

Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

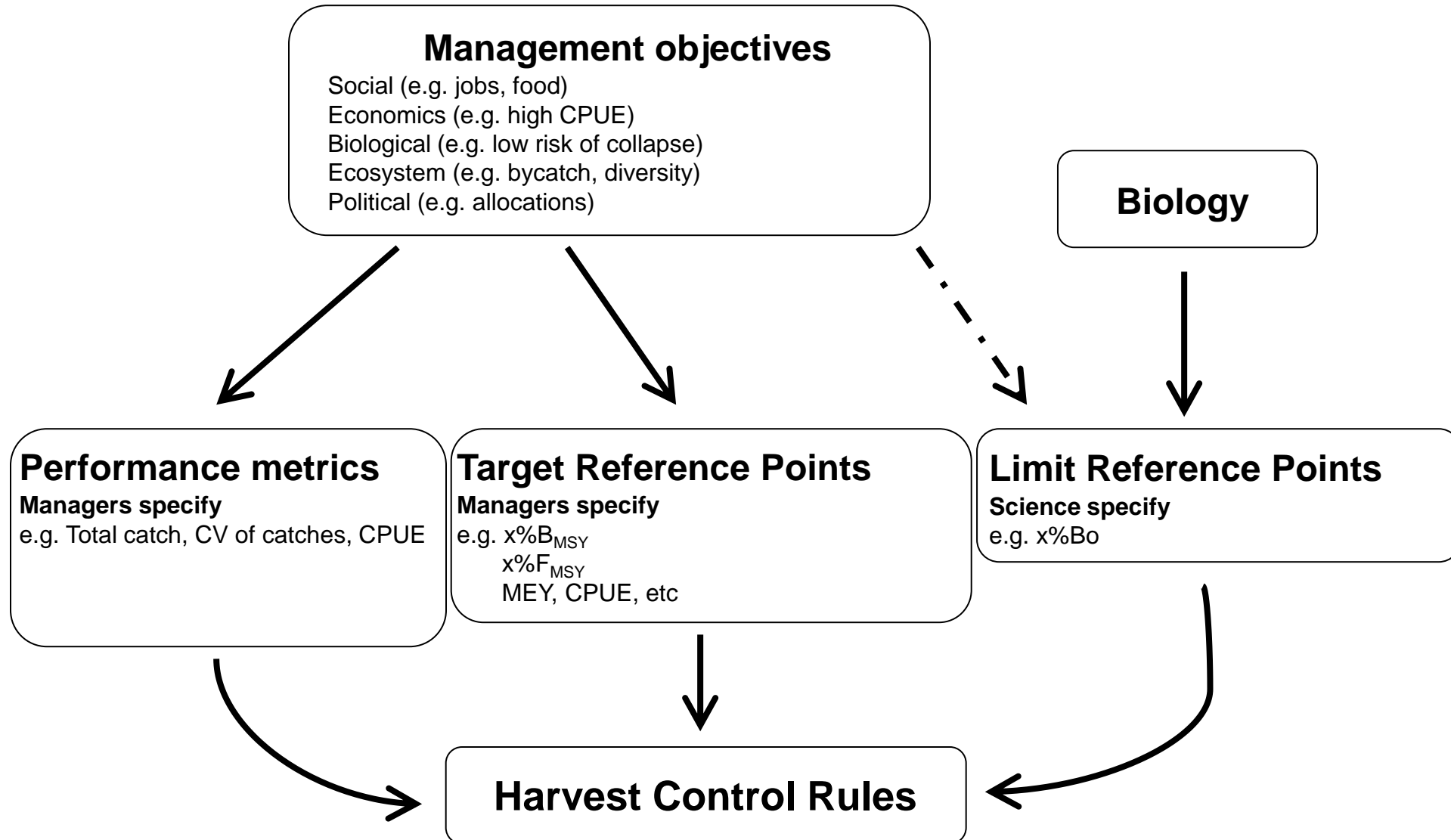


Performance Metrics

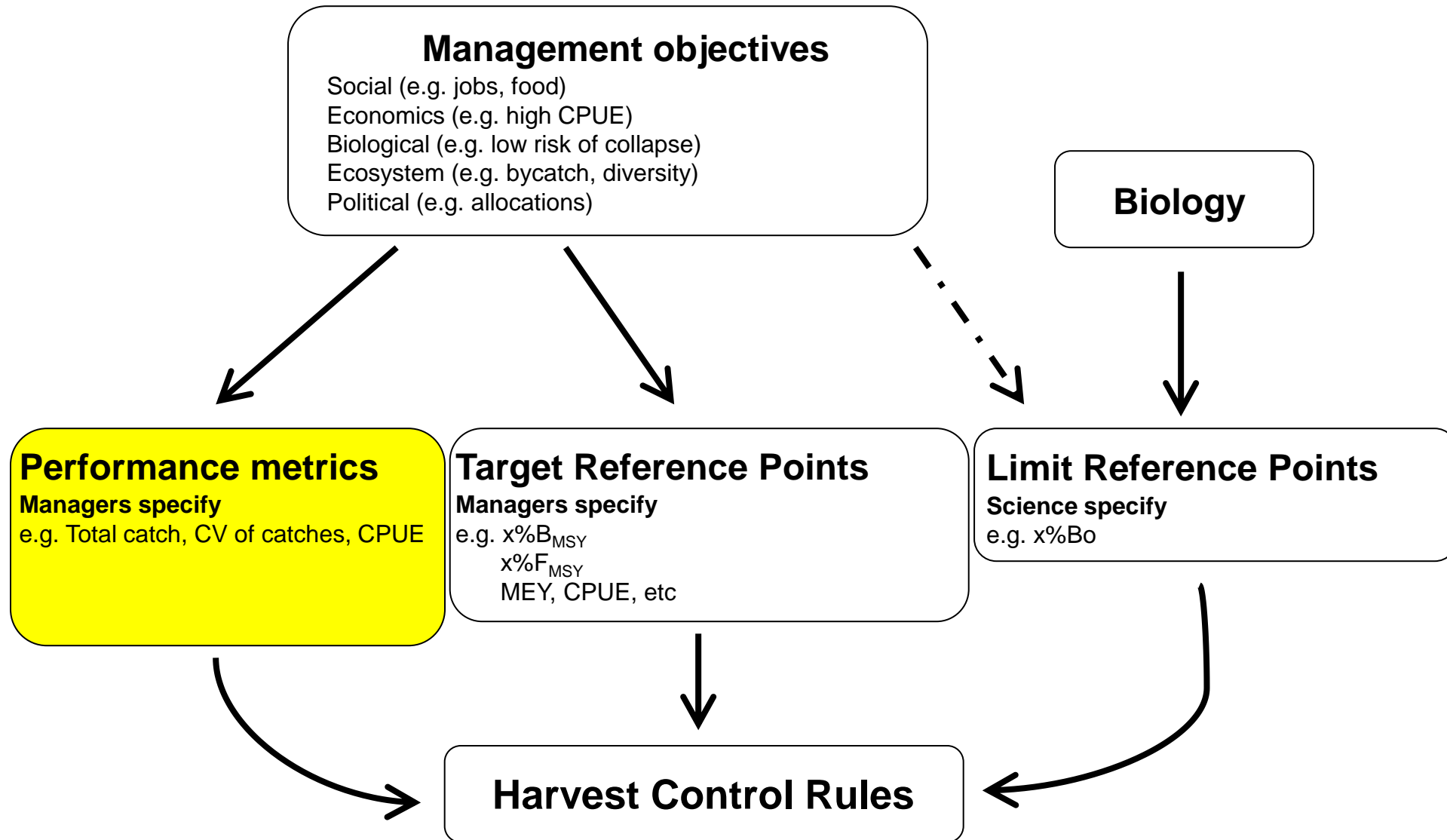
2nd IATTC Tropical Tuna MSE Workshop, *by videoconference*, May 03-04, 2021



Management strategies



Management strategies



Performance metrics

“I want it all, and I want it now...”

Freddie Mercury

- Long-term total catch
- Long-term average catch
- Long-term variability in catch
- Short-term variability in catch

- Long-term average CPUE
- Long-term average effort (fishing days)

- Probability of falling below reference points
- Probability of stock recovery

- Many more!

Tradeoffs



“You can’t always get what you want...”

Mick Jagger

- Long-term catch & Long-term CPUE
- Long-term catch & *Probability* below reference points
- Long-term catch & Short-term catch
- Long-term CPUE & Annual catch variability
- Long-term effort & *Probability of stock recovery*

Tradeoffs

- Risk metrics
 - Probability of overfishing/overfished
 - Probability of collapse (economical or biological)
 - Probability of closures (e.g. days of closure)
- Behavior towards risk
 - Risk Averse (avoidance)
 - Risk Prone (seeking)
 - Risk Neutral (indifferent)



Performance indicators and associated statistics North Atlantic albacore (ICCAT, 2016)



<i>PERFORMANCE INDICATORS AND ASSOCIATED STATISTICS</i>	<i>UNIT OF MEASUREMENT</i>	<i>TYPE OF METRICS</i>
1 Status		
1.1 Minimum spawner biomass relative to B_{MSY}	B / B_{MSY}	Minimum over [x] years
1.2 Mean spawner biomass relative to B_{MSY}^1	B / B_{MSY}	Geometric mean over [x] years
1.3 Mean fishing mortality relative to F_{MSY}	F / F_{MSY}	Geometric mean over [x] years
1.4 Probability of being in the Kobe green quadrant	B, F	Proportion of years that $B \geq B_{MSY}$ & $F \leq F_{MSY}$
1.5 Probability of being in the Kobe red quadrant ²	B, F	Proportion of years that $B \leq B_{MSY}$ & $F \geq F_{MSY}$
2 Safety		
2.1 Probability that spawner biomass is above B_{lim} ($0.4B_{MSY}$) ³	B / B_{MSY}	Proportion of years that $B > B_{lim}$
2.2 Probability of $B_{lim} < B < B_{thresh}$	B / B_{MSY}	Proportion of years that $B_{lim} < B < B_{thresh}$
3 Yield		
3.1 Mean catch – short term	Catch	Mean over 1-3 years
3.2 Mean catch – medium term	Catch	Mean over 5-10 years
3.3 Mean catch – long term	Catch	Mean in 15 and 30 years
4 Stability		
4.1 Mean absolute proportional change in catch	Catch (C)	Mean over [x] years of $ (C_n - C_{n-1}) / C_{n-1} $
4.2 Variance in catch	Catch (C)	Variance over [x] years
4.3 Probability of shutdown	TAC	Proportion of years that TAC=0
4.4 Probability of TAC change over a certain level ⁴	TAC	Proportion of management cycles when the ratio of change ⁵ $(TAC_n - TAC_{n-1}) / TAC_{n-1} > X\%$
4.5 Maximum amount of TAC change between management periods	TAC	Maximum ratio of change ⁶

Performance statistics by type of objectives (IOTC, 2016)

Candidate performance statistics

Performance measure

Summary statistic

STATUS: maximize probability of stock in the Kobe green zone

Mean spawner biomass relative to unfished

SB/SB_0

Geometric mean over years

Minimum spawner biomass relative to unfished

SB/SB_0

Minimum over years

Mean spawner biomass relative to BMSY

SB/SB_{MSY}

Geometric mean over years

Mean fishing mortality relative to target

F/F_{targ}

Geometric mean over years

Mean fishing mortality relative to FMSY

F/F_{MSY}

Geometric mean over years

Probability of being in Kobe green quadrant

SB, F

Proportion of years that $SB \geq SB_{targ}$ & $F \leq F_{targ}$

Probability of being in Kobe red quadrant

SB, F

Proportion of years that $SB < SB_{targ}$ & $F > F_{targ}$

SAFETY: maximize probability of stock above the biomass limit

Probability that spawner biomass is above 20% of SB_0

SB

Proportion of years that $SB > 0.2SB_0$

YIELD: maximize catches across regions and gears

Mean catch

C

Mean over years

Mean catch by region and/or gear

C

Mean over years

Mean proportion of MSY

C/MSY

Mean over years

ABUNDANCE: maximize catch rates to enhance fishery profitability

Mean catch rates by region and gear

A

Geometric mean over years

STABILITY: maximize stability in catches, reduce commercial uncertainty

Mean absolute proportional change in catch

C

Mean over years of absolute (C_t / C_{t-1})

Variance in catch

C

Variance over years

Variance in fishing mortality

F

Variance over years

Probability of fishery shutdown

C

Proportion of years that $C = 0$



Southern Bluefin Tuna performance statistics (CCSBT, 2018)



Catch performance measures:

Average short term (10 year) and long-term catch

Measure of TAC smoothness: average annual catch variability over 25 years

Maximum TAC decrease

Proportion of occurrence where initial 2 TAC changes are up and then down

Proportion of occurrence where initial 4 TAC changes are set up then down

Proportion of runs with TAC above the current catch at the tuning year.

Lower 10th percentile in year t, e.g. in 10 years

SSB performance:

SSB in medium term relative to SSB0

Spawning biomass in short term relative to current

Spawning biomass in medium term relative to current

Minimum spawning biomass relative to current

Proportion of runs above the current biomass at the tuning year

Catch increases while SSB stays low: ratio of catch/SSB in 2030 for a) lower 10th, b) median, c) upper 90th percentile

SSB lower (10th) percentile continuing to increase (no decline in period 2013-2035)

Lower 10th SSB percentile in year t, e.g. in 10 years

CPUE performance:

CPUE relative to CPUE in the short term.

Discussion on Performance Metrics

We will discuss alternative performance metrics as part of the discussion on Objectives