Sustainability of California's Fisheries

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Topics

- I. Population sustainability
- II. Fundamental uncertainty
- III. Management approaches: conventional, MPAs, catch shares
- IV. Data richness in California fisheries
- V. MSC certification

I. Sustainability

Sustainability and Uncertainty in Fisheries

The "Weird Relative's Will" model (similar to Macall's)

Relative leaves you a bank account with:

1. Unspecified amount (principal)
2. Unknown interest

You decide how much to withdraw each year

Example: $1,000 with 10% interest (unknown)

Withdrawl

per year	year 1	year2	year 3 …
$0	$1,000	$1,100	$1,210…
$100	$1,000	$1,000	$1,000…..
$200	$900	$790	$569…..

How to decide?

Illustrates sustainabilty and uncertainty

Key Concept: Replacement

Bank account will be sustainable only if the interest rate is high enough to replace any withdrawls.

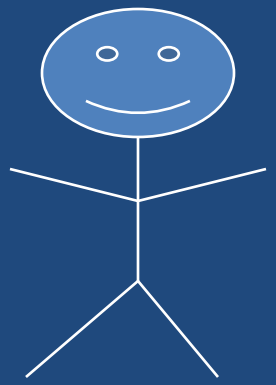
Similarly, populations will be sustainable if each individual in the population reproduces enough in its lifetime to replace itself.

Fishing reduces replacement. We can estimate how much.

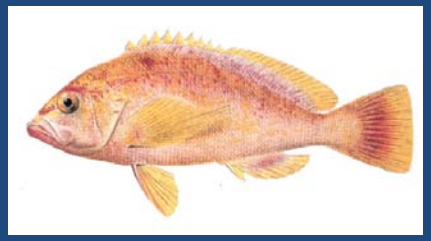
Numbers

Humans vs. Fish

Sustainability requires that individuals in a population replace themselves in their lifetime.



In humans, a couple replaces themselves with 2 babies in their lifetime.



We can observe eggs, and calculate LEP. But how many eggs does it take to replace one fish?

II. Fundamental uncertainty

How much replacement (LEP) is enough?

1. We can observe the minimum value required to avoid collapse in the slope of the stock-recruitment value at low abundance. But most fisheries are not at low abundance.
2. We express LEP as a fraction of natural, unfished LEP (i.e., FLEP).
3. From examples where we have data estimates are:

   35% (Clark 1991)

   30% (Mace and Sissenwine 1993)

   40% (Clark 1993, Mace 1994)

   55-60% (Dorn 2002, forgroundfish)

This is the fundamental uncertainty underlying fishing. It tells us how hard we can fish without collapse.

What else do we need to describe population sustainability?

Replacement = population increasing or decreasing to zero?

Need to know how far we are from zero, i.e., current abundance N or Biomass B.

How much N or B is enough?

Again choose value relative to unfished value, e.g., .4 or .5 times N_0 or B_0

III. Management

Conventional management

Frequent stock assessments estimate B/B_0, LEP/LEP_0

Adjust fishing mortality and size limits

To what goal?

Precautionary Approach (FAO 1995)

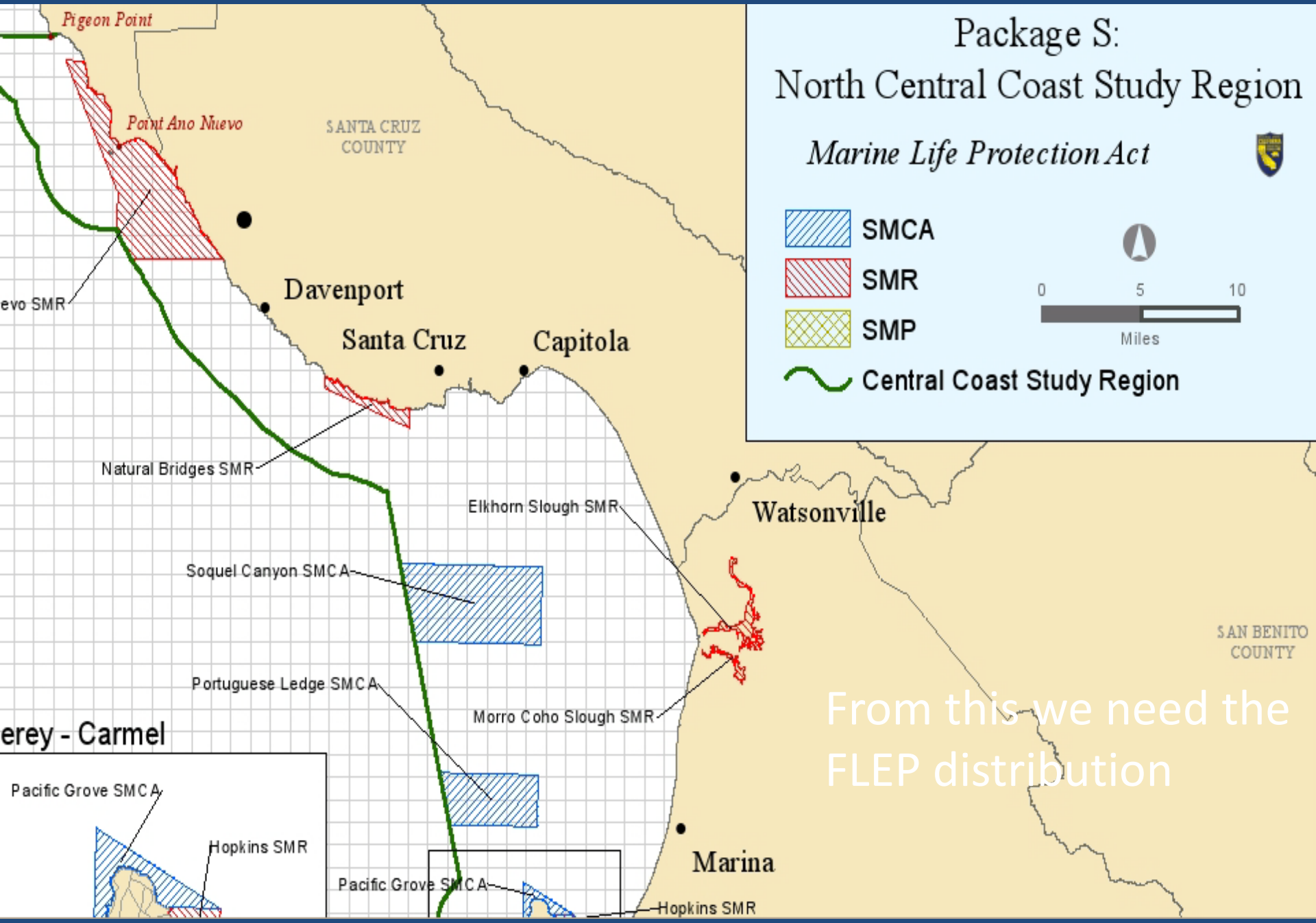
Pre-1990s: Maximum Sustained Yield (MSY)

Post-1990s: Reference Points

Target Reference Point: A goal such as MSY, OSY, MS Profit

Limit Reference Point:
- A state to be avoided, e.g. low biomass
- If breeched, take drastic, pre-agreed action

III. Management: Marine Protected Areas (MPAs)?



From this we need the FLEP distribution

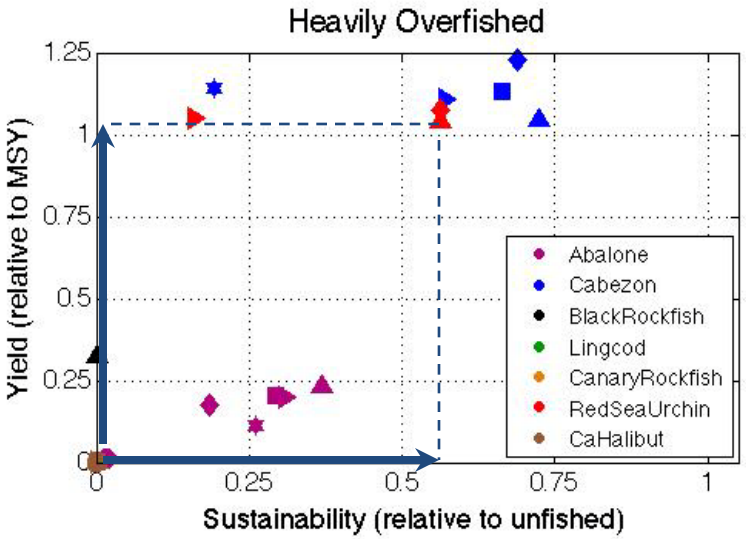
Species Considered

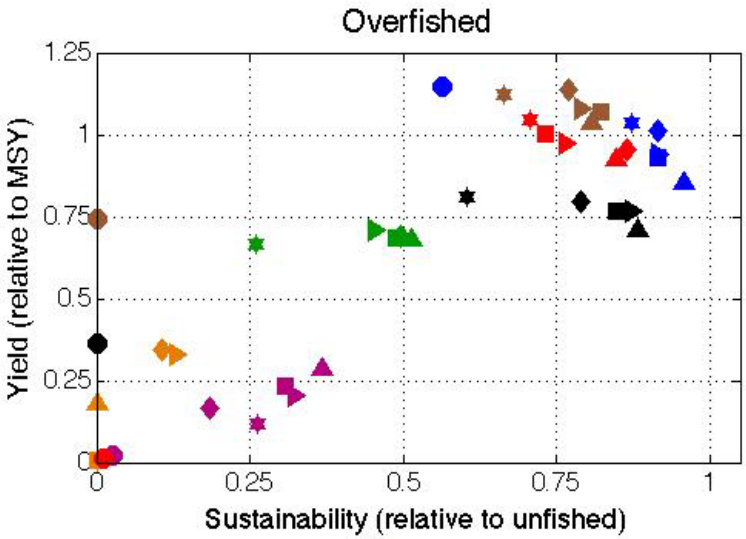
Species	Average larval dispersal distance (km)	Average home range diameter (km)
Abalone	1	1
Black Rockfish	40	6
Cabezon	100	1
Lingcod	35	15
Canary Rockfish	40	40
California Halibut	45	30
Dungeness Crab	75	14
Red Sea Urchin	50	1

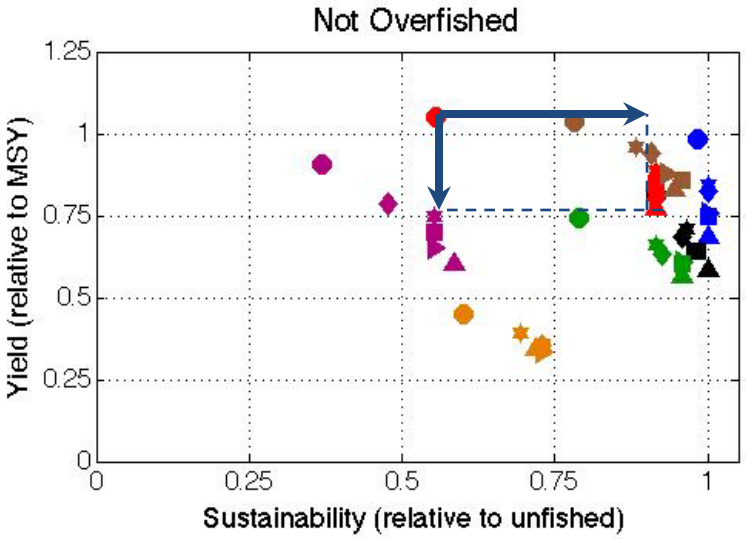
jlyles - diver.net

Each gives a different answer.

Tracy Clark







Proposed action

- No Action
- EC
- JD
- TC
- JC
- XA

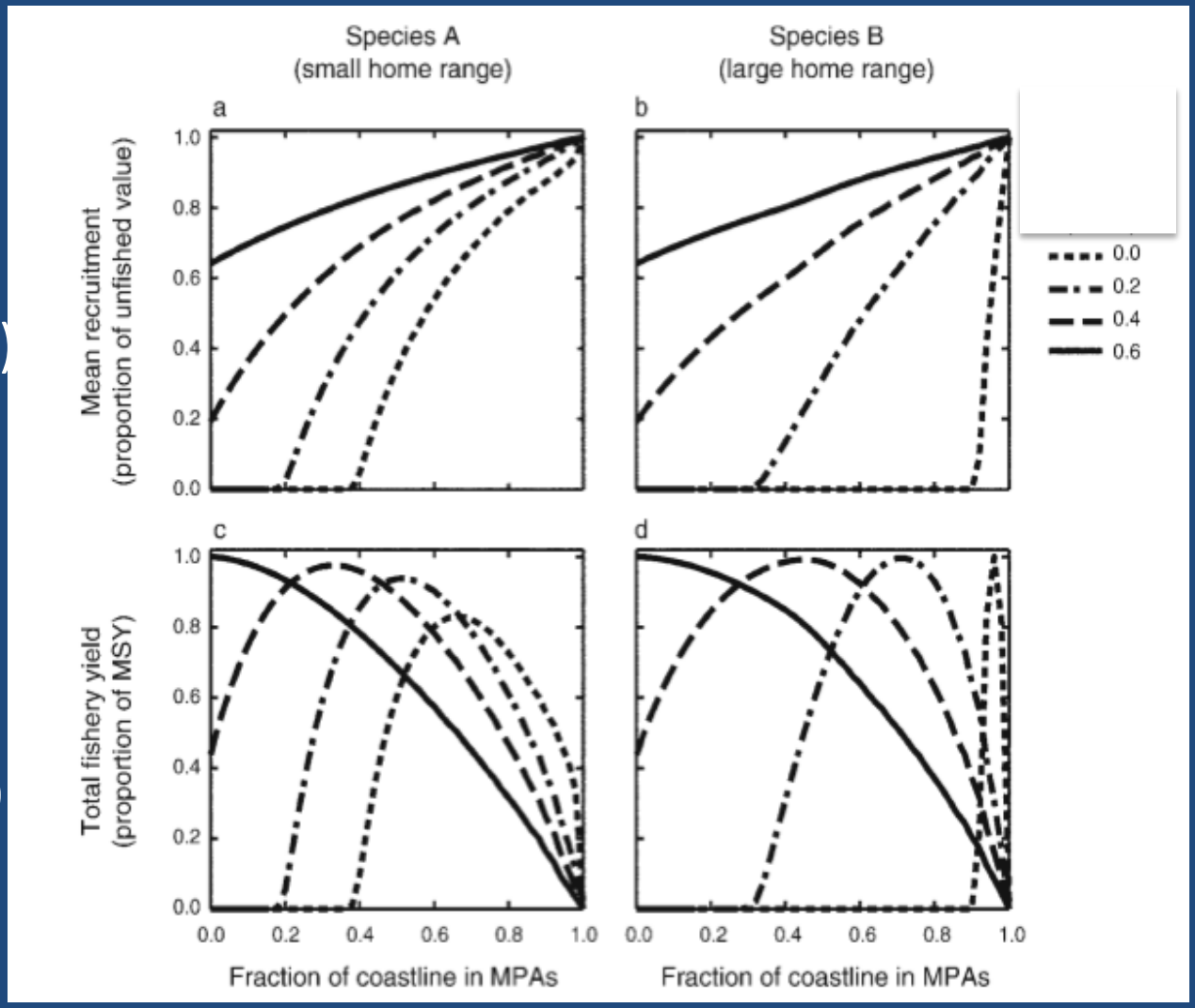
Sustainability and Yield

Depend on fishing rate, home range, dispersal distance, etc.

How will persistence and yield change with more area in MPAs?

Persistence (Sustainability)

Yield (Catch)



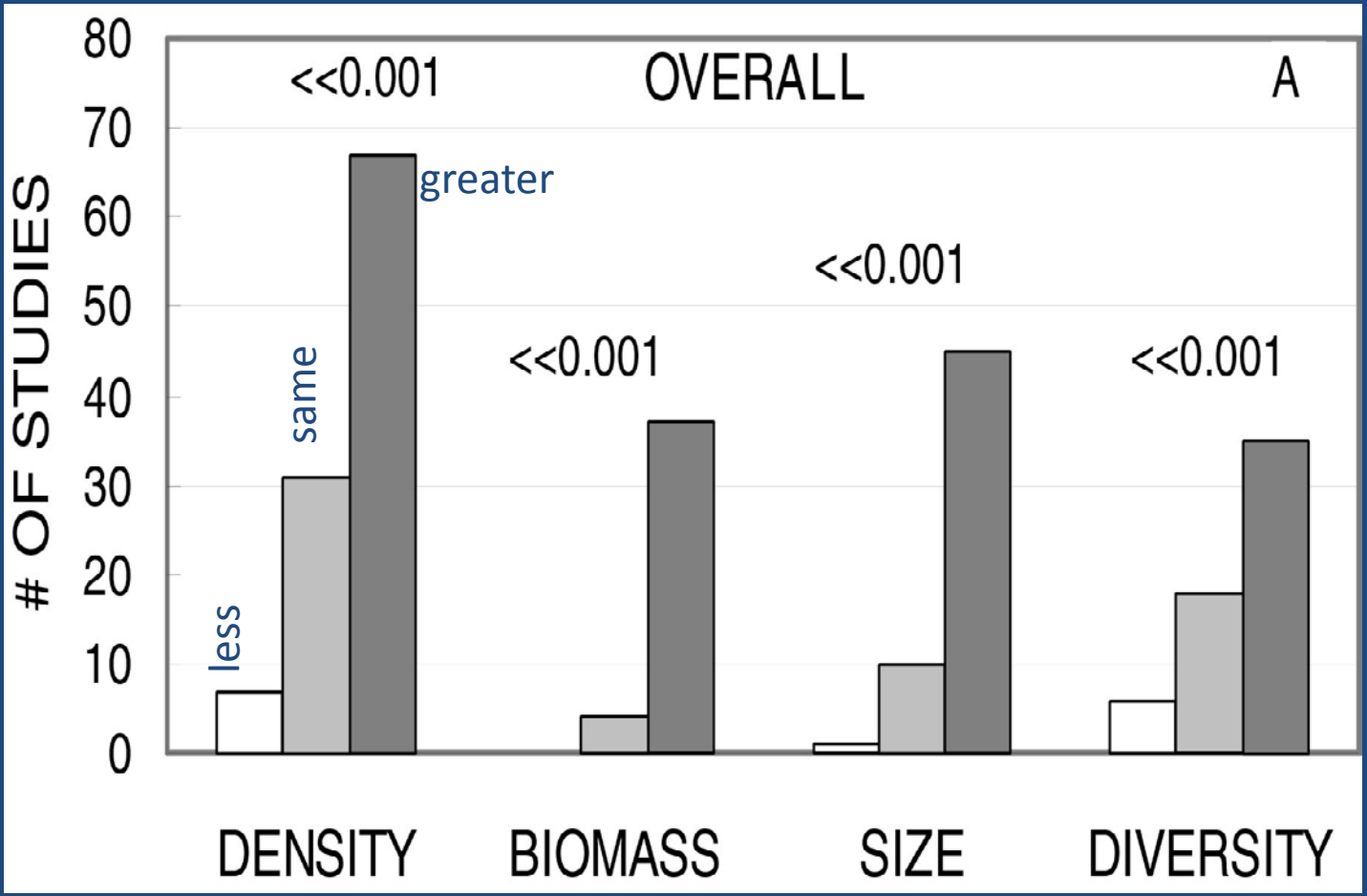
Heavily fished

Lightly fished

(n.b. many species in MPAs, different curves, peak at different places)

Consistent with empirical data?

Is this why MPAs don't always work?



(Halpern 2003)

III. Management: Catch Shares

Common Property Resource

Race for fish

Inefficient, overcapitalized, e.g. Dungeness crab

Solution

Restructure incentives - Allocate portion of catch to individual fishers (e.g., Canadian groundfish)

But still

Need to know how much can be sustainably caught

IV. Data richness/poorness in California Fisheries

Data combinations for species with no stock assessments

Potential for assessment of N/N_0 or B/B_0

Potential for assessment of $FLEP=LEP/LEP_0$

Potential for both, or stock assessment

V. Marine Stewardship Council

Third party system

Certification Team

1. Fishery-specific version of Principles and Criteria

3. Team scores fishery

Marine Stewardship Council: Principles and Criteria for Sustainable Fishing

1a. Reviewed

3a. Reviewed

Client Fishery

2. Client demonstrates how these criteria are satisfied

Important Points:

1. Incentives for distortion
2. Who does the work? (time = $)
3. Data poor fisheries

Small-Scale, Data-Deficient Study → Risk-Based Framework

Oregon Dungeness Crab Fishery

Very high replacement (LEP) if all females fertilized

4. Salmon

Hatcheries run counter to idea of sustainability

Without substantial marking, cannot tell whether population just hatchery-sustained.

Often many separate populations

CSSI Strawman

1. Credit for MPAs? Yes, MPAs always increase potential persistence . But how to calculate?

2. Credit for belonging to CFA? Value to sustainability?

3. Requiring a score of 80 for certification?
   >60 level valuable to get fishery involved

Summary

Population sustainability

Replacement FLEP=LEP/LEP_0, Biomass B/B_0

Fundamental Uncertainty

Minimum required replacement FLEP

Management approaches

Conventional: Limit reference point

MPAs: can increase sustainability, can increase/decrease catch

Catch shares: reduce pressure for overfishing

Data richness in California fisheries

2/3 w/o assessments, half of those (1/3) may have the data

Summary (continued)

MSC certification

Good choice, incentives, work, data poor

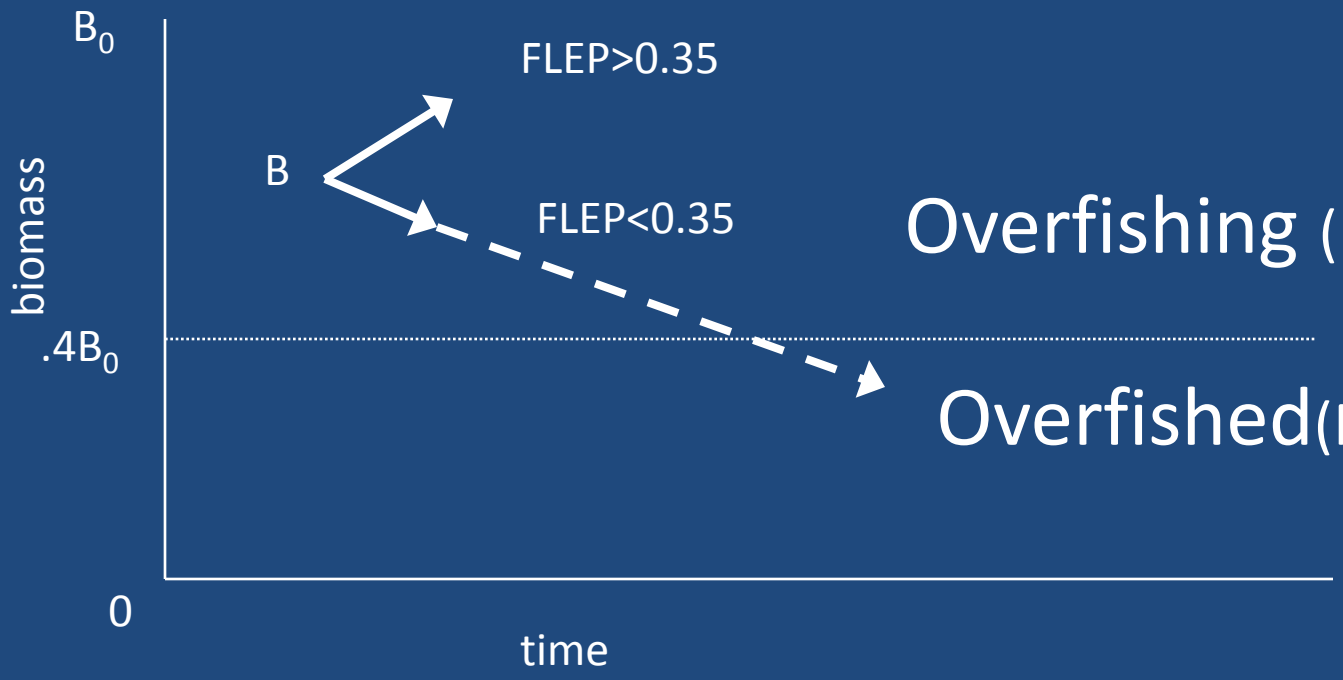
Strawman: count MPAs, CFAs?, 60-80?

THANKS!

Marine Ecosystem Management

At the Ag School, UCDavis

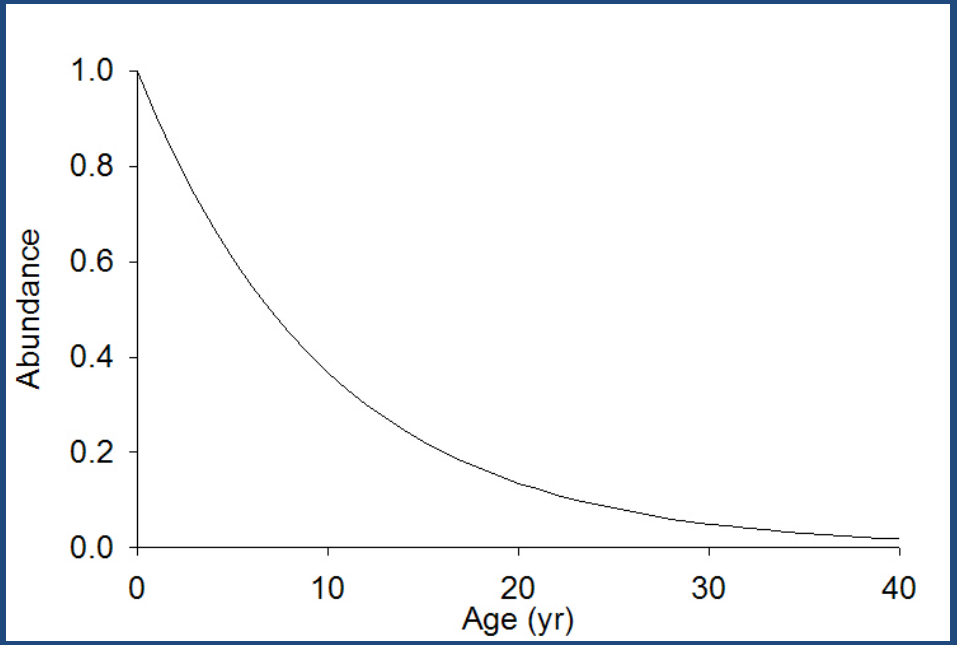
Description of Risk of Collapse = B and FLEP



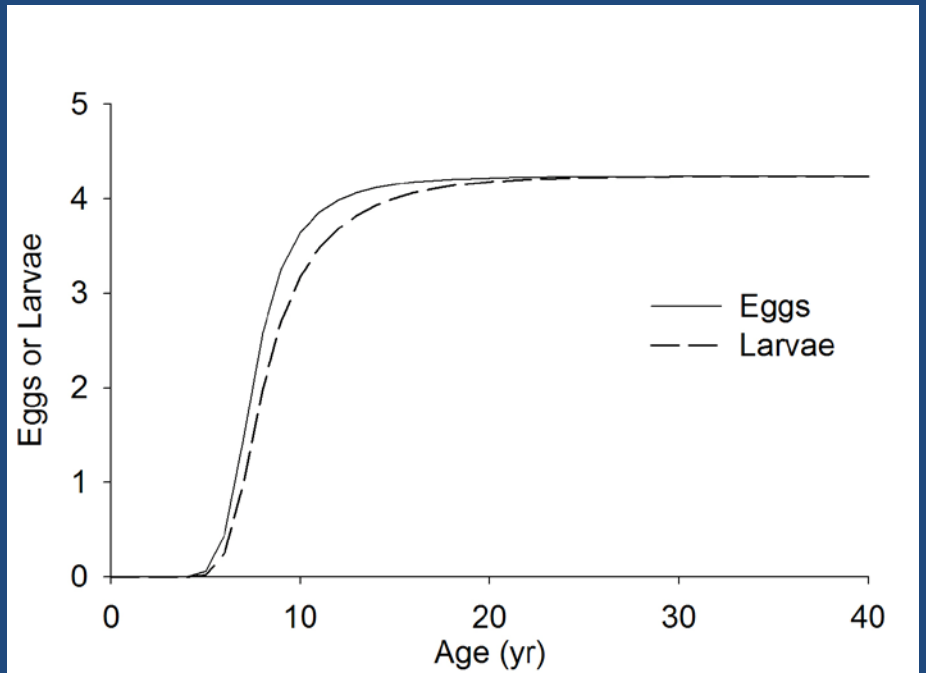
Used in NMFS and California

Replacement measured as Lifetime Egg Production

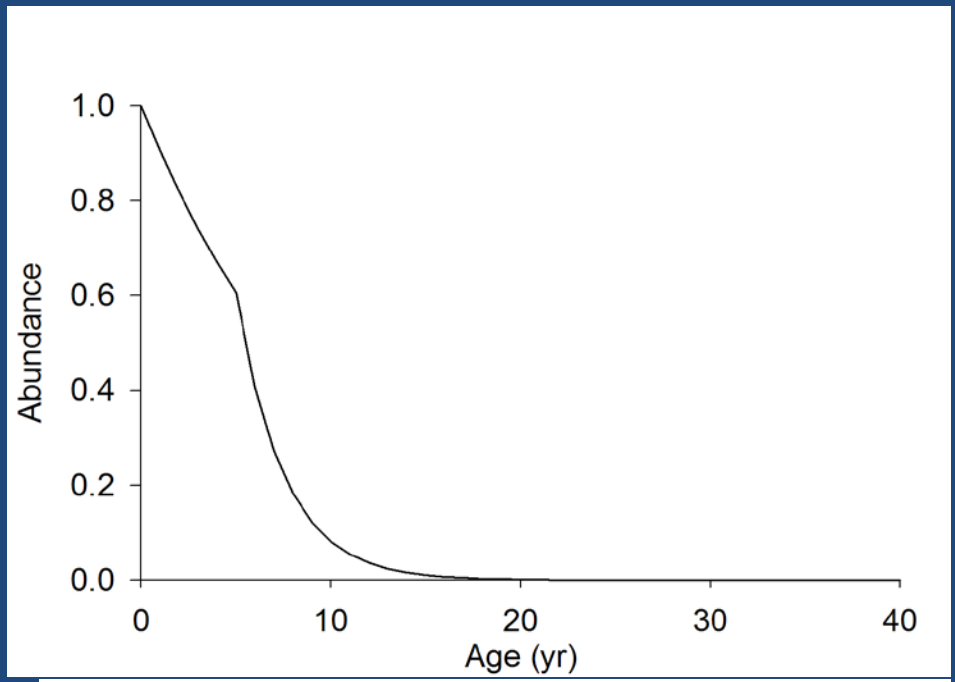
Fraction surviving to each age in an unfished population



Relative number of eggs (in millions) produced at each age



Fraction surviving to each age in a fished population



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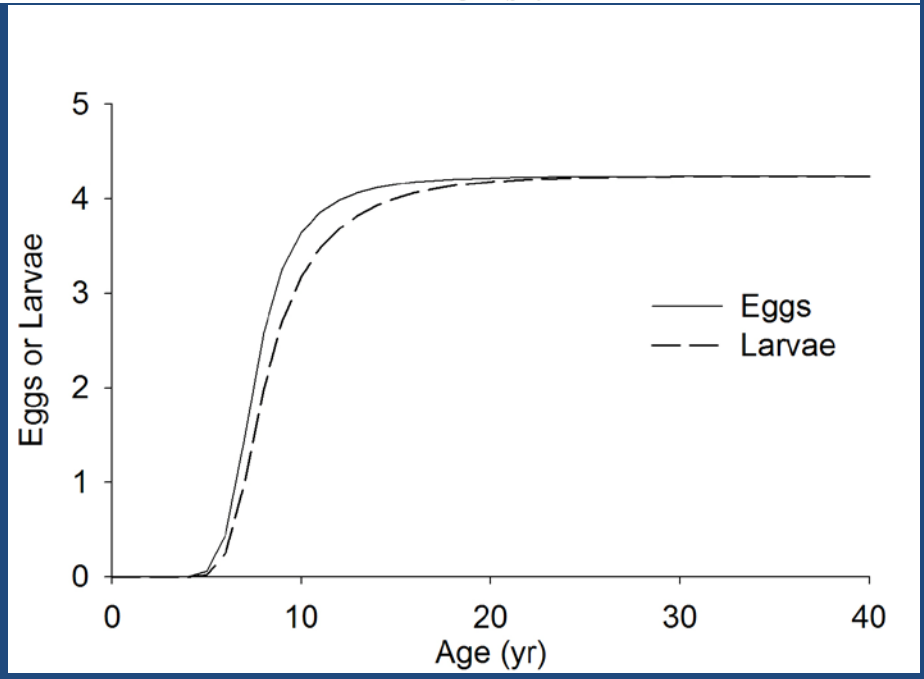

LEP is less with fishing, and we can calculate how much less.