

Introduction to Management Strategy Evaluation (MSE)

Management Strategies for Tuna Industry Stakeholders in the Eastern Pacific Ocean (EPO)
San Diego, August 12, 2019



Management Strategies

“... is analogous to an autopilot, with the associated advantages. However, this does not mean that the aircraft should be left without a pilot. The pilot must remain on board to look out for unexpected major course deviations that may not have been factored into the design, including appreciable changes in scientific perceptions concerning the resource.”

Doug S. Butterworth, University of Cape Town

Evaluation of Strategies

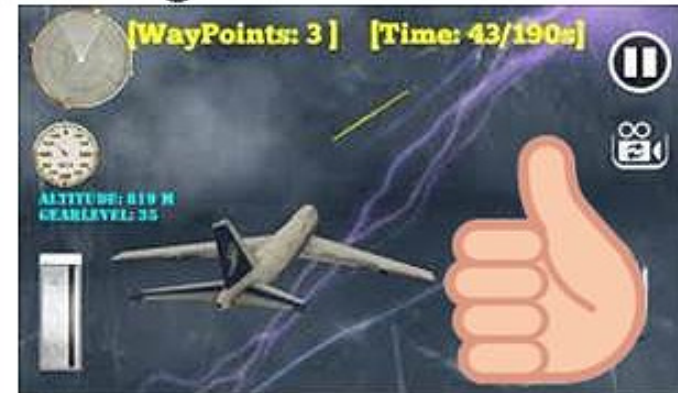
- Useful to formally answer what if questions:
 - Quotas (individual / total);
 - Closures (time / spatial);
 - Fishing gear limits (number of sets, FADs, etc);
 - Number/size of vessels
 - Better/other data (tagging, ageing, genetics, etc)



Evaluation of Strategies

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

Why stock assessments fail, or become unreliable?

*“All models are wrong, **some** are useful” George Box*

- Data too noisy, or not representative
- Model ignores or badly describes important issues:
 - Wrong spatial structure
 - Variable or wrong natural mortality, selectivity, growth, etc
 - Fish movement
 - Changes in technology, oceanography, environment, economy, etc

Would more complex (realistic) models result in better stock assessments?

We do not know (yet) since more complex models have more parameters and need more data...and they still would need to be evaluated!



Evaluation of Strategies

Objectives and Tactics

- **Strategies** are based on choosing **tactics** (quotas, minimum sizes, temporal or spatial closures) to achieve **management objectives**
- If **management objectives** are **not explicit and clear**, we cannot (sensibly) evaluate alternative strategies
- Problem: often times decision makers **have not agreed on objectives** (or are reluctant to state them publically)

Evaluation of Strategies

Objectives and Tactics

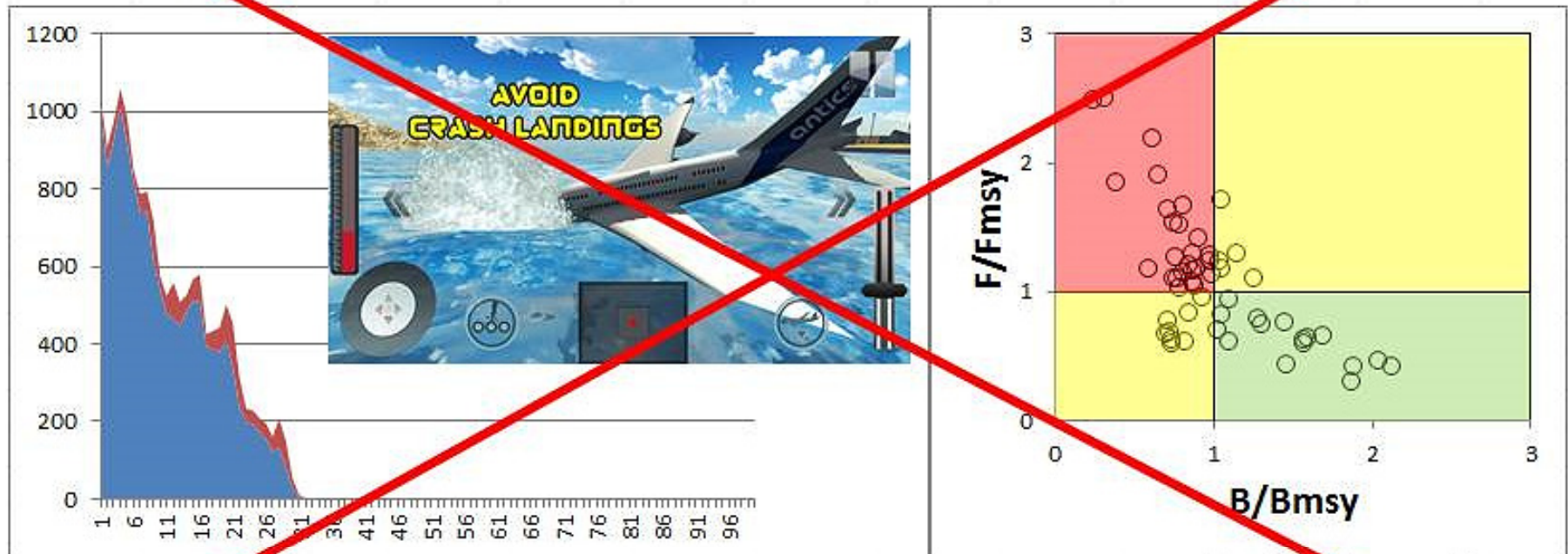
- Distinguish between
 - High level (general) objectives: “*conserve the stock*” and
 - Operational (quantitative) objectives: “the probability of falling below 10% of B_0 should not be greater than 5% over 20 years”
- Often **tactics** (**what** to do next year) get confused with **objectives** (**why** we do what we do next year)

Methods to evaluate strategies

- Most of the times, we evaluate alternative strategies using computer simulations:
 - Specify general objectives
 - Preserve the stock
 - Specify operational objectives
 - Do not fall on the red sector of Kobe plot more than 5% over 100 years
 - Develop models of the system to manage, and its uncertainty
 - Simple model with random errors in assessment
 - Use simulations to explore the consequences of each alternative strategy
 - Summarize results
 - Decide on what strategy to implement

Kobe plot, simple model

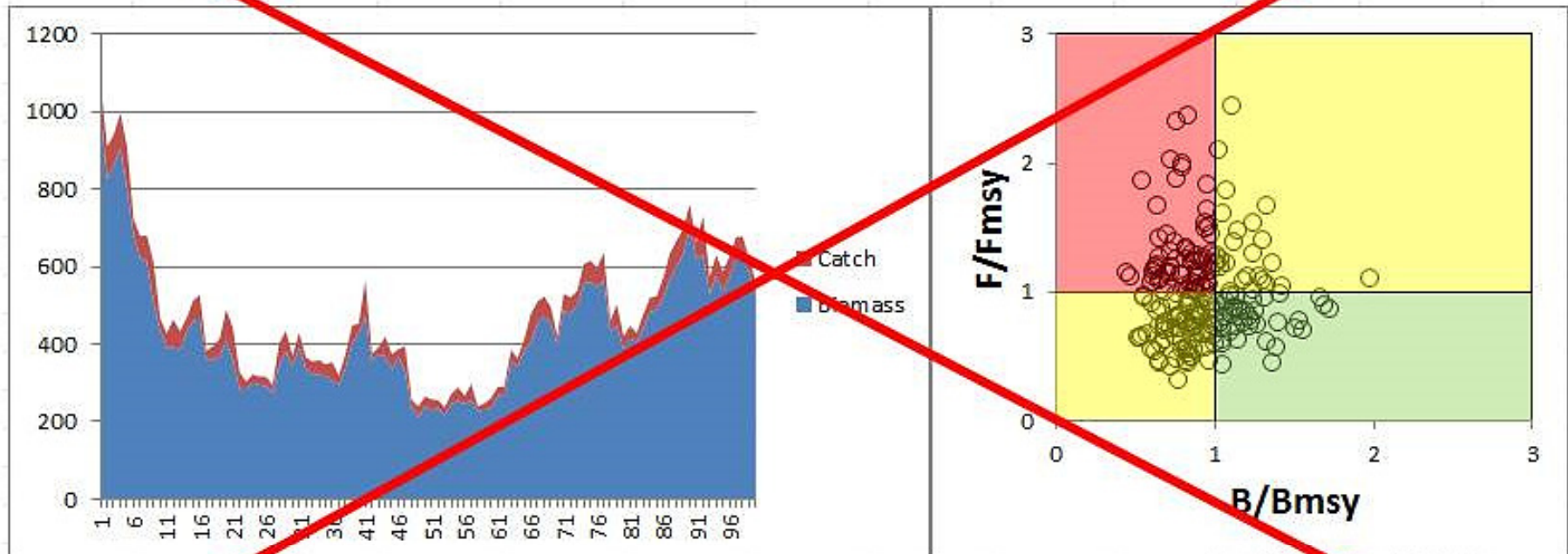
Constant catch



This strategy collapses the stock

Kobe plot, simple model

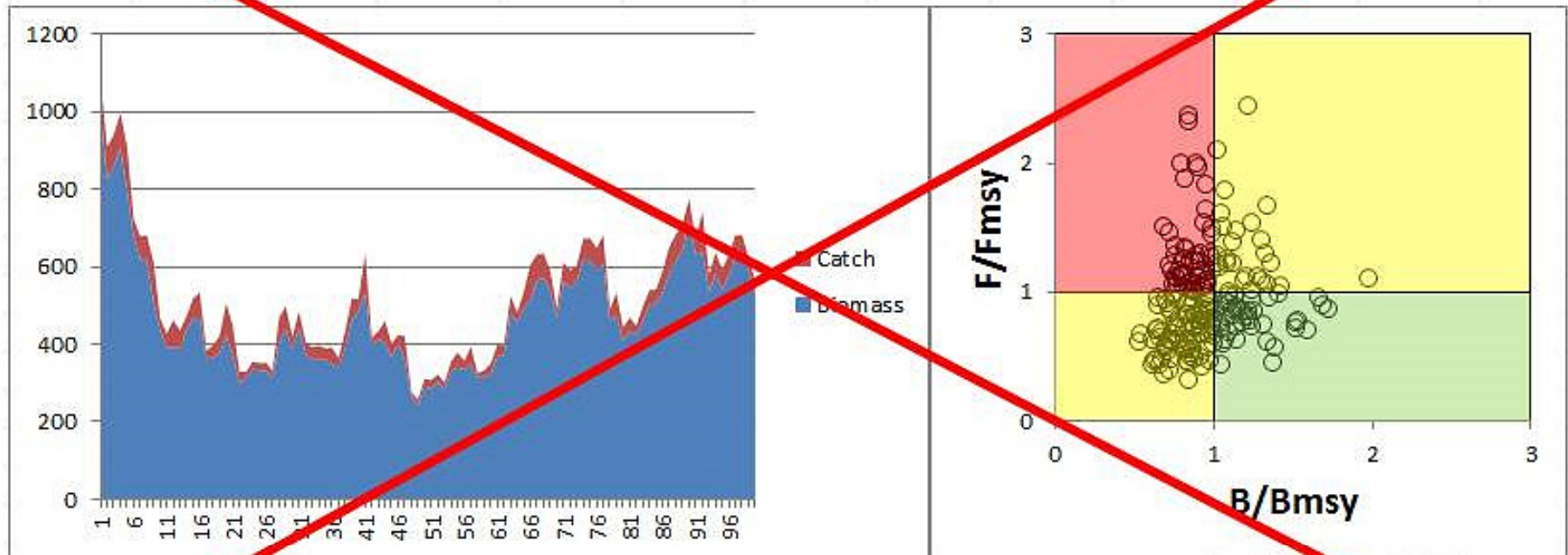
Constant HR (F_{msy}) with Stock Assessment error



This strategy results in more than 5% of the time in the red sector of Kobe

Kobe plot, simple model

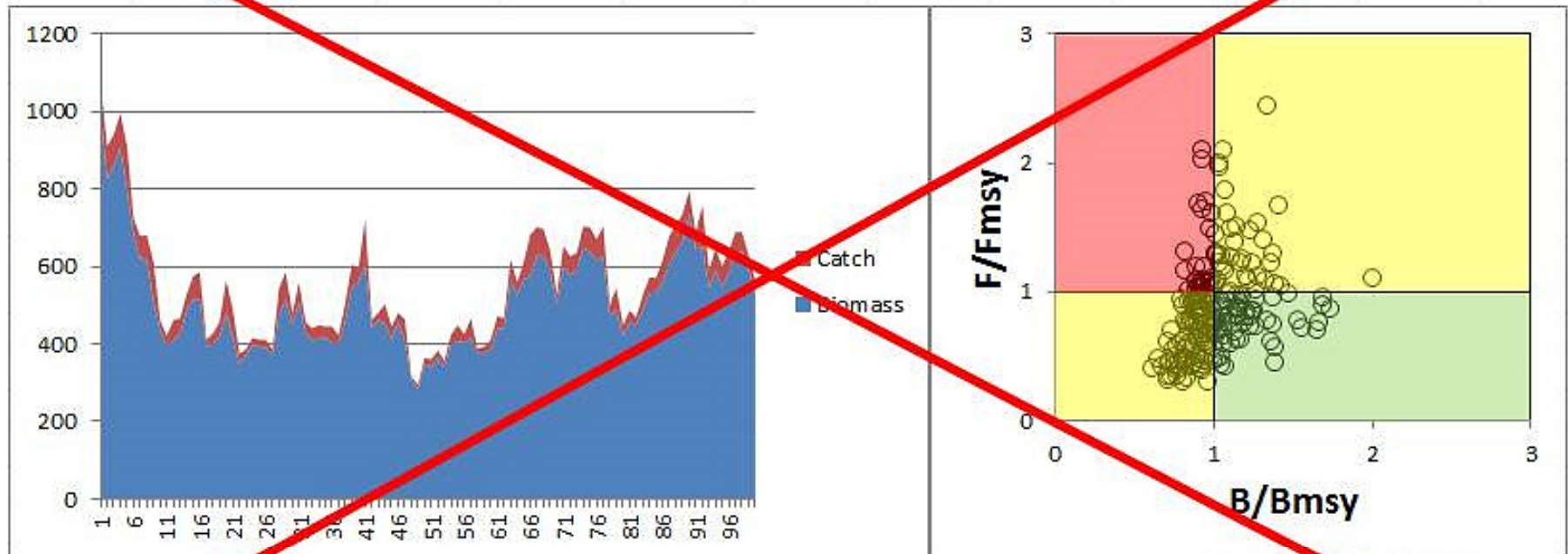
40:10 HCR, HR target (F_{msy}) with Stock Assessment error



This strategy results in more than 5% of the time in the red sector of Kobe

Kobe plot, simple model

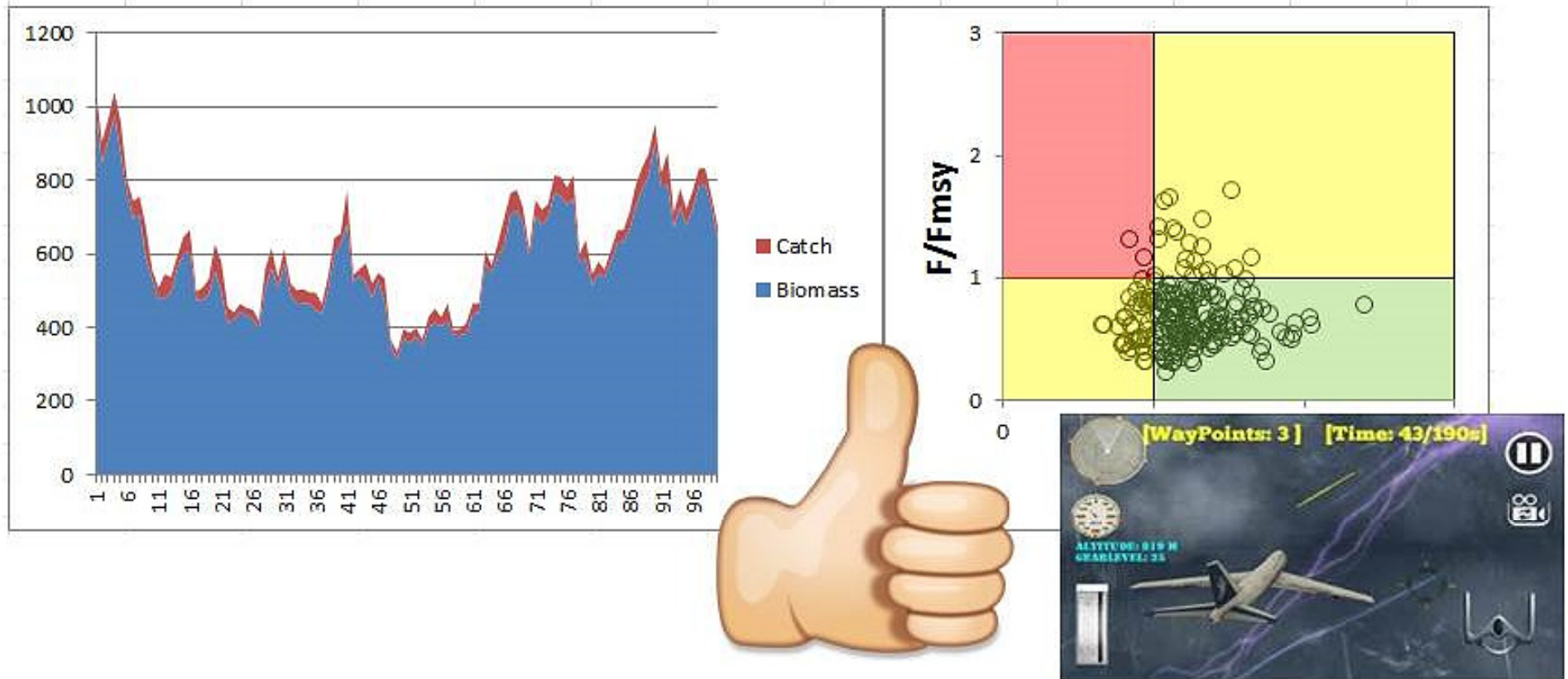
50:20 HCR, HR target (F_{msy}) with Stock Assessment error



This strategy results in more than 5% of the time in the red sector of Kobe

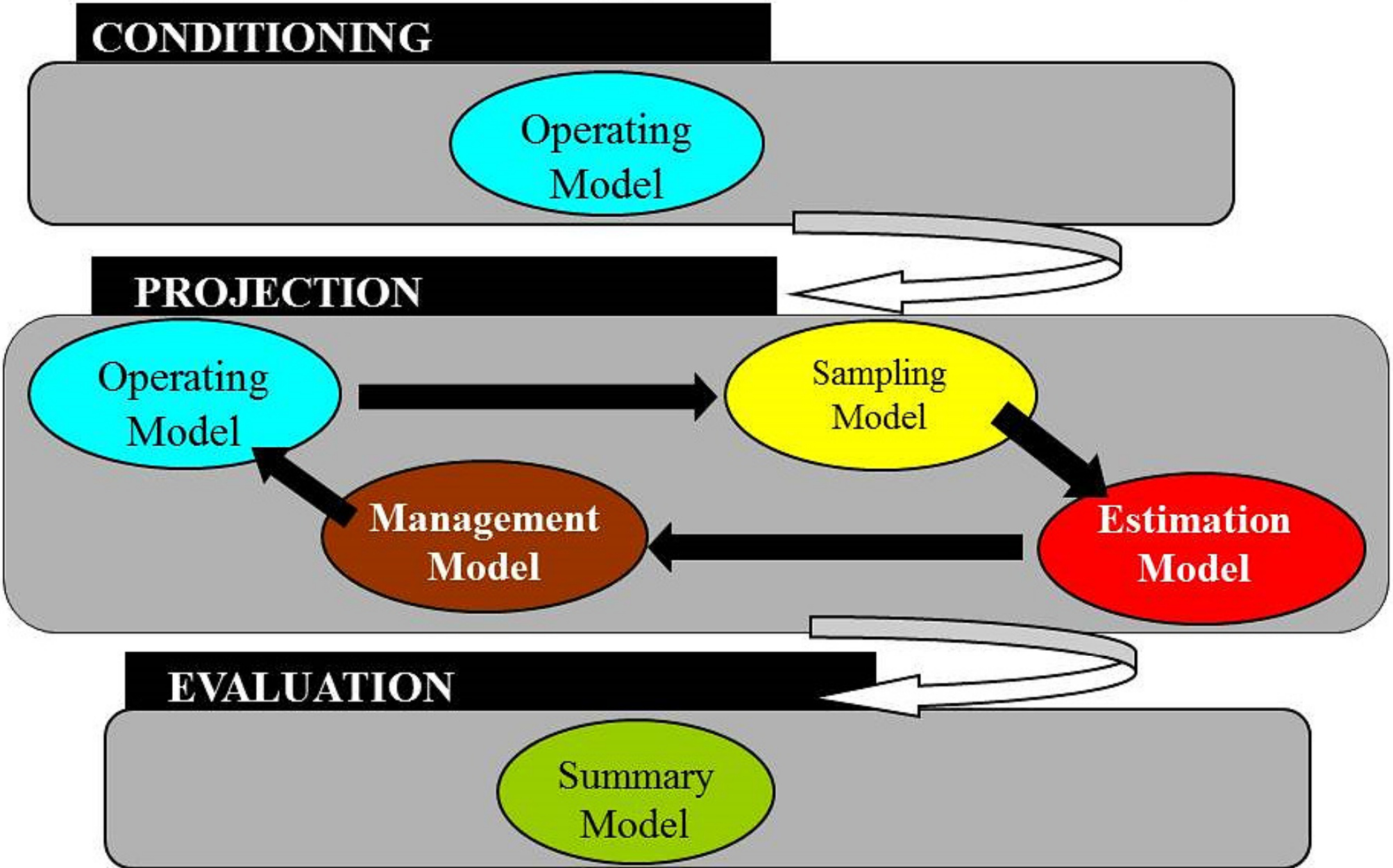
Kobe plot, simple model

40:10 HCR, HR target ($0.7 \cdot F_{msy}$) with Stock Assessment error

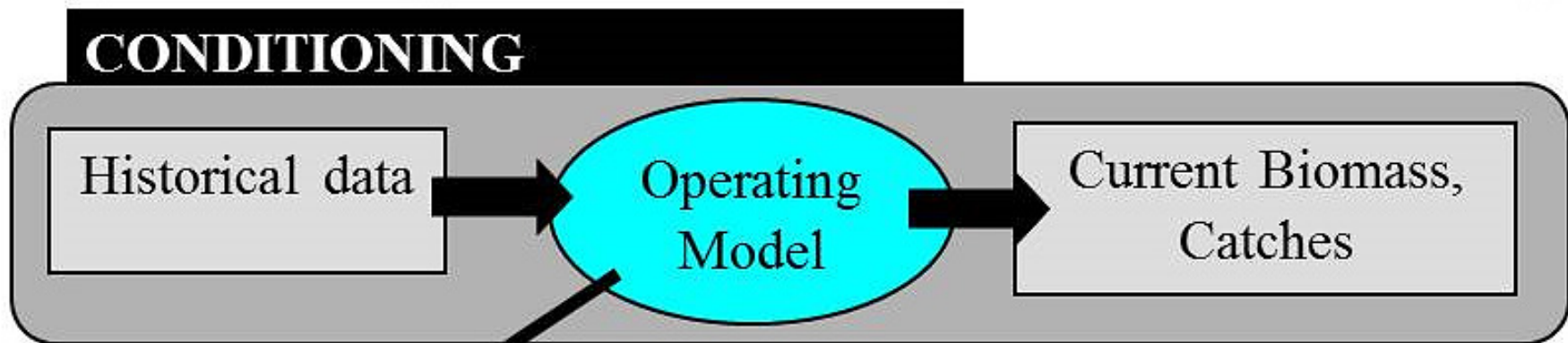


This strategy results in less than 5% of the time in the red sector of Kobe

Management Strategy Evaluation: components



Operating model and conditioning



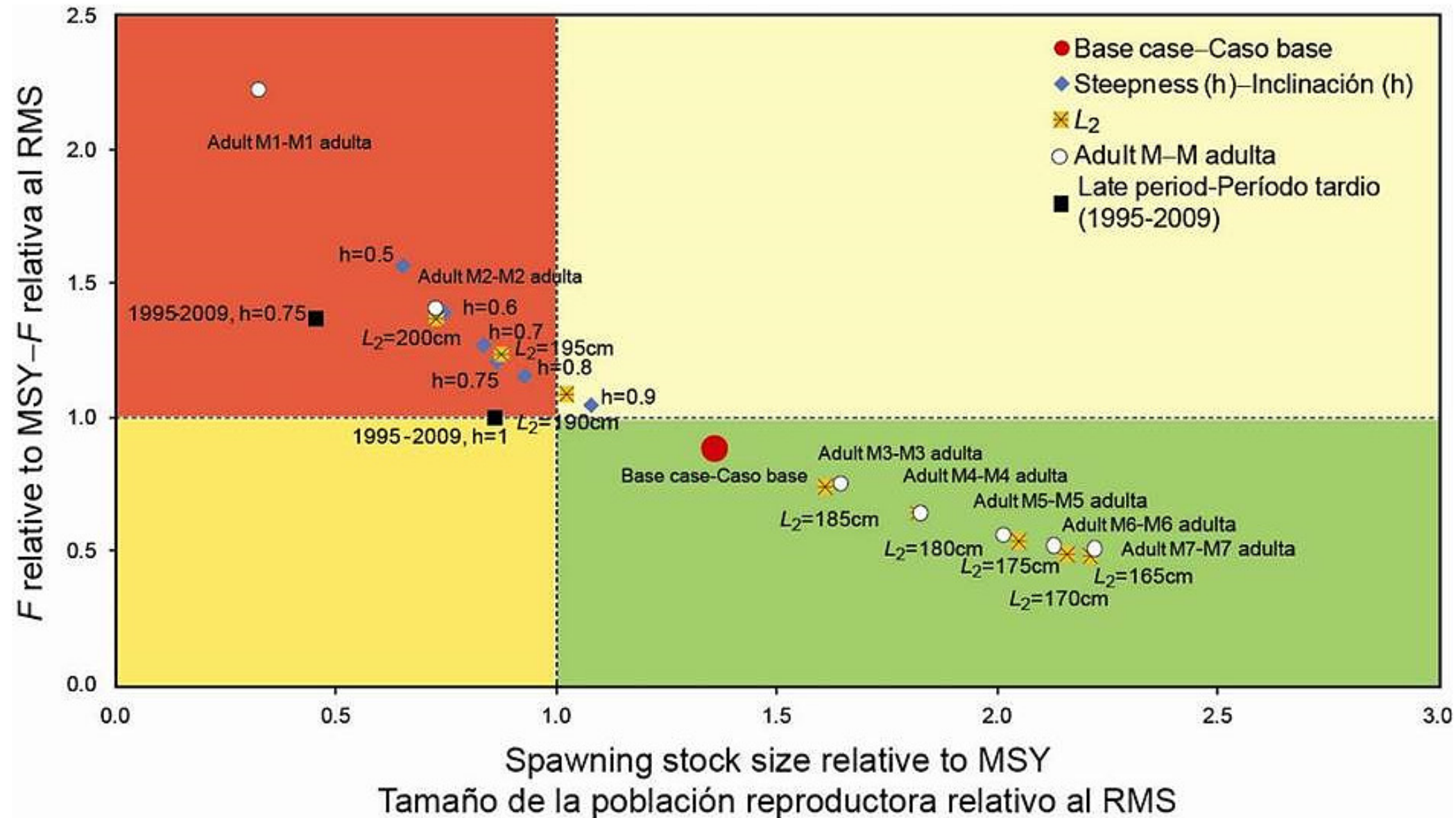
- Describes fishery and population dynamics
- Different hypotheses / model configurations to incorporate real world uncertainty; e.g.:
 - Spawner / recruit relationship
 - Selectivity / catchability changes
 - Changes in fleet composition
 - Spatial structure
 - Alternative growth scenarios
 - Etc, etc,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

Operating
Model

Operating Model

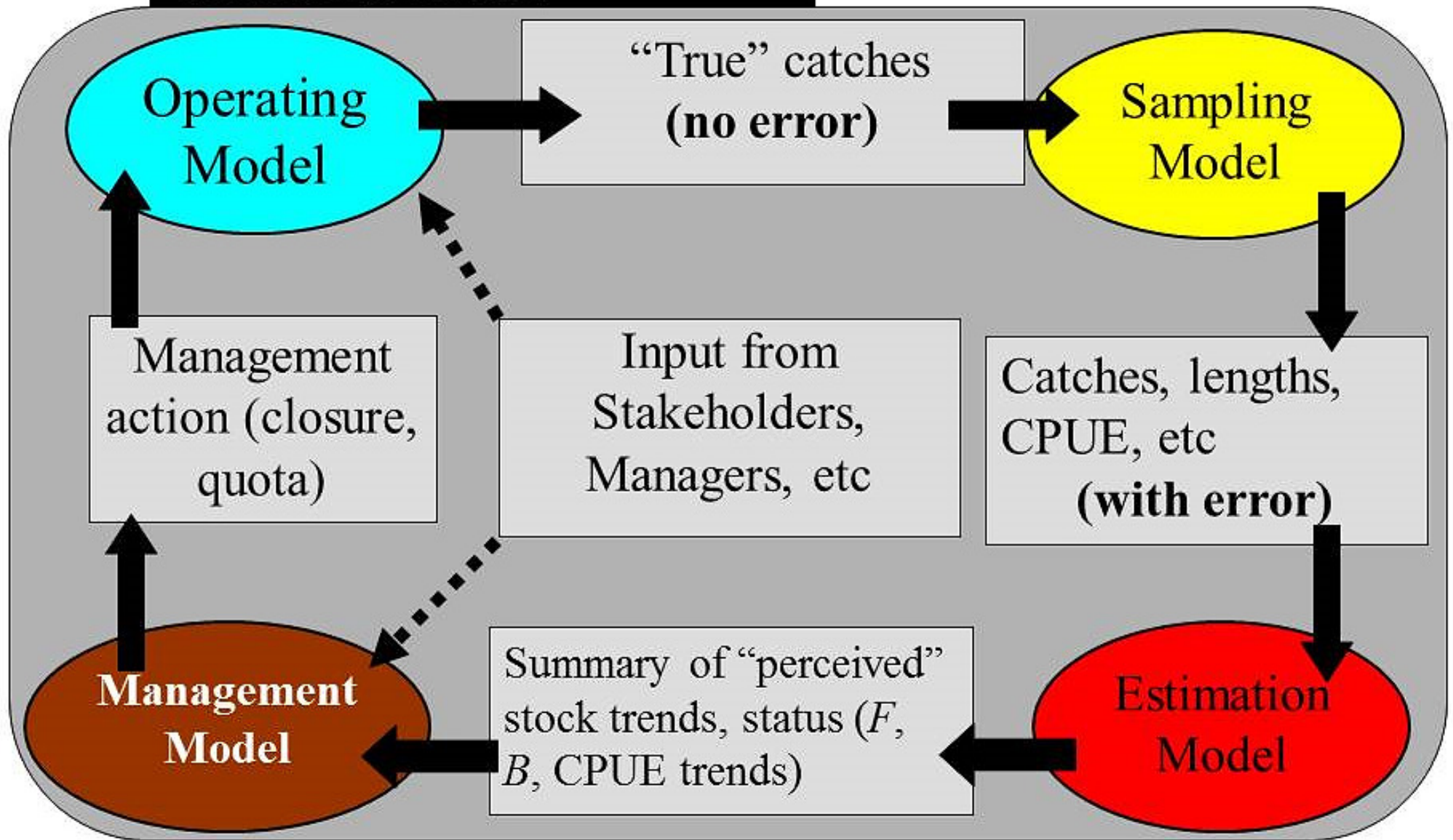
- **Key:** ensure that it incorporates appropriately the uncertainty about the stock, its dynamics and the sampling process.

Kobe plot with sensitivities around BET uncertainties

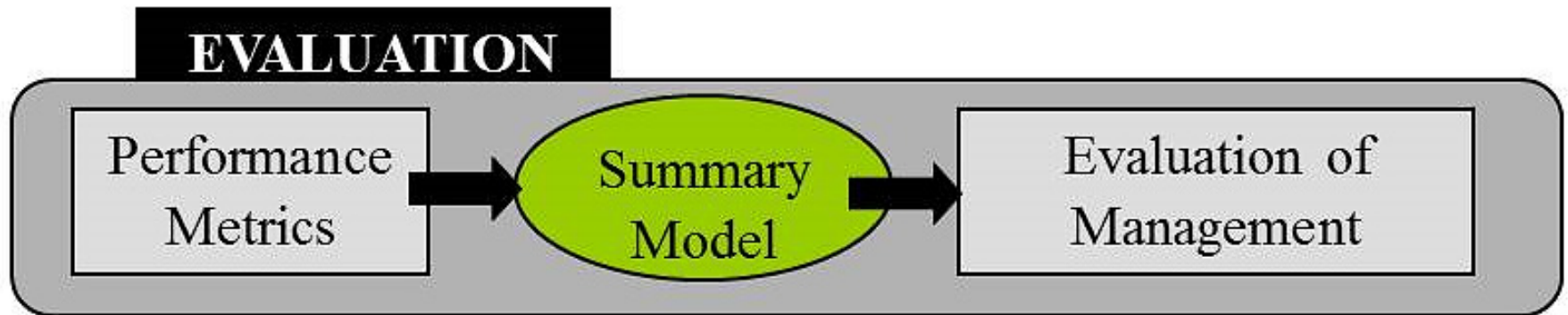


Projection Component

PROJECTION



Evaluation Component



Implementation Uncertainty

- How the intended management action relates, or not, to the actions in the real world
- It can have a large impact (e.g. if quotas that are too small are ignored and exceeded).
- Different types of implementation uncertainty must be considered so that the management strategy evaluation is realistic.

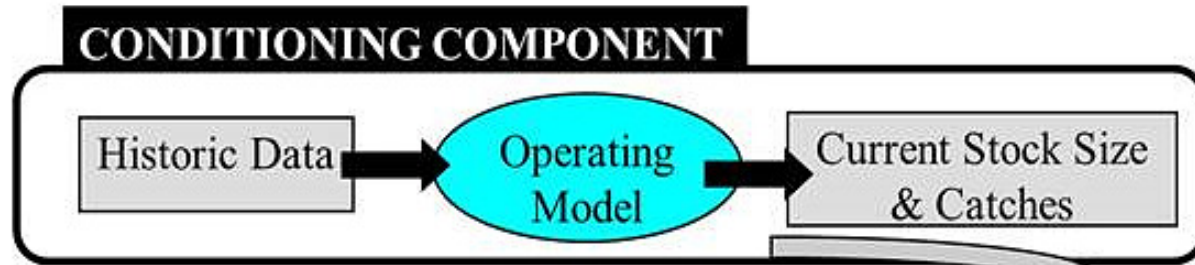
Implementation with catch limits

- Some fisheries are managed with a simple TAC
- Implementation problems:
 - Small TACs may be socio-economically unacceptable
 - Large TACs may be unacceptable given markets, capacity
 - Large changes in TACs are generally not desirable

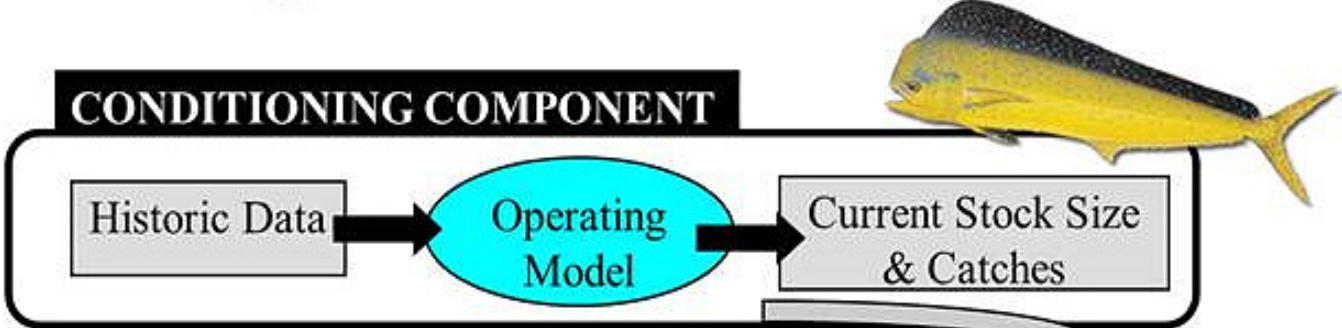
Implementation with effort limits

- Effort restrictions (closures, number of sets, FADs) are common management tools
- Implementation problems:
 - Relationship between fishing effort and fishing mortality is often noisy, difficult to understand
 - Fishermen change their behavior to maximize revenue
 - Enforcement of effort limits can be as difficult as catch limits!

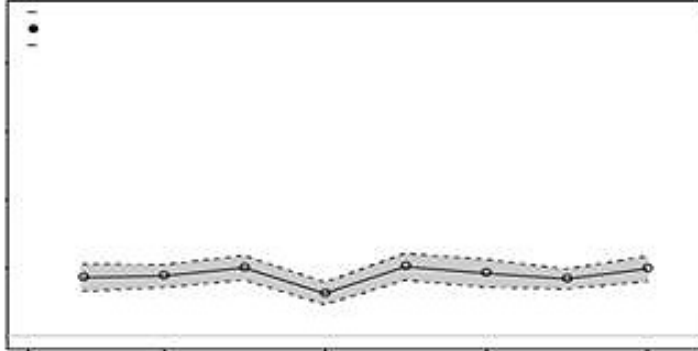
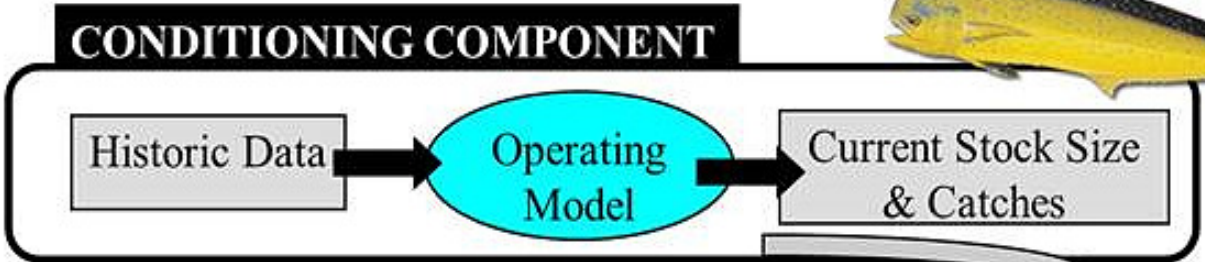
Management Strategy Evaluation example



Management Strategy Evaluation example



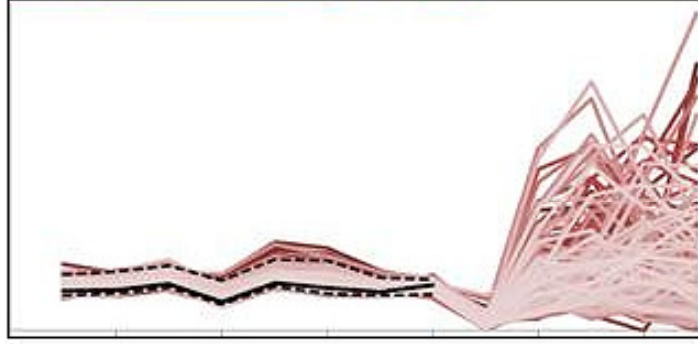
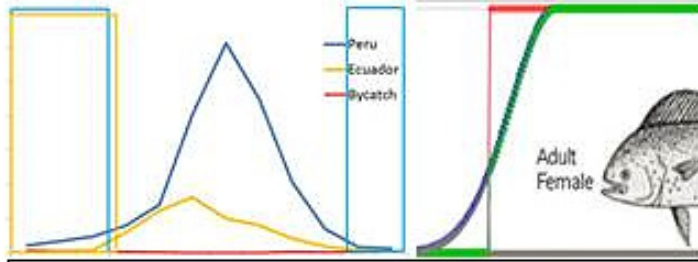
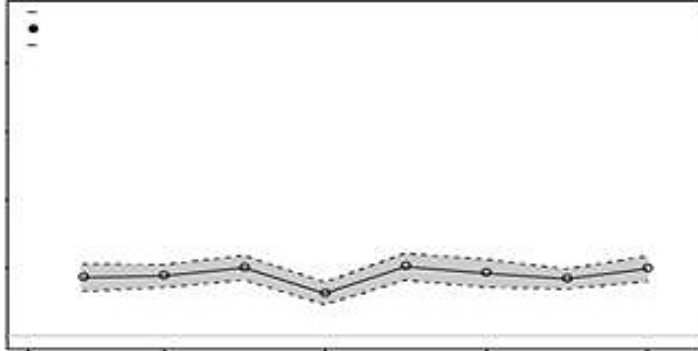
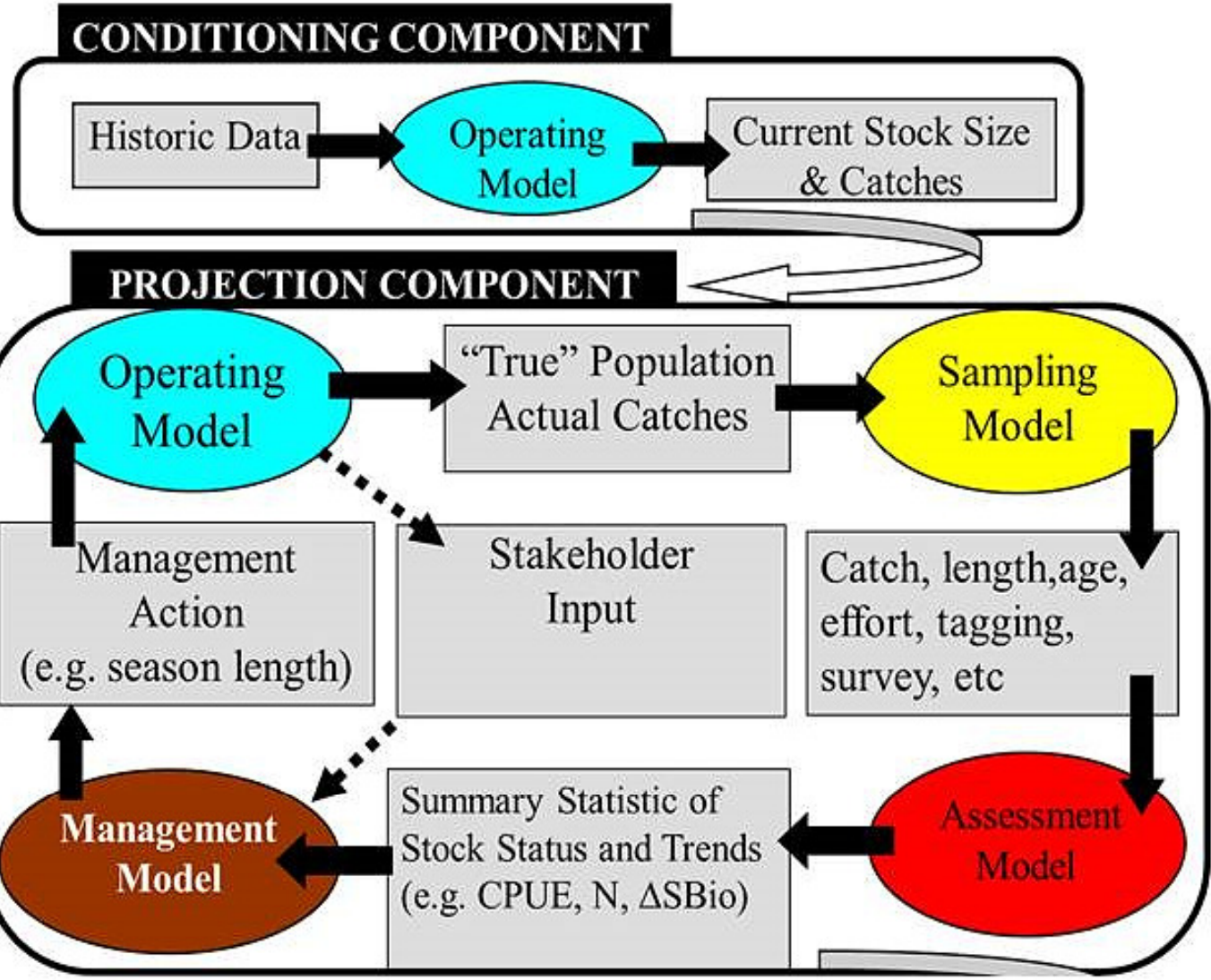
Management Strategy Evaluation example



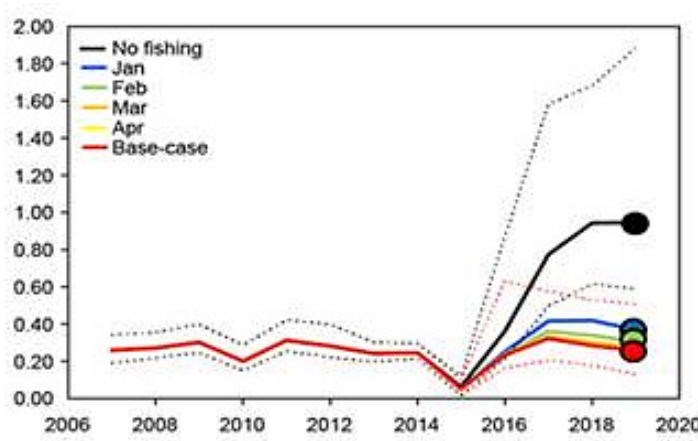
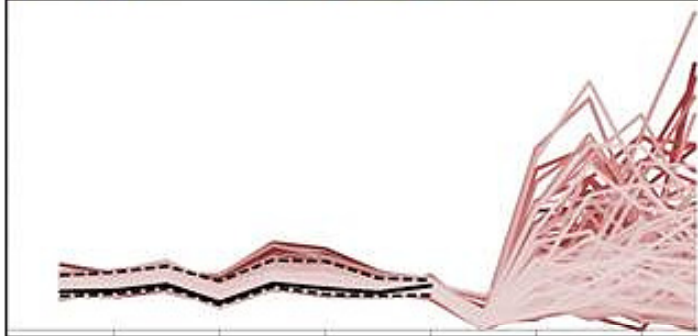
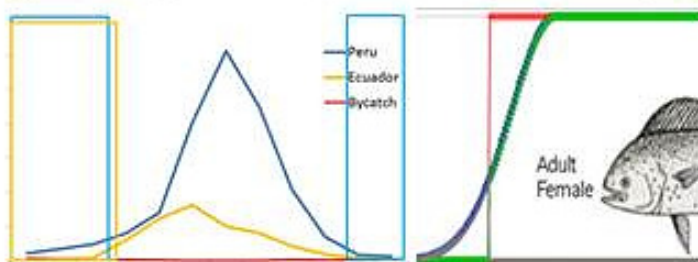
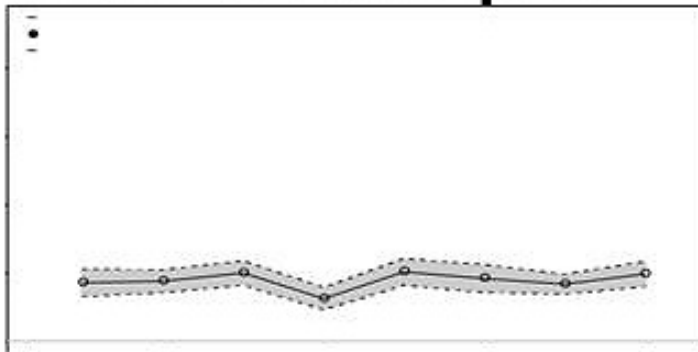
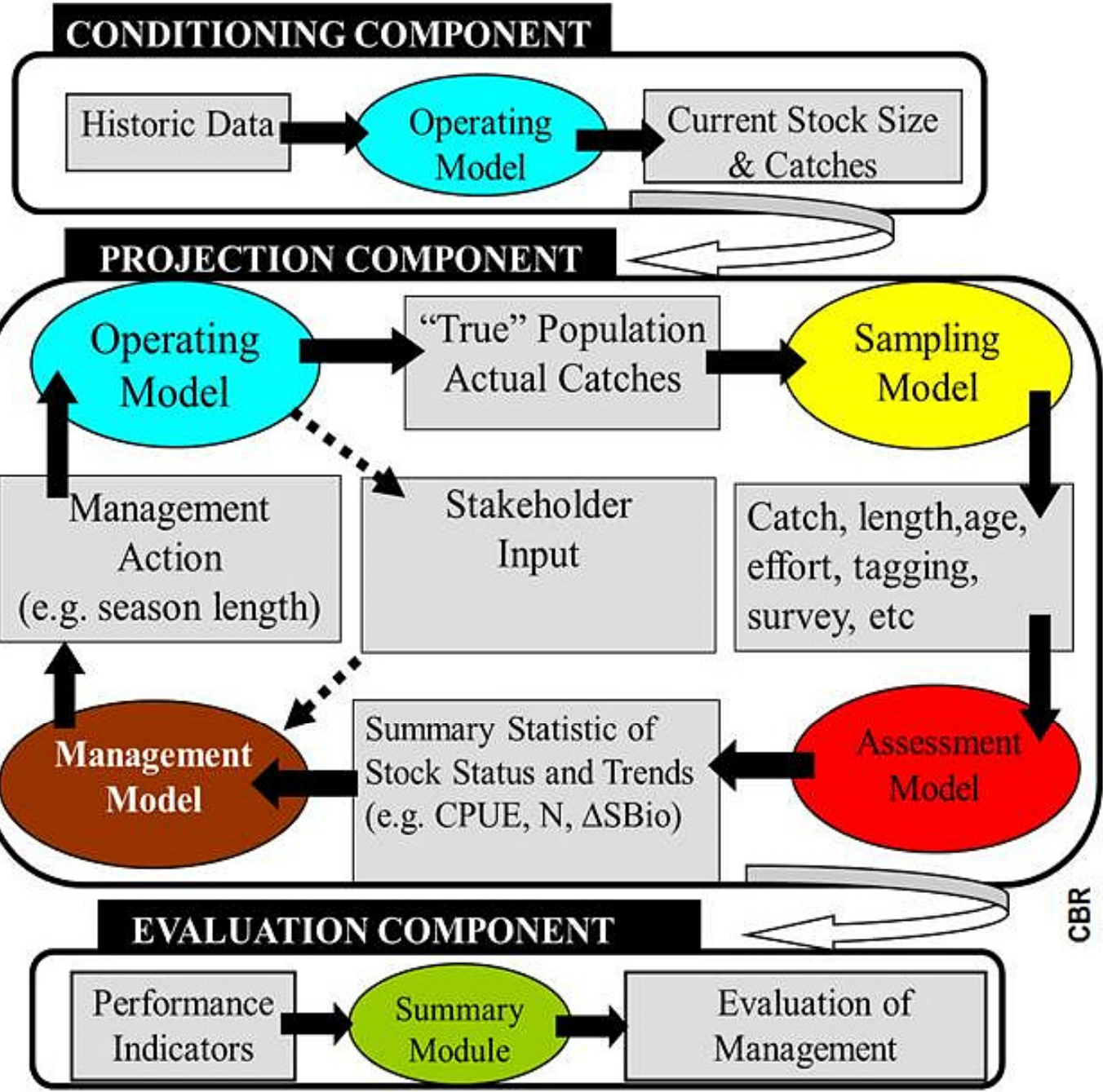
Projection component



Management Strategy Evaluation example



Management Strategy Evaluation example



Usual steps in MSE development

- Define objectives and performance metrics
- Develop candidate management strategies, harvest control rules, etc.
- Implement operating models and condition them to historical data
- Simulation and evaluation of candidate management strategies
- Select a management strategy
- Consider implementing the management strategy

PROCESS NOT LINEAR!!!

ITERATIVE!!!

Effective communication is essential

- **Several audiences:**

- Scientists ↔ Commissioners (Objectives, preliminary results)
- Scientists ↔ General public (Industry, NGOs, etc)
- Commissioners ↔ NGO, Industry, other stakeholders (national level)
- Scientists ↔ Scientists (technical support, communication support)

- **Communication mechanisms:**

- Dialogues and "spaces"/ Intermediate groups (formal or informal)
- Presentation of results in a standard and clear way

Chronogram of workshops on Management Strategy Evaluation (MSE) in the EPO

Management Strategies (Funded by WWF, FAO/ABNJ)

- **Panamá**, February 2015
- **San Diego**, USA, August 2018

Introduction to MSE to EPO Tuna Industry (Funded by WWF, FAO/ABNJ)

- **Manta**, Ecuador. June 13, 2019.
- **Panamá City**, Panamá. June 18, 2019.
- **San Diego**, USA, August 12, 2019
- **México City**, México, August 14 2019.
- **Colombia**. September 19, 2019.

Workshops for scientists-managers to elicit alternative objectives, performance metrics, harvest control rules (Funded by IATTC)

- **Asia** (English), second half 2019.
- **America** (Spanish), second half 2019.



Thank you!

