Assessing Harvest Control Rules (HCRs)

Management Strategy Evaluation (MSE)

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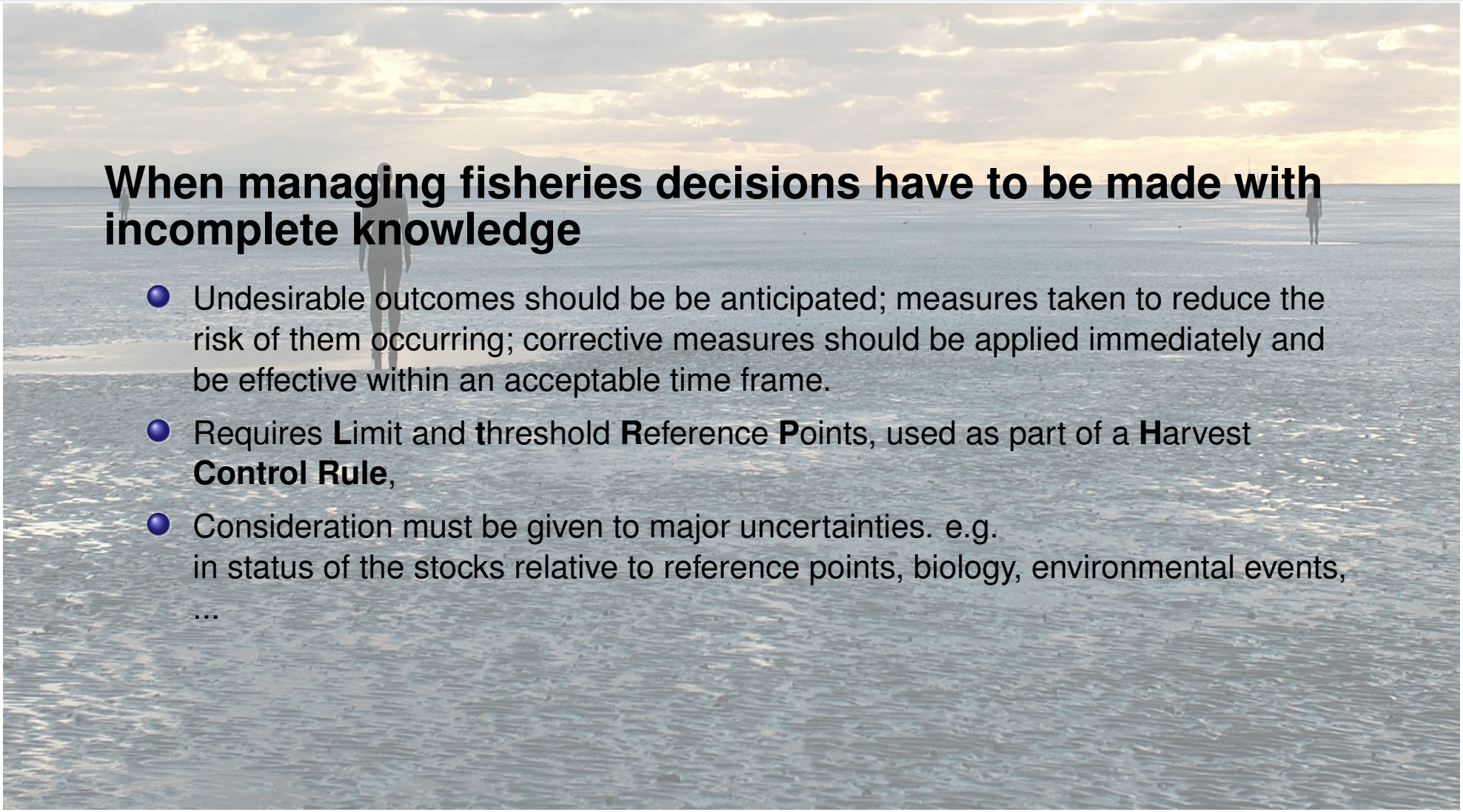
Outline

1. Precautionary Approach
2. Process
3. Examples

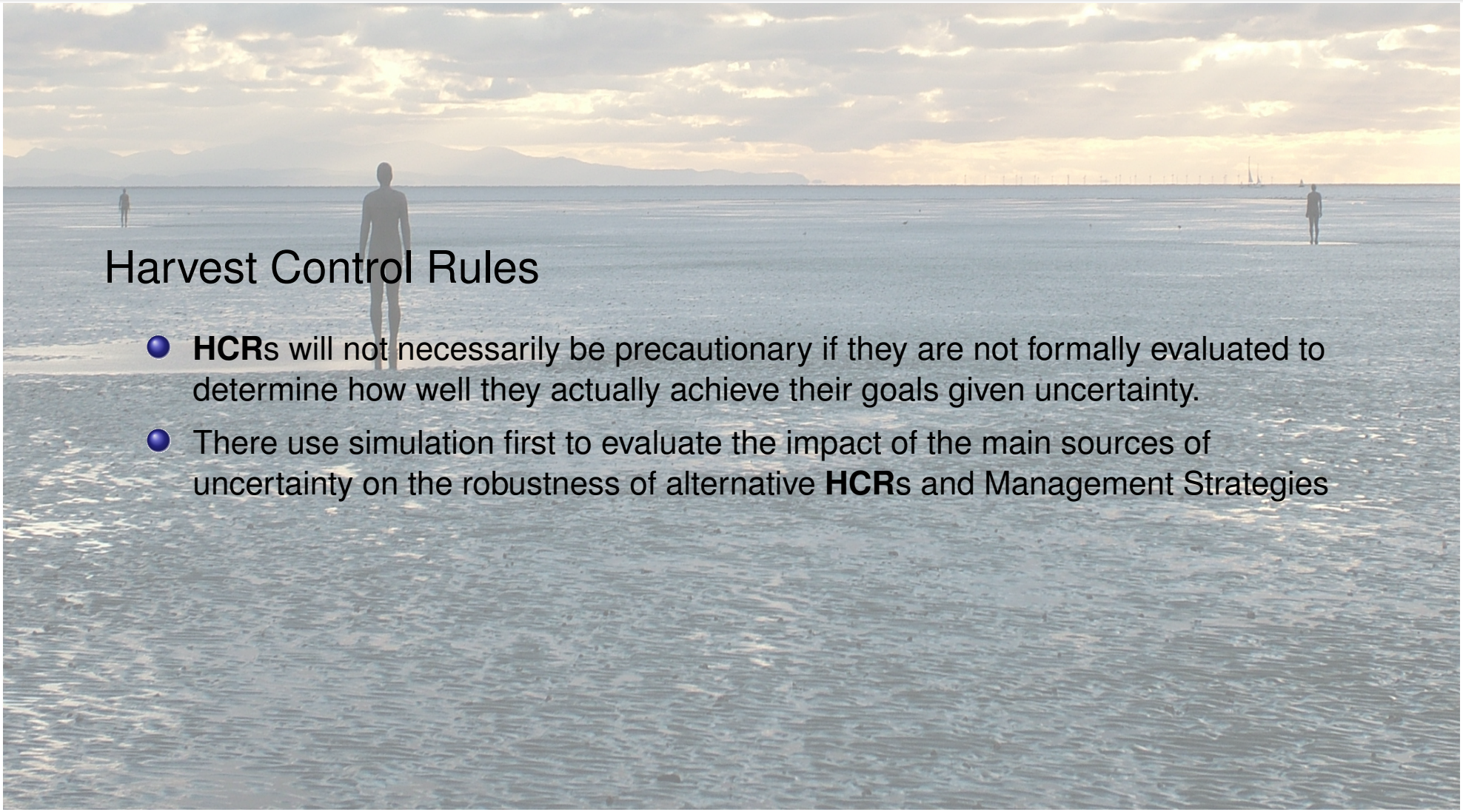
Precautionary Approach



When managing fisheries decisions have to be made with incomplete knowledge

- Undesirable outcomes should be be anticipated; measures taken to reduce the risk of them occurring; corrective measures should be applied immediately and be effective within an acceptable time frame.
- Requires **L**imit and **t**hreshold **R**eference **P**oints, used as part of a **H**arvest **Control Rule**,
- Consideration must be given to major uncertainties. e.g.
  in status of the stocks relative to reference points, biology, environmental events, ...

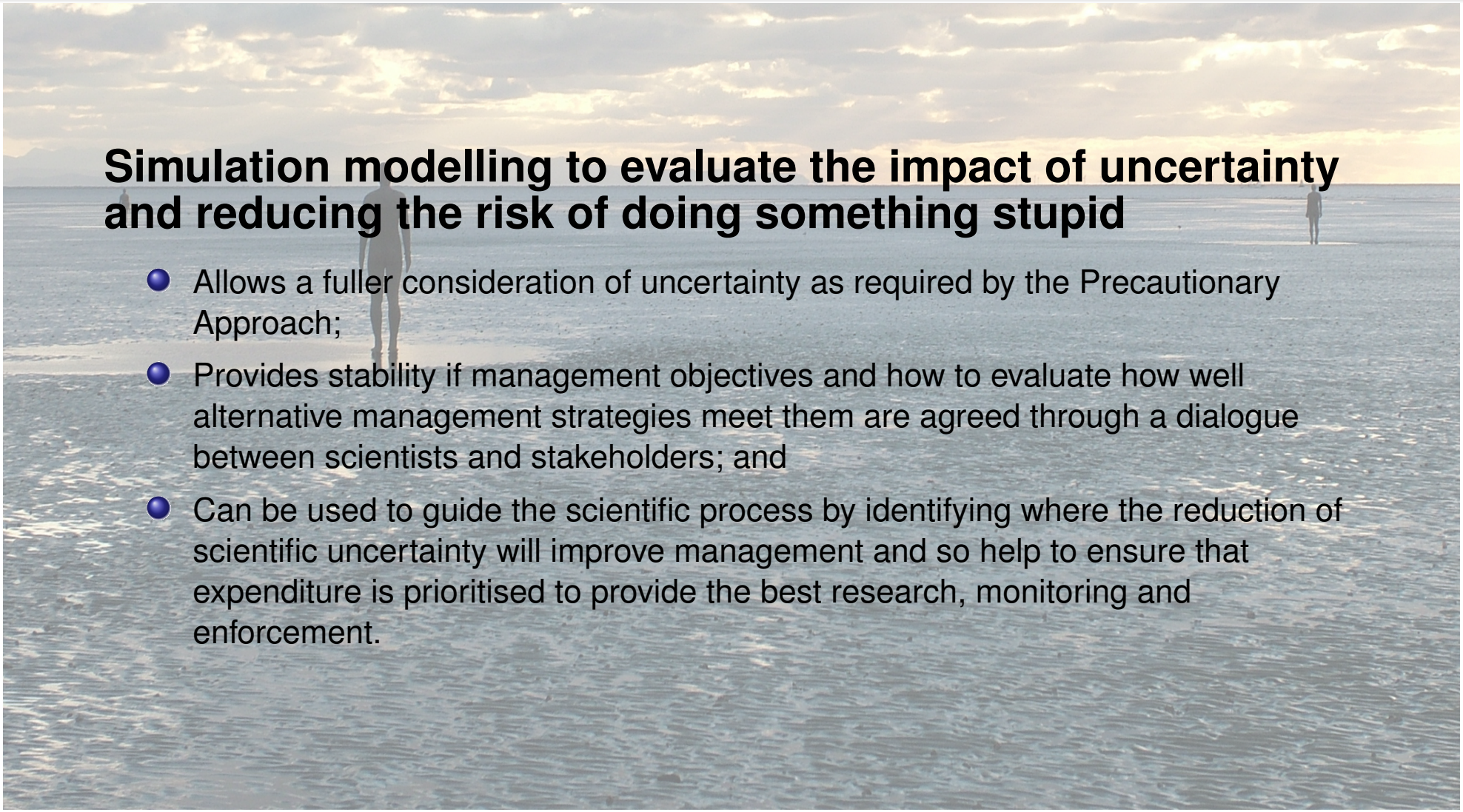
Precautionary Approach



Harvest Control Rules

- **HCR**s will not necessarily be precautionary if they are not formally evaluated to determine how well they actually achieve their goals given uncertainty.
- There use simulation first to evaluate the impact of the main sources of uncertainty on the robustness of alternative **HCR**s and Management Strategies

Management Strategy Evaluation



Simulation modelling to evaluate the impact of uncertainty and reducing the risk of doing something stupid

- Allows a fuller consideration of uncertainty as required by the Precautionary Approach;
- Provides stability if management objectives and how to evaluate how well alternative management strategies meet them are agreed through a dialogue between scientists and stakeholders; and
- Can be used to guide the scientific process by identifying where the reduction of scientific uncertainty will improve management and so help to ensure that expenditure is prioritised to provide the best research, monitoring and enforcement.

MSE Process

Six Step Program

Identification of management objectives and mapping these to performance measures to quantify how well they are achieved

Selection of hypotheses about system dynamics for building **O**perating **M**odels (i.e. Simulation Models)

Building the simulation models, i.e. Conditioning them on data and knowledge, and rejecting and weighting different hypotheses.

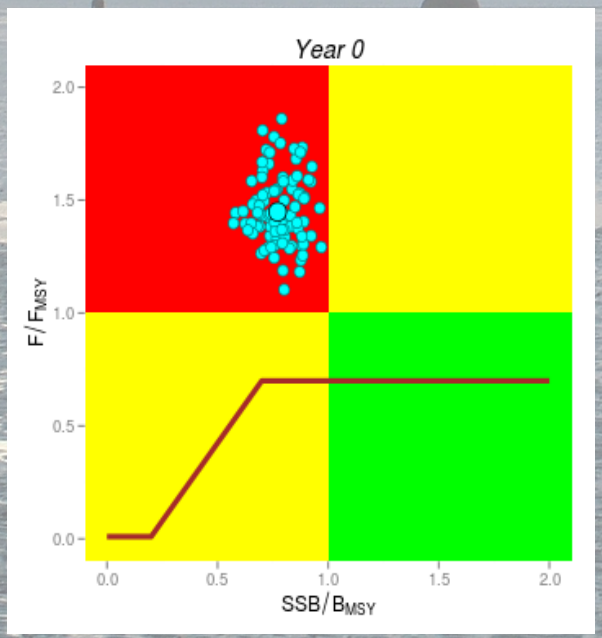
Identifying alternative management strategies, (i.e.the combination of pre-defined data, stock assessment methods, reference points and HCRs.

Running the simulations using the HCRs as feedback control procedures; and

Agreeing the Management Strategies that best meet management objectives.

Principles of Decision Making [REC 11-13]

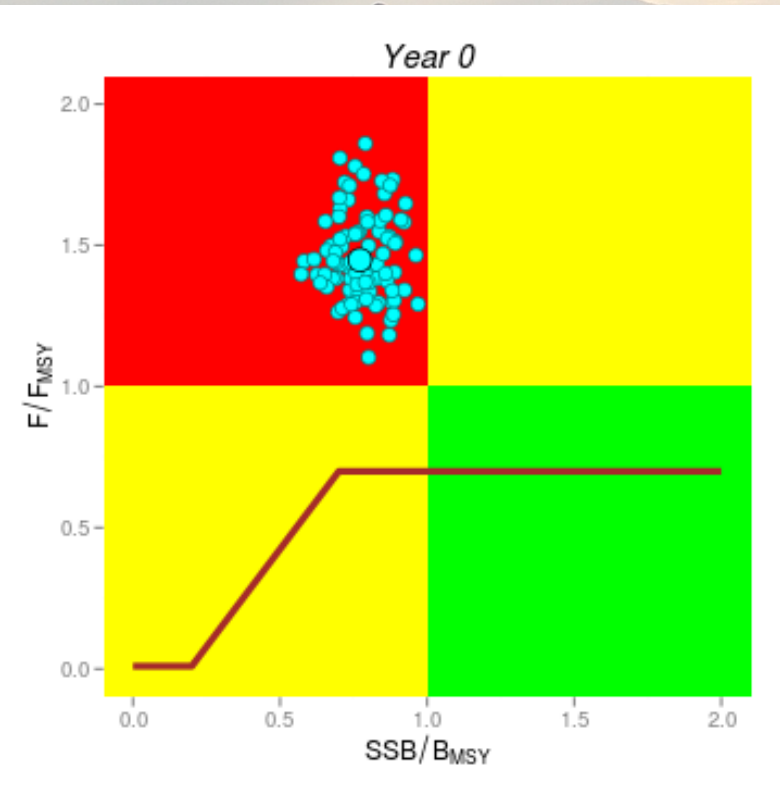
Red Quadrant i.e. overfished and overfishing



- Management should ensure a high probability of ending overfishing in as **short a time period as possible**
- A plan must be adopted for rebuilding taking into account stock biology and SCRS advice
- Risk Levels, Probabilities and Time Scales?
- Short-term objective to stop overfishing,
- Long-term objective to recover stock to a level that can support MSY

Principles of Decision Making [REC 11-13]

Stop Overfishing



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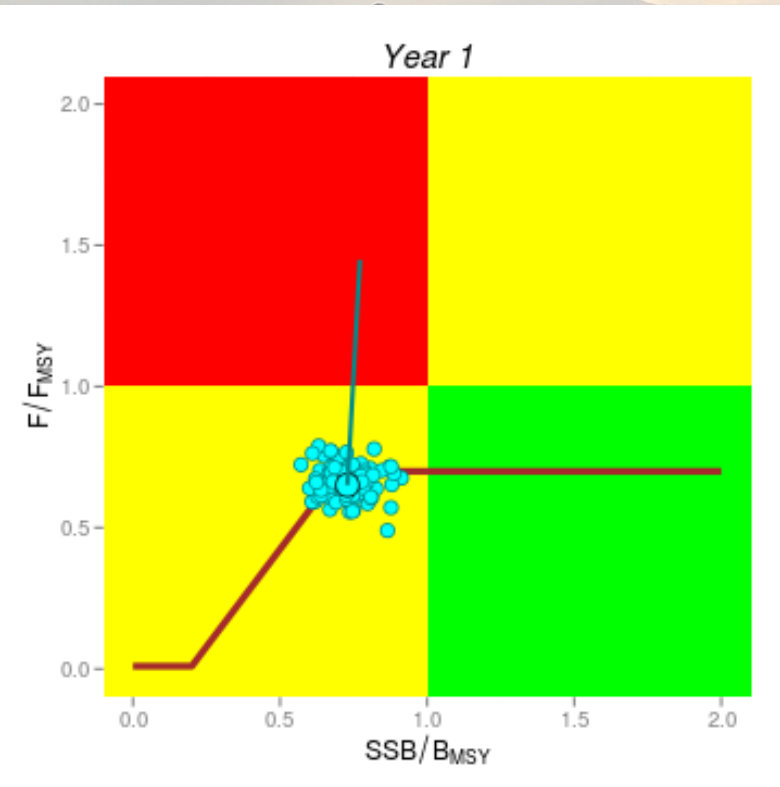

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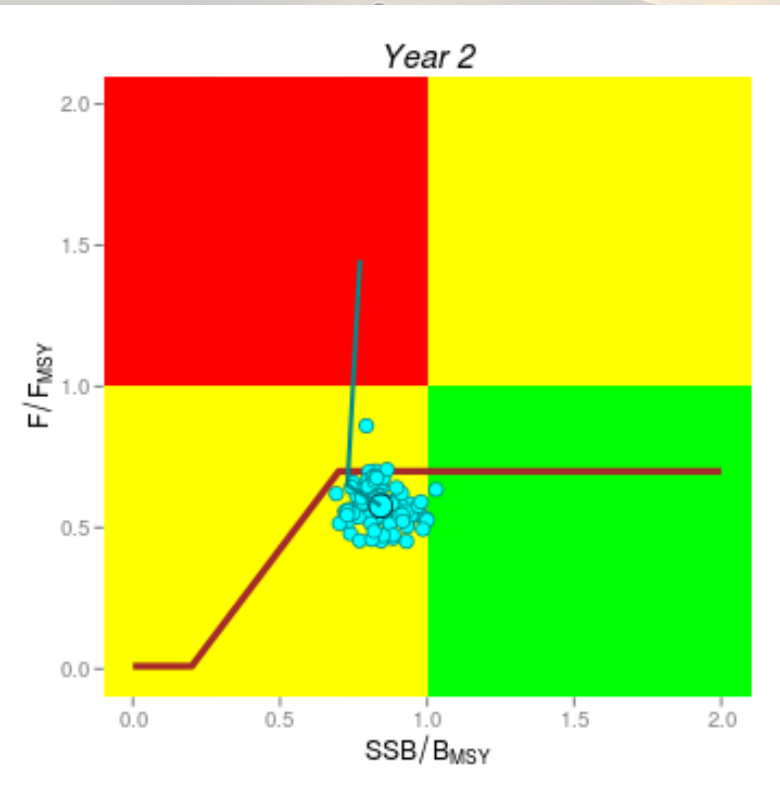

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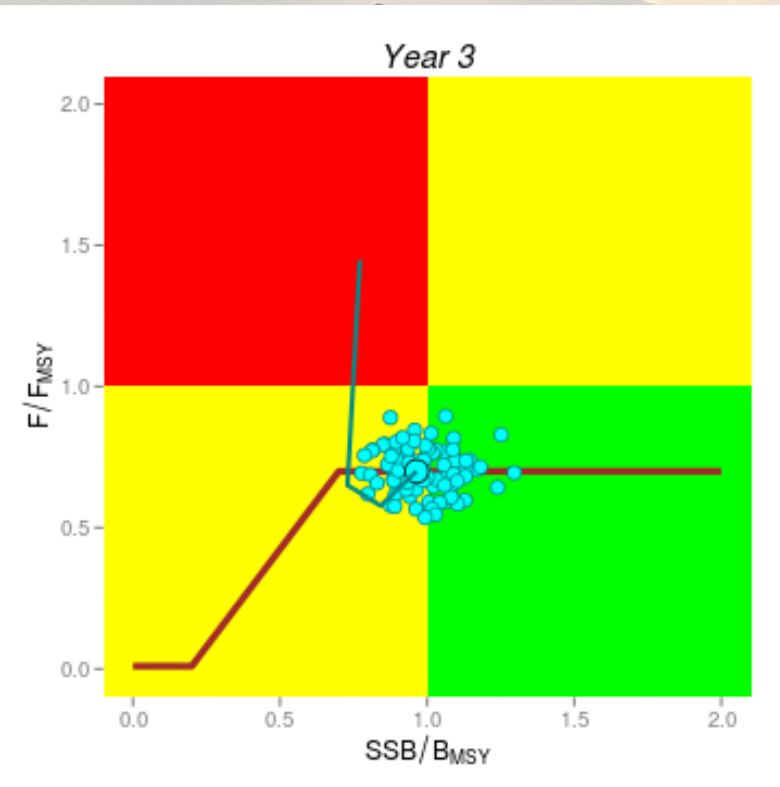

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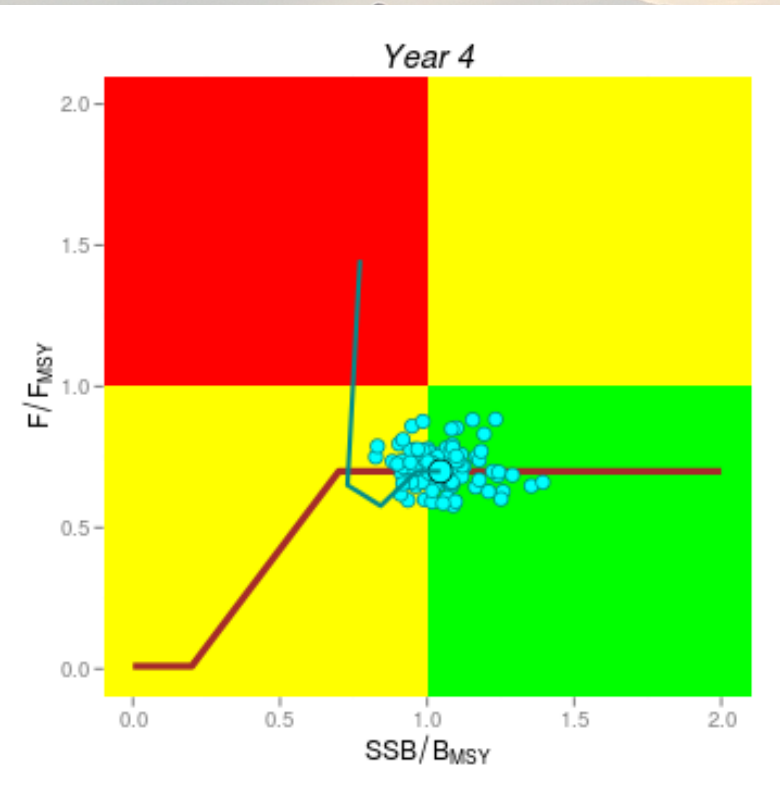

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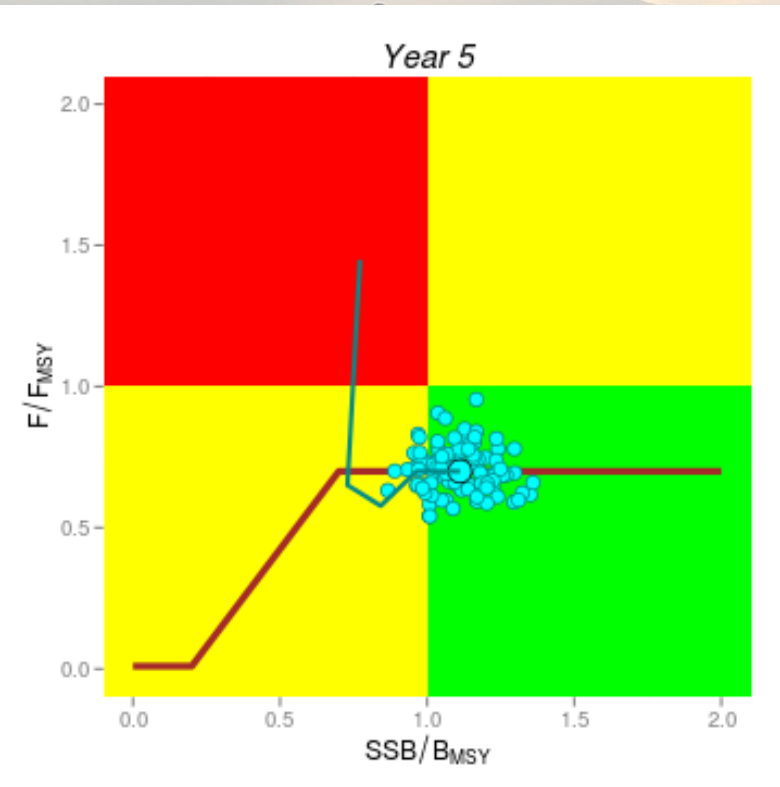

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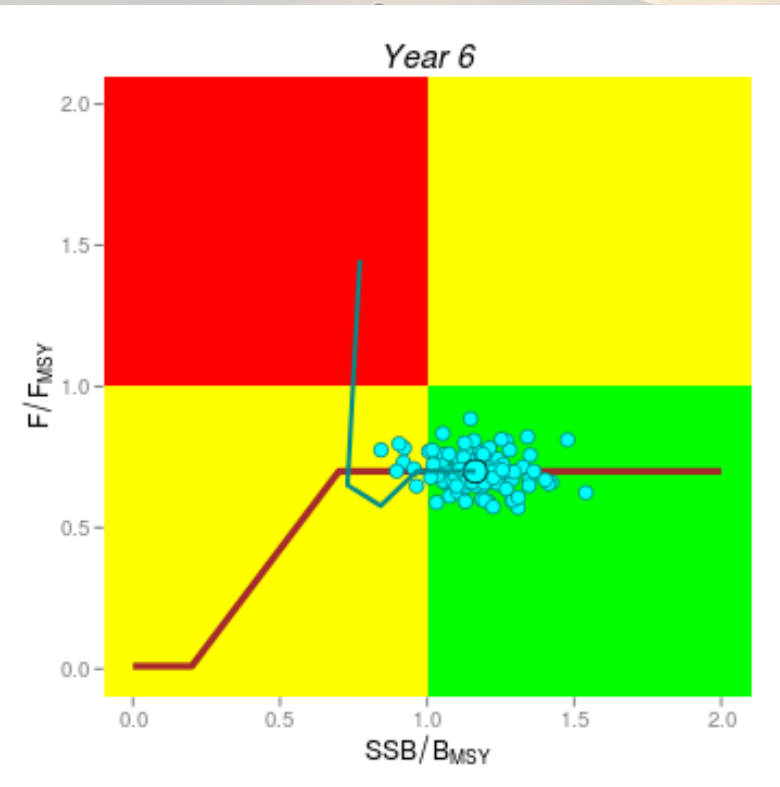

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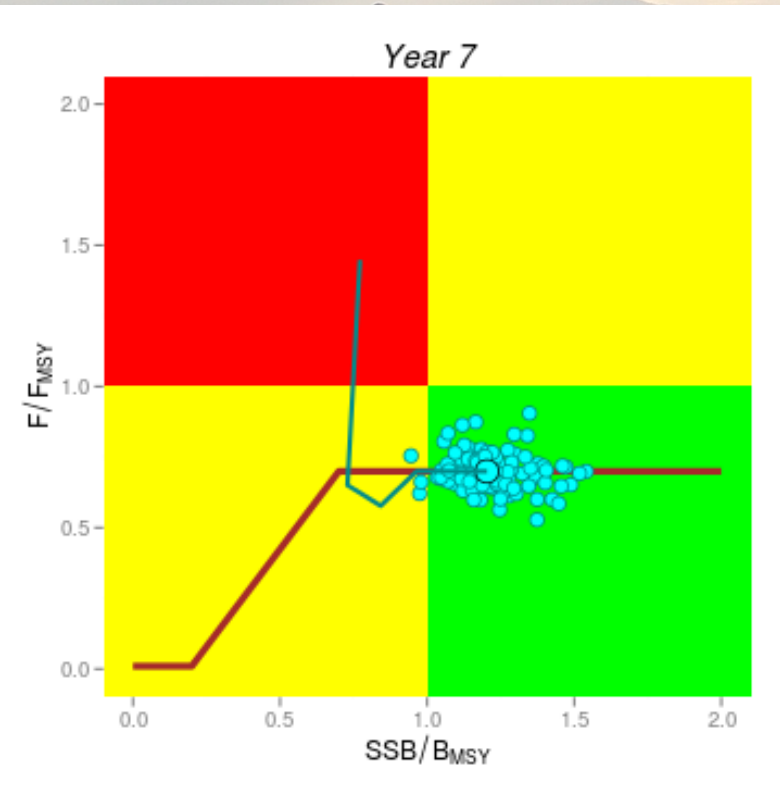

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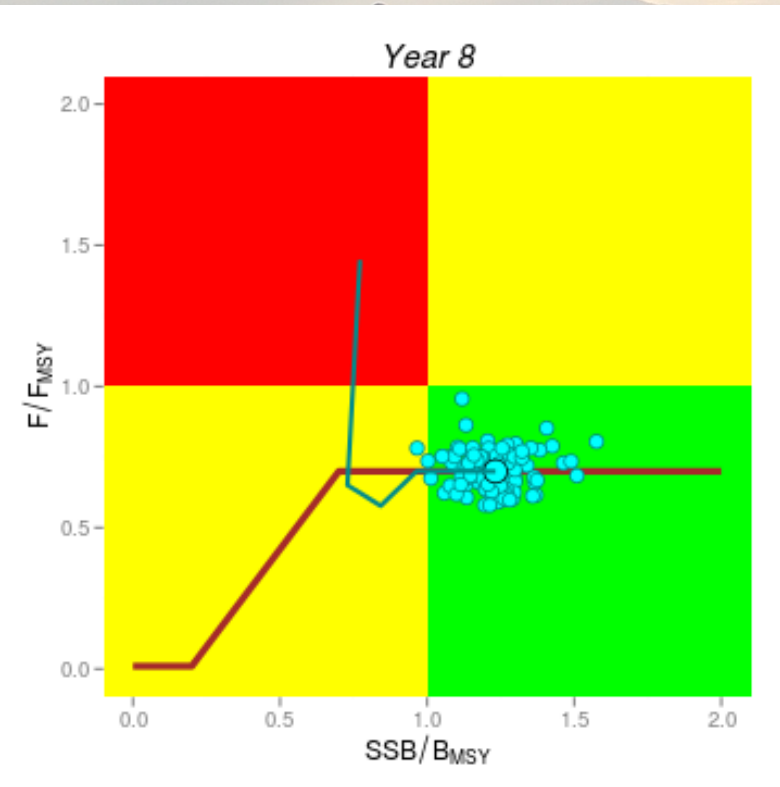
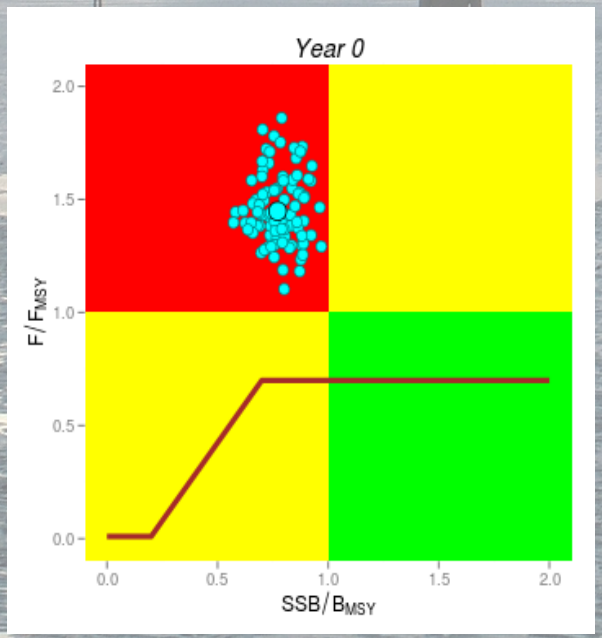


Principles of Decision Making [REC 11-13]

Short a time as possible?



Trade-offs between objectives

Short-term objective to stop overfishing,

Long-term objective to recover stock to a level that can support MSY

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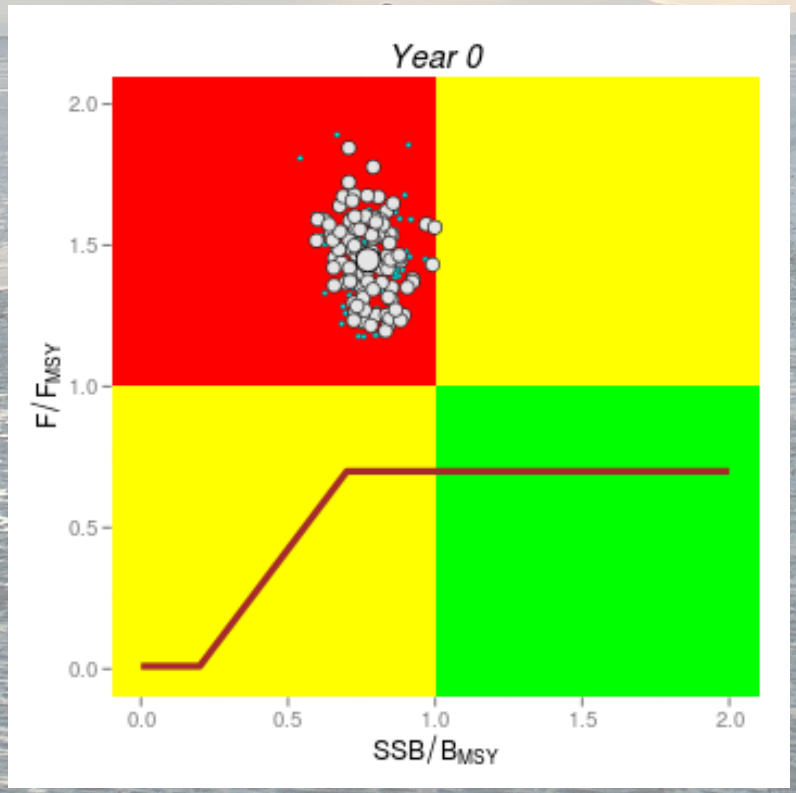

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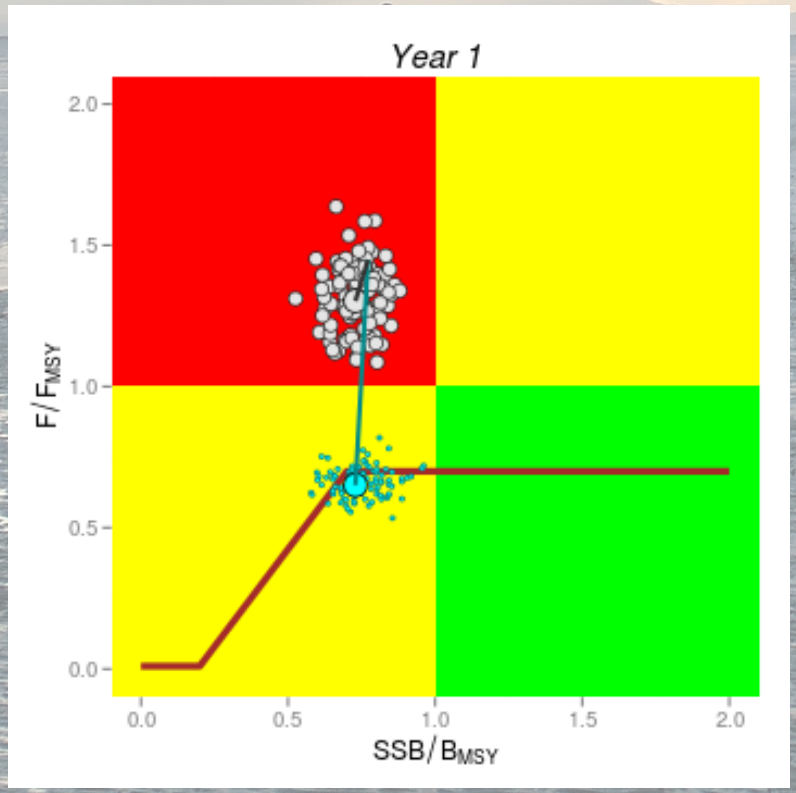

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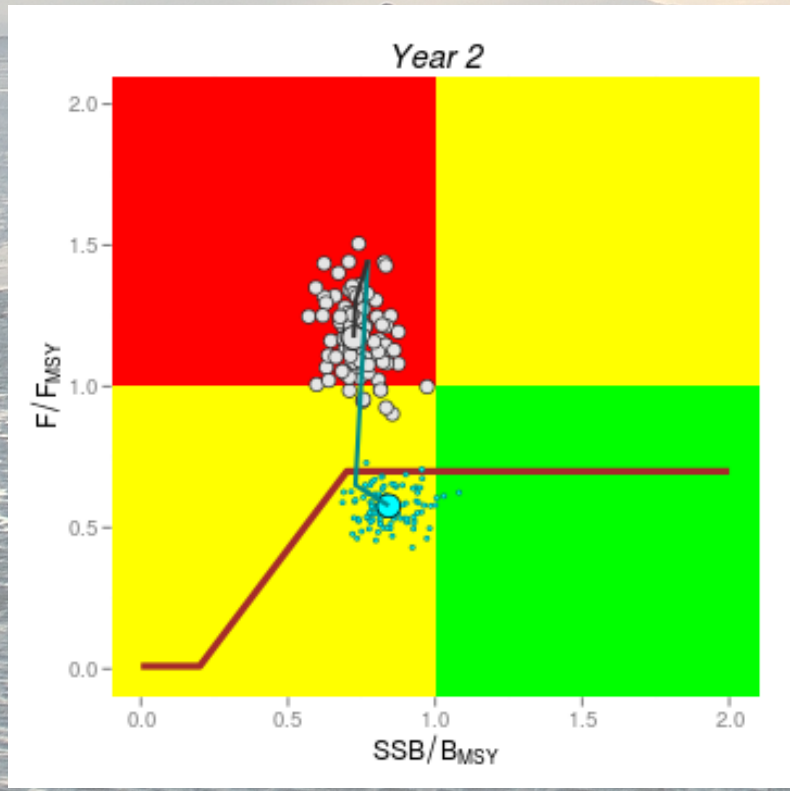

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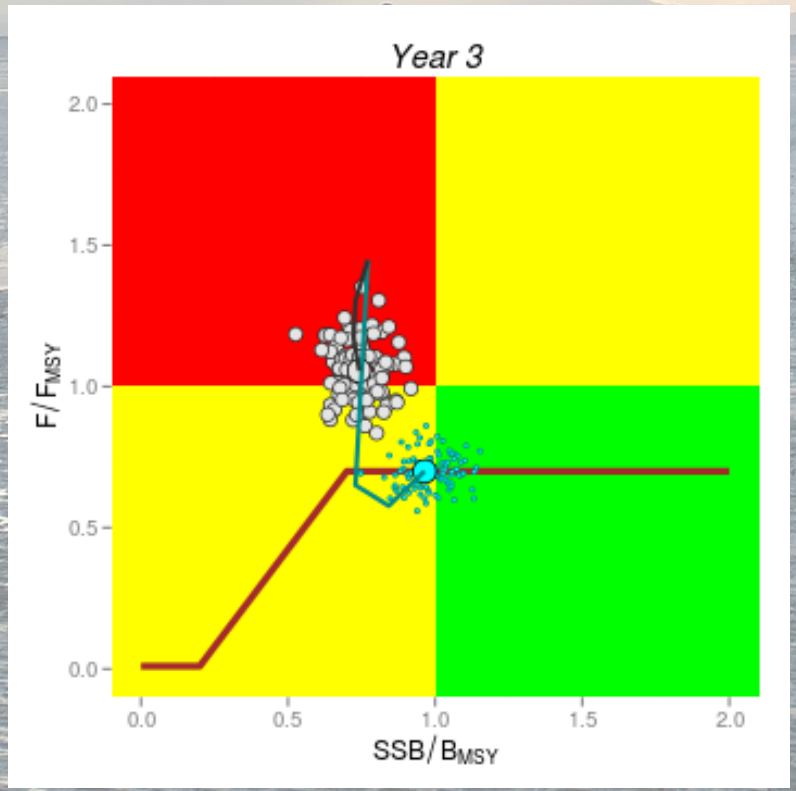

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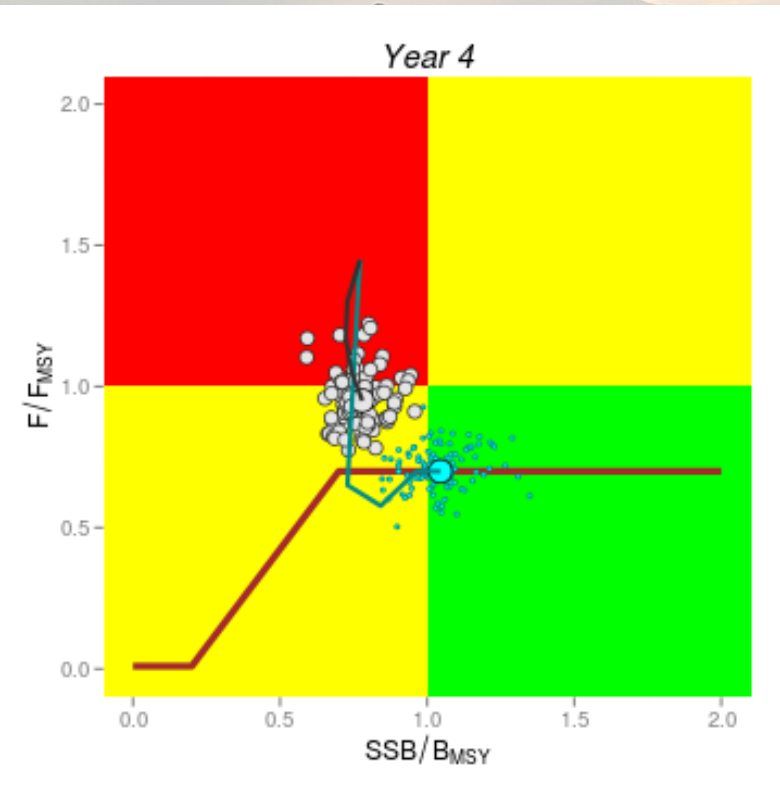

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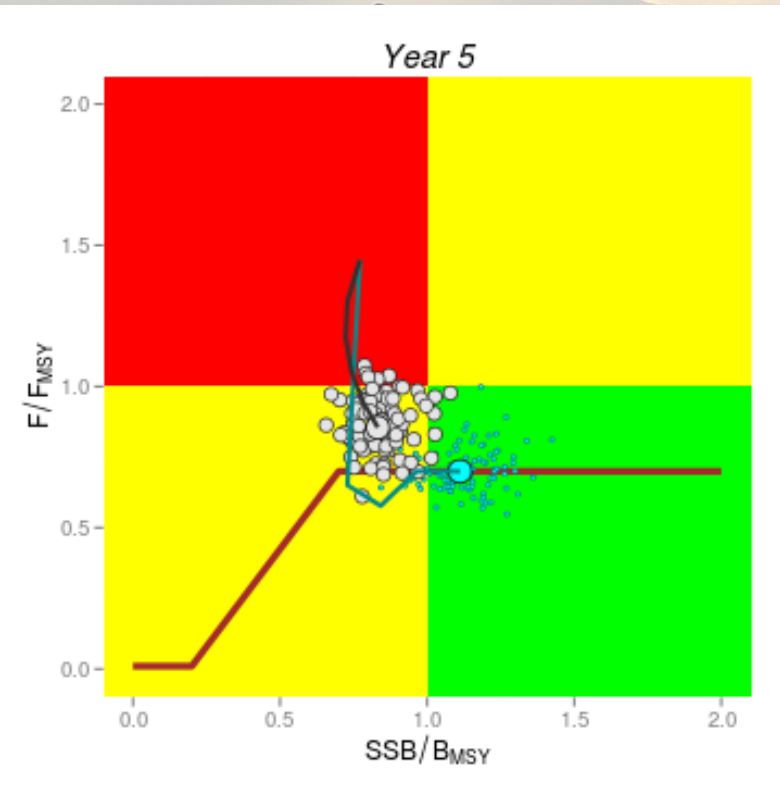

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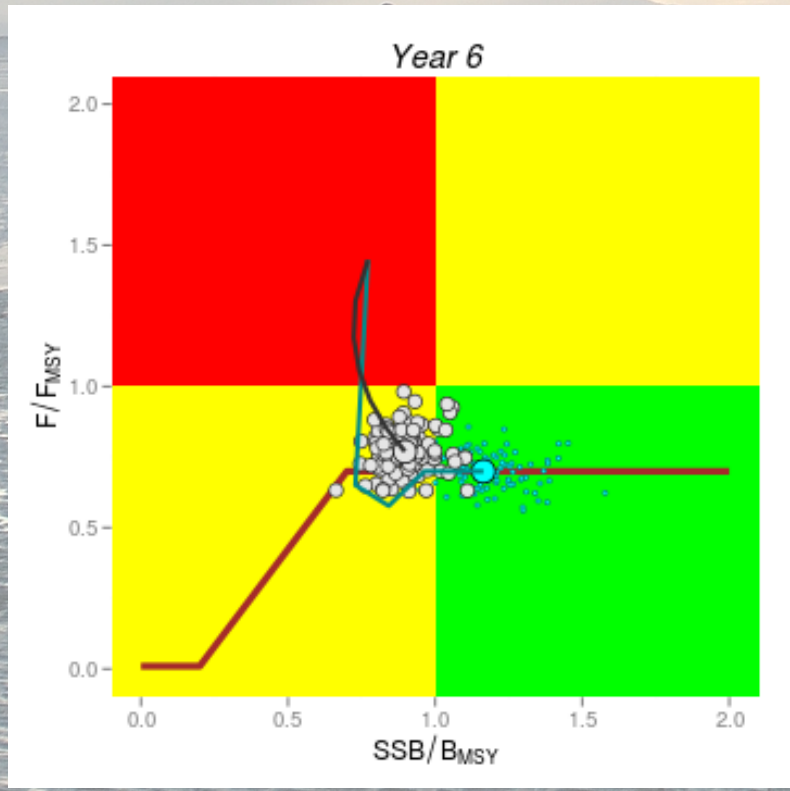

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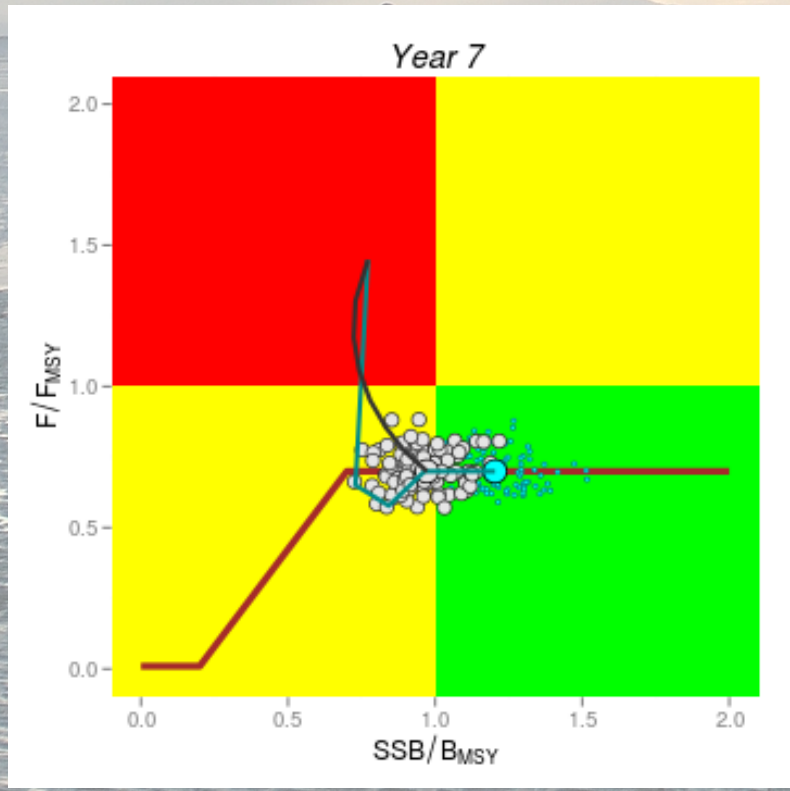

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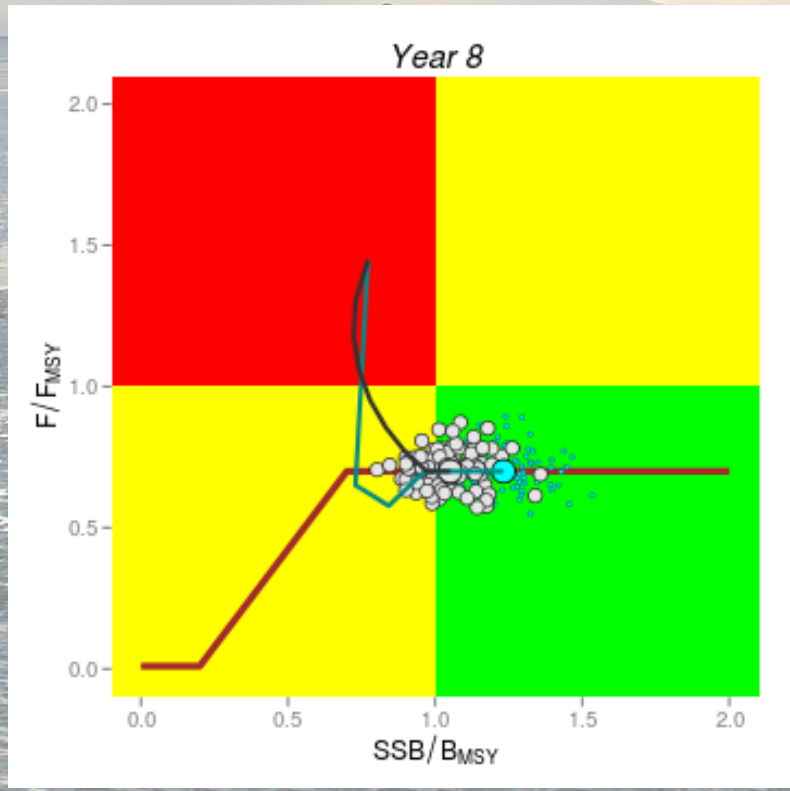

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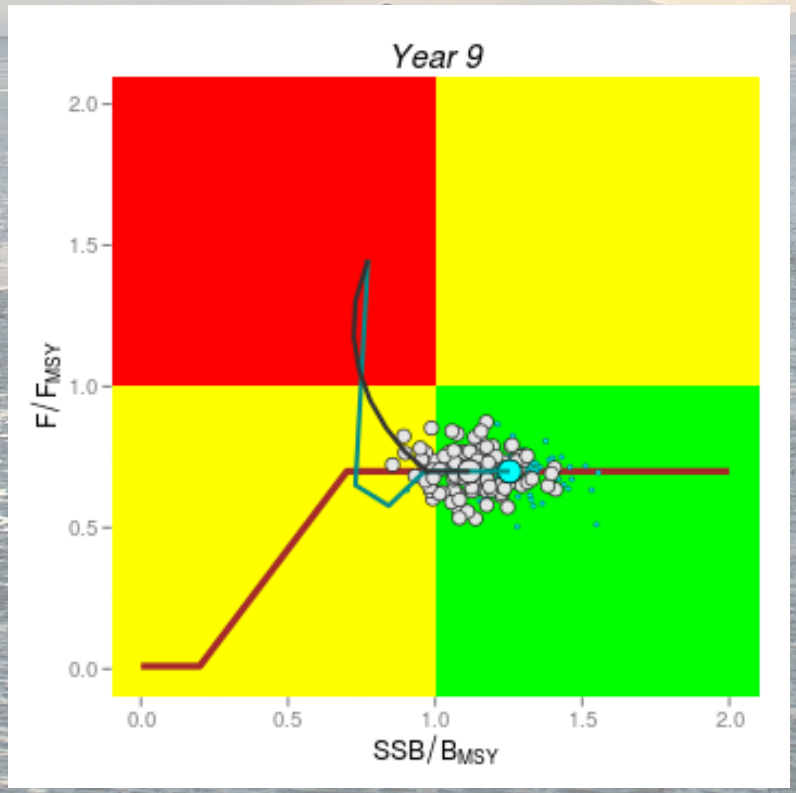

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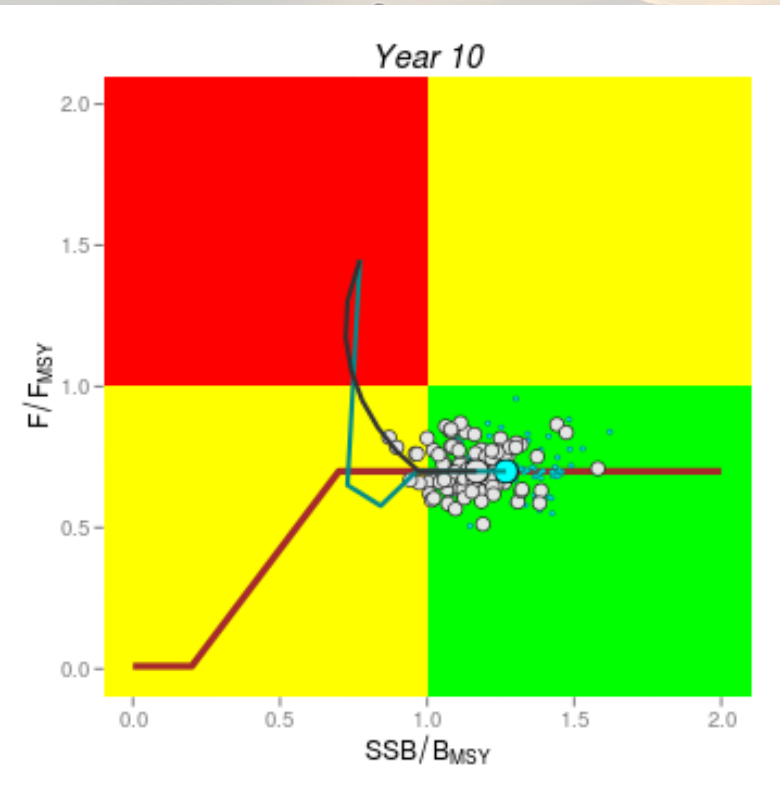

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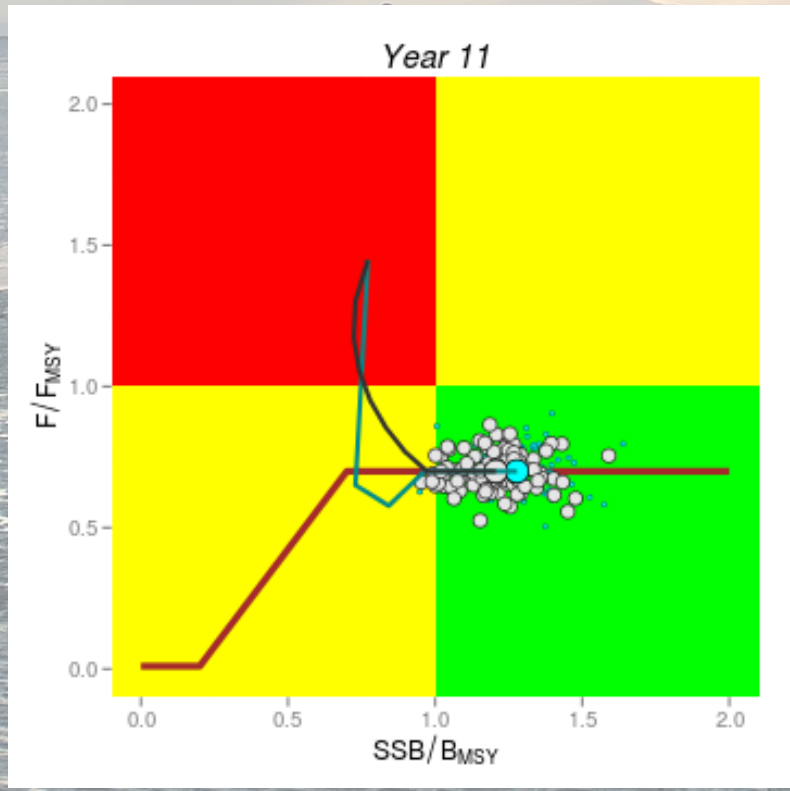
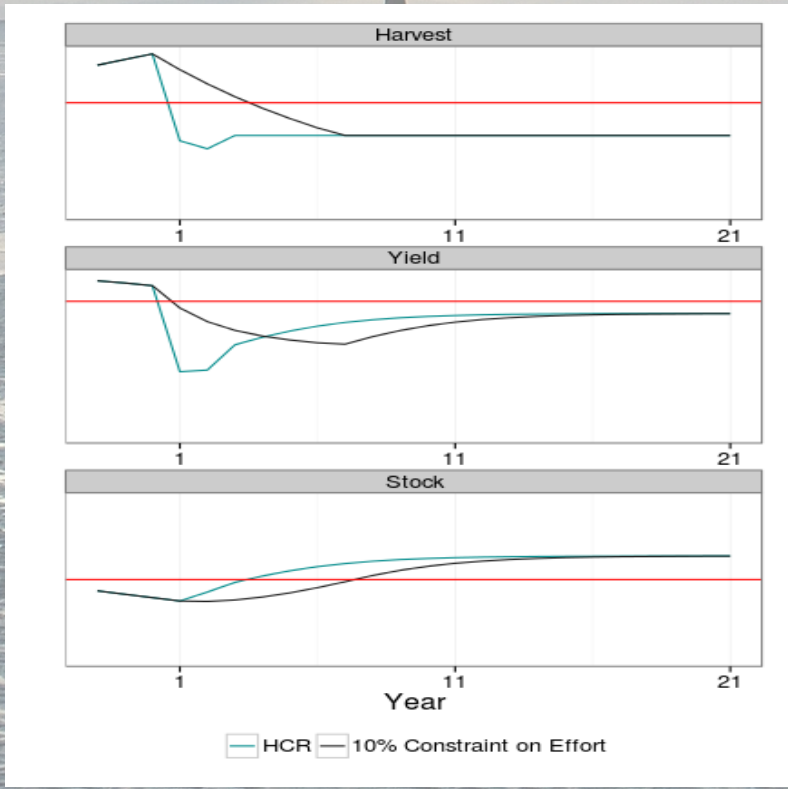


Principles of Decision Making [REC 11-13]

How Do The Recoveries Compare?

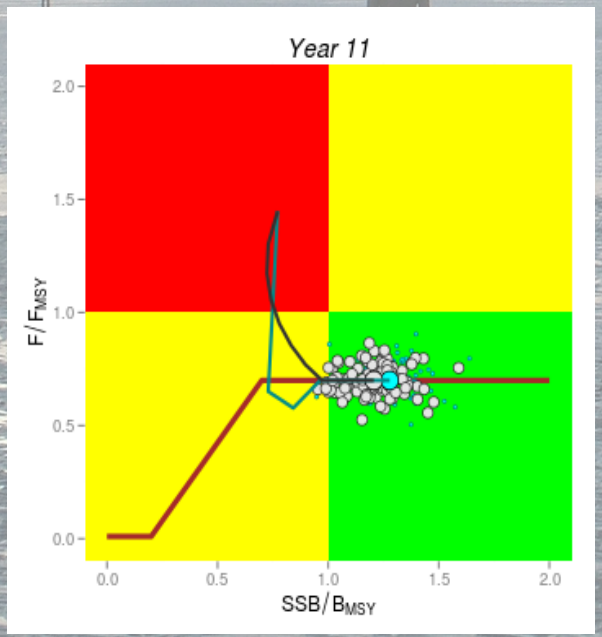


10% F Constraint

- Takes 7 years for F to be reduced to target
- Yield is higher initially but is less in the medium term
- Stock recovery takes twice as long, 6 as opposed to 3 years

Principles of Decision Making [REC 11-13]

Green Quadrant Stock Recovered



- Management measures shall be designed to result in a high probability of maintaining the stock within the green quadrant

MSE Example

MSE Example

Finance Invest the Capital and live off Interest

- Get a bank statement as requiT
- Warning! Investments can decrease as well as increase in value

Fisheries Keep the stock above B_{MSY} and harvest the surplus

- Only get a stock assessment once a year, if lucky!
- Estimate of current stock status has large uncertainty
- What if environmental change Tuces recruitment?

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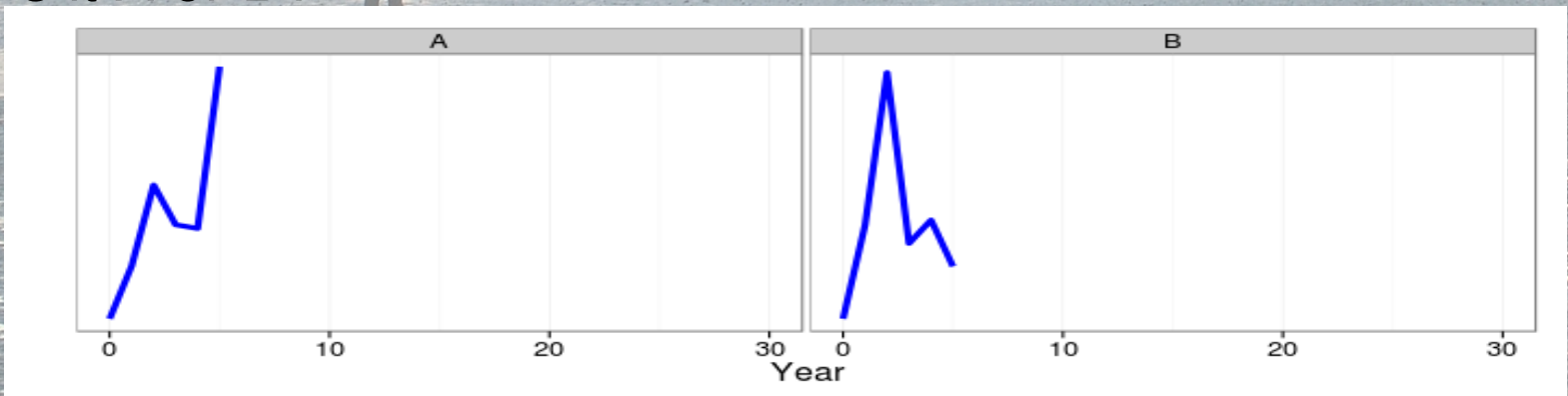

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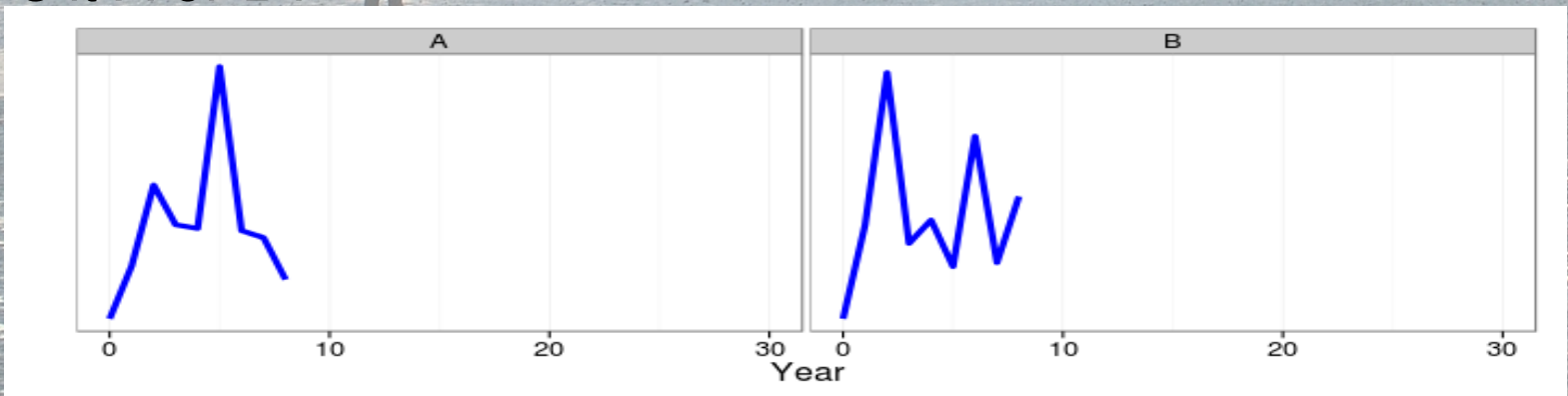

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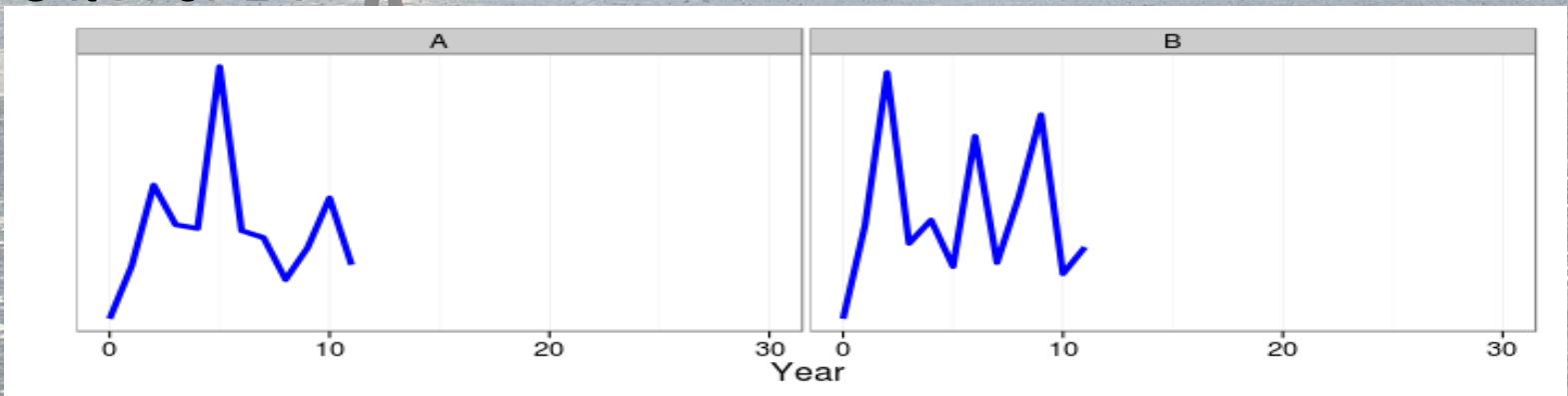

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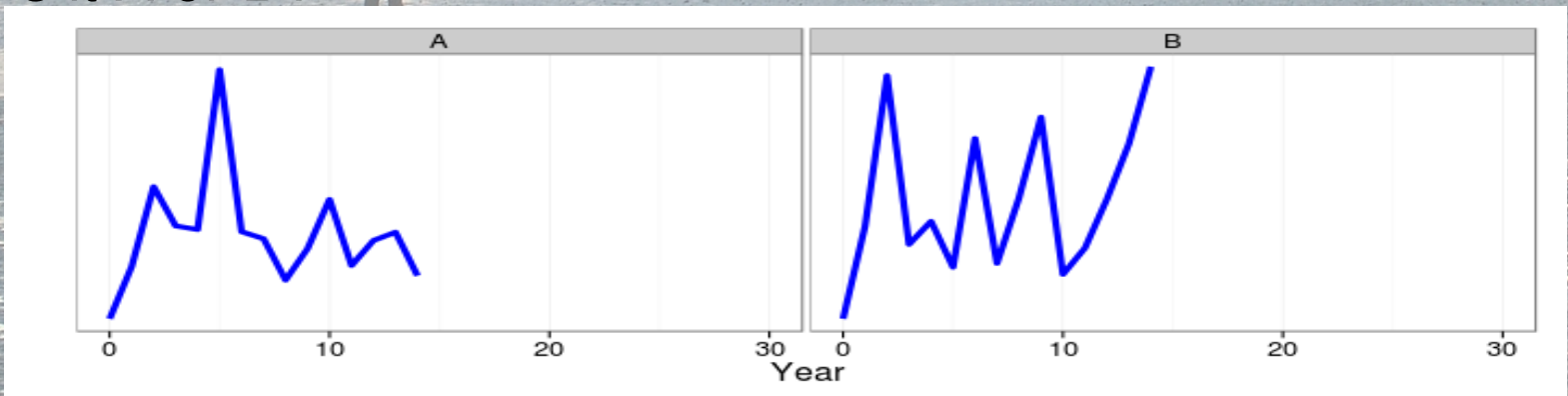

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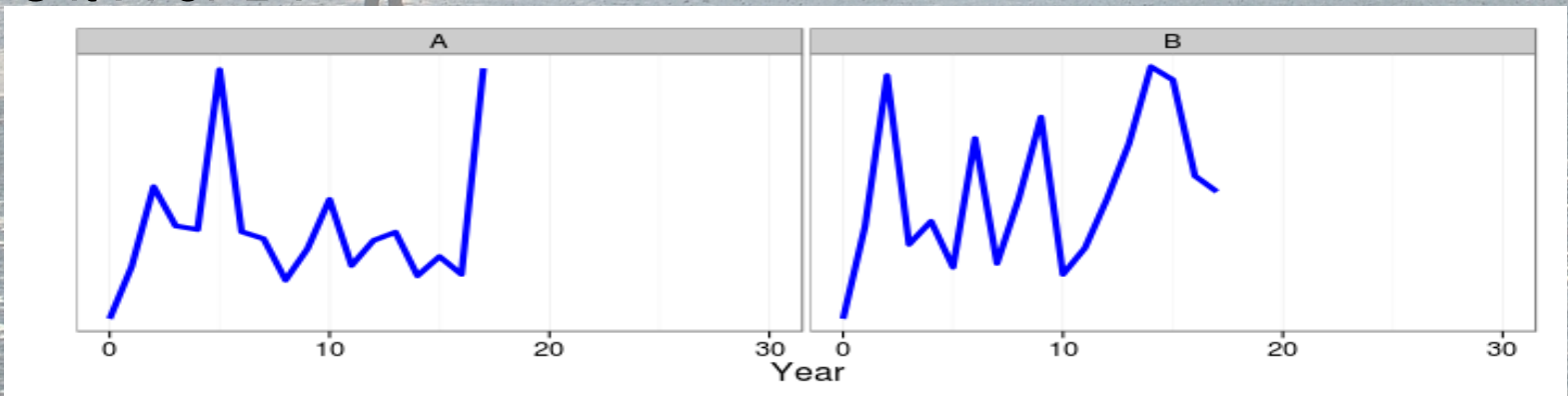

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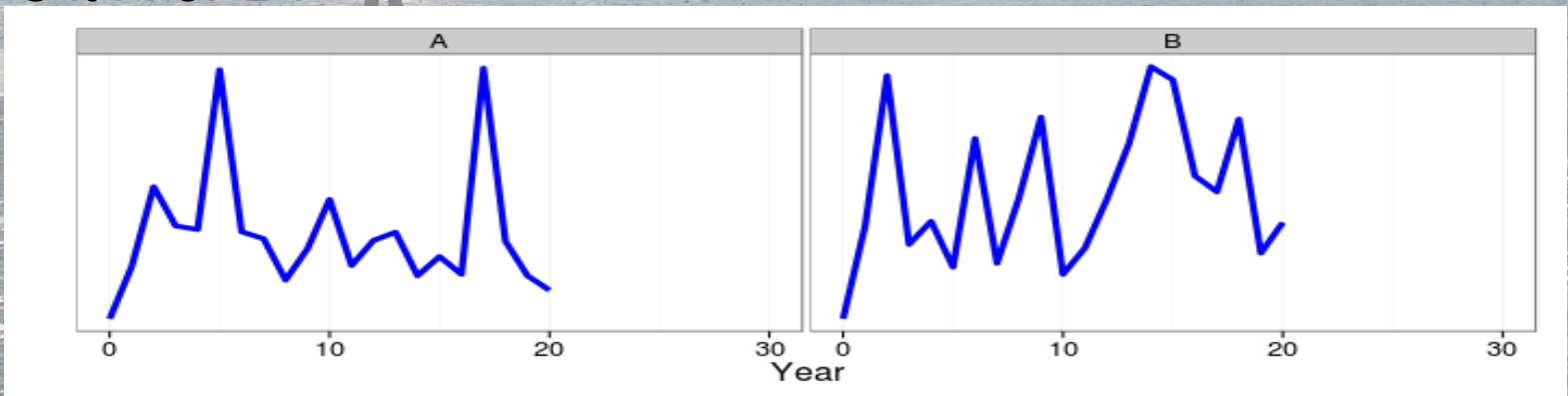

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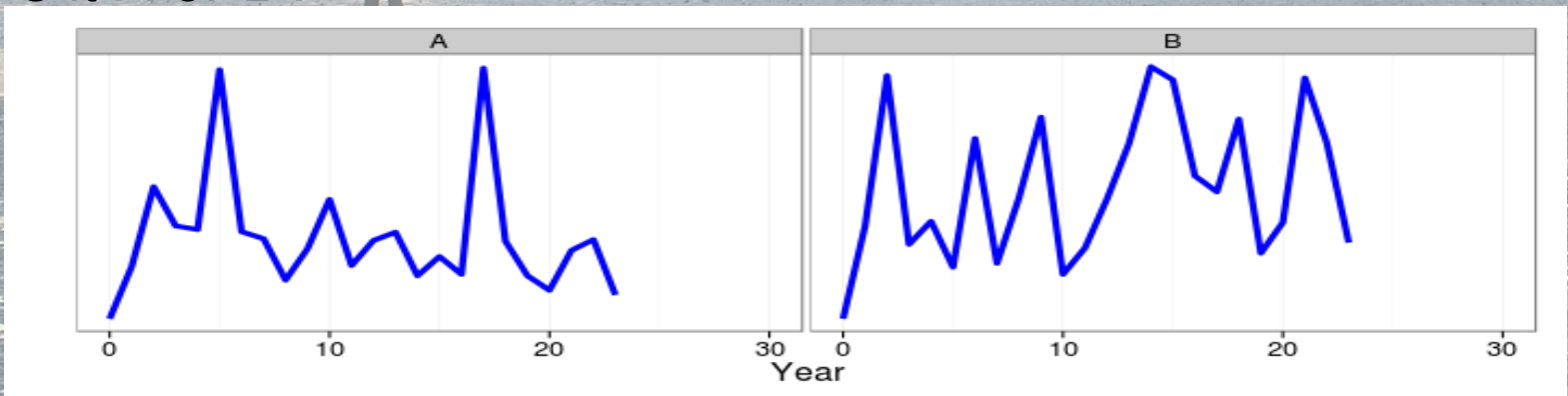

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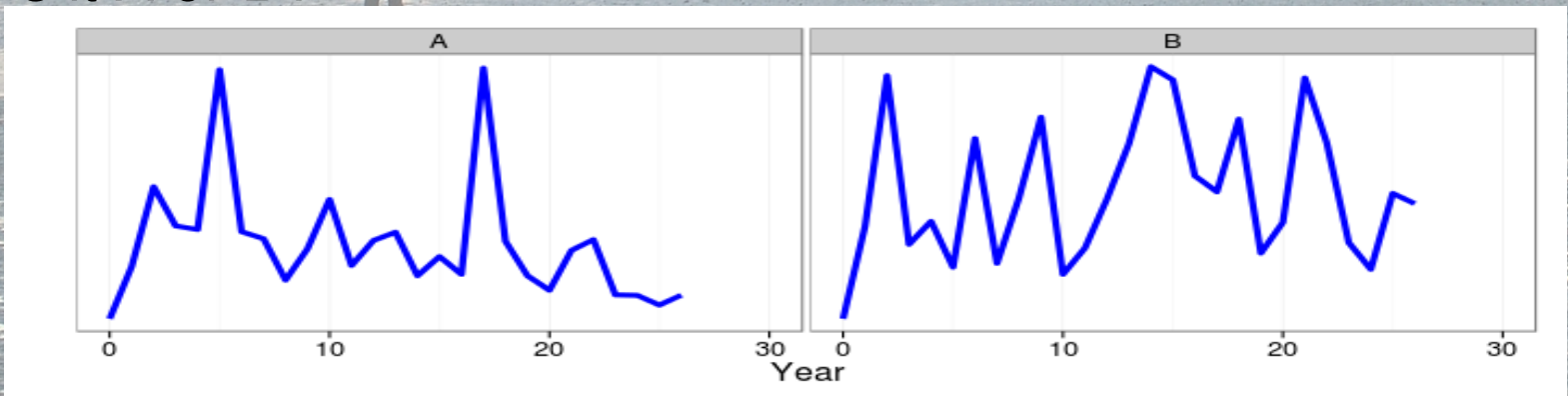

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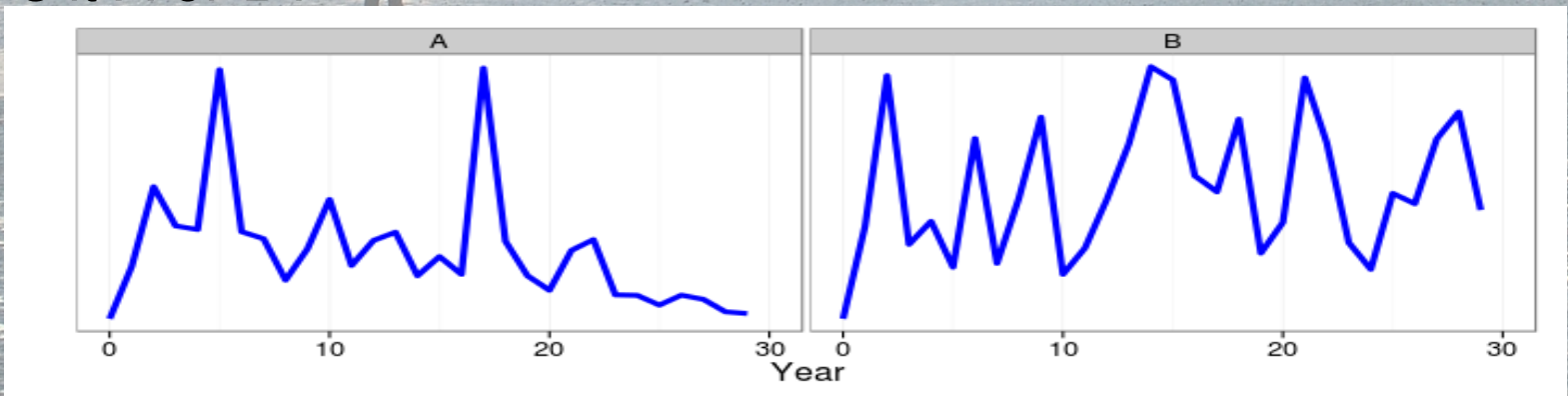

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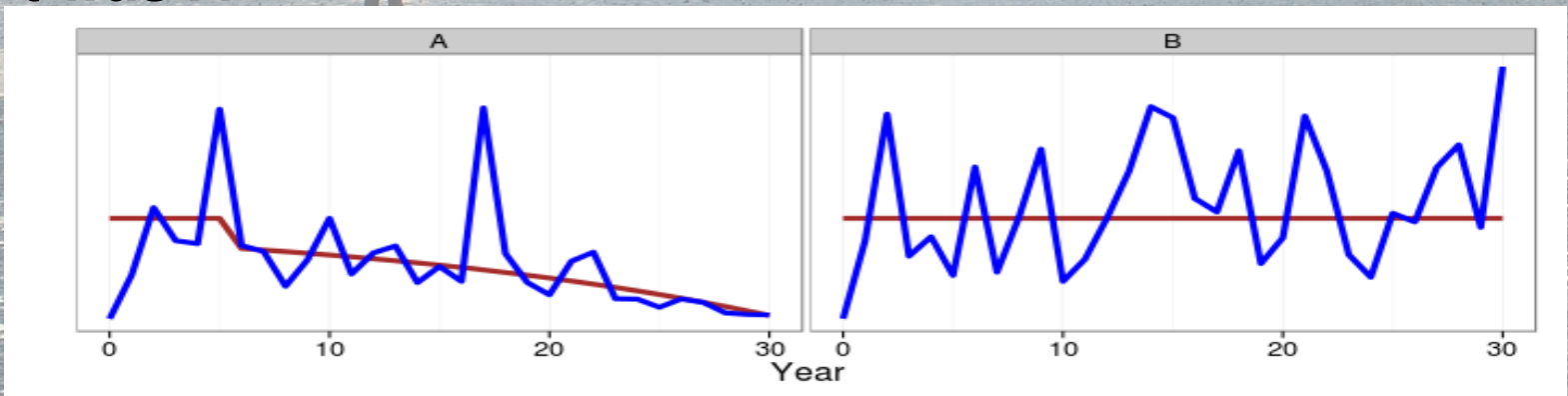
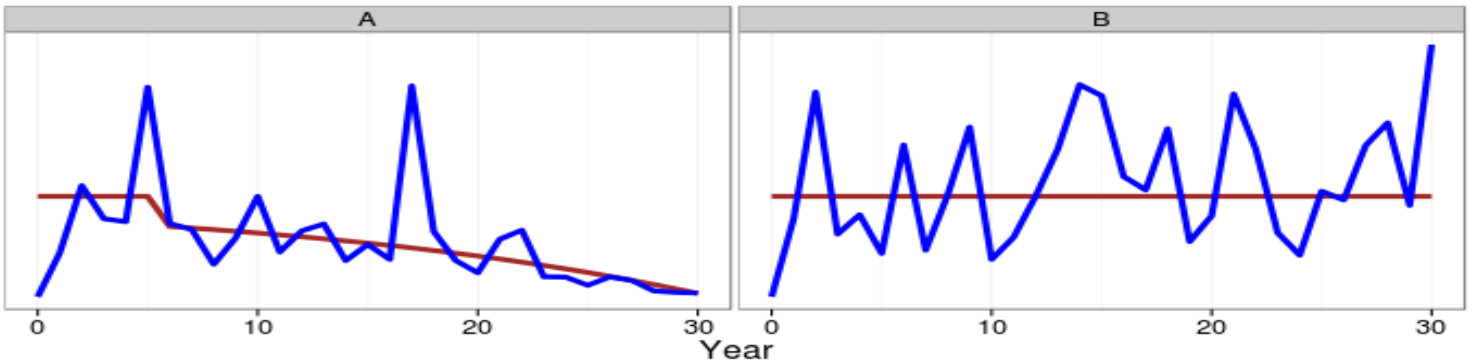


MSE Example

There has been a Regime Shift

It was A, but it took 20 years to work it out!



MSE Example

It took 20 years to work out that the stock had experienced a decline unrelated to fishing

But we can not wait 20 years!

What to do? run an MSE

- Simulate two hypotheses, i.e.
  - No Change or
  - Change in Productivity.
- Evaluate alternative management strategies i.e.
  - **I** Constant Catch
  - **II** 5% of Assessed Stock Biomass
  - **III** 80% of Last Years Catch + 20% of Catch under II

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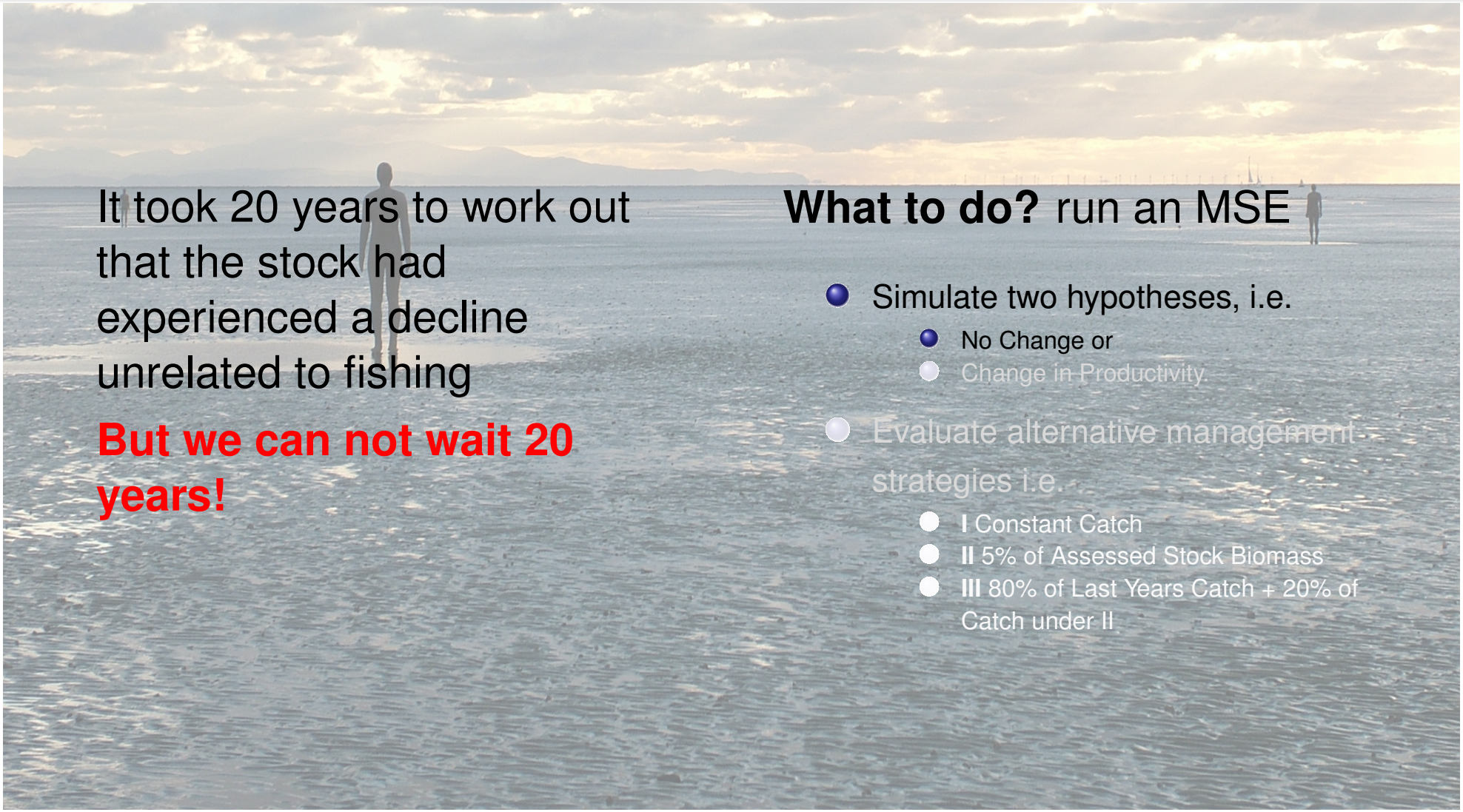

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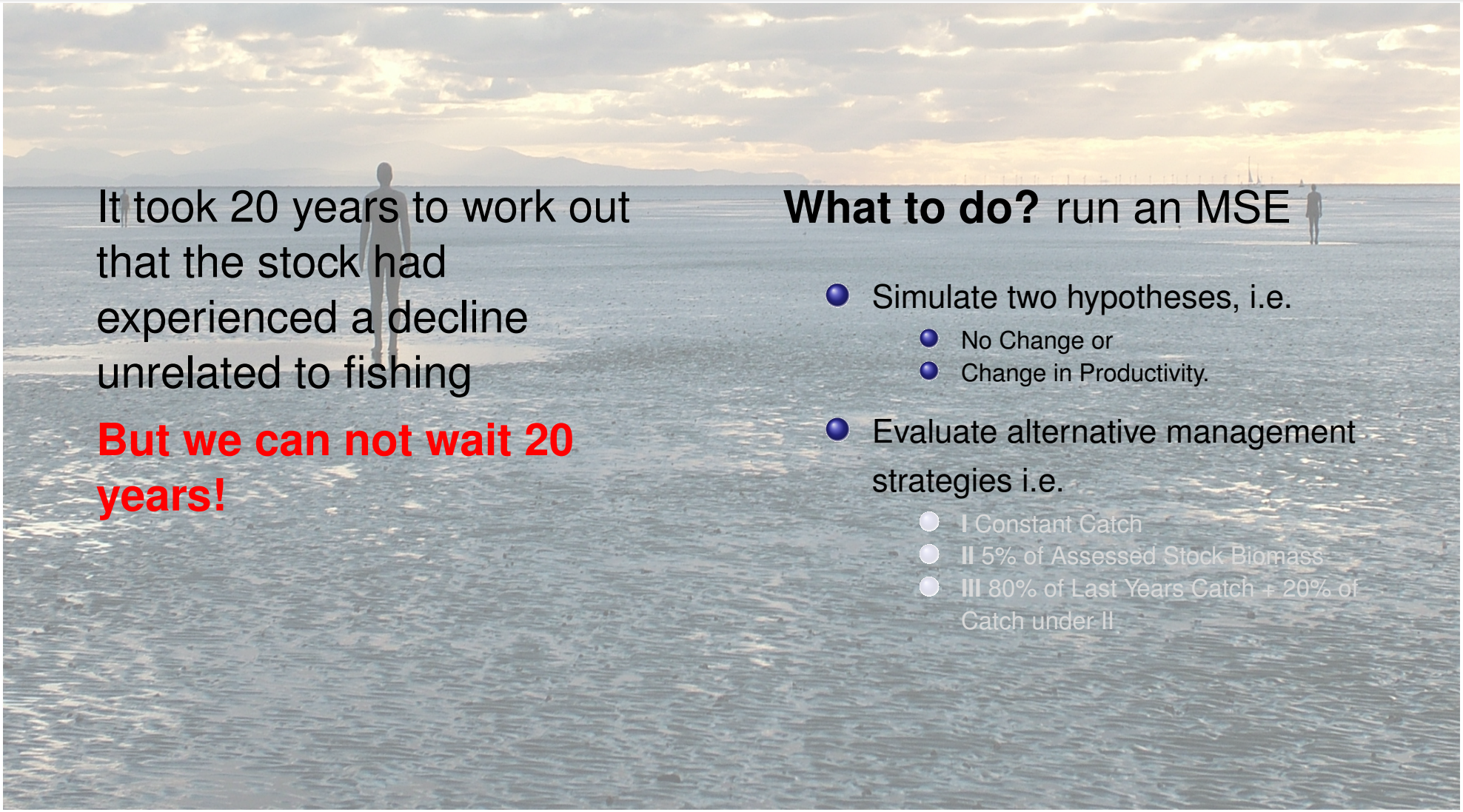

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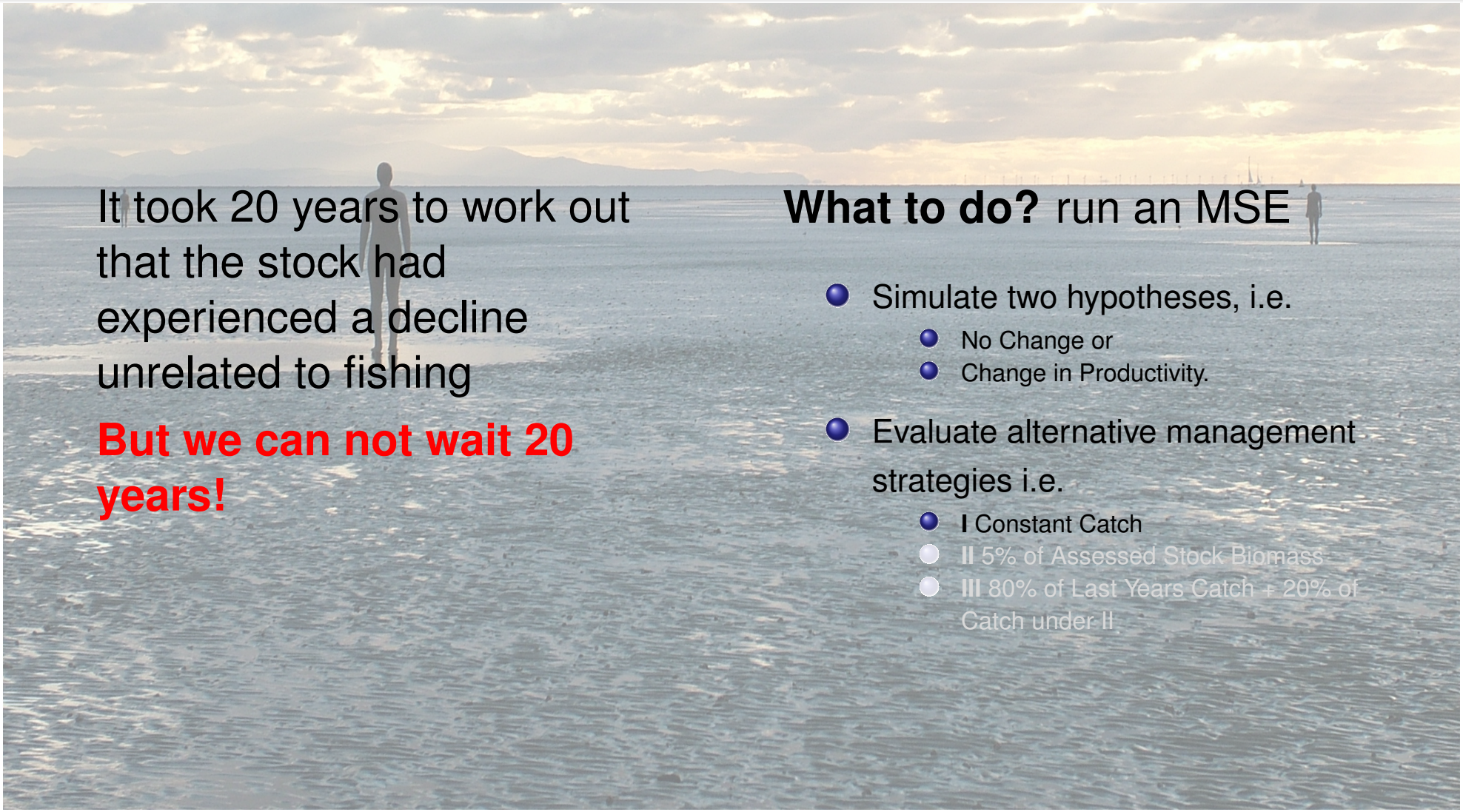

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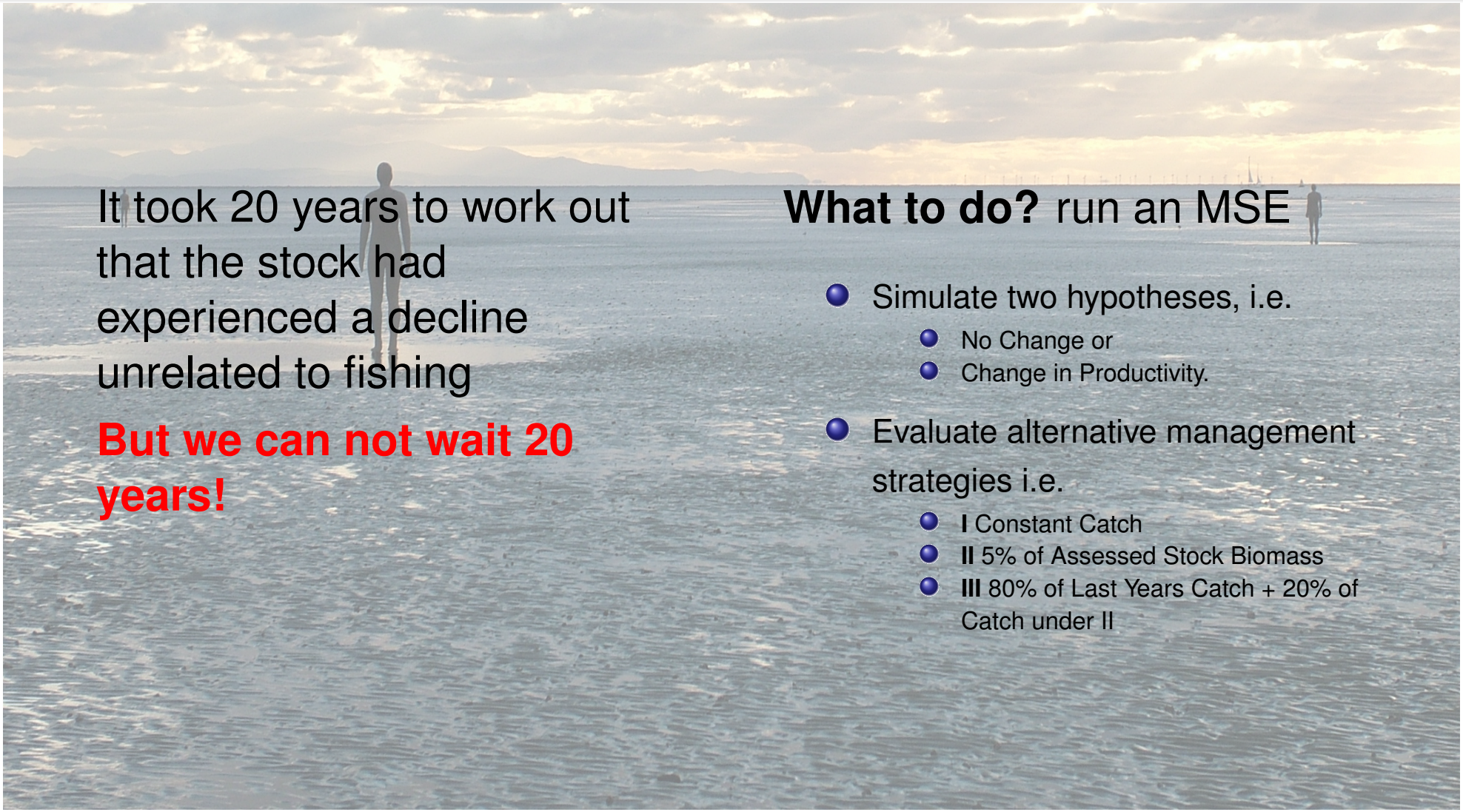

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What to do? run an MSE

- Simulate two hypotheses, i.e.
  - No Change or
  - Change in Productivity.
- Evaluate alternative management strategies i.e.
  - **I** Constant Catch
  - **II** 5% of Assessed Stock Biomass
  - **III** 80% of Last Years Catch + 20% of Catch under II

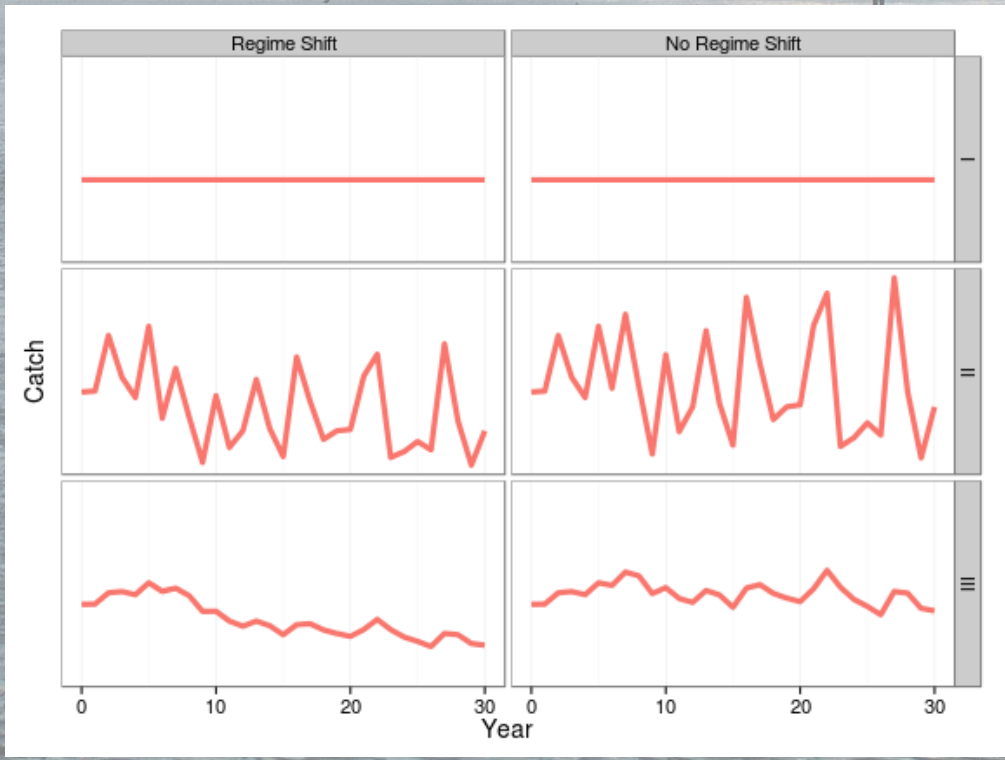
MSE Example

Which Strategy is most robust

Strategies

- **I** Constant catch
- **II** 5% of Assessed stock biomass
- **III** 80% of last years catch + 20% of catch given under II

What are the yields like?



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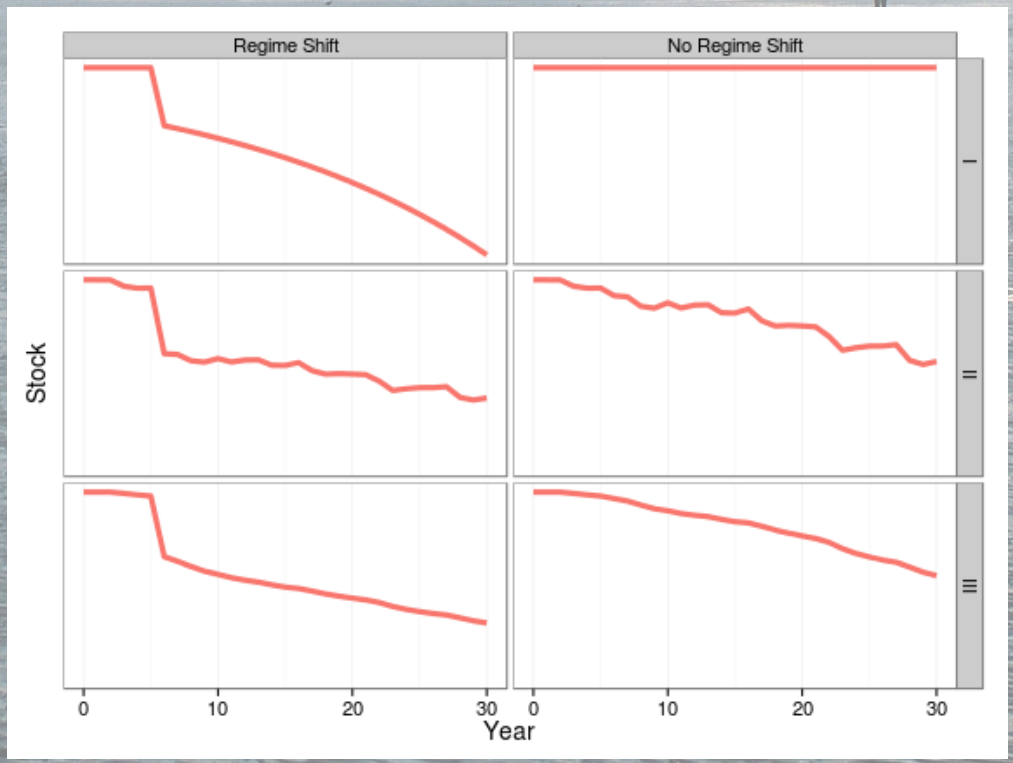

MSE Example

Run more simulations to look at variability

Strategies

- **I** Constant catch
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Results

- Catch most variable under **II**

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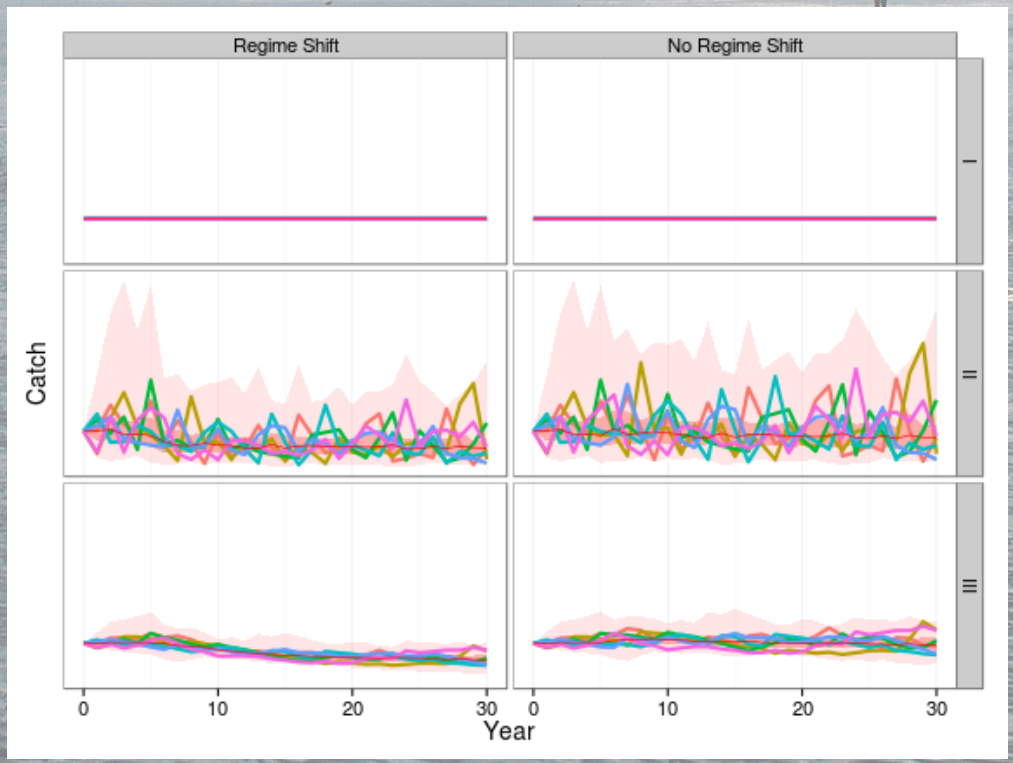

MSE Example

Run more simulations to look at variability

Strategies

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Results

- **I** and **II** are robust

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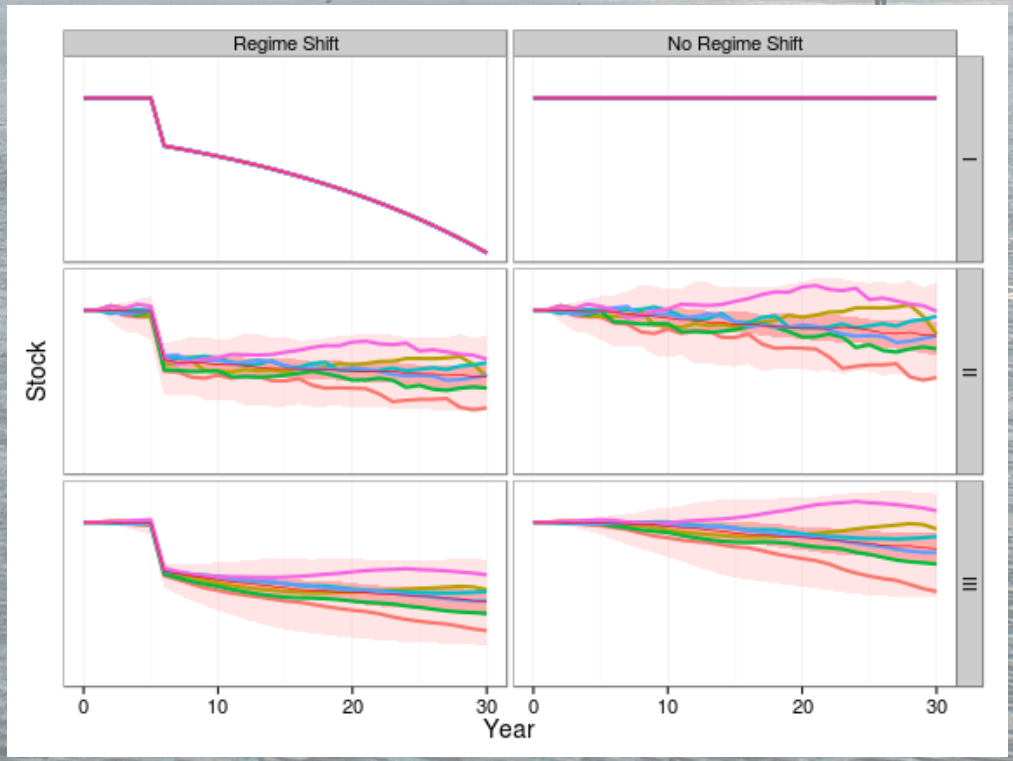

MSE Example

Results from MSE

- Strategies **II** and **III** are robust
- Catch is more variable under Strategy **II**
- Risk of not being in the Green Quadrant?
- Trade-offs between objectives?
- Risk of SCRS getting dynamics wrong and Regime Shifts, ...
- How to prioritise funding to get appropriate research, monitoring and enforcement levels? **Josu made me add this!**

MSE Example

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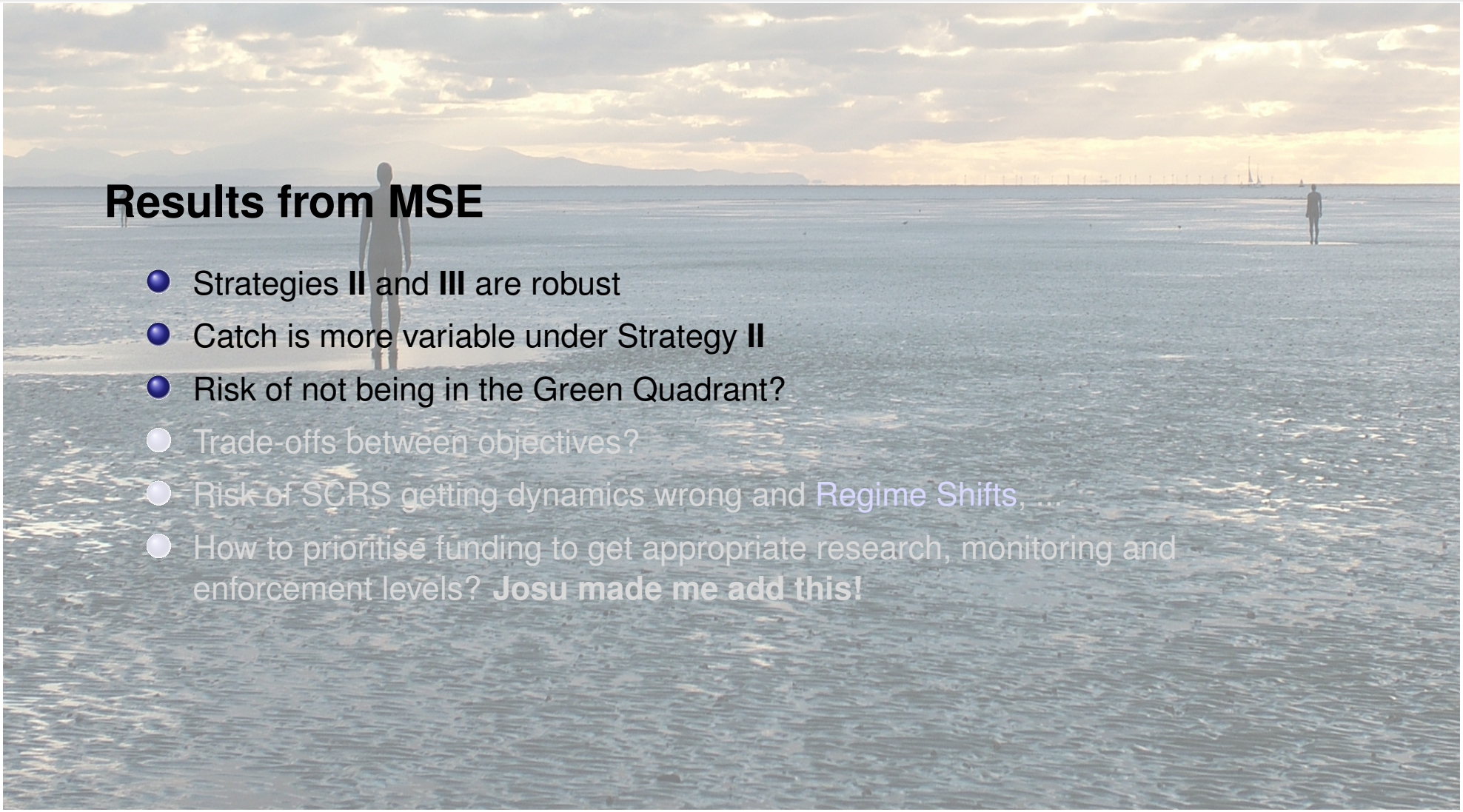

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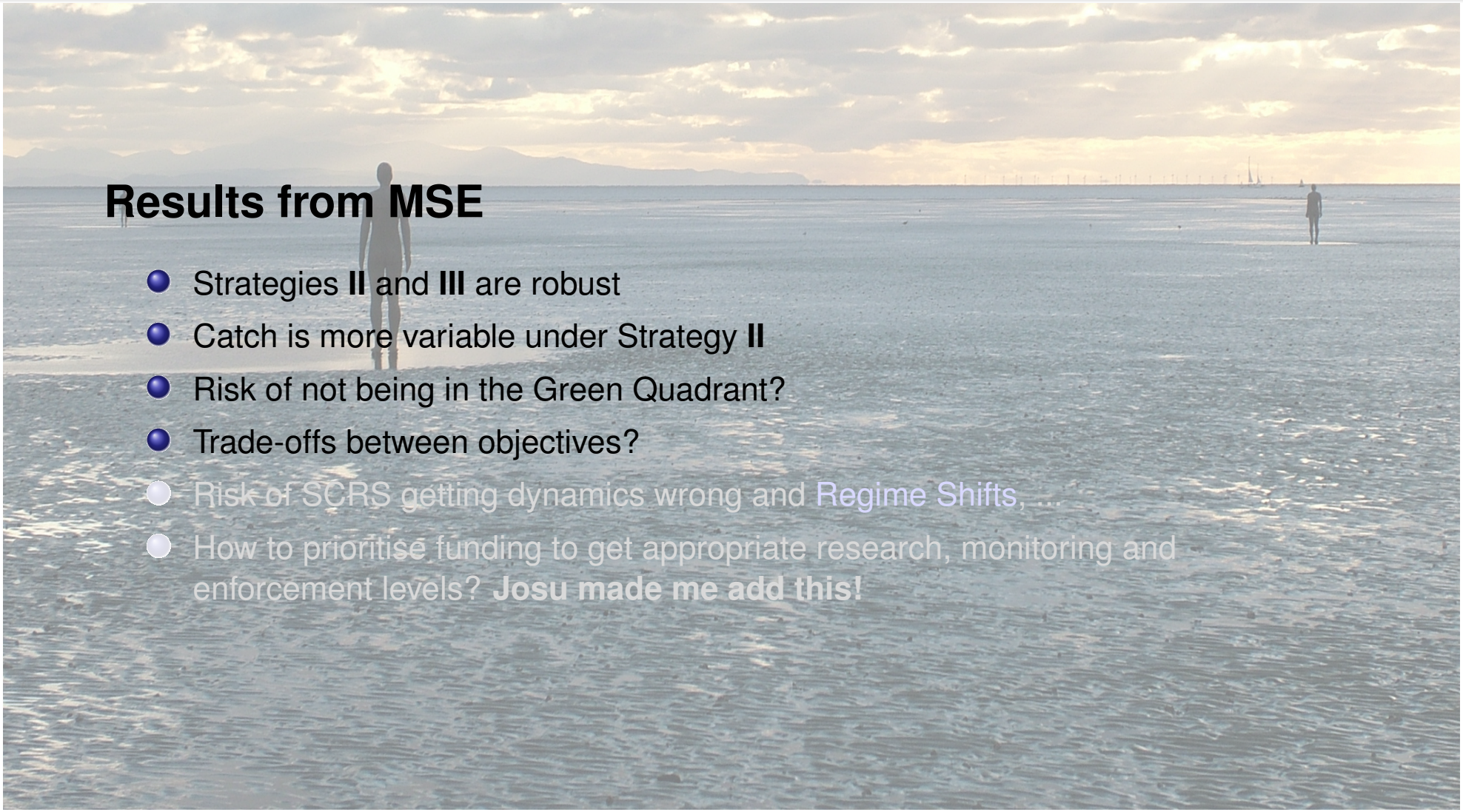

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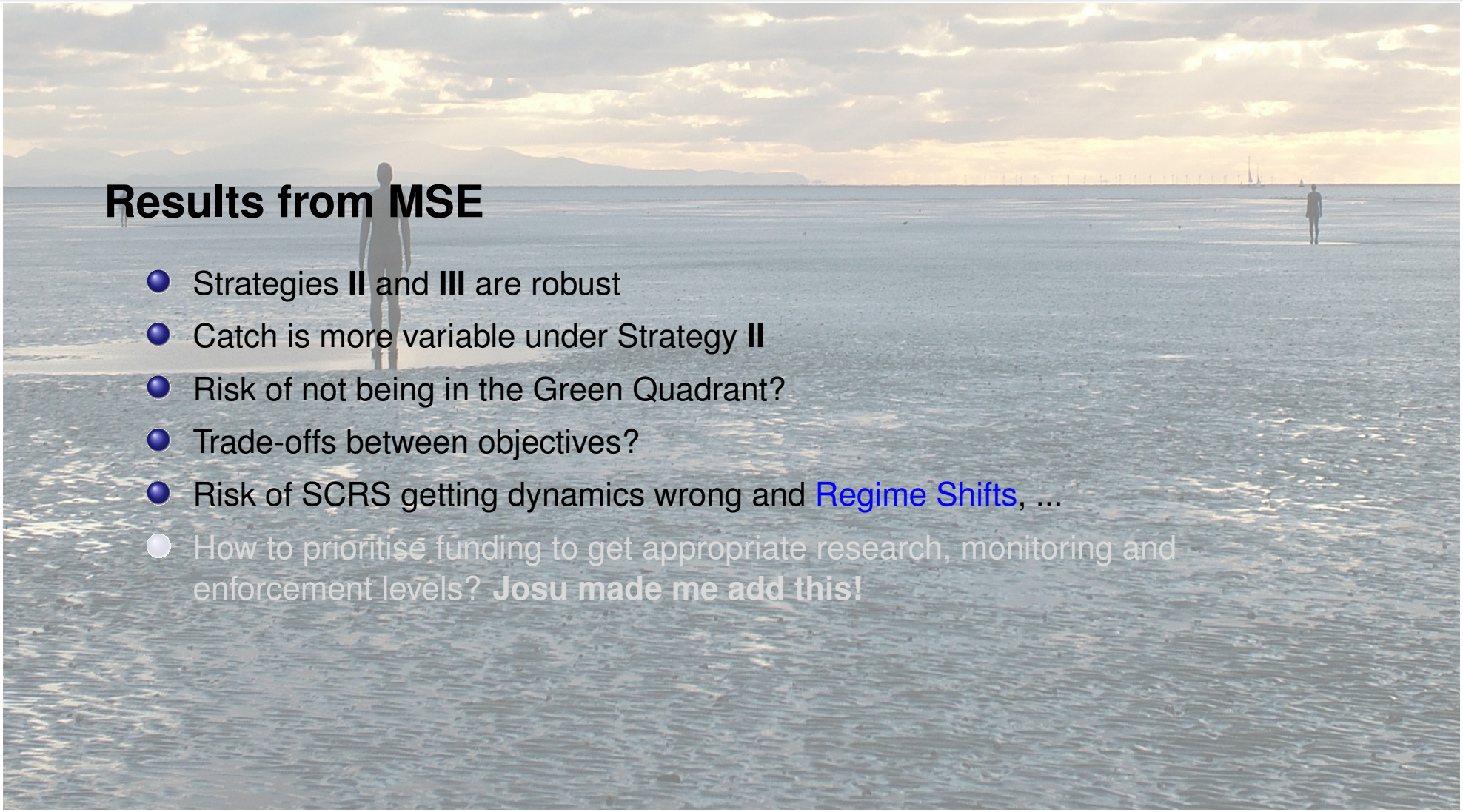

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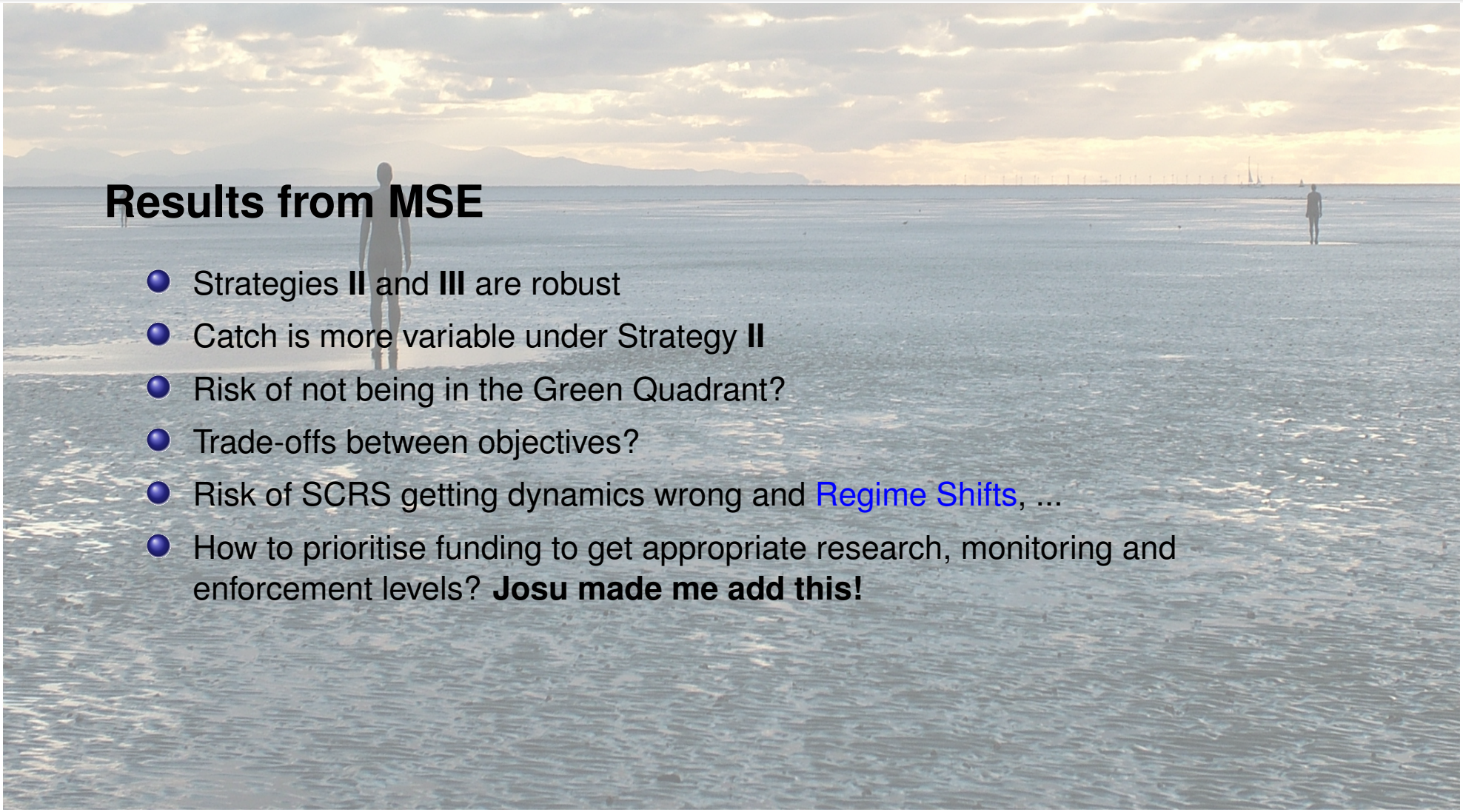

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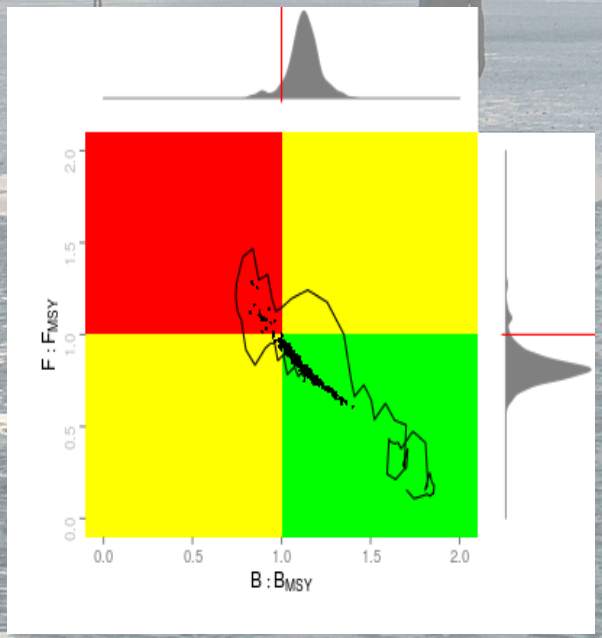
Conditioning Operating Models

Stock Assessment

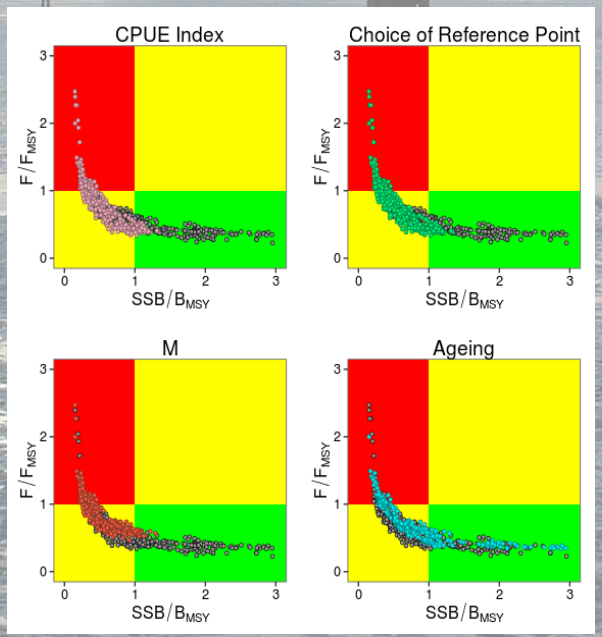


Scenarios

- North Atlantic Swordfish: **1 Assessment**
- North Atlantic Albacore: **7 Assessments** Alternative CPUE Indices
- Mediterranean Bluefin Tuna: **6 Assessments** 2 sets of Historical Catch and 3 Future Recruitment Levels

Conditioning Operating Models

Running an MSE requires many Operating Models



Many more hypotheses to be considered

- Task I & II: Quqlity of data
- Cpue Indices:
- Choice of Reference Points:
- M: Knowledge of biology
- Ageing: Data processing
- ...

MSE Work By SCRS

MSE Work In Progress

Generic **Operating Model** based either on an existing stock assessment, e.g. North Atlantic Albacore, or life history characteristics for data poor stocks.
Management Procedure a biomass stock assessment model using only CPUE and catch, e.g. North Atlantic Swordfish.

GBYP **Management Procedures** based on an stock assessment models or data only (e.g. Southern Bluefin).
Operating Model includes a range of hypotheses and will simulate data sets to reflect uncertainty about knowledge of biology, ecology and our ability to observe and control the fisheries.
Evaluation with respect to their ability to meet multiple management objectives and trade-offs between them for different choices e.g. to invest in surveys, tagging, biological studies, more monitoring, better control, ...

Six Step Process for Conducting an MSE

Six Step Program

Identification of management objectives and mapping these to performance measures to quantify how well they are achieved

Selection of hypotheses about system dynamics for building **O**perating **M**odels (i.e. Simulation Models)

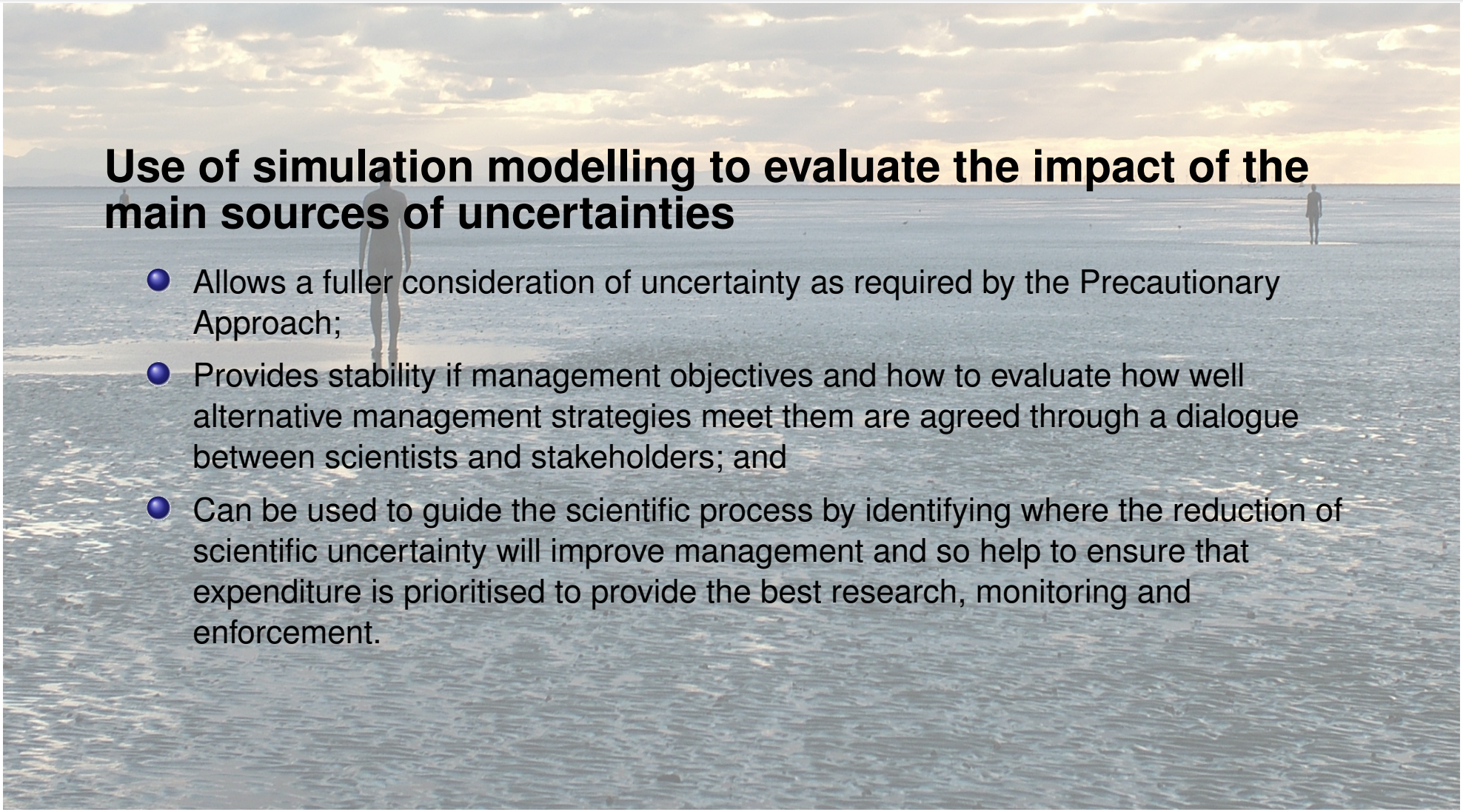
Building the simulation models, i.e. Conditioning the OMs on data and knowledge, and possible rejection of and weighting of the different hypotheses.

Identifying alternative management strategies, i.e.the combination of pre-defined data, stock assessment methods and reference points and HCRs.

Running the simulations using the HCRs as feedback control procedures; and

Agreeing the Management Strategies that best meet management objectives.

Management Strategy Evaluation



Use of simulation modelling to evaluate the impact of the main sources of uncertainties

- Allows a fuller consideration of uncertainty as required by the Precautionary Approach;
- Provides stability if management objectives and how to evaluate how well alternative management strategies meet them are agreed through a dialogue between scientists and stakeholders; and
- Can be used to guide the scientific process by identifying where the reduction of scientific uncertainty will improve management and so help to ensure that expenditure is prioritised to provide the best research, monitoring and enforcement.