# Selecting and Conditioning Operating Models for WCPO Skipjack

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**Robert Scott**

Oceanic Fisheries Programme, SPC

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# OM Conditioning

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## What is Conditioning?

- Developing models that represent the behaviour and dynamics of fish populations and the fishing fleets that exploit them.
- Identify a suite of models

## Why do it?

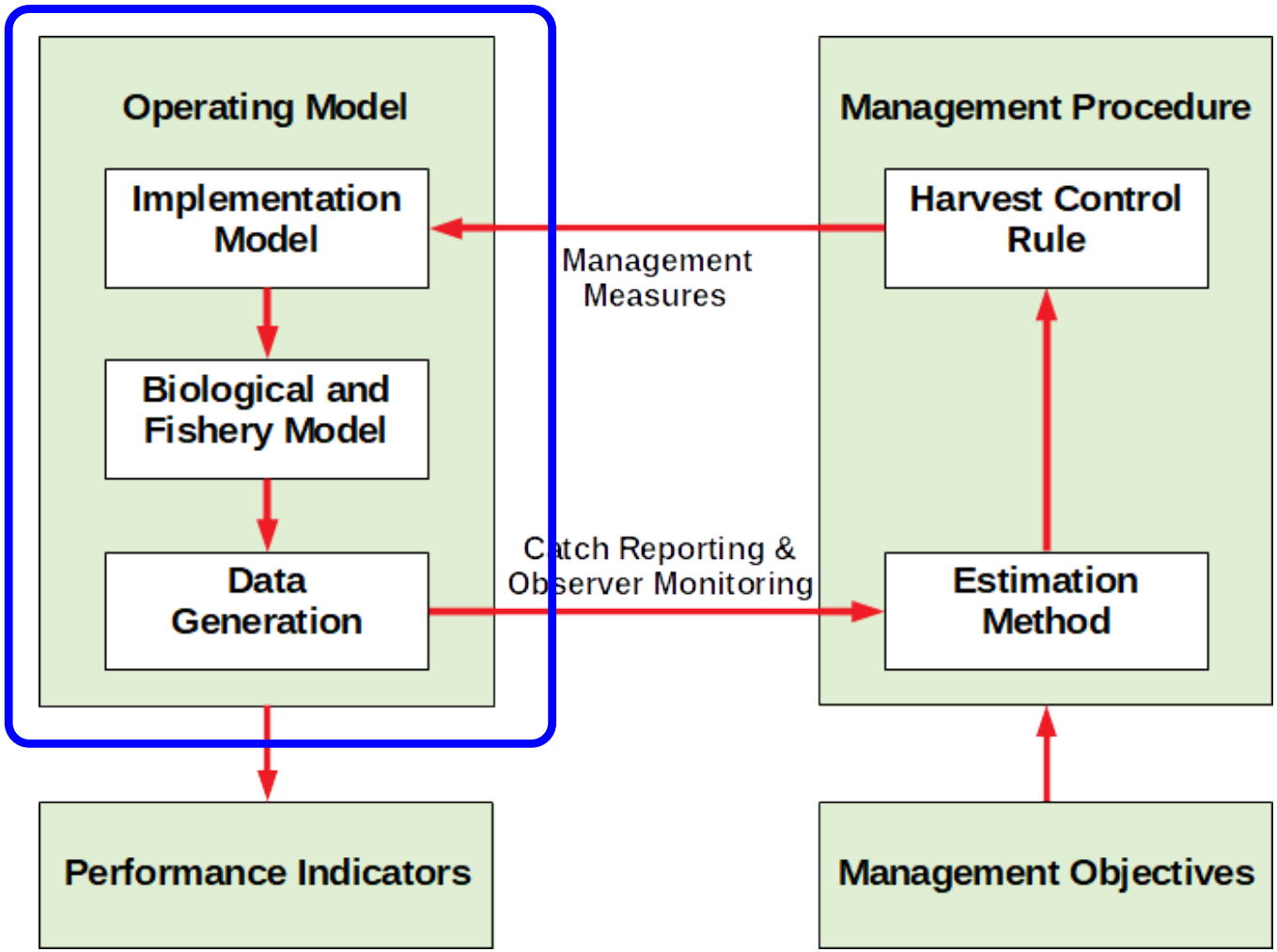
- We want to find the best performing HCR
- But We don't have perfect knowledge of the system.
- Need to identify all important sources of uncertainty and test HCRs against each. (HCR robust to uncertainty)

## How do you identify uncertainty?

- Fit the model to data - similar to stock assessment

# MSE Framework

## Operating Model



# Uncertainty

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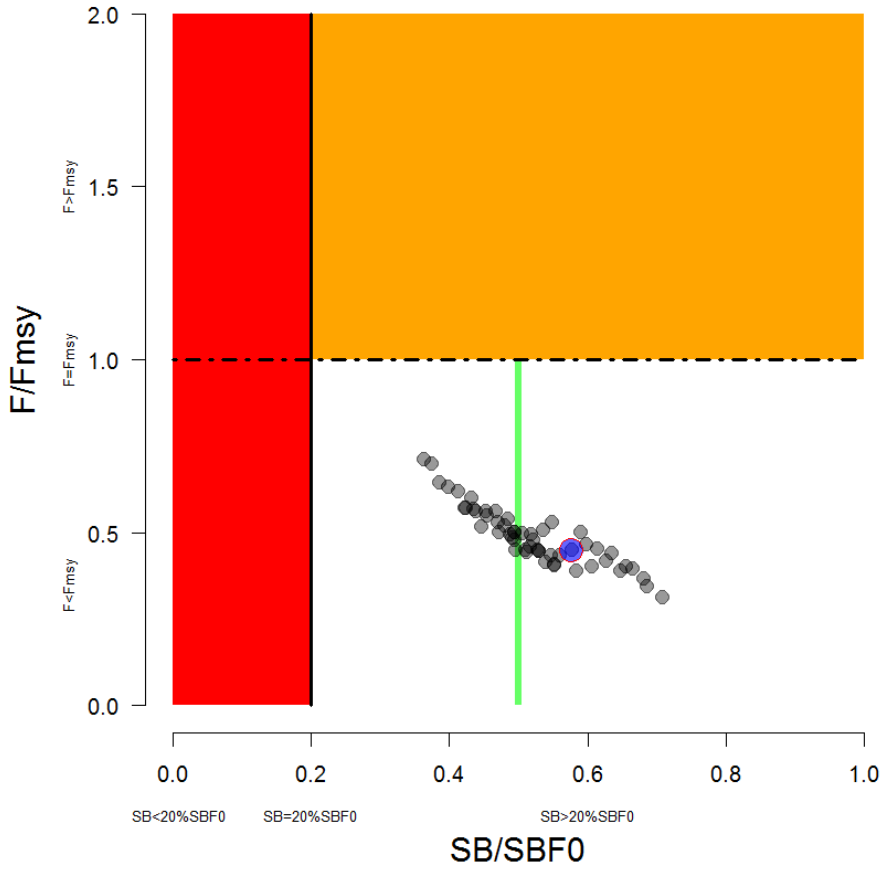
## Stock Assessment Uncertainty Grid

| Axis | Code | Levels | Options | | Importance |
|---|---|---|---|---|---|
| | | | 0 | 1 | 2 |
| Steepness | A | 3 | 0.8 | 0.65 | 0.95 |
| Length comp. wtg | B | 3 | 20 | 10 | 50 |
| Mixing period (qtr) | C | 2 | 1 | 2 | |
| Tag overdispersion | D | 3 | Default | Estimated | Fixed |

# Uncertainty - Stock Assessment



# Uncertainty

## Sources of uncertainty

- **Stock Strucure**: how are skipjack distributed throughout the region ?
- **Parameter Non-stationarity**: are things changing with time eg (maturity)
- **Process Error**: eg future recruitment variability
- **Observation Error**: eg catch and effor reporting, tag recaptures
- **Model Error**: MFCL parameter settings eg growth
- **Implementation Error**: When managagement is not perfectly followed

# Stock Structure

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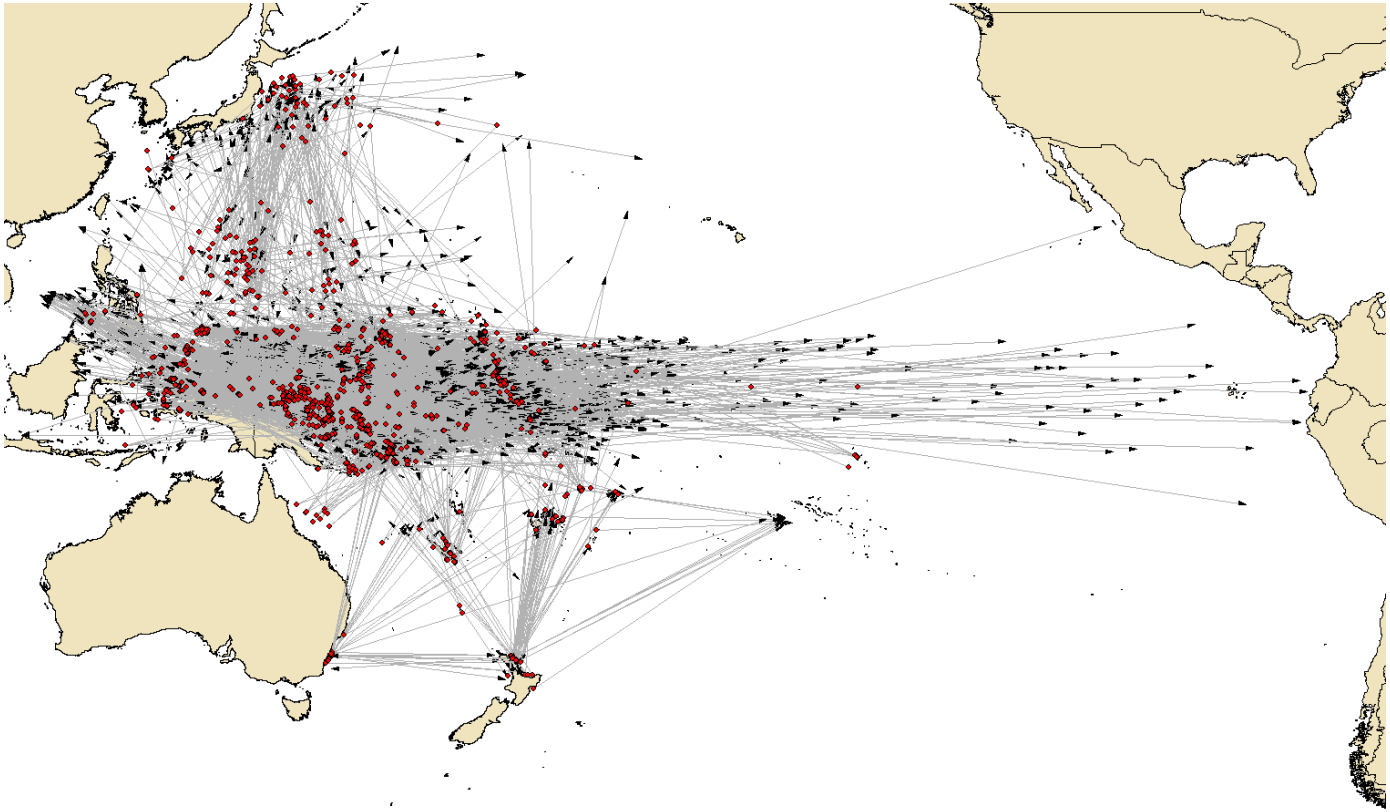
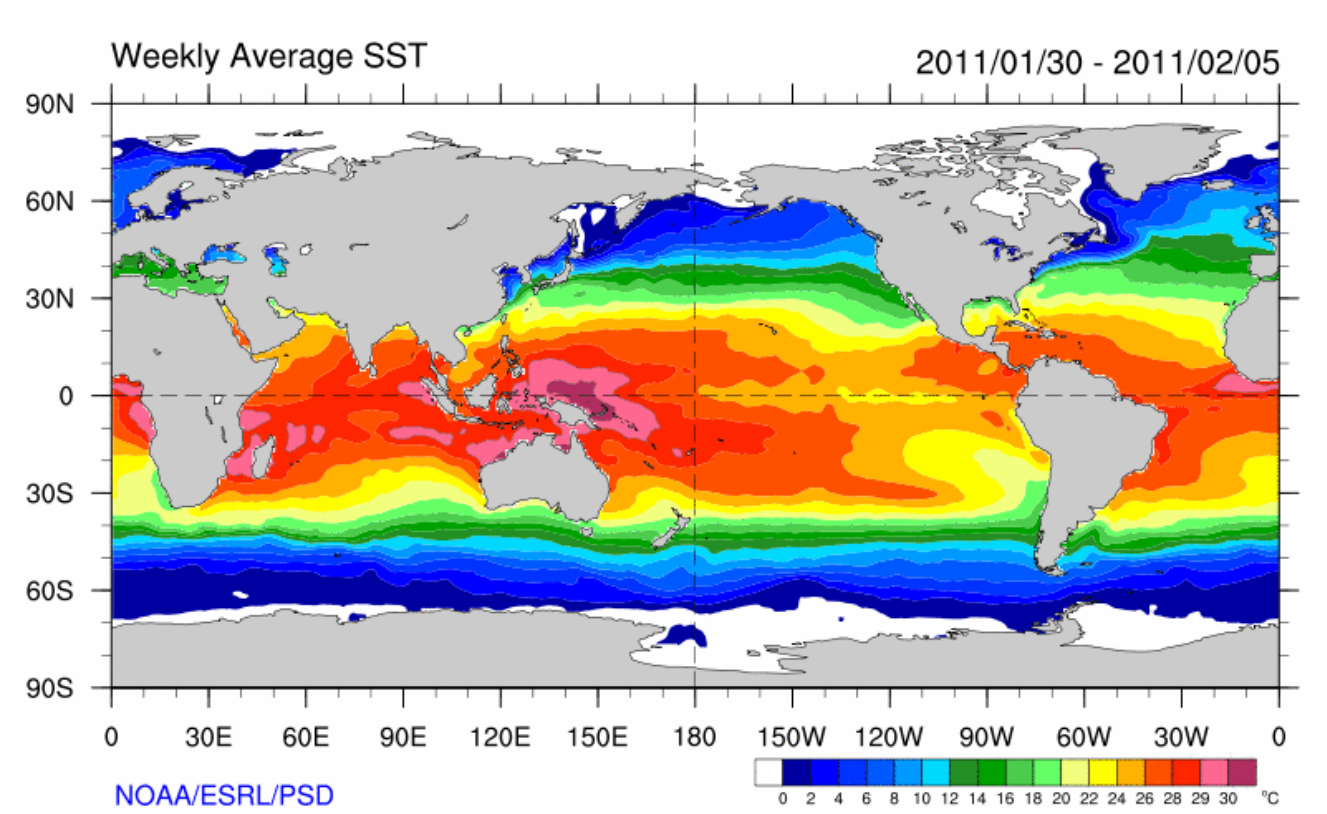
## Skipjack tag release and recapture



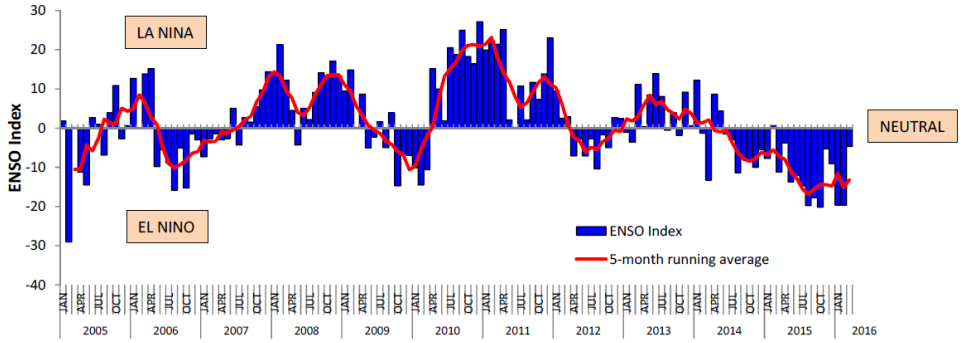
# Stock Structure

## Warm pool



# Movement

## ENSO



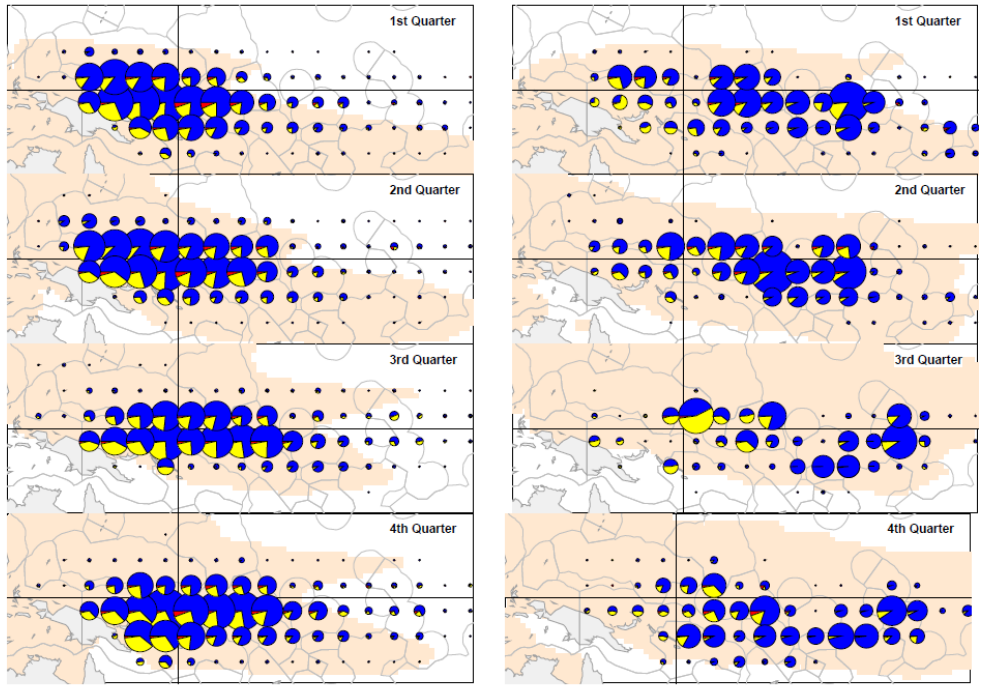
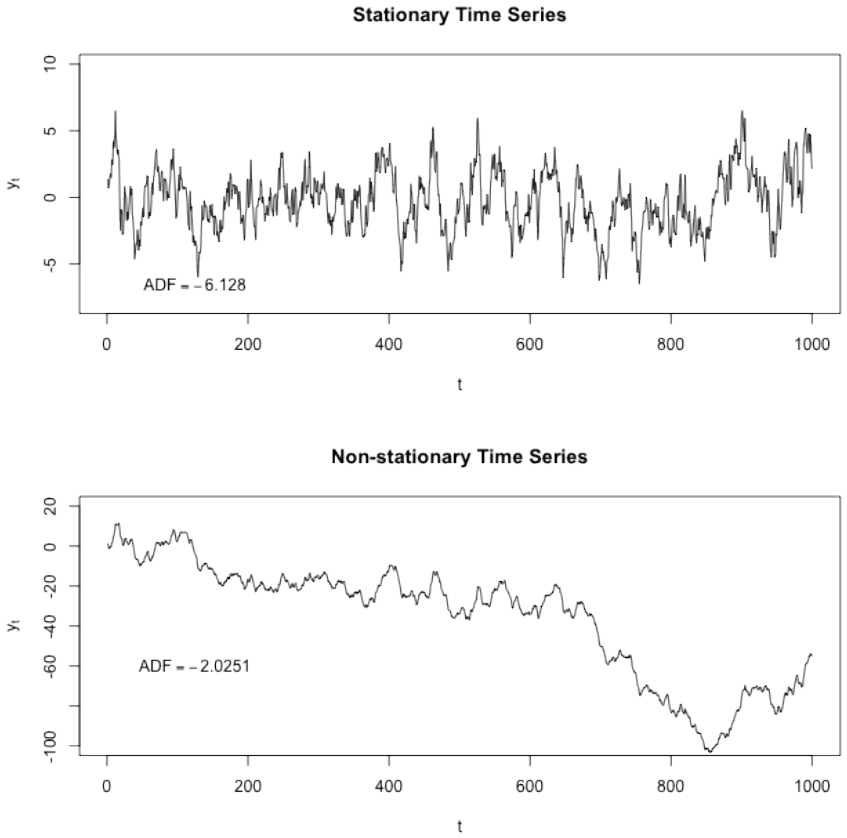




**Figure 24. Quarterly distribution of purse-seine catch by species for 2000–2014 (left) and 2015 (right).**
(Blue–Skipjack; Yellow–Yellowfin; Red–Bigeye)
Pink shading represents the extent of average sea surface temperature >28.5°C by quarter for the period 2000–2014 (left) and 2015 (right)

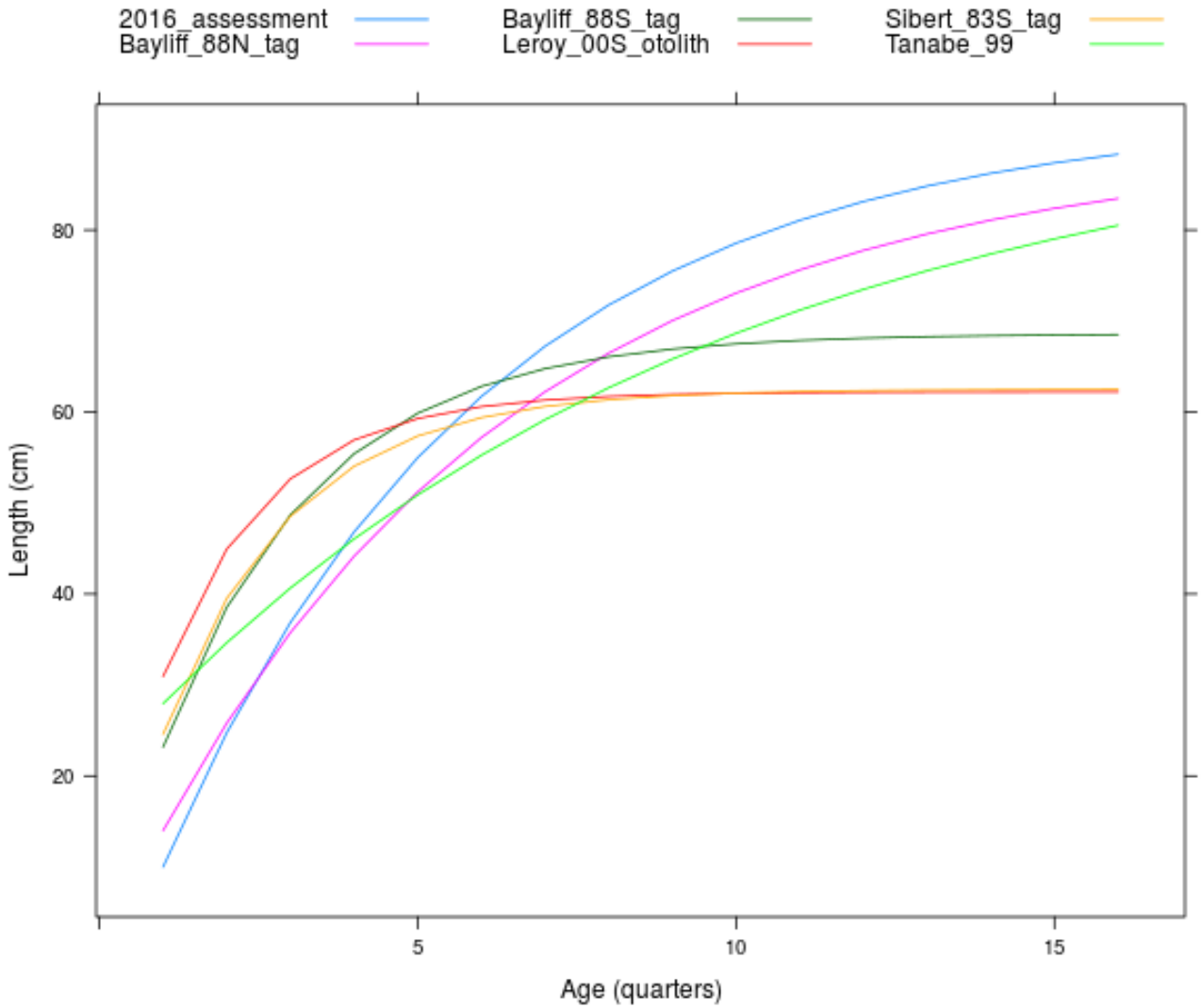
# Parameter Non-stationarity

Variation in parameter estimates over time, space, etc.

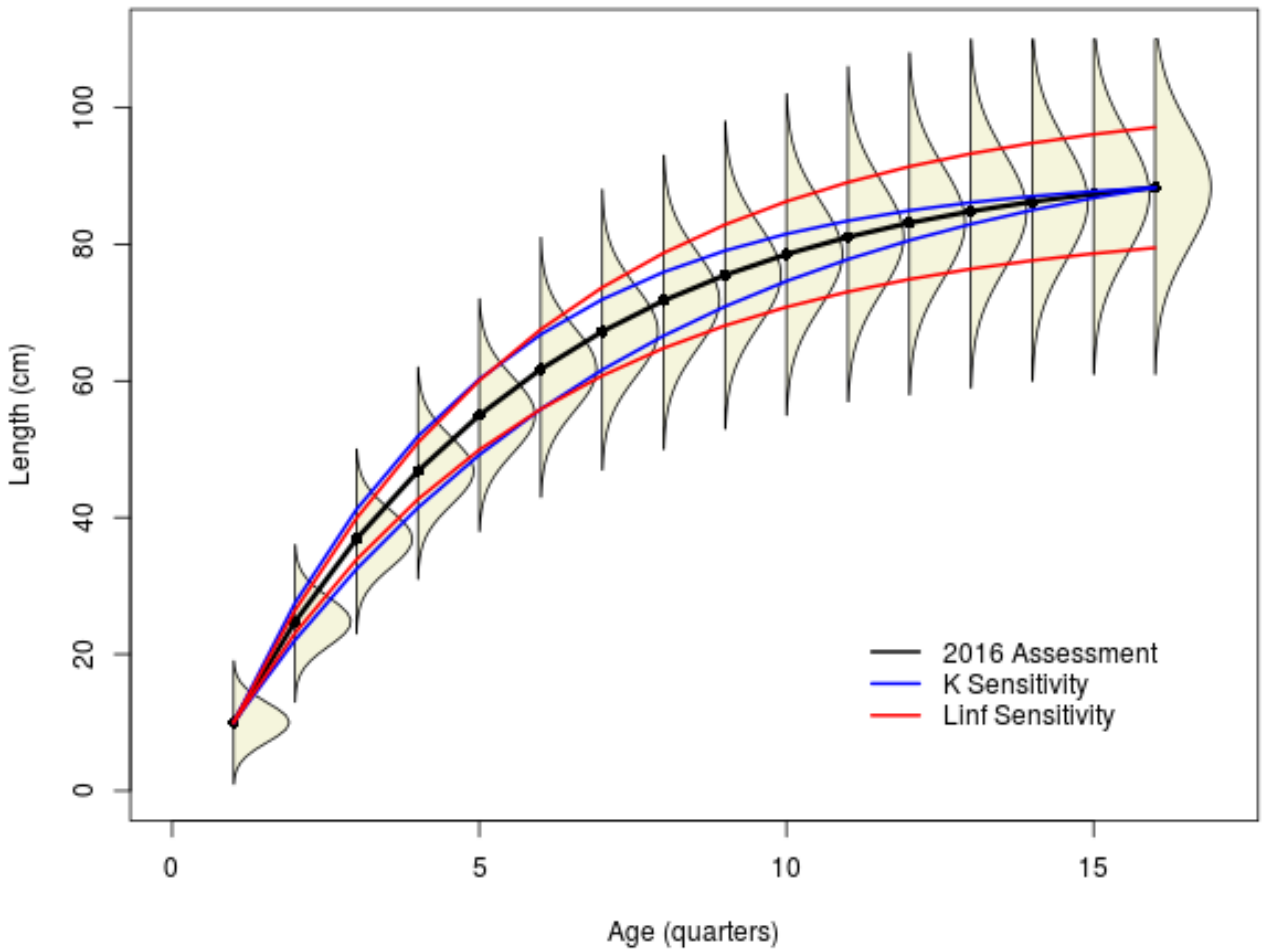



- Biological characteristics
  - Growth, maturity, natural mortality, movement
- Fishery dynamics
- Density dependent processes

# Growth

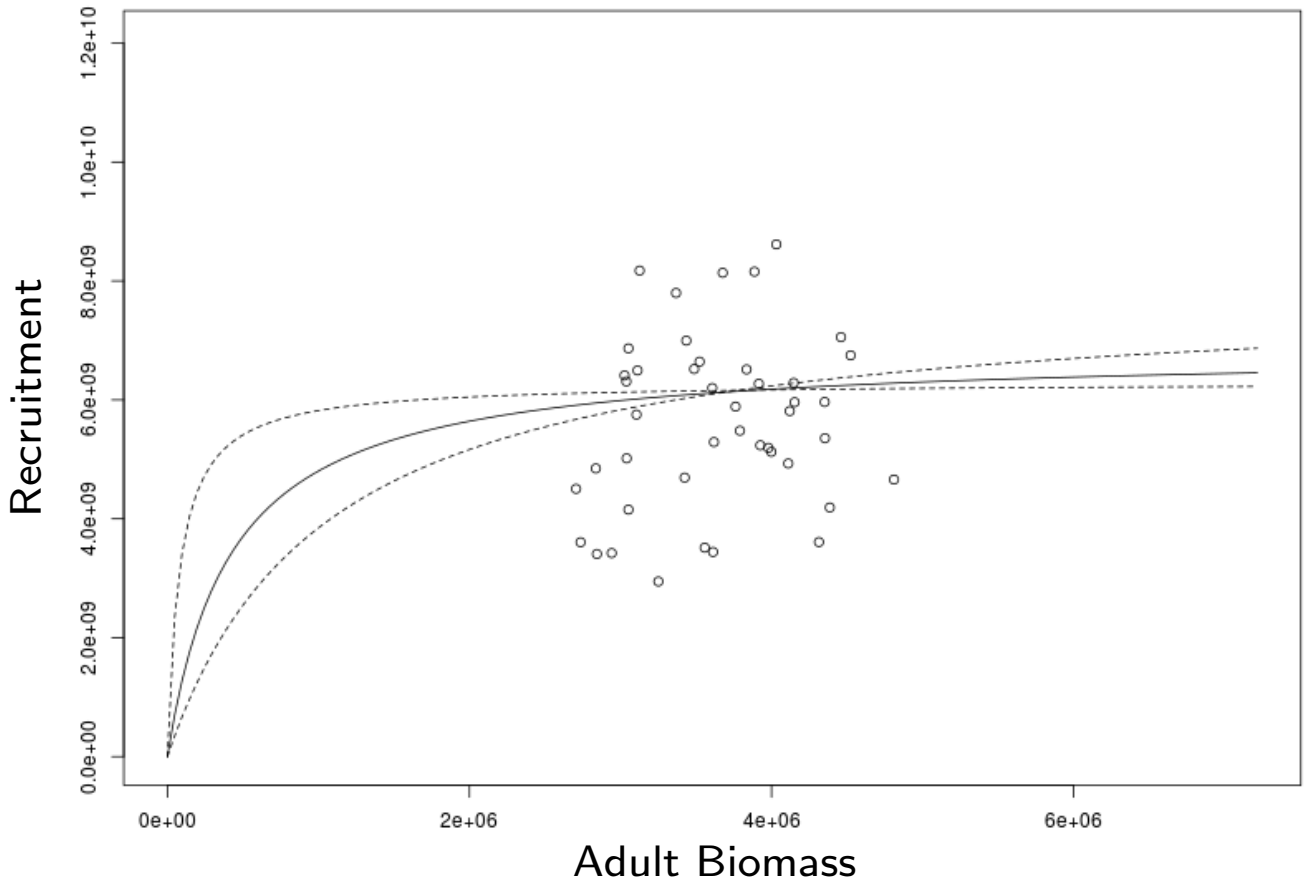


# Growth



# Density Dependence

## SRR Steepness



# Density Dependence

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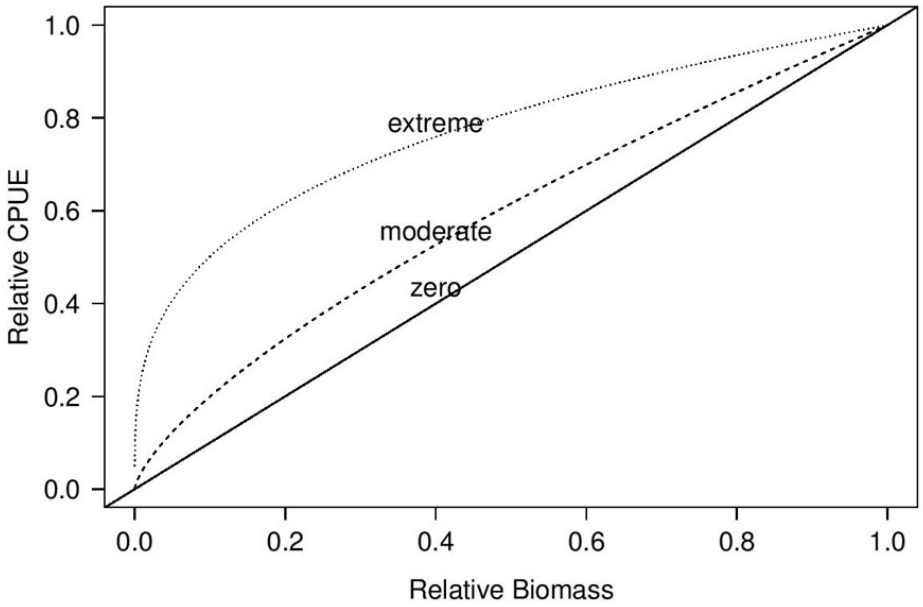
## Normal assumption

Catch rate declines as stock size decreases

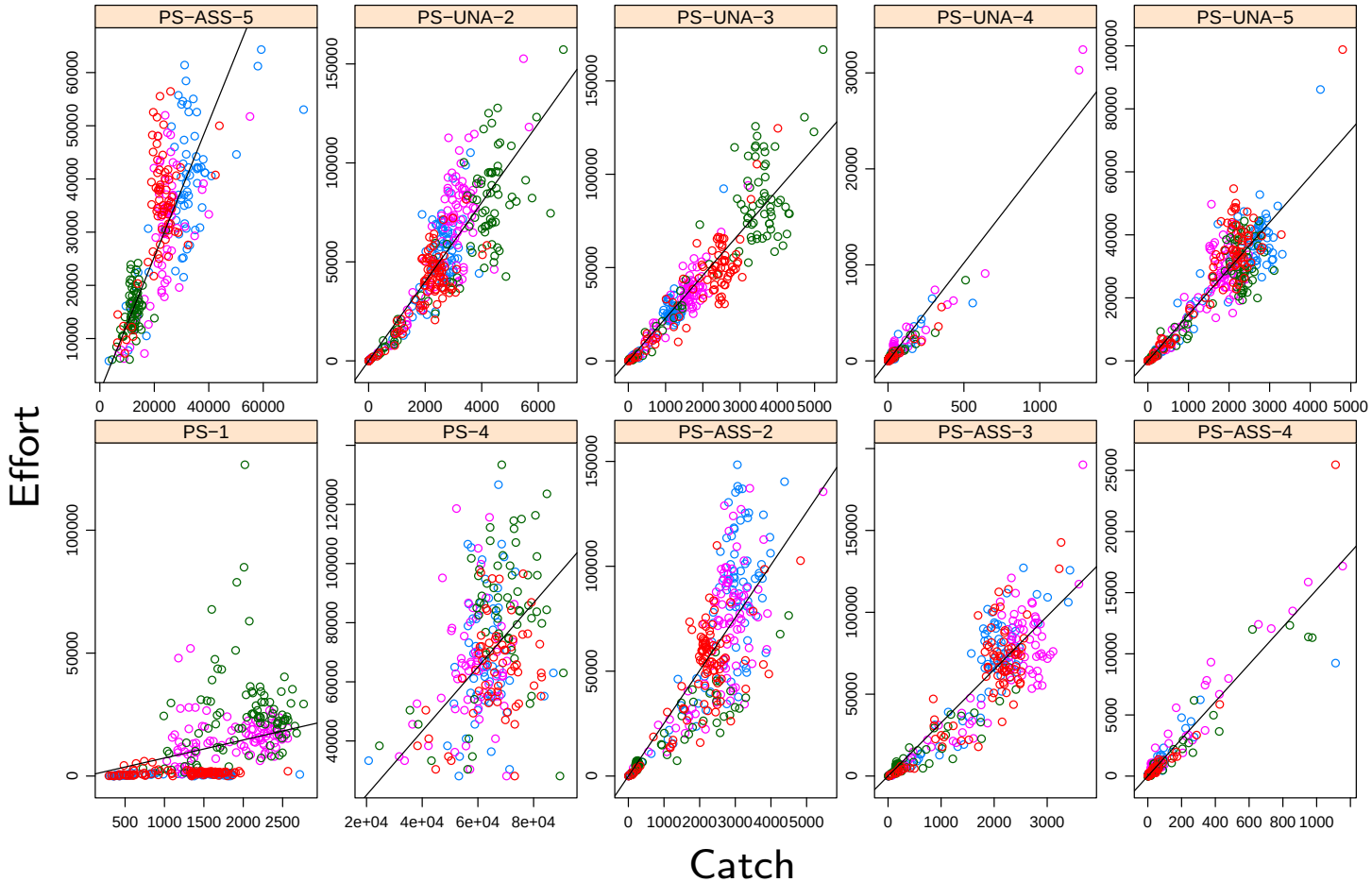
## Hyperstability in CPUE

Catch rate remains high as stock size decreases



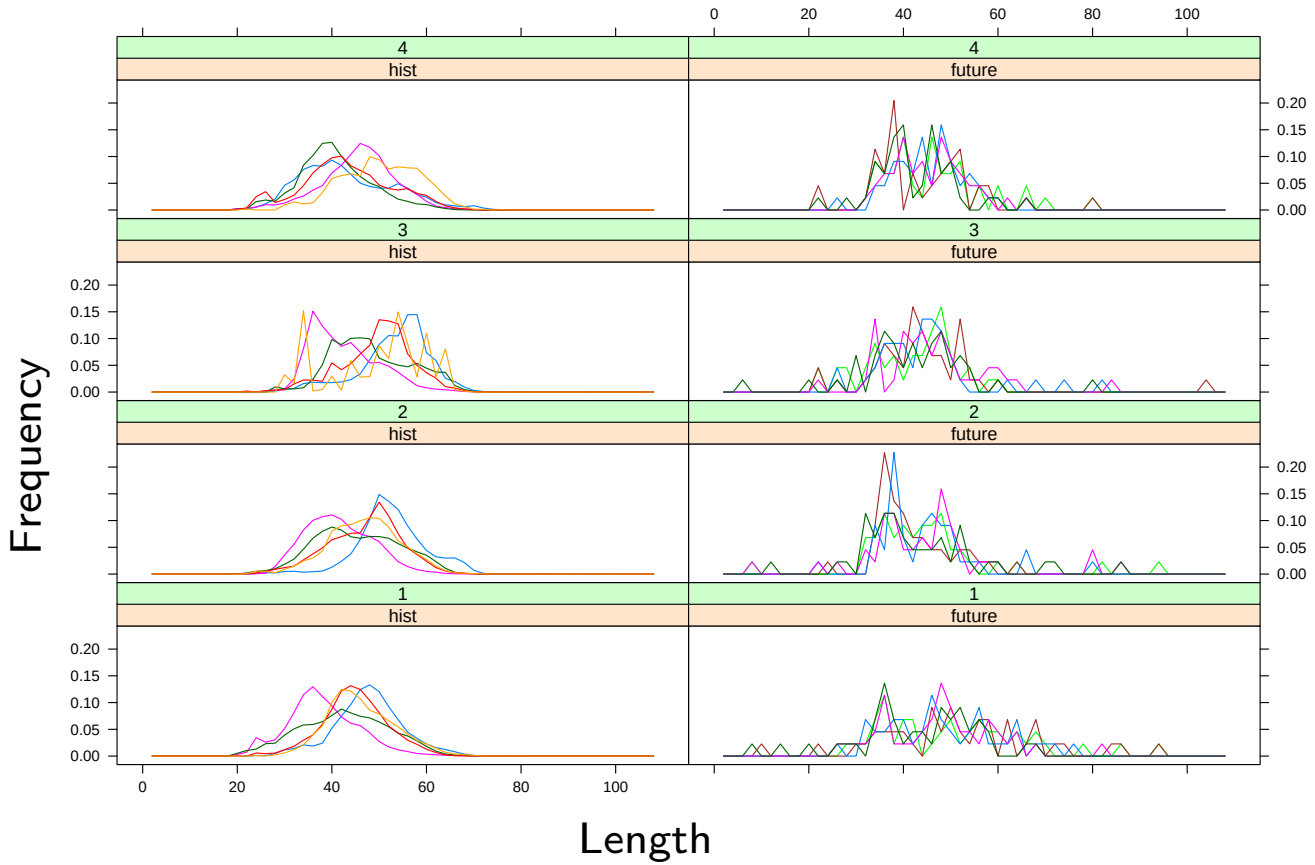
# Observation Error

## Catch and Effort



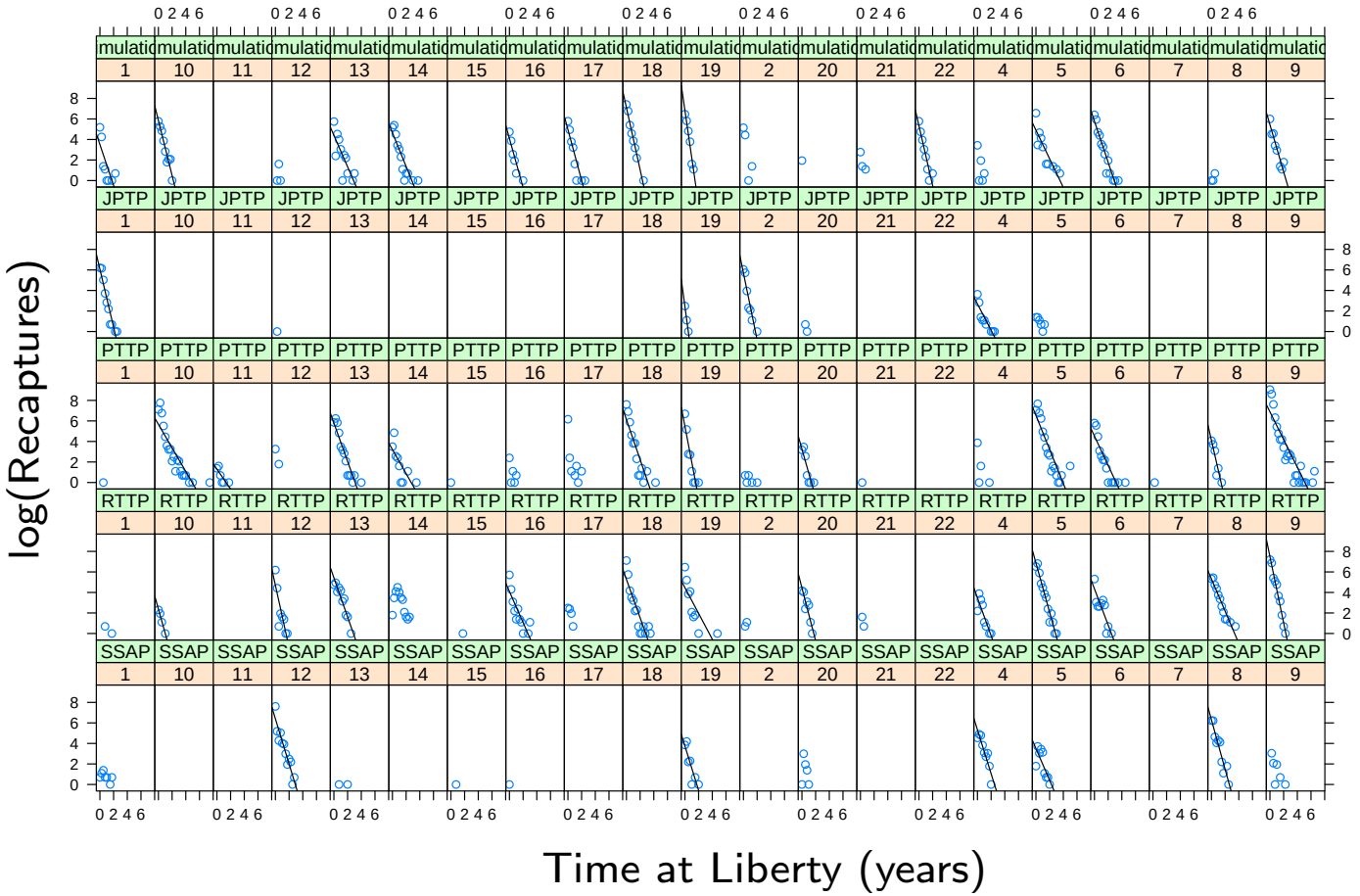
# Observation Error

## Size Composition Data



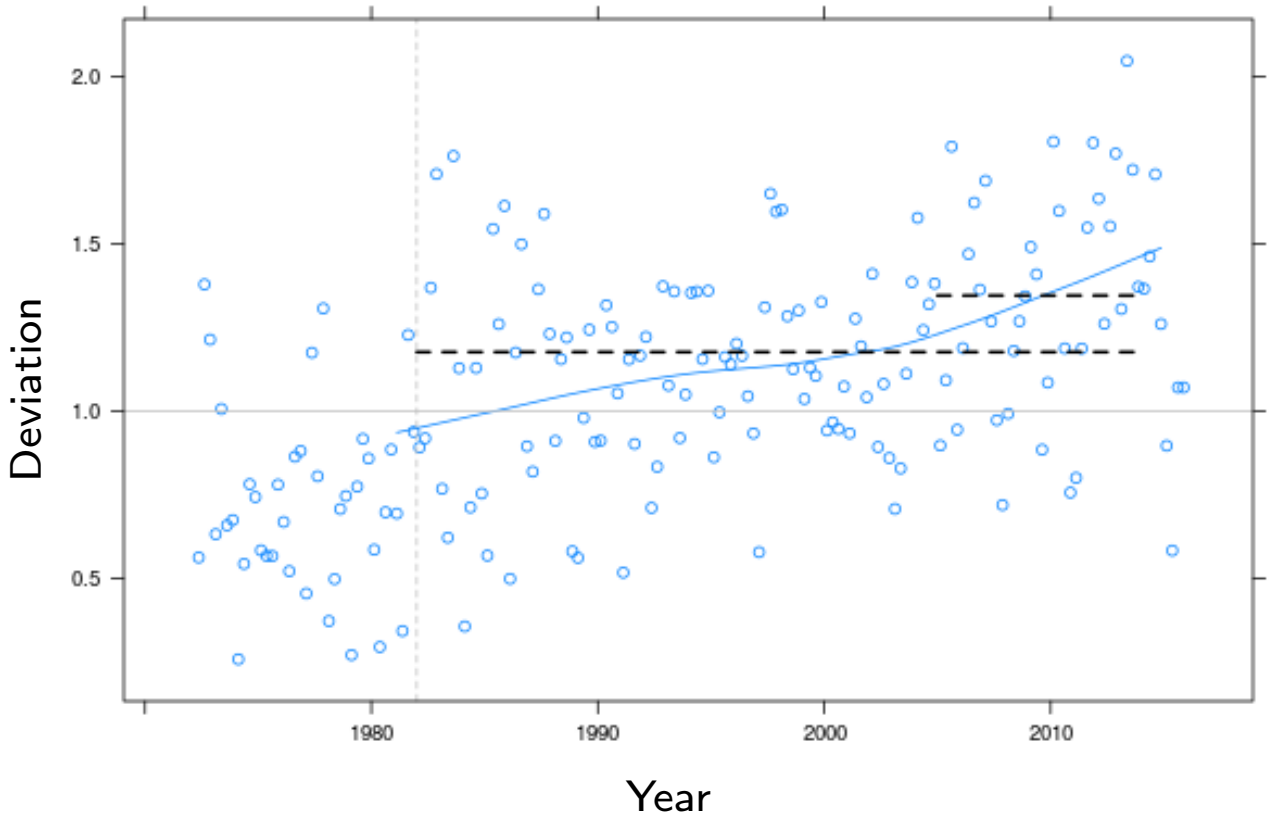
# Observation Error

## Tag Recapture Data



# Process Error

## Recruitment Variability



# Model Error

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## Potential sources of model error

- Steepness
- Tag mixing time
- Overdispersion
- Movement
- Hyperstability in CPUE

# Implementation Error

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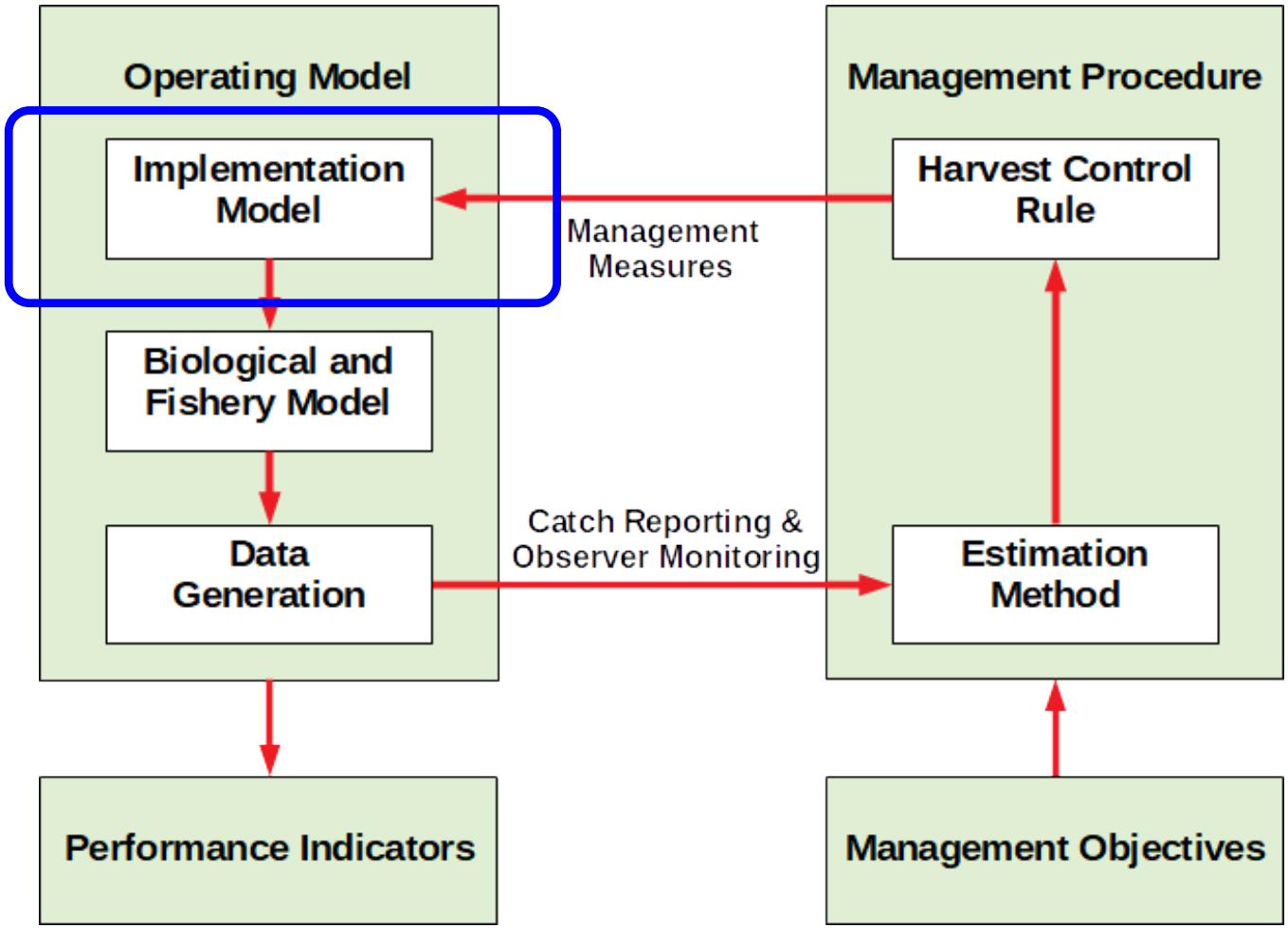
**When management action specified by HCR is not implemented precisely by the fishery**



# OM Conditioning

- **Reference Set**: Most plausible hypotheses - primary basis for PIs
- **Robustness Set**: Less likely - secondary indication of performance

- Recruitment Variability
- Observation error in catch, effort, size comp and tag data
- Steepness
- Tag mixing period
- Overdispersion
- Movement
- Catchability

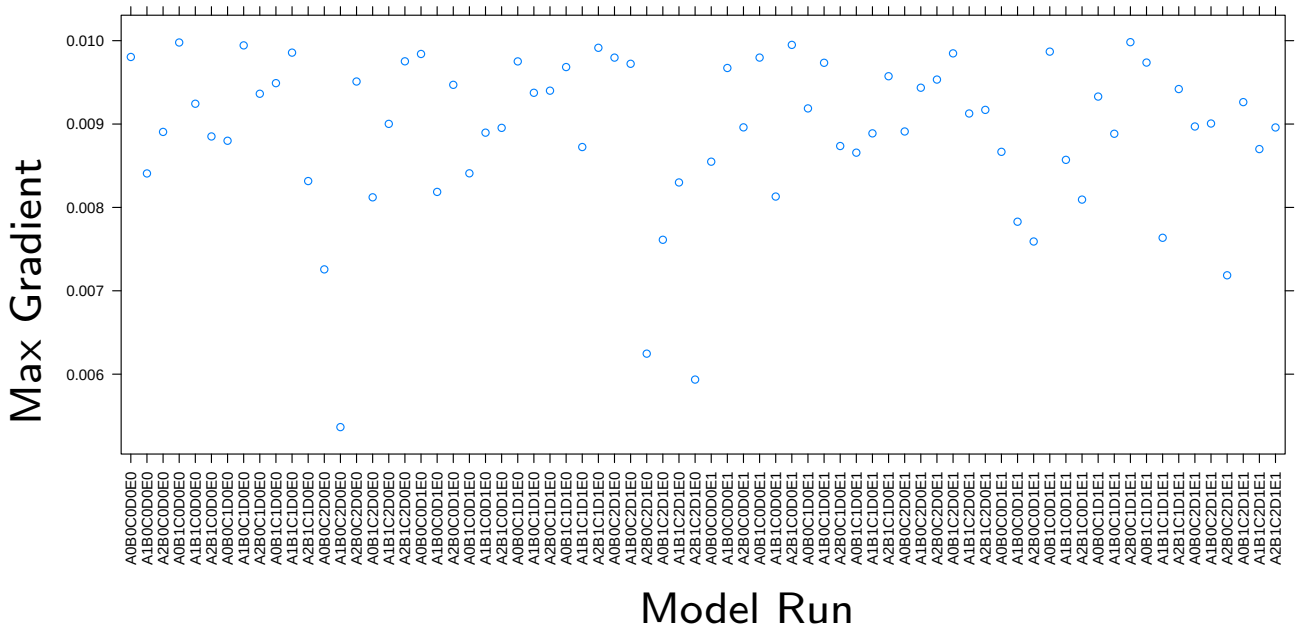
# OM Conditioning

## MSE Uncertainty Grid

| Axis | Levels | | Options | | |
|---|---|---|---|---|---|
| | Reference | Robustness | **0** | **1** | **2** |
| **Process Error** | | | | | |
| Recruitment Variability | **2** | | **1982-2014** | **2005-2014** | |
| **Observation Error** | | | | | |
| Catch and effort | **2** | | **20%** | **30%** | |
| Size composition | 1 | | all models (see section **??**) | | |
| Tag recaptures | **1** | 2 | **status quo** | low | none |
| **Model Error** | | | | | |
| Steepness ‡ | **3** | | **0.8** | **0.65** | **0.95** |
| Mixing period (qtr) ‡ | **2** | | **1** | **2** | |
| Tag overdispersion ‡ | **3** | | **high** | **medium** | **low** |
| Movement | **1** | 1 | **estimated** | El Nino/La Nina | |
| DD catchability (k) ‡ | **1** | 1 | **0** | -0.5 | |
| **Implementation Error** | | | | | |
| Effort creep | **1** | 1 | **0%** | 2% cont. | |

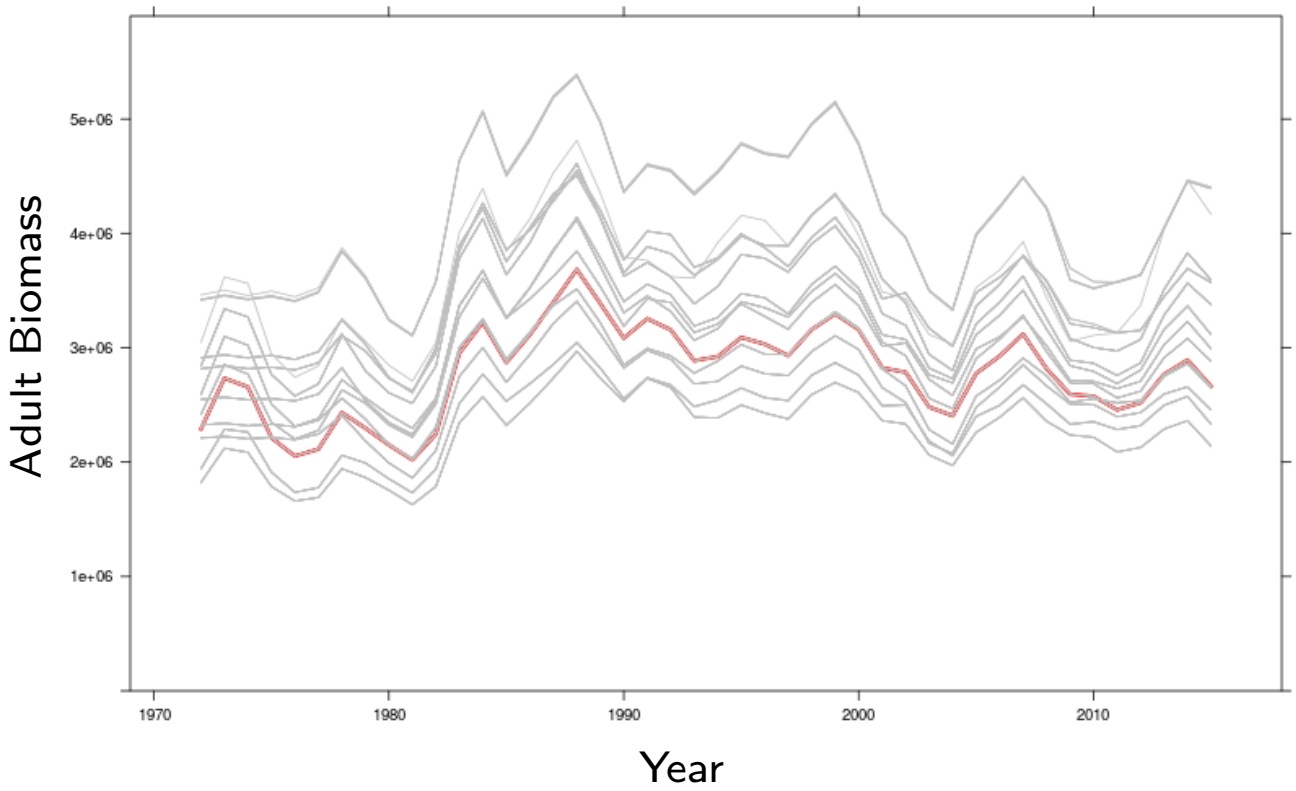
# OM Conditioning

## Validation



# OM Conditioning

## Validation



# OM Conditioning

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## Conclusions

1. **All scenarios**: Natural mortality; Length comp. data weighting
2. **Stock assessment grid**: Steepness; tag mixing; effort creep
3. **Additional MSE grid**: Observation error; DD catchability; overdispersion
4. **Low priority**: Maturity; recruitment distribution; autocorrelation
5. **Future work**: Tag reporting rates; growth; movement; effort deviations

# OM Conditioning


1. Have all important sources of uncertainty been considered?
   - what do we still not fully understand about the stock and the fishery?
   - are there any additional factors that should be included in the grid?

2. Do the ranges and parameter values adequately reflect uncertainty in the dynamics of the resource?
   - are we under- or over-estimating the knowledge we have about the stock and the fishery?

3. Are the scenarios properly allocated between reference and robustness sets?
   - are some scenarios more important than others, and if so, does the grid reflect this?