SAC GFCM
Sub-Committee on Stock Assessment

Date*	21	September	2010	Code*	HKE1810Spe

Authors*

Spedicato Maria Teresa[1], Isabella Bitetto[1], Pierluigi Carbonara[1], Loredana Casciaro[1], Jerina Kolitari[2], Aleksandar Joksimović[3], and Giuseppe Lembo[1]

Affiliation*

[1]COISPA Tecnologia & Ricerca, Bari, Italy
[2]University of Agriculture, Tirana, Albania,
[3]Institute of Marine Biology, Kotor, Montenegro

Species Scientific name*

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

2
Source: -

3
Source: -

Geographical area*

2.1

Geographical Sub-Area (GSA)*

18 - South Adriatic 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: HKE1810Spe

Date*	21	Sep	2010	Authors*	Spedicato Maria Teresa1, Isabella Bitetto1, Pierluigi Carbonara1, Loredana Casciaro1, Jerina Kolitari2, Aleksandar Joksimović3, and Giuseppe Lembo1

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

Data Source

GSA*	18 - South Adriatic Sea	Period of time*	1996-2009

Description of the analysis

Type of data*	Standardised abundance indices (N/km2 and kg/km2) standardised LFD, length structure of landings	Data source*	MEDITS, selectivity experiments, DCF monitoring of landings
Method of assessment*	Pool dynamic model, CPUE analyses from surveys, Y/R model	Software used*	ALADYM, LFDA, SURBA, VIT

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	---	1	---	1	1	1	1	4	1	1	1

Comments, bibliography, etc.

Merluccius merluccius is a high-score priority species in the Geographical Sub Area 18 that remarkably contribute to the fishery production. This is mainly based on trawlers. Past assessments conducted in the area highlithed an overexploitation condition for the stock of European hake. Thus, in the framework of the Adriamed project (Working Group of Demersals) a new assessment was conducted to monitor the stock situation and provide fishery advice.
The data used in the analyses were from the trawl surveys conducted in the whole GSA (time series of Medits from 1996 to 2009 for Italian and Albanian coasts and 2008 only for Montenegro) and from the 2009 structure of landings of the west side (data from Data Collection Framework, DCF). LFDA routine was used for age slicing. We applied a suite of models and methods to face the uncertainty in the estimation process, hence the assessment was conducted using SURBA, ALADYM and VIT models in a complementary way.
Two scenarios of growth rate were tested for sex combined, to account for uncertainty in life history profile of European hake. Natural mortality was assumed variable at age, according to the Caddy and Abella paradigm.
Estimates of total mortality and recruitment from SURBA were used to feed ALADYM model with a hindcasting approach. ALADYM routines re-estimated the total and fishing mortality using the whole information on the population parameters and a simulated exploitation pattern from the fishery.

Comments, bibliography, etc.

To simulate this pattern the selectivity of the fleet was approximated using an ogive model with the following parameters: Lc=12cm; selection range (SR) 1 cm. This was coupled with a deselection ogive with 50% deselection size at 40 cm and a deselection range of 1 cm, to account for possible avoidance/reduced availability of older fish (Abella and Serena, 1998). Also the coefficient of monthly activity of the fleet was considered in the simulation.
A simulation was also performed to forecast the possible effects of the newly enforced mesh size regulation (from 40 mm to 50 mm diamond mesh opening in the cod-end) on stock biomass, catches and other relevant population indicators in the medium-term.

Abella A.J., F. Serena. (1998) - Selettività e vulnerabilità del nasello nella pesca a strascico. Biol. Mar. Medit. Vol. 5 (2)
Bertrand, J.A., Gil De Sola, L., Papacostintinou, C., Relini, G., Souplet, A., 2002. The general specifications of the Medits Surveys. Sci. Mar. 66 (Suppl.1–2), 9–17.
Carlucci R., Lembo G., P. Maiorano, F. Capezzuto, A.M.C. Marano, L. Sion, M.T. Spedicato, N. Ungaro, A. Tursi, G. D'Onghia. 2009 Nursery areas of red mullet (Mullus barbatus), hake (Merluccius merluccius) and deep-water rose shrimp (Parapenaeus longirostris) in the Eastern-Central Mediterranean Sea. Estuarine, Coastal and Shelf Science, doi: 10.1016/j.ecss.2009.04.034.
Hoggarth 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 Science Programme (FMSP). FAO Fisheries Technical Paper. No. 487. Rome, FAO: 261p
Lembo G., Silecchia T., Carbonara P., Spedicato M.T. (2000) – Nursery areas of Merluccius merluccius in the Italian Seas and in the East Side of the Adriatic Sea. Biol. Mar. Medit., 7 (3): 98-116.
Lembo G., Carbonara P., Silecchia T., Spedicato M.T. (2002) – Prove di pesca a strascico con rete a doppio sacco per la valutazione della selettività dell'attrezzo e della qualità del prodotto. I quaderni scientifici di Lega Pesca, Roma: 1-47.
Lembo G., A. Abella, F. Fiorentino, S. Martino and M.-T. Spedicato. 2009 ALADYM: an age and length-based single species simulator for exploring alternative management strategies. Aquat. Living Resour. 22, 233–241.
Lleonart J., and Salat, J. 1997. VIT: Software for fishery analysis,. User's manual. FAO Computerised Information Series. Fisheries, 11: 107 p.
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 – 5 February 2003.
Spedicato M.T., J-C Poulard, C-Yianna Politou, K. Radtke, G. Lembo, and P. Petitgas. 2010. Using the ALADYM simulation model for exploring the effects of management scenarios on fish population metrics. Aquat. Living Resour. 23, 153–165.
Ungaro, N., Joksimovic, A., Kapidani, R., Ceriola, L. and Milone, N. 2008. Comparability of two different methods for the stock assessment of hake (Merluccius merluccius L.) in the Mediterranean Geographical Sub-Area 18 (Southern Adriatic Sea). Paper presented at the GFCM-SAC Sub Committee on Stock Assessment (Antalya, Turkey, 13-16 October 2008). CP/RER/010/ITA/OP-30. AdriaMed Occasional Papers, 30: 13 pp.
Ungaro N., Vrgoc N., Mannini P., 2003. The biology and stock assessment of Merluccius merluccius (L.) in the Adriatic Sea: an historical review by geographical sub-areas. Acta Adriat., 44 (1): 9-20.
Vrgoc, N., Arneri, E., Jukic-Peladic, S., Krstulovic Šifner, S., Mannini, P., Marceta, B., Osmani, K., Piccinetti, C., Ungaro, N., 2004. Review of current knowledge on shared demersal stocks of the Adriatic Sea. FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. GCP/RER/010/ITA/TD-12. AdriaMed Technical Documents, 12: 91 pp.

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

Assessment form

Sheet B
Biology of the species

Code: HKE1810Spe

Biology

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

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed	93.5	66.5			Reproduction season	all year round
Size at first maturity	33.2				Reproduction areas	continental shelf
Recruitment size				6	Nursery areas	continental shelf

Parameters used (state units and information sources)

			Sex			
		Units	female	male	both	unsexed
Growth model	L∞	cm/y			96	
	K				0.129	
	t0				-0.73	
	Data source	trawl survey data and landings				
Length weight relationship	a	cm;g			0.0043	
	b				3.155	

M						

sex ratio (mal/fem)	0.5

Comments

Mature females were found all year round with peaks in early winter and late spring.
A proxy of size at first maturity as estimated in the Samed project (Anonymous, 2002) using the average length at stage 2 (females with gonads at developing stage) indicated an average length of about 29 cm. According to the data obtained in the DCF framework, the proportion of mature females (fish belonging to the maturity stage 2 onwards) allowed to estimate a maturity ogive with a size at first maturity varying around 33.2 (±0.27 cm) (maturity range 6.4 ±0.29 cm).
The observed maximum lengths of European hake were 93.5 cm for females and 66.5 cm for males both registered during Medits samplings. In the commercial sampling also a female of 93.5 cm length was observed in 2009.
In the DCF framework the growth has been studied ageing fish by otolith readings using the whole sagitta and thin sections for older individuals. Length frequency distributions were also analyzed using techniques as Batthacharya for separation of modal components.
The estimates of von Bertalanffy growth parameters were obtained for sex combined from average length at age using an iterative non-liner procedure that minimises the sum of the square differences between observed and expected values.
Two scenarios of growth rate were tested for sex combined: the slow pattern using the above reported parameters (Linf=96 cm, K=0.129, t0= -0.73) and the fast growth (Linf=104 cm, K=0.2, t0= -0.01) scenarios, to account for uncertainty in life history profile of European hake.
Natural mortality was assumed variable at age, according to the Caddy and Abella paradigm (Abella et al., 1997), which resulted in:

Age	0	1	2	3	4	5+
Mslow	0.76	0.42	0.30	0.26	0.21	0.2
Mfast	1.16	0.53	0.40	0.35	0.32	

for the slow and fast growth scenarios respectively.

Maturity at age was also estimated for the two scenarios:

Age	0	1	2	3	4	5+
Matslo	0.0002	0.0051	0.325	0.67	1	1

Comments

As well as the weight (in kg) at age:

Age	0	1	2	3	4	5+
Wslo	0.01	0.04	0.15	0.35	0.66	1.77
Wfas	0.01	0.14	0.53	1.15	2.35	

The geographical distribution pattern of European hake has been studied in the area using trawl-survey data and the geostatistical methods. The higher concentration of recruits in the GSA18 have been localised off Gargano promontory along the west side and in the southern part of Albanian coasts.

Abella A., Caddy J., 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. Livin. Res., 10: 257-269.
Anonymous 2002. Stock Assessment in the Mediterranean-SAMED. Final Report EU Project n° 99/047.

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

Assessment form

Sheet P1
General information about the fishery

Code: HKE1810Spe

Data source*	EU Data collection framework	Year (s)*	2009
Data aggregation (by year, average figures between years, etc.)*	by year		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ITA	18	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	HKE
Operational Unit 2	ITA	18	E - Trawl (12-24 metres)	03 - Trawls	33 - Demersal shelf species	HKE
Operational Unit 3	ITA	18	I - Long line (12-24 metres)	09 - Hooks and Lines	33 - Demersal shelf species	HKE
Operational Unit 4	ITA	18	D - Trawl (6-12 metres)	03 - Trawls	33 - Demersal shelf species	HKE
Operational Unit 5	ITA	18	F - Trawl (>24 metres)	03 - Trawls	33 - Demersal shelf species	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 18 C 07 33 - HKE	839	Tons	27				
ITA 18 E 03 33 - HKE	579	Tons	2910				
ITA 18 I 09 33 - HKE	37	Tons	533				
ITA 18 D 03 33 - HKE	40	Tons	97				
ITA 18 F 03 33 - HKE	61	Tons	537				
Total	1556		4104				

Legal minimum size	20 cm

Comments

The fleet data are referred to the whole GSA and are related to the year 2007 (GFCM Statistical Bulletin 2008). Catch data are referred to the west side and to the year 2009 (DCF data). The operational unit ITA18E0333-HKE and ITA18E0333-HKE include also demersal slope fishing (mixed demersal according to DCF classification).

Comments

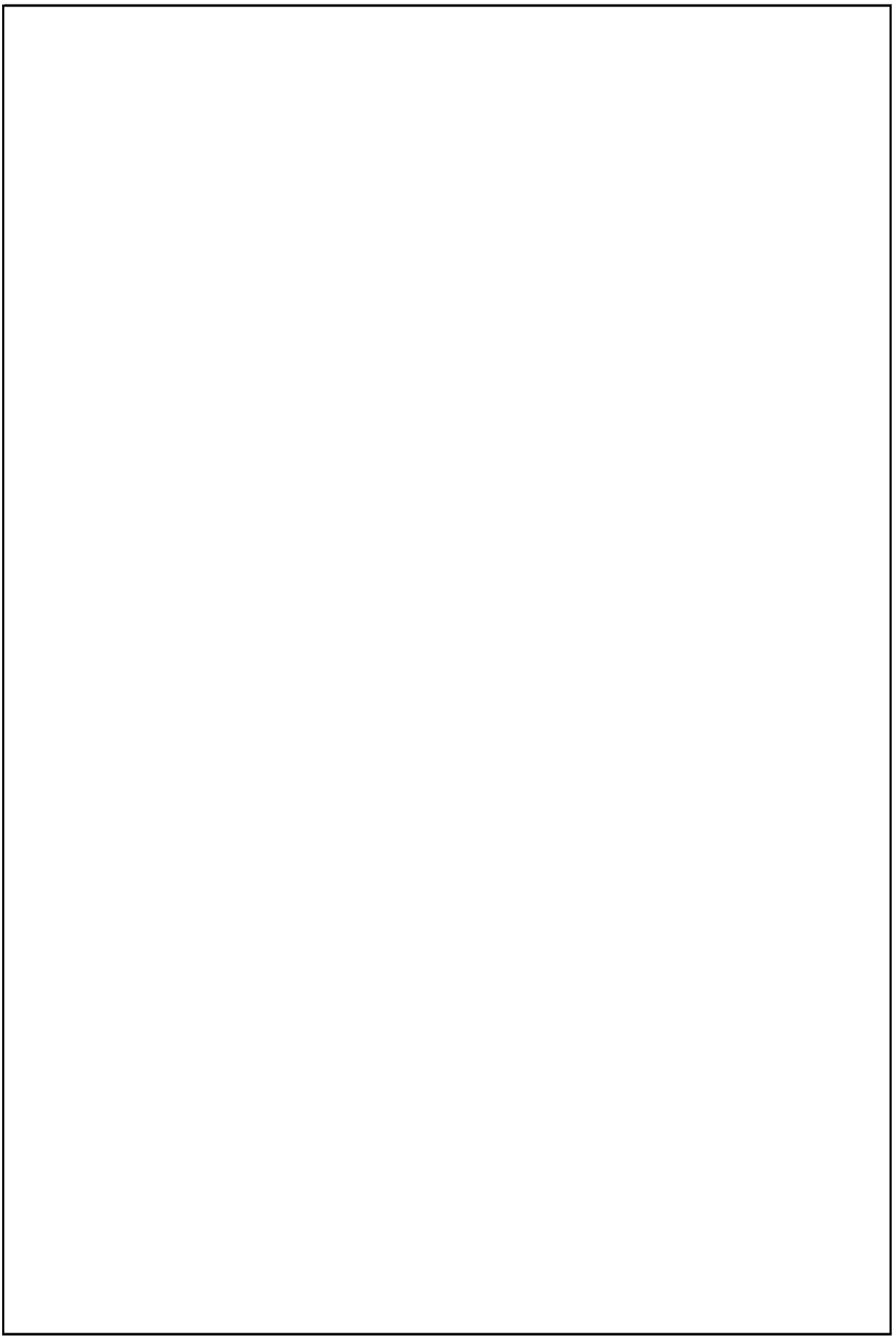
Data source*	EU data Collection framework	OpUnit 1*	ITA 18 C 07 33 - HKE

Regulations in force and degree of observance of regulations

Management regulations are based on technical measures related to the height and length of the gears as well as the mesh size opening, minimum landing sizes and number of fishing licenses for the fleet.

Accompanying species

European hake is mostly targeted by trawlers, and to a lesser extent by small scale fisheries using nets and bottom long-lines. Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth. M. barbatus, M. surmuletus, S. officinalis, O. vulgaris, E. cirrhosa and P. erythrinus may co-occur in the catches.



Data source*		OpUnit 2*	ITA 18 E 03 33 - HKE

Regulations in force and degree of observance of regulations

Management regulations are based on technical measures, closed number of fishing licenses for the fleet and area limitation (distance from the coast and depth). In order to limit the over-capacity of fishing fleet, the Italian fishing capacity has been gradually reduced. In 2008 a management plan was adopted. Other measures on which the management regulations are based regards technical measures (mesh size), minimum landing sizes (EC 1967/06) and seasonal fishing ban.

Accompanying species

Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth or 3 miles from the coast. Catches from trawlers are from a depth range between 50-60 and 500 m and hake occurs with other important commercial species as Illex coindetii, M. barbatus, P. longirostris, Eledone spp., Todaropsis eblanae, Lophius spp., Pagellus spp., P. blennoides, N. norvegicus.

Data source*		OpUnit 3*	ITA 18 I 09 33 - HKE

Regulations in force and degree of observance of regulations

Management regulations are based on technical measures related to the number of hooks and the minimum landing sizes (EC 1967/06), besides the regulated number of fishing licences.

Accompanying species

Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth. Pagellus species may co-occur in the catches.

Data source*		OpUnit 4*	ITA 18 D 03 33 - HKE

Regulations in force and degree of observance of regulations

Management regulations are based on technical measures, closed number of fishing licenses for the fleet and area limitation (distance from the coast and depth). In order to limit the over-capacity of fishing fleet, the Italian fishing capacity has been gradually reduced. In 2008 a management plan was adopted. Other measures on which the management regulations are based regards technical measures (mesh size), minimum landing sizes (EC 1967/06) and seasonal fishing ban.

Accompanying species

Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth or 3 miles from the coast. Catches from trawlers are from a depth range between 50-60 and 500 m and hake occurs with other important commercial species as Illex coindetii, M. barbatus, P. longirostris, Eledone spp., Todaropsis eblanae, Lophius spp., Pagellus spp., P. blennoides, N. norvegicus.

Data source*		OpUnit 5*	ITA 18 F 03 33 - HKE

Regulations in force and degree of observance of regulations

Management regulations are based on technical measures, closed number of fishing licenses for the fleet and area limitation (distance from the coast and depth). In order to limit the over-capacity of fishing fleet, the Italian fishing capacity has been gradually reduced. In 2008 a management plan was adopted. Other measures on which the management regulations are based regards technical measures (mesh size), minimum landing sizes (EC 1967/06) and seasonal fishing ban.

Accompanying species

Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth or 3 miles from the coast. Catches from trawlers are from a depth range between 50-60 and 500 m and hake occurs with other important commercial species as Illex coindetii, M. barbatus, P. longirostris, Eledone spp., Todaropsis eblanae, Lophius spp., Pagellus spp., P. blennoides, N. norvegicus.

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

Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: HKE1810Spe

Sex*	combined

Analysis # *	LCA

Time series

Data	Size	Age
(mark with X)		x

Model	Cohorts	Pseudocohorts
(mark with X)		x

Equation used	LCA	Tunig method	none
# of gears	3	Software	Vit4win
$F_{terminal}$	0.25		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	8.6	0.437	Recruitment	53319856	206 tons
Average	19.215	1.075	Average population	62613456	6432 tons
Maximum	54.5	6	Virgin population		93649 tons
Critical	28.497	2	Turnover		

Average mortality

		Gear					
	Total	trawl	nets	longline			
F_1	0.561	0.442	0.0134	0.069			
F_2							
Z	0.876						

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

Comments

VIT model was applied to get an approximate estimate of the fishing mortality and the order of magnitude of the recruitment. These estimates were useful for validation purposes between the models applied. In addition VIT was used to get an indicative estimate F0.1. Data of the age structure of landings were from the west side and for 2009. According to Osmani et al. (2003) the production from the west side account for about 97% of the total production of the whole GSA18. The total mortality was calculated as the geometric mean of the five age classes considered in the VIT analysis (from 0 to 4+). Likewise F1 is the geometric mean of the fishing mortality (F different from 0). These results are referred to the slow growth scenario.

Osmani, K., Decolli, P., Ceriola, L. Ungaro, N., Mannini, P. (2003). Assessment of demersal resources exploited by the Albanian trawl fishery: the case studies “hake” and “red mullet”. Paper presented at the GFCM-SAC Working Group on Demersal Species (Tangier, 12th-14th March 2003). FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. GCP/RER/010/ITA/OP-11. AdriaMed Occasional Papers, 11: 13 pp. Available from the World Wide Web at http://www.faoadriamed.org/pdf/OP-11.zip

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

Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: HKE1810Spe

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 A1
Indirect methods: VPA, LCA

This sheet will be activated once the previous page will be successfully completed

Code: HKE1810Spe

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

Assessment form

Sheet A1
Indirect methods: VPA, LCA

This sheet will be activated once the previous page will be successfully completed

Code: HKE1810Spe

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

Assessment form

Sheet A2
Indirect methods: data

Code: HKE1810Spe

Sex*	combined	Gear*	trawl, nets, longline	Analysis # *	**LCA**

Data source	Landings data from GSA18 west side, data collection framework

Data

Absolute numbers by age class from landings

Age	Nets	Trawl	Longline
0	0	39466	0
1	0	18104657	0
2	0	19809779	1704
3	11035	2485695	46911
4+	1627	448704	225632

All the other parameters used in the analyses were provided in the previous sheets.

Sex*	combine	Gear*	trawl, nets, longline	Analysis #*	LCA

Population in figures

age class	In. N.	Mean N
0	5.E+07	4.E+07
1	2.E+07	2.E+07
2	1.E+07	5.E+06
3	2.E+06	1.E+06
4+	8.E+05	2.E+06

Population in biomass

age class	In. W	Mean W
0	206	675
1	1201	1580
2	1838	1268
3	783	643
4+	0	505

weights are in tons

Fishing mortality rates

age class	Z	Total F	F Nets	F Trawl	F Longline
0	0.76	0	0	0	0
1	0.82	0.39	0	0.39	0
2	1.649	1.349	0	1.349	0
3	1.003	0.753	0.036	0.683	0.034
4+	0.5	0.25	0.005	0.106	0.139

Sex*		Gear*		Analysis #*	

Population in figures

Population in biomass

Fishing mortality rates

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

Assessment form

Sheet A3
Indirect methods: VPA results

This sheet will be activated once the previous page will be successfully completed

Code: HKE1810Spe

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

Assessment form

Sheet A3
Indirect methods: VPA results

This sheet will be activated once the previous page will be successfully completed

Code: HKE1810Spe

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

Assessment form

Sheet Y
Indirect methods: Y/R

Code: HKE1810Spe

Sex	combined

Analysis #	Y/R

# of gears	3	Software	Vit4win

Parameters used

Vector F	as in the sheet A3-1
Vector M	as reported in the sheet B
Vector N	

Model characteristics

Results

	Total	Gear			
Current YR					
Maximum Y/R					
Y/R 0.1					
F_{max}					
$F_{0.1}$					
Current B/R					
Maximum B/R					
B/R 0.1					

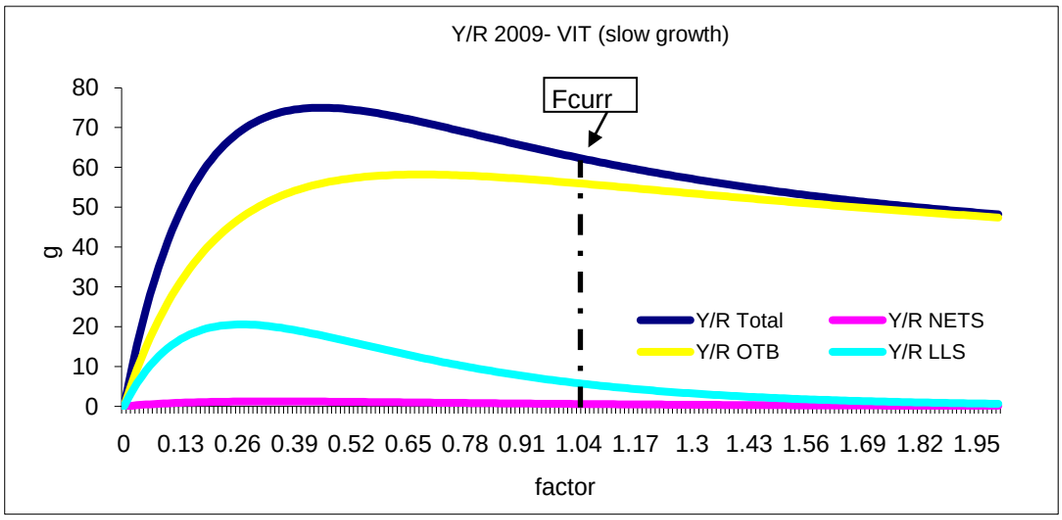
Comments

The complete results obtained using the slow growth and the fast growth scenarios are reported below.

Results of the slow growth scenario

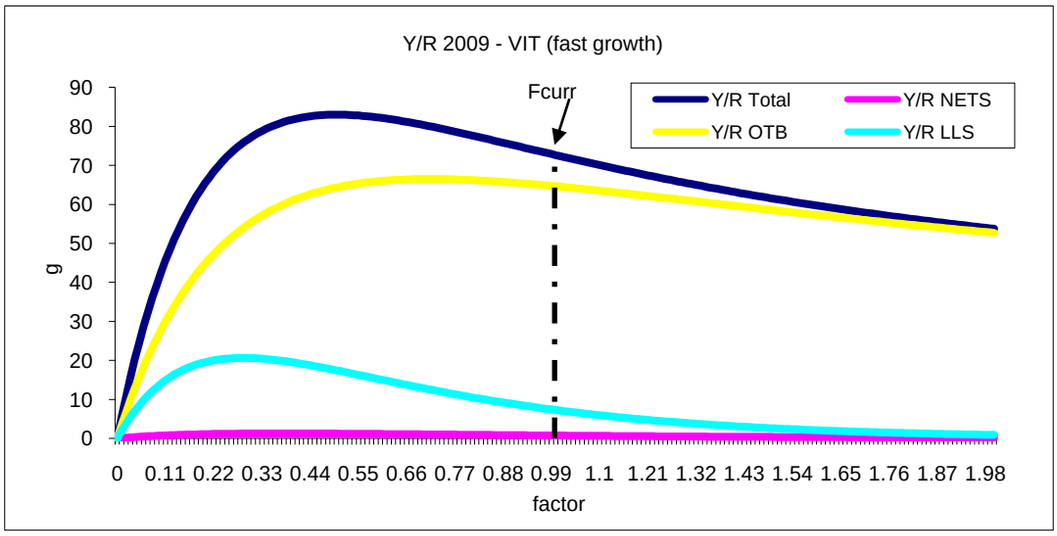
2009 Factor	F	Y/R	B/R	SSB	Y/R NE	Y/R OT	Y/R LL
F(0)	0	0	0	1756.4	1663.3	0	0	0
F(0.1)	0.34	0.1907	73.209	552.81	477.12	1.24	51.94	20.03
Fmax	0.46	0.2581	74.999	401.36	329.93	1.197	55.937	17.865
Fcurr	1.01	0.561	63.34	120.63	64.33	0.633	56.372	6.334
Fdouble	2	1.122	48.204	49.988	7.7	0.129	47.424	0.651

Comments



Results of the fast growth scenario

2009 Factor	F	Y/R	B/R	SSB	Y/R NE	Y/R OT	Y/R LL
F(0)	0	0	0	1382.8	1341.1	0	0	0
F(0.1)	0.37	0.2114	80.758	444.68	407.19	1.257	59.542	19.959
Fmax	0.51	0.2914	83.001	318.43	282.22	1.209	64.354	17.439
Fcurr	1.01	0.5714	72.643	117.91	85.799	0.726	64.652	7.264
Fdouble	2	1.1427	53.747	45.341	19.048	0.171	52.698	0.877



Other assessment methods

The assessment was conducted using the models SURBA and ALADYM in a complementary way.

- Model SURBA

The data used in the analyses were from trawl surveys (time series of Medits surveys from 1996 to 2009 for Italy and Albania, 2008 for Montenegro). All the other parameters were those reported in the sheets 0 and B.

Catchability was set as follows:

slow growth scenario

Age	0	1	2	3	4	5+
q	0.9	1	1	1	0.75	0.75

fast growth scenario

Age	0	1	2	3	4+
q	0.9	1	1	0.75	0.75

Abundance indices (N/km^2) by year and age inputs to SURBA (slow growth scenario)

Year/ag	0	1	2	3	4	5+
1996	504.51	205.3	23.325	3.897	0.834	2.026
1997	331.83	166.81	27.925	4.368	1.256	1.57
1998	303.55	111.19	11.838	2.05	0.7	1.63
1999	187.43	89.93	10.532	1.608	0.851	2.084
2000	392.52	92.795	10.303	2.01	0.462	1.578
2001	290.27	93.461	8.504	1.808	1.031	1.154
2002	633.66	76.323	12.581	1.467	0.7	0.52
2003	318.79	76.348	15.179	2.248	0.606	1.11
2004	526.87	107.64	13.964	1.488	0.753	1.542
2005	1439.3	97.526	17.655	6.351	2.013	2.24
2006	486.98	119.64	25.512	3.455	1.835	2.817
2007	418.61	86.316	16.793	5.123	1.094	2.638
2008	928.17	133.66	12.655	3.354	2.43	1.32
2009	568.87	164.34	33.612	8.138	3.295	2.281

Other assessment methods

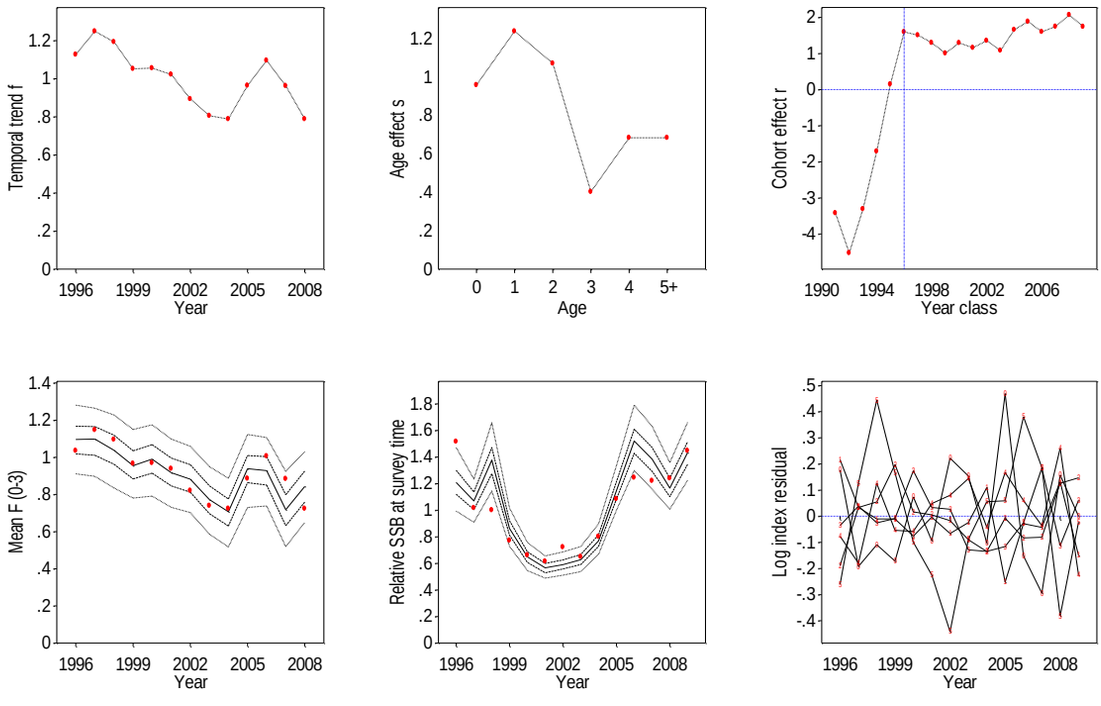
Main results from SURBA and ALADYM

Year	Z Surba	F Surba	Z Aladym_slow	F Aladym_slow
1996	1.577	1.096	1.717	0.958
1997	1.566	1.099	1.577	0.938
1998	1.519	1.038	1.510	0.885
1999	1.431	0.956	1.445	0.809
2000	1.476	0.99	1.488	0.794
2001	1.396	0.917	1.427	0.777
2002	1.369	0.882	1.461	0.749
2003	1.249	0.773	1.327	0.719
2004	1.188	0.707	1.440	0.701
2005	1.414	0.939	1.663	0.876
2006	1.405	0.928	1.427	0.892
2007	1.2	0.718	1.296	0.723
2008	1.322	0.843	1.446	0.731
2009	1.306*	0.825*	1.539	0.778

(the value of 2009 is a geometric mean of the last three years)

(F from Aladym is the month instantaneous estimate)

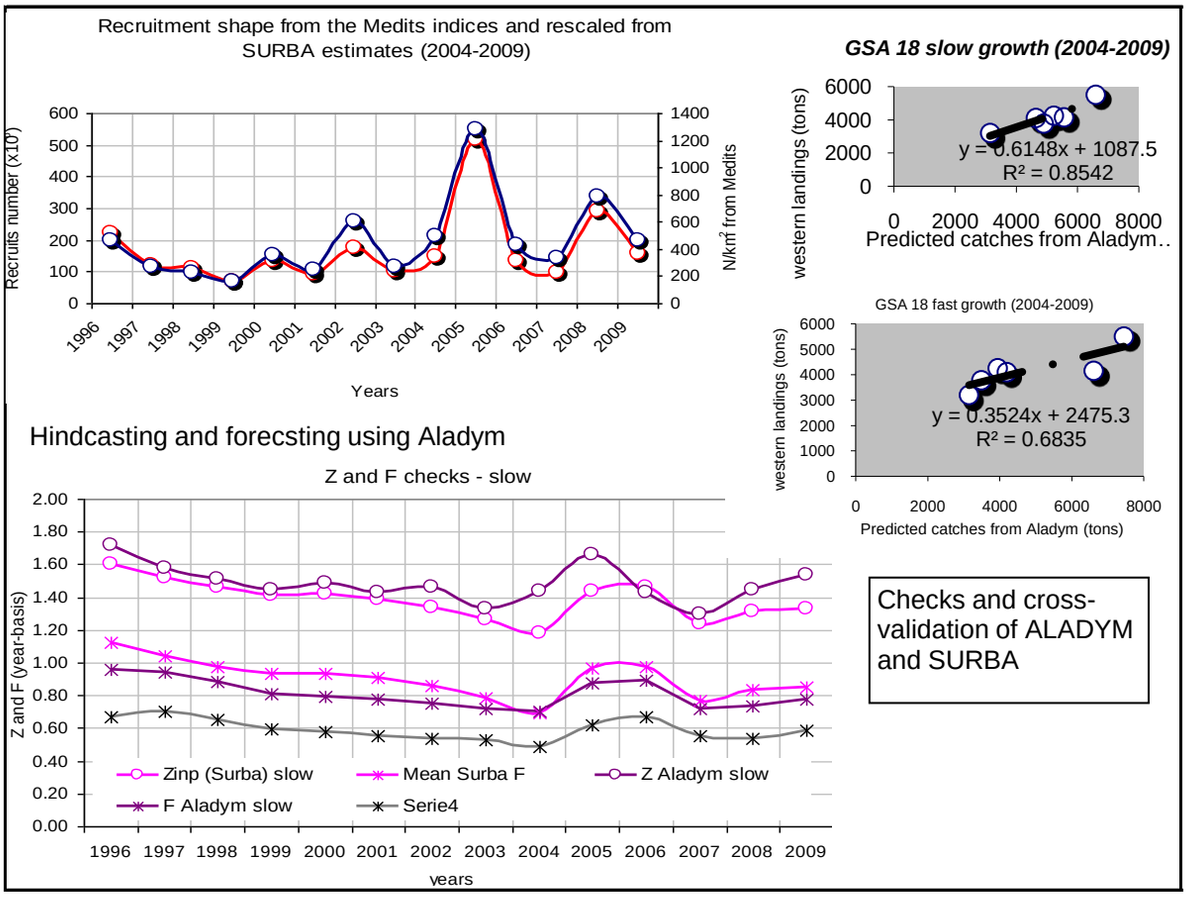
GSA18 West+East +mon 2010 M+F Mvect-growth slow



Other assessment methods

- Model ALADYM

Estimates of total mortality and recruitment from SURBA were used to feed ALADYM model using a hindcasting approach.
ALADYM routines re-estimated the total and fishing mortality using the population parameters and a simulated exploitation pattern from the fishery. All the parameters used as input are reported in the sheets: 0, B and Other 2. The proportion of offspring per month that is an input required by ALADYM was set with peaks in december, january, february, july, september, october, according to the observations carried out in the area.
The two growth scenarios were simulated also in ALADYM.
To simulate the harvesting pattern the selectivity of the fleet was approximated using an ogive model with the following parameters: Lc=12cm; selection range (SR) 1 cm. This was coupled with a deselection ogive to account for possible avoidance/reduced availability of older fish. The parameters were: 50% deselection size at 40 cm and a deselection range of 1 cm. Also the coefficient of monthly activity of the fleet, with a reduction during the seasonal ban, was considered in the simulation.
A simulation was also performed to forecast the possible effects of the newly enforced mesh size regulation on stock biomass, catches and other relevant population indicators in the medium-term. In this case the selectivity parameters from 2010 to 2015 were: L50%=16 cm; SR=1cm. The recruitment for the forecast scenarios was set equal to the geometric mean of the last three years.
All the relevant indicators were estimated as model outputs.



Other assessment methods

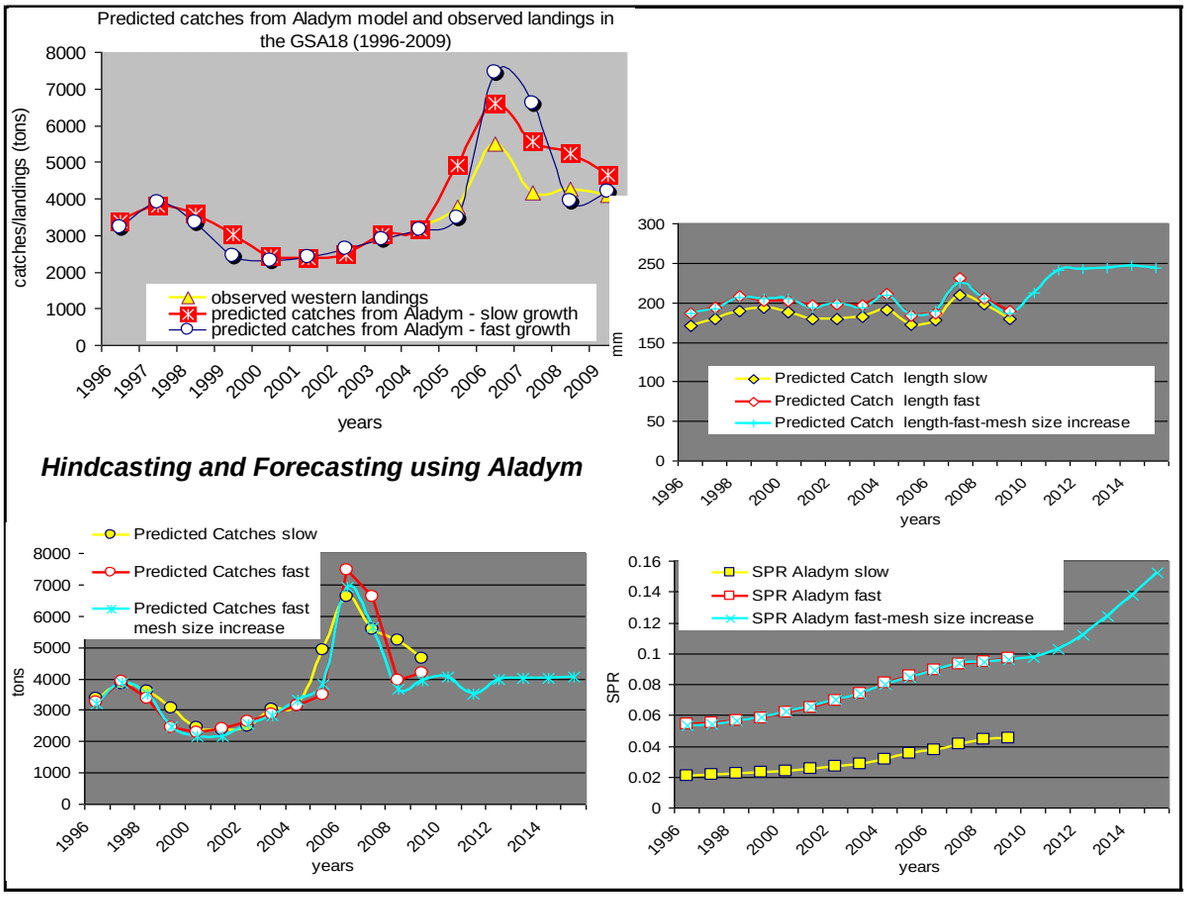
Results from ALADYM

Outcomes from ALADYM converged with the Z estimates from SURBA. The yearly average level of fishing mortality estimated using ALADYM was comparable (F=0.58) with that estimated using VIT (F=0.56) and catches simulated using ALADYM well approximated the observed ones for both the growth scenarios.

Regardless of the method used a slightly decreasing trends of total and fishing mortality were observed from 1996 to 2005 when increasing mortality values were recorded. These were maintained in 2006, while afterwards mortality went back to the levels before 2005. In this year also a remarkable increase of recruitment was observed that contribute to sustain the fishery in the subsequent years, as evidenced by the increasing western landings.

However, regardless of the growth scenarios the current fishing mortality notably exceed the level of F0.1 as approximately estimated using VIT. Thus a conspicuous reduction of F would be necessary to guarantee a more sustainable exploitation in the long-term. This can be partly achieved following the newly enforced regulation on the mesh size. The forecast regarding this technical measure evidenced poor lost for the catches in the short term and a stable situation in the future when the present levels of catches will be maintained if the fishing pressure will not be increased. Indicators regarding average length of catches and Spawning Potential Ratio (SPR) are all increasing. In addition, the higher average size of catches would increase of about 20% resulting in more valuable yields.

However, given the uncertainty of the effectiveness of mesh size regulation especially regarding fish survival, spatial and temporal management measures could valuably



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

Code: HKE1810Spe

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB					
F	0.57-0.58		F0.1=0.2		Fmax=0.3
Y					
CPUE					

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

After the exceptional peak of recruitment observed in 2005, the recruit abundance reached comparable levels as in the years before 2005. However, given the results of the present analysis, the stock of hake appears overexploited since the current fishing mortality is higher than F0.1 and Fmax. Thus a fishing mortality reduction is necessary in order to avoid future loss in stock productivity and landings.

Code: HKE1810Spe

Management advice and recommendations*

A more sustainable exploitation in the long-term can be partly achieved following the newly enforced regulation on the mesh size. The forecast regarding this technical measure evidenced poor lost for the catches in the short term and a stable situation in the future when the present levels of catches should be maintained if the fishing pressure will not be increased.
In addition, the higher average size of catches would increase of about 20% resulting in more valuable yields. However, given the uncertainty of the effectiveness of mesh size regulation, especially regarding fish survival, spatial and temporal management measures could valuably complement such technical measure.

Advice for scientific research*

Advice for scientific research

Supporting of tagging experiments of hake in different Mediterranean areas to improve knowledge on the species growth at larger scale.
Introduce a second annual scientific survey campaign in autumn to improve temporal resolution of survey data, in particular data on recruitment and mortality.

Comments*

Advice for scientific research: Supporting of tagging experiments of hake in different Mediterranean areas to improve knowledge on the species growth at larger scale.
Introduce a second annual scientific survey campaign in autumn to improve temporal resolution of survey data, in particular data on recruitment and mortality.

Comments*

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet C** **Comments**

This sheet will be activated once the previous page will be successfully completed

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet C** **Comments**

This sheet will be activated once the previous page will be successfully completed

Abstract for SCSA reporting

Authors Spedicato Maria Teresa1, Isabella Bitetto1, Pierluigi Carbonara1, Loredana Casciaro1, Jerina Kolitari2, Aleksandar Joksimović3, and Giuseppe Lembo1

Year 2010

Species Scientific name Merluccius merluccius - HKE

Source: GFCM Priority Species

Source: -

Source: -

Geographical Sub-Area 18 - South Adriatic Sea

Fisheries (brief description of the fishery)*

Merluccius merluccius is a high-score priority species in the Geographical Sub Area 18 that remarkably contribute to the fishery production. Most part of the landings of hake are from trawlers. In the western side the European hake landings are around 4100 tons in 2009. The Operational unit that contribute more to the landings (71% of the landings) in the western side is the trawl 12-24 m. Trawlers are the most important part of the fleet even along Albanian coasts.

Source of management advice*

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

The data used in the analyses were from the trawl surveys conducted in the whole GSA (time series of Medits from 1996 to 2009 for Italian and Albanian coasts and 2008 only for Montenegro) and from the 2009 structure of landings of the west side (data from Data Collection Framework, DCF). We applied a suite of models and methods to face the uncertainty in the estimation process, hence the assessment was conducted using SURBA, ALADYM and VIT models in a complementary way. Two scenarios of growth rate were tested. A simulation was also performed to forecast the possible effects of the newly enforced mesh size regulation on stock biomass, catches, average length of catches, and other relevant population indicators in the medium-term.

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

High fishing mortality

Stock abundance

Comments

Management advice and recommendations*

A more sustainable exploitation in the long-term can be partly achieved following the newly enforced regulation on the mesh size. The forecast regarding this technical measure evidenced poor lost for the catches in the short term and a stable situation in the future when the present levels of catches should be maintained if the fishing pressure will not be increased.
In addition, the higher average size of catches would increase of about 20% resulting in more valuable yields. However, given the uncertainty of the effectiveness of mesh size regulation, especially regarding fish survival, spatial and temporal management measures could valuably complement such technical measure.

Advice for scientific research*

Supporting of tagging experiments of hake in different Mediterranean areas to improve knowledge on the species growth at larger scale.

Introduce a second annual scientific survey campaign in autumn to improve temporal resolution of survey data, in particular data on recruitment and mortality.