SAC GFCM
Sub-Committee on Stock Assessment

Date*	**4**	**October**	**2010**	**Code***	**MUR0510Que**

Authors*	Quetglas A., Ordines F., González N.
Affiliation*	IEO-Centre Oceanogràfic de Balears
Species Scientific name*	*Mullus surmuletus - MUR*

Source: GFCM Priority Species

Geographical area*	Mallorca
Geographical Sub-Area (GSA)*	05 - Balearic Island Balearic Islands
Combination of GSAs 1	
2	
3	

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Assessment form

Sheet #0

Basic data on the assessment

Code: MUR0510Que

Date*	4	Oct	2010	Authors*	Quetglas A., Ordines F., González N.

Species Scientific name*	Mullus surmuletus - MUR	Species common name*	Striped red mullet

Data Source

GSA*	05 - Balearic Island	Period of time*	2000-2009

Description of the analysis

Type of data*	Size composition of commercial catches, official landings, CPUE from	Data source*	IEO, Fishermen Association, Autonomous Government, Ministry of Fisheries
Method of assessment*	Tuned cohort analysis (XSA), pseudocohort analysis and yield per	Software used*	Lowestoft (Darby and Flatman, 1994), VIT (Lleonart and Salat, 1997)

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	---	2	2	---	1	1	2	1	1	1	1	1

Comments, bibliography, etc.

Abella, A., Caddy, J.F., Serena, F., 1997. Do natural mortality and availability decline with age? An alternative yield paradigm for juvenile fisheries, illustrated by the hake Merluccius merluccius fishery in the Mediterranean. Aquat. Liv. Res., 10: 257–269.

Alemany F. and F. Álvarez (2003) Determination of effective fishing effort on hake Merluccius merluccius in a Mediterranean trawl fishery. Sci. Mar., 67(4): 491–499.

Astudillo A. y J.F. Caddy (1986) Periodicidad de los desembarcos de merluza (Merluccius merluccius) y salmonete (Mullus sp. sp.) en la Isla de Mallorca. Int. Symp. Long Term Changes Mar Fish Pop., Vigo: 221–233.

Bruno J., P. Oliver, A. Astudillo, X. Pastor and E. Daroca (1979) Contribution a la connaissance de la biologie du merlu (Merluccius merluccius L.) et du rouget (Mullus surmuletus L. et Mullus barbatus L.). Rapp. Comm. Int. Mer Médit., 25/26(10): 79–86.

Caddy, J.F., 1991. Death rates and time intervals: is there an alternative to the constant natural mortality axiom? Rev. Fish. Biol. Fish., 2: 109–138.

Darby, C.D. and Flatman, S., 1994. Virtual Population Análisis: version 3.1 (Windows/DOS) user guide. Info. Tech. Ser., MAFF Direct. Fish. Res., Lowestoft, nº 1, 85 pp.

Lleonart J. and J. Salat (1997) VIT: Software for fishery analysis. User´s manual. FAO Computerized Information Series (Fisheries). Nº 11. Rome, FAO, 105 pp.

Mas, X, Goñi, R, Fernández, JL (2004) Yields, bycatch and discards in the Mullus surmuletus gillnet fishery off southeastern Mallorca (western Mediterranean). Rapp. Comm. int. Mer Médit., 37: 397.

Morales-Nin B. (1991) Parámetros biológicos del salmonete de roca Mullus surmuletus (L. 1758) en Mallorca. Bol. Inst. Esp. Oceanogr., 7: 139–147.

Oliver P. (1993) Analysis of fluctuations observed in the trawl fleet landings of the Balearic Islands. Sci. Mar., 57(2-3): 219–227.

Pauly, D. (1980) On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. J. Cons. CIEM, 39(2): 175–192.

Reñones O., E. Massutí and B. Morales-Nin (1995) Life history of the red mullet Mullus surmuletus from the bottom-trawl fishery off the Island of Majorca (north-west Mediterranean). Mar. Biol., 123: 411-419.

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Assessment form — **Sheet B** — **Biology of the species**

Code: MUR0510Que

Biology

Somatic magnitude measured (LH, LC, etc)*	Total length	Units*	cm

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed				39(1)	Reproduction season	Spring(4)
Size at first maturity				14.2(2)	Reproduction areas	
Recruitment size				10(3)	Nursery areas	Continental shelf

Parameters used (state units and information sources)

Sex	Unsexed							
Growth model	on Bertalanffy							
Data source	Otolith readings of individuals from the Balearic Islands in the framework of the Spanish Nati							
L_∞ (growth)	40.05							
K (growth)	0.164							
t_0 (growth)	-1.883							
length-weight relationship	Biological samplings of individuals from the Balearic Islands in the framework of the Spanish							
a (length-weight)	0.0084							
b (length-weight)	3.118							
sex ratio								
M	Vector of M at age(5)							

Comments

(1) MEDITS data

(2) Data from the Spanish National Data Collection Program

(3) Reñones et al. (1995)

(4) Bruno et al. (1979)

(5) Vector of M at age, calculated from Caddy (1991) equation using the PROBIOM Excel spreadsheet (Abella et al., 1997):

Age	M
0	1
1	0.6
2	0.4
3	0.3
4	0.3
5	0.3
Mean	0.48

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Assessment form

Sheet P1

General information about the fishery

Code: MUR0510Que

Data source*	Size composition of trawl and small-scale catches: IE	Year (s)*	2000-2009
Data aggregation (by year, average figures between years, etc.)*	By year for XSA and average 2000-2008 for pseudocohort and Y/R analysis		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Gear Class	Group of Target Species
Operational Unit 1*	ESP	05	E - Trawl (12-24 metres)	03 - Trawls	34 - Demersal offshore species
Operational Unit 2	ESP	05	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal inshore species
Operational Unit 3					
Operational Unit 4					
Operational Unit 5					

Operational Units*	Fleet (n° of boats)*	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
	37	92.69	See sheet P2b	No(3)		days
ESP 05 C 07 33	67	21.96	See sheet P2b	Yes (4)	Yes (4)	days
Total	104	114.65				

Legal minimum size	11 cm

Comments

(1) Fleets (nº of boats) refers to: 1) the average number of trawlers in Mallorca during 2000-2009; and 2) the average number of boats from the small-scale fleet that targeted the species during this period.
(2) Catch is the average landings, in tons, of Mallorca during the period 2000–2009.
(3) Carbonell (1997).
(4) Since Mas *et al.* (2004), twelve species were discarded at least in one occassion, and the discarded fraction in this fishery was 1.4% in number. *M. surmuletus* were discarded in 19% of the fishing sets and made up the largest fraction of the discards (42.8% in number).

- The GFCM geographical sub-area 05 includes the waters around the Balearic Islands. This Archipelago is constituted by the islands of Mallorca, Menorca, Ibiza and Formentera. From official landings, the red mullet *Mullus surmuletus* represents the following percentages by island: 94.8% Mallorca, 2.7% Menorca and 2.5% Ibiza-Formentera. The present assessment has been performed considering exclusively data from Mallorca because: 1) reliability and availability of fishery statistics; and 2) both length and biological (growth, maturity, length-weight) samplings were carried out in this island. Hence, it must be taken into account that the present assessment represents approximately 95% of the total GSA-05.
- From official data, the total trawl fleet of the whole geographical sub-area 05 (Balearic Islands) is composed by 53 boats: on average, 41 TRB, 53 GT and 239 HP. Some of these units (smaller vessels) operate almost exclusively on the continental shelf (target species: red mullets, picarel, octopuses, hake and sea breams), others (bigger vessels) operate almost exclusively on the continental slope (target species are decapod crustaceans) and the rest can operate indistinctly on the continental shelf and slope fishing grounds, depending on the season, the weather conditions and also economic factors (e.g. landings price). In Mallorca, the percentage of these trawl fleet segments have been estimated (Alemany & Alvarez, 2003) 30, 40 and 30% of the boats, respectively.

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Assessment form	Sheet P2a Fishery by Operational Unit

Code: MUR0510Que

Data source*	IEO: size composition of trawl catches; Official lar	OpUnit 1*	0

Time series

Year*	2000	2001	2002	2003	2004	2005
Catch	84.99	117.06	105.29	81.87	82.96	93.92
Minimum size	8	7	9	7	9	9
Average size L_c	17	16.9	16.8	16.6	16.5	16.5
Maximum size	30	31	29	30	29	30
Fleet	41	39	39	37	37	37

Year	2006	2007	2008	2009		
Catch	90.77	114.22	81.92	73.94		
Minimum size	8	10	8	8		
Average size L_c	16	17.2	17.3	16.7		
Maximum size	33	32	32	33		
Fleet	36	36	34	32		

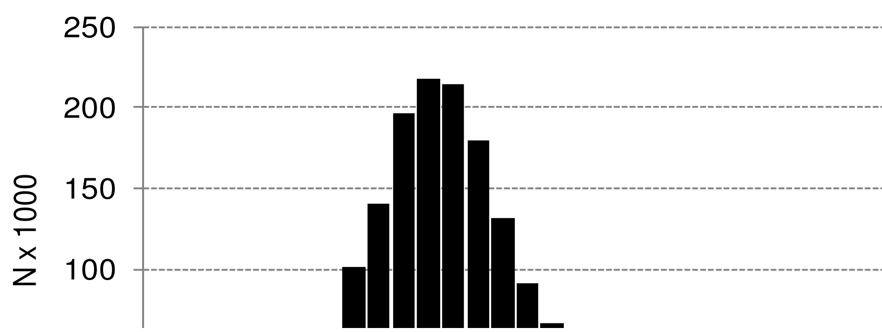
Selectivity

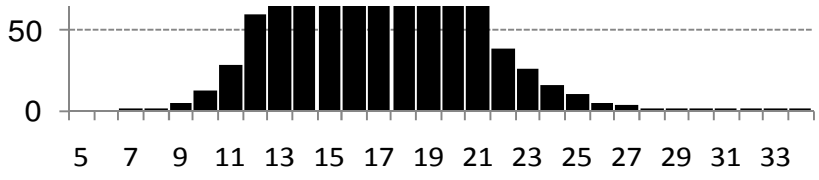
L_{25}	6.5 cm
L_{50}	8.5 cm
L_{75}	10.5 cm
Selection factor	

Remarks

This data corresponds to 40 mm diamond mesh in the cod-end. Data source: Massutí E., R. Mas, B. Guijarro y B. Pomar (2003) Informe del seguimiento científico de una acción piloto de selectividad de artes de arrastre en aguas de Mallorca (Illes Balears). Informe Secretaría General de Pesca Marítima, 76 pp.

Structure by size or age





Average size frequency distribution (cm; total length) of trawl catches in the geographical sub-area 05 (Balearic Islands) for the period 2000–2009. Size composition of catches have been obtained from monthly length sampling (stratified random method) on board trawl fishing vessels at different ports of Mallorca.

Data source*	IEO: size composition of small-scale catches; Offic	OpUnit 2*	ESP 05 C 07 33

Time series

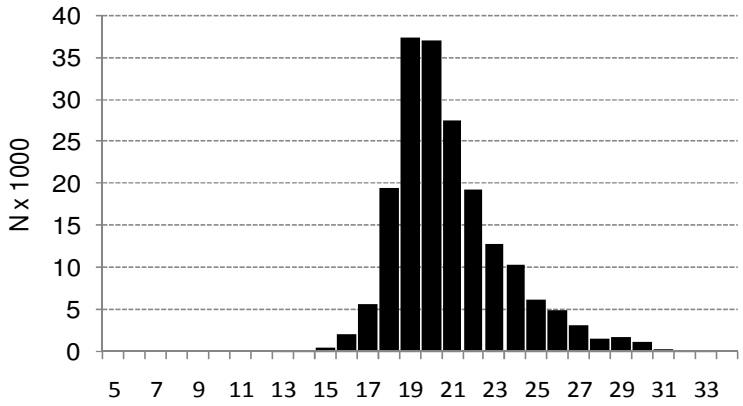
Year*	2000	2001	2002	2003	2004	2005
Catch	21.49	27.31	25.72	19.75	17.57	28.61
Minimum size	15.0	15.0	15.0	15.0	15.0	15.0
Average size L_c	20.7	20.7	20.7	20.7	20.7	20.7
Maximum size	33	33	33	33	33	33
Fleet	75	86	81	68	56	72

Year	2006	2007	2008	2009		
Catch	22.13	21.29	19.88	15.87		
Minimum size	15.0	15	13	15		
Average size L_c	21.5	20.1	21.9	21.7		
Maximum size	31	33	33	33		
Fleet	65	60	54	51		

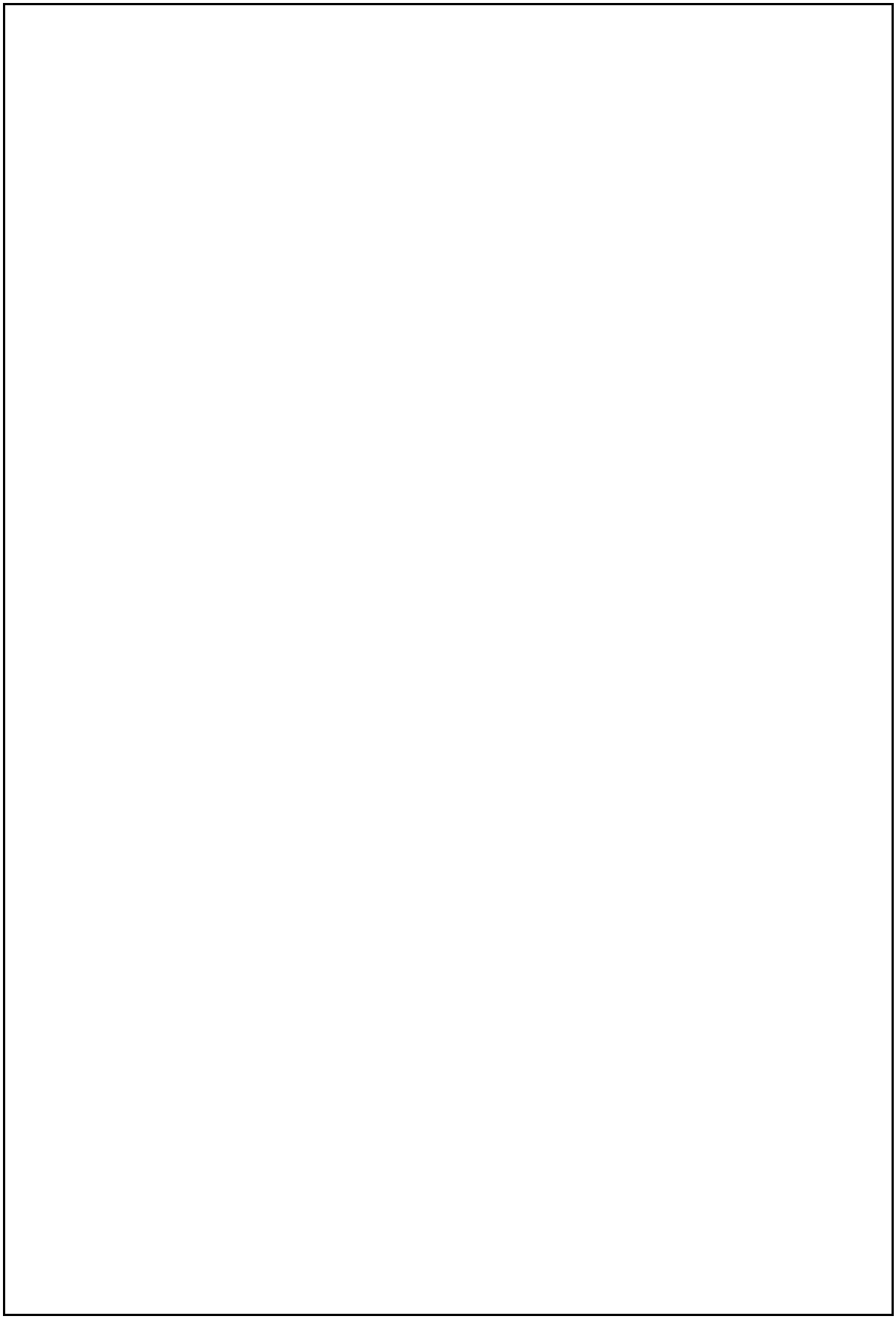
Selectivity **Remarks**

L_{25}	
L_{50}	
L_{75}	
Selection factor	

Structure by size or age



Average size frequency distribution (cm; total length) of small-scale catches in the geographical sub-area 05 (Balearic Islands) for the period 2000–2009. Size composition of catches have been obtained from on port monthly length sampling (stratified random method).



Data source*		OpUnit 3*	

Time series

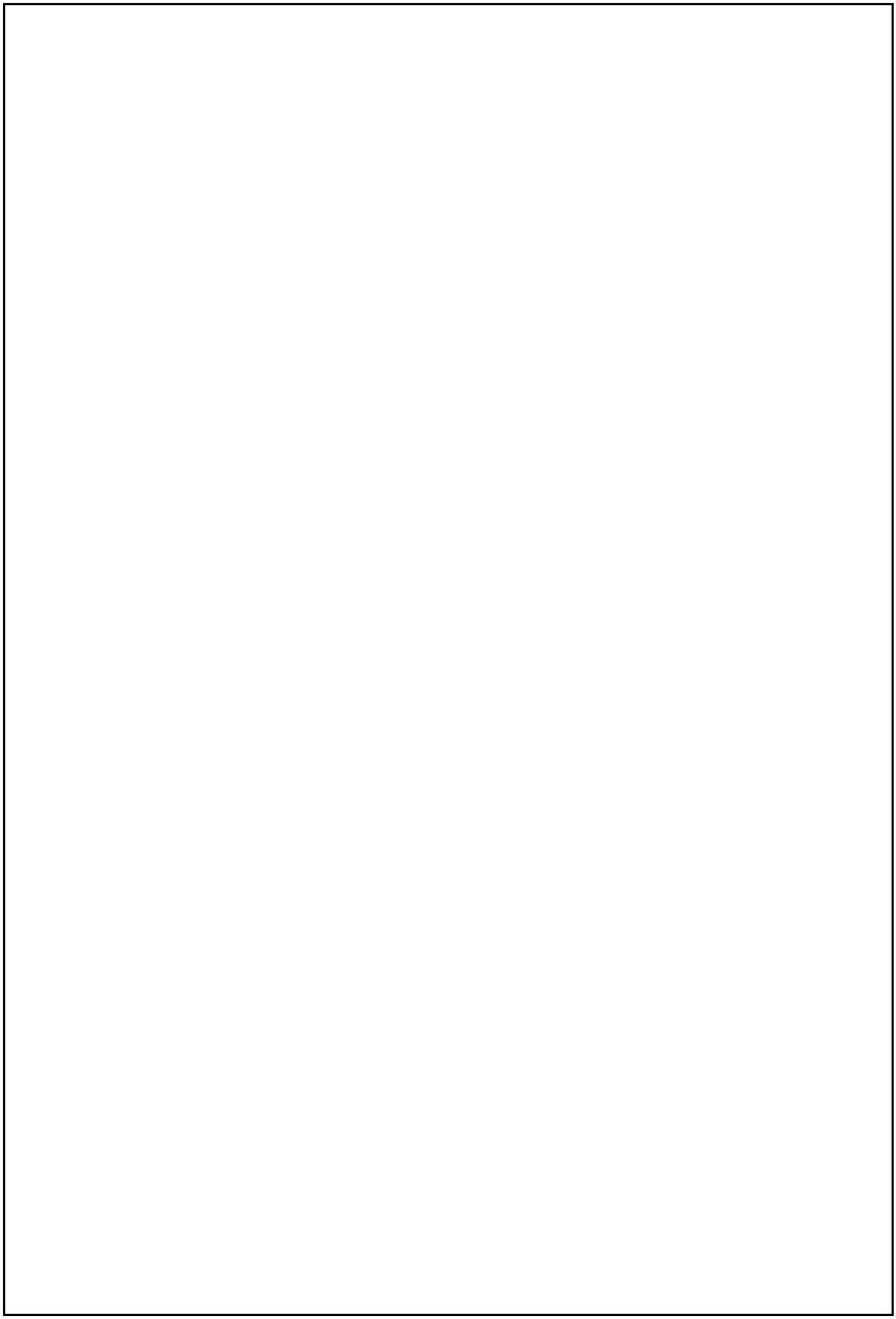
Year*						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Selectivity **Remarks**

L_{25}		
L_{50}		
L_{75}		
Selection factor		

Structure by size or age



Data source*		OpUnit 4*	

Time series

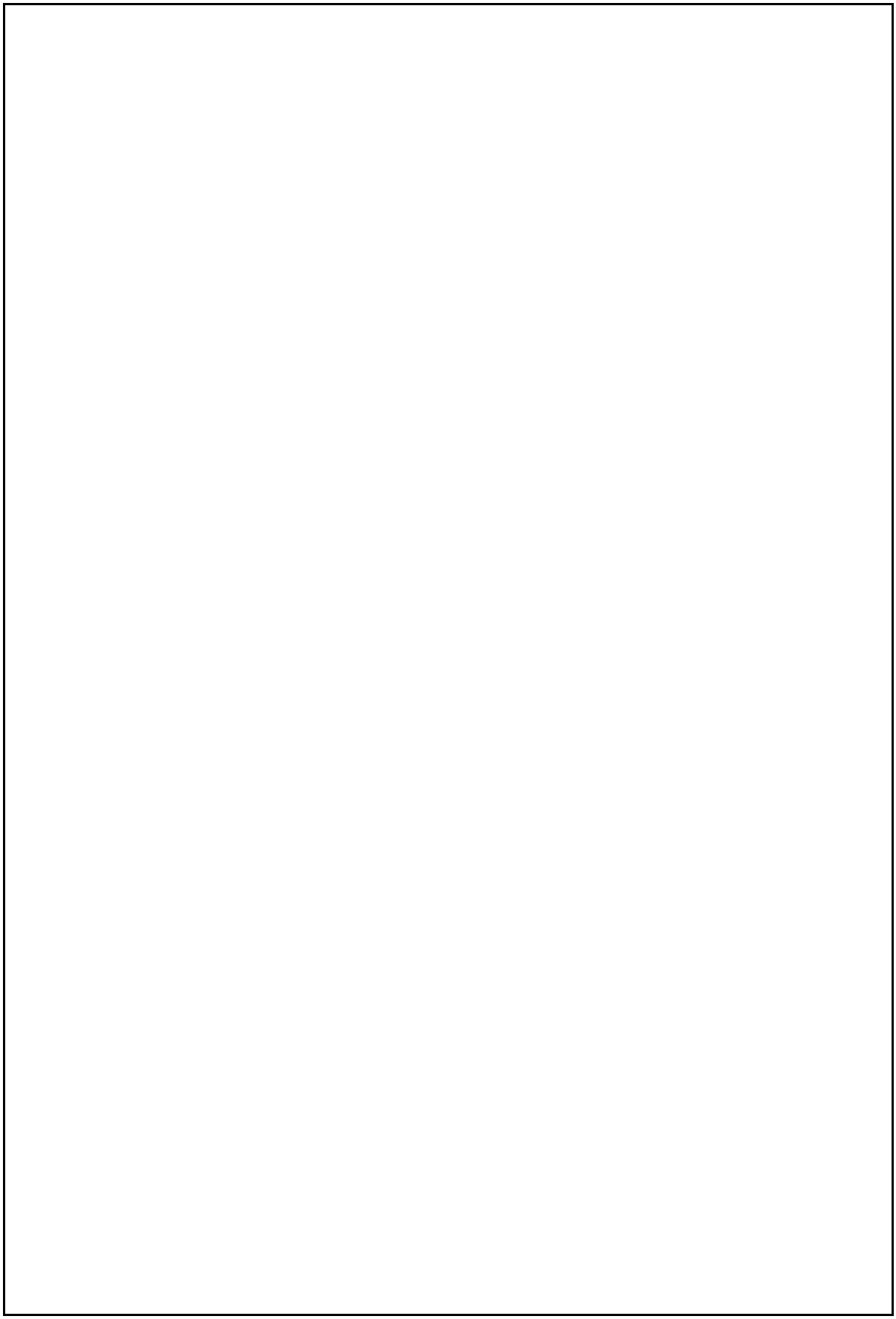
Year*						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Selectivity **Remarks**

L_{25}		
L_{50}		
L_{75}		
Selection factor		

Structure by size or age



Data source*		OpUnit 5*	

Time series

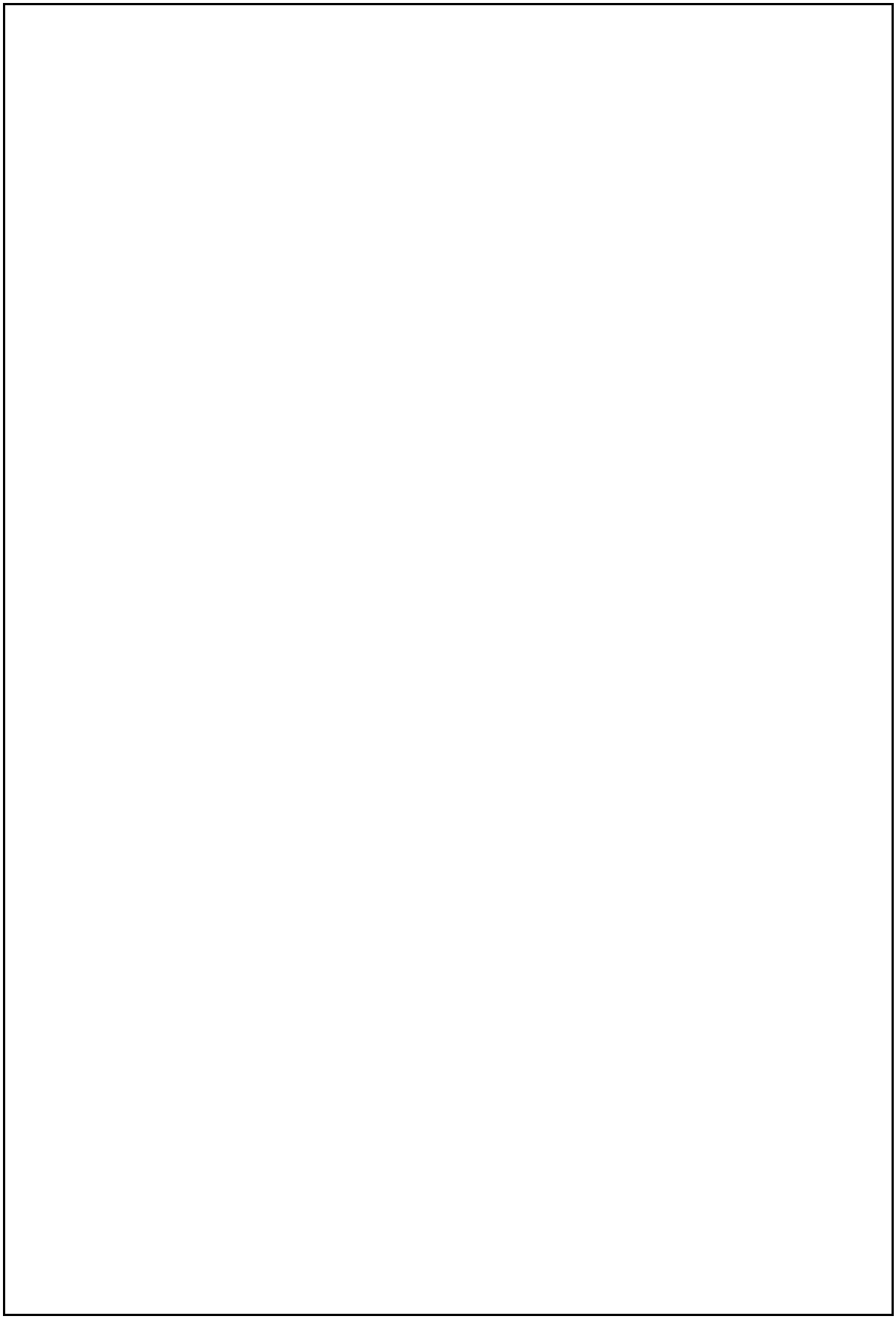
Year*						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size L_c						
Maximum size						
Fleet						

Selectivity **Remarks**

L_{25}		
L_{50}		
L_{75}		
Selection factor		

Structure by size or age



Data source*	IEO and EU research project on discards (1)	OpUnit 1*	0

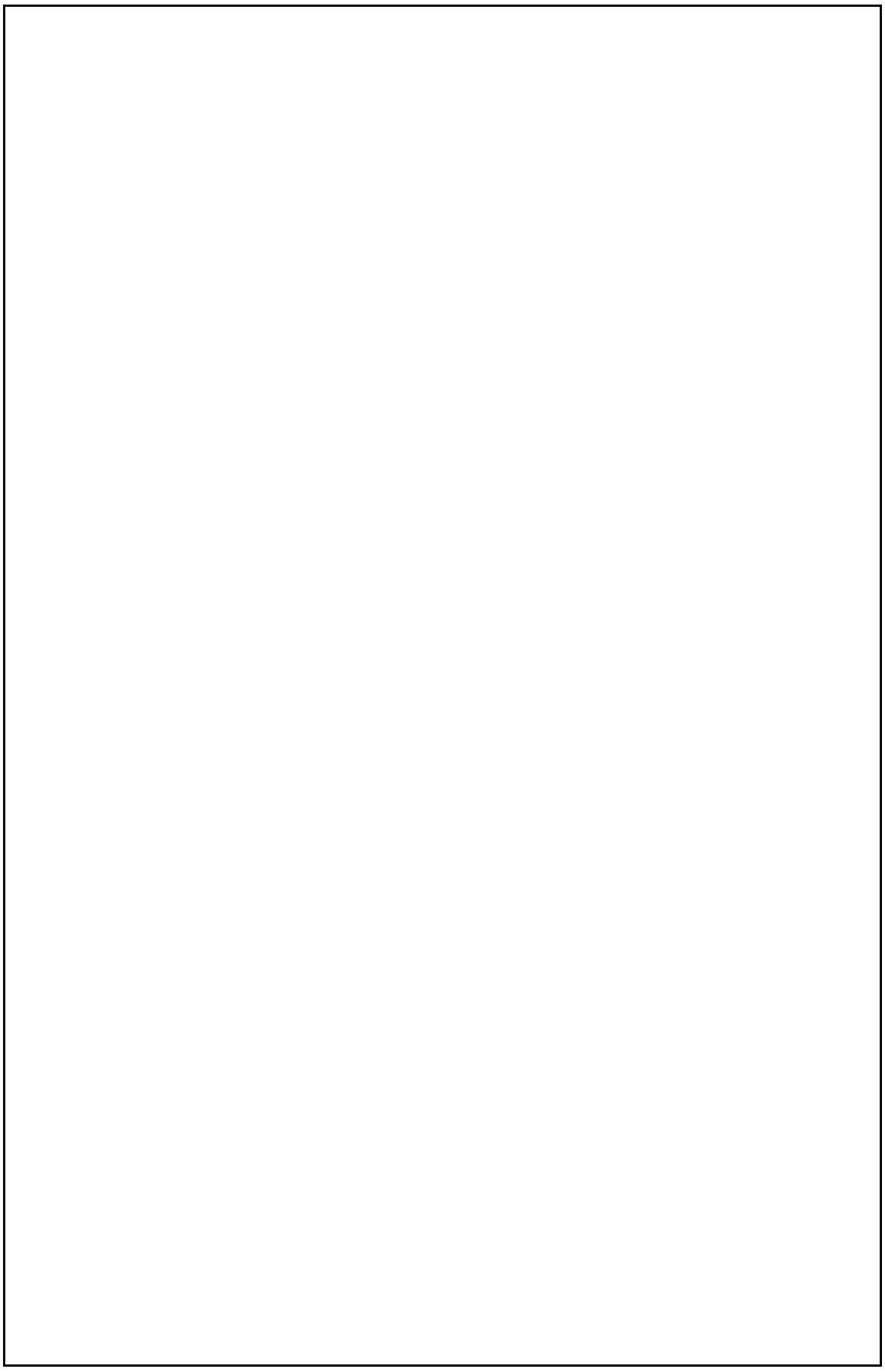
Regulations in force and degree of observance of regulations

- Fishing license: fully observed
- Engine power limited to 316 KW or 500 CV: not observed
- Mesh size in the cod-end (40 mm stretched): fully observed
- Fishing forbidden upper 50 m depth: not fully observed
- Time at sea (12 hours per day and 5 days per week): fully observed

Accompanying species

Trawl fishery developed along the continental shelf of the Balearic Islands is a multi-specific fishery. It is performed mainly on detritic bottoms of rhodophytic and corallinic algae. In addition to *M. surmuletus*, the following species can be considered as important in landings:

- *Spicara smaris*
- *Mullus barbatus*
- *Pagellus acarne*
- *Pagellus erythrinus*
- *Trachurus mediterraneus*
- *Scyliorhinus canicula*
- *Serranus cabrilla*
- *Trachinus draco*
- *Scorpaena notata*
- *Trigloporus lastoviza*
- *Scorpaena scrofa*
- *Octopus vulgaris*
- *Eledone moschata*
- *Sepia officinalis*
- *Loligo vulgaris*



Data source*	IEO and EU research project on discards (1)	OpUnit 2*	ESP 05 C 07 33

Regulations in force and degree of observance of regulations

- Fishing license: fully observed
- Fishing season (July to December): fully observed
- Maximum length of nets (2000 m/fisherman and 5000 m/boat): not fully observed
- Minimum mesh size (50 mm): fully observed
- Limitation to 6 fishing days per week: fully observed
- Time at sea (from sunrise to sunset): not fully observed
- Fishing forbidden deeper than 50 m depth: fully observed

Accompanying species

Since Mas *et al.* (2004), the main by-catch species were the following commercially important fish species:
- *Diplodus annularis*
- *Spicara maena*
- *Diplodus vulgaris*
- *Serranus scriba*

Data source*		OpUnit 3*	

Regulations in force and degree of observance of regulations

Accompanying species

Data source*		OpUnit 4*	

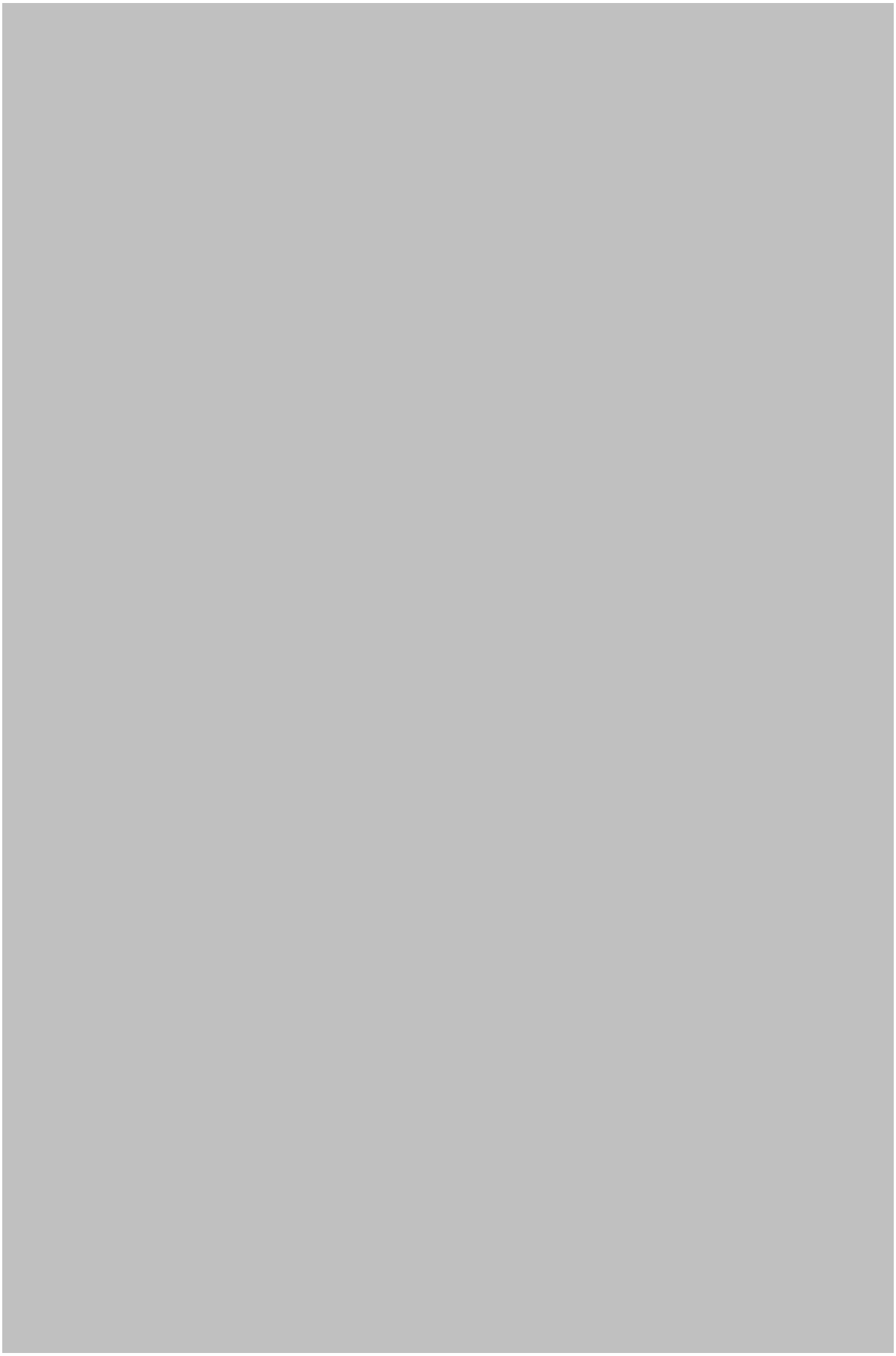
Regulations in force and degree of observance of regulations

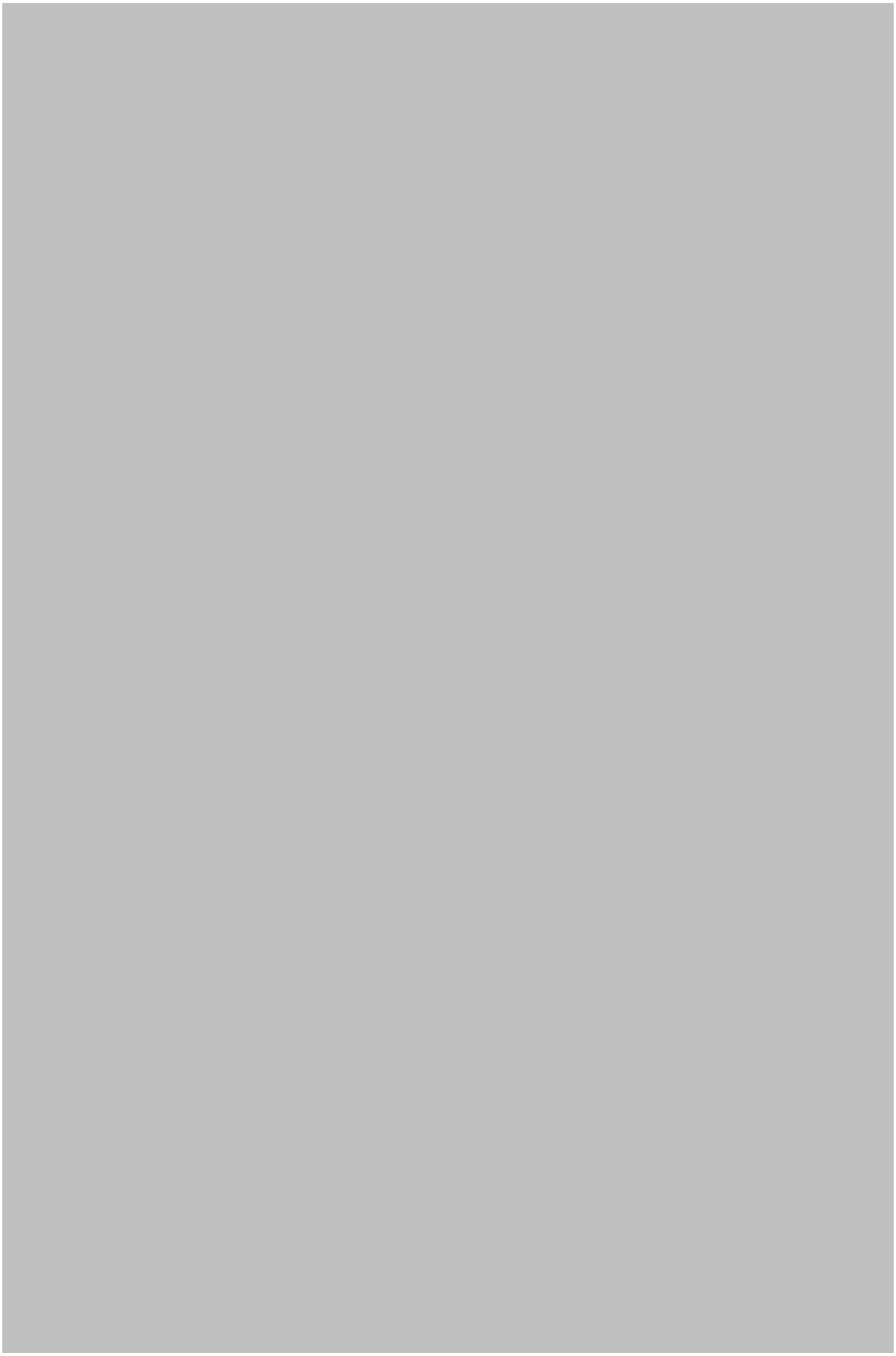
Accompanying species

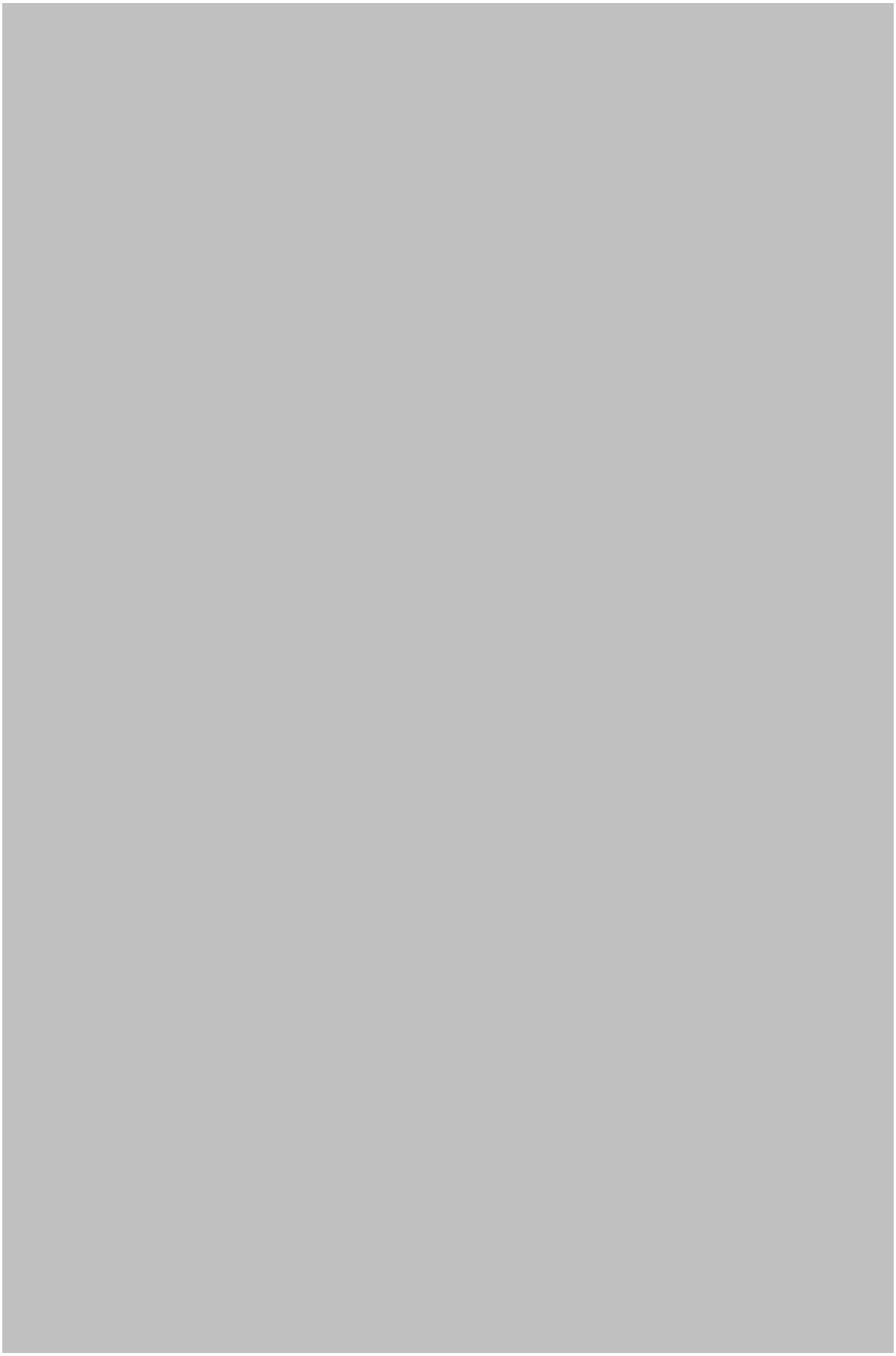
Data source*		OpUnit 5*	

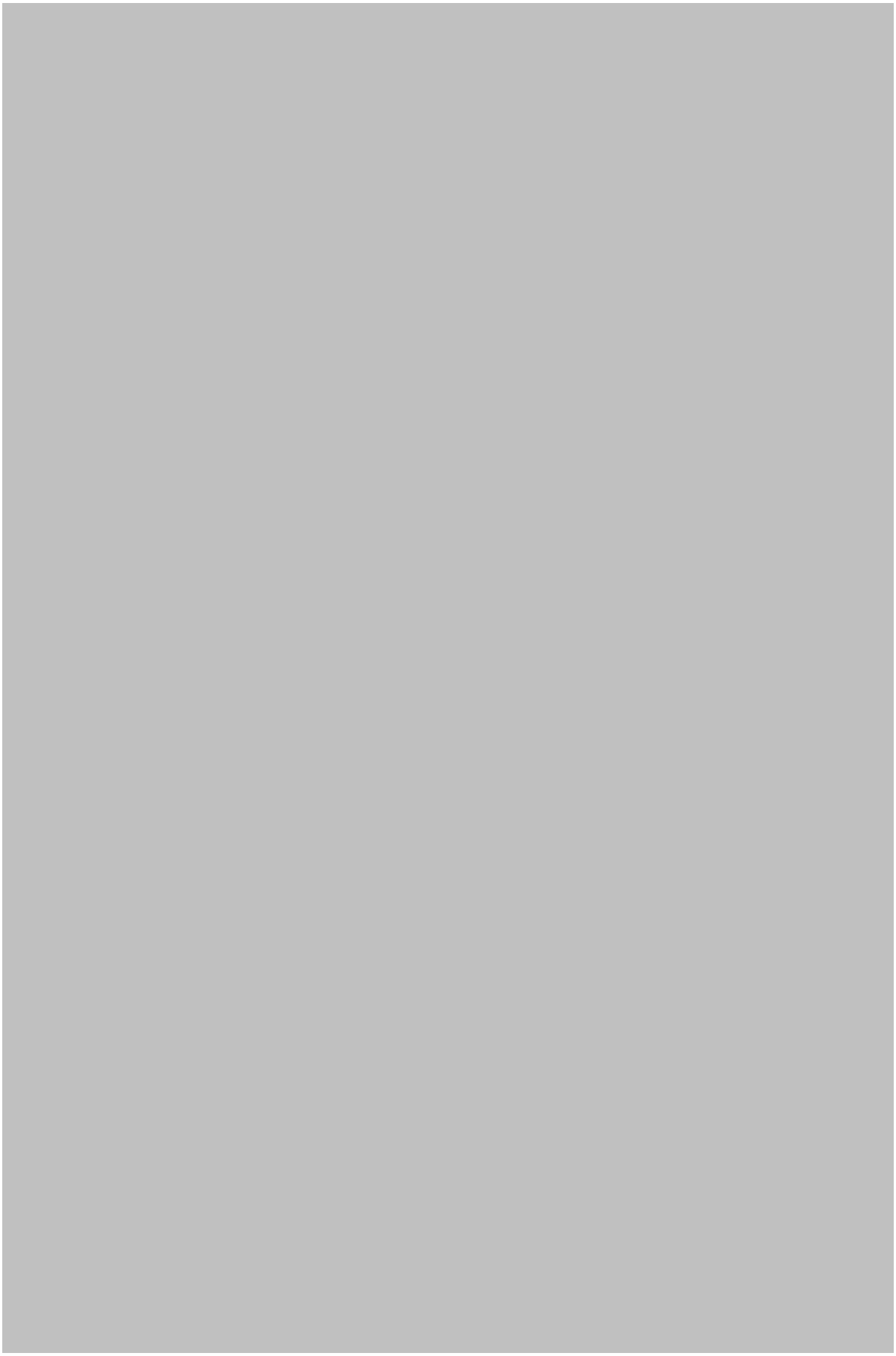
Regulations in force and degree of observance of regulations

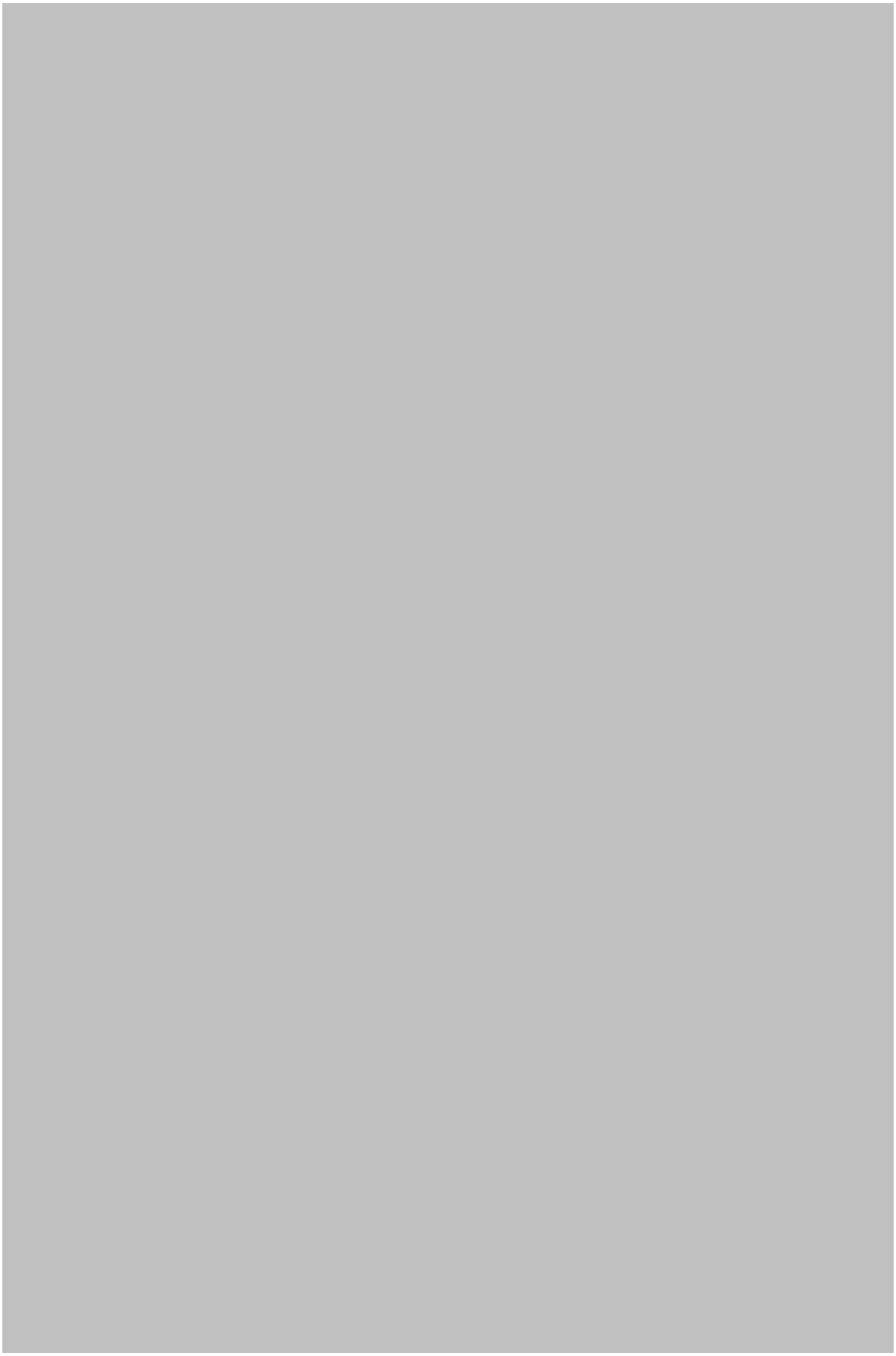
Accompanying species

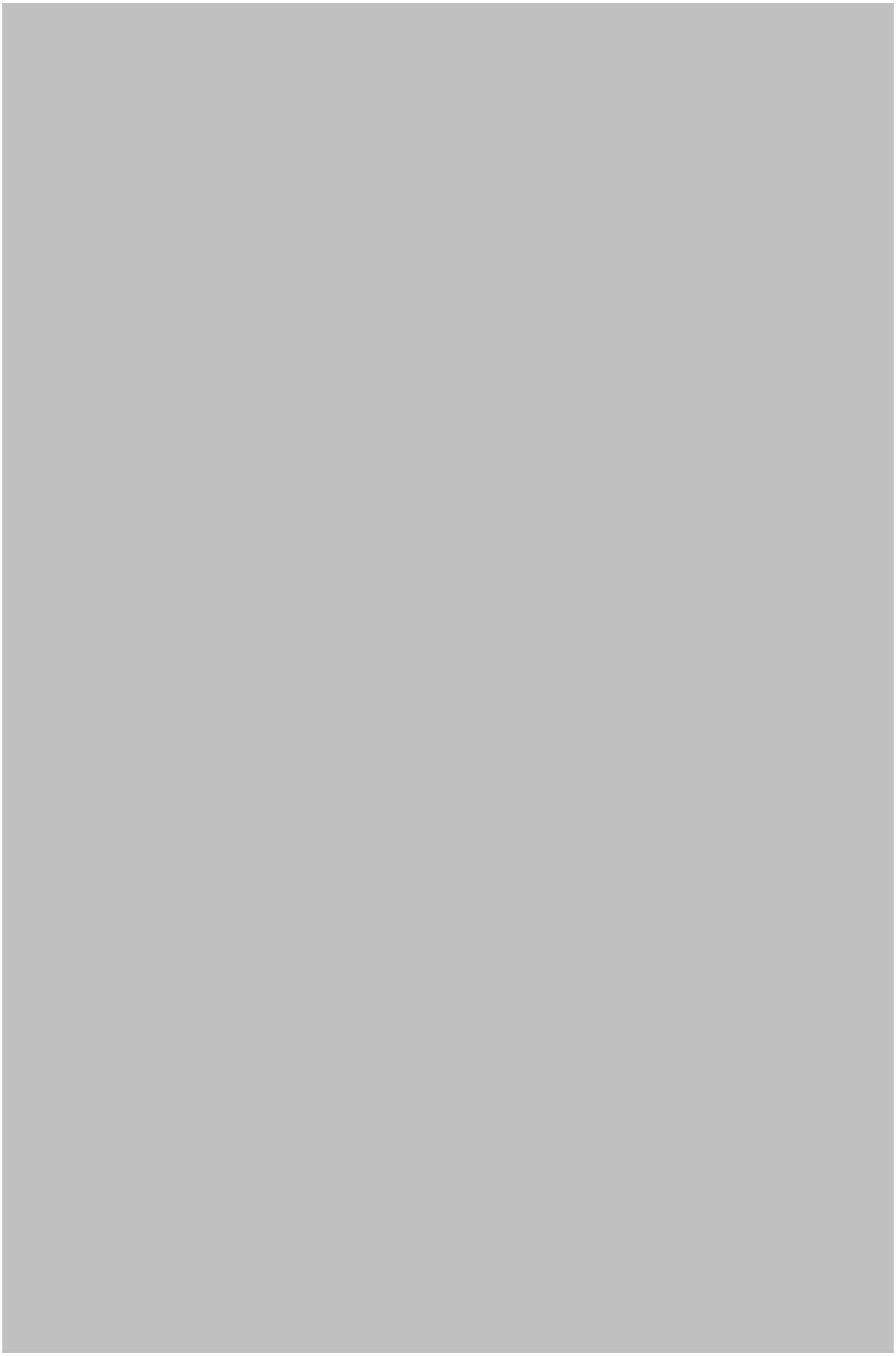












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Assessment form — **Sheet A1** — **Indirect methods: VPA, LCA**

Code: MUR0510Que

Sex*	Unsexed

Analysis # *	1

Time series

Data	Size	Age
(mark with X)	X	X

Model	Cohorts	Pseudocohorts
(mark with X)	X	2 (more A1 sheets are

Equation used	Catch equation	Tunig method	Extended Survivor Analysis
# of gears	2	Software	Lowestoft VPA suite (Darby and Flatman, 1994)
$F_{terminal}$	0.654		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum			Recruitment	7.4	216.1
Average			Average population	11.18	513
Maximum			Virgin population	SSN	SSB
Critical			Turnover	3.12	218.8
				N in millions	in tons

Average mortality

		Gear					
	Total						
F_1	0.606						
F_2	0.077						
Z	1.086						

(F1 and F2 represent different possible calculations. Please state them)

Comments

F1 was calculated averaging FBAR0-5 from 2000–2009; FBAR0-5 is an arithmetic mean calculated for each year over all the range of ages (0–5 years).

F2 is the F at age 0

Z= 0.48+F1

The vector of fishing mortalities by age in the last year was obtained from a previous separable VPA:

Age (years)	F
0	0.092
1	0.470
2	0.817
3	0.778
4	0.617
5	0.654

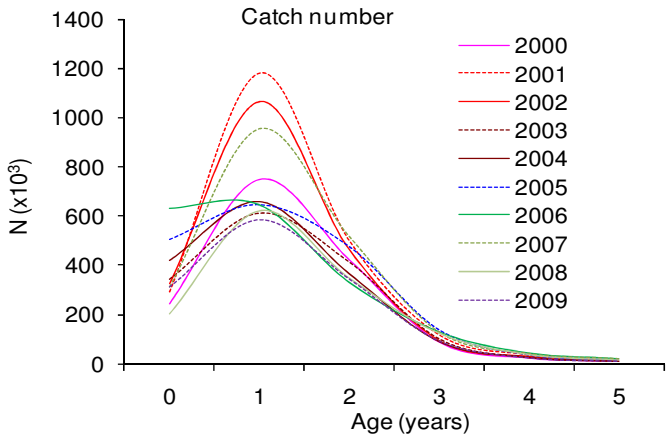
SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment for	Sheet A2 Indirect methods: data

Code: MUR0510Que

Sex*	Unsexed	Gear*	Trawl+Small-scale(trammel nets and gillnets)	Analysis # *	1

Data	Catch in number by age and CPUE from surveys and commercial fleet

Data



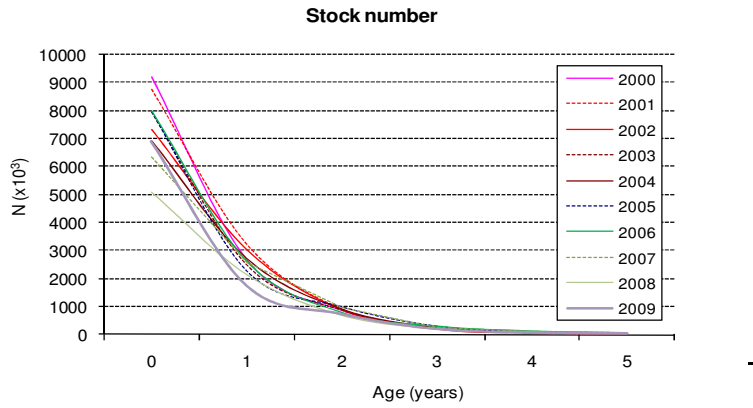
VPA tuning were performed using CPUE data from scientific surveys (N individuals per km^2) and daily landings from one port of Mallorca (Santanyí). It was used this port, situated in the SE of the island, because its fleet works basically on the continental shelf, and thus it can be considered that their CPUEs are a good indicator of the species abundance (*Mullus surmuletus* inhabits mainly on the shelf). The landings of this port represented 12–30% of the total catch of Mallorca during the assessed period.

Abundance indices from surveys were calculated considering different bathymetric strata. For tuning VPA, the values obtained in the stratum corresponding to the continental shelf (<100 m depth) were used because they best reflected the evolution of commercial landings.

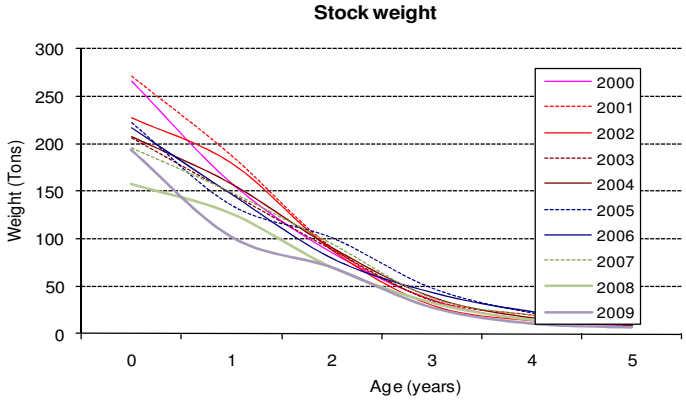
SAC GFCM - Sub-Committee on Stock Assessment (SCSA)					
Assessment for				Sheet A3 Indirect methods: VPA results	

Sex*	Unsexed	Gear*	Trawl + Small-scale (trammel nets	Analysis #*	1

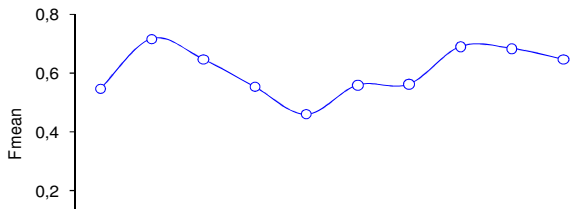
Population in figures

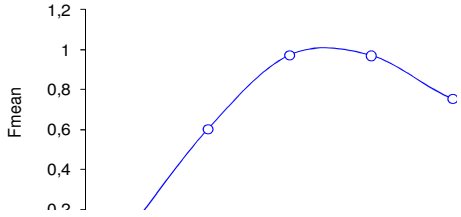


Population in biomass



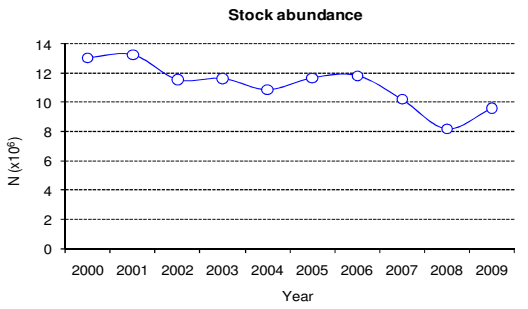
Fishing mortality

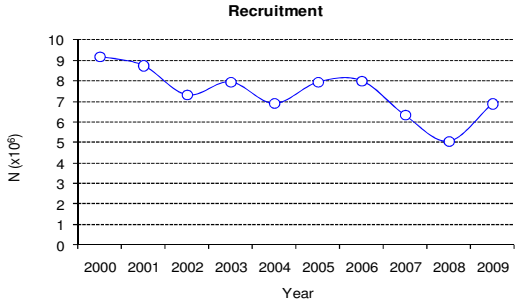




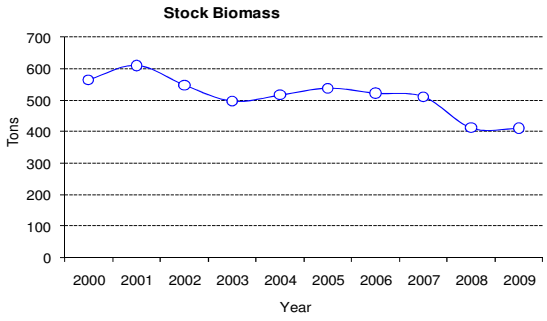
Sex*	Unsexe	Gear*	Trawl + Small-scale (trammel nets	Analysis #*	1

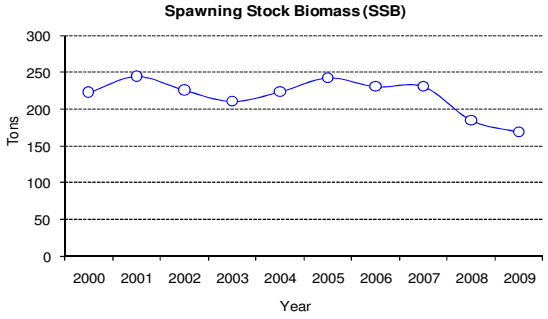
Population in figures





Population in biomass





Fishing mortality rates

Sex*		Gear*		Analysis #*	

Population in figures

Population in biomass

Fishing mortality rates

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Assessment form — **Sheet A1** — **Indirect methods: Y/R**

Code: MUR0510Que

Sex	Unsexed	Analysis #	2

# of gears	2	Software	VIT (Lleonart and Salat, 1997)

Parameters used

Vector F	From a previous separable VPA (see comments in sheet A1)
Vector M	Vector of M at age shown in sheet B
Vector N	From pseudocohort analysis

Model characteristics

From calculated mean weights

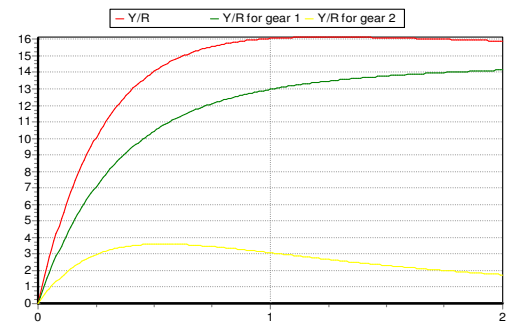
Results

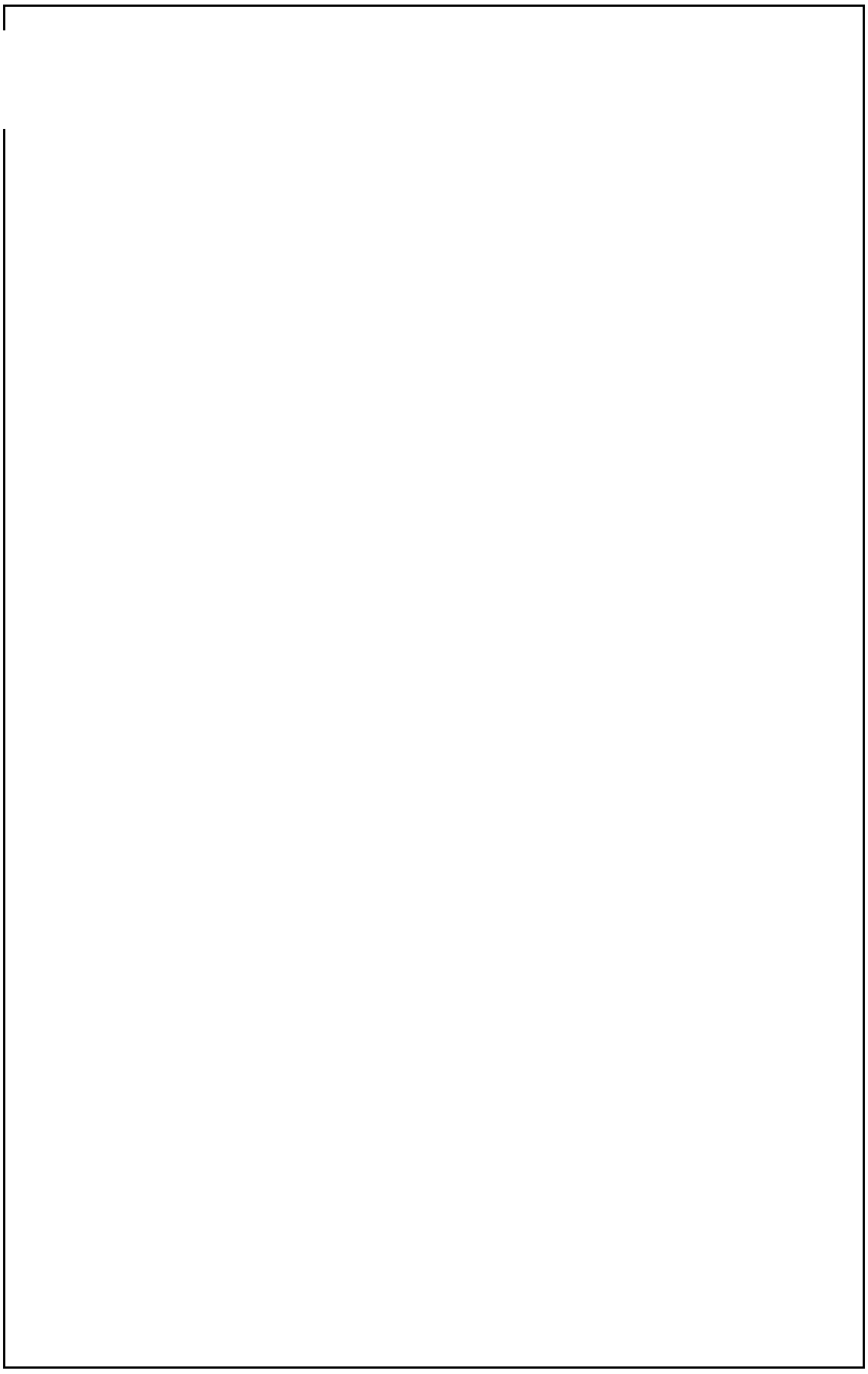
	Total	Gear			
		Trawl	Small-scale		
Current YR	16.06	12.98	3.08		
Maximum Y/R	16.15	14.14	3.62		
Y/R 0.1	15.03	11.45	3.58		
F_{max}	1.24	2.00	0.55		
$F_{0.1}$	0.63				
Current B/R	37.00				
Maximum B/R	52.18				
B/R 0.1	48.13				
Fmax (absolute)	0.744				
F0.1 (absolute)	0.378				
Fcurrent (absolute	0.6				

Comments

In Results, small-scale gear refers to trammel

Total (red), Trawl (green) and Small-scale (yellow)





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Assessment form **Sheet other**

Code: MUR0510Que

Other assessment methods

Other results from Analysis 2 (pseudo-cohort analysis)

Population results (please state units)

	Sizes (cm)	Ages (years)		Numbers (millions)	Weight (t)
Minimum			Recruitment[4]	7.16	164.93
Average	14.4	0.89	Population[4]	10.74	438.86
Maximum			SSB		198.13
Current stock[2]	15.1	1	Virgin population		730.83
Virgin stock[3]	24.8	4	Turnover (%)		110.99
			B_{now}/B_{virgin} (%)		36.3

[2]Critical size and age at current stock
[3]Critical size and age at virgin stock, assuming constant recruitment
[4]Mean values

Average mortality

		Fleets			
	Total	Trawl	Small scale		
[5]F_1 = Mean F	0.583	0.393	0.190		
[5]F_2 = Global F	0.251	0.222	0.028		
[6]F_0	0.078	0.078	0		
[7]$F_{1\text{-}2\ years}$	0.690	0.570	0.120		
[7]$F_{3\text{-}4\ years}$	0.694	0.428	0.267		
$Z= 0.48+F_1$	1.063	0.873	0.670		

[5]F_1 and F_2 are mean and global F, respectively, as defined by Lleonart and Salat (1997)
[6]F_0 is the F at age 0
[7]F*i-j* are mean fishing mortalities calculated between age classes *i* and *j*

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Assessment form — **Sheet D Diagnosis**

Code: MUR0510Que

Reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B	411	tons	513	+	Bmean as reference point (Blow= 411)
SSB	169	tons	218.8	+	SSBmean as reference point (SSBlow= 169)
F	0.6		0.378		F0.1
Y	89.82	tons	114.66	-	Ymean as reference point (Ylow= 89.82)
CPUE					
CPUE					
Density					

Stock Status* Use one (or both) of the following two systems for the stock assessment status description

Unidimensional

☐	? - (or blank) Not known or uncertain. Not much information is available to make a judgment;
☐	U - Underexploited, undeveloped or new fishery. Believed to have a significant potential for expansion in total production;
☐	M - Moderately exploited, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;
☐	F - Fully exploited. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion;
☉	O - Overexploited. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse;
☐	D - Depleted. Catches are well below historical levels, irrespective of the amount of fishing effort exerted;
☐	R - Recovering. Catches are again increasing after having been depleted or a collapse from a previous;

Bidimensional

Exploitation rate

☐	No or low fishing
☉	Moderate fishing mortality
☐	High fishing mortality
☐	Uncertain / Not assessed

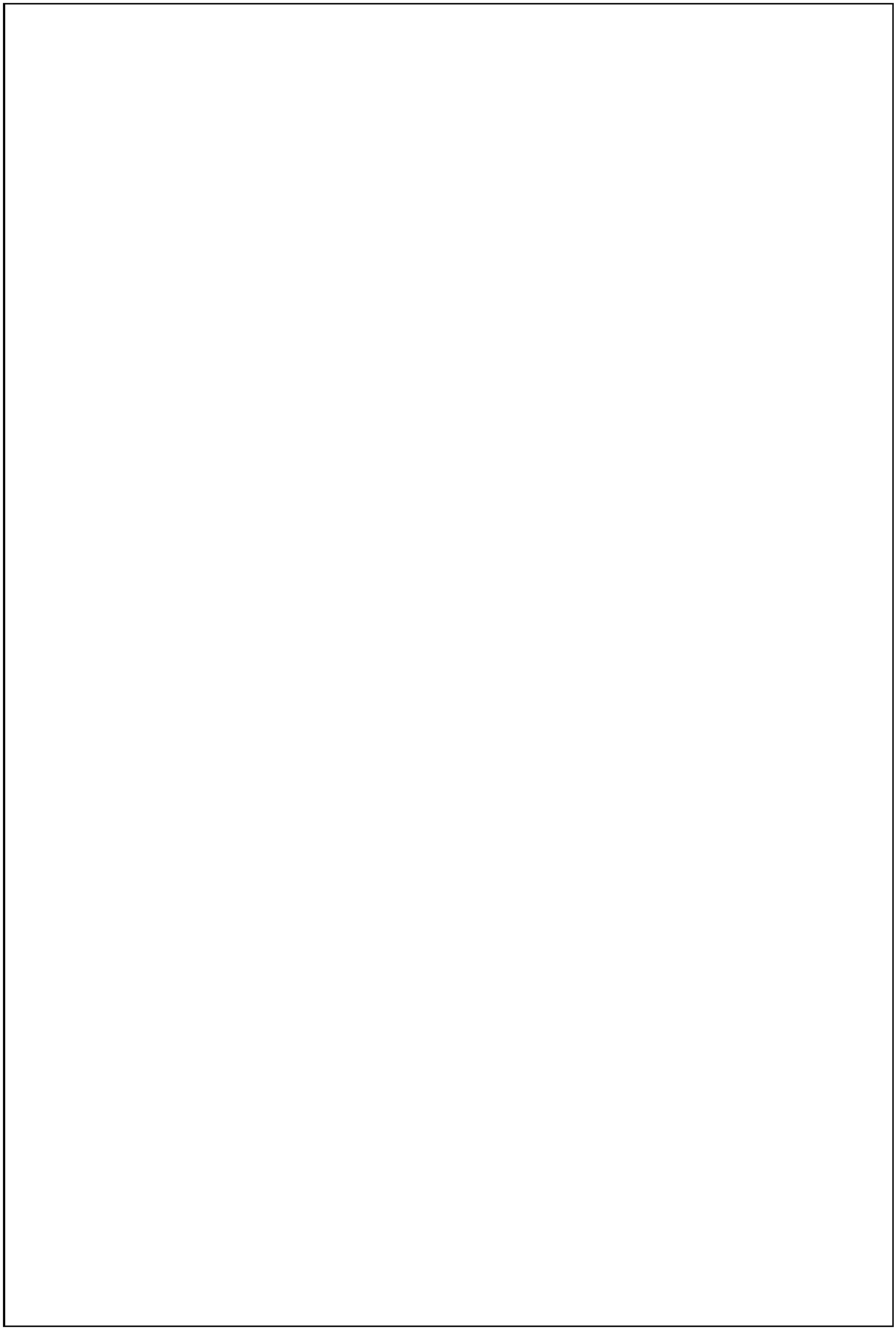
Stock abundance

☐	Virgin or high abundance
☉	Intermediate abundance
☐	Low abundance

☐	Depleted
☐	Uncertain / Not assessed

Comments

Current Y/R very close to the maximum and Bnow being 36.3 Bvirgin.



SAC GFCM - Sub-Committee on Stock Assessment (SCSA)

Assessment form

Sheet Z
Objectives and recommendations

Code: MUR0510Que

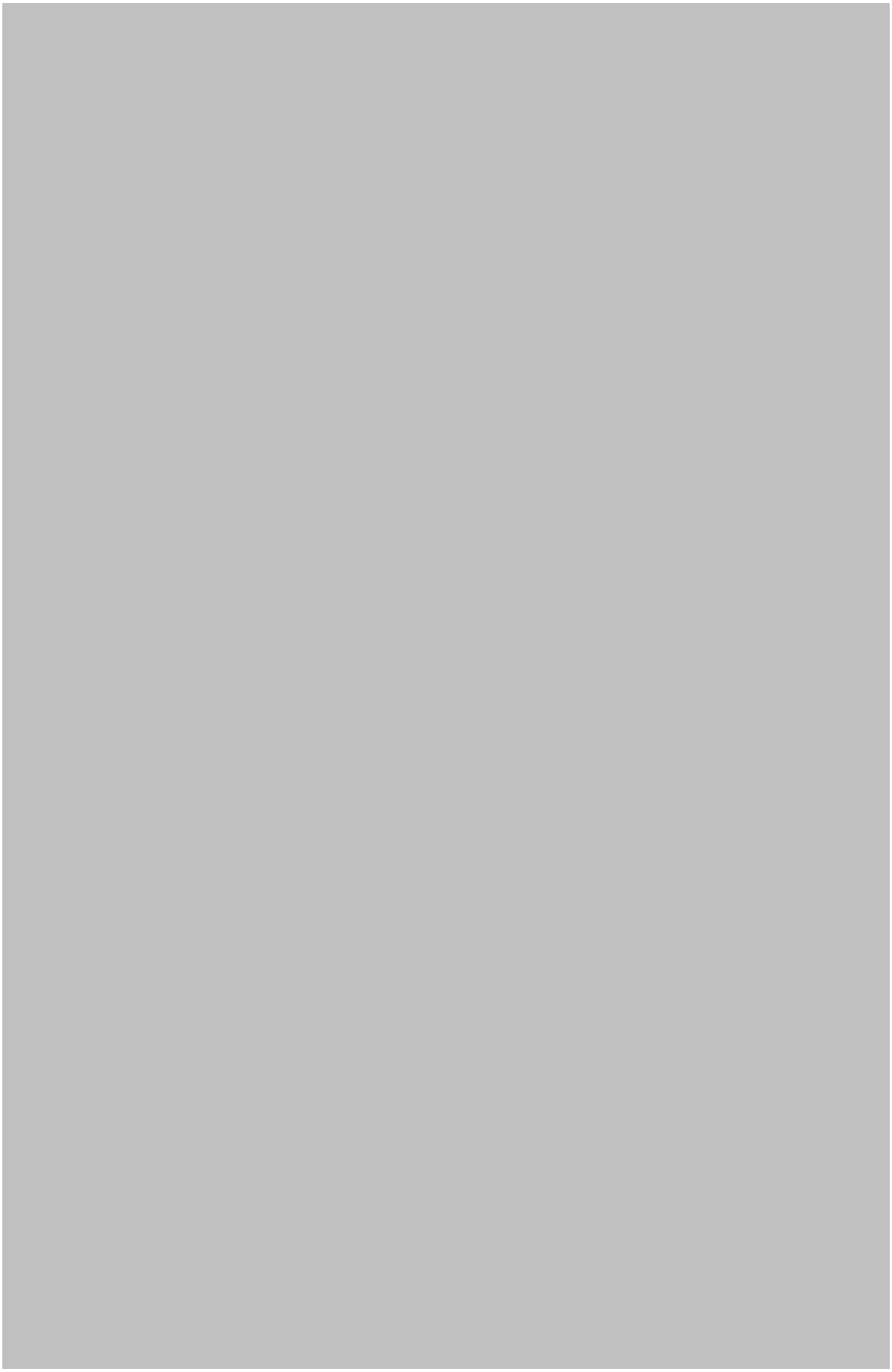
Management advice and recommendations*

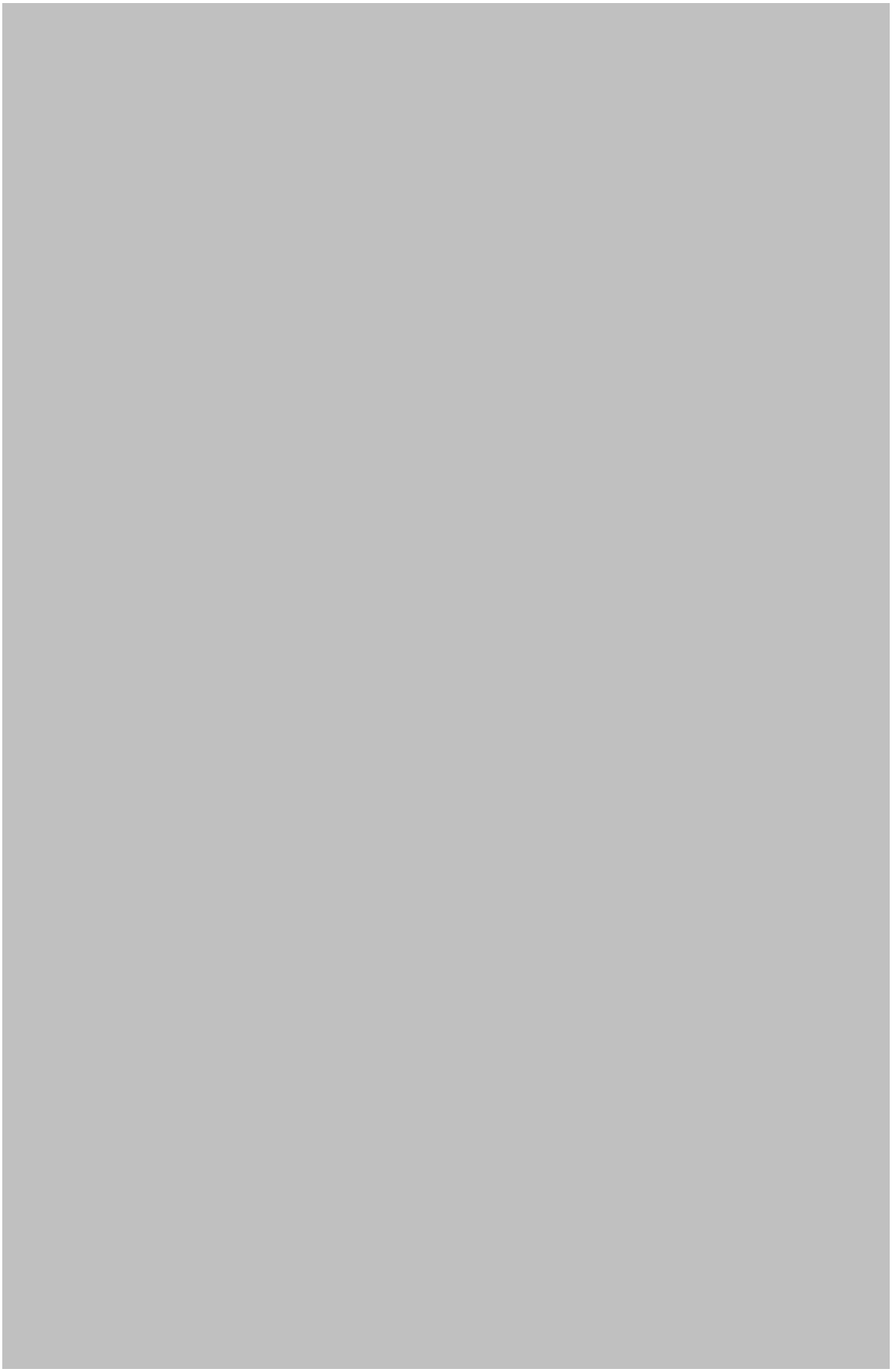
To reduce fishing mortalities by 30% to 50% which can be achieved with reducing effort capacity and improving the selection pattern of the fishery

Comments*

A retrospective analysis was performed which showed that F was underestimated and SSB overestimated.
It would be necessaty to further explore the parametrization of the model.
Both Biomass and Recruitment showed a decreasing trend during last years.

Comments*





Abstract for SCSA reporting

Authors Quetglas A., Ordines F., González N. **Year** **2010**

Species Scientific name Mullus surmuletus - MUR

Source: GFCM Priority Species

Geographical Sub-Area 05 - Balearic Island

Fisheries (brief description of the fishery)*

Striped red mullet (Mullus surmuletus) is one of the most important target species in the trawl fishery developed by around 37 vessels off Mallorca (Balearic Islands, GFCM-GSA05). A fraction of the small-scale fleet (~70 boats) also directs to this species during the second semester of the year, using both trammel nets and gillnets. During the last decade, the annual landings of this species have oscillated between 74-117 and 16-29 tons in the trawl and small-scale fishery, respectively.

Source of management advice*
(brief description of material -data- and methods used for the assessment)

The stock of Mullus surmuletus of the GFCM-GSA05 has been assessed using data from both the trawl and the small-scale fishery on a time series covering ten years (2000-2009). The assessment has been carried out applying tuned VPA (Extended Survivor Analysis, XSA) on the cohorts present during 2000-2009 and both VPA and Y/R analysis on a mean pseudo-cohort from that period. These approaches were performed using monthly size composition of catches, official landings and the biological parameters estimated within the framework of the Data Collection Programme (2003-2004). The VPA was tuned with CPUE from commercial trawl fleet (2000-2009) and bottom trawl surveys (2001–2009). The vector of natural mortality by age was calculated from Caddy´s (1991) formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997). The software used were the Lowestoft VPA program (Darby and Flatman, 1994) for the XSA and the VIT program (Lleonart and Salat, 1992) for the VPA and Y/R analysis from a mean pseudo-cohort.

Stock Status*

O - Overexploited. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse;

Exploitation rate

Moderate fishing mortality

Stock abundance

Intermediate abundance

Comments

Current Y/R very close to the maximum and Bnow being 36.3 Bvirgin.

Management advice and recommendations*

To reduce fishing mortalities by 30% to 50% which can be achieved with reducing effort capacity and improving the selection pattern of the fishery