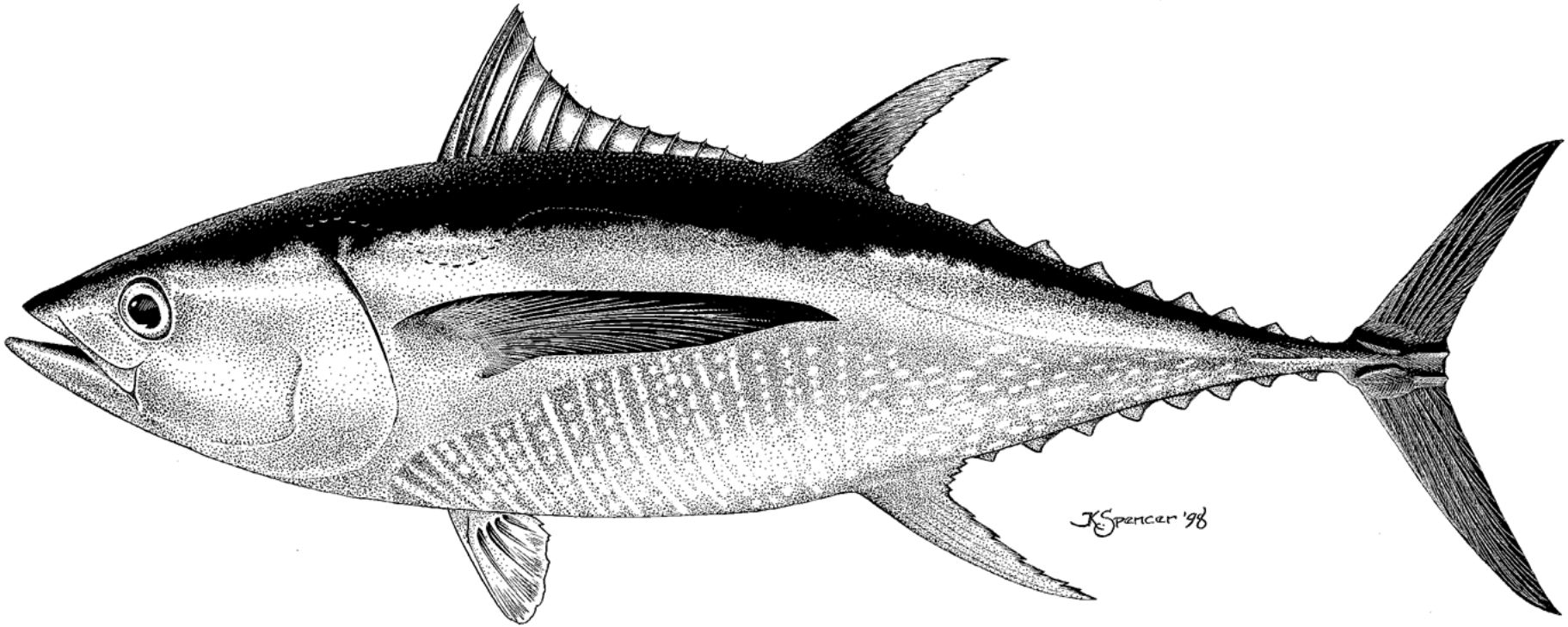
Yellowfin Tuna 1975-2006



Major Changes

- Catch, effort, and length-frequency data for the surface fisheries have been updated to include new data for 2006 and revised data for 2000-2005.
- New or updated longline catch data are available for Chinese Taipei (2002-2005), China (2001-2005), and the Republic of Korea (2003-2005).

Sensitivity Analyses

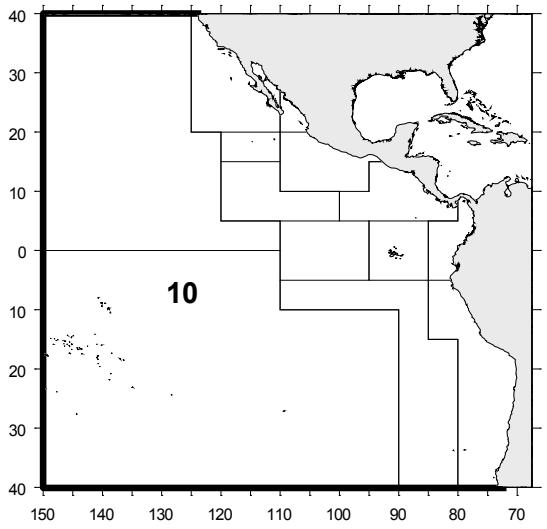
- Stock recruitment relationship

Data

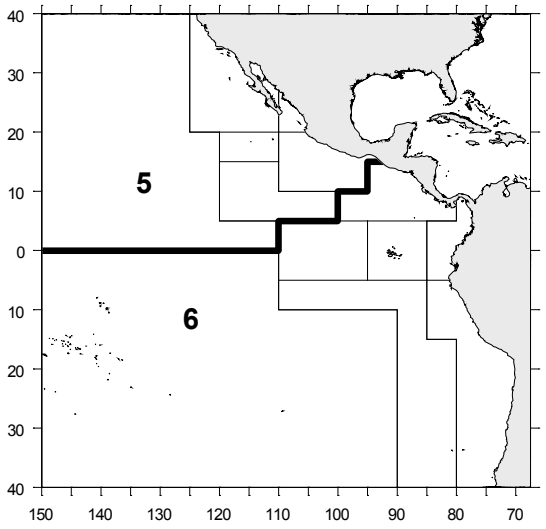
- Fishery definitions
- Catch
- Effort
- Length frequency

Yellowfin Fishery Definitions

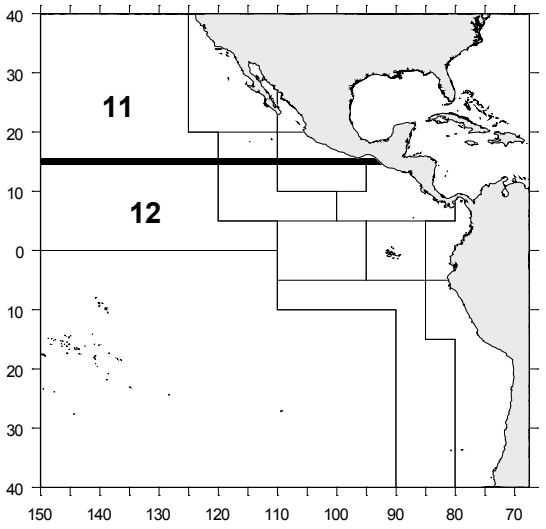
Baitboat



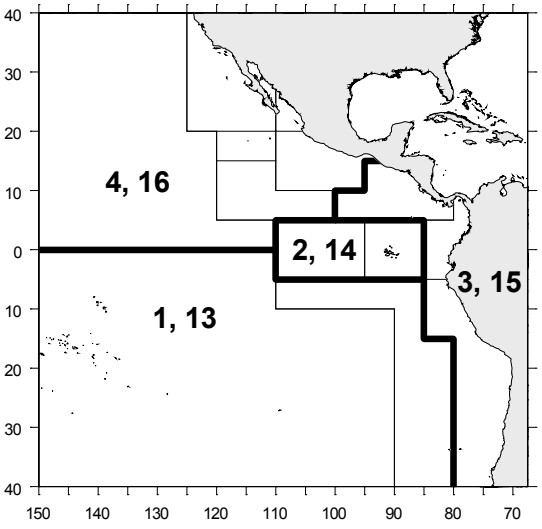
Unassociated



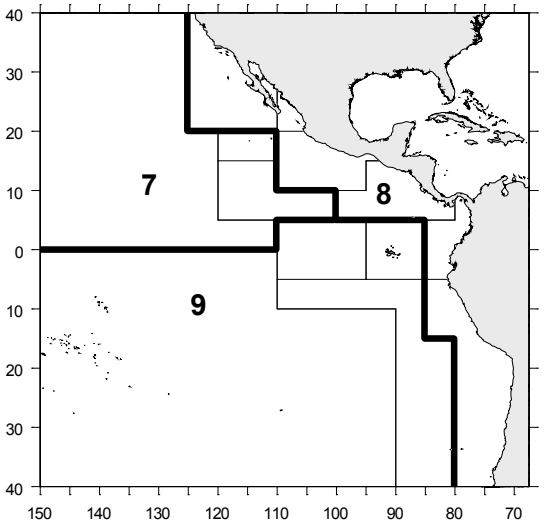
Longline



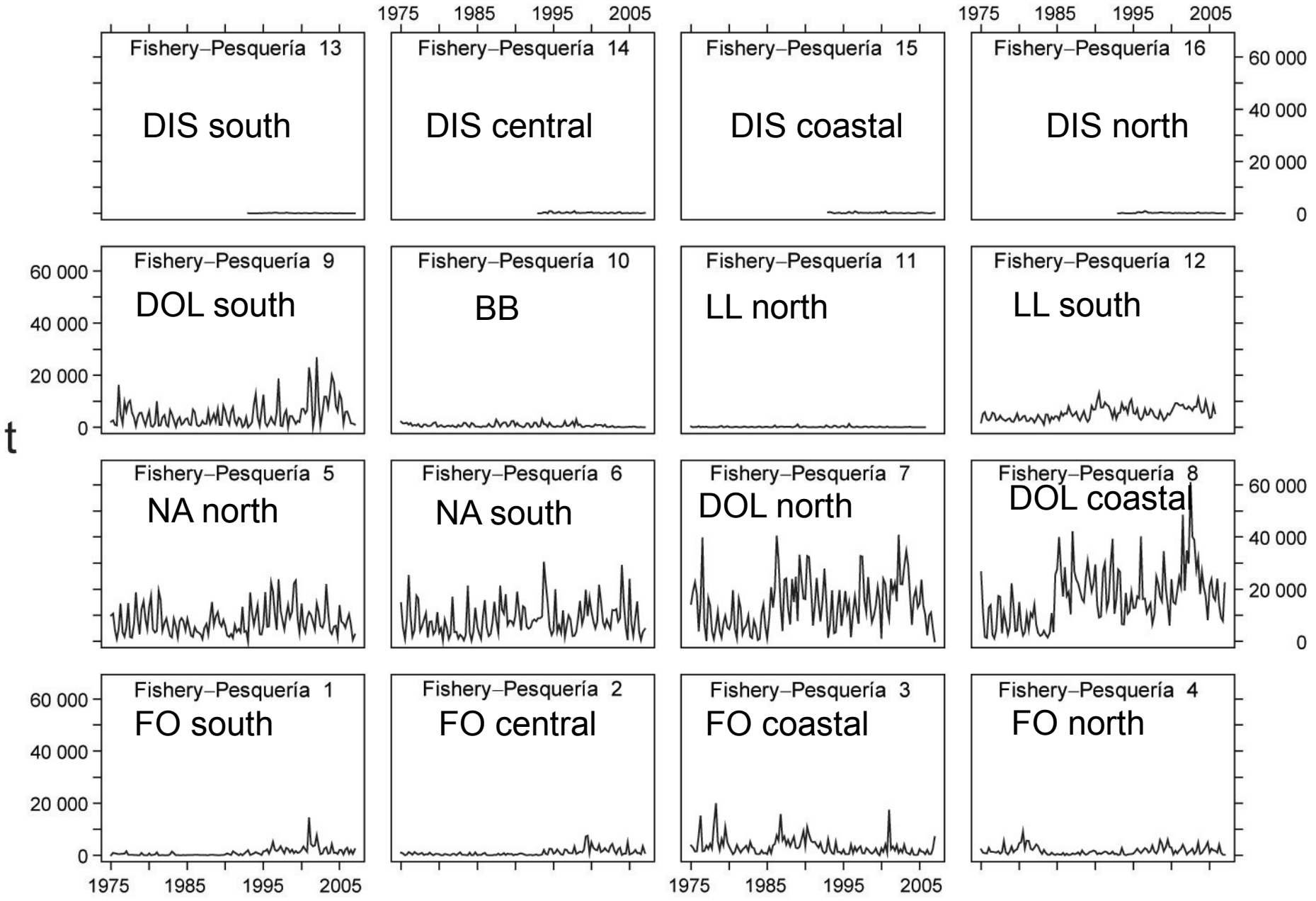
Floating Objects



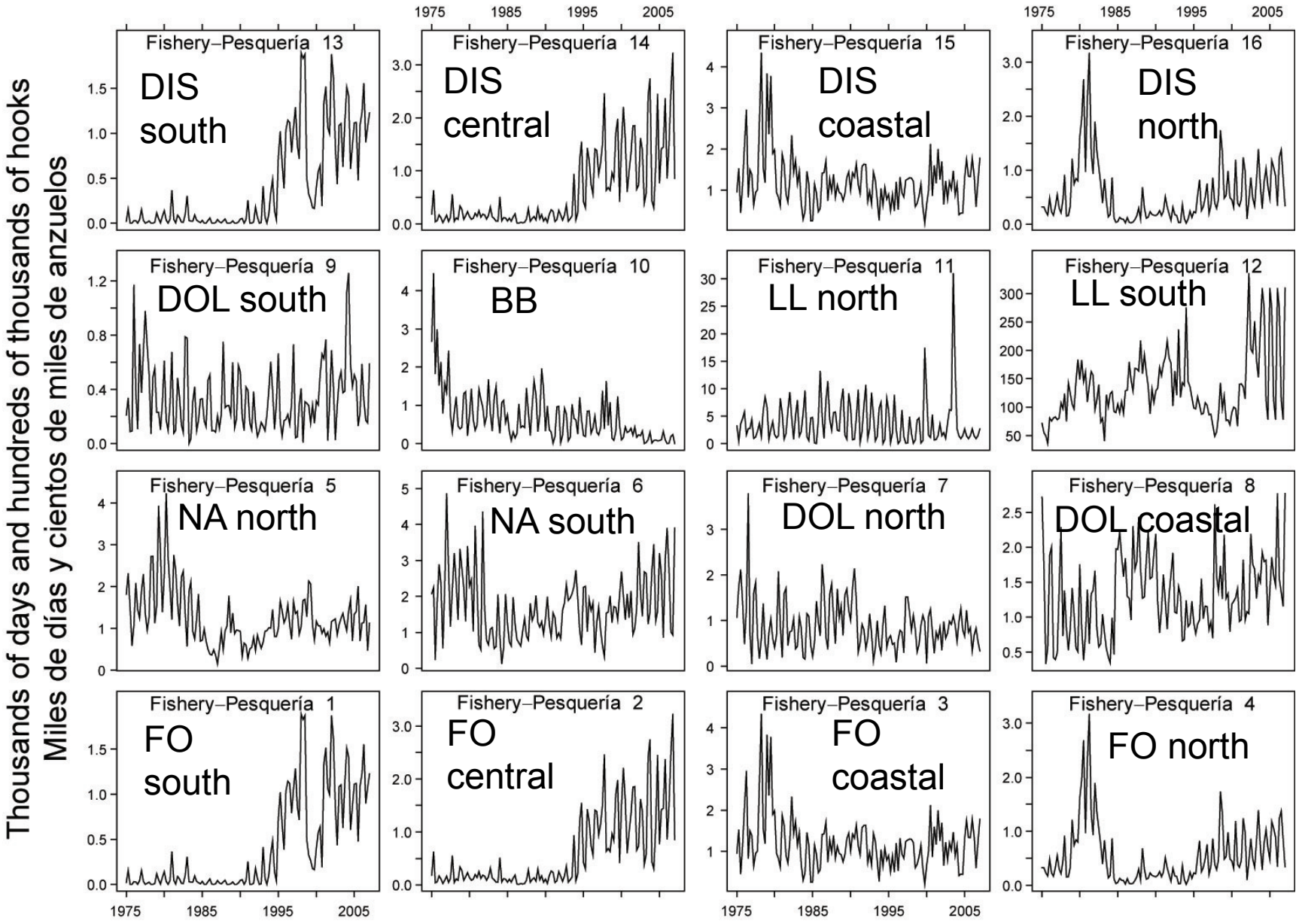
Dolphin



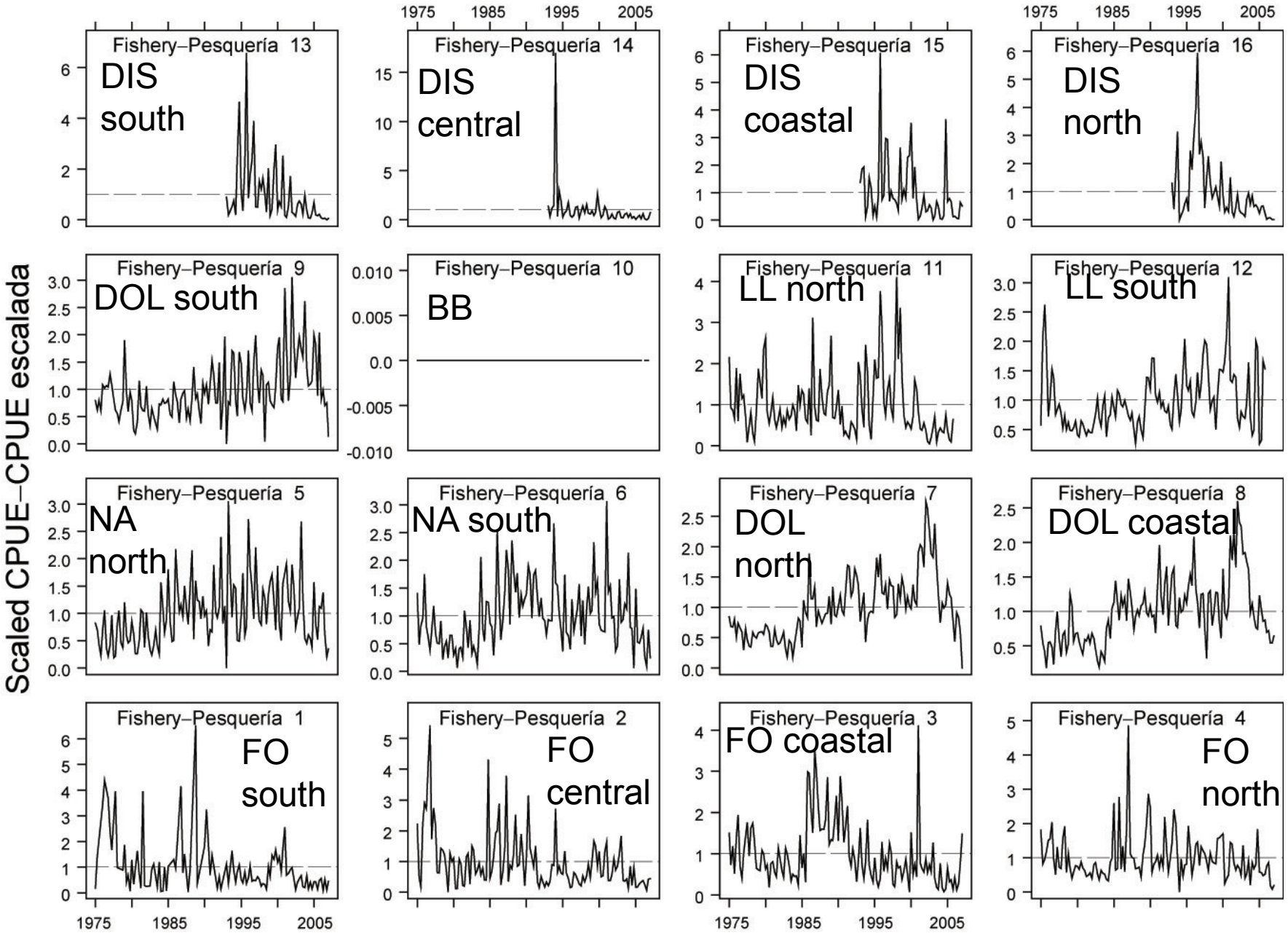
Catch


Fishery–Pesquería 13
DIS south
Fishery–Pesquería 14
DIS central
Fishery–Pesquería 15
DIS coastal
Fishery–Pesquería 16
DIS north
Fishery–Pesquería 9
DOL south
Fishery–Pesquería 10
BB
Fishery–Pesquería 11
LL north
Fishery–Pesquería 12
LL south
Fishery–Pesquería 5
NA north
Fishery–Pesquería 6
NA south
Fishery–Pesquería 7
DOL north
Fishery–Pesquería 8
DOL coastal
Fishery–Pesquería 1
FO south
Fishery–Pesquería 2
FO central
Fishery–Pesquería 3
FO coastal
Fishery–Pesquería 4
FO north
t
0
20 000
40 000
60 000
1975
1985
1995
2005

Effort


Thousands of days and hundreds of thousands of hooks
Miles de días y cientos de miles de anzuelos
Fishery–Pesquería 13
DIS south
Fishery–Pesquería 14
DIS central
Fishery–Pesquería 15
DIS coastal
Fishery–Pesquería 16
DIS north
Fishery–Pesquería 9
DOL south
Fishery–Pesquería 10
BB
Fishery–Pesquería 11
LL north
Fishery–Pesquería 12
LL south
Fishery–Pesquería 5
NA north
Fishery–Pesquería 6
NA south
Fishery–Pesquería 7
DOL north
Fishery–Pesquería 8
DOL coastal
Fishery–Pesquería 1
FO south
Fishery–Pesquería 2
FO central
Fishery–Pesquería 3
FO coastal
Fishery–Pesquería 4
FO north
1975
1985
1995
2005

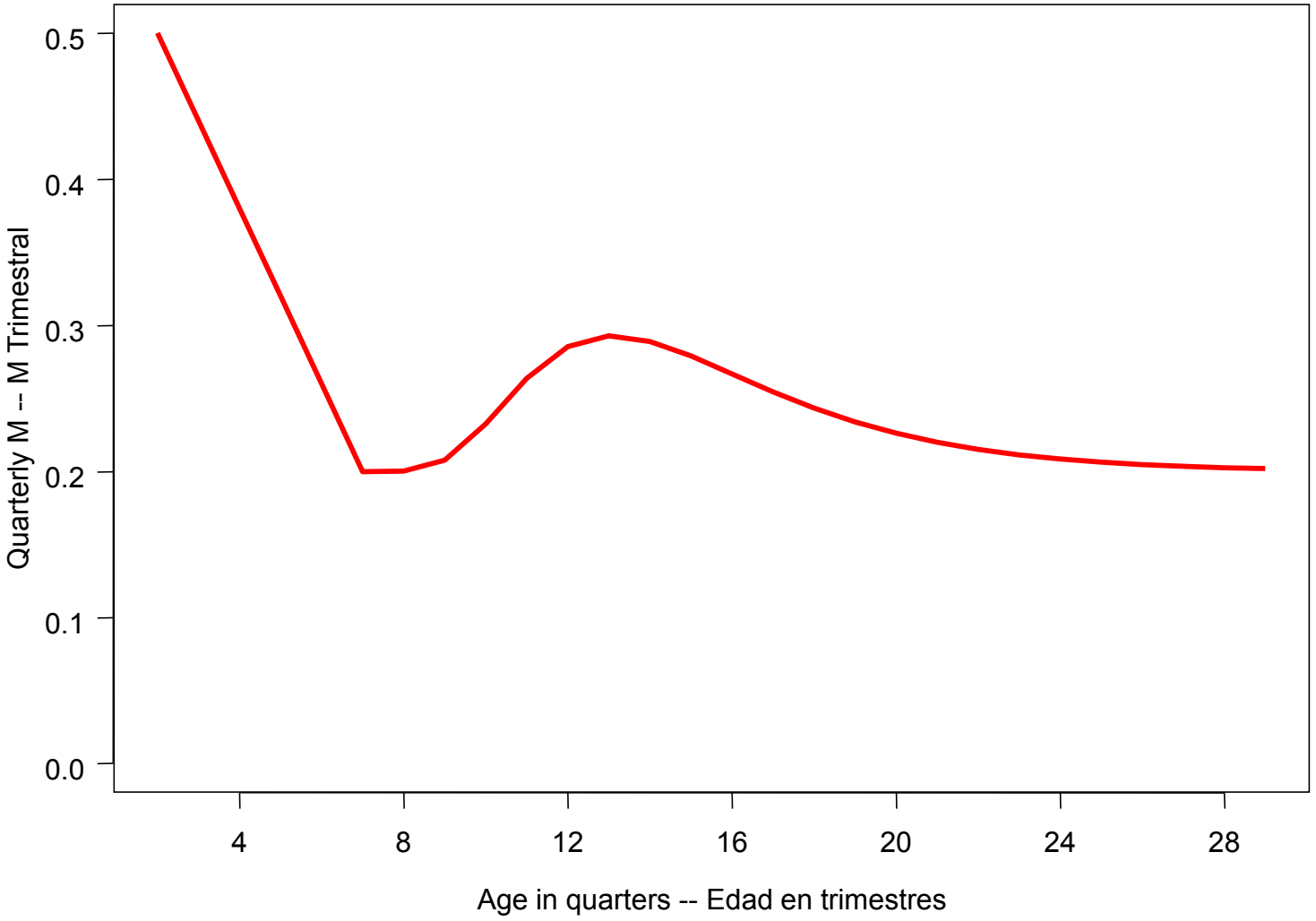
CPUE


Scaled CPUE–CPUE escalada
Fishery–Pesquería 13
DIS south
Fishery–Pesquería 14
DIS central
Fishery–Pesquería 15
DIS coastal
Fishery–Pesquería 16
DIS north
Fishery–Pesquería 9
DOL south
Fishery–Pesquería 10
BB
Fishery–Pesquería 11
LL north
Fishery–Pesquería 12
LL south
Fishery–Pesquería 5
NA north
Fishery–Pesquería 6
NA south
Fishery–Pesquería 7
DOL north
Fishery–Pesquería 8
DOL coastal
Fishery–Pesquería 1
FO south
Fishery–Pesquería 2
FO central
Fishery–Pesquería 3
FO coastal
Fishery–Pesquería 4
FO north
1975
1985
1995
2005

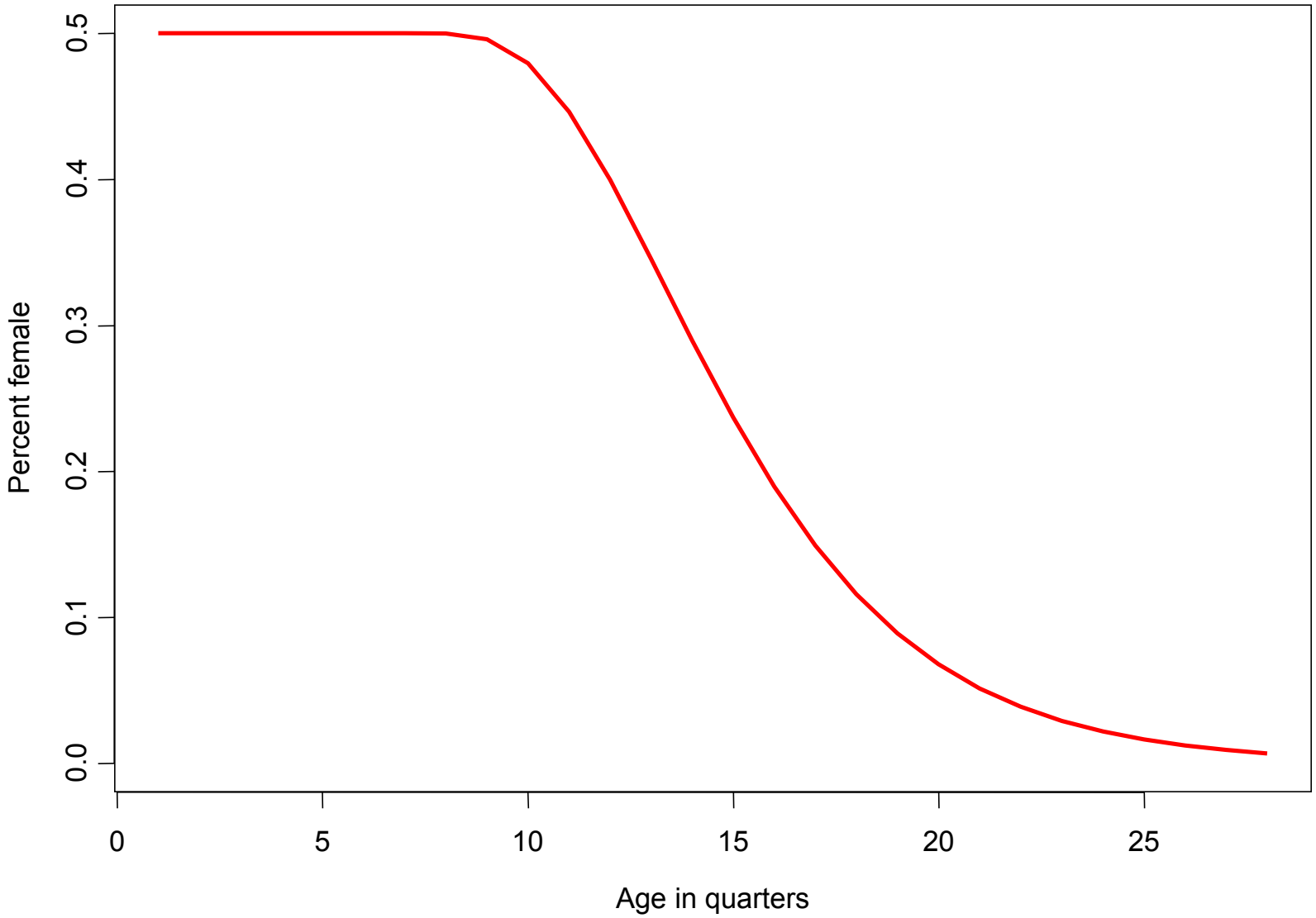
Fixed Parameters

- 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)

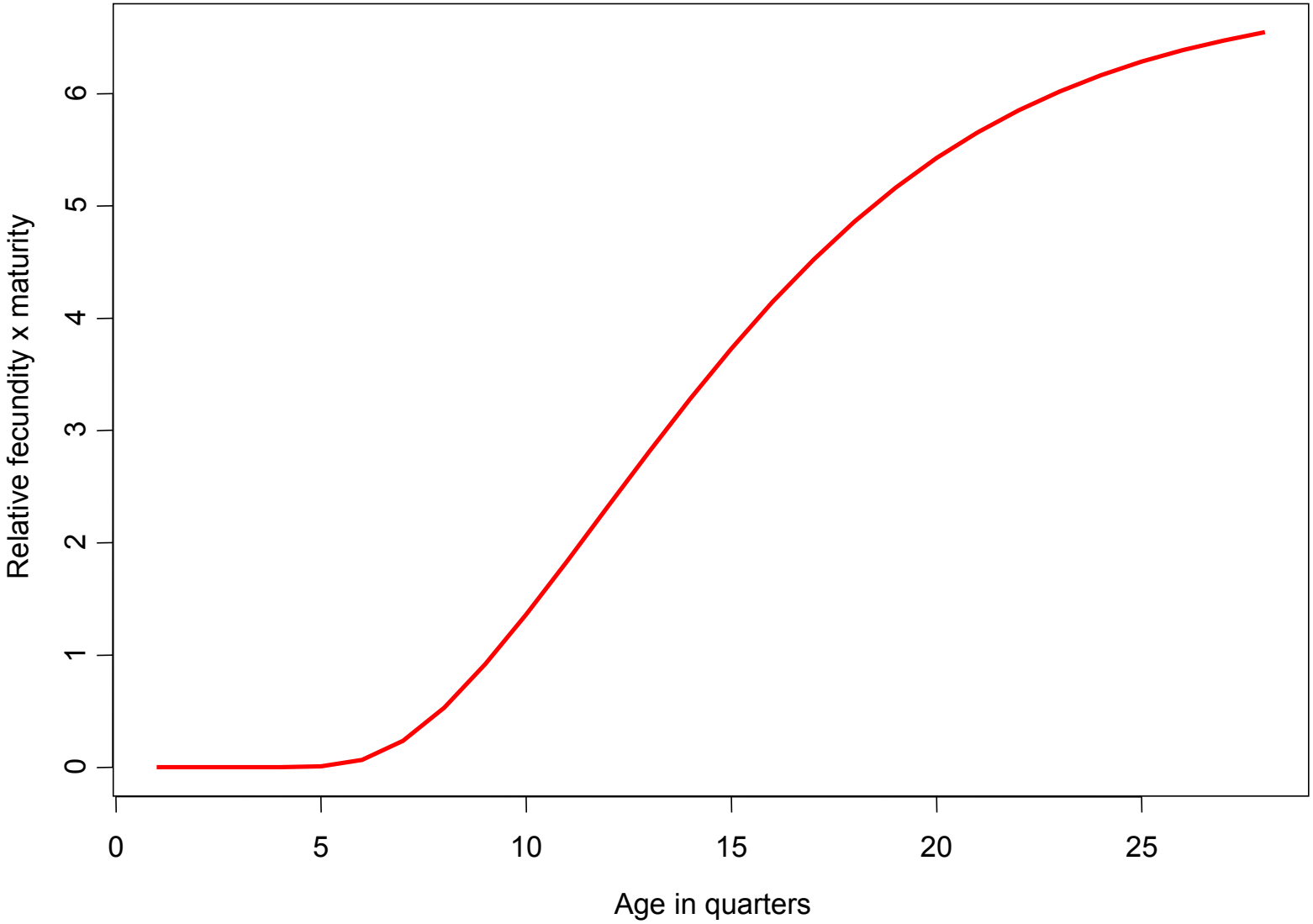
Natural Mortality



Sex Ratio



Relative Fecundity



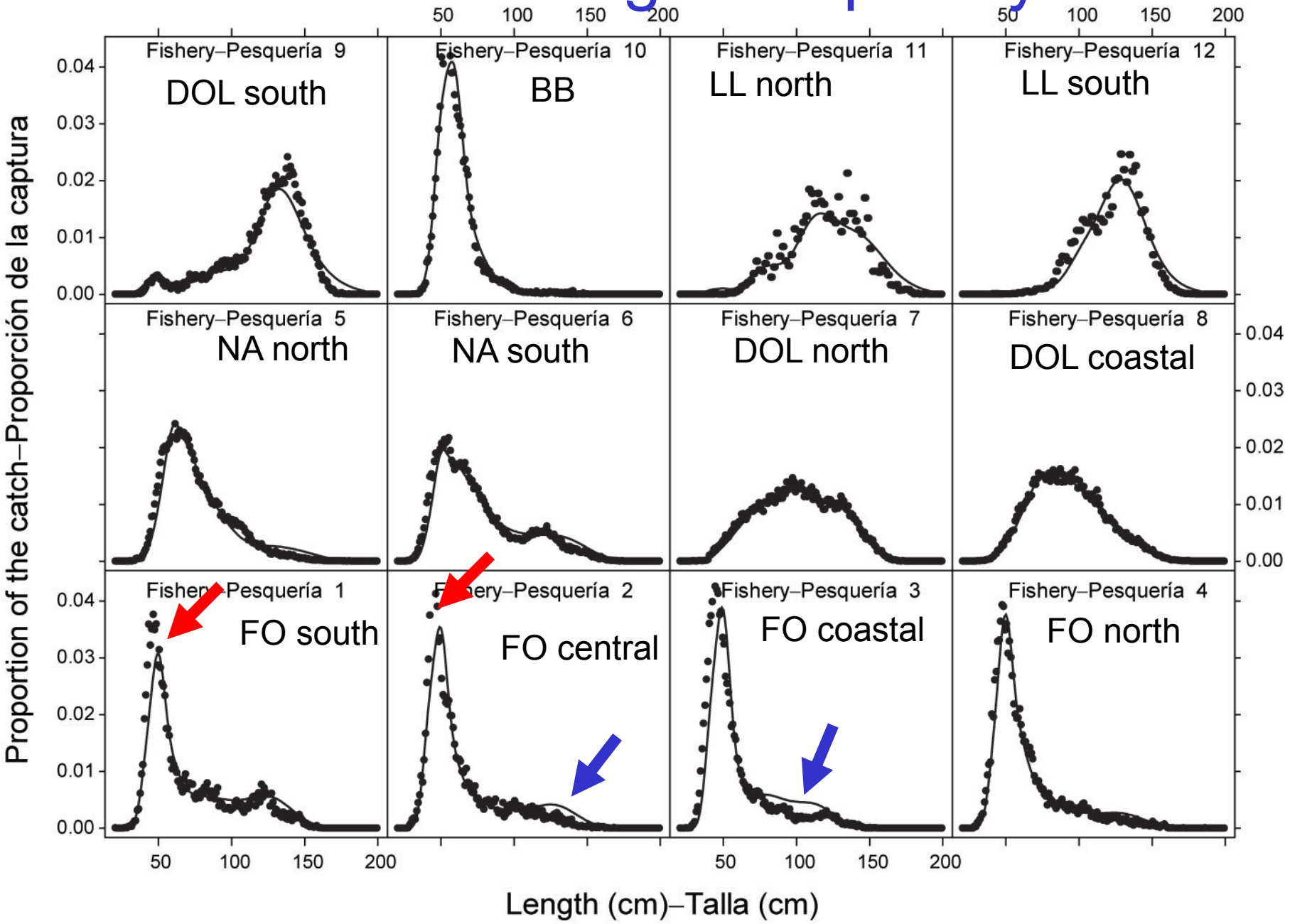
Estimated parameters

- **Recruitment**
  - Temporal anomalies
- **Catchability**
  - Temporal anomalies
- **Selectivity**
- **Initial population size and age-structure**
- **Mean length at age**
- **Variation of length at age**

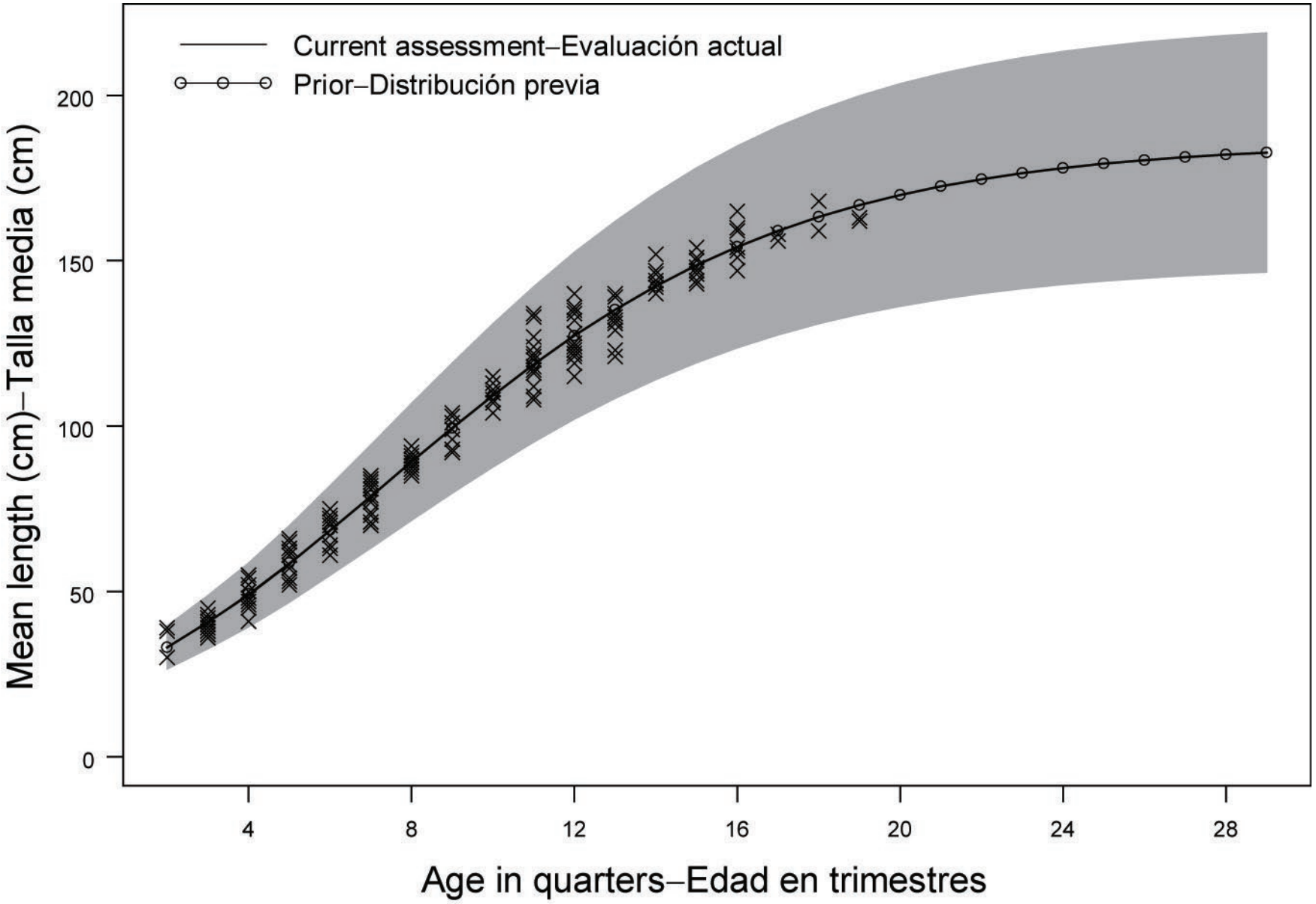
Results

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

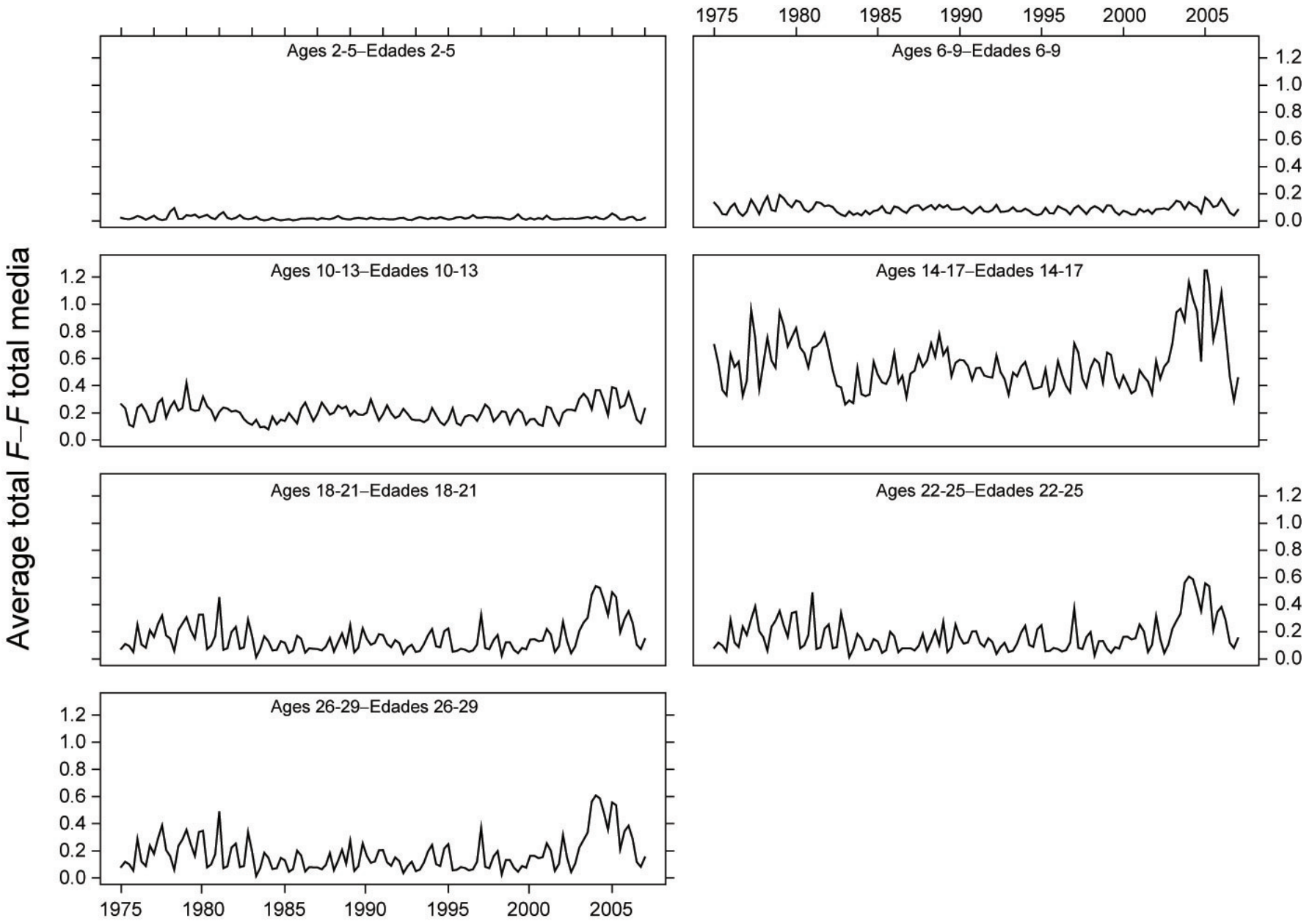
Fit to the length-frequency



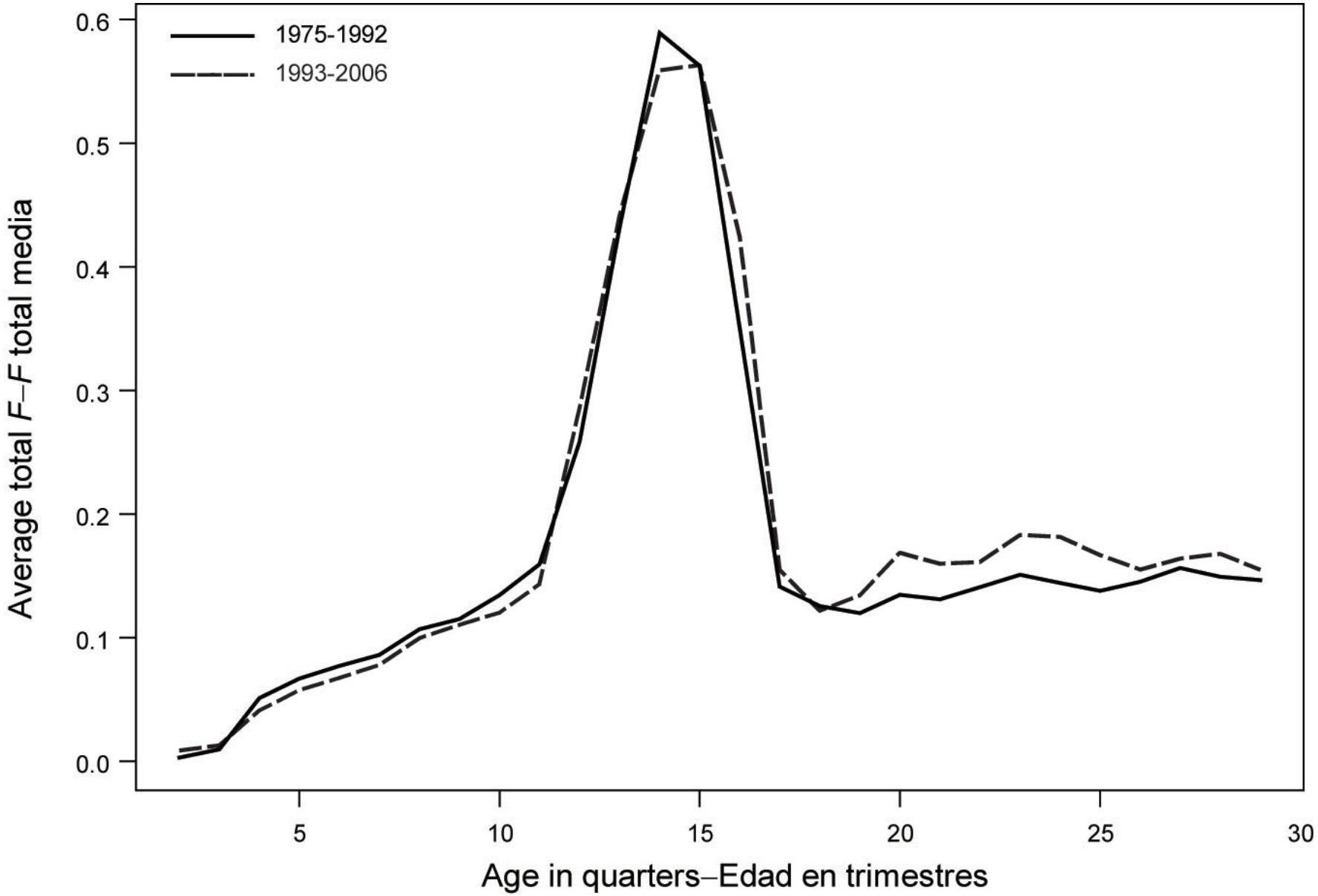
Growth


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

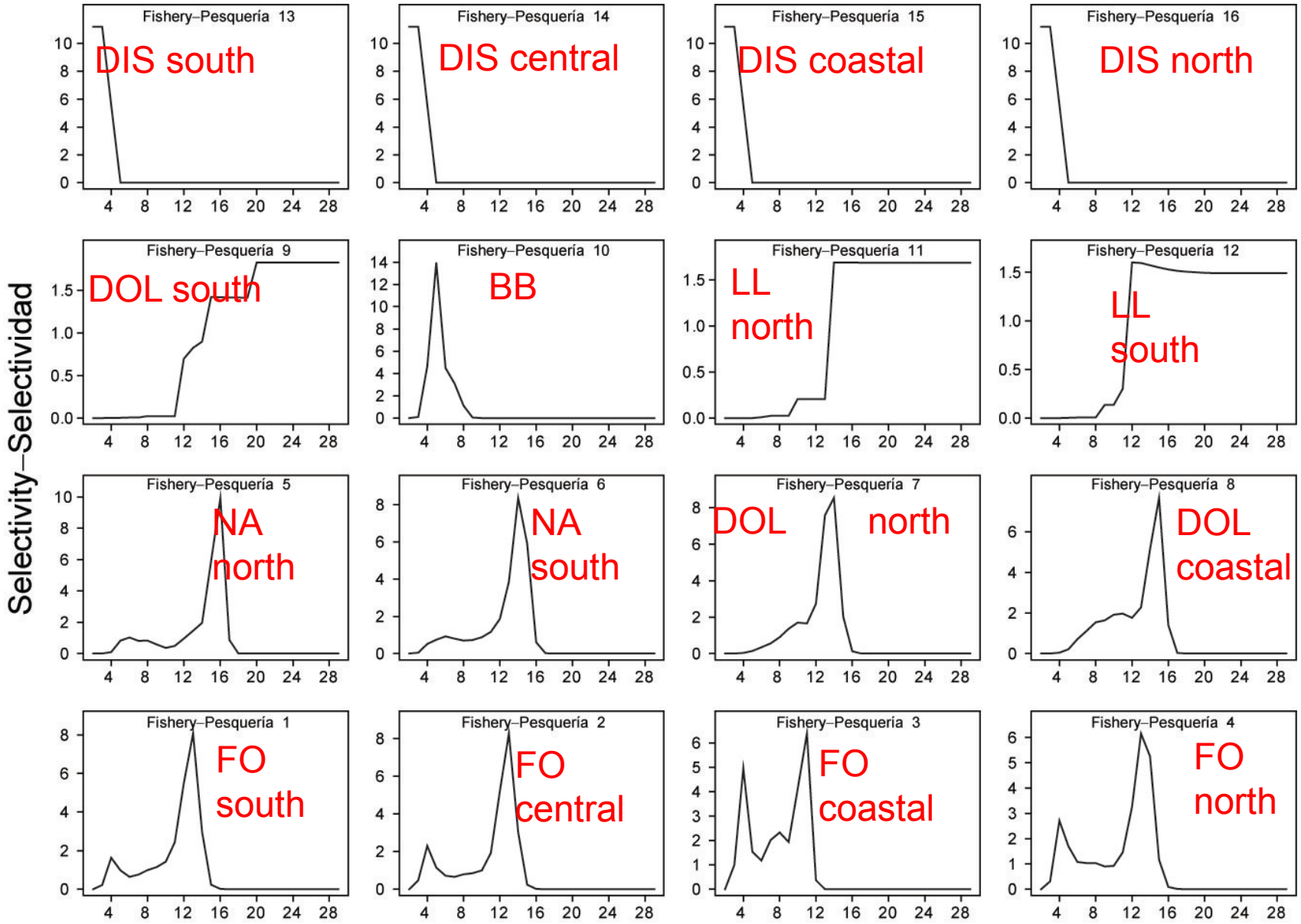
Fishing mortality



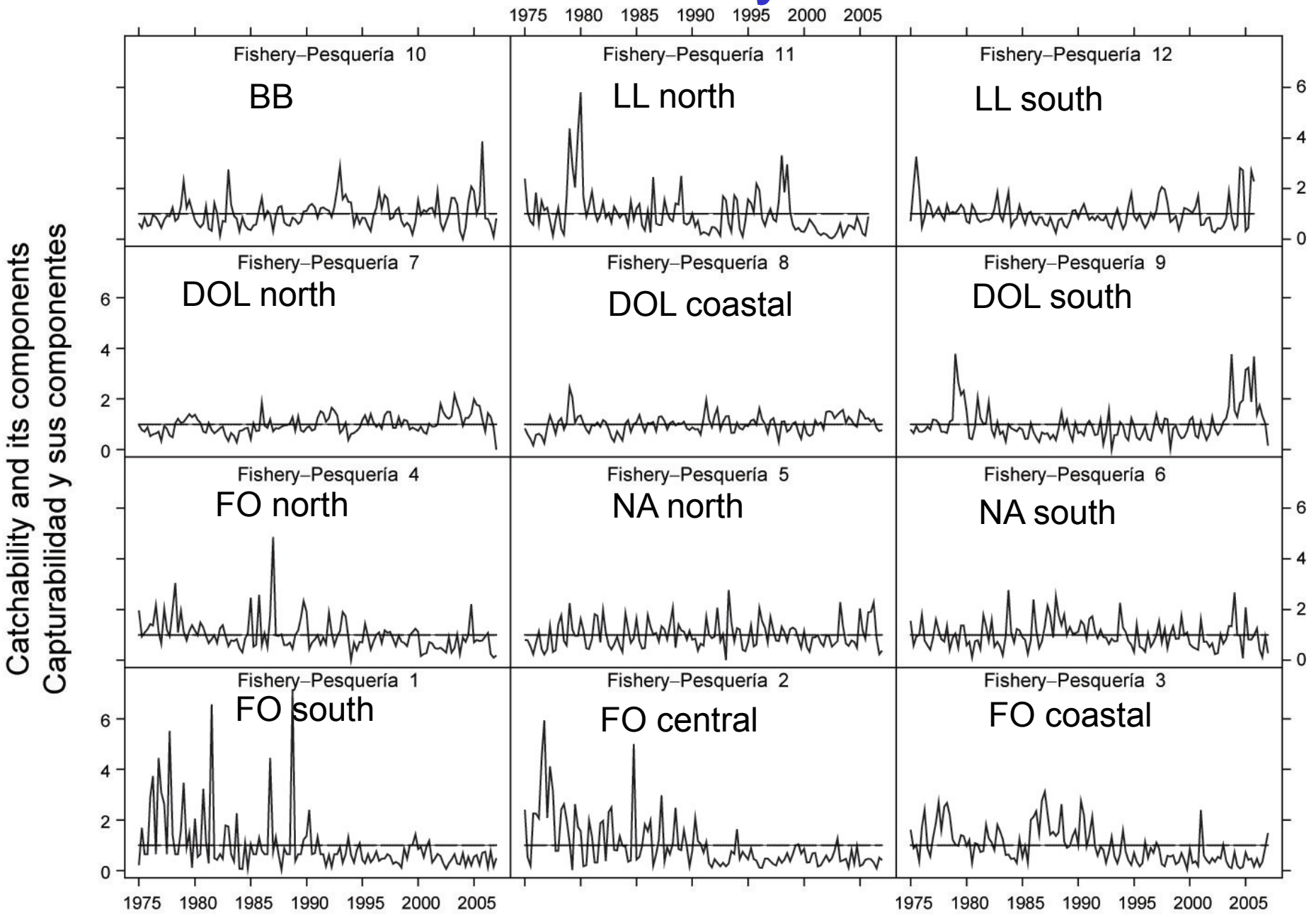
Age Specific Fishing Mortality



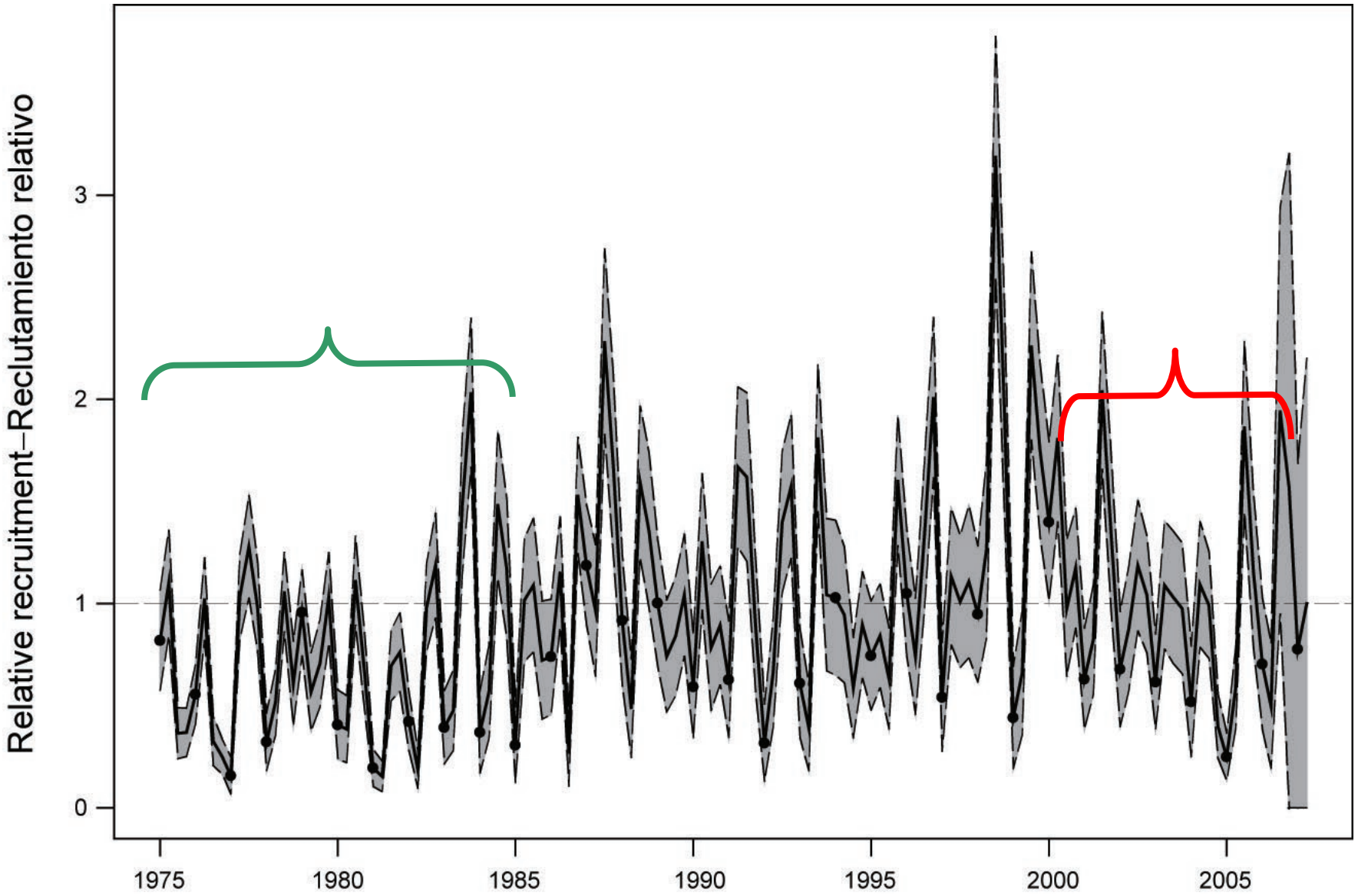
Selectivity



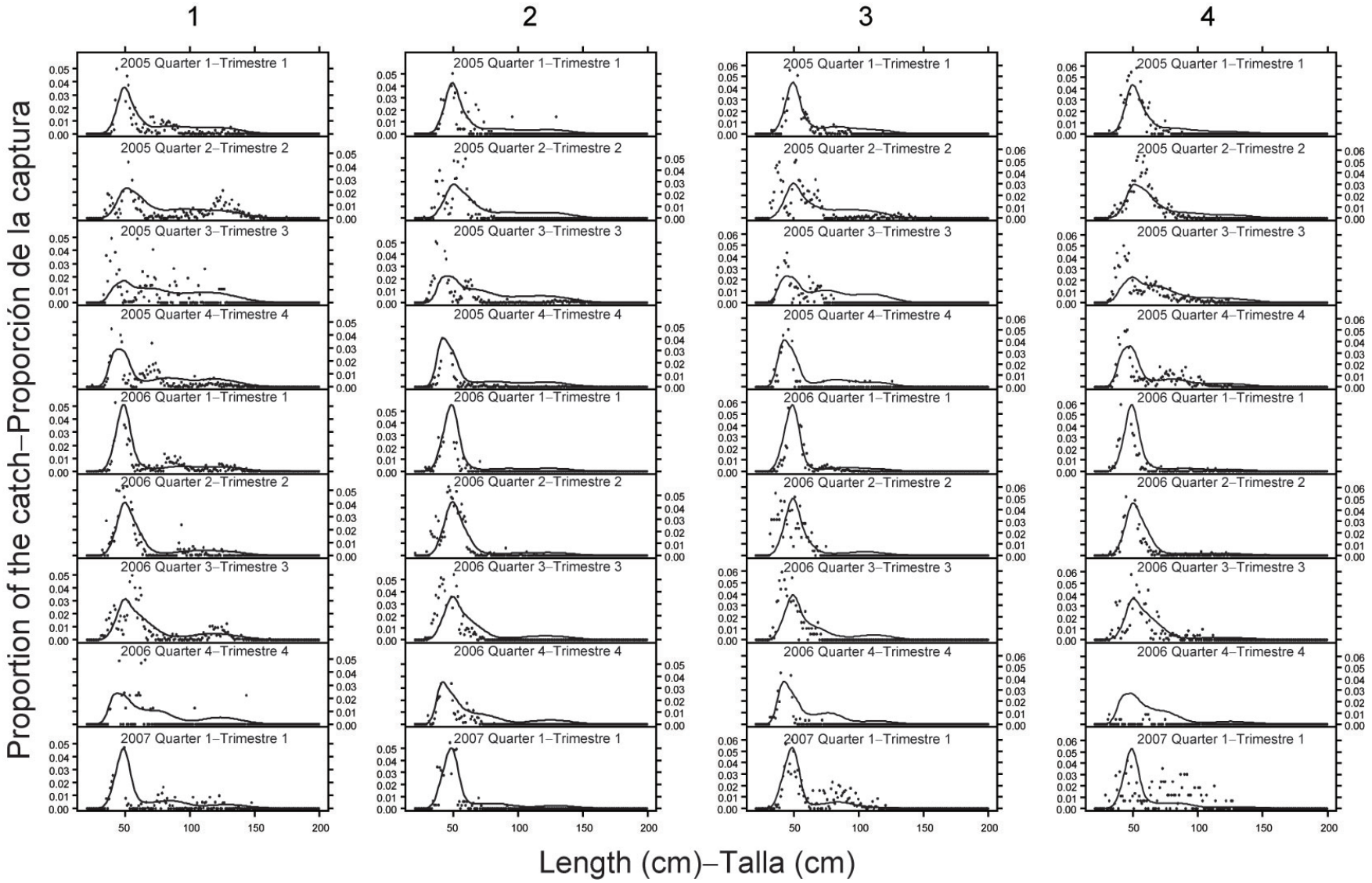
Catchability



Recruitment

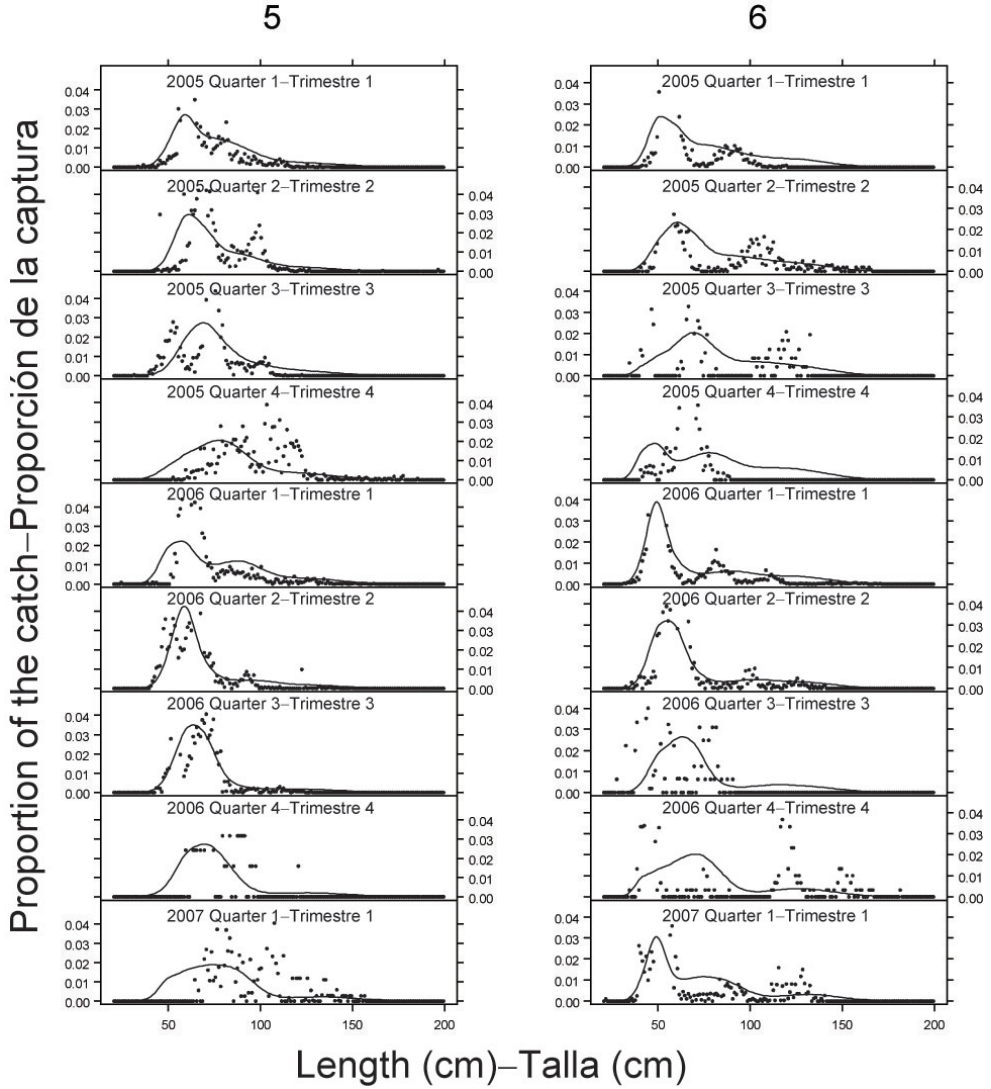


Recent length-frequency data (FO)

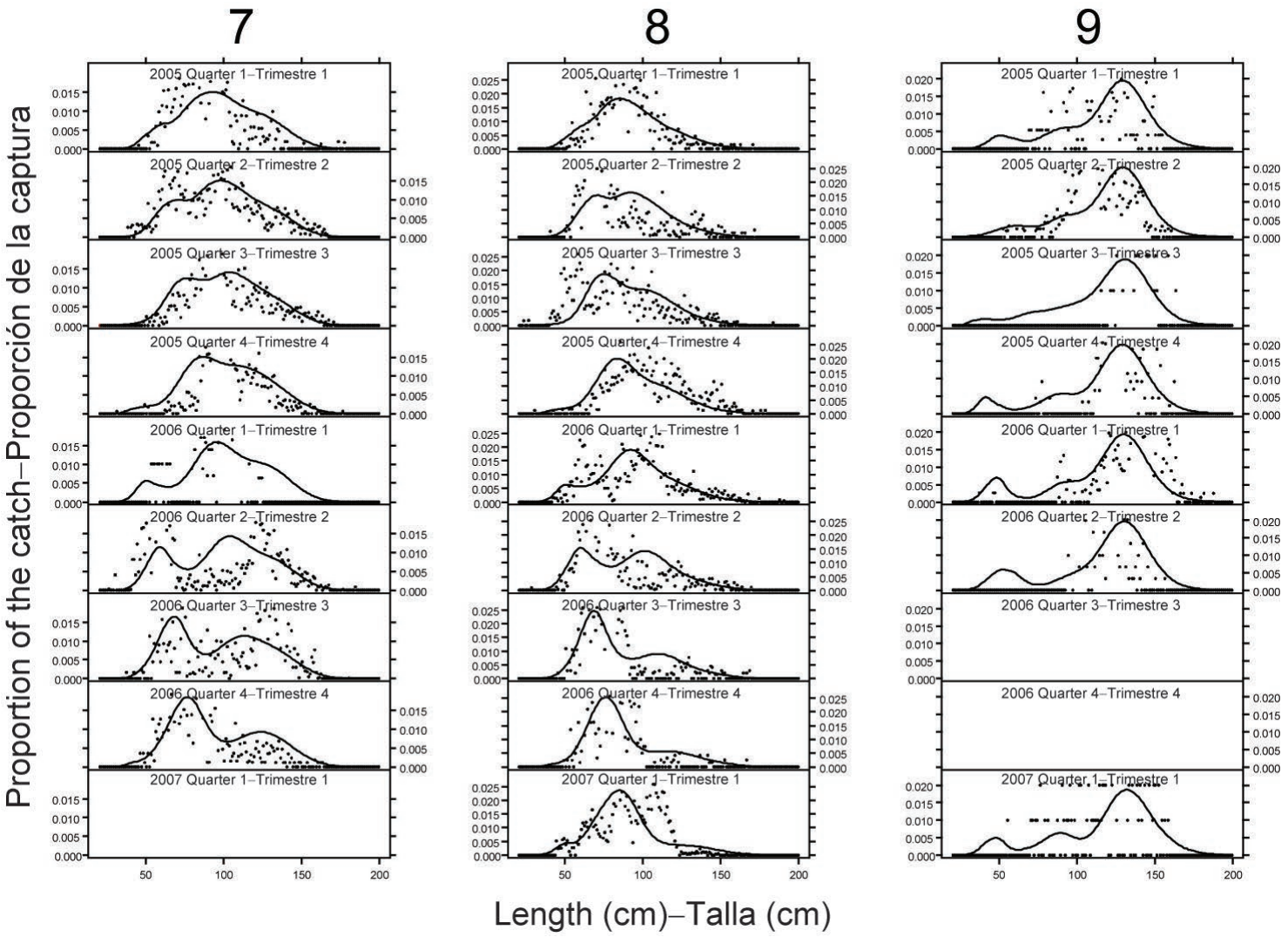


FO south FO central FO coastal FO north

Recent length-frequency data (Unassociated)



Recent length-frequency data (Dolphin associated)

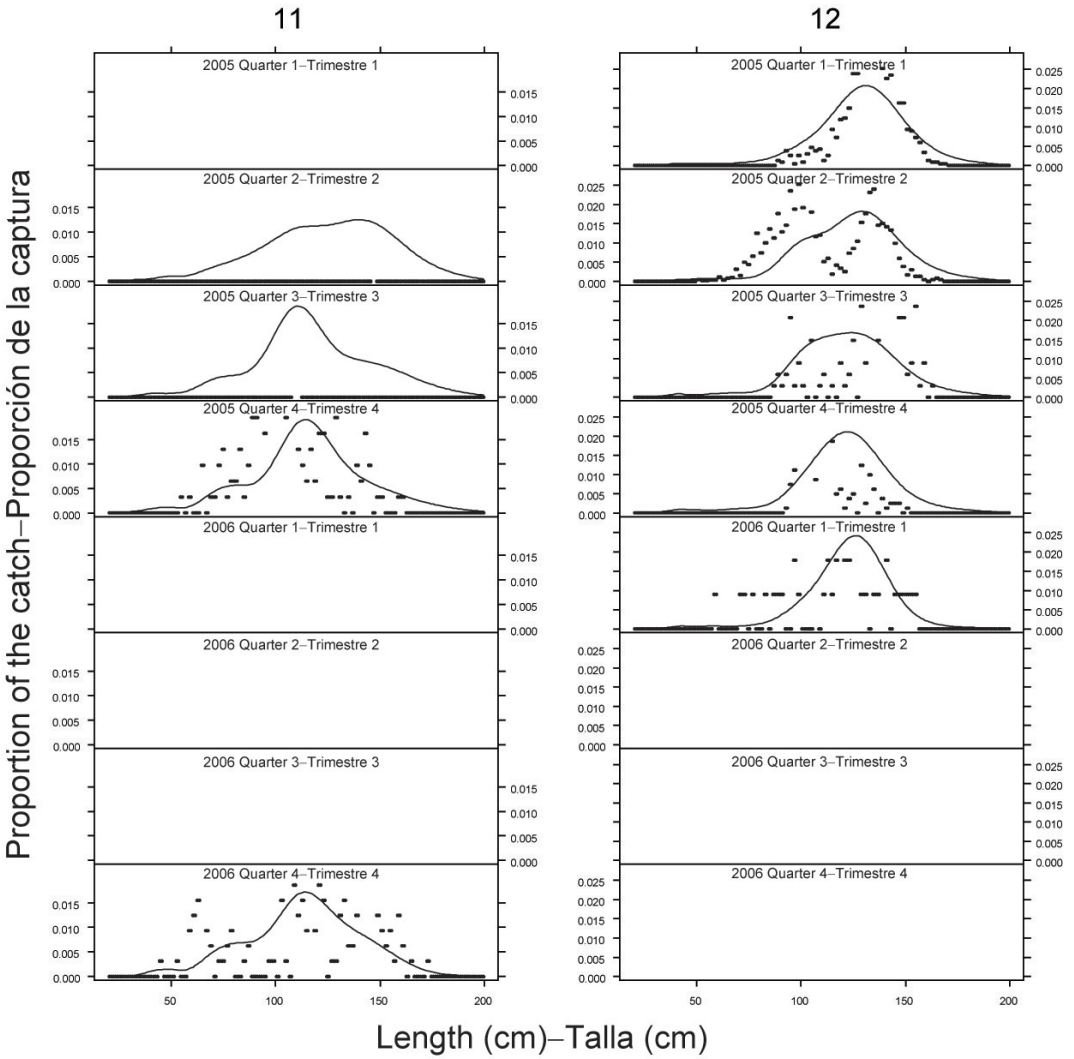


DOL north

DOL coastal

DOL south

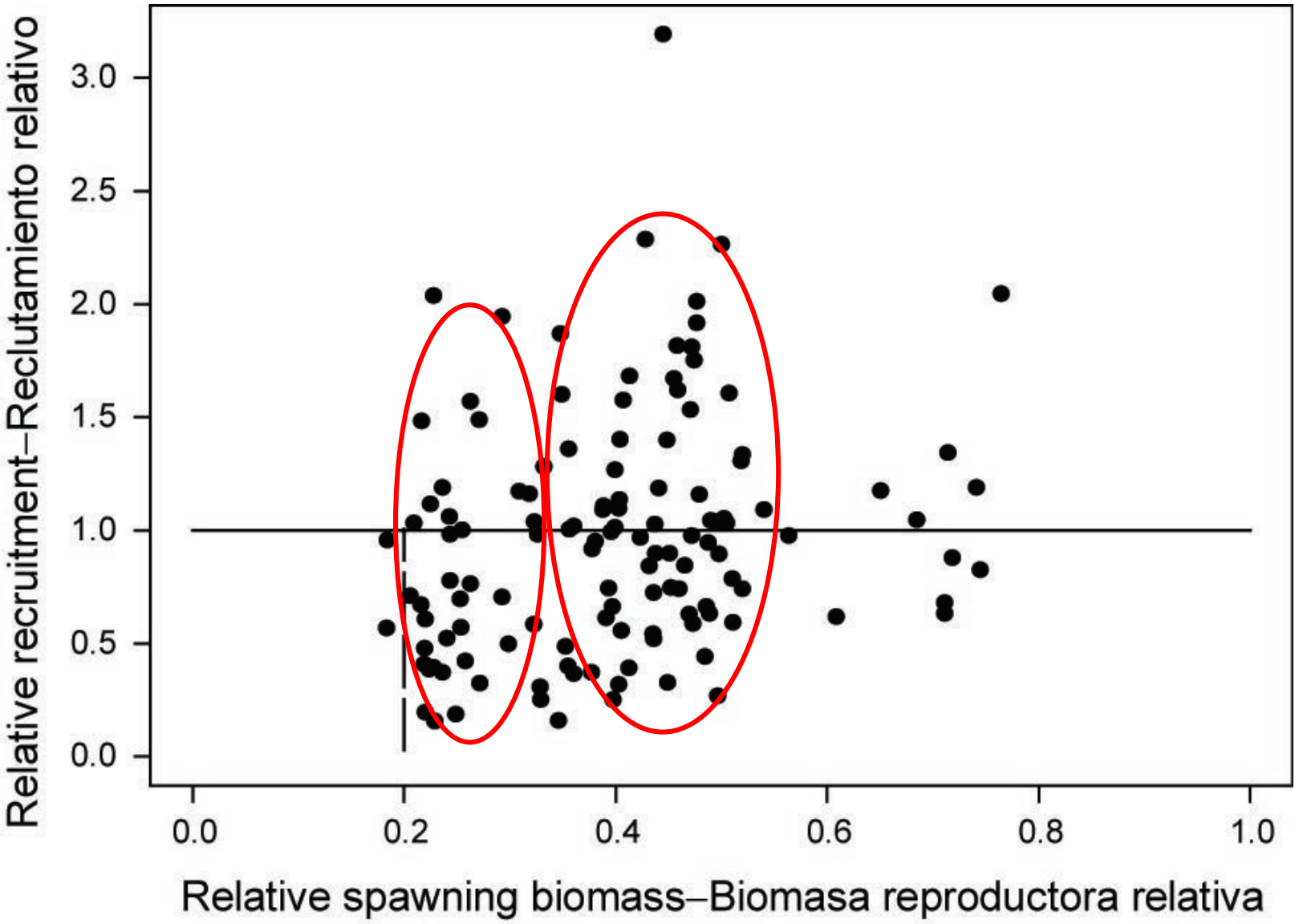
Recent length-frequency data (longline)



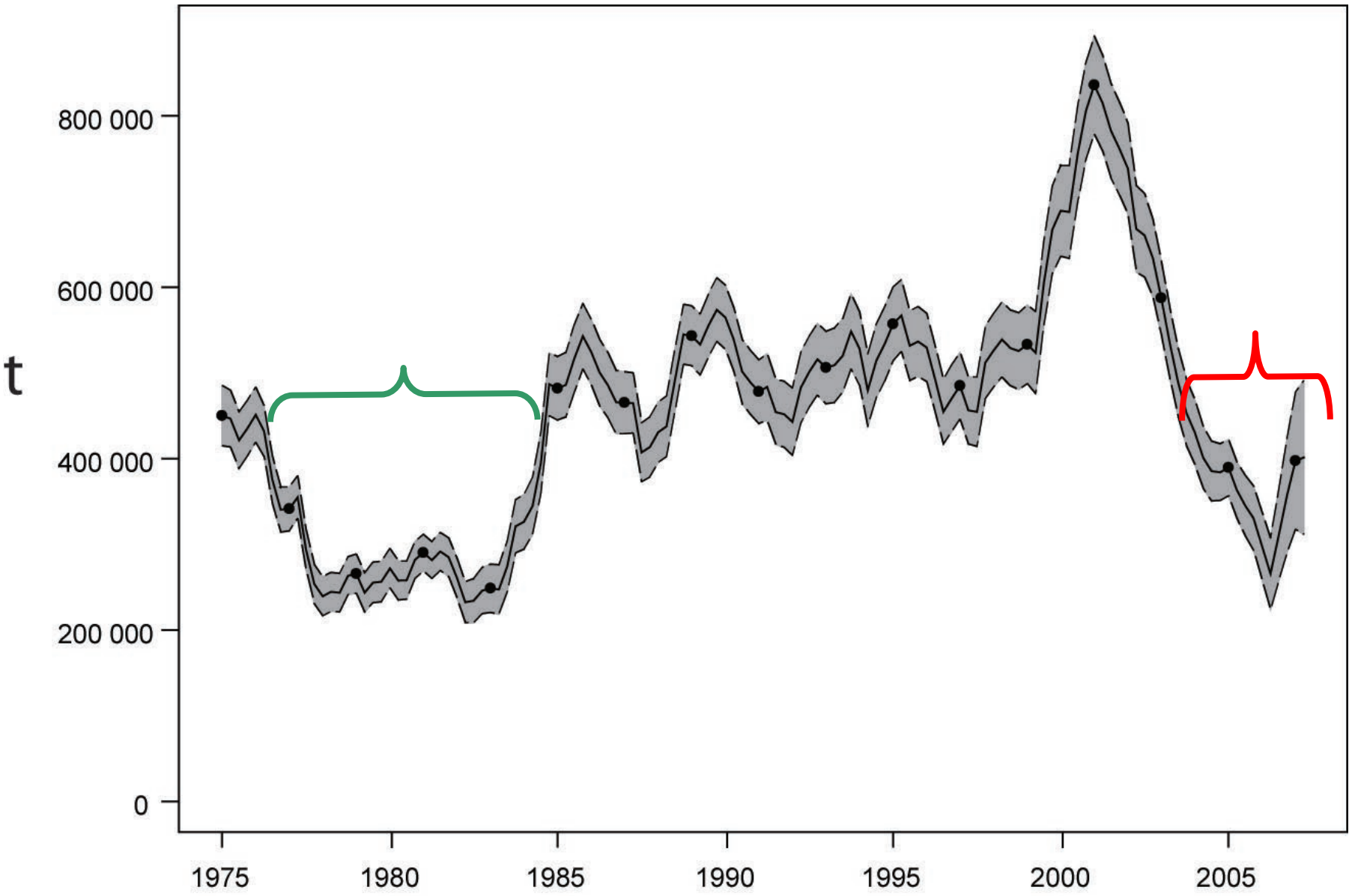
LL north

LL south

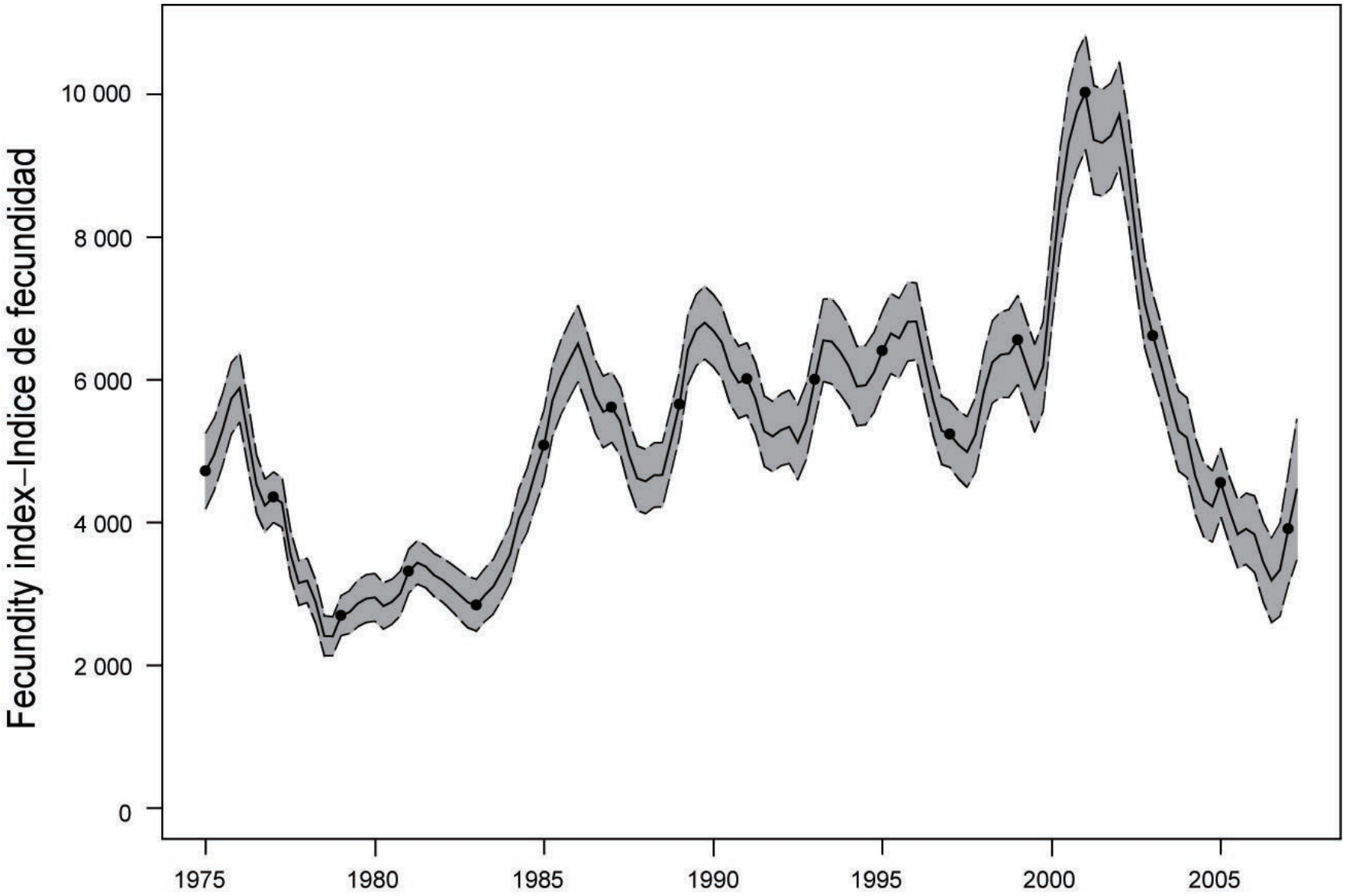
Stock - recruitment



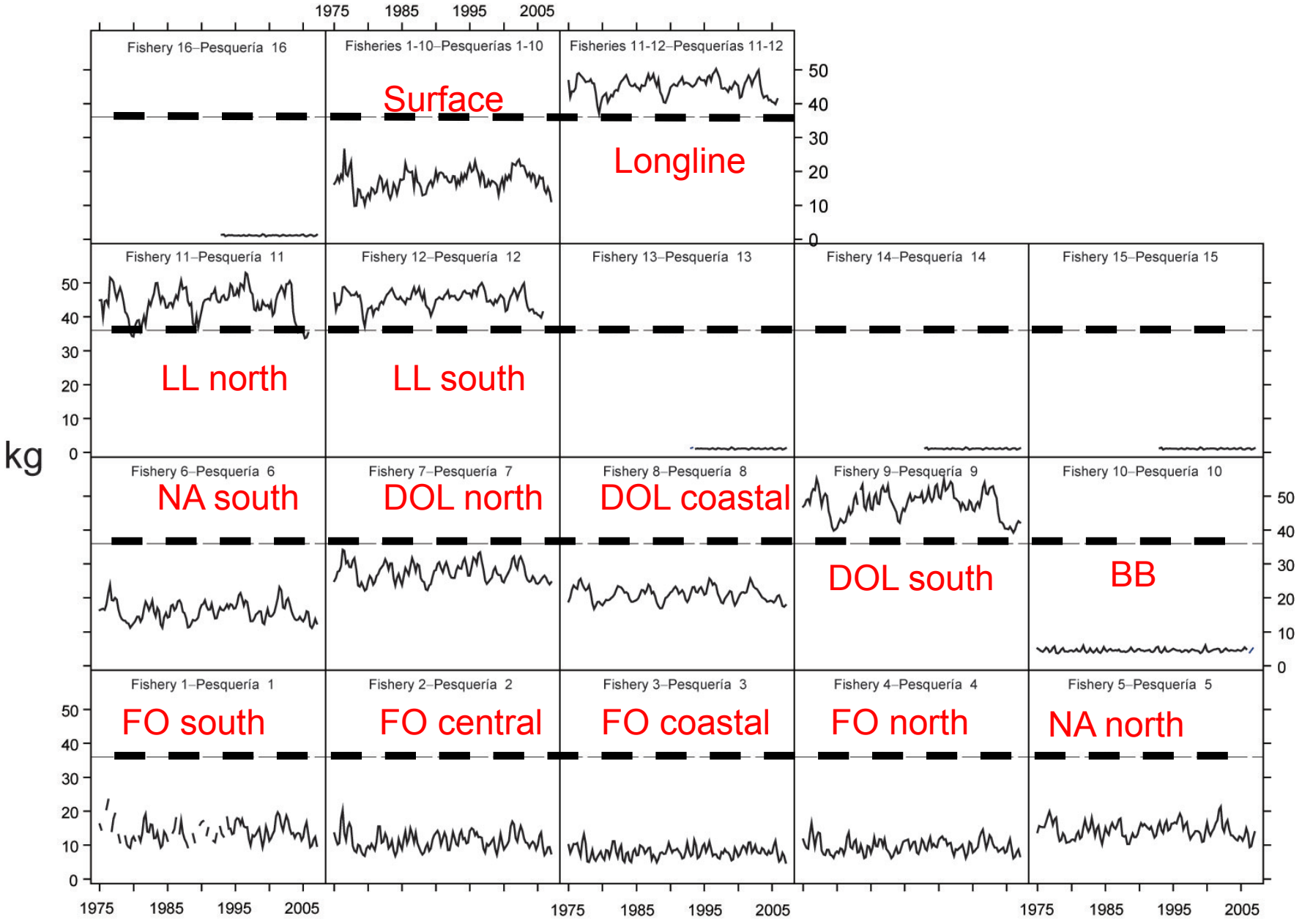
Biomass


t
800 000
600 000
400 000
200 000
0
1975
1980
1985
1990
1995
2000
2005

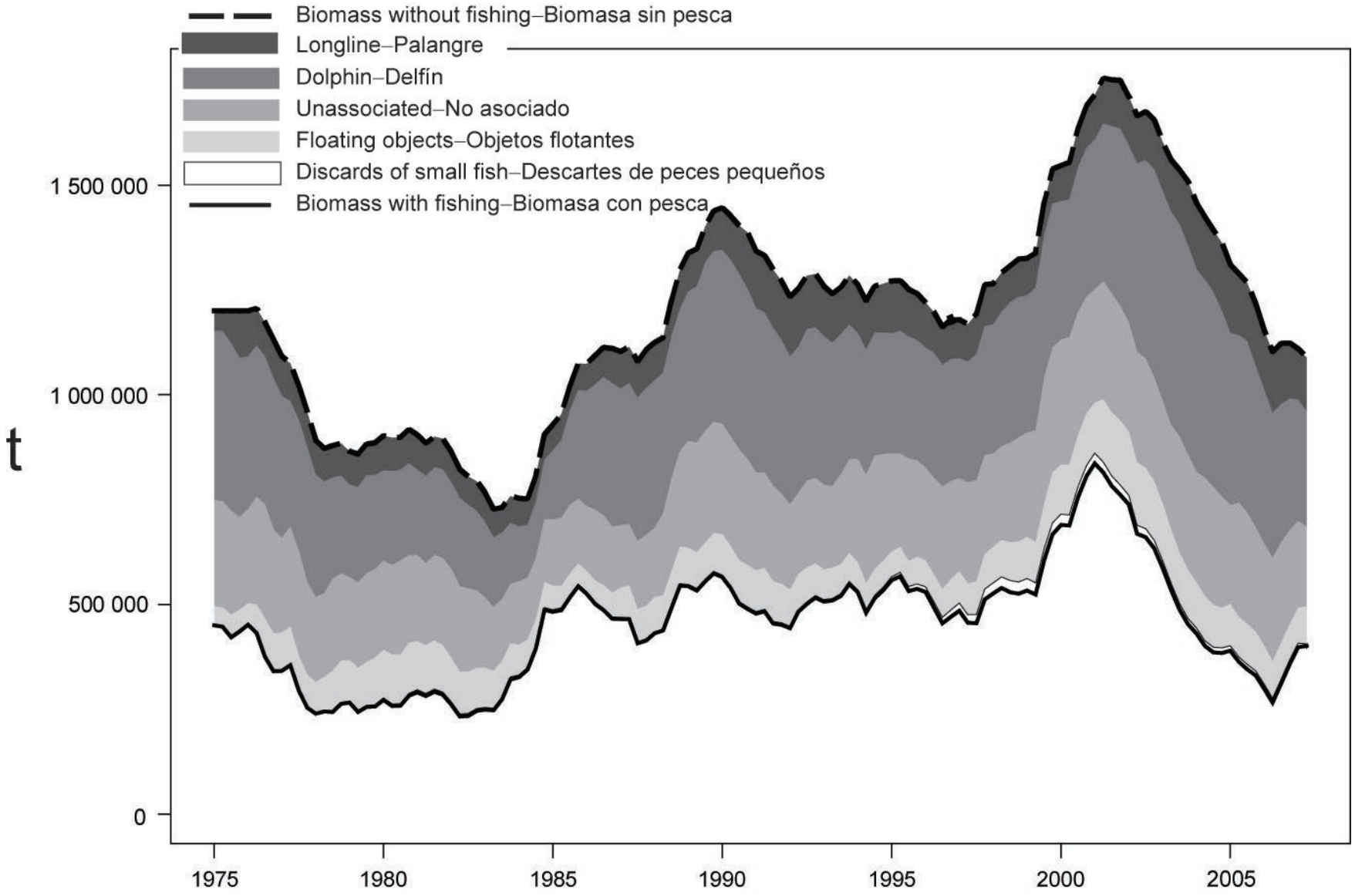
Spawning Biomass



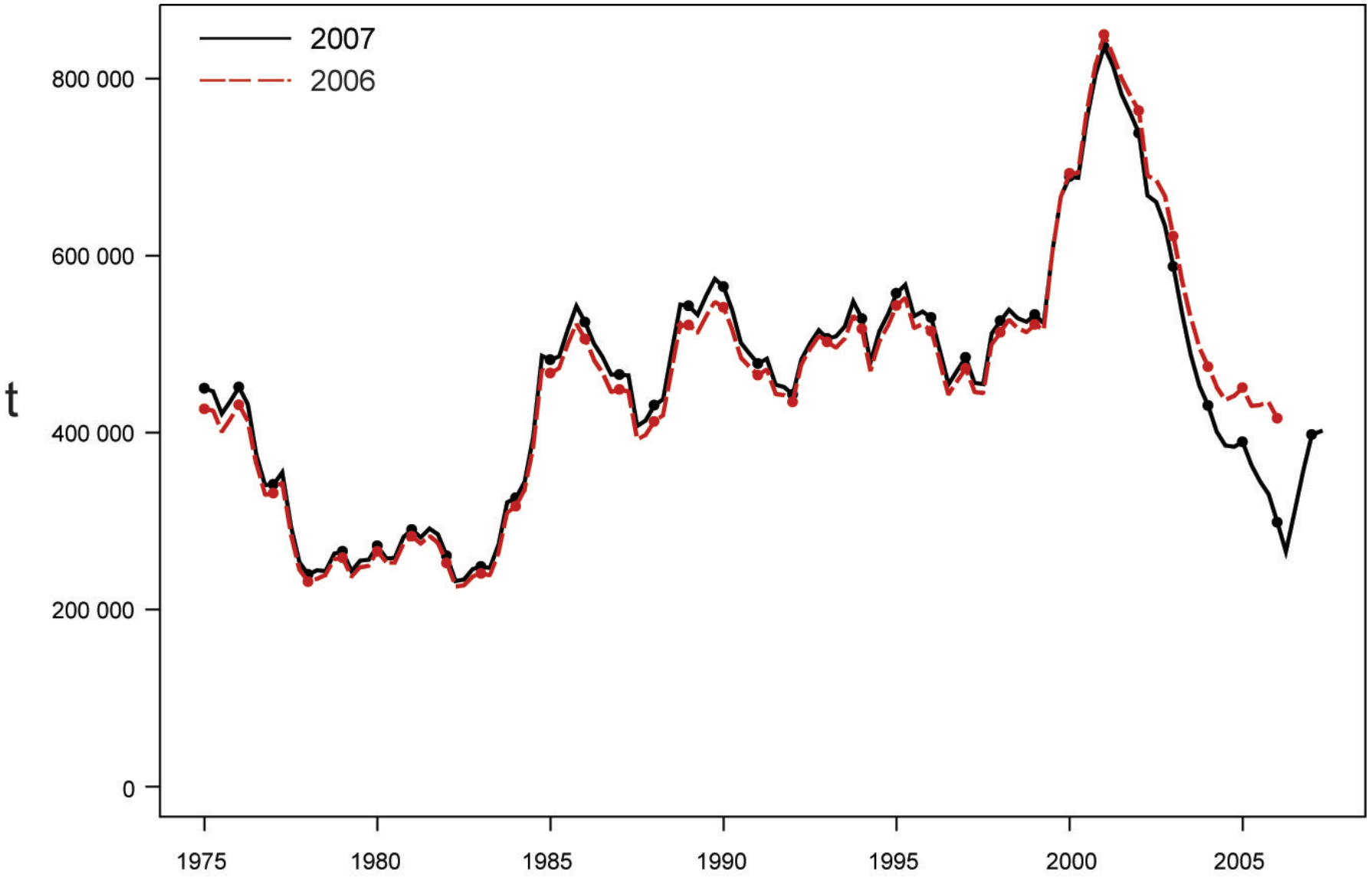
Average weight



No Fishing and Fishery Impact



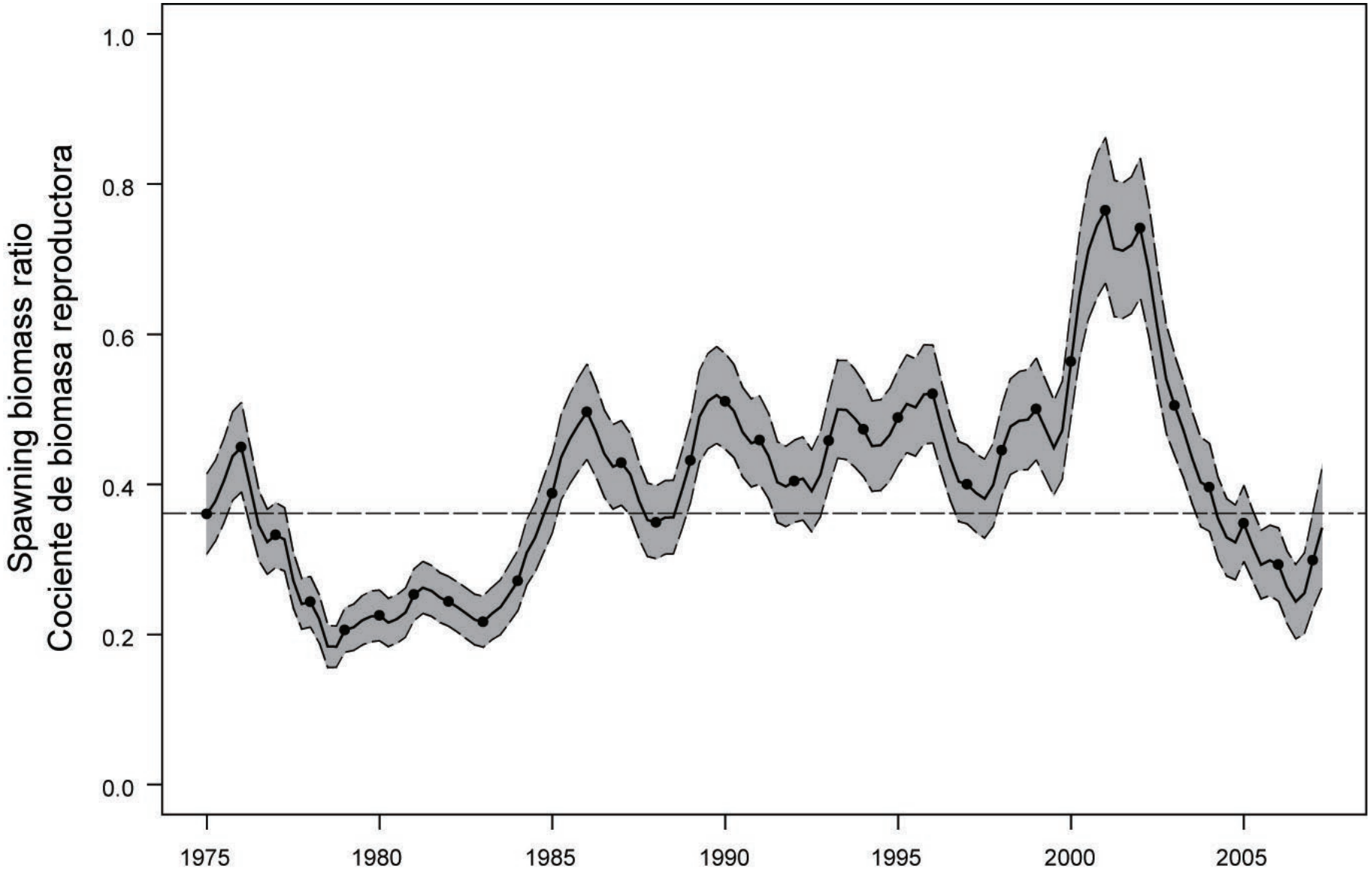
Biomass Comparisons



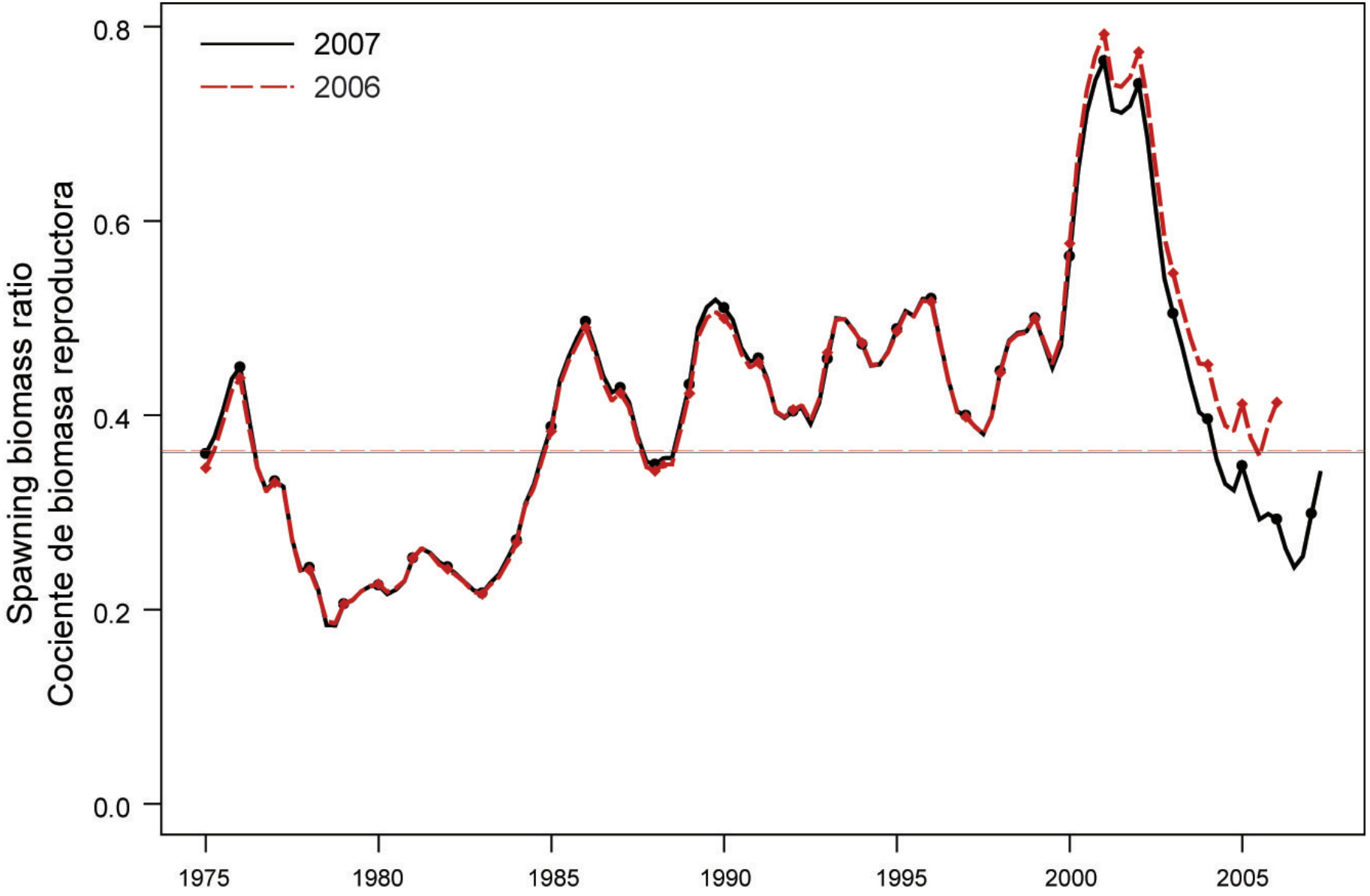
Reference points & projections

- Assumptions
  - For MSY calculations
    - Average of 2004-2005 for fishing mortality
  - For forward projections
    - Average of 2004-2005 for catchability
    - 2006 effort

SBR


Spawning biomass ratio
Cociente de biomasa reproductora
1.0
0.8
0.6
0.4
0.2
0.0
1975
1980
1985
1990
1995
2000
2005

SBR


2007
2006
Spawning biomass ratio
Cociente de biomasa reproductora
0.0
0.2
0.4
0.6
0.8
1975
1980
1985
1990
1995
2000
2005

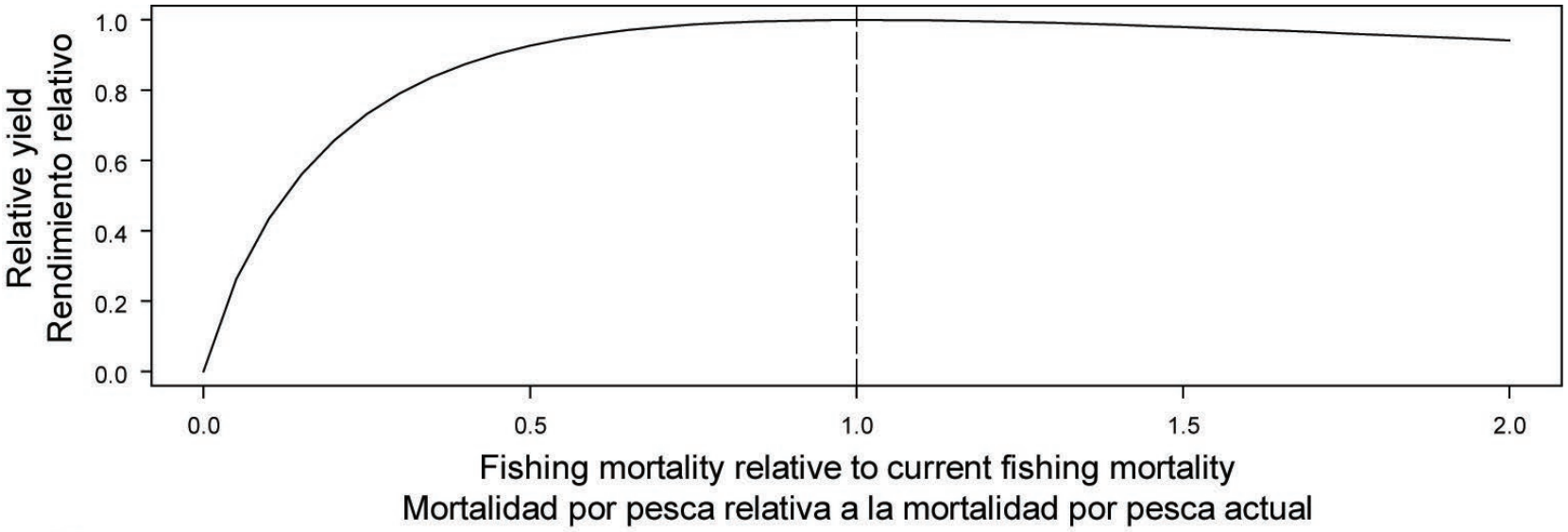
AMSY by method

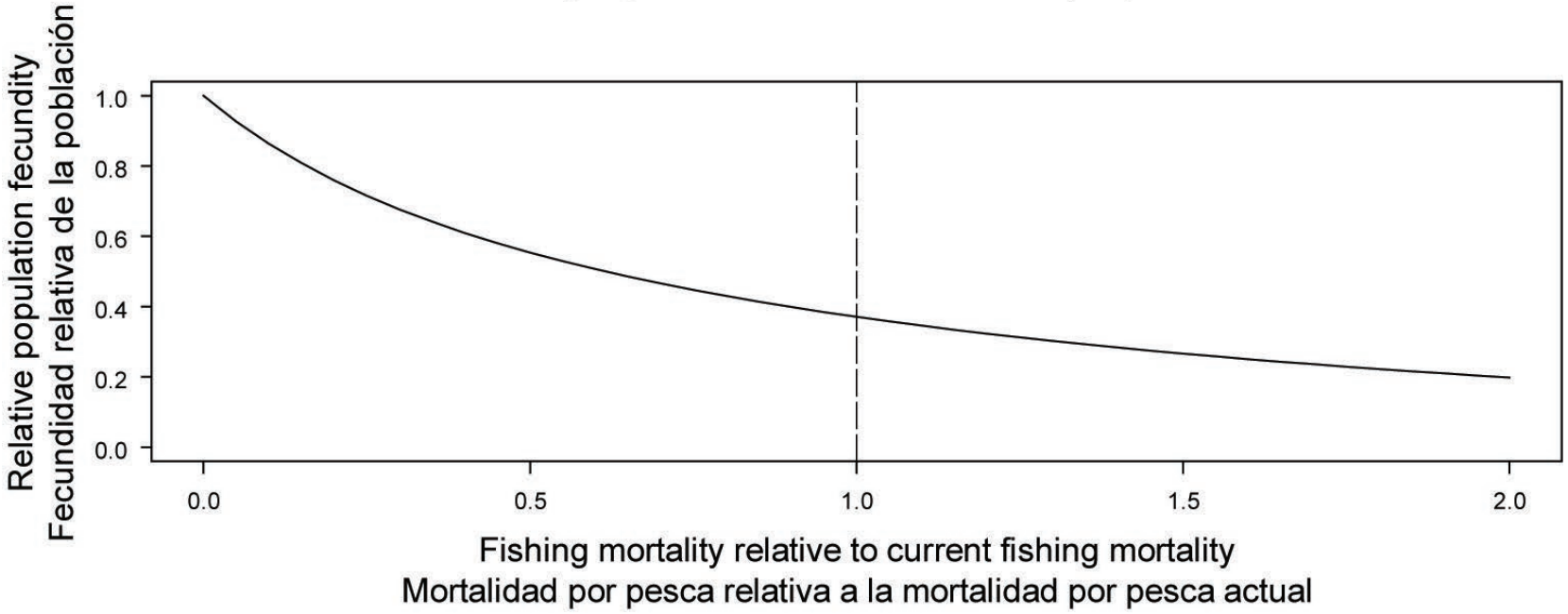
Fishery	AMSY	B_{AMSY}	S_{AMSY}	$B_{AMSY}/B_{F=0}$	$S_{AMSY}/S_{F=0}$	*F* multiplier
Pesquería	**RMSP**	B_{RMSP}	S_{RMSP}	$B_{RMSP}/B_{F=0}$	$S_{RMSP}/S_{F=0}$	**Multiplicador de *F***
All—Todas	289,140	417,813	4,738	0.35	0.36	0.88
OBJ	210,100	318,560	3,541	0.27	0.27	8.89
NOA	263,646	396,896	4,570	0.33	0.35	3.13
DEL	312,527	418,716	4,528	0.35	0.35	1.85
LL	360,277	470,118	5,097	0.39	0.39	32.16

AMSY with method removed

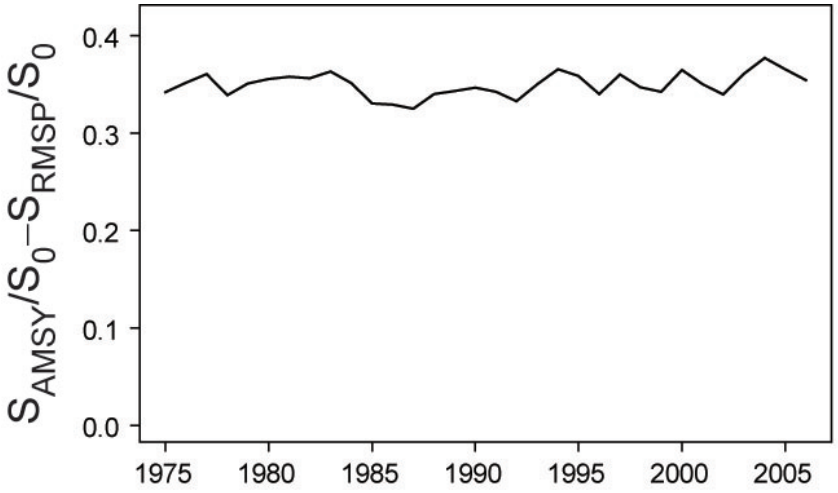
	All gears	Purse-seine only	Longline only	Purse-seine adjusted	Longline adjusted
	Todas artes	**Cerco solamente**	**Palangre solamente**	**Cerco ajustado**	**Palangre ajustado**
AMSY—RMSP	289,140	285,643	360,172	290,407	302,951
B_{AMSY}—B_{RMSP}	417,813	420,192	469,913	442,207	309,165
S_{AMSY}—S_{RMSP}	4,738	4,777	5,094	5,083	3,002
B_{AMSY}/B_0—B_{RMSP}/B_0	0.35	0.35	0.39	0.37	0.26
S_{AMSY}/S_0—S_{RMSP}/S_0	0.36	0.36	0.39	0.39	0.23
F multiplier—Multiplicador de *F*	0.88	0.91	30.48	0.79	23.59

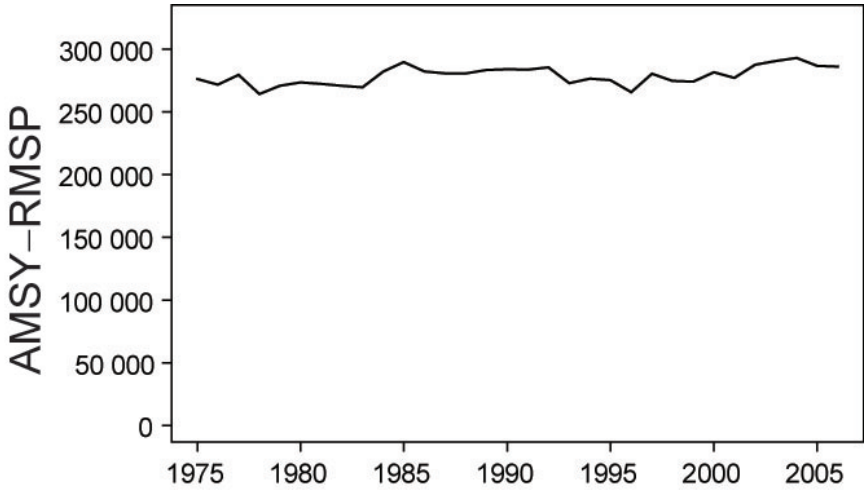
Yield

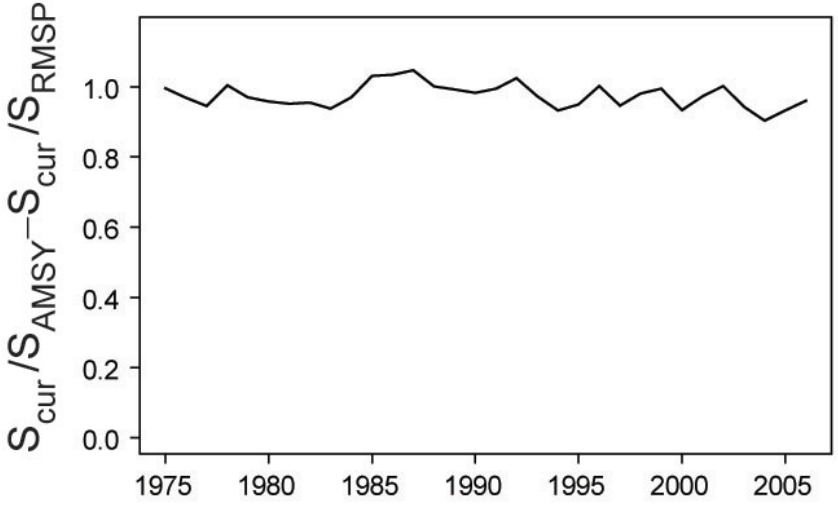

Relative yield
Rendimiento relativo
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual

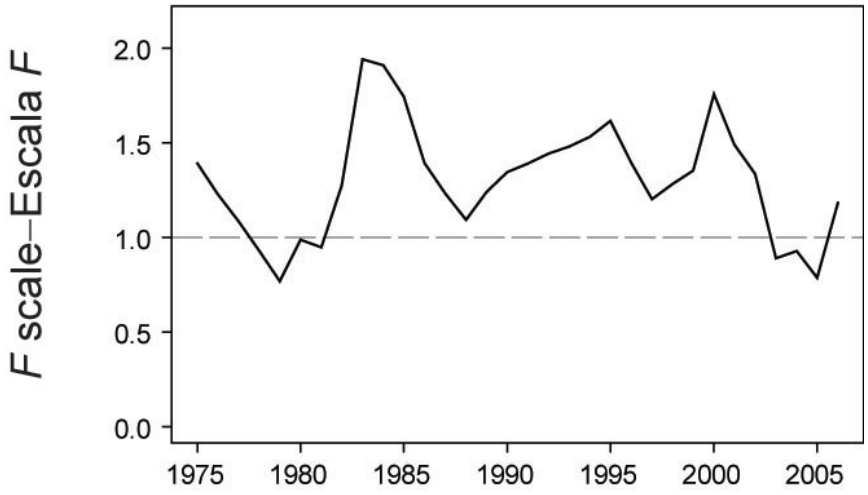

Relative population fecundity
Fecundidad relativa de la población
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Fishing mortality relative to current fishing mortality
Mortalidad por pesca relativa a la mortalidad por pesca actual

AMSY quantities using F(y)

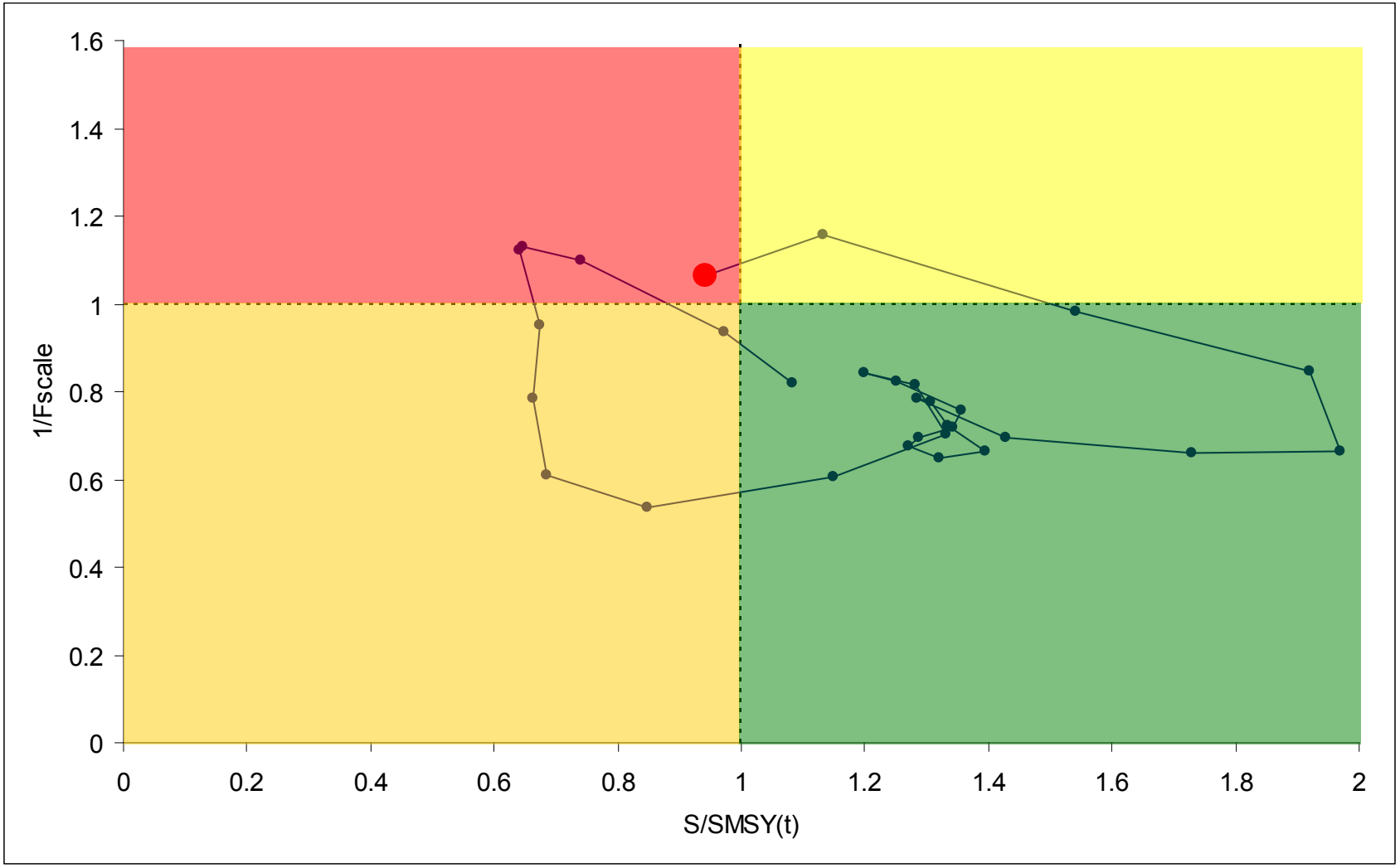








Phase plot



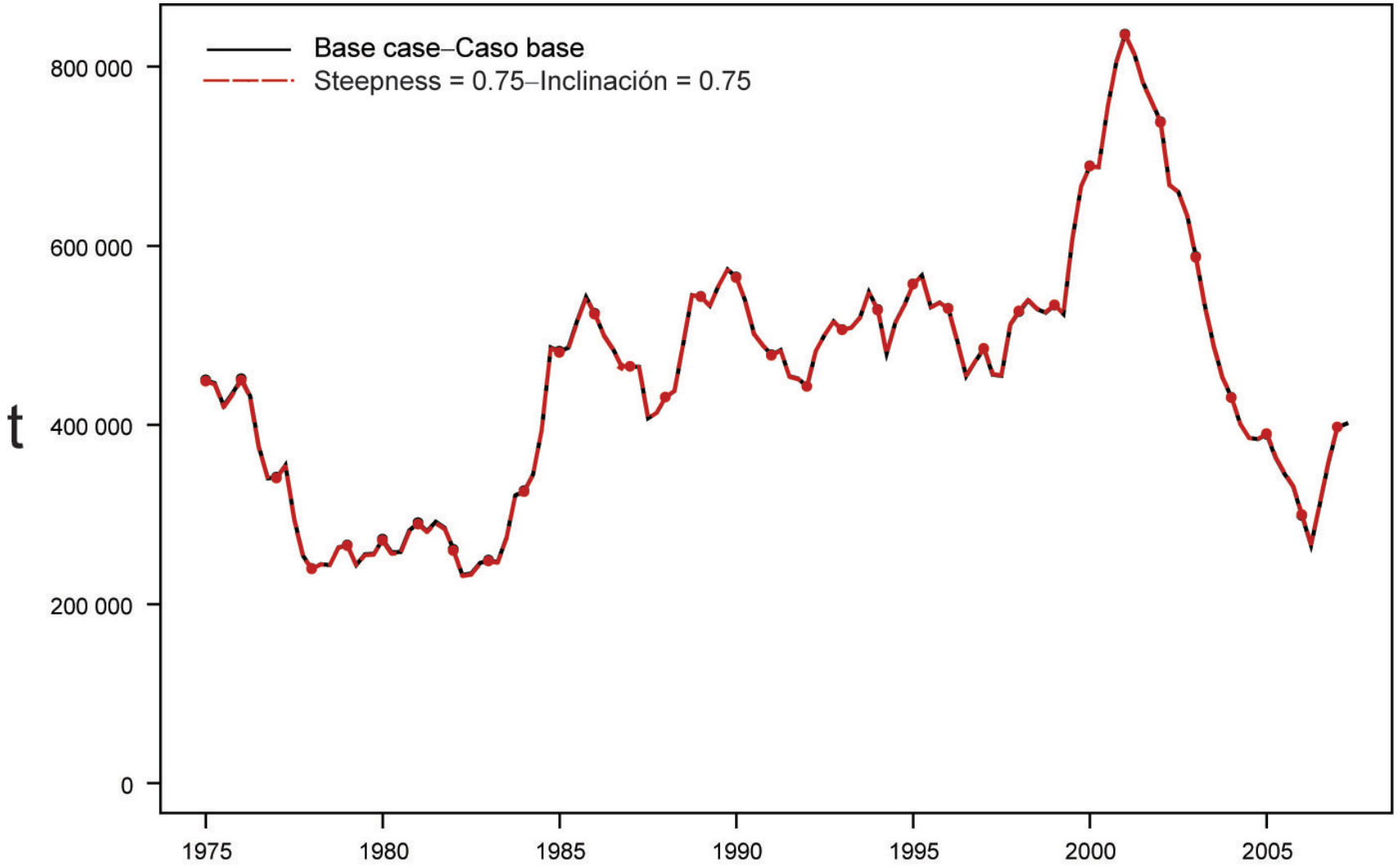
Regime dependent

Sensitivity: h = 0.75

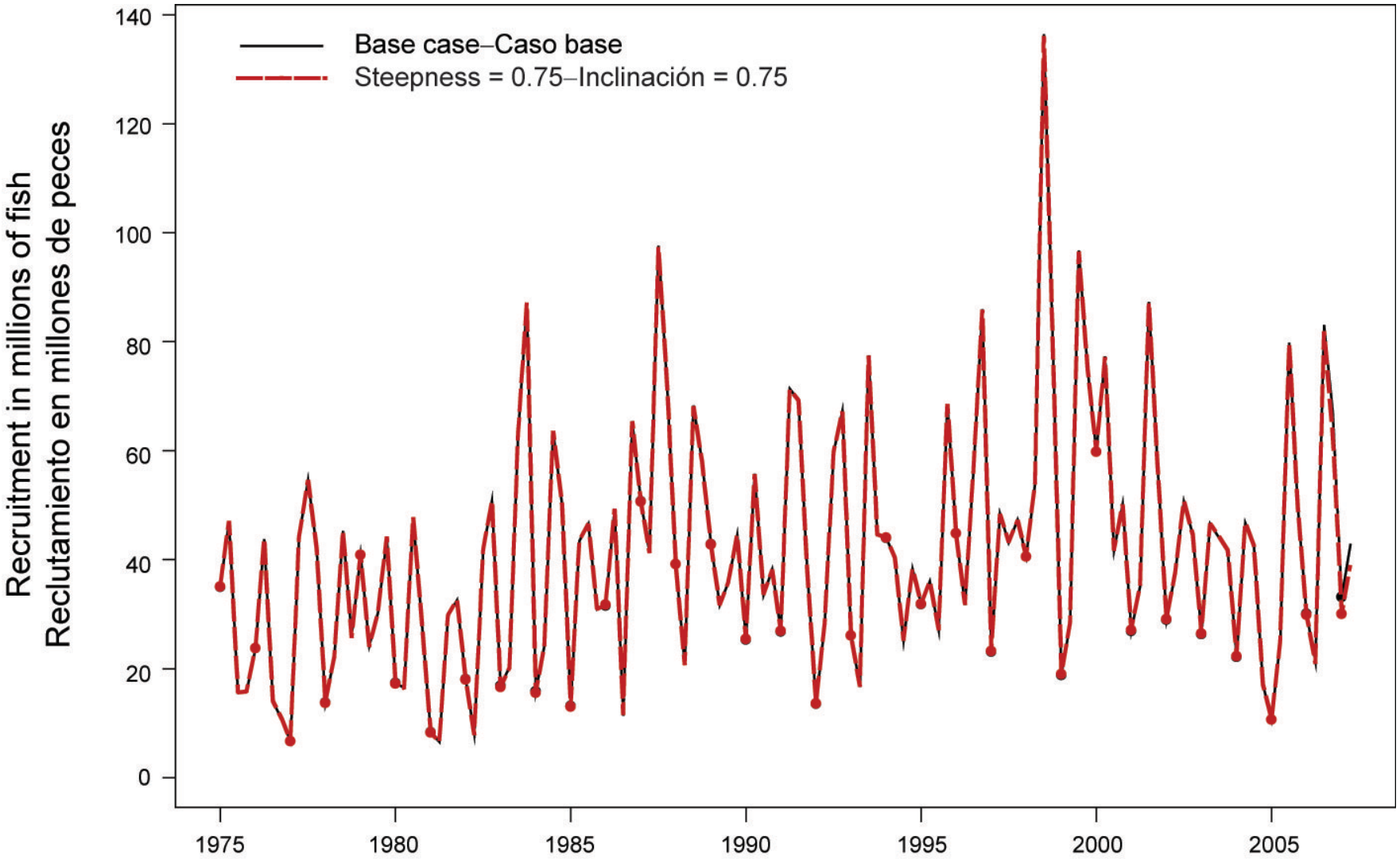
- When the spawning population is 20% of its unexploited level the recruitment is 75% of its unexploited level

- Biomass
- Recruitment
- SBR
- Yield Curve
- AMSY

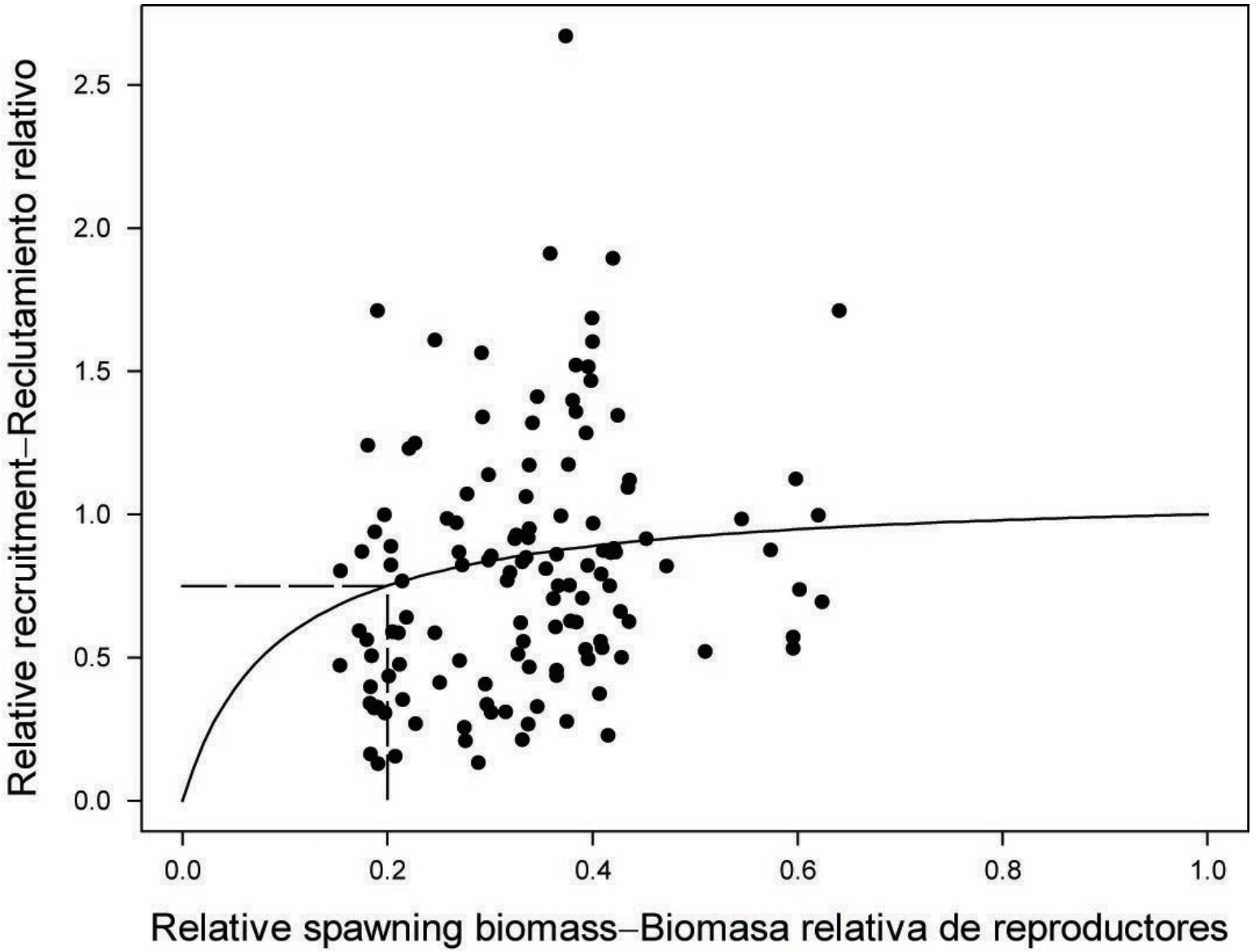
Biomass Comparison



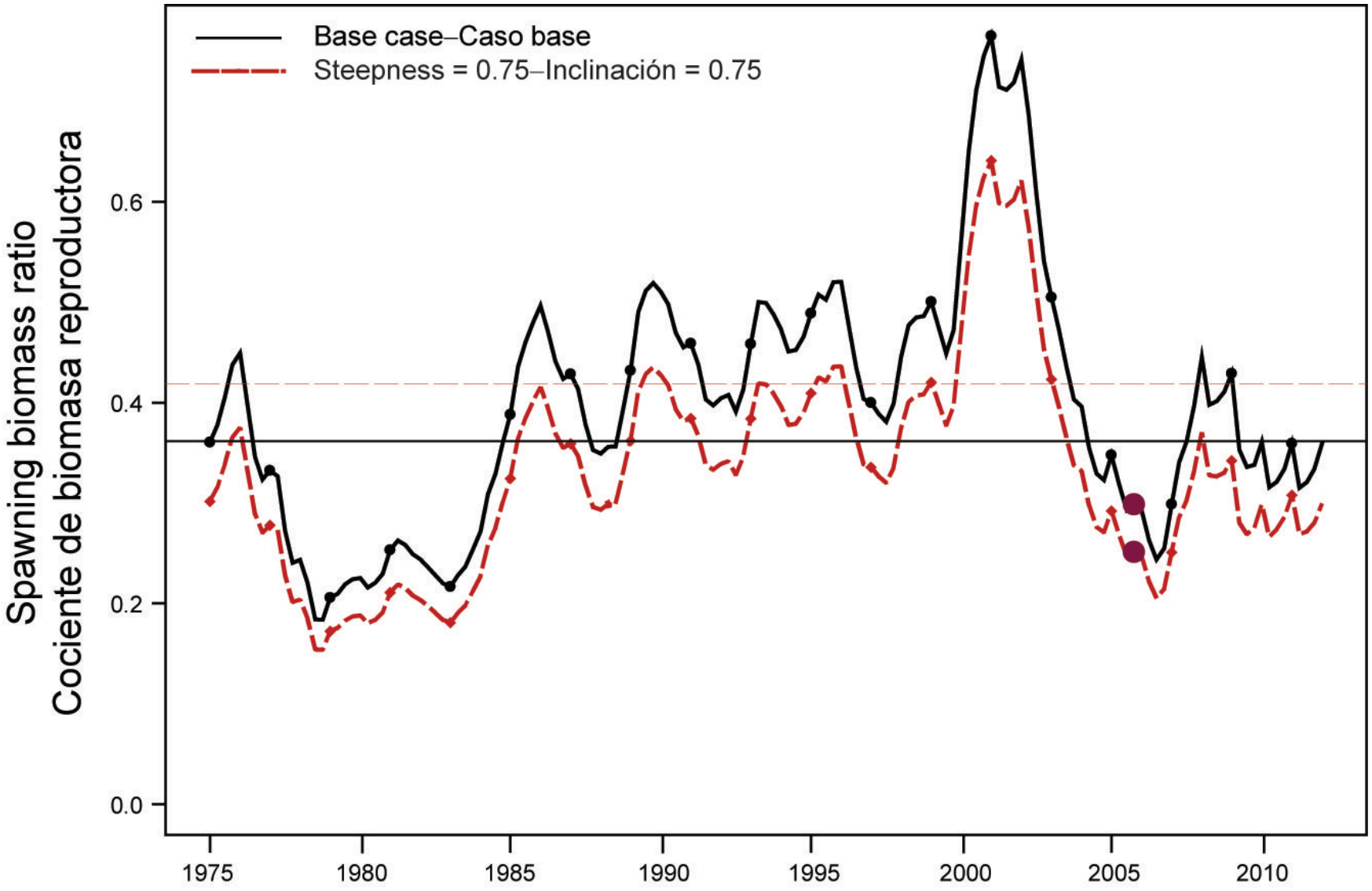
Recruitment



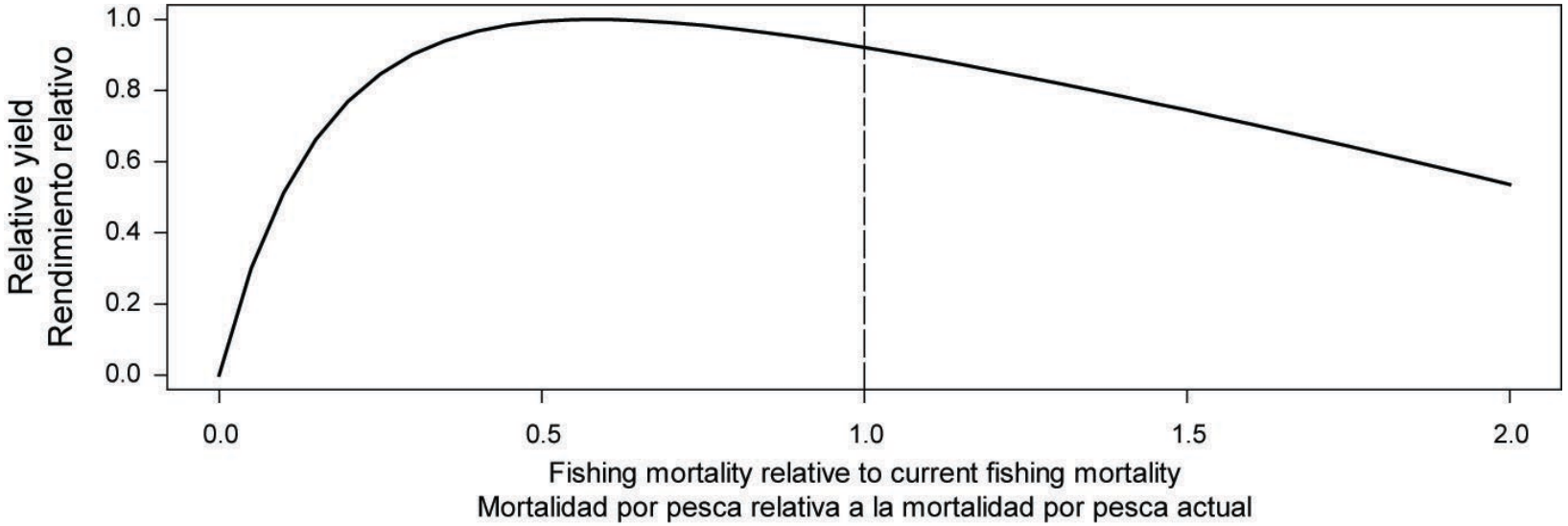
Recruitment

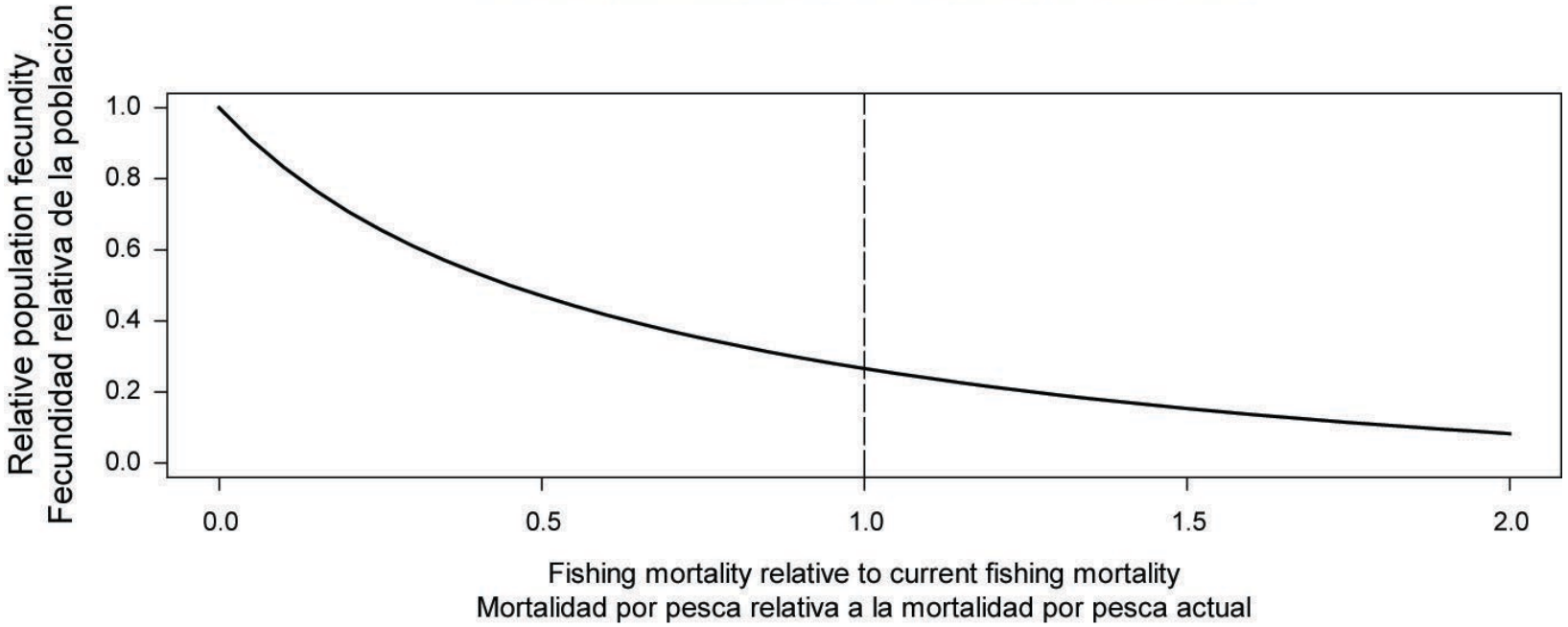


SBR


Base case–Caso base
Steepness = 0.75–Inclinación = 0.75
Spawning biomass ratio
Cociente de biomasa reproductora
0.0
0.2
0.4
0.6
1975
1980
1985
1990
1995
2000
2005
2010

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 población
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

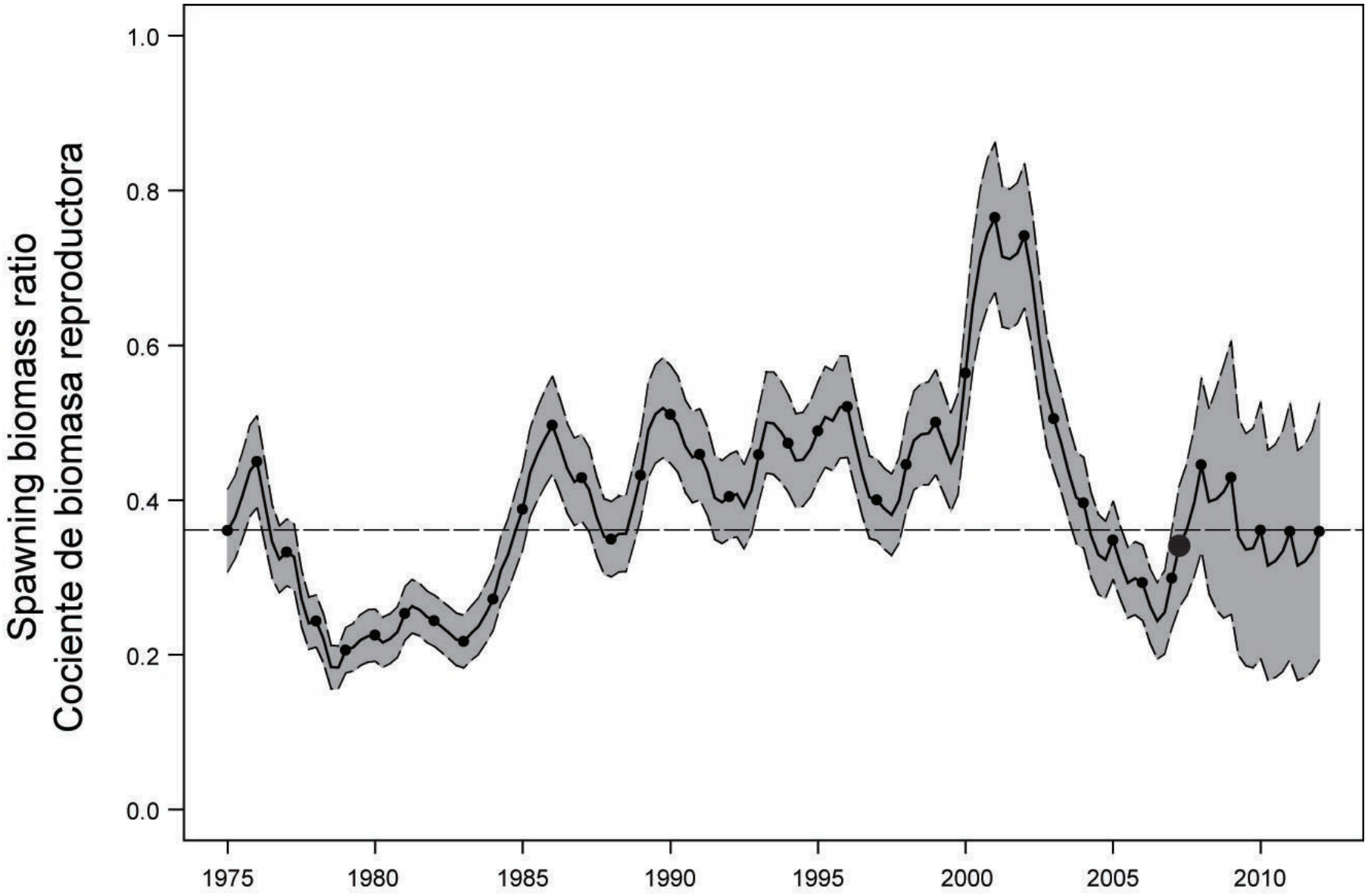
AMSY table

	Base case **Caso base**	**h = 0.75**
AMSY–RMSP	289,140	301,867
B_{AMSY}–B_{RMSP}	417,813	550,277
S_{AMSY}—S_{RMSP}	4,738	6,539
C_{recent}/AMSY—C_{recent}/RMSP	0.59	0.56
B_{recent}/B_{AMSY}–B_{recent}/B_{RMSP}	0.96	0.73
S_{recent}/S_{AMSY}–S_{recent}/S_{RMSP}	0.94	0.68
$S_{AMSY}/S_{F=0}$–$S_{RMSP}/S_{F=0}$	0.3616	0.4185
F multiplier—Multiplicador de *F*	0.88	0.59

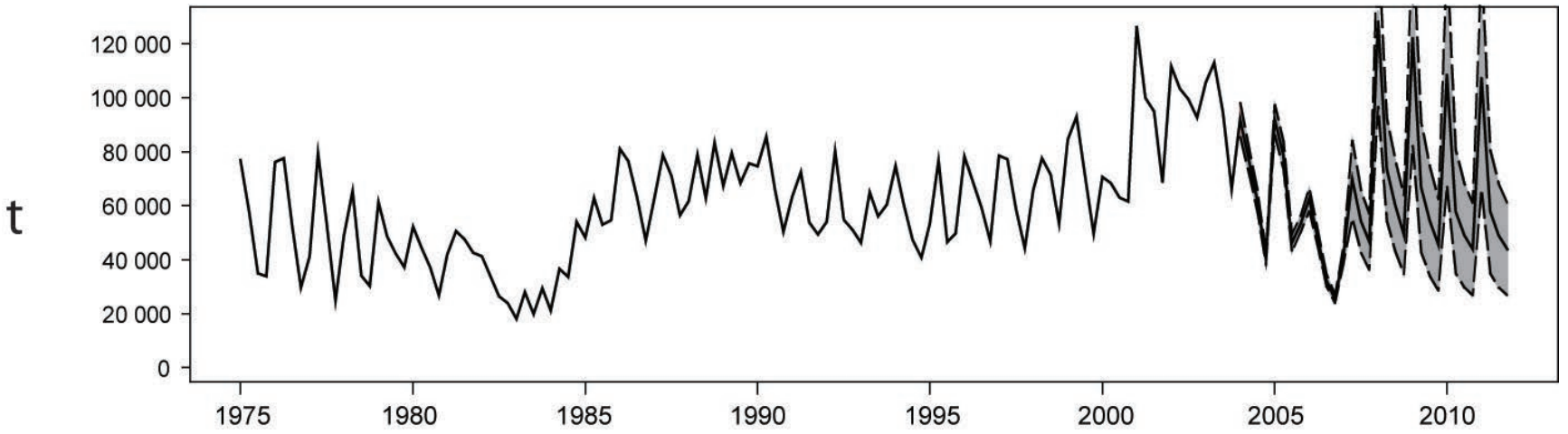
Forward Simulations

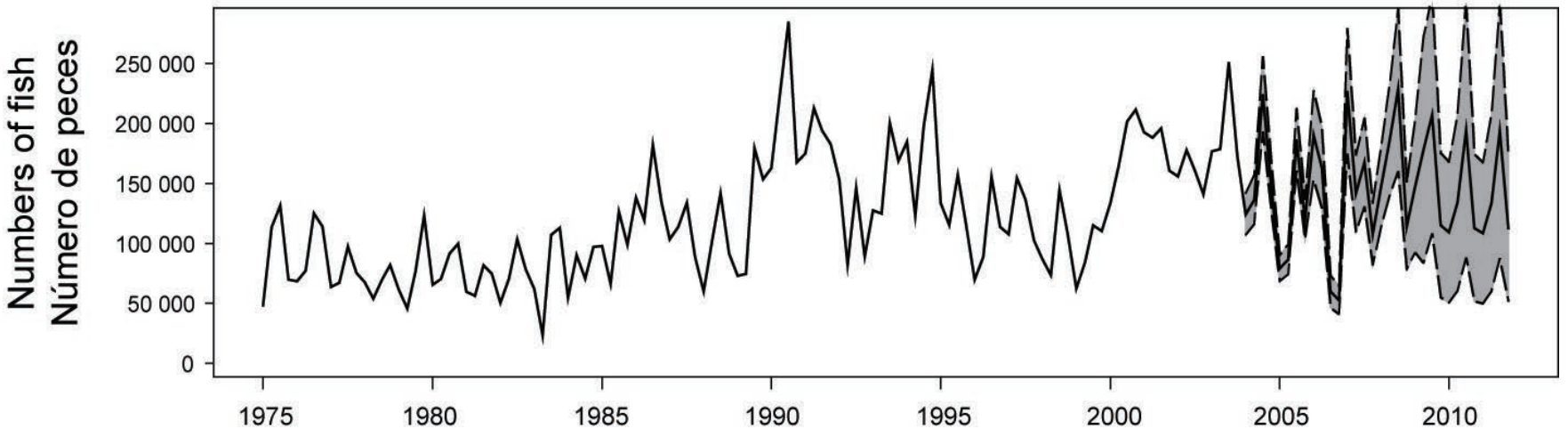
- SBR
- Surface fishery catch
- Longline catch

SBR


Spawning biomass ratio
Cociente de biomasa reproductora
1.0
0.8
0.6
0.4
0.2
0.0
1975
1980
1985
1990
1995
2000
2005
2010

Catch

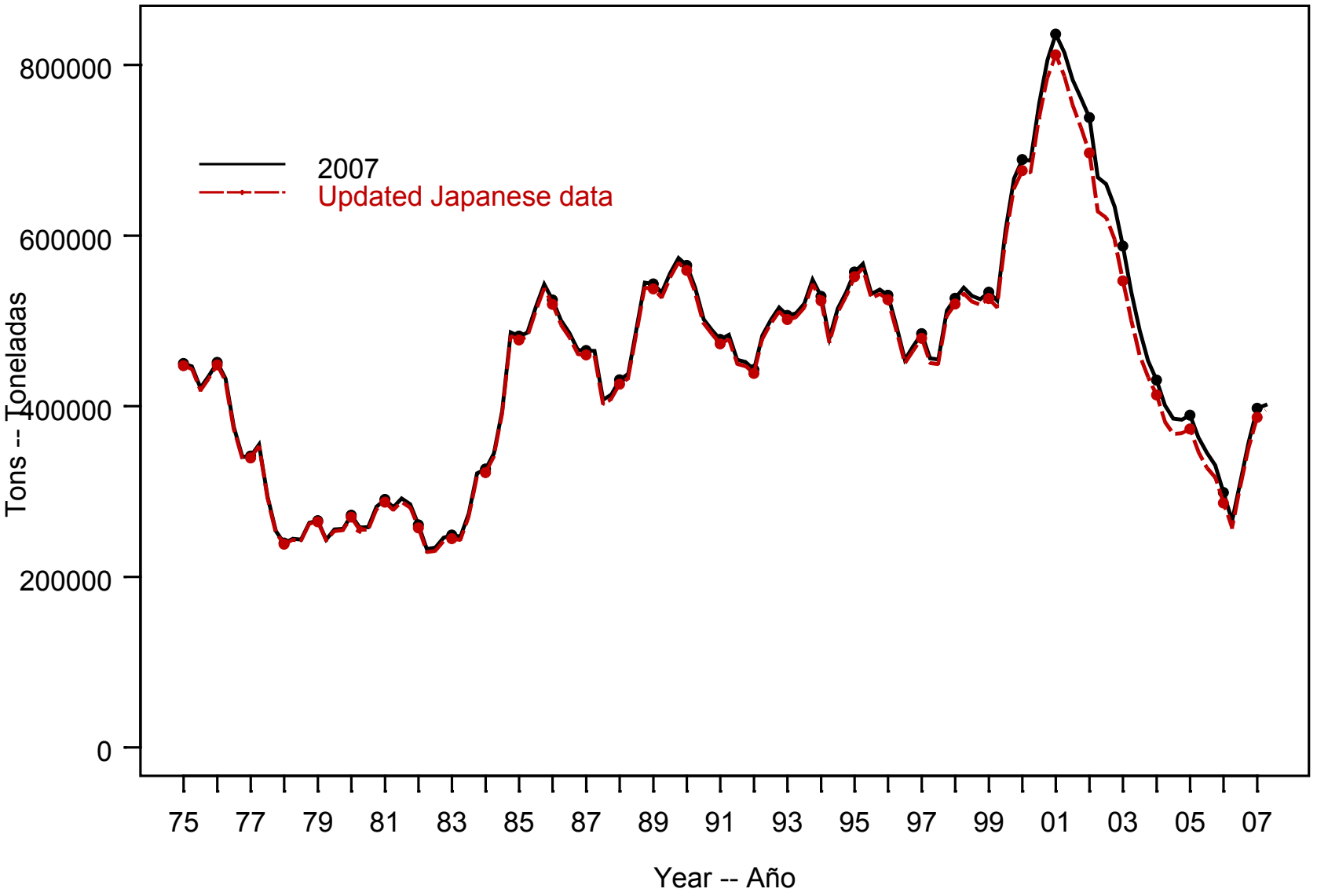

t
120 000
100 000
80 000
60 000
40 000
20 000
0
1975
1980
1985
1990
1995
2000
2005
2010


Numbers of fish
Número de peces
250 000
200 000
150 000
100 000
50 000
0
1975
1980
1985
1990
1995
2000
2005
2010

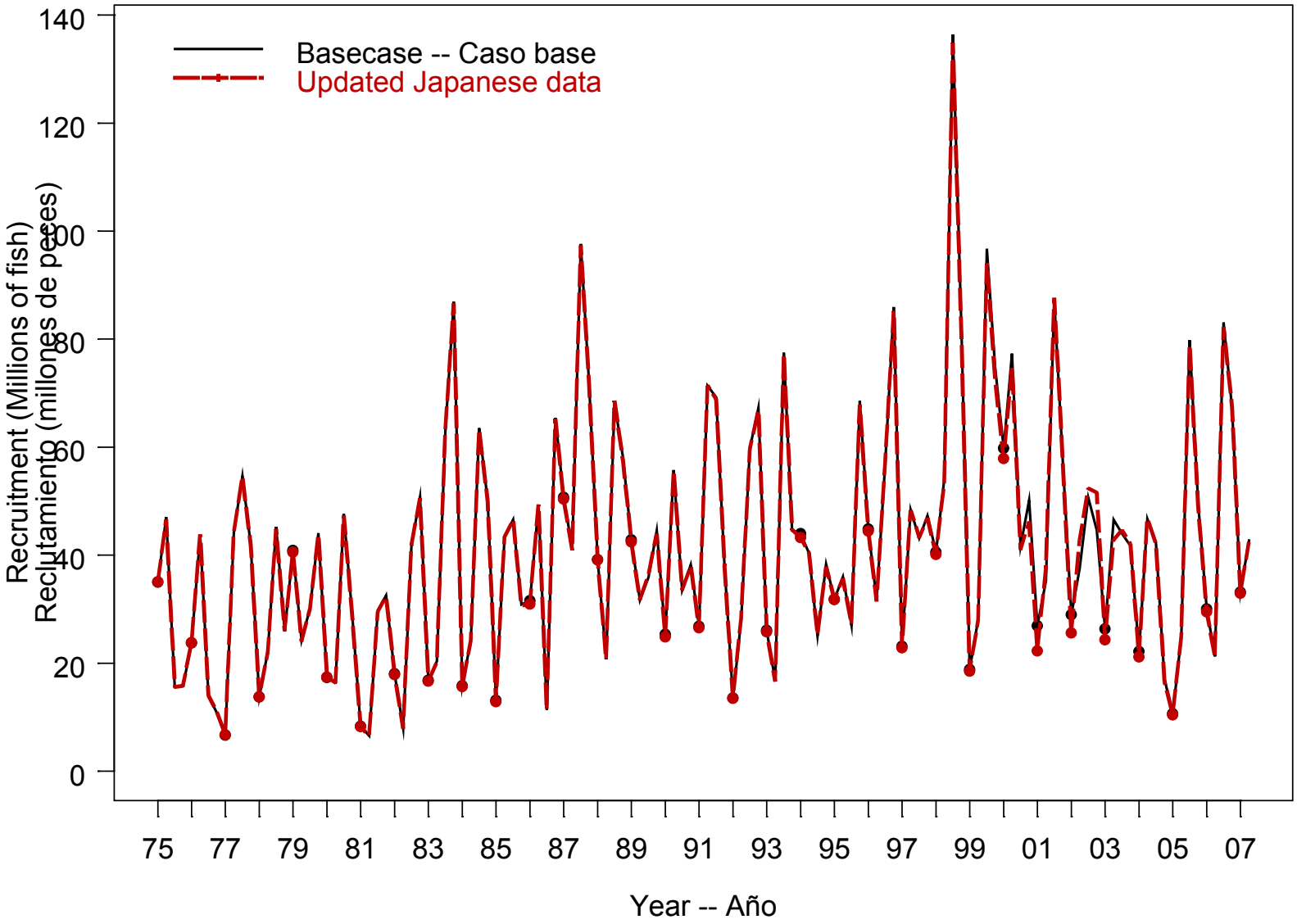
Updated Japanese data

- New data for 2005
- Catch
- CPUE
- Length frequency

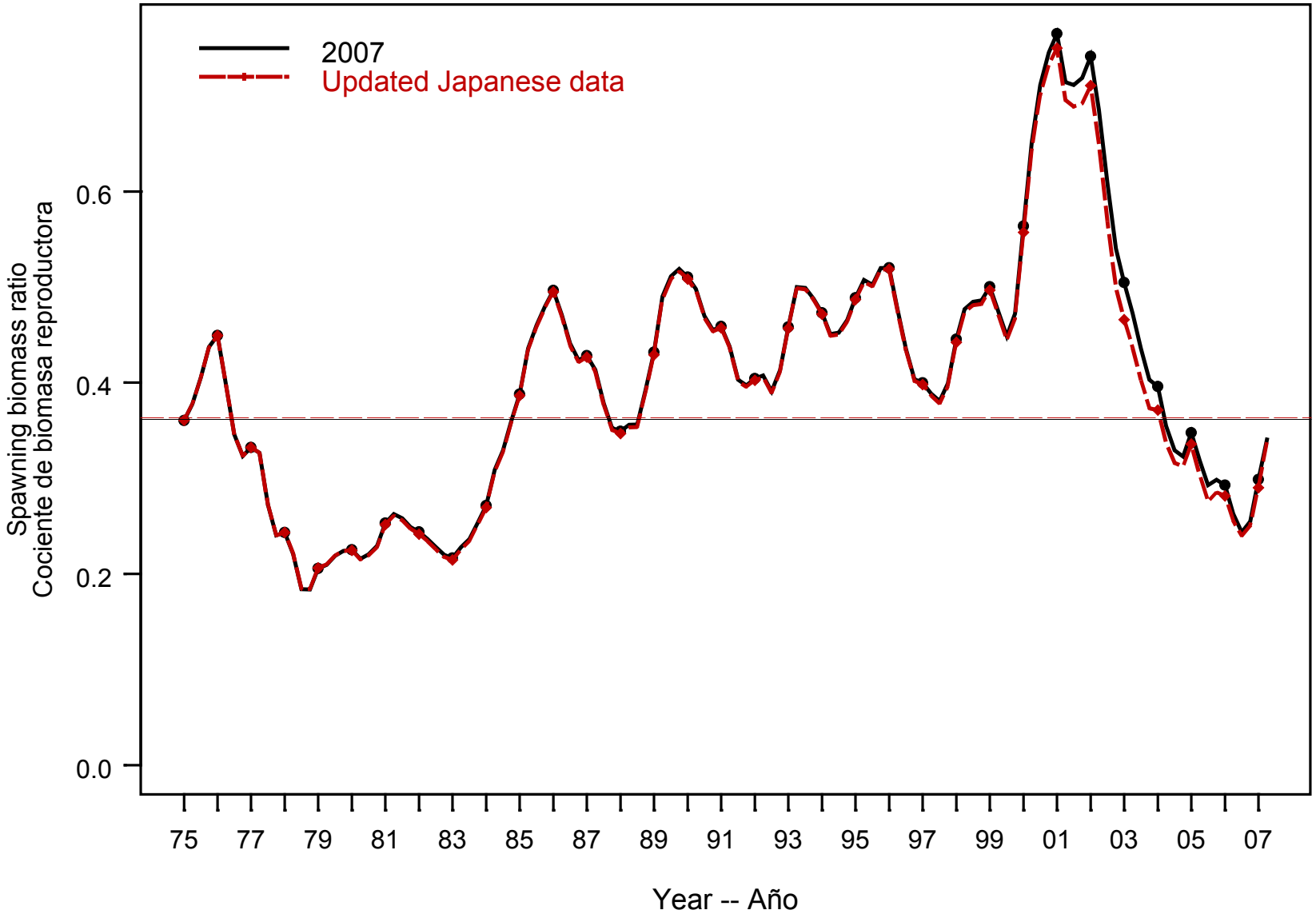
Updated Japanese data: Biomass



Updated Japanese data: Recruitment



Updated Japanese data: SBR



Summary: Main Results

- The results are similar to the previous assessment
- The biomass is estimated to have declined to levels substantially lower than recent years
- 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
- Uncertainty in current biomass and recruitment

Conclusions

1. The biomass is estimated to have declined to levels substantially lower than recent years
2. The current SBR is 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 possibly three, and the biomass required to produce AMSY may differ between the regimes

The END