Basics of Using SPR as Biological Reference Points

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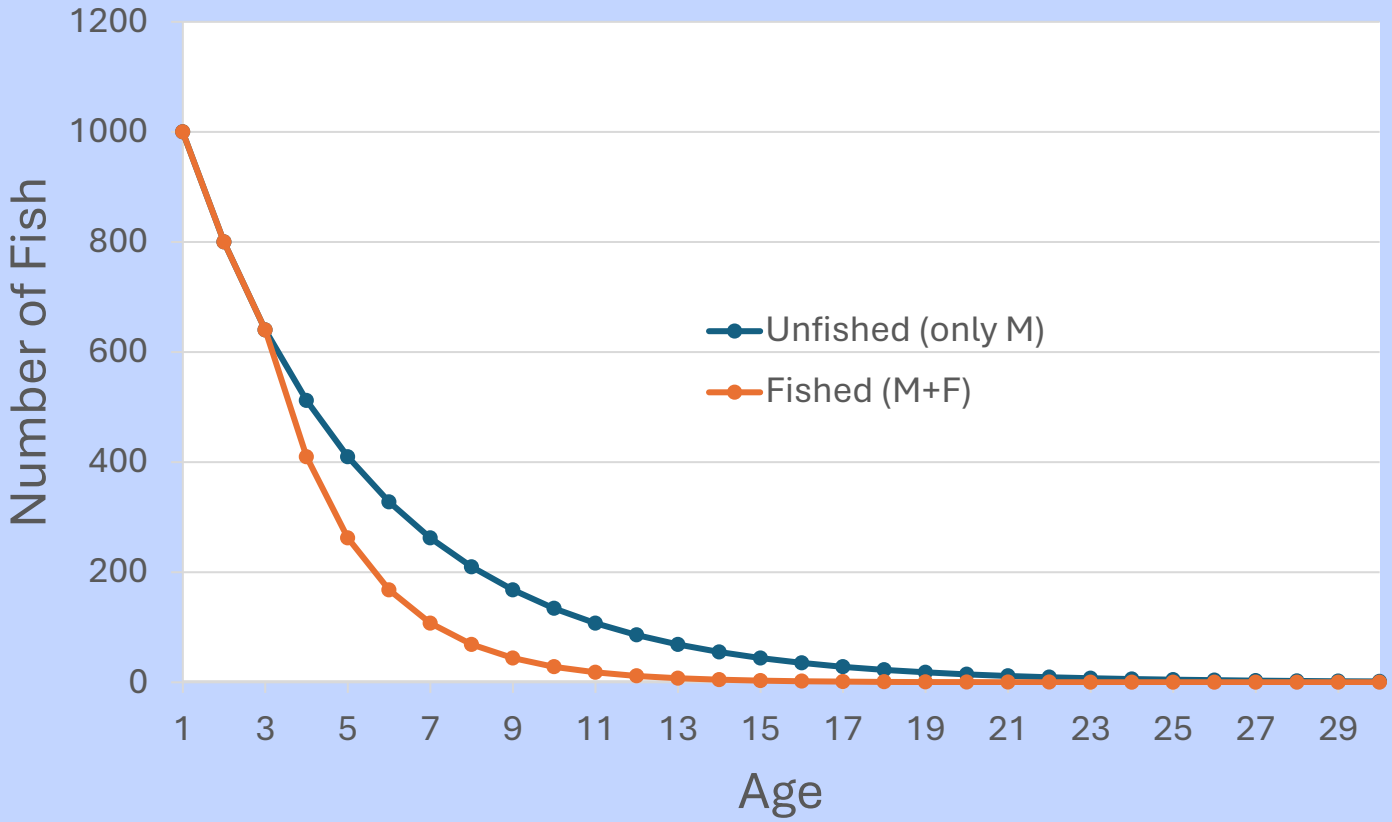
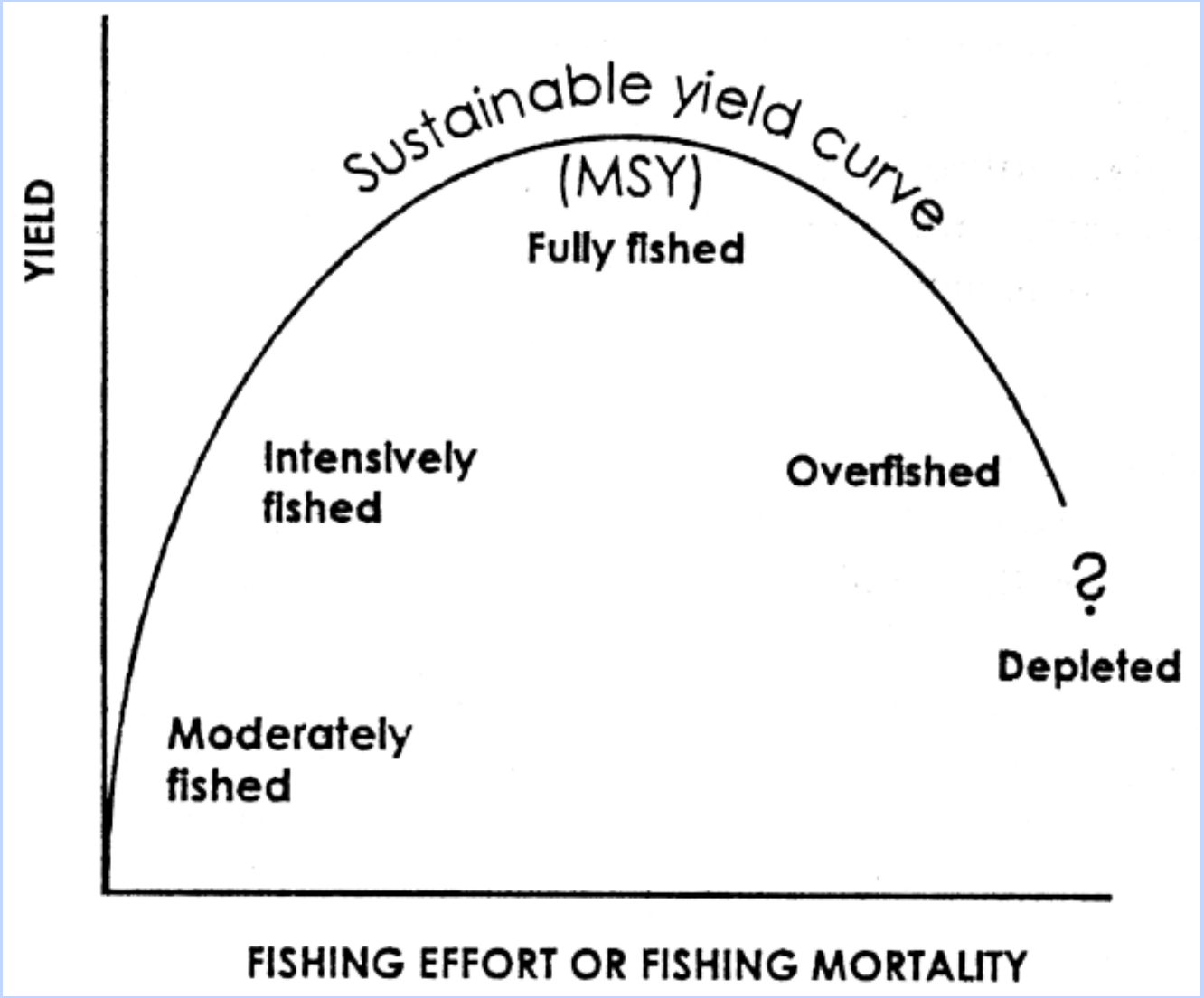
Overview

- Effects of fishing on age structure, abundance, and reproductive potential
- Use of MSY – Criteria for overfishing
- Why use a biological reference point instead of MSY?
- Spawning Potential Ratio - definition and use



- Fishing erodes the age structure, reducing the number of large fish, total biomass, and total egg production
- The degree of impact will vary with size limit (i.e., when they become vulnerable to harvest)


YIELD
Sustainable yield curve
(MSY)
Fully fished
Intensively
fished
Overfished
?
Depleted
Moderately
fished
FISHING EFFORT OR FISHING MORTALITY

Source: FAO

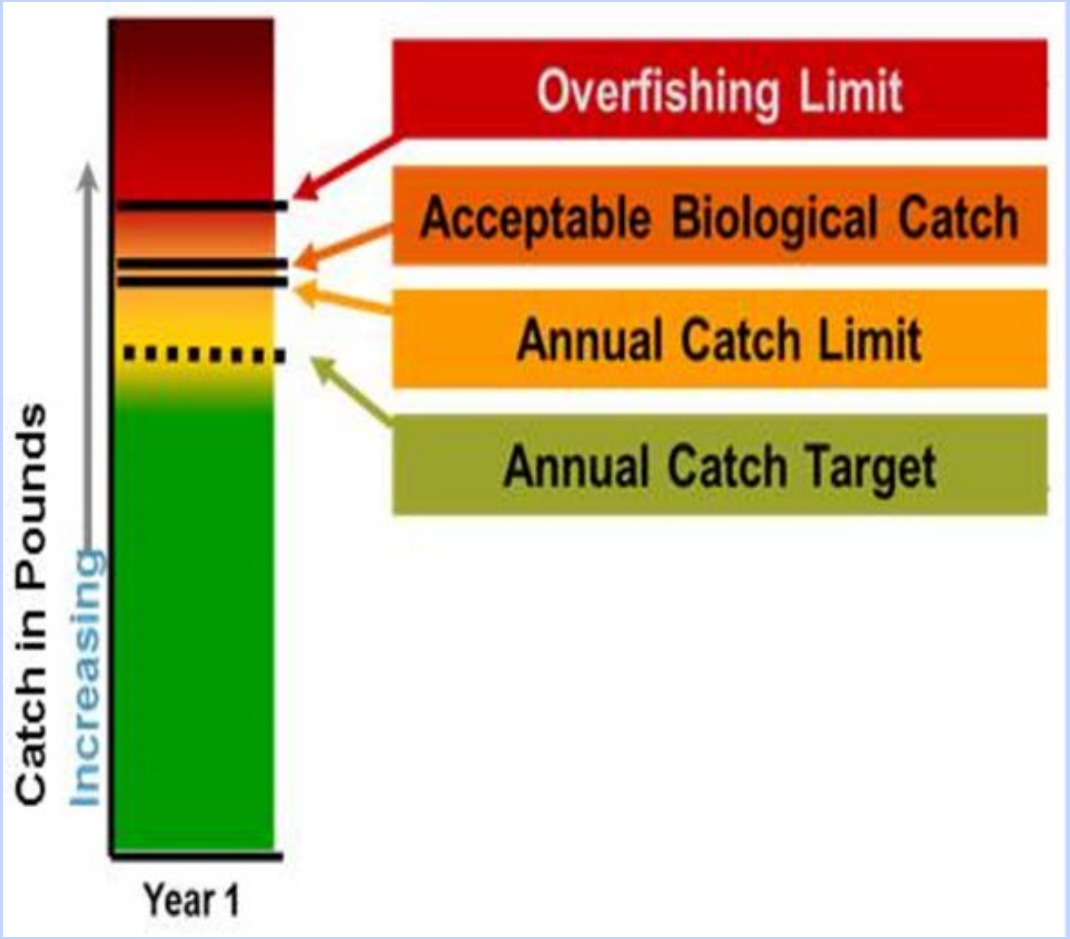
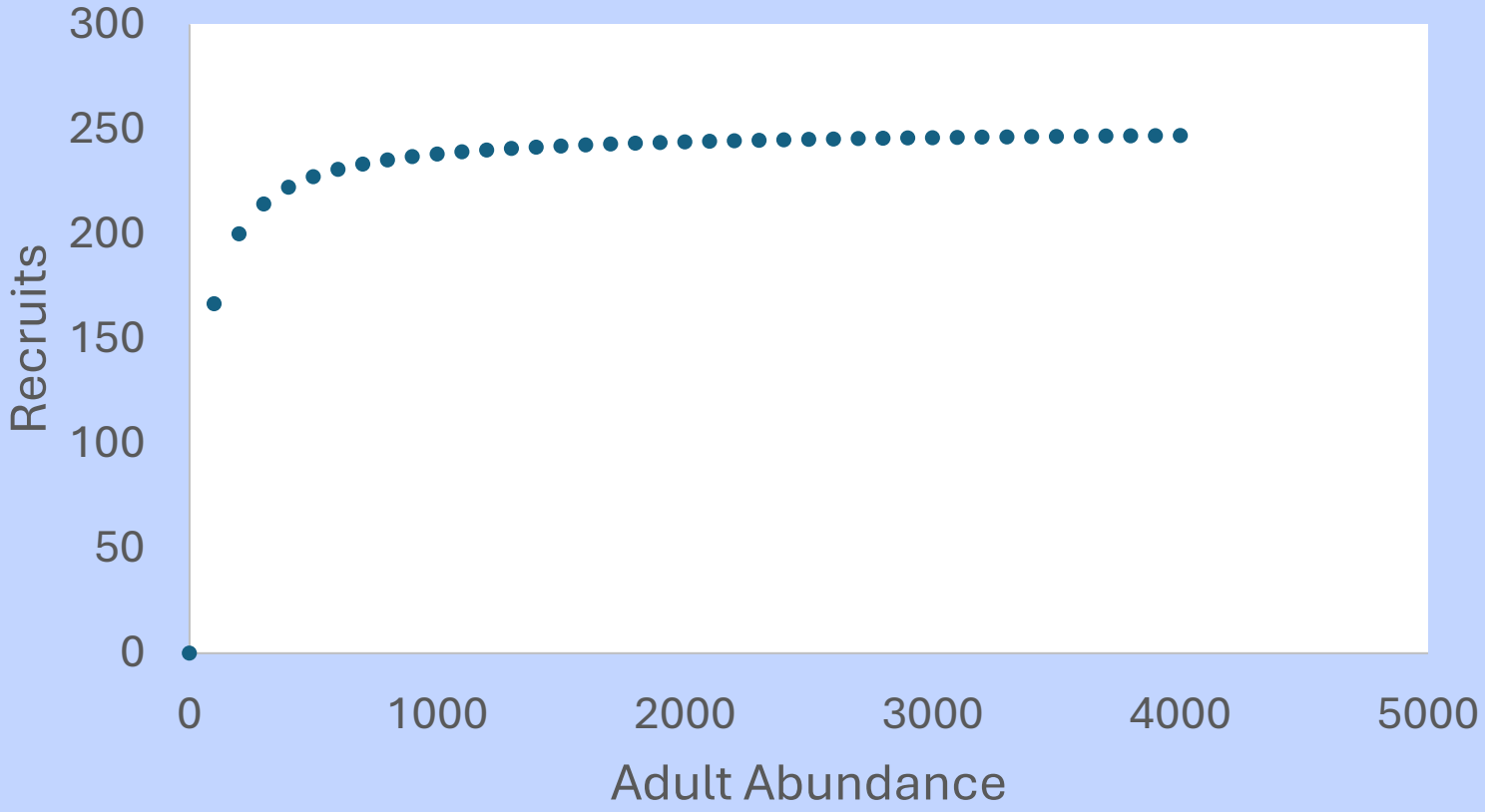


Figure 1. Illustration of the tiered approach towards establishing the overfishing limit (OFL), acceptable biological catch (ABC), annual catch limit (ACL), and annual catch target (ACT).

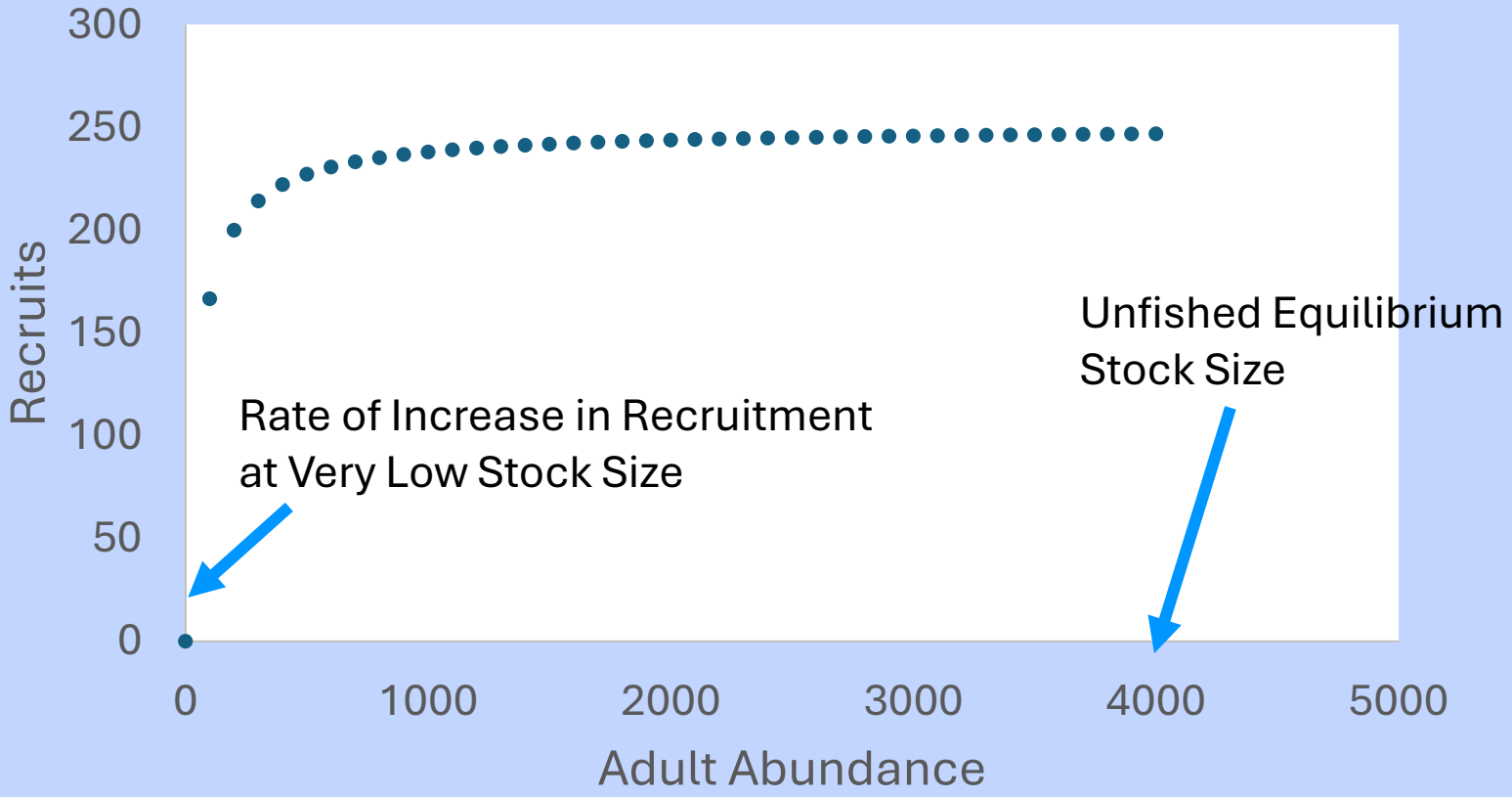
https://www.fisheries.noaa.gov/southeast/sustainable-fisheries

Estimating MSY

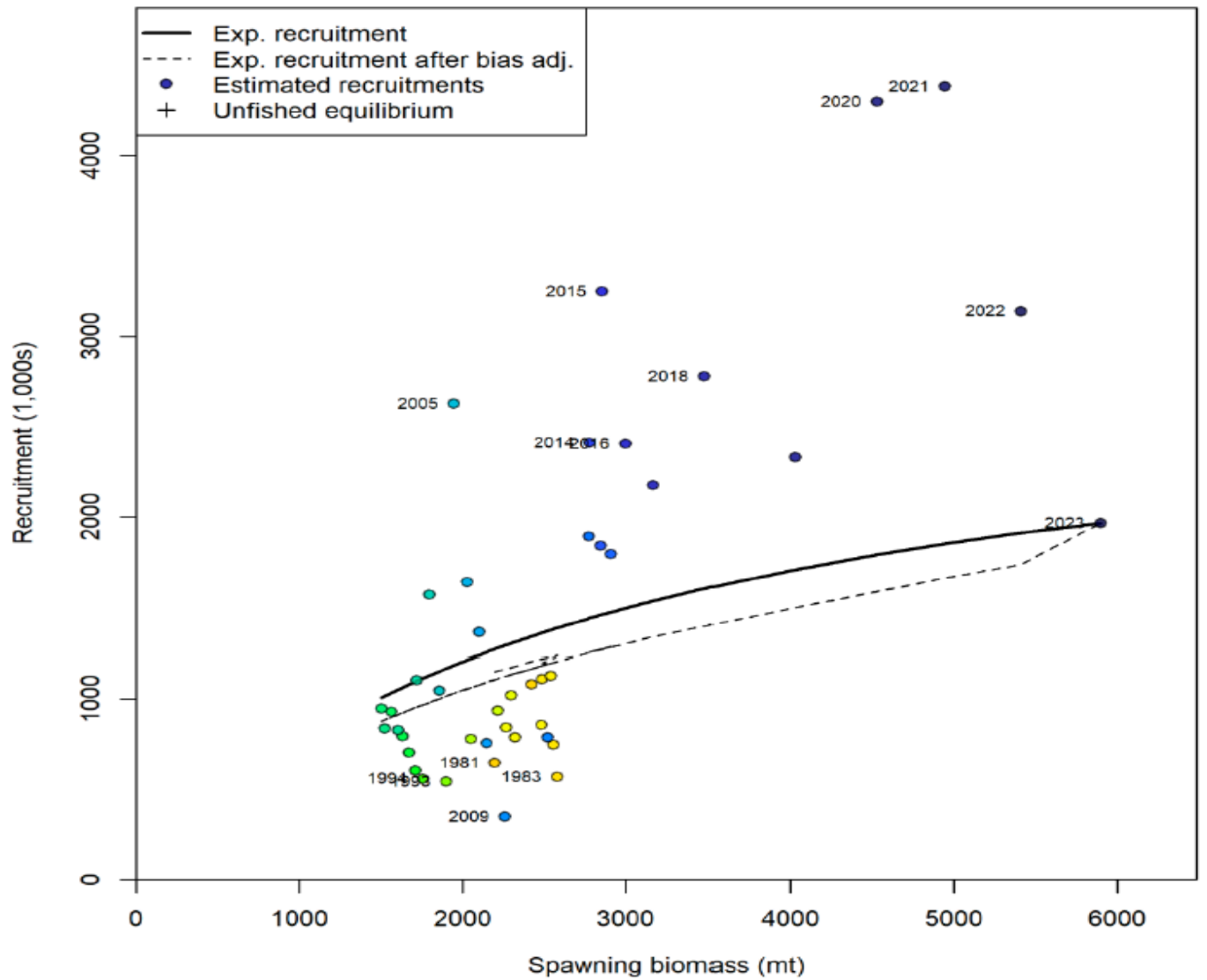
- MSY depends on the life history (e.g., growth, maturity, natural mortality and recruitment)
- Estimating MSY requires an estimate of the stock recruit relationship, which is the degree to which recruitment will change as fishing mortality increases



- Fish stocks exhibit similar average recruitment over a wide range of stock sizes
- This means that recruits per spawner increases as stock declines (recruitment compensation)



- To estimate MSY, we need to know the rate of recruitment that would occur at very low stock sizes (often indexed with “steepness”)
- Often not estimable in stock assessments
    - Lack of data at very low stock sizes
    - Lack of contrast in adult abundance
    - High uncertainty in both estimates of S and R



Example

Source: SEDAR 79: Mutton Snapper

When MSY Cannot be Estimated

- We need a proxy that could serve as a good index of where we are relative to MSY
- Need to account for the erosion in the total egg production that has a occurred for a given level of fishing
- Spawning Potential Ratio is a common one
  - Simple
  - Estimates the loss of egg production for a given level of fishing
  - SPR is a per recruit calculation, so not dependent on recruitment or environmental variability

$$SPR = \frac{Eggs\ per\ Recruit\ in\ Fished\ Condition}{Eggs\ per\ Recruit\ in\ Unfished\ Condition}$$

- Eggs per recruit is the product of survival (F+M), maturity (yes or no), and fecundity across ages
- SPR is a common biological reference point used to indicate the stock status, in absence of an estimate of MSY
- Meta-analyses across global fish stocks show that SPR values below 0.2-0.4 typically indicate overfishing based on MSY
- Appropriate target SPR values dependent on life history (especially natural mortality, growth coefficient (K), age at maturity, hermaphrodism, etc.)

Summary

- We hope to estimate MSY from the data from each fish stock, which allows direct estimation
- Often we can’t due to data limitations, and in those cases we look for reference points to indicate potential for overfishing
- SPR is the most common reference point used
- Has strong analytical and data support
- In the Gulf, recent work shows that SPR reference points should generally range between 0.3-0.5 to prevent overfishing