STATUS OF YELLOWFIN TUNA IN THE EASTERN PACIFIC OCEAN IN 2015

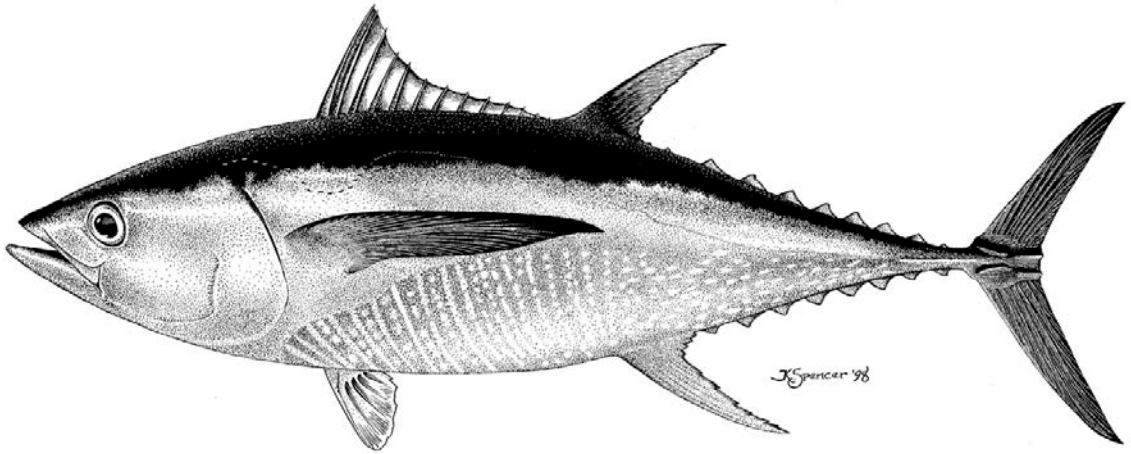
AND OUTLOOK FOR THE FUTURE

CONDICIÓN DEL ATÚN ALETA AMARILLA EN EL OCÉANO PACÍFICO ORIENTAL EN 2015

Y PERSPECTIVAS PARA EL FUTURO

SAC-07-05b

January 1975 – December 2015



7th Meeting of the Scientific Advisory Committee
La Jolla, 09-13 May 2016

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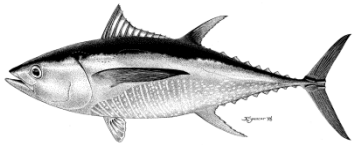
Outline - *Temario*

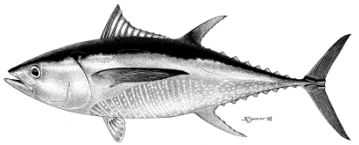


- Fishery data
- Stock assessment model
- Stock assessment results
  - Base case
  - Sensitivity analyses
- Summary conclusions
- Future directions

- *Datos de la pesquería*
- *Modelo de evaluación*
- *Resultados de la evaluación*
  - Caso base
  - Análisis de sensibilidad
- *Resumen de las conclusiones*
- *Direcciones futuras*

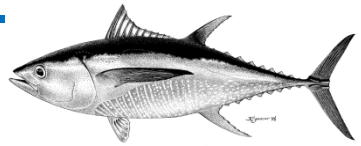
New or updated data
Datos nuevos o actualizados

Fishery data

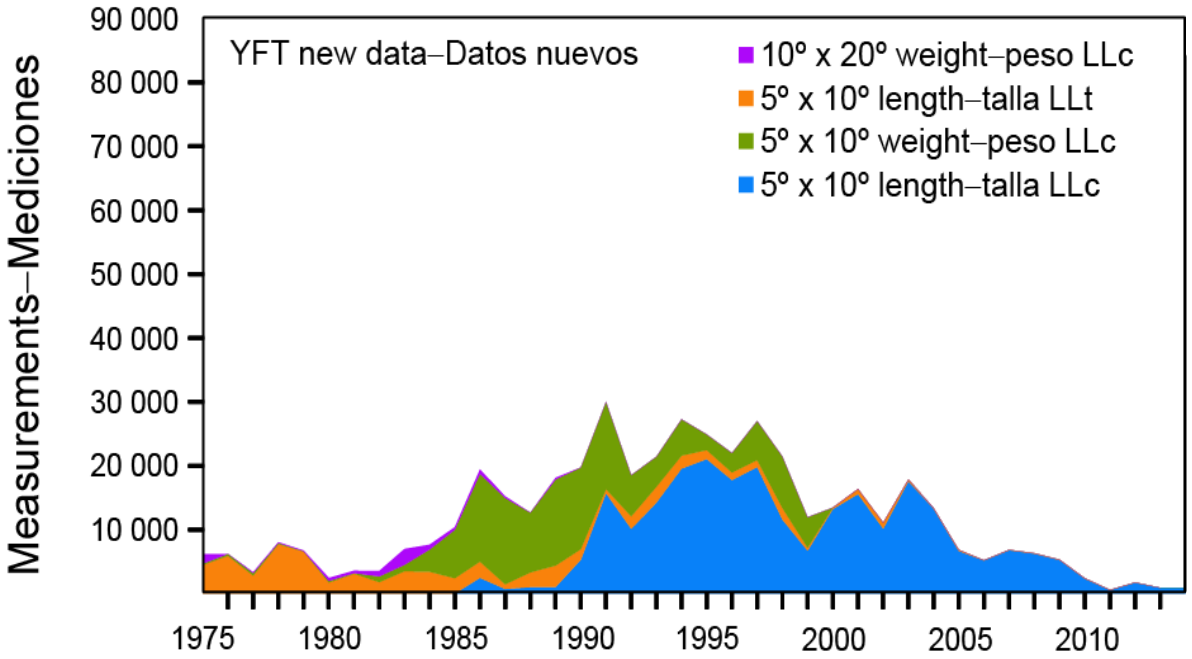


- Surface fisheries - *Pesquerías de superficie*
  - Catch, CPUE and size-frequency recent data updated and new data for 2015.
- Longline fisheries - *Pesquerías de palangre*
  - New or updated longline catch data: China (2014), Chinese Taipei (2013-2014), Japan (2014), Korea (2006,2014), US (2013-2014), French Polynesia (2013-2014), Vanuatu (2007-2014) and other nations (2013-2015)
  - New or updated CPUE data available for Japan (1975-2015)
  - New or updated longline size-frequency for Japan commercial vessels (1986-2014)
- Longline "survey" – *"Estudio" palangrero*
  - New longline size-frequency for Japan training vessels (1975-2014)

Changes in Japanese longline size-composition data
Cambios en la composición de tallas de la flota palangrera japonesa



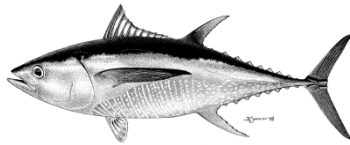
SAC-07-03d and SAC-07-04a

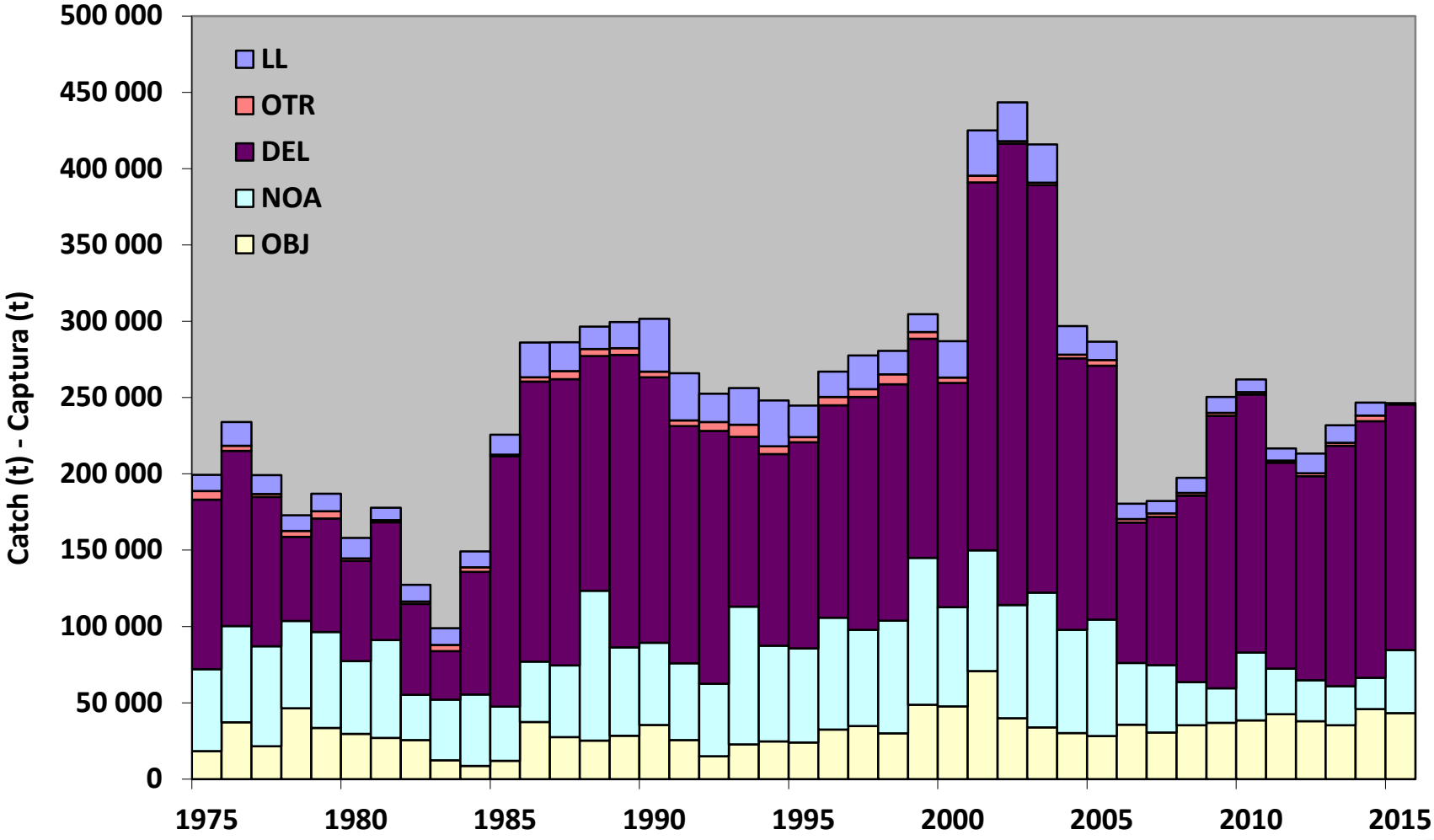


LLc: commercial longline vessel – buque palangrero comercial

LLt: longline training vessel – buque palangrero de entrenamiento

Total catches – *Capturas totales*





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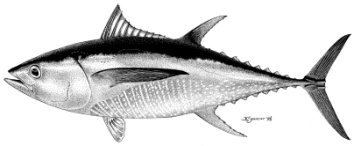
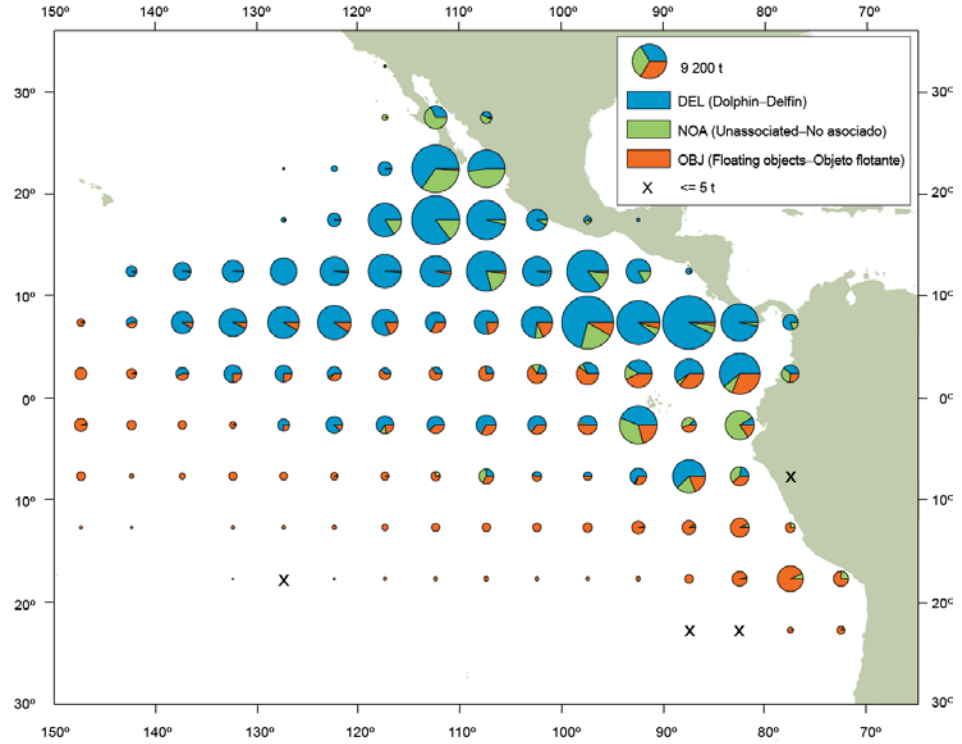
Distribution of purse-seine catches
Distribución de las capturas de cerqueros



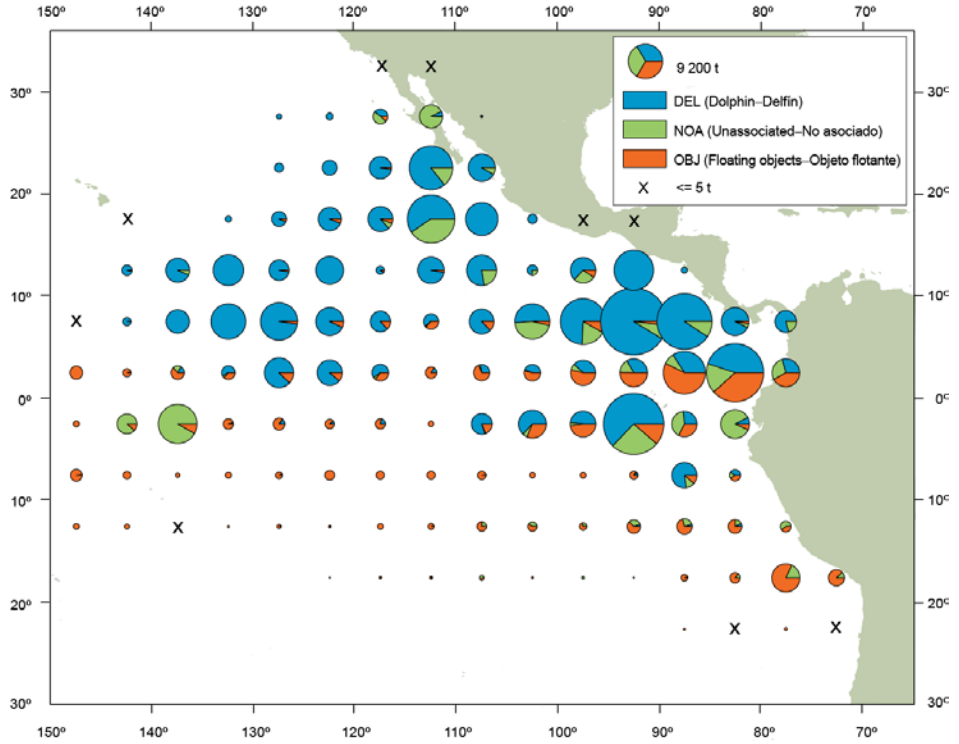
Average 2010-2014



222 000 t

(198 000 - 251 000)

2015



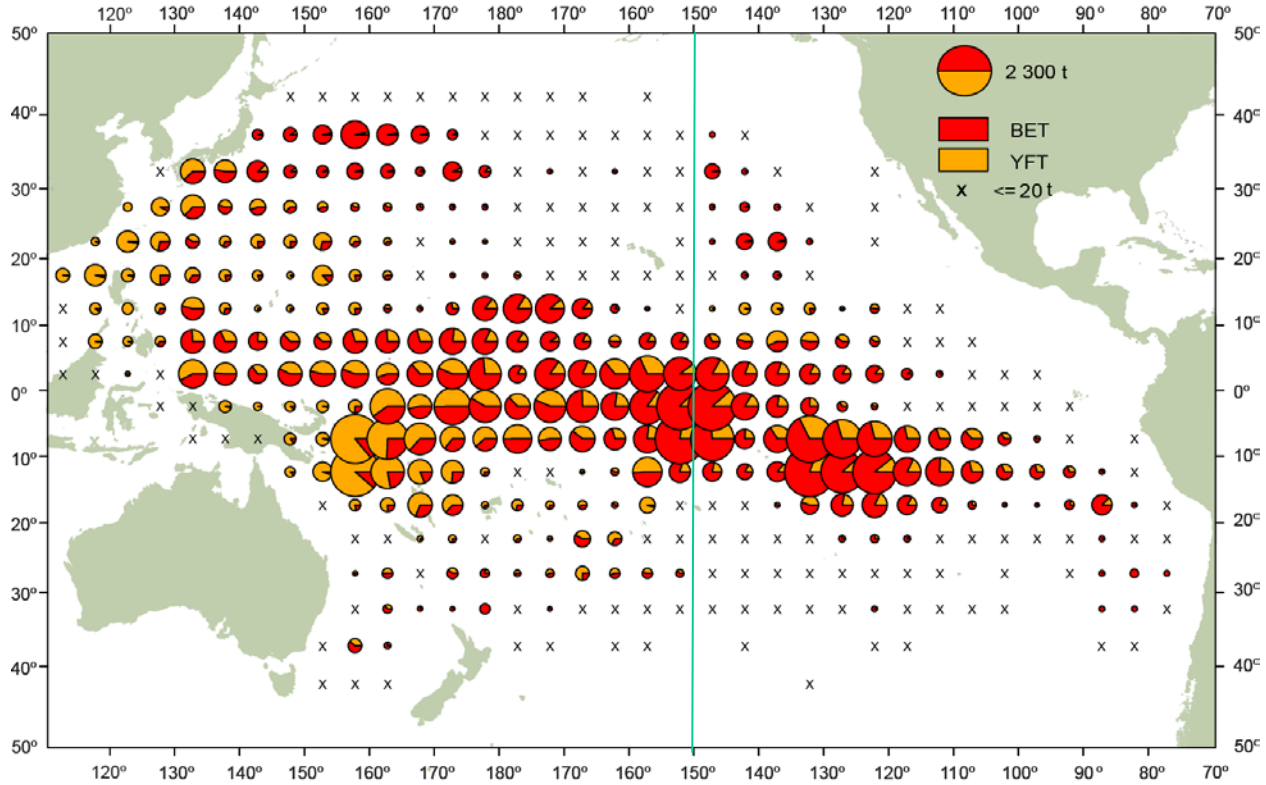
245 000 t

10% Higher

SAC 07-03a

Distribution of longline catches

Distibución de las capturas de palangreros



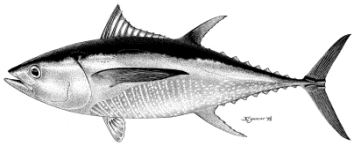
Distributions of the average annual catches of **bigeye** and **yellowfin** tunas in the Pacific Ocean 2010-2014

Chinese, Japanese, Korean and Chinese Taipei vessels

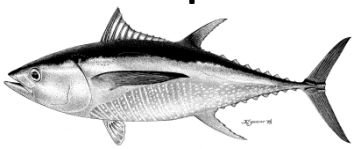
The sizes of the circles are proportional to the amounts of bigeye and yellowfin caught in those 5° by 5° areas.

SAC 07-03a

Model assumptions I
Supuestos del modelo I



- The 2015 assessment uses the same model as in SAC6 with the addition of two “surveys”
- One stock is assumed for the whole EPO
- Fishery definitions: 16 fisheries + 2 surveys



Fishery definitions
Definición de las pesquerías

Defined based on:

- *gear type* (purse seine, pole and line, and longline)
- *purse-seine set type* (sets on schools associated with floating objects, free schools, dolphin-associated schools)
- *area* (IATTC length-frequency sampling area or latitude)
- *discards*

TABLE A. Fisheries defined for the stock assessment of yellowfin tuna in the EPO. PS = purse seine; LP = pole and line; LL = longline; OBJ = floating objects; NOA = unassociated fish; DEL = dolphin. The sampling areas are shown in Figure A.

Fishery	Gear type	Set type	Region	Sampling areas
1	PS	OBJ	South	11-12
2	PS	OBJ	Central	7, 9
3	PS	OBJ	Inshore	5-6, 13
4	PS	OBJ	North	1-4, 8, 10
5	PS	NOA	North	1-4, 8, 10
6	PS	NOA	South	5-7, 9, 11-13
7	PS	DEL	North	2-3, 10
8	PS	DEL	Inshore	1, 4-6, 8, 13
9	PS	DEL	South	7, 9, 11-12
10	LP		All	1-13
11	LL		North	N of 15°N
12	LL		South	S of 15°N
Discard fisheries				
13	PS	OBJ	South	11-12
14	PS	OBJ	Central	7, 9
15	PS	OBJ	Inshore	5-6, 13
16	PS	OBJ	North	1-4, 8, 10

10 surface fisheries

2 longline fisheries

4 discard fisheries

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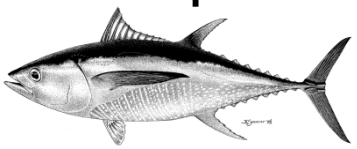
Fishery definitions
Definición de las pesquerías



Survey	Gear type	Set type	Years	Sampling areas	Catch data
Estudio	**Tipo de arte**	**Tipo de lance**	**Años**	**Zonas de muestreo**	**Datos de captura**
S1	LL-C	-	1975-1994	N of-de 15°N	No catches, only weight-composition data (not used to fit the model) – Sin capturas, datos de composición por tallas solamente (no usados para ajustar el modelo)
S2	LL-C	-	1975-1994	S of-de 15°N	No catches, only weight-composition data (not used) – Sin capturas, datos de composición por tallas solamente (no usados para ajustar el modelo)
17 S3	LL-T	-	1975-present	N of-de 15°N	No catches, only length-composition data – Sin capturas, datos de composición por tallas solamente
18 S4	LL-T	-	1975-present	S of-de 15°N	No catches, only length-composition data – sin capturas, datos de composición por tallas solamente

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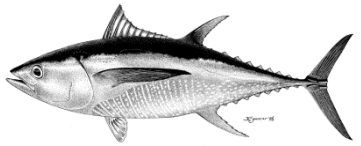
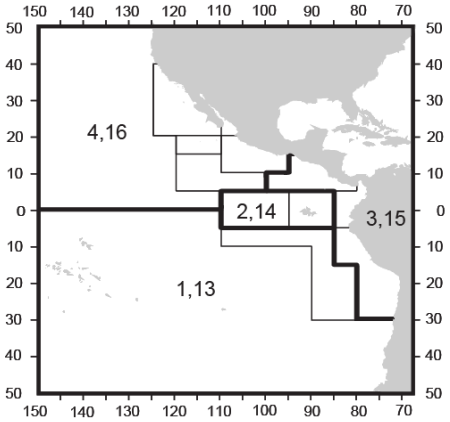
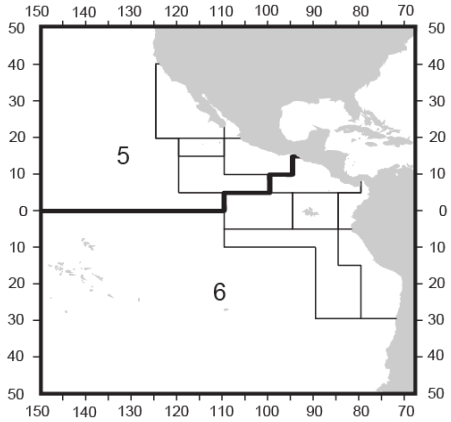
Fishery definitions
Definición de las pesquerías



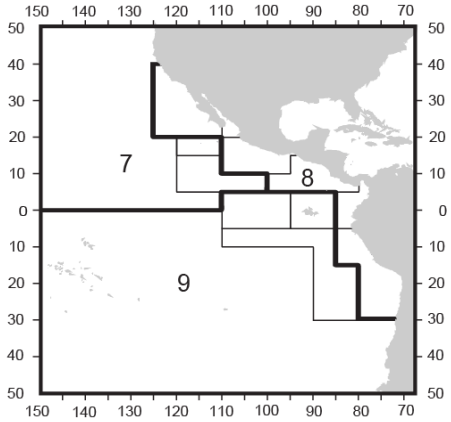
Floating objects–Objetos flotantes



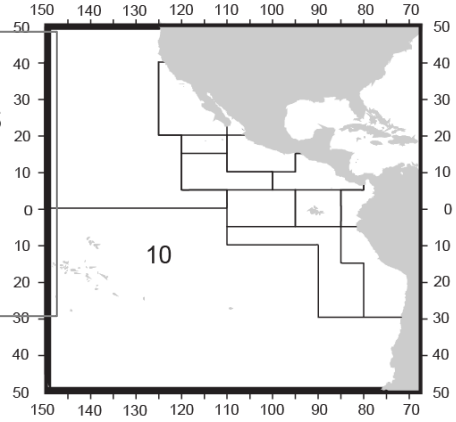
Unassociated–No asociado



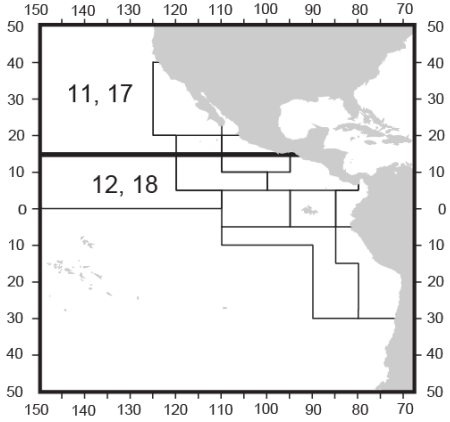
Dolphin–Delfín



Pole-and-line–Caña



Longline–Palangre

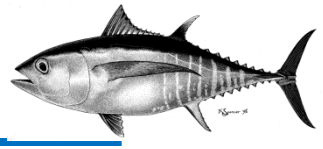


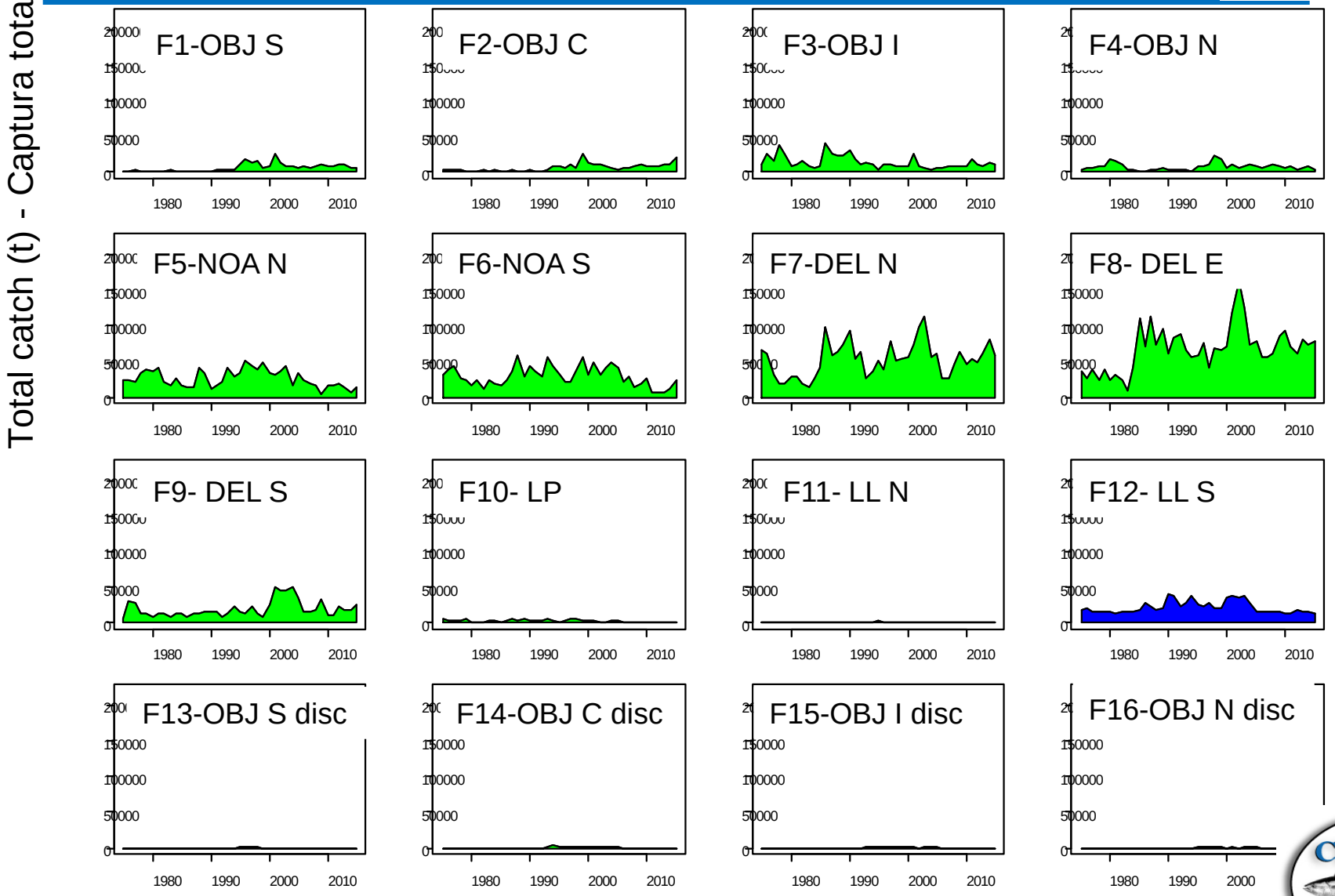
__ IATTC length-frequency sampling areas

__ fishery definition areas

Annual catches by fishery

Capturas anuales por pesquería

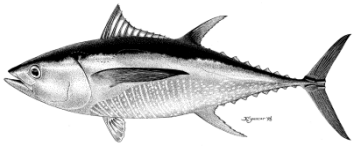


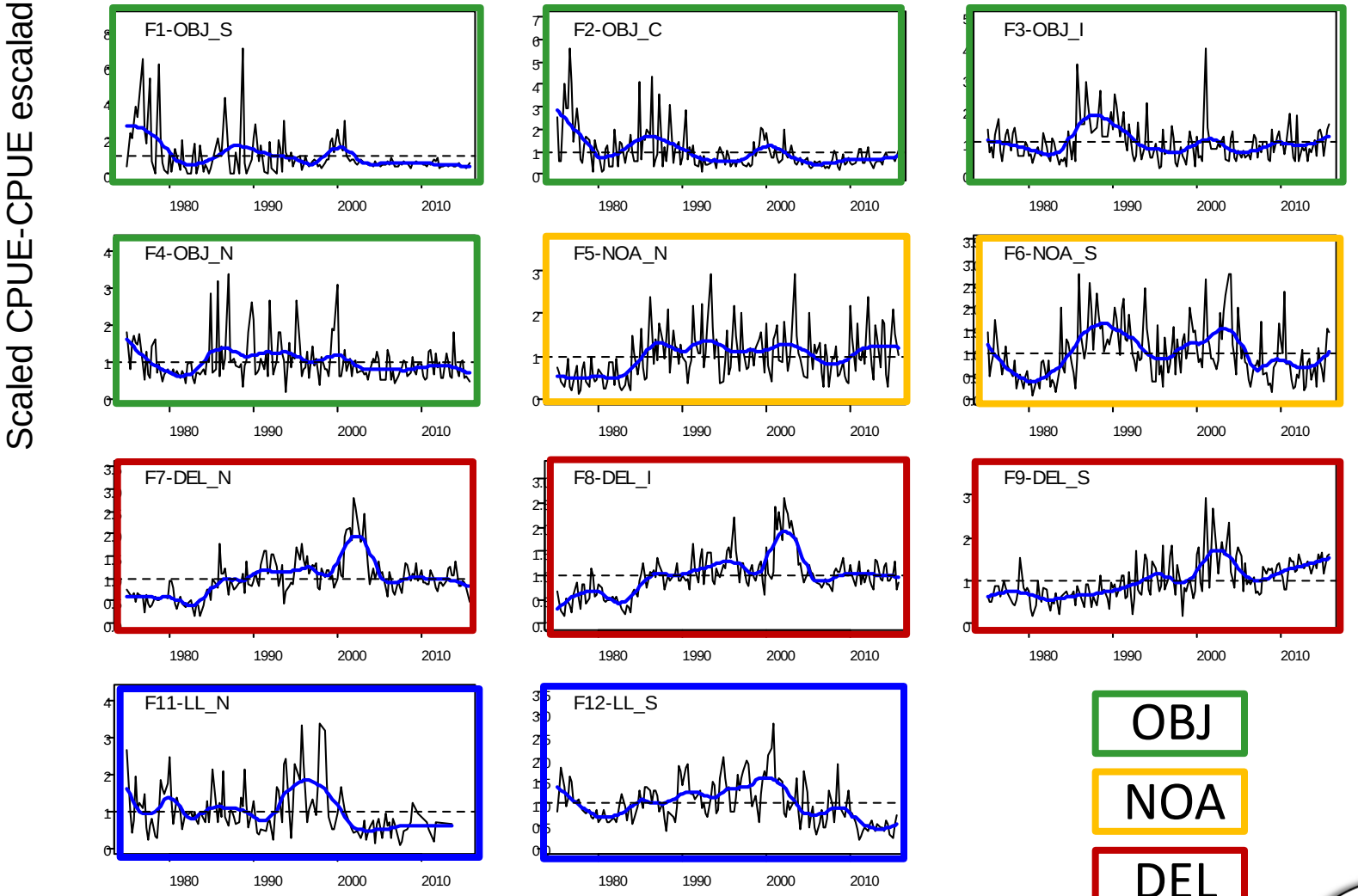


Catch-per-unit effort (CPUE)

Captura por unidad de esfuerzo

Fishery data

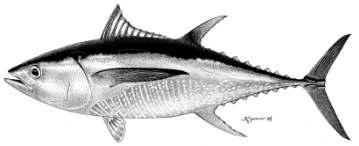


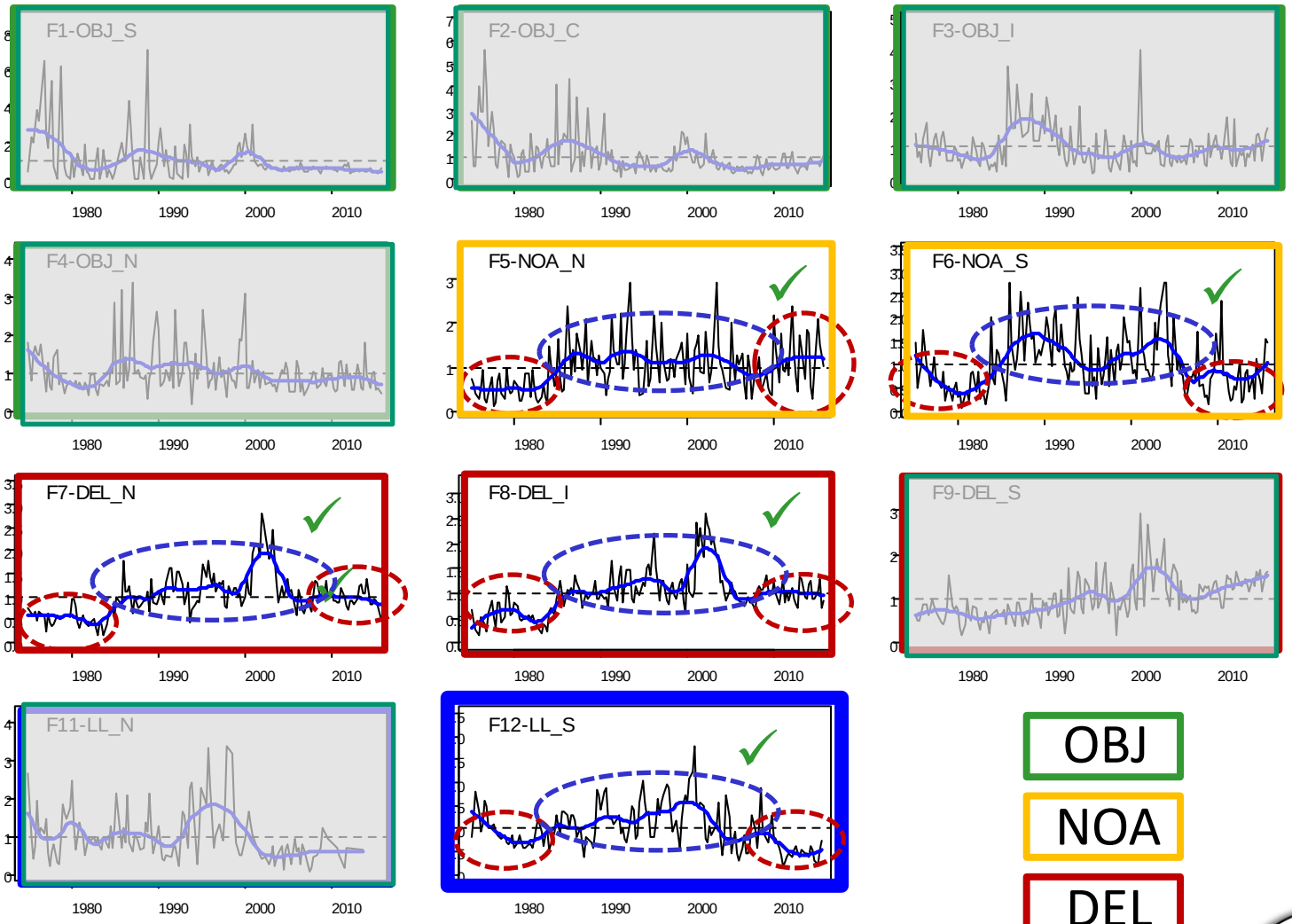


Catch-per-unit effort (CPUE)

Captura por unidad de esfuerzo

Fishery data





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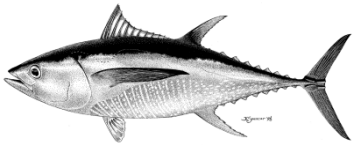
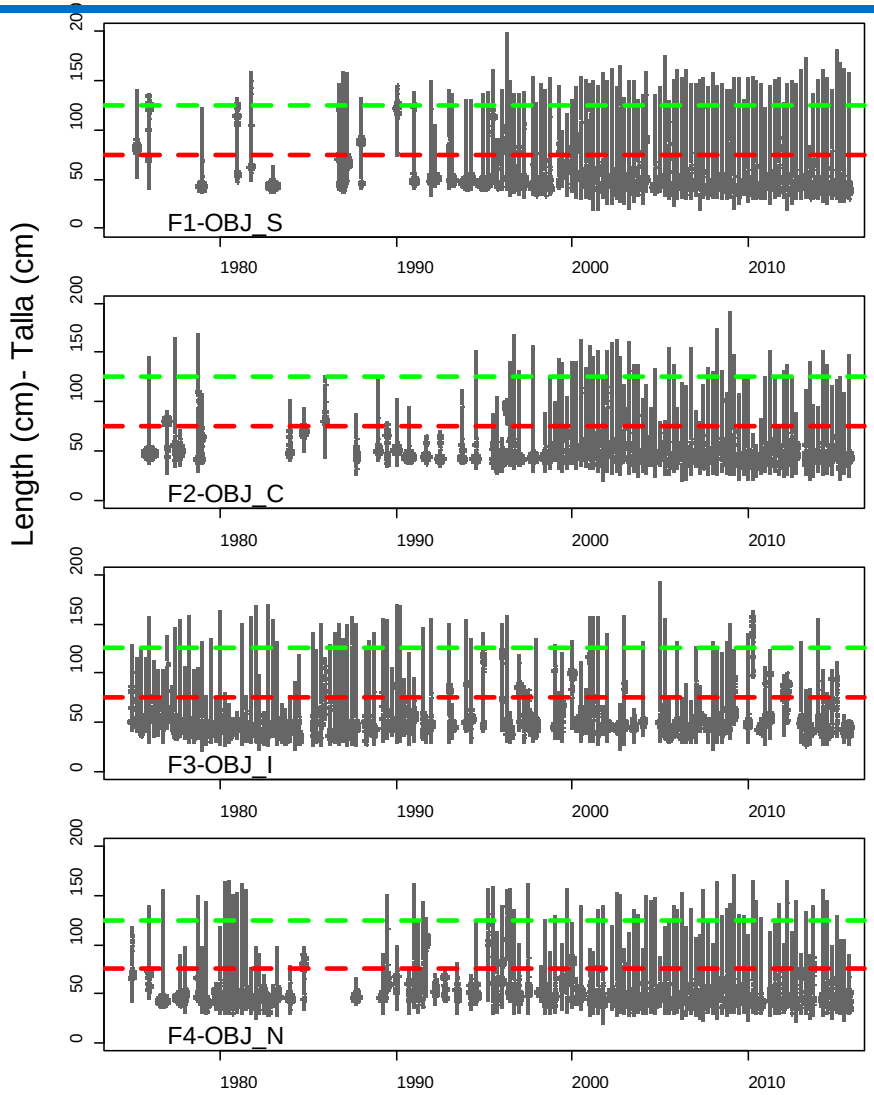
Size compositions – OBJ fisheries

Composición por tallas – Objetos flotantes

Fishery data





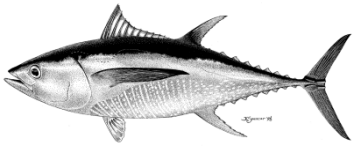
125 cm

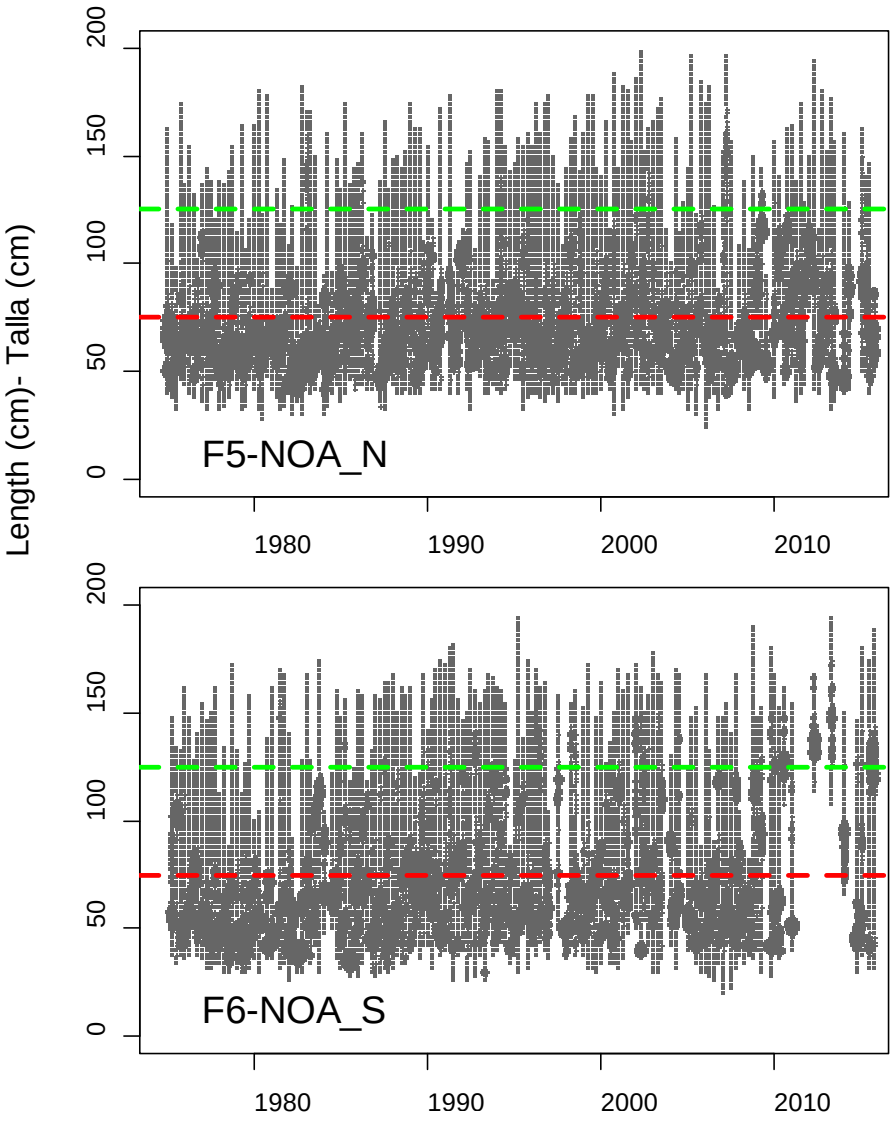
75 cm

Size compositions – NOA fisheries

Composición por tallas – No asociado

Fishery data



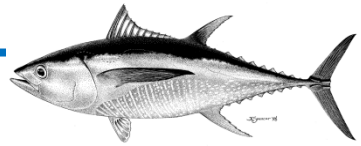


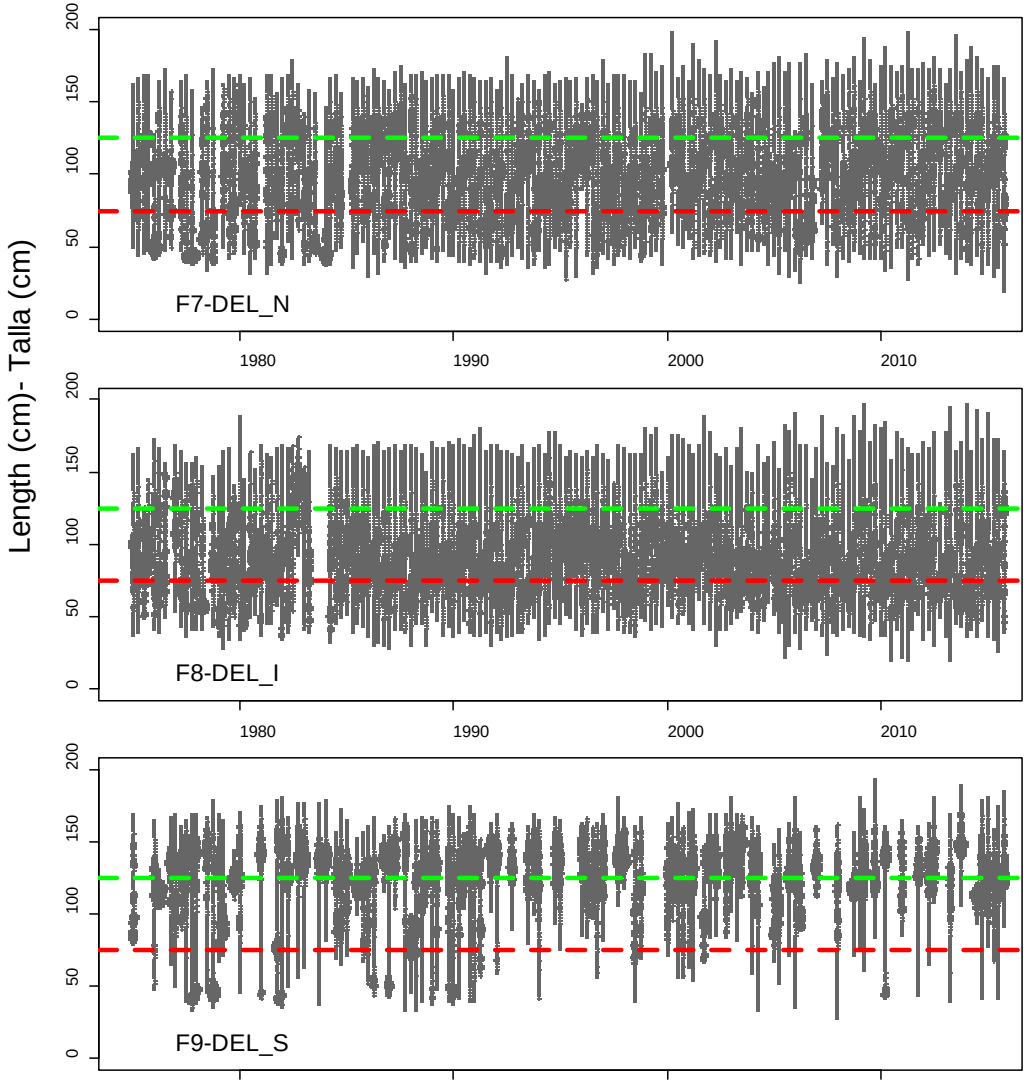
125 cm

75 cm

Size compositions – DEL fisheries

Composición por tallas – Lances sobre delfines





125 cm

75 cm

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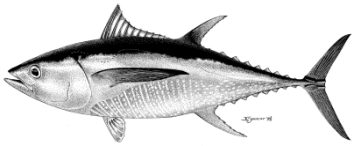
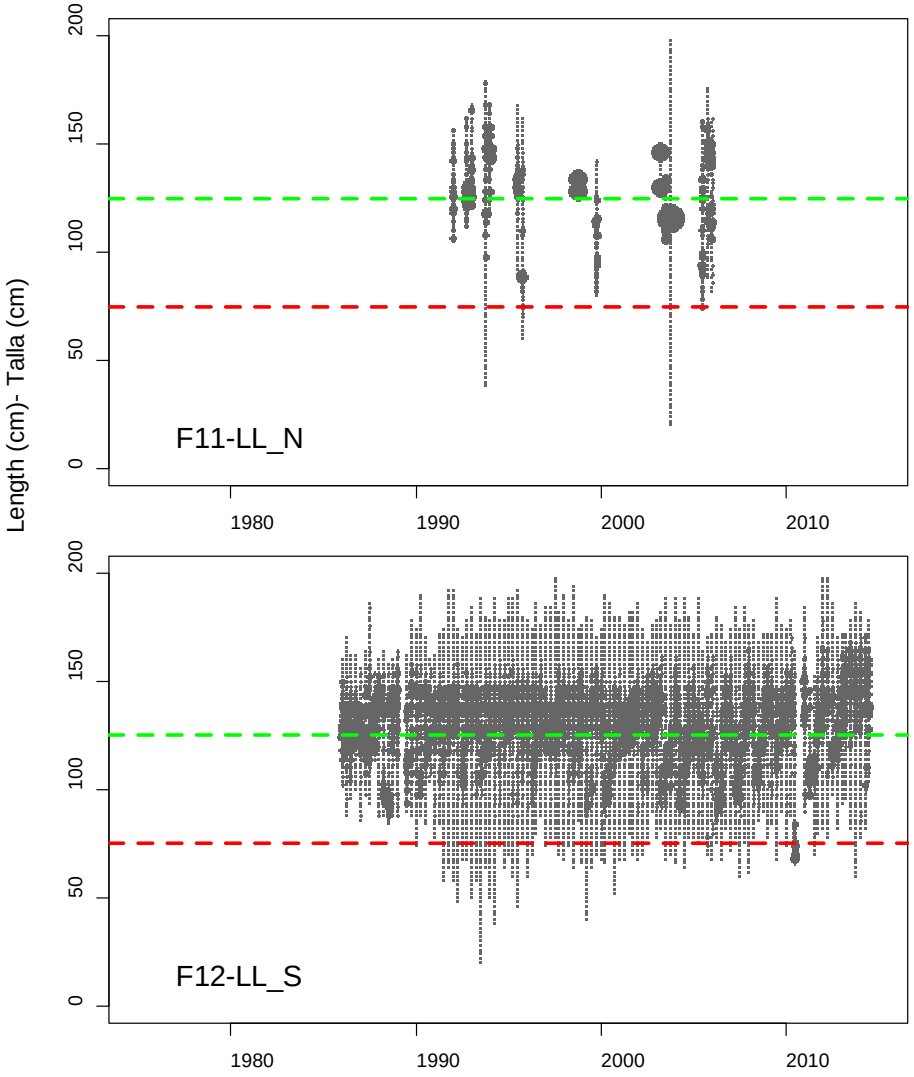
Size compositions – LL fisheries

Composición por tallas – palangre

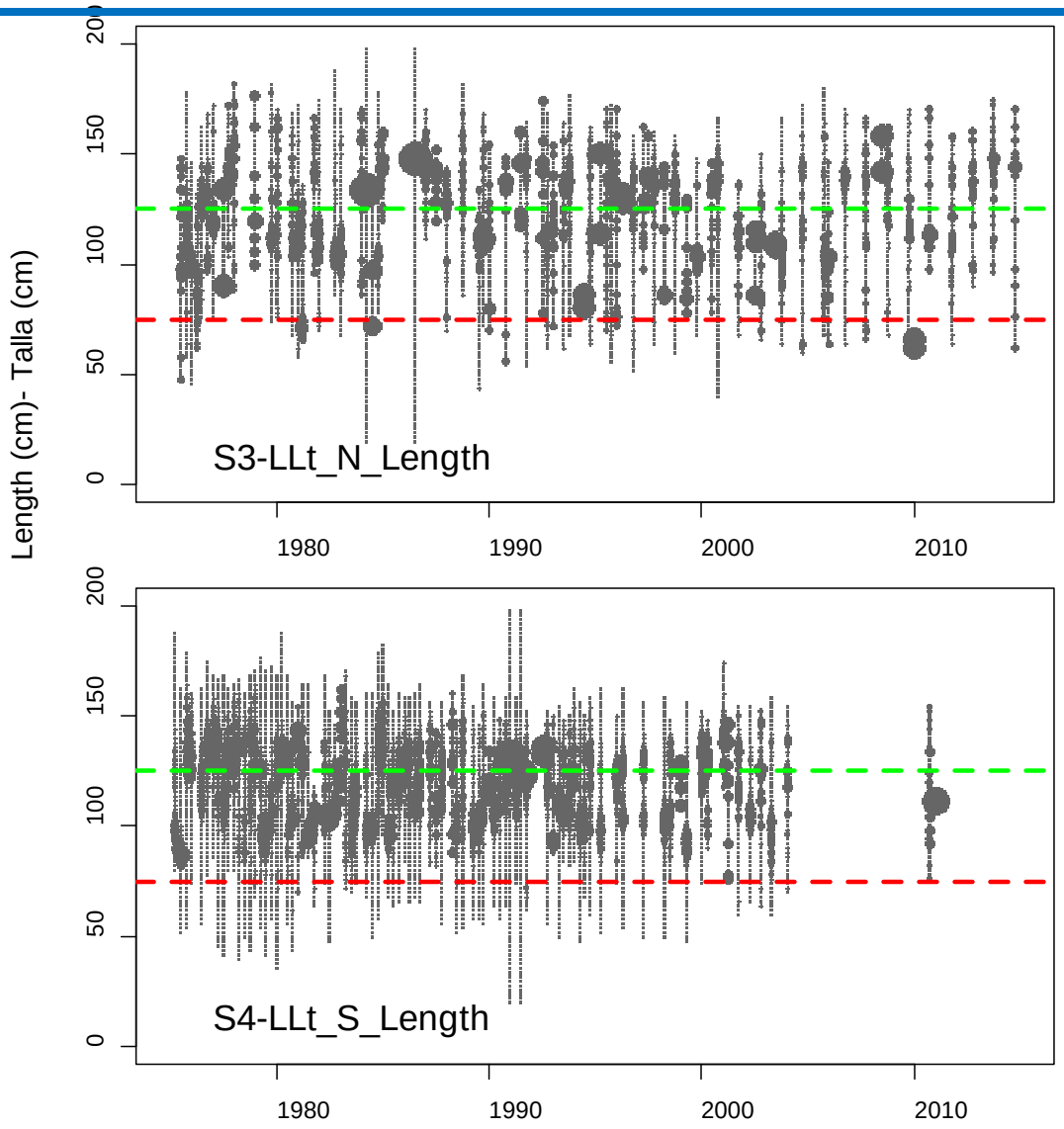




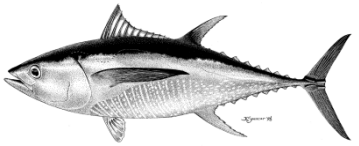
Size compositions – LL training vessels (surveys)

Fishery data

Composición por tallas – palangre, flota de entrenamiento

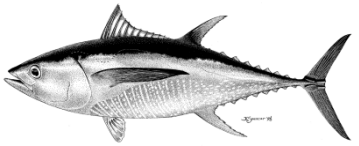


Model assumptions II
Supuestos del modelo II



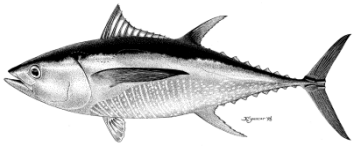
- Growth: Richards curve with fixed parameters
- Natural mortality: sex-specific
- Stock-recruitment function: B-H with h=1.0
- Modeling of catchability and selectivity:
  - Catchability coefficients for 5 CPUE time series are estimated (NOA-N, NOA-S, DEL-N, DOL-E, LL-S)
  - Selectivity curves for 11 of the 16 fisheries are estimated (F9 DEL-S mirrors F12 LL-S) and for the 2 longline “surveys”
  - Logistic selectivity for LL-S and DEL-S, and dome-shaped for other fisheries (except discards) and “surveys”

Model assumptions III
Supuestos del modelo III

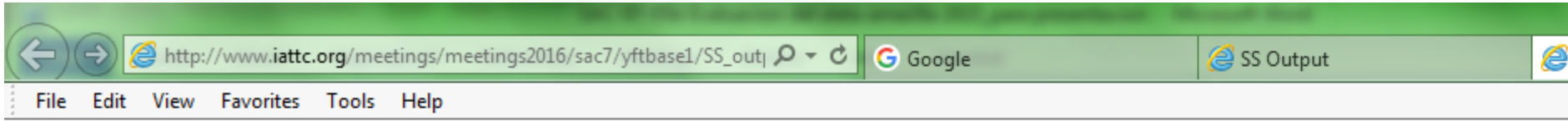


- Data weighting:
  - Relative abundance indices:
    - Main index: standardized CPUE LL_S fishery, CV fixed at 0.2
    - Secondary indices: nominal CPUE for NOA-N, NOA-S, DEL-N,DOL-E fisheries, extra CV component estimated
  - Length-frequency data:
    - sample sizes for LL fleets re-scaled so they have the same average as the PS DEL-N fleet

Results - *Resultados*



- Fishing mortality – *mortalidad por pesca*
- Recruitment - *reclutamiento*
- Biomass - *biomasa*
- Fisheries impact – *impactos de las pesquerías*
- Diagnostics - *diagnósticos*
- Sensitivities - *sensibilidades*



Home | Bio | Sel | Timeseries | RecDev | S-R | Catch | SPR | Index | Numbers | CompDat | LenComp | A@LComp | Yield | Data

EPO Yellowfin Tuna 2016 Base Case Assessment

The assessment was conducted using Stock Synthesis (SS). These web pages provide information
SS output files and files used to run the stock assessment. The information contained in these web
publically redistributed without the permission of the IATTC.

IATTC yellowfin tuna stock assessment document

The SS output is also available as a pdf

SS model files in zip archive

SS output files in zip archive

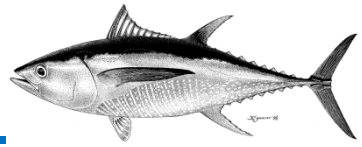
SS version: SS-V3.23b-safe-win64;_11/05/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADM

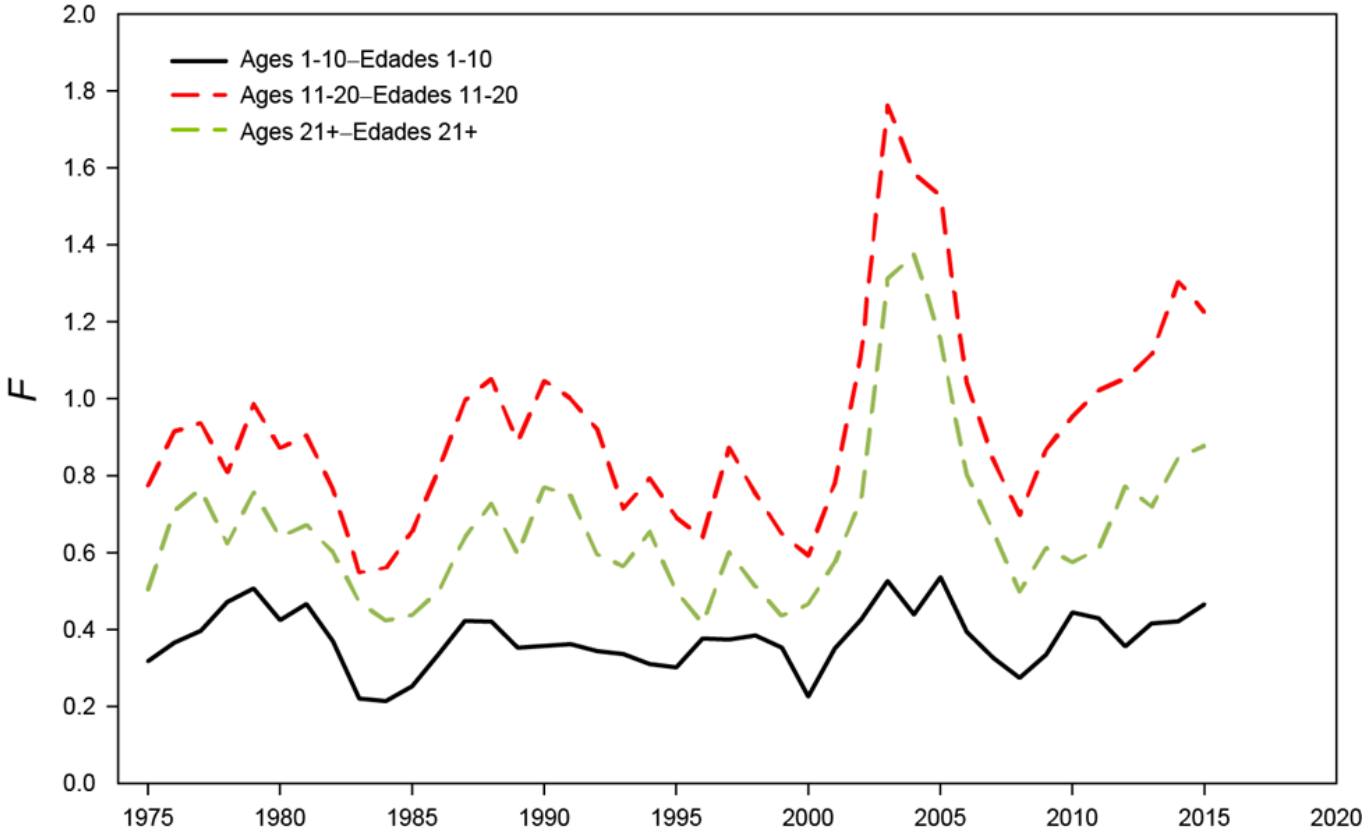
Starting time of model: Mon Apr 18 10:43:45 2016

Warnings (from file warnings.sso): None

http://www.iattc.org/meetings/meetings2016/sac7/yftbase1/SS_output.html

Fishing mortality – *Mortalidad por pesca*

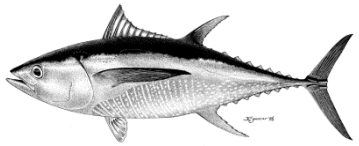




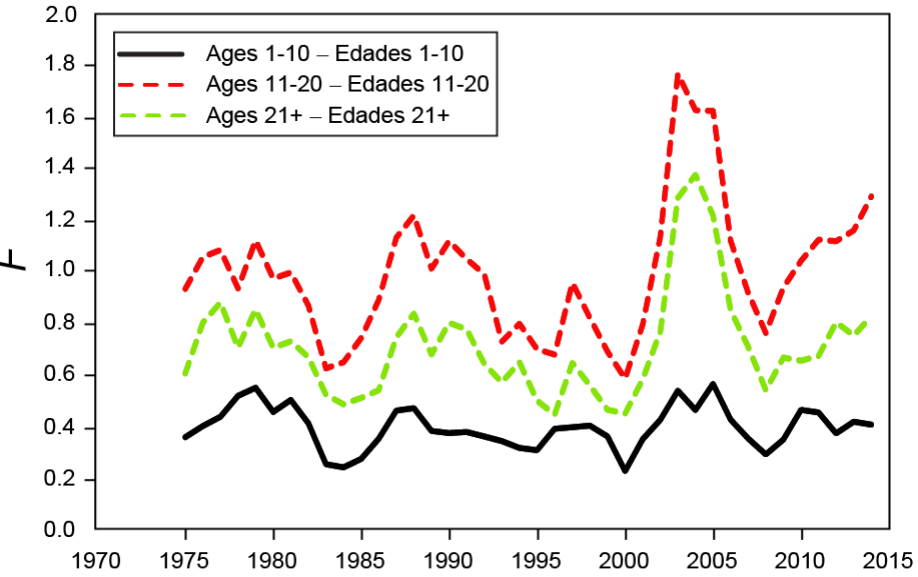
Average annual fishing mortality (*F*) by age groups, by all gears, of yellowfin tuna recruited to the fisheries of the EPO.

Mortalidad por pesca (F) anual media, por grupo de edad, por todas las artes, de atún aleta amarilla reclutado a las pesquerías del OPO.

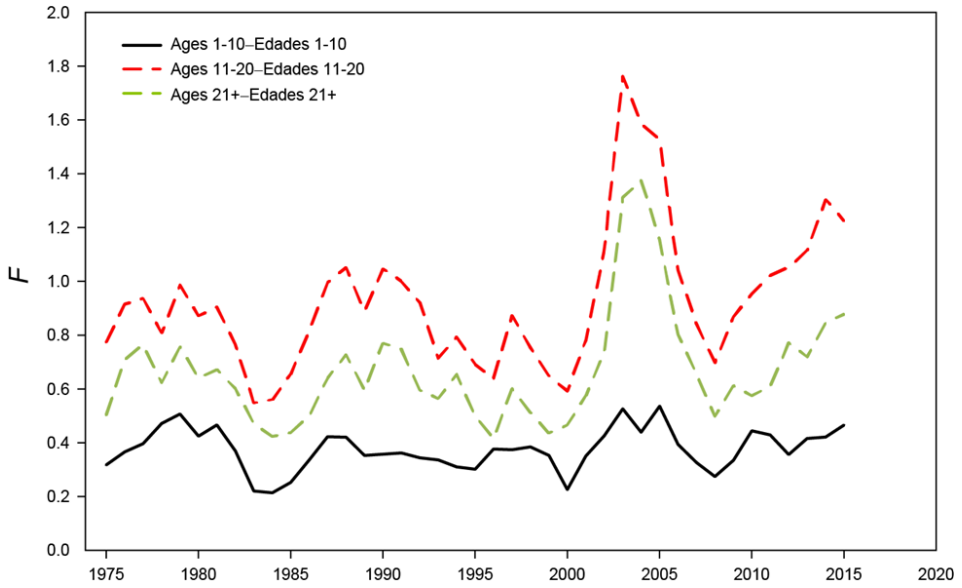
Fishing mortality – *Mortalidad por pesca*



SAC6



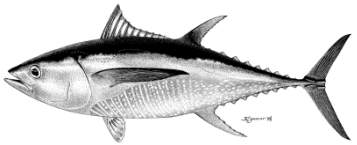
SAC7

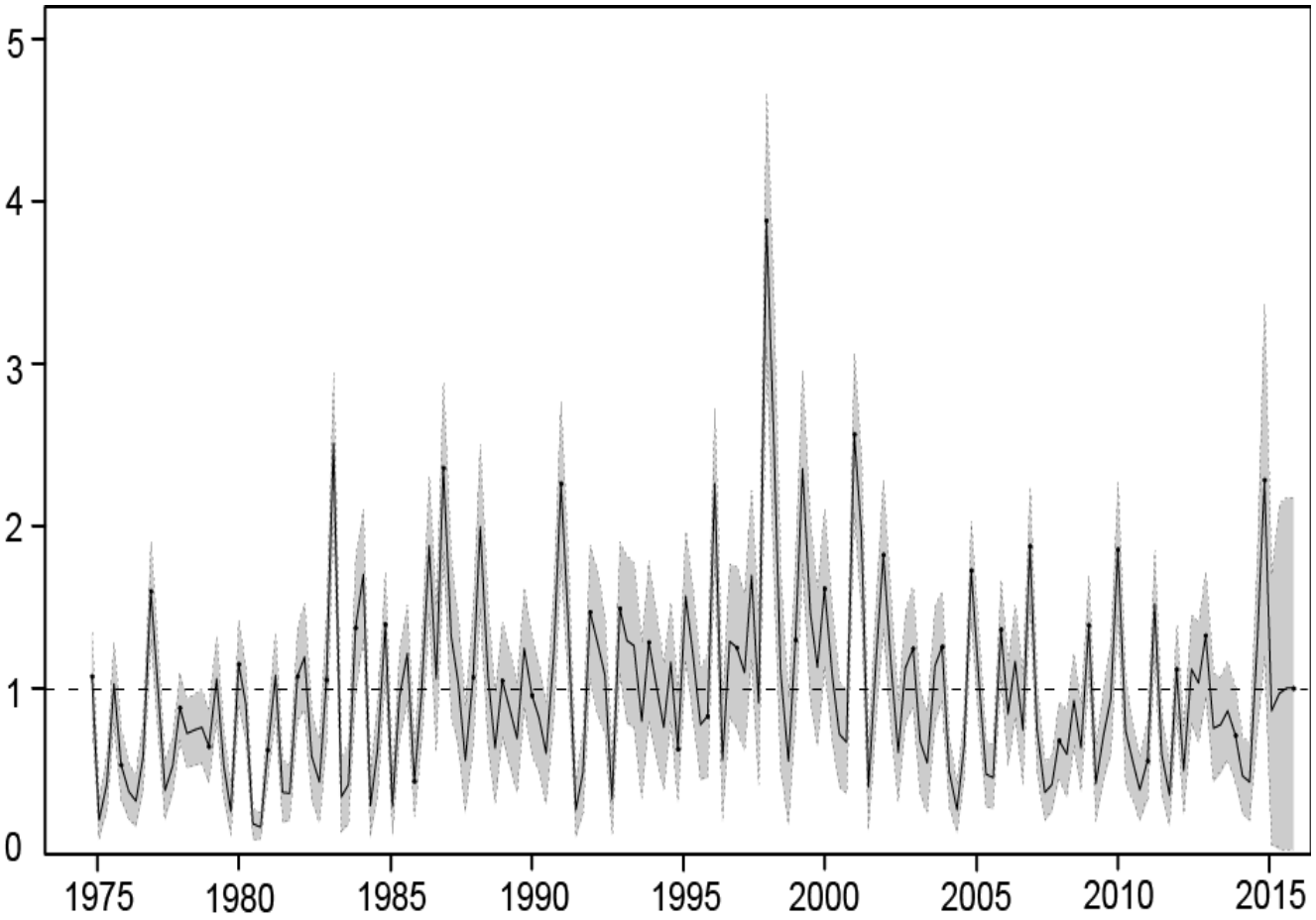


CIAT
IATTC

Recruitment by quarter

Reclutamiento por trimestre

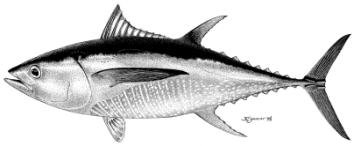


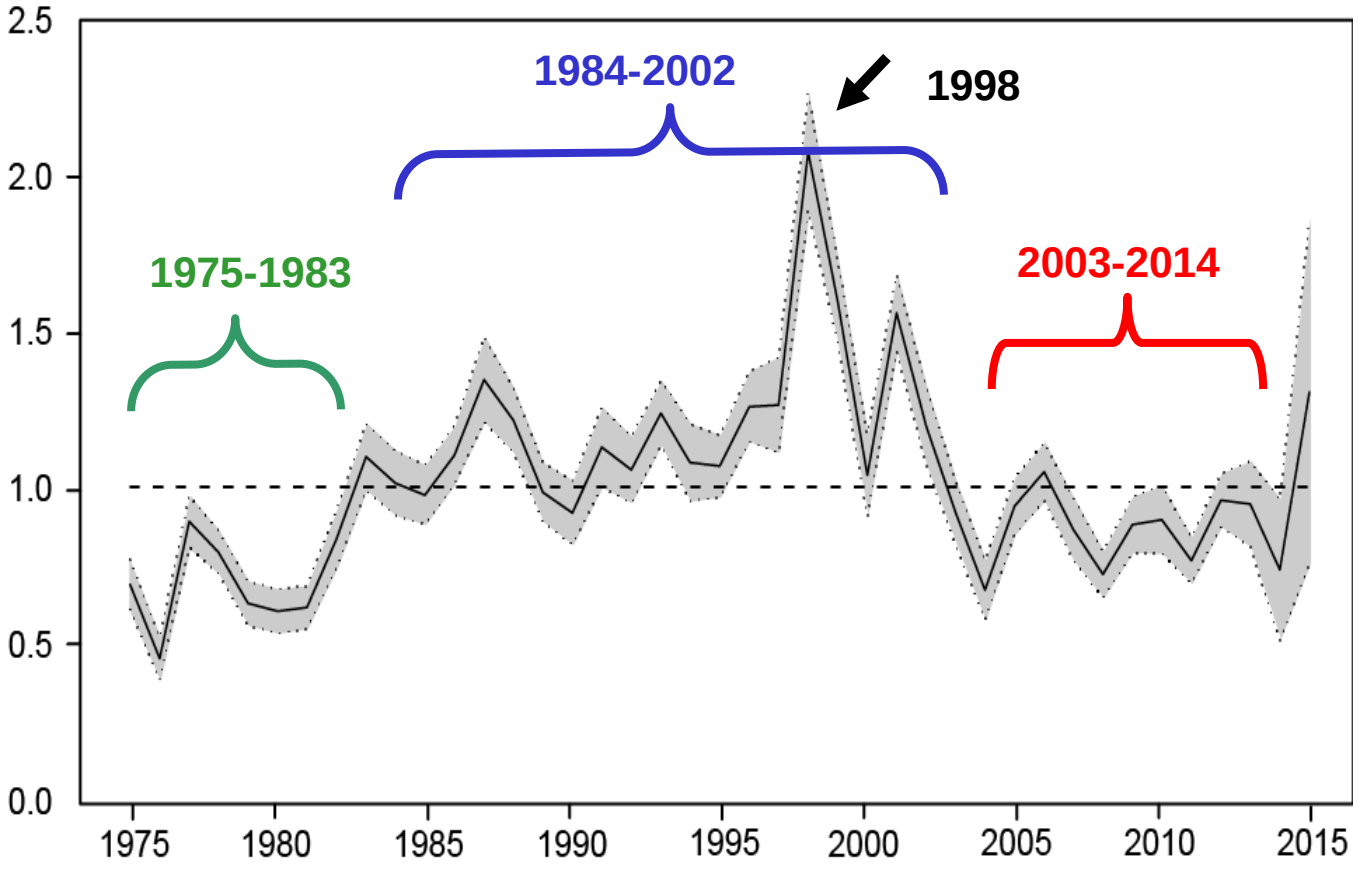


_ MLE
-- 95% CI

CIAT
IATTC

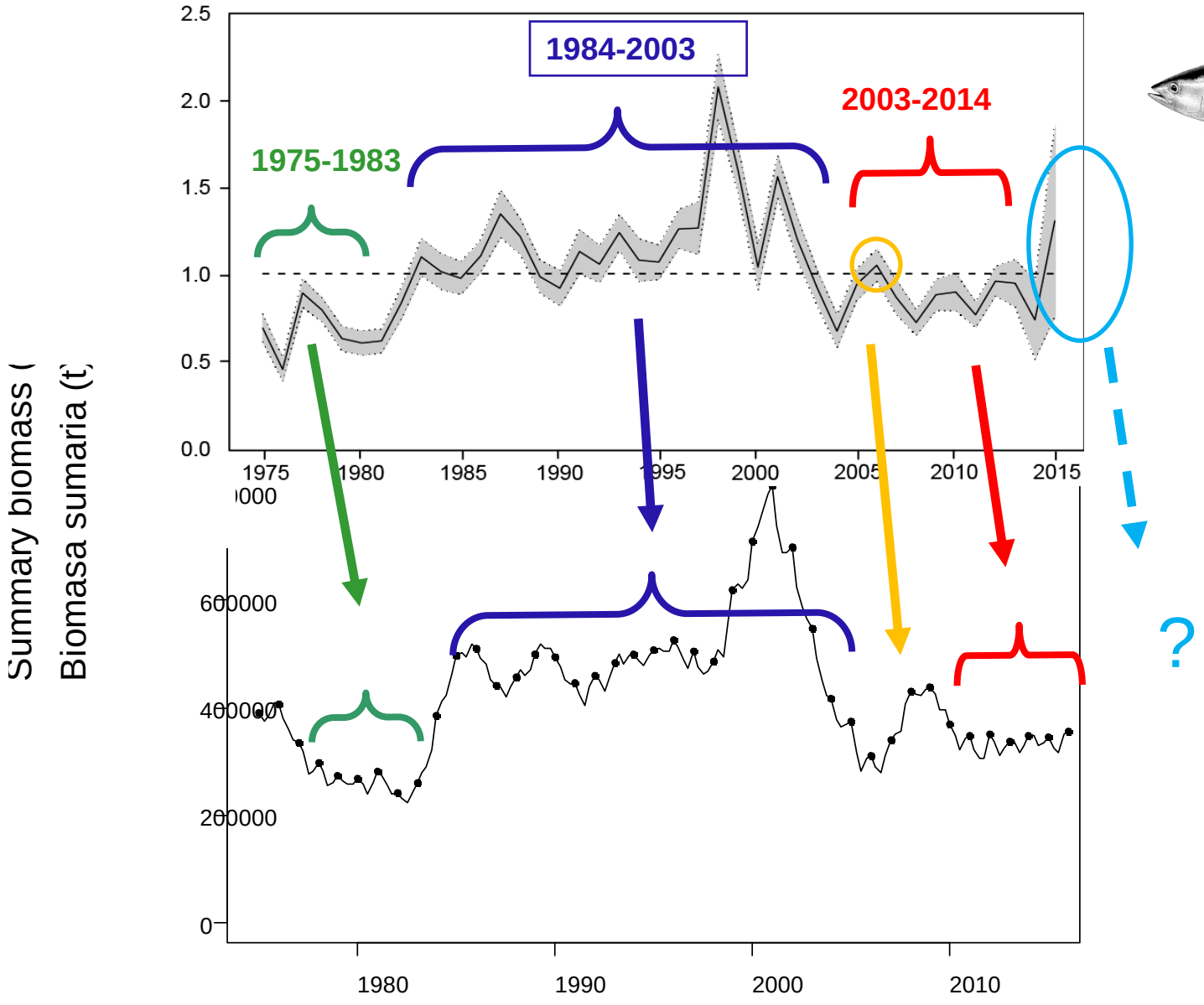
Annual Recruitment
Reclutamiento anual

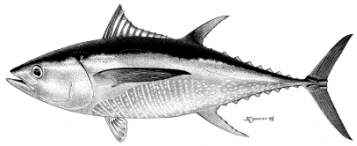




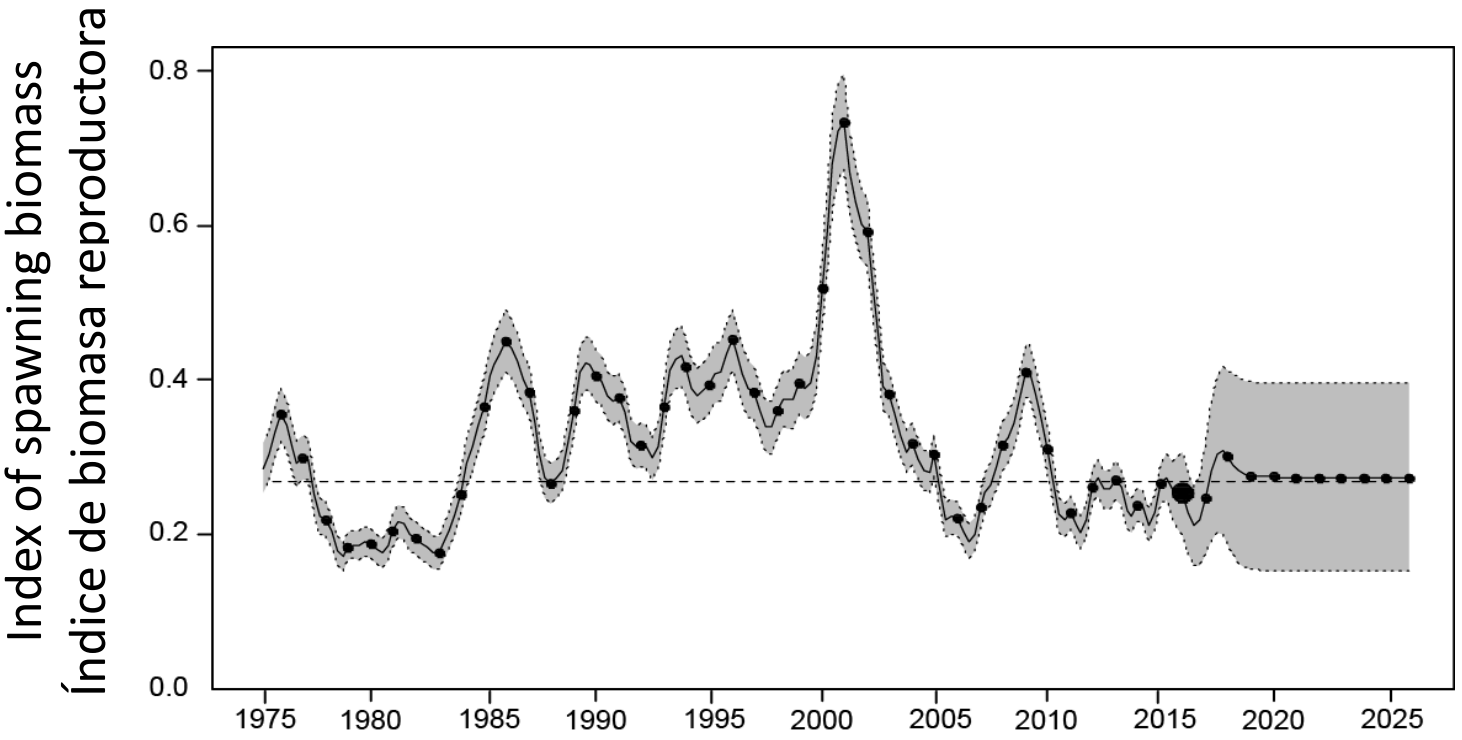
Biomass fish 3+ quarters old

Biomasa de peces con 3+ trimestres de edad

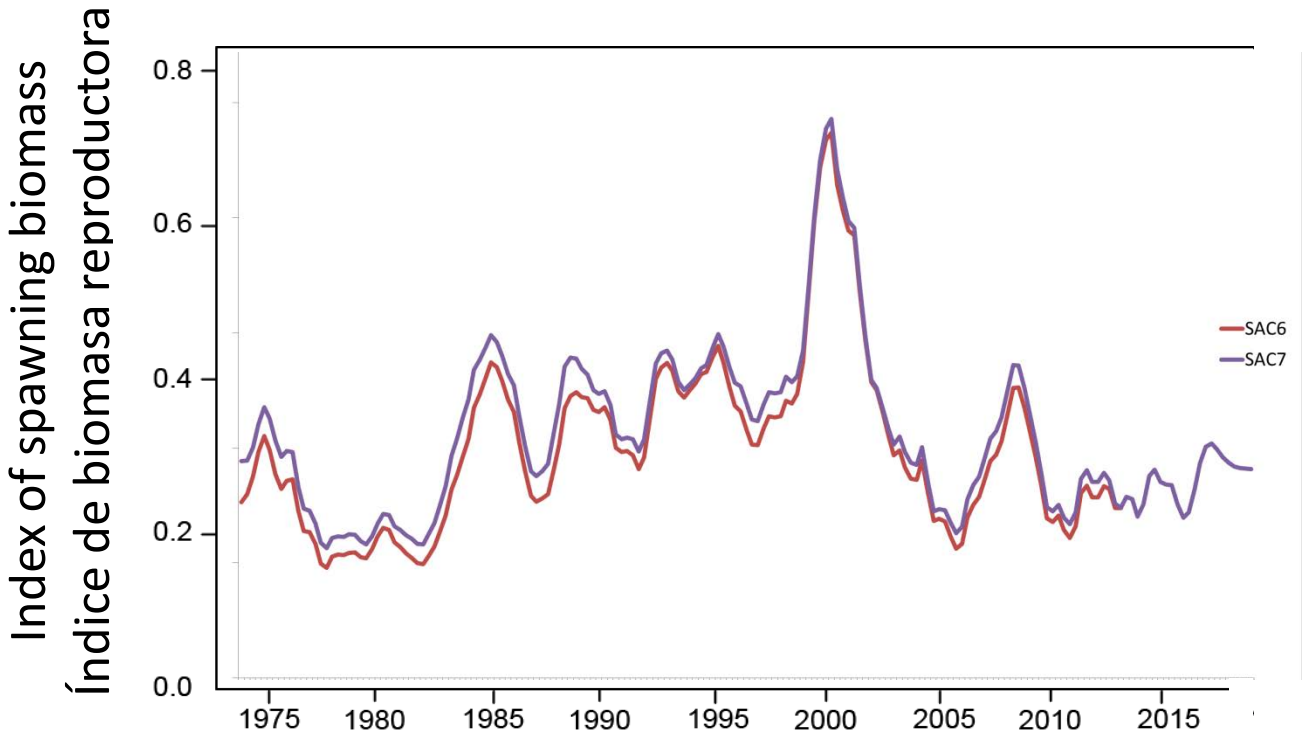




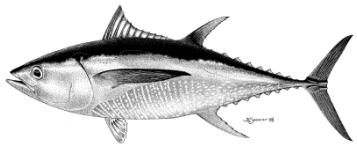
Spawning biomass - *Biomasa reproductiva*

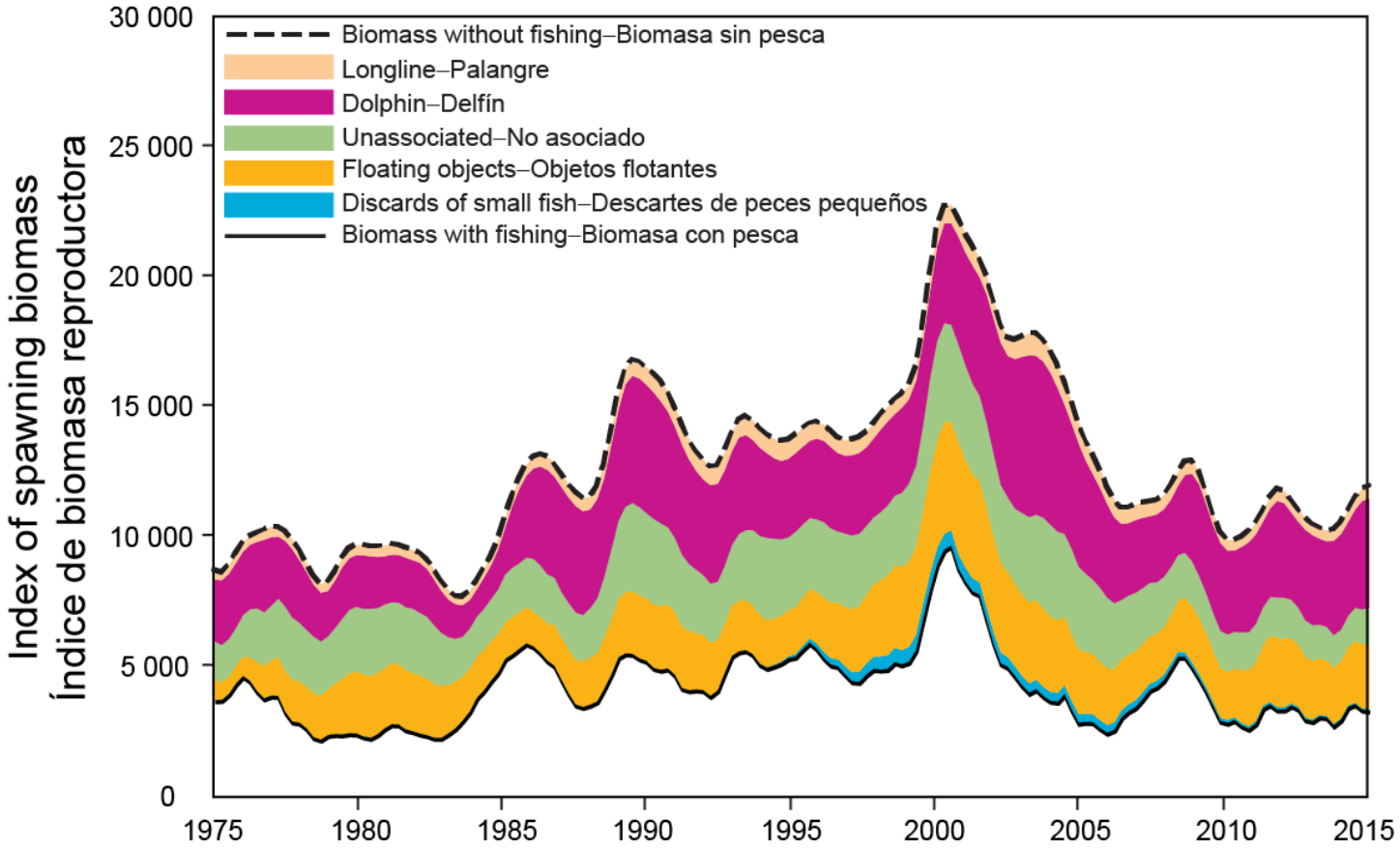


Spawning biomass - *Biomasa reproductiva*



Fishery impact – *Efecto de la pesquería*

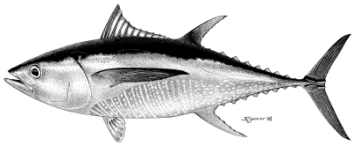




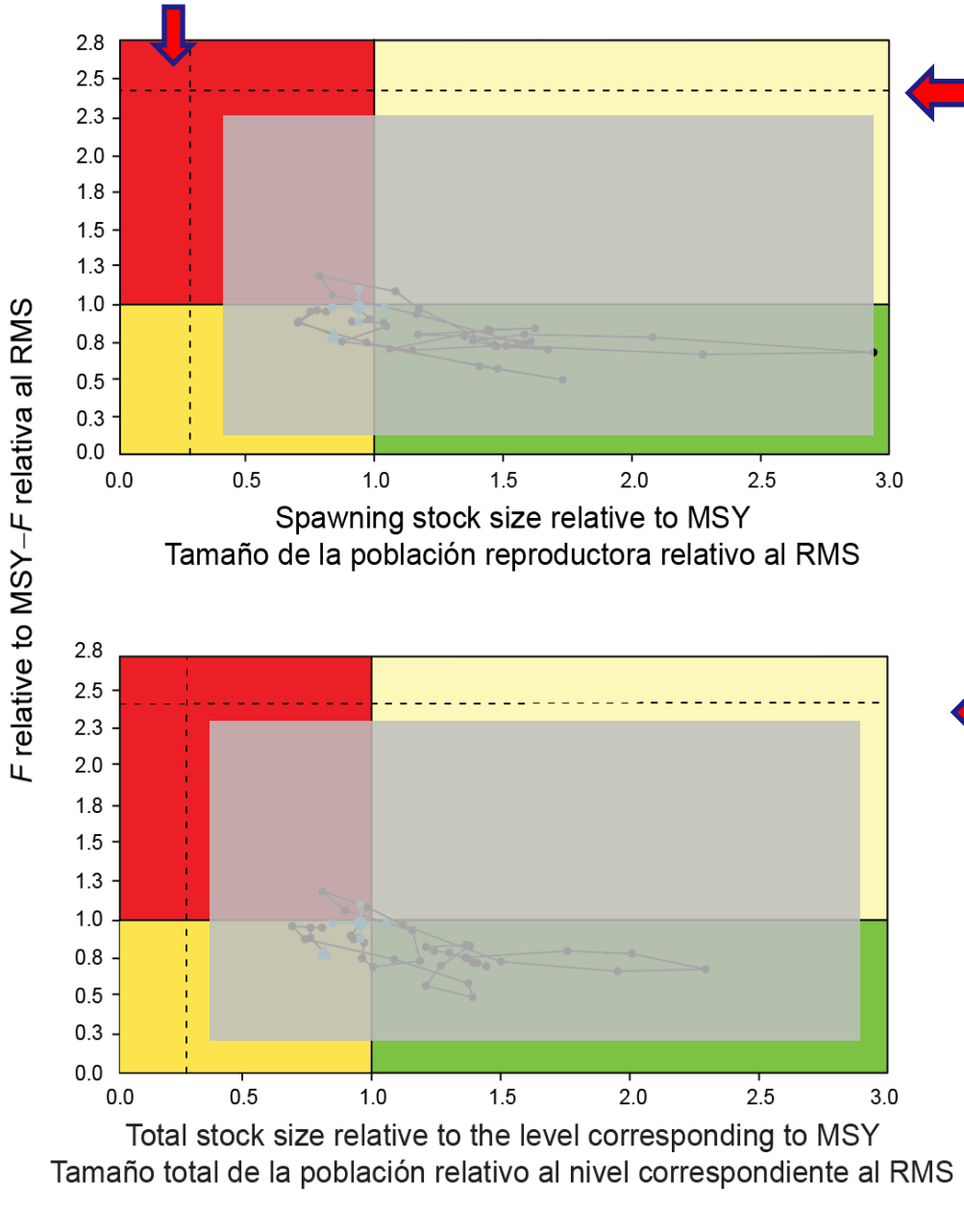
Spawning biomass of a simulated population never exploited(- - -), predicted by the stock assessment model (__), and portions of the impact attributed to each fishing method.

Biomasa reproductora de una población simulada nunca explotada , la que predice el modelo de evaluación y efecto atribuido a cada método de pesca

Kobe plots – *Gráfica de Kobe*



Interim limit reference points – *puntos de referencia límite provisionales*

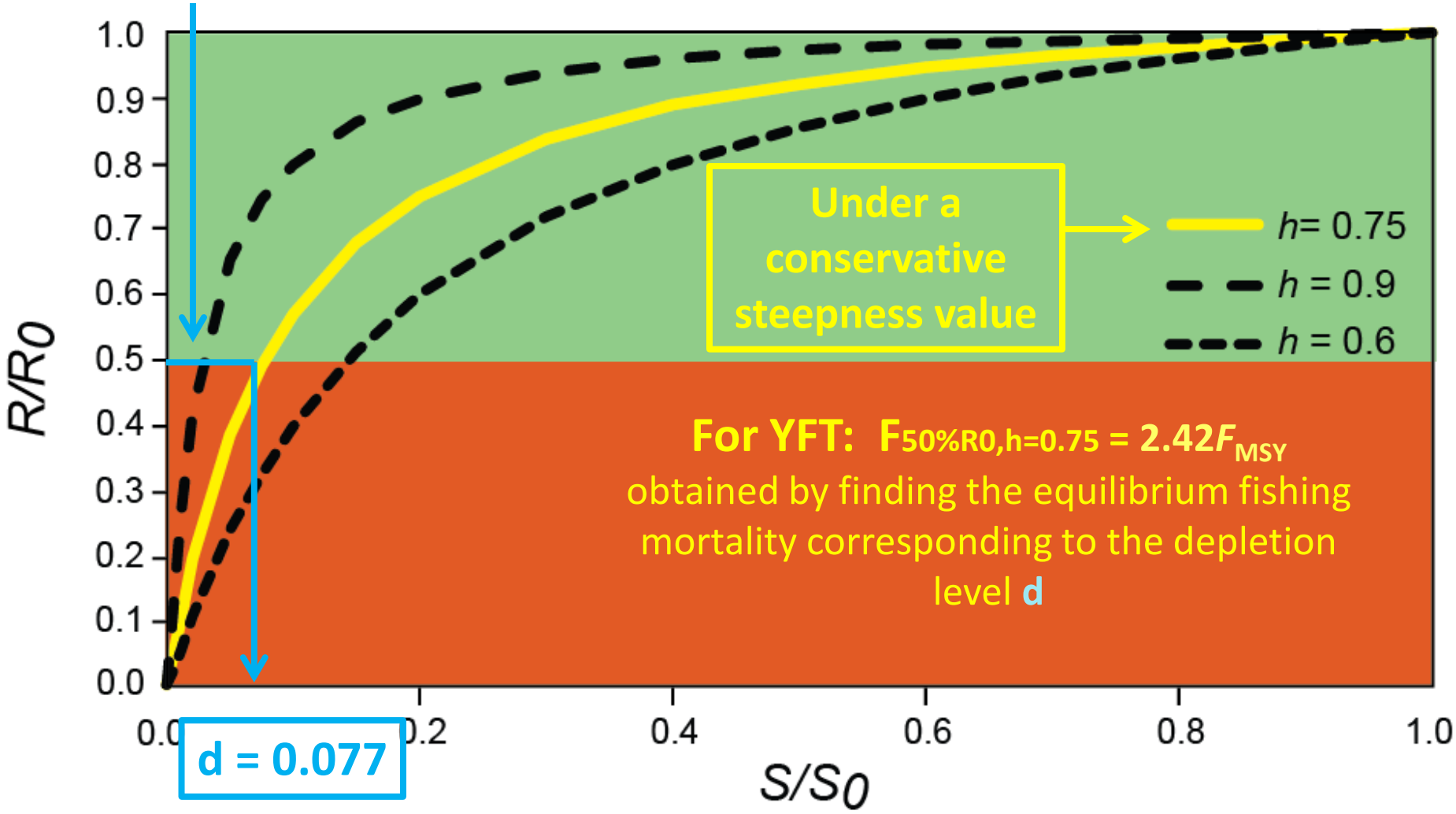


Interim limit reference point

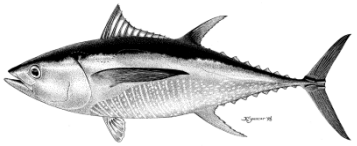
Interim limit reference points
Puntos de referencia límite provisionales

50 % reduction in recruitment

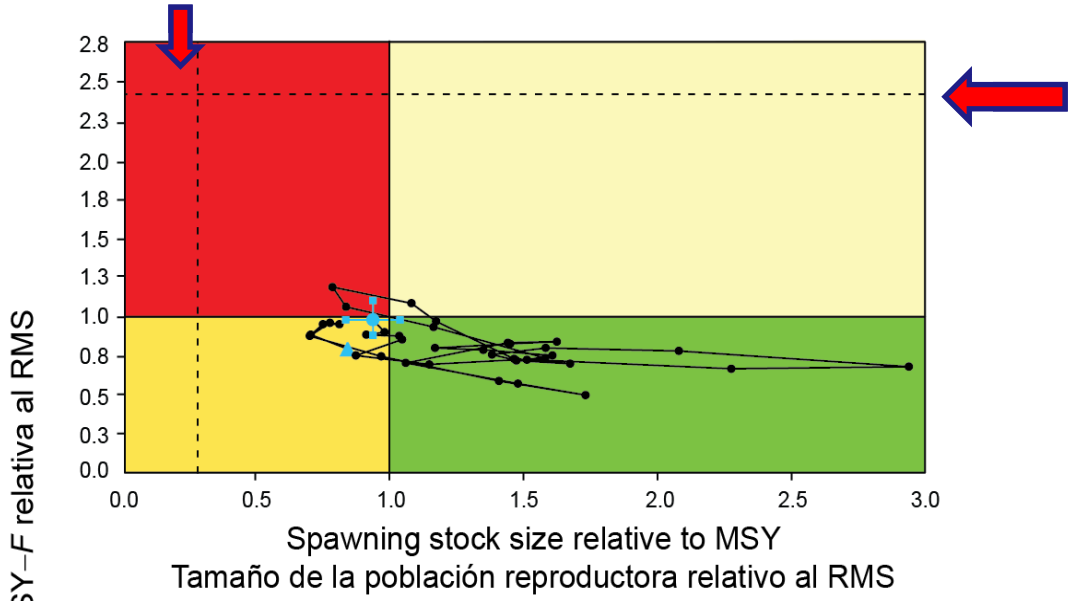
Maunder and Deriso (2014) **SAC-05-14**

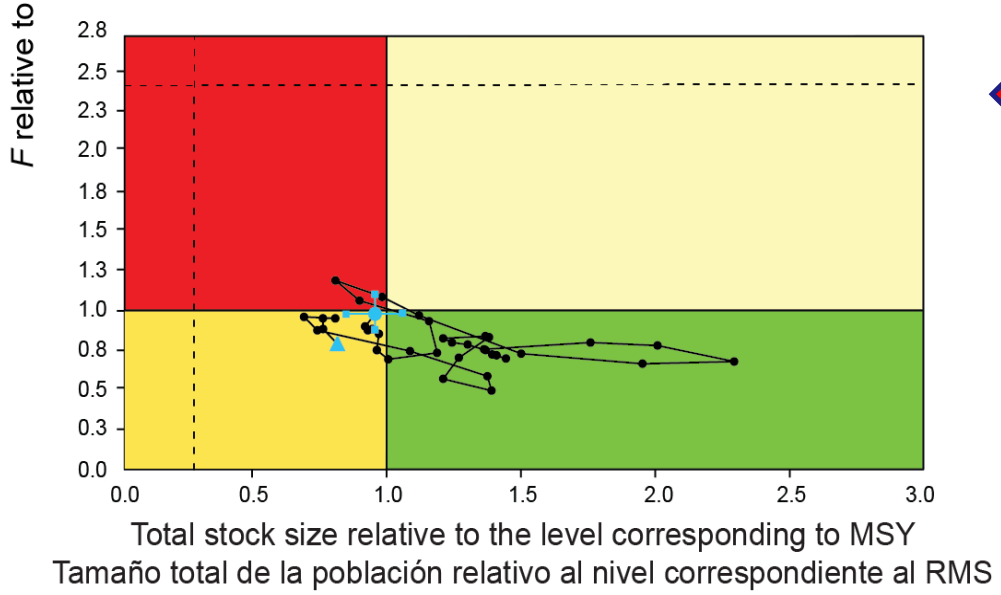


Kobe plots – *Gráfica de Kobe*

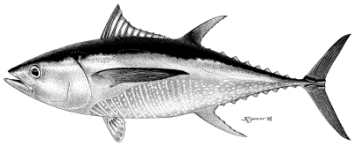


Interim limit reference points – *puntos de referencia límite provisionales*





MSY and related quantities
RMS y cantidades relacionadas

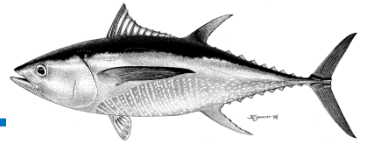


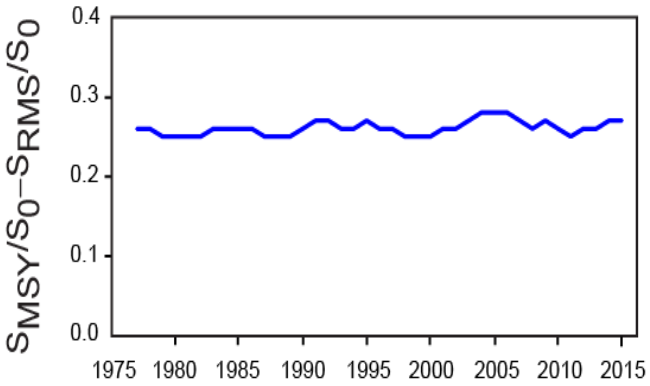
	Base case
YFT	Caso base
MSY-RMS	272,841
B_{MSY}- B_{RMS}	372,010
S_{MSY}- S_{RMS}	3,528
B_{MSY}/B_0- B_{RMS}/B_0	0.32
S_{MSY}/S_0- S_{RMS}/S_0	0.27
C_{recent}/MSY- C_{recent}/RMS	0.94
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95
F multiplier- Multiplicador de *F*	1.02

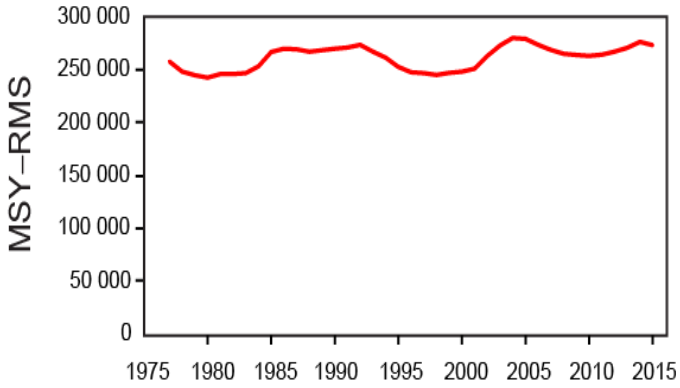
Time varying indicators

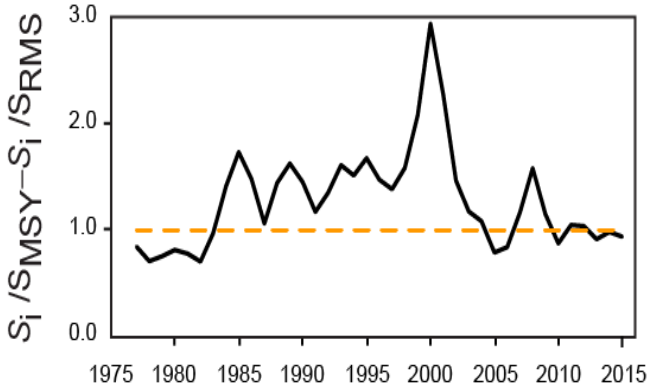
Stock status – base case

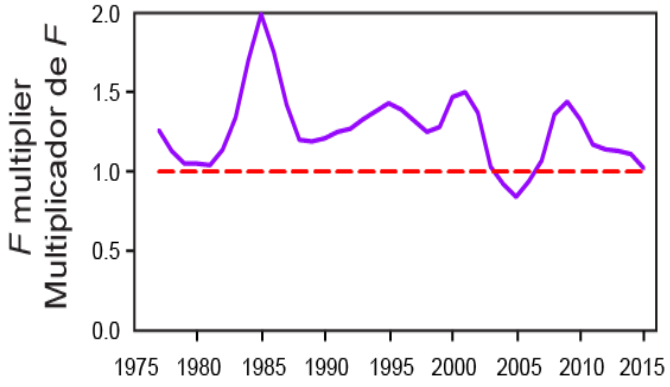
Indicadores con variación temporal







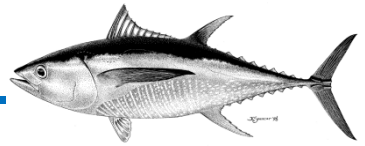




MSY-related quantities calculated using the average age-specific fishing mortality for each year

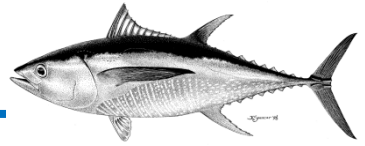
Cantidades relacionadas con el RMS calculadas a partir de la mortalidad por pesca media por edad para cada año.

MSY and related quantities
RMS y cantidades relacionadas

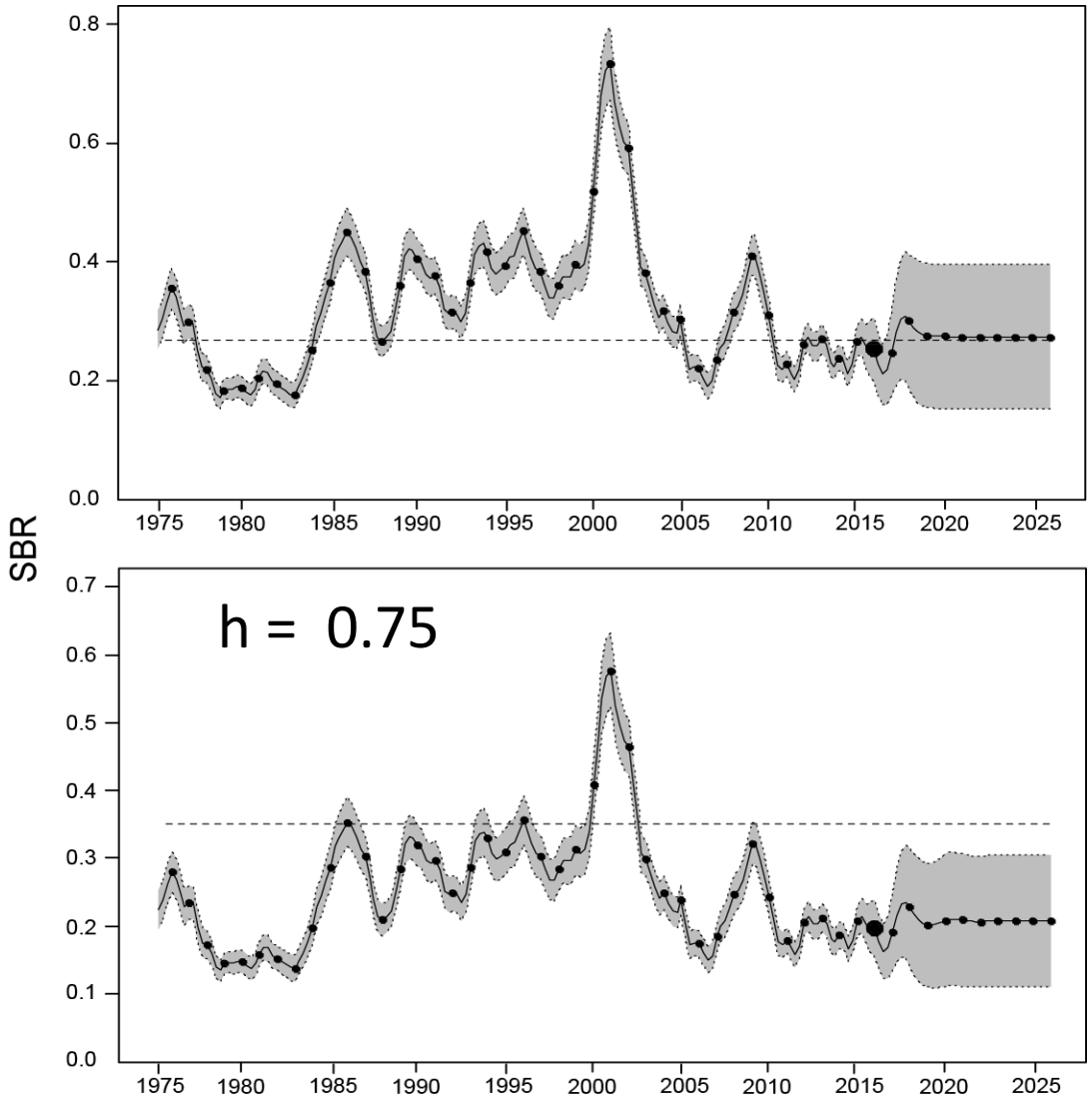


YFT	Base case Caso base	*h* = 0.75
MSY-RMS	272,841	287,476
B_{MSY}- B_{RMS}	372,010	547,238
S_{MSY}- S_{RMS}	3,528	5,897
B_{MSY}/B_0- B_{RMS}/B_0	0.32	0.37
S_{MSY}/S_0- S_{RMS}/S_0	0.27	0.35
C_{recent}/MSY- C_{recent}/RMS	0.94	0.89
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96	0.64
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95	0.56
F multiplier- Multiplicador de *F*	1.02	0.65

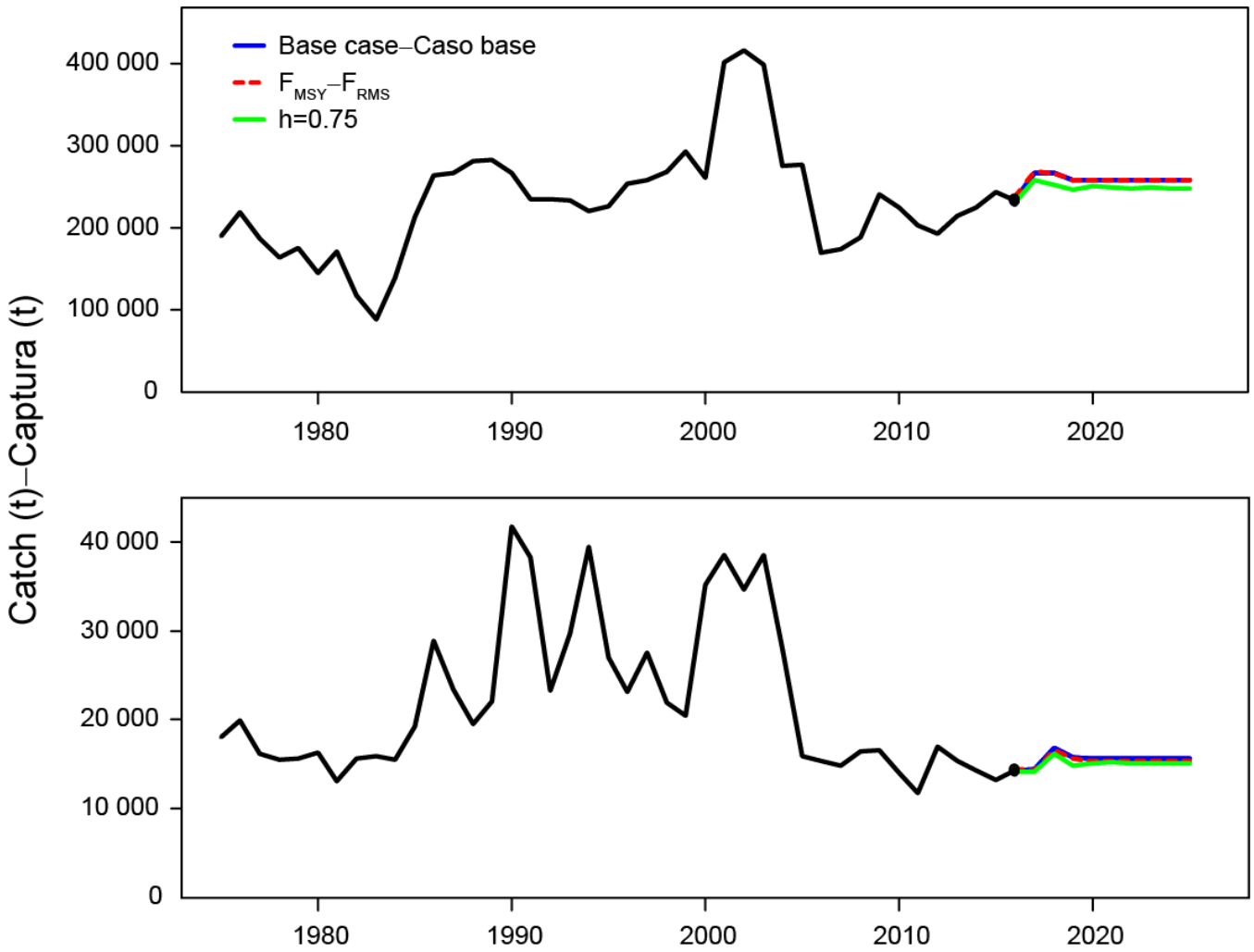
Spawning Biomass Ratio (SBR)
Cociente de biomasa reproductiva



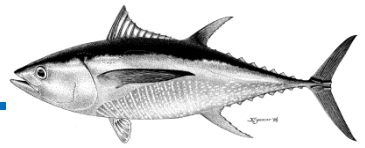
Base case h=1 – *Caso base h=1*

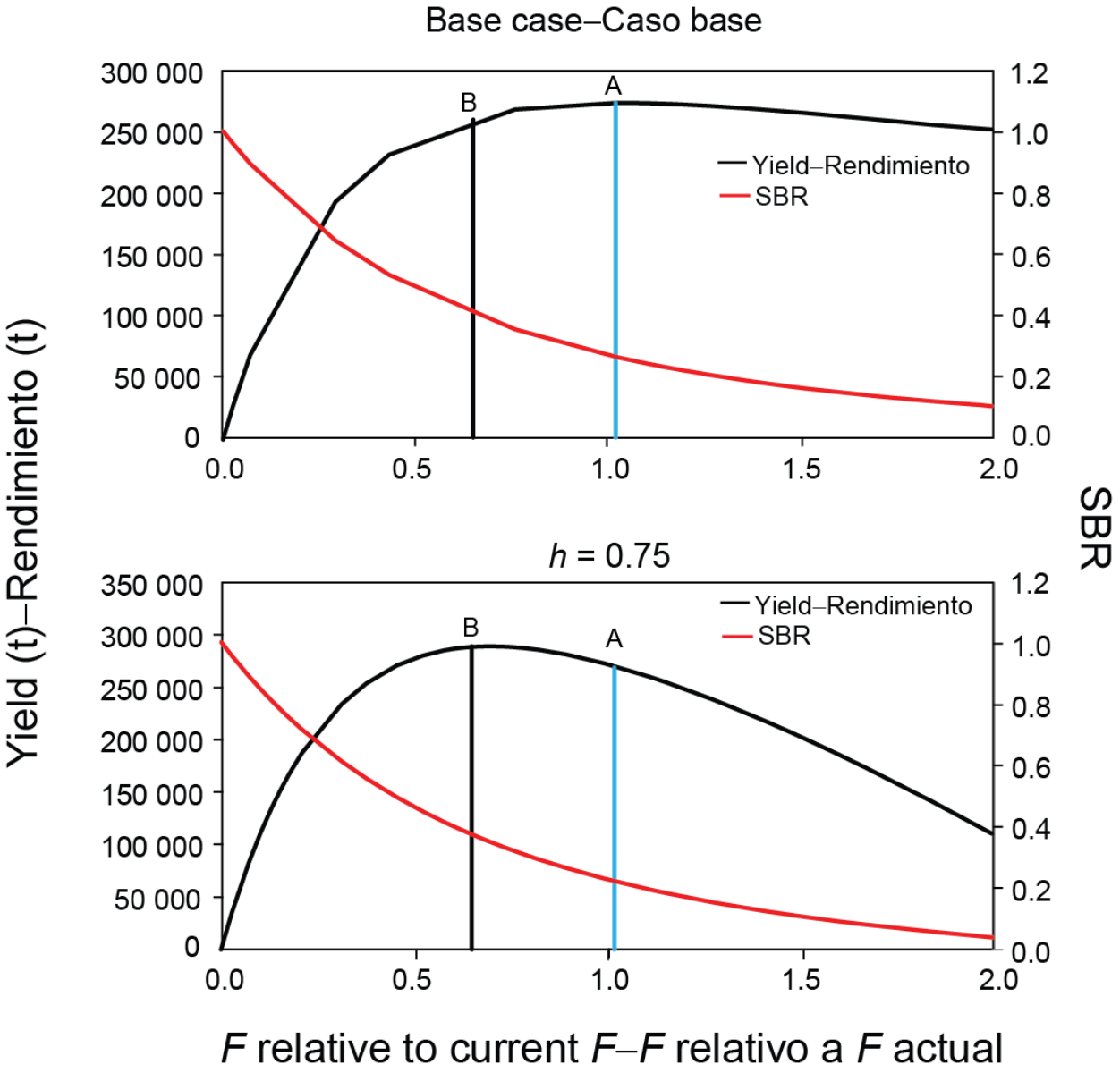


Projected catches – *Capturas proyectadas*



Yield - *Rendimiento*





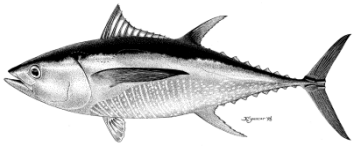
A ___ base case – *caso base*

B___ h=0.75

CIAT
IATTC

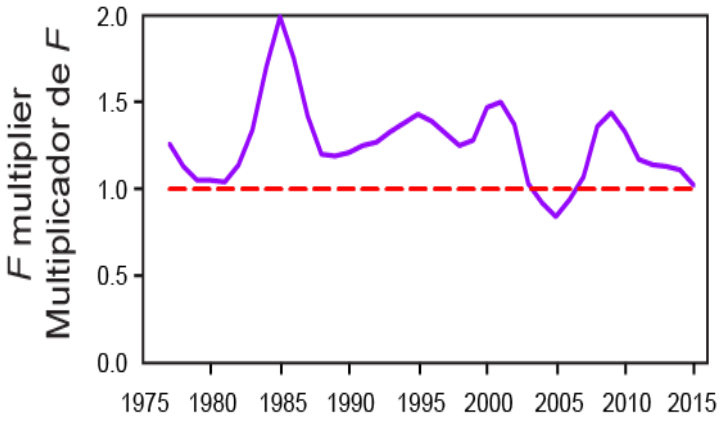
Summary: key results

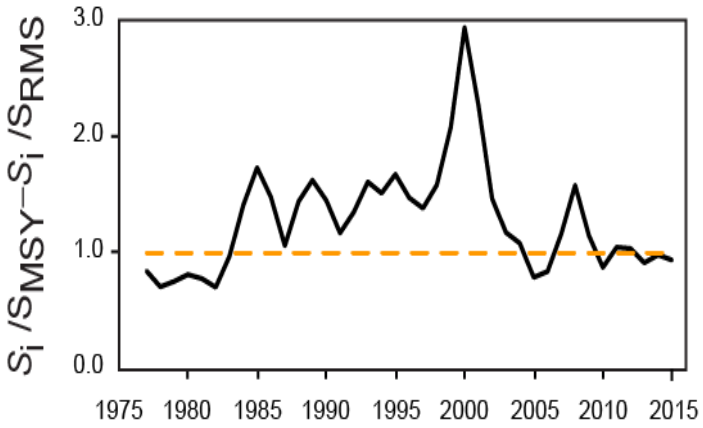
Resumen: resultados clave



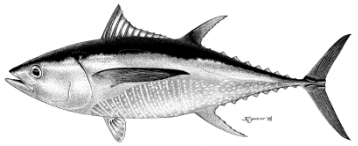
- The recent **fishing mortality** rates are estimated to be slightly below those corresponding to the MSY, so Fmultiplier > 1
- $F_{recent} < F_{MSY}$

- The recent levels of **spawning biomass** are estimated to be below at those corresponding to the MSY
- ($S_{recent} < S_{MSY}$)





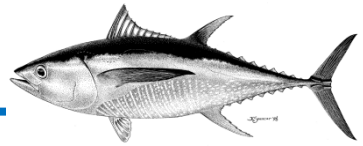
Diagnostics
Diagnósticos

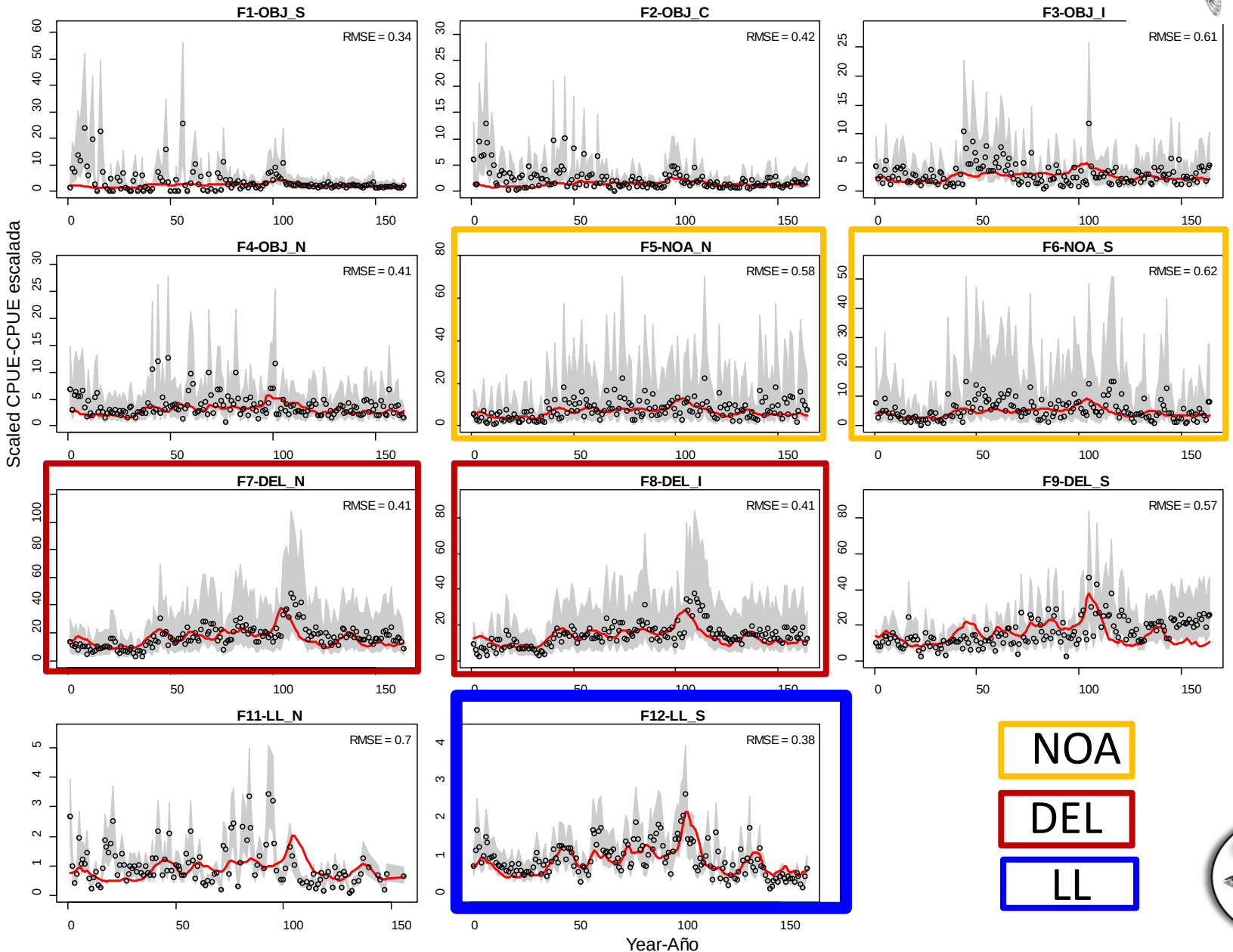


- Fits - *Ajustes*
- R0 profile – *perfil de R0*
- Age-structured production model (ASPM) –

Modelo de producción con estructura por edades

Fit to CPUE – *Ajustes a la CPUE*





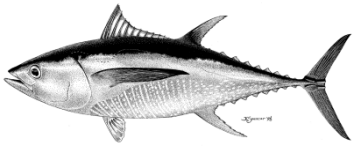
NOA

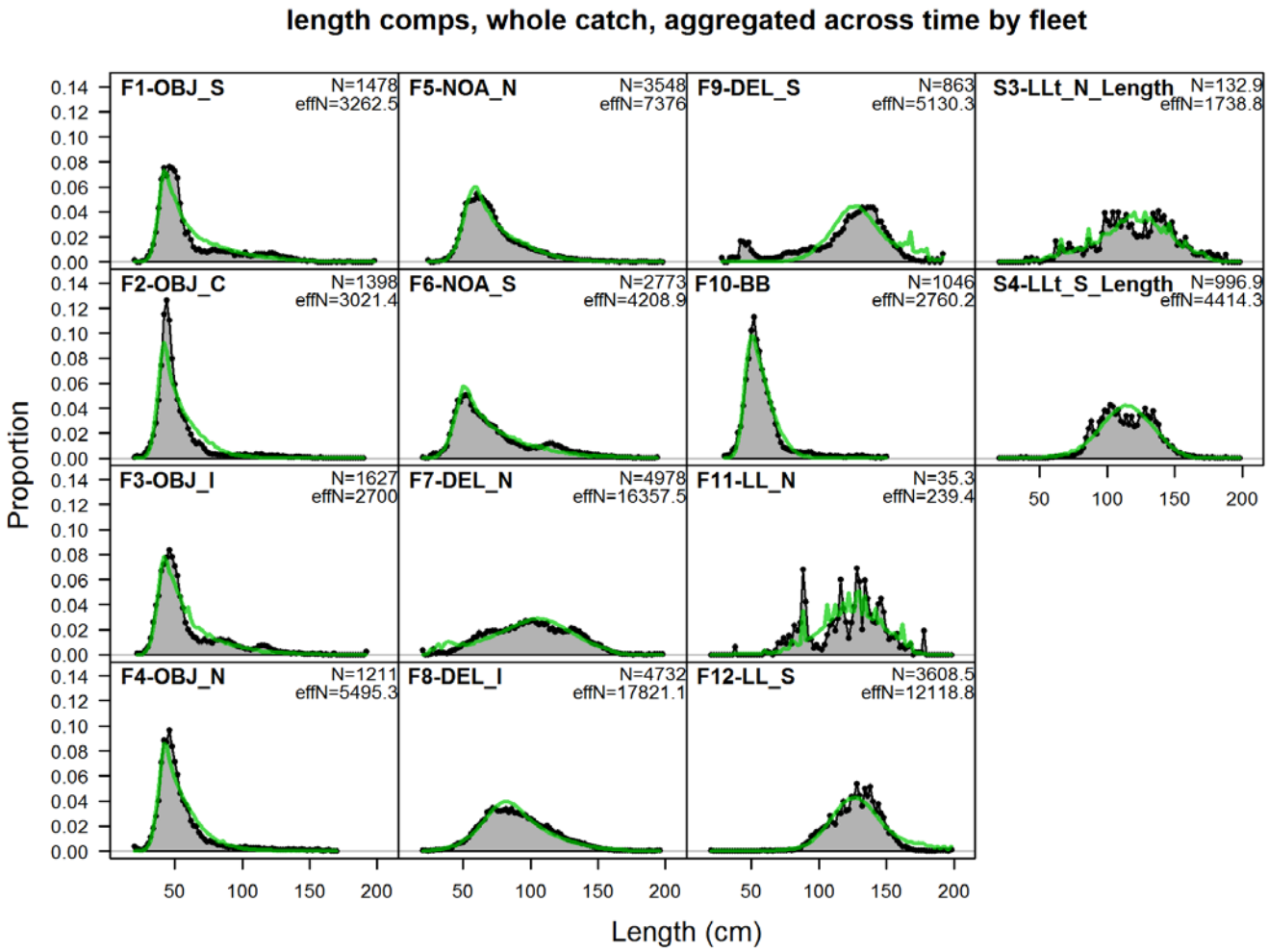
DEL

LL

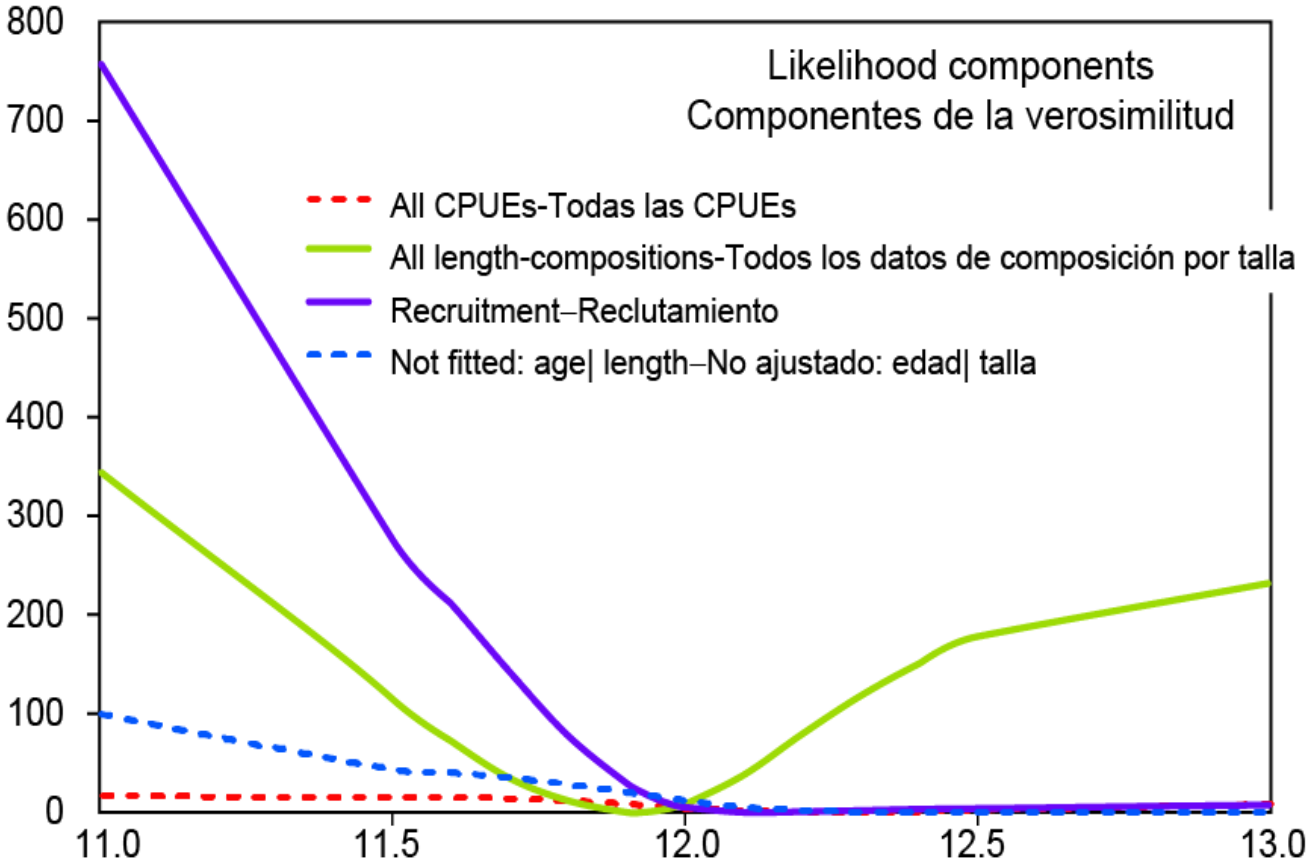
CIAT IATTC

Fit to length compositions
Ajustes a la composición de tallas



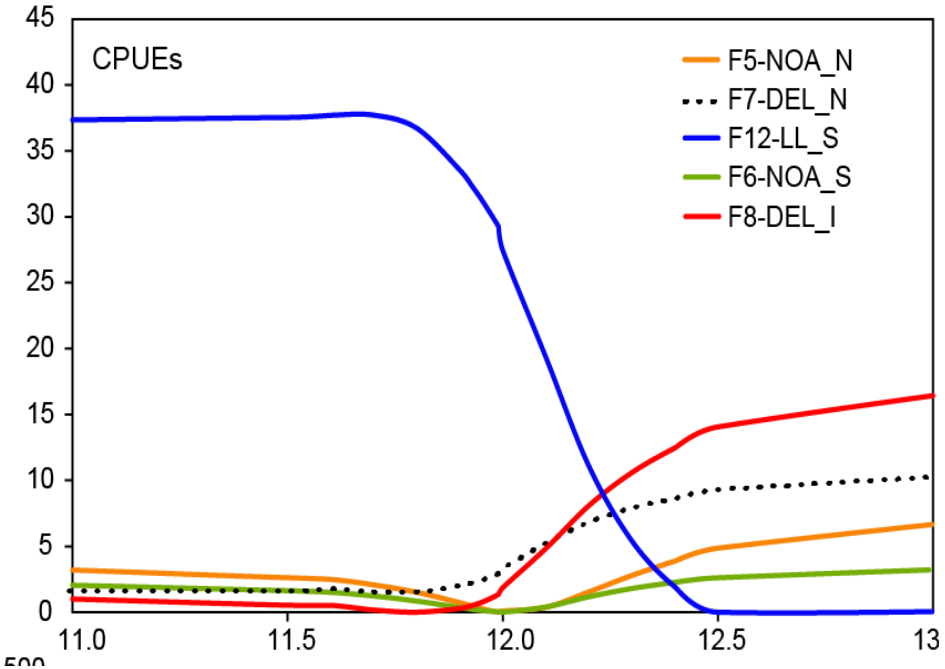


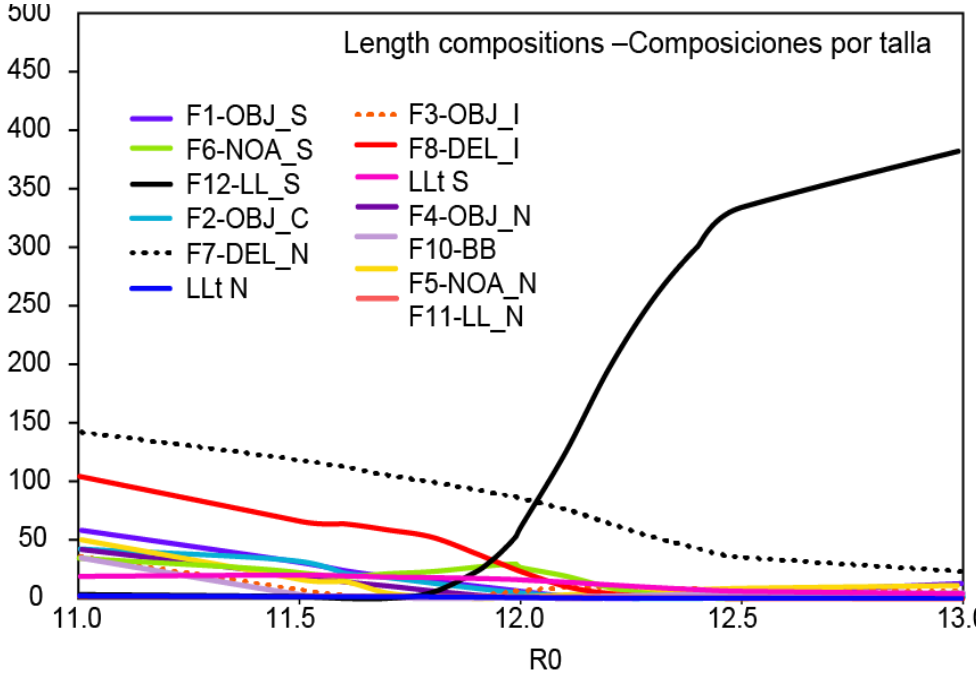
R0 profile - *perfil de R0*



R0

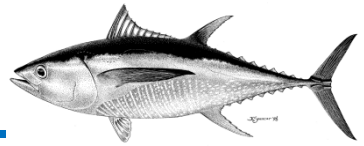
R0 profile - *perfil de R0*



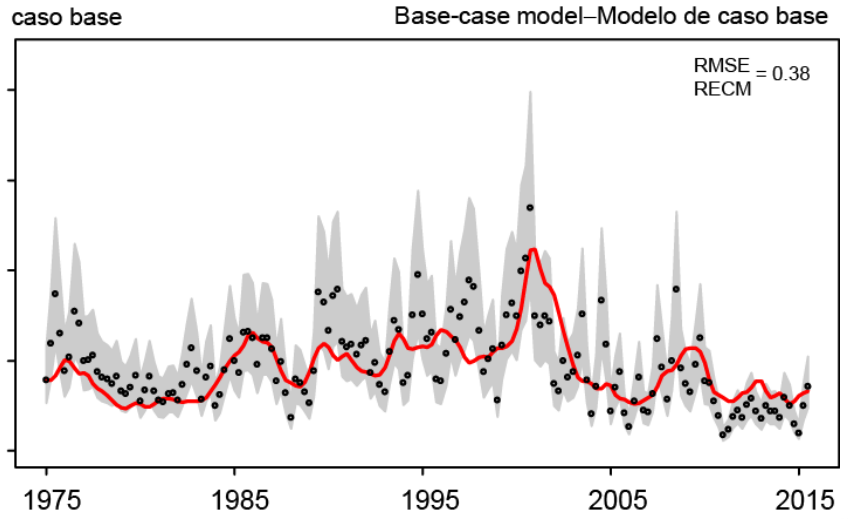


Age-structured production model
Modelo de producción con estructura por edades

Diagnostics

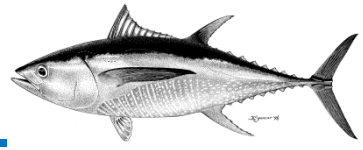


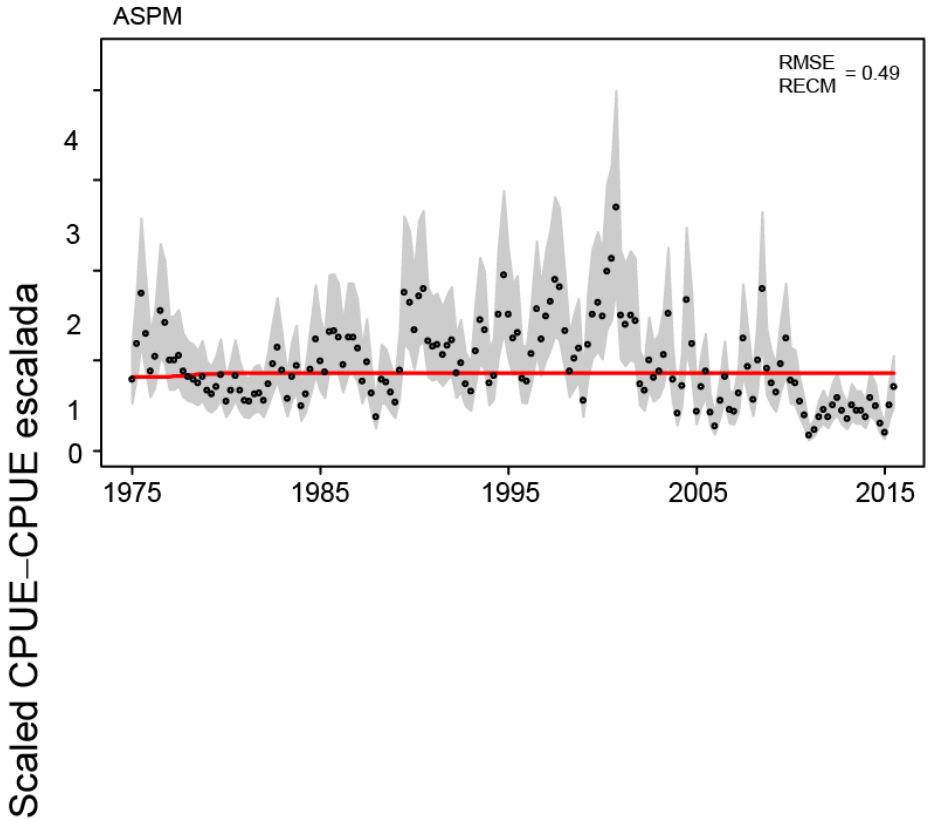
Scaled CPUE–CPUE escalada

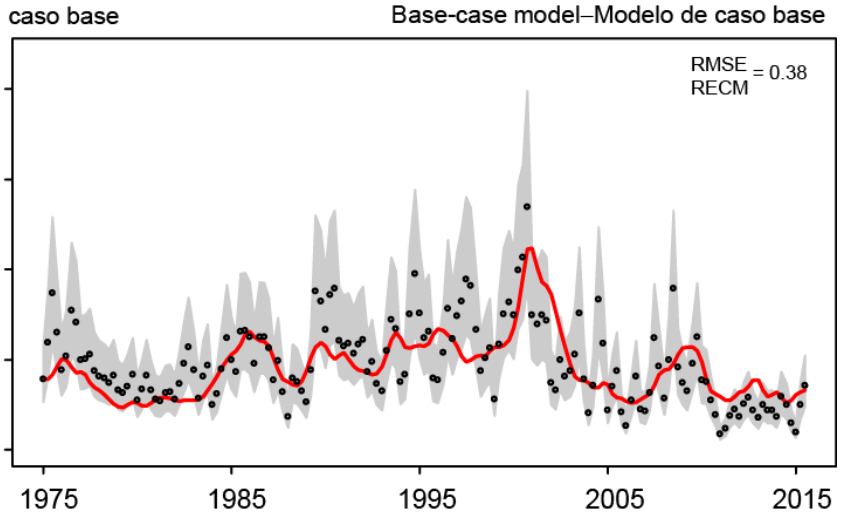


Age-structured production model
Modelo de producción con estructura por edades

Diagnostics

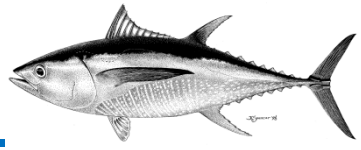




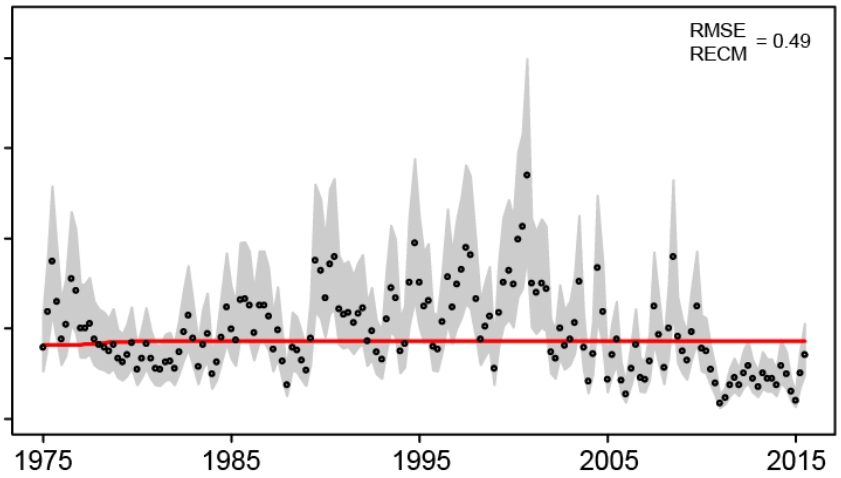


Age-structured production model
Modelo de producción con estructura por edades

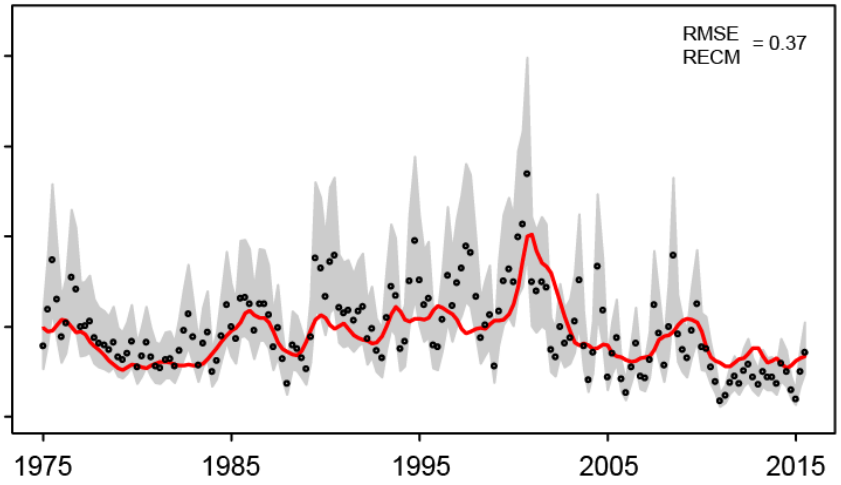
Diagnostics



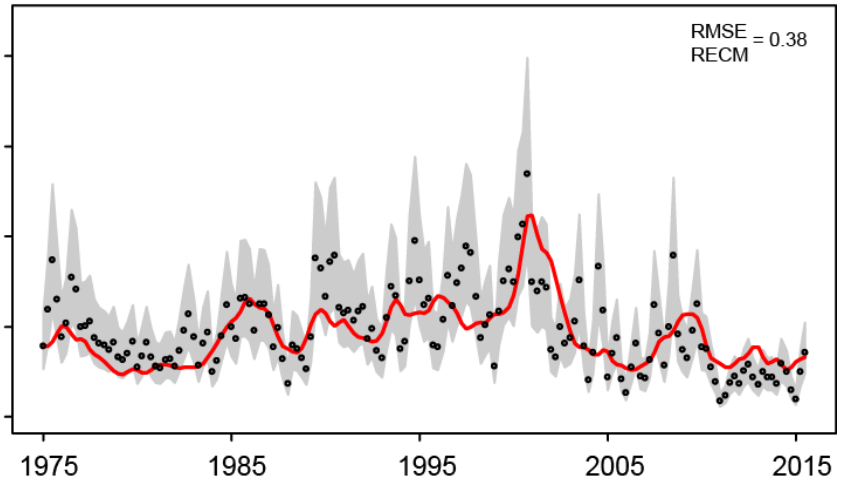
ASPM



ASPM with recruitment deviations set to the base-case model estimates
ASPM con desvíos de reclutamiento fijos a los valores estimados por el modelo de caso base



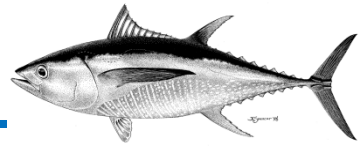
Base-case model–Modelo de caso base

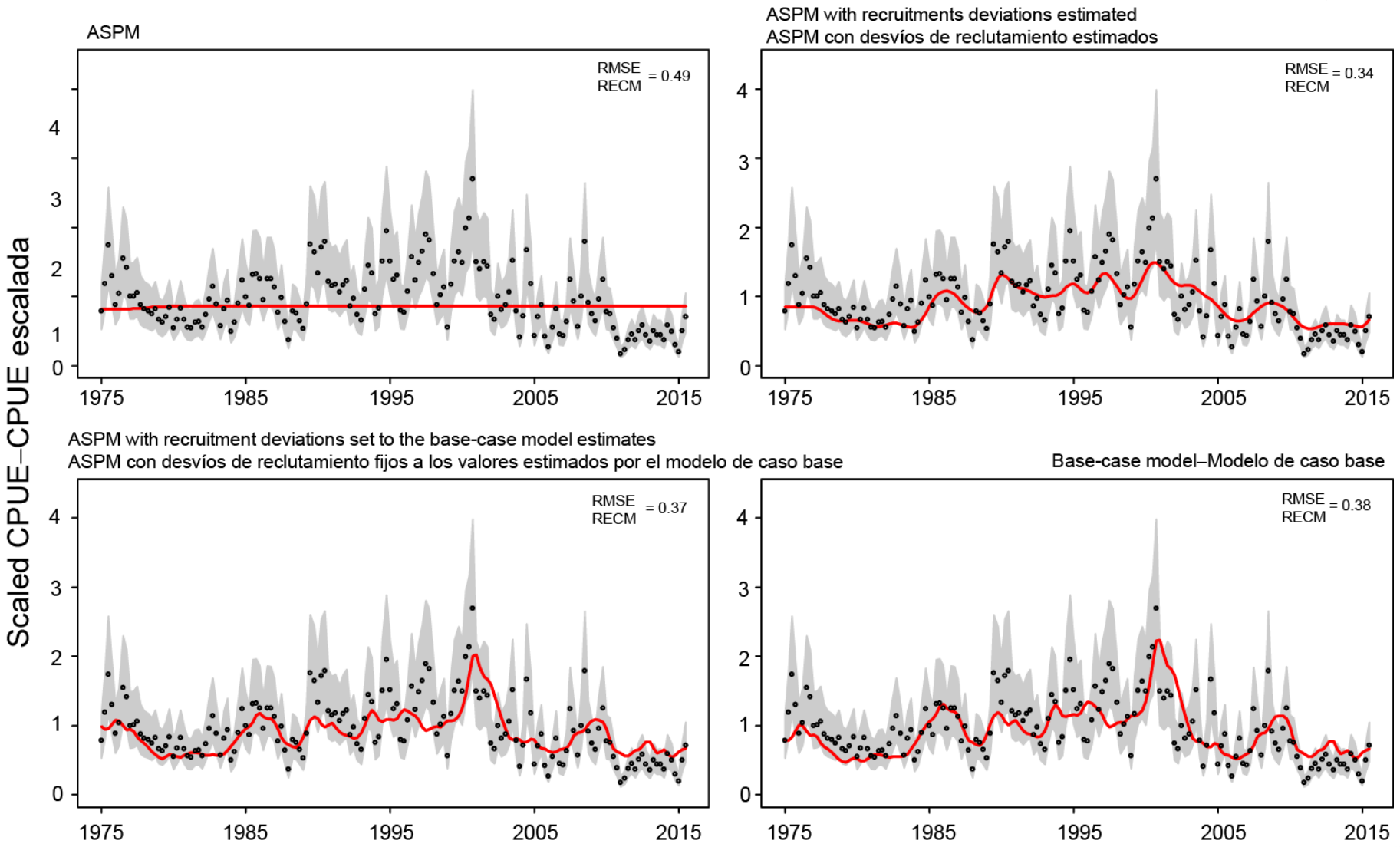


Scaled CPUE–CPUE escalada

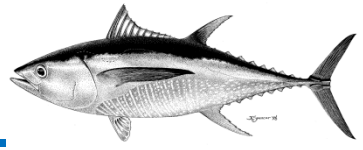
Age-structured production model
Modelo de producción con estructura por edades

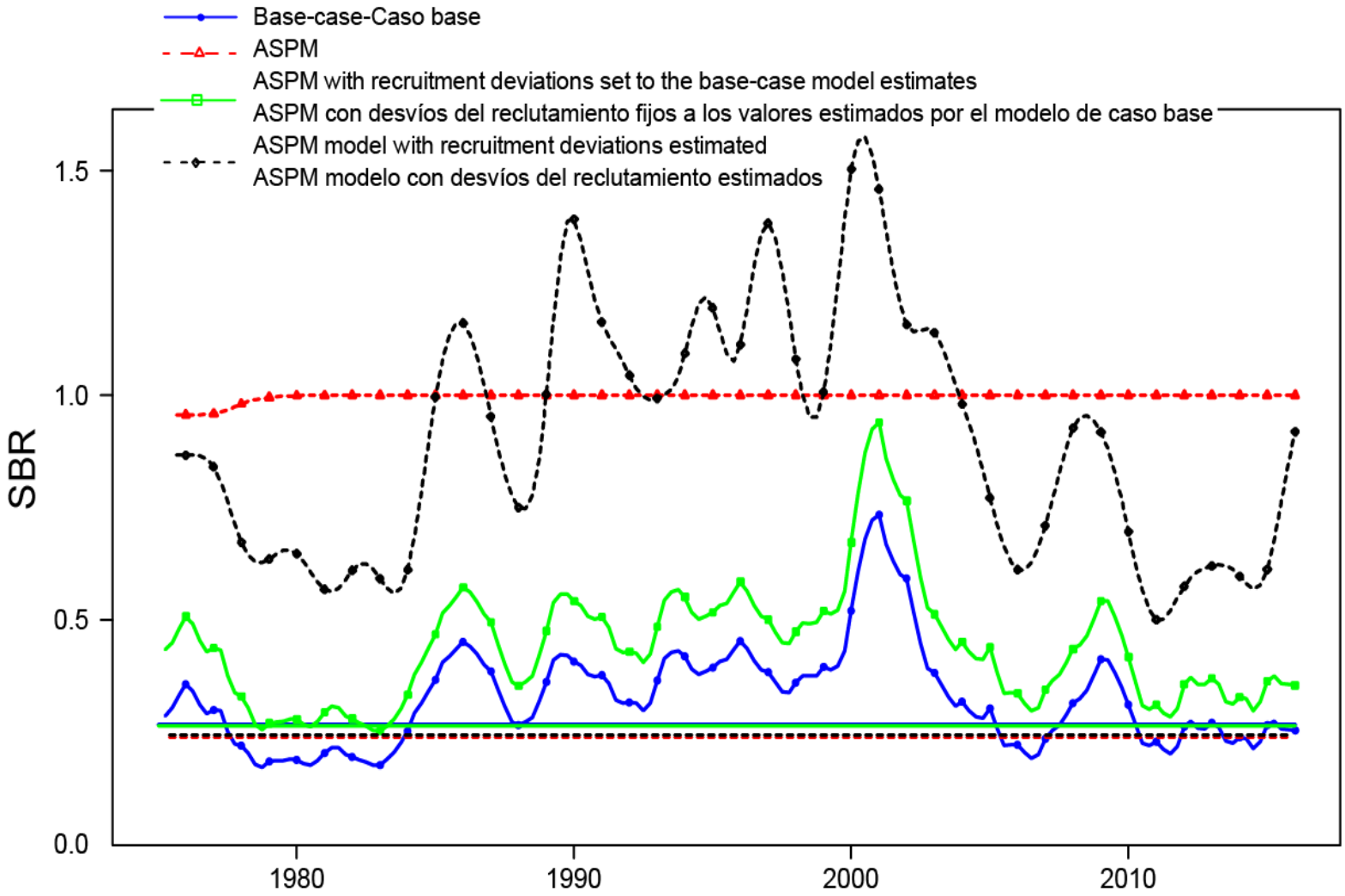
Diagnostics





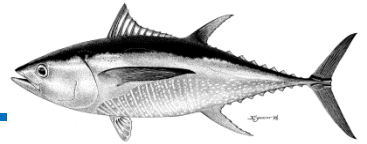
Age-structured production model
Modelo de producción con estructura por edades

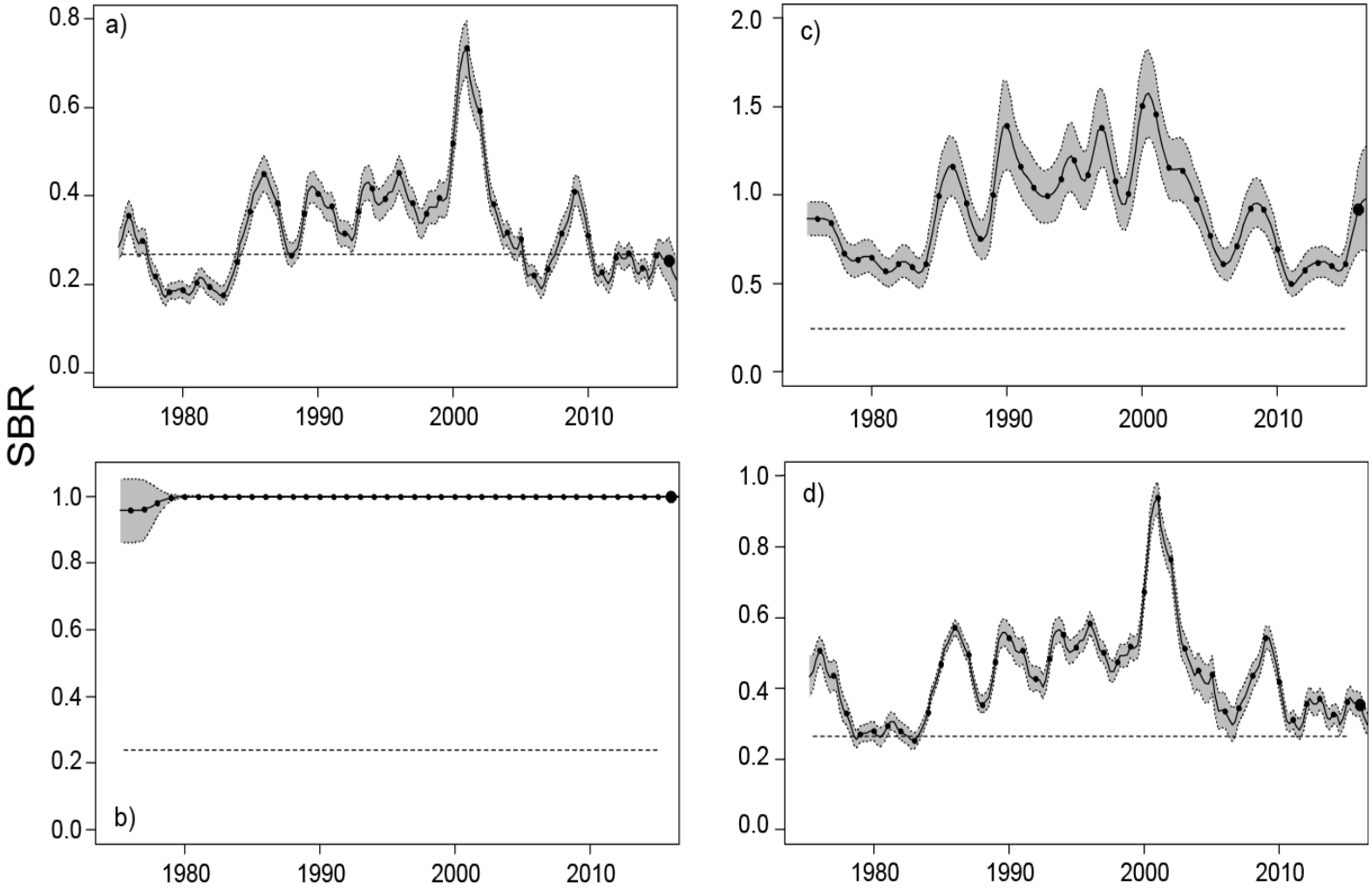




Age-structured production model

Modelo de producción con estructura por edades





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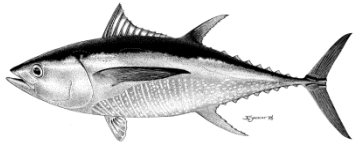
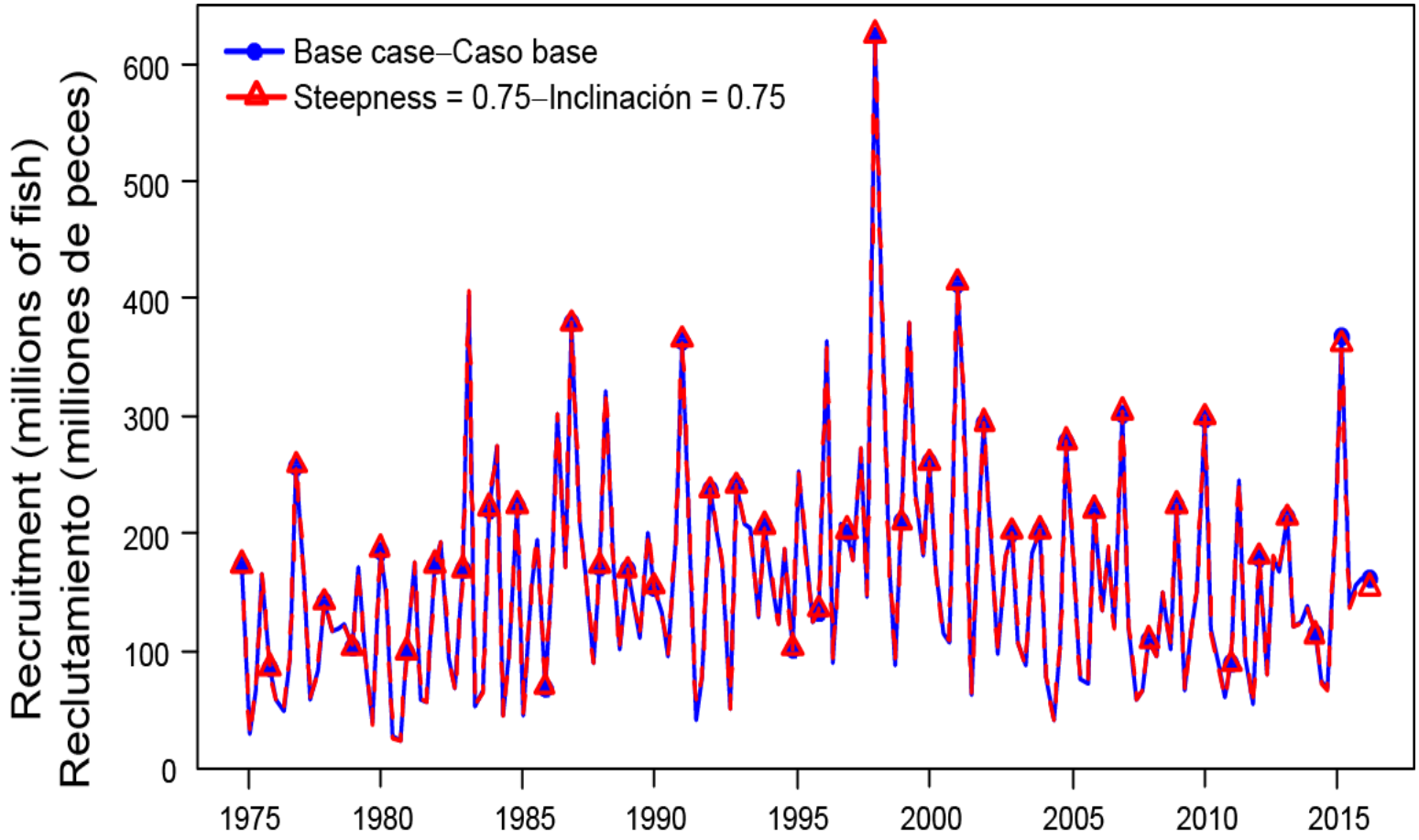
Sensitivity analyses –

Análisis de sensibilidad



- Steepness of SR relationship (Appendix B)
- Average size of oldest fish (L_2) (Appendix C)
- Main index of abundance (Appendix D)
- Weighting assigned to the size-composition data (Appendix E)

Steepness of SR relationship
Inclinación de la relación SR



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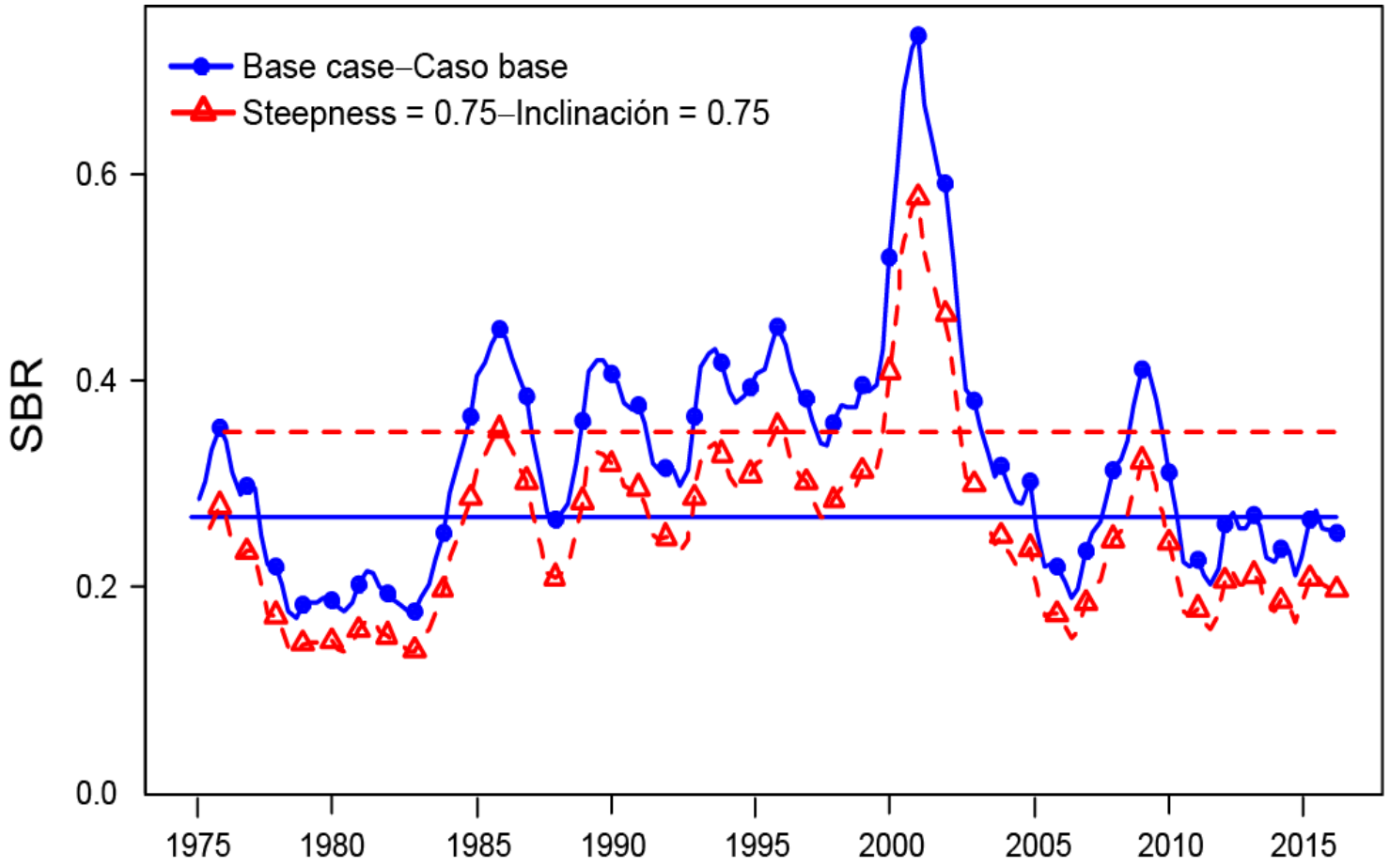
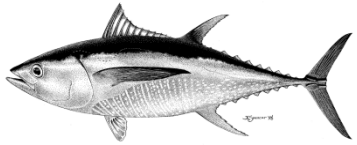


Sensitivity analyses –

Análisis de sensibilidad



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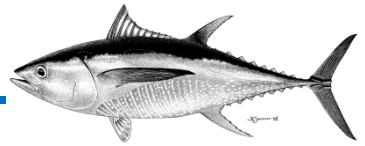
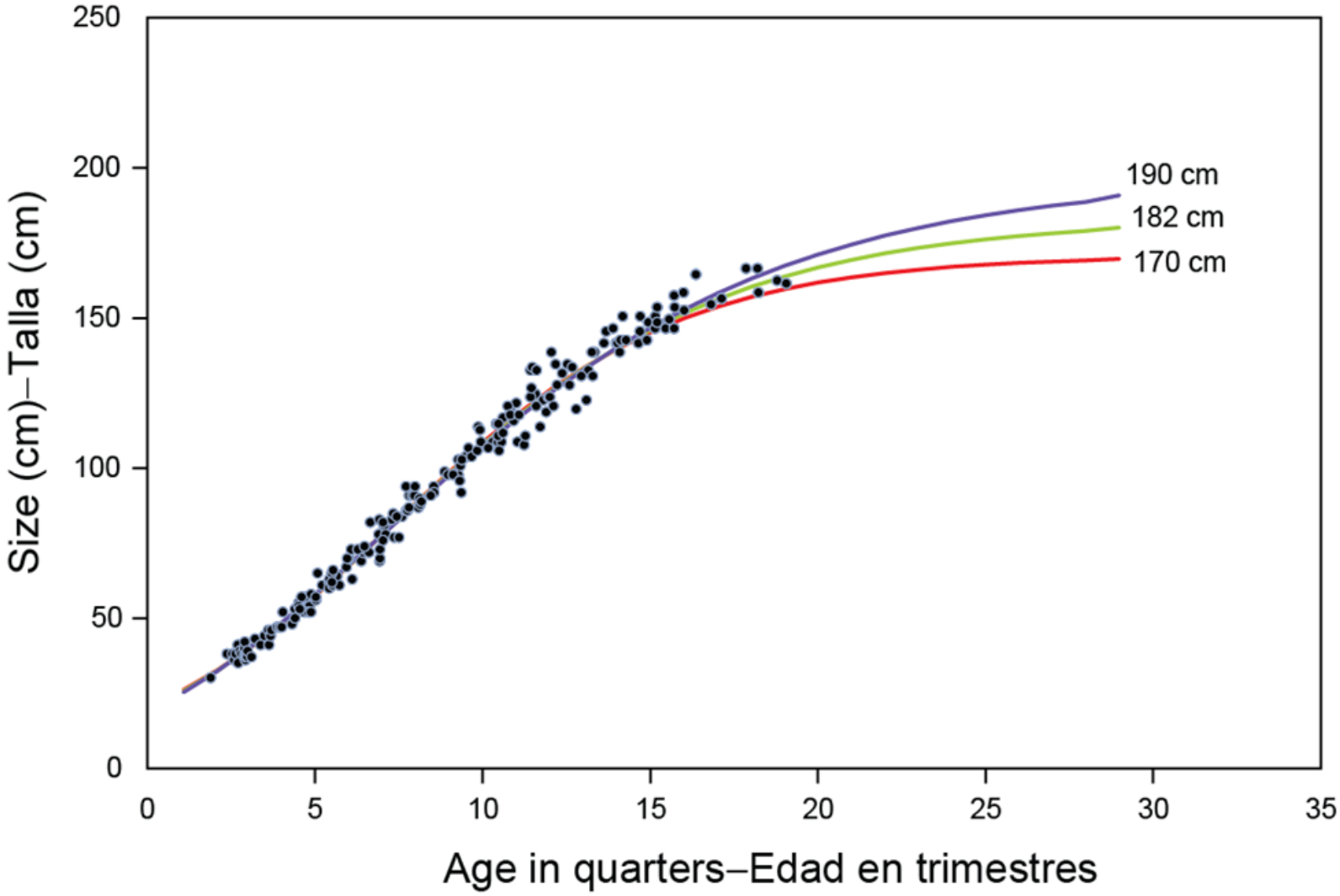
MSY and related quantities
RMS y cantidades relacionadas



YFT	Base case Caso base	h = 0.75
MSY-RMS	272,841	287,476
B_{MSY}- B_{RMS}	372,010	547,238
S_{MSY}- S_{RMS}	3,528	5,897
B_{MSY}/B_0- B_{RMS}/B_0	0.32	0.37
S_{MSY}/S_0- S_{RMS}/S_0	0.27	0.35
C_{recent}/MSY- C_{recent}/RMS	0.94	0.89
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96	0.64
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95	0.56
F multiplier- Multiplicador de F	1.02	0.65

Average size of oldest fish
Tamaño del pez más viejo



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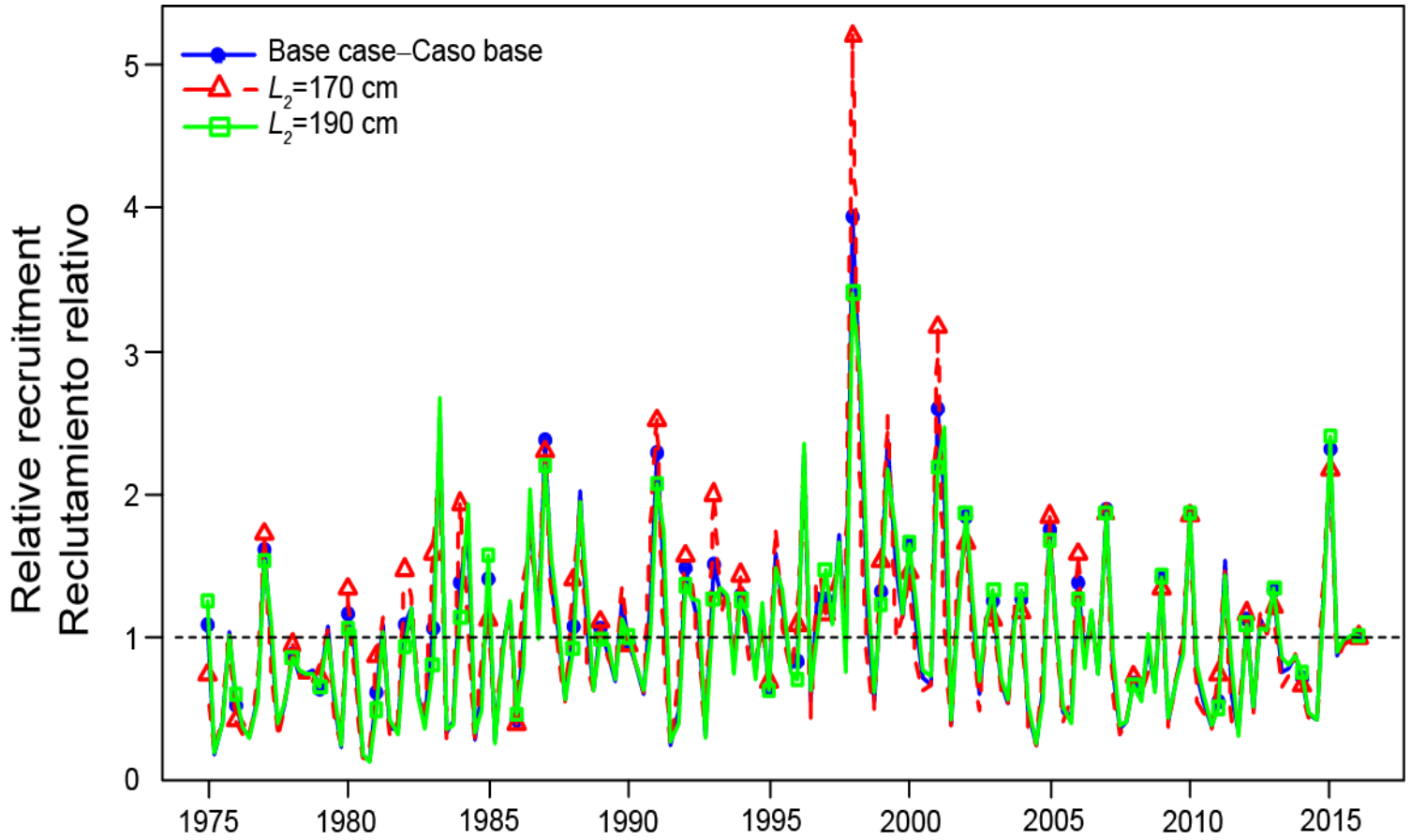

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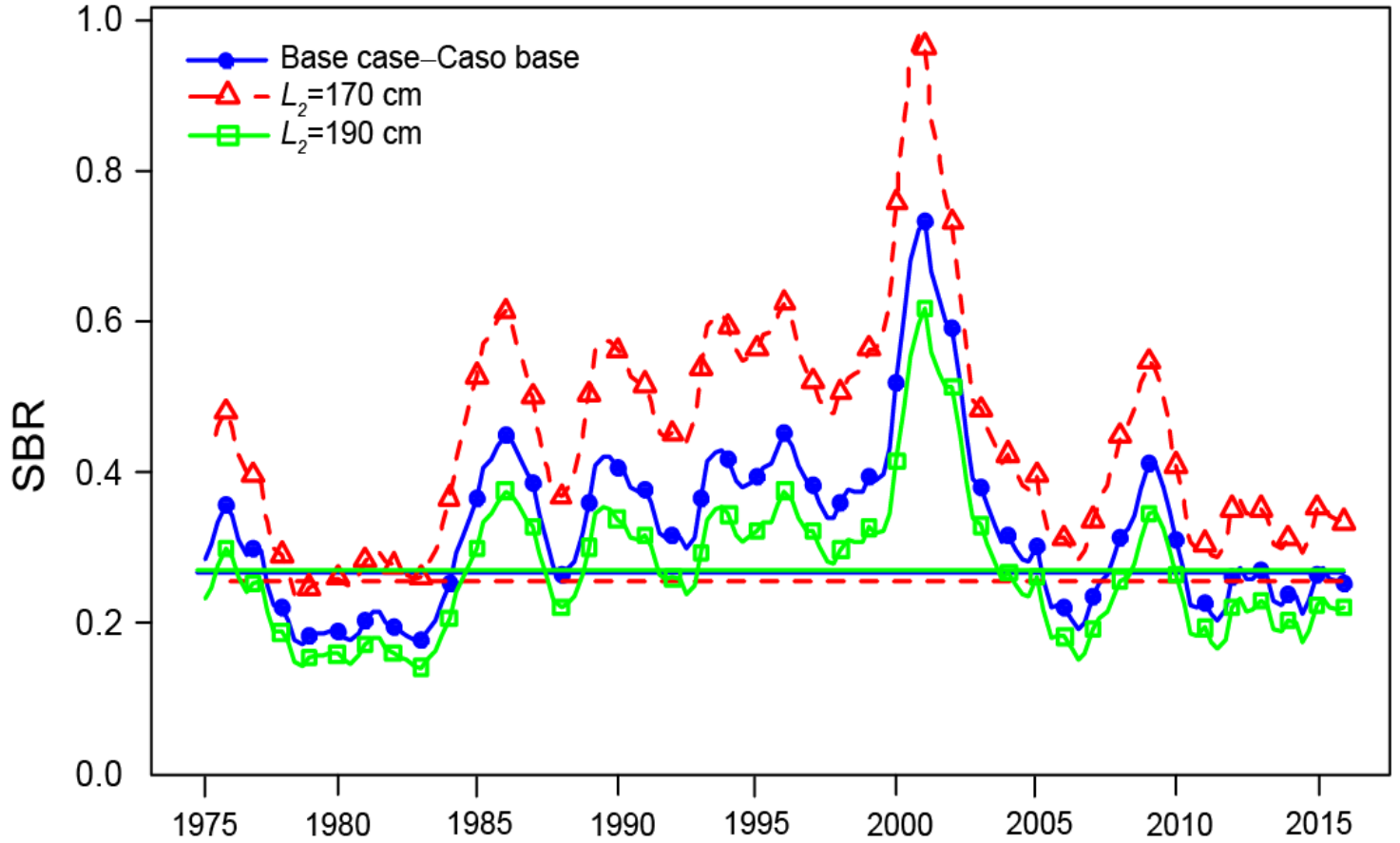

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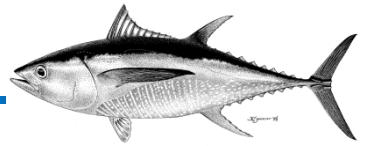
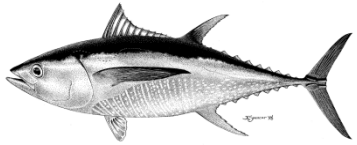


YFT	Base case Caso base	$h = 0.75$	$L_2 = 170$	$L_2 = 190$
MSY-RMS	272,841	287,476	288,672	272,782
B_{MSY}- B_{RMS}	372,010	547,238	395,744	374,461
S_{MSY}- S_{RMS}	3,528	5,897	4,152	3,627
B_{MSY}/B_0- B_{RMS}/B_0	0.32	0.37	0.32	0.33
S_{MSY}/S_0- S_{RMS}/S_0	0.27	0.35	0.26	0.28
C_{recent}/MSY- C_{recent}/RMS	0.94	0.89	0.89	0.94
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96	0.64	1.18	0.82
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95	0.56	1.3	0.74
F multiplier- Multiplicador de *F*	1.02	0.65	1.48	0.88



Sensitivity analyses –

Análisis de sensibilidad

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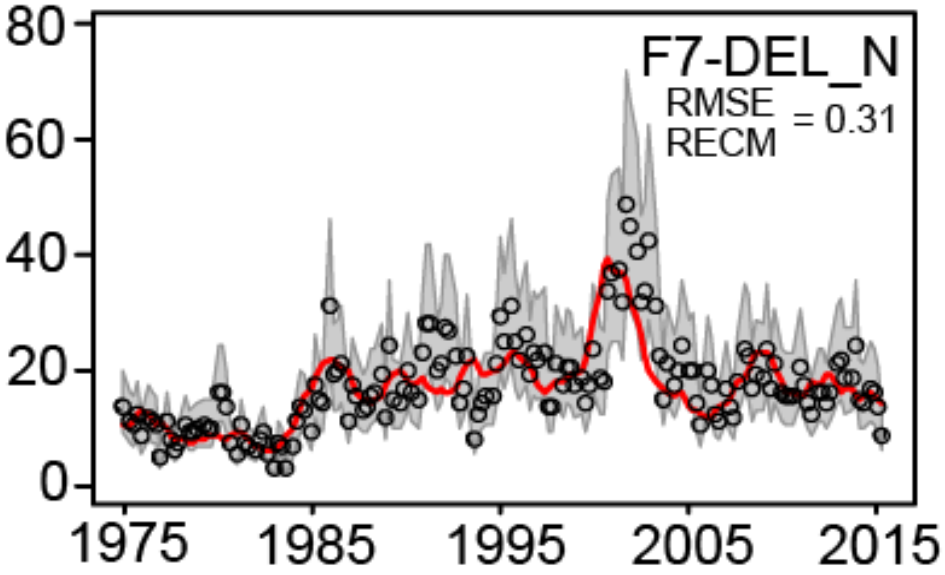
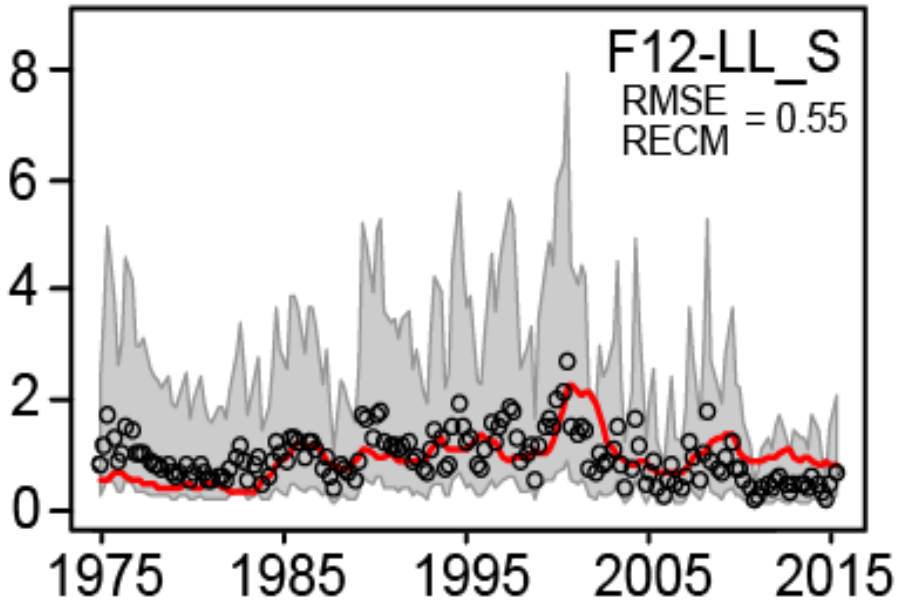
Main index of abundance
Índice principal de abundancia

Sensitivity analysis to fitting the CPUE of the northern dolphin-associated fishery as the main index of abundance

Análisis de sensibilidad al ajuste de la CPUE de la pesquería asociada a delfines del norte como índice principal de abundancia





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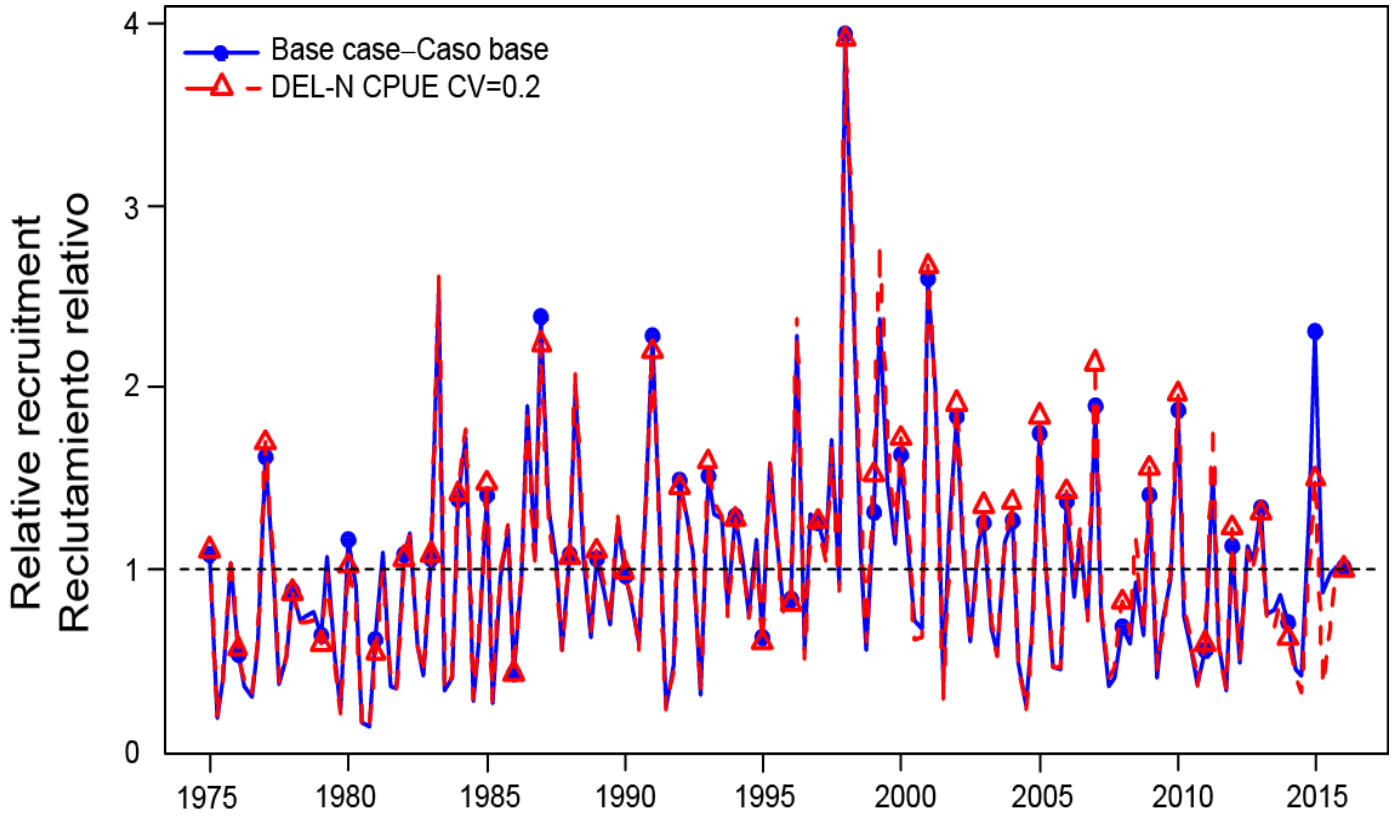

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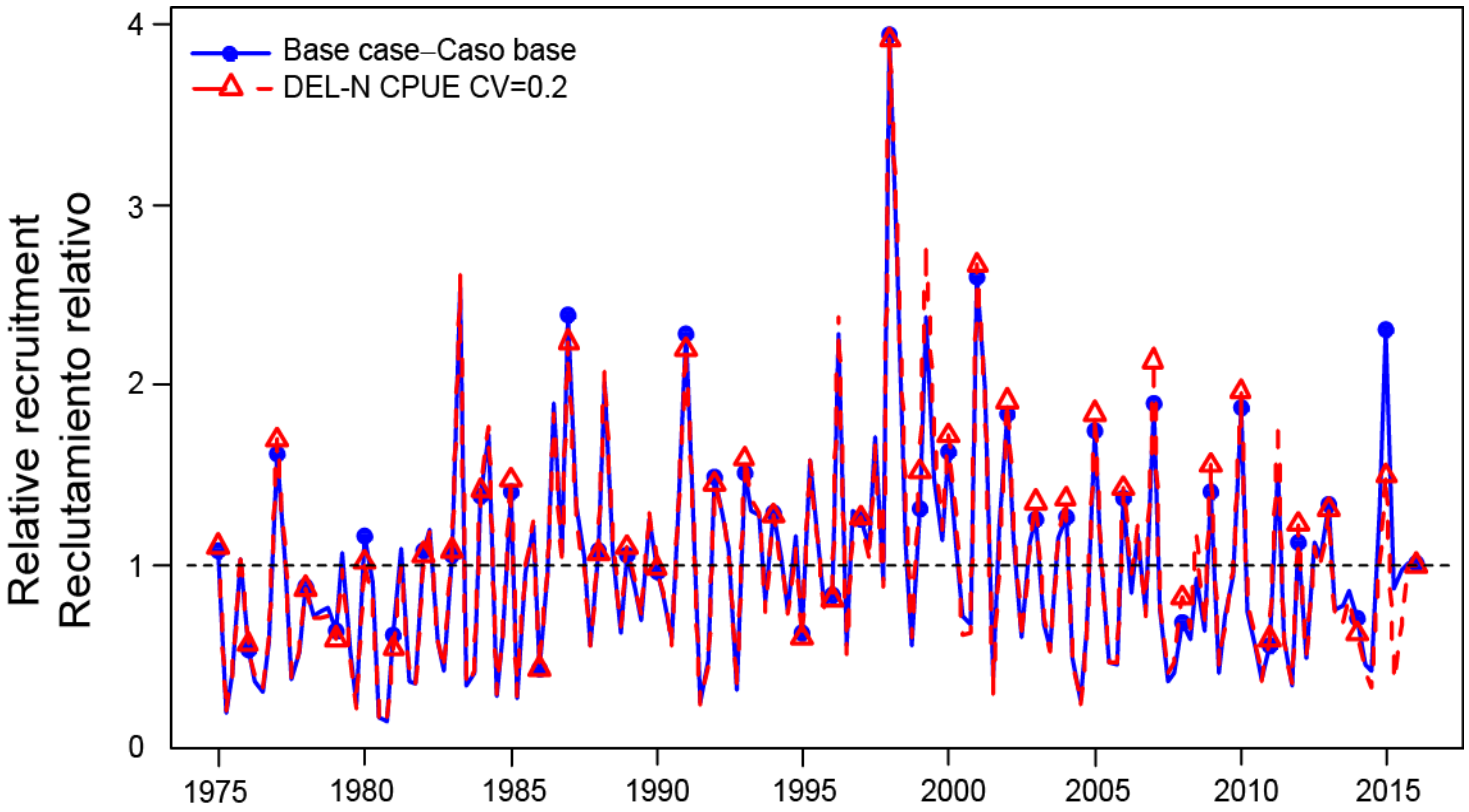

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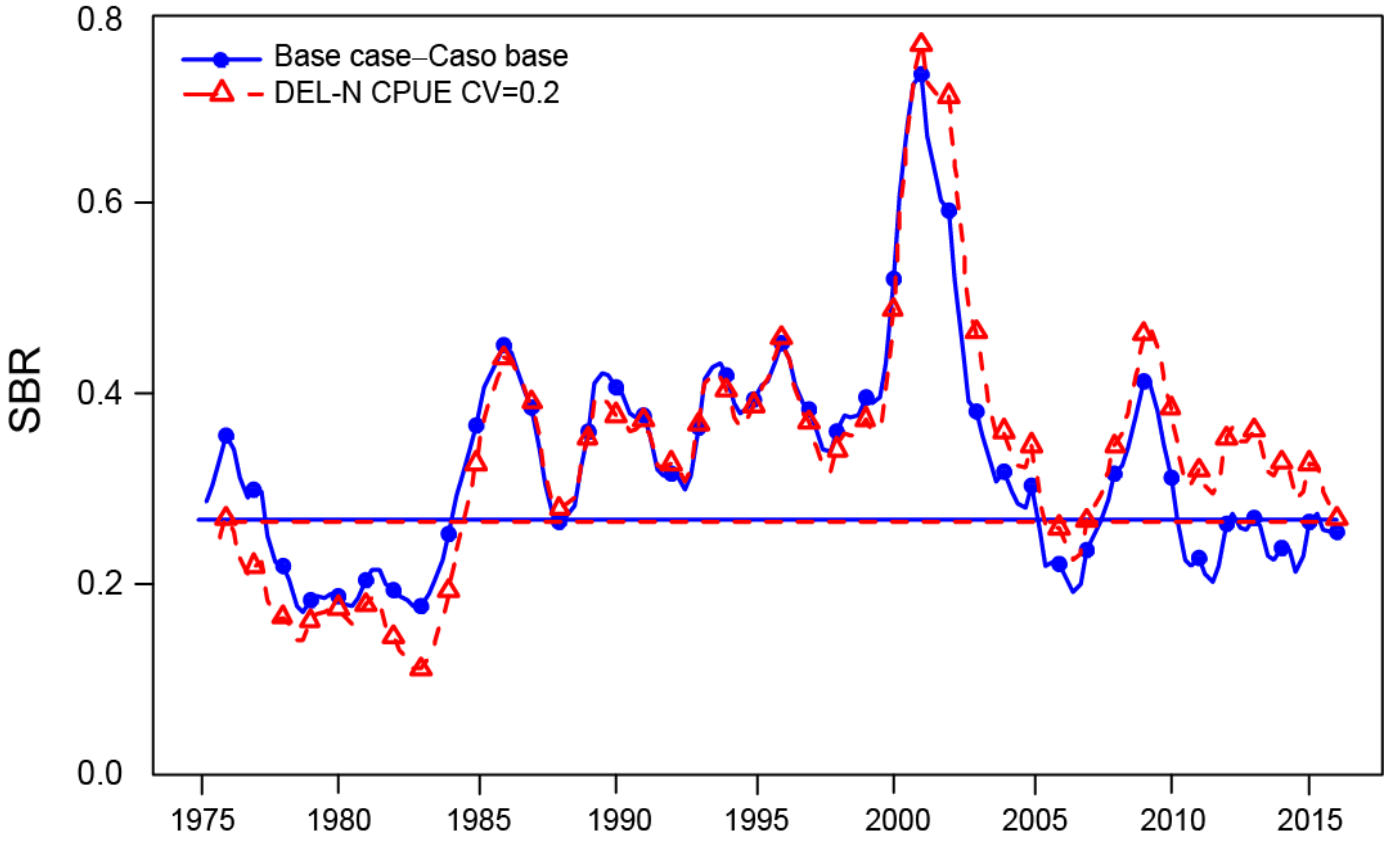
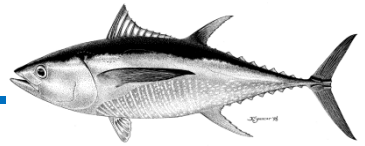


MSY and related quantities
RMS y cantidades relacionadas



YFT	Base case Caso base	$h = 0.75$	$L_2 = 170$	$L_2 = 190$	DEL-N
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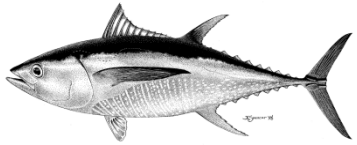
S_{MSY}/S_0- S_{RMS}/S_0	0.27	0.35	0.26	0.28	0.26
C_{recent}/MSY- C_{recent}/RMS	0.94	0.89	0.89	0.94	1.00
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96	0.64	1.18	0.82	0.88
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95	0.56	1.3	0.74	1.02
F multiplier- Multiplicador de *F*	1.02	0.65	1.48	0.88	1.21

Sensitivity analyses –

Análisis de sensibilidad



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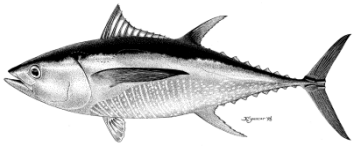
Length composition data weighting
Ponderación de datos de composición de tallas



Sensitivity analysis to data weighting

Análisis de sensibilidad a la ponderación de los datos

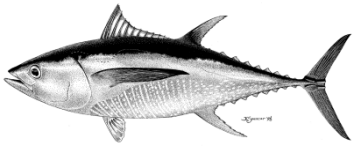
- Since the length-composition data are assumed to follow a multinomial distribution in Stock Synthesis, their weights are a function of the sample sizes
- The sample sizes for the length-composition data were computed after the initial run of the base case assessment was completed
- The new sample sizes are equal to the input sample sizes and a multiplicative weighting factor (lambda, λ)
- Two methods were used to compute λ: the “Francis” method (equation TA1.8 in Francis (2011)), and the “harmonic mean” method, which is the ratio of the harmonic mean of the effective sample size to the arithmetical mean of the input sample si

Length composition data weighting

Ponderación de datos de composición de tallas

Fleet - Flota	Mean input sample size - *Tamaño inicial de muestra médio*	Harmonic mean effective sample size - *Média harmónica del tamaño de muestra effectivo*	**Harmonic mean method - *Método de la média harmónica*** HarMean(effN)/meanN	**Francis method - Método de Francis** Francis weights	CI Francis - *Intervalo de confianza*
F1-OBJ_S	14.9	12.2	0.8	0.5	0.37-0.63
F2-OBJ_C	14.7	6.2	0.4	0.3	0.19-0.43
F3-OBJ_I	12.9	5.4	0.4	0.2	0.10-0.30
F4-OBJ_N	10.7	5.7	0.5	0.3	0.16-0.70
F5-NOA_N	22.5	16.2	0.7	0.2	0.15-0.24
F6-NOA_S	19.8	3.3	0.2	0.1	0.10-0.18
F7-DEL_N	31.9	59.8	1.9	0.3	0.21-0.34
F8-DEL_I	29.8	49.1	1.6	0.3	0.26-0.41
F9-DEL_S	8.4	6.7	0.8	0.3	0.18-0.42
F10-BB	12.5	16.7	1.3	0.3	0.18-0.41
F11-LL_N	2.4	5.9	2.5	1.1	0.56-6.22
F12-LL_S	31.9	55.0	1.7	0.3	0.25-0.46
		Average -Média	1.08	0.34	
		Min	0.17	0.12	
		Max	2.5	1.1	
S3-LLt_N_Length	1.8	3.4	1.9	1.5	0.92-2.77
S4-LLt_S_Length	11.1	12.9	1.2	0.3	0.20-0.63

Length composition data weighting
Ponderación de datos de composición de tallas



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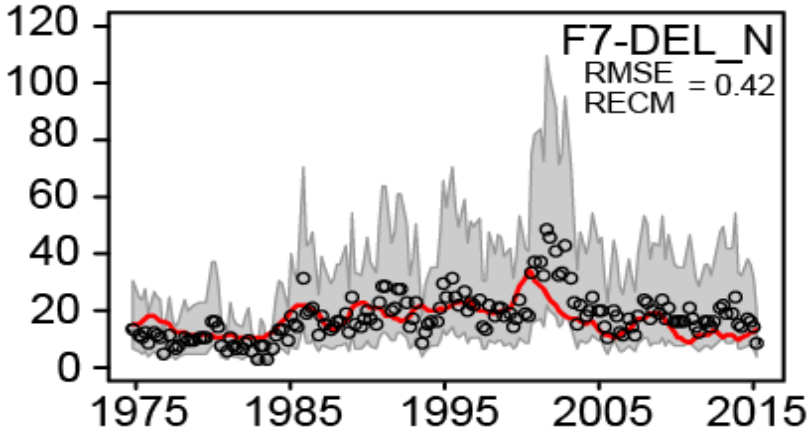

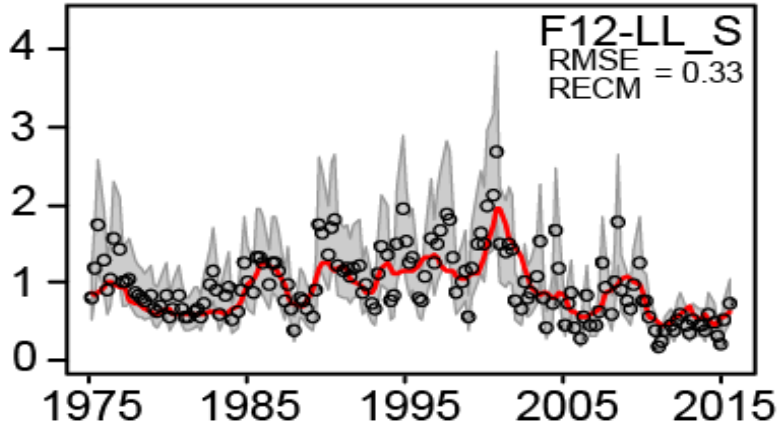

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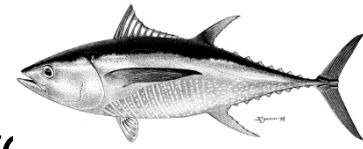

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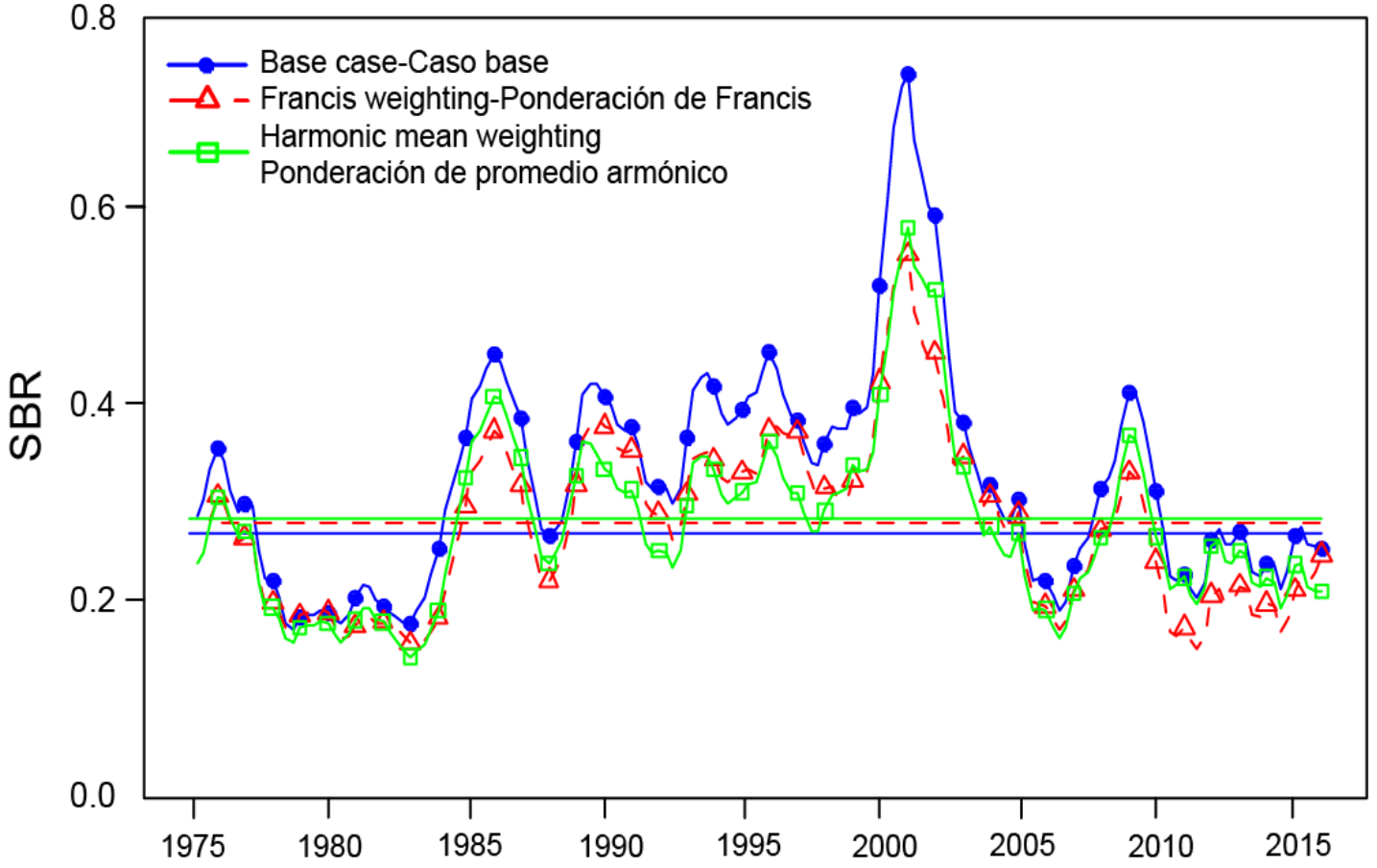

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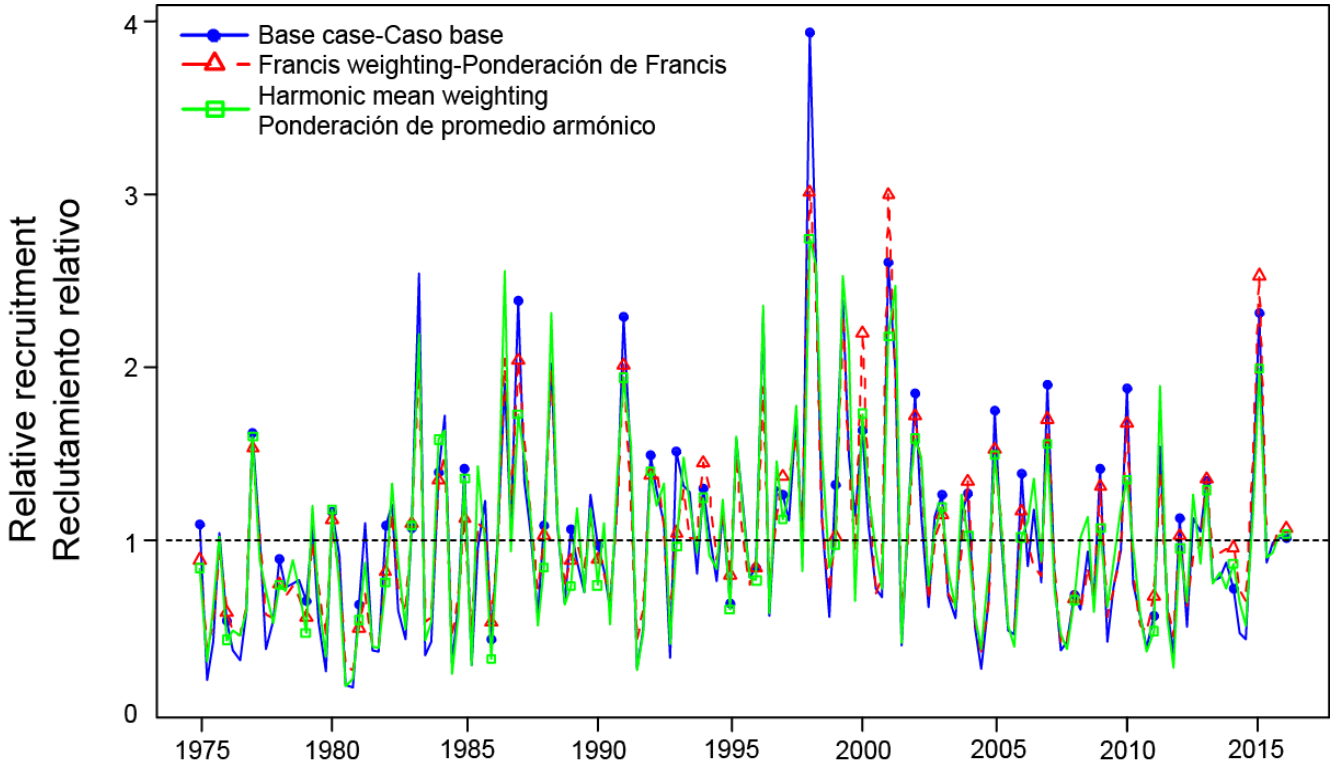

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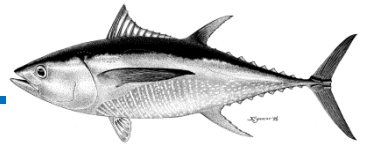

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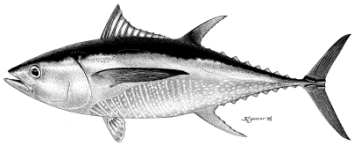
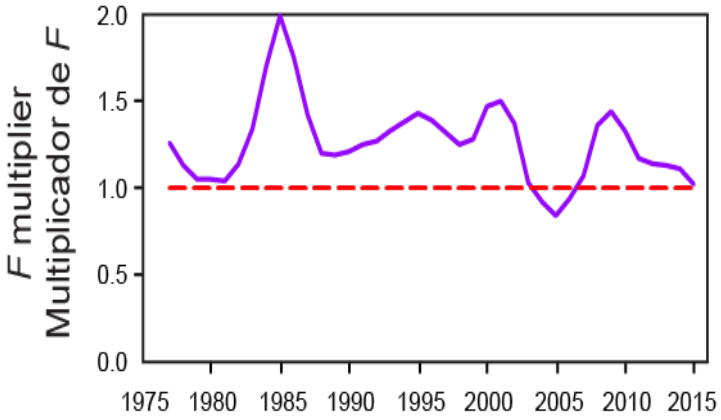
C_{recent}/MSY- C_{recent}/RMS	0.94	0.89	0.89	0.94	1.00	0.88	0.94
B_{recent}/B_{MSY}- B_{recent}/B_{RMS}	0.96	0.64	1.18	0.82	0.88	0.98	0.82
S_{recent}/S_{MSY}- S_{recent}/S_{RMS}	0.95	0.56	1.3	0.74	1.02	0.88	0.74
F multiplier- Multiplicador de *F*	1.02	0.65	1.48	0.88	1.21	0.88	0.88

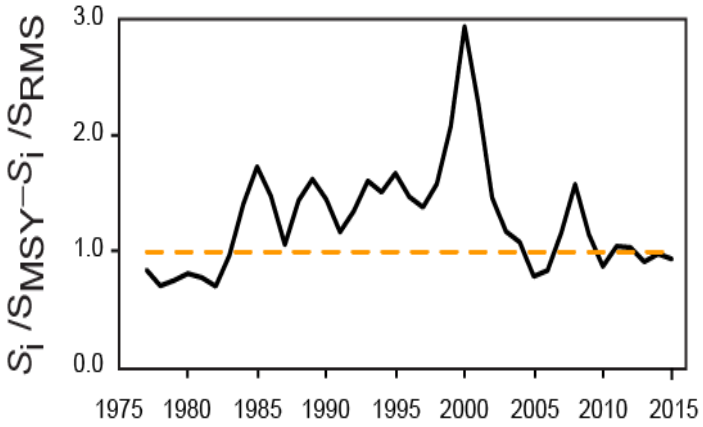
Summary: key points
Resumen: puntos clave



- The recent **fishing mortality** rates are estimated to be slightly below those corresponding to the MSY, so Fmultiplier > 1
- $F_{recent} < F_{MSY}$

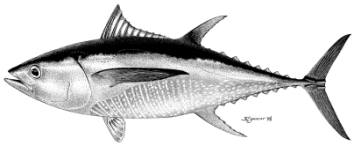


- The recent levels of **spawning biomass** are estimated to be below at those corresponding to the MSY
- ($S_{recent} < S_{MSY}$)

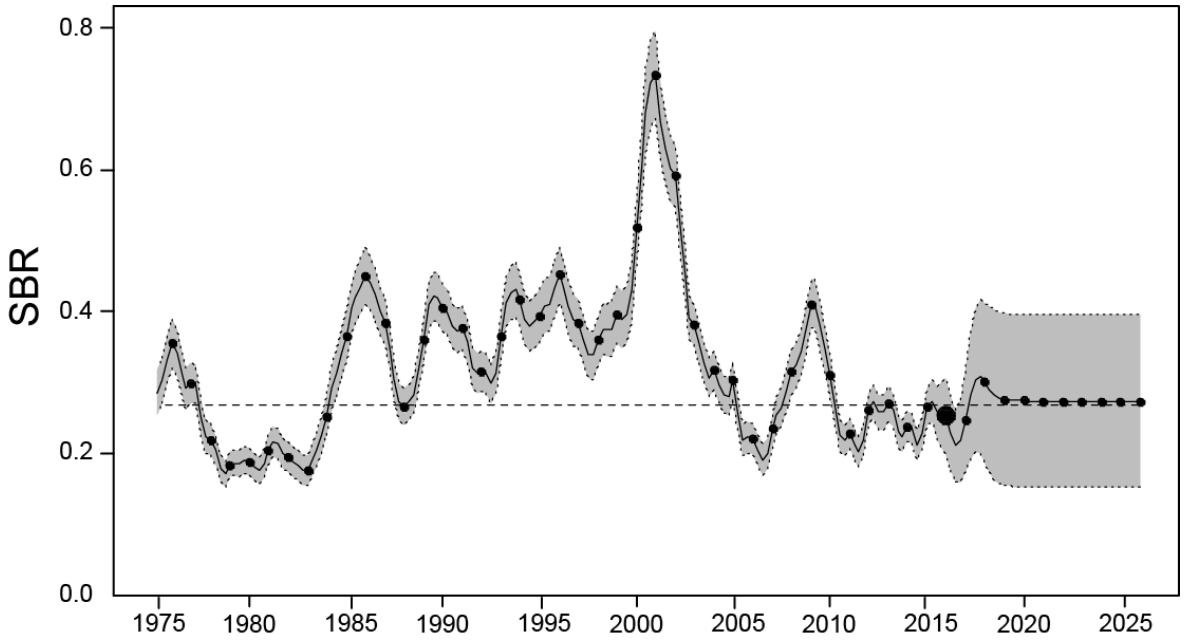


Summary: key points

Resumen: puntos clave

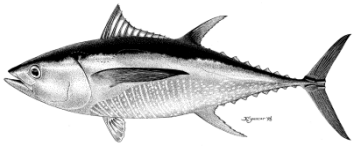


- There have been two, and possibly three, different productivity regimes since 1975, and the levels of maximum sustainable yield (MSY) and the biomasses corresponding to the MSY may differ among the regimes. The population may have switched in the last ten years from a high to an intermediate productivity regime.
- The spawning biomass ratio (SBR) has been below average since 2006, with the exception of 2008-2010, which resulted from a high recruitment in 2006.
- At current fishing mortality levels, and average recruitment, SBR is predicted to stabilize slightly above SBR at MSY

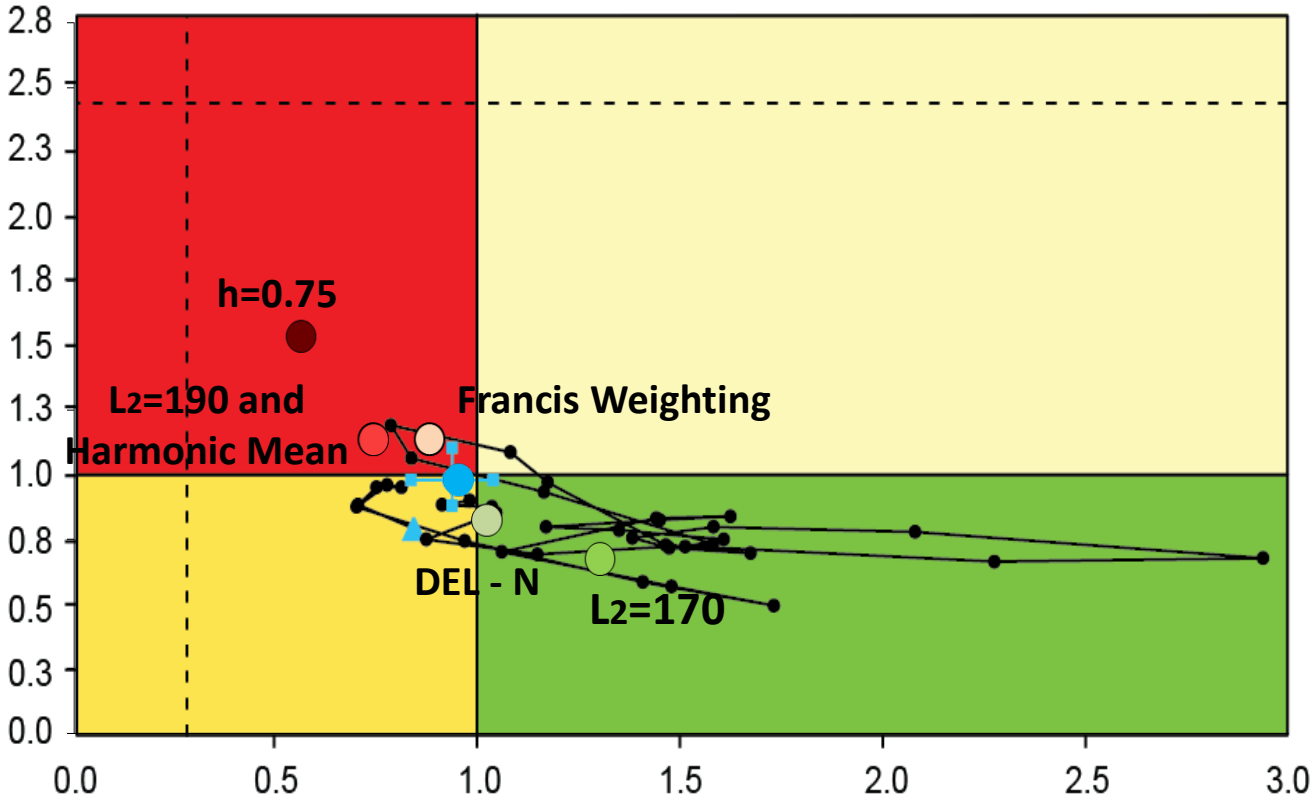


Kobe plots – *Gráfica de Kobe*

Summary Sensitivities



Sensitivity analyses – *Análisis de sensibilidad*



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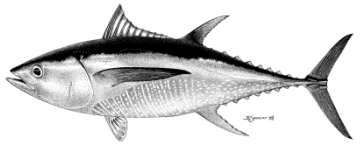
Plausible Sensitivities and Uncertainties
Sensibilidades e incertidumbres plausibles



Lessons from this assessments and previous research

- Results are more **pessimistic** with:
  - The inclusion of a stock-recruitment relationship
  - Higher values of the average size of the oldest fish (L_2 > 182 cm)
  - Lower rates of adult natural mortality (M)
  - Reweigthing of the size-composition data

- Results are more **optimistic** with:
  - Lower values of the average size of the oldest fish (L_2 < 182 cm)
  - Higher rates of adult natural mortality (M)
  - Fitting to CPUE DEL-N as main index of abundance (S_{recent}>S_{MSY})

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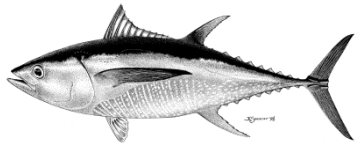
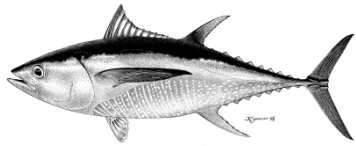
Future directions: priorities in research
Direcciones futuras: prioridades en investigación



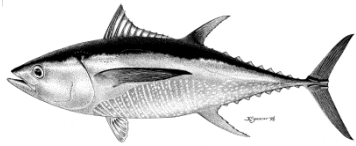
- Implementation of a large-scale tagging program to address hypotheses about stock structure and regional differences in life-history parameters and depletion.
- Improved estimates of growth, particularly for older fish.
- Fine-tuning of the weights of the different data sets that are fitted to the assessment model.
- Refinement of fisheries definitions within the assessment model.

Future directions: priorities in future research for improving the yellowfin stock assessment:



- Implementation of time-variant selectivity, mainly for the purse-seine fisheries on floating objects.
- Exploration of alternative assumptions about stock structure within the assessment model.
- Analysis of changes in spatial distribution of effort for the Southern longline fishery, and whether they invalidate the use of the CPUE of this fishery as the main abundance index in the assessment model.

Future directions: Refinements to the assessment model and methods



The following improvements will be explored in future assessments:

- Determine appropriate weighting for the different data sets;
- Refine the fisheries definitions;.
- Explore alternative assumptions on stock structure (spatial analysis);
- Implement time-variant selectivity for the purse-seine fisheries on floating objects.

Thank you - *Gracias*