

*Science, Service, Stewardship*



## Does Size Matter?

Effect of catching various sizes of fish on stock sustainability

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**NOAA  
FISHERIES  
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How do you present size related mortality in the context of a barotrauma workshop?

## **Size dependent mortality factors**

- Does one fish have a better chance of surviving than another

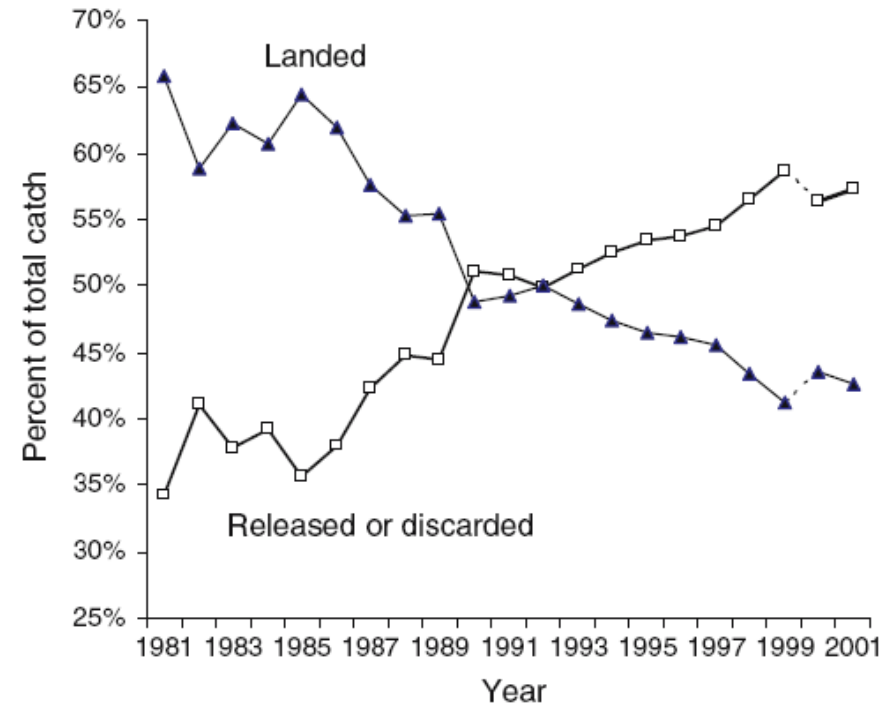
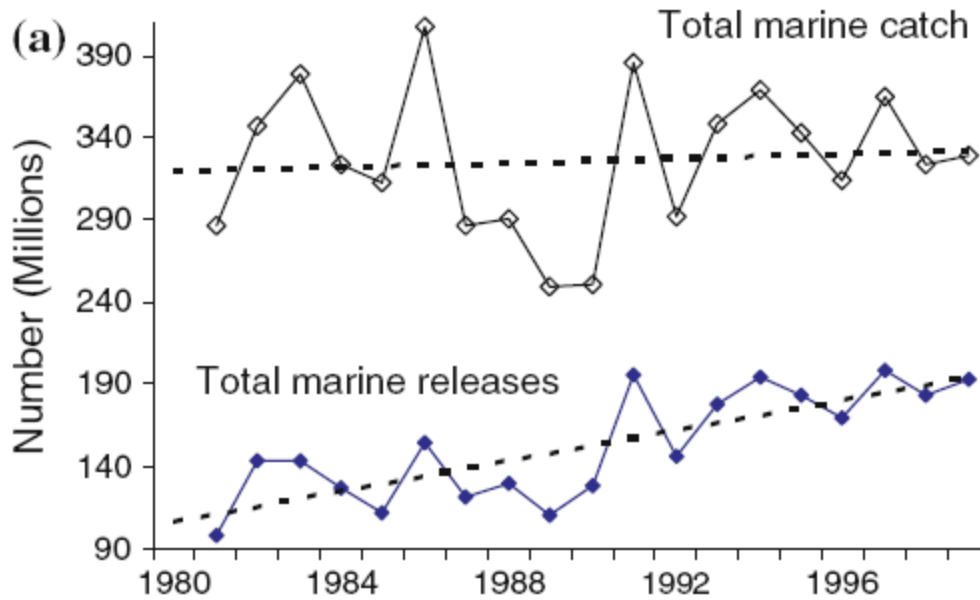
## **Stock sustainability factors**

- Does one fish contribute more to the population than another

***Release the right fish to promote population health***



# Releasing fish has become common in the US





## Fish size and release mortality

- **Are there differential mortality rates associated with fish size?**
- **Should handling/release techniques vary with fish size?**
- **What are the unseen effects - physiological and repeated capture effects?**
- **How do size selective removals impact a population's ability to sustain itself?**



## Factors that affect release mortality

- **Hook Location**
- **Gear effects**
- **Recompression/venting**
- **Environmental conditions**
- **Stress**
- **Size of fish**
- **Depth of capture**

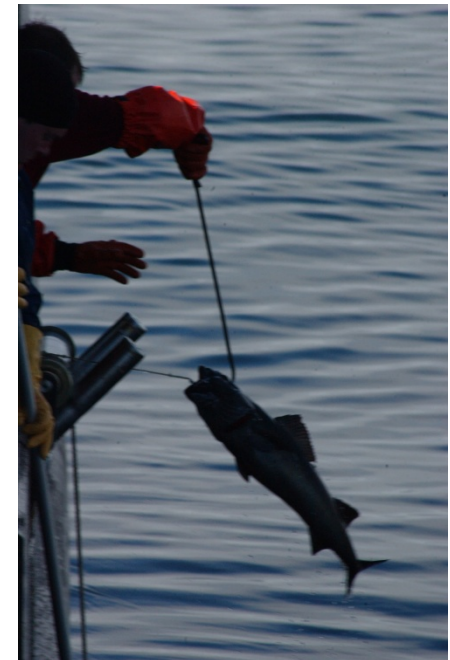




## Catch and release and mortality

### Every capture event has some probability of mortality associated with it

- Short term
  - Physical injury due to capture
- Mid term
  - Physiological stress due to capture
- Long term
  - Population effects due to removal





# Are there differential mortality rates by size?

## • Review of 274 studies and 14 mortality factors

**Hook location\***

Fish size

**Bait/artificial\***

Hook size

Treble/single hook

**Circle/J- hook\*\***

**Barbed/barbless hook\*\*\***

Modified hook

**Hook removal/cut line\***

**Venting\*\***

Active/passive fishing

**Play/handling time\*\***

**Capture depth\***

**Water temperature\***

\*highly significant  $p < 0.01$

\*\*significant  $p < 0.05$

\*\*\*marginally significant  $p < 0.1$



## Should handling and release techniques vary by fish size?

### Should larger/smaller fish be handled differently?

- physical injury probability higher for larger fish
- physiological stress probability higher for larger fish
- smaller fish less able to recover from serious injury







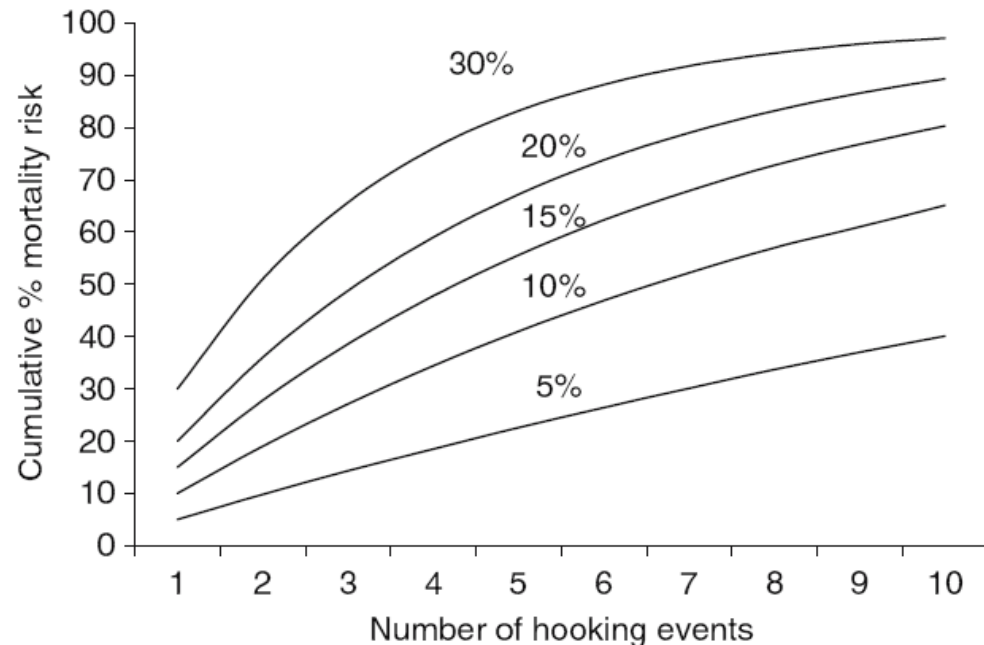
# The unforeseen mortality factors

## Physiological effects

- delayed mortality difficult to measure – large fish especially susceptible

## Cumulative effects

- repeated captures increases risk of mortality – larger fish are more likely to have been caught multiple times





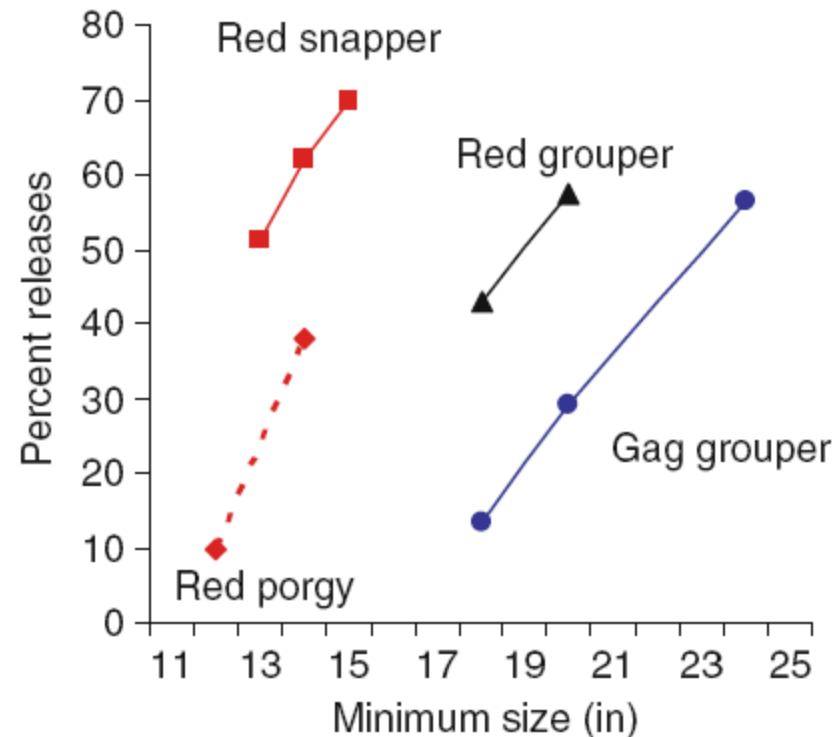
# Indirect impacts on release mortality

## Minimum size limit regulation

- when min size limit increased the probability of a fish being released increases

## Cumulative effects

- increased probability of release also increases the probability of being recaptured





# Release mortality summary

## Review of 274 catch and release studies

- mean mortality was 18%
- multiple factors contribute to mortality risk
- risk of mortality extends beyond the capture event
- fish size alone is often not a significant factor but has indirect impacts on mortality





## Release mortality - West Coast

### Stock assessment assumptions

- IPHC assumes 16% mortality in under 32" Pacific halibut
- discard mortality rate for released sablefish was 11% based on tag returns
- majority of discard rates in Alaska are assumed to be 100%
- West Coast rockfish discard estimates are a function of capture depth





## Workshop challenge – size and mortality

### Points to ponder

- even when released there will be discard mortality
- size only one of many factors that contribute to risk of mortality
- need to consider cumulative effects to understand mortality
- should size be considered by management as a release criteria





## Fish size and stock sustainability

- **not talking about if fish X will survive at release**
  - size dependent mortality
- **how many fish X's and fish Y's should there be to ensure a healthy population**
  - size/age structure of population

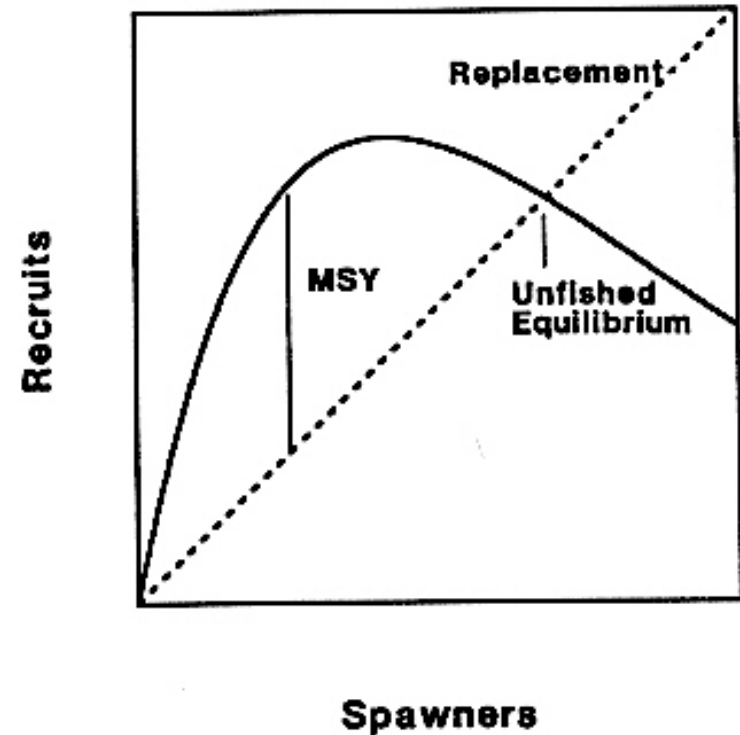




## Fisheries management objectives

### Maximum sustainable yield

- stock productivity is based on growth and recruitment
- many West Coast species don't have good stock/recruit relationship
- need some measure of reproductive capacity - or spawning potential





## Measuring spawning potential of a population

### Spawning Stock Biomass

- proxy for measurement of mature females in a population
- harvest policy conserves 40% of SSB population compared to unfished biomass
- assumes reproductive output per unit weight is same for all mature females







Does spawning stock biomass accurately describe spawning potential?

## Reproductive characteristics vary by fish size and age

- fecundity
- fish experience
- maternal age effects





## Size matters - fecundity

### Larger fish are more fecund

- proportional to body size
- can dedicate more energy to reproductive growth
- Atlantic cod fecundity can vary from 150,000 eggs to 25 million eggs





## Size matters - experience

### Larger/older fish have more experience

- larger fish produce larger eggs and larvae
- more batch spawnings
- experienced Atlantic cod contributed 10-12 times more offspring to age 1 than inexperienced fish





## Size matters – maternal age

### Larger/older fish gamble better (Pacific rockfish)

- commit more reproductive energy to larvae than smaller/younger fish
- able to gamble on release timing
- produce further developed embryos, larvae with more energy storage, larger larvae, and produce offspring with higher survival





## Spawning potential and size based mortality

### Fishing effects may reduce spawning potential

- reduces population resiliency to change and perturbation
- evokes evolutionary responses which reduces spawning potential
- reduces the reproductive capacity of a population

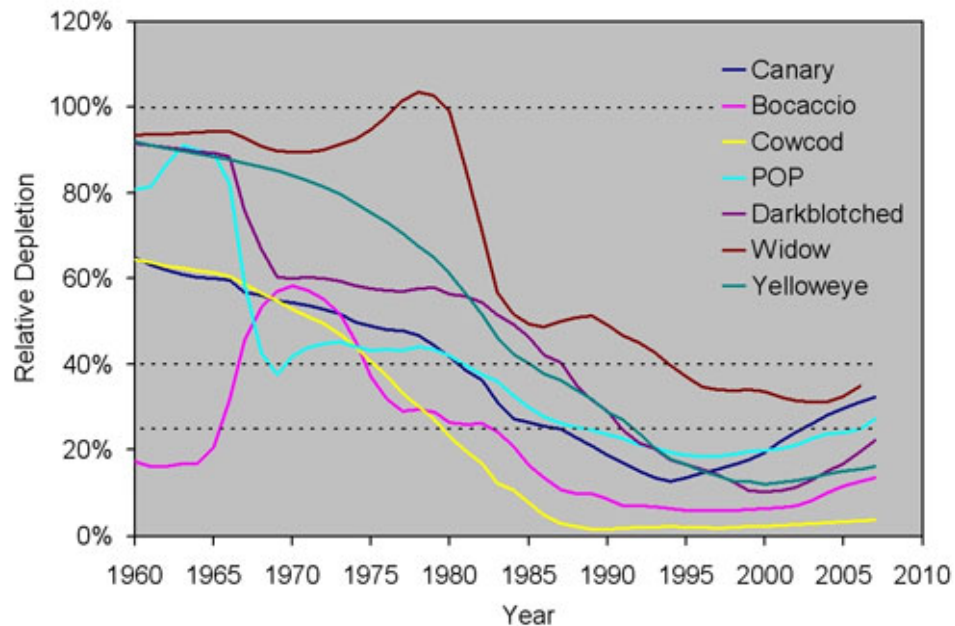




## Size matters – Pacific rockfish

### Spawning potential important

- older larger females important to population - max ages >100
- size/age truncation may affect reproductive capacity
- West Coast rockfish are overfished
- is B40% conservative enough?  
B50%? B60%?





## Size matters - Pacific Halibut

### Pacific halibut are big

- max age is 55 years
- 50 lb female produces 500,000 eggs
- 250 lb female produces 4 million
- females grow faster and tend to live longer
- few males reach 80 lbs
- fish over 100 lbs nearly all female
- 500 pounders are often 30 something
- currently in a very slow growth regime





## Spawning potential in a recreational context

### Size-based mortality effects and recreational fishing

- size selective fishing is common - 1 fish at a time
- do spawning potential benefits outweigh discard mortality risks?
- outreach efforts on things like spawning potential effects can influence angler mindset







## Does size matter – release mortality and stock sustainability

### Points to ponder when making recommendations

- strive to promote stable age/size population structure
- reduce discard mortality yet realize capture events contribute to mortality
- keep exploitation rates in perspective even though promoting releasing fish - especially with unknown effects of barotrauma

