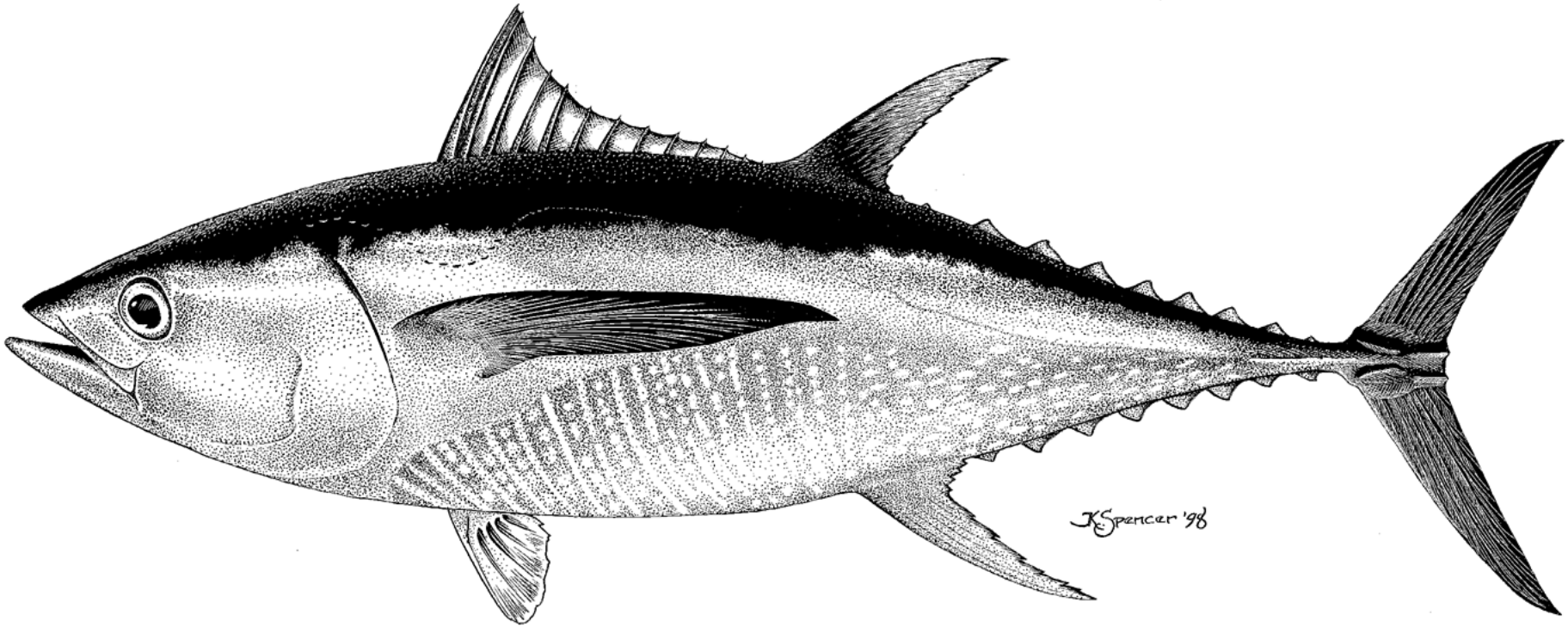
Yellowfin Tuna 1975-2005



Major Changes

- Catch, effort, and length-frequency data for the surface fisheries have been updated to include new data for 2005 and revised data for 1975-2004.
- Catch data for the Japanese longline fisheries have been updated for 2000-2003 and to include new data for 2004.
- Catch data for the longline fisheries of Chinese Taipei have been updated for 2002 and new data added for 2003.
- Catch data fore the longline fisheries of Korea have been updated to include new data for 2003
- Catch data for the longline fisheries of the Peoples Republic of China have been updated to include new data for 2003 and 2004.
- Longline catch-at-length data for 2002-2003 have been updated and new data for 2004 added.
- Longline catch per unit effort data have been standardized using a delta-lognormal model, updated to include 2004 data.
- Growth model has been changed to fix length-at-age at the prior distribution of a Richards growth curve based on otolith data

Sensitivity Analyses

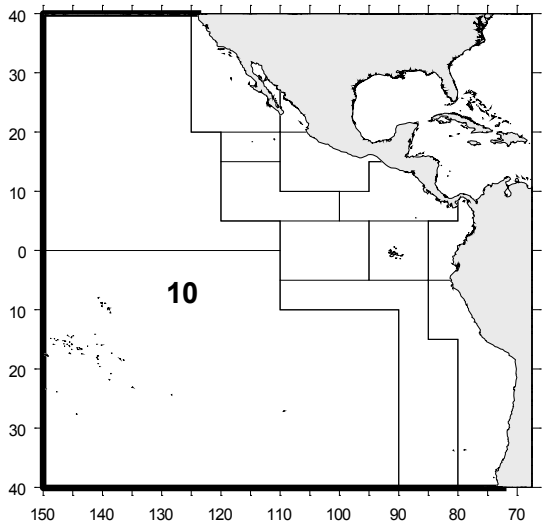
- Stock recruitment relationship
- Asymptotic length

Data

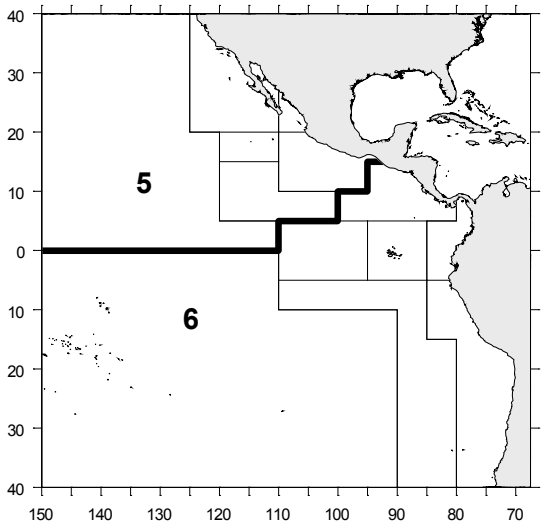
- Fishery definitions
- Catch
- Effort
- Length frequency

Yellowfin Fishery Definitions

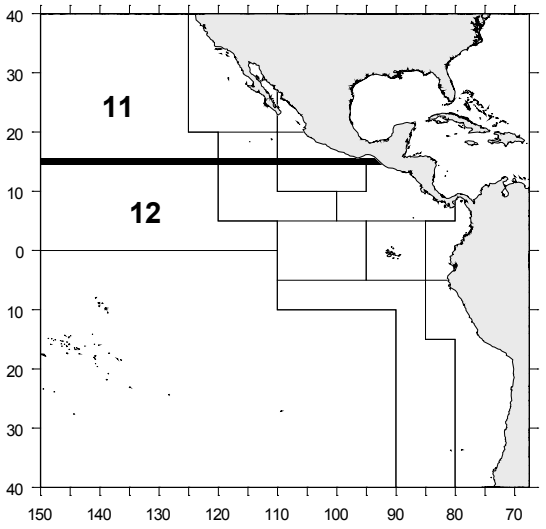
Baitboat



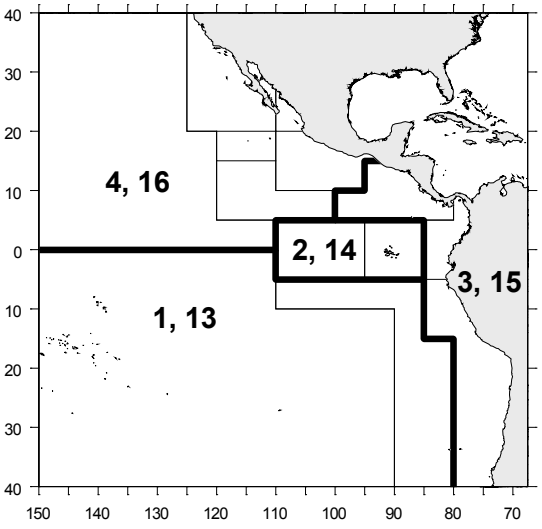
Unassociated



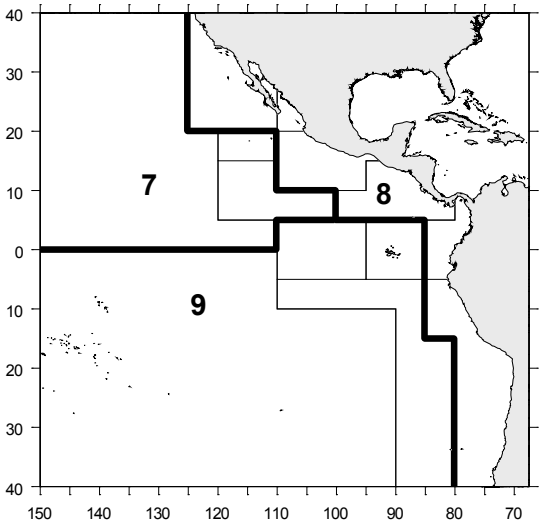
Longline



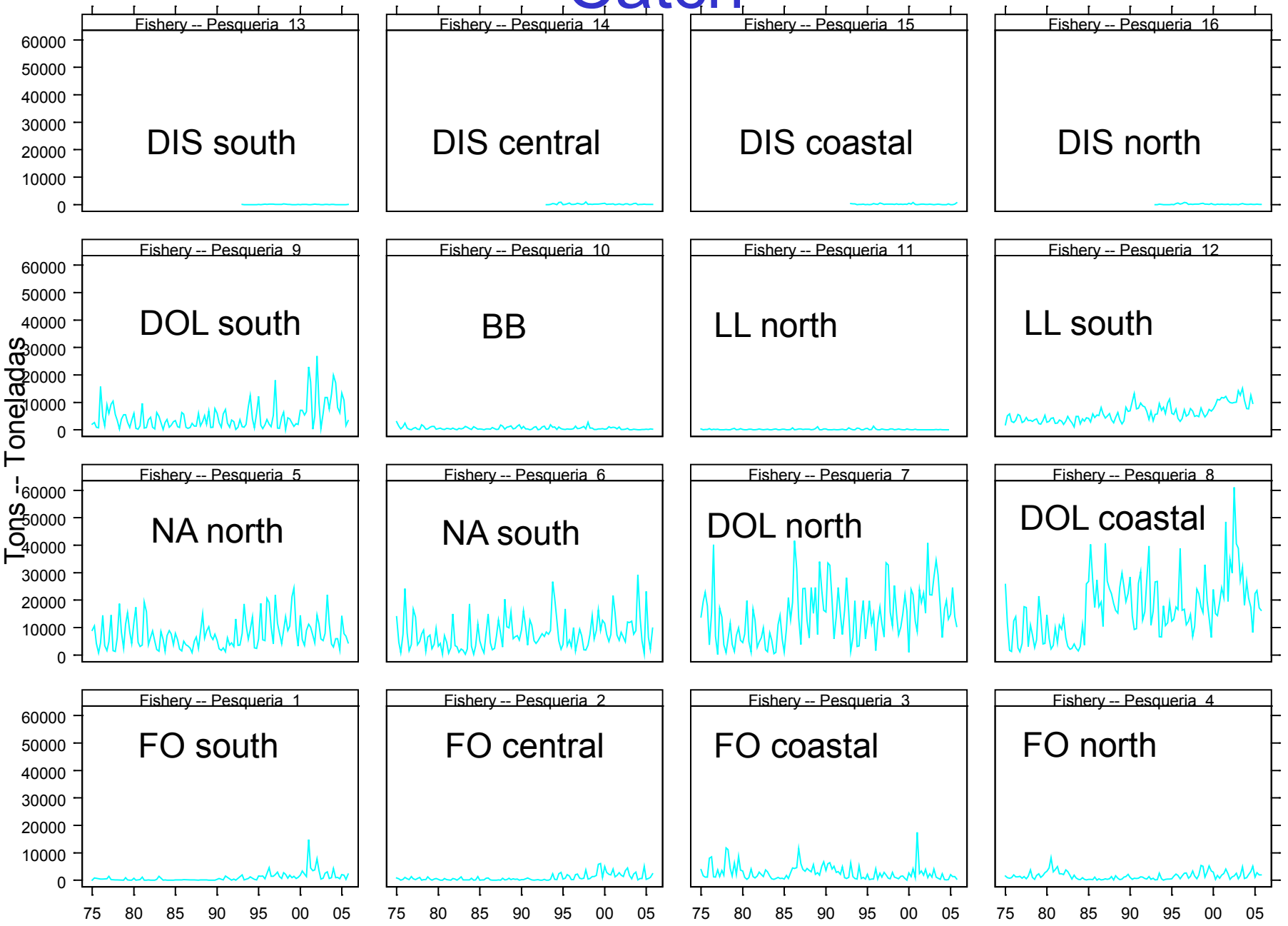
Floating Objects



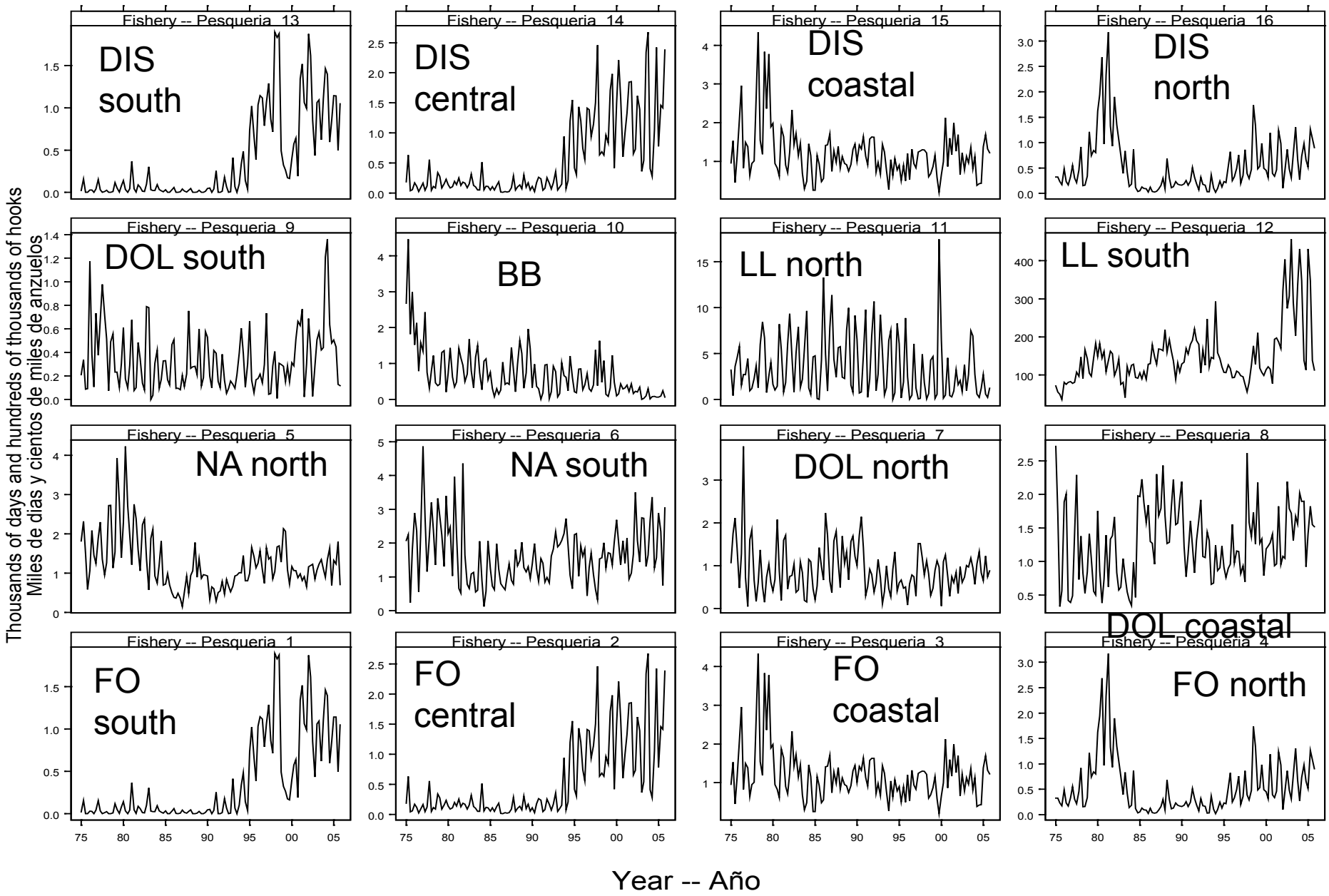
Dolphin



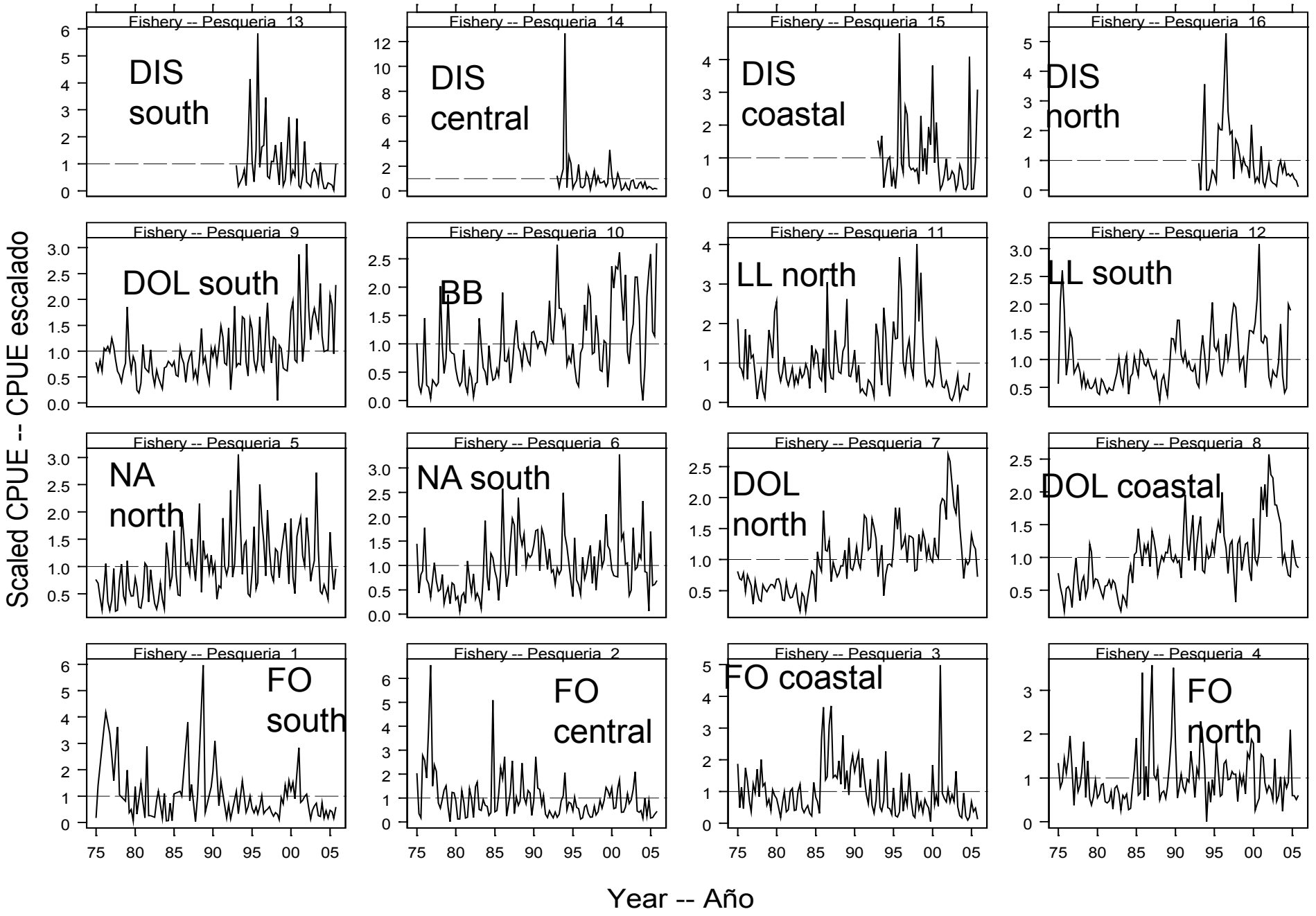
Catch


Fishery -- Pesqueria 13
DIS south
Fishery -- Pesqueria 14
DIS central
Fishery -- Pesqueria 15
DIS coastal
Fishery -- Pesqueria 16
DIS north
Fishery -- Pesqueria 9
DOL south
Fishery -- Pesqueria 10
BB
Fishery -- Pesqueria 11
LL north
Fishery -- Pesqueria 12
LL south
Fishery -- Pesqueria 5
NA north
Fishery -- Pesqueria 6
NA south
Fishery -- Pesqueria 7
DOL north
Fishery -- Pesqueria 8
DOL coastal
Fishery -- Pesqueria 1
FO south
Fishery -- Pesqueria 2
FO central
Fishery -- Pesqueria 3
FO coastal
Fishery -- Pesqueria 4
FO north
0
10000
20000
30000
40000
50000
60000
75
80
85
90
95
00
05
Tons -- Toneladas
Year -- Año

Effort


Fishery -- Pesqueria 13
DIS south
Fishery -- Pesqueria 14
DIS central
Fishery -- Pesqueria 15
DIS coastal
Fishery -- Pesqueria 16
DIS north
Fishery -- Pesqueria 9
DOL south
Fishery -- Pesqueria 10
BB
Fishery -- Pesqueria 11
LL north
Fishery -- Pesqueria 12
LL south
Fishery -- Pesqueria 5
NA north
Fishery -- Pesqueria 6
NA south
Fishery -- Pesqueria 7
DOL north
Fishery -- Pesqueria 8
Fishery -- Pesqueria 1
FO south
Fishery -- Pesqueria 2
FO central
Fishery -- Pesqueria 3
FO coastal
DOL coastal
Fishery -- Pesqueria 4
FO north
Thousands of days and hundreds of thousands of hooks
Miles de días y cientos de miles de anzuelos
75 80 85 90 95 00 05
Year -- Año

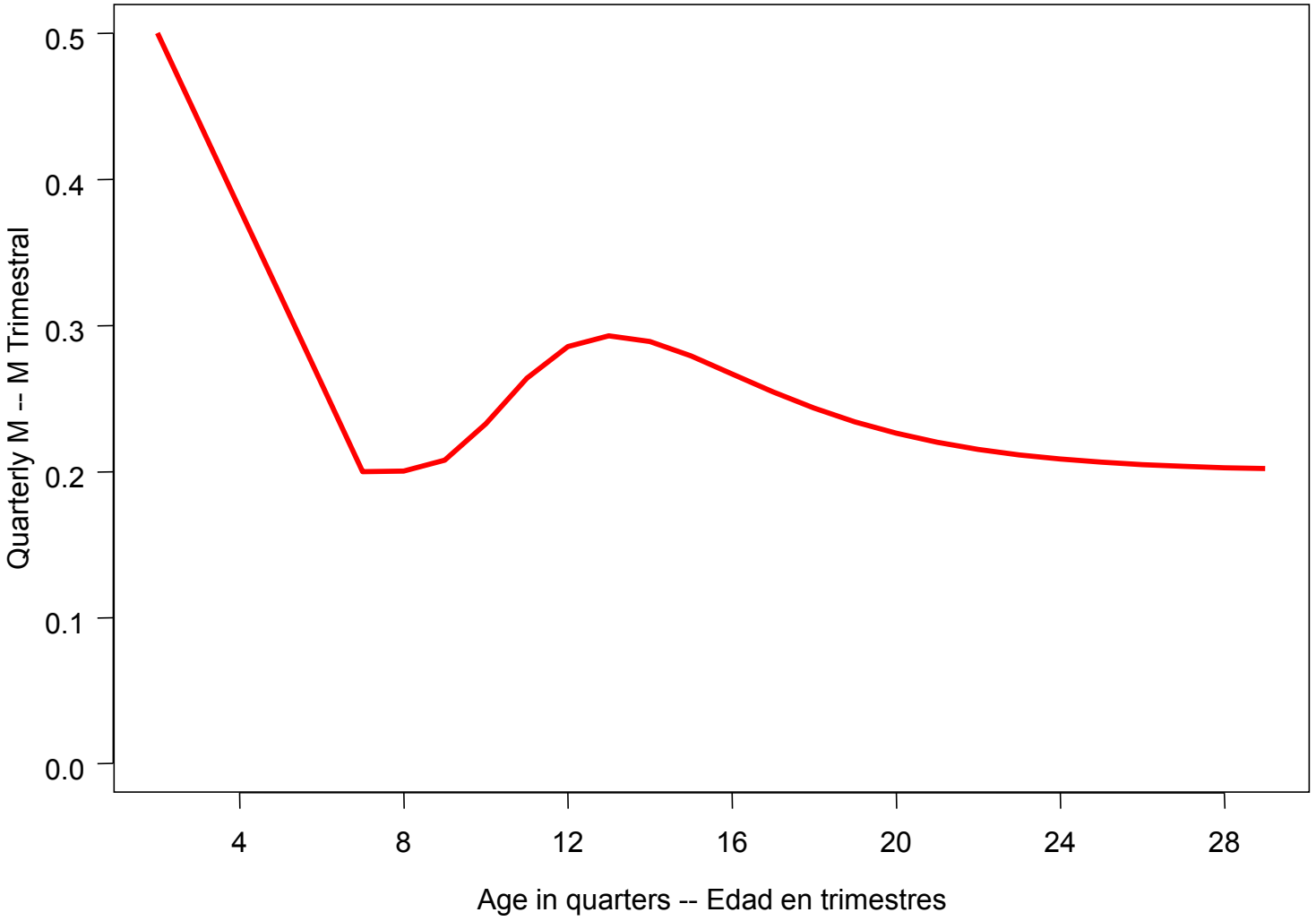
CPUE


Fishery -- Pesqueria 13
DIS south
Fishery -- Pesqueria 14
DIS central
Fishery -- Pesqueria 15
DIS coastal
Fishery -- Pesqueria 16
DIS north
Fishery -- Pesqueria 9
DOL south
Fishery -- Pesqueria 10
BB
Fishery -- Pesqueria 11
LL north
Fishery -- Pesqueria 12
LL south
Fishery -- Pesqueria 5
NA north
Fishery -- Pesqueria 6
NA south
Fishery -- Pesqueria 7
DOL north
Fishery -- Pesqueria 8
DOL coastal
Fishery -- Pesqueria 1
FO south
Fishery -- Pesqueria 2
FO central
Fishery -- Pesqueria 3
FO coastal
Fishery -- Pesqueria 4
FO north
Scaled CPUE -- CPUE escalado
75 80 85 90 95 00 05
Year -- Año

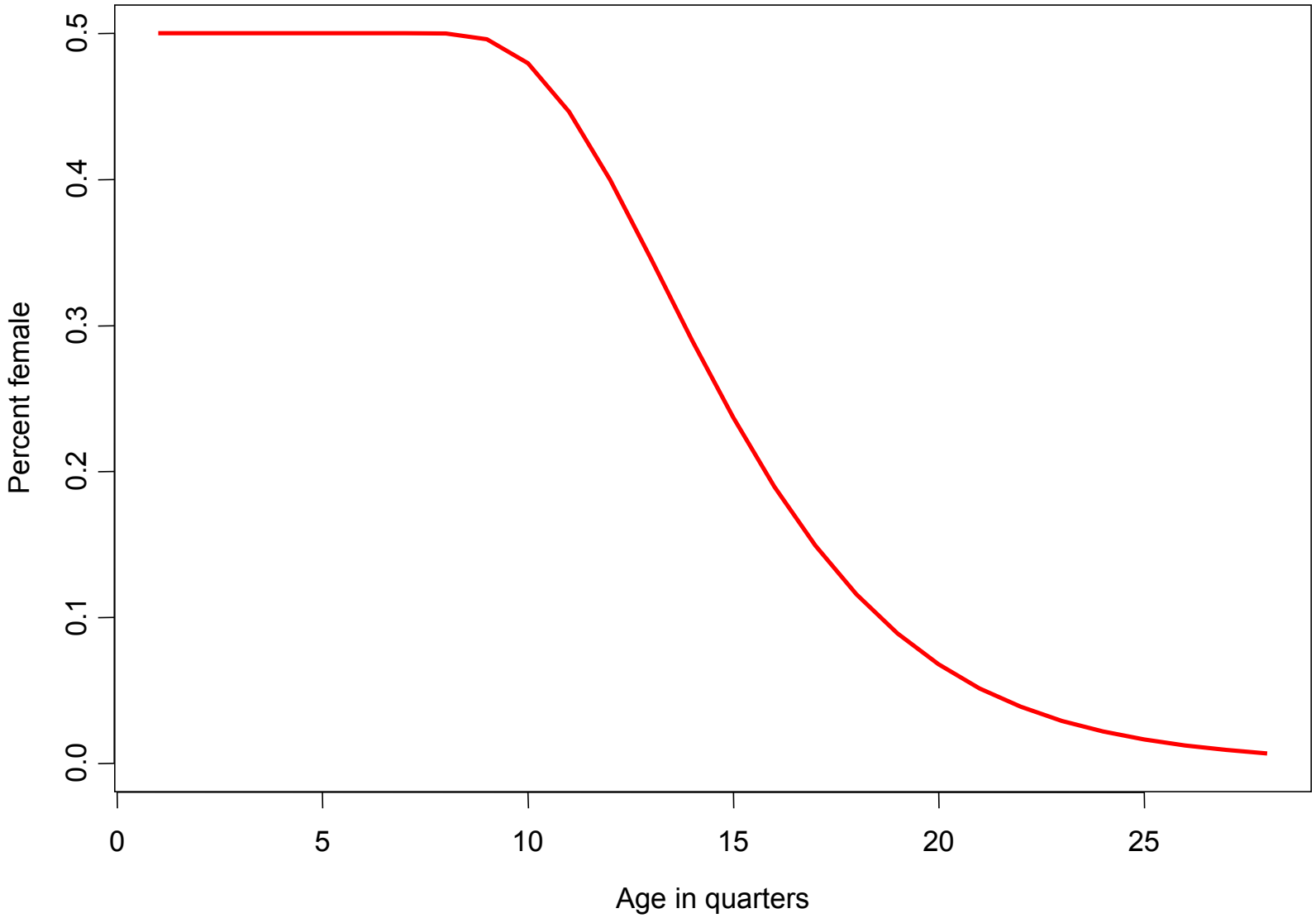
Fixed Parameters

- Natural Mortality
- Fecundity at age
- Sex ratio at age
- Selectivity curves for the discard fisheries
- The steepness of the stock recruitment relationship = 1 (no relationship)

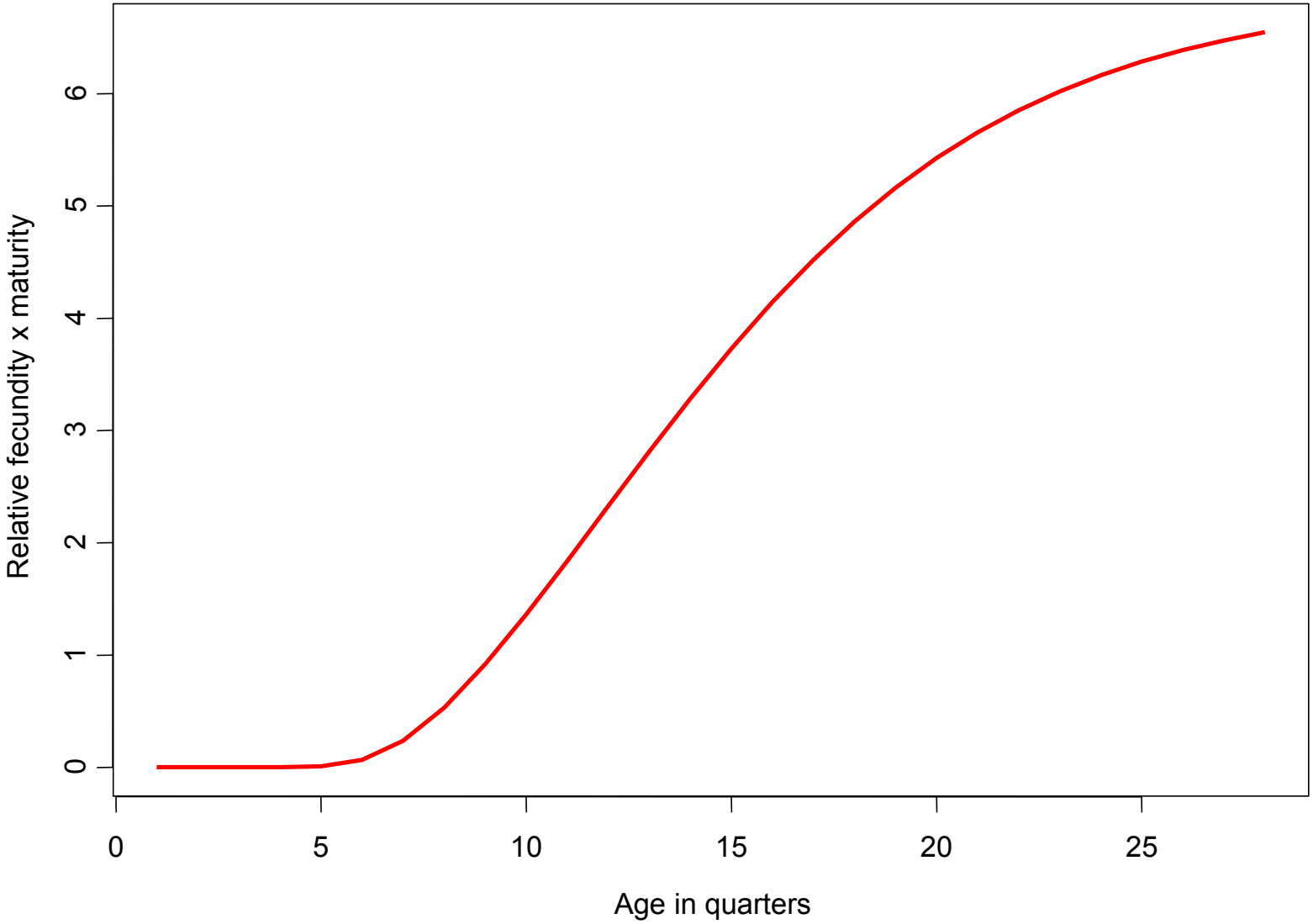
Natural Mortality



Sex Ratio



Relative Fecundity



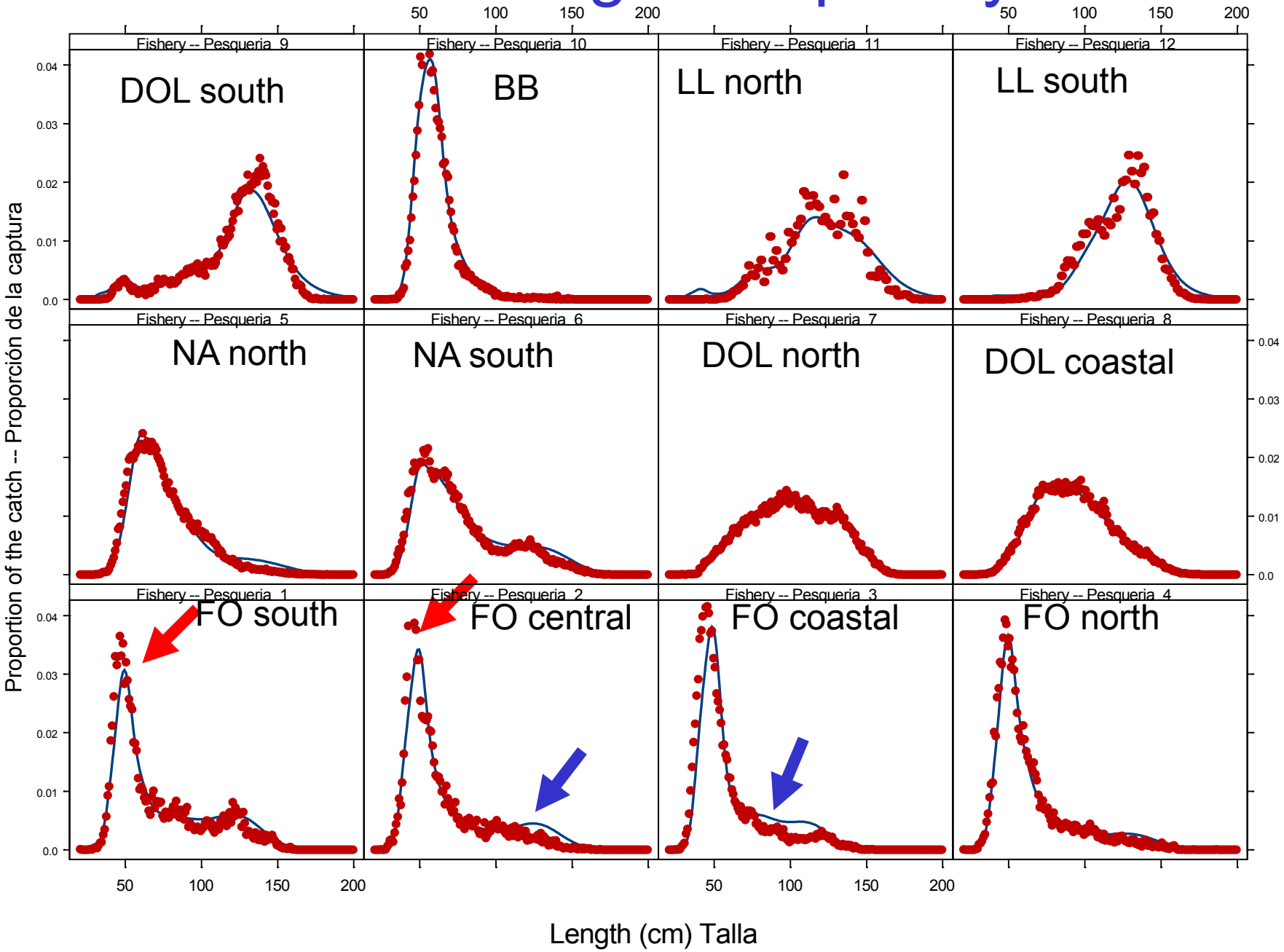
Estimated parameters

- **Recruitment**
  - Temporal anomalies, (no Seasonal component)
- **Catchability**
  - Temporal anomalies
- **Selectivity**
- **Initial population size and age-structure**
- **Mean length at age**
- **Variation of length at age**

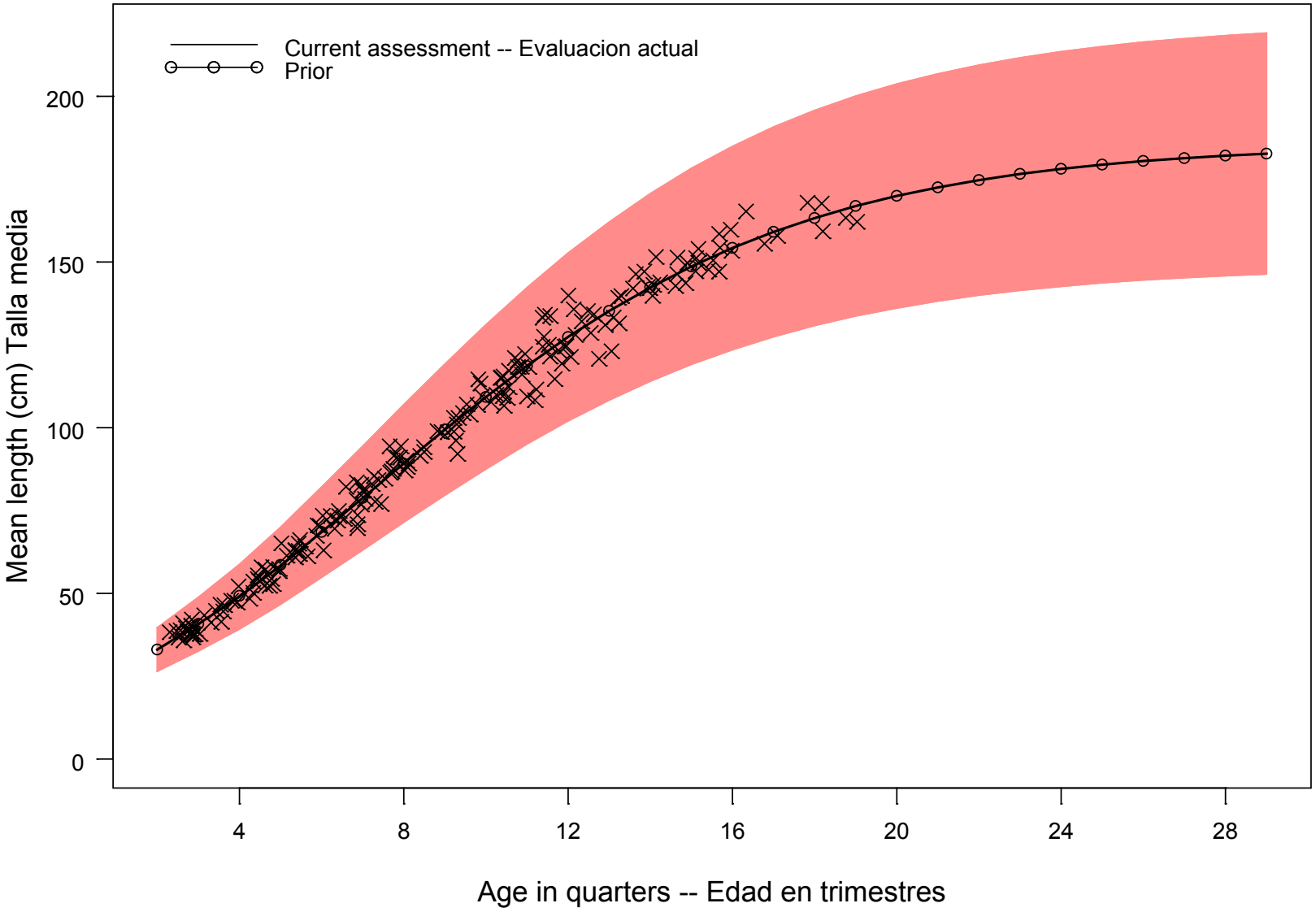
Results

- Fit to the length frequency
- Growth
- Fishing mortality
- Selectivity
- Recruitment
- Biomass
- Catchability

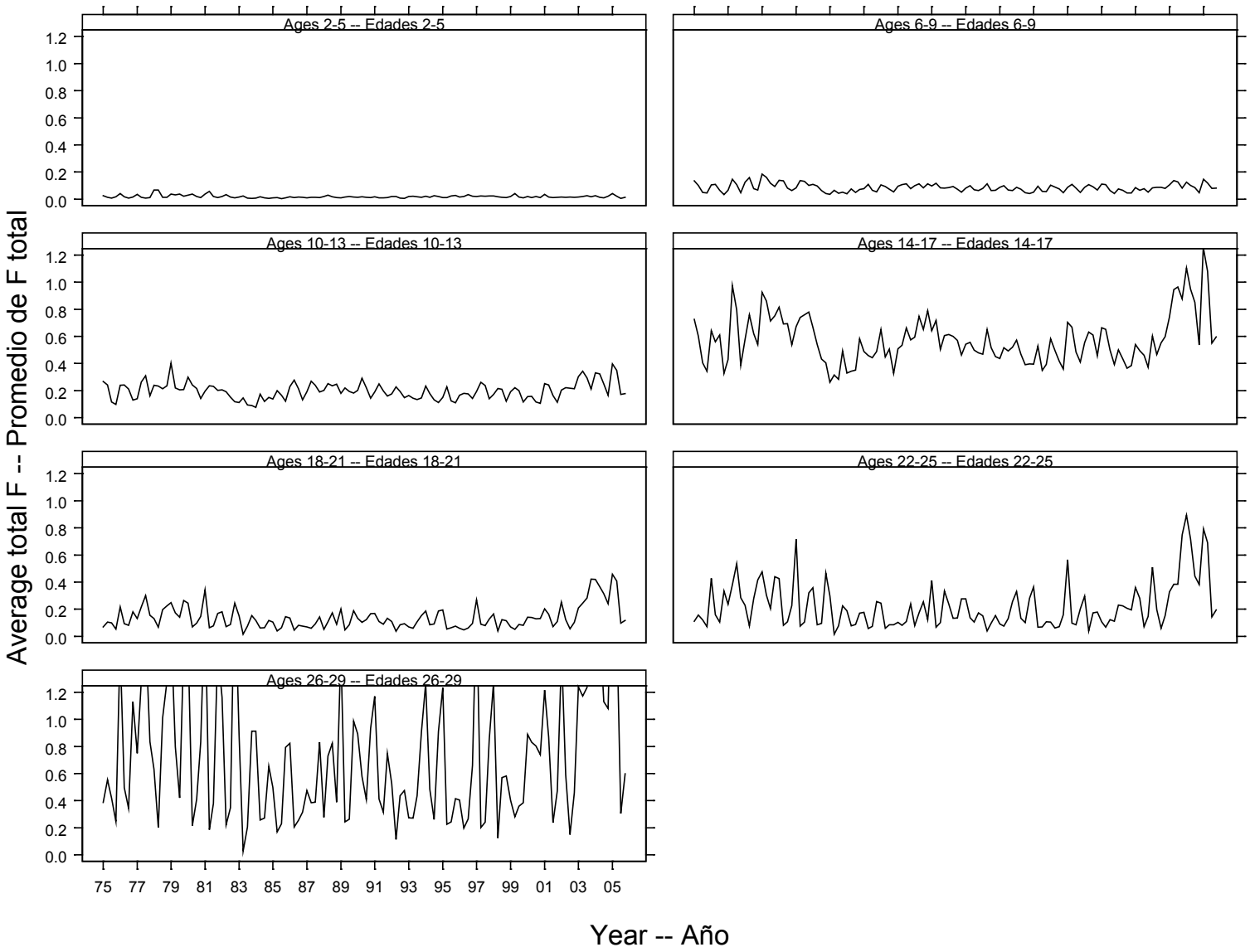
Fit to the length-frequency



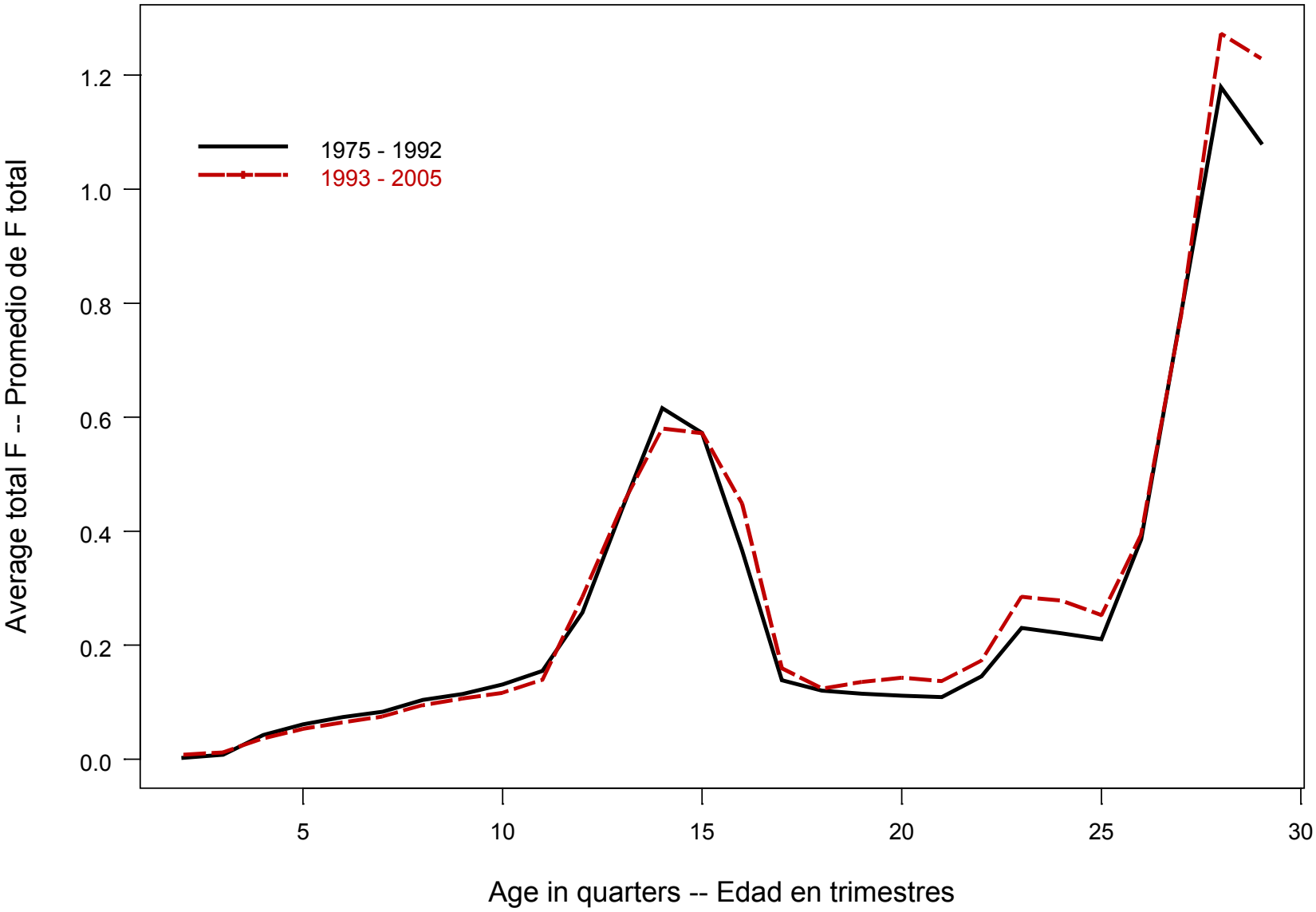
Growth


Current assessment -- Evaluacion actual
Prior
Mean length (cm) Talla media
0
50
100
150
200
4
8
12
16
20
24
28
Age in quarters -- Edad en trimestres

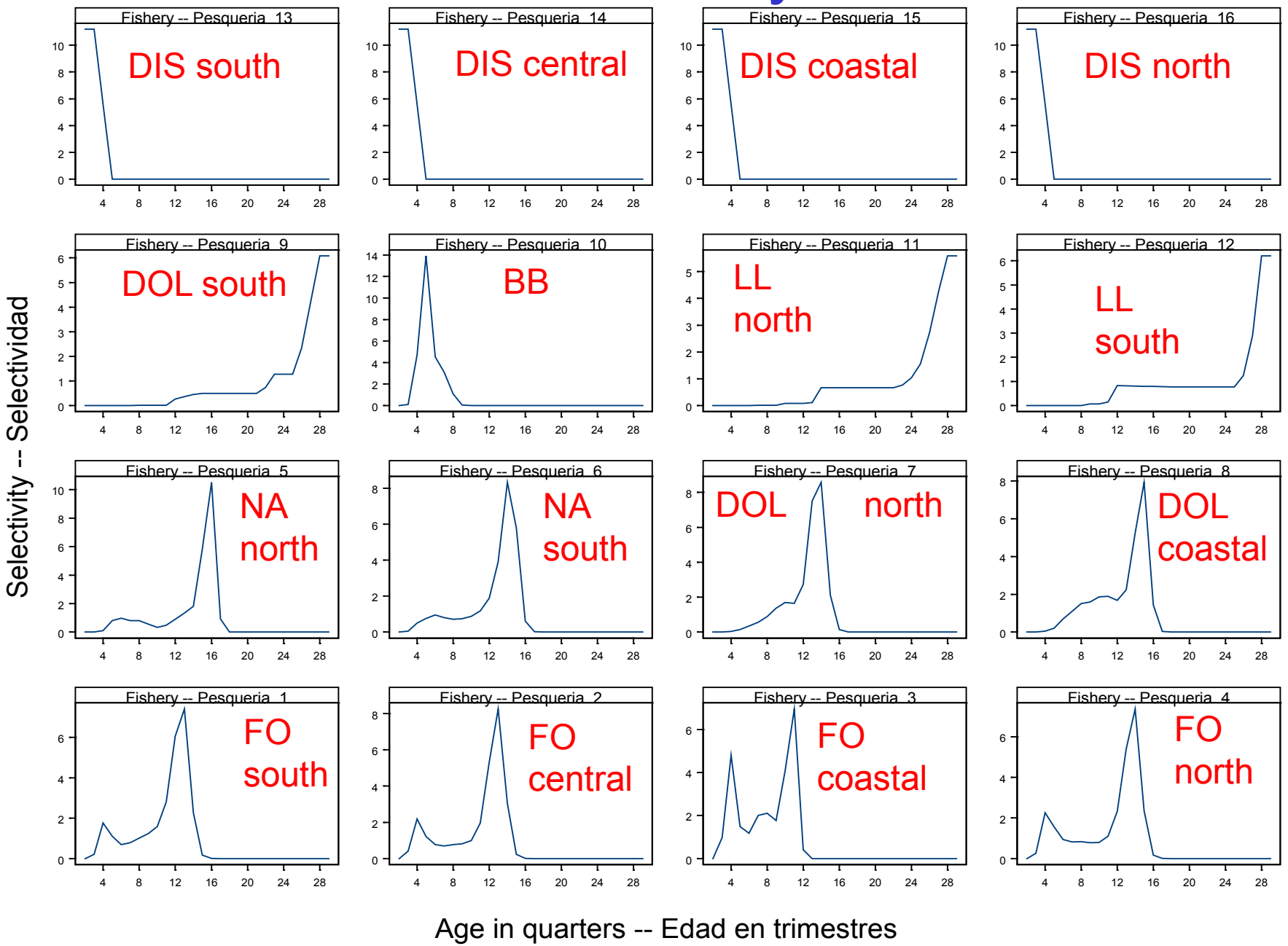
Fishing mortality



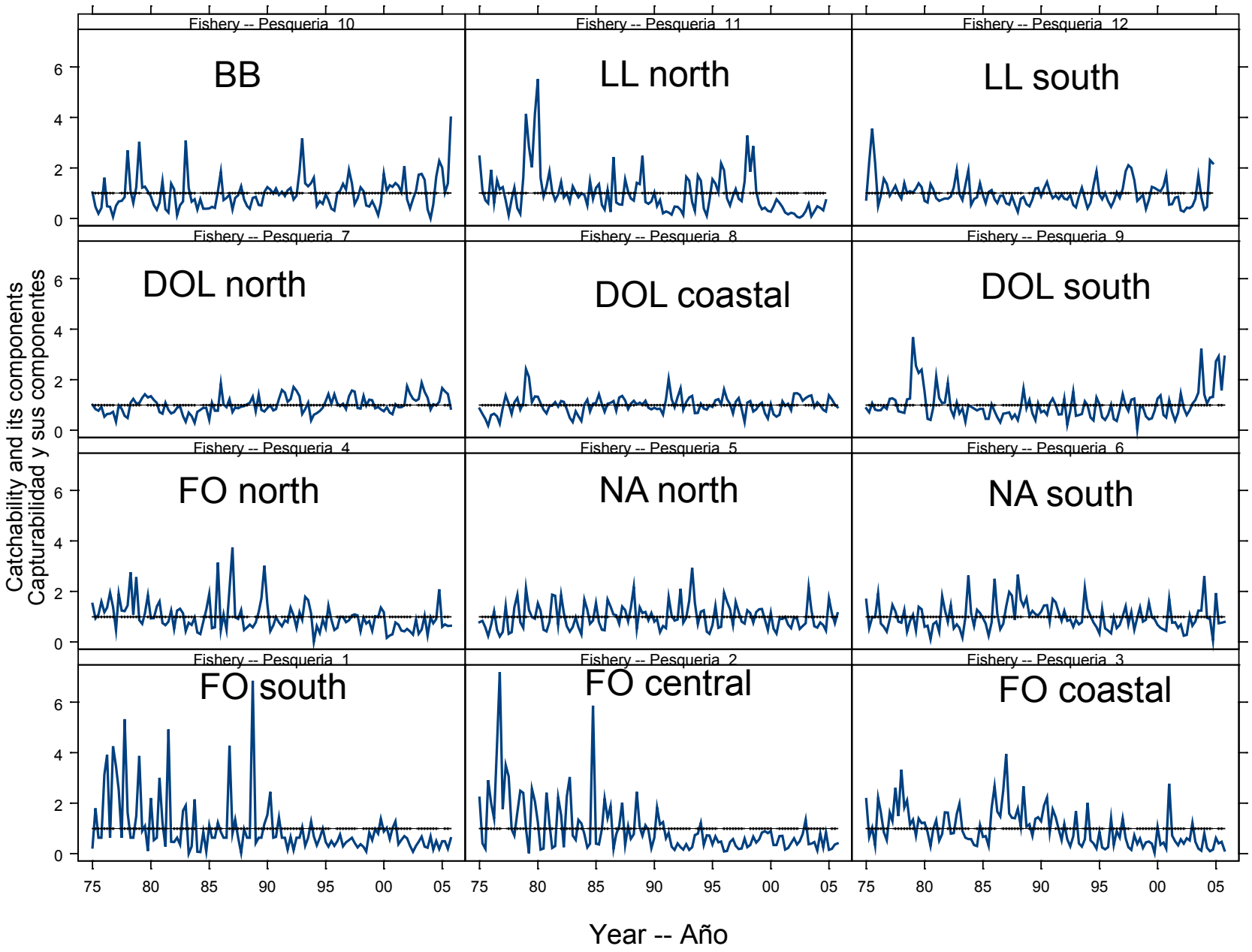
Age Specific Fishing Mortality



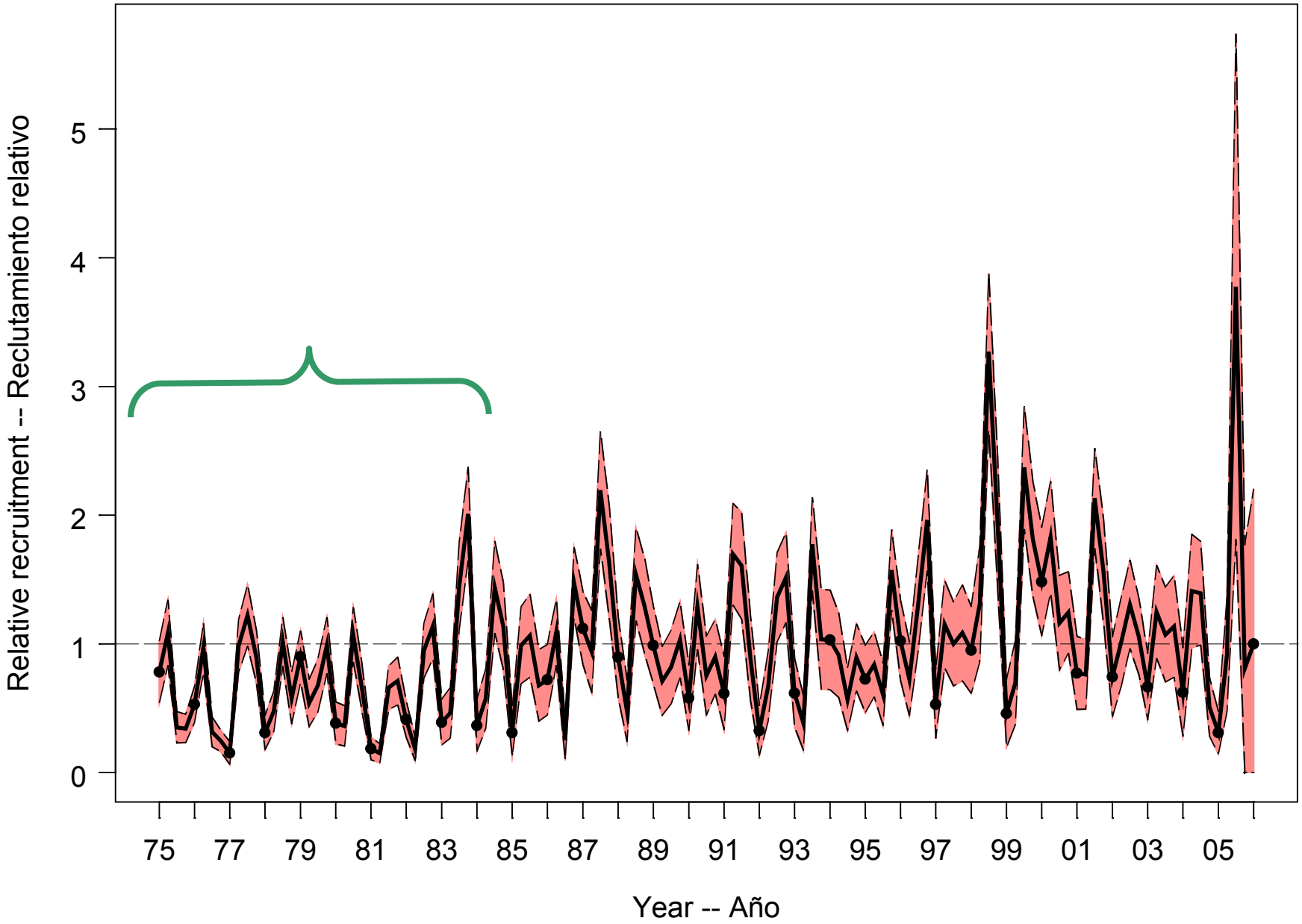
Selectivity



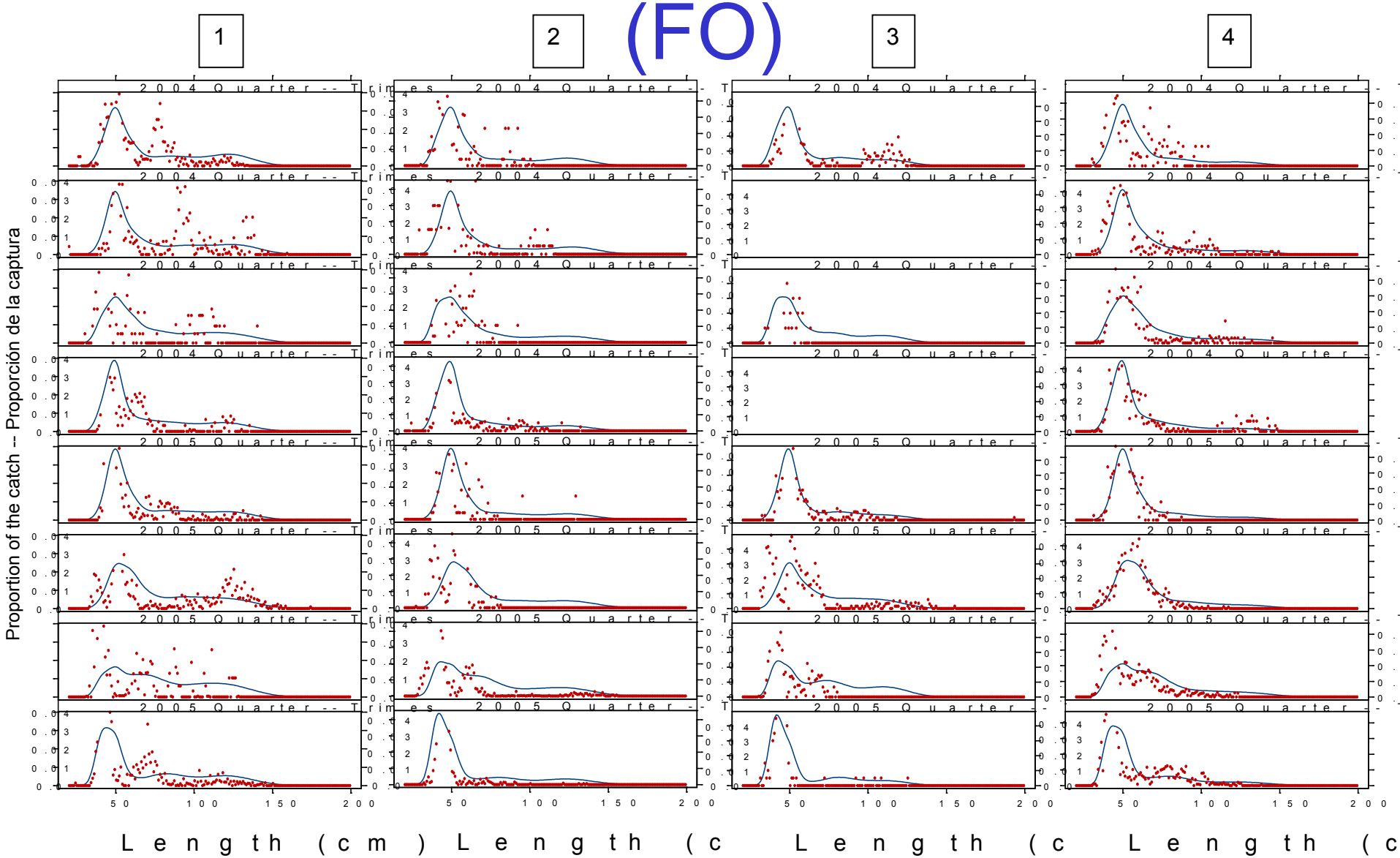
Catchability



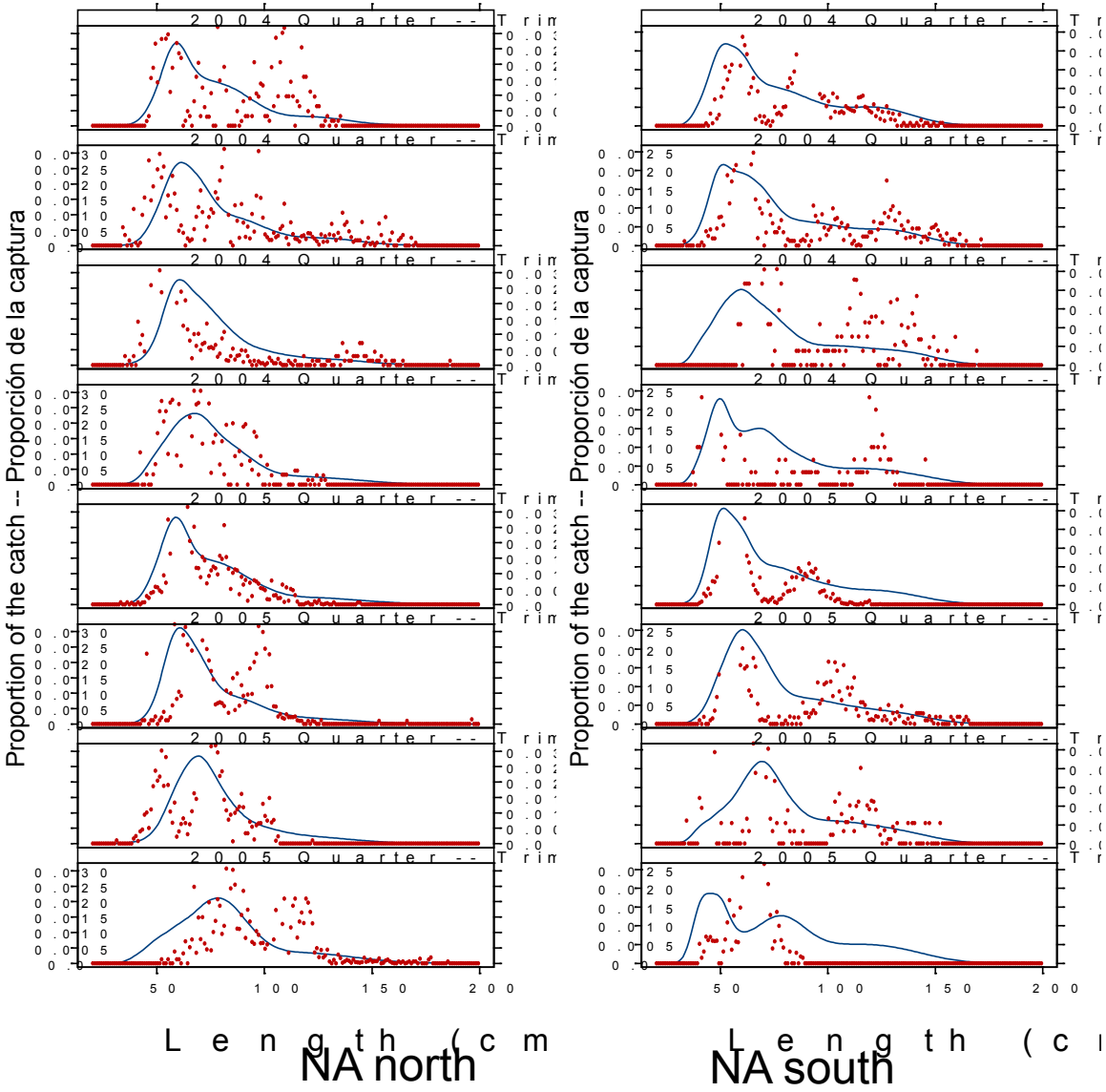
Recruitment



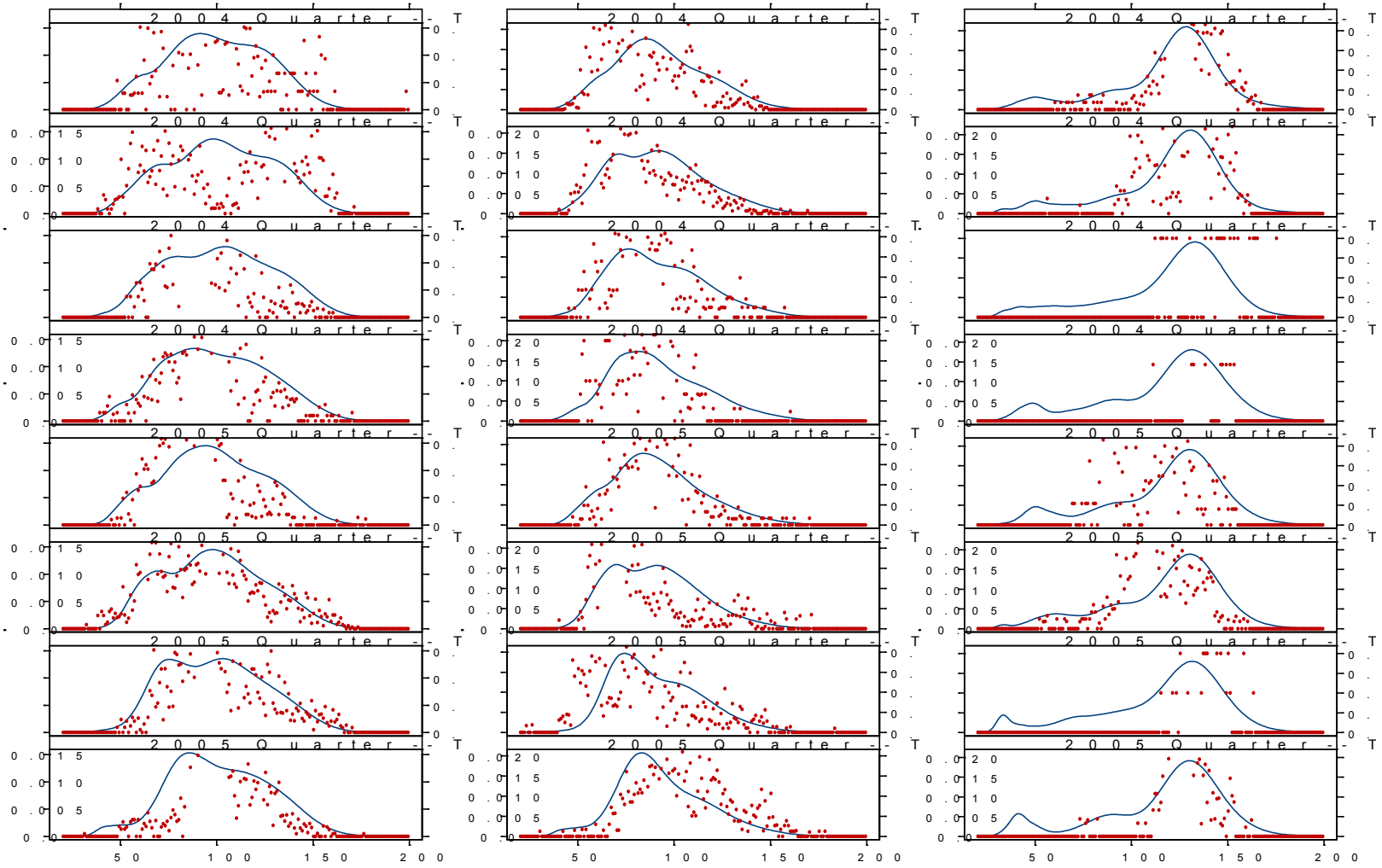
Recent length-frequency data (FO)



Recent length-frequency data (Unassociated)



Recent length-frequency data (Dolphin associated)

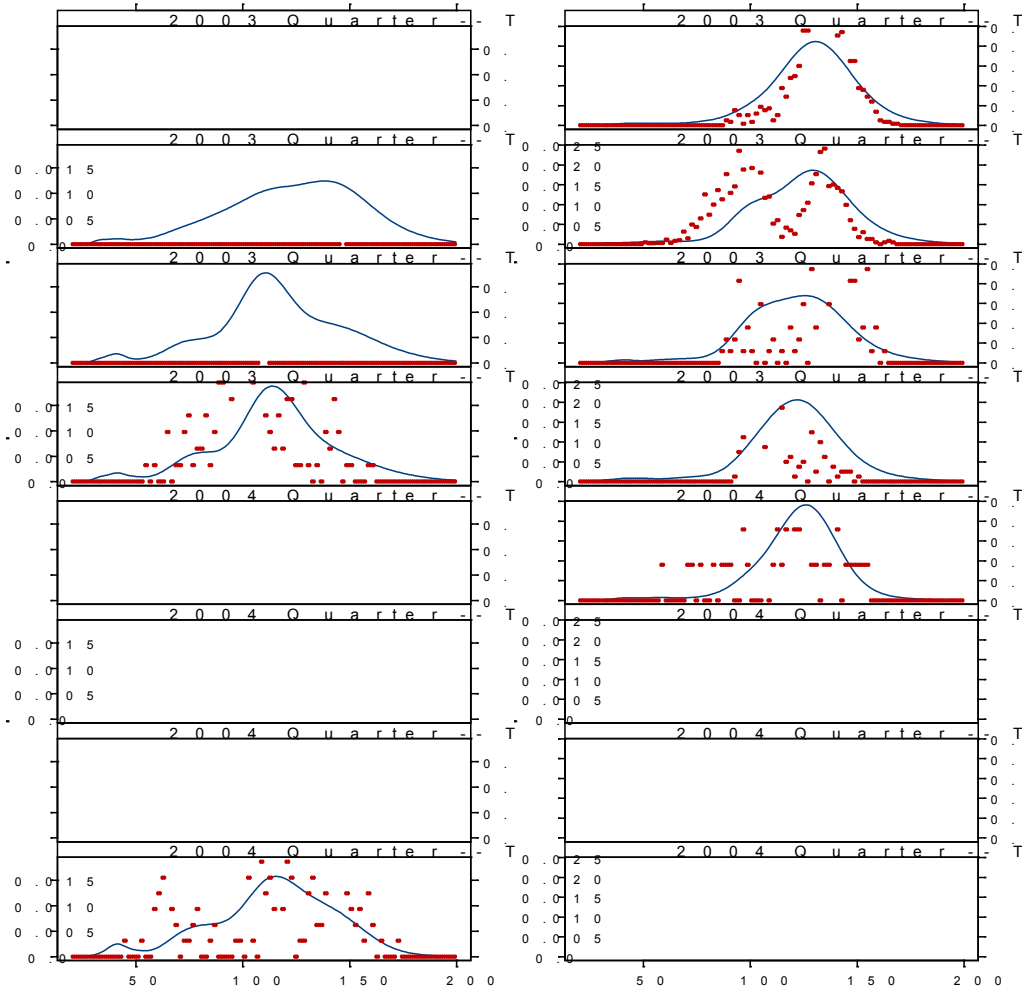


DOL north

DOL coastal

DOL south

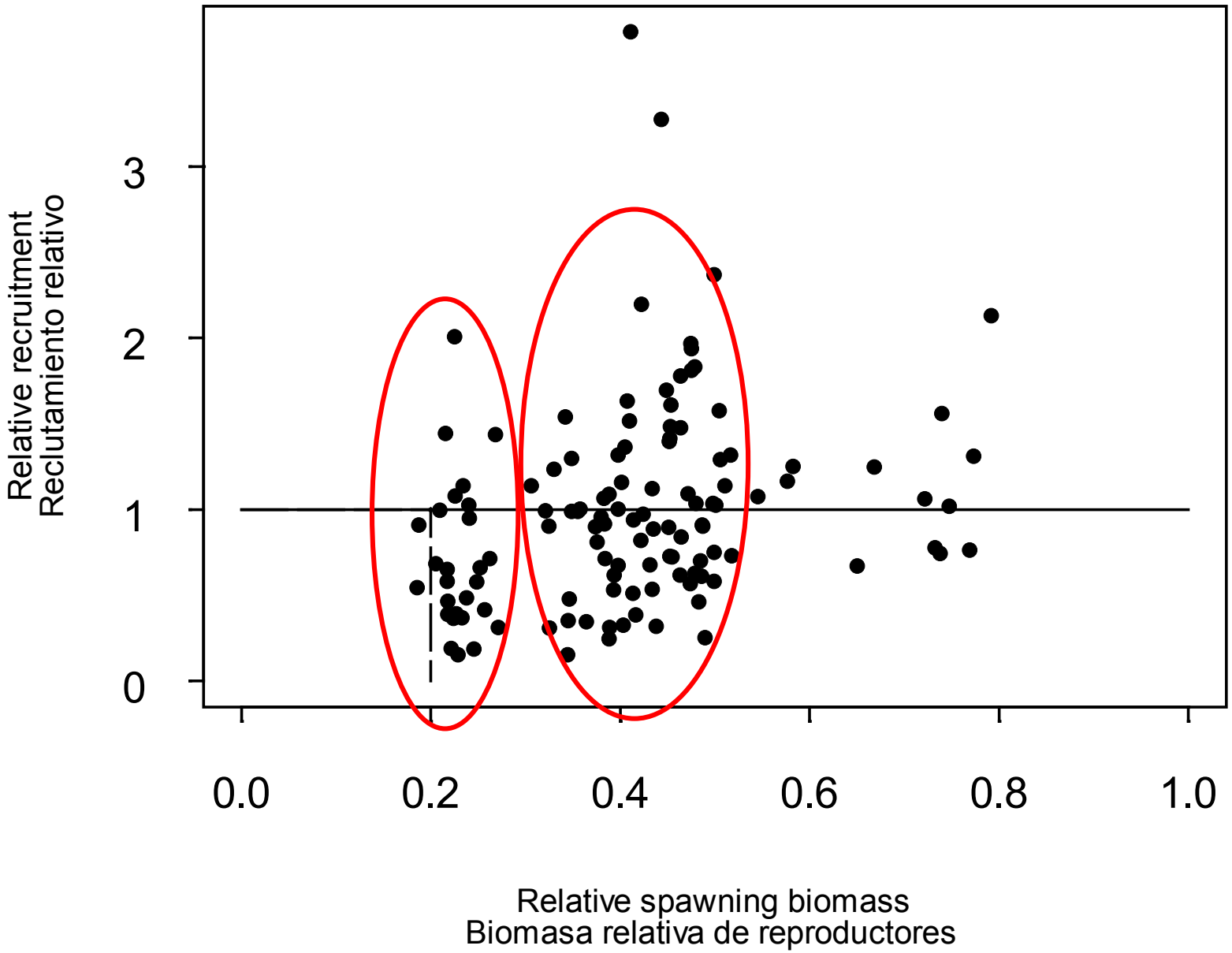
Recent length-frequency data (longline)



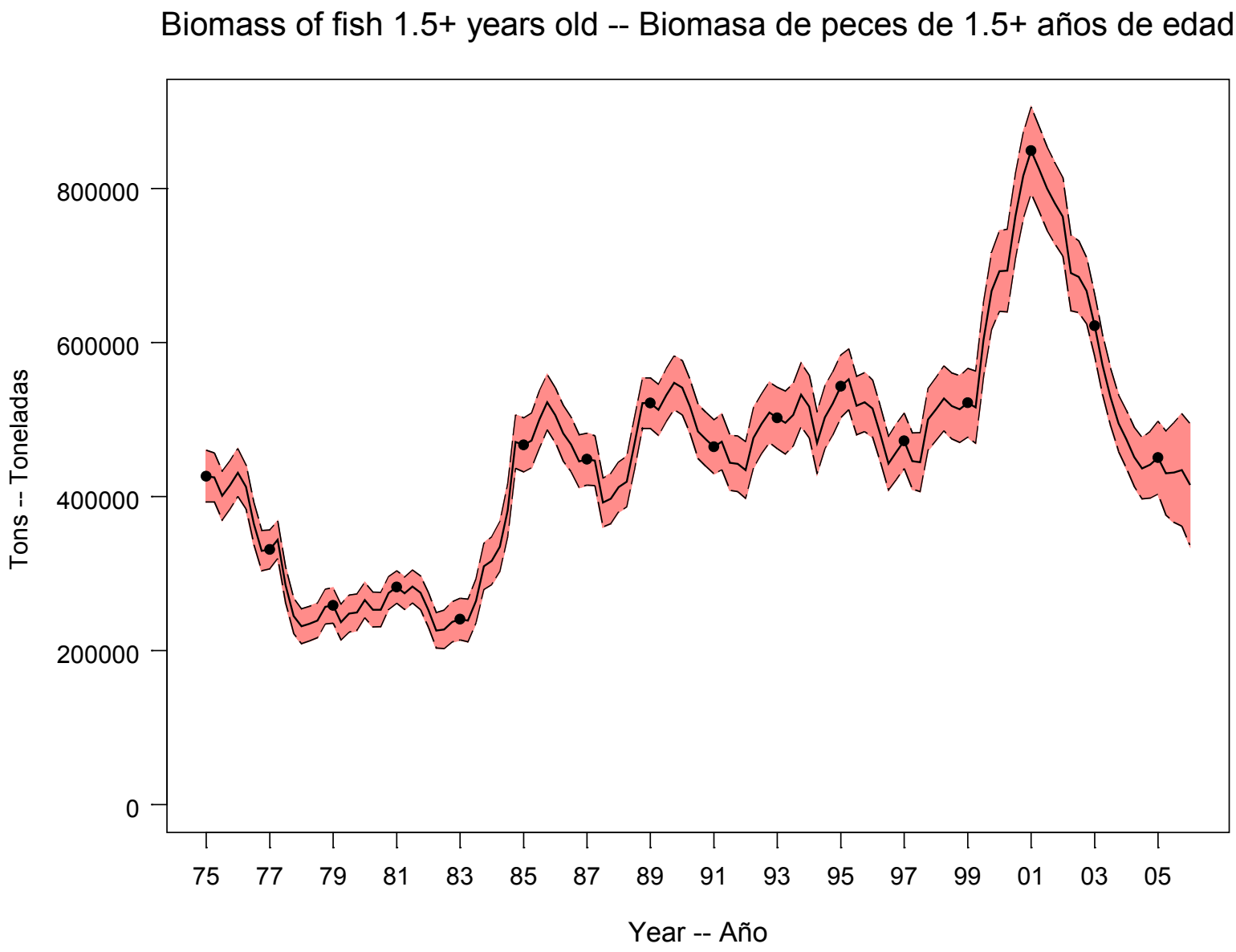
LL north

LL south

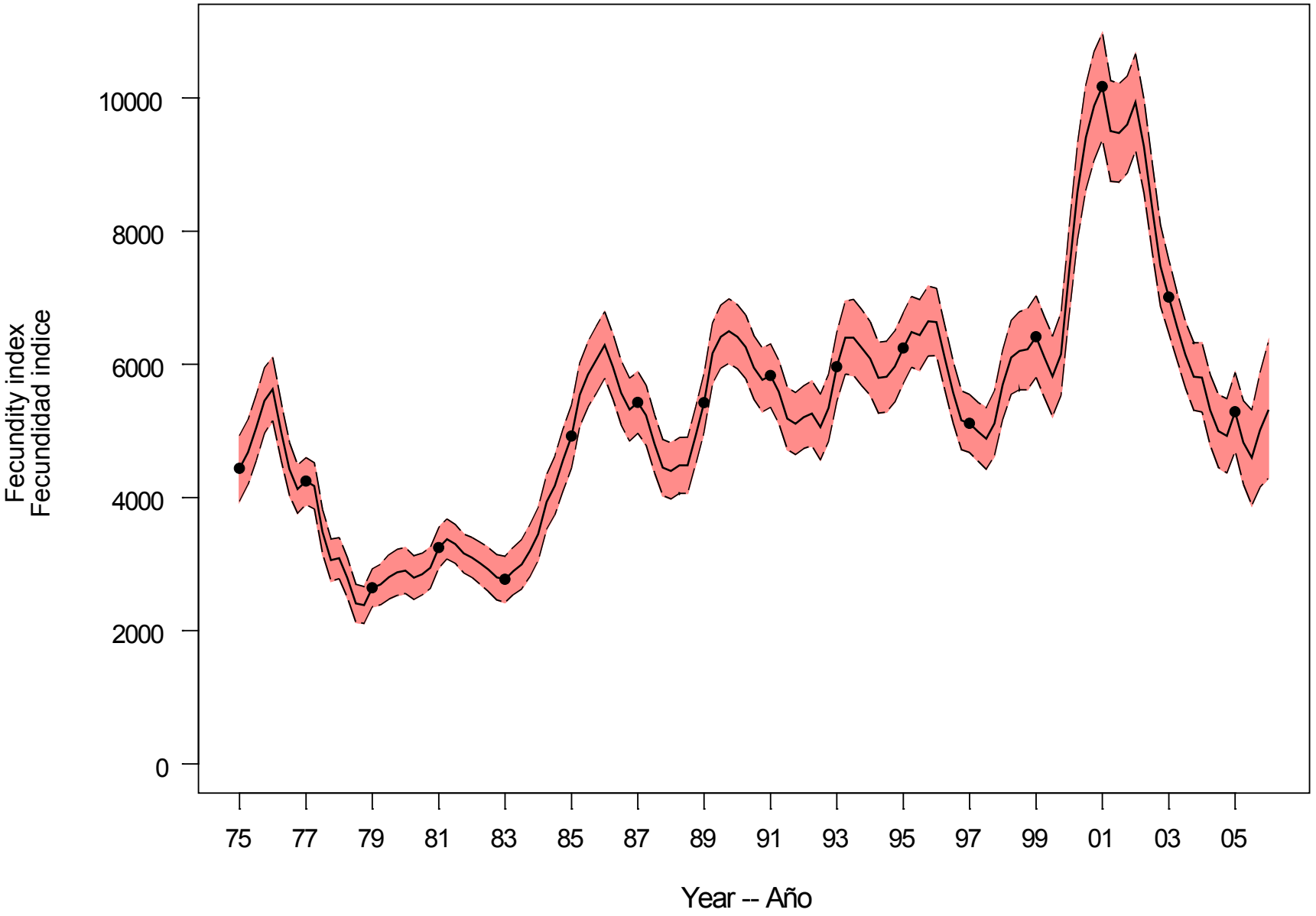
Stock - recruitment



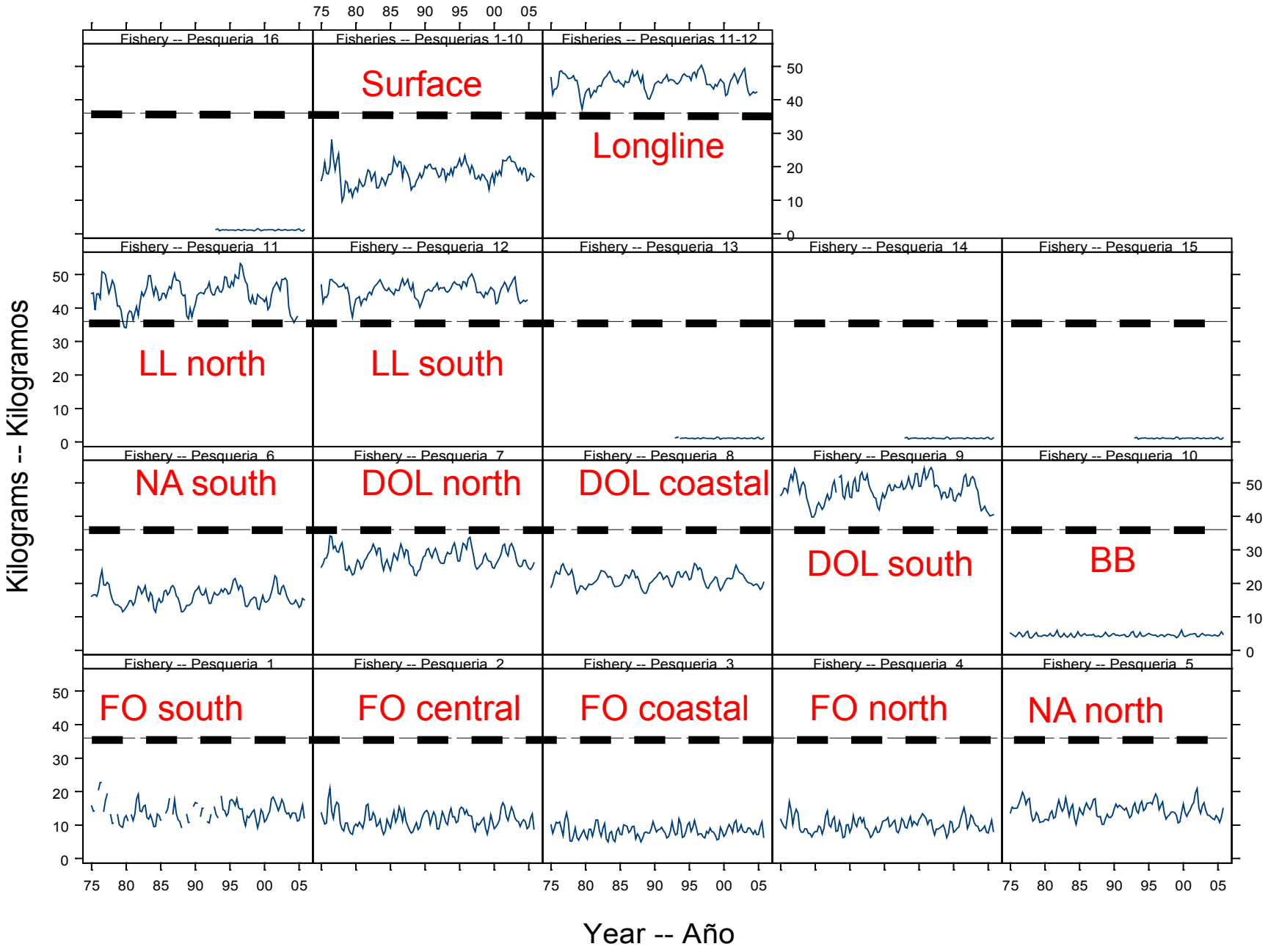
Biomass


Biomass of fish 1.5+ years old -- Biomasa de peces de 1.5+ años de edad
Tons -- Toneladas
800000
600000
400000
200000
0
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año

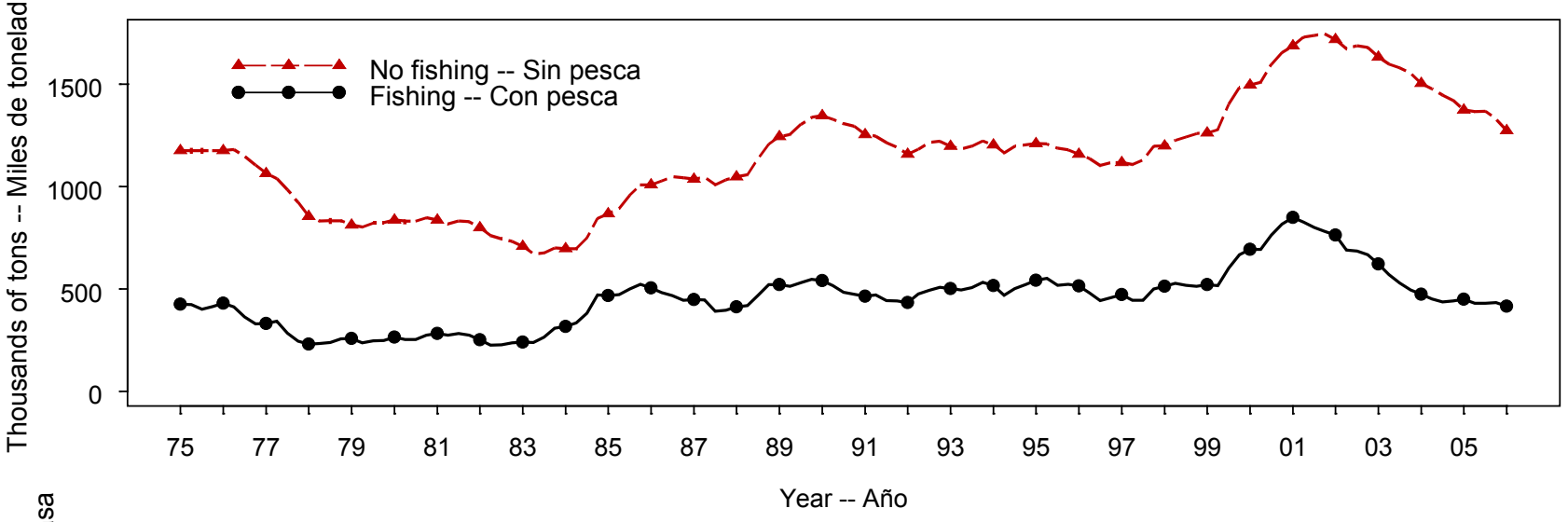
Spawning Biomass

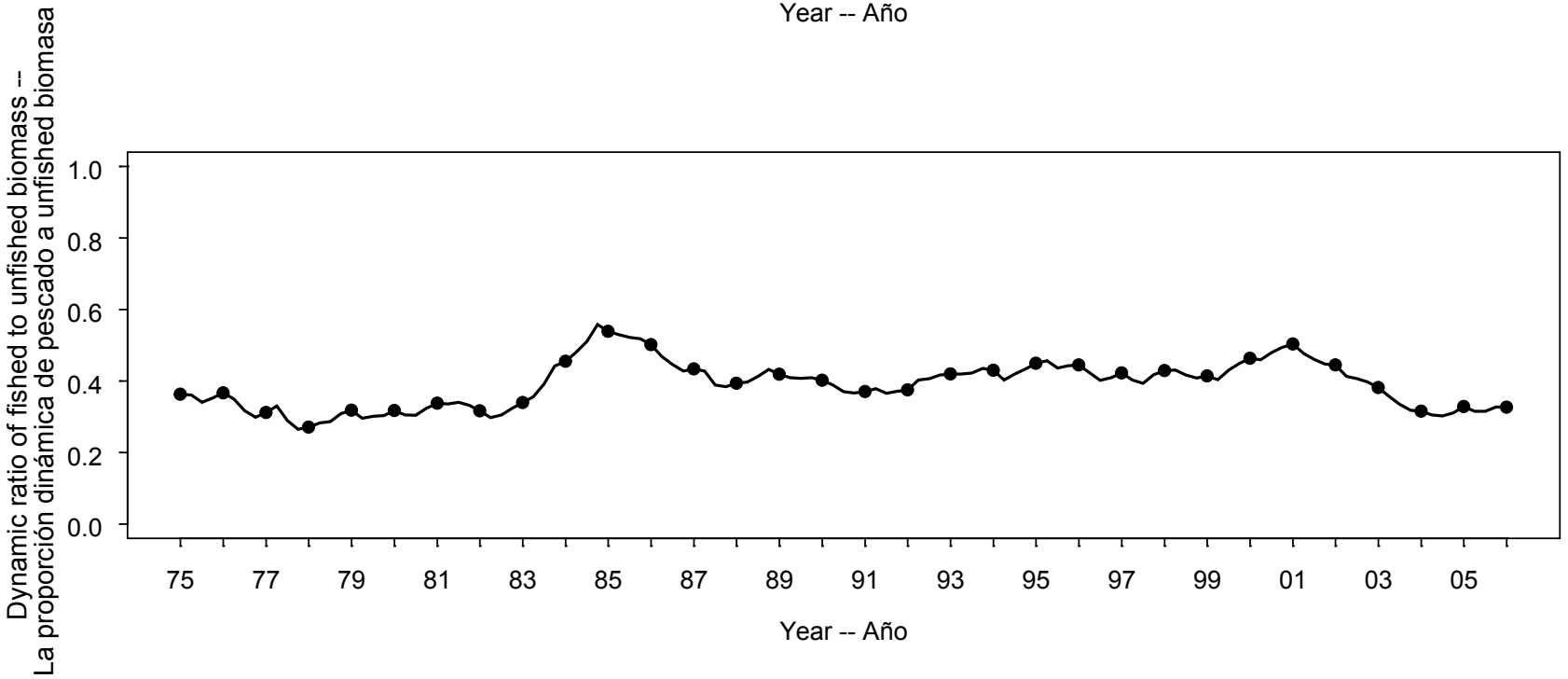


Average weight

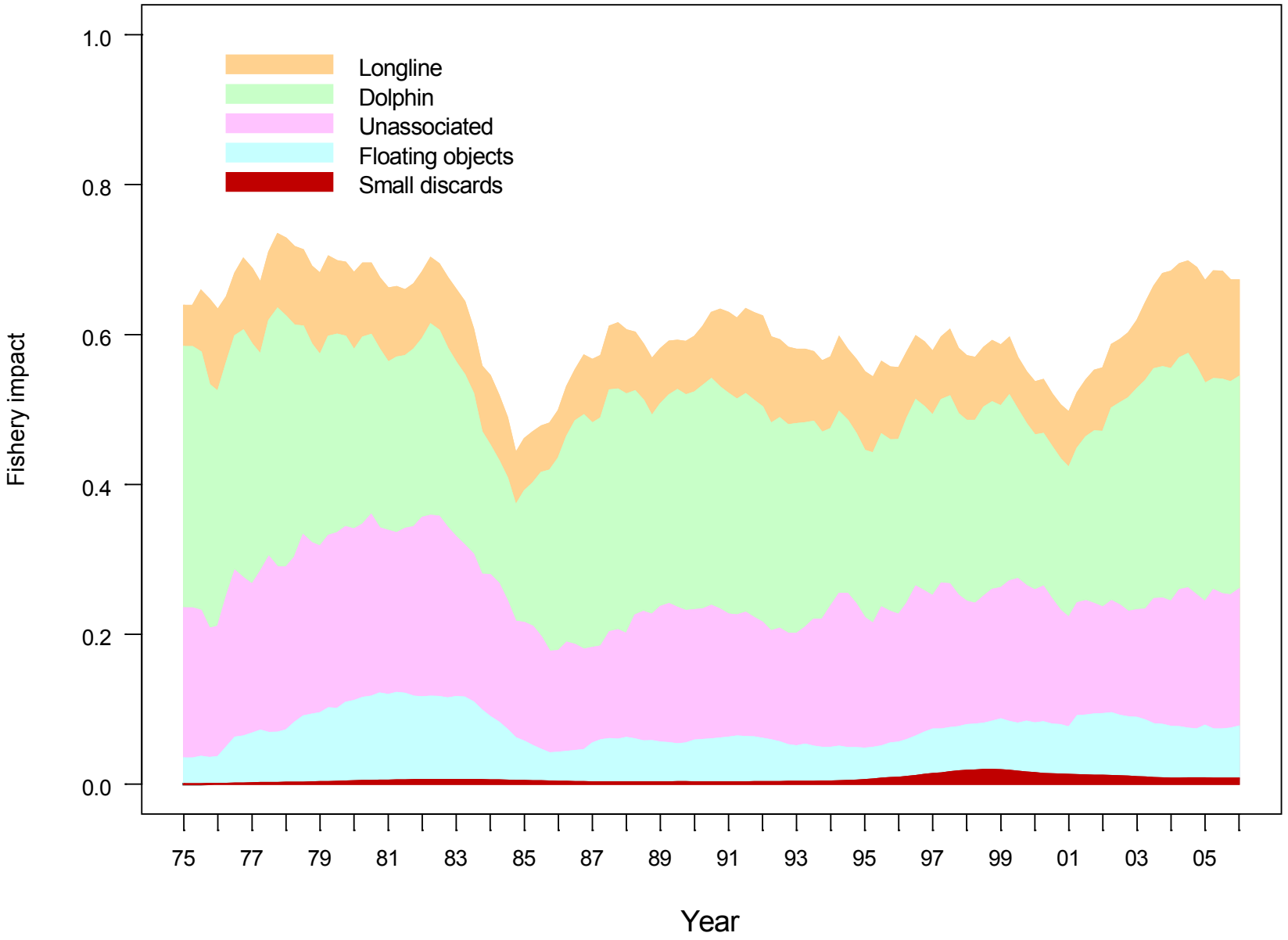


No Fishing

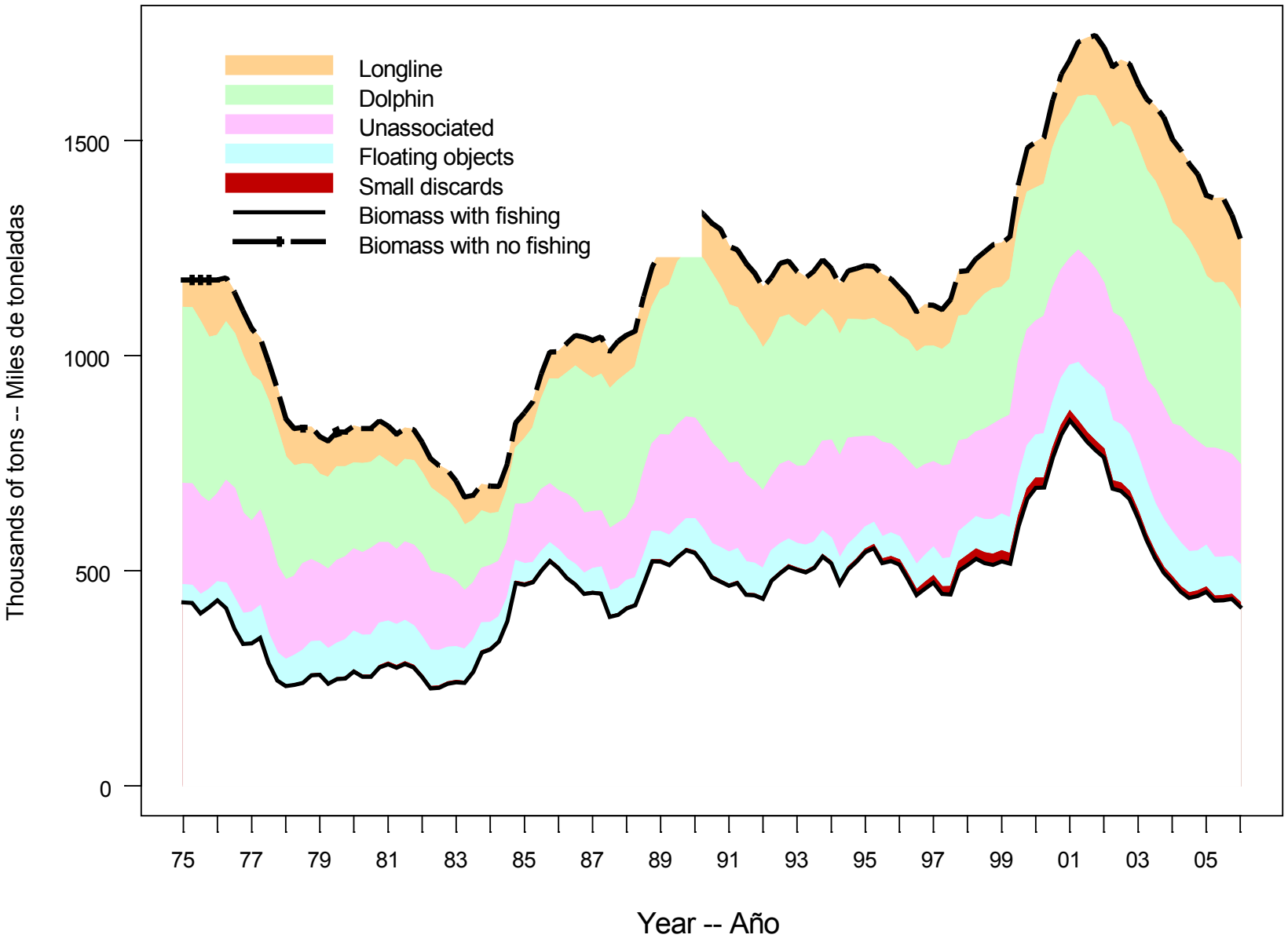

Thousands of tons -- Miles de toneladas
No fishing -- Sin pesca
Fishing -- Con pesca
0
500
1000
1500
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año


Dynamic ratio of fished to unfished biomass --
La proporción dinámica de pescado a unfished biomasa
0.0
0.2
0.4
0.6
0.8
1.0
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año

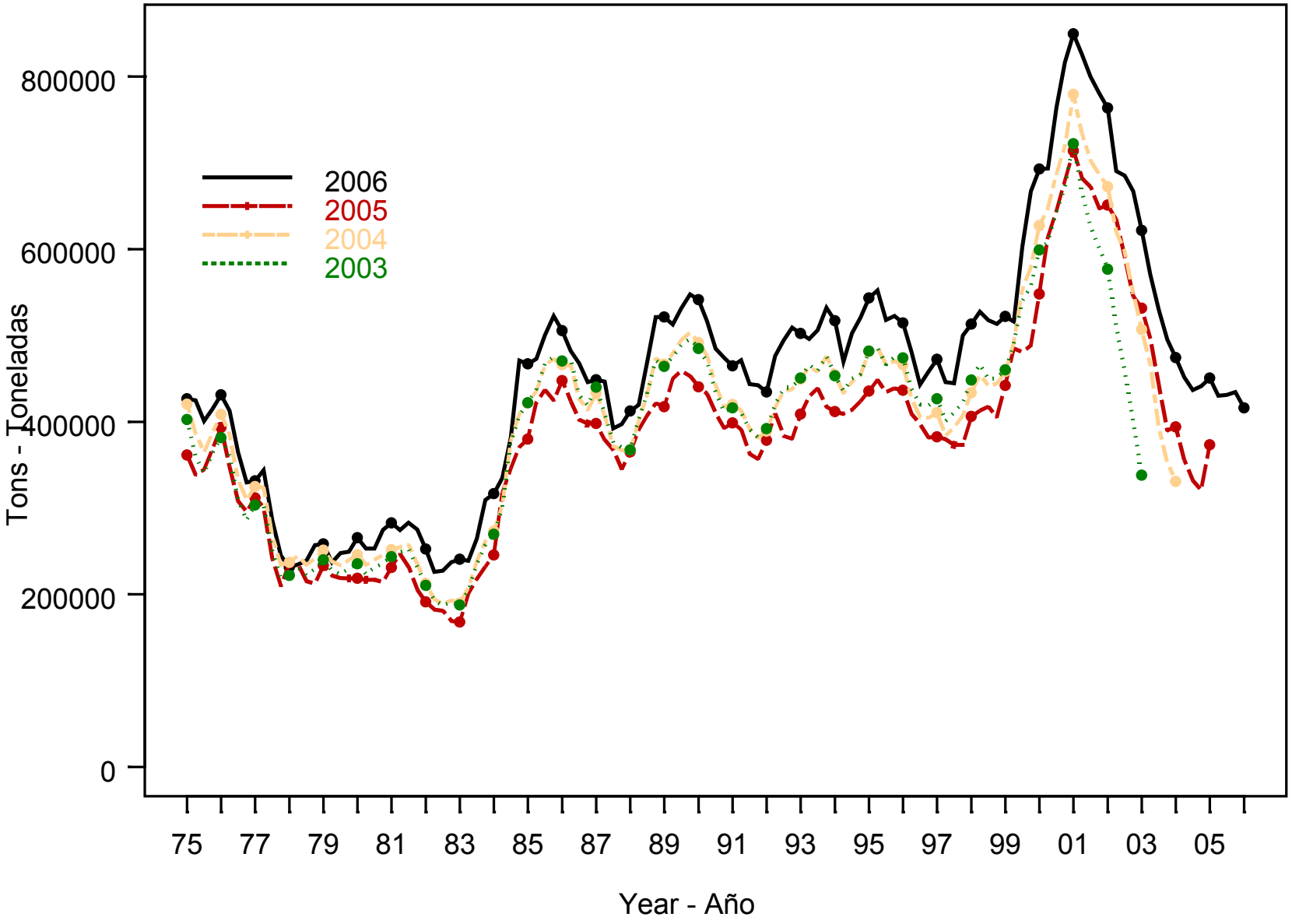
Fishery impact



No Fishing and Fishery Impact



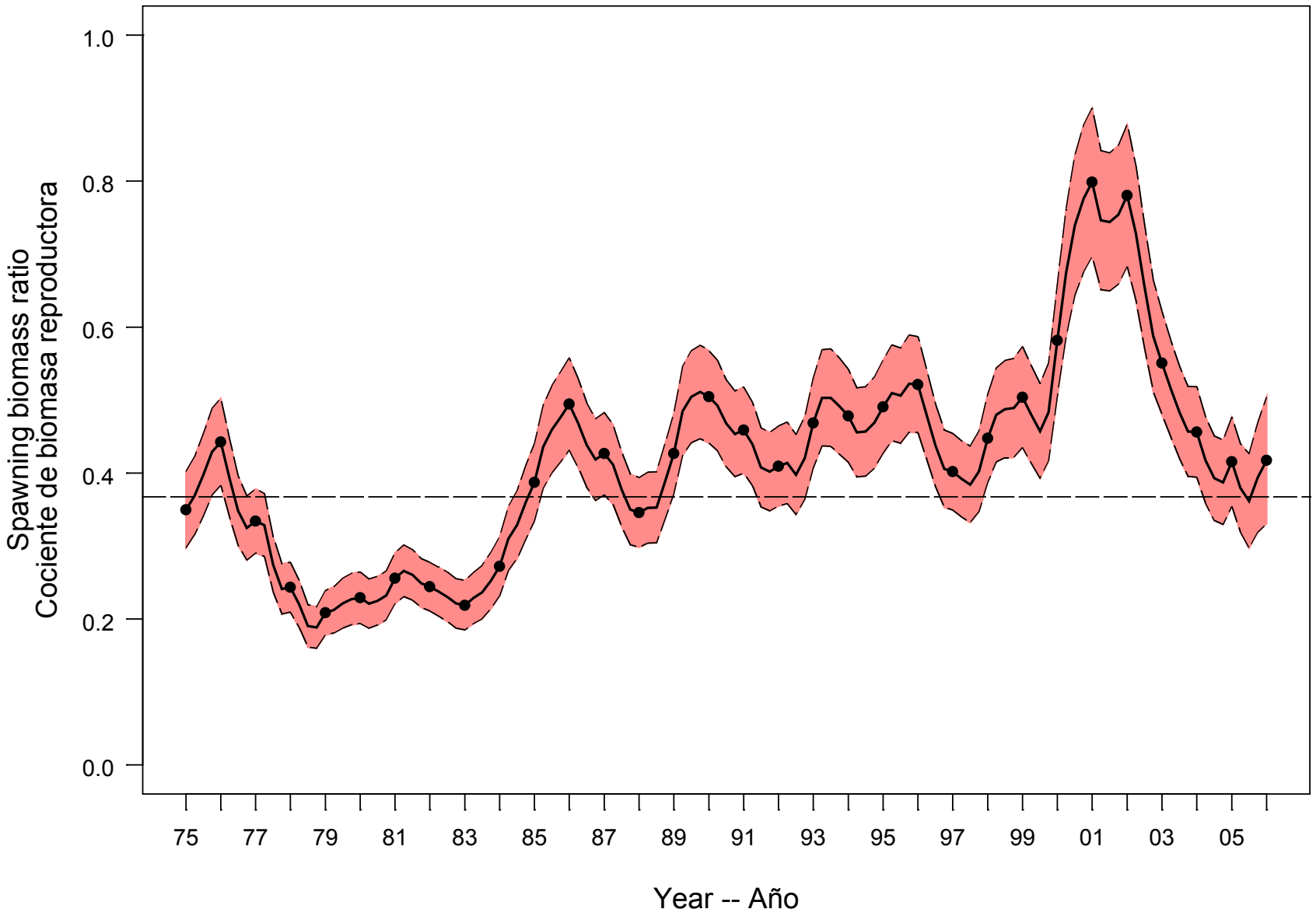
Biomass Comparisons



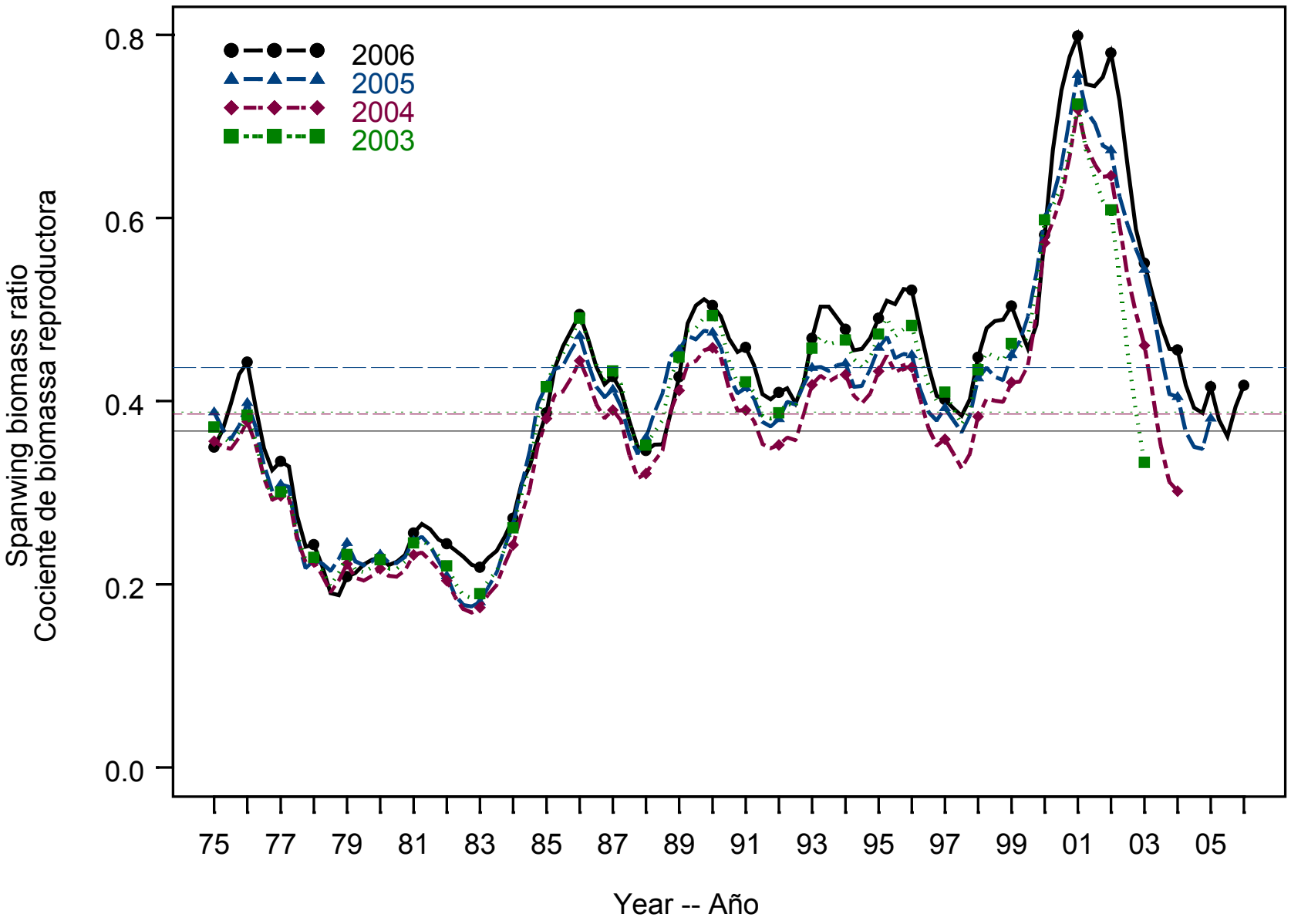
Reference points & projections

- Assumptions
  - For MSY calculations
    - Average of 2002-2003 for fishing mortality
  - For forward projections
    - Average of 2002-2003 for catchability
    - 2004 effort

SBR


Spawning biomass ratio
Cociente de biomasa reproductora
1.0
0.8
0.6
0.4
0.2
0.0
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año

SBR


2006
2005
2004
2003
Spanwing biomass ratio
Cociente de biomassa reproductora
0.0
0.2
0.4
0.6
0.8
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año

AMSY by method

Fishery	**AMSY**	B_{AMSY}	S_{AMSY}	$B_{AMSY}/B_{F=0}$	$S_{AMSY}/S_{F=0}$	***F* multiplier**
Pesquería	**RMSP**	B_{RMSP}	S_{RMSP}	$B_{RMSP}/B_{F=0}$	$S_{RMSP}/S_{F=0}$	**Multiplicador de *F***
All—Todos	287 519	416 379	4 677	0.36	0.37	1.02
OBJ	214 243	316 331	3 520	0.27	0.28	11.06
NOA	259 574	385 228	4 392	0.33	0.34	4.20
DEL	304 745	406 369	4 335	0.35	0.34	2.11
LL	350 562	460 673	4 961	0.39	0.39	25.18

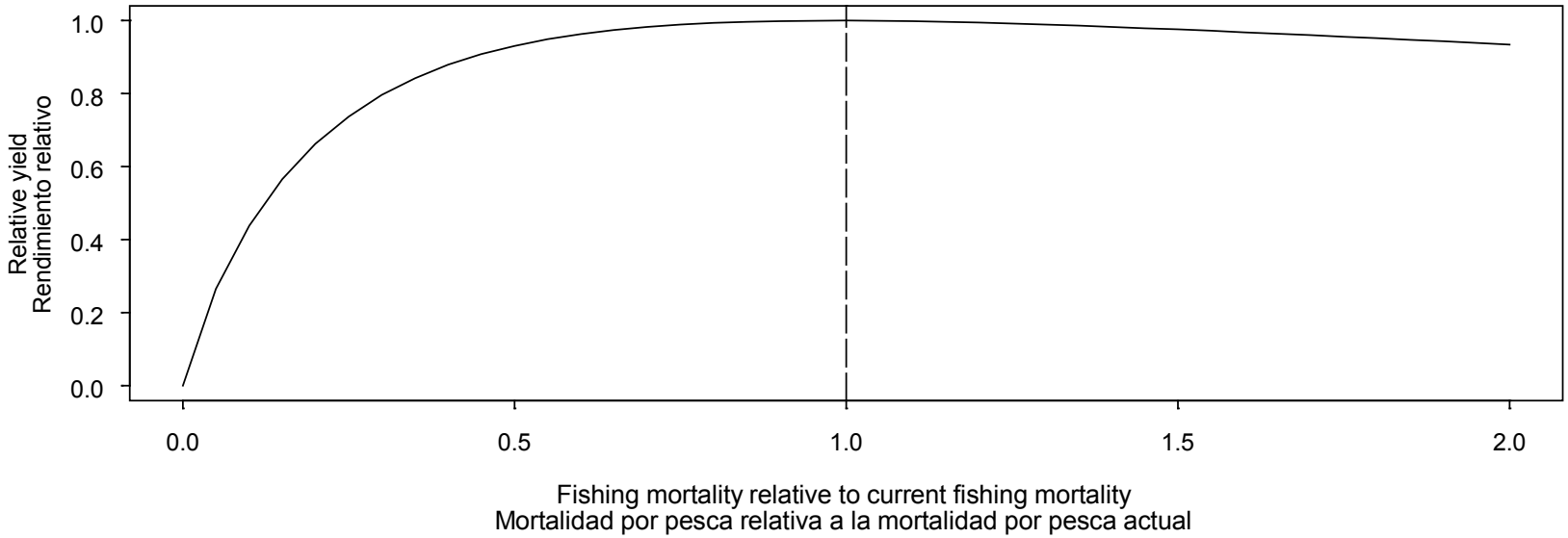
AMSY with method removed

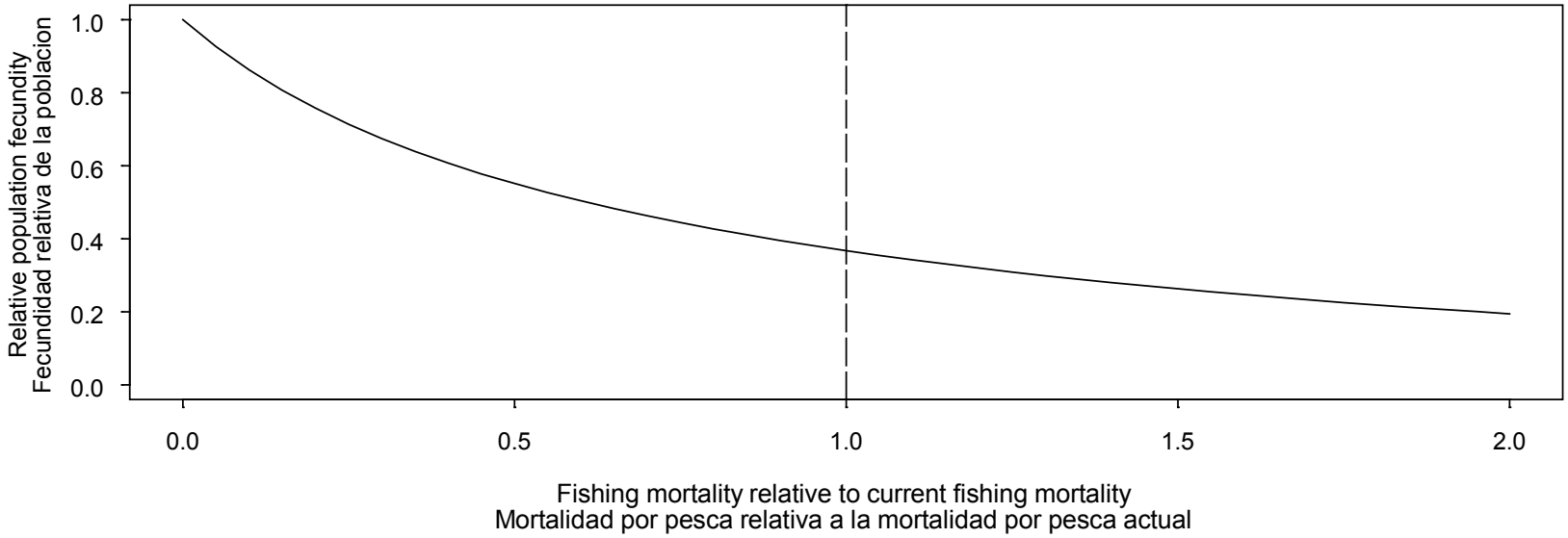
Fishery	**AMSY**	B_{AMSY}	S_{AMSY}	$B_{AMSY}/B_{F=0}$	$S_{AMSY}/S_{F=0}$	***F* multiplier**
Pesquería	**RMSP**	B_{RMSP}	S_{RMSP}	$B_{RMSP}/B_{F=0}$	$S_{RMSP}/S_{F=0}$	**Multiplicador de *F***
All—Todos	287 519	416 379	4 677	0.36	0.37	1.02
No FLT	295 231	416 062	4 607	0.36	0.36	1.20
No UNA	296 439	421 719	4 687	0.36	0.37	1.39
No DOL	268 587	419 120	4 894	0.36	0.38	2.08
No LL	282 176	406 755	4 549	0.35	0.36	1.12

AMSY with effort adjusted

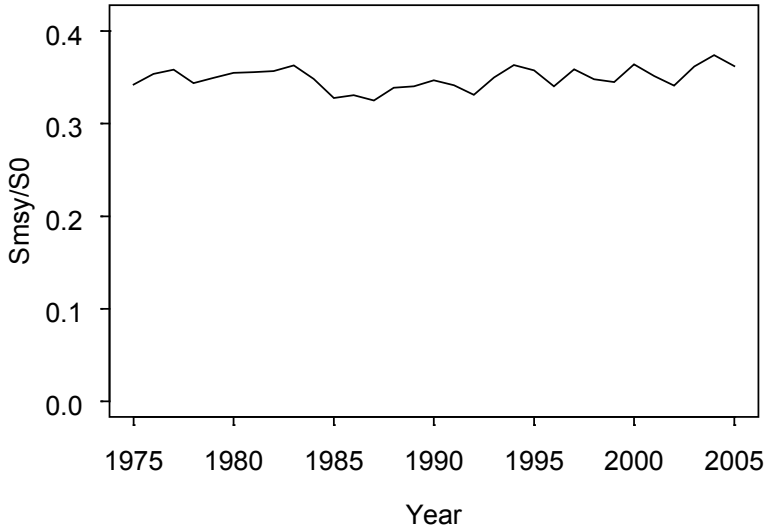
	All gears	Purse-seine only	Longline only	Purse-seine scaled	Longline scaled
	Base				
AMSY—RMSP	287 519	282 176	373 759	287 625	306 171
B_{AMSY}—B_{RMSP}	416 379	406 755	577 040	433 243	327 698
S_{AMSY}—S_{RMSP}	4 677	4 549	6 755	4 920	3 204
B_{AMSY}/B_0—B_{RMSP}/B_0	0.36	0.35	0.41	0.37	0.28
S_{AMSY}/S_0—S_{RMSP}/S_0	0.37	0.36	0.44	0.39	0.25
F multiplier—Multiplicador de *F*	1.02	1.12	12.41	0.94	19.62

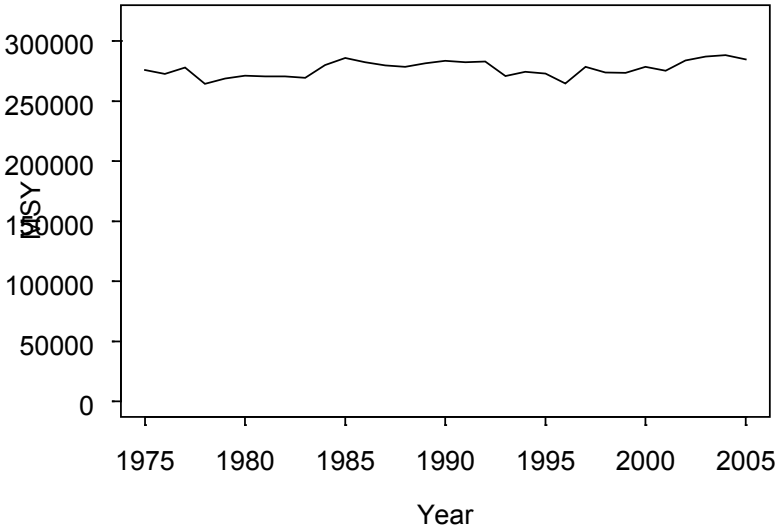
Yield

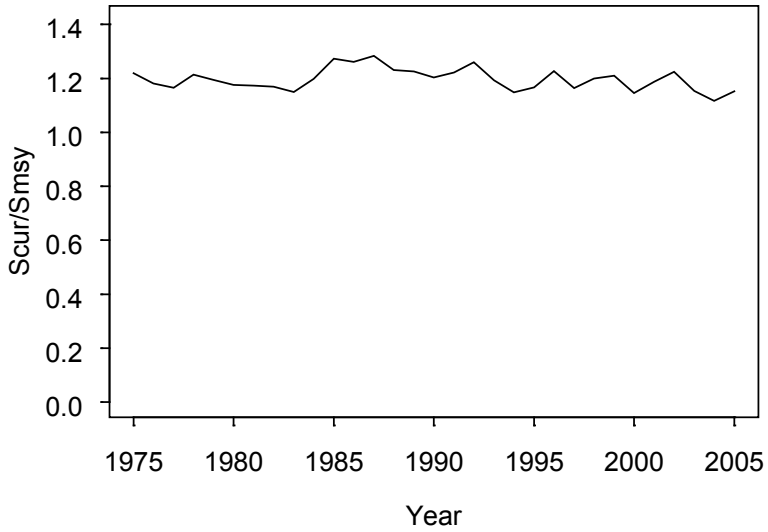

Relative yield
Rendimiento relativo
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual

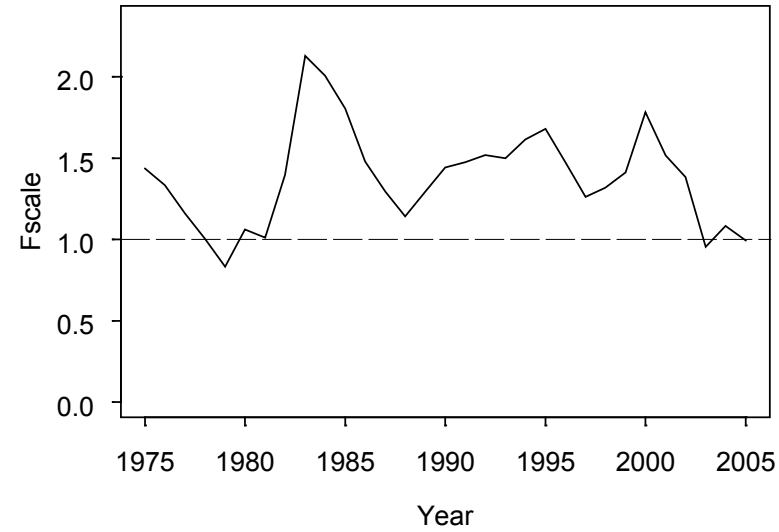

Relative population fecundity
Fecundidad relativa de la poblacion
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual

AMSY quantities using F(y)







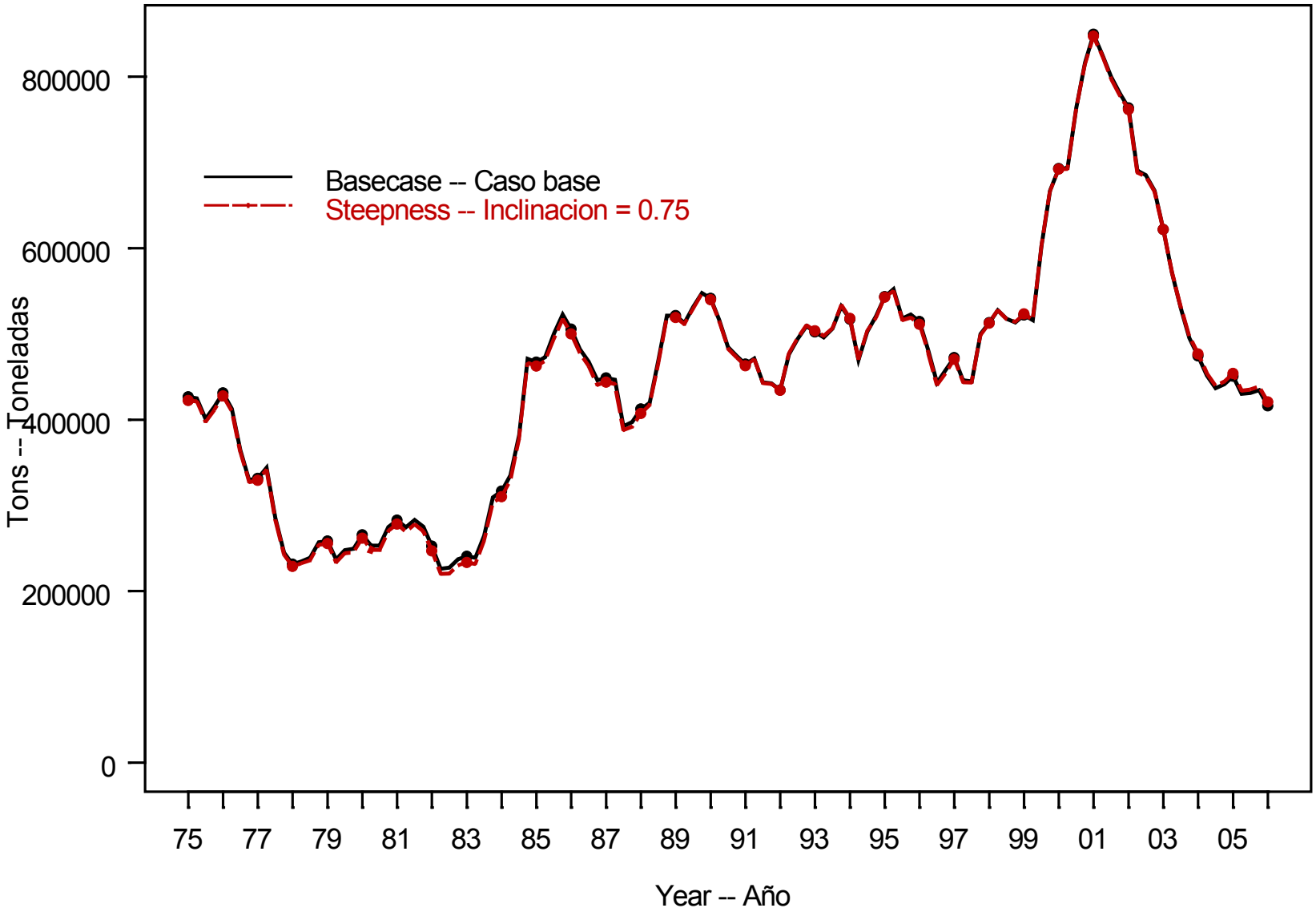


Sensitivity: h = 0.75

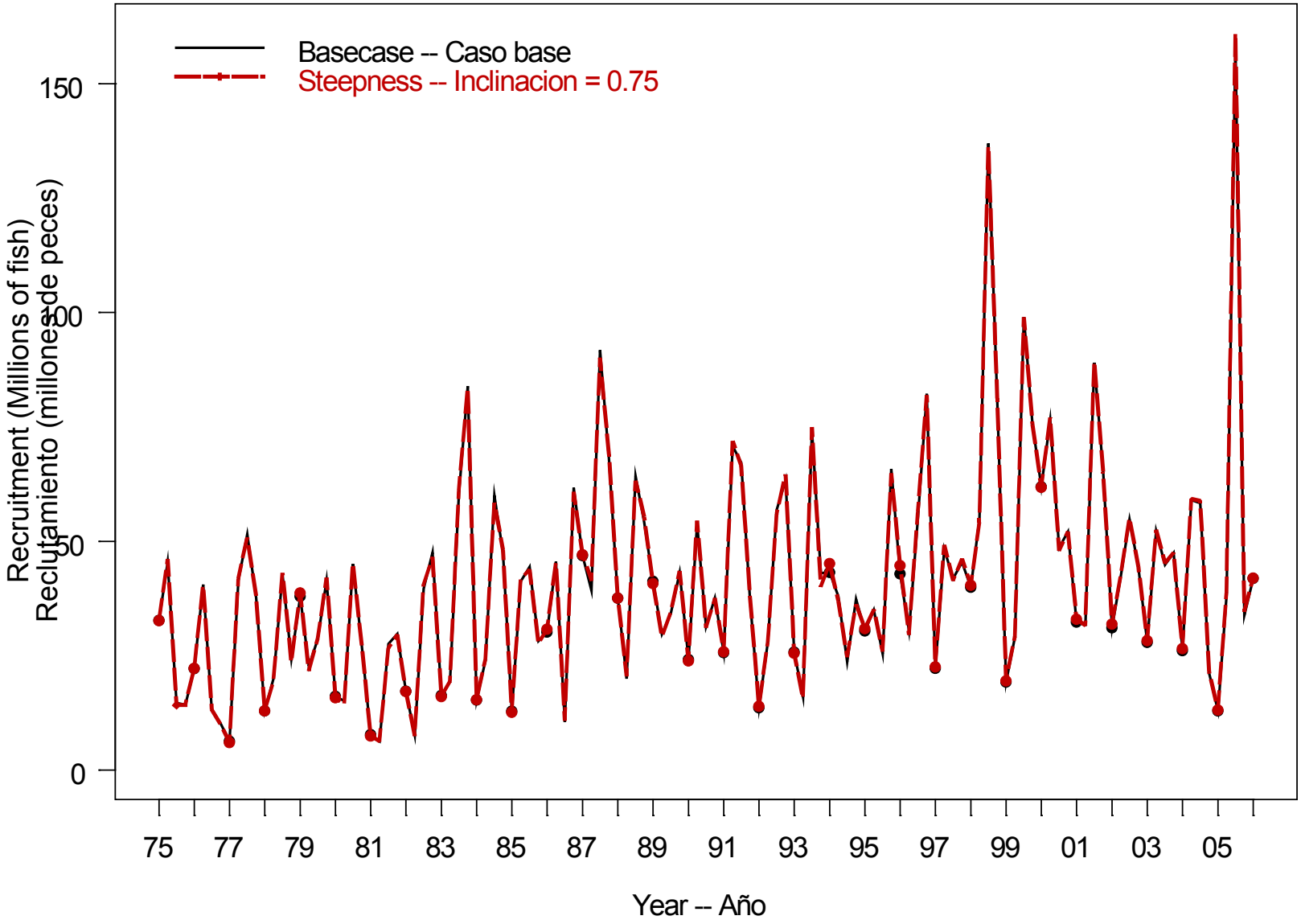
- When the spawning population is 20% of its unexploited level the recruitment is 75% of its unexploited level

- Biomass
- Recruitment
- SBR
- Yield Curve
- AMSY

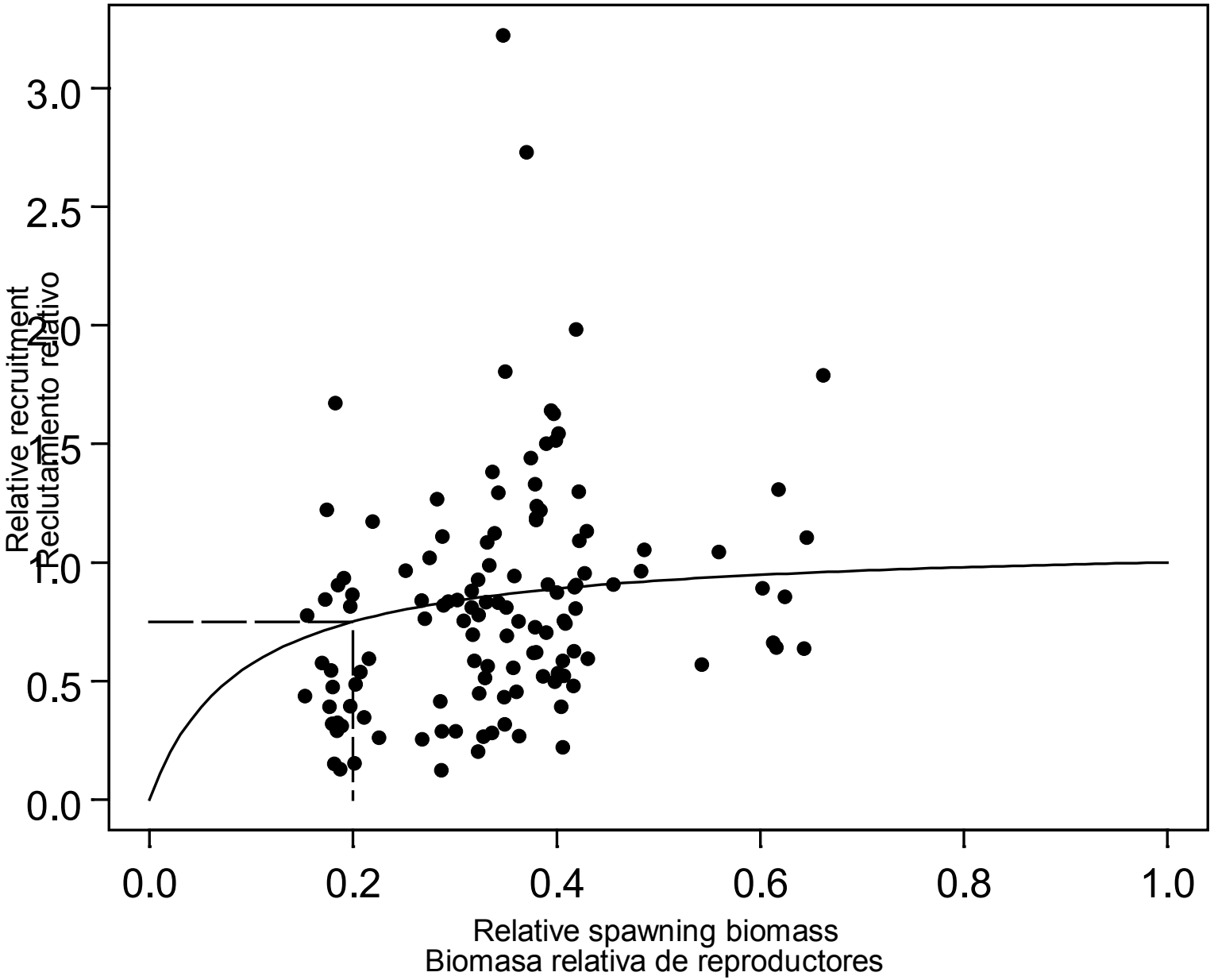
Biomass Comparison



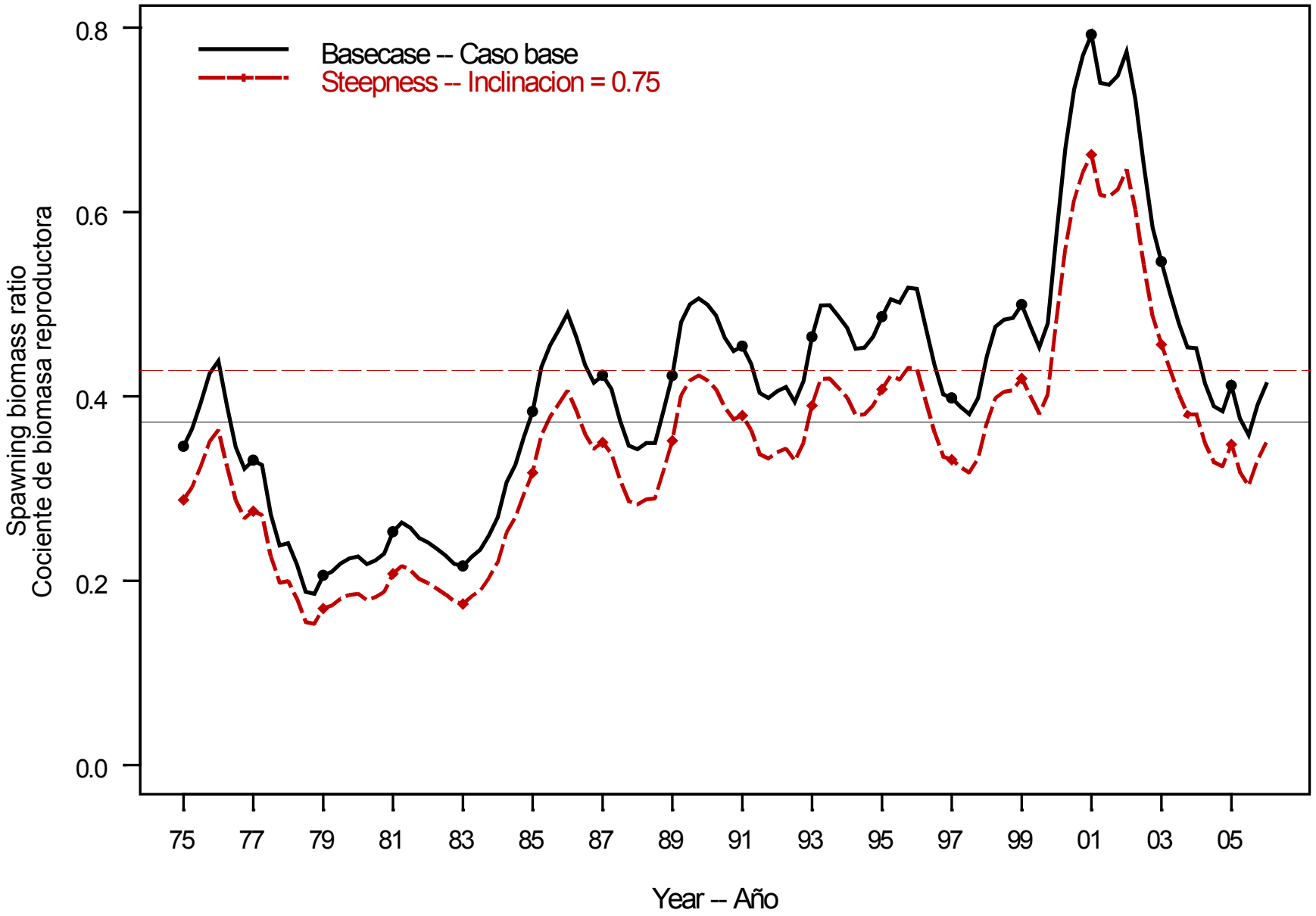
Recruitment



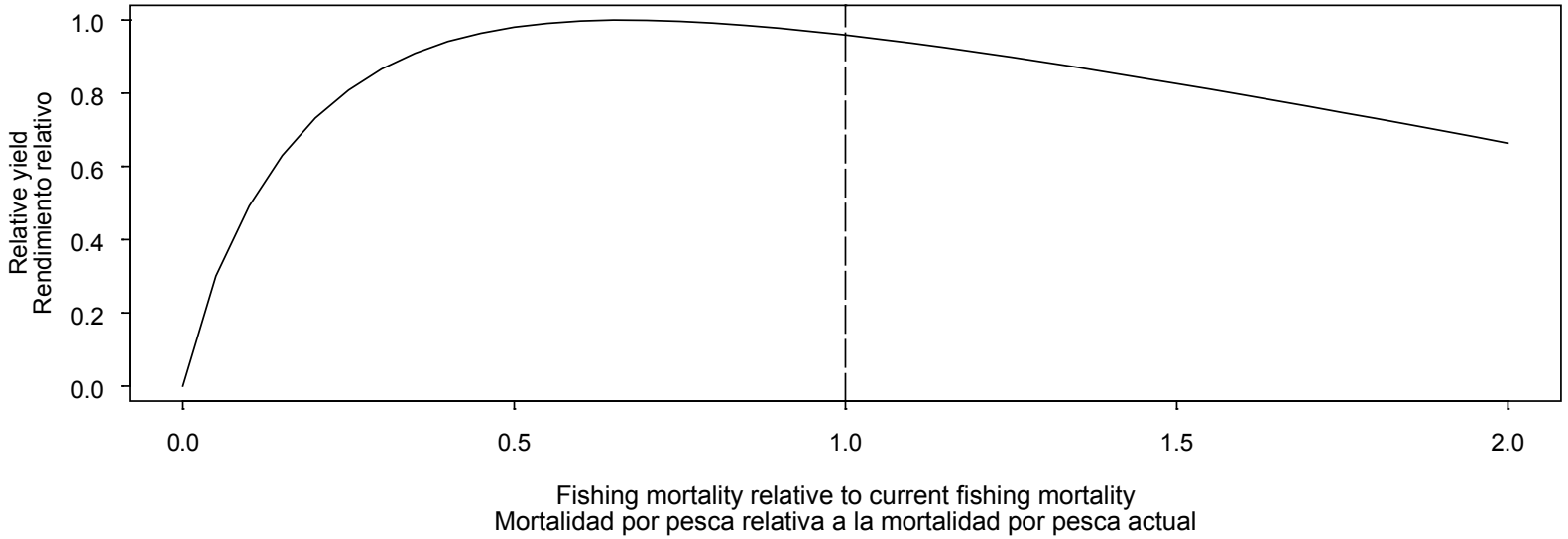
Recruitment

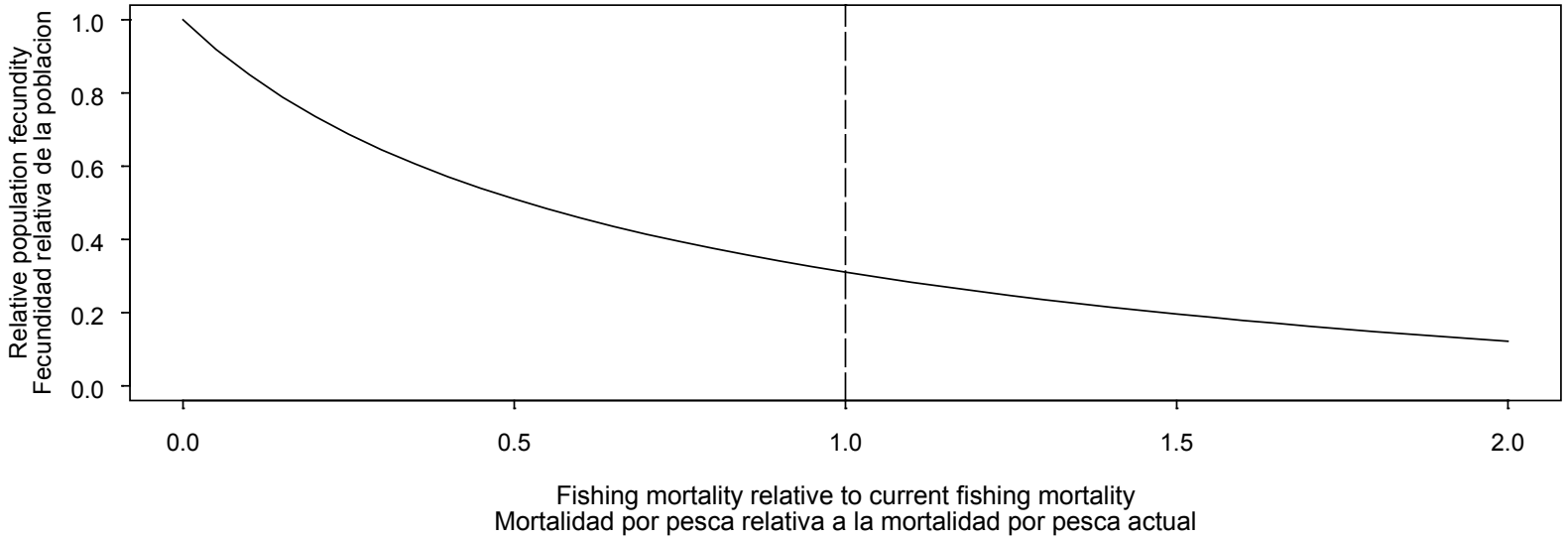


SBR

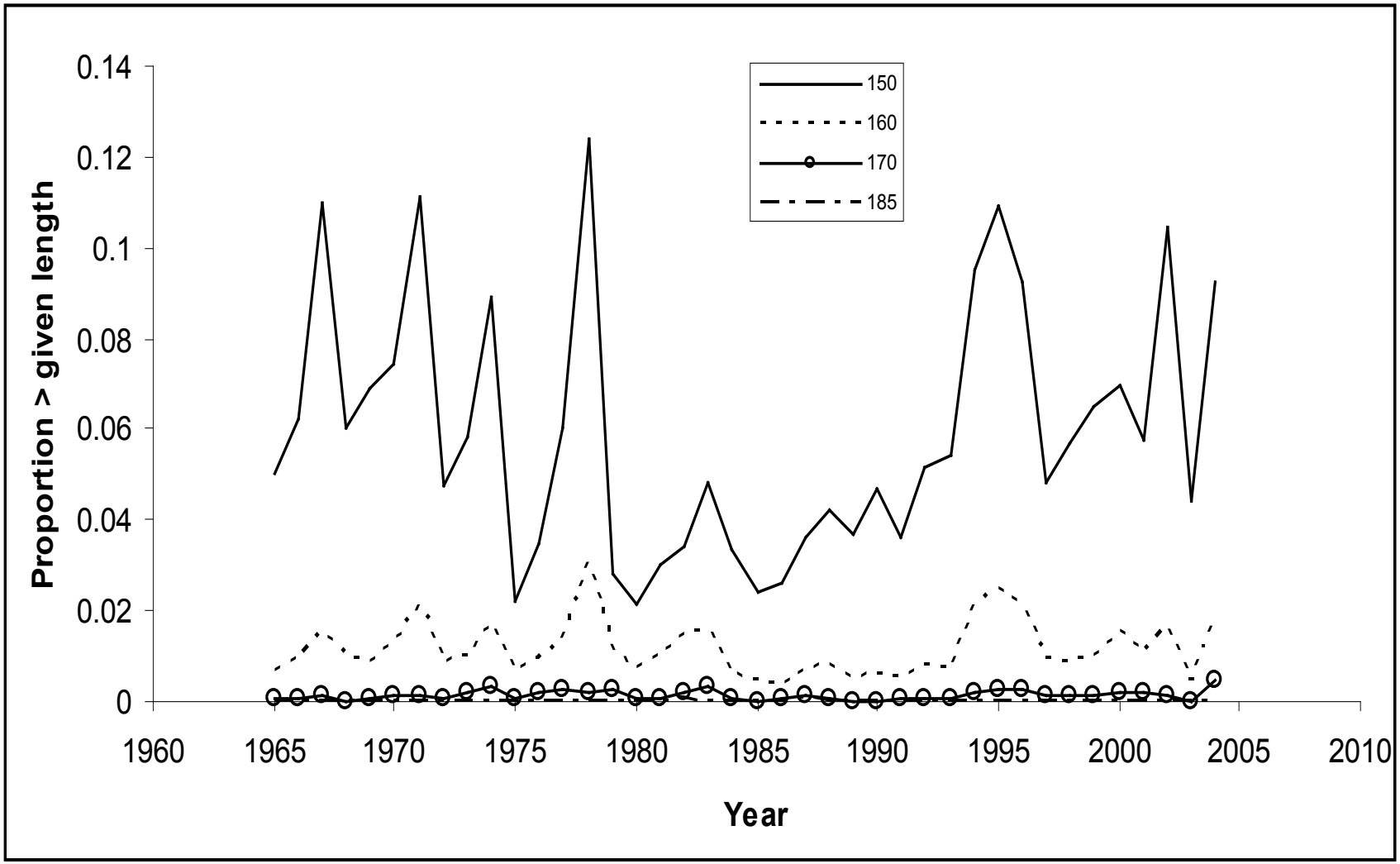

Basecase -- Caso base
Steepness -- Inclinacion = 0.75
Spawning biomass ratio
Cociente de biomasa reproductora
0.0
0.2
0.4
0.6
0.8
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
Year -- Año

Yield Curve

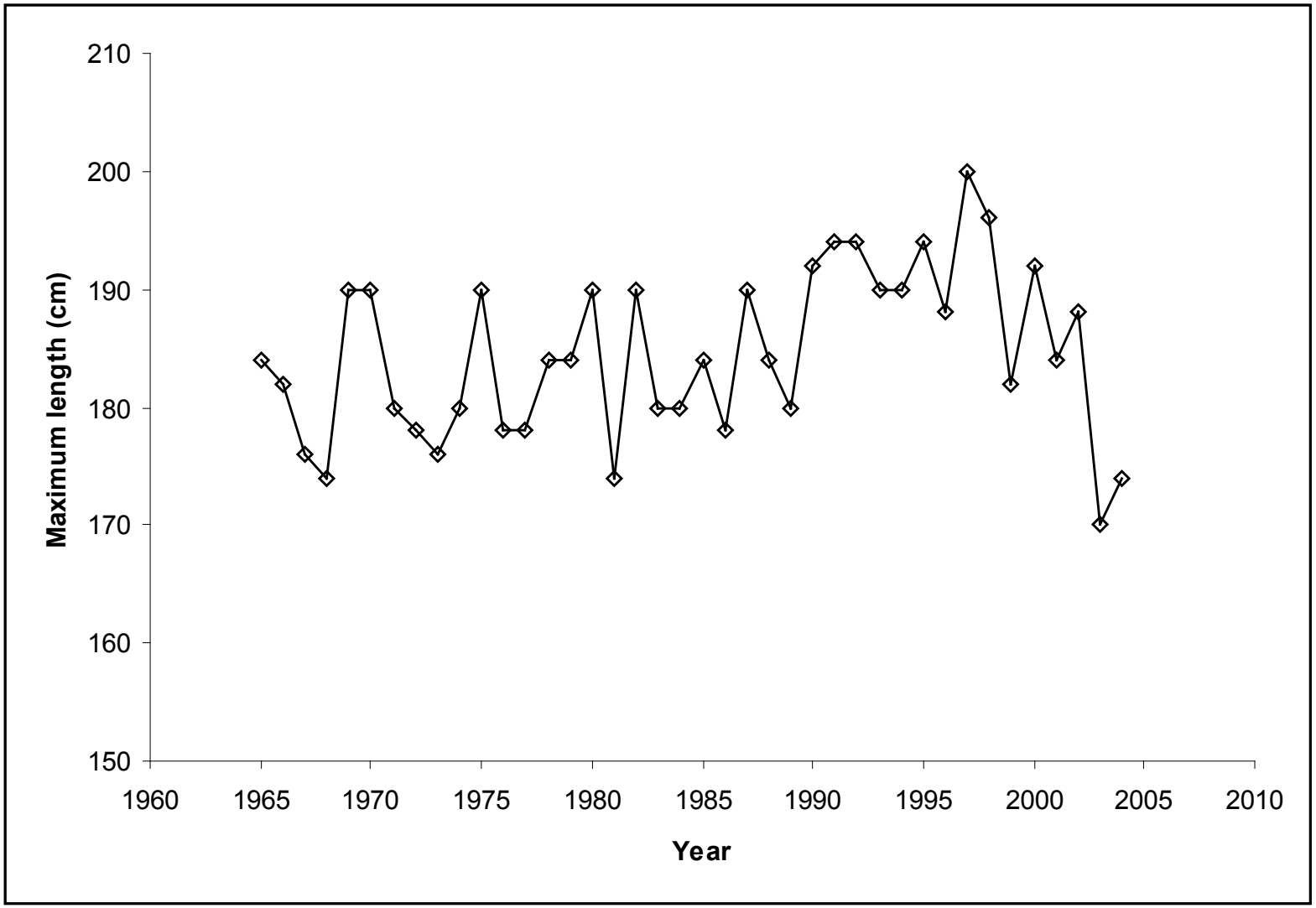

Relative yield
Rendimiento relativo
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual


Relative population fecundity
Fecundidad relativa de la poblacion
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual

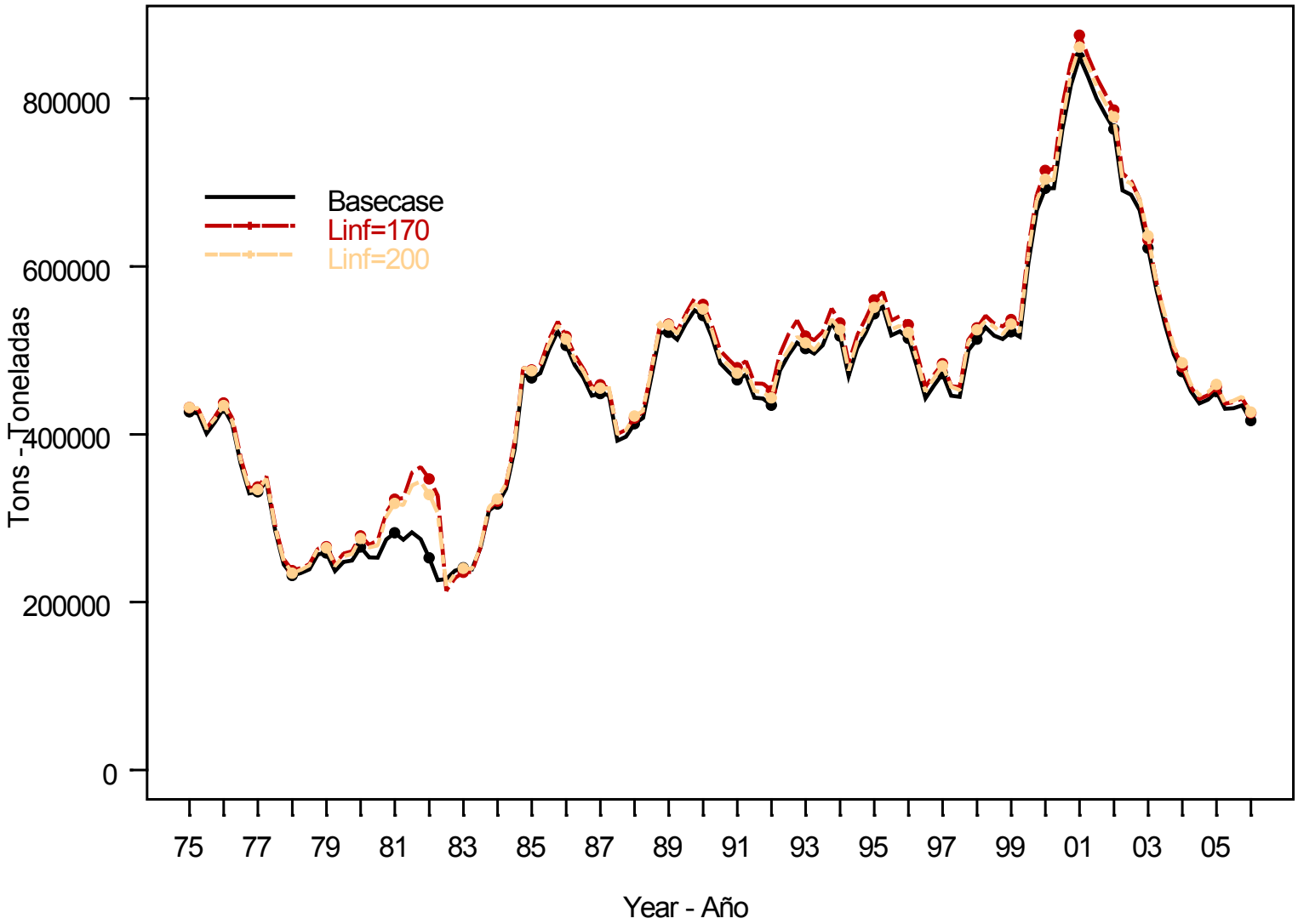
Sensitivity to L_∞: proportion YFT > given length



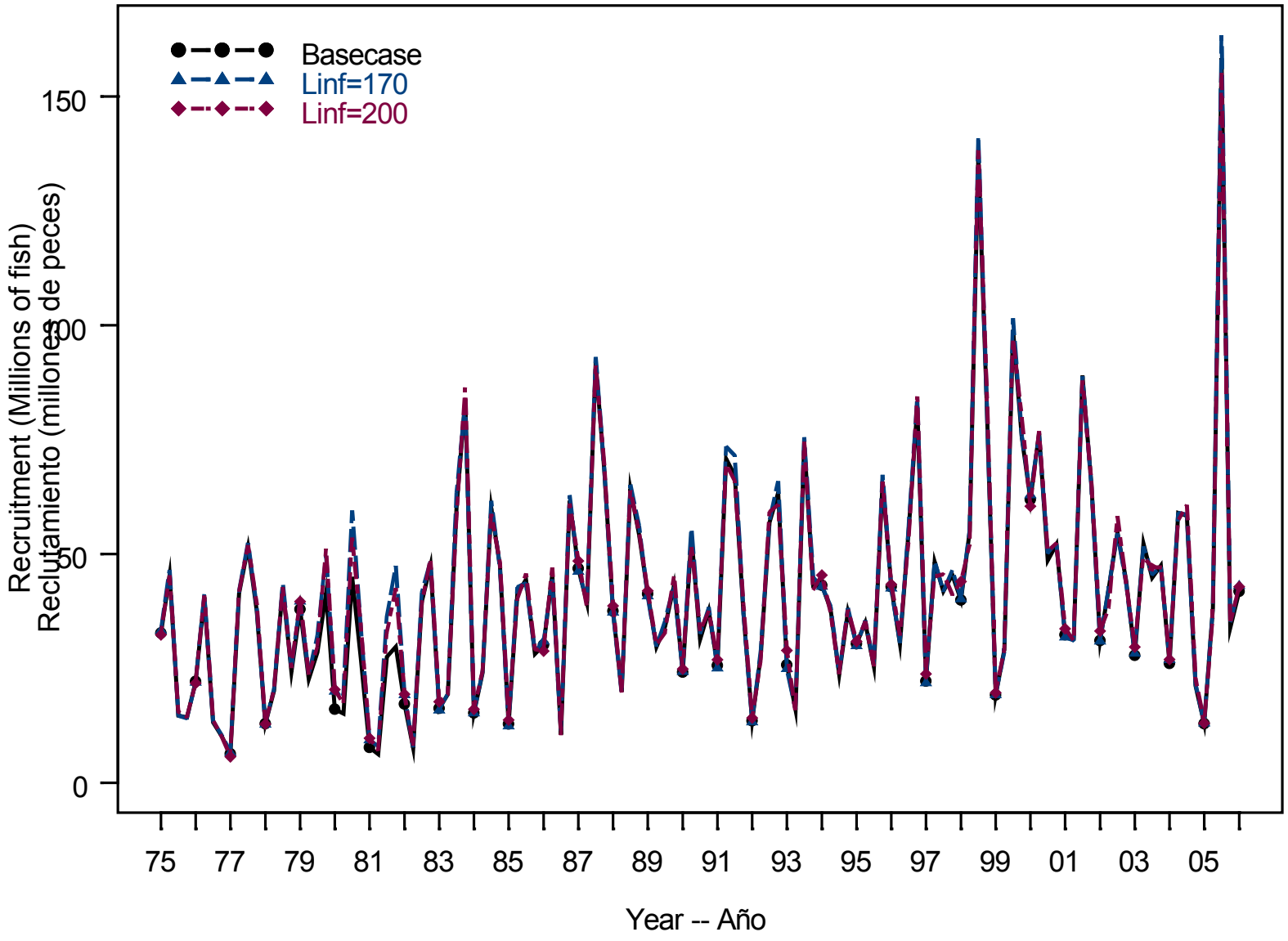
Maximum length observed by yr



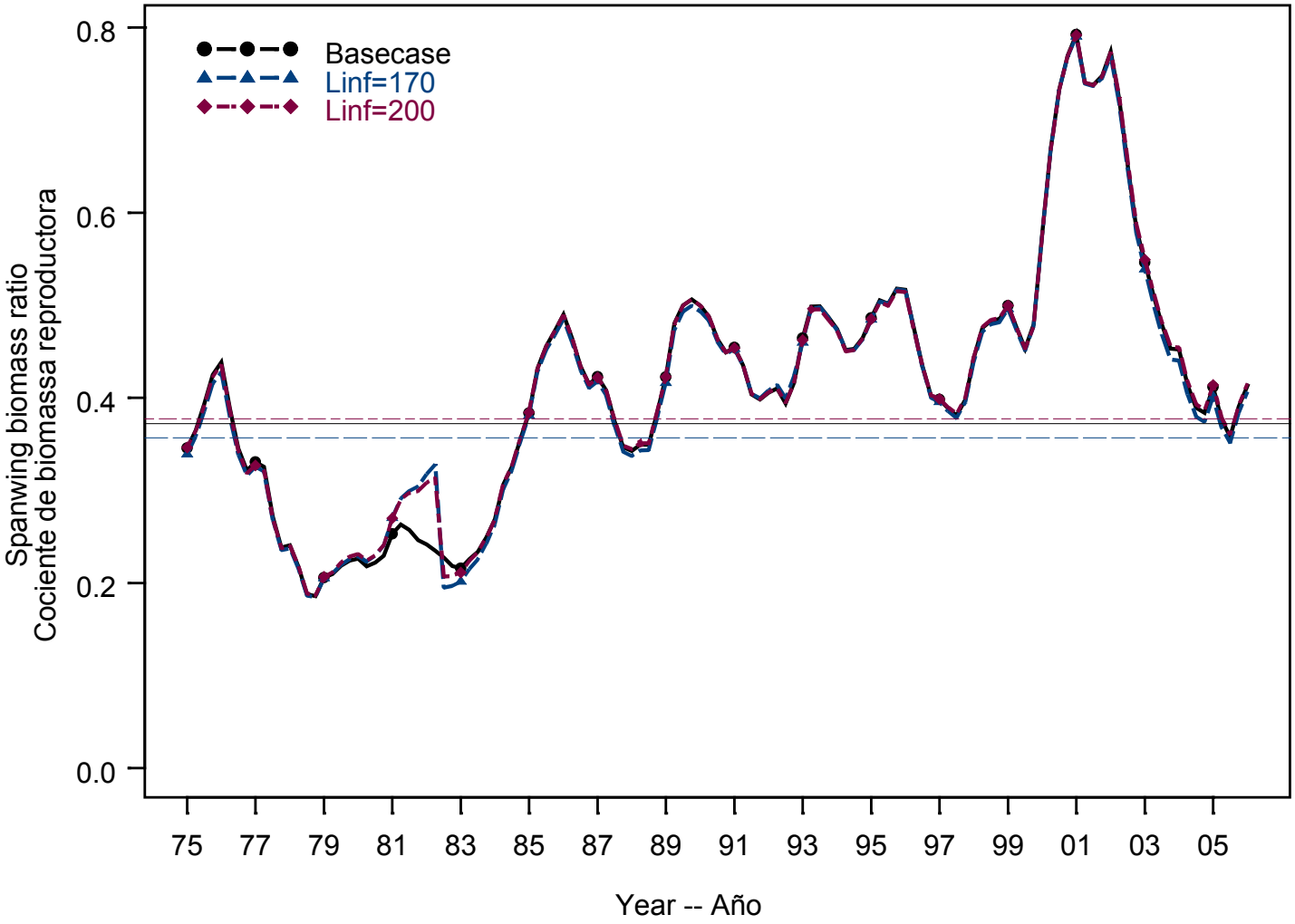
Sensitivity to assumed L_∞: Biomass



Recruitment

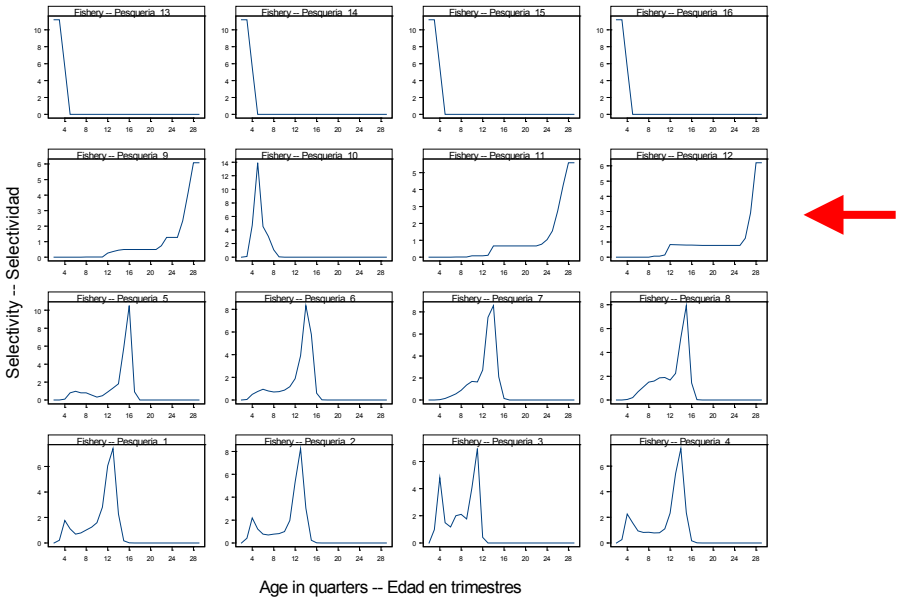


Spawning biomass ratio

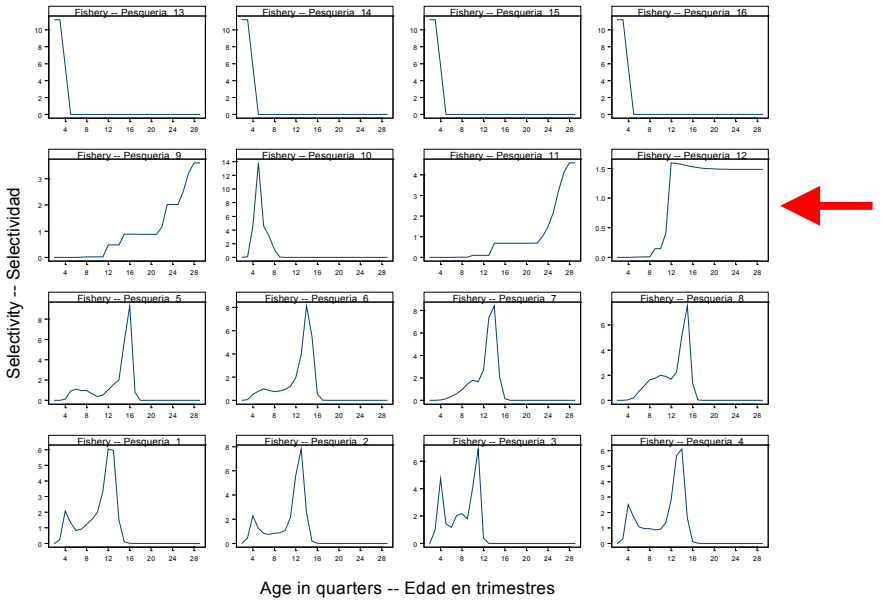


Selectivity

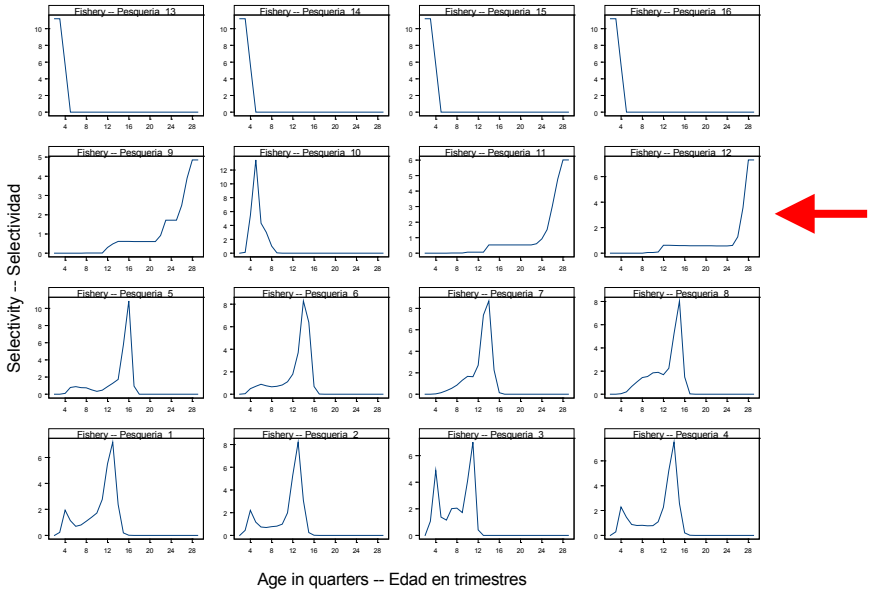
Base case



$L_\infty = 170$



$L_\infty = 200$



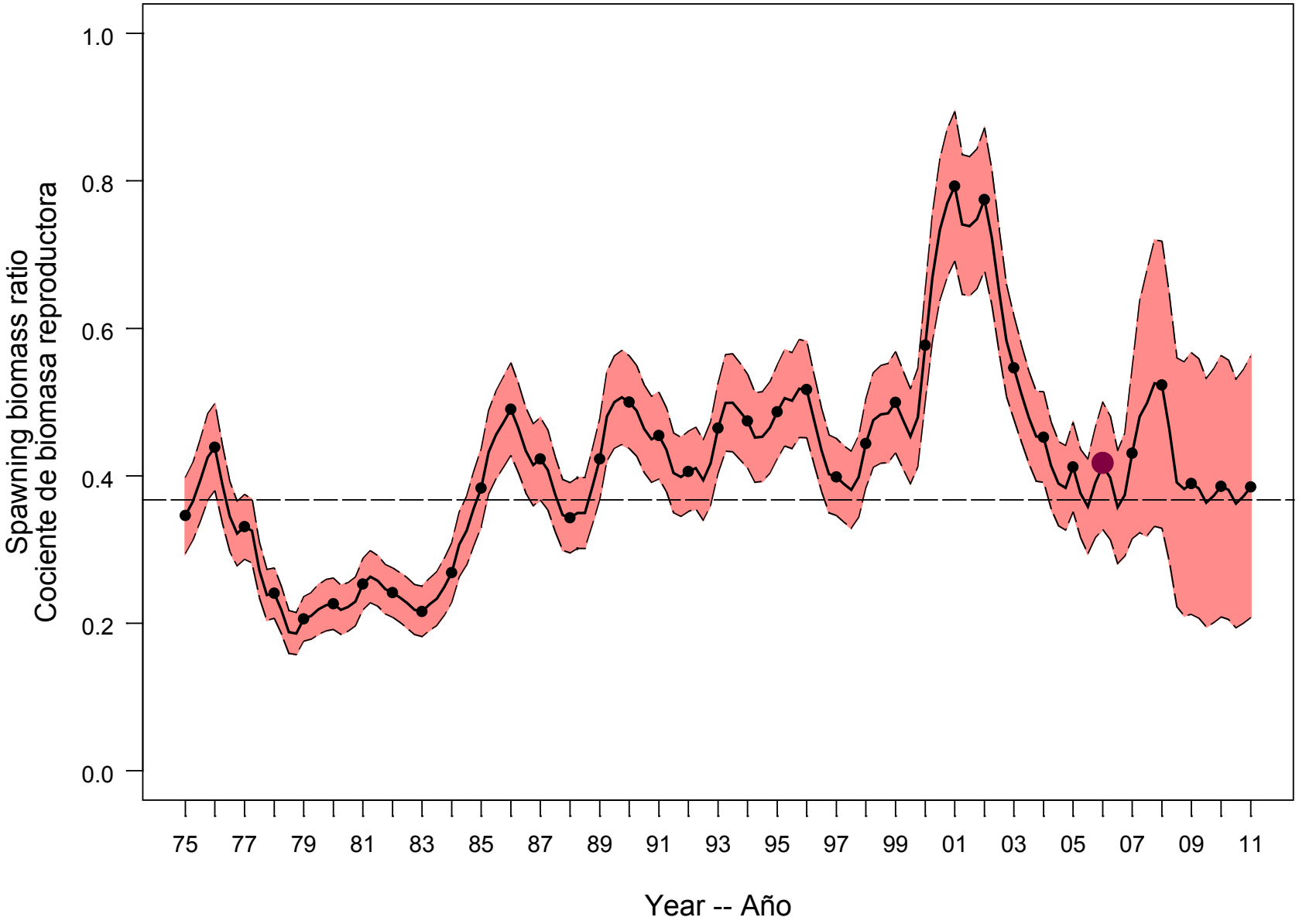
AMSY table

	Base case	**h = 0.75**	**L_∞ = 170**	**L_∞ = 200**
	Caso base	**h = 0.75**	**L_∞ = 170**	**L_∞ = 200**
AMSY–RMSP	287 377	301 706	296 085	292 675
B_{AMSY} –B_{rm2}	420 343	551 532	421 933	432 480
S_{AMSY} —S_{rm2}	4 775	6 555	4 708	4 958
C_{RECENT}/AMSY—C_{2002}/RMSP	1.06	1.01	1.03	1.04
B_{RECENT}/B_{AMSY} –B_{2003}/B_{RMSP}	0.99	0.76	1.01	0.99
S_{RECENT}/S_{AMSY} –S_{2003}/S_{RMSP}	1.11	0.82	1.14	1.10
$S_{AMSY}/S_{F=0}$ –$S_{RMSP}/S_{F=0}$	0.37	0.43	0.36	0.38
F multiplier—Multiplicador de *F*	0.98	0.67	1.05	1.00

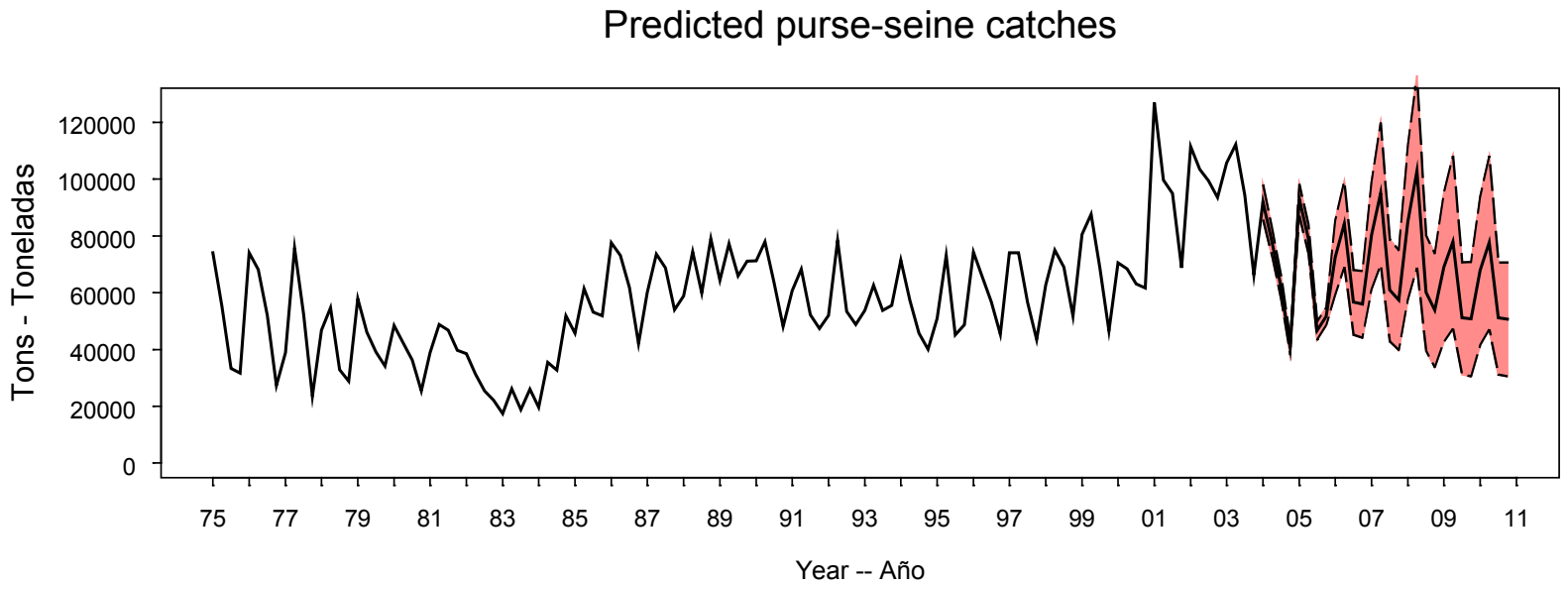
Forward Simulations

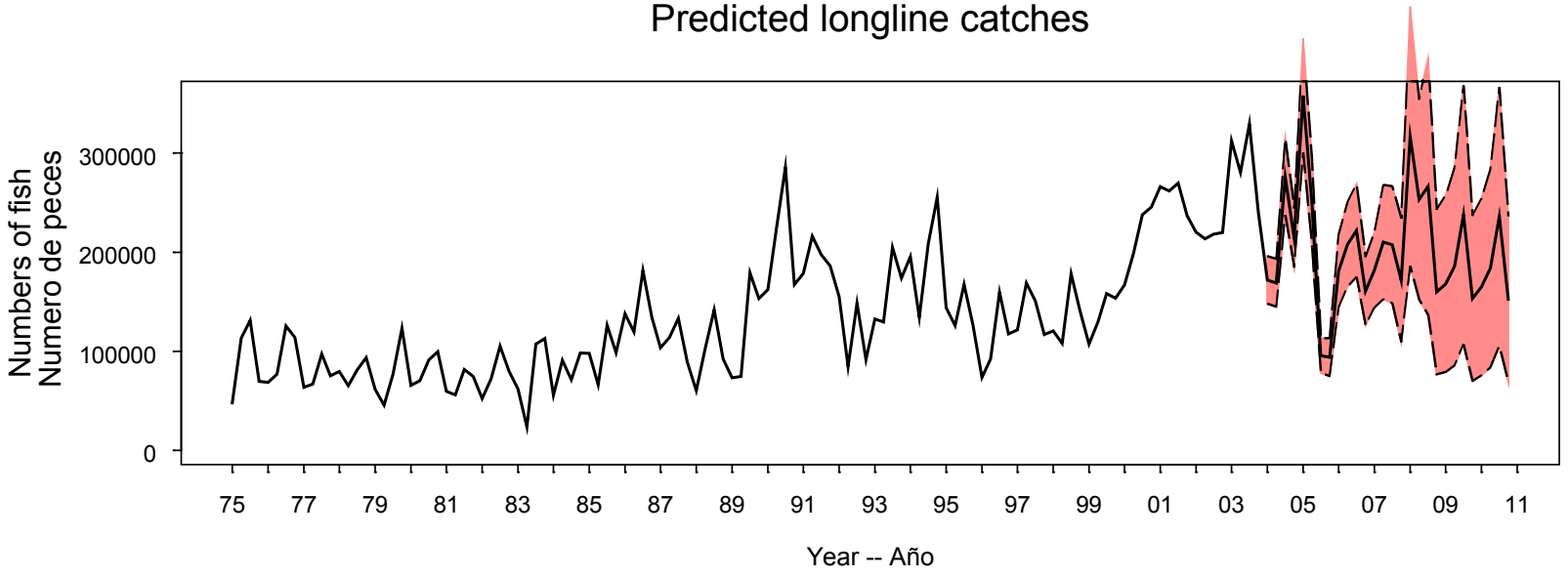
- Depletion ratio
- Surface fishery catch
- Longline catch

SBR

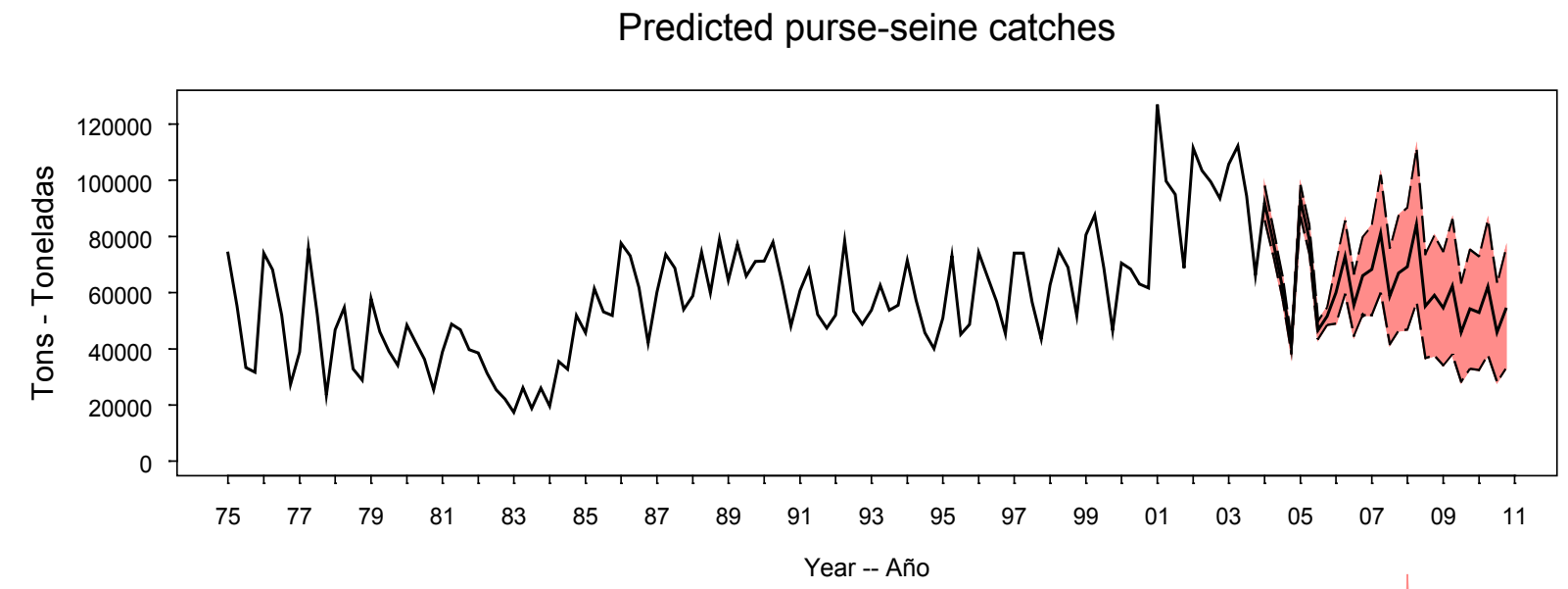

Spawning biomass ratio
Cociente de biomasa reproductora
1.0
0.8
0.6
0.4
0.2
0.0
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
07
09
11
Year -- Año

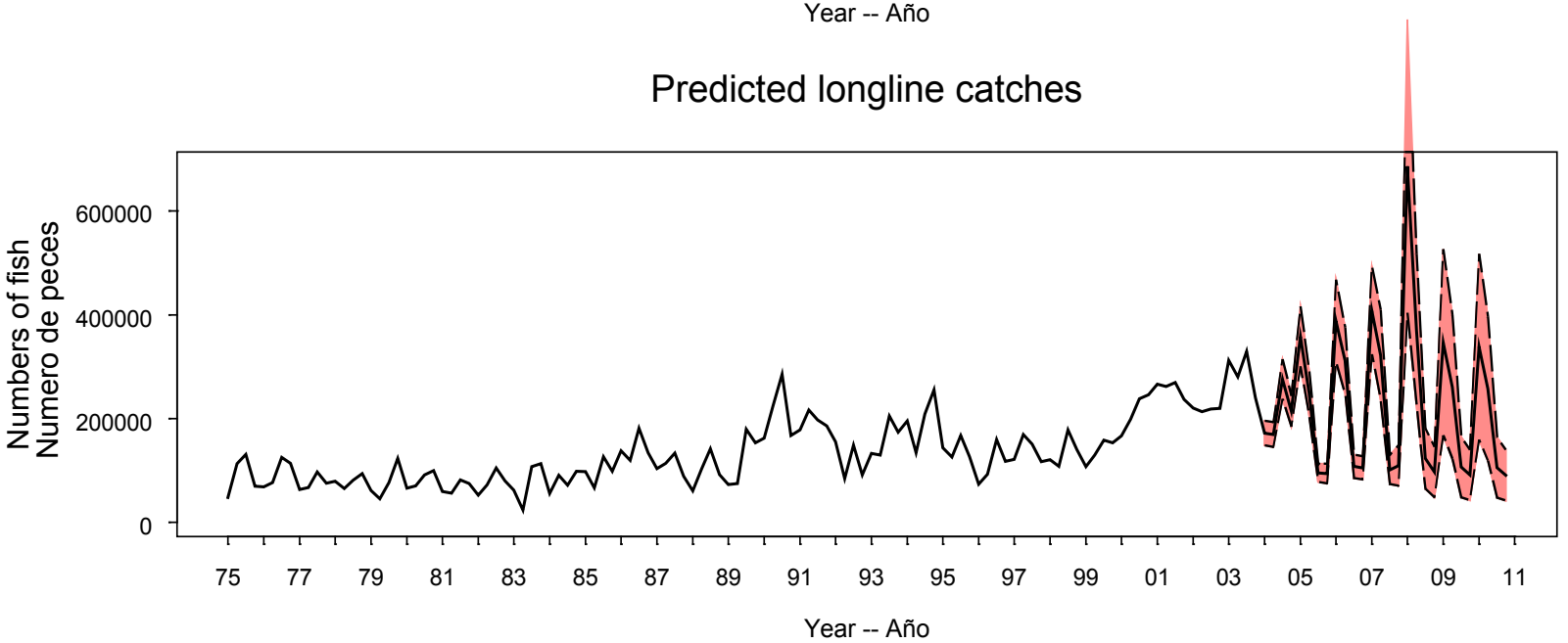
Catch


Predicted purse-seine catches
Tons - Toneladas
120000
100000
80000
60000
40000
20000
0
75 77 79 81 83 85 87 89 91 93 95 97 99 01 03 05 07 09 11
Year -- Año


Predicted longline catches
Numbers of fish
Numero de peces
300000
200000
100000
0
75 77 79 81 83 85 87 89 91 93 95 97 99 01 03 05 07 09 11
Year -- Año

Catch with median catchability





Summary: Main Results

- The results are similar to the previous four assessments, except that SBR at SBR_{AMSY} is lower than in the last assessment
- The biomass is estimated to have declined slightly in 2005
- There is uncertainty about recent and future recruitment and biomass levels

What is robust

- The trend in biomass
- The regime shift in recruitment

Plausible Sensitivities and Uncertainties

- The stock recruitment relationship
- Asymptotic length
- Uncertainty in current biomass and recruitment

Conclusions

1. The biomass is estimated to have declined slightly in 2005
2. The current SBR may be close to the SBR required to produce AMSY
3. The current fishing mortality rates are close to those required to produce AMSY
4. The average weight of a yellowfin in the catch is much less than the critical weight and increasing the average weight could increase AMSY
5. There have been two different productivity regimes and the levels of AMSY and the biomass required to produce AMSY may differ between the regimes

The END