Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

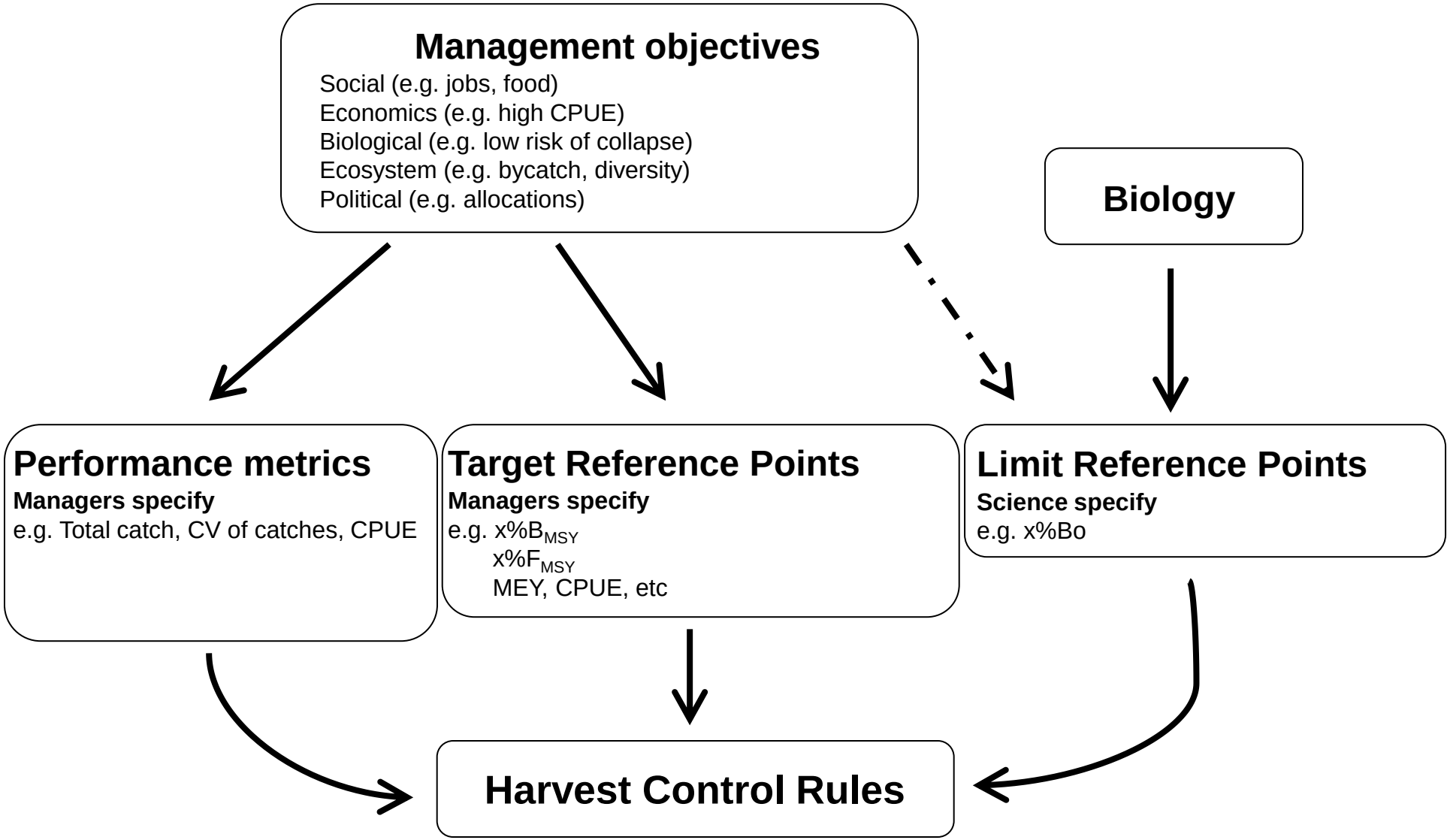
Introduction/Refresher on Management Strategies and MSE

3rd IATTC Tropical Tuna MSE Workshop, *by videoconference*, December 08-09, 2022

What are Management Strategies

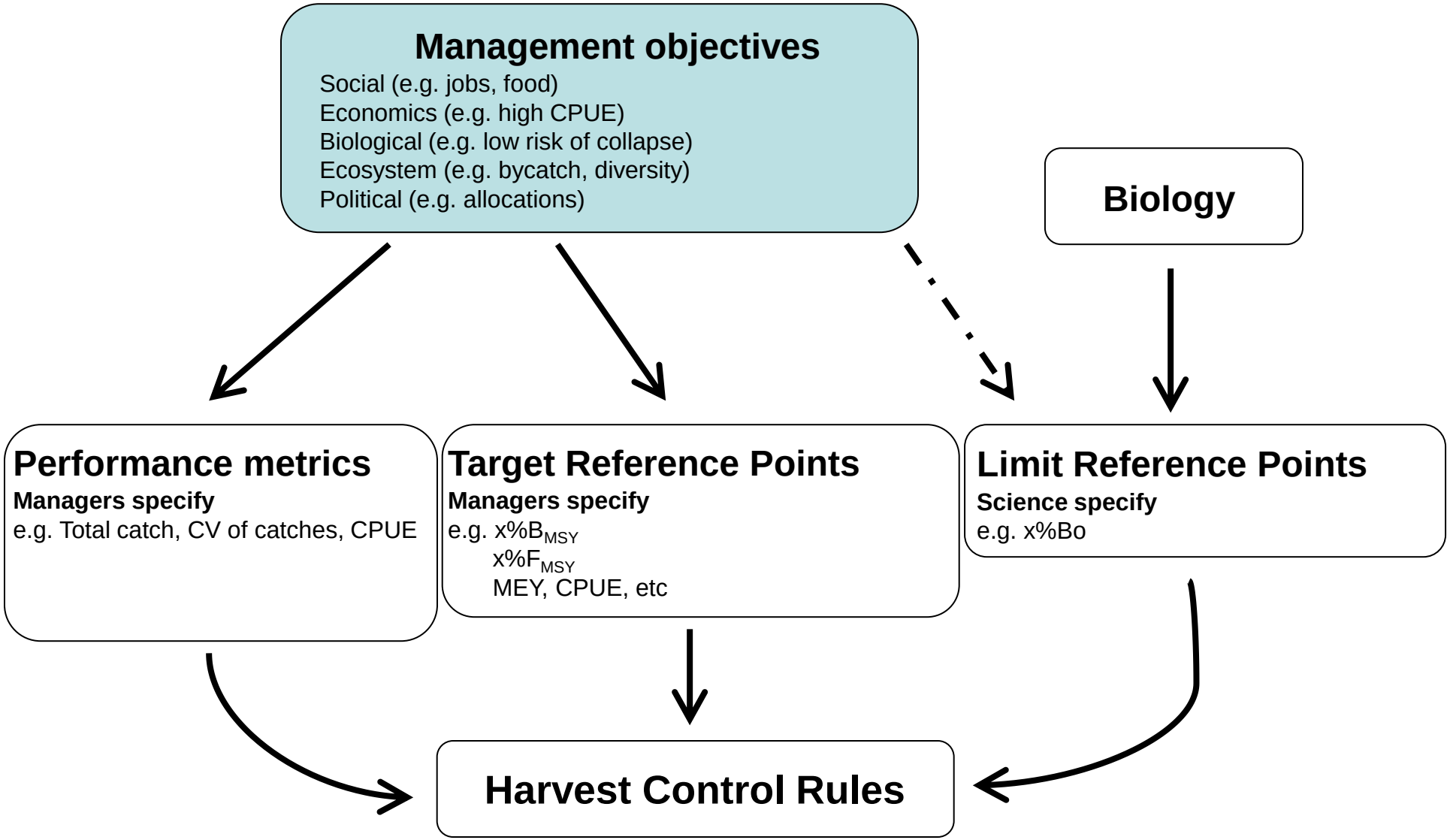
- Combination of monitoring, stock status evaluation, harvest control rule (with or without Reference Points) and management actions **designed to achieve fisheries objectives**.
- Development and success of Management Strategies benefit from the **involvement of all stakeholders** in the management planning stage.

Management strategies



Modified from Berger et al. 2012

Management strategies: Objectives

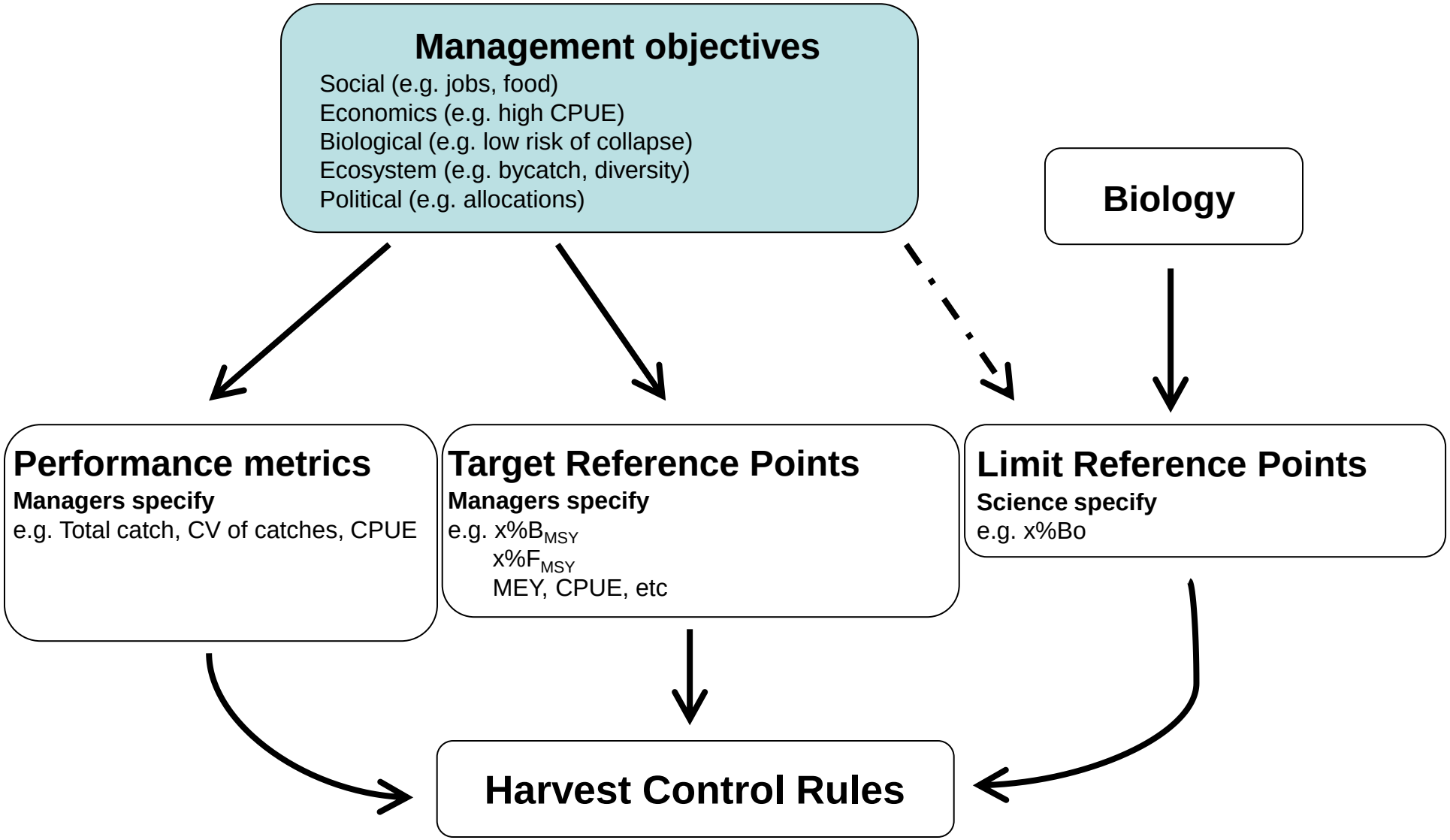


Modified from Berger et al. 2012

Management objectives

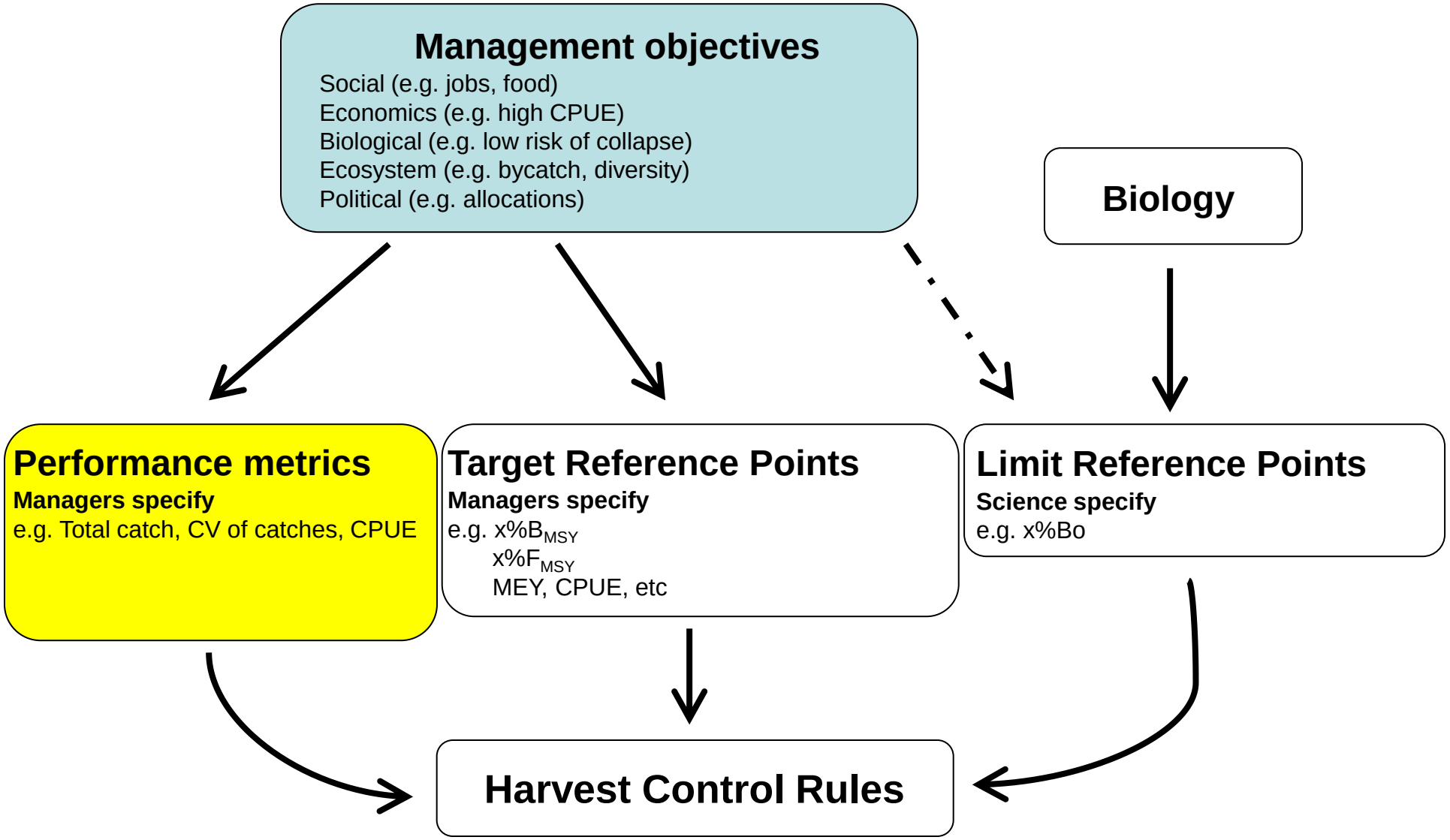
- Clear objectives fundamental to establish reference points and evaluate performance of management strategies
- Avoid being too generic (examples)
- Should specify:
  - Quantities
  - Probabilities
  - Timelines

Management strategies



Modified from Berger et al. 2012

Management strategies: Performance metrics



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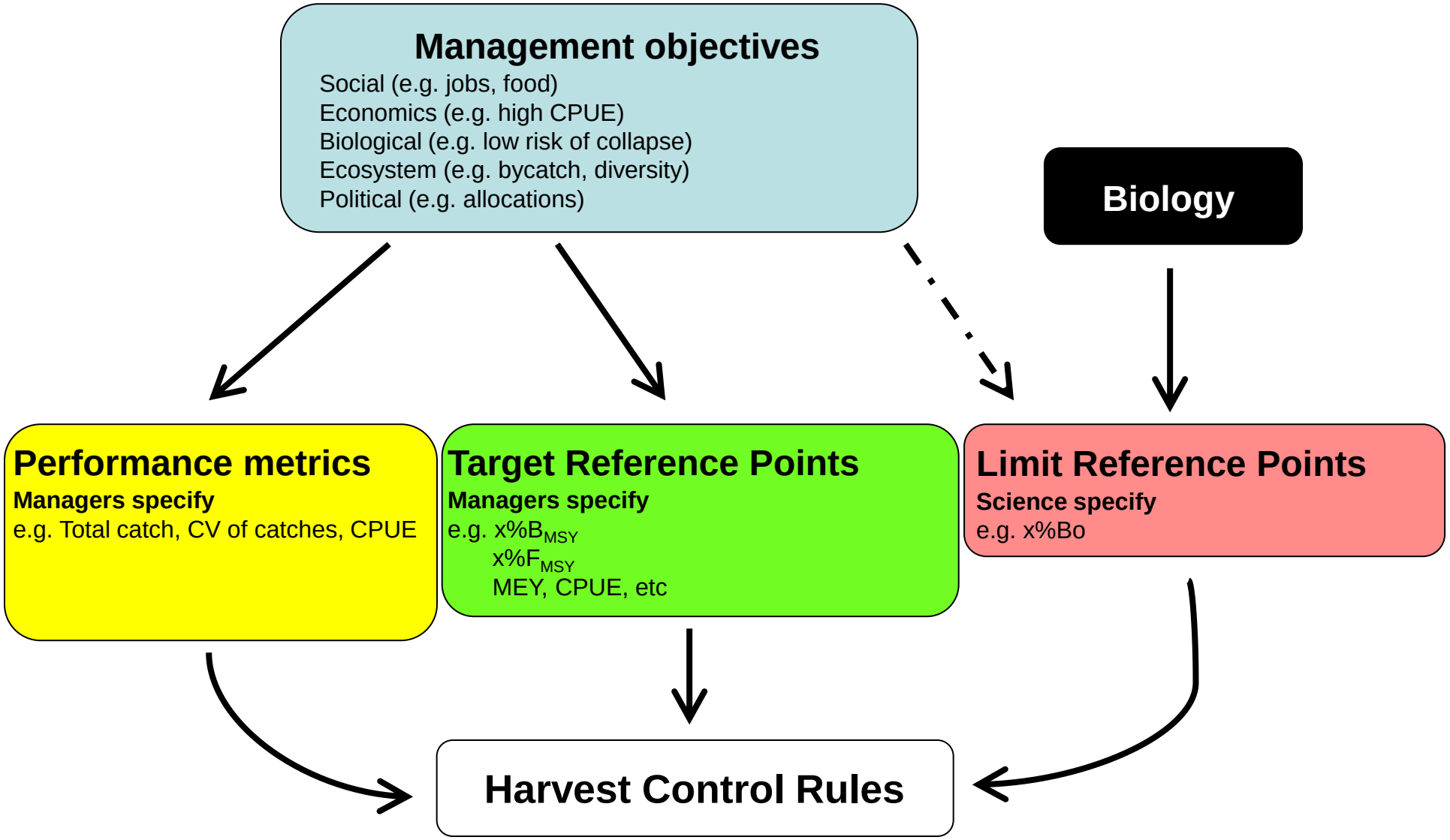
Management strategies: Reference Points



Modified from Berger et al. 2012

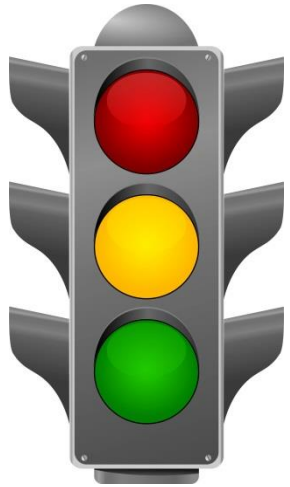
Reference Points

Management benchmarks (levels) against which to measure **stock abundance, fishing mortality or other indicators to determine stock status.**

Limit Reference Point

Threshold Reference Point

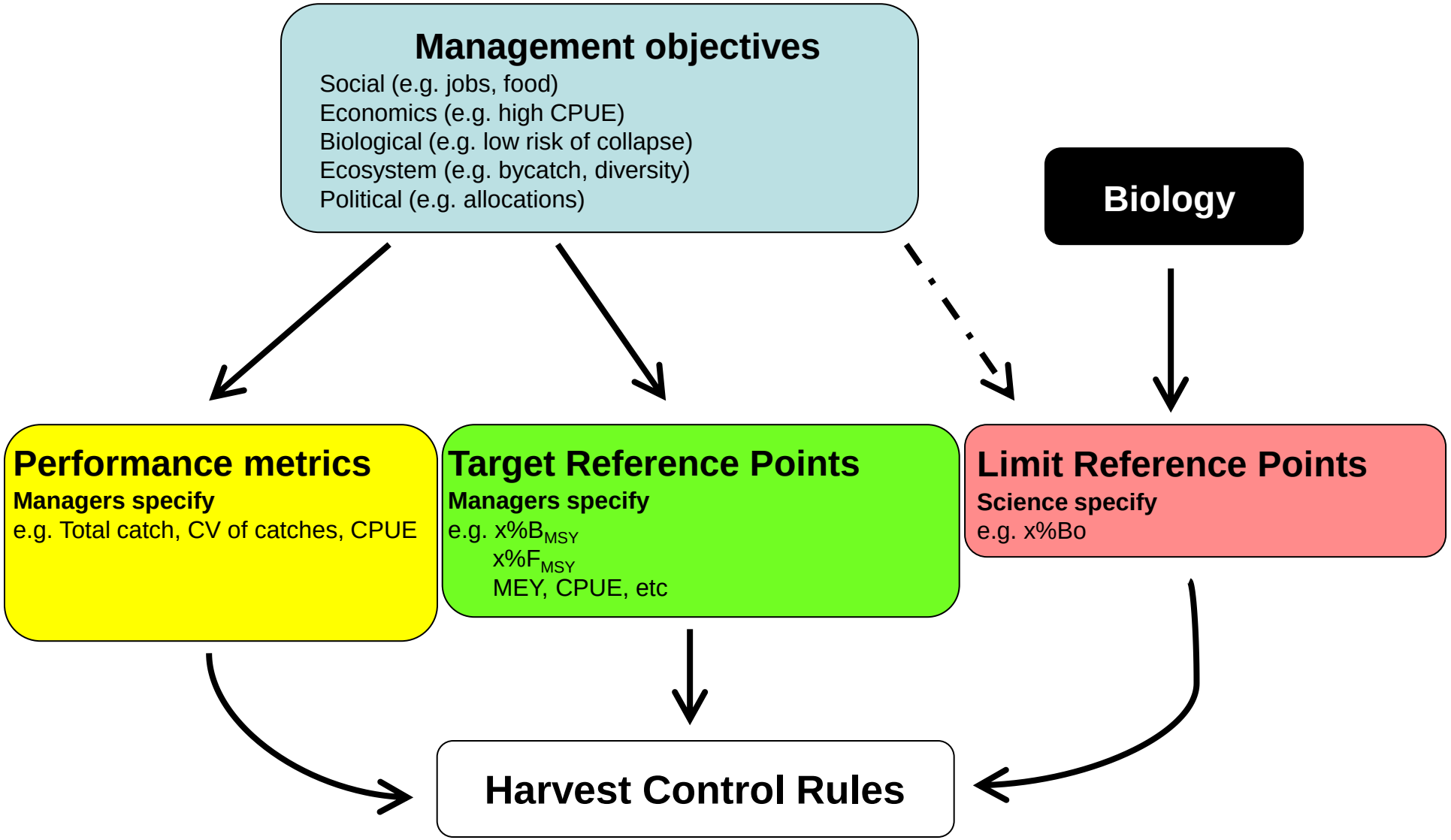
Target Reference Point



Reference Points

- Based on models
  - Biomass (B_{MSY}, B_{MEY}) or fishing mortality (F_{MSY})
  - F_{max}, $F_{0.1}$, $F_{35\%}$, $F_{40\%}$, per-recruit calculations
- Based on data alone (empirical)
  - CPUE
  - Fish size

Management strategies



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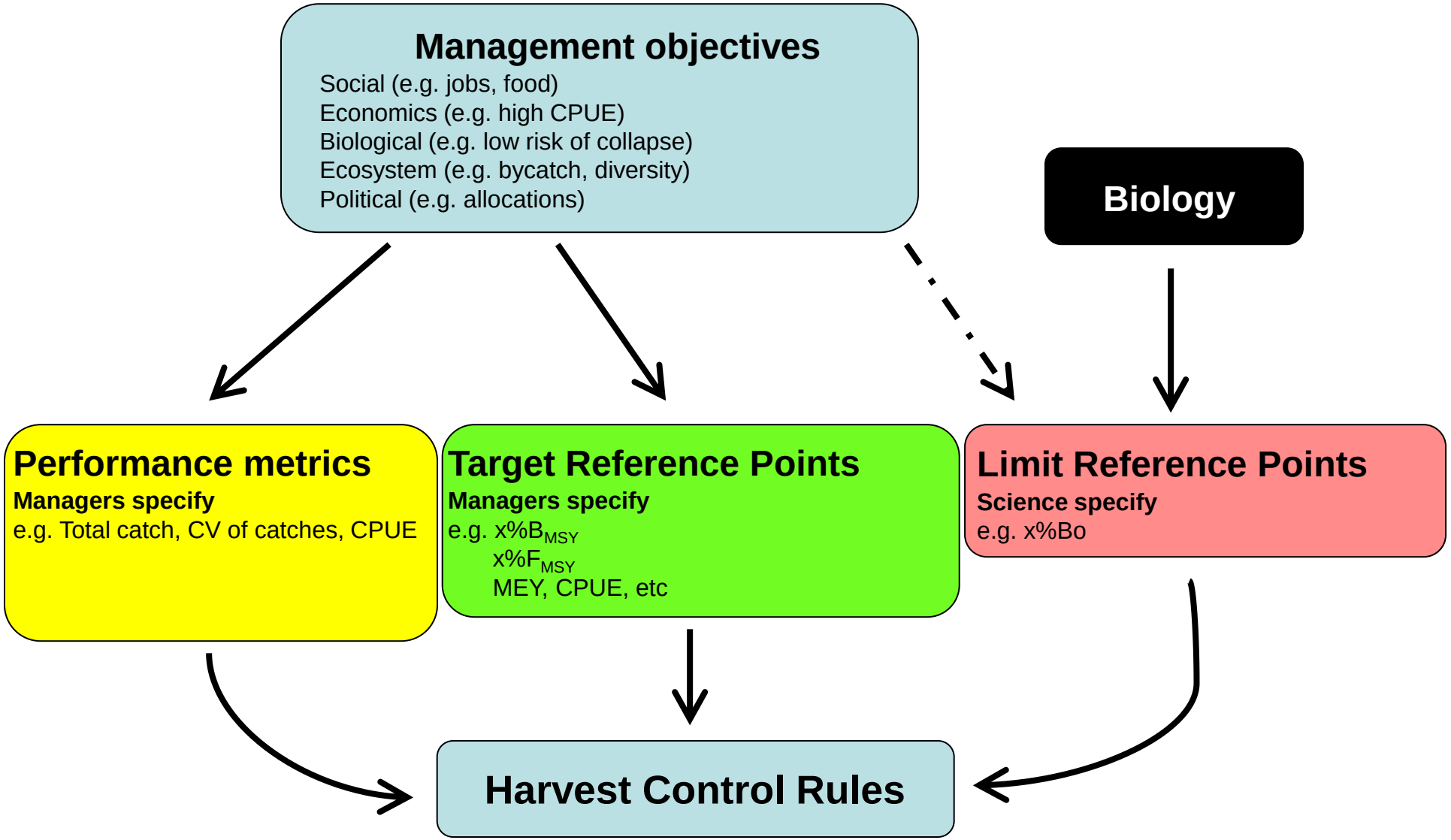
Management strategies: Harvest Control Rules

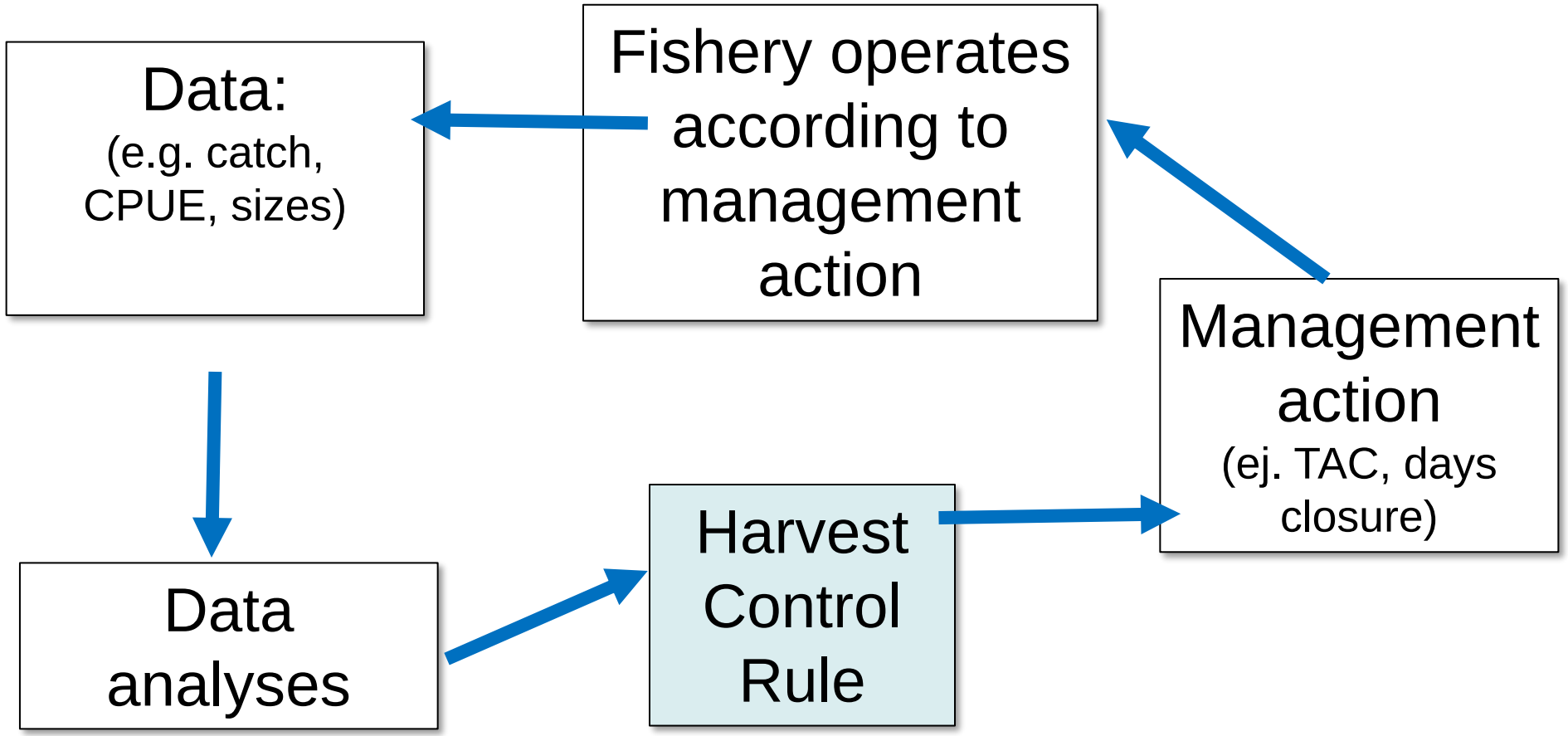


Modified from Berger et al. 2012

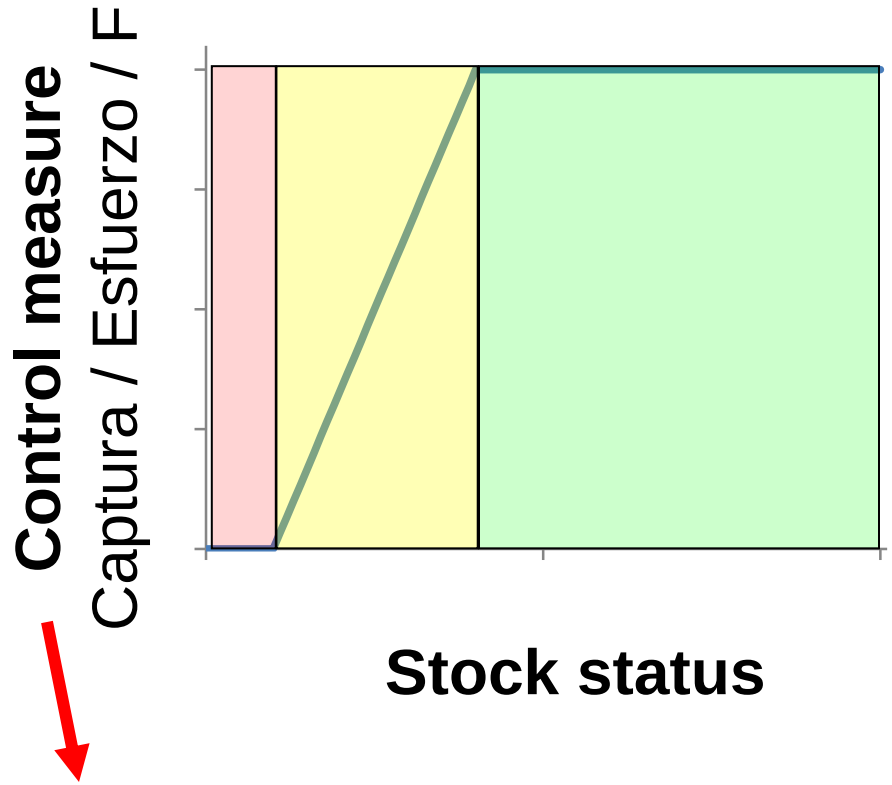
Harvest Control Rules (HCR)

- **Pre-agreed** management actions to changes in the stock and/or environmental, economic factors relative to **reference points**, **or trends** in stock indicators.
- Operationalize **management objectives**
- Increase management decisions **transparency**
- Framework to implement harvest strategies using **decision making based on science**.

Harvest Control Rule Cycle



Harvest Control Rule elements



- **Control measure, tactics:**
  - Regulations available to apply the strategy

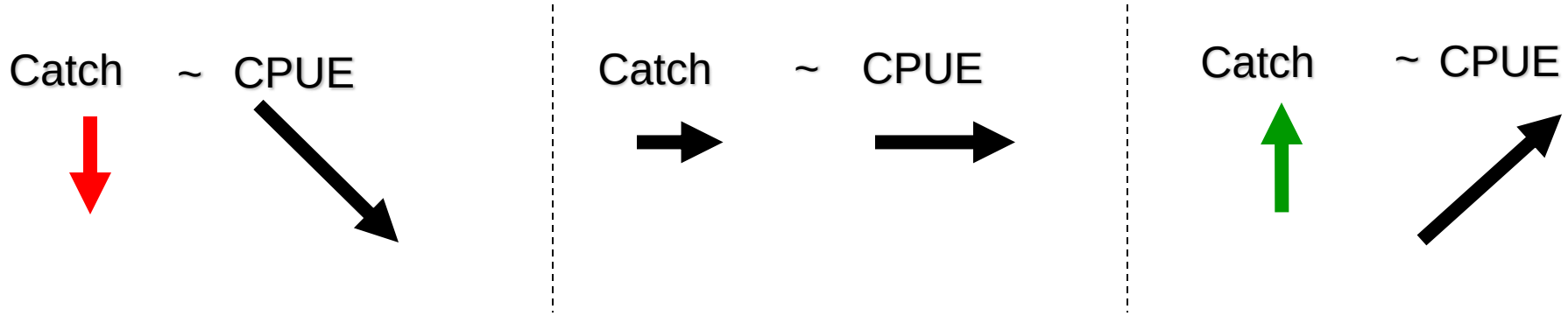
Harvest Control Rule types

- **Constant**
- **Empirical Rule**
  - Minimum treatment of data
  - Easy to compute, explain and understand
  - Care required to minimize responses to noisy data
- **Model-based Rule**
  - Based on models of varied complexity (e.g. assessments)

Empirical Harvest Control Rules

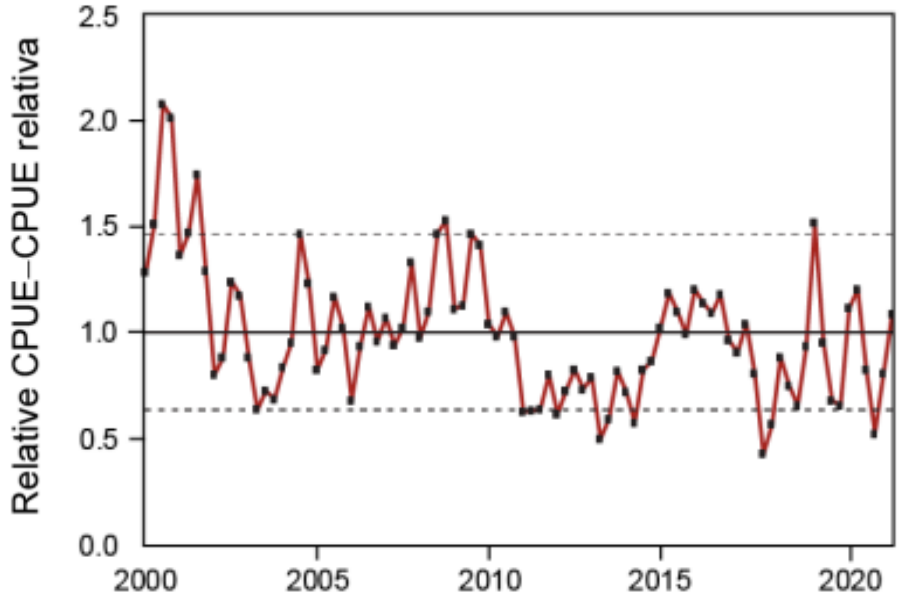
- Based on monitoring and feedback
- Simple rule, even when evaluation of its performance uses complex computer simulations (such as MSE)

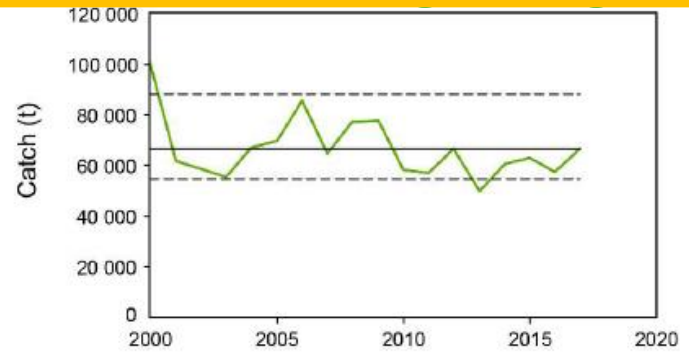
Example: adjust catch using CPUE trends

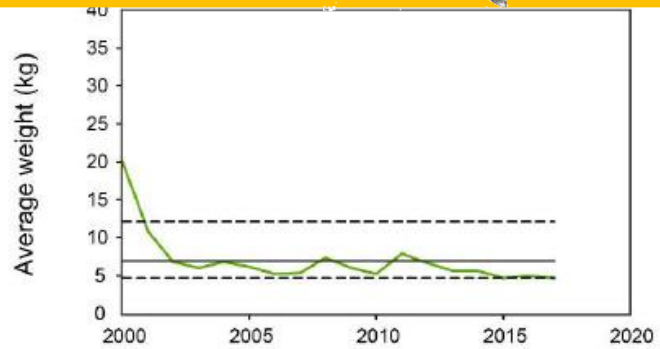


Indicators EPO Bigeye tuna

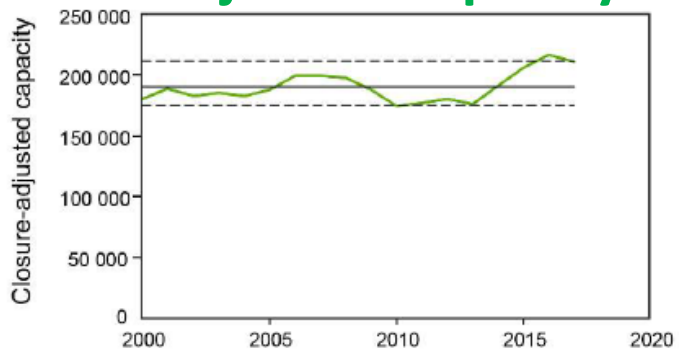
Standardized Japanese longline CPUE index





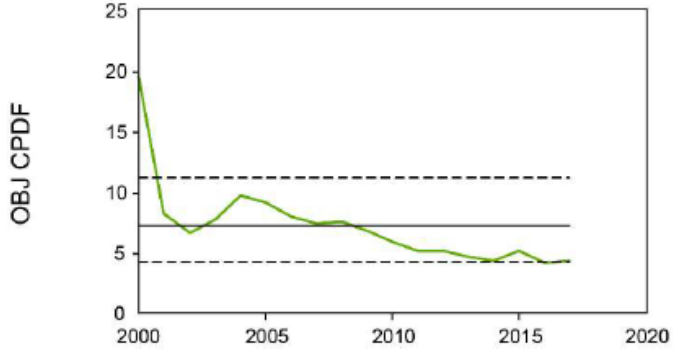


adjusted-capacity



number of sets

CPUE



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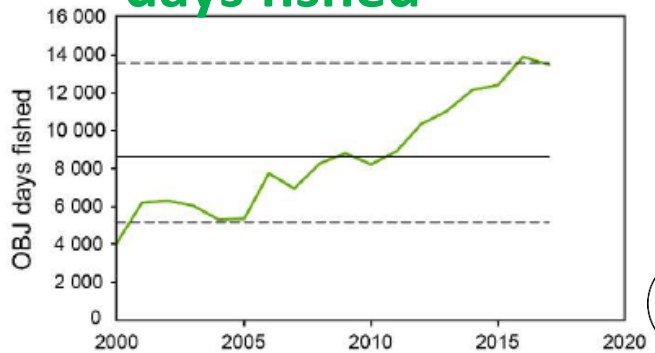
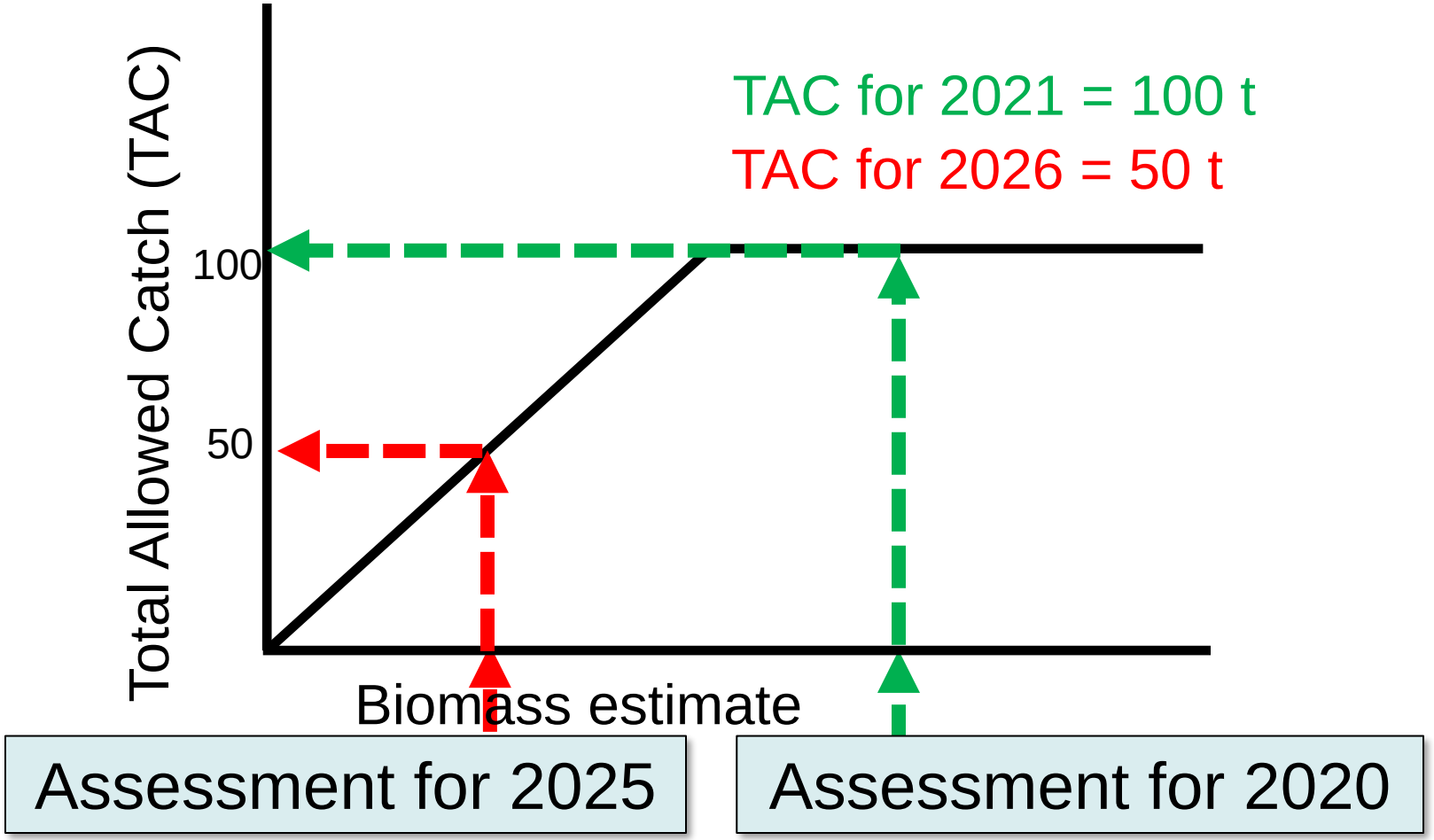
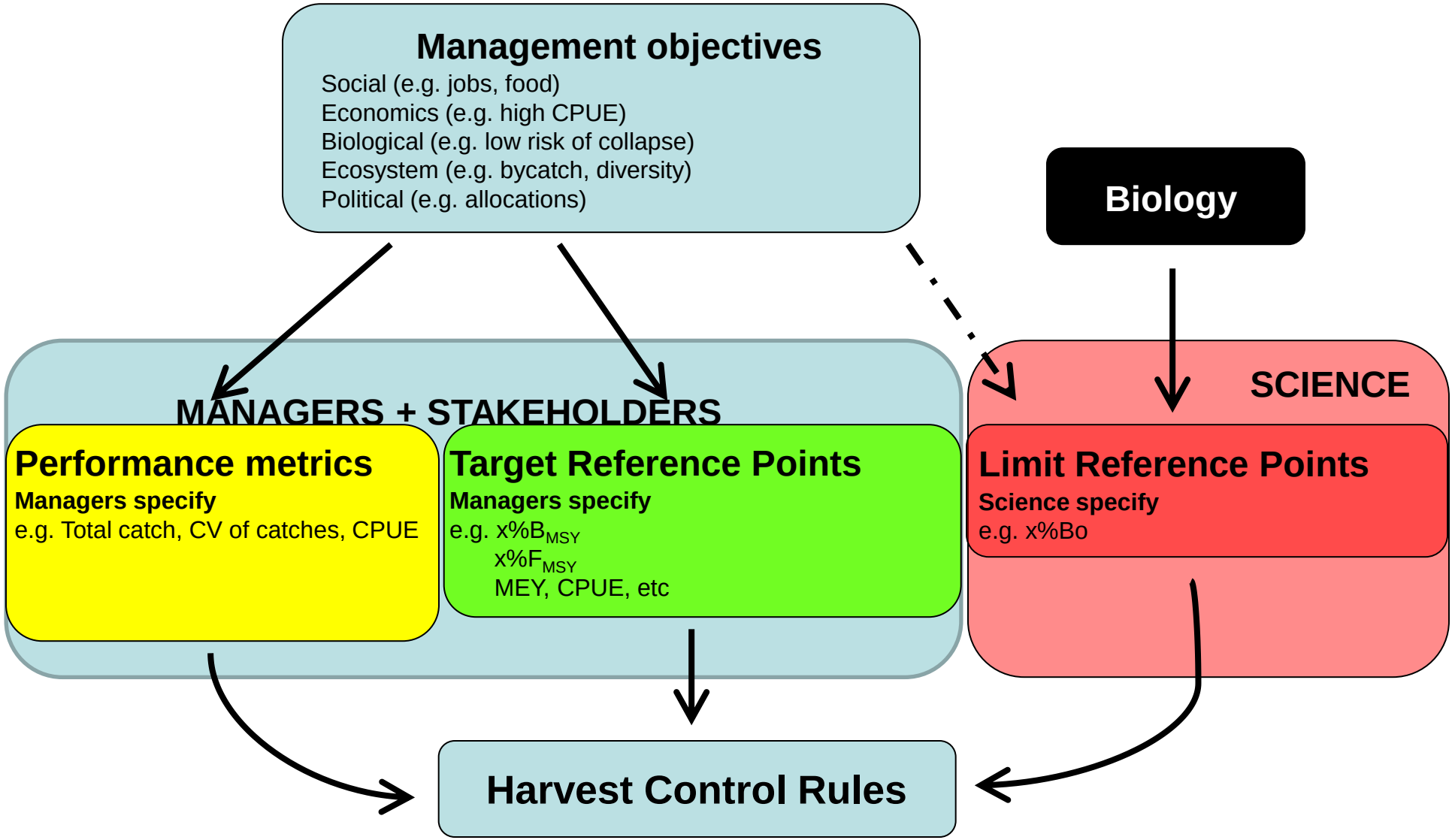


Model-based Control Rule

1) Fit a pre-specified stock assessment
2) Use the HCR to determine next year's TAC



Management strategies: Roles



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Roles of Participants

- Managers and stakeholders identify:
  - Management objectives,
  - Candidate target reference points,
  - Candidate harvest control rules, criteria against which their performance should be evaluated.
- Scientists identify appropriate biological limits to exploitation and evaluate the performance of identified candidate strategies.

Management Strategy Evaluation

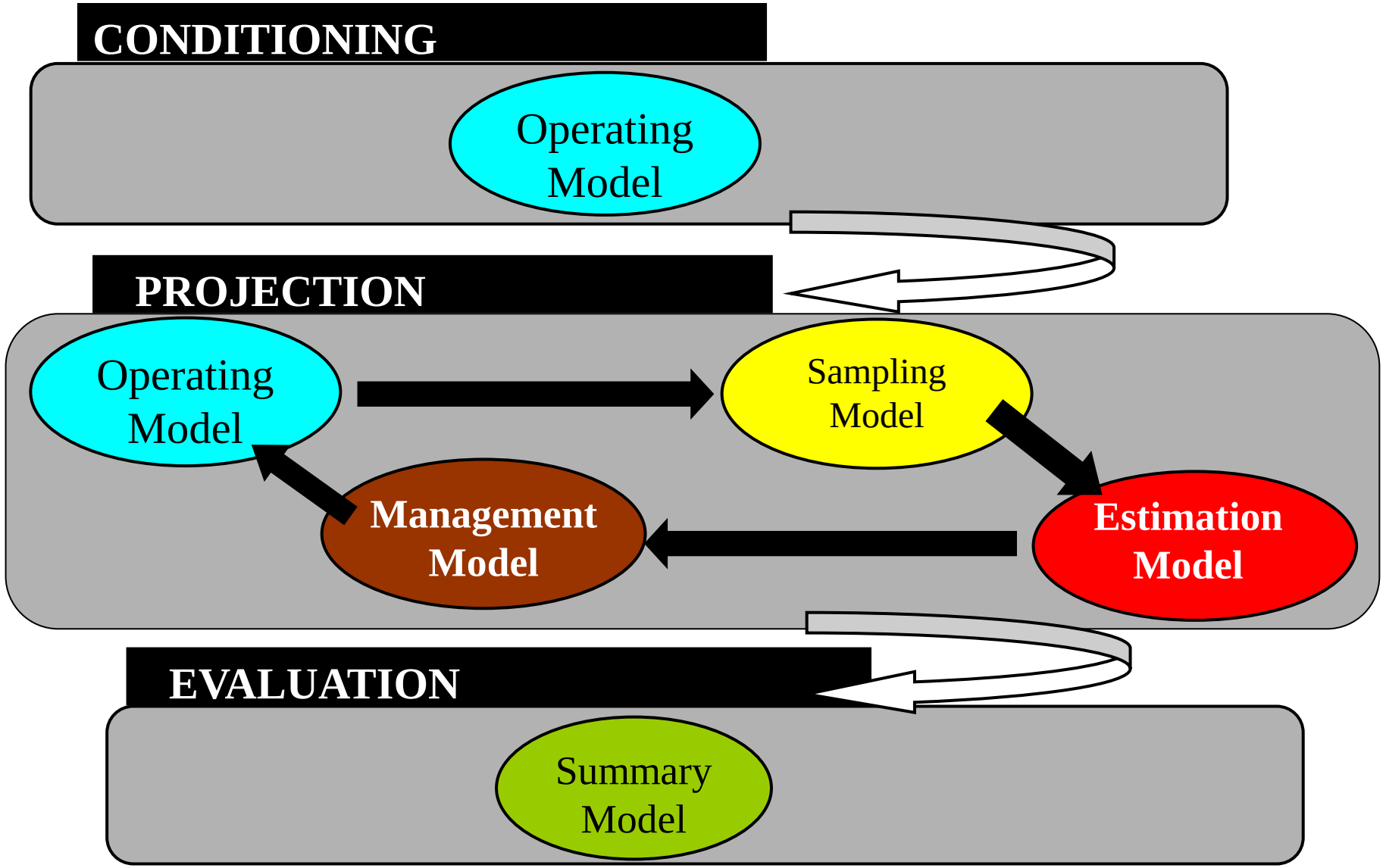
- Not looking for **optimal** strategies
- Looking for strategies **robust** to:
  - Estimation errors
  - Uncertainty about the correct model
  - Uncertainty about implementation
  - Environmental impacts
  - Etc, etc, etc…
- Discarding strategies that don't work
  - If they do not work on the computer, little chance they work in the real world

- **Optimal** strategies can be found if we knew the correct model, but can perform badly if applied to the wrong model

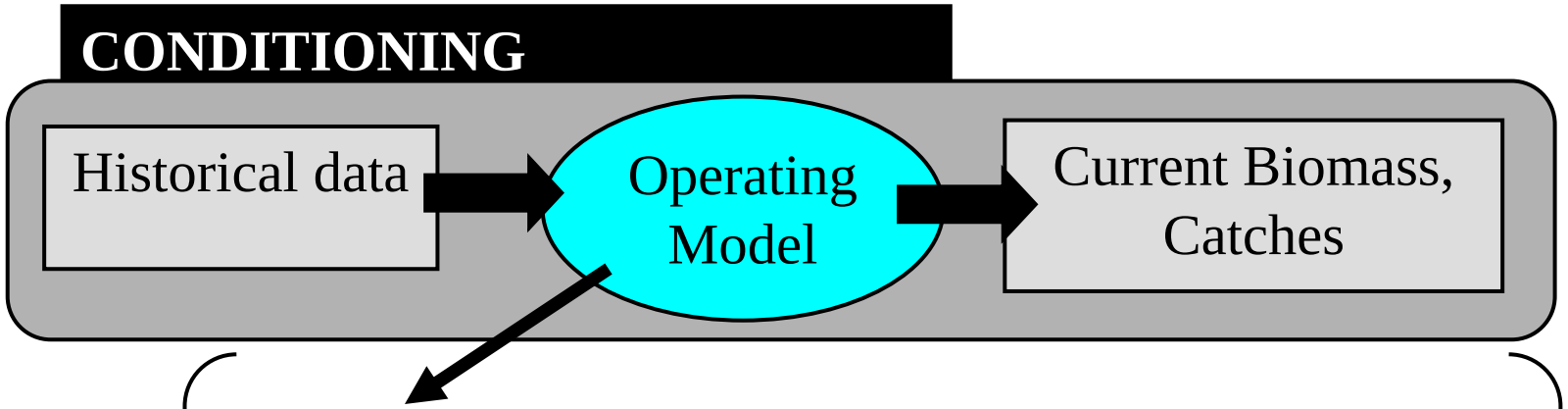
How to evaluate strategies (example)

- Rarely we can evaluate alternatives analytically (i.e. formula)
- Typically, we evaluate alternative strategies using computer simulations:
  - Specify general objectives
    - Preserve the stock
  - Specify operational objectives
    - Maintain the stock in the green sector of Kobe plot more than 50% over 30 years
  - Develop candidate management strategies, harvest control rules, etc.
  - Develop models of the system to manage, and its uncertainty
    - Simulation models describing biology, fisheries, sampling, management, etc
  - Use simulations to explore the results of each alternative strategy
  - Summarize results
  - Decide on what strategy to implement

Management Strategy Evaluation: Components

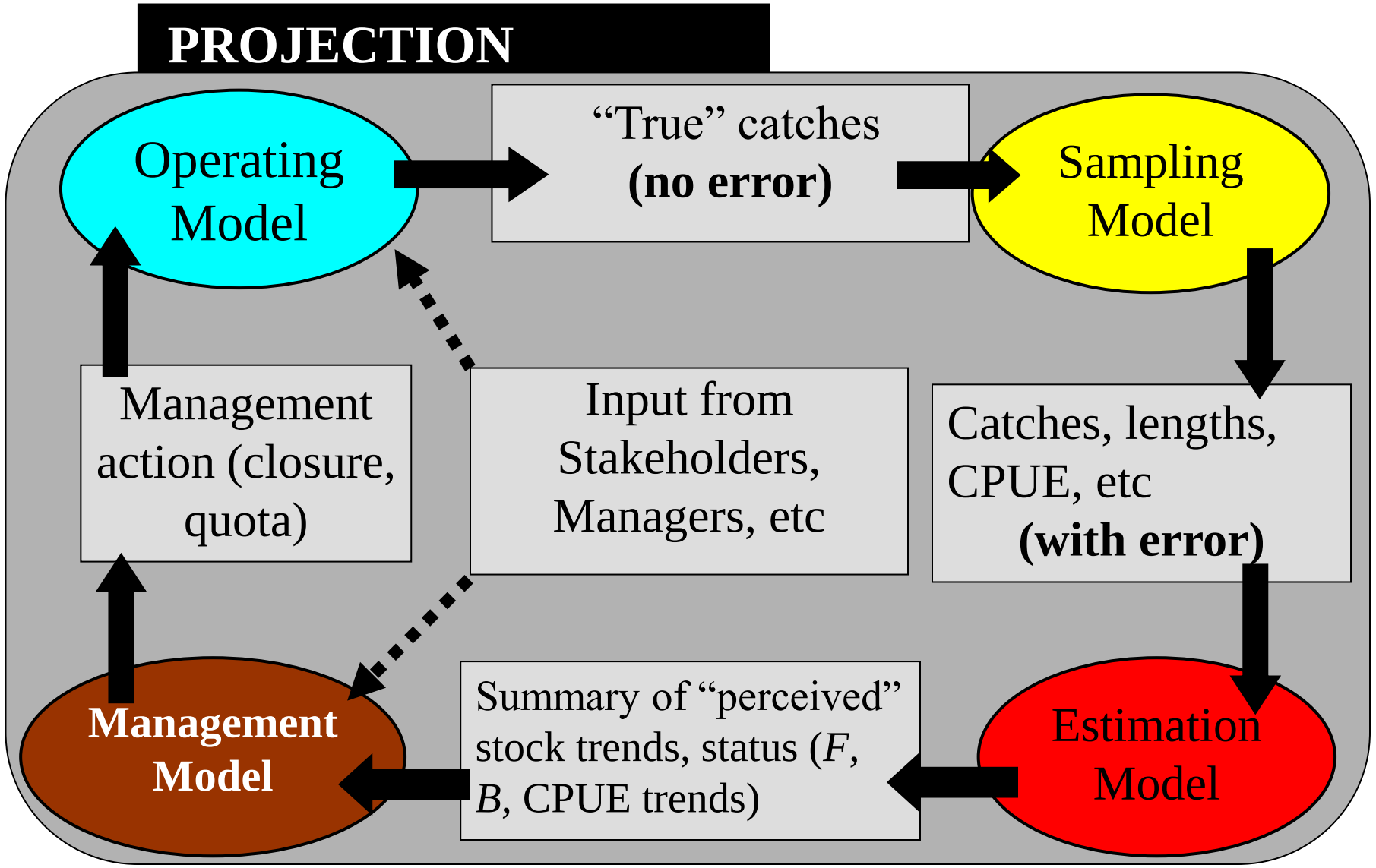


Operating Model and Conditioning



- Describes fishery and population dynamics
- Different hypotheses / model configurations to incorporate real world uncertainty; e.g.:
  - -Spawner / recruit relationship
  - -Selectivity / catchability changes
  - -Changes in fleet composition
  - -Spatial structure
  - -Alternative growth scenarios
  - -Etc, etc, etc…
- **Consistent with historical data!**

Projection component

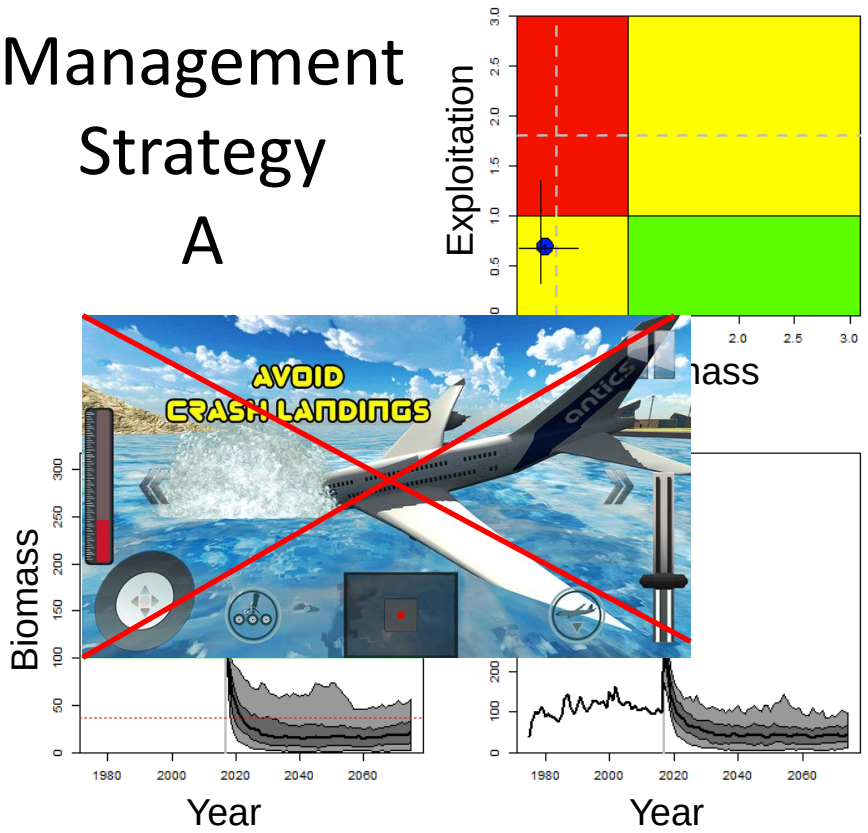


Evaluation component

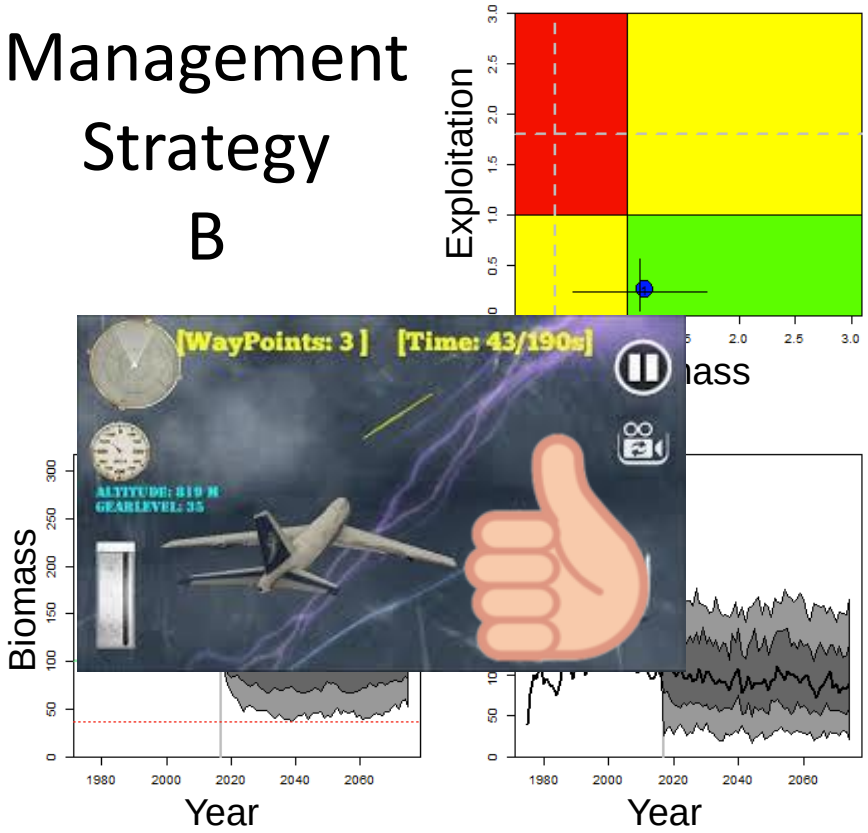
EVALUATION

Performance Metrics → Summary Model → Evaluation of Management

Management Strategy A



Management Strategy B



Management Strategies and MSE Summary

- Combination of monitoring, stock status evaluation, harvest control rule (with or without RPs) and management actions designed to achieve **fisheries objectives**.
- RPs and HCRs cannot be properly evaluated without specific management objectives, data collection, analyses, treatment of uncertainty and other components of a management strategy.
- Management Strategy Evaluation involves two components:
  - **Dialogue component** to define several alternative strategies to evaluate
  - **Technical component**, computer simulation and evaluation of strategies

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Questions?