

Comisión Interamericana del Atún Tropical  
Inter-American Tropical Tuna Commission



# Videojuego de Evaluación de Estrategias de Ordenación para atún patudo

3<sup>er</sup> Taller CIAT sobre Evaluación de Estrategias de Ordenación para atunes tropicales,  
*por videoconferencia*, Diciembre 08-09, 2022



# 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



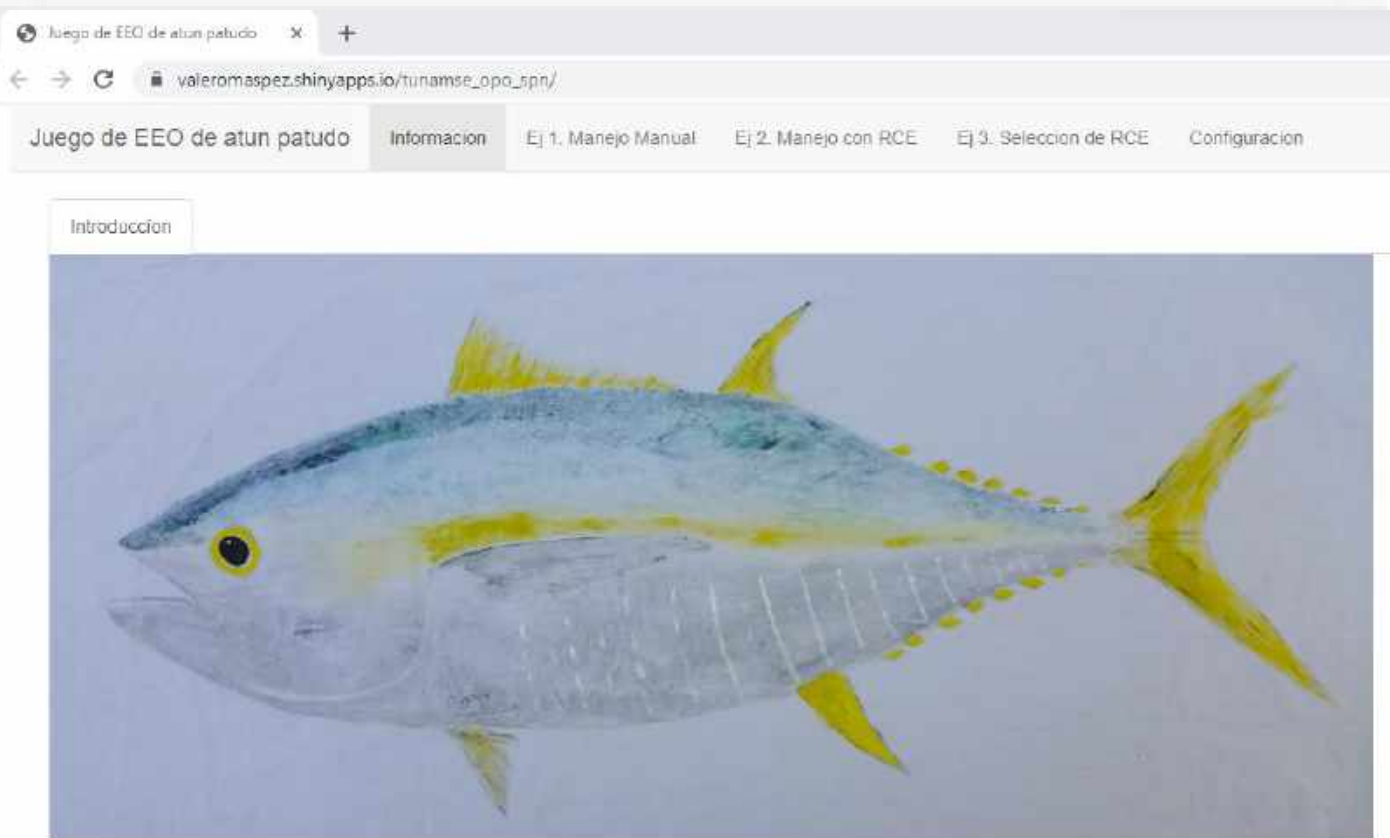
# En que consiste este juego

- 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



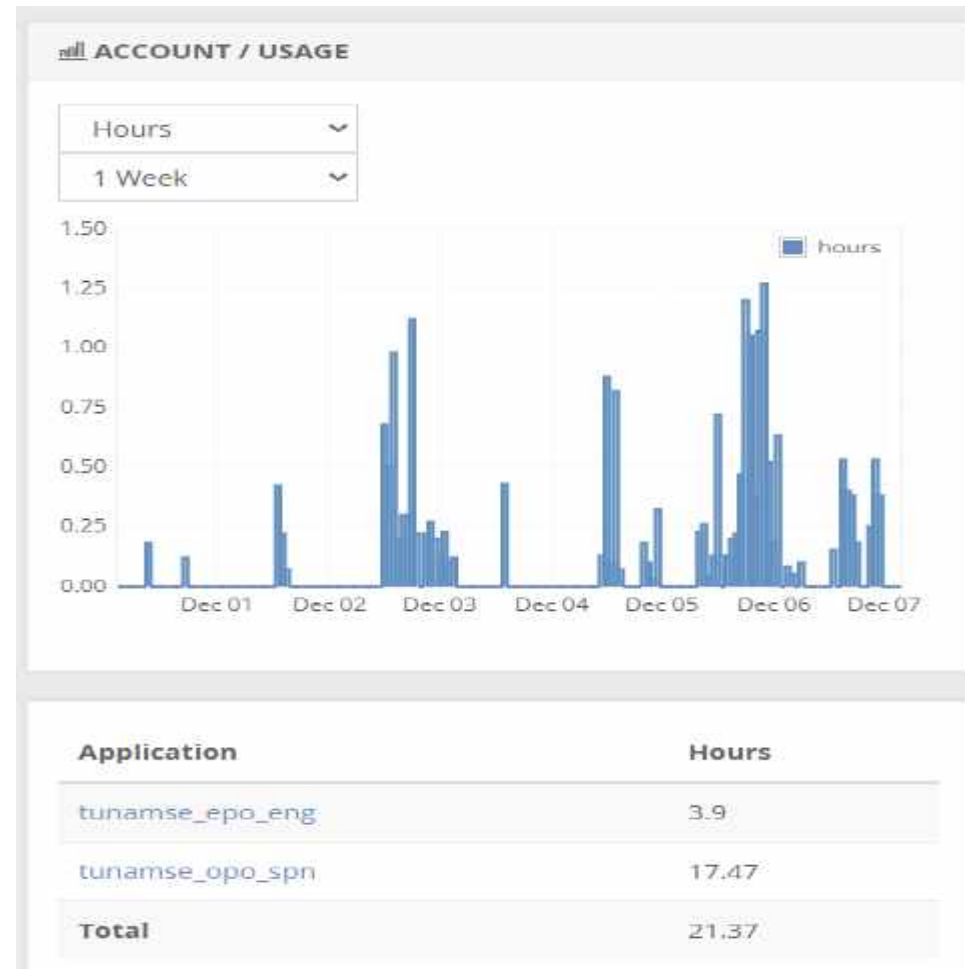
# Como usar este juego

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



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

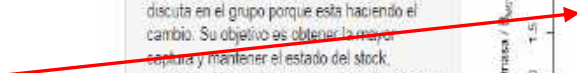
Esta herramienta permite a los usuarios explorar el desempeño de opciones de reglas de control de explotación para la ordenación de especies de túnidos. Ha sido herramienta educativa para resaltar aspectos de la aproximación de **evaluación de estrategias de explotación (EEO)**.



# Como interpretar resultados del juego



Biomasa



Captura



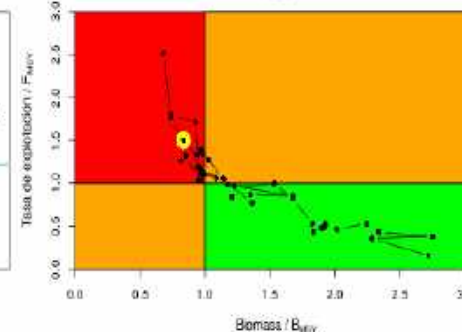
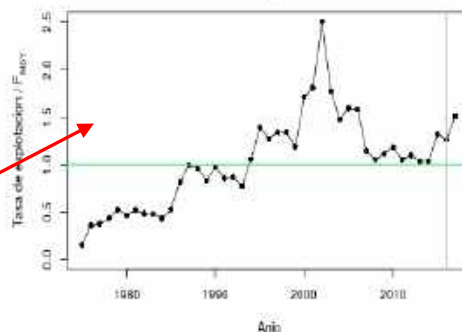
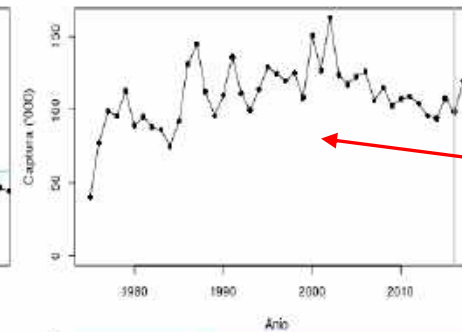
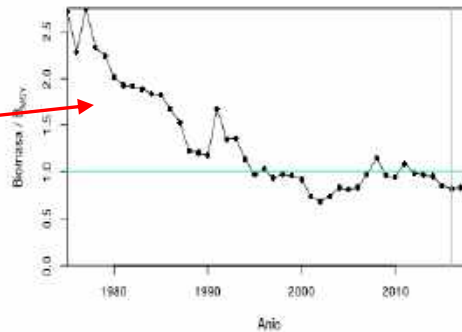
Manejo de la pesquería de manera 'manual' determinando el límite de captura en cada año

Cada vez que cambio el límite de captura, discuta en el grupo porque está 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 (0000)

Duración de límite de captura (años)

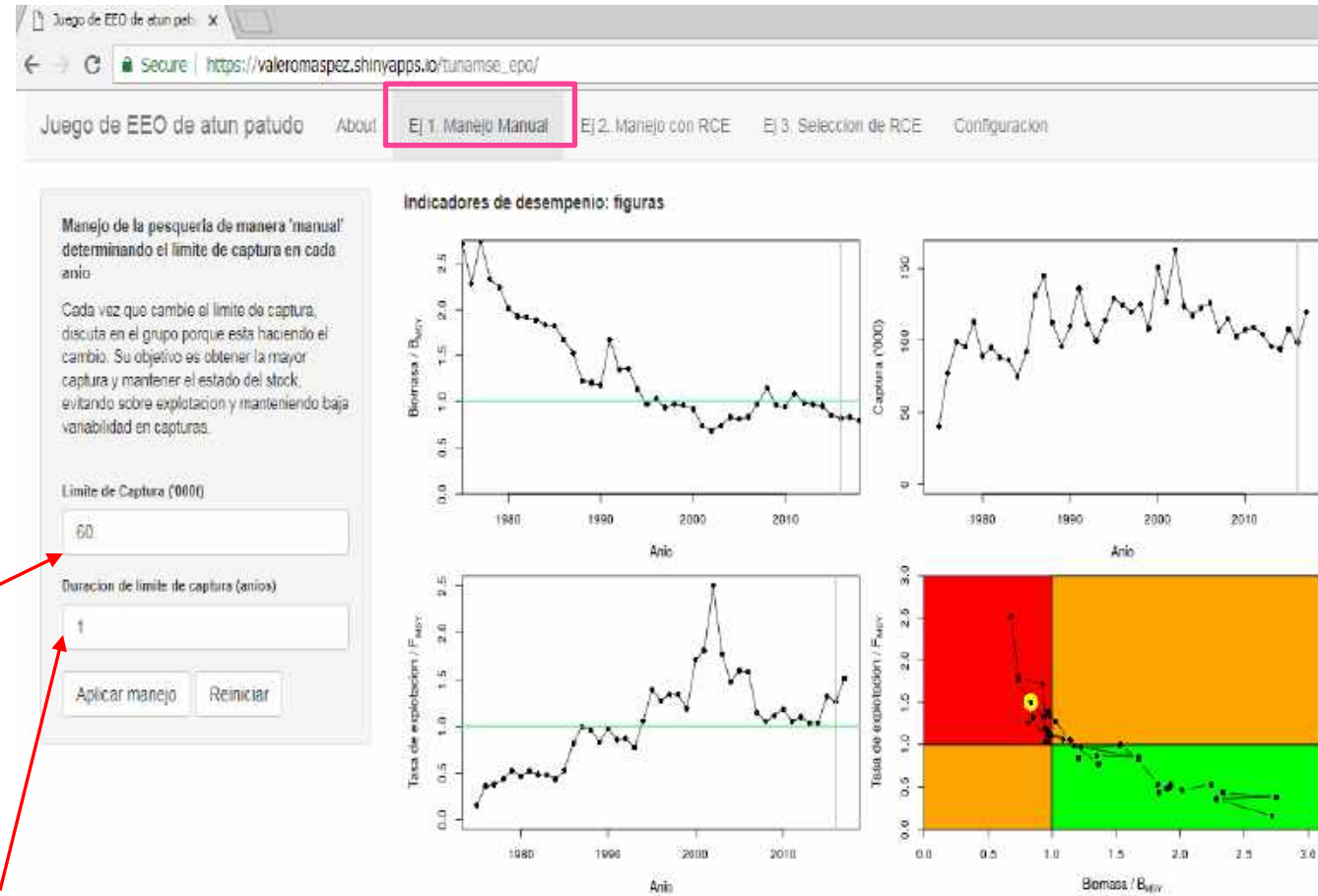
Indicadores de desempeño: figuras



Tasa de explotación



# Especificaciones del juego



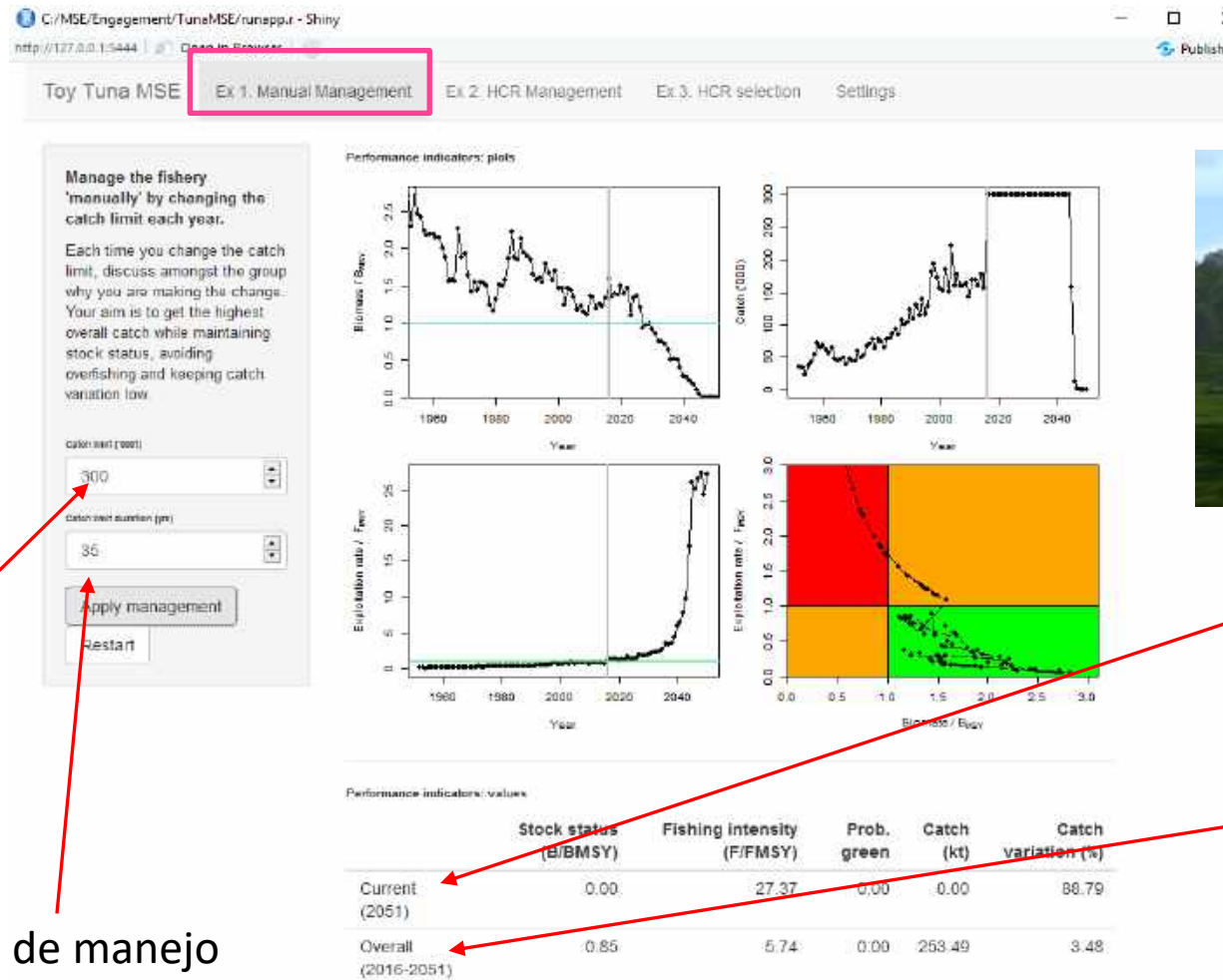
Captura a futuro  
60,000 toneladas

Periodo de manejo 1 año





# Especificaciones del juego



Captura  
300,000  
toneladas

Periodo de manejo  
35 años



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/TuneMSE/runapp1 - 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.

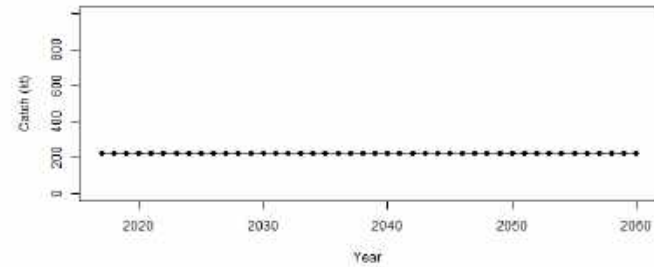
Type of HCR:  
Constant Catch

Catch ('000t)  
225

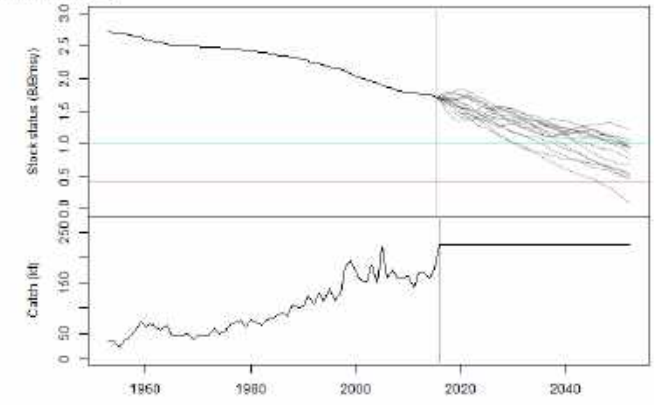
Number of simulations  
15

Run simulations

Harvest control rule



Simulation outcomes



# Ejercicio (2) – proyección con reglas de control

Toy Tuna MSE

Ex 1. Manual Management | **Ex 2. HCR Management** | Ex 3. HCR selection | Settings

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Type of HCR:  
Threshold Exp. Rate

Maximum exploitation rate ( $F_{\text{targ}}$ )  
0.0

Range ( $B_{\text{lim}}$  &  $B_{\text{thresh}}$ ):  
0.0

Number of simulations  
10

Harvest control rule

Simulation outcomes

# Ejercicio (2) – proyección con reglas de control

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.

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Type of HCR:  
Threshold Exp. Rate

Maximum exploitation rate (F<sub>target</sub>):  
0

Range (B<sub>lim</sub> & B<sub>thresh</sub>):  
0.4 1

Number of simulations:  
10

Harvest control rule

Simulation outcomes

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

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

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?

Use this to choose which HCR to plot trajectories for:

Key

HCR control parameters

- Catch: the control catch
- Exp. rate: the constant exploitation rate
- Fmult: the multiplier for the constant control rate
- Blim: the biomass level to be reached (lower control rate)

Performance indicators

- Median depletion (%): Median of  $B_{t+1}/B_t$
- Prob. green: probability of being above  $B_{lim}$  and  $F < F_{max}$
- Catch: median catch over the last 10 years
- Catch var: variance of median catch over the last 10 years

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	200.2
3	Threshold	NA	NA	0.8	0.4	1.2	48.2	0.661	184.8

Candidate HCRs Plots

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.

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Performance indicators

- Median depletion (%): Median of  $B_{t+1}/B_t$
- Prob. green: probability of being above  $B_{lim}$  and  $F < F_{max}$
- Catch: median catch over the last 10 years
- Catch var: variance of median catch over the last 10 years

Biomass /  $B_{lim}$

Exp. rate /  $F_{max}$

Biomass /  $B_{lim}$

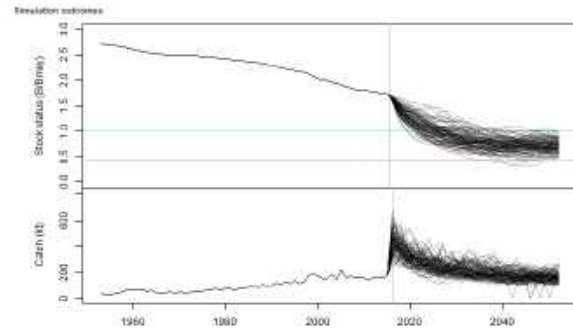
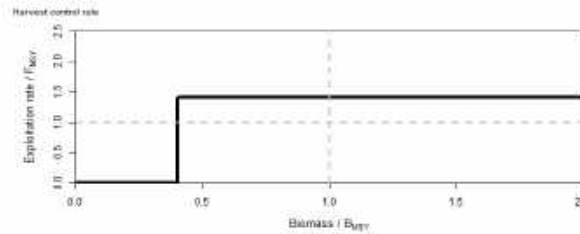
Catch (000t)

Year

Year

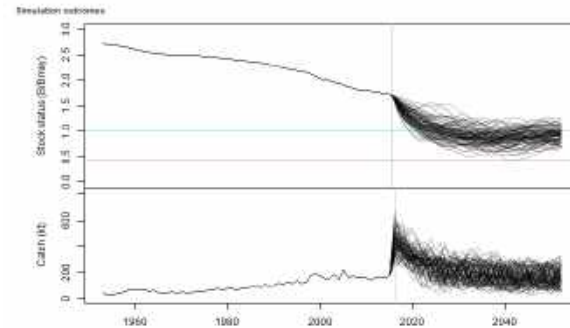
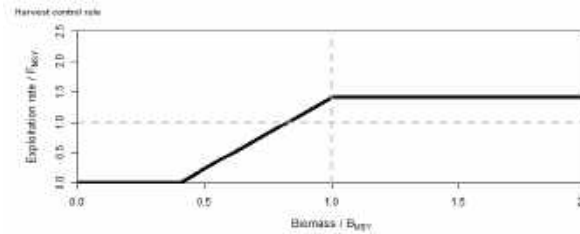
# Ejemplos de resultados de juego

HCR 1



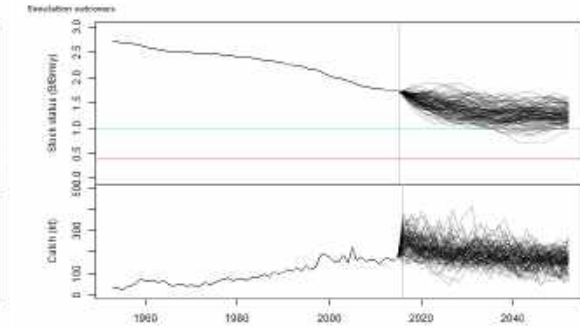
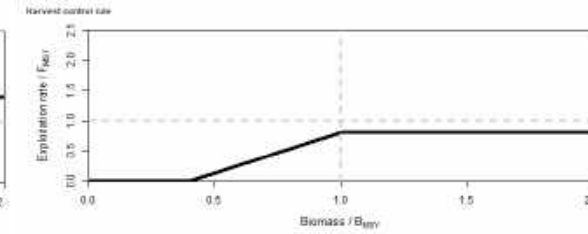
Agresiva

HCR 2



Moderada

HCR 3

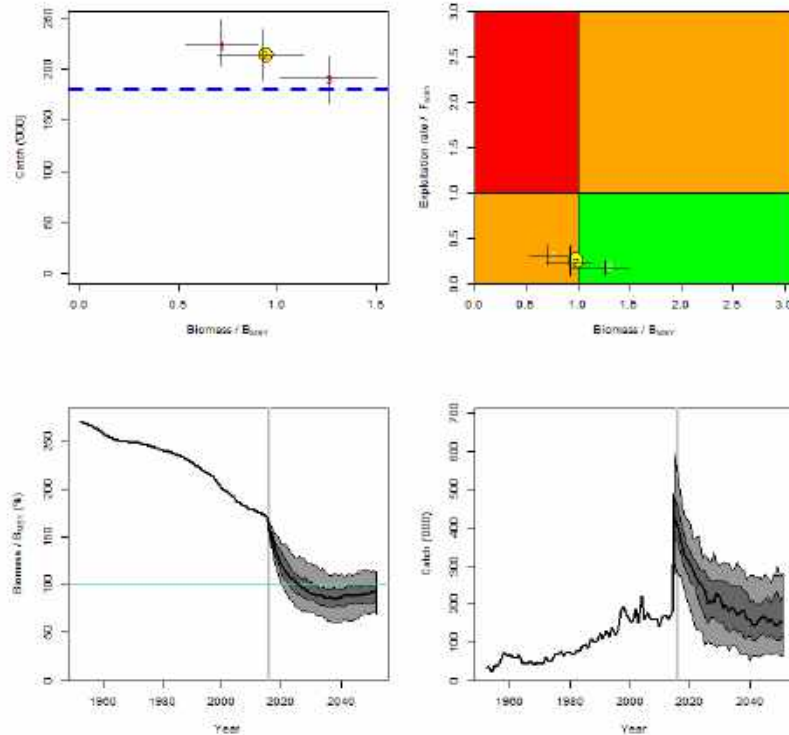


Conservativa

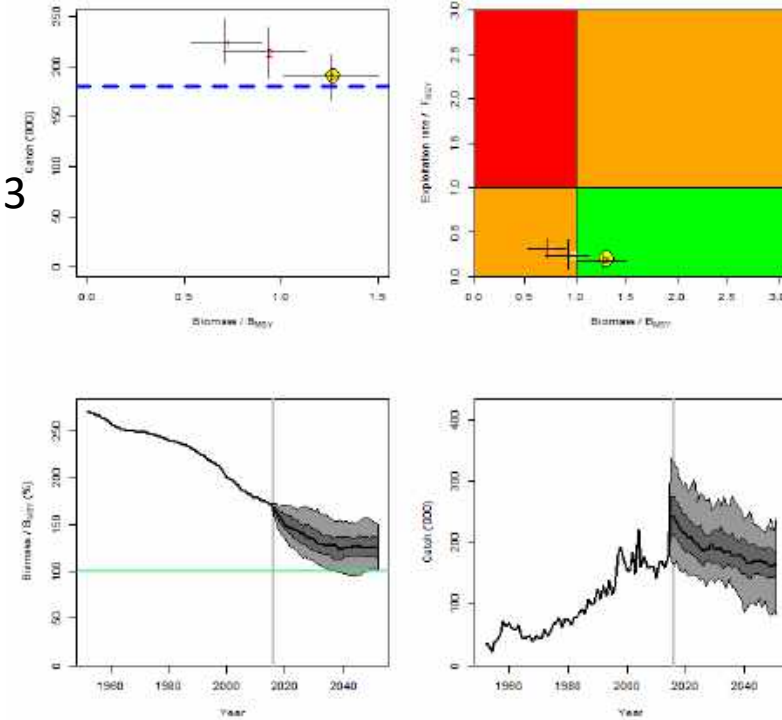
# Ejemplos de resultados de juego

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?