SAC GFCM
Sub-Committee on Stock Assessment

Date*	17	October	2010	Code*	HKE0910F.

Authors*

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Species Scientific name*

1

Source: GFCM Priority Species

2

Source: -

3

Source: -

Geographical area*

Northwestern Mediterranean

Geographical Sub-Area (GSA)*

09 - Ligurian and North Tirrenian Sea

Combination of GSAs 1
2
3

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

Assessment form

Sheet #0
Basic data on the assessment

Code: HKE0910F.

Date*	17	Oct	2010	Authors*	F. Colloca1, P. Sartor2, M. Sbrana2, A.Mannini3, A. Abella4

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

Data Source

GSA*	09 - Ligurian and North Tirrenian Sea	Period of time*	1994-2006

Description of the analysis

Type of data*	commercial catches, size structure of the catch by gear, trawl surveys size	Data source*	catch assessment surveys
Method of assessment*	Length cohort analysis; Yield forecasting	Software used*	SURBA, ICES software for HCR, Yield software, VIT, excel spreadsheets

Sheets filled out

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

Comments, bibliography, etc.

Hoggart D.D., Abeyasekera S., Arthur R.I. Beddington J.R., Burn R.W., Halls A. S., Kirkwood G.P., McAllister M., Medley P., Mees C.C., Parkes G.B., Pilling G.M., Wakeford R.C., Welcomme R.L. (2006) - Stock assessment for fishery management- A framework guide to the stock assessment tools of the fisheries management sciences- Programme FMSP. Fao Fish. Tech. Pap, 280 pp.

Lleonart, J., Salat J (1997) VIT: Software for fishery analysis. User's manual. FAO Computerized Information Series (Fisheries), 11, Rome, FAO. 105 pp.

Needle C. L. (2003) - Survey-based assessments with SURBA. Working Document to the ICES Working Group on Methods of Fish Stock Assessment, Copenhagen, 29 January to 5 February 2003.

Comments, bibliography, etc.

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet B Biology of the species

Code: HKE0910F.

Biology

Somatic magnitude measured (LH, LC, etc)*	TL				Units*	cm
Sex	Fem	Mal	Both	Unsexed		
Maximum size observed	104	62			Reproduction season	mainly in february
Size at first maturity	31-37	22-26			Reproduction areas	yes
Recruitment size	12	12			Nursery areas	yes

Parameters used (state units and information sources)

Sex	F							
Growth model								
Data source								
L∞ (growth)	104							
K (growth)	0.2							
t0 (growth)	-0.03							
length-weight relationship								
a (length-weight)	0.006657							
b (length-weight)	3.028							
sex ratio	1							
M	vector							

Comments

M vector Age1=1.3 , Age2=0.6, Age3=0.46, Age4=0.41, Age5=0.3; Age6=0.2

Catchability (age 0+) = 0.8, (age 1+) = 1.0, (age 2+)=0.7, (age 3+)=0.7, (age 4+)=0.7

Juvenile growth rate was estimated to be about 1.5 cm.month-1 using daily growth increments on otoliths (Belcari et al., 2006). According to this growth rate, hake reaches an average length of about 18 cm TL at the end of the first year. According to these observations, the growth of hake in the GSA 9 seems to follow the pattern estimated in the NW Mediterranean (Garcia-Rodriguez and Esteban, 2002) adopting the hypothesis that two rings are laid down within otoliths each year.
Large size hake are targets of a specifically targeted gillnet fishery carried out by several vessel working in the southern part (northern and central Tyrrhenian Sea) of the GSA9 (Sartor et al., 2001a). Reproductive biology and fecundity of hake have been studied in northern Tyrrhenian Sea (Biagi et ;al 1995; Nannini et al., 2001; Recasens et al., in press) by monthly samplings of adults caught by trawling and gillnets.
Females in advanced maturity, spawning and partial post-spawning are present all year round, but reproductive activity is concentrated from January to May, with two peaks of spawning in February and May. The presence of hake spawners seems to be more concentrated in the southern part of GSA9, in particular in northern Tyrrhenian Sea.

Comments

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet P1 General information about the fishery

Code: HKE0910F.

Data source*	EC Data Collection Regulation	Year (s)*	1994-2006
Data aggregation (by year, average figures between years, etc.)*	Monthly		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ITA	09	B - Minor gear with engine (<6 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	HKE
Operational Unit 2	ITA	09	D - Trawl (6-12 metres)	03 - Trawls	33 - Demersal shelf species	HKE
Operational Unit 3	ITA	09	E - Trawl (12-24 metres)	03 - Trawls	33 - Demersal shelf species	HKE
Operational Unit 4	ITA	09				HKE
Operational Unit 5	ITA	09				HKE

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ITA 09 B 07 33 - HKE	50	Kg	108146				
ITA 09 D 03 33 - HKE		Kg	848542				
ITA 09 E 03 33 - HKE		Kg					
	361						
Total	411		956688				

Legal minimum size	20

Comments

Reported hake catch for trawlers is the sum of the two size categories

Official data on total annual catch of acompanying important commercial species:
Eledone cirrhosa 945 tons, *Parapenaeus longirostris* 463 tons, *Mullus barbatus* 1050 tons, *Nephrops norvegicus* 248 tons.

Comments

Tab. 7.4.1 - Technical characteristics of the trawl fleet of GSA9 (DCR official data)

Year	2004	2005	2006
N. of boats	344	358	361
GT	12.818	12.961	13.191
kW	74.017	74.606	75.514
Mean GT	37.3	36.2	36.5
Mean kW	215.2	208.4	209.2

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet P2a Fishery by Operational Unit

Code: HKE0910F.

Data source*	catch assessment survey (DCR)	OpUnit 1*	ITA 09 B 07 33 - HKE

Time series

Year*	2004	2005	2006	2007	2008	
Catch	1195	1920	2330	1753	1329	
Minimum size	4	4	4	12	12	
Average size Lc						
Maximum size	72	72	72	72	72	
Fleet	344	358	361	361	361	

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity **Remarks**

L25	8	S.F.=Lc/mesh size (both in mm)
L50	12	
L75	14	
Selection factor	3	

Structure by size or age

Structure by size or age

Size	Total catch	Catch of gear 1	Catch of gear 2
12	335404.947	335404.947	0
14	3208204.303	3204841.657	3362.646233
16	3682557.93	3680876.607	1681.323117
18	3434167.119	3433326.457	840.6615583
20	2322822.138	2303486.922	19335.21584
22	1527796.636	1461084.725	66711.91114
24	966340.0201	896913.843	69426.17711
26	776460.55	673121.7027	103338.8472
28	389857.9111	249918.9772	139938.9338
30	194868.7685	64709.23763	130159.5309
32	164049.5245	37932.32898	126117.1955
34	121322.9337	40968.15637	80354.77736
36	97665.0652	38443.08123	59221.98397
38	81670.42261	35201.4659	46468.95671
40	46375.73439	27009.20972	19366.52467
42	39805.47633	26632.11829	13173.35804
44	24773.65549	2885.146148	21888.50935
46	15589.22096	4660.620701	10928.60026
48	11831.21851	1711.970979	10119.24753
50	25100.68762	7415.486066	17685.20155
52	3662.304133	2821.642574	840.6615583
54	14821.04971	3329.014786	11492.03493
56	17073.36338	3931.31417	13142.04921
58	14227.91486	2735.87993	11492.03493
60	1681.323117	0	1681.323117
62	3839.657289	1626.208335	2213.448954
64	4503.626658	1109.671595	3393.955063
66	0	0	0
68	5607.404017	0	5607.404017
70	0	0	0
72	840.6615583	0	840.6615583

Data source*		OpUnit 2*	ITA 09 D 03 33 - HKE

Time series

Year*						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity **Remarks**

L25		
L50		
L75		
Selection factor		

Structure by size or age

Structure by size or age

Data source*		OpUnit 3*	ITA 09 E 03 33 - HKE

Time series

Year*						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity **Remarks**

L25		
L50		
L75		
Selection factor		

Structure by size or age

Structure by size or age

Data source*	official data	OpUnit 1*	ITA 09 B 07 33 - HKE

Regulations in force and degree of observance of regulations

Fishing closure for trawling: 30 days in late summer (only enforced some years)
Minimum landing sizes: EC regulation 1967/2006: 20 cm TL for hake.
Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.
Two small No Take Zones ("Zone di Tutela Biologica", ZTB) are present inside the GSA9; one off the Giglio Island (50 km2, northern Tyrrhenian Sea) another off Gaeta, (125 km2, central Tyrrhenian Sea). In both areas fishing gears operating on the bottom are not allowed six months per year.

Accompanying species

Data source*		OpUnit 2*	ITA 09 D 03 33 - HKE

Regulations in force and degree of observance of regulations

Accompanying species

Data source*		OpUnit 3*	ITA 09 E 03 33 - HKE

Regulations in force and degree of observance of regulations

Accompanying species

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

Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: HKE0910F.

Sex*	both

Analysis # *	1

Time series

Data	Size	Age
(mark with X)	x	

Model	Cohorts	Pseudocohorts
(mark with X)		x

Equation used	catch equation	Tunig method	no
# of gears	2	Software	VIT
$F_{terminal}$	0.3		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum			Recruitment		354485239.7
Average			Average population		
Maximum			Virgin population		
Critical	18	1	Turnover	2.54	

Average mortality

		Gear					
	Total						
F_1	0.761	bottom trawl					
F_2	0.42	gillnet					
Z	1.537						

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

Comments

Spawning Stock Biomass= 280394846.7
Total Biomass= 747865084.7
Recruitment (B) = 354485239.7

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet A1 Indirect methods: VPA, LCA

Code: HKE0910F.

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

		Gear					
	Total						
F_1							
F_2							
Z							

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

Comments

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

Assessment form

Sheet A2
Indirect methods: data

Code: HKE0910F.

Sex*	both	Gear*	bottm trawl=gear 1; gillnet=gear 2	Analysis # *	LCA

Data	Total catches (number of specimens)

Data

Size	Total ca	Catch o	Catch of gear 2
12	335405	335405	0
14	3E+06	3E+06	3362.6
16	4E+06	4E+06	1681.3
18	3E+06	3E+06	840.66
20	2E+06	2E+06	19335
22	2E+06	1E+06	66712
24	966340	896914	69426
26	776461	673122	103339
28	389858	249919	139939
30	194869	64709	130160
32	164050	37932	126117
34	121323	40968	80355
36	97665	38443	59222
38	81670	35201	46469
40	46376	27009	19367
42	39805	26632	13173
44	24774	2885.1	21889
46	15589	4660.6	10929
48	11831	1712	10119
50	25101	7415.5	17685
52	3662.3	2821.6	840.66
54	14821	3329	11492
56	17073	3931.3	13142
58	14228	2735.9	11492
60	1681.3	0	1681.3
62	3839.7	1626.2	2213.4
64	4503.6	1109.7	3394
66	0	0	0
68	5607.4	0	5607.4
70	0	0	0
72	840.66	0	840.66

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

Code: HKE0910F.

Sex*	both	Gear*	bottom trawl + gillnet	Analysis #*	LCA

Population in figures

Size	ean number	Size	ean number	Size	ean number
12	3E+06	36	49453	60	5531.1
14	3E+06	38	38405	62	5221.3
16	2E+06	40	30134	64	4638.3
18	1E+06	42	23913	66	3979.3
20	847448	44	19678	68	3271.9
22	530507	46	17320	70	2973.6
24	336484	48	15546	72	3004.5
26	209543	50	13263		
28	130857	52	11546		
30	95674	54	10378		
32	77210	56	8383.5		
34	62167	58	6413.3		

Population in biomass

Size	Mean Weight	Size	Mean Weight	Size	Mean Weight
12	4E+07	36	2E+07	60	1E+07
14	6E+07	38	2E+07	62	1E+07
16	6E+07	40	2E+07	64	1E+07
18	6E+07	42	2E+07	66	1E+07
20	6E+07	44	1E+07	68	1E+07
22	5E+07	46	1E+07	70	1E+07
24	4E+07	48	2E+07	72	1E+07
26	3E+07	50	1E+07		
28	2E+07	52	1E+07		
30	2E+07	54	1E+07		
32	2E+07	56	1E+07		
34	2E+07	58	1E+07		

Fishing mortality rates

Size	Total F	F of gea	F of gea	Size	Total F	F of gea	F of gea	Size	Total F	F of gea	F of gear 2
12	0.12	0.12	0	36	1.503	0.863	0.64	60	0.163	0	0.162
14	1.378	1.377	0.001	38	1.665	1.018	0.647	62	0.572	0.346	0.226
16	2.12	2.12	0	40	1.339	0.995	0.343	64	0.656	0.266	0.391
18	2.897	2.897	0	42	1.531	1.237	0.294	66	0.804	0	0.803
20	3.042	3.03	0.012	44	0.757	0.163	0.594	68	0.916	0.001	0.916
22	3.138	3.071	0.067	46	0.636	0.299	0.337	70	0.001	0.001	0
24	3.076	2.966	0.11	48	0.47	0.122	0.348	72	0.15	0.001	0.149
26	3.841	3.577	0.264	50	1.333	0.621	0.712				
28	2.697	2.125	0.573	52	0.31	0.271	0.039				
30	1.478	0.751	0.727	54	0.948	0.356	0.592				
32	1.418	0.546	0.873	56	1.358	0.521	0.838				
34	1.423	0.732	0.691	58	1.431	0.474	0.957				

Sex*		Gear*		Analysis #*	

Population in figures

Population in biomass

Fishing mortality rates

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet Y Indirect methods: Y/R

Code: HKE0910F.

Sex	both	Analysis #	Y/R

# of gears	2	Software	Yield

Parameters used

Vector F	yes
Vector M	yes
Vector N	

Model characteristics

M vector Age1=1.3 , Age2=0.6, Age3=0.46, Age4=0.41, Age5=0.3; Age6=0.2
Fmax = 0.35; F0.1= 0.22 and Fref = 0.28

Results

	Total	Gear			
Current YR	33.7				
Maximum Y/R	46.42				
Y/R 0.1					
F_{max}	0.35				
$F_{0.1}$	0.22				
Current B/R					
Maximum B/R					
B/R 0.1					
Fref	0.28				

Comments

Comments

Other assessment methods

Trawl Surveys data were used expressed in kg/km2. The estimation of Z was done using SURBA, after the reconstruction of the demographic structure of the stock and slicing among age classes.

Other assessment methods

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	Sheet D Diagnosis

Code: HKE0910F.

Reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B	77	tons	470	ncreasin	470 as potential B at F=0
SSB	5 to 10	%SSBc	30%	ncreasin	
F	1.4 to 1.6			stable	progressive reduction of fishing pressure on juveniles
Y					
CPUE					decreasing up to 2002 and increasing in more recent years
Fmax			0.35		
F0.1			0.22		
F30%SSE			0.28		
ZMBP					

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
☒	High fishing mortality
☐	Uncertain / Not assessed

Stock abundance

☐	Virgin or high abundance
☐	Intermediate abundance
☒	Low abundance

☐	Depleted
☐	Uncertain / Not assessed

Comments

Landings per unit effort show an increasing trend in the last 3-4 years in some ports. It is too early for stressing that this phenomenon is a signal of recovering of the stock that was (or is still) almost depleted.

Code: HKE0910F.

Management advice and recommendations*

The current SSB is likely to be between 5 and 10% of the SSB at Fmsy.
Stock productivity does not appear to be impaired and able to still produce relatively large year classes.
In relation to the proposed precautionary and target levels, the stock appears to be highly overexploited and F needs to be reduced in the order of 40-50%. However, considering the high productivity in terms of incoming year classes, the stock has the potential to recover fast if F is reduced towards Fmsy. Good results can be obtained by avoiding the operation of the fleets within the nursery areas where juveniles are densely concentrated.

Advice for scientific research*

Comments*

Most of the assessments have been performed during the Working groups organized by the Scientific Technical and Economic Commission of Fisheries (STECF) of the European Comunity. While data on commercial catches is available up to 2008, trawl surveys data are available up to 2009 and SURBA was used with this new set of data.

Comments*

Abstract for SCSA reporting

Authors F. Colloca1, P. Sartor2, M. Sbrana2, A.Mannini3, A. Abella4

Year 2010

Species Scientific name Merluccius merluccius - HKE

Source: GFCM Priority Species

Source: -

Source: -

Geographical Sub-Area 09 - Ligurian and North Tirrenian Sea

Fisheries (brief description of the fishery)*

Hake is the demersal species providing the highest landings and incomes for the GSA9. About 90% of landings of hake is due to bottom trawl vessels; the remaining fraction is provided by artisanal vessels using set nets, in particular gillnets.
The trawl fleet of GSA9 at the end of 2008 accounted for 361 vessels .
The main trawl fleets of GSA9 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium).
The majority of bottom trawlers of GSA9 performs daily fishing trips; only some vessels can stay out for two-three days, especially in summer.
The total fishing days carried out by all the GSA9 trawlers varied from about 65,000 in 2004 to about 63,000 in 2006, a little decrease of the mean number of fishing days/year per vessel was observed in this period, from 187 to 177.
Hake fishing grounds consists in soft bottoms of continental shelfs and the upper part of continental slope. Fishing pressure shows some geographical differences inside the GSA9 according to the fleets size and bottom characteristics.
The artisanal fleets, according to the official data account for 1309 vessels; widespread in many harbours along the continental and insular coasts. Of these, about 50 vessels, located in some harbors of the GSA9 (e.g. Marina di Campo, Ponza, Porto Santo Stefano), are working, especially from winter to summer, with gillnets targeting medium and large sized hakes (greather than 25 cm TL).

Source of management advice*

(brief description of material -data- and methods used for the assessment)

Assessments were performed with both, size structure and catches of commercial data by fishing gear for year 2008 and a time series of data on catch rates and demographic structure derived from trawl surveys conducted between 1985 and 2008.
Several alternative or complementary methods were used for the assessment of the exploitation status of European hake in the GSA9. Yield per recruit analysis allowed to define the level of F that is expected to maximize yield per recruit (Fmax) as well as the precautionary reference points F0.1 and F30%SSBo. F for each year was estimated using the software SURBA, assuming different catchability and natural mortality rate by age.
All the approaches suggest the need of a reduction of the fishing pressure on the species also considering the very early age of first capture.

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	Stock abundance
High fishing mortality	Low abundance

Comments

Landings per unit effort show an increasing trend in the last 3-4 years in some ports. It is too early for stressing that this phenomenon is a signal of recovering of the stock that was (or is still) almost depleted.

Management advice and recommendations*

The current SSB is likely to be between 5 and 10% of the SSB at Fmsy.
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Advice for scientific research*