

Comisión Interamericana del Atún Tropical  
Inter-American Tropical Tuna Commission



# Videojuego de Evaluación de Estrategias de Ordenación para atún patudo

2º Taller CIAT sobre Evaluación de Estrategias de Ordenación para atunes tropicales,  
*por videoconferencia, Mayo 03-04, 2021*



# Aprendizaje mediante prueba y error

## **Vida real:**

Costoso, poca o ninguna repetición



## **Videojuego:**

Casi sin costo, repito cuanto quiera



# Juguemos con los conceptos simulando la ordenación

## SIMULADOR DE VUELO



# Este juego es mas simple que un simulador realista



# En que consiste este juego

- Aspectos de evaluación de estrategias de ordenación
- TunaMSE, herramienta simple que ilustra interactivamente:
  - Proyección de modelo poblacional/pesquero
  - Elementos del proceso de evaluación de estrategias
    - Compara RCEs simples
    - Utiliza Interrogating performance measures to make comparisons between HCRs
  - Configurado para atún patudo en el OPO

# Como usar este juego

[https://valeromaspez.shinyapps.io/TunaMSE\\_OPO\\_SPN/](https://valeromaspez.shinyapps.io/TunaMSE_OPO_SPN/)



Juego de EEO de atun patudo x +

← → ↻ valeromaspez.shinyapps.io/tunamse\_opo\_spn/

Juego de EEO de atun patudo Información Ej 1. Manejo Manual Ej 2. Manejo con RCE Ej 3. Seleccion de RCE Configuración

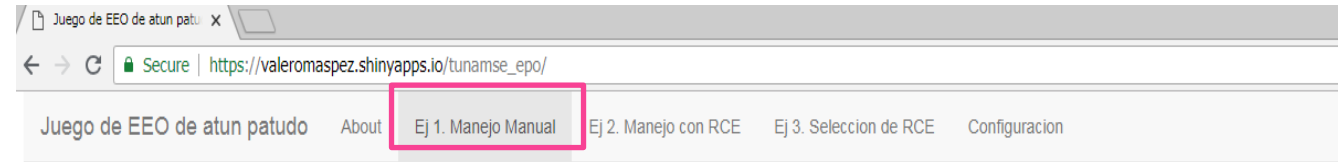
Introducción



### Ejemplo de Evaluación de Estrategias de Explotación (EEO)

Esta herramienta permite a los usuarios explorar el desempeño de opciones de reglas de control de explotación para la ordenación de especies de túnidos. Ha sido desarrollada como herramienta educativa para resaltar aspectos de la aproximación de **evaluación de estrategias de explotación (EEO)**.

# Como interpretar resultados del juego



Manejo de la pesquería de manera 'manual' determinando el límite de captura en cada año

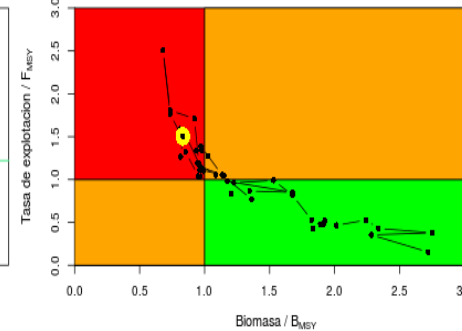
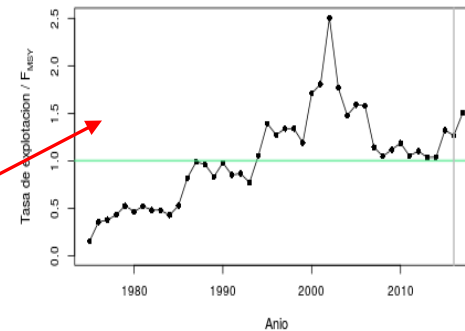
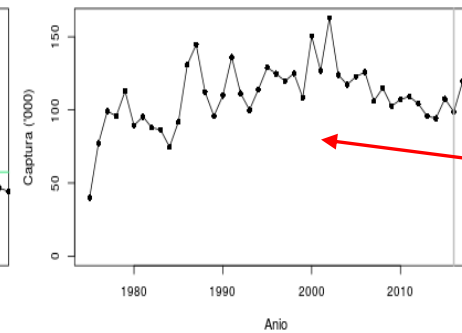
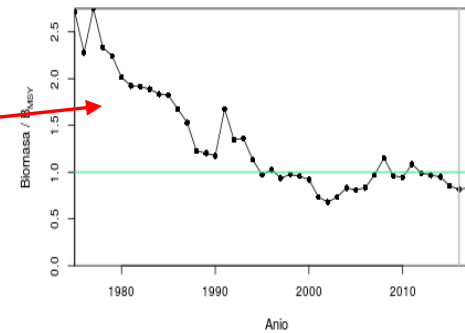
Cada vez que cambie el límite de captura, discuta en el grupo porque esta haciendo el cambio. Su objetivo es obtener la mayor captura y mantener el estado del stock, evitando sobre explotación y manteniendo baja variabilidad en capturas.

Límite de Captura ('000t)

Duración de límite de captura (años)

Aplicar manejo Reiniciar

Indicadores de desempeño: figuras

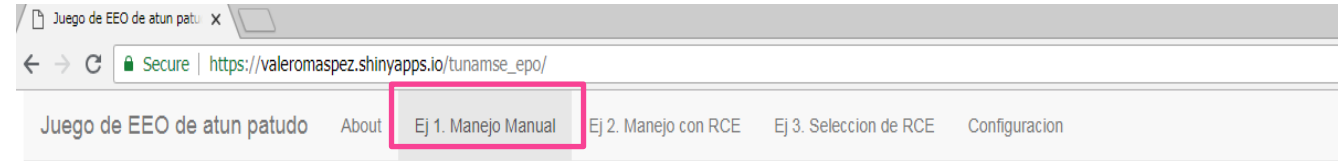


Biomasa

Captura

Tasa de explotación

# Especificaciones del juego



**Manejo de la pesquería de manera 'manual'**  
determinando el límite de captura en cada año

Cada vez que cambie el límite de captura, discuta en el grupo porque esta haciendo el cambio. Su objetivo es obtener la mayor captura y mantener el estado del stock, evitando sobre explotación y manteniendo baja variabilidad en capturas.

Límite de Captura ('000t)

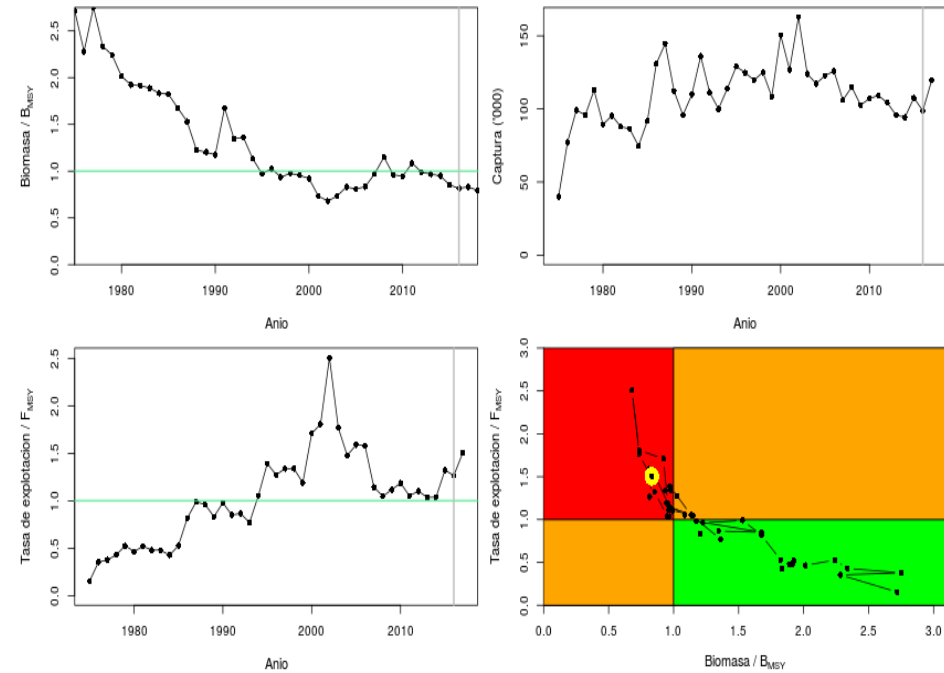
Duración de límite de captura (años)

Aplicar manejo    Reiniciar

Captura a futuro  
60,000 toneladas

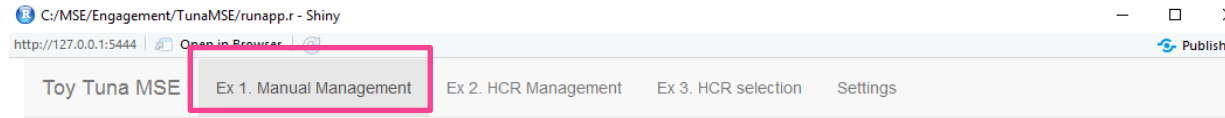
Indicadores de desempeño: figuras



Periodo de manejo 1 año



# Especificaciones del juego



**Manage the fishery 'manually' by changing the catch limit each year.**

Each time you change the catch limit, discuss amongst the group why you are making the change. Your aim is to get the highest overall catch while maintaining stock status, avoiding overfishing and keeping catch variation low.

Catch limit ('000t)

300

Catch limit duration (yrs)

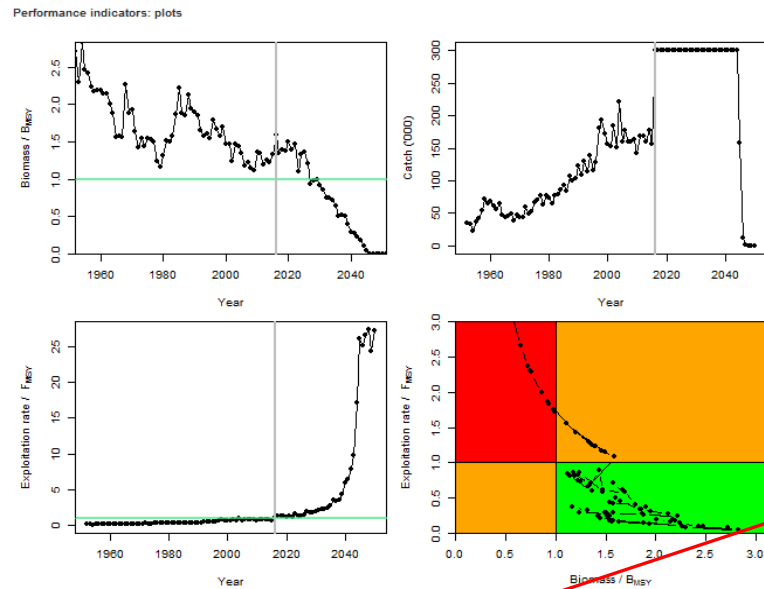
35

Apply management

Restart

Captura  
300,000  
toneladas

Periodo de manejo  
35 años



Performance indicators: values

	Stock status (B/B <sub>MSY</sub> )	Fishing intensity (F/F <sub>MSY</sub> )	Prob. green	Catch (kt)	Catch variation (%)
Current (2051)	0.00	27.37	0.00	0.00	88.79
Overall (2016-2051)	0.85	5.74	0.00	253.49	3.48



Año final

Promedio años  
de proyección

# Métricas de desempeño

- Estado del stock -  $B/B_{MSY}$
- Tasa de explotación -  $F/F_{MSY}$
- Probabilidad de estar dentro de área Verde Kobe
- Captura
- Variabilidad en capturas
  
- Todos los indicadores son igualmente importantes?
- Cual es el periodo de tiempo de interés? Corto, largo plazo?

# Ejercicio (1) – proyección manual

- Pruebe proyecciones con distintos niveles de captura y duración de manejo.
  - Use gráficos e indicadores de desempeño para ver como les va con el juego y cambie la captura para mantener al stock cerca de  $B_{msy}$
  - Ej.
    - 3 años de proyección, captura = 60 kt
      - Seguido de:
    - 3 años de proyección, captura = 100 kt
      - Seguido de:
    - 3 años de proyección, captura = 120 kt

# Ejercicio (2) – proyección con reglas de control

C:/MSE/Engagement/TunaMSE/runapp.r - Shiny  
http://127.0.0.1:3980 Open in Browser Publish

Toy Tuna MSE Ex 1. Manual Management **Ex 2. HCR Management** Ex 3. HCR selection Settings

**Use a harvest control rule (HCR) to manage the fishery.**

Try different types of HCR. The 'Constant Catch' and 'Constant Exp. Rate' HCRs are 'static' - they fix catch or exploitation rate at a constant level. The 'Threshold Exp. Rate' HCR is 'adaptive' or 'dynamic', it adjusts the exploitation rate depending upon the status of the stock.

Each HCR has one or more control parameters. These are like tuning knobs on an autopilot - they allow you to alter how the HCR operates. Try changing each control parameter and see how it affects the biomass and catch trajectories. Your aim is to get a high average catch, without too much variability, while maintaining the stock status around the green line and away from the red line.

Note: The <simulation outcomes> graph is ONLY updated when the <Run Simulations> button is pressed.

**Type of HCR:**  
Constant Catch

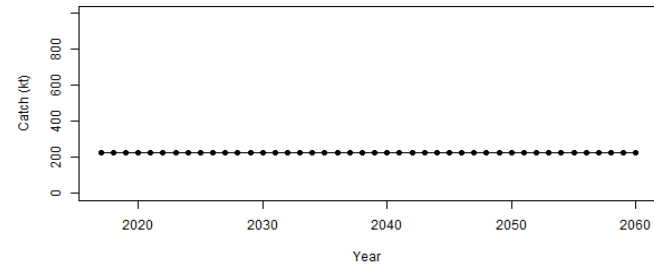
**Catch ('000t)**  
0 225

The catch limit in every year

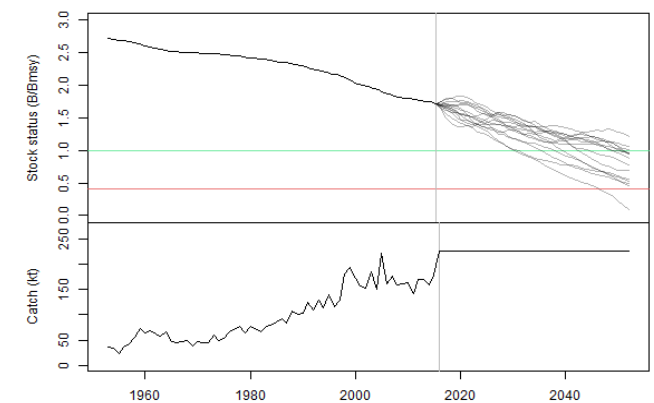
**Number of simulations**  
15

Run simulations

**Harvest control rule**



**Simulation outcomes**



# Ejercicio (2) – proyección con reglas de control

C:/MSE/Engagement/TunaMSE/runapp.r - Shiny  
http://127.0.0.1:3032 Open in Browser Publish

Toy Tuna MSE Ex 1. Manual Management **Ex 2. HCR Management** Ex 3. HCR selection Settings

**Use a harvest control rule (HCR) to manage the fishery.**

Try different types of HCR. The 'Constant Catch' and 'Constant Exp. Rate' HCRs are 'static' - they fix catch or exploitation rate at a constant level. The 'Threshold Exp. Rate' HCR is 'adaptive' or 'dynamic', it adjusts the exploitation rate depending upon the status of the stock.

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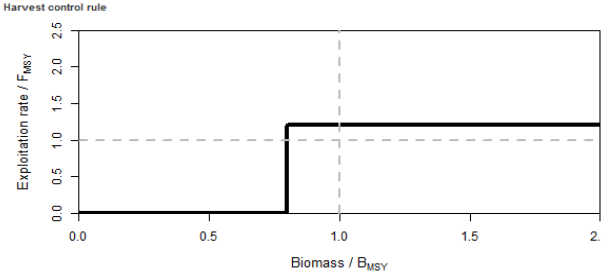
**Type of HCR:**  
Threshold Exp. Rate

**Maximum exploitation rate (F<sub>target</sub>):**  
1.2

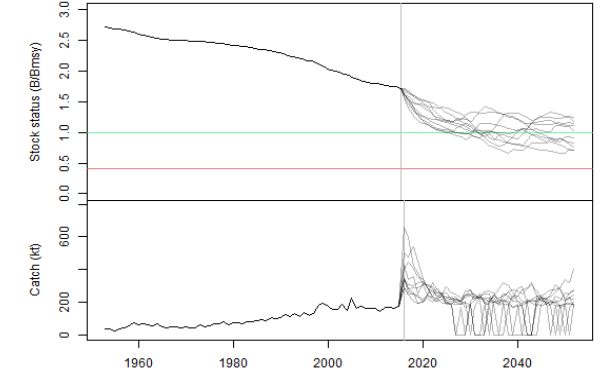
**Range (B<sub>lim</sub> & B<sub>thresh</sub>):**  
0.8

**Number of simulations:**  
10

**Harvest control rule**



**Simulation outcomes**



# Ejercicio (2) – proyección con reglas de control

C:/MSE/Engagement/TunaMSE/runapp.r - shiny  
 http://127.0.0.1:3032 | Open in Browser | Publish

Toy Tuna MSE   Ex 1. Manual Management   **Ex 2. HCR Management**   Ex 3. HCR selection   Settings

**Use a harvest control rule (HCR) to manage the fishery.**

Try different types of HCR. The 'Constant Catch' and 'Constant Exp. Rate' HCRs are 'static' - they fix catch or exploitation rate at a constant level. The 'Threshold Exp. Rate' HCR is 'adaptive' or 'dynamic', it adjusts the exploitation rate depending upon the status of the stock.

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Note: The <simulation outcomes> graph is ONLY updated when the <Run Simulations> button is pressed.

**Type of HCR:**  
 Threshold Exp. Rate

**Maximum exploitation rate (F<sub>targ</sub>)**  
 0 1.2 2  
 0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2

**Range (B<sub>lim</sub> & B<sub>thresh</sub>):**  
 0 0.4 1 2  
 0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2

**Number of simulations**  
 10

**Harvest control rule**

**Simulation outcomes**

Catch (kt)	HCR	Type	Catch	Exp. rate	F <sub>mult</sub>	B <sub>lim</sub>	B <sub>thresh</sub>	Median Depletion (%)	*Prob. green	*Catch	*Catch var.
	1	Knife-edge	NA	NA	1.2	0.8	0.8	37.7	0.694	207.5	0.227
	2	Slope	NA	NA	1.2	0.4	1	37.9	0.675	209.2	0.172

Median Depletion (%)

\*Prob. green

\*Catch

\*Catch var.

# Ejercicio (2) – proyección con reglas de control

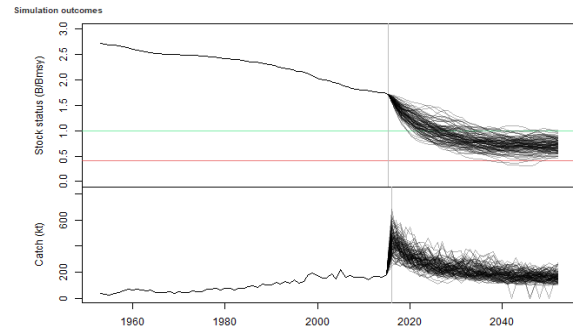
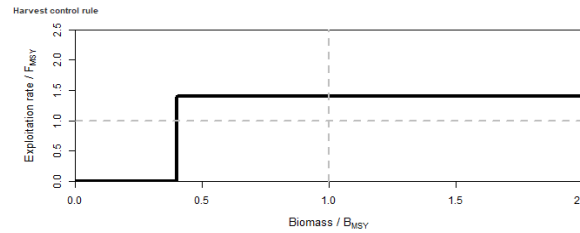
The image displays two side-by-side screenshots of a Shiny web application interface for 'Toy Tuna MSE'. The interface is divided into several sections:

- Navigation:** Tabs for 'Ex 1. Manual Management', 'Ex 2. HCR Management', and 'Ex 3. HCR selection' are visible. The 'Ex 3. HCR selection' tab is active in both screenshots.
- Left Panel (Instructions):**
  - Select the HCR that best achieves your management objectives.** The performance indicators have been recorded for each of the HCRs that you tested during Exercise 2. Select one HCR that you think has the best tradeoffs amongst the performance indicators. You can go back to Exercise 2 and evaluate more HCRs to try and find a HCR with even better performance.
  - Plot trajectories for which HCR?** A dropdown menu shows '3'.
  - Key:**
    - HCR control parameters:** Catch is the constant catch; Exp. rate is the constant exploitation rate; F<sub>flag</sub>, B<sub>lim</sub> and B<sub>thresh</sub> define the threshold harvest control rule.
    - Performance indicators:** Median depletion (%): Median of B<sub>unfished</sub> B; Prob. green: probability of being above B > B<sub>MSY</sub> and F < F<sub>MSY</sub>; Catch: median over sims of the catch; Catch var.: median over sims of the catch variation.
- Table (Left Screenshot):**

HCR	Type	Catch	Exp. rate	Fmult	Blim	Bthresh	Median Depletion (%)	*Prob. green	*Catch
1	Threshold	NA	NA	1.2	0.8	0.8	37.7	0.694	207.5
2	Threshold	NA	NA	1.2	0.4	1	37.9	0.675	209.2
3	Threshold	NA	NA	0.8	0.4	1.2	49.2	0.981	184.8
- Right Panel (Plots):**
  - Candidate HCRs:** A plot showing performance indicators for HCRs 1, 2, and 3. HCR 3 is highlighted with a red circle.
  - Plots:** A 2x2 grid of plots showing biomass and catch trajectories over time (1960-2040). The top-left plot shows biomass (B<sub>MSY</sub>) vs. catch (1000). The top-right plot shows exploitation rate (F<sub>MSY</sub>) vs. biomass (B<sub>MSY</sub>). The bottom-left plot shows biomass (B<sub>MSY</sub> %) vs. year. The bottom-right plot shows catch (1000) vs. year.

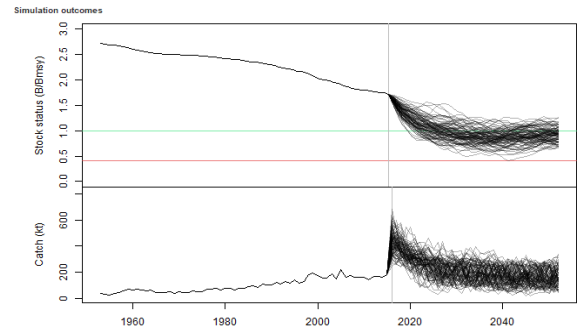
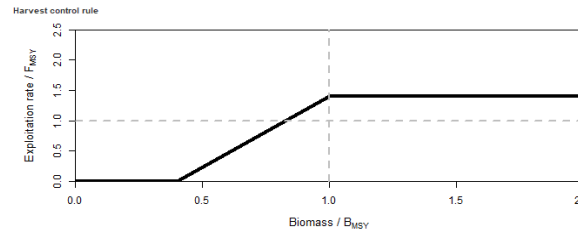
# Ejemplos de resultados de juego

## HCR 1



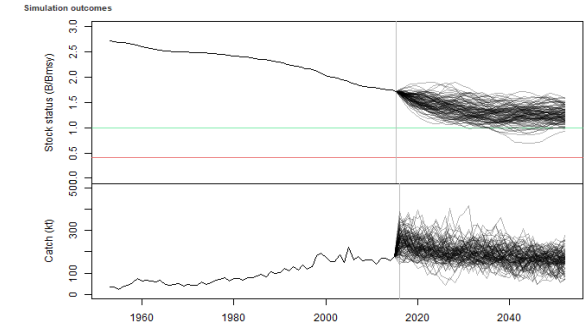
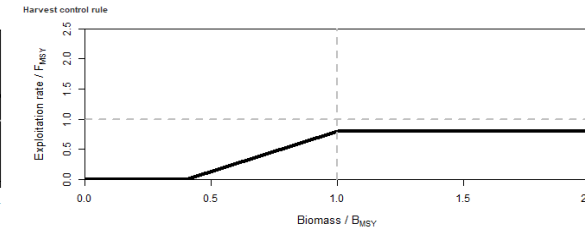
## Agresiva

## HCR 2



## Moderada

## HCR 3



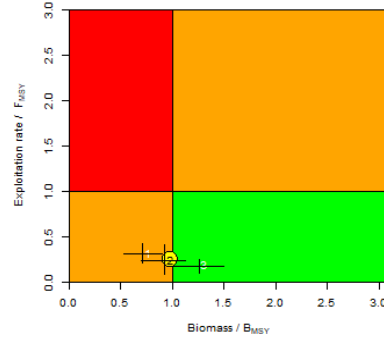
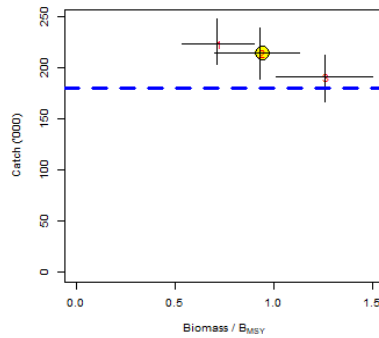
## Conservativa



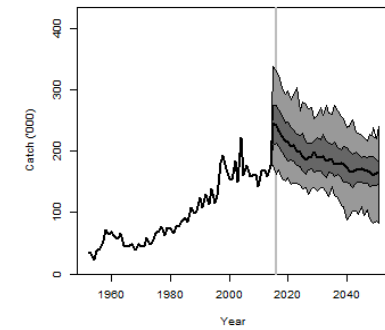
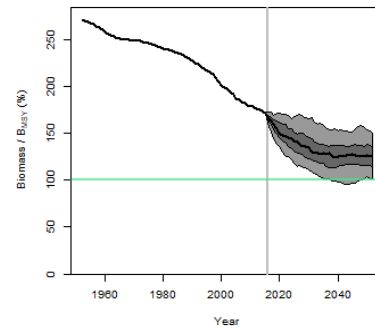
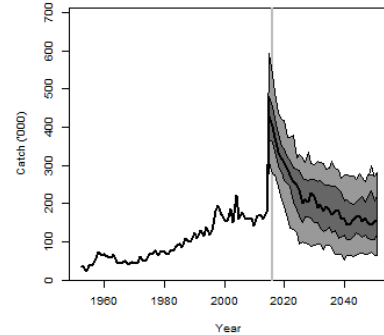
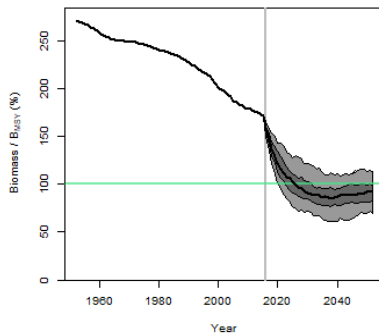
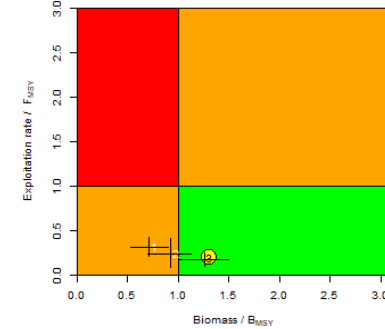
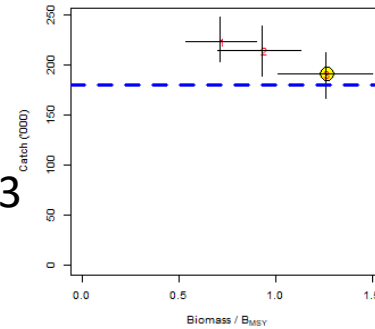
# Ejemplos de resultados de juego

HCR	Type	Catch	Exp. rate	Fmult	Blim	Bthresh	Median Depletion (%)	*Prob. green	*Catch	*Catch var.
1	Threshold	NA	NA	1.4	0.4	0.4	26.3	0.306	223.3	0.11
2	Threshold	NA	NA	1.4	0.4	1	34	0.419	214	0.2
3	Threshold	NA	NA	0.8	0.4	1	46.3	0.972	191.5	0.113

HCR 2



HCR 3



# CIAT IATTC



¿Preguntas?