South Atlantic Dolphinfish MSE

7. Management Procedures

a. The mahiMP

b. Status quo management

c. Management regulations (trip limits, size limits)

d. Empirical MPs

e. MP tuning

27th July 2026

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7a. The mahiMP (mahiMSE R package)

Overview

An empirical TAC control MP and accounts for current regulations

Features

- TAC control by fleet and area based on indices (SSB, biomass, vulnerable biomass) that can be specific to fleet and area.
- Stackable (e.g., TAC control of Fleet 1 using index 1 and HCR 1, TAC control of Fleet 2 using index 4 and HCR 3 etc).
- Allows for simultaneous effort control (e.g. can project with current effort (F) or catches or potentially include effort dynamics models within the MP)
- Allows for changes in min size, max size, trip limits and post-release mortality
- Flexible empirical (relative to current catch and current index levels) harvest control rule (HCR) with upper and lower control points including additional constraints including max upward and downward TAC changes, smoothing of indices & dampening of TAC changes

7a. The mahiMP (mahiMSE R package)

mahiMSE User Manual

An R Package for Informing Management of U.S. South Atlantic Dolphinfish Fisheries

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2026-03-12

bluematter openMSE www.openmse.com

1 Foreword

This research and decision support tools use operating models and MSE (Management Strategy Evaluation) simulation testing to characterize scientific uncertainty to inform robust management decision making.

2 Objective of this document

This document is intended to guide prospective users on how to:

- work with mahi operating models
- design and test management procedures (MPs)
- summarize MP performance

https://blue-matter.github.io/mahiMSE/supporting/mahiMSE.html

7a. The mahiMP (mahiMSE R package)

The Mahi Management Procedure (OpenMSE v2.0)

Description

A function for emulating status quo mahi management and allowing for a wide range of combine
RecN, (3) RecS, (4) HireN, (5) HireS, (6) Intl, (7) Disc, (8) UnRep. Areas (n = 5) are: (1) "CAR+

Usage

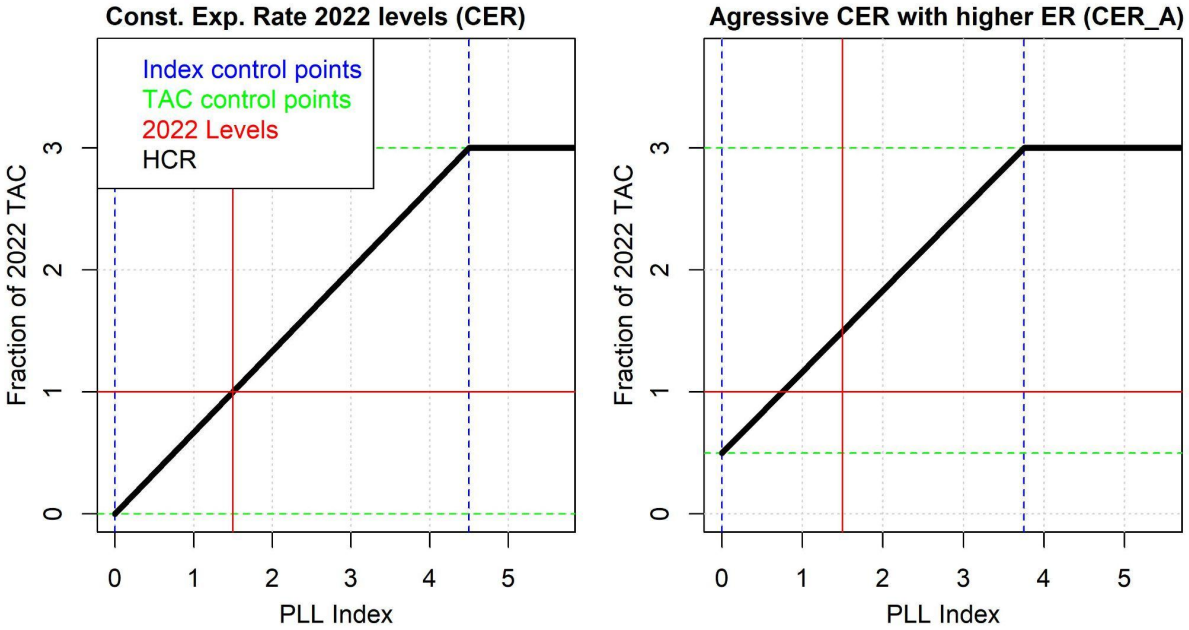
```
mahiMP(
  Data,
  TAC = NA,
  rel_TAC = NA,
  TAE = NA,
  rel_TAE = 1,
  SLmin = c(0, 0, 500, 0, 500, 0, 0, 0),
  SLmax = c(10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000),
  TL = c(NA, 54, 54, 54, 54, NA, NA, NA),
  PRM = list(0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25, 0.25),
  HCR_use = F,
  HCR_ICP = NA,
  HCR_LCP = NA,
  HCR_calib = 145:148,
  HCR_fleet = list(NA),
  HCR_sens = 1,
  HCR_lever = "TAC",
  HCR_up_max = 0.5,
  HCR_down_max = 0.5,
  HCR_input = 1,
  HCR_smooth = NA,
  Index_type = "VAST",
  Index_cv = NA,
  Index_ac = NA,
  Index_lag = 1,
  Index_seed = 1,
  TL_empirical = T,
  plot = F,
  ...
)
```

`Data`	An object of openMSE class 'Data'
`TAC`	Annual total allowable catch. A single value (all fleets, all areas), a vector length nFleet or a matrix nFleet x nArea. Positive real number.
`rel_TAC`	A single value that is current TAC relative to the most recent historical year. Positive real number. Can be a single number, a vector nfleet long or a matrix nfleet by narea long.
`TAE`	Annual total allowable effort. Single value (all fleets, all areas) or a vector length nFleet. Positive real number.
`rel_TAE`	Relative effort (an improper fraction of effort in the last historical year). Positive real number. Single number (all fleets/areas), vector of length nfleets (8), vector of length nareas, or matrix with nfleets rows and nareas columns (8 x 7).
`SLmin`	Minimum size limit (mm). Positive real number. Can be a single number (all fleets) or a vector nfleets long (8).
`SLmax`	Maximum size limit (mm). Positive real number larger than Smin (if specified). Can be a single number (all fleets) or a vector nfleets long (8).
`TL`	Trip limit (fish retained per trip). Positive integer. Can be a single number (all fleets) or a vector nfleets long (8). Note that predictive models are only available for RecS and HireS in regions CAR+FLK and NCFL.
`PRM`	Post Release Mortality (discard mortality). List nfleet long of either a Fraction (all length classes) or a vector nlengths long. Default from US hook and line estimates of Rudershausen et al 2019 (DOI: 10.1002/nafm.10348). Can be a single number or a vector of length nareas (7).
`HCR_use`	Should HCR(s) be used? Boolean. If False, all other HCR arguments will be ignored.
`HCR_ICP`	Index control points. These are a pair of x-axis control points for a hockey-stick control rule. Phrased in terms of the levels of the index (HCR_input) over the HCR_calib years.
`HCR_LCP`	Management Lever control points. These are a pair of y-axis control points for a hockey-stick control rule. Phrased in terms of the levels of the Lever (HCR_lever) over the HCR_calib years.
`HCR_calib`	The calibration years used - which historical time period is used? Vector of integer time steps.
`HCR_fleet`	The fleet for which the HCR is used. Vector of positive integers nHCR long. If NA this sets advice for all fleets combined based on the HCR_input specified.
`HCR_sens`	Sensitivity of the response. A vector of positive real numbers nHCR long. A value of 1 is proportional.
`HCR_lever`	The output variable. A vector of character strings nHCR long. E.g., "TAC", "TAE".
`HCR_up_max`	The maximum rate of advice increase. Positive imperfect fraction. E.g., 0.2 is a maximum management increase of +20 per cent.
`HCR_down_max`	The maximum rate of advice decrease. Positive fraction. E.g. 0.8 is a maximum management decreate of 80 per cent.
`HCR_input`	The indices used in the harvest control rule. A list of integer vectors, nHCR long. E.g., HCR_input = list(2:3, c(1,3)) uses indices 1 and 2 for the first HCR, indices 1 and 3 for the second HCR
`HCR_smooth`	The effective number of parameters of a polynomial smoother applied to the input indices. Defaults to NA - raw data. A value of 0.1 means that there will be length(Index)*0.1 number of smoothing parameters. Hence, higher values are less smoothing. This parameterization keeps smoothing consistent as the length of the time series increases in projections.
`Index_type`	The origin of the index. Character string nIndex long. Can be biomass ("B"), spawning stock biomass ("SSB"), vulnerable biomass of fleet 1 ("VB1"), vulnerable biomass of fleet 2 ("VB2"), etc.
`Index_cv`	The coefficient of variation of the index (CV). Vector of positive real numbers nIndex long.
`Index_ac`	The lag-1 autocorrelation of the index. (Generally positive) Vector of fractions nIndex long.
`Index_lag`	The number of years of data lag. Vector of integers, nIndex long. 1 is a single year.
`Index_seed`	Real number, a random number seed for generating index observation errors nIndex long
`TL_empirical`	Should the empirical distribution of catch rates be used to calculate release rate according to trip limits?

7a. The mahiMP (mahiMSE R package)

HCR

A two-control point empirical HCR:



(can be any index supplied)

7b. Status Quo Management

Current Regulations

Management Lever	Level
Commercial ACL	1,719,953 lbs
Rec. ACL	22,850,811 lbs
Rec. trip limit	54 fish
Min size	20” in SC, GA and FL

Complexities

Currently, the U.S. fleets catch less than their ACL.

To avoid a discontinuity (a sharp increase in the first projection year), TAC controls start from catches in the last historical year.

Status quo projections can either project from current catches or current effort (F).

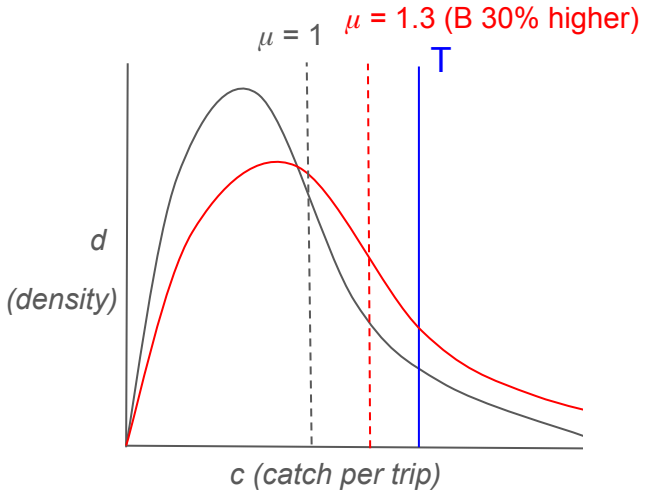
Projections current start from 2023. Revisions to the framework will include known catches for interim years (i.e., after 2022 and before 2027).

7c. Management Regulations (trip limits, size limits)

Implementing Trip Limits

- Characterized the historical trip-level catch rate data that are available (explored catch rate models and empirical distribution)
- Calibrated this to vulnerable biomass (B) and assumed constant coefficient of variability ($c = qB$).
- Calculated the expected fraction released (r) using a numerical approximation (Carruthers et al. 2026):

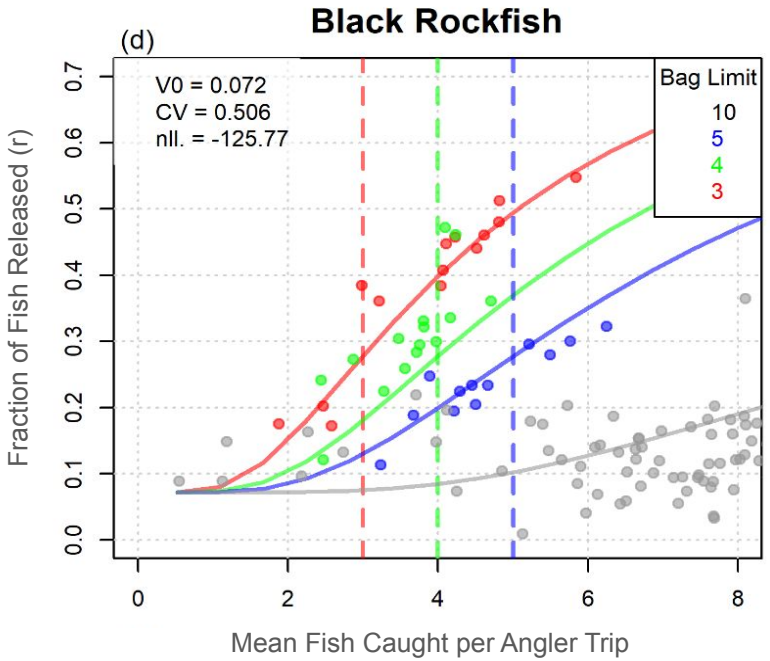
Equation	Terms
$r = 1 - k$	r: release rate of fish (average fraction released).
$k = \frac{\sum_{i=1}^{n} d_i y_i}{\sum_{i=1}^{n} d_i c_i}$	k: proportion of fish retained.
	d_i: probability density at catch rate c_i.
$y_i = \begin{cases} c_i & c_i < T \\ T & T \leq c_i \end{cases}$	y_i: predicted retained catch rate.
	c_i: catch rate.
	n: the length of the c and d vectors
	i: vector position [1, 2, …, n]
	T: trip limit.



Example: California Black Rockfish

Carruthers et al. (2026) Fitted a lognormal model to logbook data from northern California.

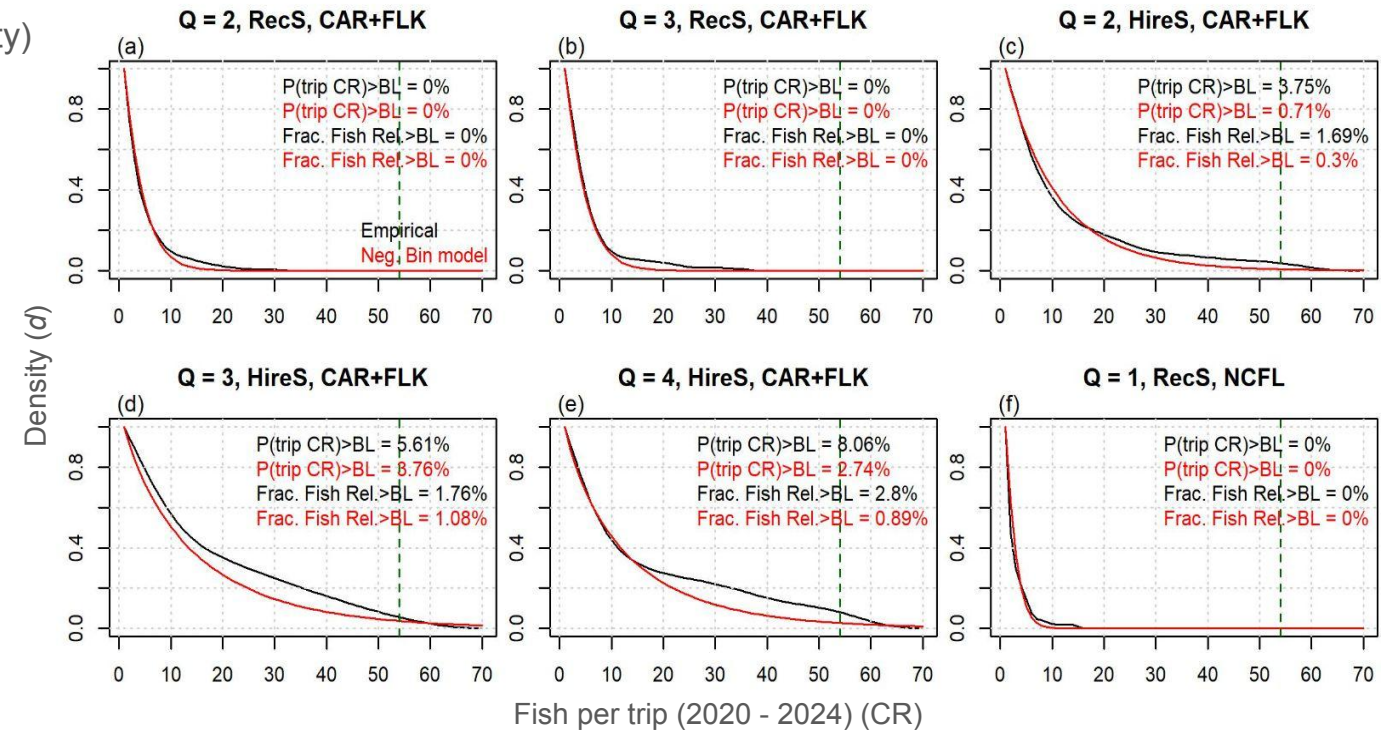
Model fitted the observed release rate (monthly mean) over different historical periods of bag limit regulations.



7c. Management Regulations (trip limits, size limits)

Two distributions (*d*) were investigated:

- Empirical (kernel density)
- Negative binomial



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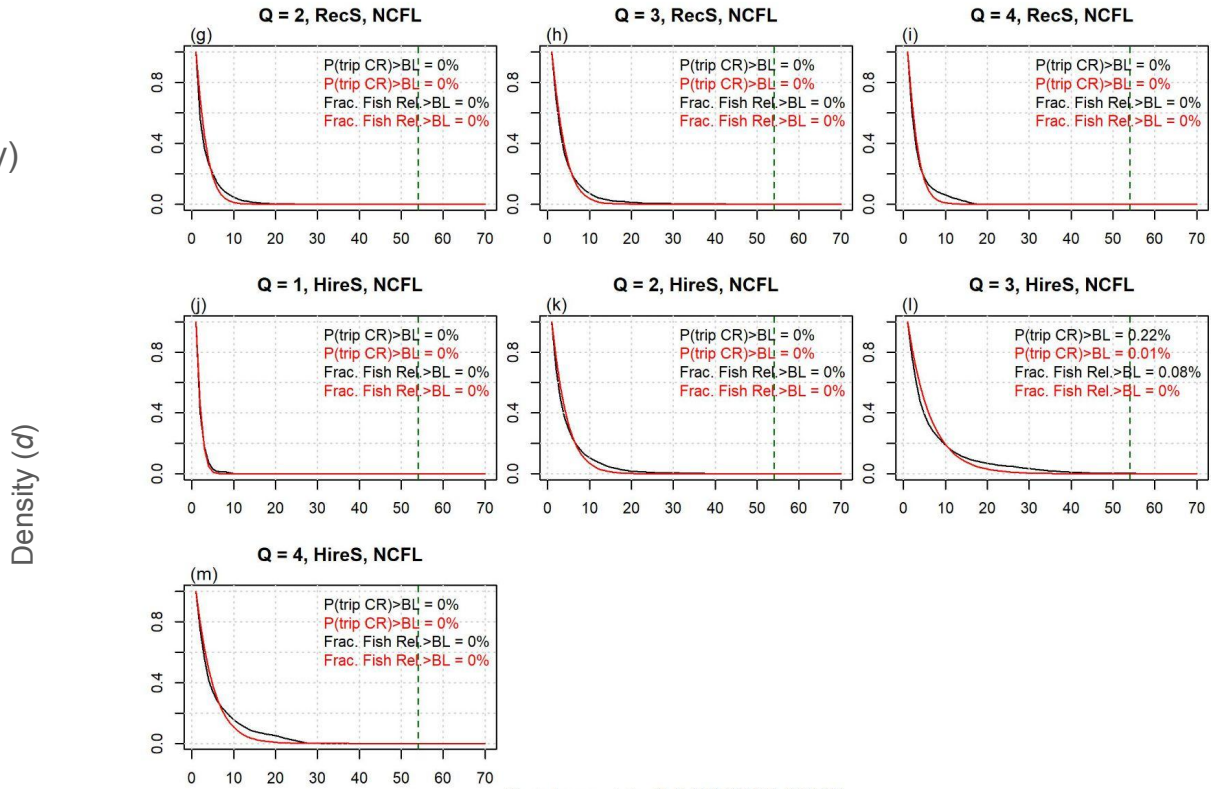


7c. Management Regulations (trip limits, size limits)

Expected Impacts of Trip Limits

- Few catch per trip data were available in Northern regions. Only modelled for RecS and HireS for which catch per trip data are available
- Only HireS in CAR+FLK has an appreciable fraction of trips (2020-2024) above the 54 fish limit
- Modelling releases using the empirical density would lead to the highest estimated release rates (captures the ‘fatter’ upper tail of the distribution)
- Impact on biomass is expected to be near zero: HireS is approximately 3% of the current stock-wide exploitation, 25% of fish are expected to die after release. Assuming the largest impact for a single area and season (HireS, CAR+FLK, Q3 = 1% release rates) was applied to the entire fleet over all areas and quarters, the reduction in total current exploitation rate is expected to be approximately 0.03 * (1-0.25) * 0.01 = 0.0225%.
- Impact on catch of HireS and RecS fleet is expected to be minimal (approx 0.75% at current catch rates).
- Note that trip limits are expected to be non-impactful at low stock sizes (low catch rates) so of limited conservation benefit (they throttle F at high stock sizes).

7c. Management Regulations (trip limits, size limits)

Bag limits and size limits

- Bag limits were not investigated as the degree of sharing among anglers is not clear. For example, in California party charter boats anglers simply pass fish off to other anglers ‘bag’. It was confirmed that this happens to varying degrees in recreational vessels catching Dolphinfish. Data are currently insufficient to approximate this behavior and instead trip limits were investigated.
- Size limits are implemented via a retention curve. OpenMSE applies post release mortality to individuals caught (selectivity) but not retained (retention curve).

7c. Regulatory Amendment 3 Scoping

Potential regulatory measures:

1. Extending geographic range for 20 inch fork length minimum size limit for dolphin currently in place off Florida, Georgia, & South Carolina northward,
2. Modifying daily bag limit for dolphin,
3. Modifying vessel limit for dolphin,
4. Removing or reducing captain and crew bag limits for dolphin.

Test 1 & 3 with MSE tool. We do not model individual bag limits in MSE tool, so consider 2 & 4 as special cases of vessel limit, without average number of anglers / trip for each fleet & assuming bag limit sharing.

7c. Regulatory Amendment 3 Scoping

SQM = status quo management

EMSL = expand min size limit (20” FL) for all commercial and private

RVL12 = recreational vessel limit of 12 fish

RVL24 = recreational vessel limit of 24 fish

RVL36 = recreational vessel limit of 36 fish

RVL48 = recreational vessel limit of 48 fish

RVL12p = recreational vessel limit of 12 fish for private rec only

RVL12f = recreational vessel limit of 12 fish for for-hire rec only

RVL36p = recreational vessel limit of 36 fish for private rec only

RVL36f = recreational vessel limit of 36 fish for for-hire rec only

Status quo management

- 1,719,953 lbs commercial ACL
- 22,850,811 lbs recreational ACL
- Recreational vessel limit of 54 fish / bag limit 10 fish
- 20” FL minimum size in SC, GA and FL

Modeled as Constant Catch

Modeled as Constant Effort

7d. Empirical MPs

SQ (Status Quo) (tune param: catch)

Constant catch at 2022 levels, up to 20% upward and downward TAC adjustments.

CER (Constant Exploitation Rate) (tune param: catch/Index)

Constant Catch/Index at 2022 levels up to 3x 2022 catch

CER_A (Aggressive) (tune param: catch/Index)

As CER but +50% 2022 Catch

CER_B (Bounded) (tune param: catch/Index)

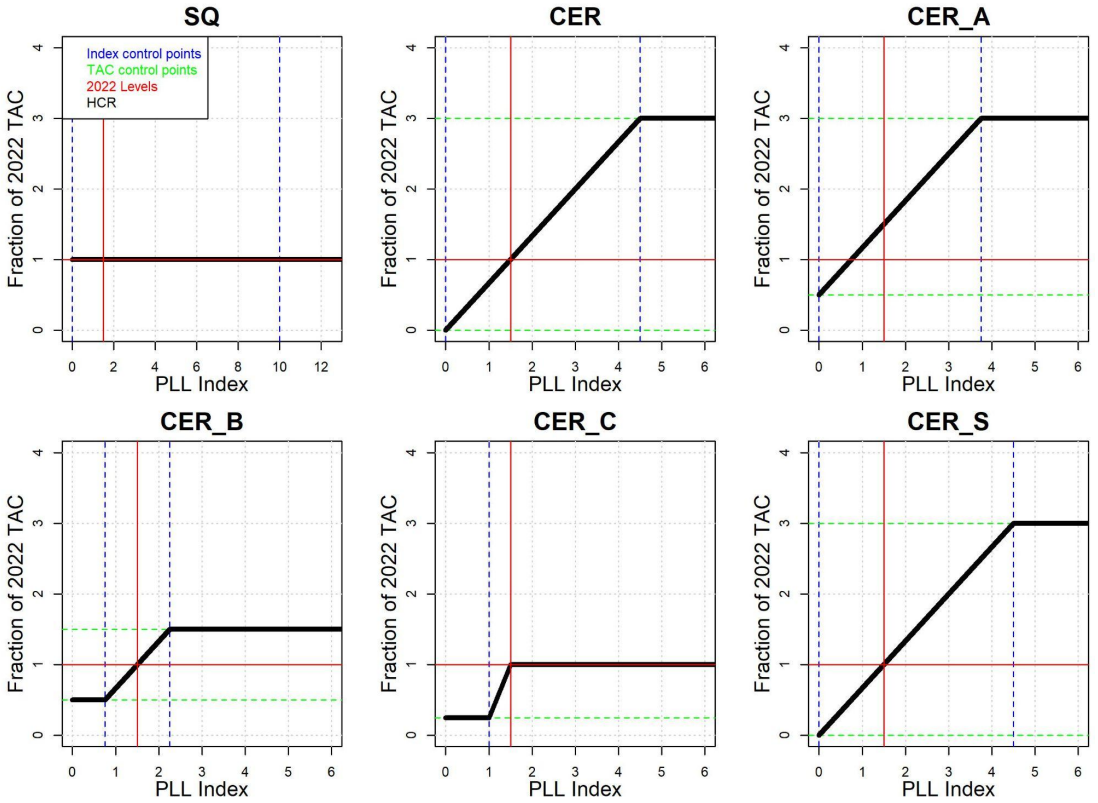
As CER but bounded to +/- 50% 2022 Catch

CER_C (Conservative) (tune param: max catch)

Min 25%, Max 100% 2022 catches

CER_S (Stable) (tune param: catch/index)

As CER but up to 10% upward and downward TAC adjustments.



7d. Empirical MPs

Other MP Options

- Longer management update intervals
- Additional indices
- Control rules specific to regions
- MPs that use regional catches in addition to indices (availability)
- Alternative smoothing (polynomial smoothness or means)

7e. MP Tuning

Purpose

To control for one of the two principal performance trade-offs (expected yield, conservation) allowing for more intuitive comparison of CMP performance.

It is desirable to make this a limit where possible, a requirement by which all MPs must ‘pass’.

Tuning Metrics

Probability of Green Kobe (probability of underfishing and underfished status)

Tuning Levels

Primary: 60% PGK

Alternative: 70% PGK

Tuning parameters

To avoid complex optimization problems, it is normally the case that CMPs are configured such that a single parameter controls the exploitation level. For the mahiMP, this is the slope of the HCR defined by catch / index.

Tuning OMs

One or more reference set OMs (some times all ref set OMs).

Applicable TORs

6. Evaluate candidate management procedures.
    a. Did the candidate management procedures only utilize data available for the stock in practice?
    b. Did the management procedure explore management tools and controls that are applicable to the stock (e.g., appropriate management procedure archetype)?
    c. Were top-performing management procedures tuned to minimally achieve all satisficing criteria?
    d. If empirical management procedure, does the MSE include a mechanism to periodically update stock status?