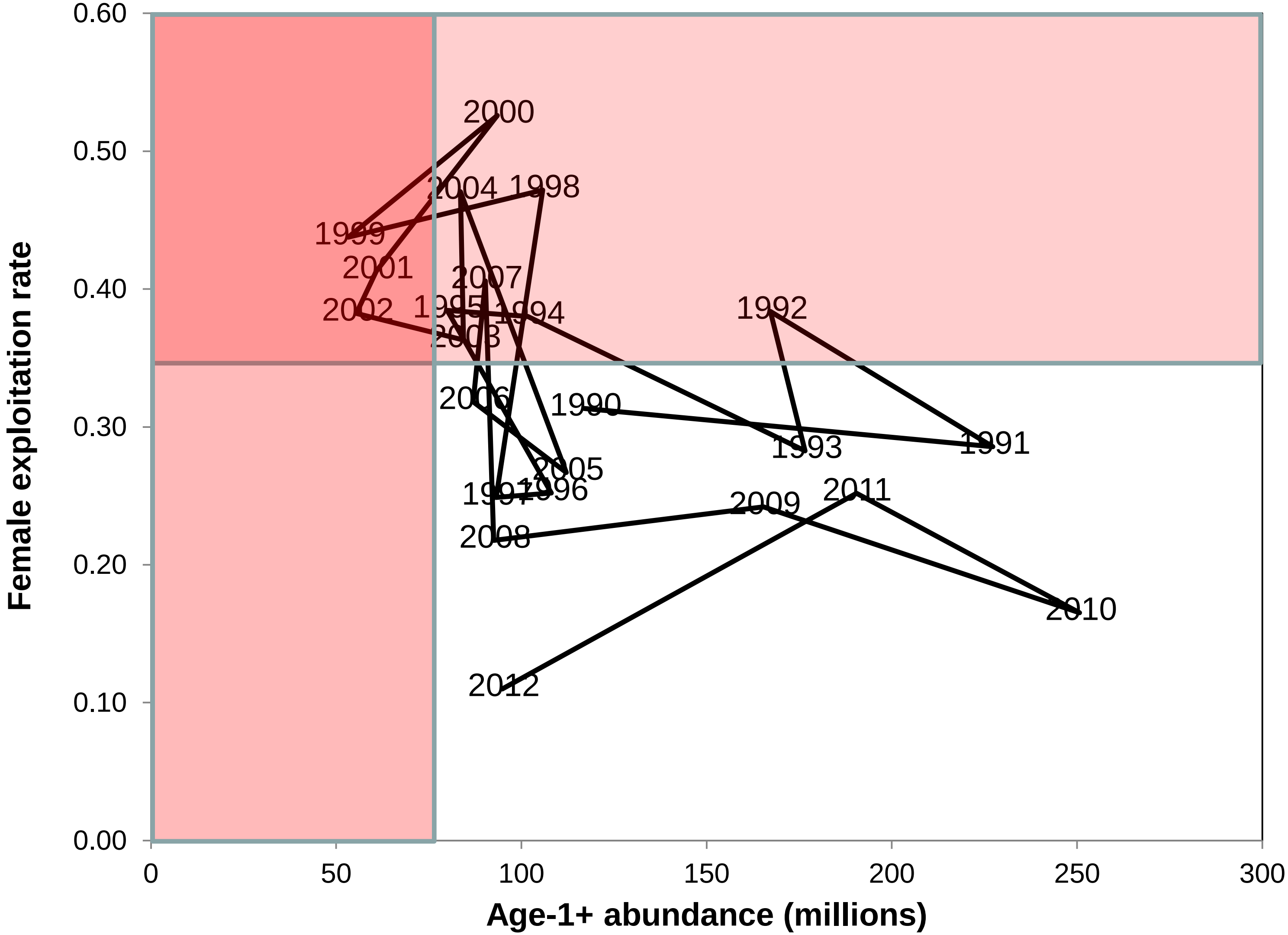
Control rule



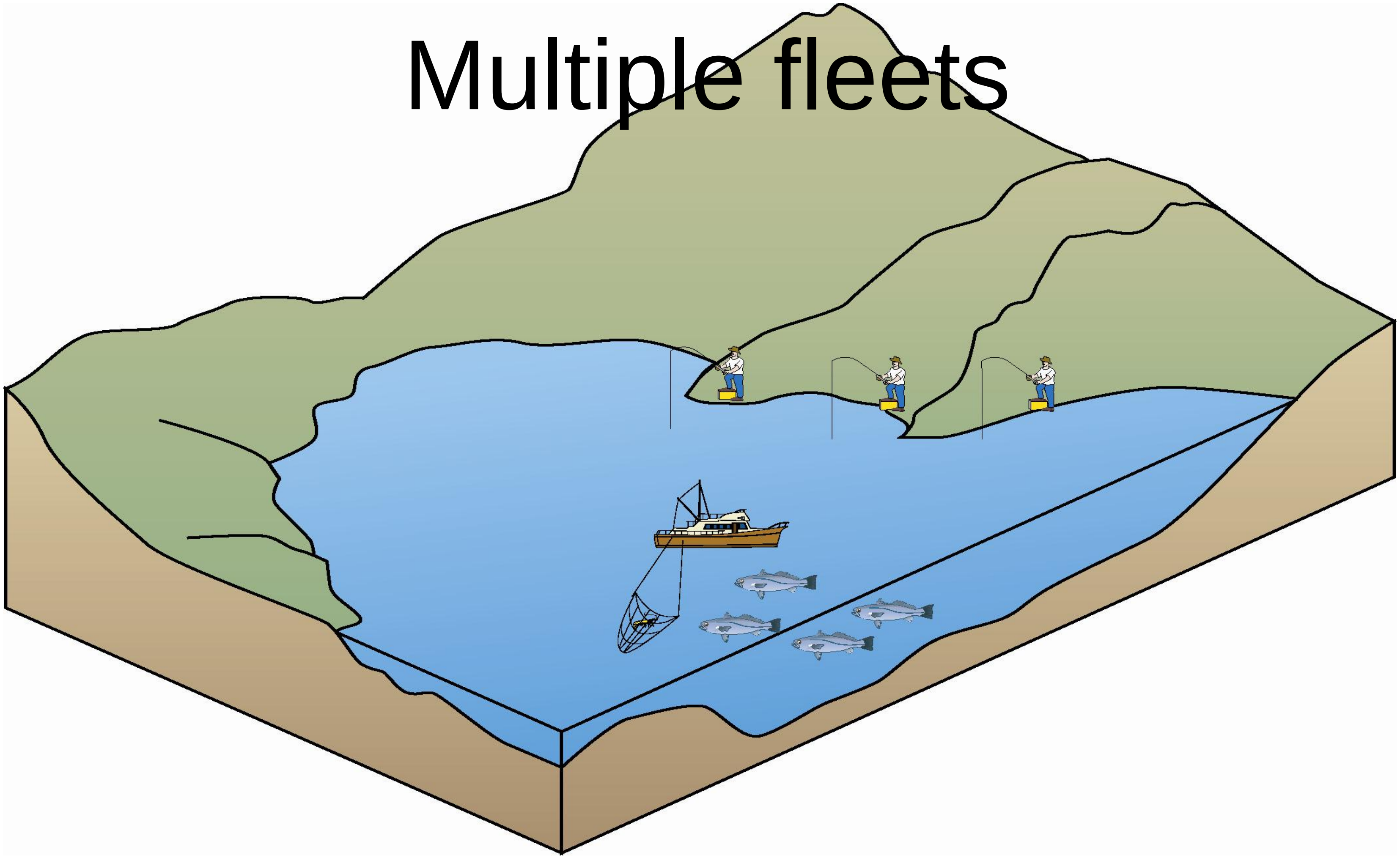
Control rule



Blue crab control rule

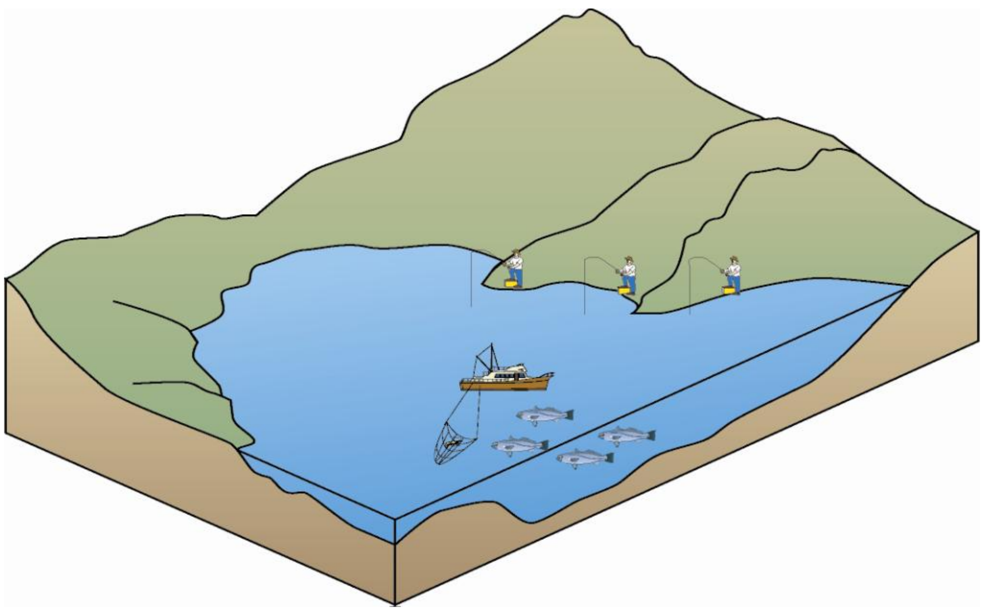


Multiple fleets



$$B_{t+1} = G + R - (F_1 + F_2) - M$$

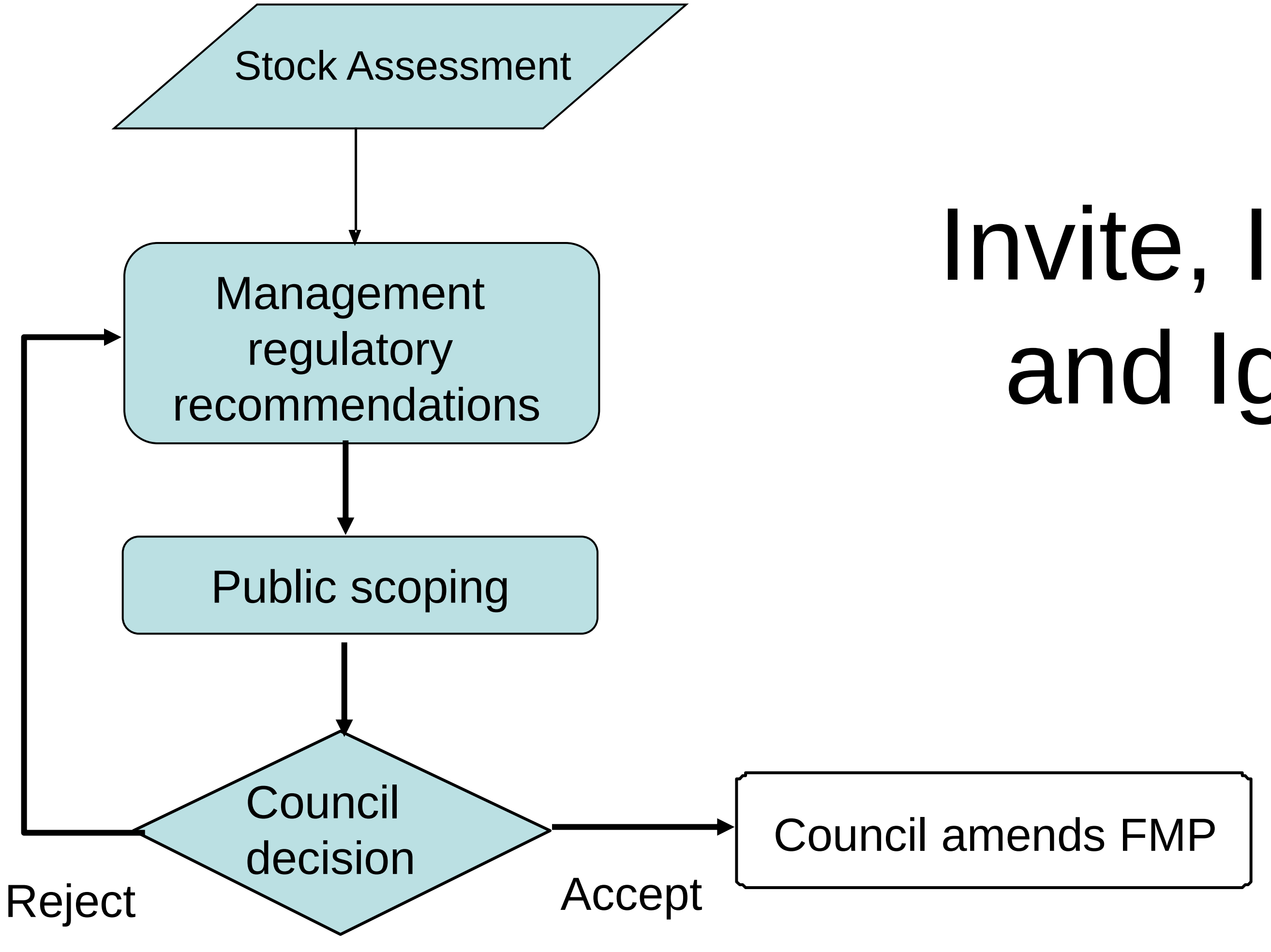
Stakeholders with multiple fleets



$$B_{t+1} = G + R - \boxed{(F_1 + F_2)} - M$$

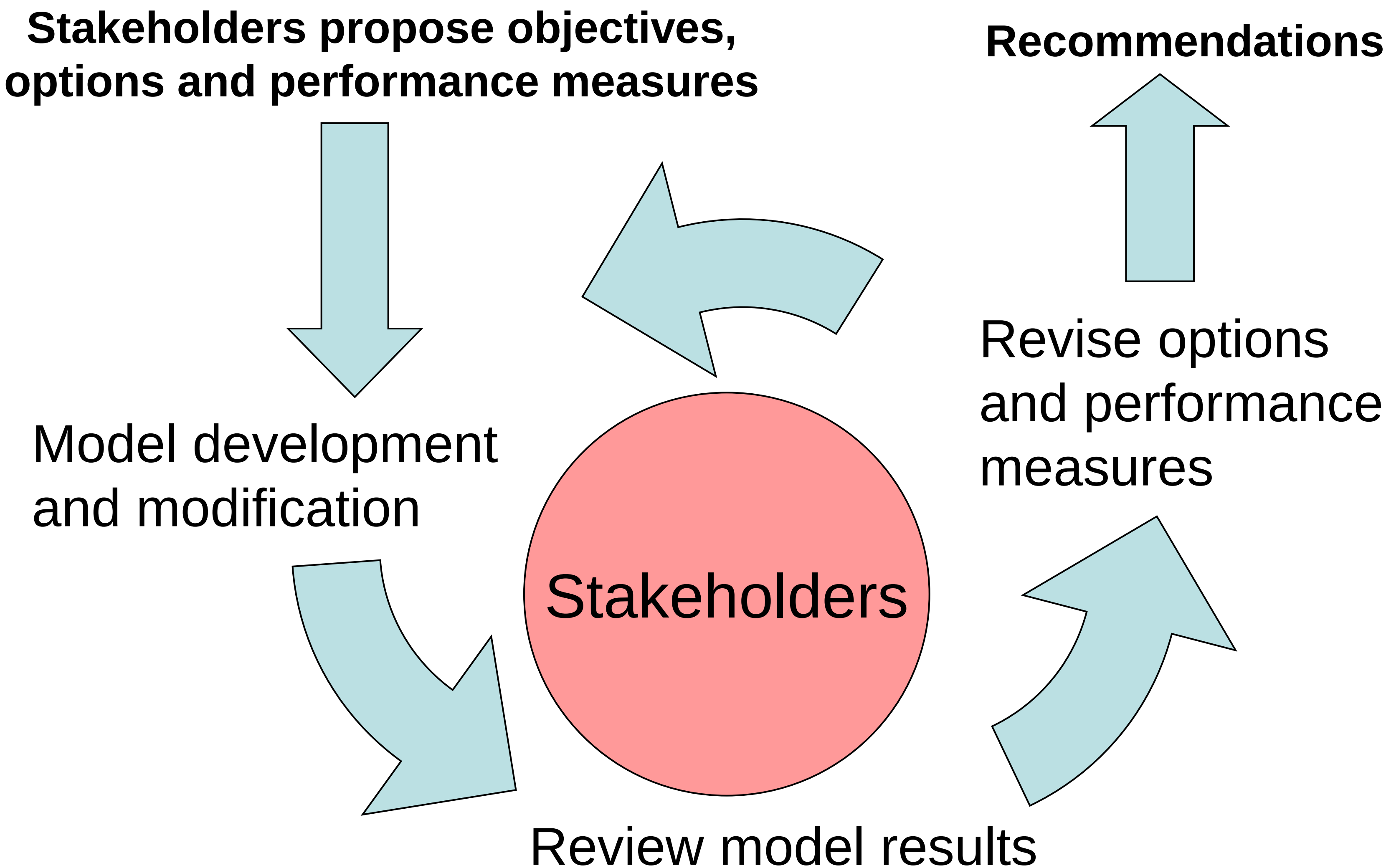
- Management goals can become more complex – yield and allocation, but tools remain constant
- Stakeholders include
  - Commercial
  - Recreational
  - Managers (protecting societal interests)
  - Allied interests
    - Boat industry
    - Tackle industry
- Assessment approach is the same

Management process

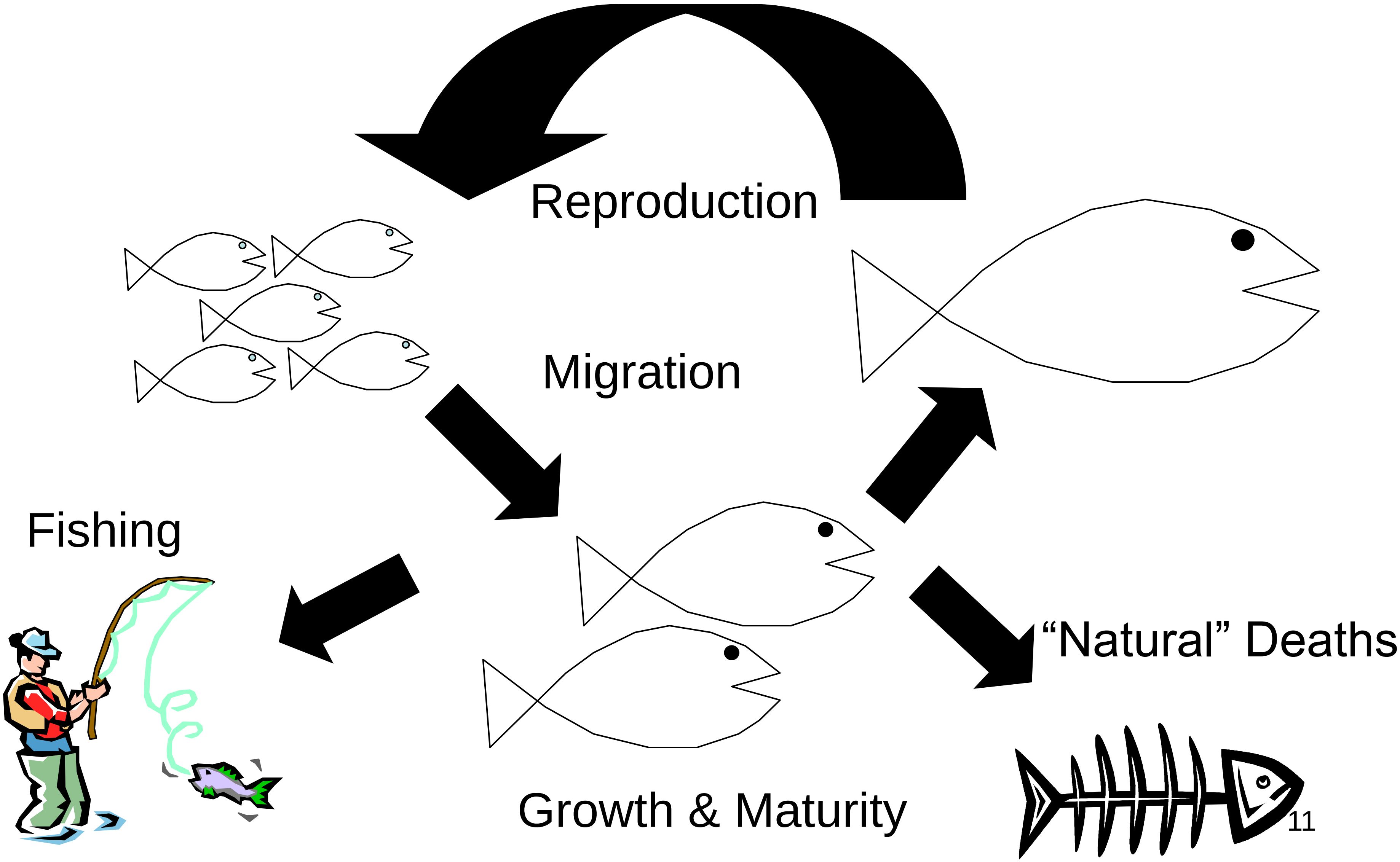


Invite, Inform and Ignore

Stakeholder-centered approach



Model Schematic



Model Structure

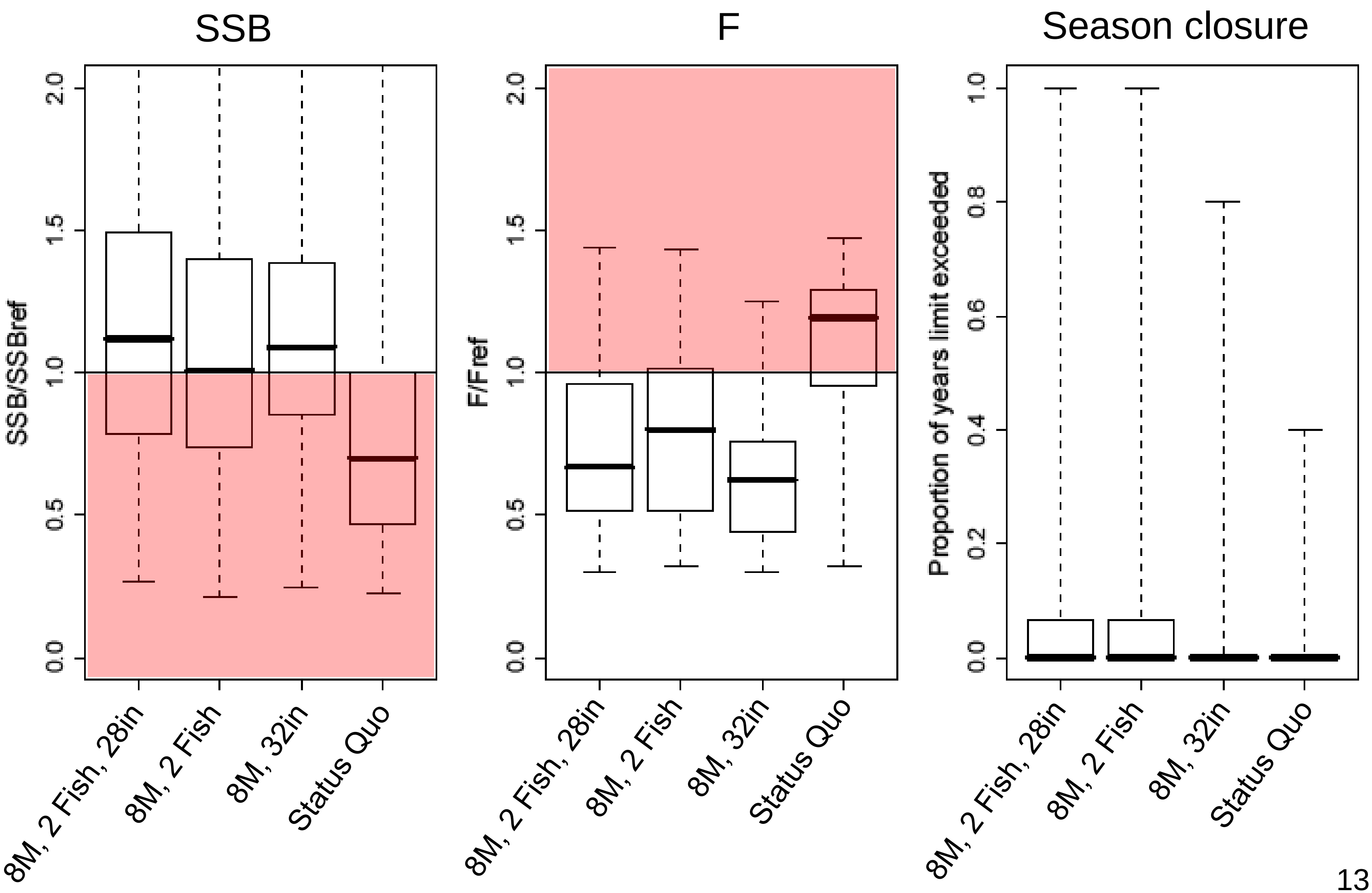
- Abundance $$N_{y+t,a+t,x,o} = \sum_{o} p_{a,s} N_{y,a,x,o} e^{-Z_{y,sa,x,o}}$$
- Mortality $$Z_{y,s,a,x,o} = M_{a,x} + \sum_{f} F_{y,s,a,x,o,f}$$
- Catch $$C_{y,s,a,x,o,f} = F_{y,s,a,x,o} \overline{N}_{y,s,a,x,o}$$

N = Abundance
M = Natural mort.
p = migration rate
y = year
a = age
o = area

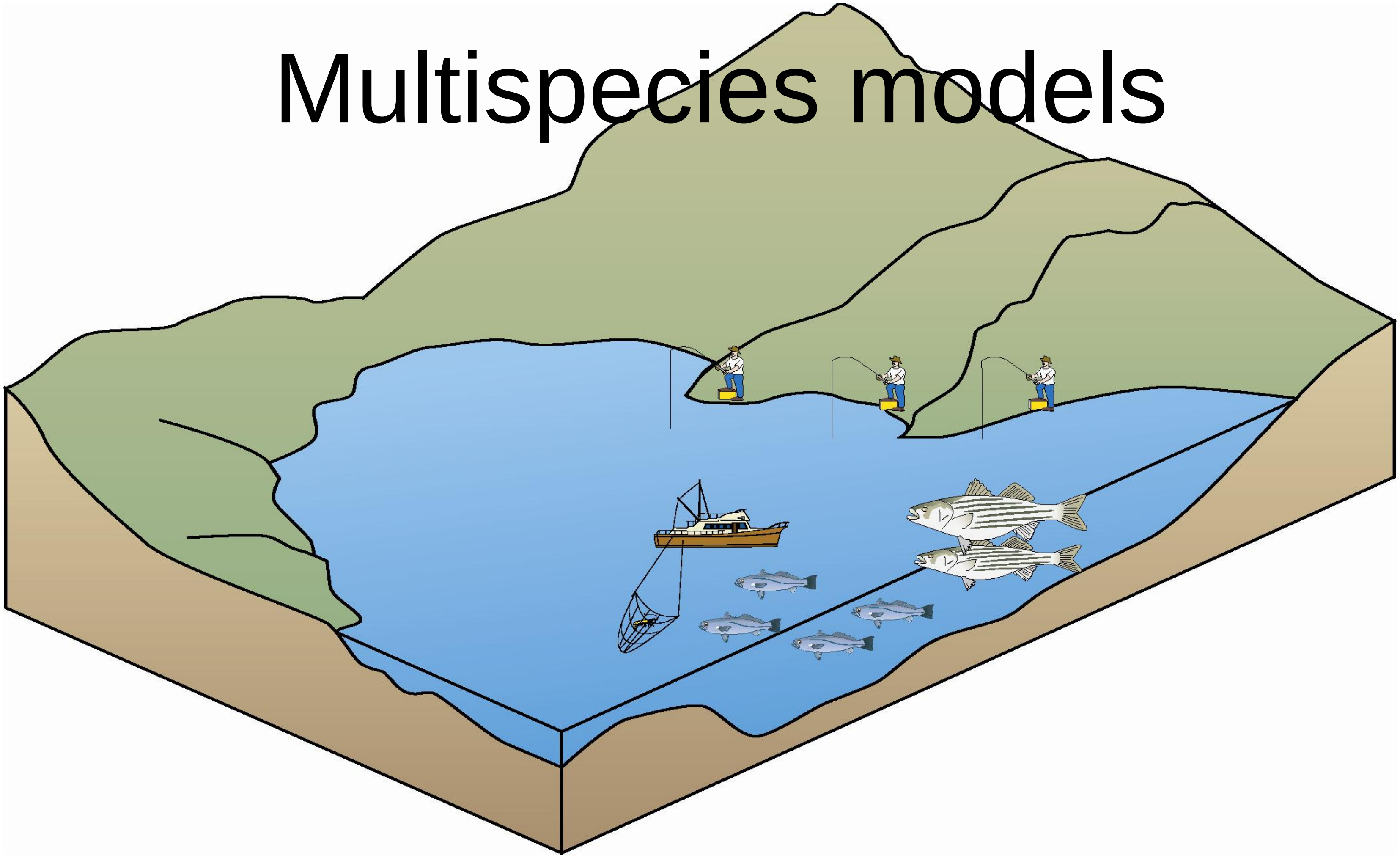
F = Inst. Fishing mort. Rate
Z = Total mort.

s = season
x = sex
f = fishery

Recommended options



Multispecies models

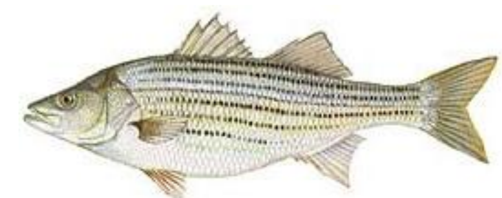


$$B_{t+1} = G + R - (F_1 + F_2) - (M + M_2)$$

Is single species management effective in an ecosystem?

- Calculated single species sustainable fishing rates
- Single species rates applied in EwE model to simulate fishing at MSY for individual and multiple species

Atlantic Croaker



Striped Bass

Blue Crab

White Perch

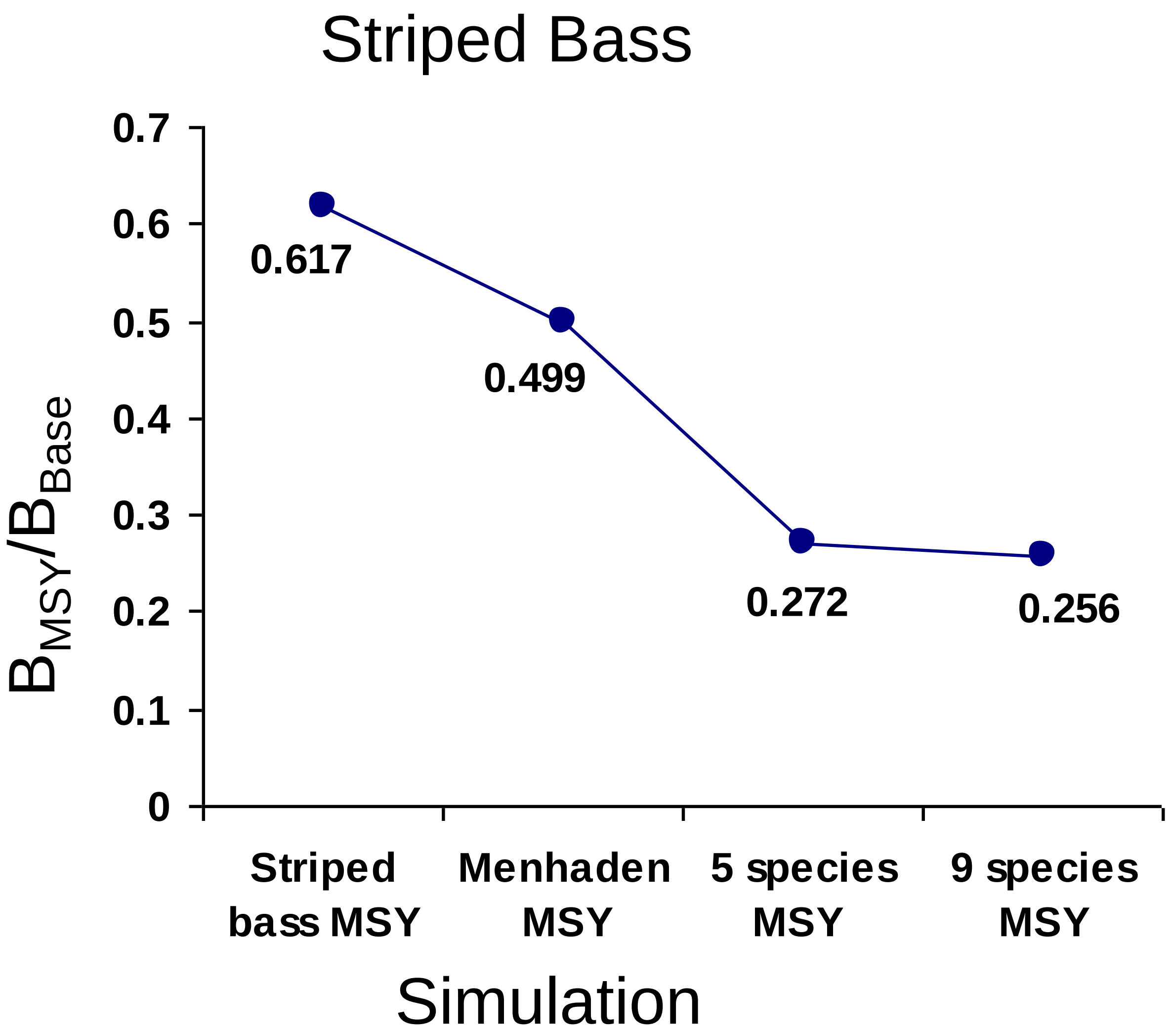
Eastern Oyster

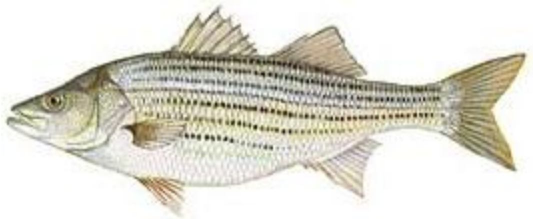
Atlantic Menhaden

Kunrath and Miller 2011

Images Courtesy of the Chesapeake Bay Program

Is MSY too high?





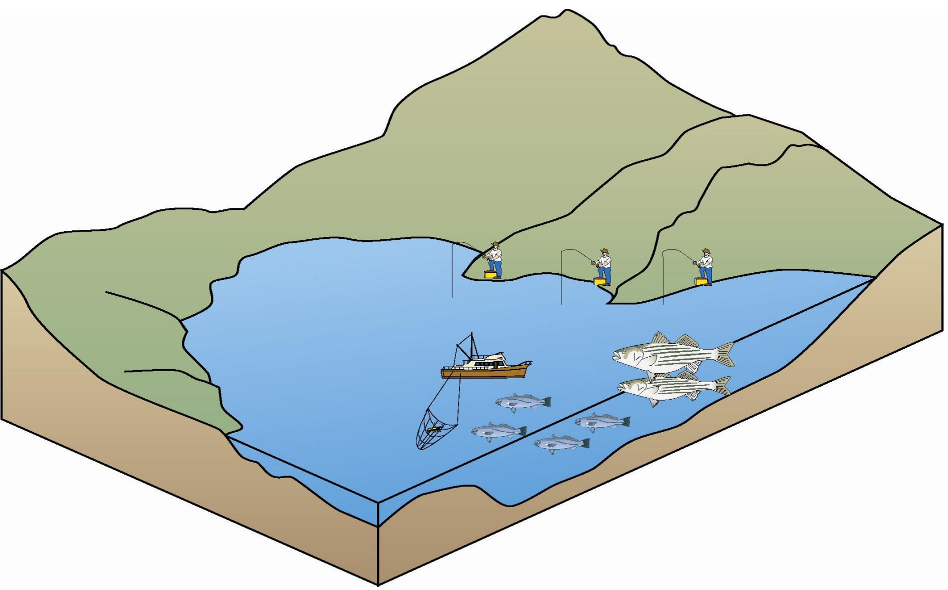
Striped Bass

Menhaden

Bluefish

Fish Images Courtesy of Chesapeake Bay Program

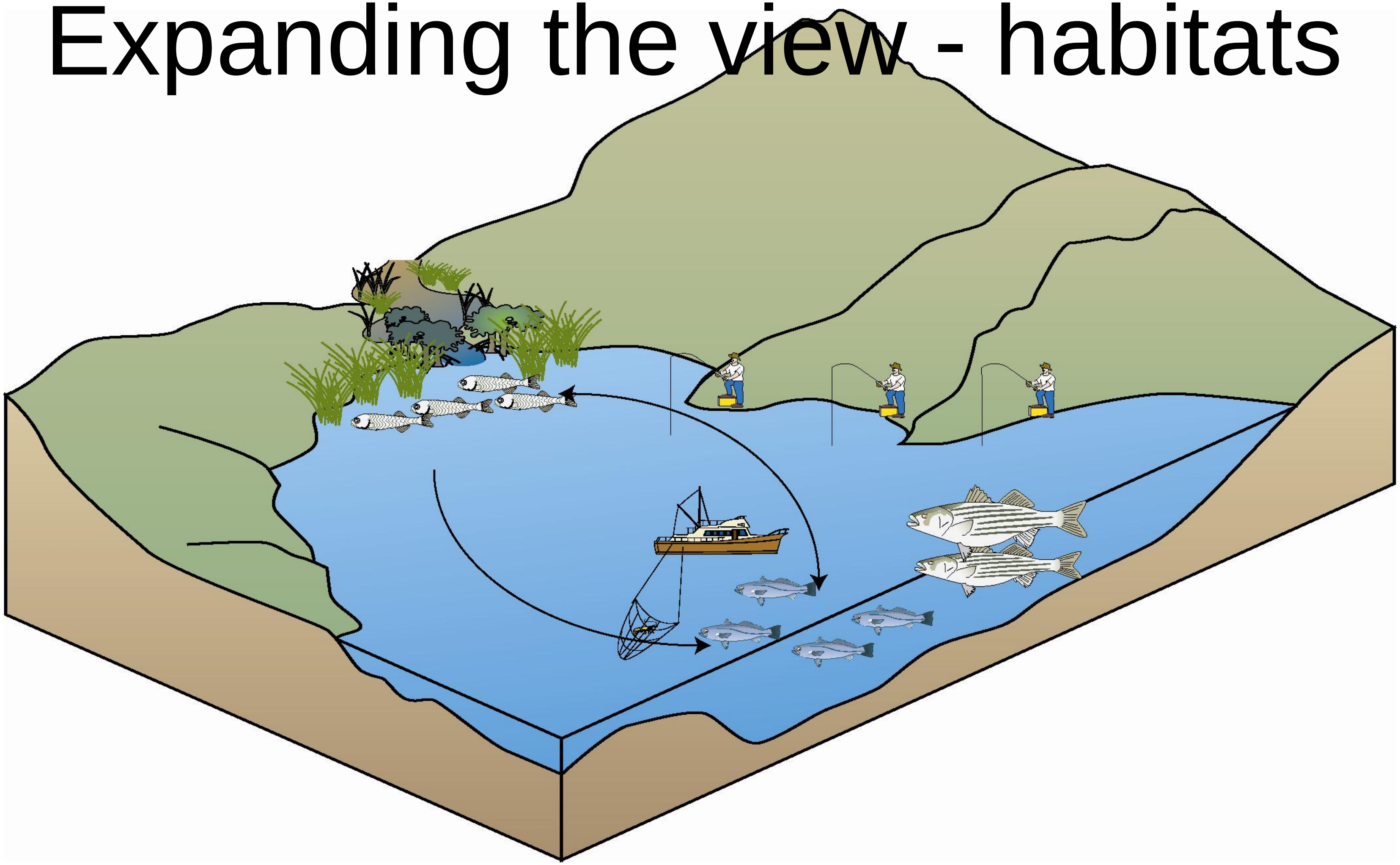
Multispecies stakeholders



$$B_{t+1} = G + R - (F_1 + F_2) - (M + M_2)$$

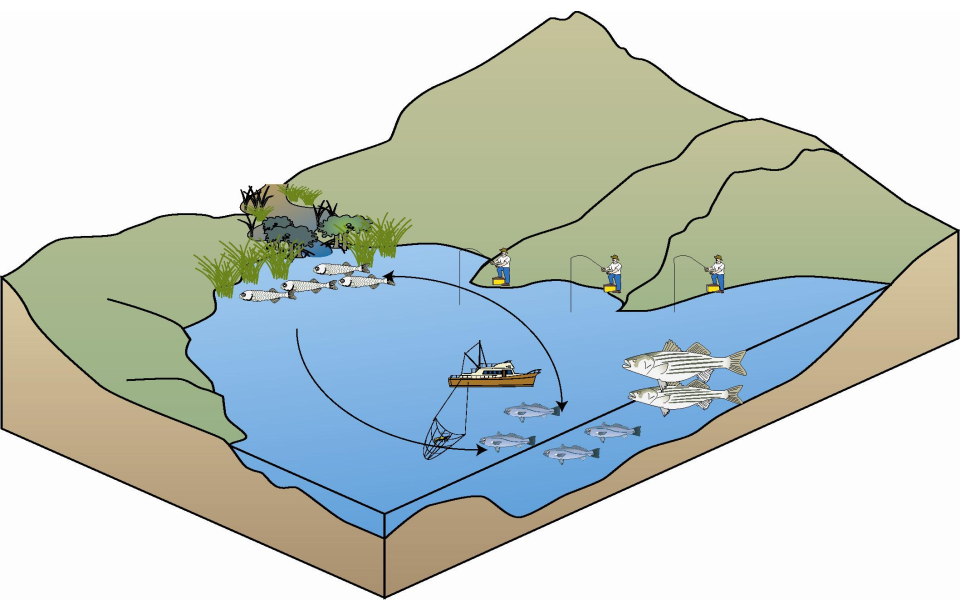
- Single species models coupled dynamically
- Biomass reference points are adjusted upwards to allocate biomass to predators
- Stakeholders include
  - Commercial
  - Recreational
  - Managers (protecting societal interest)
  - Predator stakeholders

Expanding the view - habitats



$$B_{t+1} = G + R' - (F_1 + F_2) - (M + M_2)$$

Habitat issues



$$B_{t+1} = G + R' - (F_1 + F_2) - (M + M_2)$$

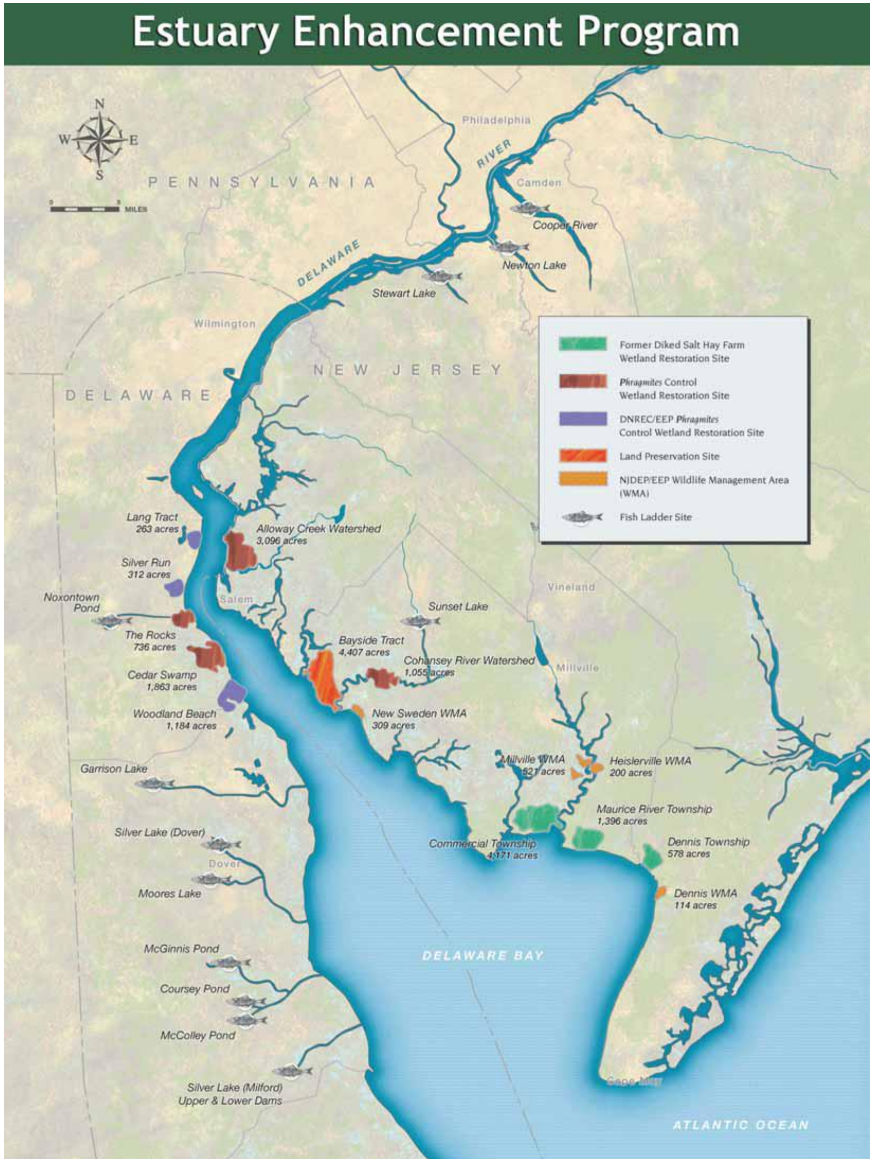
- FCMA include essential fish habitat, but provided no teeth to the concept
- ESA does have teeth, but because of that is rarely used in fisheries
- Traditional fisheries approaches would adjust reference points to account for R’, but not change goals
- New stakeholders: land use planning, other government agencies, NGOs, restoration organizations

Approaches to habitat issues in fisheries

- Spatial issues
  - Spatially structured population models
  - Spatially-explicit management
    - MPAs
    - Marine spatial planning
- Case study: Power plant impingement
  - Cooling water intakes impinge substantial numbers of early life stages of fish
  - How has society asked power plant operators to respond
    - Avoidance technologies
    - Sponsor large scale research efforts – VEE, HRF
    - Stock enhancement efforts
    - Habitat restoration

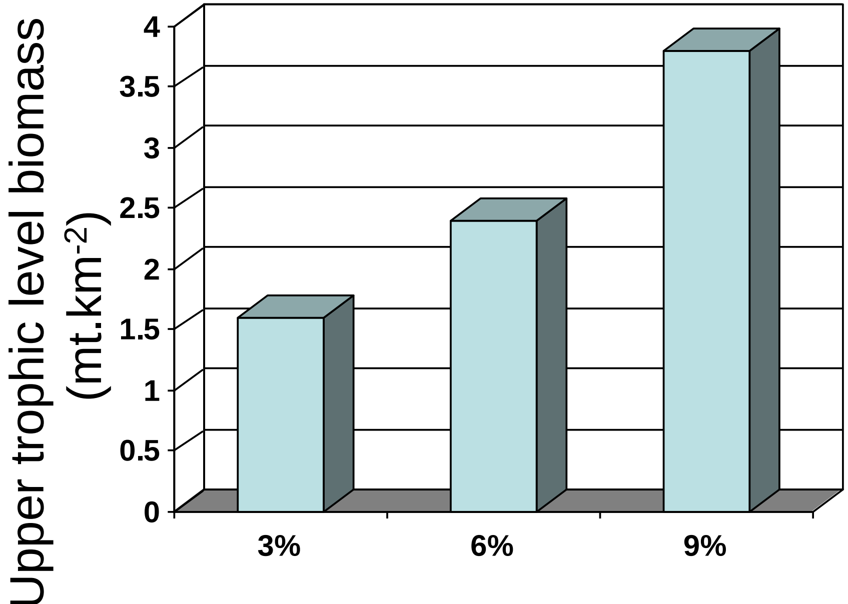
Seek to offset production loss

PSE&G Delaware Bay



Delaware Ecosim Model

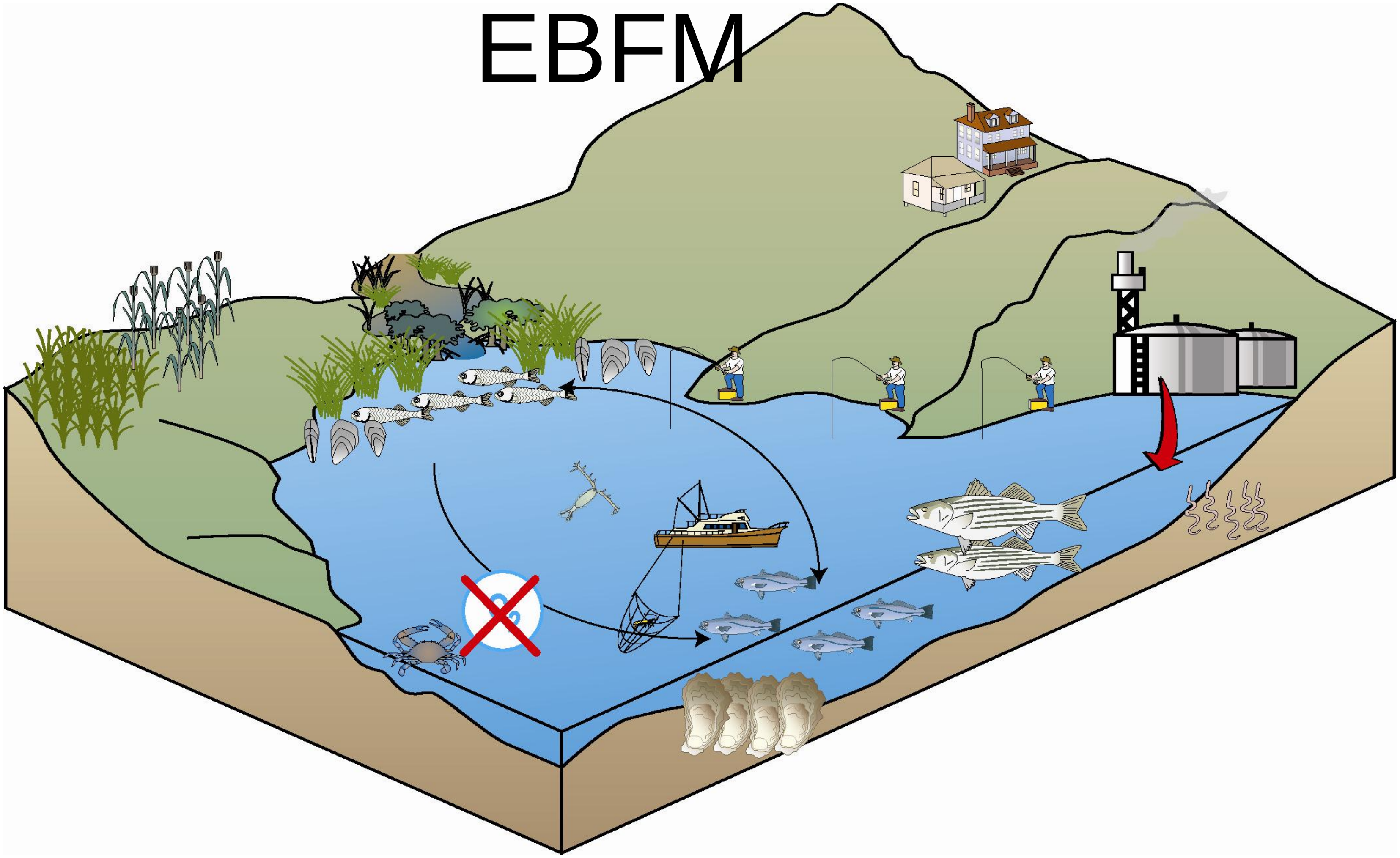
Biomass Lost if Restoration Not Conducted



% reduction in marsh area in model

Frisk et al. (in press). Ecol. Appl.

EBFM



$$B_{t+1} = G' + R' - (F_1 + F_2) - (M + M_2)$$

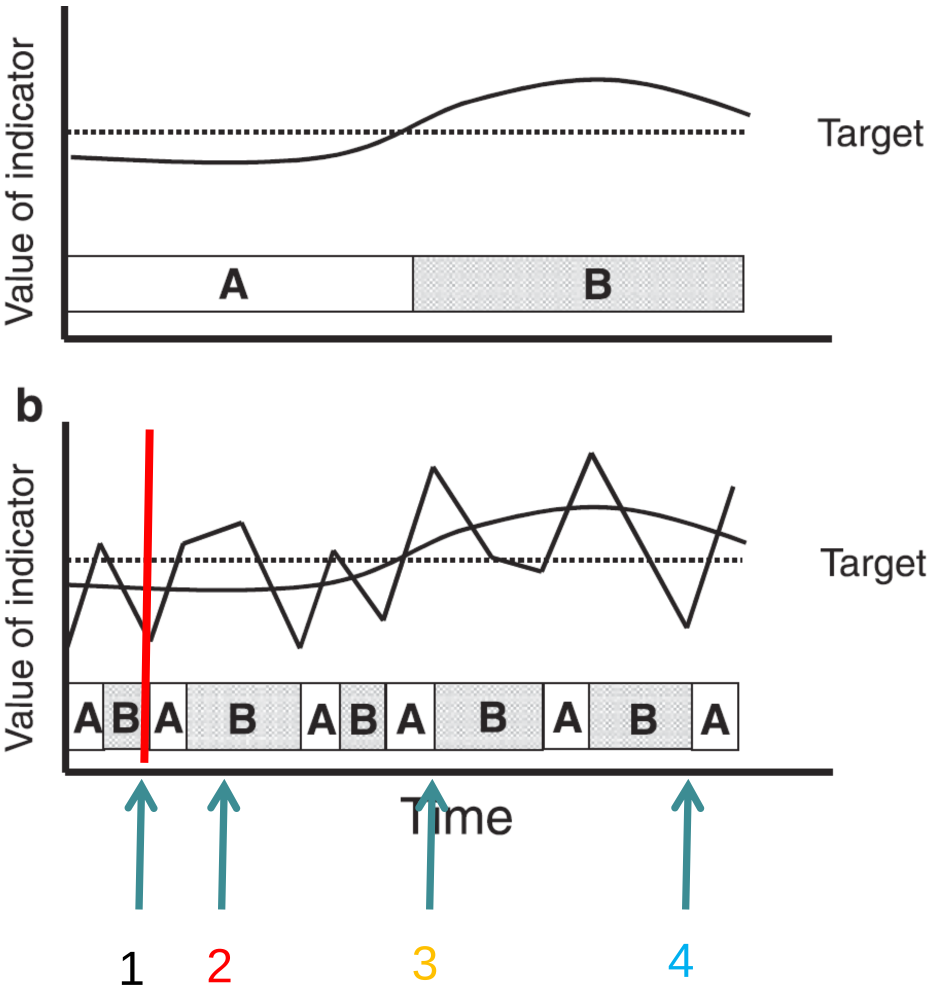
?

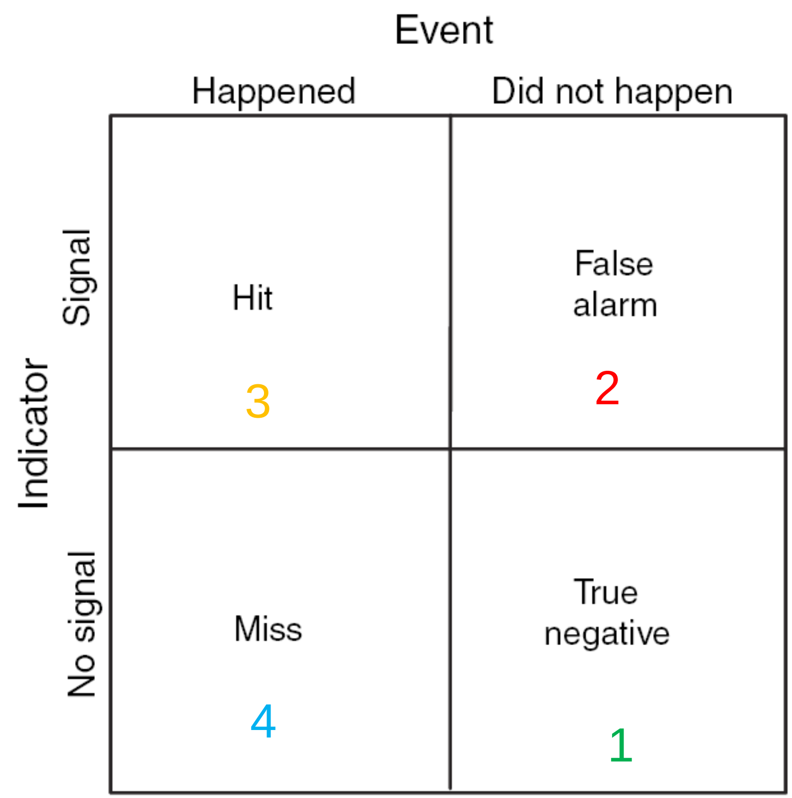
Ecosystem-based indicators, reference points, directions and trajectories

- Objectives:
  - Strategic , e.g. sustainable fishery
  - Operational, e.g., BRP -- Age 1+ crab abundance > 200 million
- Indicators – reflect distance from the objective.
  - Direction and trajectories can be used
- Indicators must have high signal:noise and be responsive to ecosystem state and management
- Graduated indicators avoid need for harsh and immediate action in the limit

From Jennings 2005:Fish & Fisheries 6:212-232

Noise and management systems





From Jennings 2005:Fish & Fisheries 6:212-232

Challenges to identifying stakeholders for EBFM

- What comes first – goal or stakeholders
  - The stakeholders you have in the room will affect the state goal or vision
- Given a goal, how is allocation determined
  - Allocation is often the most contentious issue in fisheries management because it is often not a scientific question
- Given an allocation, how is performance determined
  - What is monitored, and how is it related back to the goals

Candidate Indicators and BRPs

- Total system catch (e.g., NE Pacific, CCAMLR
    - System MSY << Sum of Species MSY's
    - Forces agencies to allocate
    - As an interim establish an empirical system-level catch limit ~ 300,000 mt (CFEPTAP 2006).
        - Promotes explicit recognition of trade-offs
        - Recognizes system level limits to production

Candidate indicators (ctd)

- Total catch of trophic level (e.g., piscivores)
- Ratios of catches or abundances
  - Pelagic: Benthic
  - Menhaden: Striped bass

How to move forward

- Many of these proposed steps involve enhancements to the regions ability to conduct stock assessments
  - Invest in capacity building
    - Student training
    - Staff development
    - Regional consortia
- Many of the proposed steps require improvements to fishery-dependent and fishery-independent data
  - Invest in data infrastructure
    - QA/QC on catch records
    - Improvement, standardization and rationalization of scientific surveys
    - Application of new technologies

Challenges to identifying stakeholders for EBFM

- What comes first – goal or stakeholders
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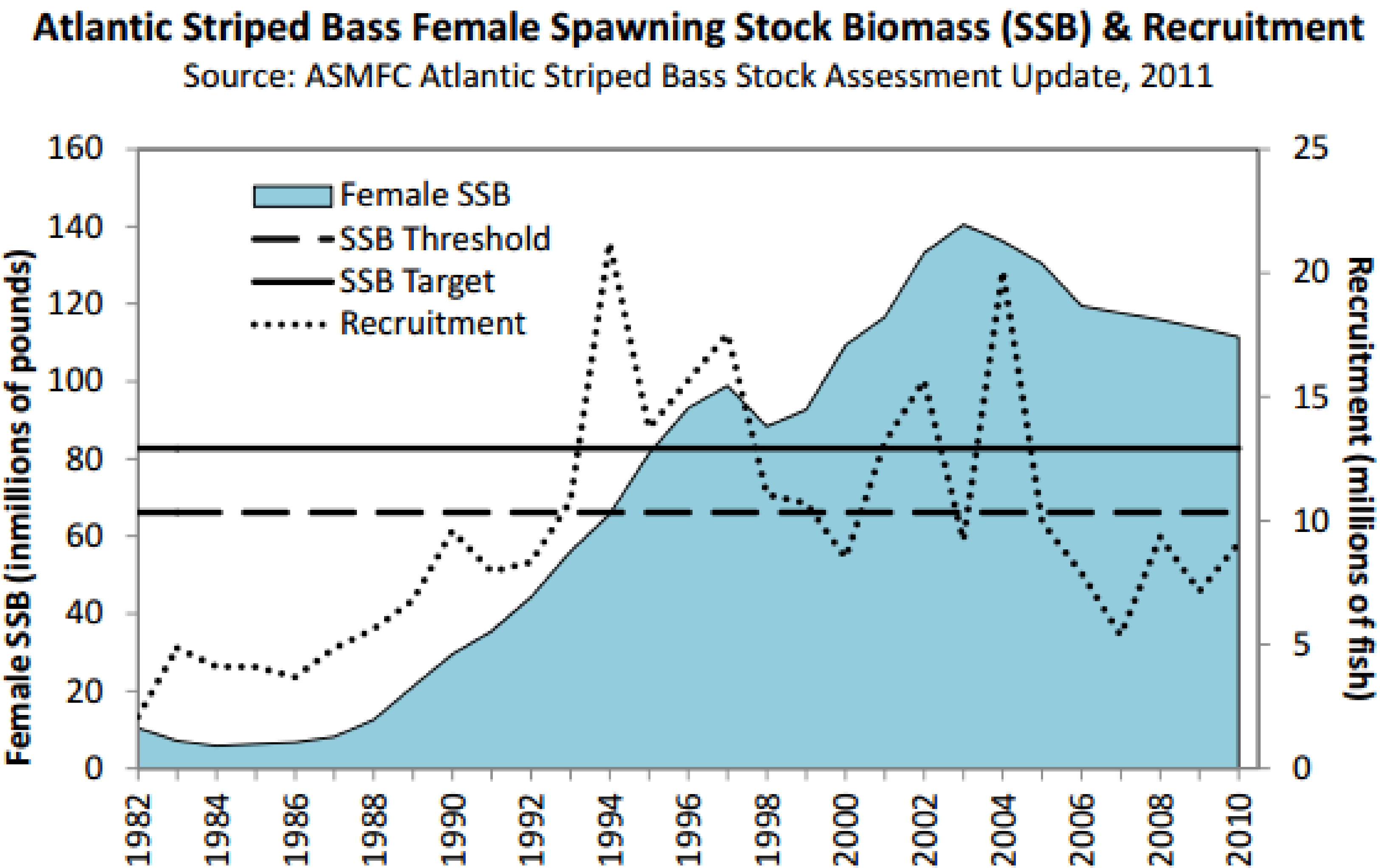
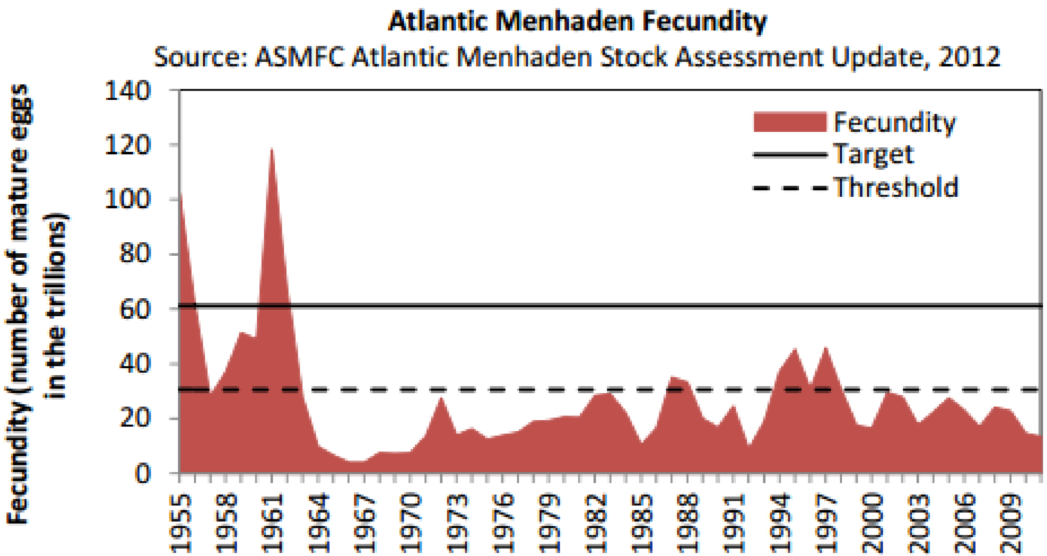
  - Allocation is often the most contentious issue in fisheries management because it is often not a scientific question
- Given an allocation, how is performance determined
  - What is monitored, and how is it related back to the goals

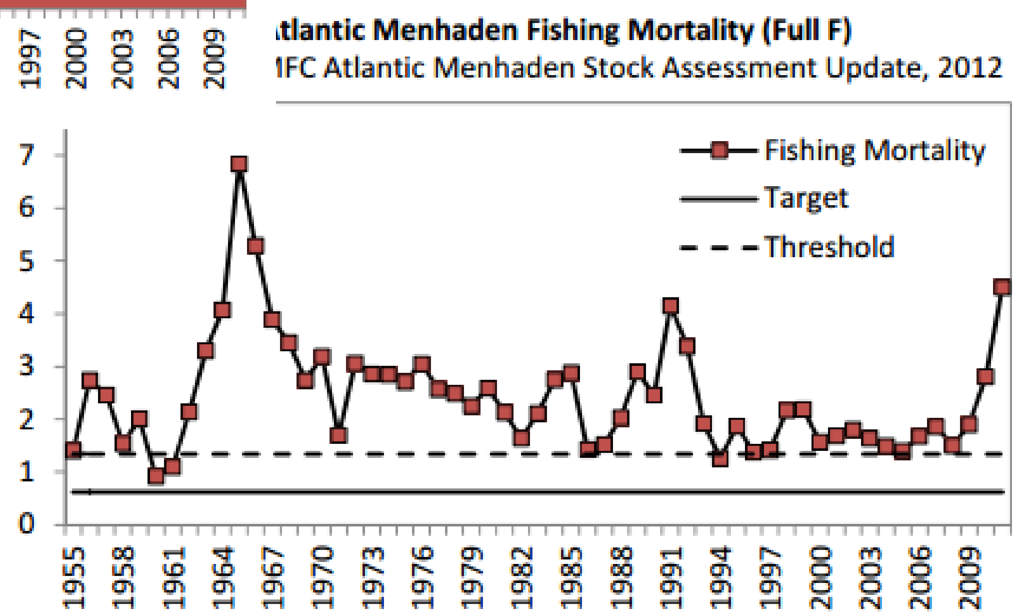

BUT MOST IMPORTANTLY
SET GOALS

Striped bass



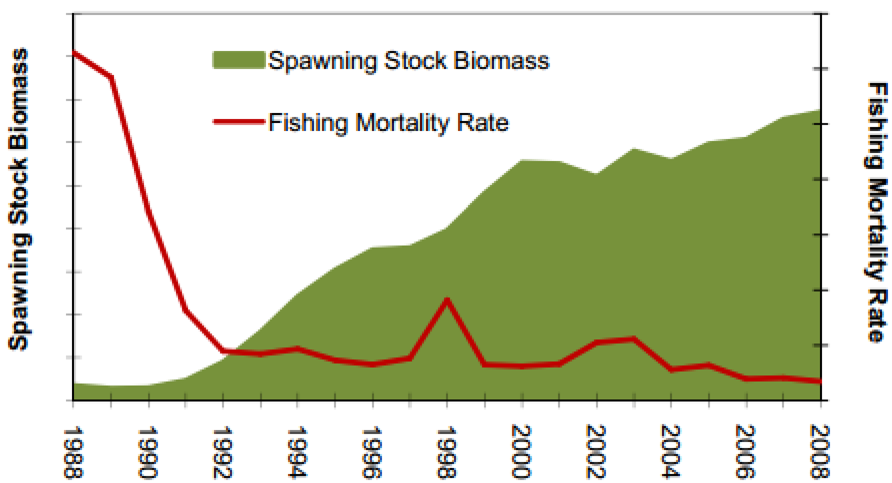
Atlantic menhaden





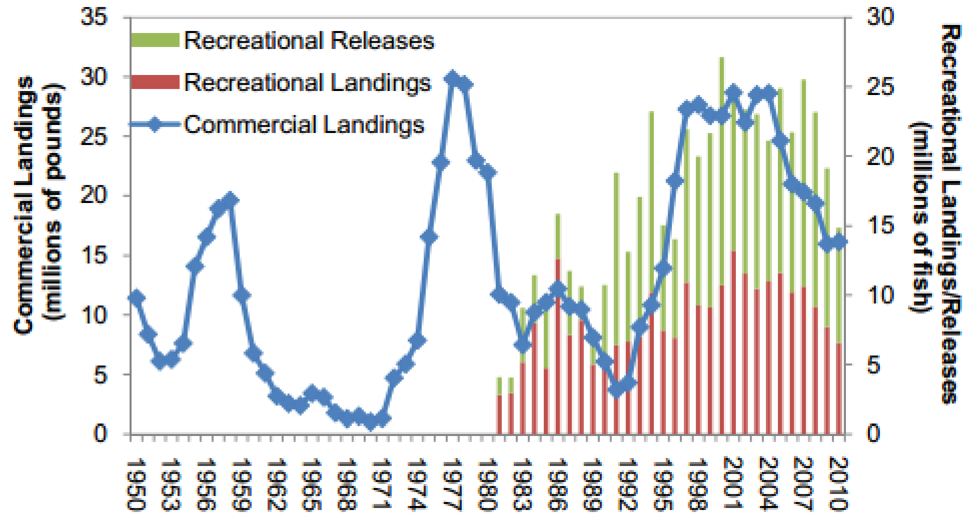
Atlantic croaker

Trends in Atlantic Croaker Spawning Stock Biomass & Fishing Mortality Rate (Source: 2010 ASMFC Atlantic Croaker Stock Assessment Report)

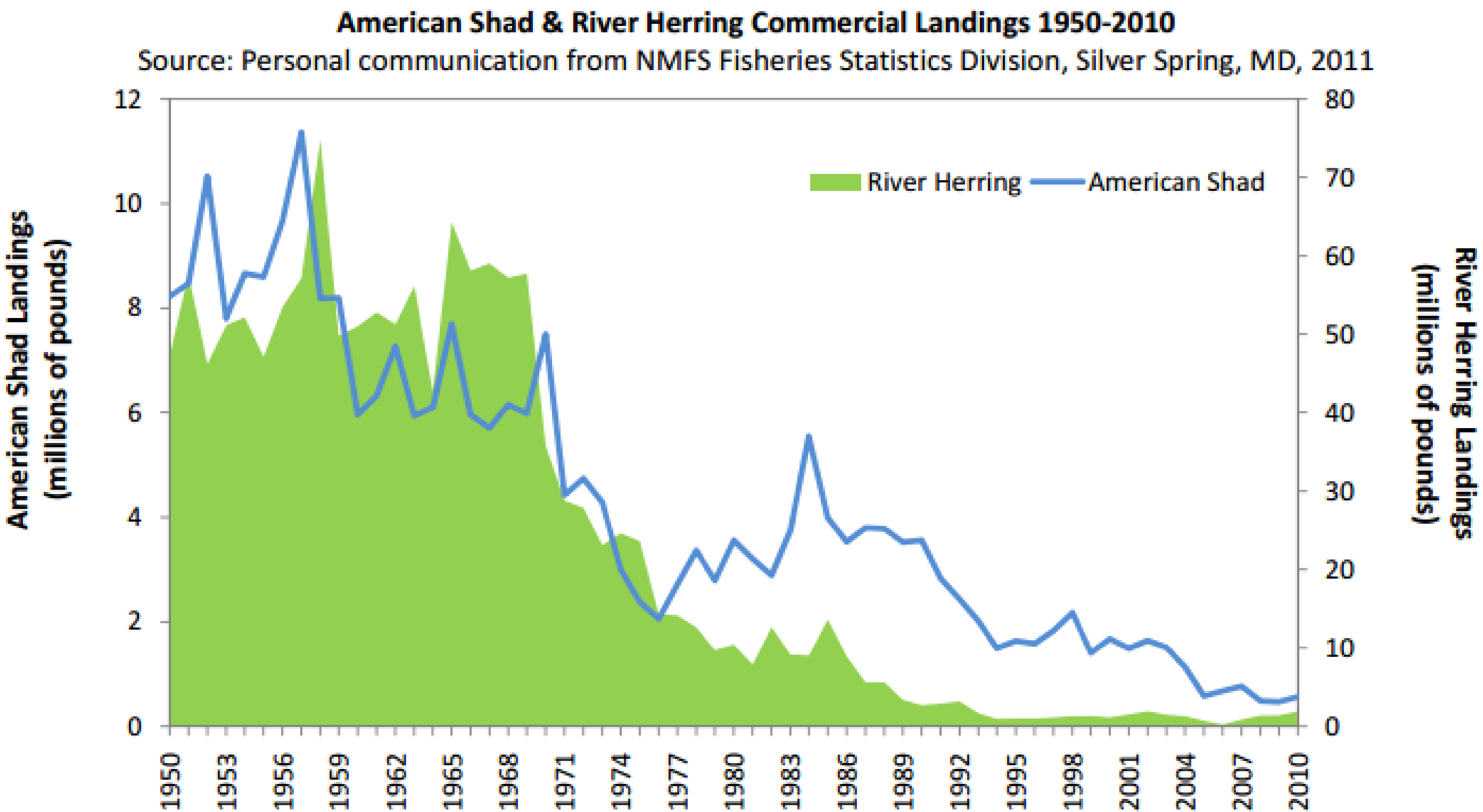


Management Considerations:

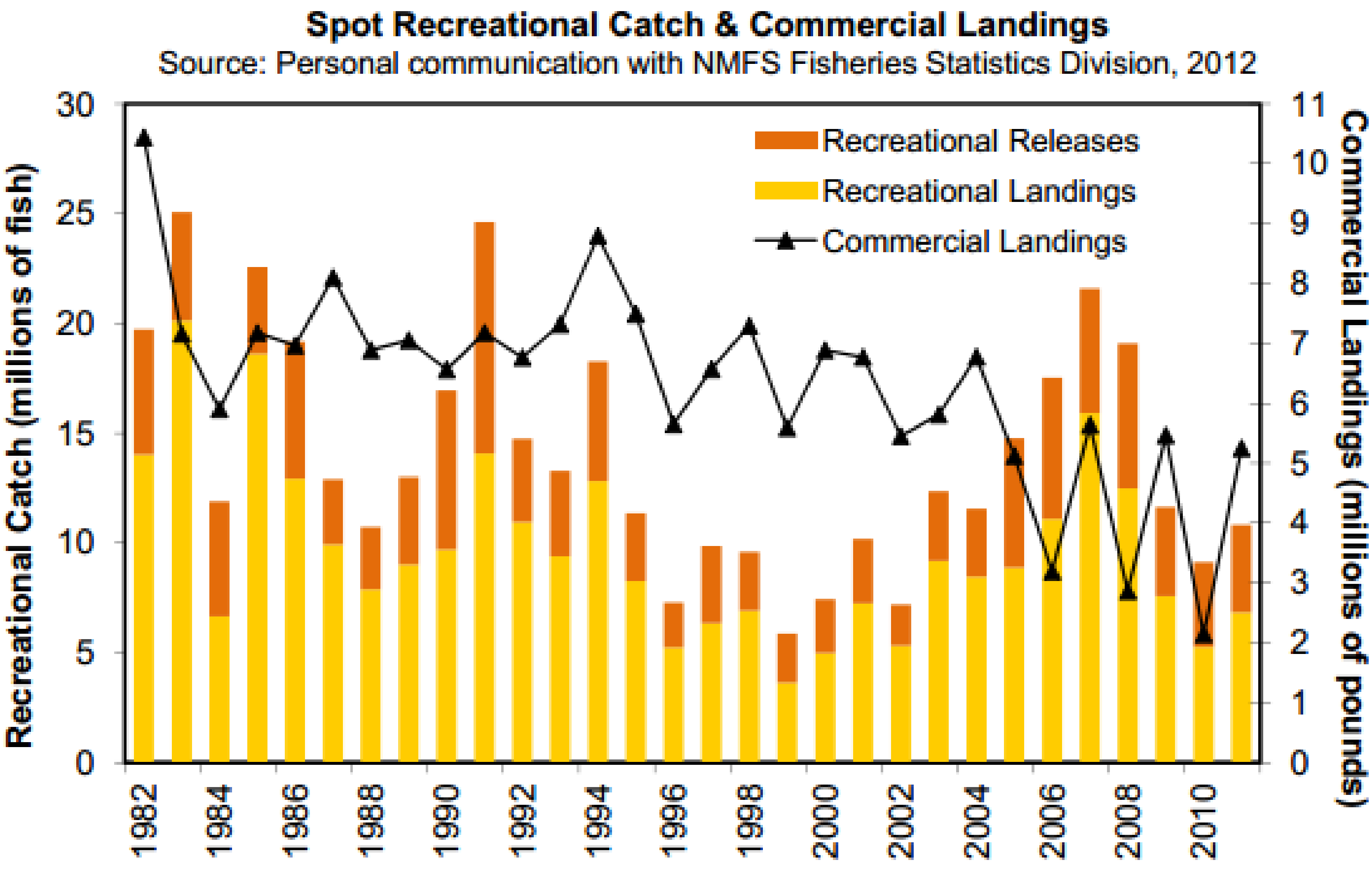
Atlantic Croaker Commercial Landings and Recreational Landings & Releases (Source: Personal communication NMFS Fisheries Statistics Division, Silver Spring, MD, 2011)



River herrings and American shad



Spot


Spot Recreational Catch & Commercial Landings
Source: Personal communication with NMFS Fisheries Statistics Division, 2012
Recreational Releases
Recreational Landings
Commercial Landings
Recreational Catch (millions of fish)
Commercial Landings (millions of pounds)
0
5
10
15
20
25
30
0
1
2
3
4
5
6
7
8
9
10
11
1982
1984
1986
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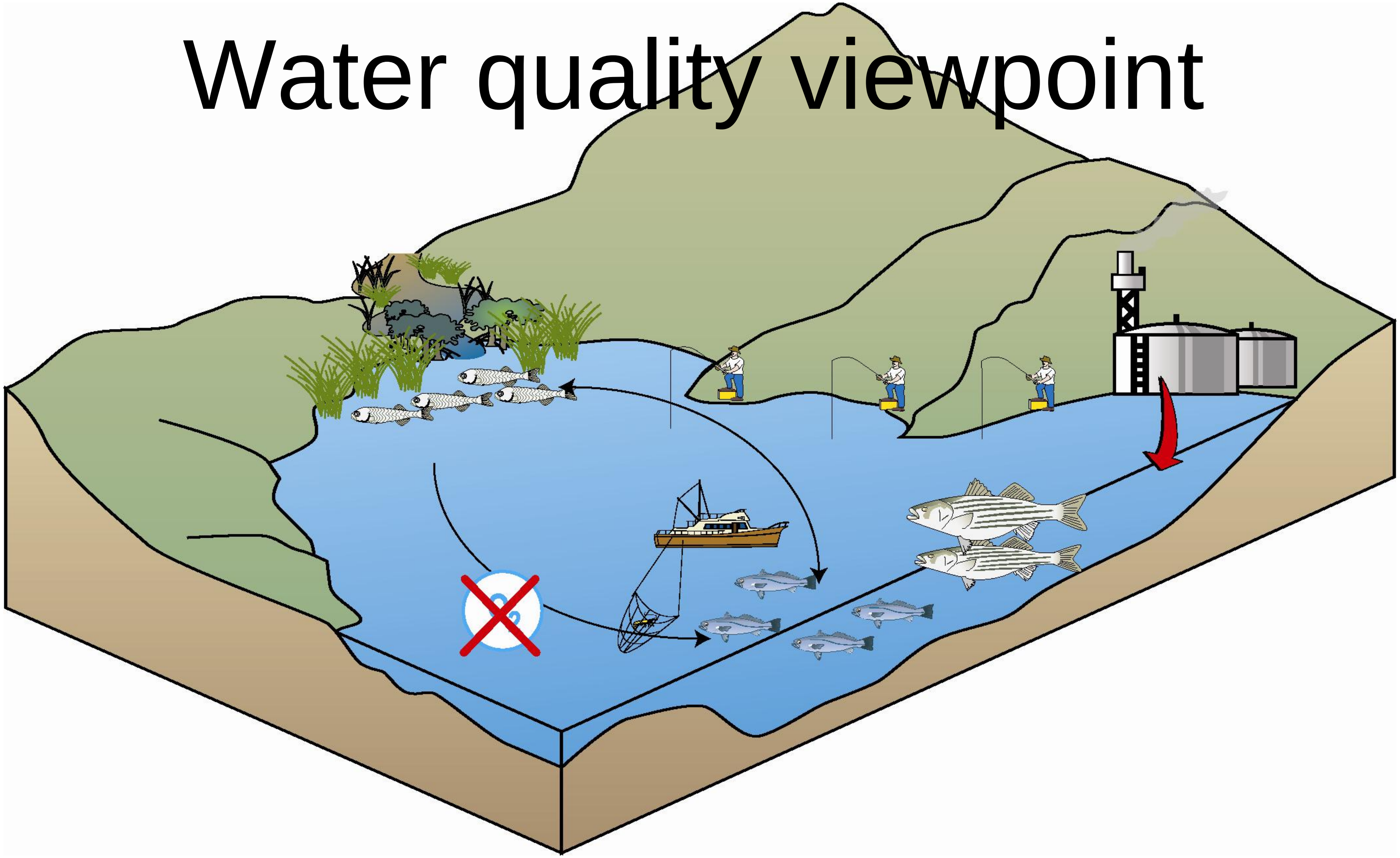
2010

Water quality viewpoint



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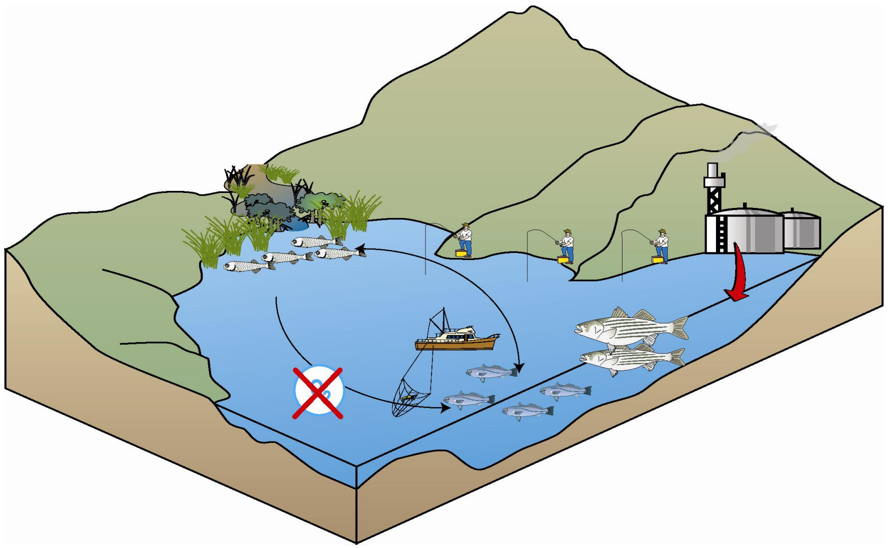
Water quality viewpoint



$$B_{t+1} = G' + R' - (F_1 + F_2) - (M + M_2)$$

- Traditional fisheries approaches would adjust reference points to account for G’, but not change goals
- No new stakeholders beyond habitat issues

Alternative water quality view

- Case study: CBP
  - Long term attempt to reverse decline in water quality in CB via comprehensive, watershed scale management.
  - TMDL approach to setting limits for water quality
  - BUT, CBP remains outside of fisheries management arena (e.g., ASMFC, MAFMC)
    - Even Bay-specific, CBP goals not dominant (e.g., crabs and oysters)