



# PA and Management

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# Overview

- PA and its use
- Why is PA important in Fisheries management and some history of its application
- Challenges in Fisheries management and dealing with Uncertainty
- Reference points and the interplay with PA
- Decision to take with underlying uncertainty
- PA and MSE's

# Fisheries Management - Goals

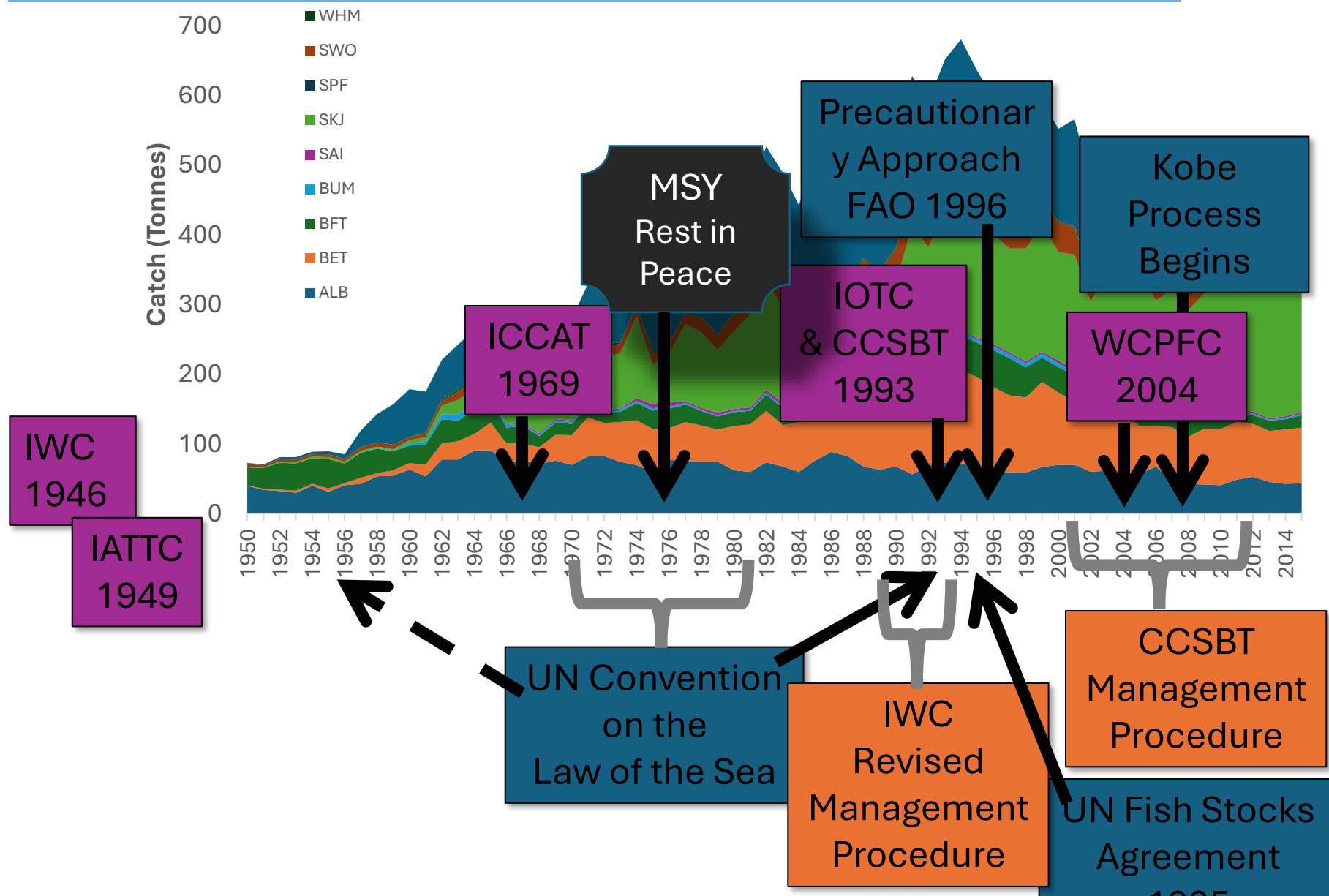
## Goals

- Sustainable economic and social benefits from harvesting
- Conserving productivity of the fish stock
- Minimising direct and indirect impacts on wider ecosystem

## Requires

- Clear set of objectives for the fishery
- Assessment of sustainable level of harvest
- A means to monitor stock status and the level of fishing
- Allocation of sustainable harvest among participants
- Measures to control fishing in response to change

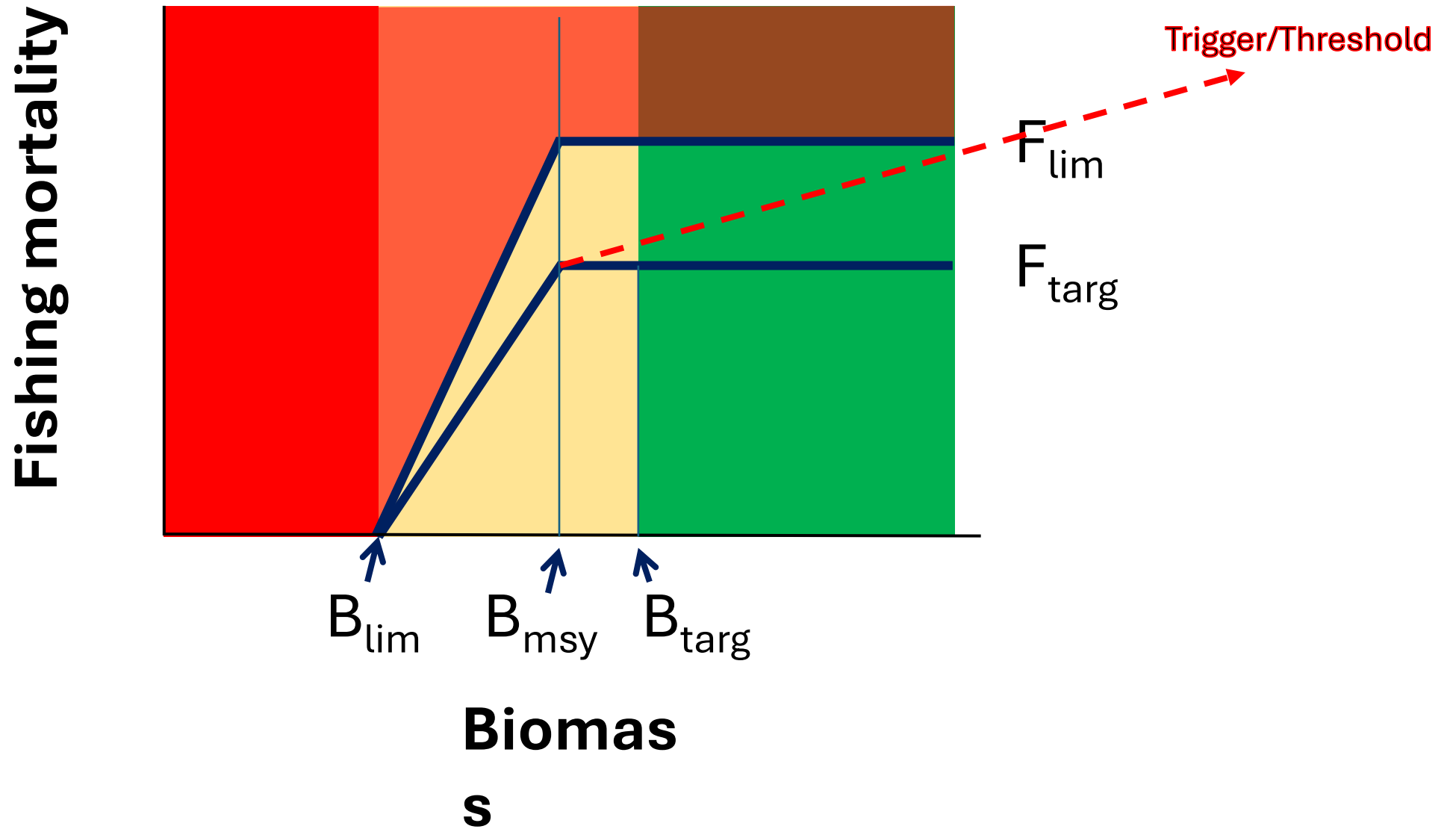
# Context – historical development



# Fisheries Management - Challenges

- Articulating management objectives at a level that they are operationally informative
- Making trade-offs between short and long-term objectives and social and economic imperatives
- Incorporating uncertainty the stock assessments
- Monitoring impacts on the wider ecosystem
- Making decisions under large uncertainty

# Reference points and harvest control rule



# Central to this

## Precautionary Approach



## Precautionary Principle

Precautionary RPs



Limit RP

Unwanted change

serious harm

*(set relative to the limits, with recognition of time lag to identify and rectify issues before limit RP is reached)*

*(ecosystem recoverable)*

irreversible Harm

*(when it is reduced to the point where the ecosystem now functions without it and it CANNOT comeback on its own)*

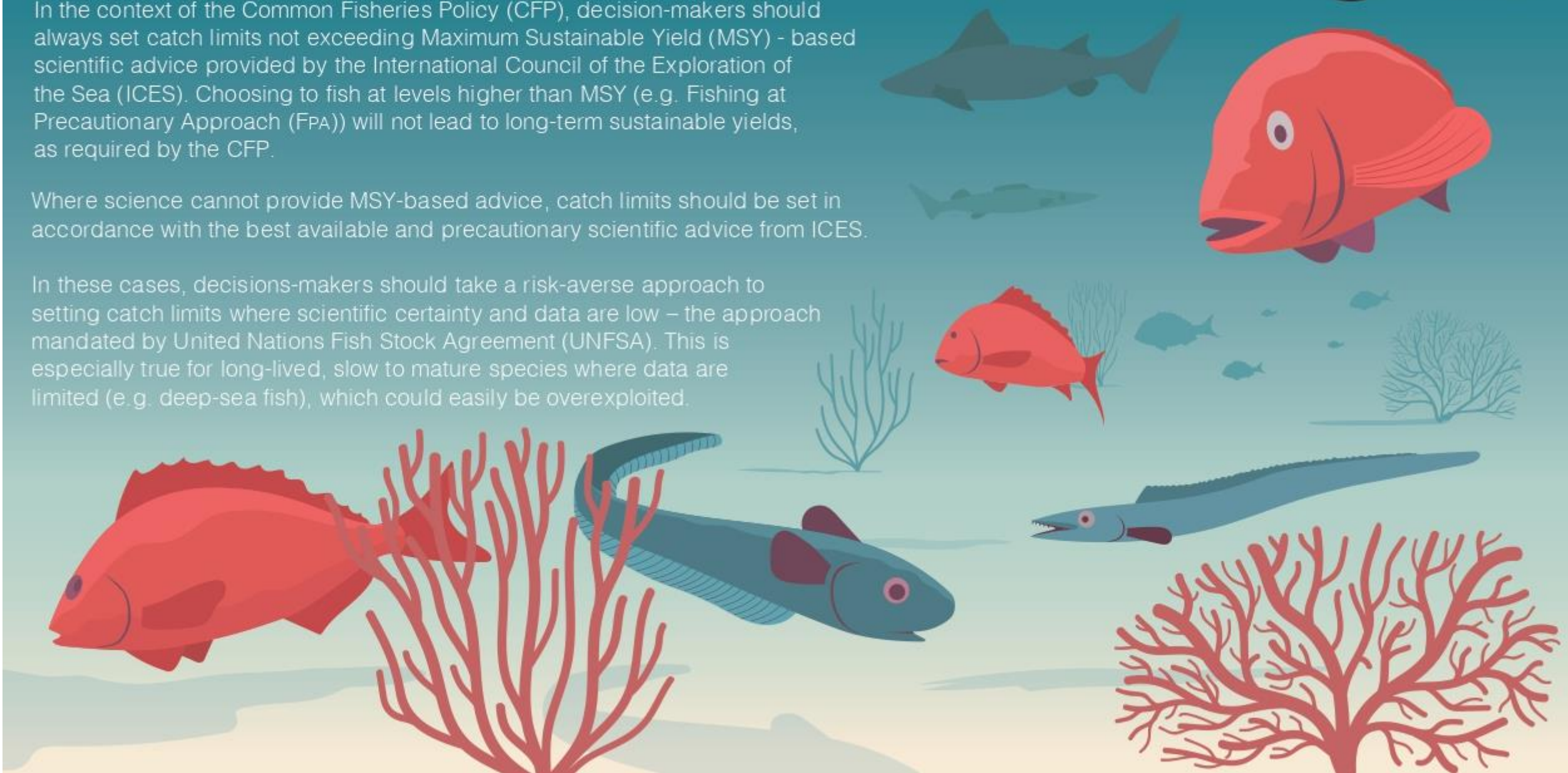
# THE PRECAUTIONARY APPROACH - A CLEAR PATH TO ENDING OVERFISHING



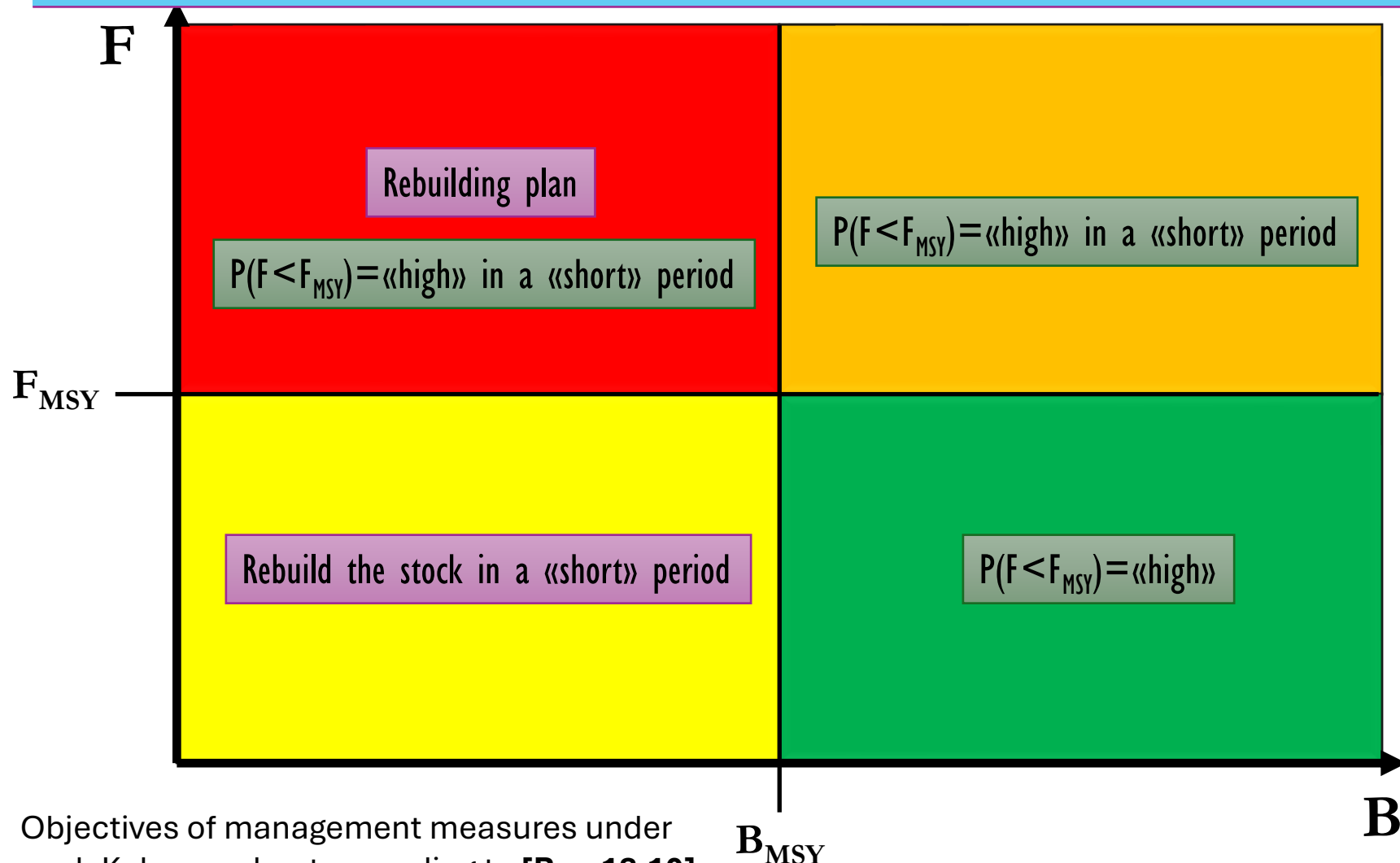
In the context of the Common Fisheries Policy (CFP), decision-makers should always set catch limits not exceeding Maximum Sustainable Yield (MSY) - based scientific advice provided by the International Council of the Exploration of the Sea (ICES). Choosing to fish at levels higher than MSY (e.g. Fishing at Precautionary Approach (FPA)) will not lead to long-term sustainable yields, as required by the CFP.

Where science cannot provide MSY-based advice, catch limits should be set in accordance with the best available and precautionary scientific advice from ICES.

In these cases, decisions-makers should take a risk-averse approach to setting catch limits where scientific certainty and data are low – the approach mandated by United Nations Fish Stock Agreement (UNFSA). This is especially true for long-lived, slow to mature species where data are limited (e.g. deep-sea fish), which could easily be overexploited.



# Harvest Control Rules (HCR) - Objectives



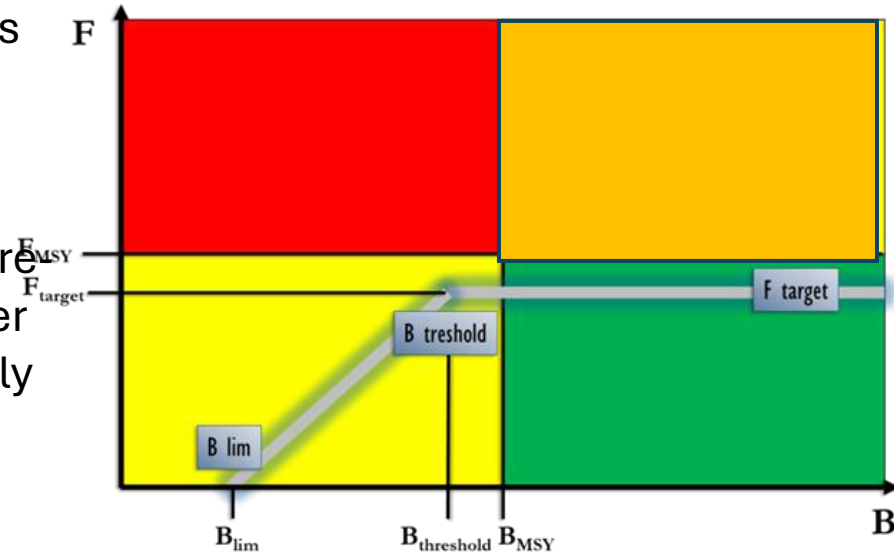
Objectives of management measures under each Kobe quadrant according to [Rec 13-10]

$B_{MSY}$

Courtesy: ICCAT

# Harvest Control Rules (HCR)

- **Ref Points** are only relevant if placed as **part of harvest strategies** or decision rules pre-agreed (HCR).
- **Harvest Control Rules (HCR)**: Set of pre-agreed rules that will be applied in order to ensure that a given fishery continually seeks to achieve TRPs and avoid LRPs

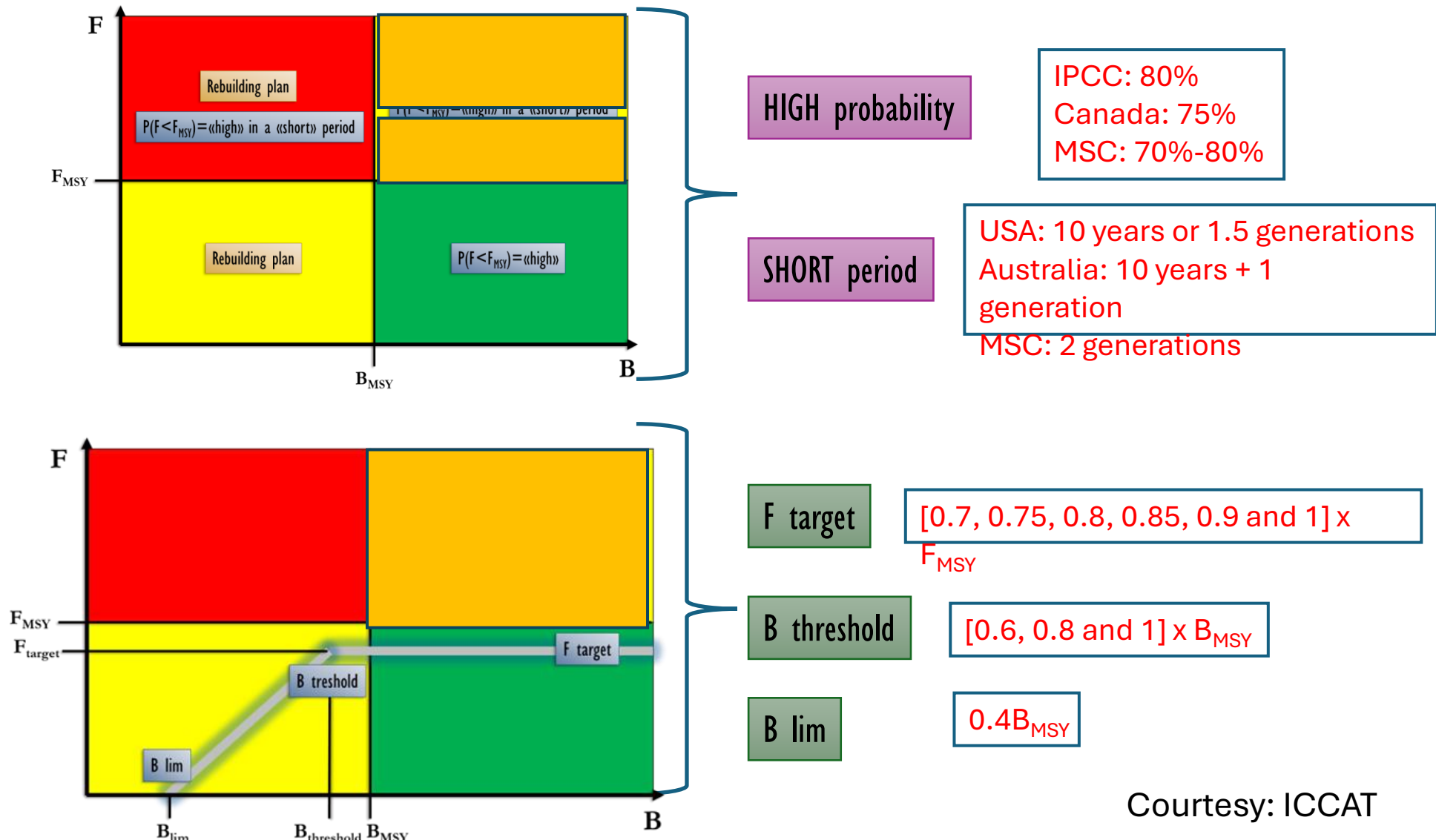


Generic form of the HCR recommended by SCRS in 2010 that would be consistent with UNFSA (Report of the 2010 WGSAM)

## IOTC

- [**Rec 13-10/ Res 15-10 superseded**] Point 4: **provides HCR framework** but parameters not defined ("high" or "low" probability, timeframes)

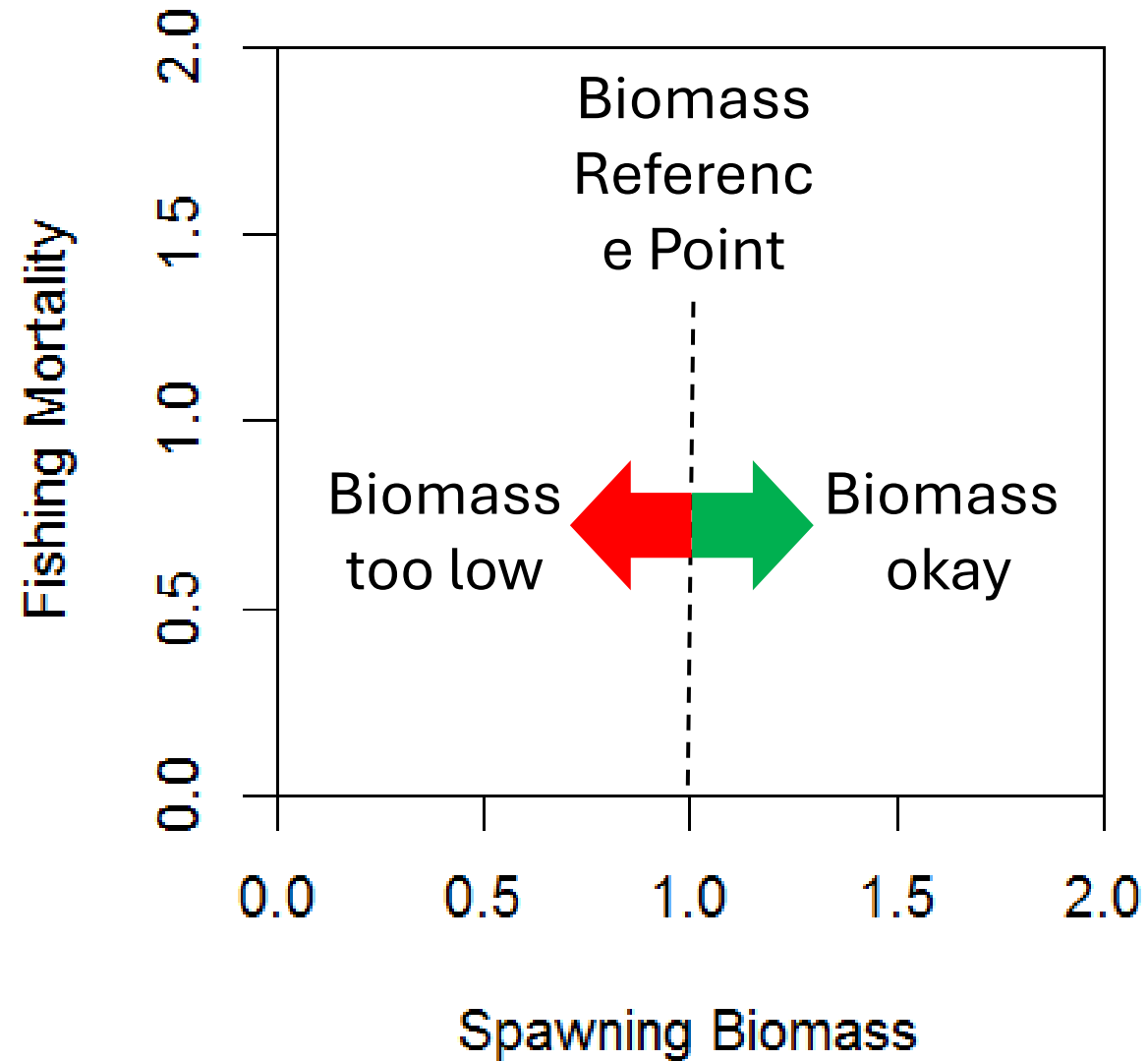
# Possible different reference targets and recovery time based on other forums



# The Kobe Process Introduces Phase Plots and Decision Matrices to Tuna RFMOs

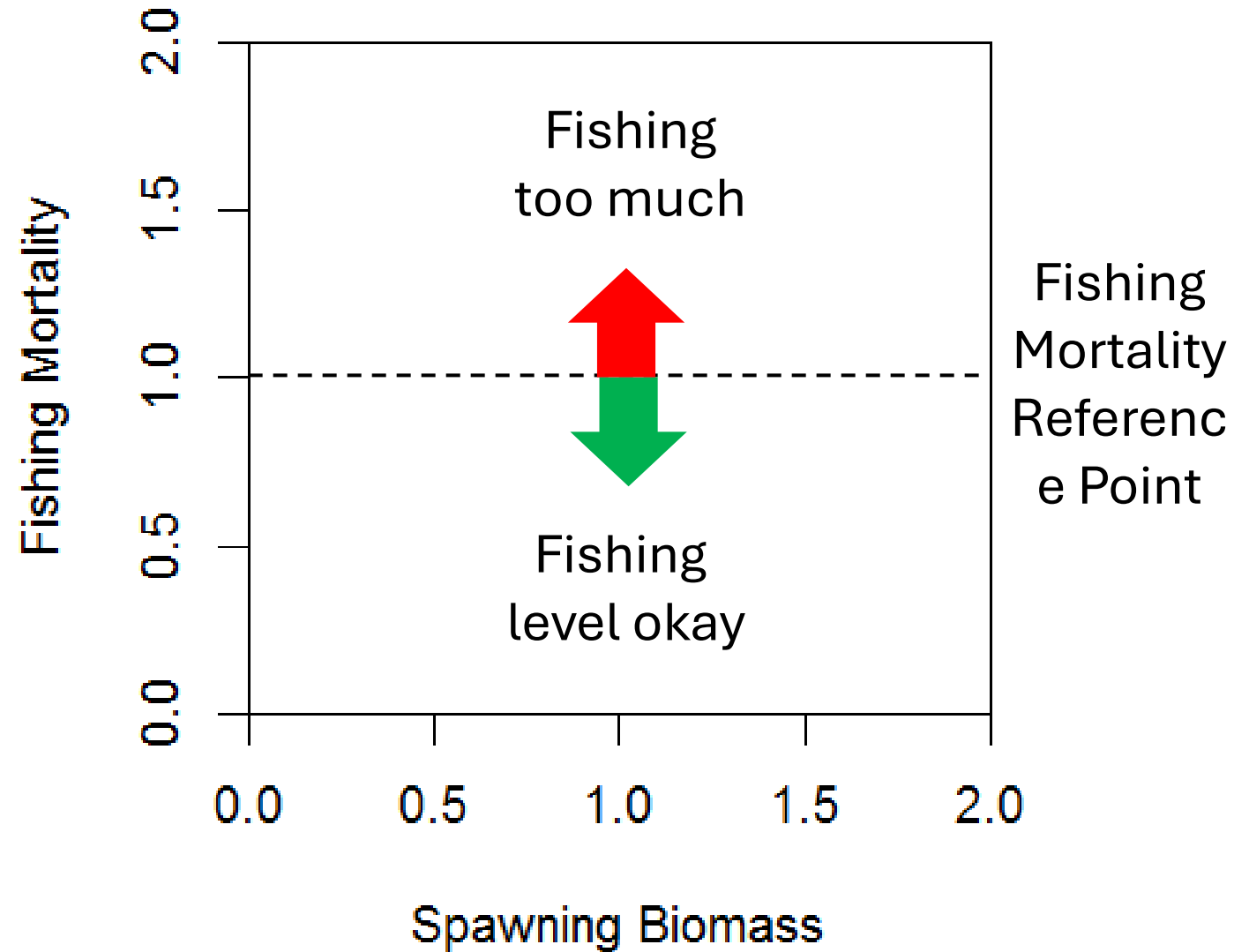
# The Kobe Plot

(a fishery summary)



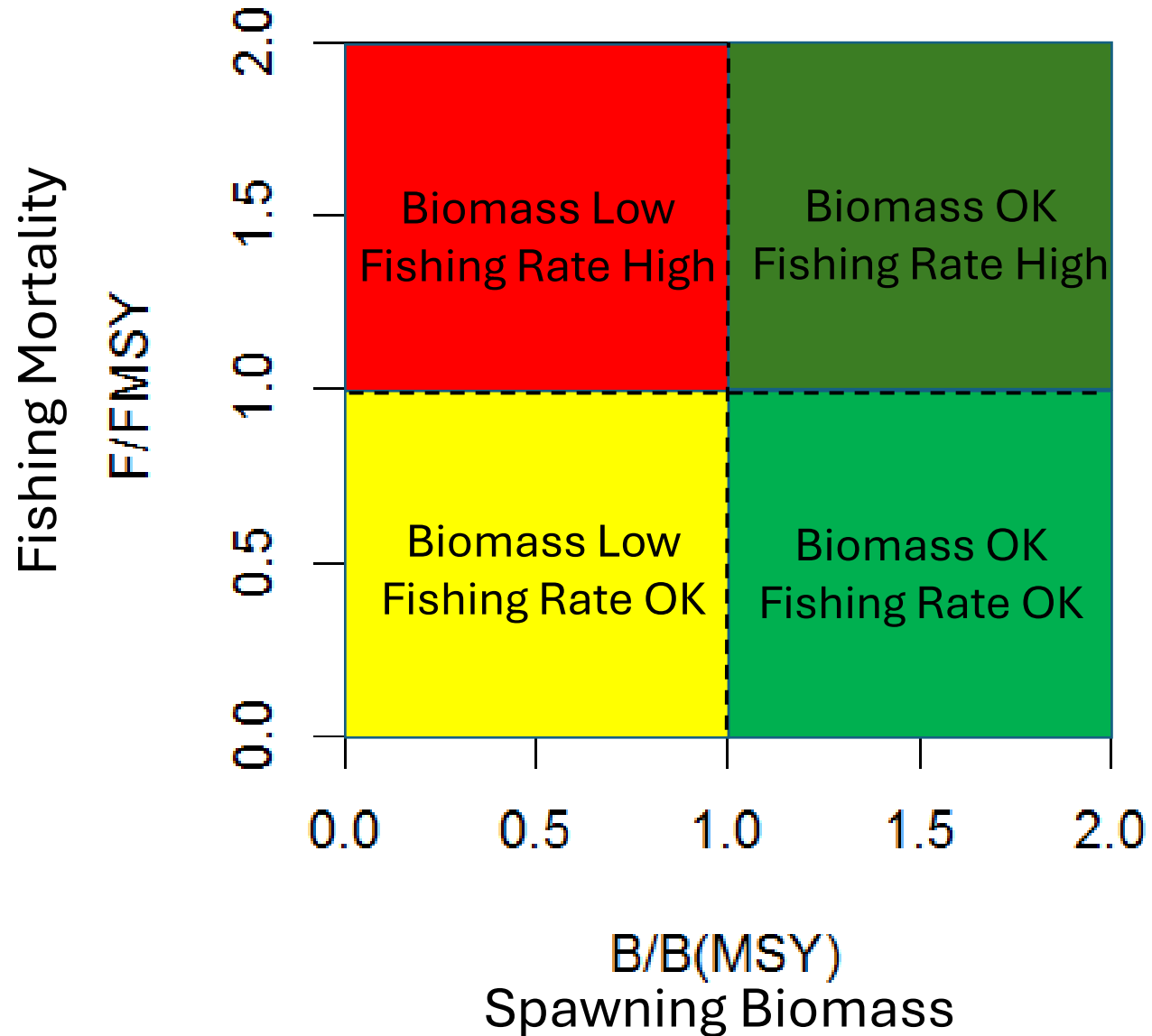
# The Kobe Plot

(a fishery summary)



# The Kobe Plot

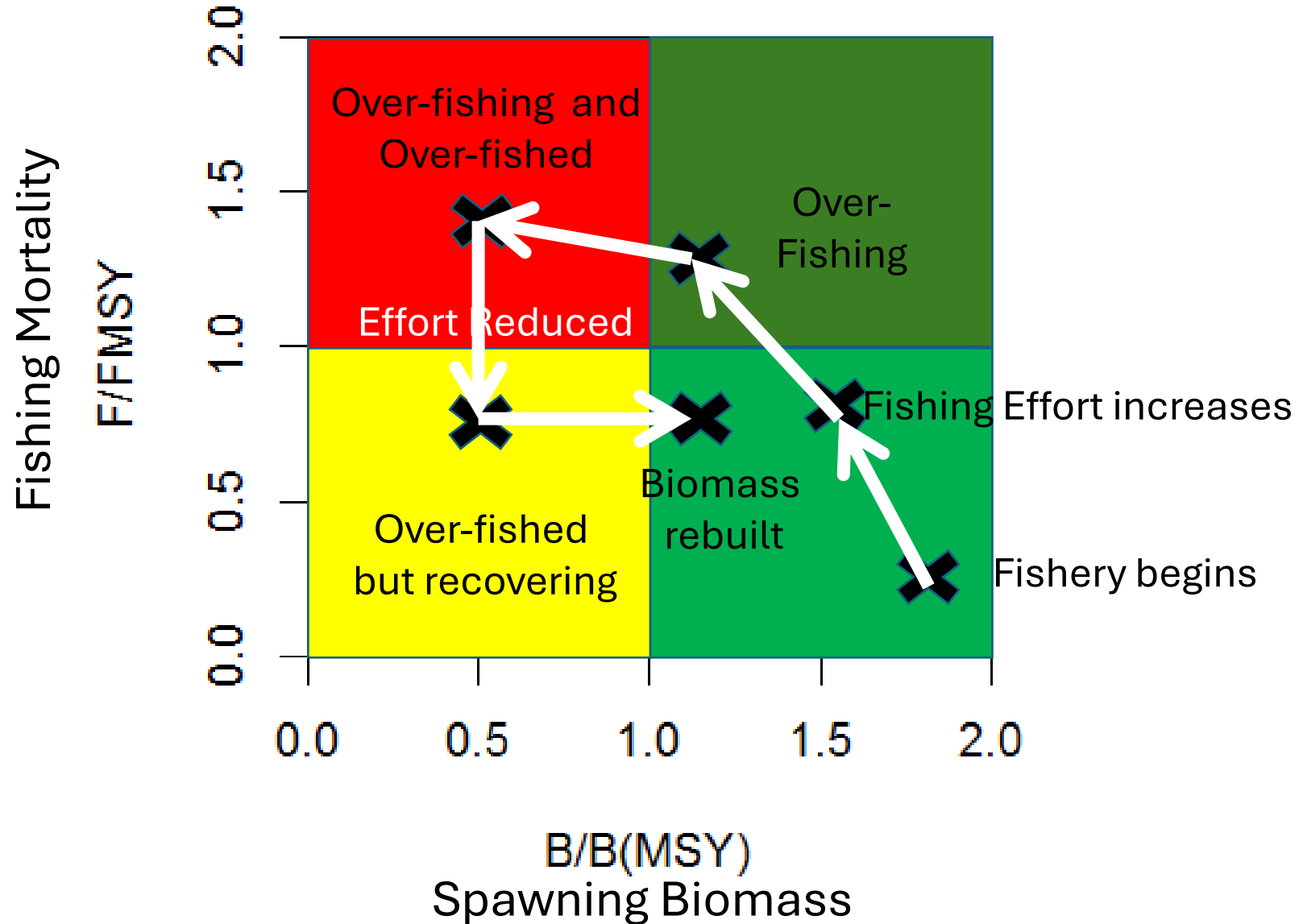
Where is your fishery now?



# The Kobe Plot

A common fishery story

You are here



# Source of uncertainty

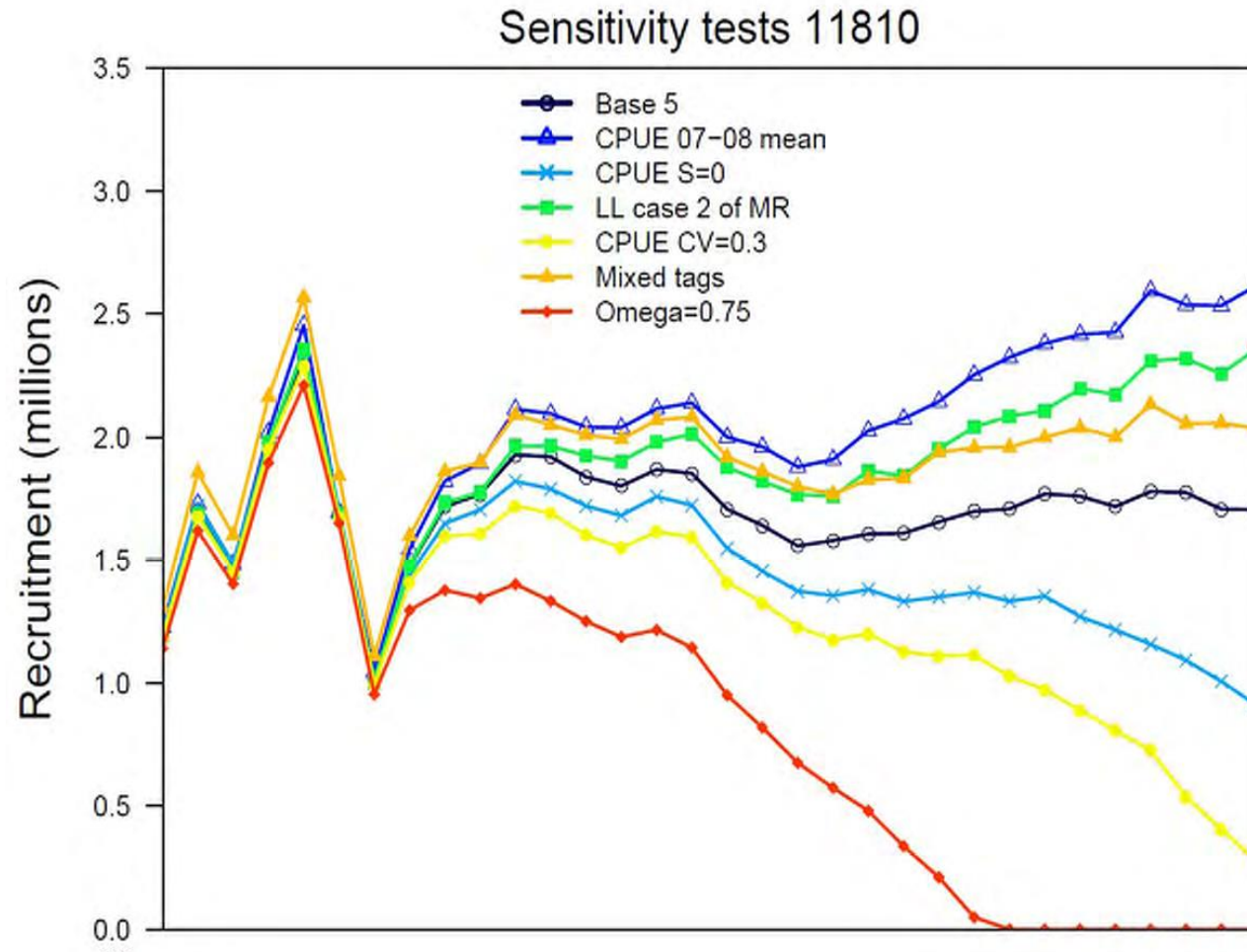
- How well we observe/measure/estimate
- Natural variability in processes
- Response of the fishery to change
- Effectiveness of management measures
- Definition of objectives
- Decisions by management

# Uncertainty in the status of the stock

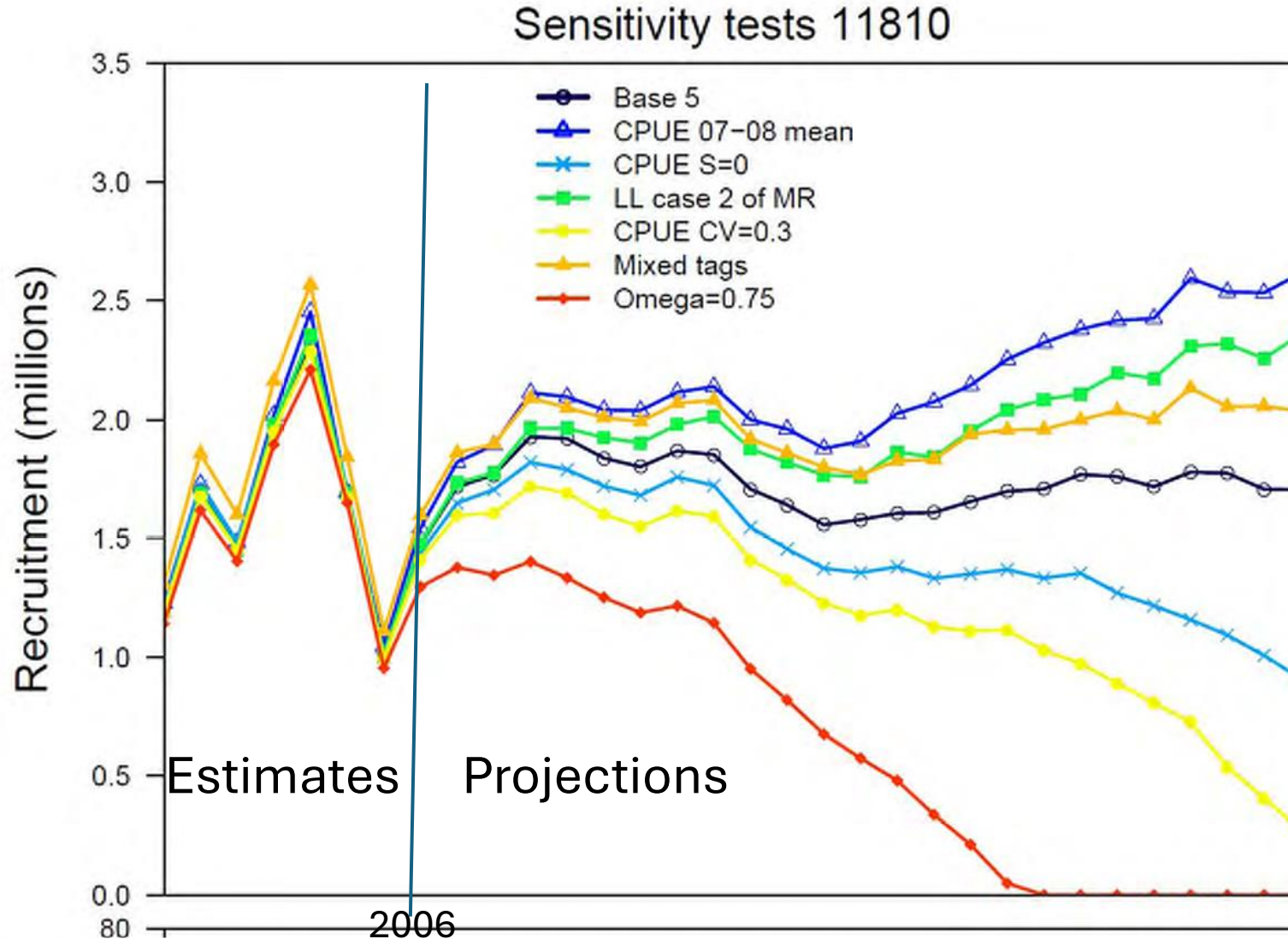
*"Counting fish is just like counting trees, except they're invisible and they move"*

(John Shepherd)

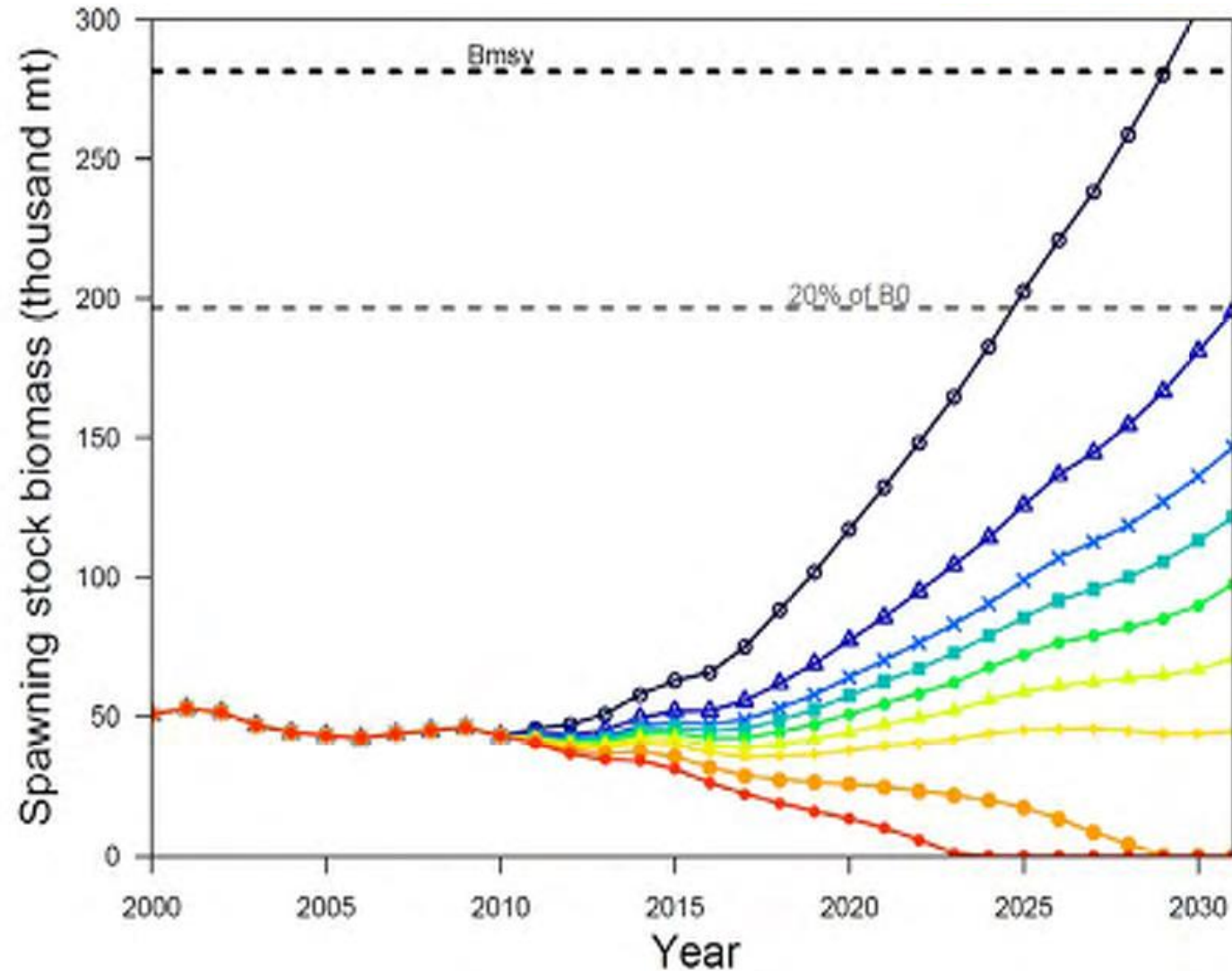
# Uncertainty in the status of the stock



# Uncertainty in future levels of recruitment



# Uncertainty in impacts of future catches



# Maximum Sustainable Yield

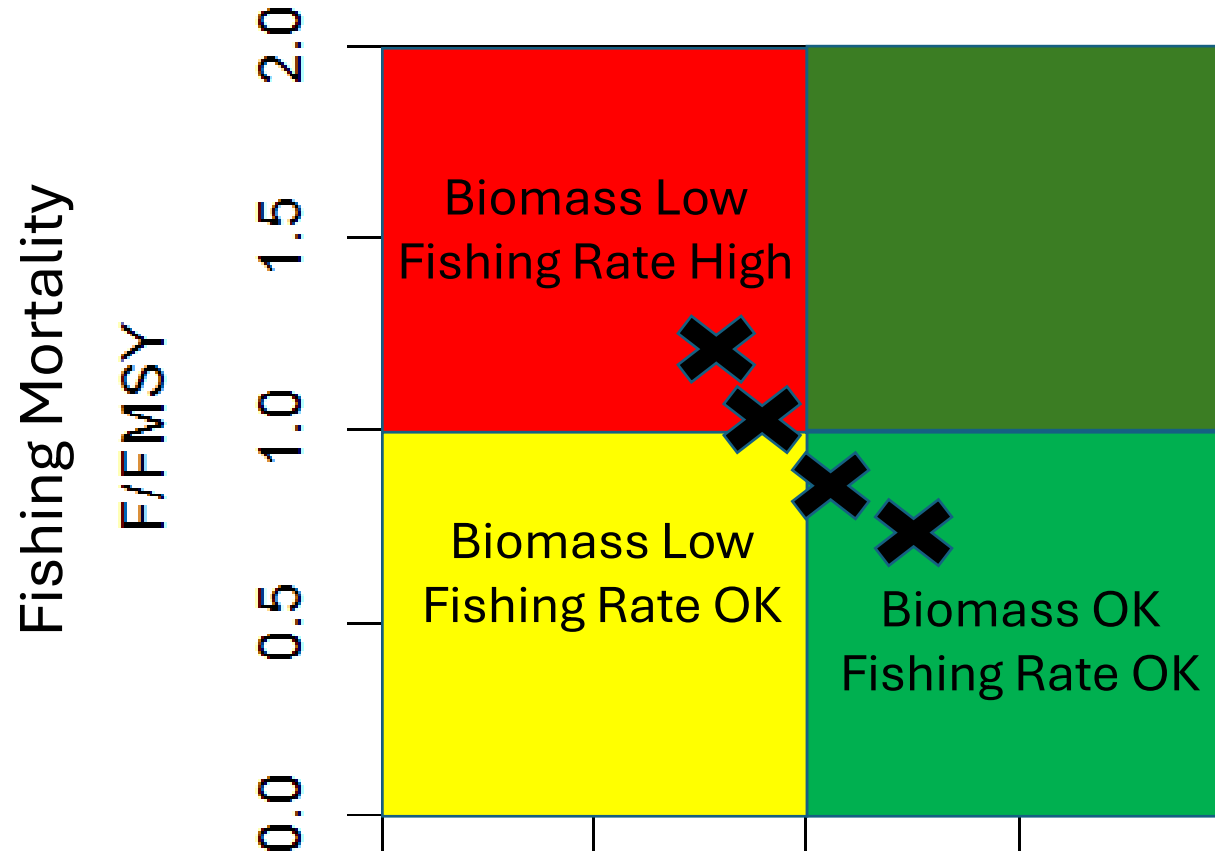
M. S. Y.  
1930s–1970s

Here lies the concept, MSY.  
It advocated yields too high,  
And didn't spell out how to slice the pie.  
We bury it with the best of wishes,  
Especially on behalf of fishes.  
We don't know yet what will take its place,  
But hope it's as good for the human race.

R. I. P.

# The Kobe Plot

Assessment uncertainty!



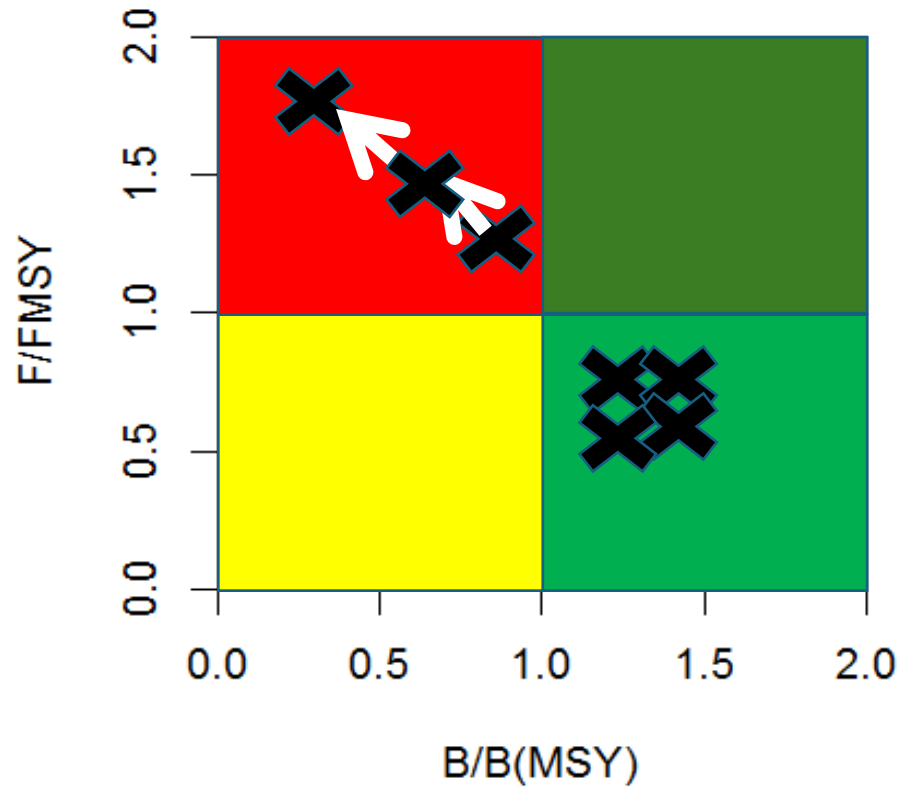
You are in one of these spots **X** now, but you do not know which

What is the appropriate management action?  
Do we reduce fishing effort or not?

# Uncertainty Impacts on decision-making

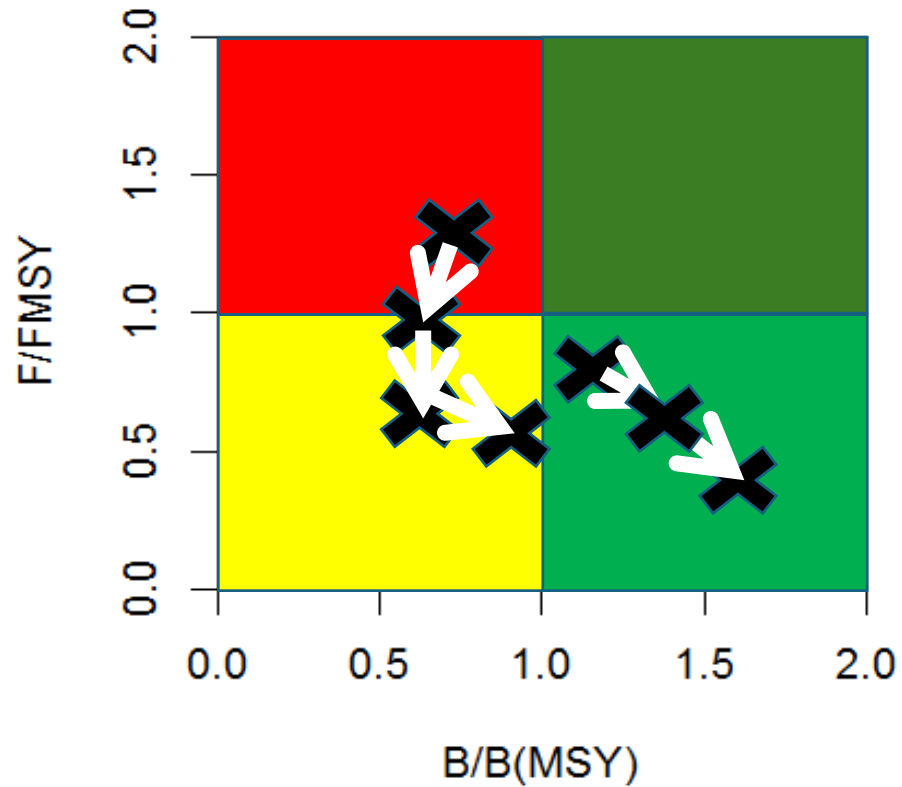
- Conflicting objectives in the short-term
- Misguided quest for “the correct model”
- Under-estimates uncertainty and risks
- Inertia in decision making
- Generally leads to poor outcomes...

# If you act as though optimistic model is correct



- If you are right, okay
- If you are wrong, fishery gets worse

# Conversely, if you act as though pessimistic model is correct



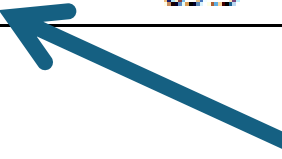
- If you are right, okay
- If you are wrong, lost opportunity

# Kobe 2 Strategy Matrix

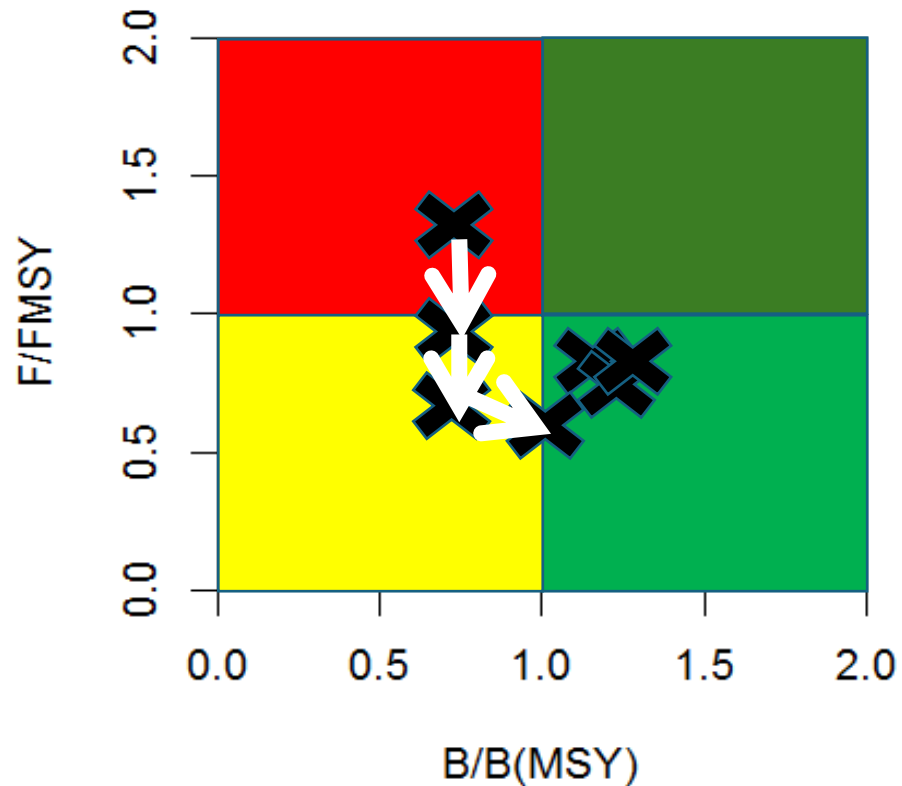
- IOTC Yellowfin Tuna Example

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating reference point				
	60% (165,600 t)	80% (220,800 t)	100% (276,000 t)	120% (331,200 t)	140% (386,400 t)
$SB_{2013} < SB_{MSY}$	<1	<1	<1	<1	<1
$F_{2013} > F_{MSY}$	<1	<1	58.3	83.3	100
$SB_{2020} < SB_{MSY}$	<1	<1	8.3	41.7	91.7
$F_{2020} > F_{MSY}$	<1	41.7	83.3	100	100

Probabilities  
reflect uncertainty



# Harvest Control Rules can be designed to provide robust advice whichever model is correct



A good Harvest Control Rule:

- Is simulation tested
- Has an acceptable likelihood of meeting social and economic objectives
- Learns from data to improve performance over time
- Is precautionary; has a high probability of avoiding worst outcomes

# Precautionary Approach and MSE

- Incorporate uncertainty
  - “Known” uncertainties
  - “Unkown” uncertainties, e.g. plausible surprises
  - Risk-weighted management options
- Limit and Target Reference Points
  - Target is where you want to aim for
  - Limit is what you want to avoid
- Management Strategy Evaluation
  - Should integrate all of the uncertainties,
  - Extract useful information from data in feedback-based Harvest Control Rules
  - Evaluated with respect to relevant performance measures on the right time-scale
  - Best tool we have for Precautionary Approach

# Acknowledgements

- Campbell Davies, Dale Kolody. Shijie Zhou CSIRO
- Common Oceans