

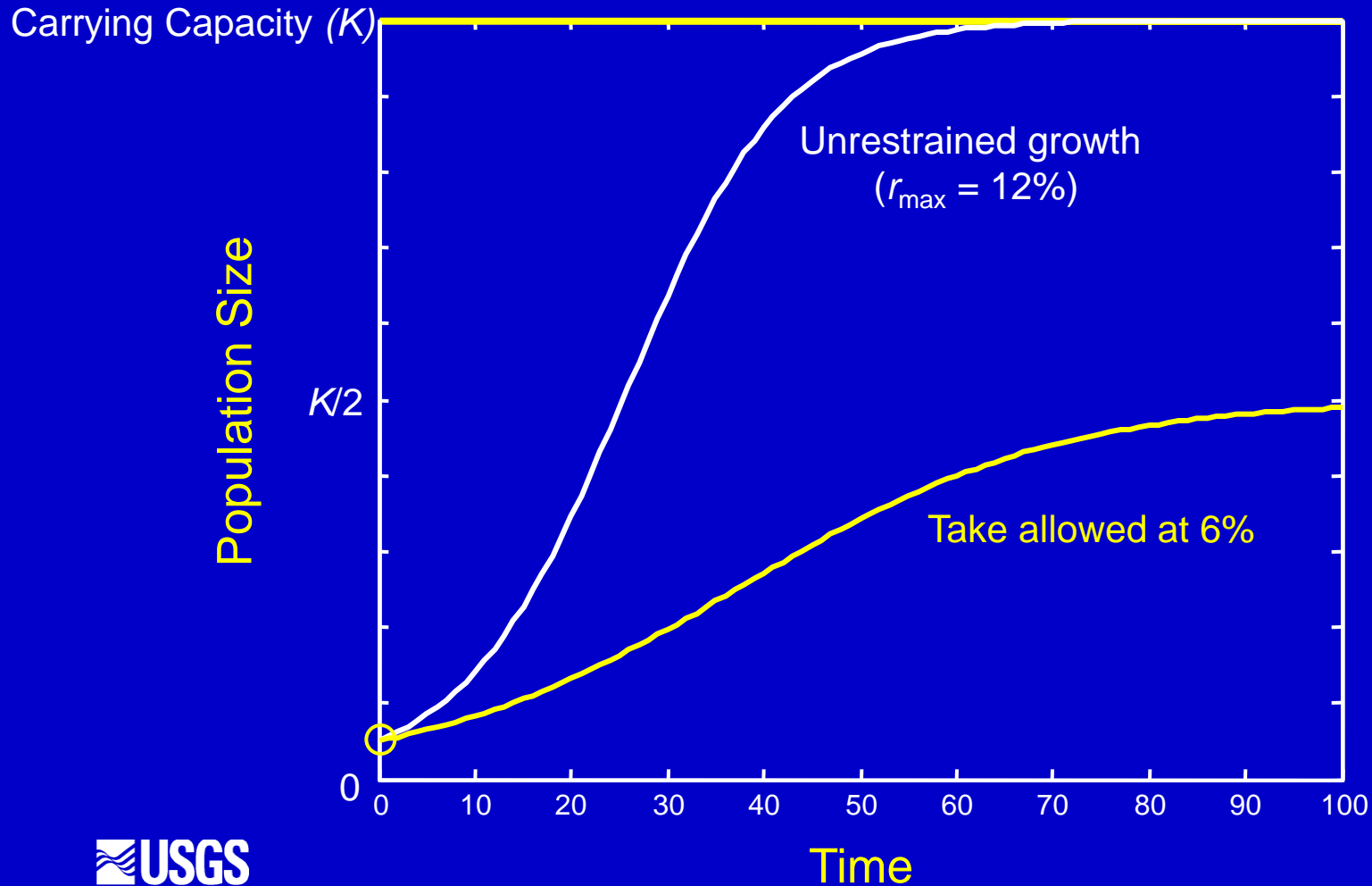
# Optimum Sustainable Population & Changes in Carrying Capacity

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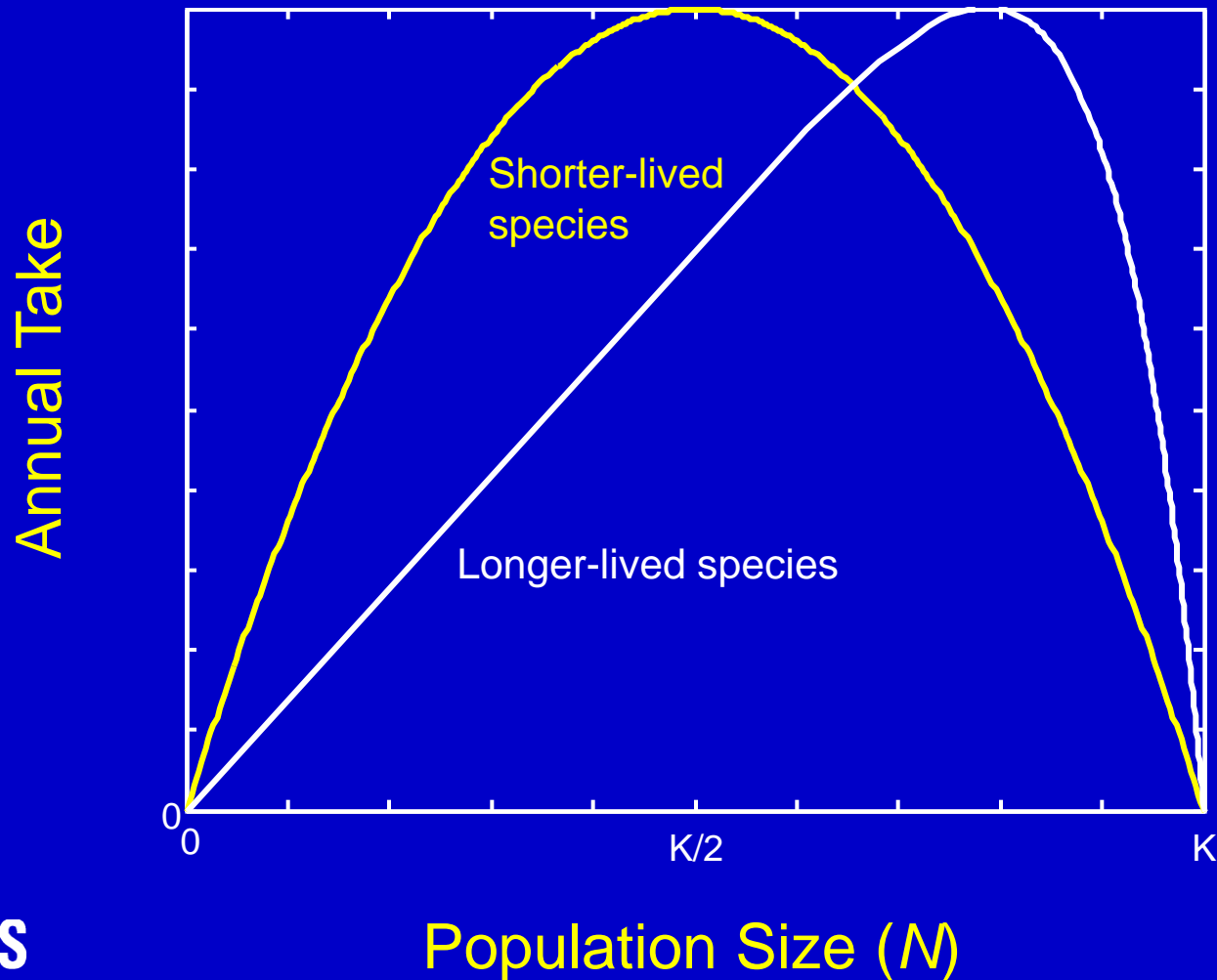
Marine Mammal Commission 2014 Annual Meeting  
*Theme 5: Issues Associated with Increasing Marine  
Mammal Stocks*  
7 May 2014, Washington, DC

# Population Growth with Take



# Yield Curve

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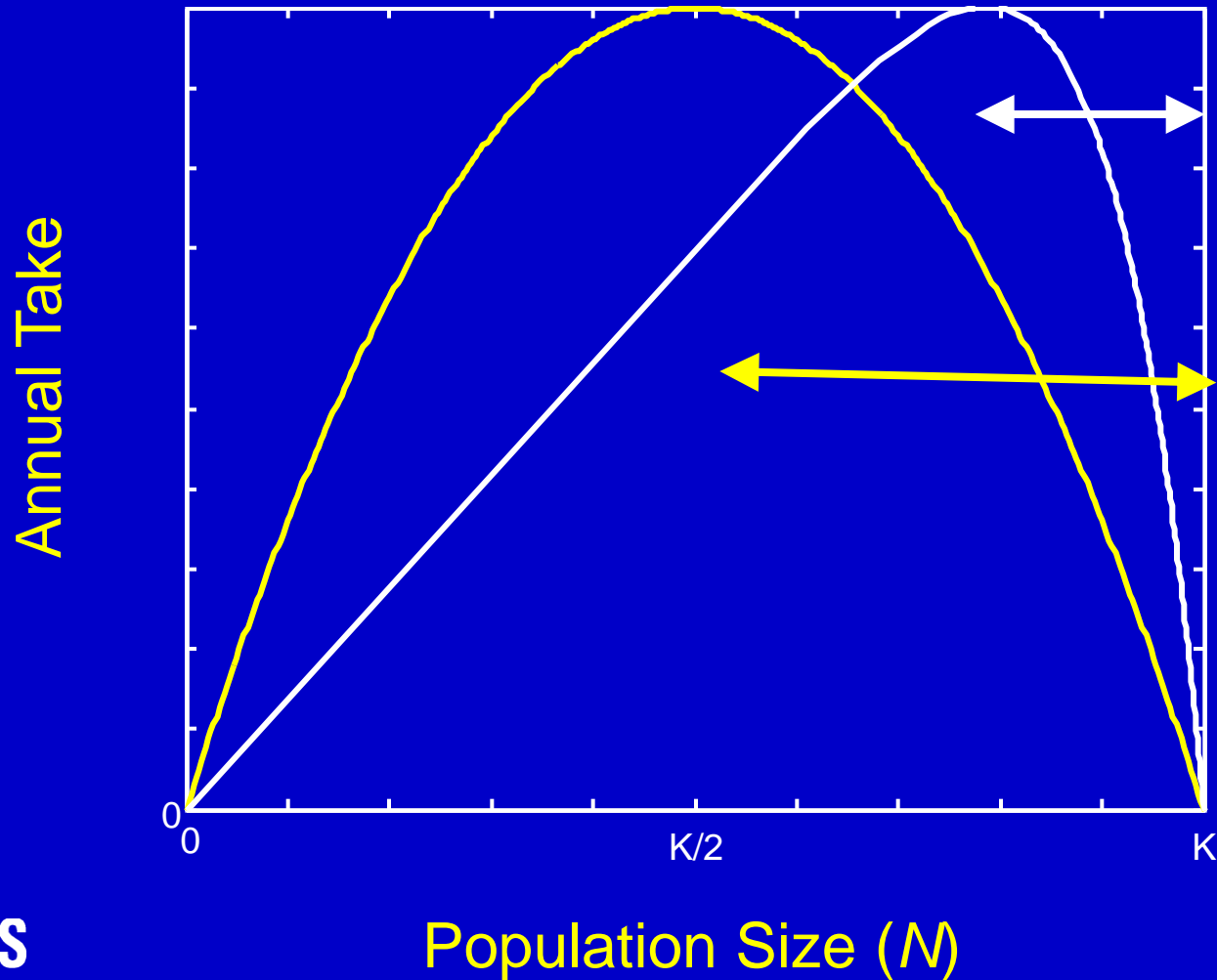


# OSP

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- Concept defined in the MMPA
- Optimum sustainable population
  - A population that is between the “maximum net productivity level” and the carrying capacity
- Think of this as being on the right shoulder of the yield curve
  - Or having population size greater than the species-specific fraction of carrying capacity

# OSP



# How to determine if OSP is met

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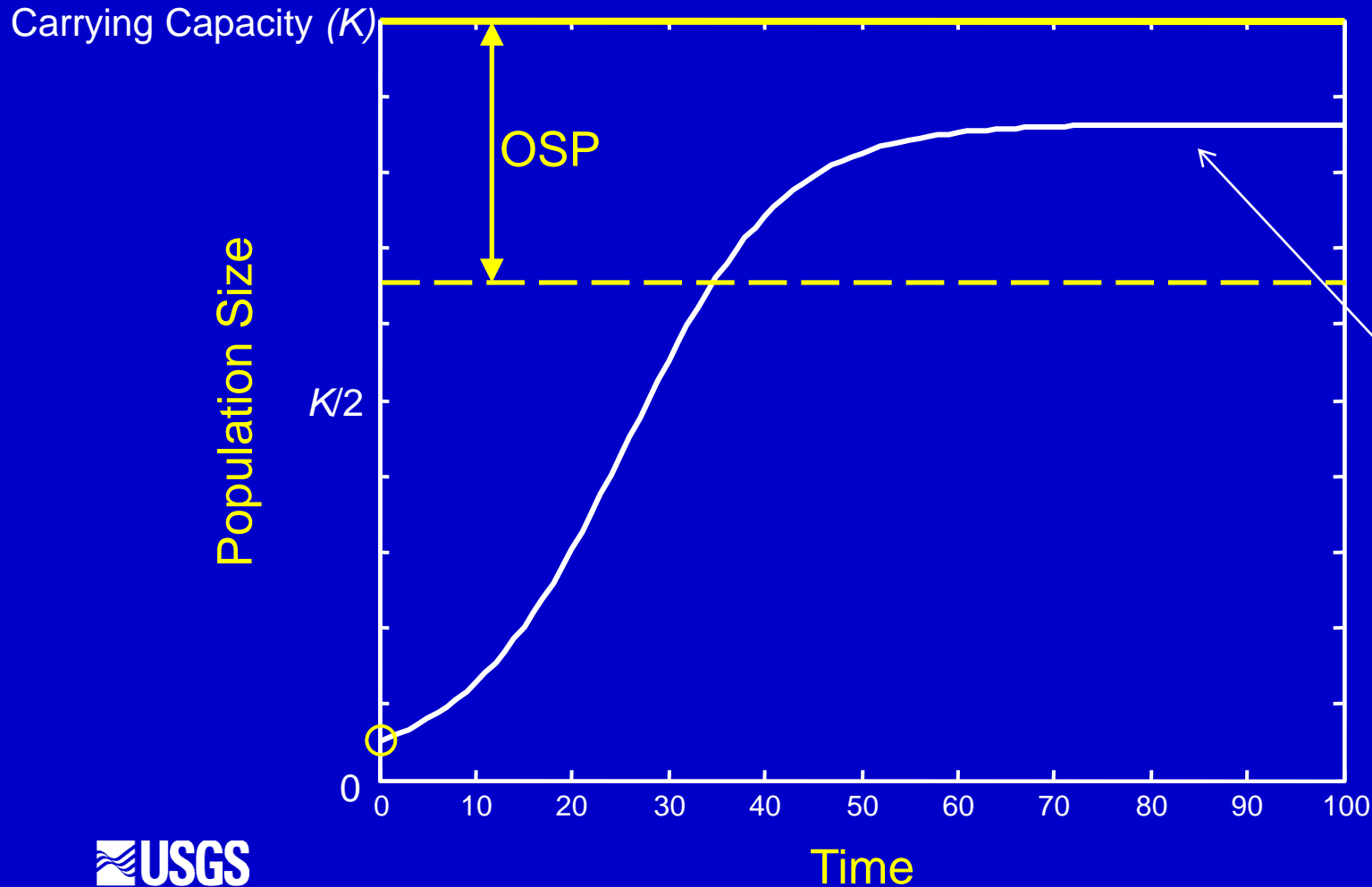
- Method 1: Compare current population size to maximum net productivity level
  - Determine MNPL as appropriate fraction of carrying capacity: requires estimation of  $K$  and modeling to determine the fraction
    - Modern methods: “integrated population models”
  - Estimate current population size

# How to determine if OSP is met

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- Method 2: Compare *rate of take* to allowable rate of take
  - Determine allowable rate of take (modeling)
  - Estimate current level of take (marking studies)
  - Assumptions:
    - Take occurs at a fixed rate, not at a fixed quota
    - Take has been at an allowable level for long-enough to allow recovery

# Achieving OSP



But what if this level exceeds the "social" carrying capacity?



# Spatial scale of OSP

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- OSP is determined at the scale of the marine mammal stock
  - Carrying capacity, OSP, and allowable take are all defined at that same scale
- Take could occur at more local scales
  - A stock could still meet OSP even if a local take rate exceeded allowable levels

# What Happens if Carrying Capacity Changes?

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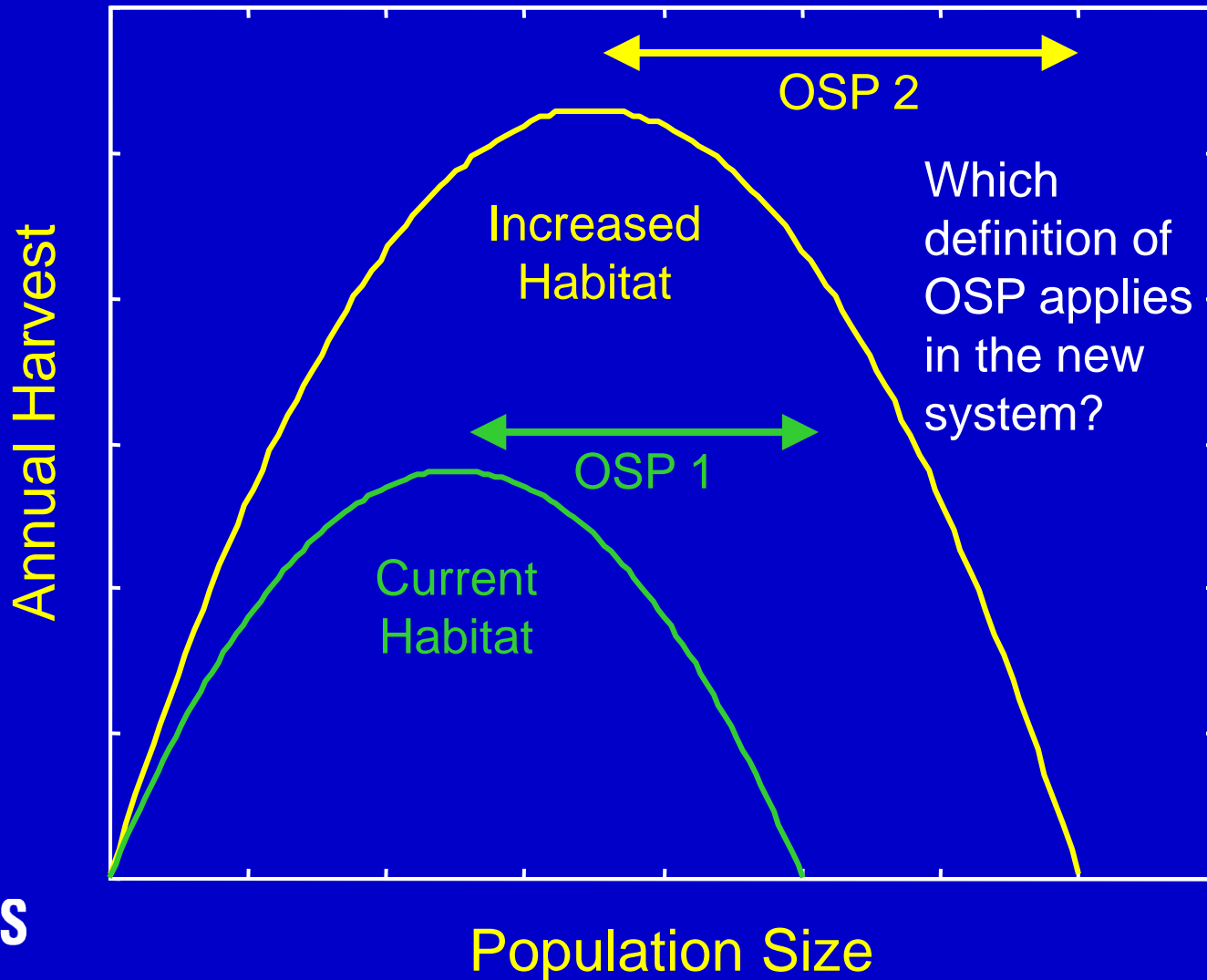
What does OSP mean?

# OSP and Changing K

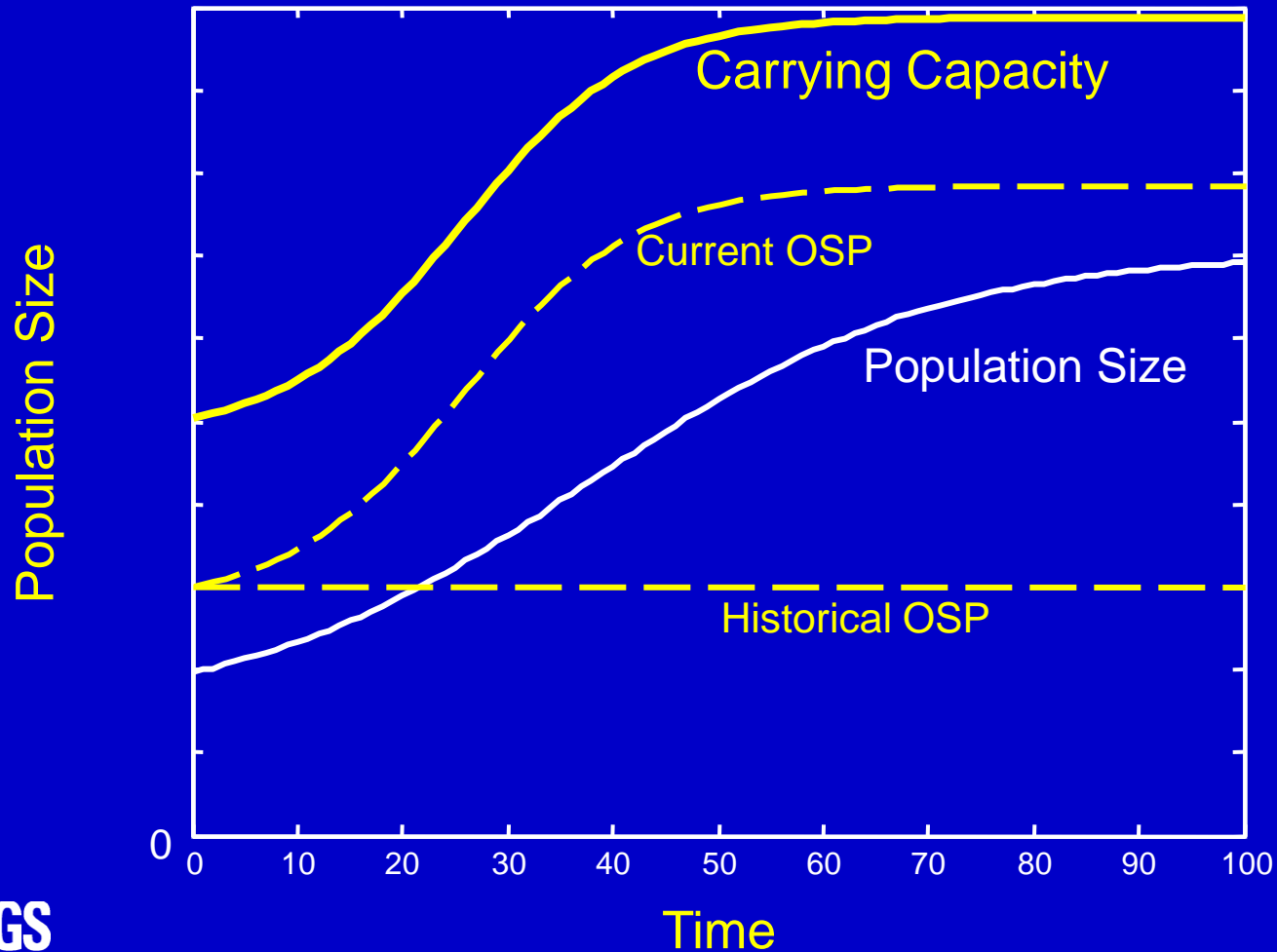
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- The concepts described in the MMPA (OSP, PBR, MNPL, etc.)
  - Are most easily understood in the context of a stable carrying capacity
- But what does OSP mean when the carrying capacity increases or decreases?

# Habitat Changes & OSP



# Changing Carrying Capacity



# Challenges

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- Scientific
  - There are technical challenges to estimating carrying capacity, OSP, population size, etc.
  - But with the advent of modern modeling methods, these are getting easier
- Policy
  - Management options once a stock reaches OSP
  - Management options before a stock reaches OSP
  - How to define OSP in the face of changing  $K$