
INTERNATIONAL PACIFIC HALIBUT COMMISSION

# Accounting for temporal variability in productivity of Pacific halibut

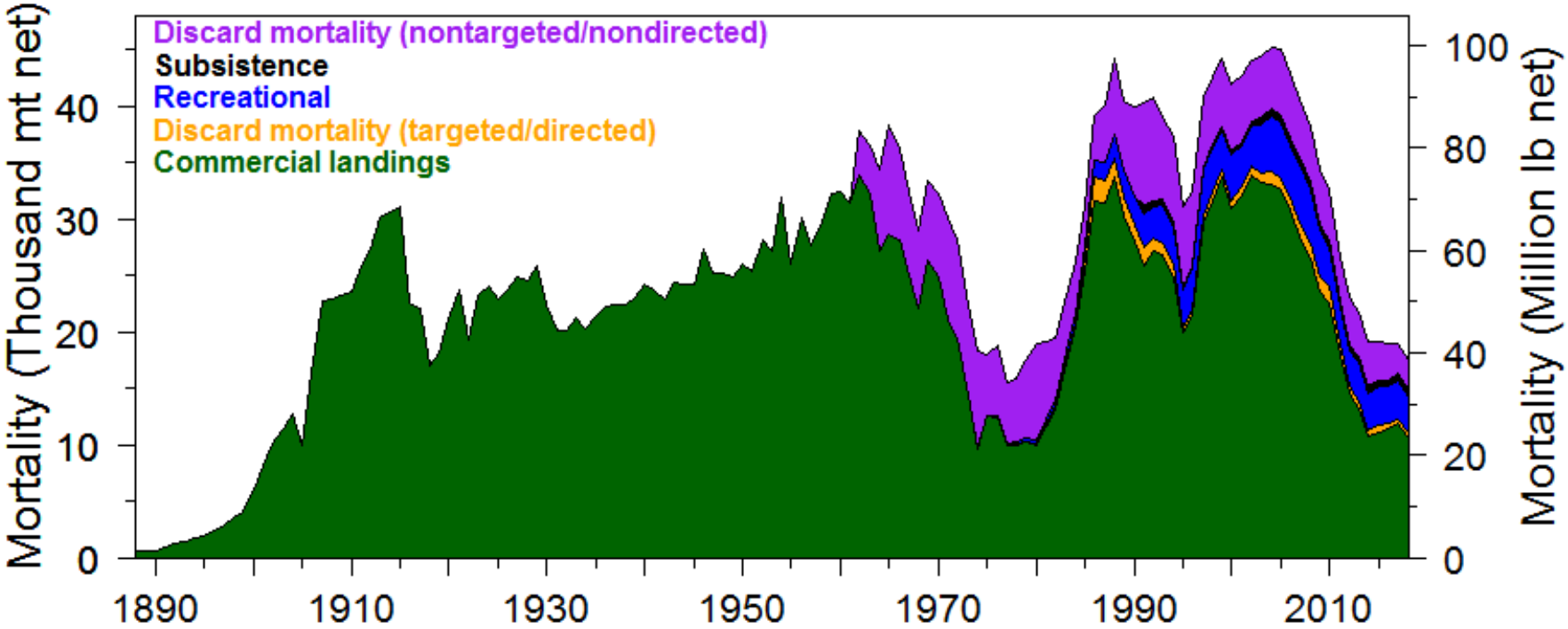
Allan Hicks
Piera Carpi, Ian Stewart

Pacific Halibut Workshop
PICES Annual Meeting 2019

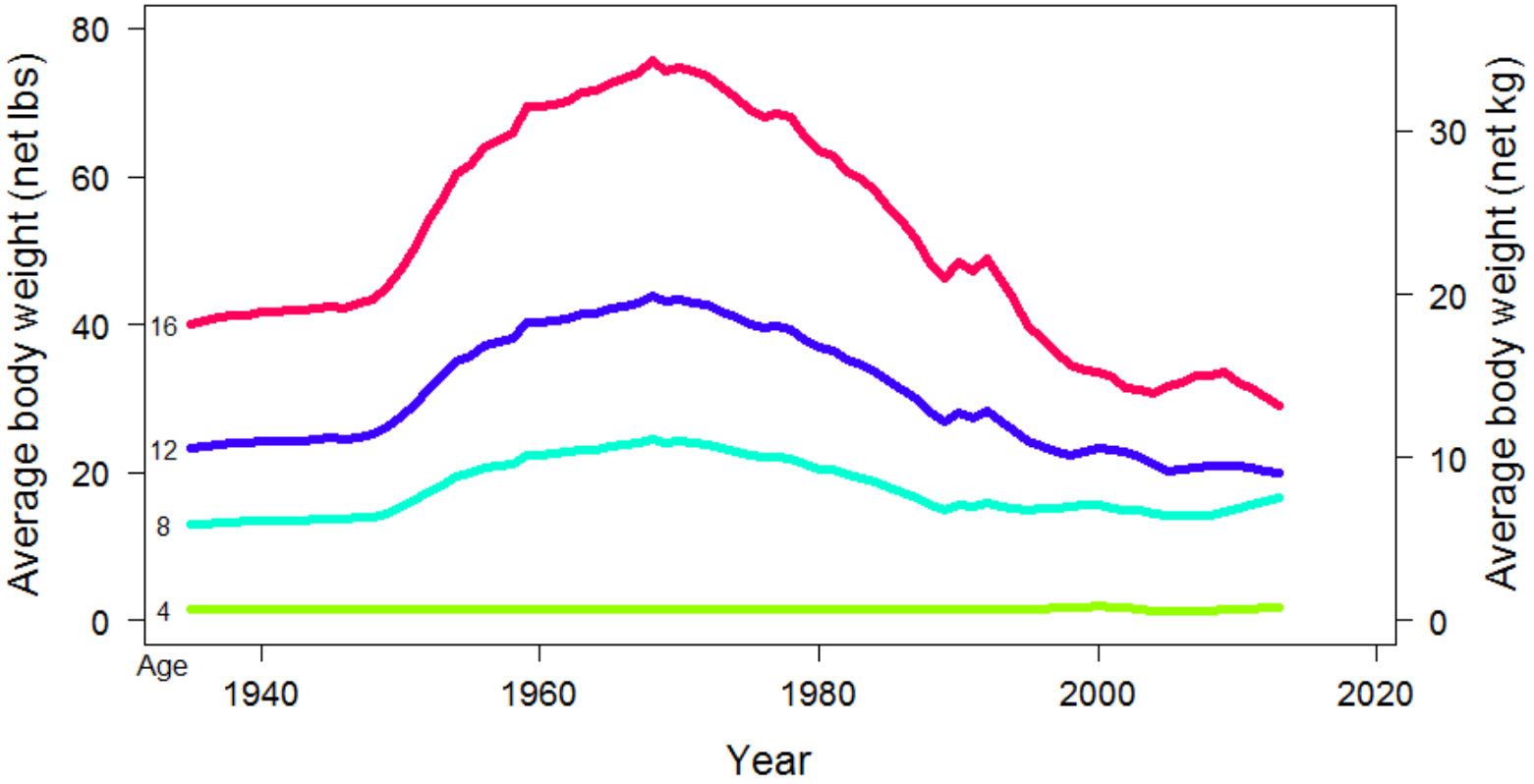
# Pacific halibut (*Hippoglossus stenolepis*)

- Range from CA through BC, AK, and the western Pacific Ocean
- Live to greater than 30 years
- Grow to greater than 400 pounds
- Highly variable weight-at-age across years
- Have been observed to migrate very long distances

# Pacific halibut fishing mortality

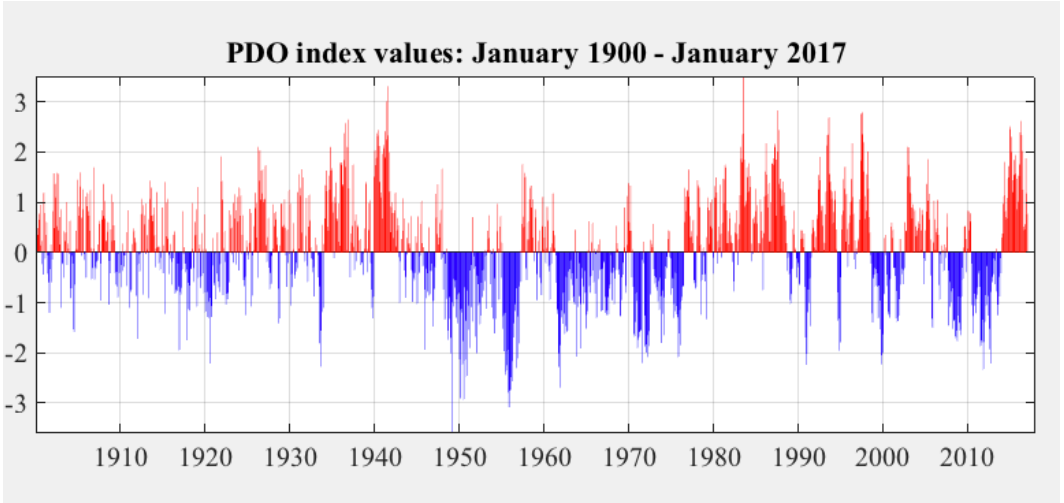


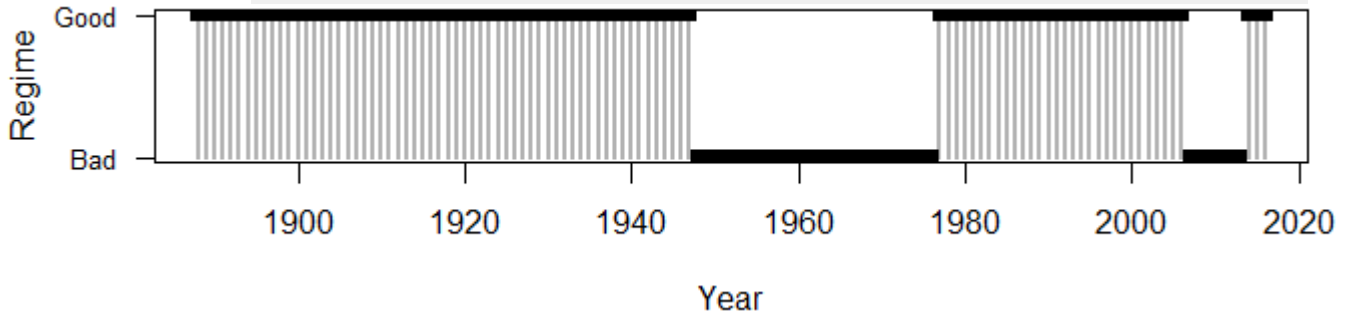
# Pacific halibut weight-at-age



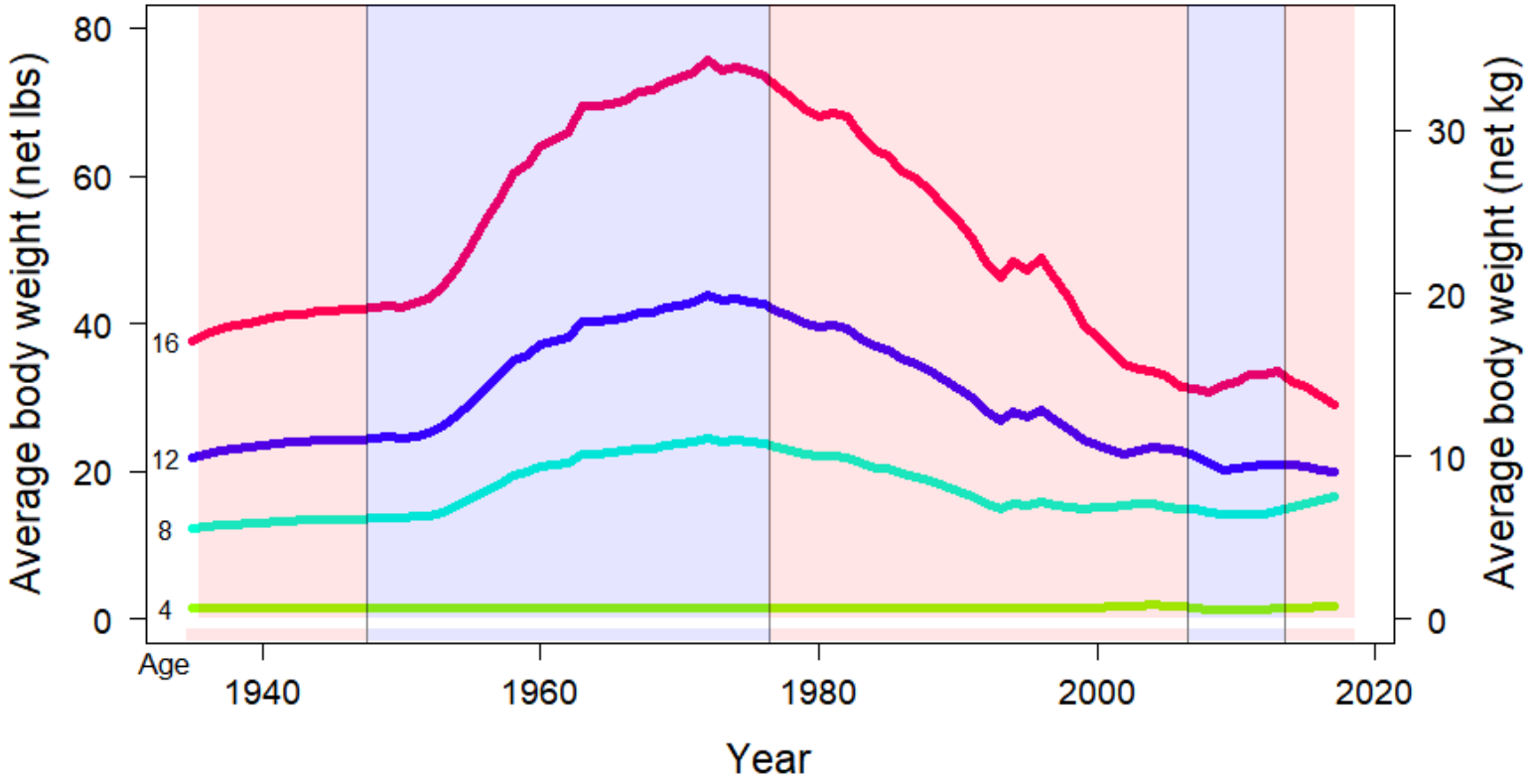
# Recruitment Regimes

- Average age-0 recruitment is linked to environmental conditions
  - Pacific Decadal Oscillation (PDO)
  - ~1.5 to 3.2 times greater in good conditions



# Productivity of Pacific halibut

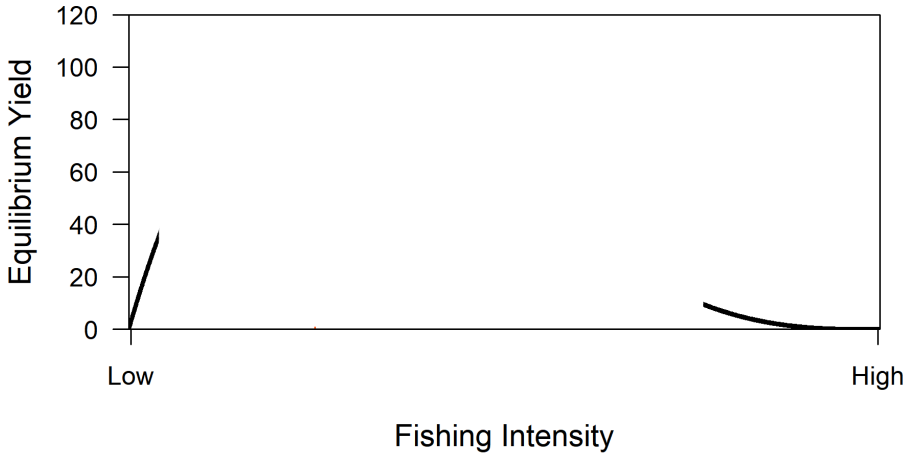


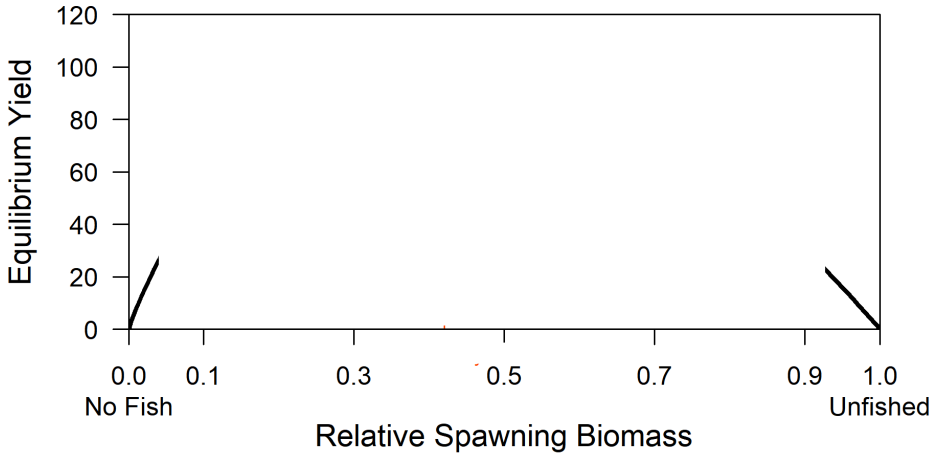
# Biological reference points

- Values that are useful for managing fish stocks
  - $SB_0$:  Unfished spawning biomass
  - MSY: Maximum Sustainable Yield
  - RSB: Relative spawning biomass (relative to $SB_0$)
  - SPR: Spawning Potential Ratio
- These may change with changes in productivity

# Equilibrium yield curve

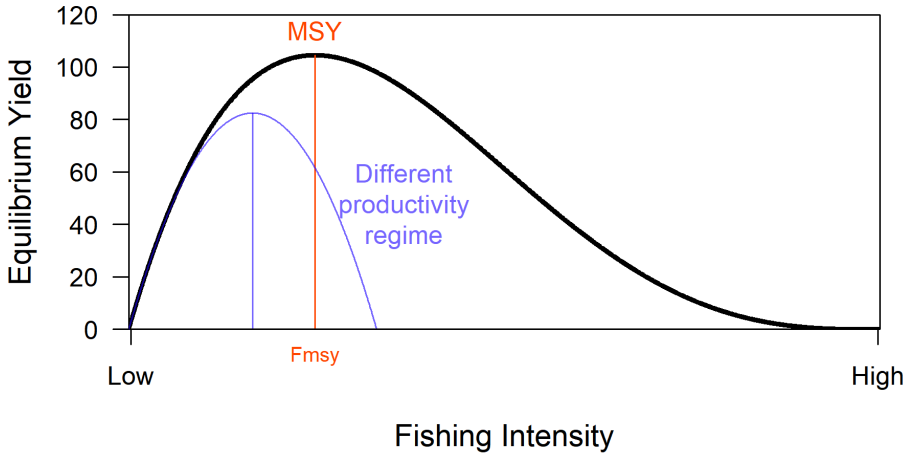
- With no fishing
  - Yield is zero
  - Unfished biomass
- With extremely high F
  - Yield is zero
  - No biomass

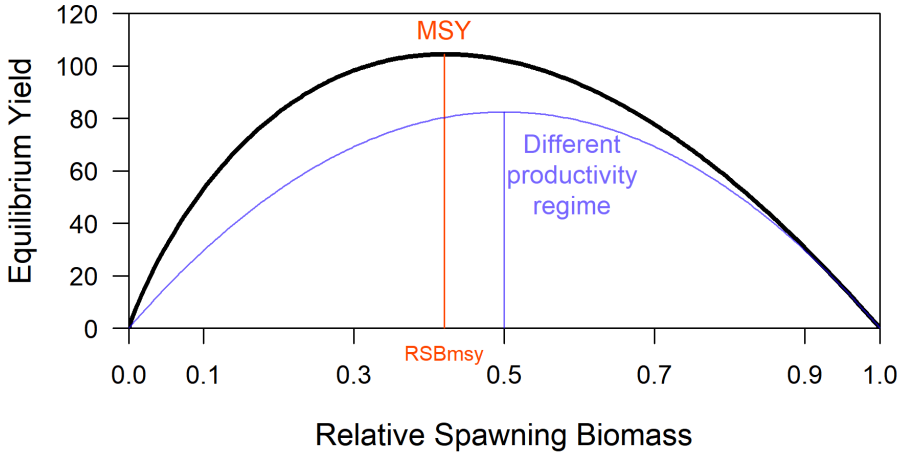


# Equilibrium yield curve

- MSY
  - Maximum Sustainable Yield
  - The maximum of the yield curve
- $F_{MSY}$
  - The fishing mortality rate that would result in MSY
- Productivity regimes
  - Change the shape of the equilibrium yield curve



# Dynamic Reference Points

Purpose:

- to investigate variability in reference points given
  - changes in productivity and selectivity
  - different types of uncertainty

Reference points considered:

- SB0: Unfished biomass given the current regime
- MSY: Maximum Sustainable Yield
- $RSB_{MSY}$: Relative spawning biomass at MSY
- $SPR_{MSY}$: Spawning Potential Ratio at MSY

# Use of models for fisheries management

| Conceptual Understanding | Strategic Planning | Tactical Decisions |
|---|---|---|
| Broad understanding | Long-term | Short-term |
| Forms underlying context for management planning | Policy goals | Operational objectives |
| Research | MSE | Harvest control rule |
| Investigate changes in productivity | Management procedures robust to temporal change | Past trends in productivity and short-term advice |

FAO 2008. Technical guidelines for responsible fisheries. 4, Suppl. 2, Add. 1

# Dynamic Reference Points

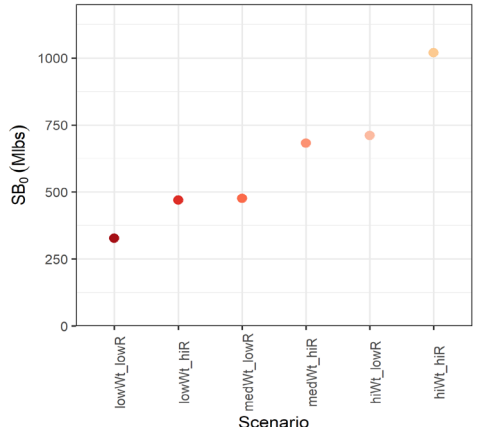
Methodology:

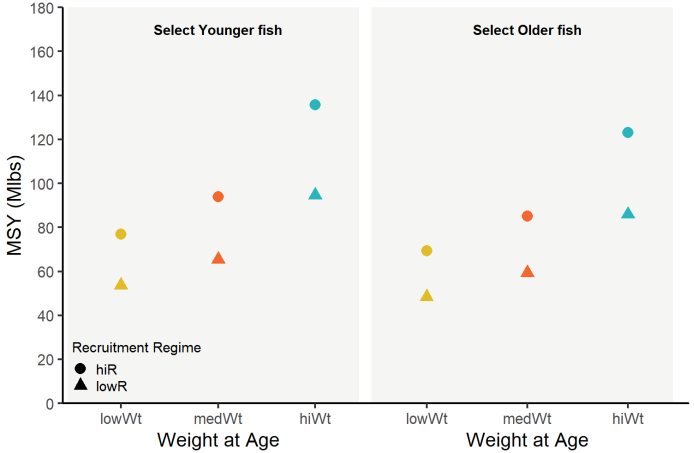
- Conceptual: Equilibrium model
- Tactical: 2018 stock assessment model
- Strategic: Coastwide MSE operating model

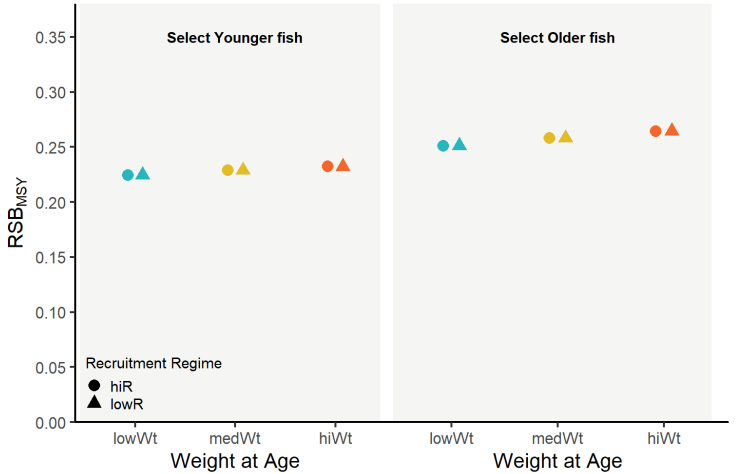
Main sources of variability considered:

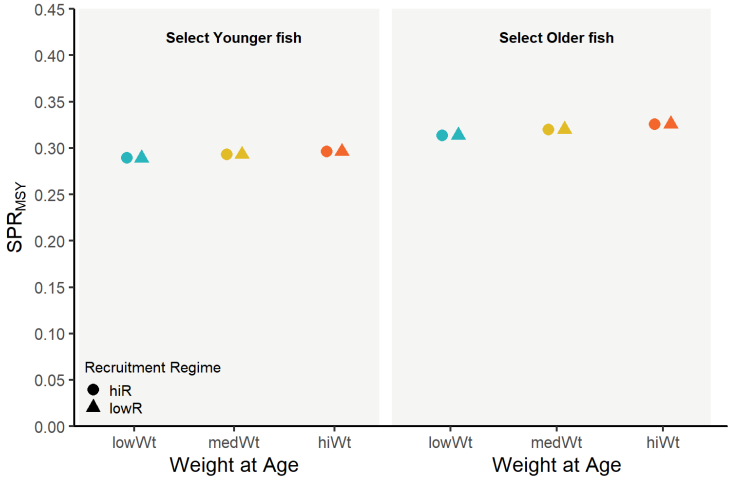
- Environmental regimes
- Weight at age
- Selectivity
- Steepness
- Natural mortality

# Equilibrium model

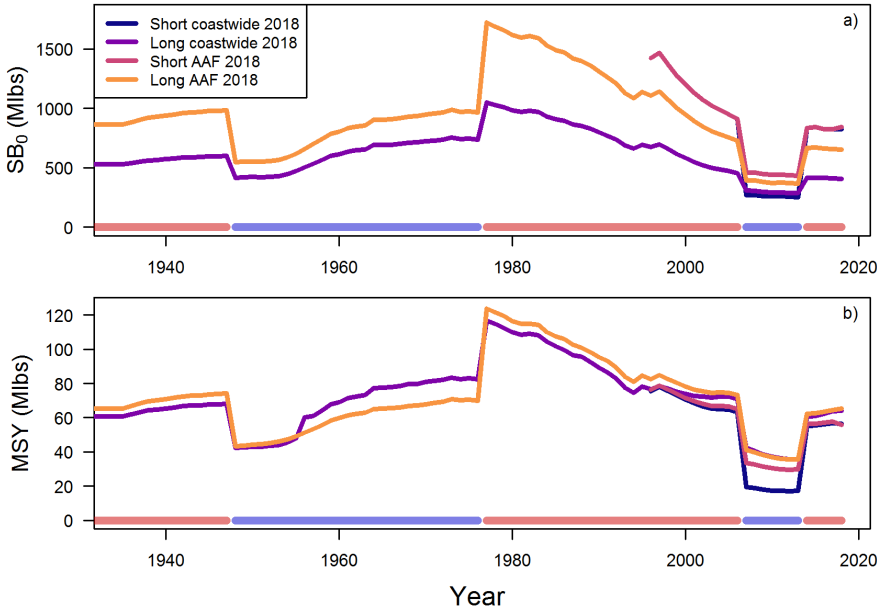


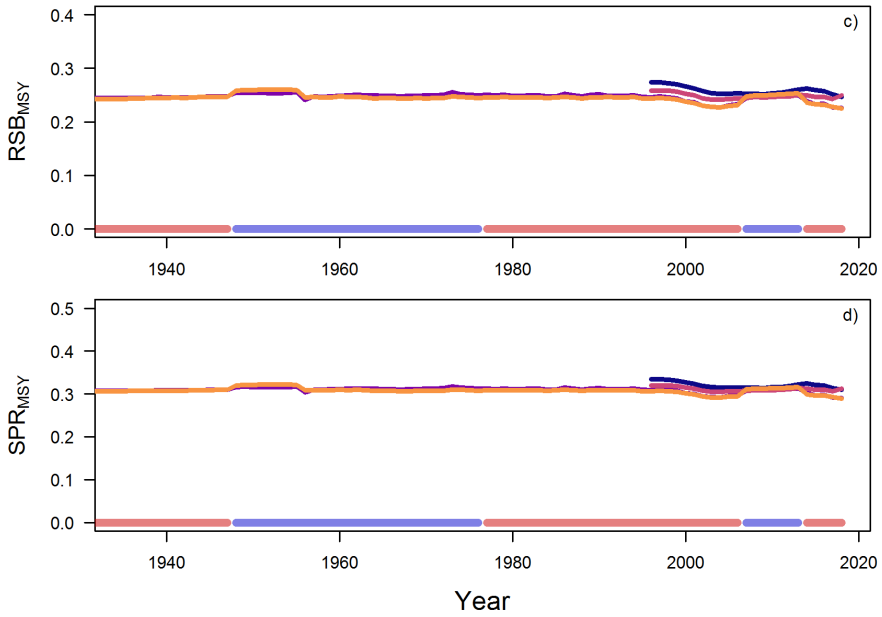



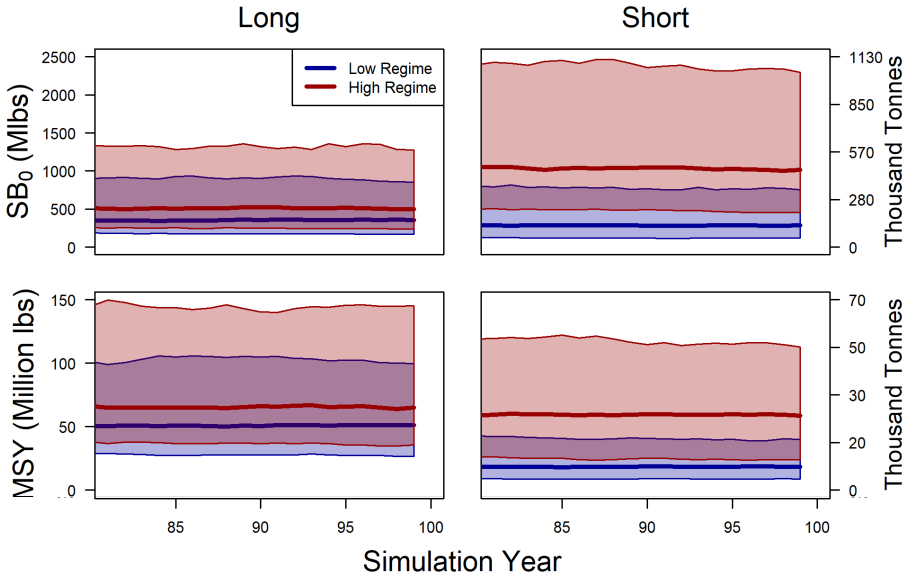



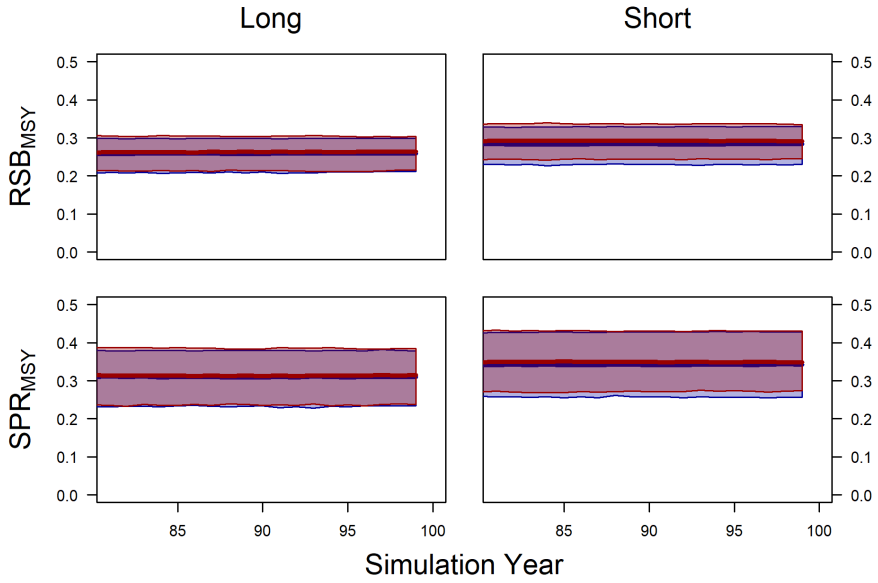
# Results from stock assessment models



# Results from MSE operating model



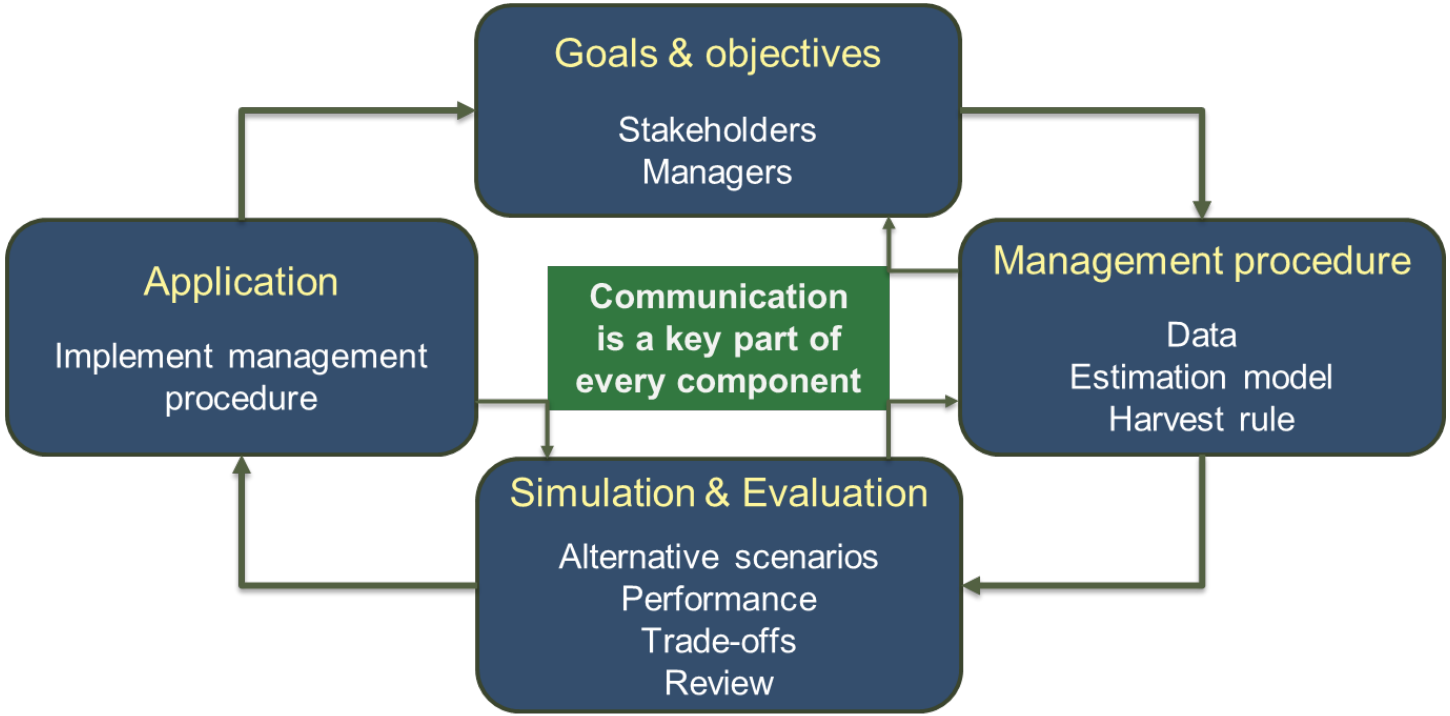



# Conclusions

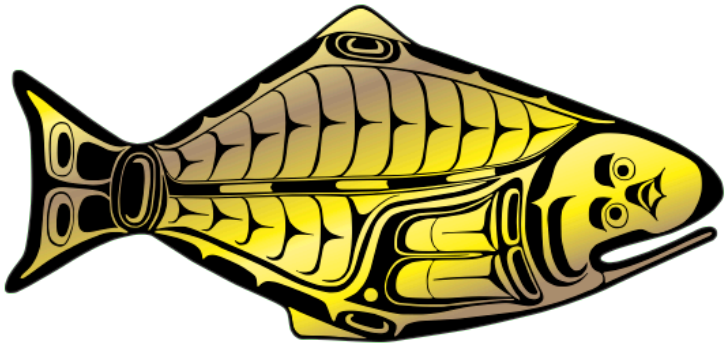
- $SB_0$ and MSY vary depending on regime
- $RSB_{MSY}$ and $SPR_{MSY}$ are more stable
  - $RSB_{MSY}$ ~ 20-30%
  - $SPR_{MSY}$ ~ 30-35%

# Development of a harvest strategy

## Management Strategy Evaluation (MSE)



INTERNATIONAL PACIFIC



HALIBUT COMMISSION