SAC GFCM
Sub-Committee on Stock Assessment

Date*	21	October	2009		Code*	HKE0609Pal

Authors*
Paloma Martín, Laura Recasens, Jordi Lleonart

Affiliation*
CSIC Institut de Ciències del Mar

Species Scientific name*

1   *Merluccius merluccius - HKE*
Source: GFCM Priority Species

2
Source: -

3
Source: -

Geographical area*
Catalan Coast (northern GSA06), from Cape Creus the Delta of Ebre River

Geographical Sub-Area (GSA)*

06 - Northern Spain- northern part

Combination of GSAs   1
2
3

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Species Scientific name*	Merluccius merluccius - HKE	Species common name*	European hake, merluza, merlu, lluç,

Data Source

GSA*	06 - Northern Spain- northern part	Period of time*	2008 (Jan to Dec, length distribution by gear) and

Description of the analysis

Type of data*	monthly size distribution be gear and hake daily landings by vessel	Data source*	Generalitat de Catalunya- Fisheries Department
Method of assessment*	LCA- pseudocohort and Y/R	Software used*	VIT (Lleonart and Salat, 1992)

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	3	3	---	1	---	---	1	1	1	1	---

Comments, bibliography, etc.

The growth parameters used fit with a fast growth for the species.
One of the objectives of this assessment is to analyse the gear interaction.

Comments, bibliography, etc.

Abella A., J.F. Caddy and F. Serena. 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. Living.Resourc., 10: 257- 269.

García-Rodríguez M. and A. Esteban. 2002. How fast does hake grow? A study on the Mediterranean hake (Merluccius merluccius L.) comparing whole otoliths readings and length frequency distributions data. Scientia Marina 66(2): 145- 156.

Lleonart J., F. Maynou, L. Recasens and R. Franquesa. 2003. A bioeconomic model from Mediterranean fisheries, the hake off Catalonia (western Mediterranean) as a case study. Scientia Marina 67 (Suppl. 1) : 337-351.

Lleonart J. and J. Salat. 1992. VIT Programa de Análisis de Pesquerías. Inf. Téc. Scientia Marina 168-169.

Martín P., P. Sartor and M. García-Rodríguez. 1999. Exploitation patterns of the European hake Merluccius merluccius, red mullet Mullus barbatus and striped red mullet Mullus surmuletus in the western Mediterranean. J. Appl. Ichthyol., 15:24-28.

Olivar M.P., G. Quílez and M. Emelianov. 2003. Spatial and temporal distribution and abundance of European hake, Merluccius merluccius, eggs and larvae in the Catalan coast (NW Mediterranean). Fisheries Research 60: 321-331.

Recasens L., V. Chiericoni and P. Belcari. 2008. Spawning pattern and batch fecundity of the European hake (Merluccius merluccius (Linnaeus, 1758)) in the western Mediterranean. Scientia Marina 72(4): 721- 732.

Sánchez P., M. Demestre and P. Martín. 2004. Characterization of the discards generated by bottom trawling in the Northwestern Mediterranean. Fisheries Research, 67: 71-80.

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Biology

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

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed			82		Reproduction season	all year; late summer-
Size at first maturity			36		Reproduction areas	shelf edge
Recruitment size			15		Nursery areas	continental shelf

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	$L\infty$	cm			106.8	
	K				0.2	
	t0				0.0028	
	Data source	García-Fernández and Esteban 2002				
Length weight relationship	a				3,060	
	b	cm and g			0.0028	eonart et al 2003)

M		vector estimated with Probiom		(Abella et al 1997)

sex ratio (mal/fem)	

Comments

Mean M: 0,476 as from the M vector

Age	M
0	1,514
1	0,836
2	0,518
3	0,428
4	0,408
5	0,379
6	0,356
7	0,341
8	0,330
9	0,322
10	0,316
11	0,311
12	0,306
13	0,303

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Data source*	Generalitat de Catalunya, Fisheries Department	Year (s)*	2000- 2008
Data aggregation (by year, average figures between years, etc.)*	Annual hake landings by fishing gear taken from the daily landings by vessel.		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ESP	06	E - Trawl (12-24 metres)	03 - Trawls	33 - Demersal shelf species	HKE
Operational Unit 2	ESP	06	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	HKE
Operational Unit 3	ESP	06	I - Long line (12-24 metres)	09 - Hooks and Lines	34 - Demersal slope species	HKE
Operational Unit 4						
Operational Unit 5						

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ESP 06 E 03 33 - HKE	309	Kg	1,866,326				days
ESP 06 C 07 33 - HKE	598	Kg	214,323				days
ESP 06 I 09 34 - HKE	52	Kg	163,038				days
Total	959		2243687				

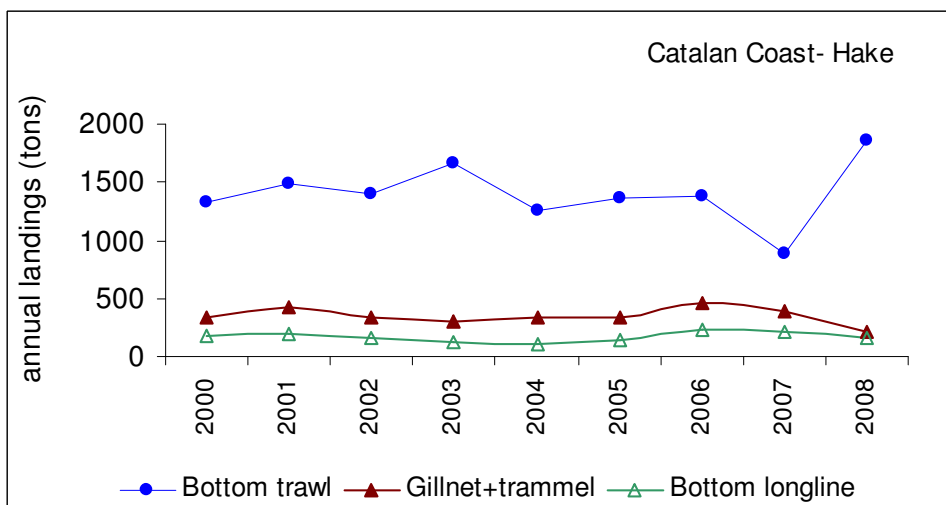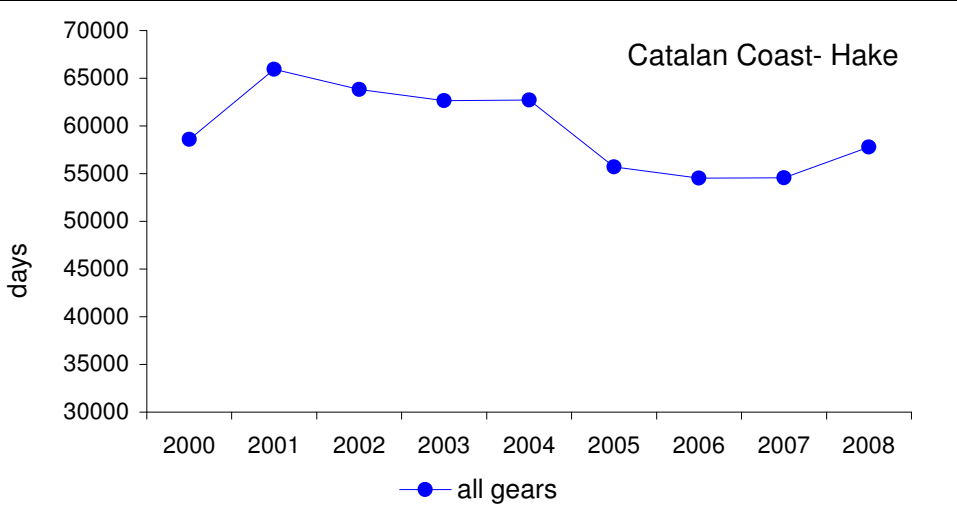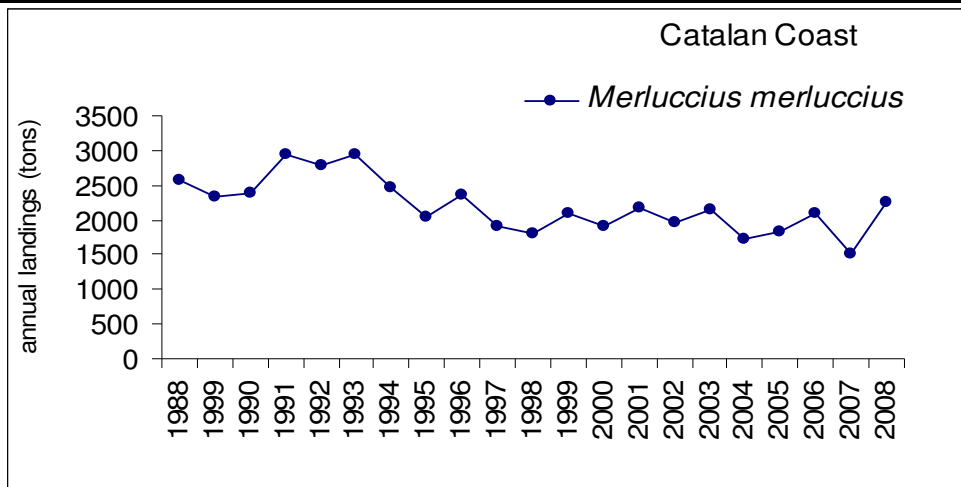| Legal minimum size	20 cm TL

Comments

Number of vessels: Fishing fleet census 2008, Generalitat de Catalunya, Fisheries Department
Hake discards are very low in the area (Sánchez et al.2004). In general, in species with commercial interest the amount of catch discarded is very small, except in the case of blue whiting.

Hake is exploited by bottom trawl, gillnet and longline, each fishing gear targeting a given length range.
Highest landings, both in weight and in numbers, correspond to bottom trawling.
Recruits are the main component of the overall landings. The catch mean age is around 1 year.
Annual hake landings along the Catalan Coast since late nineties were around 2000 tonnes and were produced by a total effort of between 55000-65000 fishing days (number of days with hake landing, all fishing gears combined).
Landings in 2008 were highest for the period 2000-2008, and correspond to the increase in bottom trawl landings; landings by the artisanal vessels and longliners in 2008 decreased regarding the previous year.
In 2007 hake annual landings were the lowest for the period 1988- 2008.

Comments

Catalan Coast

Merluccius merluccius

Catalan Coast- Hake

all gears

Catalan Coast- Hake

Bottom trawl　Gillnet+trammel　Bottom longline

Data source*	Generalitat de Catalunya- Fishing statistics	OpUnit 1*	ESP 06 E 03 33 - HKE

Time series

Year*	2000	2001	2002	2003	2004	2005
Catch	1320809	1480617	1401420	1663653	1259656	1359663
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year	2006	2007	2008			
Catch	1378337	886554	1866326			
Minimum size			6			
Average size Lc			20.7			
Maximum size			66			
Fleet			309			

Selectivity

Remarks

L25	
L50	
L75	
Selection factor	

Structure by size or age

HAKE ANNUAL DISTRIBUTION —— Bottom trawl

Sampling period: 2008 Jan-Dec, monthly sampling. Total length (cm), both sexes combined

Structure by size or age

Fishing effort

Catalan Coast- Hake

days

Bottom trawl

Code: HKE0609Pal

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Data source*	Generalitat de Catalunya- Fishing statistics	OpUnit 2*	ESP 06 C 07 33 - HKE

Time series

Year*	2000	2001	2002	2003	2004	2005
Catch	340616	421644	338360	302799	335859	328899
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year	2006	2007	2008			
Catch	467566	391366	214323			
Minimum size			30			
Average size Lc			42.1			
Maximum size			54			
Fleet			598			

Selectivity   **Remarks**

L25	
L50	
L75	
Selection factor	

Structure by size or age

HAKE ANNUAL DISTRIBUTION

— Gillnet

Sampling period: 2008 Jan-Dec, monthly sampling. Total length (cm), both sexes combined

...

Fishing effort

Catalan Coast- Hake

days

10000
9000
8000
7000
6000
5000
4000
3000

2000 2001 2002 2003 2004 2005 2006 2007 2008

▲ Small scale
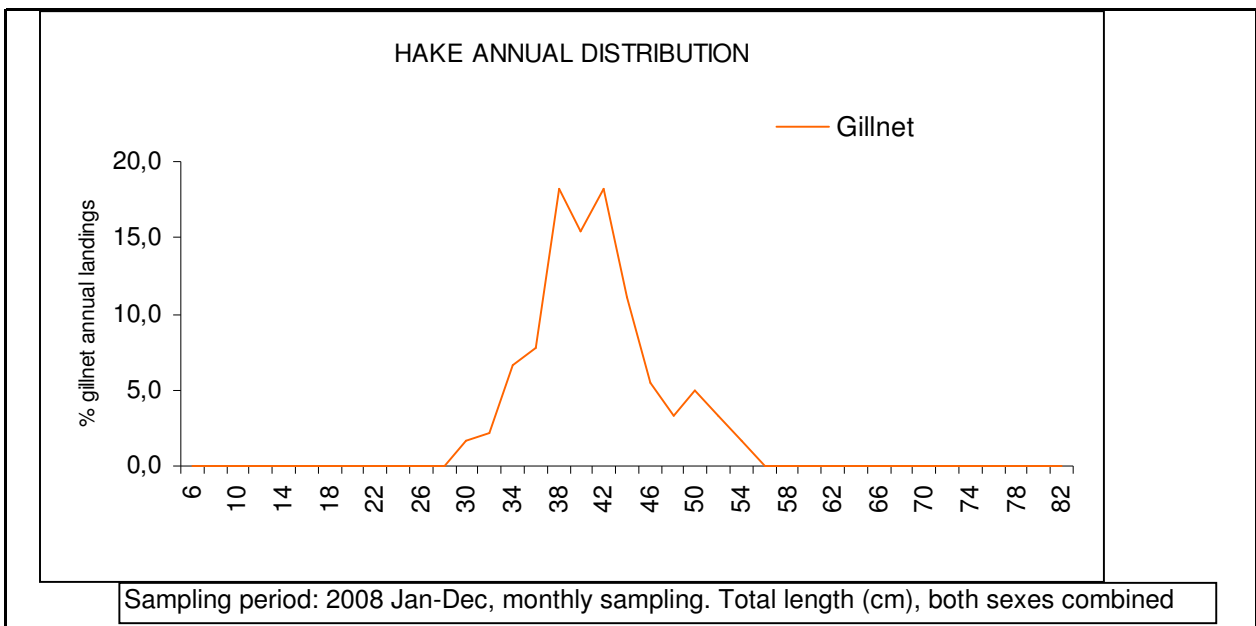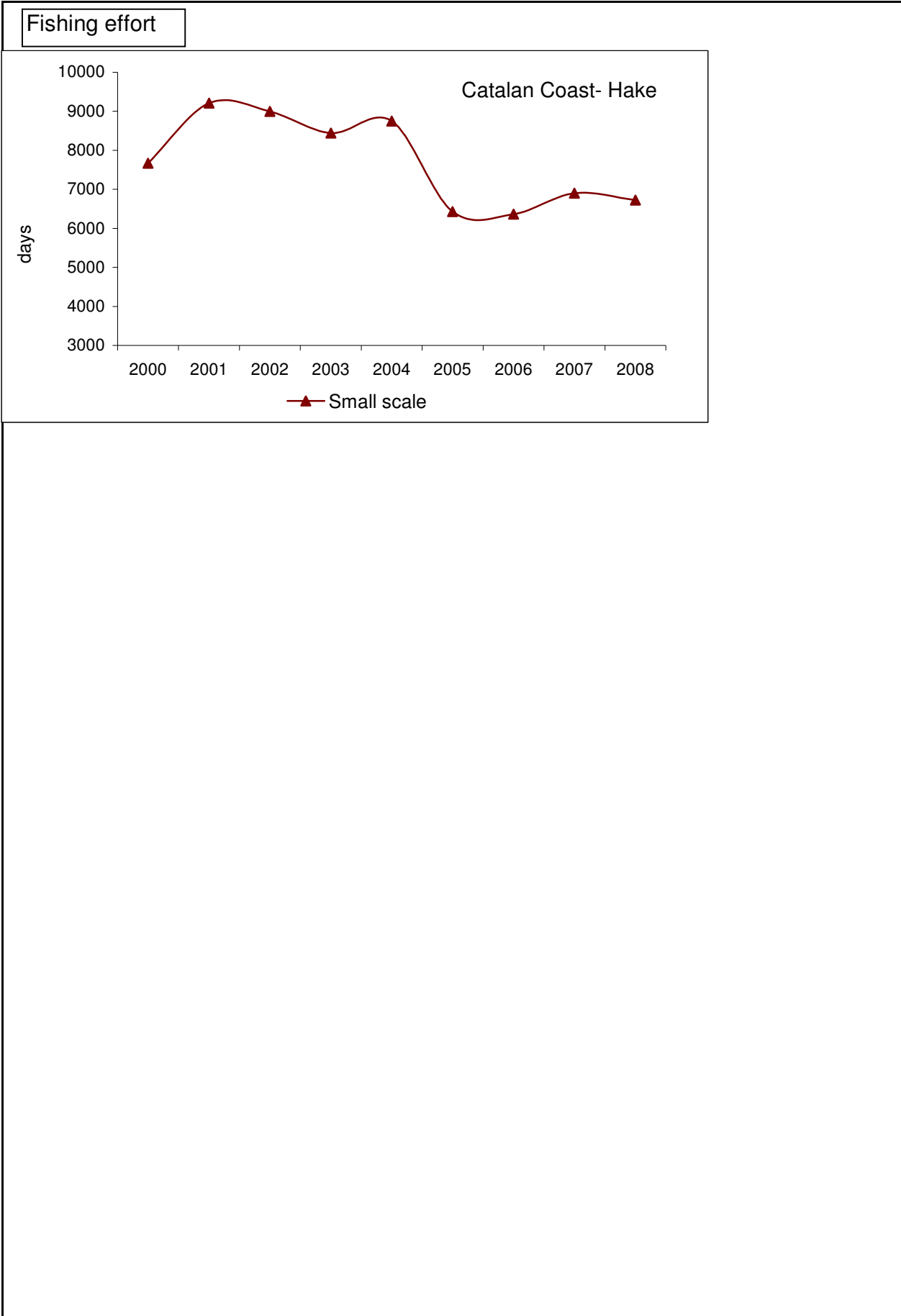
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Assessment form

Sheet P2a
Fishery by Operational Unit

Code: HKE0609Pal
Page 3 / 3

Data source*	Generalitat de Catalunya- Fishing statistics	OpUnit 3*	ESP 06 I 09 34 - HKE

Time series

Year*	2000	2001	2002	2003	2004	2005
Catch	177520	202780	159889	115667	107933	135142
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year	2006	2007	2008			
Catch	226042	208454	163038			
Minimum size			26			
Average size Lc			44.3			
Maximum size			82			
Fleet			52			

Selectivity

Remarks
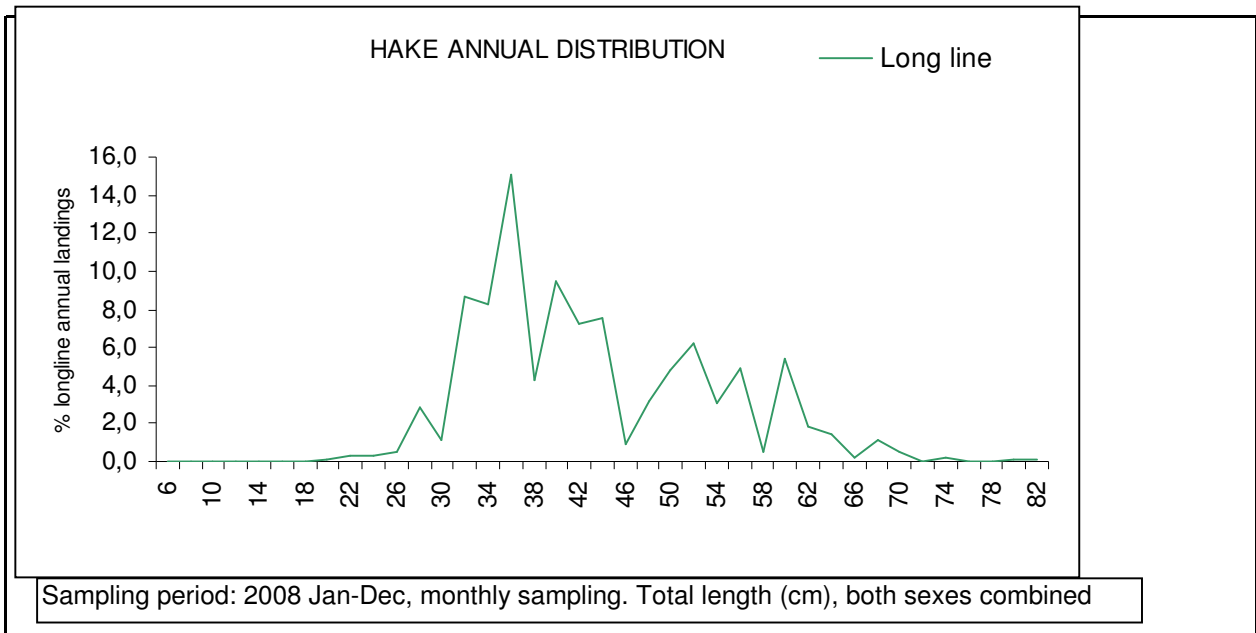
L25	
L50	
L75	
Selection factor	

Structure by size or age

HAKE ANNUAL DISTRIBUTION — Long line

Sampling period: 2008 Jan-Dec, monthly sampling. Total length (cm), both sexes combined

Fishing effort

Catalan Coast- Hake

days

—△— Bottom longline

Data source*	BOE (Boletín Oficial del Estado) and personal observa	OpUnit 1*	ESP 06 E 03 33 - HKE

Regulations in force and degree of observance of regulations

Fishing license : fully observed
Engine power limited to 500 HP: not fully observed
Mesh size in the codend (40 mm stretched): fully observed
Fishing forbidden at < 50 m depth: not fully observed
Time at sea (12 hours per day and 5 days per week): fully observed
In the southern part (Tarragona) a two-months closed season is implemented, by the end of spring or in summer.

Accompanying species

- *Micromesistius poutassou, Lophius spp, Phycis blennoides, Helicolenus dactylopterus, Lepidorhombus boscii, Conger conger, Mullus barbatus, Mullus surmuletus,Trisopterus minutus*
- *Nephrops norvegicus, Liocarcinus depurator*
- *Eledone cirrhosa, Octopus vulgaris*

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: HKE0609Pal
Page 2 / 3

Data source*	BOE (Boletín Oficial del Estado) and personal observa	OpUnit 2*	ESP 06 C 07 33 - HKE

Regulations in force and degree of observance of regulations

Small scale fishing takes place all year round, with alternating seasons for the main target
fish species. For hake, the season with highest landings is late spring (peak in June).
Minimum distance from the soaked fishing gear to the coast: 100 m.
For gillnet: each piece is 50 long and 4 m hight; 30 pieces by fishermen on board allowed (and total
length of the set 4500 m).
Fishing 5 days (nights) a week.
Landings are to be commercialized through the auction: not fully observed.

Accompanying species

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: HKE0609Pal
Page 3 / 3

Data source*	BOE (Boletín Oficial del Estado) and personal observa	OpUnit 3*	ESP 06 I 09 34 - HKE

Regulations in force and degree of observance of regulations

Small scale fishing takes place all year round, with alternating seasons for the main target
fish species. For hake, the season with highest landings is late spring (peak in June).
Minimum distance from the soaked fishing gear to the coast: 100 m.
For bottom longline: total length < 7000 m and total number of hooks < 3.000
Fishing 5 days (nights) a week.
Landings are to be commercialized through the auction: not fully observed.

Accompanying species

Code: HKE0609Pal

Analysis #*

Page 1 /

Data source*		Gear*	

Model characteristic

Type of model*		Fitting criterion	
Software		Bibliographical source	

Data

Year						
Catch						
Effort						
CPUE						

Year						
Catch						
Effort						
CPUE						

Adjustment

RMS	

Results

Carryng capacity		a	
Growth rate		b	
Catchability			
MSY			
EMSY		TACMSY	
E0.1		TAC0.1	
Ecurrent			

Comments

Code: HKE0609Pal
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Sex*	Both

Analysis # *	1- LCA

Time series

Data	Size	Age
(mark with X)	x	

Model	Cohorts	Pseudocohorts
(mark with X)		x

Equation used	Standard VPA	Tunig method	
# of gears	3	Software	VIT (Lleonart and Salat 1992)
$F_{terminal}$	0.15		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	6	0.3	Recruitment	101901195	
Average	13.9	0.7	Average population	39831170	1.700 t
Maximum	82	7.3	Virgin population		
Critical	18	0.93	Turnover	210.67	
Virgin stock critic	64	4.56			

Average mortality

	Total	Gear					
		trawl	gillnet	longline			
F_1	0.876	0.522	0.096	0.258	F1= mean F		
F_2	0.601	0.585	0.01	0.006	F2= global F		
Z	1.35						

Comments

Minimum and maximum sizes and ages are those observed in the landings. Average and critical values refer to the stock.

---	Biomass	Percentage
Recruitment	138229650,3	3,85
Growth	3449529081	96,15
Natural death	1344071731	37,46
Fishing	2243687000	62,54

Bmax/Bmean: 51.88

B/R	SSB/R
16,712	5,656

Mean F for age classes 1-3

Total F	trawl	gillnet	longline
1,41	1,02	0,23	0,15

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Assessment form

Sex*	

Analysis # *

Time series

Data	Size	Age
(mark with X)		

Model	Cohorts	Pseudocohorts
(mark with X)		

Equation used		Tunig method	
# of gears		Software	
$F_{terminal}$			

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum			Recruitment		
Average			Average population		
Maximum			Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F_1							
F_2							
Z							

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

Comments

Code: HKE0609Pal

Sex	both		Analysis #	**2**

# of gears	3	Software	VIT (Lleonart and Salat, 1992)

Parameters used

Vector F	
Vector M	
Vector N	
	Input data for the analysis are the output of the VPA

Model characteristics

Results

	Total	Gear			
		bottom trawl	gillnet	longline	
Current YR	22,018	18,315	2,103	1.6	
Maximum Y/R	36.537	21.533	5.233	10.94	
Y/R 0.1					
F_{max}	0.3				
$F_{0.1}$					
Current B/R	150.038				
Maximum B/R	178.738				
B/R 0.1					

Comments

Comments

Legend: — Y/R for gear 1 — Y/R for gear 2 — Y/R for gear 3

Legend: – B/R – SSB/R
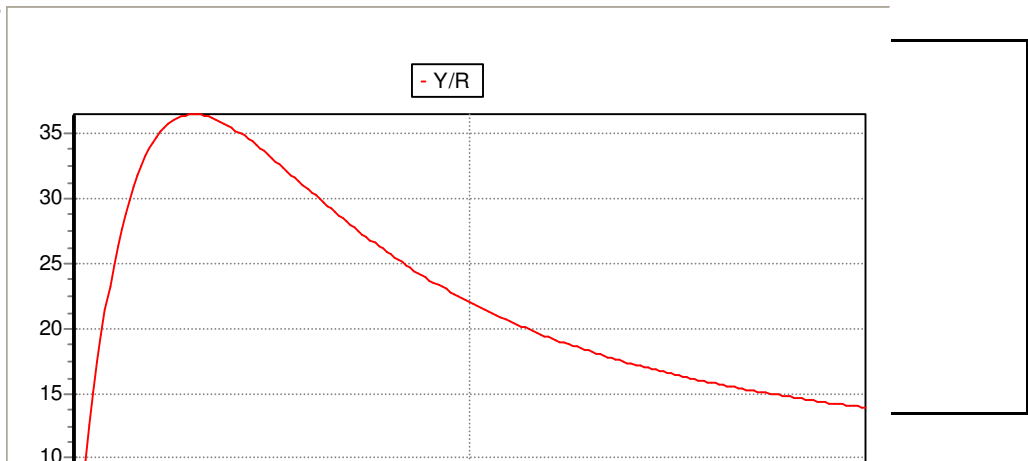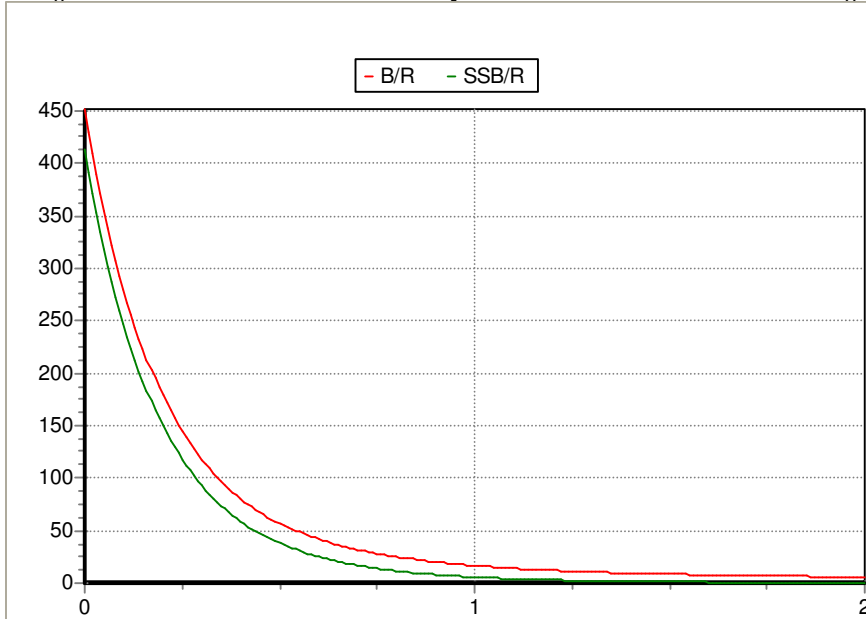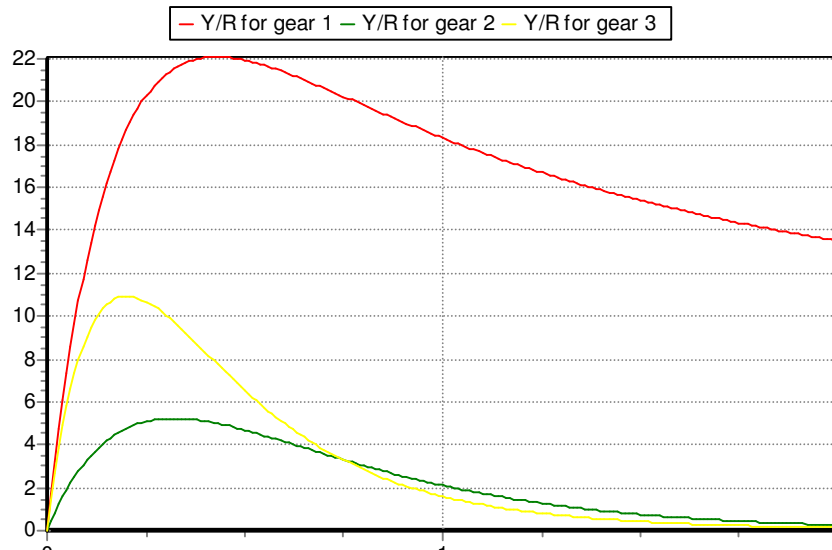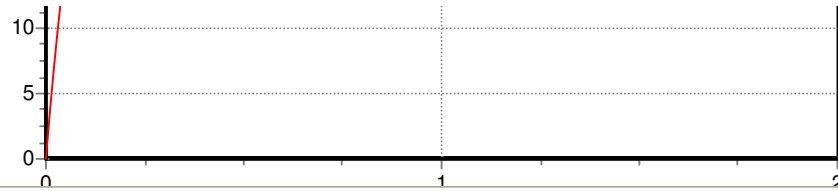
Slope at origin	Method	Num_pc	Max factor of effort
369.83	Calc. Me	200	2

| Factor	Y/R	B/R	SSB	Y/R Gear 1	Y/R Gear 2	Y/R Gear 3
0	0	452.06	413.4	0	0	0
0.21	34.359	178.74	150.04	18.654	4.764	10.94
0.22	35.207	164.03	136.13	19.386	4.921	10.9
0.31	36.537	117.94	92.998	21.265	5.221	10.05
0.33	36.499	108.98	84.718	21.533	5.233	9.733
0.44	34.856	72.438	51.474	22.095	4.999	7.762
1.01	22.018	16.712	5.656	18.315	2.103	1.6
2	13.903	5.841	0.302	13.509	0.26	0.134

Other assessment methods

TRANSITION ANLYSIS

The effect on Y/R of a reduction of 20% of bottom trawl effort would result in a decrease of Y/R of trawl the year first year after the reduction, and already in the next year Y/R would recover the previous values and in the third year Y/R higher than before the reduction might be expected. This reduction could be implemented by reducing the time of fishing, that is, fishing four days a week (instead of the current 5 days a week).

Since gillnet and longline exploit higher sizes, the effect of trawl effort reduction would be expected by year 2 after the implementation of the measure. The increase in biomass (biomass per recruit and spawning stock biomass per recruit) is evident from the first year after the reduction of trawl effort.

The figures at the bottom show the increase in biomass resulting from the implementation of the reduction of bottom trawl effort and the current F by fishing gear and age class (gear 1= bottom trawl; gear2= gillnet; gear3= longline).
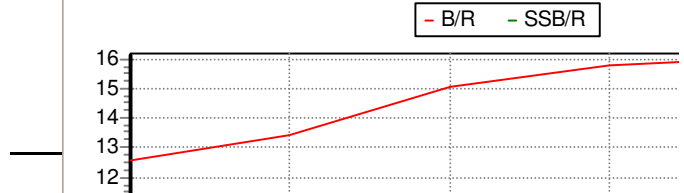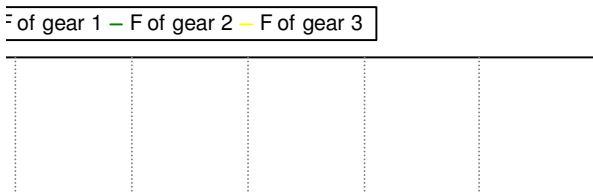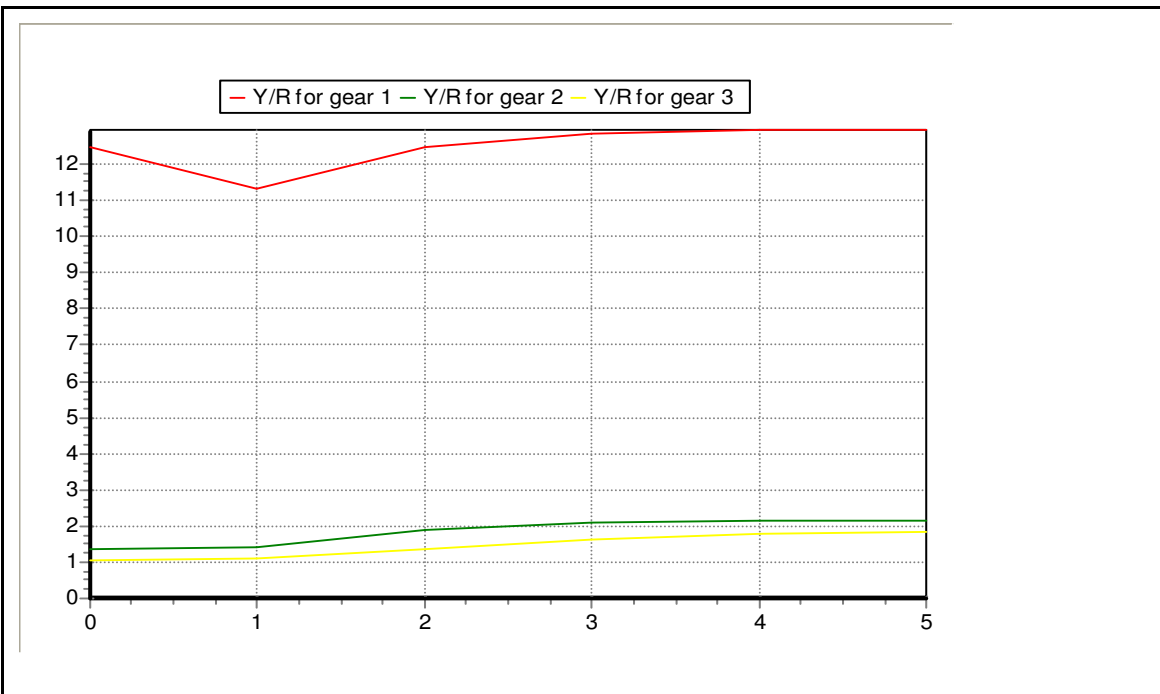
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Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB	570 t				
F	0.876				
Y	2243t				
CPUE					
Bmean	1700t				
Turnover	210.67				
F/Z	0.65				
M	0.48				

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**		**Stock abundance**		
	⊙ No or low fishing		⊙ Virgin or high abundance	⊙ Depleted	
	⊙ Moderate fishing		⊙ Intermediate abundance	⊙ Uncertain / Not assessed	
	⦿ High fishing mortality		⦿ Low abundance		
	⊙ Uncertain / Not assessed				

Comments

The exploitation is based on recruits.
This stock is overexploited (growth and danger of recruitment overexploitation).
Nevertheless, the landings in 2008 were much higher than those in the previous year, suggesting a refugium for the spawning stock.

Management advice and recommendations*

Fishing effort of bottom trawl should be reduced. The bulk of the catch of this gear consists of recruits (mean age of the catch around 1 year).

An example of the result of the implementation of a reduction by 20% of trawl fishing effort is presented in page "Other". In the first year bottom trawl yield per recruit would decrease, and from then, Y/R would increase, the values attained in the third year higher than the current Y/R. As for gillnet and longline, Y/R would increase already in the second year, with no losses in the first year. The benefit of this measure is more evident in the increase in biomass, observed already in the first year after the reduction in trawl effort.

The reduction in trawl effort by 20% could be implemented by reducing the number of fishing days during the week, from the current five days, to four.