TABLES/TABLEAUX

Table/Tableau 1.6.1: Catches (1990–2008) in the subregion by species and year (weight in tonnes)
Captures totales (1990-2008) dans la sous-région par espèce et par année (poids en tonnes)

Country	Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Morocco	*S. pilchardus*	1112762	1067776	720633	622605	645707	646046	587449	629767	592200	519551
	S. aurita	103075	18829	267	3524	3318	14558	12333	29560	81493	84332
	S. maderensis	38014	7186	0	14	14	59	49	118	327	339
	T. trachurus	12069	10092	16185	24987	41000	49104	31712	38940	64409	68106
	T. trecae				585	4695	6982	5667	7846	14445	14301
	C. rhonchus										
	S. japonicus	26512	10592	13244	22451	69877	100041	81869	159967	158829	112920
	E.encrasicolus	10324	19125	16635	10310	7516	10257	12039	24697	40403	30373
	E.fimbriata										
	Total Morocco	**1302756**	**1133600**	**766964**	**684476**	**772127**	**827047**	**731118**	**890895**	**952106**	**829922**
Mauritania	*S. pilchardus*							11579	24394	19602	11278
	S. aurita	78645	50425	53756	35436	23409	65175	205756	188166	258602	185893
	S. maderensis	28355	7445	14146	8859	5799	16350	41804	23675.05	35427	17747
	T. trachurus	33000	11949	20316	23250	15172	22492	16054	11558	20601	15051
	T. trecae	57000	94398	116995	86769	56850	97272	70274	52320	91455	65206
	C. rhonchus	22000	6487	1927	9451	6235	345	630	1236	1386	648
	S. japonicus	20000	8235	20303	16578	19094	44730	98017	48464	41192	21470
	E. encrasicolus		8279	17358	6489	2612	986	3609	34511	79162	93164
	E. fimbriata										
	Total Mauritania	**239000**	**187218**	**244801**	**186832**	**129171**	**247350**	**447723**	**384325**	**547427**	**410457**
Senegal	*S. pilchardus*		167	123	1	1892	268	0	0	3	1
	S. aurita	94422	115404	175455	149443	135564	100793	145342	147704	115661	83554
	S. maderensis	75420	79537	88611	85357	50919	57301	121714	89943	100885	106520
	T. trachurus										
	T. trecae	1558	4191	3095	17957	11559	17198	14442	12251	16604	4065
	C. rhonchus	4731	2907	13716	4874	3154	4175	3268	5423	4107	19308
	S. japonicus	2499	931	2290	2616	3413	2297	4924	5768	4993	7809
	E. encrasicolus										
	E. fimbriata	14785	11542	12164	17332	13504	15686	17462	16423	13833	20540
	Total Senegal	**193415**	**214679**	**295454**	**277580**	**220005**	**197718**	**307152**	**277512**	**256086**	**241797**

Table/Tableau 1.6.1 (cont.): Catches (1990–2008) in the subregion by species and year (weight in tonnes)
Captures totales (1990-2008) dans la sous-région par espèce et par année (poids en tonnes)

Country	Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
The Gambia	*S. pilchardus*	0	0	0	0	0	0	0	0	0	0
	S. aurita	2697	933	77	57	6	6	12	81	39	124
	S. maderensis	3274	567	16	33	5	5	9	36	37	105
	T. trachurus										
	T. trecae	482	807	41	591	187	245	236	396	128	273
	C. rhonchus	177	44	205	91	65	173	176	134	60	185
	S. japonicus	284	294	30	66	61	106	126	158	42	184
	E. encrasicolus										
	E. fimbriata	8039	17646	12019	14053	16897	13897	22648	21523	21952	16115
	Total Gambia	**14953**	**20291**	**12387**	**14891**	**17221**	**14432**	**23207**	**22328**	**22258**	**16986**
All Countries	*S. pilchardus*	1112762	1067943	720756	622606	647600	646313	599028	654161	611805	530830
	S. aurita	278839	185591	229555	188460	162297	180532	363443	365511	455795	353903
	S. maderensis	145063	94735	102773	94263	56737	73715	163576	113772	136676	124711
	T. trachurus	45069	22041	36501	48237	56172	71596	47766	50498	85010	83157
	T. trecae	59040	99396	120131	105902	73291	121697	90619	72813	122632	83845
	C. rhonchus	26908	9438	15848	14416	9454	4693	4074	6793	5553	20141
	S. japonicus	49295	20052	35867	41711	92445	147174	184936	214357	205056	142383
	E. encrasicolus	10324	27404	33993	16799	10128	11243	15648	59209	119565	123537
	E. fimbriata	22824	29188	24183	31385	30401	29583	40110	37946	35785	36655
	Total Subregion	**1750123**	**1555788**	**1319606**	**1163779**	**1138524**	**1286547**	**1509200**	**1575060**	**1777877**	**1499162**

Table/Tableau 1.6.1 (cont.): Catches (1990–2009) in the subregion by species and year (weight in tonnes)
Captures totales (1990-2009) dans la sous-région par espèce et par année (poids en tonnes)

Country	Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Morocco	*S. pilchardus*	559183	768546	674120	656407	635536	696099	620802	573022	683590	815482
	S. aurita	46308	13893	0	94	1388	12822	33982	41337	41298	43024
	S. maderensis	0	5957	0	0	189	2056	5898	1436	3744	481
	T. trachurus	63048	55743	9159	14382	93371	96857	69297	55724	56998	68011
	T. trecae	42481	38788	0	0	595	76158	46154	40676	56004	77936
	C. rhonchus										
	S. japonicus	123690	90805	22702	34538	122001	138051	169115	172723	197340	194176
	E. encrasicolus	22096	47417	18473	17000	7068	6073	10037	18899	19811	17195
	E.fimbriata										
	Total Morocco	**856806**	**1021149**	**724454**	**722421**	**860149**	**1028116**	**955285**	**903816**	**1058784**	**1216304**
Mauritania	*S. pilchardus*	23545	18632	37572	83556	80830	65239	73662	85252	81218	104638
	S. aurita	197704	181169	191246	208426	136630	189000	126068	253732	248942	211702
	S. maderensis	6386	24417	22442	39810	20561	15202	13592	27092	28198	26706
	T. trachurus	5132	14206	32203	49675	75979	23953	23094	44297	47434	51554
	T. trecae	128776	170235	149013	98547	178176	190233	204847	262041	292774	260560
	C. rhonchus	43290	21662	66103	31771	38670	16682	41561	21058	26350	36813
	S. japonicus	65074	65662	104615	133218	96566	37961	33446	80176	60455	44500
	E. encrasicolus	104090	105350	136232	162854	136777	78090	109940	120796	102300	98448
	E. fimbriata	4026	6378	12899	8298	1680	4545	4545	633	2	3041
	Total Mauritania	**578023**	**607711**	**752325**	**816155**	**765869**	**620905**	**630755**	**895077**	**887673**	**837962**
Senegal	*S. pilchardus*	3	2	507	0	0	14878	10170	12195	4034	7544
	S. aurita	111905	123566	118013	121616	140554	198955	150787	188428	257505	263594
	S. maderensis	111109	119751	126885	164469	156413	116705	91574	106993	81851	80395
	T. trachurus										
	T. trecae	667	2735	4545	2573	2584	5640	5356	4017	8419	8113
	C. rhonchus	4029	2392	5806	3455	4179	4833	5264	4438	3716	5458
	S. japonicus	2823	1949	8896	14173	3942	5852	3428	4383	4920	5122
	E. encrasicolus										
	E. fimbriata	15227	24471	11828	13095	9792	8731	5675	9225	9285	5727
	Total Senegal	**245763**	**274866**	**276480**	**319381**	**317464**	**355594**	**272254**	**329679**	**369729**	**375953**

Table/Tableau 1.6.1 (cont.): Catches (1990–2009) in the subregion by species and year (weight in tonnes)
Captures totales (1990-2009) dans la sous-région par espèce et par année (poids en tonnes)

Country	Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
The Gambia	*S. pilchardus*	0	0	0	0	0	0	0	0		0
	S. aurita	115	203	1022	804	680	1030	1117	1639	2335	2527
	S. maderensis	94	281	1275	1291	1029	1287	4024	2800	4771	5130
	T. trachurus										
	T. trecae	189	225	290	255	265	303	341	308	349	342
	C. rhonchus	136	169	249	202	200	0	124	153	432	413
	S. japonicus	140	169	344	308	276	186	277	261	126	133
	E. encrasicolus										
	E. fimbriata	20508	18516	18701	22118	16052	19881	13187	13247	11744	11868
	Total Gambia	**21182**	**19563**	**21881**	**24978**	**18502**	**22687**	**19070**	**18408**	**19757**	**20413**
All Countries	*S. pilchardus*	582732	787180	712198	739963	716366	776216	704634	670469	768842	927664
	S. aurita	356032	318831	310281	330940	279252	401807	311954	485136	550080	520847
	S. maderensis	117589	150406	150602	205570	178192	135250	115088	138321	118564	112712
	T. trachurus	68180	69949	41362	64057	169350	120810	92391	100021	104431	119565
	T. trecae	172113	211983	153848	101375	181620	272334	256698	307042	357546	346951
	C. rhonchus	47455	24223	72158	35428	43049	21515	46949	25649	30498	42684
	S. japonicus	191727	158585	136557	182237	222784	182050	206266	257543	262841	243931
	E. encrasicolus	126186	152767	154705	179854	143845	84163	119977	139695	122111	115643
	E. fimbriata	39761	49365	43428	43511	27524	33157	23407	23105	21031	20636
	Total Region	**1701774**	**1923289**	**1775140**	**1882934**	**1961983**	**2027301**	**1877365**	**2146980**	**2335943**	**2450632**

Table/Tableau 1.7.1: Conversion factors used for the acoustic biomass time series by species and vessel
Facteurs de conversion utilisés pour les séries de la biomasse acoustique par espèces et navire

	Itaf Deme/Nansen	Al-Awam/Nansen	Al-Amir/Nansen	Itaf Deme/Nansen	Al-Awam/Nansen	Al-Amir/Nansen
	2005	**2005**	**2006**	**2009***	**2009**	**2009**
Sardina pilchardus		0.23	0.89			
Sardinella maderensis	1.14	0.48	-	0.87	0.50	1.01
S. aurita	0.35	1	-	0.87	1.00	1.01
Sardinella spp.	-	-	1.01			
Horse mackerels	1.77	0.9	1.08			
Decapterus ronchus	-	-	-			
Scomber japonicus	-	-	1.51			
Engraulis encrasicolus	-	0.46	1.42			
Other pelagics	2.35	3.85	-			
Total	**1.13**	**0.41**	**1.18**			

*calculated based on the basic data allocated to sardinella

Table/Tableau 2.2.1a: Catches (tonnes) of *Sardina pilchardus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Sardina pilchardus (*1990-2009) par zone, flottille et année

Zone	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
North (35°45'–32°N)	Moroccan coastal purse seiners	15478	17261	18745	24496	16643	16661	11497	7154	5567	4277
	Spanish purse seiners										
	Total North	**15478**	**17261**	**18745**	**24496**	**16643**	**16661**	**11497**	**7154**	**5567**	**4277**
A (32°N–29°N)	Moroccan coastal purse seiners	48881	33643	46199	54145	30838	19381	3546	16237	33186	21814
	Total A	**48881**	**33643**	**46199**	**54145**	**30838**	**19381**	**3546**	**16237**	**33186**	**21814**
B (29°N–26°N)	Moroccan coastal purse seiners	223714	261757	197939	253322	399051	477947	354820	423268	347965	370164
	Spanish purse seiners	58481	100319	28071	2218	12790	89	25			
	Total B	**282195**	**362076**	**226010**	**255540**	**411841**	**478036**	**354845**	**423268**	**347965**	**370164**
Total A+B		**331076**	**395719**	**272209**	**309685**	**442679**	**497417**	**358391**	**439505**	**381151**	**391978**
C (26°N–South)	Moroccan coastal purse seiners and RSW	28450	33727	31919	30127	18880	27561	8439	37951	45355	18715
	Spanish purse seiners	66075	16229	68759	112243	67800	13714	125813	113053	138166	55726
	Ukrainian and other pelagic trawlers (5)							30188	7474	16861	44093
	Russian pelagic trawlers (3)	356203	262579	144627	67523	53845	45417	53121	24630	5100	4762
	Other pelagic trawlers (2)	315479	342261	184374	78532	45860	45276				
	European Union (5)										
	Mauritanian (artisanal)										
	Mauritanian (industrial)										
	Others Mauritania (4)*							10356	15139	8118	7144
	European Union (4)							1223	9255	11484	4134
	Senegalese (artisanal)		167	123	1	1892	268	0	0	3	1
	Senegalese (industrial)										
	Total C	**766207**	**654963**	**429802**	**288426**	**188277**	**132236**	**229140**	**207502**	**225087**	**134575**
All fleets and zones		**1112762**	**1067943**	**720756**	**622606**	**647600**	**646313**	**599028**	**654161**	**611805**	**530830**

(1) Data obtained from COPACE/PACE SERIES 90/50 tables A3 (page 31) and A7 (page 35)

(2) Data obtained from COPACE/PACE SERIES 97/60, table 9 page 15

(3) Data from 1983–1995 obtained from COPACE/PACE/SERIES 97/60, table 9, page 15, for the period 1996–1999. The data are Russian statistics from statistical subdivisions 34.1.3 and 34.3.1. For these years the Russian Federation did not fish in Senegal

(4) Data obtained from IMROP statistics

(5) Moroccan statistics (INRH)

Table/Tableau 2.2.1a (cont.): Catches (tonnes) of *Sardina pilchardus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Sardina pilchardus* (1990-2009) par zone, flottille et année

Zone	Fleet	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
North (35°45'–32°N)	Moroccan coastal purse seiners	6790	6302	18516	20655	21451	17363	18484	13399	11072	9100
	Spanish purse seiners								240	282	470
	Total North	**6790**	**6302**	**18516**	**20655**	**21451**	**17363**	**18484**	**13639**	**11354**	**9570**
A (32°N–29°N)	Moroccan coastal purse seiners	29694	45725	23206	74578	60471	25160	25618	11725	32791	10793
	Total A	**29694**	**45725**	**23206**	**74578**	**60471**	**25160**	**25618**	**11725**	**32791**	**10793**
B (29°N–26°N)	Moroccan coastal purse seiners	485124	699246	610872	517271	473987	528071	363297	356810	446141	589703
	Spanish purse seiners										
	Total B	**485124**	**699246**	**610872**	**517271**	**473987**	**528071**	**363297**	**356810**	**446141**	**589703**
Total A+B		**514818**	**744970**	**634078**	**591849**	**534458**	**553231**	**388915**	**368535**	**368535**	**478932**
C (26°N–Sud)	Moroccan coastal purse seiners and RSW	1448	3118	21527	43903	76249	108331	148779	134536	136388	163480
	Spanish purse seiners										
	Ukrainian and other pelagic trawlers (5)	36127	14156			476	6599	33290	16071	15100	12732
	Russian pelagic trawlers (3)					2902	10575	31334	32461	10673	11863
	Other pelagic trawlers (2)										
	European Union (5)								7780	31142	17341
	Mauritanian (artisanal)										
	Mauritanian (industrial)						45				
	Others Mauritania (4)*	11952	4988	9783	32853	25359	25597	53472	68363	64778	74351
	European Union (4)	11593	13644	27789	50703	55471	39597	20190	16889	16440	30287
	Senegalese (artisanal)	3	2	507			14212	10170	12191	3758	6302
	Senegalese (industrial)						666		4	276	1242
	Total C	**61123**	**35908**	**59605**	**127459**	**160457**	**205622**	**297235**	**288295**	**278555**	**317598**
All fleets and zones		**582732**	**787180**	**712199**	**739963**	**716366**	**776216**	**704634**	**670469**	**670469**	**768842**

(1) Data obtained from COPACE/PACE SERIES 90/50, tables A3 (page 31) and A7 (page 35)

(2) Data obtained from COPACE/PACE SERIES 97/60, table 9 page 15

(3) Data from 1983-1995 obtained from COPACE/PACE/SERIES 97/60, table 9, page 15, for the period 1996–1999
the data are Russian statistics from statistical sub-divisions 34.1.3 and 34.3.1. For these years the Russian Federation did not fish in Senegal.

(4) Data obtained from IMROP statistics

(5) Moroccan statistics (INRH)

Table/Tableau 2.2.1b: Effort of *Sardina pilchardus* (1990–2009) by zone, fleet and year
Effort de *Sardina pilchardus* (1990-2008) par zone, flottille et année

Zone	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
North (35°45'–32°N)	Moroccan coastal purse seiners (1)	1675	1943	3160	3189	2865	3046	1872	936	800	(**)
A (32°N–29°N)	Moroccan coastal purse seiners (1)	7330	4605	5848	6829	4135	1943	578	1530	2364	5122
B (29°N–26°N)	Moroccan coastal purse seiners (1)	7023	10085	9163	10404	16375	20693	19361	9365	10248	14102
	Spanish purse seiners (2)	407	782	477	20	259	2	1			
C (26°N–20°N)	Moroccan coastal purse seiners (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Moroccan purse seiners RSW (2)										
	Spanish purse seiners (2)	416	187	546	715	471	115	910	814	870	567
	Ukrainian and other pelagic trawlers (2)(4)	NA	NA	NA	93	1194	2323	2239	3080	5797	4803
	Russian Federation (2)(4)				1476	2818	4162	2952	4411	7399	6524
	All fleets (2)(5)	15188	14199	7497	5027	3389	2297				
	Others Mauritania (3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	European Union (4)							715	940	1300	1538
	Senegalese (artisanal)										
	Senegalese (industrial)										

NA: not available

(1) Trips with sardine catches

(2) Fishing days

(3) Do not target sardine

(4) Morocco-INRH

(5) Standardized effort (RTMS, from COPAC/PACE Series 97/61 p. 17, table 13)

(6) Total trips

Table/Tableau 2.2.1b (cont.): Effort of *Sardina pilchardus* (1990–2009) by zones, fleet and year
Effort de *Sardina pilchardus* (1990-2009) par zone, flottille et année

Zone	Fleet	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
North (35°45'–32°N)	Moroccan coastal purse seiners (1)										
	Spanish purse seiners (2)									323	634
A (32°N–29°N)	Moroccan coastal purse seiners (1)	8797	3674	4012	6847	7440	2204	1245	4845	6246	3439
B (29°N–26°N)	Moroccan coastal purse seiners (1)	23367	15512	28392	18780	26945	27338	21137	20146	24134	26959
	Spanish purse seiners (2)										
C (26°N–20°N)	Moroccan coastal purse seiners (1)	NA	NA	180	805	1762	1117	1236	1366	1125	1271
	Moroccan RSW (2)			346	342	479	2415	2204	2883	2230	1643
	Spanish purse seiners (2)										
	Ukrainian and other pelagic trawlers (2)(4)	3982	2218			479	1603		1231	1103	560
	Russian Federation (2)(4)					1466	1623	2212	1026	778	1115
	European Union (4)								355	296	445
	All fleets (2)(5)										
	Others Mauritania (3)	8147	8337	7833	8158	11571	7168	7108	7080	7494	9373
	European Union	1308	1857	2178	2085	2006	1456	998	2541	2903	4397
	Senegalese (artisanal) (6)						81461	76303	84571	100148	72320
	Senegalese (industrial) (2)						159		59	204	150

NA: not available

(1) Trips with sardine catches

(2) Fishing days

(3) Do not target sardine

(4) Morocco-INRH

(5) Standardized effort (RTMS, from COPAC/PACE Series 97/61 p. 17, table 13)

(6) Total trips

Table/Tableau 2.4.1: Sampling intensity of *Sardina pilchardus* in 2009
Intensité d'échantillonnage de *Sardina pilchardus* en 2009

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
	Fleet y	**Total catch in tonnes**				
		Number of samples				
		Number of fish measured				
Country x		**Number of fish aged**				
Morocco Zone North	Moroccan	NA				
Morocco Zone A	Moroccan	**3244**	**2057**	**2903**	**2589**	**10793**
		44	25	25	55	149
		4155	1286	2577	5146	13164
		158	116	120	160	554
Morocco Zone B	Moroccan	**72497**	**105048**	**194560**	**217596**	**589703**
		75	104	78	93	350
		5240	6157	3777	4713	19887
		231	337	270	280	1118
Zone C, north of C. Blanc	Moroccan	**33105**	**38638**	**41664**	**50073**	**163480**
		8	9	9	11	37
		534	815	745	1158	3252
		70	88	64	90	312
	Russian	**137**	**2323**	**771**	**8632**	**11863**
		0	0	7	16	23
		0	0	0	0	0
		0	0	205	336	541
	Ukrainian and others					
Mauritania	EU	**8760**	**14147**	**26**	**2513**	**25446**
		12	12	4	0	28
		3040	2360	696	0	6096
		0	0	0	0	0
	Russian	**2595**	**796**	**54**	**1509**	**4954**
		0	0	0	4	4
		0	0	0	0	0
		0	0	0	172	172
	Ukrainian and others	**31177**	**10285**	**1854**	**26081**	**69397**
			8			
			620			
Senegal	Artisanal	**2997**	**3305**	**0**	**0**	**6302**
		15	18	0	0	33
		298	1533	0	0	1831

Table/Tableau 2.5.1a: Age–length key, Zone A+B 2009 (in numbers) (Moroccan catches)/ Clé taille–âge, Zone A+B 2009 (en individus) (captures marocaines)

Zone A+B 2007								
Length (cm)	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Total**
6.0								
6.5								
7.0								
7.5	338							338
8.0	0							0
8.5	301							301
9.0	0							0
9.5	0							0
10.0	846							846
10.5	2237							2237
11.0	2111							2111
11.5	7085							7085
12.0	11377							11377
12.5	22805							22805
13.0	75376							75376
13.5	61596							61596
14.0	107592							107592
14.5	123404							123404
15.0	157355	13113						170468
15.5	142961	32991						175952
16.0	281267	52738						334005
16.5	178588	111617	11162					301367
17.0	87688	438439	14615					540742
17.5		505425	12327					517752
18.0		618700	168736					787437
18.5		644619	148758					793377
19.0		608931	336514	16024				961469
19.5		372903	507148	74581				954631
20.0		67496	755954	161990				985440
20.5		10372	497837	238547				746756
21.0			251026	334701				585728
21.5			138020	154258	8119			300396
22.0			31521	130588	4503			166612
22.5			10861	65167	10861			86890
23.0			5362	45581	40219			91162
23.5				29501	92192			121693
24.0				5404	91868	43232		140503
24.5					77985	32494		110478
25.0					21215	58341	5304	84860
25.5					2532	20258	7597	30387
26.0						13423	8948	22371
26.5							6669	6669
27.0							1004	1004
27.5							0	0
28.0							693	693
Total (in thousands)	1262589	3477343	2889843	1256343	349493	167747	29522	9433912
Mean length (cm)	15.44	18.41	20.09	21.30	24.06	25.04	26.09	19.27
Mean weight (kg)	0.031	0.053	0.069	0.083	0.119	0.134	0.152	0.061

Table/Tableau 2.5.1b: Age-length key (AtlantNiro-Kalinegrad), Zone C 2009 (in thousands of individuals)
Clé taille-âge (AtlantNiro-Kalinegrad), Zone C 2009 (en individus)

Zone C 2007								
Length	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Total**
9.0								
9.5								
10.0								
10.5								
11.0								
11.5								
12.0								
12.5								
13.0								
13.5								
14.0								
14.5								
15.0								
15.5	5	1						7
16.0	103	21						124
16.5	14	10						24
17.0	33	26						59
17.5	80	114						194
18.0	180	505						686
18.5	144	1077	72					1293
19.0		3363	259					3622
19.5		3748	535					4284
20.0		6464	4309					10773
20.5		7936	5291					13227
21.0		7870	11805					19675
21.5		23719	9488	4744				37950
22.0		39724	33103	19862				92688
22.5		27833	69583	13917	13917			125250
23.0		47319	78866	47319	15773			189278
23.5			113132	47138	18855	18855		197981
24.0			82919	93284	31095	10365		217663
24.5			10577	105767	74037	21153		211535
25.0			37441	58835	53486	32092		181854
25.5			8225	45239	49352	20563		123379
26.0			7551	30205	45308	15103		98167
26.5				10717	21435	26793	5359	64304
27.0						15767	12614	28381
27.5						5677	7569	13246
28.0						1639	1639	3277
28.5							164	164
29.0							128	128
29.5							56	56
Total (in thousands)	559	169732	473156	477028	323258	168007	27529	1639269
Mean length (cm)	17.82	22.19	23.54	24.51	25.06	25.65	27.37	24.26
Mean weight (kg)	0.045	0.087	0.103	0.117	0.125	0.134	0.163	0.113

Table/Tableau 2.5.2a: Catch-at-age (thousands of individuals) of *Sardina pilchardus* in Zone A+B
Capture par âge (milliers d'individus) de *Sardina pilchardus* dans la zone A+B

Age/ year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	45270	15128	38261	2999957	1869433	1882528	1596381	8566572	3058732	1045264	3422264	1630954	3626884
1	589629	1636731	450608	1777920	4717104	3757581	3908056	6083372	5898782	2346296	2166548	2729404	4118047
2	1826829	1530553	2643529	954213	1824105	2723592	1646273	1199298	2111017	1871809	1970485	4450602	2591126
3	1222857	994532	333241	253858	454180	1131255	997641	252393	187031	832765	1483769	2671350	655140
4	516916	486308	113119	205332	264557	497298	270374	125102	105540	710509	560989	472617	605361
5	386516	302275	23395	292772	122245	177757	333451	145026	84831	488961	266672	259516	176381
6	25909	40272	737	115747	37865	130572	53847	28611	84525	233510	48739	239837	
7+	37319	45478	129	24	33	37	32	59	41	27	36	45	
Total	4651245	5051277	3603019	6599823	9289523	10300622	8806054	16400434	11530499	7529140	9919501	12454323	11772939

The series 1990–2001 was obtained from the 2002WG (FAO 2002).

Table/Tableau 2.5.2b: Mean weight-at-age (kg) of *Sardina pilchardus* in Zone A+B
Poids moyen par âge (kg) de *Sardina pilchardus* dans la Zone A+B

Age/ year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0.027	0.037	0.026	0.026	0.031	0.027	0.023	0.022	0.022	0.023	0.025	0.024	0.023
1	0.046	0.089	0.054	0.040	0.042	0.041	0.035	0.031	0.035	0.037	0.038	0.038	0.045
2	0.065	0.088	0.071	0.053	0.051	0.046	0.044	0.038	0.043	0.051	0.059	0.055	0.058
3	0.079	0.097	0.070	0.060	0.068	0.060	0.055	0.048	0.050	0.059	0.074	0.066	0.097
4	0.084	0.099	0.081	0.074	0.090	0.074	0.078	0.056	0.060	0.066	0.086	0.076	0.120
5	0.090	0.103	0.085	0.085	0.101	0.085	0.092	0.080	0.075	0.072	0.095	0.084	0.139
6	0.094	0.114	0.096	0.106	0.105	0.104	0.119	0.106	0.085	0.084	0.108	0.096	
7+	0.131	0.139	0.114										

The series 1990–2001 was obtained from the 2002WG (FAO 2002).

Table/Tableau 2.5.2a (cont): Catch-at-age (thousands of individuals) of *Sardina pilchardus* in Zone A+B
Capture par âge (milliers d'individus) de *Sardina pilchardus* dans la Zone A+B

Age/ year	2003	2004	2005	2006	2007	2008	2009
0	2918742	1358525	721420	509436	1022757	4572024	1262589
1	2891346	2293358	1430273	970472	653529	1284682	3477343
2	2461023	3719324	4464664	2199032	513022	701427	2889843
3	1304157	1006405	1165911	1049341	1030476	538860	1256343
4	541733	307211	311665	470092	700234	730076	349493
5	195026	71976	88027	94749	250953	509108	167747
6	31005	12915	14249	23252		52215	29522
7+							
Total	10343033	8769715	8196209	5316375	4170971	8388392	9432881

The series 1990–2001 was obtained from the 2002WG (FAO 2002).

Table/Tableau 2.5.2b (cont): Mean weight-at-age (kg) of *Sardina pilchardus* in Zone A+B
Poids moyen par âge (kg) de *Sardina pilchardus* dans la Zone A+B

Age/ year	2003	2004	2005	2006	2007	2008	2009
0	0.026	0.029	0.024	0.025	0.035	0.033	0.031
1	0.037	0.045	0.052	0.045	0.050	0.049	0.053
2	0.065	0.061	0.070	0.069	0.082	0.066	0.069
3	0.095	0.094	0.098	0.094	0.108	0.100	0.083
4	0.119	0.116	0.132	0.118	0.129	0.116	0.119
5	0.136	0.133	0.152	0.133	0.144	0.129	0.134
6	0.148	0.147	0.170	0.153		0	0.152
7+							

The series 1990–2001 was obtained from the 2002WG (FAO 2002).

Table/Tableau 2.5.2c: Catch-at-age (thousands of individuals) of *Sardina pilchardus* in Zone C
Capture par âge (milliers d'individus) de *Sardina pilchardus* dans la Zone C

Age/year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	129		420	68	1741	125	2894	77448	19813	28108	8144	4784	523
1	889223	624613	588710	106919	55705	41876	62995	551093	1211337	330086	261948	153886	86732
2	2036191	1604457	1961506	623152	664866	170317	417509	741833	979006	541112	258328	151759	177207
3	2658165	2327931	1495437	1971575	1347683	320607	980631	496298	423899	110766	90861	53378	137394
4	2891544	2658842	172164	644966	547308	574014	495336	424345	283838	27746	52950	31107	99051
5	1309369	1130307	1090898	303493	100737	340482	153962	110890	113496	10520	21075	12381	37950
6	314011	233996	298608	100455	6565	89430	7030	41633	7808	2592	1767	1038	
7	91165	31124	12199	16051	1726	5595	4197	0	1715	526	381	224	
Total	10189797	8611270	5619942	3766679	2726331	1542446	2124554	2443540	3040911	1051458	695454	408556	538857

Table/Tableau 2.5.2d: Mean weight-at-age (kg) of *Sardina pilchardus* in Zone C
Poids moyen par âge (kg) de *Sardina pilchardus* dans la Zone C

Age/year	1990	1991	1992	1993	1994	1995	1996*	1997	1998	1999*	2000	2001	2002
0	0.018	0.023	0.027	0.020	0.022	0.021	0.024	0.014	0.019	0.027	0.023	0.025	0.026
1	0.067	0.072	0.070	0.048	0.043	0.046	0.029	0.040	0.051	0.062	0.056	0.059	0.051
2	0.081	0.083	0.072	0.072	0.055	0.083	0.068	0.070	0.064	0.077	0.070	0.074	0.100
3	0.089	0.089	0.071	0.076	0.059	0.089	0.085	0.094	0.086	0.092	0.089	0.091	0.115
4	0.094	0.093	0.113	0.083	0.085	0.105	0.104	0.107	0.117	0.111	0.114	0.112	0.128
5	0.102	0.101	0.104	0.091	0.108	0.100	0.117	0.114	0.121	0.119	0.120	0.120	0.147
6	0.108	0.101	0.093	0.110	0.102	0.106	0.128	0.124	0.119	0.141	0.130	0.135	
7	0.103	0.101	0.131	0.110	0.109	0.109	0.130	0.122	0.132	0.160	0.146	0.153	

Table/Tableau 2.5.2c (cont): Catch-at-age (thousands of individuals) of *Sardina pilchardus* in Zone C
Capture par âge (milliers d'individus) de *Sardina pilchardus* dans la Zone C

Age/year	2003	2004	2005	2006	2007	2008	2009
0			0	5487	58	1679	559
1	142702	4399	552	109133	21922	56924	169732
2	258420	179480	81894	961899	345123	244956	473156
3	363571	466303	483289	1023005	692871	598211	477028
4	259917	217335	412637	360939	404292	791175	323258
5	150986	122344	260291	102013	150528	454449	168007
6	28268	13740	38497	11301	24475	103360	27529
7							
Total	1203864	1003601	1277158	2573777	1639269	2250753	1639269

Table/Tableau 2.5.2d (cont): Mean weight-at-age (kg) of *Sardina pilchardus* in Zone C
Poids moyen par âge (kg) de *Sardina pilchardus* dans la Zone C

Age/year	2003	2004	2005	2006	2007	2008	2009
0				0.031	0.036	0.030	0.045
1	0.050	0.057	0.064	0.067	0.076	0.069	0.087
2	0.076	0.090	0.096	0.097	0.104	0.103	0.103
3	0.105	0.105	0.114	0.115	0.127	0.125	0.117
4	0.129	0.125	0.130	0.129	0.145	0.137	0.125
5	0.145	0.138	0.142	0.142	0.157	0.147	0.134
6	0.174	0.166	0.166	0.154	0.170	0.171	0.163
7							

Table/Tableau 2.5.2e : Mean length at age from zones A+B and C in the period 2003–2009/
Taille moyenne par âge dans les zones A+B et C au cours de la période 2003-2009

		0	1	2	3	4	5	6
ZONE A+B	**2003**	15.20	16.90	19.90	22.40	24.00	25.00	25.70
	2004	15.30	17.60	19.50	22.30	23.90	25.00	25.80
	2005	14.50	18.40	20.10	22.20	24.20	25.20	26.10
	2006	14.48	17.42	20.02	22.16	23.86	24.79	25.93
	2007	15.93	17.87	21.06	23.05	24.45	25.35	
	2008	15.67	18.00	19.85	22.79	23.96	24.82	25.63
	2009	15.44	18.41	20.09	21.30	24.06	25.04	26.09

		0	1	2	3	4	5	6
ZONE C	**2003**	-	18.30	20.60	22.80	24.20	25.00	26.40
	2004	-	18.50	21.60	22.70	24.10	25.00	26.50
	2005	-	19.20	22.10	23.40	24.60	25.30	26.70
	2006	15.03	19.56	22.14	23.46	24.42	25.26	25.95
	2007	16.22	20.52	22.69	24.19	25.22	25.84	26.50
	2008	15.29	18.64	23.07	24.25	25.01	25.66	26.53
	2009	17.82	22.19	23.54	24.51	25.06	25.65	27.37

Table/Tableau 2.5.2f: Growth Parameters
Paramètres de croissance

	$L\infty$	k	t_0	a	b	r^2
Zone A+B	26.248	0.864	-0.36	0.0088	2.9857	0.9586
Zone C	27.500	0.870	-0.28	0.0084	3.0204	0.6644

Table/Tableau 3.2.1a: Catches (tonnes) of *Sardinella aurita* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Sardinella aurita* (1990-2009) par zone, flottille et année

Country	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Morocco Zone North	Moroccan										
Morocco Zone A	Moroccan										
Morocco Zone B	Moroccan										
Zone C, north of C. Blanc	Moroccan										
	Russian Federation	103075	18829	267	3423	1932	5619	1537	13790	15256	23089
	Ukrainian and others				101	1386	8939	10796	15770	66237	61243
Mauritania	EU (Holland, France, UK and Germany)							51989	99464	137123	137691
	Other industrial	78645	50425	53756	35436	23409	65175	153767	68598	106549	35732
	Artisanal								20104	14930	12470
Senegal	Industrial	10761	20290	19586	4499	3455	5948	6610	6024	2423	3525
	Artisanal	83661	95114	155869	144944	132109	94845	138732	141680	113238	80029
The Gambia	Industrial	2691	933	74	55	6	5	6	21	6	88
	Artisanal	6	0	3	2	0	1	6	60	33	36
Total	**All fleets**	**278839**	**185591**	**229555**	**188460**	**162297**	**180532**	**363443**	**365511**	**455795**	**353903**

Country	Fleet	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Morocco Zone North	Moroccan							34	19	42	7
Morocco Zone A	Moroccan								1		2
Morocco Zone B	Moroccan							3	106	118	719
Zone C, north of C. Blanc	Moroccan				94			530	20578	13015	21523
	Russian Federation	0	0	0	0	880	3970	11980	11277	5161	5499
	Ukrainian and others	46308	13893	0	0	508	8852	21435	9356	17391	10983
	EU									5571	4291
Mauritania	EU (Holland, France, UK and Germany)	109268	112224	87696	130237	72437	91,927	58270	101577	77482	61171
	Other industrial	68250	50066.6	82926	52517	42138	79,263	51598	127275	127408	101759
	Artisanal	20186	18878	20624	25672	22055	17810	16200	24880	49800	48772
Senegal	Industrial	444	1282	1326	409	885	1035	264	324	2011	1033
	Artisanal	111461	122284	116687	121207	139669	197920	150523	188104	255494	262561
The Gambia	Industrial	110	174	215	199	168	107	122	55	19	47
	Artisanal	5	29	807	605	512	923	995	1584	2316	2480
Total	**All fleets**	**356032**	**318831**	**310281**	**330940**	**279252**	**401807**	**311954**	**485136**	**555828**	**520847**

Table/Tableau 3.2.1b: Catches (tonnes) of *Sardinella maderensis* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Sardinella maderensis* (1990-2009) par zone, flottille et année

Country	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Morocco Zone North	Moroccan										
Morocco Zone A	Moroccan										
Morocco Zone B	Moroccan										
Zone C, north of C. Blanc	Moroccan										
	Russian Federation	38014	7186		14	8	23	6	55	61	93
	Ukrainian and others				0	6	36	43	63	266	246
Mauritania	EU (Holland, France, UK and Germany)							36027	12331	20006	8955
	Other industrial	28355	7445	14146	8859	5799	16350	5777	11052	15236	8213
	Artisanal								292	185	579
Senegal	Industrial	6714	9962	14286	8389	4639	10717	7398	9008	4306	3720
	Artisanal	68706	69575	74325	76968	46280	46584	114316	80935	96579	102800
The Gambia	Industrial	3257	567	15	32	5	4	4	10	6	73
	Artisanal	17	0	1	0.8	0	0.5	5	26	31	32
Total	**All fleets**	**145063**	**94735**	**102773**	**94263**	**56737**	**73715**	**163576**	**113772**	**136676**	**124711**

Country	Fleet	2000	2001	2002	2003	2004	2005	2006**	2007**	2008**	2009*
Morocco Zone North	Moroccan										
Morocco Zone A	Moroccan										
Morocco Zone B	Moroccan										
Zone C, north of Cap Blanc	Moroccan									1370	370
	Russian Federation	0	0	0		120	700	2114	785	543	
	Ukrainian and others	0	5957	0		69	1356	3784	651	1831	
	EU										111
Mauritania	EU (Holland, France, UK and Germany)	2613	13396	12939	6186	7279	3758	4115	1756	2732	4778
	Other industrial	1632	9682	7138	18826	11880	10566	9477	25254	26096	20842
	Artisanal	2141	1339	2365	0	1402	878	225	149	348	1086
Senegal	Industrial	1176	1288	1362	2186	1776	1960	17	122	597.8	502
	Artisanal	109933	118463	125523	162283	154637	114745	91557	106871	80833	79893
The Gambia	Industrial	88	250	375	408	275	162	78	38	12	33
	Artisanal	6	31	900	883	754	1125	3946	2762	4759	5097
Total	**All fleets**	**117589**	**150406**	**150602**	**190772**	**178192**	**135250**	**115313**	**138388**	**119122**	**112712**

*Preliminary, ** were modified in 2010 SPWG

Table/Tableau 3.2.2: Effort of sardinellas 1990–2009 (in fishing days; number of trips for Senegalese artisanal fisheries)
Effort de pêche des sardinelles 1990-2009 (en jours de pêche et nombre de voyages pour les pêcheries artisanales sénégalaises)

Country	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N of Cap Blanc	Russian Federation				1383	1624	1839	713	1331	1602	1721
	Ukrainian and others				93	1194	2323	2239	3080	5797	4803
Mauritania	Russian Federation, Ukrainian and others		7865	8415	7317	3893	6272	9318	6879	8100	7340
	EU, standardized							715	940	1300	1538
	Artisanal										
Senegal	Industrial	239	636	1347	770	344	431	482	598	480	1367
	Artisanal (1)	72800	69174	80000	80555	70322	65377	71365	87157	77844	76810

Country	Fleet	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
N of Cap Blanc	Russian Federation						1603	2212	1026	778	1115
	Ukraine and others	3982	2218				1623		1231	1103	560
Mauritania	Russian Federation, Ukrainian and others	8147	8337	7833	8158	11571	7168	7108	8892	7488	5344
	EU, standardized	1308	1857	2178	2085	2006	1456	791	729	782	1012
	artisanal								8563		
Senegal	Industrial	121	185	153	172	178	159	20	60	204	150
	Artisanal (1)	82187	91684	92339	97315	75439	81461	76303	82011	100148	72320
Gambia	Artisanal								5563	4985	

(1) Number of trips. *Preliminary.

Table/Tableau 3.4.1: Sampling intensity of *Sardinella aurita* (2009)
Intensité d'échantillonnage de S*ardinella aurita* (2009)

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
country x	**fleet y**	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone B	Moroccan					0
						0
						0
						0
Zone C, north of Cap. Blanc	Moroccan	**10302**	**3708**	**4495**	**3019**	**21523**
		2	0	3	1	6
		124	0	103	41	268
		0	0	0	20	20
	Russian	**0**	**455**	**1581**	**2732**	**4768**
		0	0	11	5	16
		0	0	0	0	0
		0	0	197	48	245
Mauritania	EU catch, IMROP samples	**2086**	**18235**	**20407**	**10189**	**50917**
		0	0	13	39	52
		0	0	2529	4970	7499
	Eu catch, IEO samples	**2086**	**18235**	**20407**	**5803**	**46531**
		10	21	21	0	52
		1197	2468	2226	0	5891
		0	0	0	0	0
	Russian catch, Russian samples	**603**	**3837**	**2890**	**578**	**7907**
		0	13	36	0	49
		0	4118	11523	0	15641
		0	110	140	0	250
	Russian and others, IMROP samples	**6547**	**20093**	**59533**	**15587**	**101760**
		0	39	0	0	39
		0	2215	0	0	2215
		0	0	0	0	
	Artisanal	**7369**	**6194**	**17400**	**17809**	**48772**
		0	0	0	0	0
		0	0	0	0	0
Senegal	industrial					
	artisanal	**43520**	**77371**	**74585**	**67080**	**262556**
		53	48	22	49	172
		6396	7816	1849	5759	21820
		27	30		10	67
The Gambia						

* Commercial/research surveys

Table/Tableau 3.4.2: Sampling intensity of *Sardinella maderensis* (2009)
Intensité d'échantillonnage de *Sardinella maderensis* (2009)

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
country x	fleet y	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Zone C North Cape Blanc	Moroccan	**170**	**0**	**200**	**0**	**370**
		2	0	2	0	4
		27	0	45	0	72
	Russian	**0**	**10**	**259**	**59**	**328**
		0	0	0	0	0
		0	0	0	0	0
		0	0	0	0	0
Zone C South Cape Blanc Mauritania	EU catch, IMROP sampling	**223**	**200**	**2376**	**1020**	**3819**
		0	0	13	30	43
		0	0	481	655	1136
	EU catch, IEO sampling	**223**	**200**	**2376**	**474**	**3273**
		4	1	7	11	23
		410	61	625	916	2012
		0	0	0	0	0
	Russian catch, Russian sampling	**52**	**127**	**15**	**0**	**194**
		0	0	0	0	0
		0	933	1228	0	2161
		0	0	0	0	0
	Russian and others, IMROP sampling	**1341**	**4115**	**12193**	**3193**	**20842**
		0	22	0	0	22
		0	702	0	0	702
		0	0	0	0	
	Artisanal	**19**	**715**	**257**	**97**	**1088**
		0	0	0	0	0
		0	0	0	0	0
		0	0	0	0	0
Senegal	industrial					
	artisanal	**29754**	**26006**	**8819**	**15313**	**79892**
		43	37	20	25	125
		3863	3023	1115	2323	10324
		8	10	0	0	18
The Gambia	industrial					
	artisanal					

Table/Tableau 4.2.1a: Catches (tonnes) of *Trachurus trachurus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Trachurus trachurus* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Morocco Zone North	Moroccan	7111	4851	7085	12380	9250	11291	2259	3873	3384	5824	7170	5167
Morocco Zone A	Moroccan	4948	5231	9071	10255	12863	9773	6695	3149	1899	4389	4634	4482
Morocco Zone B	Moroccan	10	10	29	12	110	111	90	533	1346	688	1062	281
Zone C, north of C. Blanc	Moroccan									3	3	7	1
	Russian				2020	2523	6897	4024	4736	10147	13418	0	0
	Ukrainian and others				320	16254	21032	18644	26649	47630	43784	50175	45812
	UE												
Mauritania	UE												
	others												
	all	**33000**	**11949**	**20316**	**23250**	**15172**	**22492**	**16054**	**11558**	**20601**	**15051**	**5132**	**14206**
Senegal	industrial												
	artisanal												
The Gambia	industrial												
	artisanal												
TOTAL	**all fleets**	**45069**	**22041**	**36501**	**48237**	**56172**	**71596**	**47766**	**50498**	**85010**	**83157**	**68180**	**69949**

Table/Tableau 4.2.1a (cont.): Catches (tonnes) of *Trachurus trachurus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Trachurus trachurus* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009***
Morocco Zone North	Moroccan	6128	8731	10431	7811	12217	9776	8299	**6731**
Morocco Zone A	Moroccan	2858	5192	3368	3688	1330	2993	3704	4401
Morocco Zone B	Moroccan	165	459	424	256	3430	374	533	**1704**
Zone C, north of C. Blanc	Moroccan	0		11	4953	1586	2255	1026	**2798**
	Russian	0		51223	32316	27755	3689	10084	**7343**
	Ukrainian and others	8		27916	47833	22979	36638	26225	**34024**
	UE						0	7126	**11009**
Mauritania	UE		1050	684	7668	4409	12257	13721	**12170**
	others		48625	75295	16285	18685	32040	48961	**39384**
	all	**32203**							
Senegal	industrial								
	artisanal								
The Gambia	industrial								
	artisanal								
Total	**all fleets**	**41362**	**64057**	**169350**	**120810**	**92391**	**100021**	**119679**	**119565**

* preliminary

Table/Tableau 4.2.1b: Catches (tonnes) of *Trachurus tracae* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Trachurus tracae* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Morocco Zone North	Moroccan												
Morocco Zone A	Moroccan												
Morocco Zone B	Moroccan												
Zone C, north of C. Blanc	Moroccan												
	Russian				505	631	1724	1006	1184	2537	3355	0	0
	Ukrainian and others				80	4064	5258	4661	6662	11908	10946	42481	38788
Mauritania	UE												
	others												
	all	**57000**	**94398**	**116995**	**86769**	**56850**	**97272**	**70274**	**52320**	**91455**	**65206**	**128776**	**170235**
Senegal	industrial	33	234	877	14614	10597	15816	13397	11666	13888	2600	0	7
	artisanal	1525	3957	2218	3343	962	1382	1045	585	2716	1465	667	2728
The Gambia	industrial	452	747	14	542	166	181	176	383	90	170	111	132
	artisanal	30	60	27	49	21	64	60	13	38	103	78	93
Total	**all fleets**	**59040**	**99396**	**120131**	**105902**	**73291**	**121697**	**90619**	**72813**	**122632**	**83845**	**172113**	**211983**

Table/Tableau 4.2.1b (cont.): Catches (tonnes) of *Trachurus tracae* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Trachurus tracae* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009***
Morocco Zone North	Moroccan								
Morocco Zone A	Moroccan								
Morocco Zone B	Moroccan								
Zone C, north of C. Blanc	Moroccan				3806	1219		1540	1441
	Russian	0		595	26893	23097	5857	15126	39635
	Ukrainian and others	0			45459	21838	34819	39338	36860
Mauritania	UE		4471	18938	14668	39524	61427	67338	43946
	others		94077	159239	175566	165323	200614	269287	216614
	all	**149014**							
Senegal	industrial	8	3		83	0		236	1
	artisanal	4537	2570	2584	5557	5356	4017	8183	8112
The Gambia	industrial	140	110	125	121	117	41	23	38
	artisanal	150	145	140	182	224	267	326	304
Total	**all fleets**	**153849**	**101375**	**181621**	**272334**	**256698**	**307042**	**401397**	346951

* preliminary

Table/Tableau 4.2.1b: Catches (tonnes) of *Caranx rhonchus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Caranx rhonchus* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Morocco Zone North	Moroccan												
Morocco Zone A	Moroccan												
Morocco Zone B	Moroccan												
Zone C, north of C. Blanc	Moroccan												
	Russian												
	Ukrainian and others												
Mauritania	UE												
	others												
	all	**22000**	**6487**	**1927**	**9451**	**6235**	**345**	**630**	**1236**	**1386**	**648**	**43290**	**21662**
Senegal	industrial	6	0	10066	867	564	601	288	1742	140	16251	5	0
	artisanal	4725	2907	3650	4007	2590	3574	2980	3681	3967	3057	4024	2392
The Gambia	industrial	83	0	161	32	9	7	4	57	1	98	81	109
	artisanal	94	44	44	59	56	166	172	77	59	87	55	60
Total	**all fleets**	**26908**	**9438**	**15848**	**14416**	**9454**	**4693**	**4074**	**6793**	**5553**	**20141**	**47455**	**24223**

Table/Tableau 4.2.1b (cont.): Catches (tonnes) of *Caranx rhonchus* (1990–2009) by zone, fleet and year
Captures (tonnes) de *Caranx rhonchus* (1990-2009) par zone, flottille et année

Zone	**Fleet**	**2002**	**2003**	**2004**	**2005**	**2006***	**2007**	**2008**	**2009***
Morocco Zone North	Moroccan								
Morocco Zone A	Moroccan								
Morocco Zone B	Moroccan								
Zone C, north of C. Blanc	Moroccan								
	Russian								
	Ukrainian and others								
Mauritania	UE		1733	891	4106	8276	461		11494
	others		30038	37779	12576	33285	20597	31475	25319
	all	**66103**							
Senegal	industrial	5	0	0	0	0	5	100	34
	artisanal	5801	3455	4179	4833	5264	4433	3616	5458
The Gambia	industrial	115	76	89		33	16	28	23
	artisanal	134	126	111		91	137	404	390
total	**all fleets**	**72158**	**35428**	**43049**	**21515**	**46949**	**25649**	**35623**	**42718**

*preliminary

Table/Tableau 4.4.1: Sampling intensity of *Trachurus trachurus* (2009)
Intensité d'échantillonnage de *Trachurus trachurus* (2009)

Country	**Fleet**	Q1	Q2	Q3	Q4	2009
country x	fleet y	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone North	Moroccan					
Morocco Zone A	Moroccan	**911**	**1451**	**1134**	**905**	**4401**
		6	7	4	21	38
		474	161	96	882	1613
		0	0	0	0	0
Morocco Zone B	Moroccan					
Zone C, north of C. Blanc	Moroccan	**724**	**533**	**1311**	**1120**	**3689**
		0	0	2	0	2
		0	0	86	0	86
	Russian					0
						0
						0
						0
Mauritania	EU	**42**	**206**	**53**	**395**	**696**
		0	0	0	0	0
		0	0	0	0	0
		0	0	0	0	0
	Russian, Ukrainian and others	**17152**	**18773**	**6331**	**6480**	**48736**
		0	174	0	0	174
		0	10452	0	0	10452
		0	0	0	0	0
	Russian*					0
						0
						0
						0
Senegal	industrial					
	artisanal					
The Gambia	industrial					
	artisanal					

Table/Tableau 4.4.2: Sampling intensity of *Trachurus tracae* (2009)
Intensité d'échantillonnage de *Trachurus tracae* (2009)

Country	**Fleet**	Q1	Q2	Q3	Q4	2009
country x	fleet y	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone North	Moroccan					
Morocco Zone A	Moroccan					
Morocco Zone B	Moroccan					
Zone C, north of C. Blanc	Moroccan	0	0	0	7	7
		0	0	0	1	1
		0	0	0	19	19
	Russian	**720**	**849**	**1863**	**3451**	**6883**
		0	0	6	33	39
		0	0	0	0	0
				107	352	459
Mauritania	EU	**149**	**736**	**190**	**1404**	**2479**
		0	0	3	22	25
		0	0	30	1298	1328
		0	0	0	0	0
	Russian, Ukrainian and others	**94337**	**103254**	**34819**	**35642**	**268052**
			364			364
			33349			33349
						0
	Russian*	0	0	0	0	0
		0	0	0	17	17
		0	0	0	0	0
		0	0	0	148	148
Senegal	industrial					
	artisanal					0
						0
						0
Gambie	industrial	NA	NA	NA	NA	NA
	artisanal	NA	NA	NA	NA	NA

Table/Tableau 4.4.2: Sampling intensity of *Caranx rhonchus* (2009)
Intensité d'échantillonnage de *Caranx rhonchus* (2009)

Country	**Fleet**	Q1	Q2	Q3	Q4	2009
country x	fleet y	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone North	Moroccan					
Morocco Zone A	Moroccan					
Morocco Zone B	Moroccan					
Zone C, north of C. Blanc	Moroccan					
	Russian					
Mauritania	EU	**39**	**192**	**50**	**389**	**670**
		0	2	4	0	6
		0	39	396	0	435
		0	0	0	0	0
	Russian, Ukrainian and others	**11026**	**12069**	**4070**	**4166**	**31331**
			924			924
			925			925
						0
	Russian*					0
						0
Senegal	artisanal					0
Gambie	artisanal	NA	NA	NA	NA	NA
		NA	NA	NA	NA	NA
		NA	NA	NA	NA	NA
		NA	NA	NA	NA	NA

Table/Tableau 4.6.1: Catch-at-age (thousands of individuals) of *Trachurus trachurus* (1990–2009) in the subregion
Capture par âge (milliers d'individus) de *Trachurus trachurus* (1990-2009) dans la sous-région

Age*/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
																		123936		76898
1	4	6484	53108	66916	1536	12098	15126	10646	326	1376	0	0	12	2600	8464	7551	10610	83414	26219	68842
2	4586	13185	28247	35600	107303	14031	30261	24820	94706	15260	1661	2761	1234	15928	494776	253340	188088	297826	418534	102233
3	22892	9050	15942	20089	111357	40680	32404	18779	134126	19154	4760	13933	14836	34786	308491	350470	328260	491275	238908	134411
4	48754	6983	5970	7534	8222	64130	33910	17397	79966	25152	15375	67957	26026	38726	161607	76289	188763	303117	66362	103459
5	17855	7626	5444	6796	584	51569	33737	38216	38008	29947	28735	59492	18538	29972	82263	41694	54488	81114	38254	115208
6	6014	3872	6198	7829	238	8145	15470	29132	28945	40700	31238	46787	20378	25957	33521	36823	25621	24077	27598	110876
7	3721	807	1967	2511	482	1459	3514	13619	26358	37394	31015	31598	15360	11925	8728	15638	12694	33973	15633	68505
8	38	9	252	295	369	1215	1159	1243	25607	61210	19660	7541	4267	6914	5138	5398	5714	69577	7579	10317
Catch (N)	105854	50008	119118	149562	232085	195322	167577	155849	430041	232193	134444	230069	100651	166808	1102990	789208	814239	1508309	1508309	790749
Catch (t)	33000	11949	20316	25590	33949	50421	38722	42943	78381	72256	55314	69949	31916	54604	169350	120810	92391	95581	105971	119565

NOTE: Age readings by Russian Federation only

Table/Tableau 4.6.2: Catch-at-age (thousands of individuals) of *Trachurus trecae* (1990–2009) in the subregion
Capture par âge (milliers d'individus) de *Trachurus trecae* (1990-2009) dans la sous-région

Age*/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
																		110318	**242590**	68302
1	38	12677	54654	44199	56387	3025	13503	2492	3616	1075	11672	4962	87	9846	64240	19694	346054	1611664	349490	267067
2	1313	54198	248592	188981	127537	10938	5974	29124	4175	12010	38323	161508	9895	11870	495572	172353	366131	1692360	370275	386735
3	41906	93601	85537	96421	64950	94808	8138	31855	24753	20126	74209	199627	136052	32852	246183	179968	408270	962663	382290	200781
4	60131	99139	45507	40423	27161	111123	14507	19509	24555	19473	71320	159871	130940	57701	233177	123763	283962	272460	271835	180754
5	41011	45512	44714	38346	25979	56587	32892	51305	3812	26416	102520	103886	79390	50233	94663	93817	145690	280119	235793	142871
6	14893	15279	21722	18504	12400	24002	113357	41444	1783	64113	107894	72646	55764	34346	25199	72455	35658	153909	127840	93724
7	1492	3692	7599	6611	4429	11916	65982	27841	1528	42040	55660	56142	34046	28750	5578	32996	4107	33879	54753	30716
8+	254	694	4210	4427	2952	7575	11228	11527	1769	26494	59365	48022	39578	47201	12744	33824	330	5597	12452	7543
Catch (N)	161037	324793	512535	437912	321795	319976	265581	215097	65992	211747	520963	806665	485752	272799	1177355	728871	1590201	5122970	2047318	1378493
Catch (t)	59040	99396	120130	105902	73291	121697	90619	72737	122720	84145	171906	210043	168339	100624	178951	190300	256698	307042	357510	346951

NOTE: Age readings by Russian Federation only

Table/Tableau 5.2.1: Catch (tonnes) of *Scomber japonicus* (1990–2009) by zone, fleet and year
Captures (en tonnes) de *Scomber japonicus* (1990-2009) par zone, flottille et année

Country/Zone	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Morocco Zone North	Moroccan	2474	829	1051	1181	1710	1678	887	2224	862	3353	5612	1911	5779
Morocco Zone A	Moroccan	21519	6145	8863	9948	34886	24762	10600	13712	5272	11034	23267	9347	7426
Morocco Zone B	Moroccan	2519	3618	3330	4510	384	910	4021	11761	4849	1401	4281	14361	9495
Northern Fishery		**26513**	**10592**	**13244**	**15639**	**36979**	**27351**	**15507**	**27697**	**10983**	**15788**	**33160**	**25619**	**22700**
Zone C, Cap Bojador to Cap Blanc	Moroccan								55	1				2
	Russian				4988	20970	27030	10975	50200	32290	30531	0	0	0
	Ukrainian and others				1824	11927	45661	55386	82015	115555	66601	90530	65186	0
	UE													
	Total				**6812**	**32897**	**72691**	**66361**	**132270**	**147846**	**97132**	**90530**	**65186**	**2**
Mauritania	EU													
	NON UE													
	Artisanal													
	Total	**20000**	**8235**	**20303**	**16578**	**19094**	**44730**	**98017**	**48464**	**41192**	**21470**	**65074**	**65662**	**104615**
Senegal	Industrial	17	88	431	1240	2189	1	3532	3534	3062	6461	51	13	27
	Artisanal	2482	843	1859	1376	1224	2296	1392	2234	1931	1348	2772	1936	8869
	Total	**2499**	**931**	**2290**	**2616**	**3413**	**2297**	**4924**	**5768**	**4993**	**7809**	**2823**	**1949**	**8896**
The Gambia	Industrial	235	281	7	46	34	0	46	116	20	125	98	107	125
	Artisanal	49	13	23	20	27	106	80	42	22	59	42	62	219
	Total	**284**	**294**	**30**	**66**	**61**	**106**	**126**	**158**	**42**	**184**	**140**	**169**	**344**
Southern Fishery		**22783**	**9460**	**22623**	**26072**	**55465**	**119824**	**169428**	**186660**	**194073**	**126595**	**158567**	**132966**	**113857**
Total Northern and Southern Fishery	**TOTAL N+S**	**49296**	**20052**	**35867**	**41711**	**92444**	**147175**	**184935**	**214357**	**205056**	**142383**	**191727**	**158585**	**136557**

Note: In Zone C North of Cap Blanc the boats are vessels operated under rental agreements or joint ventures (Russian Federation, Ukraine and others).

Table/Tableau 5.2.1 (cont.): Catches (tonnes) of *Scomber japonicus* (1990–2009) by zone, fleet and year/ Captures (en tonnes) de *Scomber japonicus* (1990-2009) par zone, flottille et année

Country/Zone	Fleet	2003	2004	2005	2006	2007	2008	2009**
Morocco Zone North	Moroccan	6039	7174	12369	11097	14604	10515	12886
Morocco Zone A	Moroccan	9487	44402	45359	16491	58691	36772	31866
Morocco Zone B	Moroccan	18940	4423	4174	40389	10509	24860	7323
Northern fishery		**34465**	**55999**	**61902**	**67977**	**83804**	**72146**	**52075**
Zone C, Cap Bojador to Cap Blanc	Moroccan	72	1826	21494	18276	22779	33792	44084
	Russian	0	57636	40343	66187	34156	35740	38469
	Ukrainian and others	0	6539	14312	16675	31984	40639	45220
	EU						15023	14328
	Total	**72**	**66002**	**76149**	**101138**	**88919**	**125194**	**142100**
Mauritania	EU	32168	8356	4645	7345	15202	11201	9905
	NON UE	101050	88210	33314	26101	64974	57036	34515
	Artisanal	0	0	1	0*	1	25	80
	Total	**133218**	**96566**	**37961**	**33446**	**80177**	**68262**	**44500**
Senegal	Industrial	0	1	71	0	0	116	39
	Artisanal	14173	3941	5781	3428	4383	2481	5083
	Total	**14173**	**3942**	**5852**	**3428**	**4383**	**2597**	**5122**
The Gambia	Industrial	187	148	120	121	53	30	32
	Artisanal	121	128	66	156	208	96	101
	Total	**308**	**276**	**186**	**277**	**261**	**126**	**133**
Southern fishery		**147771**	**166785**	**120148**	**138289**	**173740**	**196179**	**191856**
Total northern and southern fishery	**TOTAL N+S**	**182237**	**222784**	**182050**	**206266**	**257544**	**268325**	**243931**

* 1 824 tonnes were caught in Mauritania and declared in the landings of Senegal within the framework of the fishing agreements. The artisanal catch in 2007 of Senegal is estimated by the four last years.

** Preliminary

Note: In Zone C North of Cap Blanc the boats are vessels operated under rental agreements or joint ventures (Russian Federation, Ukraine and others).

Table/Tableau 5.3.1: CPUE of *Scomber japonicus*, catch (tonnes) and effort (fishing days) standardized to units of RTMS (Russian Federation and Ukraine)
CPUE de *Scomber japonicus*, capture (en tonnes) et effort (jours de pêche) standardisés aux unités de RTMS (Russie et Ukraine)

Year	Catch (tonnes)			Standardized effort (fishing days)			CPUE (tonnes/ RTMS day)
	South	North	Total	South	North	Total	
1992	22623	13244	35867	425	249	674	53.2
1993	26072	15639	41711	447	268	715	58.3
1994	55465	36979	92444	1098	732	1831	50.5
1995	119824	27351	147175	2278	520	2798	52.6
1996	169428	15507	184935	3246	297	3543	52.2
1997	186022	27697	213719	3812	568	4379	48.8
1998	194073	10983	205056	4120	233	4354	47.1
1999	126595	15788	142383	3007	375	3382	42.1
2000	158116	33160	191276	3188	669	3856	49.6
2001	132910	25619	158529	2352	453	2806	56.5
2002	113857	22700	136557	2797	558	3355	40.7
2003	147771	34465	182237	3151	735	3886	46.9
2004	166785	55999	222784	3317	1114	4431	50.3
2005	120148	61902	182050	2888	1488	4376	41.6
2006	138289	67977	201658	3381	1662	4931	40.9
2007	176594	83804	260398	4297	2039	6336	41.1
2008	190695	72146	262841	4040	1529	5569	47.2
2009	191856	52075	243931	3868	1050	4918	49.6

Table/Tableau 5.4.1: Sampling intensity of *Scomber japonicus* (2009) by country (zone) and fleet
Intensité d'échantillonnage de *Scomber japonicus* (2009) par pays (zone) et flottille

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
country x	fleet y	total catch in tonnes				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone North	Moroccan					
Morocco Zone A	Moroccan	**4987**	**10748**	**12532**	**3599**	**31866**
		13	50	77	23	163
		815	3244	6269	1152	11480
		80	161	220	100	561
Morocco Zone B	Moroccan	**546**	**2344**	**3712**	**722**	**7323**
		0	4	5	3	12
		0	0	62	158	220
		0	0	0	0	0
Zone C	Moroccan	**9353**	**5899**	**23190**	**10230**	**48672**
		1	5	7	4	17
		18	196	344	182	740
		0	0	20	20	40
North of C. Blanc	Russian*	**8810**	**4170**	**9367**	**10037**	**32384**
		0	0	0	0	0
		0	0	0	0	0
		0	0	164	441	605
	Ukrainian and others					**45220**
Mauritania	EU (IMROP sampling)	**78**	**283**	**66**	**612**	**1039**
		0	0	5	30	35
		0	0	43	534	577
		0	0	0	0	0
	Russian, Ukranian and others (IMROP sampling)	**11221**	**16621**	**5151**	**11725**	**44718**
		0	86	0	0	86
		0	4829	0	0	4829
		0	0	0	0	0
	Artisanal	**2**	**0**	**0**	**78**	**80**
Senegal	industrial					
						0
						0
						0
	artisanal	**2443**	**1507**	**8**	**1125**	**5038**
		7	5	2	8	22
		670	867	58	919	2514
						0
The Gambia	industrial					**32**
	artisanal					**101**

Table/Tableau 5.6.3a: Catch-at-age (thousands of individuals) of *Scomber japonicus* (1993–2009)
Capture par âge (milliers d'individus) de *Scomber japonicus* (1993-2009)

Catch at age northern fishery

Years/age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	261	1463	110	88	62610	37	12152	71	2958	41	134681	172	17591	985974	283295	321285	30340
1	548	16048	23752	9202	17556	20443	58920	13565	36671	76482	108040	396062	464539	172745	555521	332336	118696
2	2867	16854	30898	49999	18056	27984	47172	54090	22756	20362	36925	68406	156846	192038	134880	276483	327944
3	4228	17428	17596	25258	7262	11561	7238	42175	34080	24875	43854	27828	25584	45208	11291	26548	32741
4	2526	21556	13093	7017	6817	6161	3283	15927	11714	12423	9737	10841	22394	3717	1478	1746	6712
5	2615	16079	7970	1735	7307	1509	906	1988	1610	2643	7335	1814	6857	241	18	116	131
6+	11654	18640	9813	261	21812	496	341	429	601	611	3029	183	542	27	3	21	11

Catch at age southern fishery

Years/age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0												14	2828	48580	60034	342712	7209
1	4498	35055	46550	17925	31292	20329	92849	2308	34078	23922	360111	86010	26975	246942	251289	518369	225579
2	13590	129184	99270	180866	94725	113192	49287	40097	24917	203398	347178	356013	56844	160077	221902	816428	679840
3	19296	79351	97803	167190	71091	140459	48866	125987	160809	99517	122761	148921	123936	191236	177324	311983	233870
4	9453	17871	103182	102857	124697	151813	70084	82484	74060	57191	54356	55508	101899	122681	121831	100892	48439
5	4115	6065	51575	92490	101892	100758	64717	16667	20819	26989	22823	33517	80169	86385	36092	40935	21783
6+	9194	5944	22260	40602	83725	48929	52657	61975	36486	30255	6049	37690	41780	47617	8744	12053	8044

Catch at age total (northern + southern) fishery

Years/age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	261	1463	110	88	62610	37	12152	71	2958	41	134681	186	20419	1034554	343329	663996	37549
1	5046	51103	70302	27127	48848	40772	151769	15873	70749	100404	468151	482072	491514	419686	806810	850706	344275
2	16457	146038	130168	230865	112781	141176	96459	94187	47673	223760	384103	424419	213690	352114	356782	1092911	1007784
3	23524	96779	115399	192448	78353	152020	56104	168162	194889	124392	166615	176749	149519	236444	188615	338531	266611
4	11979	39427	116275	109874	131514	157974	73367	98411	85774	69614	64093	66349	124293	126398	123309	102638	55151
5	6730	22144	59545	94225	109199	102267	65623	18655	22429	29632	30158	35331	87026	86627	36110	41051	21915
6+	20848	24584	32073	40863	105537	49425	52998	62404	37087	30866	9078	37873	42322	47644	8748	12074	8055

Age-length key from Russian Federation only

Table/Tableau 5.6.3b: Mean weight-at-age (kg) of *Scomber japonicus* (1992–2009) for the southern stock
Poids moyen par classe d'âge (kg) de *Scomber japonicus* (1992-2009) pour le stock sud

Years/age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
0	0.117	0.117	0.061	0.057	0.048	0.052	0.060	0.049	0.108	0.119	0.084	0.071	0.086	0.076	0.064	0.071		
1	0.213	0.213	0.152	0.128	0.121	0.133	0.136	0.188	0.183	0.211	0.162	0.162	0.141	0.119	0.096	0.101	0.071	0.092
2	0.348	0.348	0.253	0.227	0.219	0.213	0.228	0.269	0.307	0.278	0.280	0.266	0.227	0.201	0.132	0.179	0.099	0.108
3	0.511	0.511	0.364	0.353	0.339	0.335	0.341	0.390	0.436	0.450	0.361	0.371	0.410	0.268	0.207	0.263	0.164	0.177
4	0.728	0.728	0.515	0.503	0.498	0.498	0.493	0.529	0.574	0.603	0.427	0.452	0.643	0.382	0.315	0.407	0.261	0.345
5	0.961	0.883	0.687	0.914	0.719	0.768	0.894	0.745	1.075	0.910	0.624	0.541	0.864	0.556	0.480	0.541	0.347	0.687
6+	0.117	0.117	0.061	0.057	0.048	0.052	0.060	0.049	0.108	0.119	0.084	0.071	0.086	0.076	0.064	0.071	0.830	0.850

Table/Tableau 5.6.5a: Chub mackerel. Total stock (northern and southern fishery), fishing mortalities per year and age, as estimated in ICA final run Maquereau. Stock total (pêcheries nord et sud), mortalités totales par année et par âge, selon les estimations dans l'application finale ICA

Fishing mortalities (north + south) ICA

Years/age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.005	0.001	0.02	0.03	0.02	0.04	0.03	0.09	0.01	0.02	0.03	0.19	0.18	0.16	0.07	0.08	0.07	0.032
2	0.009	0.008	0.06	0.08	0.16	0.17	0.21	0.11	0.10	0.06	0.14	0.24	0.37	0.15	0.31	0.34	0.30	0.135
3	0.042	0.023	0.08	0.09	0.22	0.10	0.50	0.17	0.38	0.45	0.30	0.20	0.23	0.30	0.42	0.47	0.42	0.187
4	0.040	0.038	0.07	0.18	0.16	0.32	0.44	0.72	0.72	0.49	0.41	0.35	0.15	0.35	0.58	0.64	0.58	0.254
5	0.048	0.035	0.12	0.19	0.31	0.32	0.63	0.48	0.60	0.51	0.45	0.45	0.49	0.44	0.72	0.81	0.72	0.317

Table/Tableau 5.6.5b: Chub mackerel. Total stock (northern and southern fishery) residuals per year and age as estimated in ICA final run Maquereau. Stock total (pêcheries nord et sud), résidus par année et par âge, selon les estimations dans l'application finale ICA

Residuals (north + south) ICA

Years/age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	-0.47	-1.82	-0.14	-0.12	-0.57	-0.21	-0.63	0.89	-1.30	-0.25	-0.10	1.68	1.29	1.22	0.75	0.43	-0.27	-0.39
2	-0.99	-1.17	-0.07	-0.28	0.23	0.04	0.28	-0.16	-0.32	-0.55	0.11	0.72	0.84	-0.05	0.40	0.37	0.33	0.28
3	-0.02	-0.69	-0.36	-0.71	-0.04	-1.00	0.62	-0.27	0.45	0.94	0.35	-0.05	-0.21	0.09	0.26	0.56	0.49	-0.45
4	-0.37	-0.49	-0.86	-0.26	-0.67	-0.16	0.19	0.95	0.82	0.74	0.37	0.26	-0.91	-0.05	0.55	0.43	0.38	-0.93
5	-0.39	-0.76	-0.44	-0.44	-0.16	-0.35	0.37	0.32	0.42	0.57	0.26	0.30	0.06	-0.03	0.40	0.20	0.26	-0.60

Table/Tableau 5.6.5c: Chub mackerel. Total stock (northern and southern fishery) fishing mortalities per year and age, as estimated in XSA final run Maquereau. Stock total (pêcheries nord et sud), mortalités totales par année et par âge, selon les estimations dans l'application finale XSA

Fishing mortalities (north + south) XSA

Years/age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.003	0.001	0.01	0.02	0.02	0.03	0.02	0.06	0.01	0.02	0.02	0.16	0.15	0.15	0.12	0.11	0.04	0.10
2	0.007	0.005	0.05	0.05	0.11	0.12	0.14	0.07	0.07	0.04	0.11	0.17	0.29	0.13	0.21	0.31	0.34	0.23
3	0.024	0.016	0.05	0.06	0.14	0.07	0.34	0.10	0.24	0.27	0.19	0.15	0.15	0.22	0.29	0.50	0.69	0.25
4	0.026	0.021	0.05	0.11	0.11	0.18	0.27	0.39	0.38	0.26	0.20	0.20	0.11	0.21	0.42	0.46	0.56	0.22
5	0.027	0.023	0.07	0.13	0.17	0.21	0.30	0.24	0.23	0.19	0.18	0.17	0.22	0.29	0.31	0.31	0.37	0.21

Table/Tableau 5.6.5d: Chub mackerel. Total stock (northern and southern fishery) residuals per year and age as estimated in XSA final run Maquereau. Stock total (pêcheries Nord et Sud), résidus par année et par âge, selon les estimations dans l'application finale XSA

Residuals (North+South) XSA

Years/age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	-0.83	-1.64	-0.52	-0.42	-0.4	-0.27	-0.63	0.32	-1.03	-0.45	-0.44	0.9	0.65	0.64	0.44	0.17	-0.58	0.31
2	-1.29	-1.57	-0.34	-0.64	-0.11	-0.24	-0.1	-0.52	-0.72	-0.91	-0.12	0.38	0.61	-0.19	0.29	0.51	0.57	0.34
3	-0.43	-0.86	-0.64	-0.87	-0.33	-1.24	0.36	-0.59	0.13	0.55	0.05	-0.18	-0.49	-0.09	0.16	0.54	0.85	-0.02
4	-0.34	-0.62	-0.76	-0.3	-0.57	-0.26	0.12	0.74	0.57	0.52	0.08	0.12	-0.79	-0.15	0.53	0.46	0.65	-0.11
5	-0.32	-0.54	-0.41	-0.19	-0.1	-0.14	0.23	0.24	0.07	0.21	0	-0.03	-0.09	0.18	0.22	0.06	0.23	-0.17

Table/Tableau 6.2.1 Catches (tonnes) of *Engraulis encrasicolus* (1990–2009) by zone, fleet and year
Captures (en tonnes) d'*Engraulis encrasicolus* (1990-2009) par zone, flottille et année

Country	**Fleet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Morocco Zone North	Moroccan													
Morocco Zone North	Spanish													
Morocco Zone A	Moroccan													
Morocco Zone B	Moroccan													
Zone C, north of C. Blanc	Moroccan													
Zone C, north of C. Blanc	Russian													
Zone C, north of C. Blanc	Ukrainian and others													
Zone C, north of C. Blanc	European Union													
Total Morocco	**all**	**10324**	**19125**	**16635**	**10310**	**7516**	**10257**	**12039**	**24697**	**40403**	**30373**	**22096**	**47417**	**18473**
Mauritania	Russian, Ukrainian and others													
	Lithuania, Latvia, Estonia and Poland													
Total Mauritania	**all**		**8279**	**17358**	**6489**	**2612**	**986**	**3609**	**34511**	**79162**	**93164**	**104090**	**105350**	**136232**
Senegal	industrial													
	artisanal													
The Gambia	industrial													
	artisanal													
TOTAL	**all fleets**	**10324**	**27404**	**33993**	**16799**	**10128**	**11243**	**15648**	**59208**	**119565**	**123537**	**126186**	**152767**	**154705**

Table/Tableau 6.2.1 (cont.): Catches (tonnes) of *Engraulis encrasicolus* (1990–2009) by zone, fleet and year
Captures (en tonnes) d'*Engraulis encrasicolus* (1990-2009) par zone, flottille et année

Country	**Fleet**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Morocco Zone North	Moroccan		1561	1837	1440	3212	3175	3137
Morocco Zone North	Spanish					928	1008	775
Morocco Zone A	Moroccan		5380	2393	1407	6158	5364	5367
Morocco Zone B	Moroccan		126	1538	6828	8601	10237	7125
Zone C, north of C. Blanc	Moroccan			305	362	0	0	1
Zone C, north of C. Blanc	Russian						27	780
Zone C, north of C. Blanc	Ukrainian and others							3
Zone C, north of C. Blanc	European Union							7
Total Morocco	**all**	**17000**	**7068**	**6073**	**10037**	**18899**	**19811**	**17185**
Mauritania	Russian, Ukrainian and others		104934	51589	74691	86538	71078	74215
	Lithuania, Latvia, Estonia and Poland		31843	26501	35249	34258	31222	24233
Total Mauritania	**all**	**162854**	**136777**	**78090**	**109940**	**120796**	**102300**	**98448**
Senegal	industrial							
	artisanal							
The Gambia	industrial							
	artisanal							
TOTAL	**all fleets**	**179854**	**143845**	**84163**	**119977**	**139695**	**122111**	**115633**

Table/Tableau 6.4.1: Sampling intensity of *Engraulis encrasicolus* (2009) by country (zone) and fleet
Intensité d'échantillonnage d'*Engraulus encrasicolus* (2009) par pays (zone) et flottille

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
country x	**fleet y**	**total catch in tonnes**				
		number of samples				
		number of fish measured				
		number of fish aged				
Morocco Zone North	Moroccan					
	Spanish	**0**	**557**	**215**	**3**	**775**
		0	4	3	2	**9**
		0	338	216	187	**741**
		0	0	0	0	**0**
Morocco Zone A	**Moroccan**	**773**	**2818**	**1368**	**408**	**5367**
		1	24	40	12	**77**
		3423	3572	5893	2455	**15343**
		78	119	120	30	**347**
Morocco Zone B	**Moroccan**	**936**	**5320**	**868**	**0**	**7125**
		6	6	0	0	**12**
		945	913	0	0	**1858**
		0	30	0	0	**30**
Zone C, north of C. Blanc	Moroccan	NO SAMPLING				
	Russian	NO SAMPLING				
	Ukrainian and others	NO SAMPLING				
Mauritania	EU	0	0	0	0	**0**
		0	0	0	0	**0**
		0	0	0	0	**0**
		0	0	0	0	**0**
	Russian, Ukrainian and others	**31723**	**24250**	**20784**	**21690**	**98447**
		0	0	0	0	**0**
		0	0	0	0	**0**
		0	0	0	0	**0**
	others	NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
	artisanal	NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
Senegal	industrial	NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
	artisanal	NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				
		NO SAMPLING				

Table/Tableau 6.3.1a: Biomass estimate of *Engraulis encrasicolus* in the period 2003–2009 south of Cap Blanc by R/V AL AWAM
Estimations de la biomass d'*Engraulis encrasicolus* en 2009 au sud du cap Blanc par le N/R AL AWAM

Campagne	Cap Timiris–Cap Blanc	Saint.Louis–Cap Timiris	Total
Jun-03	333122	-	333122
Dec-03	53789	9754	63544
Apr-04	248996	79495	328490
Nov-04	16160	0	16160
Mar-05	5969	1727	7695
Nov-05	44842	0	44842
Mar-06	27536	483	28019
Nov-07	18888	0	18888
Mar-08	21000	7000	28000
Nov-08	24000	0	24000
Nov-09	500	0	500

Table/Tableau 6.5.1: Length frequency of *Engraulis encrasicolus* in 2009 for Morocco and Mauritania by R/V AL AMIR and AL AWAM
Fréquence de taille d'*Engraulis encrasicolus* en 2009 au Maroc et en Mauritanie – N/R AL AMIR et AL AWAM

Autumn 2009				
	R/V AMIR	R/V AMIR	R/V AMIR	R/V AWAN
Length (TL cm)	Zone A	Zone B	Zone C - N Cape Blanc	Zone C - S Cape Blanc
4				55
5				197
6				50
7	30	1	26	
8	50	14	186	
9	255	83	112	
10	522	435	18	
11	920	825	2	
12	493	1293		
13	173	963		
14	32	762		
15	32	176		
16	5	23		
17				
18				

Table/Tableau 7.2.1: Catches (tonnes) of *Ethmalosa fimbriata* (1990–2009) by zone, fleet and year
Captures (tonnes) d'*Ethmalosa fimbriata* (1990-2009) par zone, flottille et année

Country	Fleet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Morocco Zone North	Moroccan										
Morocco Zone A	Moroccan										
Morocco Zone B	Moroccan										
Zone C, north of C. Blanc	Moroccan										
	Russian										
	Ukrainian and others										
Mauritania	EU industrial										
	Other industrial										
	Artisanal					50	52	49	120	185	161
Senegal	Industrial										
	Artisanal	14785	11542	12164	17332	13504	15686	17462	16423	13833	20540
The Gambia	Industrial										
	Artisanal	8039	17646	12019	14053	16897	13897	22648	21523	21952	16115
TOTAL	**All fleets**	**22824**	**29188**	**24183**	**31385**	**30451**	**29635**	**40159**	**38066**	**35970**	**36816**

Country	Fleet	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Morocco Zone North	Moroccan										
Morocco Zone A	Moroccan										
Morocco Zone B	Moroccan										
Zone C, north of C. Blanc	Moroccan										
	Russian										
	Ukrainian and others										
Mauritania	EU industrial										
	Other industrial										
	Artisanal	4026	6378	12899	8298	1680	4545	4545	633	2	3041
Senegal	Industrial										
	Artisanal	15227	24471	11828	13095	9792	8731	5675	9225		
The Gambia	Industrial									9000	5727
	Artisanal	20508	18516	18701	22118	16052	19881	13187	13247		
TOTAL	**All fleets**	**39761**	**49365**	**43428**	**43511**	**27524**	**33157**	**23407**	**23105**	**11744**	**11868**

*Preliminary

Table/Tableau 7.2.2a: Effort data by trips and CPUE (tonnes/trip) in Senegal
Données d'effort en nombre de sorties et CPUE (tonnes/sortie) au Sénégal

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Senegal (tonnes)	14785	11542	12164	17332	13504	15686	17462	16423	13833	20540
Effort (N° of trips) (FME)	40012	42298	46383	45298	35629	32441	45138	87157	77844	76810
CPUE*1000	369.52	272.87	262.25	382.62	379.01	483.51	386.85	188.43	177.70	267.41
CPUE	0.37	0.27	0.26	0.38	0.38	0.48	0.39	0.19	0.18	0.27

	2000	2001	2002	2003	2004	2005	2006	2007
Senegal (tonnes)	15227	24471	11828	13095	9792	8731	5675	7203
Effort (N° of trips) (FME)	82187	91684	92339	97315	75439	81461	76303	84571
CPUE*1000	185.27	266.91	128.09	134.56	129.80	107.18	74.37	85.17
CPUE	0.19	0.27	0.13	0.13	0.13	0.11	0.07	0.09

Table/Tableau 7.2.2b: CPUE (tonnes/trips) of *Ethmalosa fimbriata* (1990–2009) of Senegalese and Gambians surrounding gillnets
CPUE (tonnes/sorties) d´*Ethmalosa fimbriata* (1990-2009) des filets maillants (FME) tournant sénégalais et gambiens (SGN)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Effort Senegal (N° of trips) (FME)	22283	18547	22671	18197	13645	15697	27434	35953	22401	22040
Effort Gambia (N° of trips) (SGN)										
Total effort (N° of trips) FME	22283	18547	22671	18197	13645	15697	27434	35953	22401	22040
CPUE*1000	1024	1574	1067	1725	2228	1885	1462	1055	1597	1663
CPUE Senegal	1.02	1.57	1.07	1.72	2.23	1.88	1.46	1.06	1.60	1.66
CPUE Gambia										

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Effort Senegal (N° of trips) (FME)	20618	24418	19543	22091	19427	23317	22988	21483	19604	17650
Effort Gambia (N° of trips) (SGN)							25504	31156	19882	20365
Total effort (N° of trips) FME	20618	24418	19543	22091	19427	23317	48492	52639	39486	38015
CPUE*1000	1733	1760	1562	1594	1330	1227	821	1046	1058	1037
CPUE Senegal	1.73	1.76	1.56	1.59	1.33	1.23	0.82	1.05	1.06	1.04
CPUE Gambia							0.74	0.72	1.04	0.90

Table/Tableau 7.4.1: Sampling intensity of *Ethmalosa fimbriata* in 2009
Intensité d'échantillonnage d'*Ethmalosa fimbriata* en 2009

Country	**Fleet**	**Q1**	**Q2**	**Q3**	**Q4**	**2009**
country x	fleet y	total catch in tonnes				
		number of samples				
		number of fish measured				
		number of fish aged				
Mauritania	EU					
	Russian					
	Ukrainian and others					
	artisanal					
						0
						0
						0
Senegal	industrial					
	artisanal	**997**	**3482**	**997**	**251**	**5727**
		2	6	7	4	19
		71	394	271	229	965
						0
The Gambia	industrial					0
						0
						0
						0
	artisanal	**2365**	**4006**	**4222**	**1275**	**2366**
		0	25	30	30	85
			4023	4799	3007	11829

FIGURES

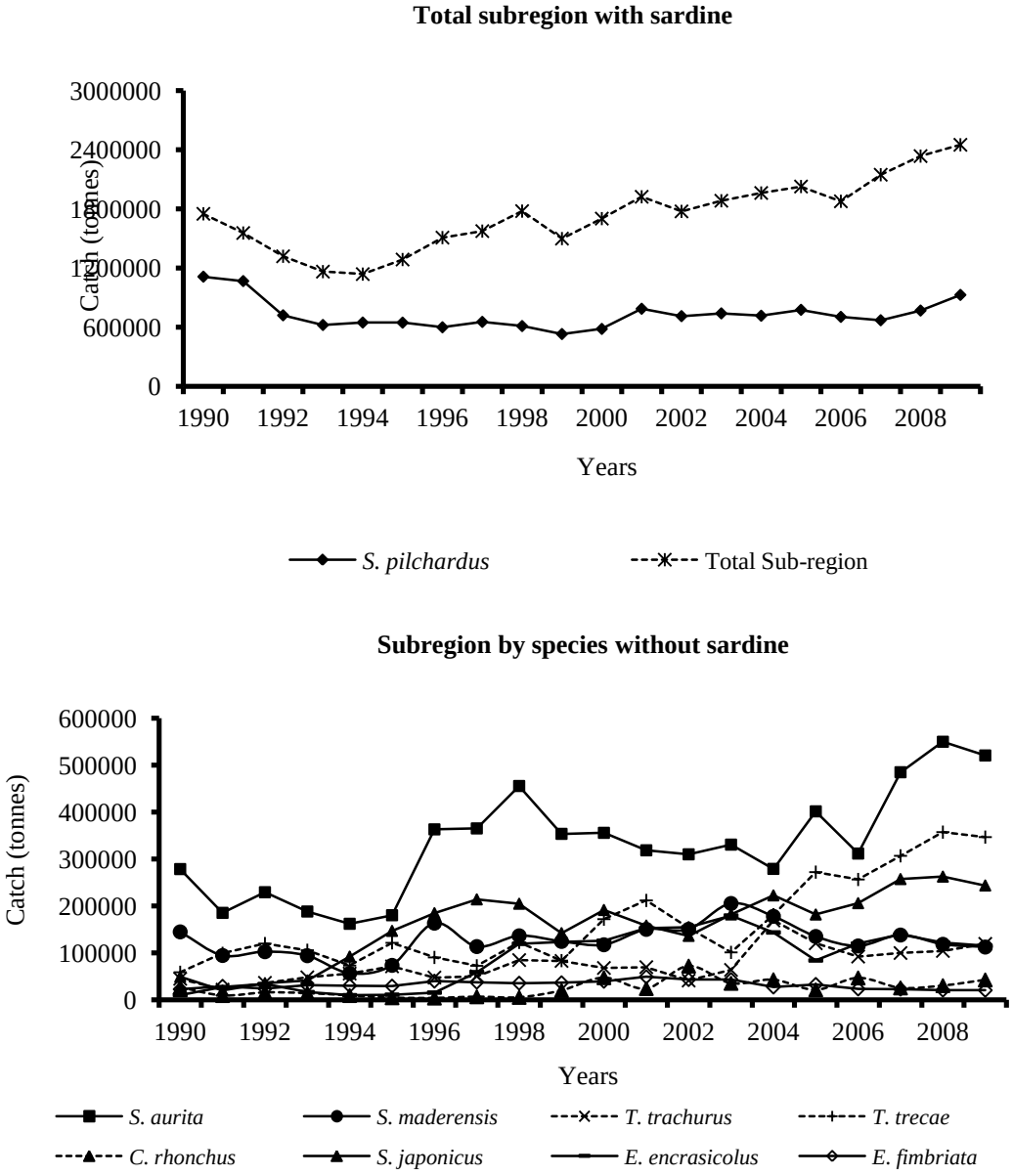


Figure 1.6.1a: Catches (1990–2009) in the subregion by species and year (weight in tonnes)/ Captures totales (1990-2009) dans la sous-région par espèce et par année (poids en tonnes)

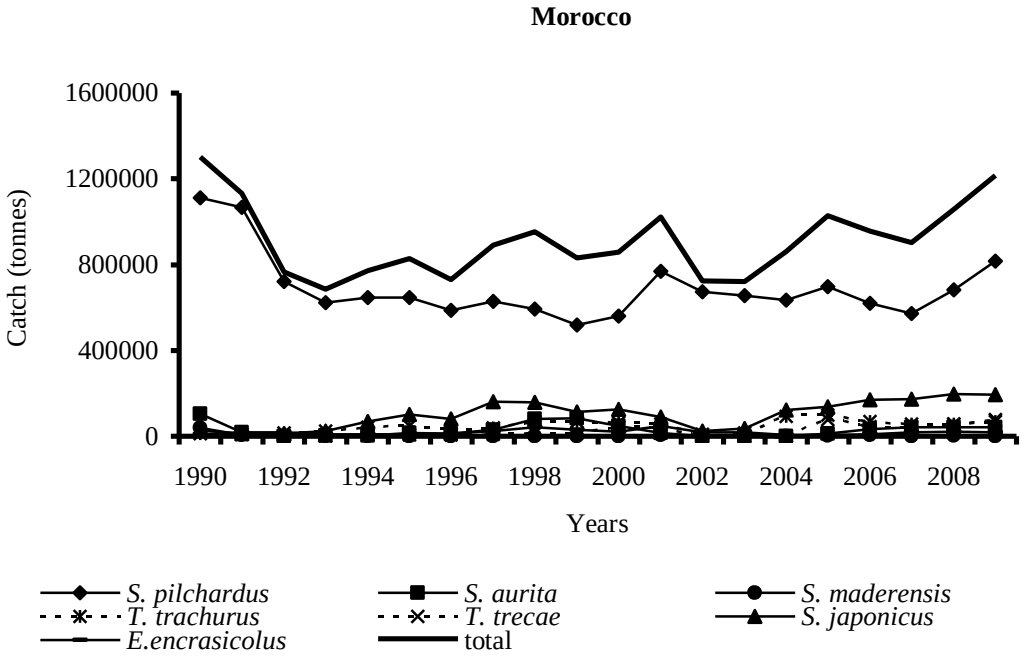


Figure 1.6.1b: Catches (1990–2009) in Morocco by species and year (weight in tonnes)/ Captures (1990-2009) au Maroc par espèce et par année (poids en tonnes)

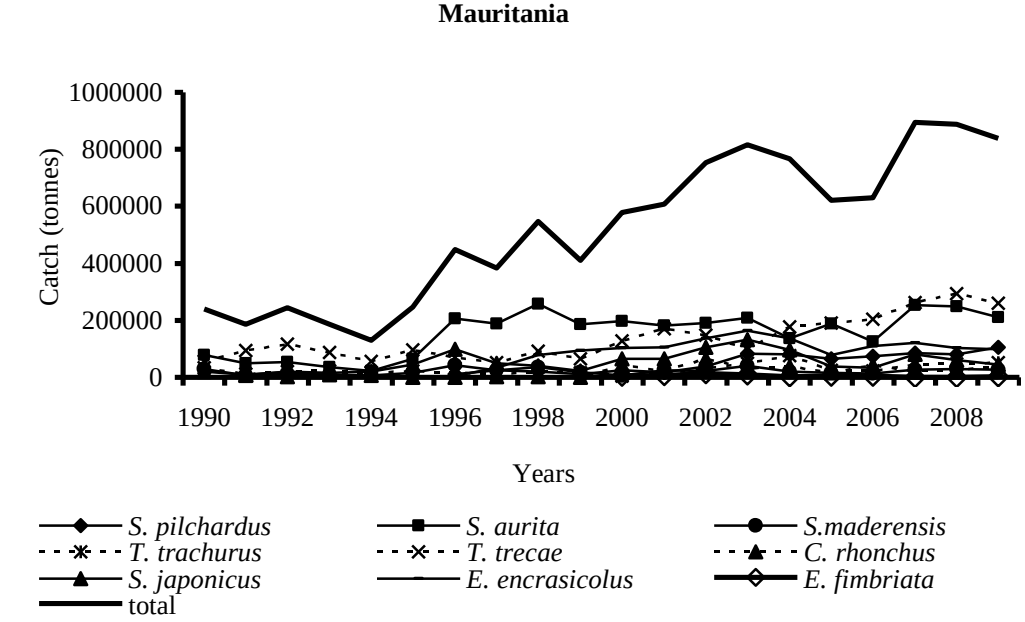


Figure 1.6.1c: Catches (1990–2009) in Mauritania by species and year (weight in tonnes)/ Captures (1990-2009) en Mauritanie par espèce et par année (poids en tonnes)

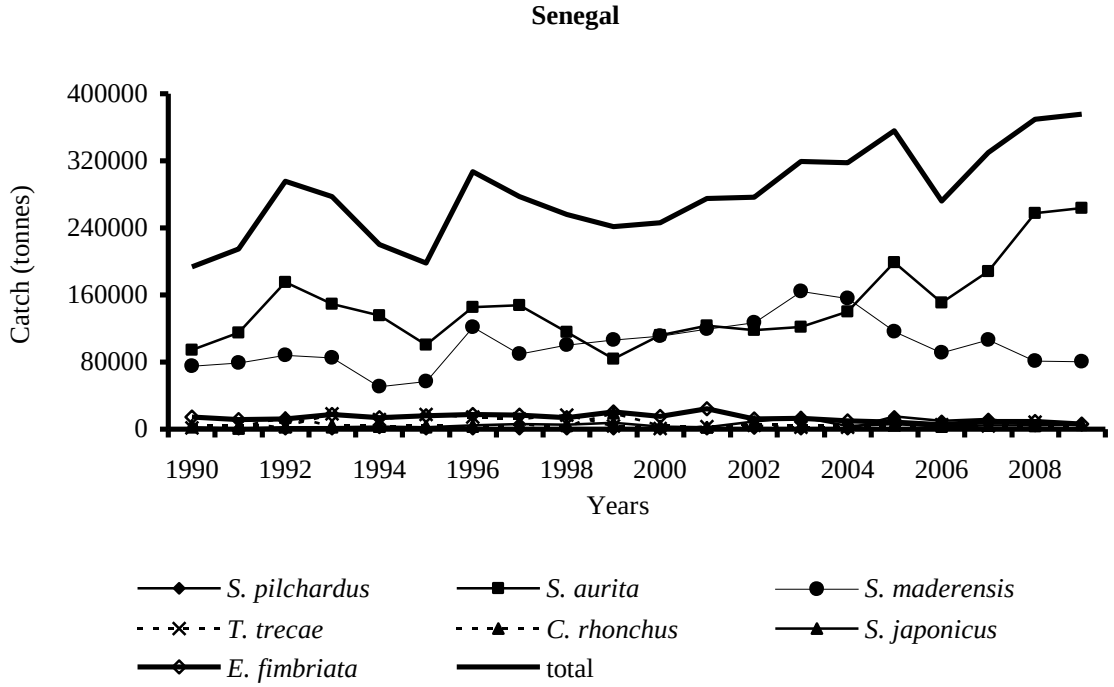


Figure 1.6.1d: Catches (1990–2009) in Senegal by species and year (weight in tonnes)/ Captures (1990-2009) au Sénégal par espèce et par année (poids en tonnes)

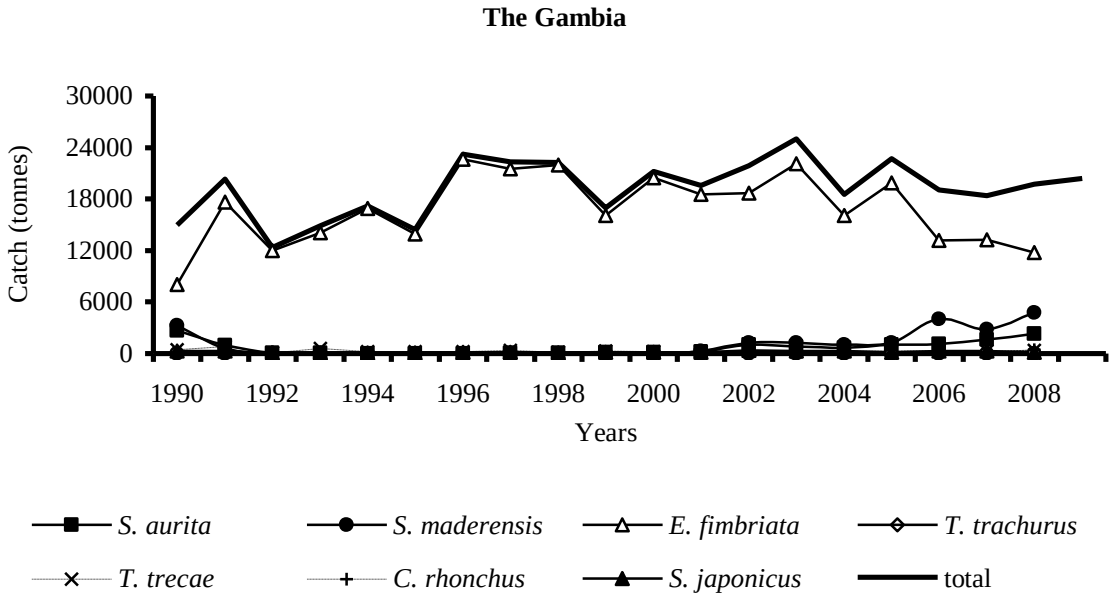


Figure 1.6.1e: Catches (1990–2009) in Gambia by species and year (weight in tonnes)/ Captures (1990-2009) en Gambie par espèce et par année (poids en tonnes)

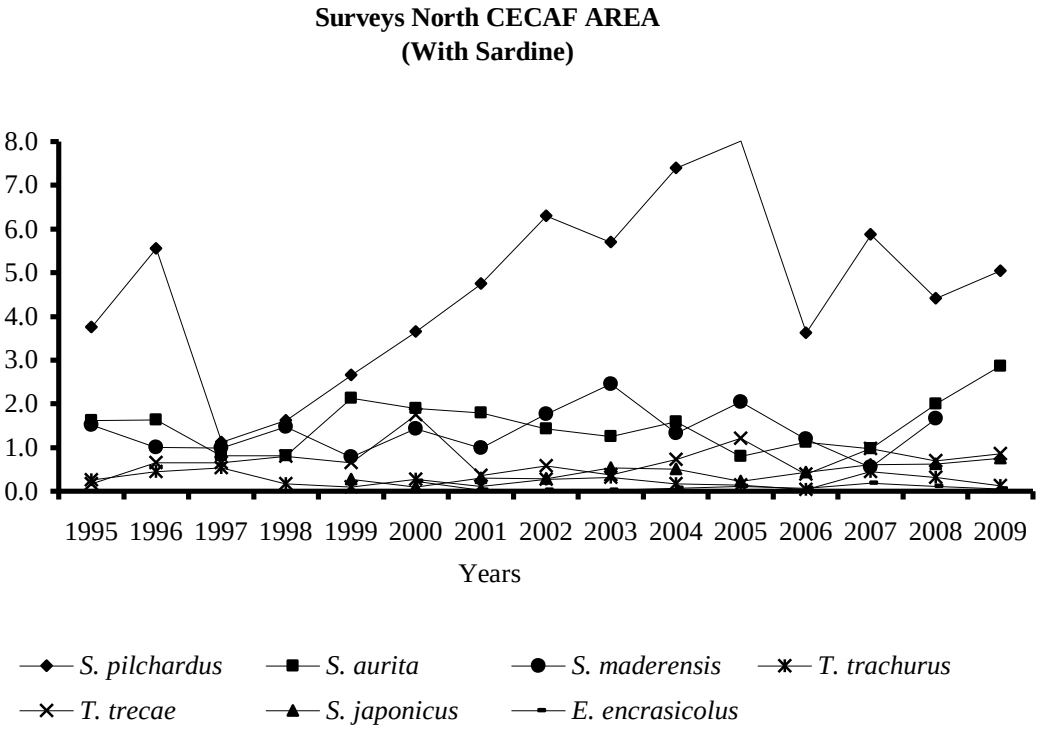


Figure 1.7.1a: Evolution of biomass in million tonnes for the period 1995–2009/ Évolution de la biomasse en millions de tonnes pendant la période 1995-2009
Note: 1995–2006 R/V F. NANSEN; 20072008 R/Vs AL AMIR, AL AWAM and ITAF DEME in NANSEN equivalents; 2009 R/Vs AL AMIR and AL AWAM in NANSEN equivalents

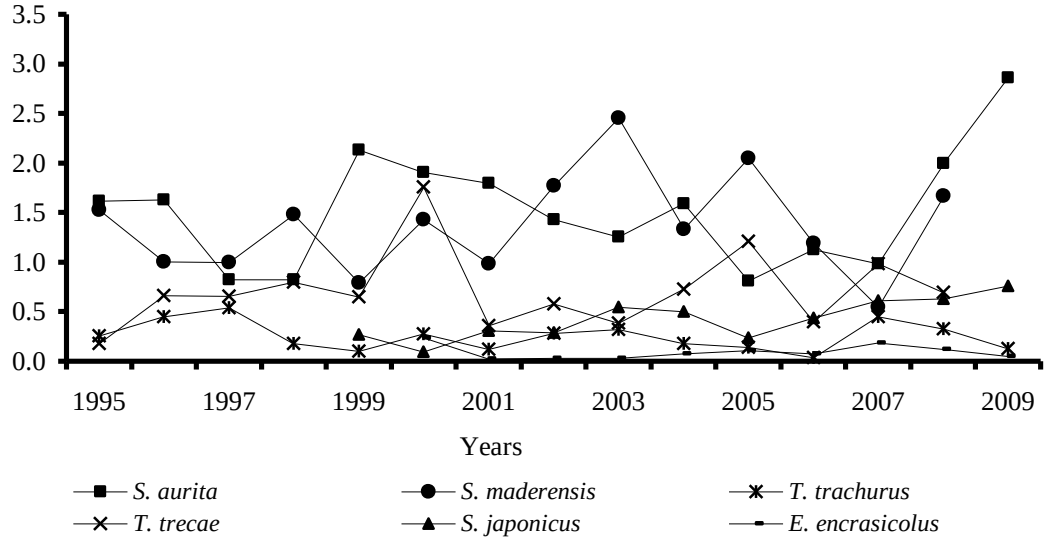


Figure 1.7.1b: Evolution of biomass of small pelagics without sardine in million tonnes in the period 1995–2008/Évolution de la biomasse de petits pélagiques sans sardine en millions de tonnes pendant la période 1995-2008
Note: 1995–2006 R/V F. NANSEN ; 2007–2008 R/Vs AL AMIR, AL AWAM and ITAF DEME in NANSEN equivalents; 2009 R/Vs AL AMIR and AL AWAM in NANSEN equivalents

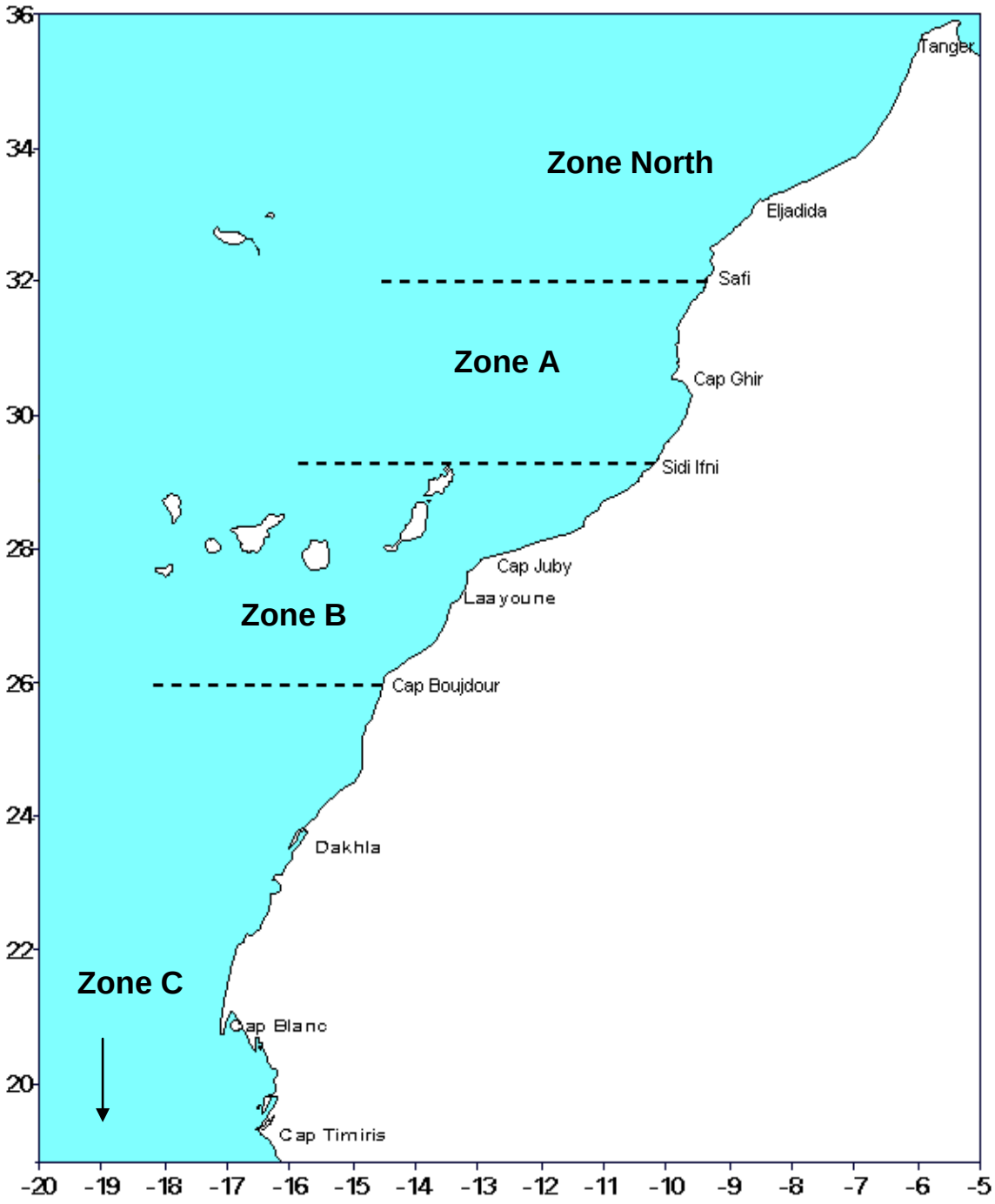


Figure 2.1.1: Stock units and sardine fisheries/
Unités de stock et pêcheries de sardine

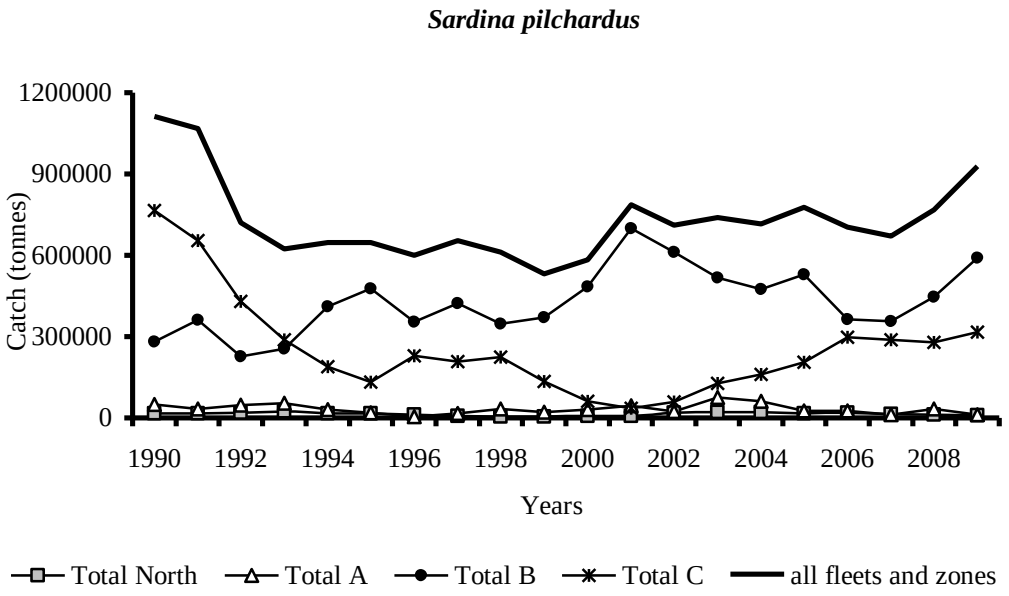


Figure 2.2.1a: Catches (1990–2009) of *Sardina pilchardus* by zone and year (weight in tonnes)/
Captures (1990-2009) de *Sardina pilchardus* par zone et année (poids en tonnes)

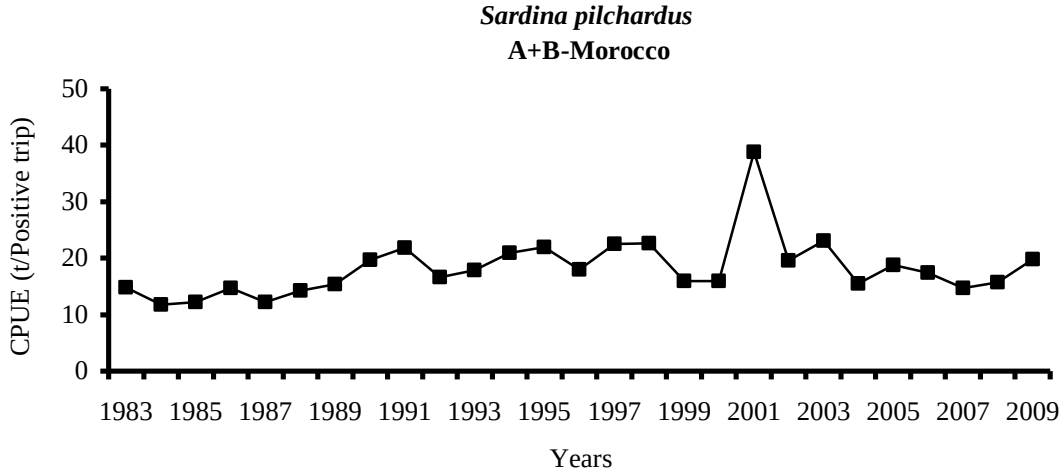


Figure 2.3.1a: CPUE of *Sardina pilchardus* (1983–2009) in Zone A+B (Morocco tonnes/positive trips)/
CPUE de *Sardina pilchardus* (1983-2009) dans la Zone A+B (Maroc tonnes/sorties positives)

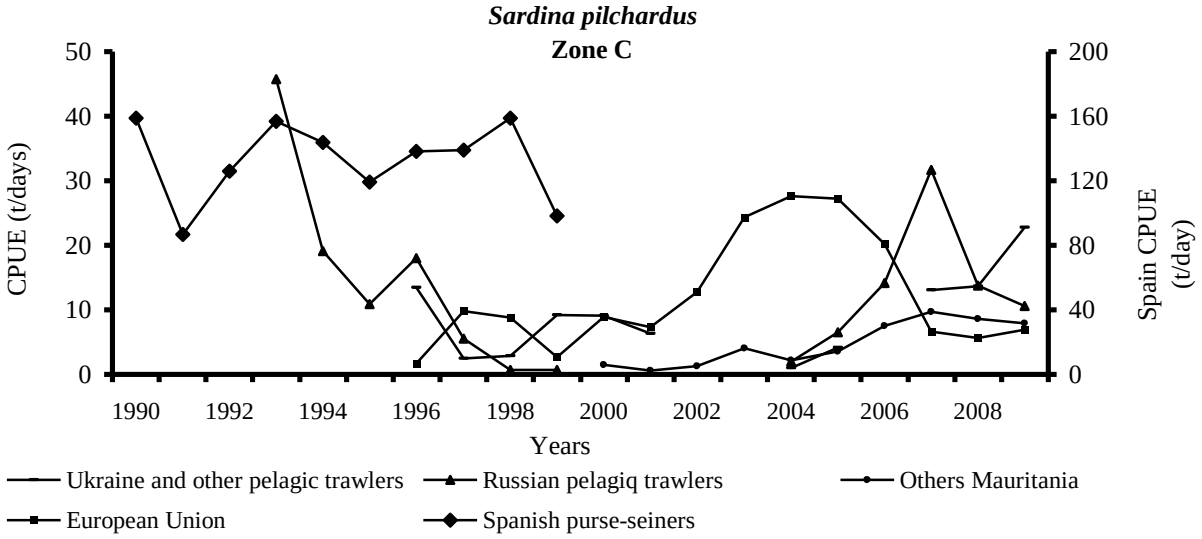


Figure 2.3.1b: CPUE of *Sardina pilchardus* (1992–2009) by fishery in Zone C (tonnes/fishing days)/
CPUE de *Sardina pilchardus* (1992-2009) par pêcherie dans la Zone C (tonnes/jours de pêche)

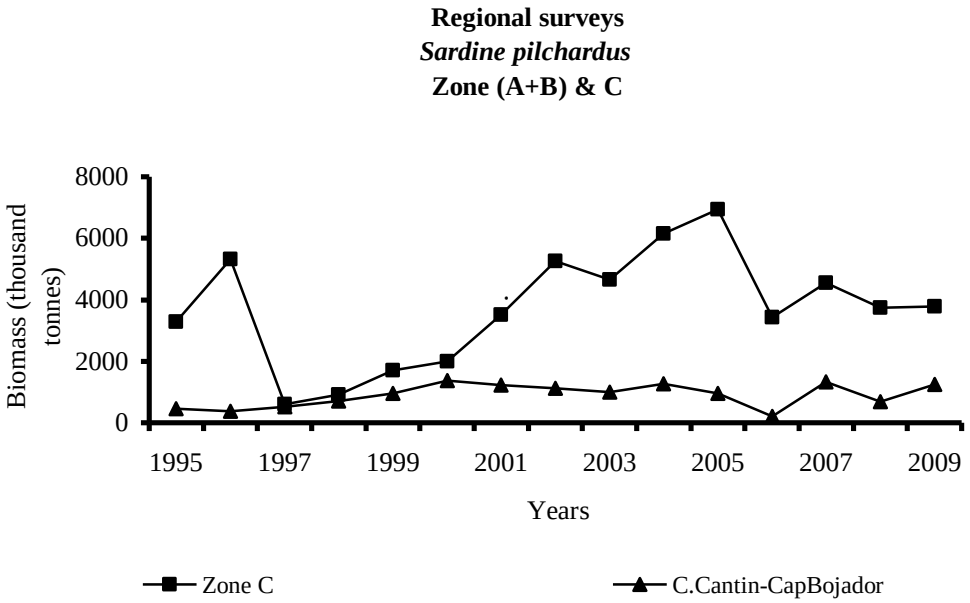


Figure 2.3.2a: Biomass estimates of sardine (1995–2009) for Zones A+B and C from R/V DR. FRIDTJOF NANSEN and regional research vessels (in thousand tonnes)/
Estimations de la biomasse de sardine (1995-2009) dans les Zones A+B et C du N/R DR. FRIDTJOF NANSEN et navires de recherche régionaux (en milliers de tonnes)

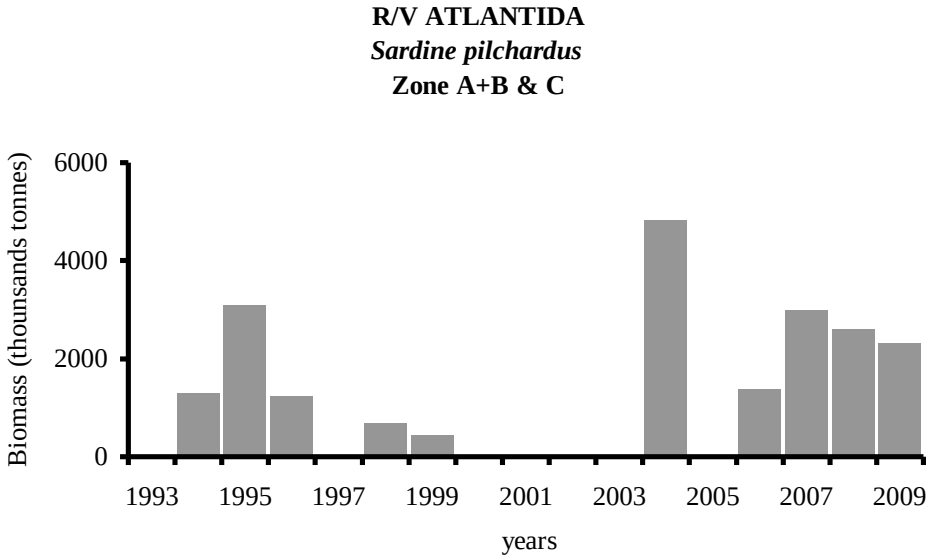


Figure 2.3.2b: Biomass estimates of sardine (1994–2009) for Zone C from R/V ATLANTIDA (in thousand tonnes)/
Estimations de la biomasse de sardine (1994-2009) dans la Zone C du N/R ATLANTIDA (en milliers de tonnes)

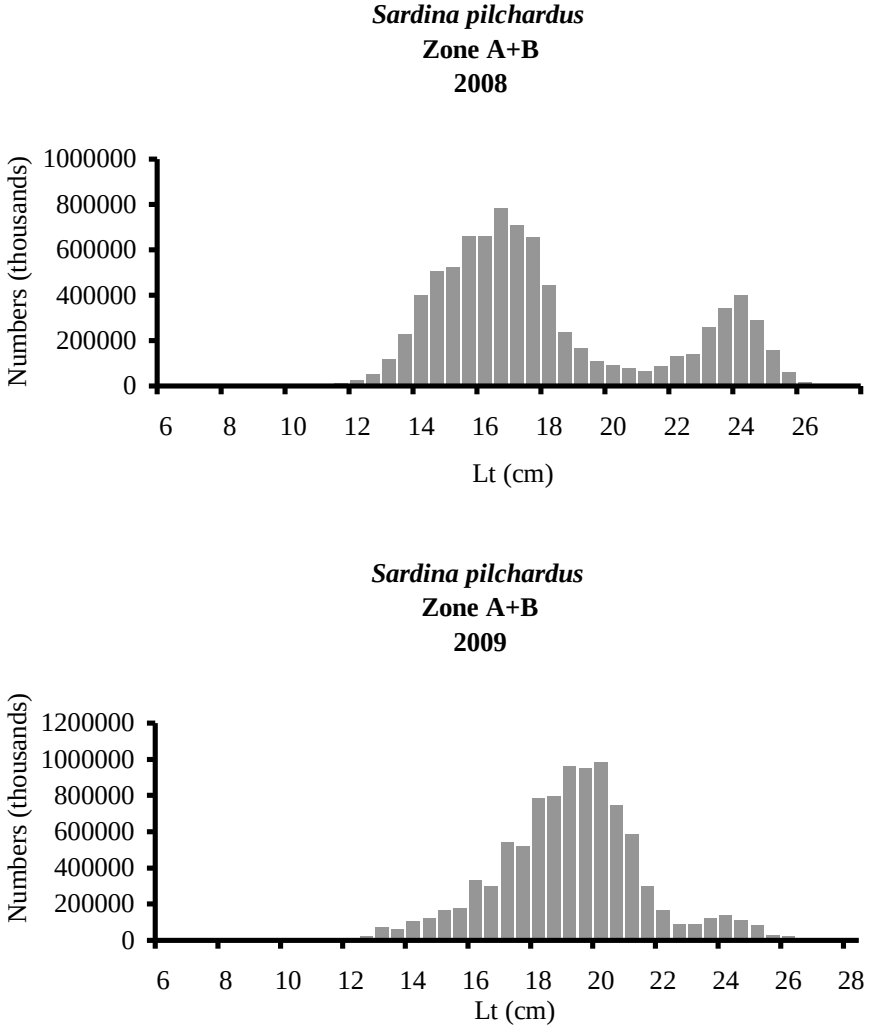


Figure 2.5.1a: Length composition of catches for 2008–2009 in Zone A+B/
Composition par taille des captures en 2008-2009 dans la Zone A+B

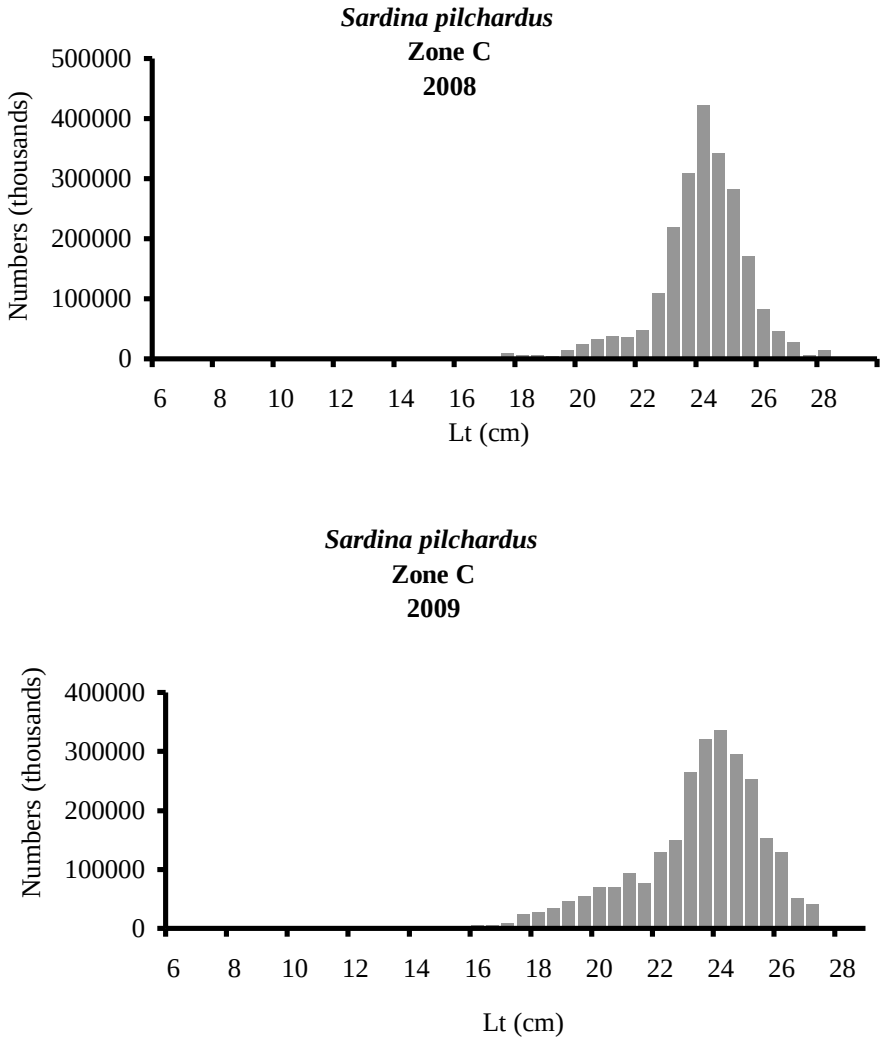
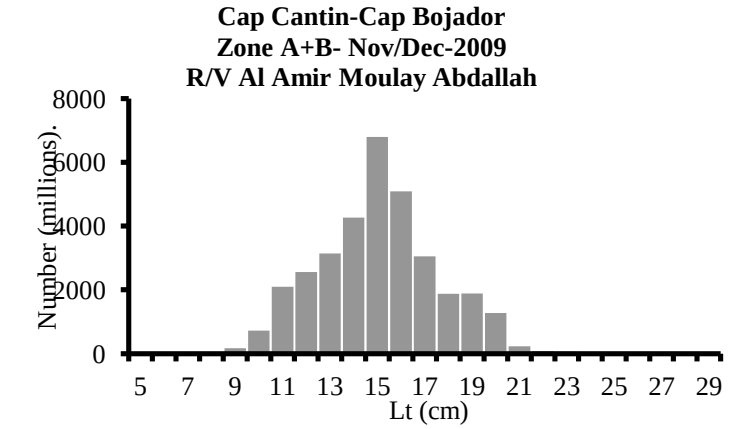


Figure 2.5.1b: Length composition of catches for 20082009 in Zone C/
Composition par taille des captures en 2008-2009 dans la Zone C



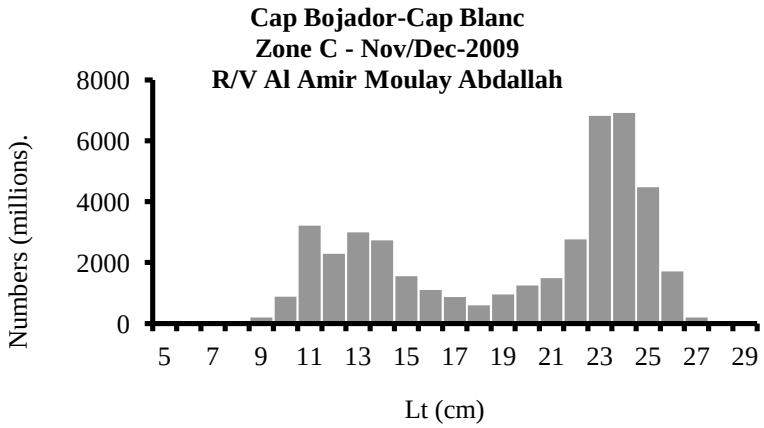


Figure 2.5.2a: Length composition of sardine (November–December 2009 Zone A+B and C) – R/V AL AMIR MOULAY ABDALLAH/
Composition en taille des sardines (novembre-décembre 2009 Zones A+B et C) – N/R AL AMIR MOULAY ABDALLAH

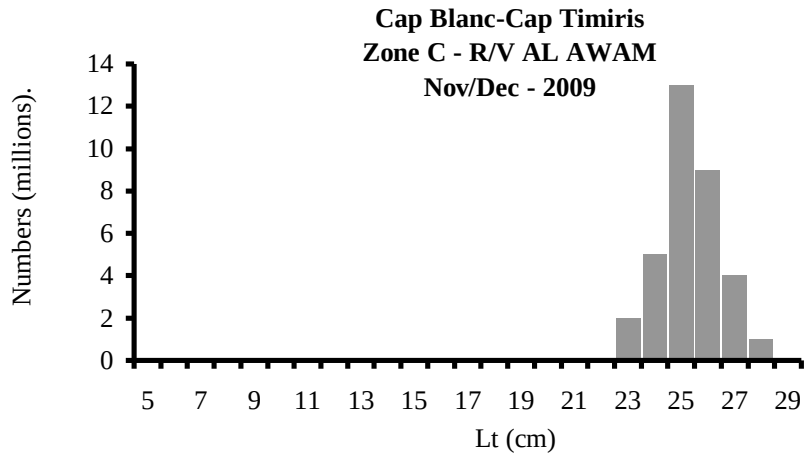


Figure 2.5.2b: Length composition of sardine (November–December 2009 Zone C) – R/V AL AWAM/
Composition en taille des sardines (novembre–décembre 2009 Zone C) – N/R AL AWAM

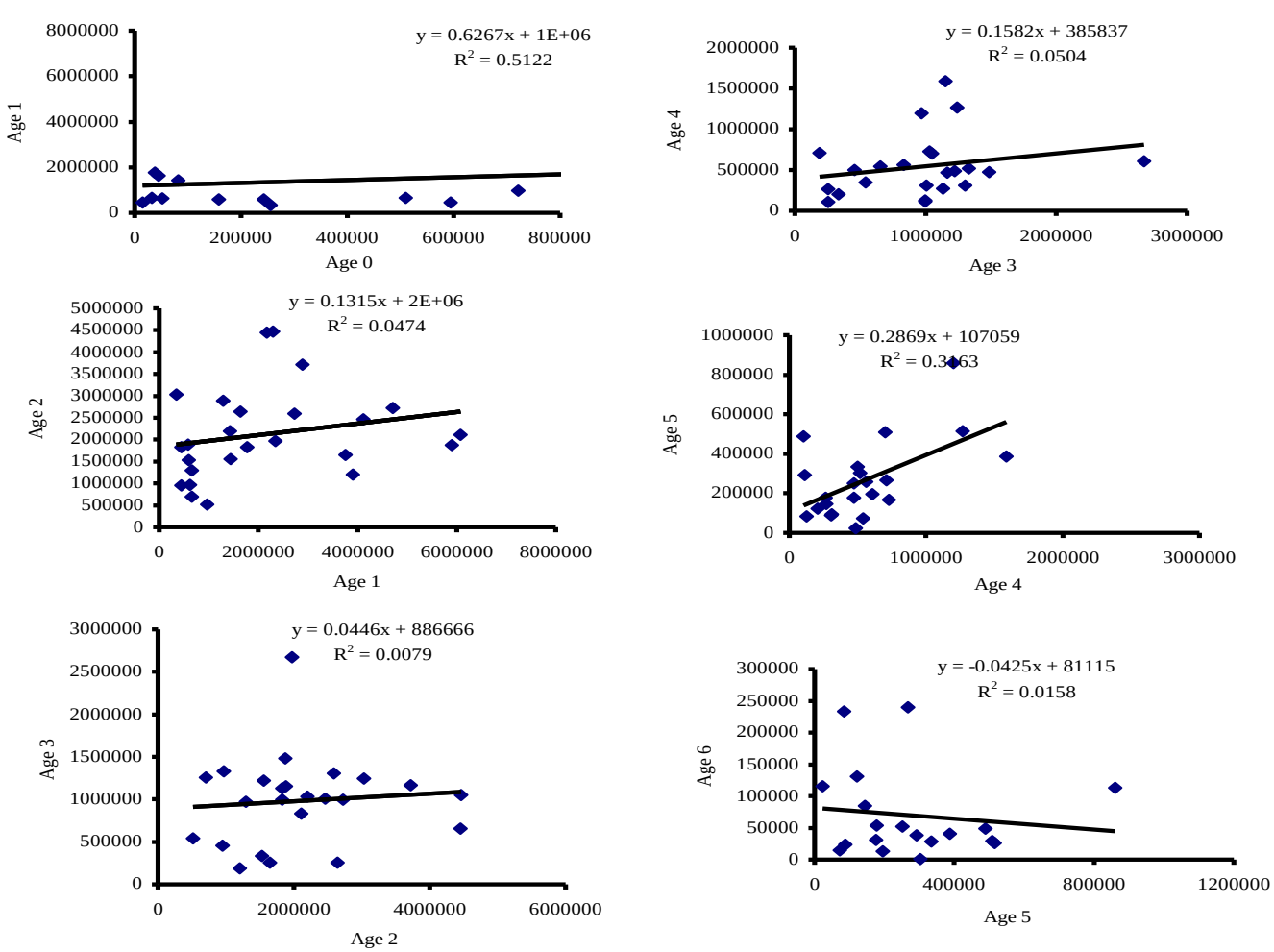


Figure 2.6.1: Exploratory analyses of the data for sardine in Zone A+B (2009)/
Analyses exploratoires des données pour la sardine dans la Zone A+B (2009)

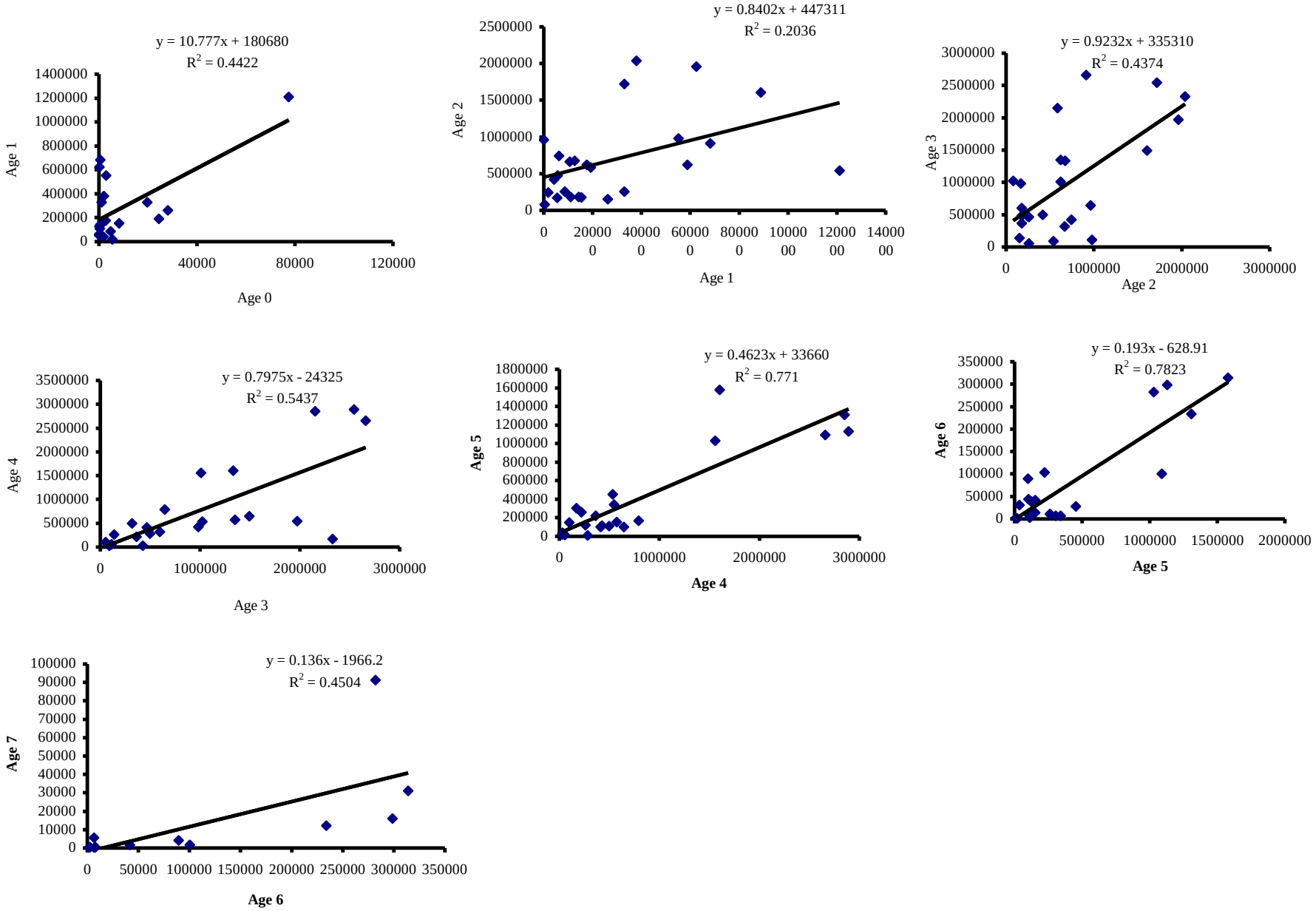


Figure 2.6.2: Exploratory analyses of the data for sardine in Zone C (2009)/Analyses exploratoires des données pour la sardine dans la Zone C (2009)

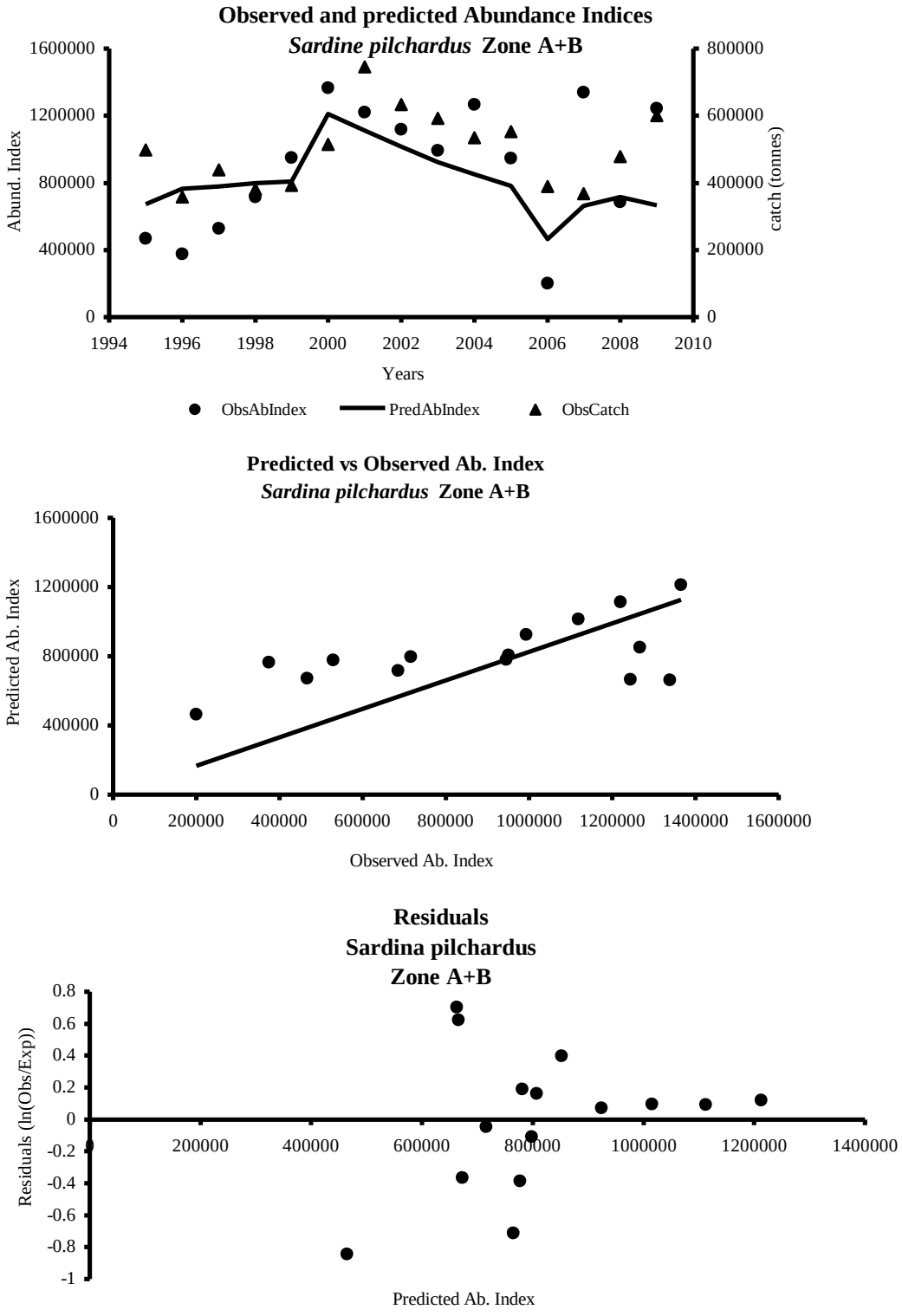


Figure 2.6.3a: Observed and predicted abundance indices for Sardine Zone A+B using estimates from R/V DR. FRIDTJOF NANSEN and national research vessels (1995–2009) and diagnostics of the model fit/

Indices d'abondance observés et prévus pour la sardine dans la Zone A+B à partir des estimations du N/R DR. FRIDTJOF NANSEN et des navires de recherche nationaux (1995-2009) ainsi que des diagnostics du modèle

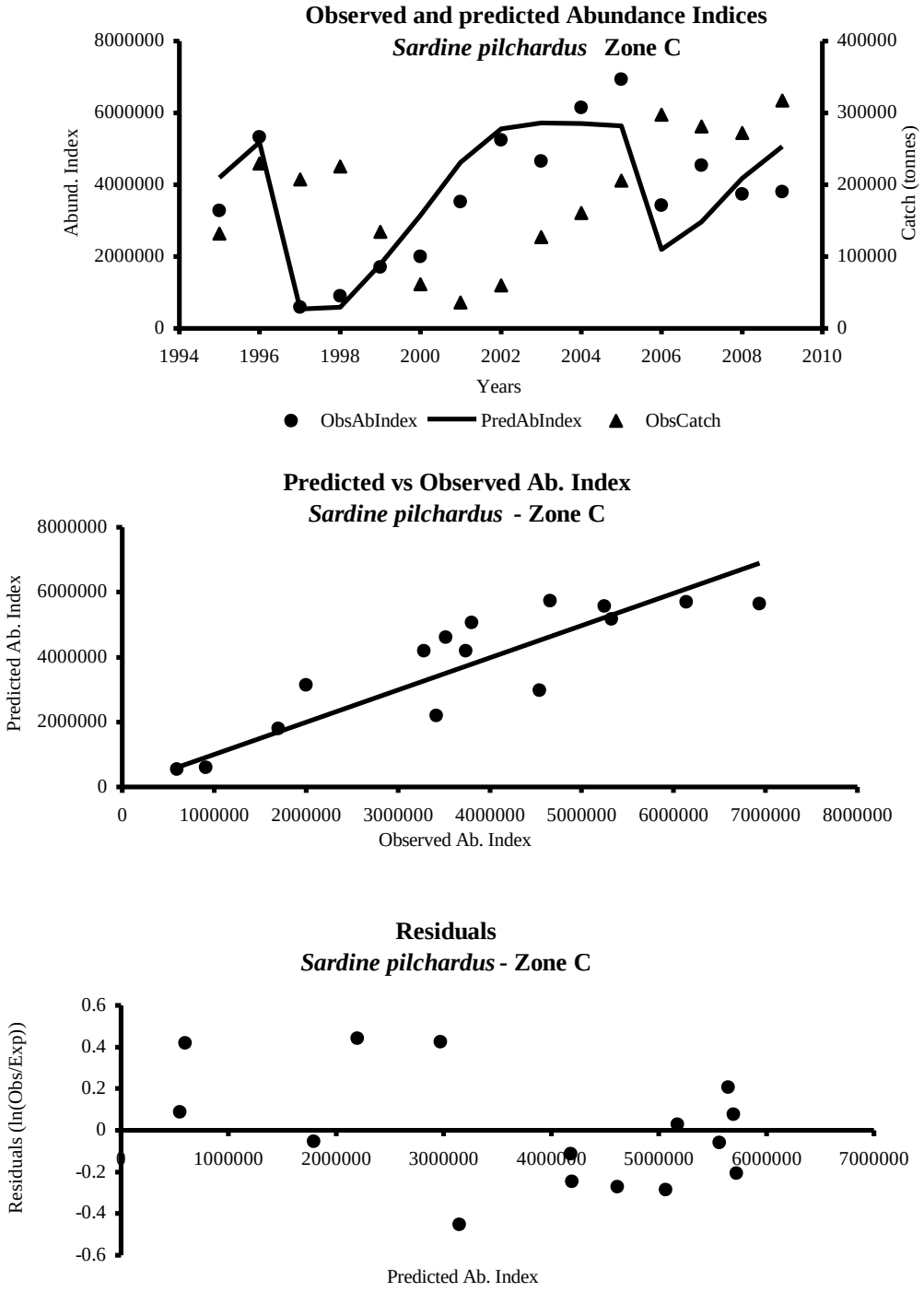
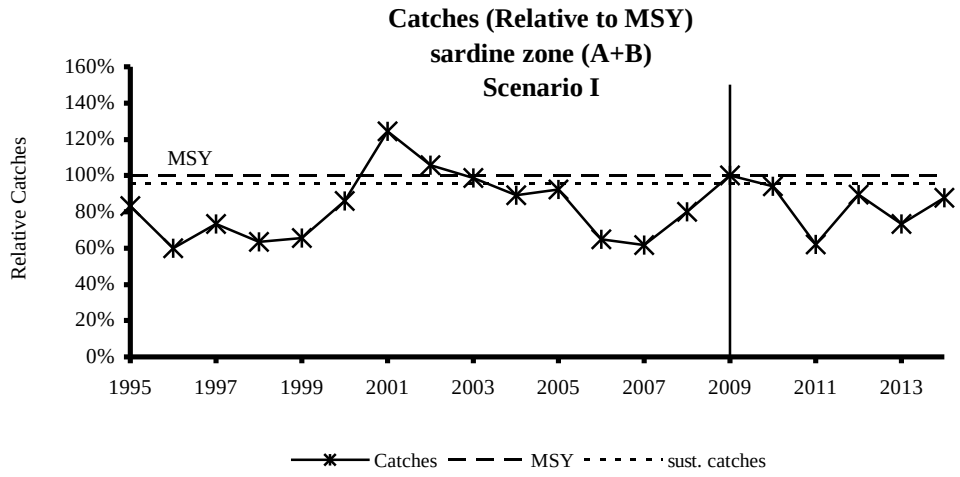


Figure 2.6.3b: Observed and predicted abundance indices for Sardine Zone C using estimates from R/V DR. FRIDTJOF NANSEN and research national vessels (1995–2008) and diagnostics of the model fit/

Indices d'abondance observés et prévus pour la sardine en Zone C en utilisant les estimations du N/R DR. FRIDTJOF NANSEN et des navires de recherche nationaux (1995-2008) ainsi que des diagnostics du modèle



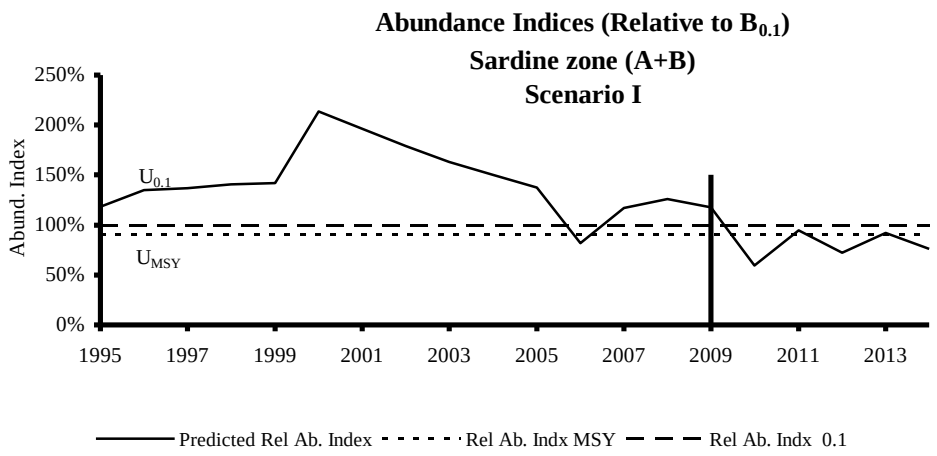
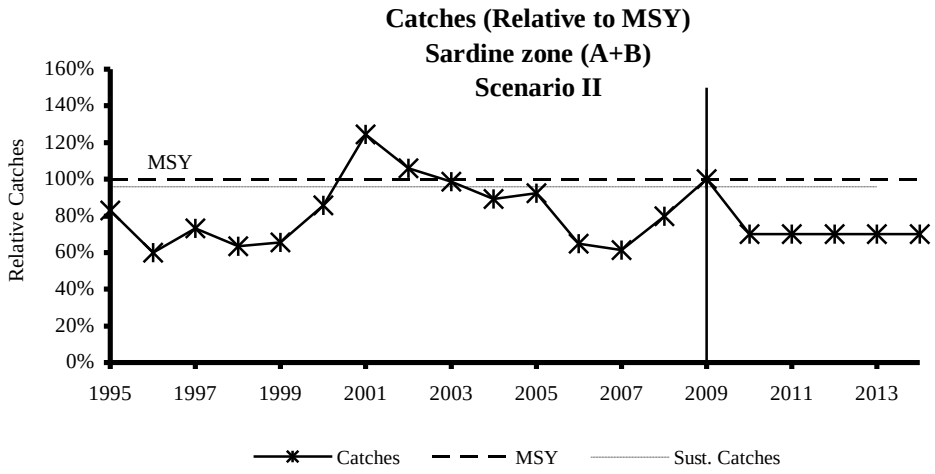


Figure 2.7.1a: Predicted trends in catches and abundance of sardine in Zone A+B – Scenario I (status quo)/
Prédictions des captures et de l'abondance de sardines dans la Zone A+B – Scénario I (status quo)



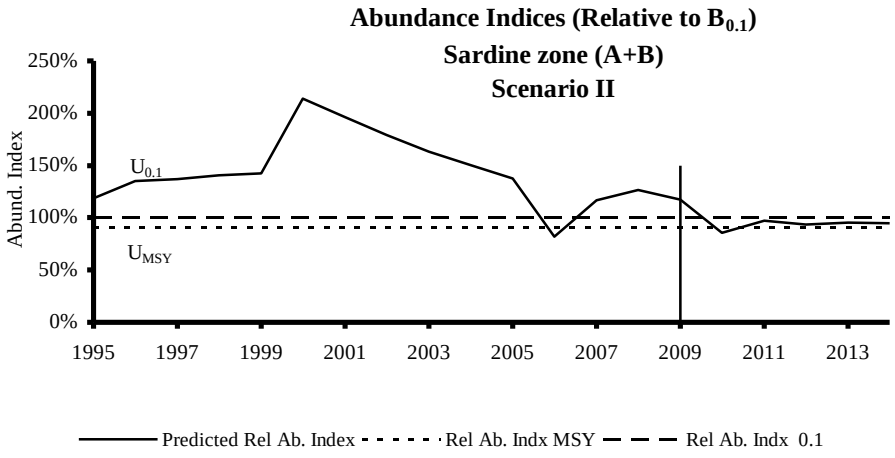
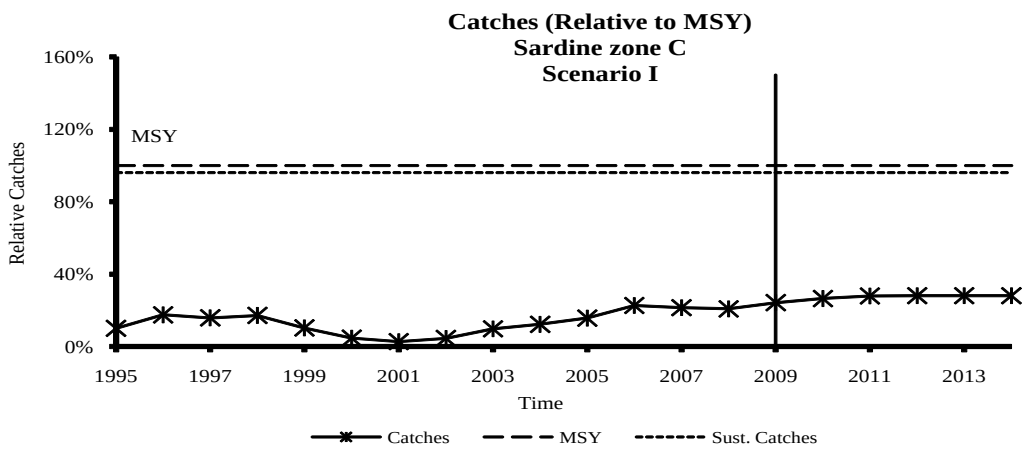


Figure 2.7.1b: Predicted trends in catches and abundance of sardine in Zone A+B – Scenario II (30 percent decrease in catch)/
Prédictions des captures et de l'abondance de sardines dans la Zone A+B – Scénario II (30 pour cent réduction de la capture)



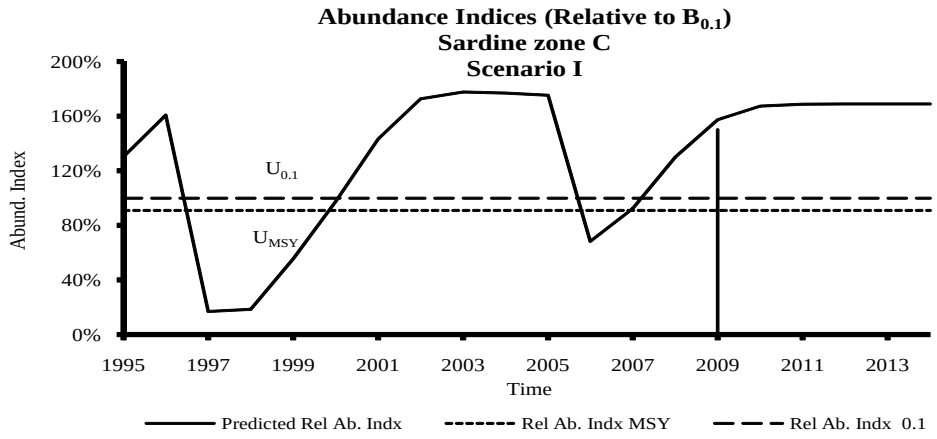
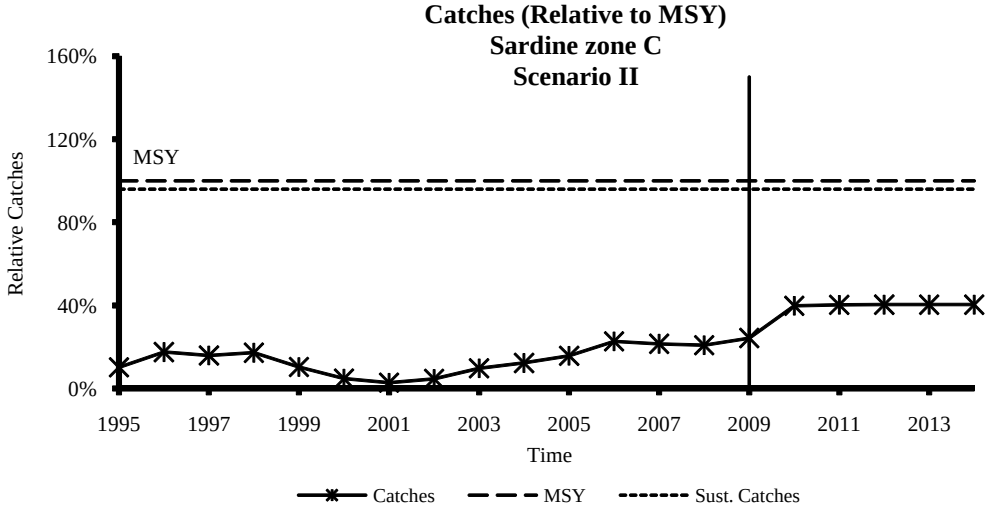


Figure 2.7.2a: Predicted catches and abundance of sardine in Zone C – Scenario I (status quo)/
Prédictions des captures et de l'abondance de sardines dans la Zone C – Scénario I (status quo)



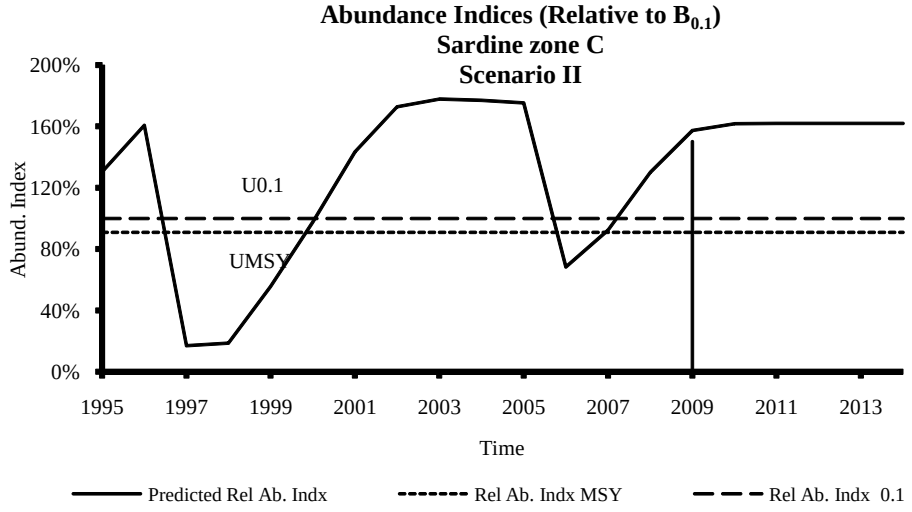


Figure 2.7.2b: Predicted trends in catches and abundance of sardine in Zone A+B – Scenario II (50 percent increase in effort)/
Prédictions des captures et de l'abondance de sardines dans la Zone A+B – Scénario II (50 pour cent d'accroissement de l'effort)

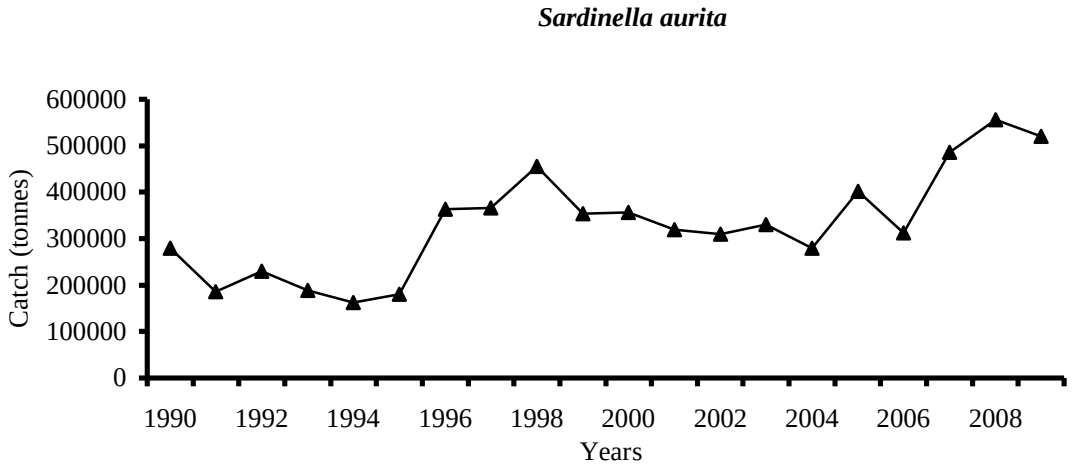


Figure 3.2.1a: Total catch of *Sardinella aurita* (1990–2009) in the whole subregion/ Captures totales de *Sardinella aurita* (1990-2009) dans toute la sous-région

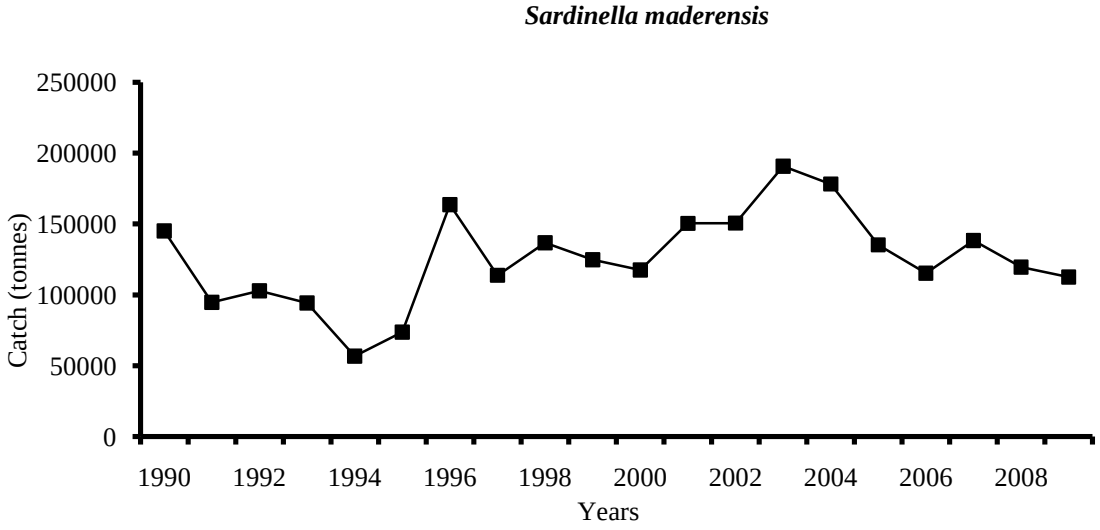


Figure 3.2.1b: Total catch of *Sardinella maderensis* (1990–2009) in the whole subregion/ Captures totales de *Sardinella maderensis* (1990-2009) dans toute la sous-région

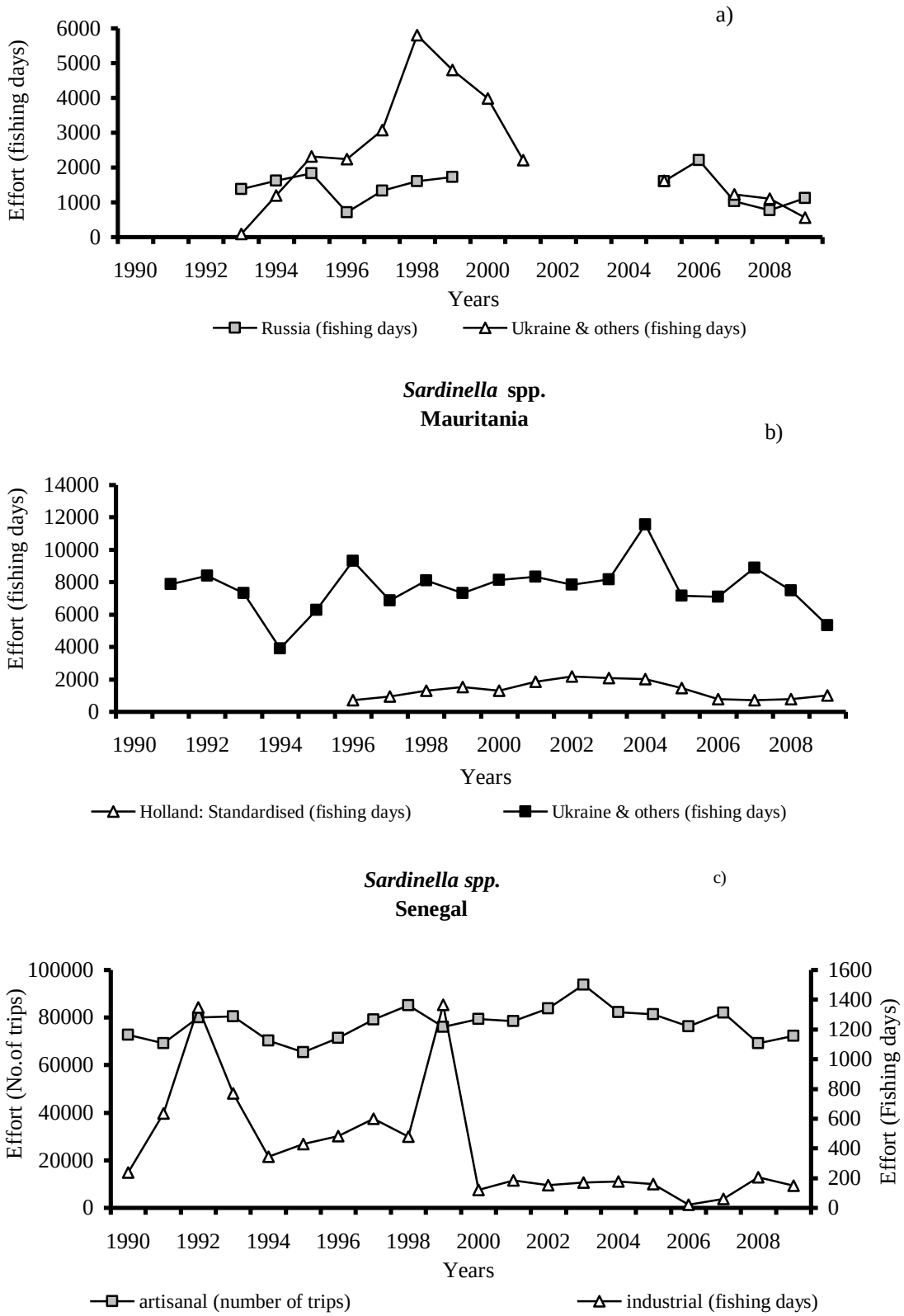


Figure 3.2.2a,b,c: Effort of *Sardinella* spp. (1990–2009) by fleet and year (a) Zone 26°N–20°N, (b) Mauritania and (c) Senegal (effort in fishing days or number of trips)/ Effort de *Sardinella* spp. (1990-2009) par flottille et par année (a) zone 26°N-20°N, (b) en Mauritanie et (c) au Sénégal (effort en jours de pêche ou en nombre de sorties)

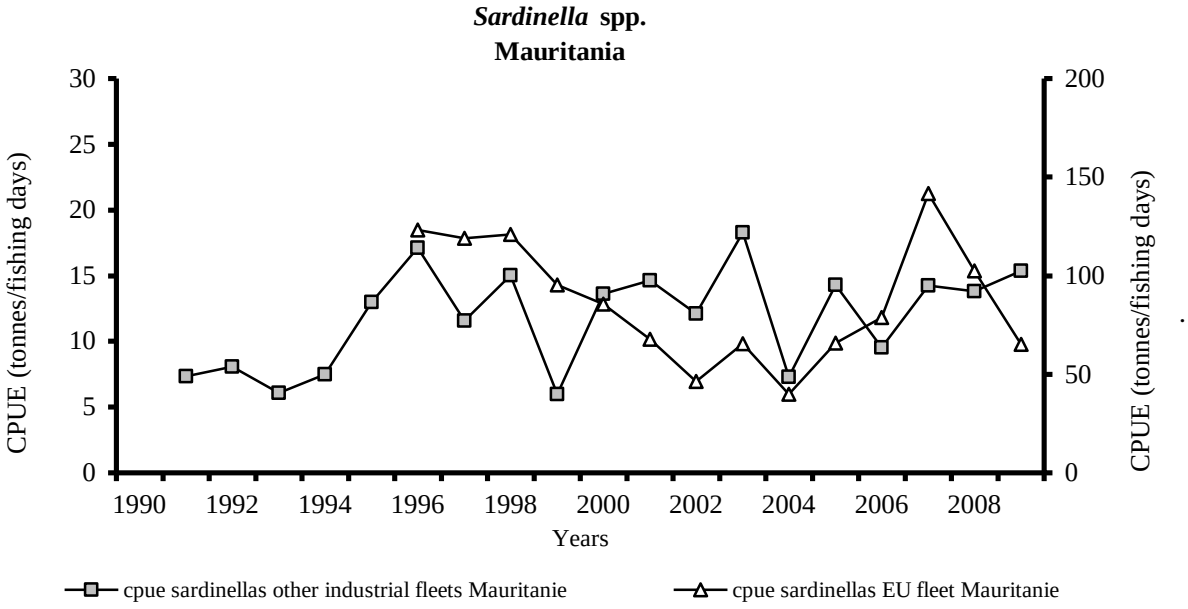


Figure 3.3.1a: CPUE of *Sardinella* spp. (1990–2009) by fishery in Mauritania (tonnes/fishing days)/
CPUE de *Sardinella* spp. (1990-2009) par pêcherie en Mauritanie (tonnes/jours de pêche)

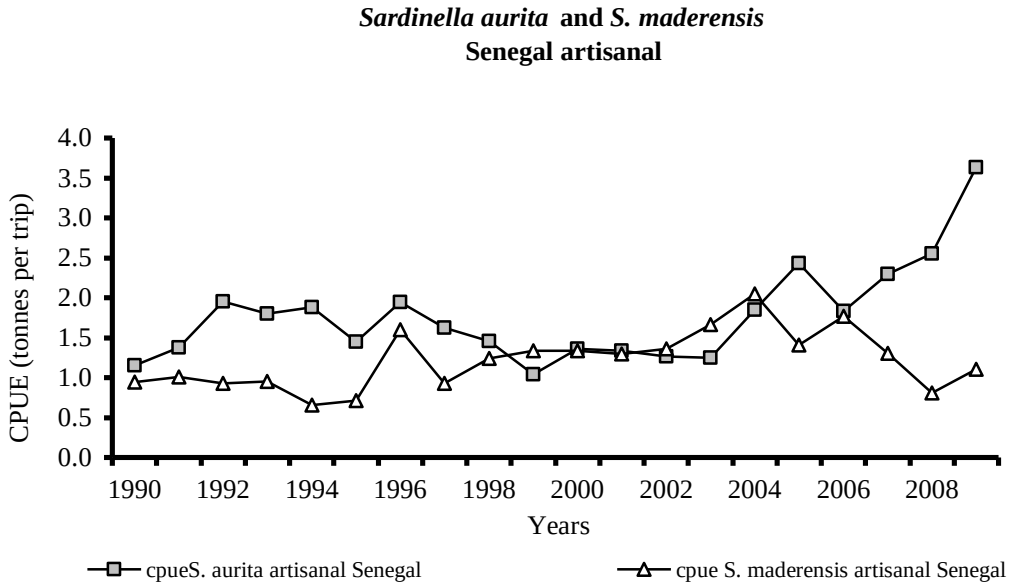


Figure 3.3.1b: CPUE of *Sardinella* spp. (1990–2009) by species for the artisanal fishery in Senegal (tonnes/number of trips)/
CPUE de *Sardinella* spp. (1990-2009) par espèce pour la pêcherie artisanale au Sénégal (tonnes/nombre de sorties)

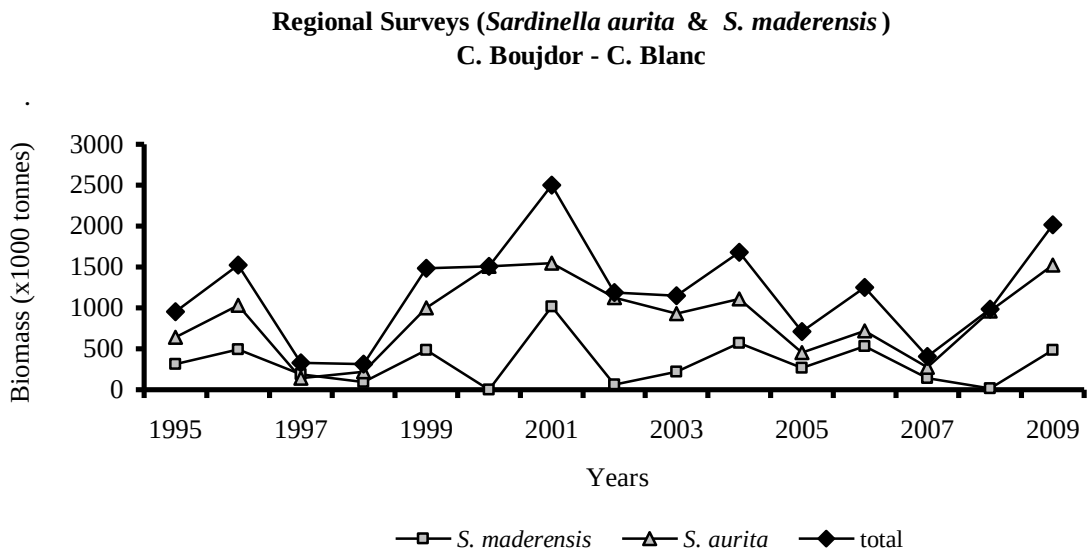


Figure 3.3.2a: Biomass estimates of *S. aurita* and *S. maderensis* (1995–2009) North of Cape Blanc, R/V DR. FRIDTJOF NANSEN and AL AMIR MOULAY ABDALLAH (biomass in thousand tonnes)/
Estimations de la biomasse de *S. aurita* et *S. maderensis* (1995-2009) pour la zone nord du Cap Blanc, N/R DR. FRIDTJOF NANSEN et AL AMIR MOULAY ABDALLAH (biomasse en milliers de tonnes)

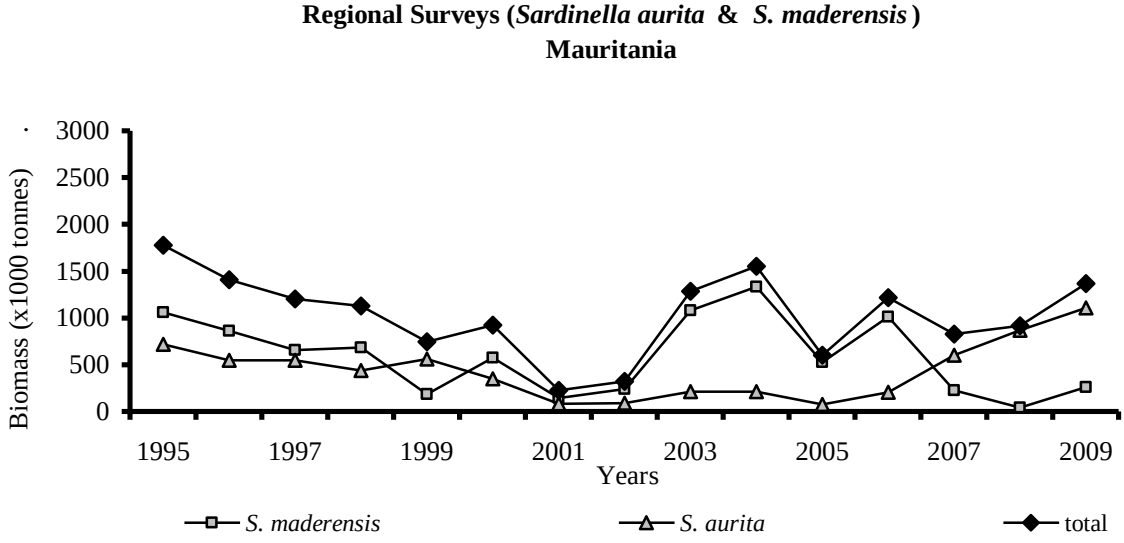


Figure 3.3.2b: Biomass estimates of *S. aurita* and *S. maderensis* (1995–2009) for Mauritania, R/V DR. FRIDTJOF NANSEN and AL AWAM (biomass in thousand tonnes)/
Estimations de la biomasse de *S. aurita* et *S. maderensis* (1995-2009) pour la Mauritanie, N/R DR. FRIDTJOF NANSEN et AL AWAM (biomasse en milliers de tonnes)

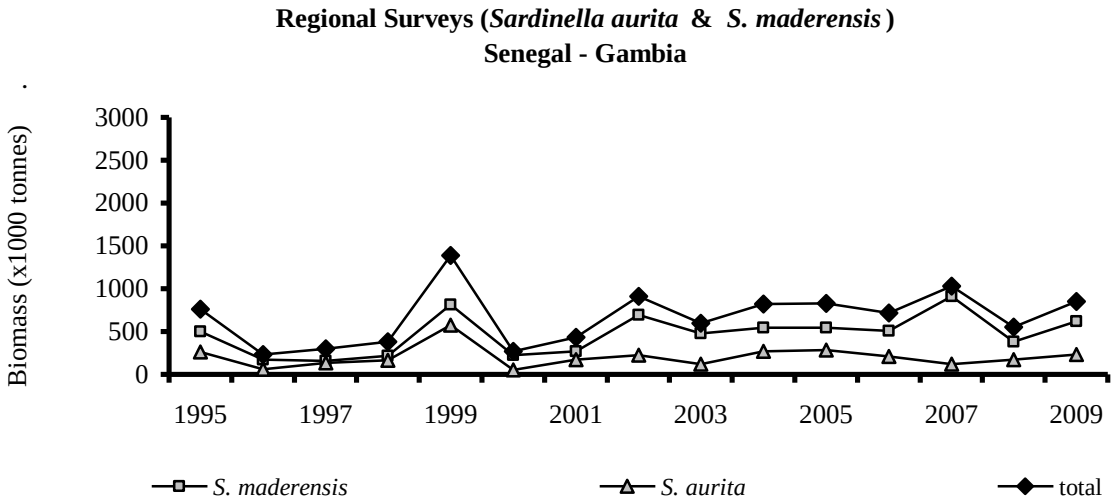


Figure 3.3.2c: Biomass estimates of *S. aurita* and *S. maderensis* (1995–2008) for Senegal and Gambia, R/V DR. FRIDTJOF NANSEN and ITAF DEME (biomass in thousand tonnes)/
Estimations de la biomasse de *S. aurita* et *S. maderensis* (1995-2009) pour le Sénégal et la Gambie, N/R DR. FRIDTJOF NANSEN et ITAF DEME (poids en milliers de tonnes)

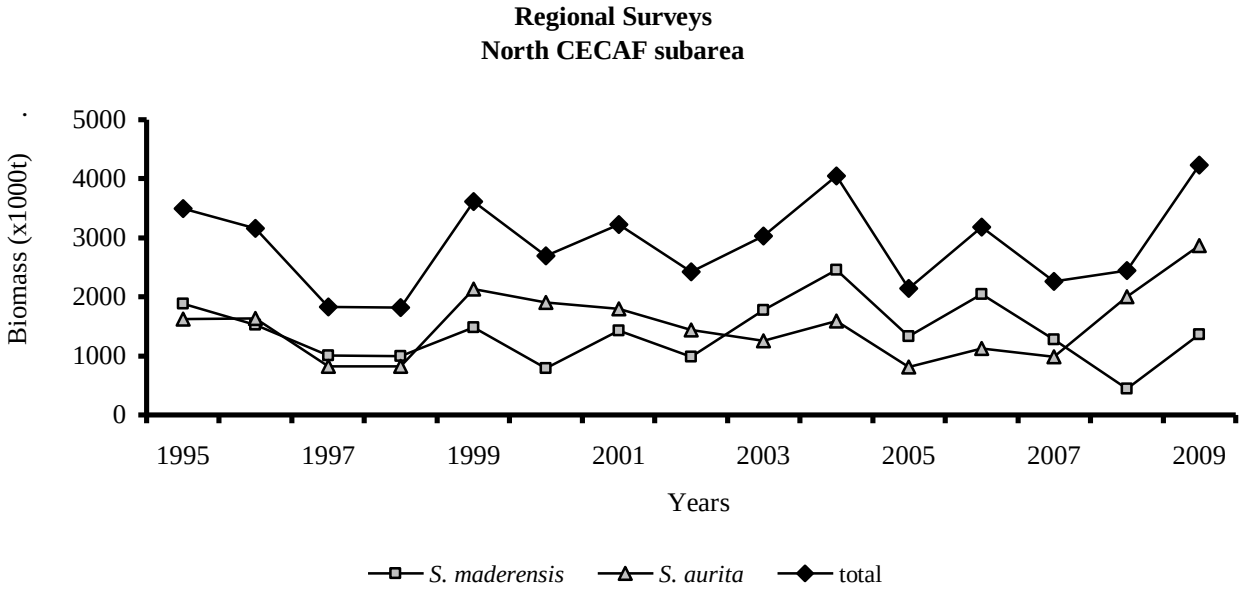


Figure 3.3.2d: Biomass estimates of *S. aurita* and *S. maderensis* (1995–2009) for the subregion, R/Vs DR. FRIDTJOF NANSEN and AL AMIR, AL AWAM and ITAF DEME (biomass in thousand tonnes)/
Estimations de la biomasse de *S. aurita* et *S. maderensis* (1995-2009) pour la sous-région, N/R DR. FRIDTJOF NANSEN et AL AMIR, AL AWAM et ITAF DEME (biomasse en milliers de tonnes)

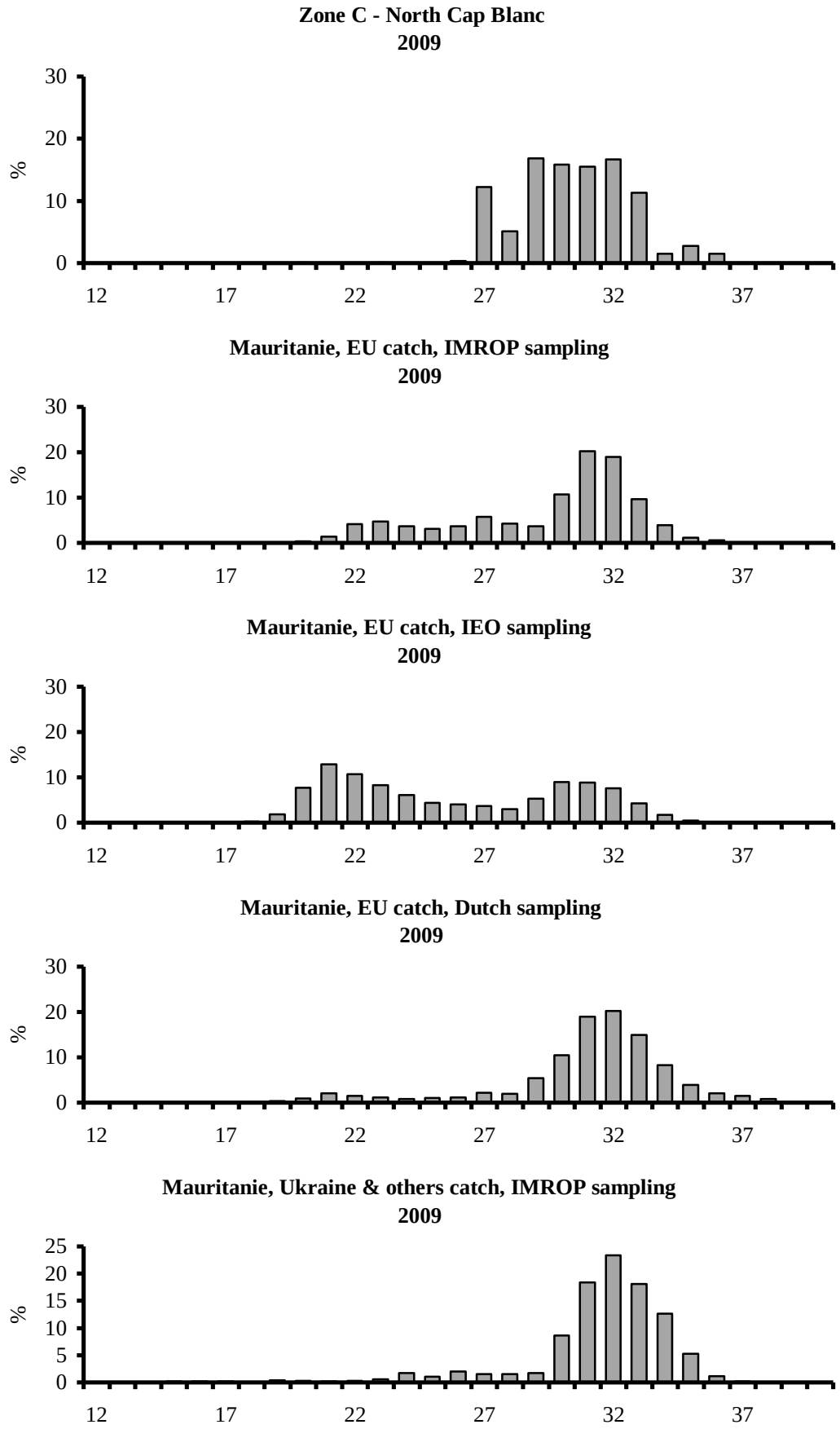


Figure 3.5.1a : Comparison of length distributions of catch and landings of *Sardinella aurita* in zone C by different sampling schemes (2009)/
Comparaison des distributions par taille des débarquements de *Sardinella aurita* dans la zone C selon les différents schémas d'échantillonnage (2009)

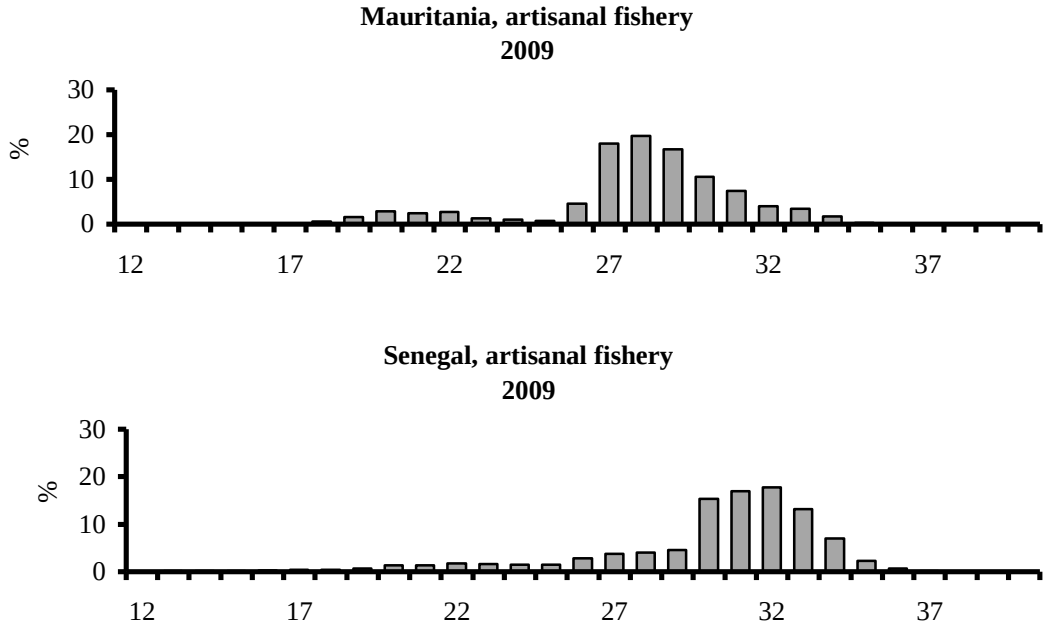


Figure 3.5.1a (cont.): Comparison of length distributions of catch and landings of *Sardinella aurita* in zone C by different sampling schemes (2009)/
Comparaison des distributions par taille des débarquements *Sardinella aurita* dans la Zone C selon les différents schémas d'échantillonnage (2009)

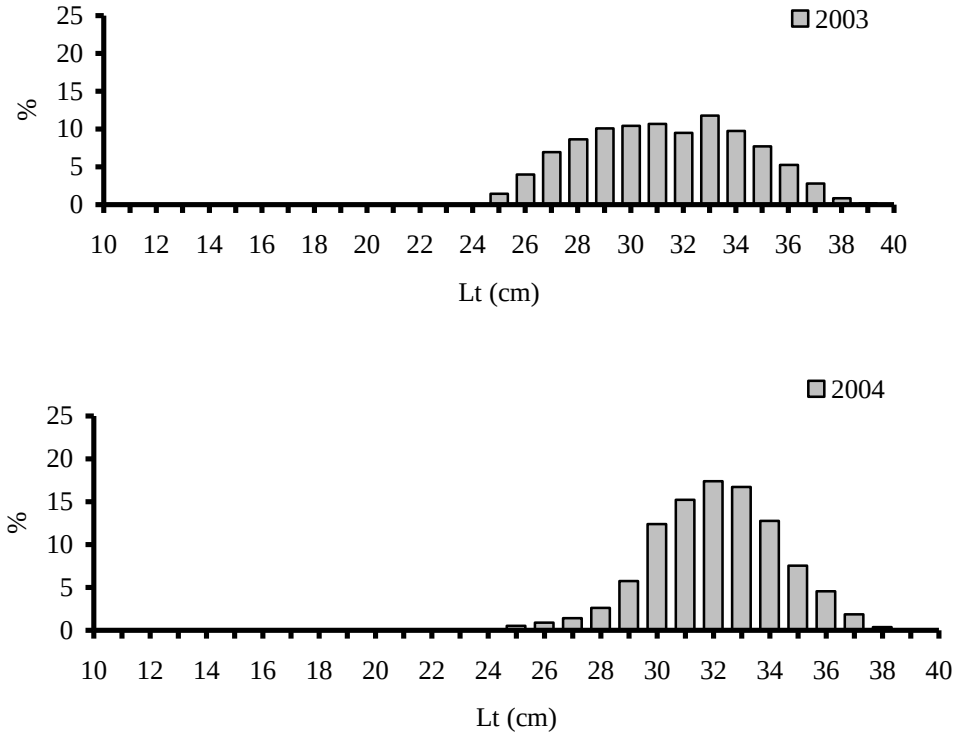


Figure 3.5.1b: Length distributions of landings/catches of *Sardinella aurita* in Mauritania (2003–2009)/
Distributions par taille des débarquements *Sardinella aurita* en Mauritanie (2003-2009)

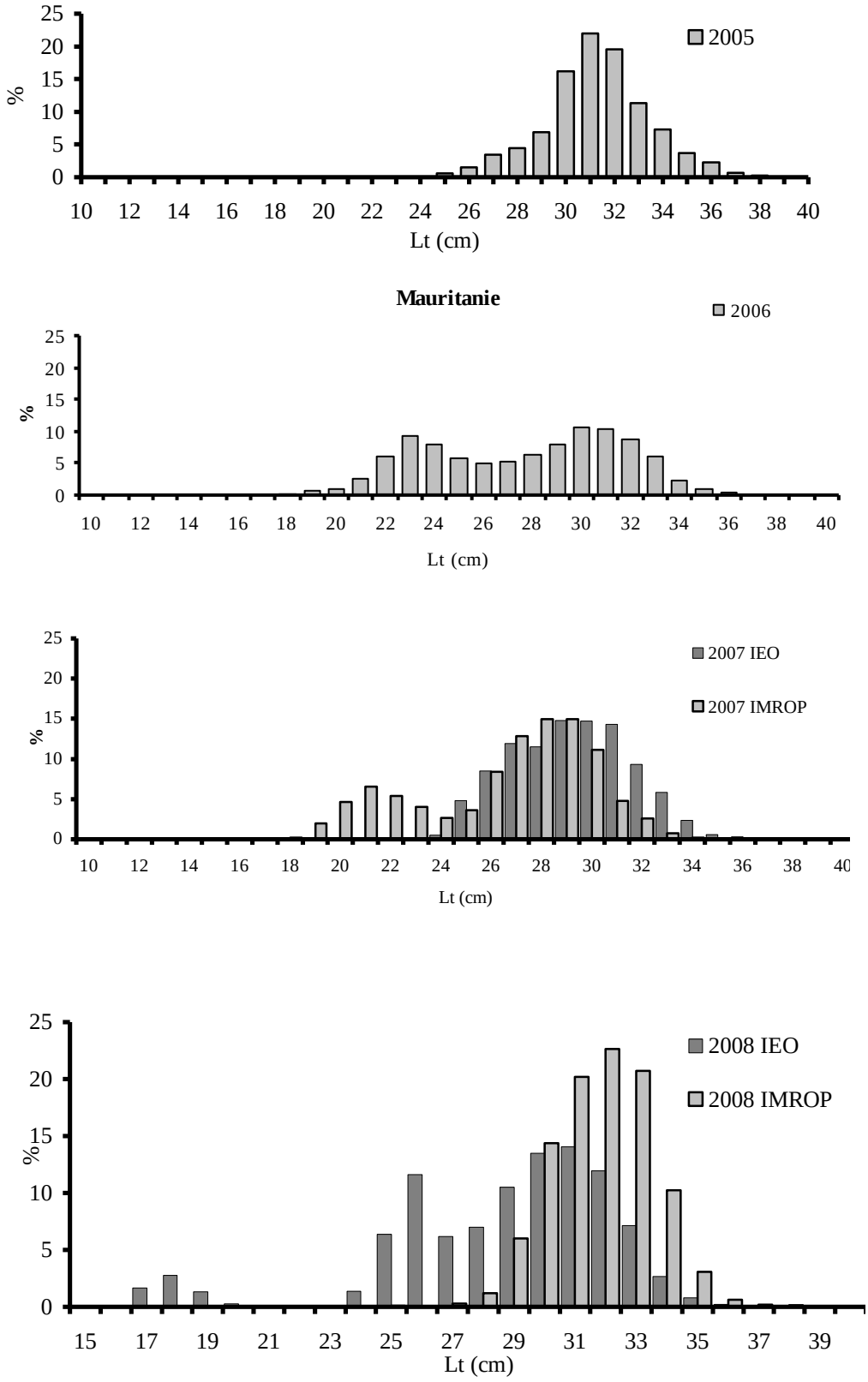


Figure 3.5.1b (cont.): Length distributions of landings/catches of *Sardinella aurita* in Mauritania (2003–2009)/
Distributions par taille des débarquements *Sardinella aurita* en Mauritanie (2003-2009)

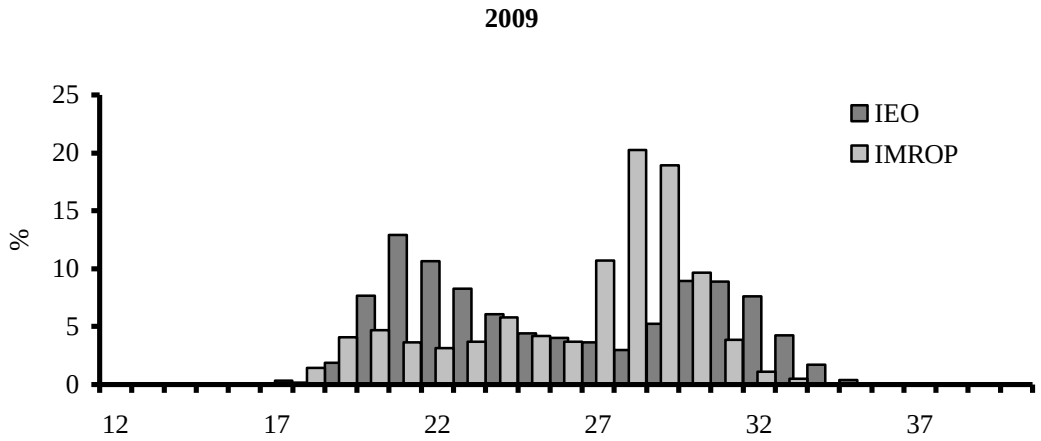
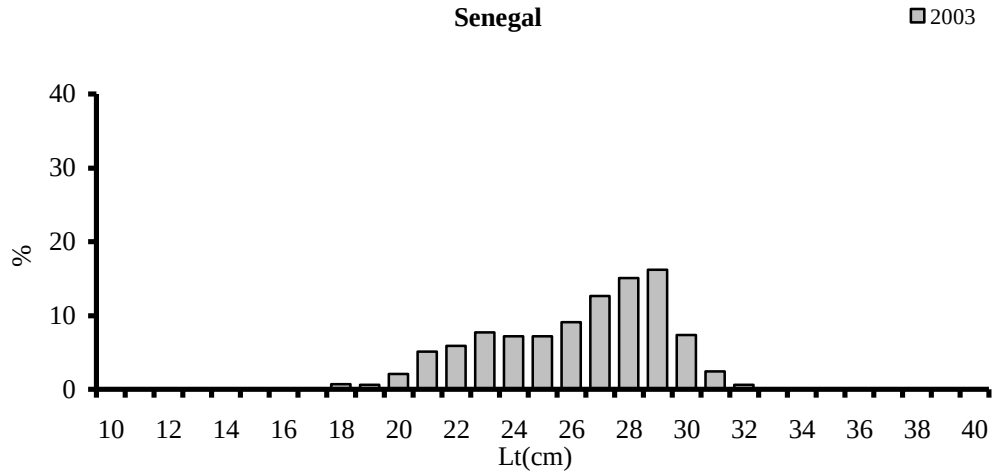


Figure 3.5.1b (cont.): Length distributions of landings/catches of *Sardinella aurita* in Mauritania (2003–2009)/
Distributions par taille des débarquements *Sardinella aurita* en Mauritanie (2003-2009)



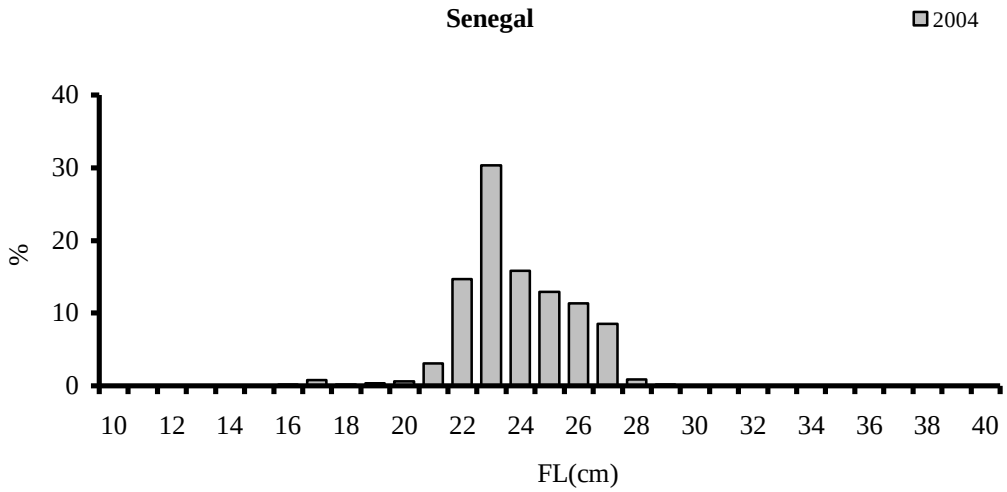


Figure 3.5.1c: Length distributions of landings of *Sardinella aurita* in Senegal (2003–2009)/
Distributions par taille des débarquements de *Sardinella aurita* au Sénégal (2003-2009)

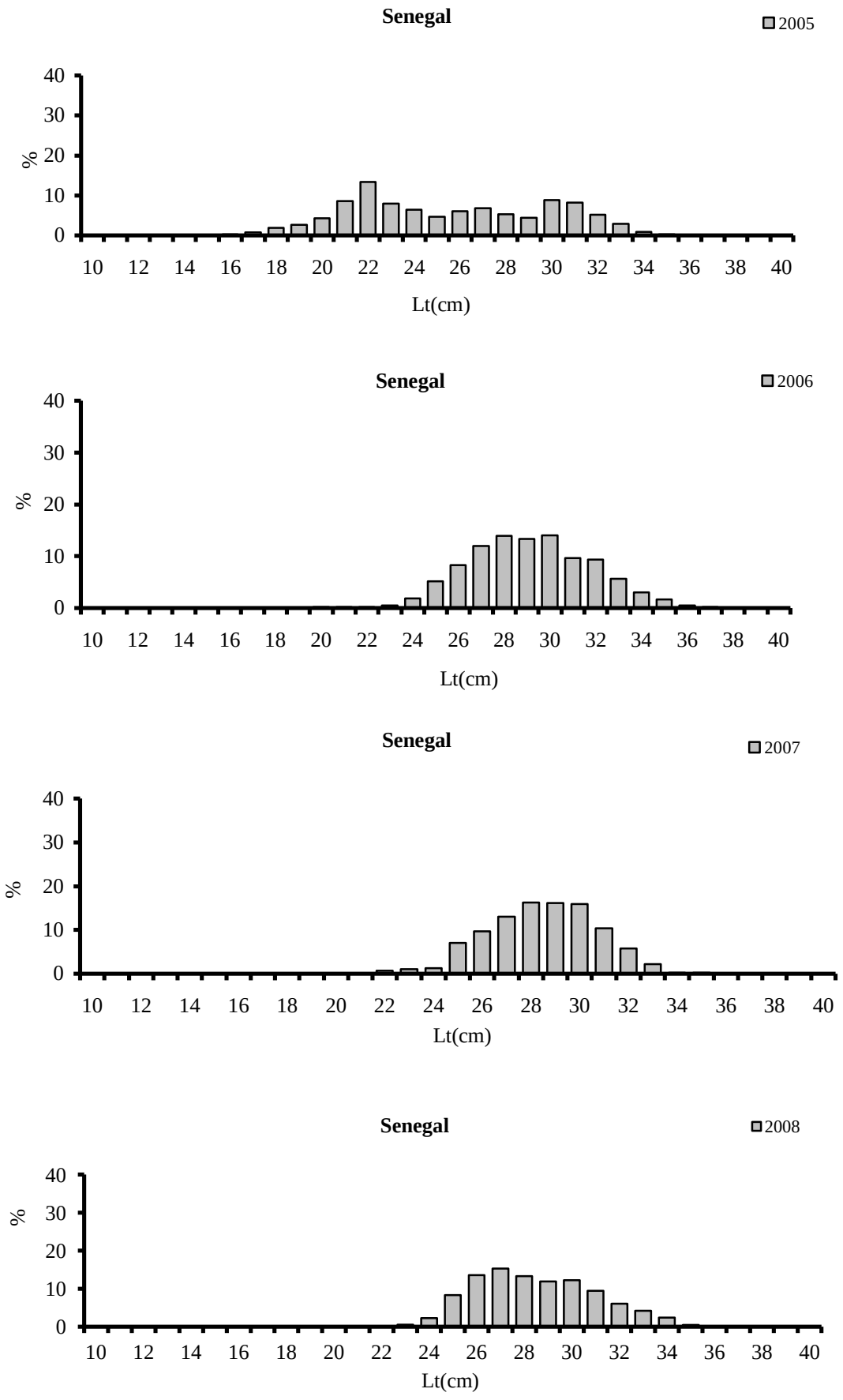


Figure 3.5.1c (cont.): Length distributions of landings of *Sardinella aurita* in Senegal (2003–2009)/
Distributions par taille des débarquements de *Sardinella aurita* au Sénégal (2003-2009)

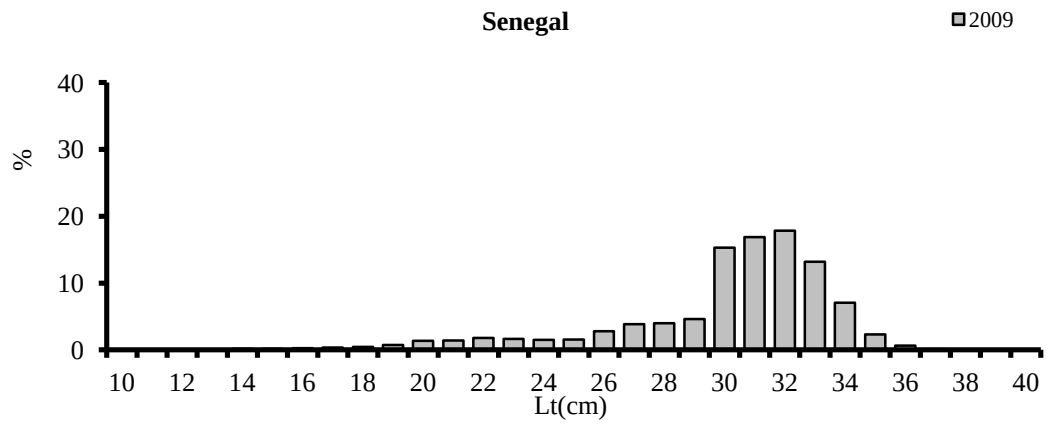
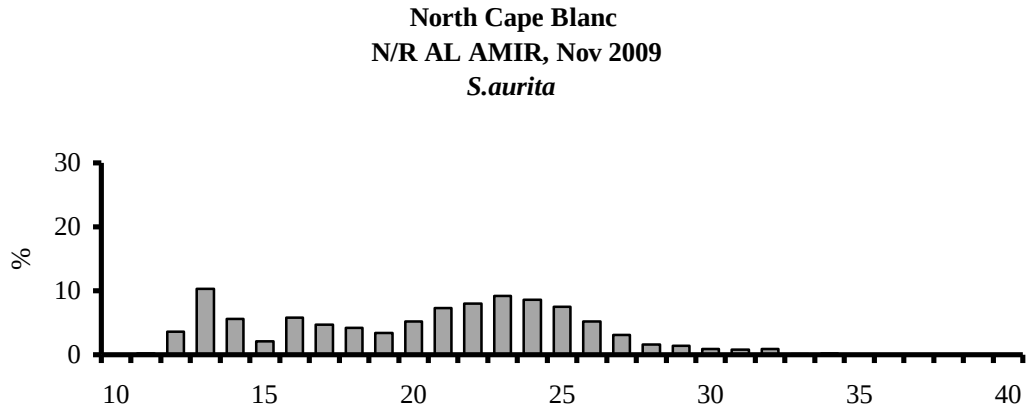


Figure 3.5.1c (cont.): Length distributions of landings of *Sardinella aurita* in Senegal (2003–2009)/
Distributions par taille des débarquements de *Sardinella aurita* au Sénégal (2003-2009)



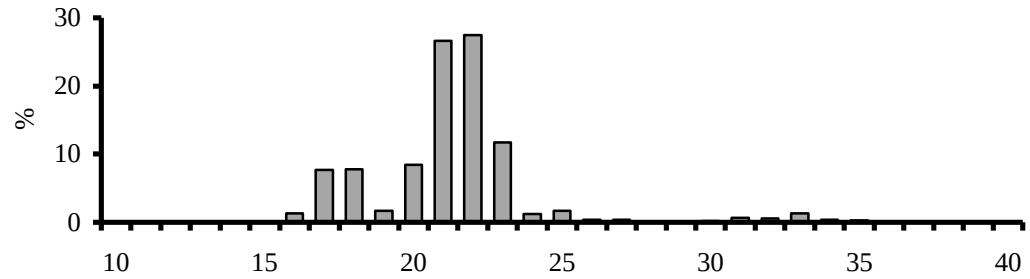


Figure 3.5.1d: Length distribution of *Sardinella aurita* (2009) in Morocco, Mauritania and Senegal, by different research vessels/
Distribution par taille (2009) de *Sardinella aurita* au Maroc, en Mauritanie et au Sénégal selon différents navires de recherche

South Cape Blanc to St. Louis
Al Awam, November 2009
S.aurita

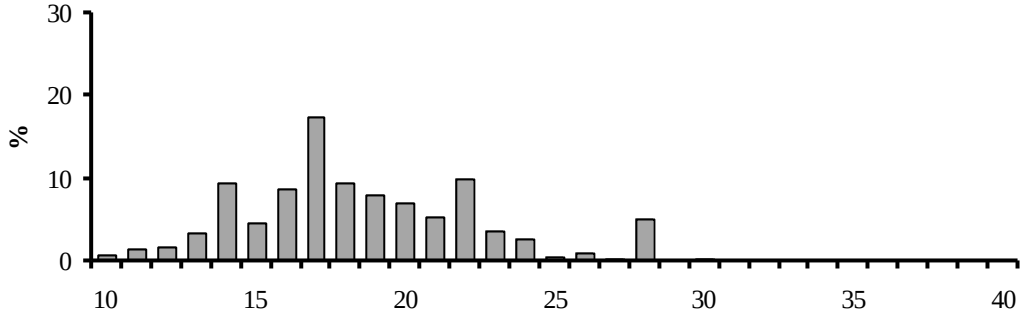


Figure 3.5.1d (cont.): Length distribution of *Sardinella aurita* (2009) in Morocco, Mauritania and Senegal, by different research vessels/
Distribution par taille (2009) de *Sardinella aurita* au Maroc, en Mauritanie et au Sénégal selon différents navires de recherche

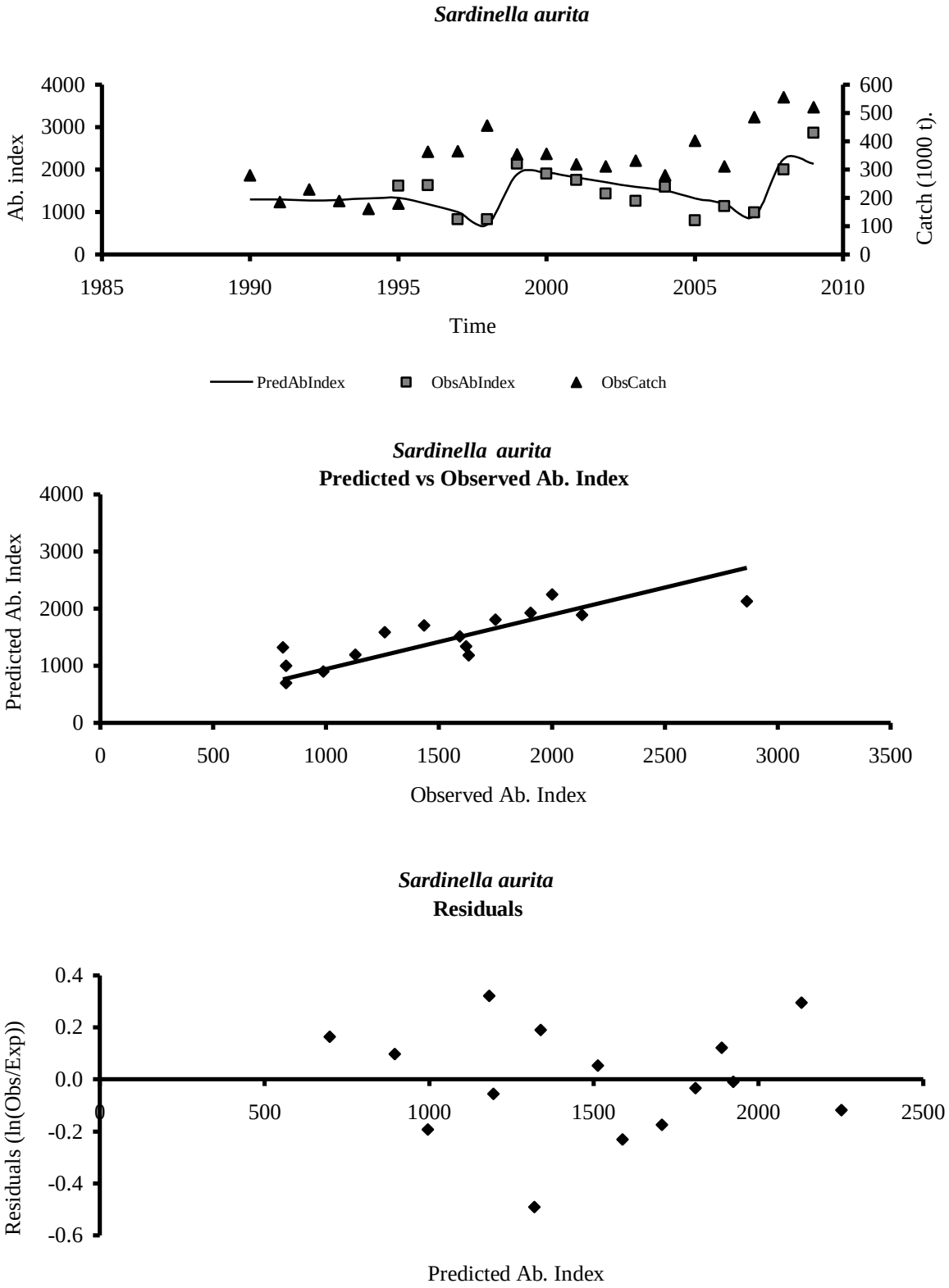


Figure 3.6.2: Observed and predicted abundance indices for *Sardinella aurita* using biomass estimates from R/V DR. FRIDTJOF NANSEN and regional research vessels (1995–2009) and diagnostics of the model fit/

Indices d'abondance observés et prévus pour *Sardinella aurita* en utilisant les estimations de biomasse du N/R DR. FRIDTJOF NANSEN et les navires de recherche régionaux (1995-2009) et les diagnostics du modèle

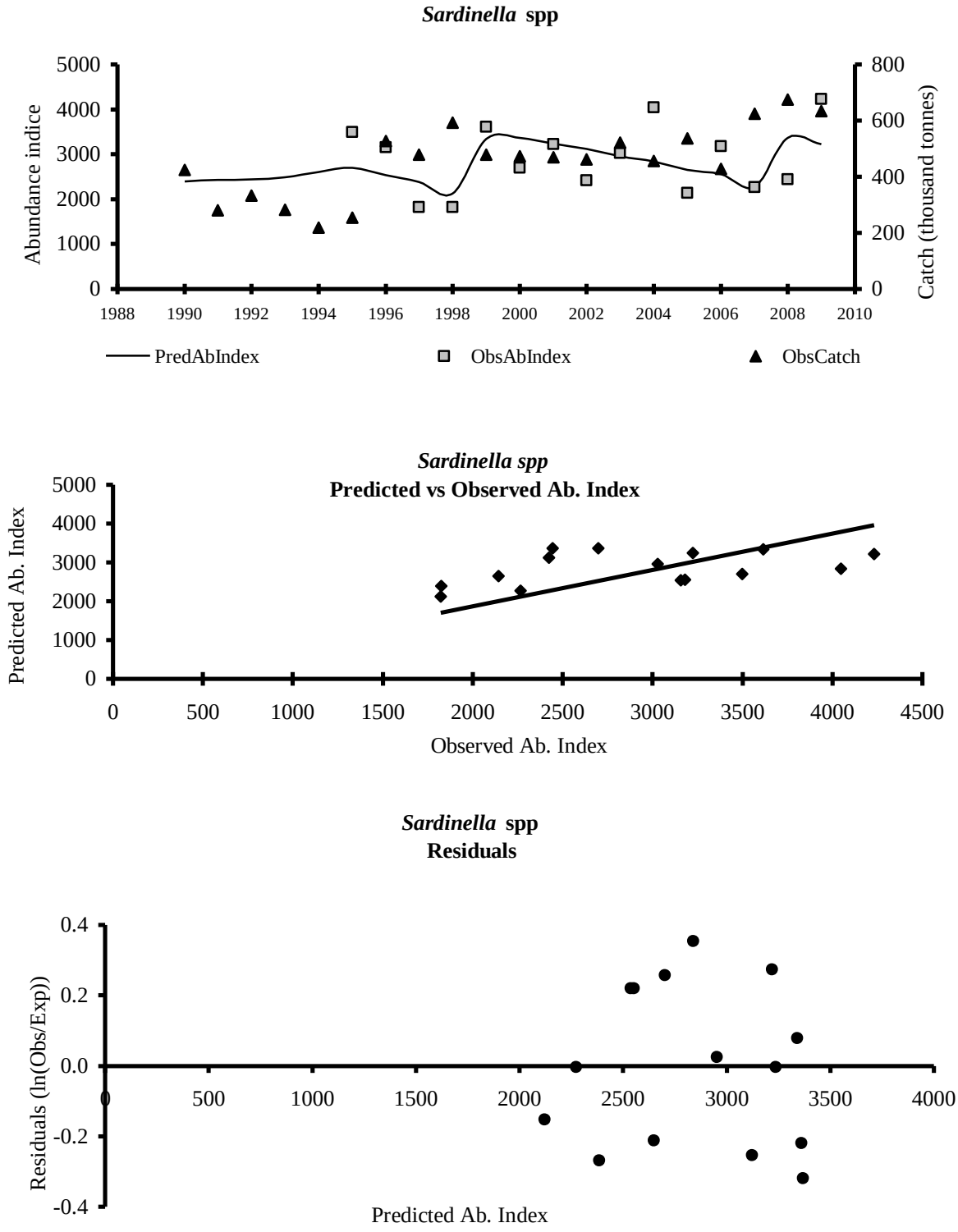


Figure 3.6.3: Observed and predicted abundance indices for *Sardinella* spp using biomass estimates from R/V DR. FRIDTJOF NANSEN and regional vessels (1995–2009) and diagnostics of the model fit/ Indices d'abondance observés et prévus pour *Sardinella* spp. en utilisant les estimations de biomasse du N/R DR. FRIDTJOF NANSEN et des navire de recherche régionaux (1995-2009) et les diagnostics du modèle

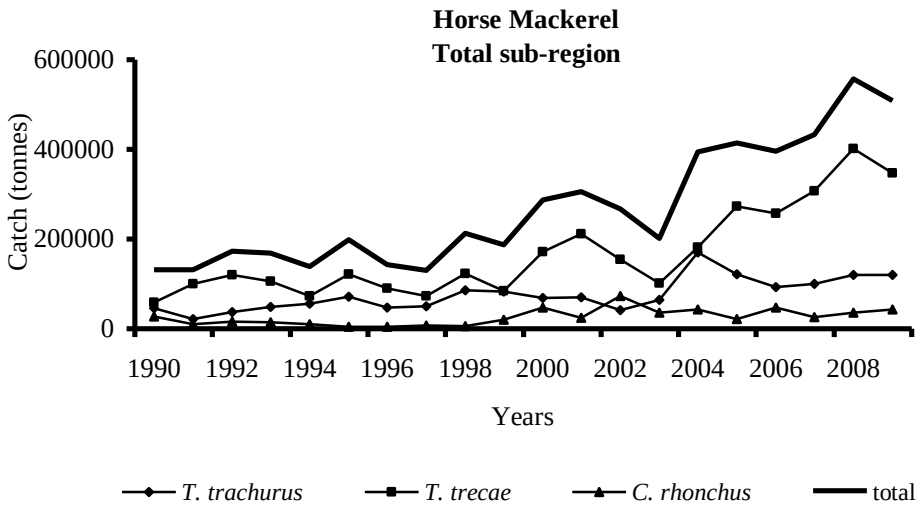


Figure 4.2.1: Total catches (tonnes) of horse mackerel in the subregion by species and year (1990–2009)/
Captures totales (tonnes) de chinchards dans la sous-région par espèce et par année (1990-2009)

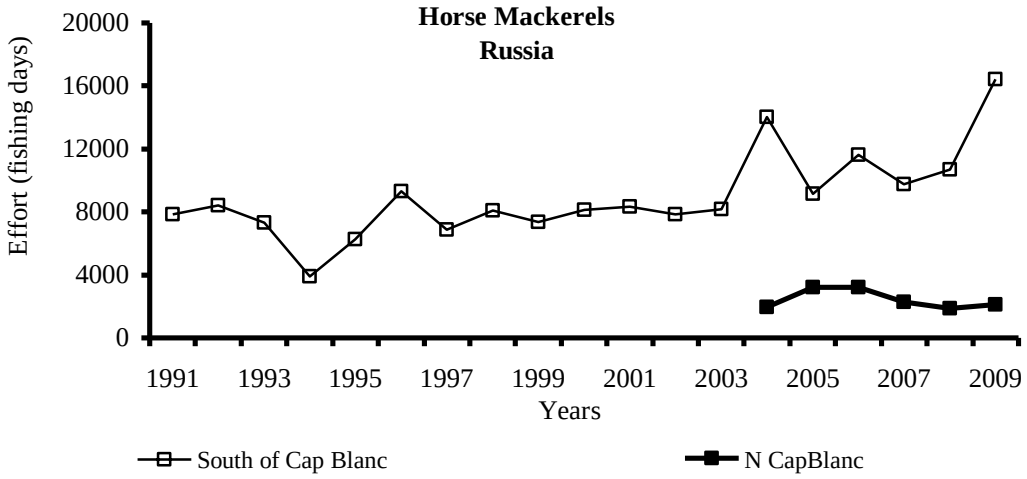


Figure 4.2.2: Effort (fishing days) of the Russian fleet in Mauritania and north of Cap Blanc (1990–2009)/
Effort (jours de pêche) de la flottille russe en Mauritanie et au nord du Cap Blanc (1990-2009)

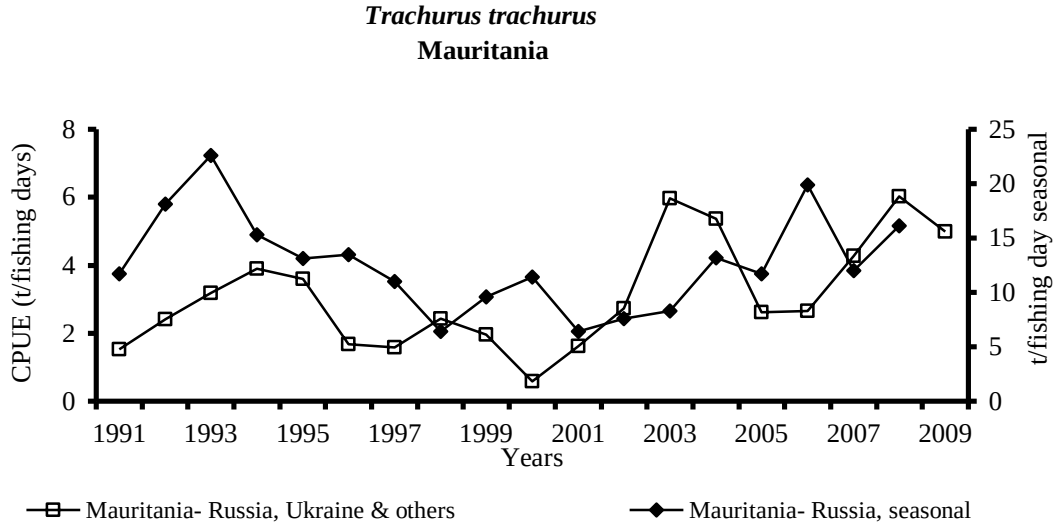


Figure 4.3.1a: CPUE (tonnes/Russian fishing days) of *Trachurus trachurus*, Mauritania (1990–2009)/
CPUE (tonnes/jours de pêche Russie standardisés) de *Trachurus trachurus*, Mauritanie (1990-2009)

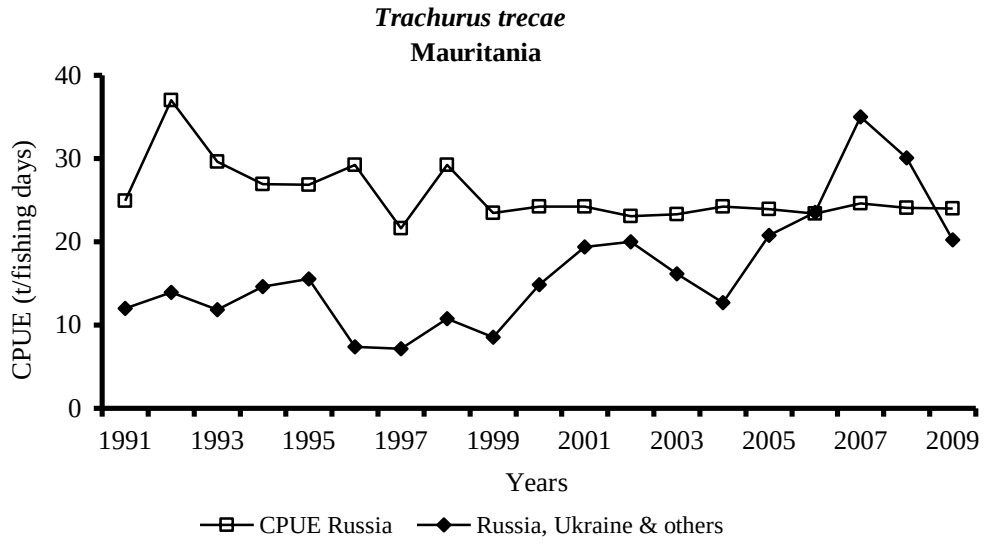


Figure 4.3.1b: CPUE of *Trachurus trecae*, in Mauritania (1990–2009) by Russian fleet/
CPUE de *Trachurus trecae*, en Mauritanie (1990-2009) de la flottille russe

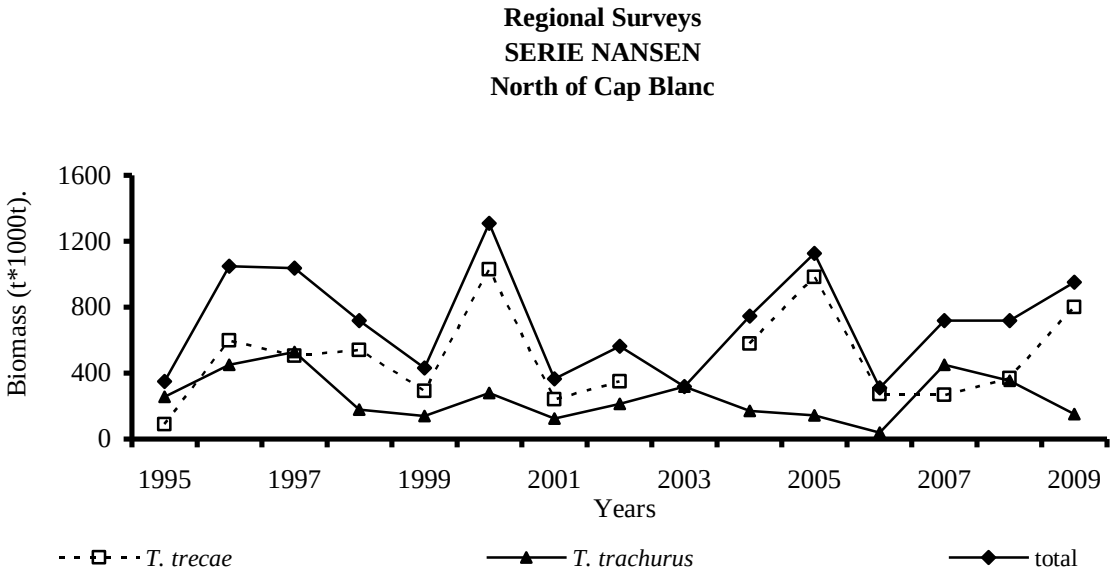


Figure 4.3.2a: Biomass estimates of *Trachurus trachurus* and *T. trecae* (1995–2006) for the zone north of Cap Blanc, R/V DR. FRIDTJOF NANSEN (Nov.–Dec.) and R/V AL AMIR (2007–2009) corrected/
Estimations de la biomasse de *Trachurus trachurus* et *T. trecae* (1995-2006) pour la zone au nord du Cap Blanc, N/R DR. FRIDTJOF NANSEN (nov.-déc.) et N/R AL AMIR (2007-2009) corrigée

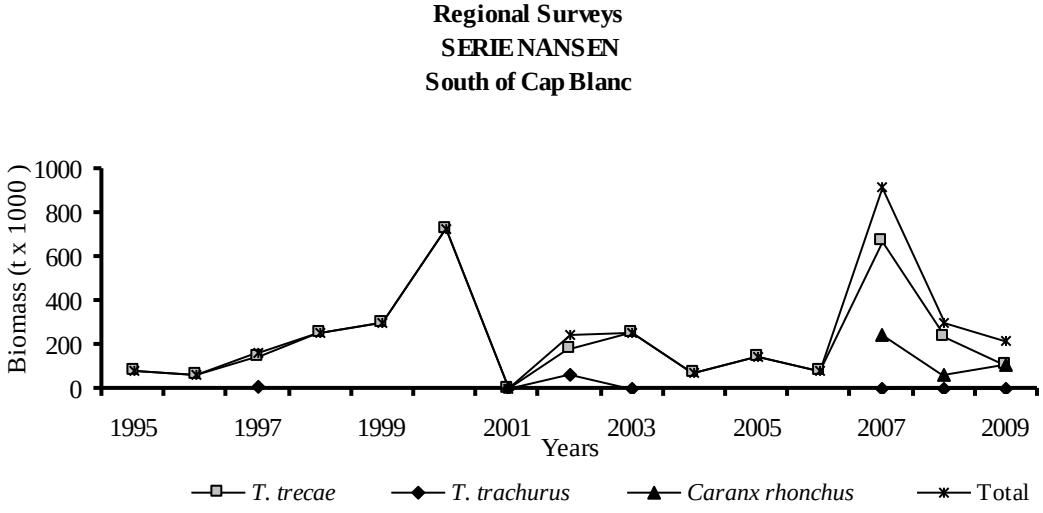


Figure 4.3.2b: Biomass estimates of *Carangidae* (1995–2006) for Mauritania, R/V DR. FRIDTJOF NANSEN (Nov.–Dec.) and R/V AL AWAM (2007–2009)/
Estimations de la biomasse de *Trachurus trachurus* et *T. trecae* (1995-2006) en Mauritanie, N/R DR. FRIDTJOF NANSEN (nov.-déc.) et N/R AL AMAM (2007-2009) corrigée

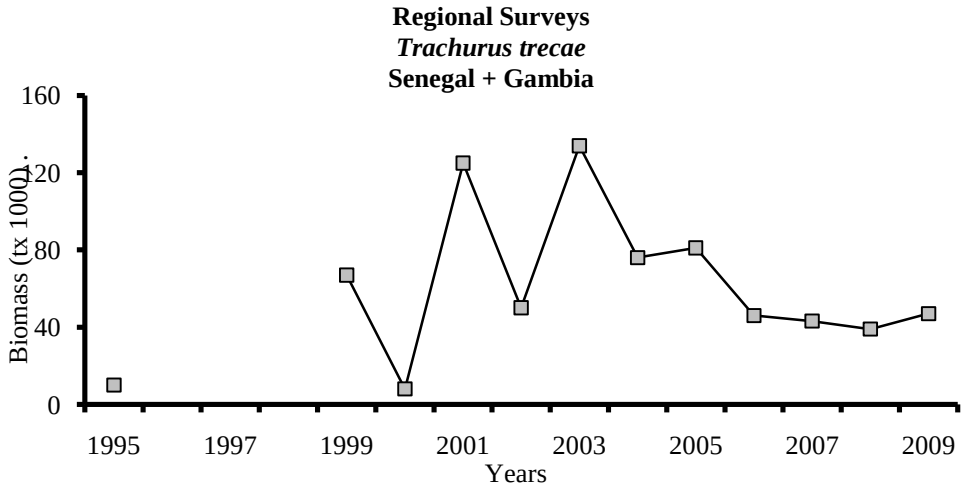


Figure 4.3.2c: Biomass estimates of *Trachurus trecae* (1995–2006) for Senegal and Gambia, R/V DR. FRIDTJOF NANSEN (Nov.–Dec.) and R/V ITAF DEME 2007–2009. *No survey in Senegal–Gambia/
Estimations de la biomasse de *Trachurus trecae* (1995-2006) au Sénégal et en Gambie, N/R DR. FRIDTJOF NANSEN (nov.-déc.) et N/R ITAF DEME 2007-2009. *Pas de campagne au Sénégal et en Gambie

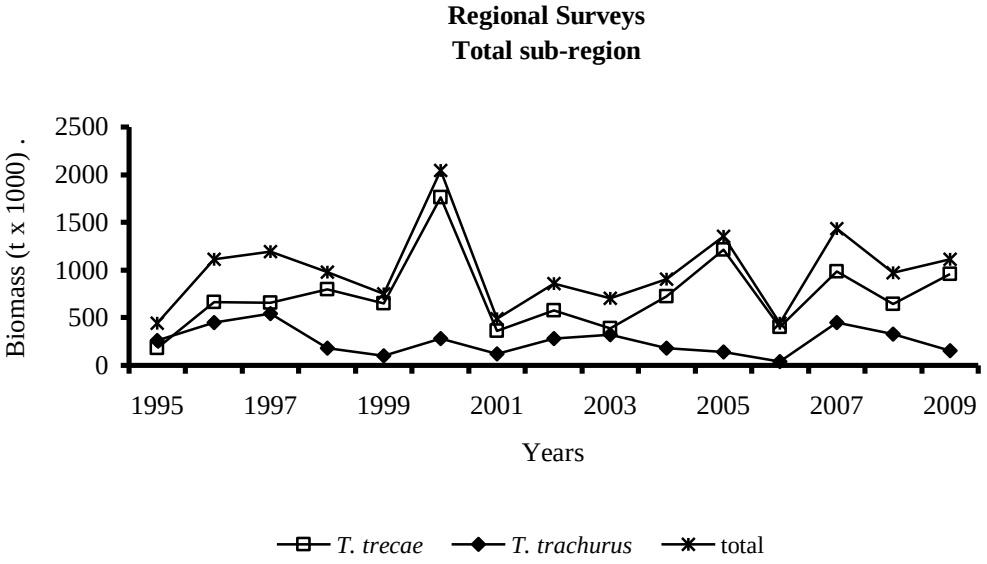


Figure 4.3.2d: Biomass estimates of *Trachurus trecae* and *T. trachurus* (1995–2006) for total subregion by R/V DR. FRIDTJOF NANSEN (Nov.–Dec.) and national R/Vs for 2007–2008 corrected and 2009 estimates by the other R/Vs/
Estimations de la biomasse de *Trachurus trachurus* et *T. trecae* (1995-2006) pour toute la sous-région, N/R DR. FRIDTJOF NANSEN (nov.-déc.) et navires de recherche nationaux 2007-2008 corrigée et 2009 estimation à partir des autres N/R

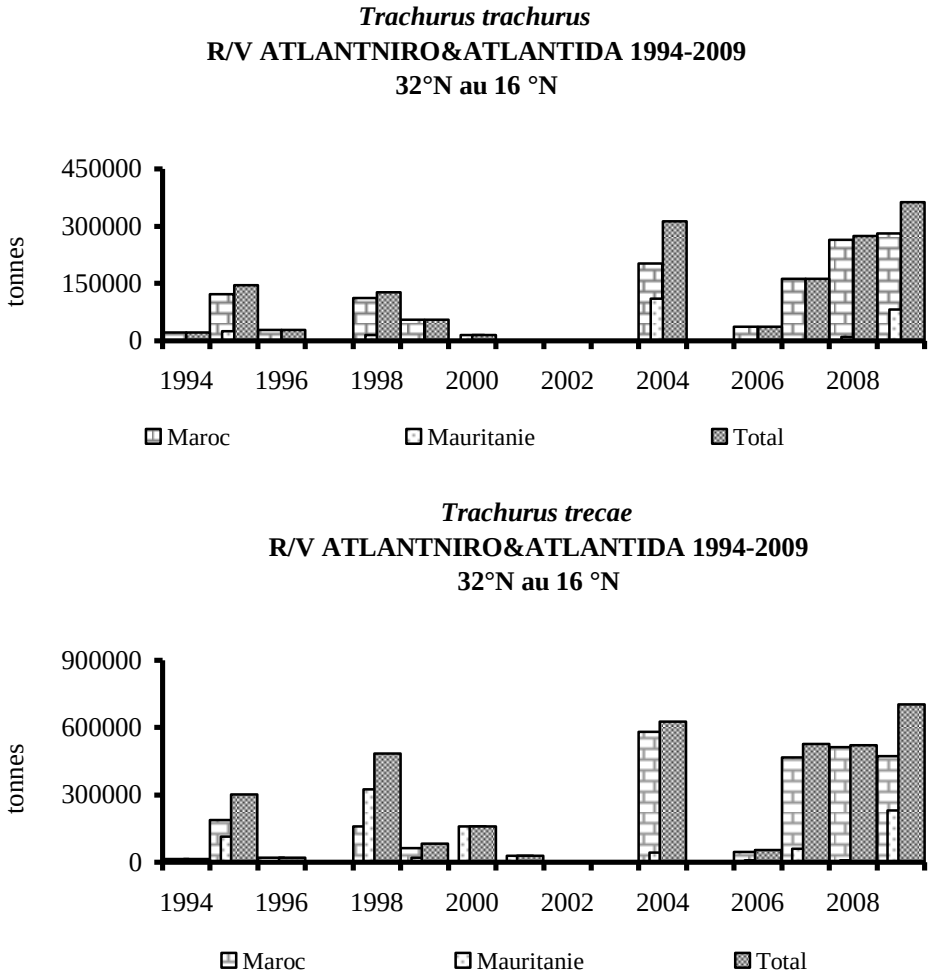
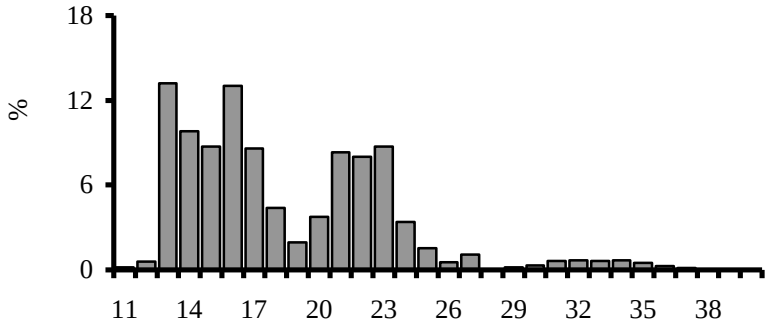


Figure 4.3.2e: Biomass estimates of carangids (1994–2009) by R/V ATLANTNIRO and ATLANTIDA from 32°N to 16°N/
Estimations de la biomasse des chinchards (1994-2009) de 32°N à 16°N, N/R ATLANTNIRO et ATLANTIDA

Trachurus trachurus
North Cap Blanc 2009



Trachurus trachurus
South Cap Blanc 2009

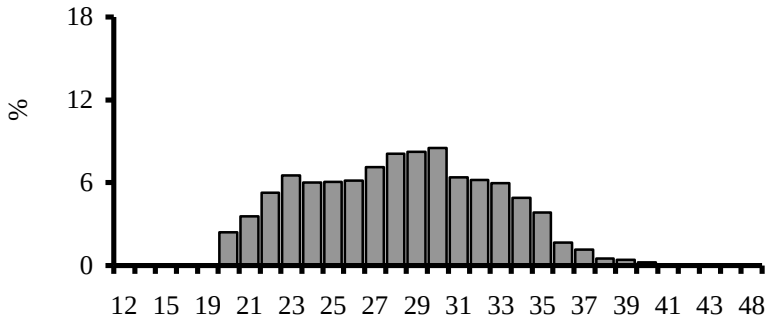
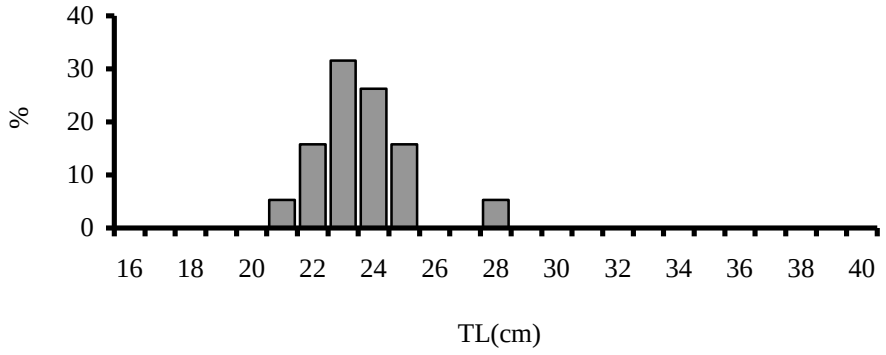


Figure 4.5.1a: Catch length distribution in percentage of *Trachurus trachurus* from Russian fleet in Zone C in 2009/
Composition en taille des captures de *Trachurus trachurus* de la flottille russe en pourcentage en 2009 dans la zone C

Trachurus trecae
North Cap Blanc 2009



Trachurus trecae
South Cap Blanc 2009

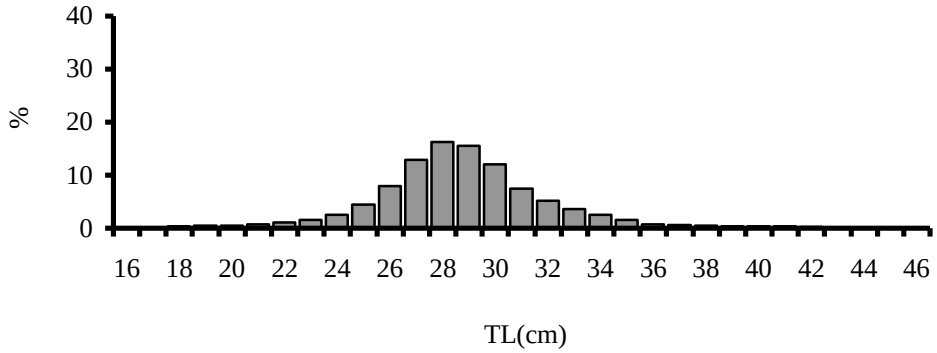


Figure 4.5.1b: Length distribution of catches in percentage of *Trachurus trecae* from Russian fleet in Zone C in 2009/
Composition par tailles des captures de *Trachurus trecae* de la flottille russe en pourcentage en 2009 dans la zone C

Caranx ronchus
Senegal 2009

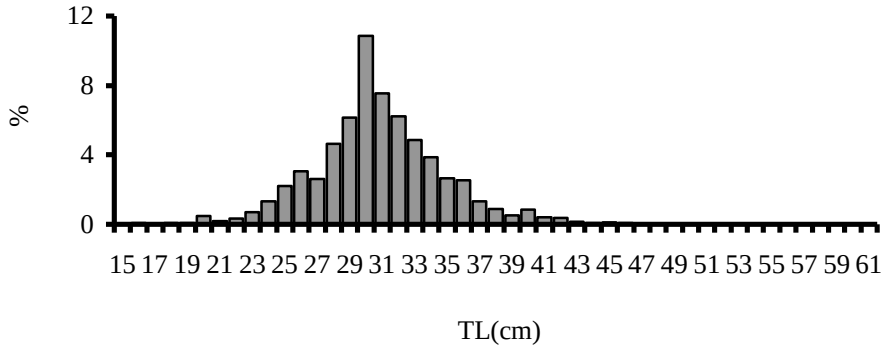
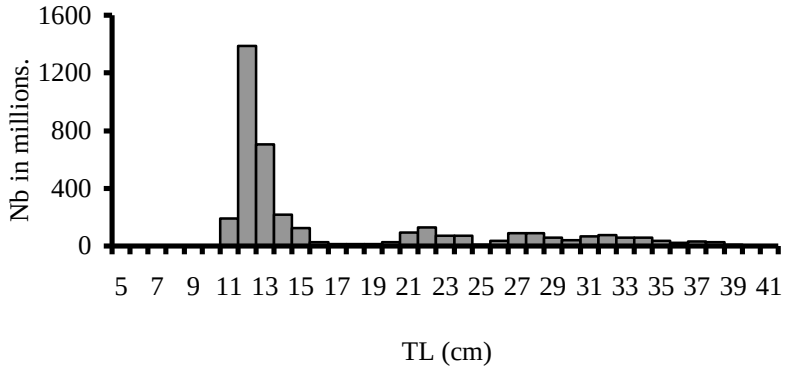


Figure 4.5.1c: Length composition of *Caranx rhonchus* of artisanal landings of Senegalese fleet in 2009/
Composition par tailles des captures artisanales de *Caranx rhonchus* de la flottille sénégalaise en 2009

Trachurus trachurus
North of Cap Blanc
R/V ATLANTIDA July 2009



Trachurus trecae
North of Cap Blanc
R/V ATLANTIDA July 2009

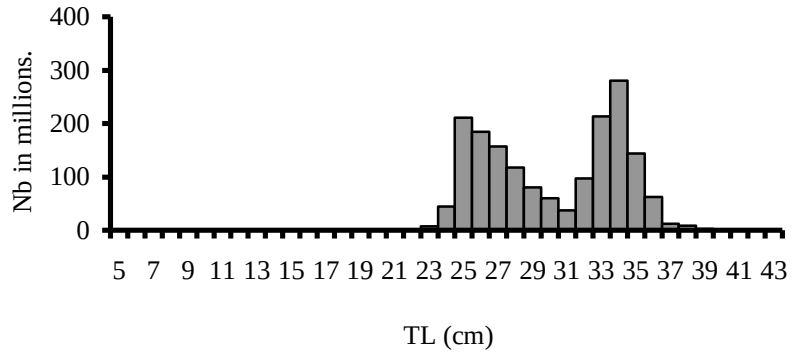


Figure 4.5.1d: Length composition (in millions of individuals) for *Trachurus trachurus* et *Trachurus trecae* in July 2009 by R/V ATLANTIDA/ Composition par tailles (en millions) de *Trachurus trachurus* et *Trachurus trecae* en juillet 2009 – N/R ATLANTIDA

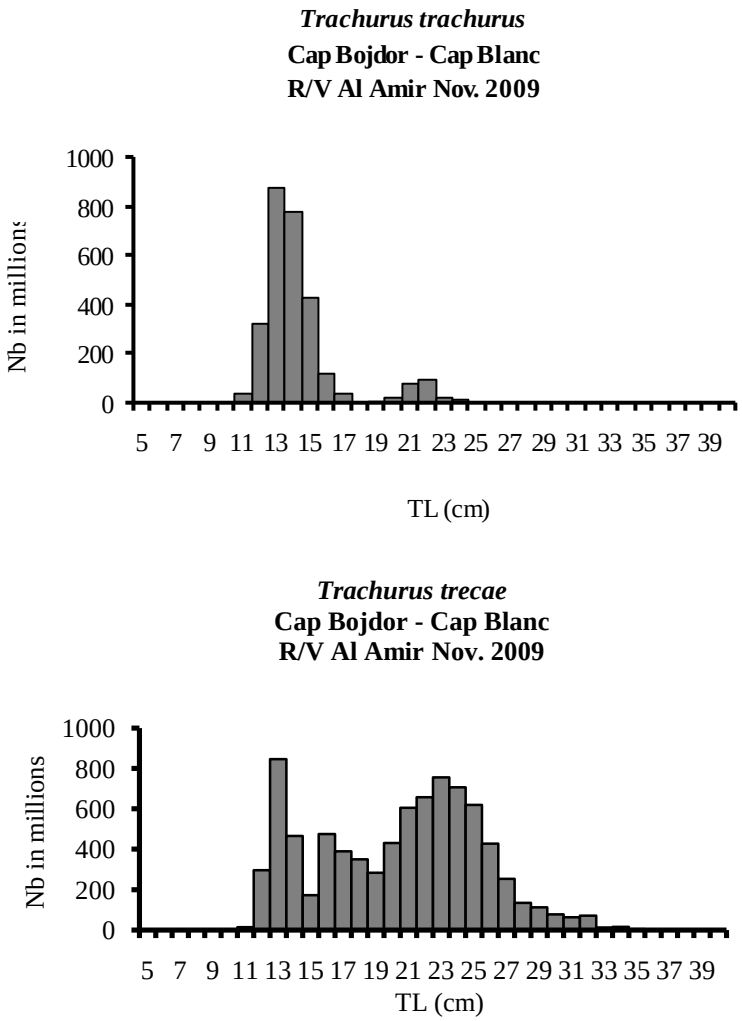
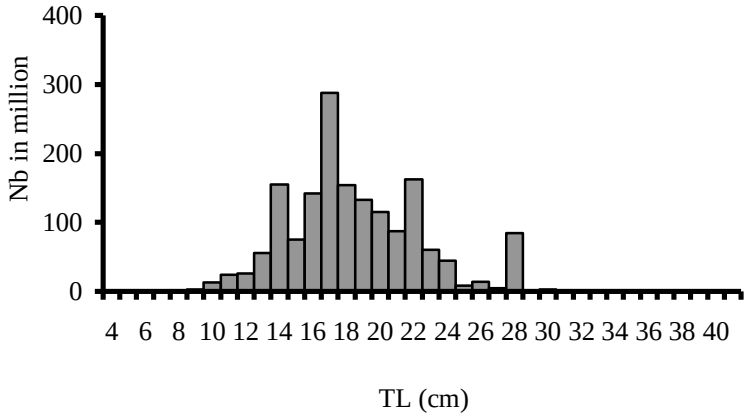


Figure 4.5.1e: Length composition (in millions of individuals) for *Trachurus trachurus*. and *T. trecae* (November 2009), R/V AL AMIR MOULAY ABDALLAH/
Composition par tailles (en millions) de *Trachurus trachurus* et *T. trecae* (novembre 2009), N/R AL AMIR MOULAY ABDALLAH

Trachurus tracae
Saint Louis - Cap Blanc
R/V AL AWAM Nov. 2009



Caranx rhonchus
Saint Louis - Cap Blanc
R/V AL AWAM Nov. 2009

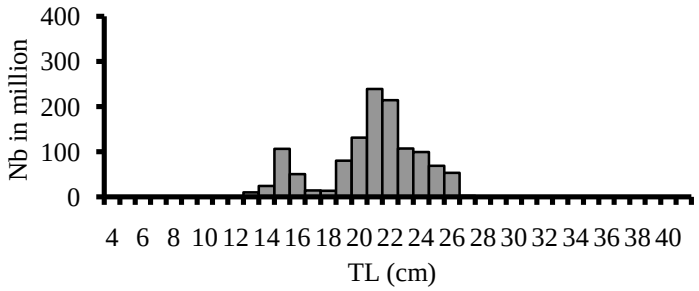


Figure 4.5.1f: Length composition (in millions of individuals) for *Trachurus trecae* and *Caranx rhonchus* (November 2009), R/V AL AWAM/ Composition par tailles (en millions) de *Trachurus trecae* et *Caranx rhonchus* (novembre 2009), N/R AL AWAM

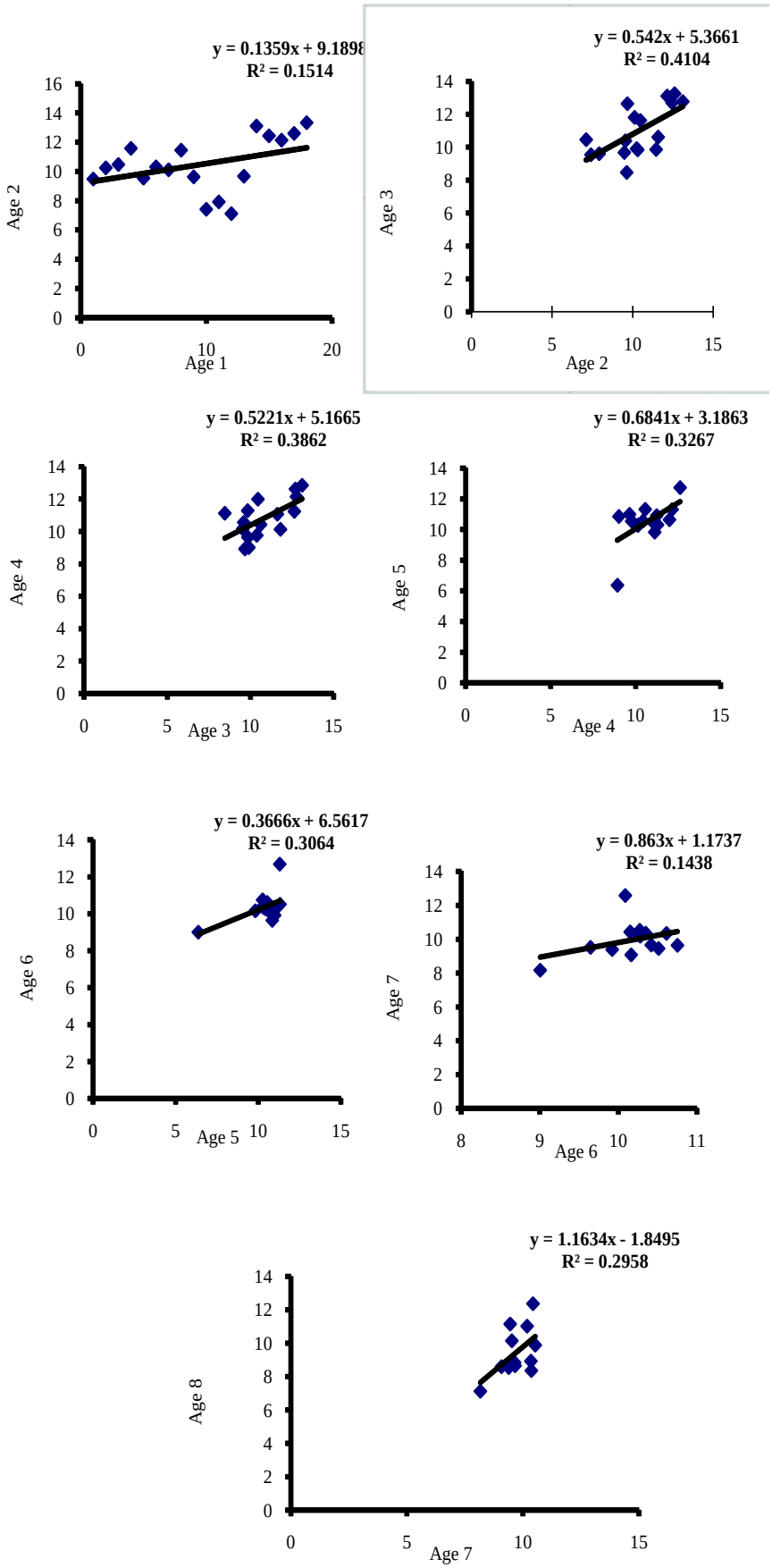


Figure 4.6.1: Exploratory analyses of the age data for *Trachurus trachurus* in 2009
Analyses exploratoires des données d´âge de *Trachurus trachurus* in 2009

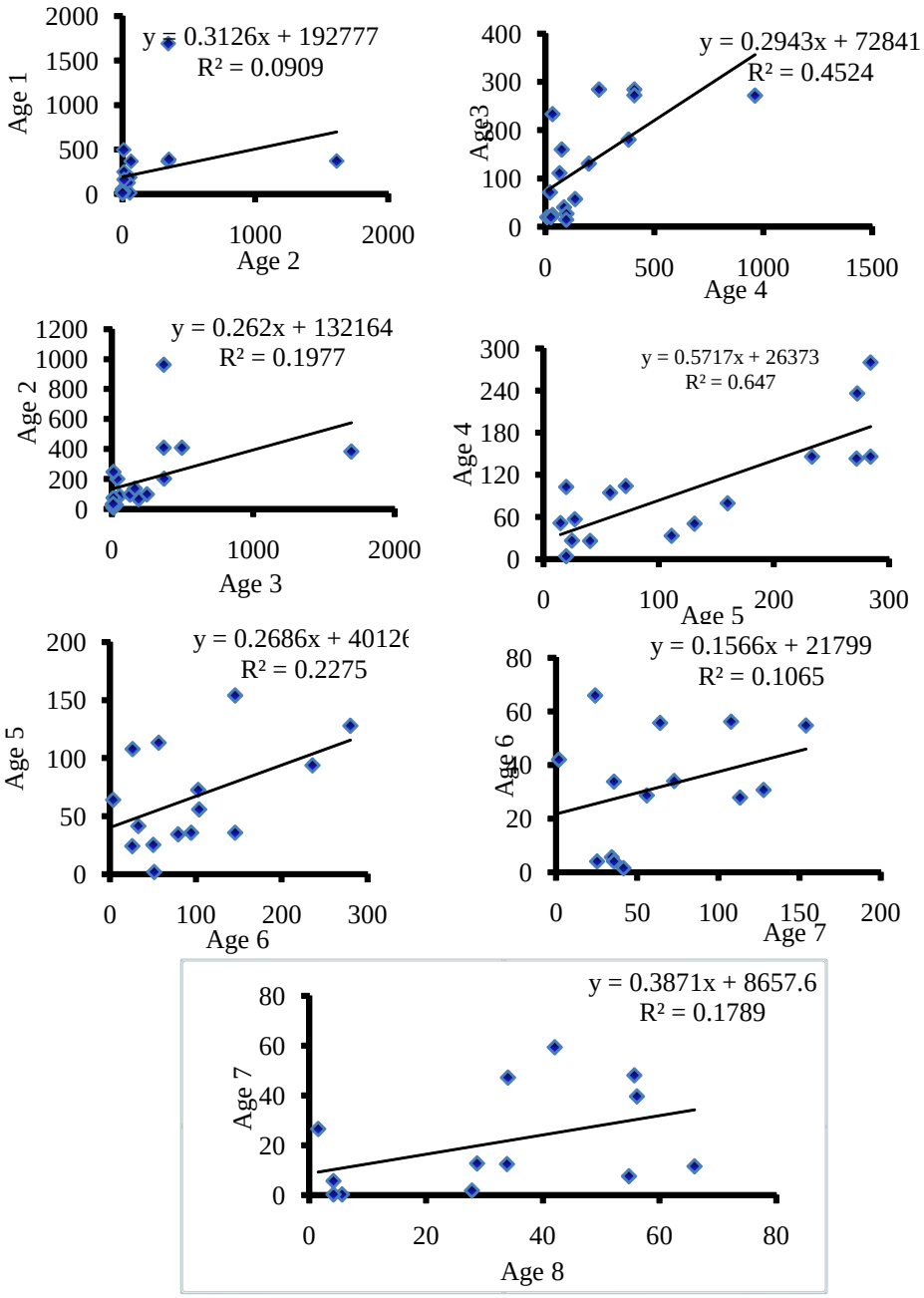


Figure 4.6.2: Exploratory analyses of the age data for *Trachurus trecae*
Analyses exploratoires des données d´âge de *Trachurus trecae*

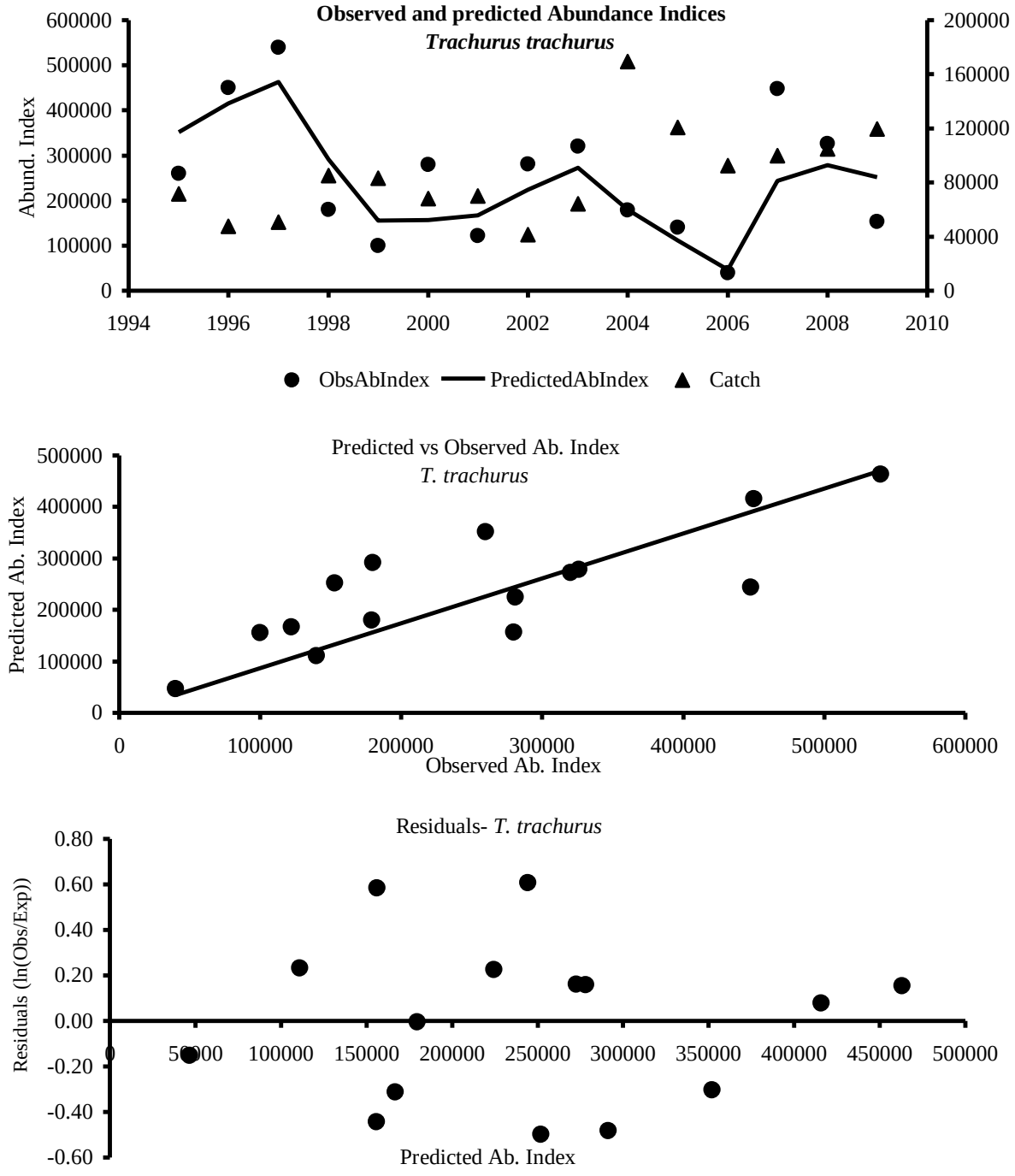


Figure 4.6.3: Observed and predicted abundance indices for *T. Trachurus* using biomass estimates from R/V DR. FRIDTJOF NANSEN and coordinated national surveys and diagnostics of the model fit/
Indices d'abondance observés et prévus pour *T. Trachurus* en utilisant les estimations de biomasse du N/R DR. FRIDTJOF NANSEN, les campagnes de recherche nationales coordonnées et les diagnostics du modèle

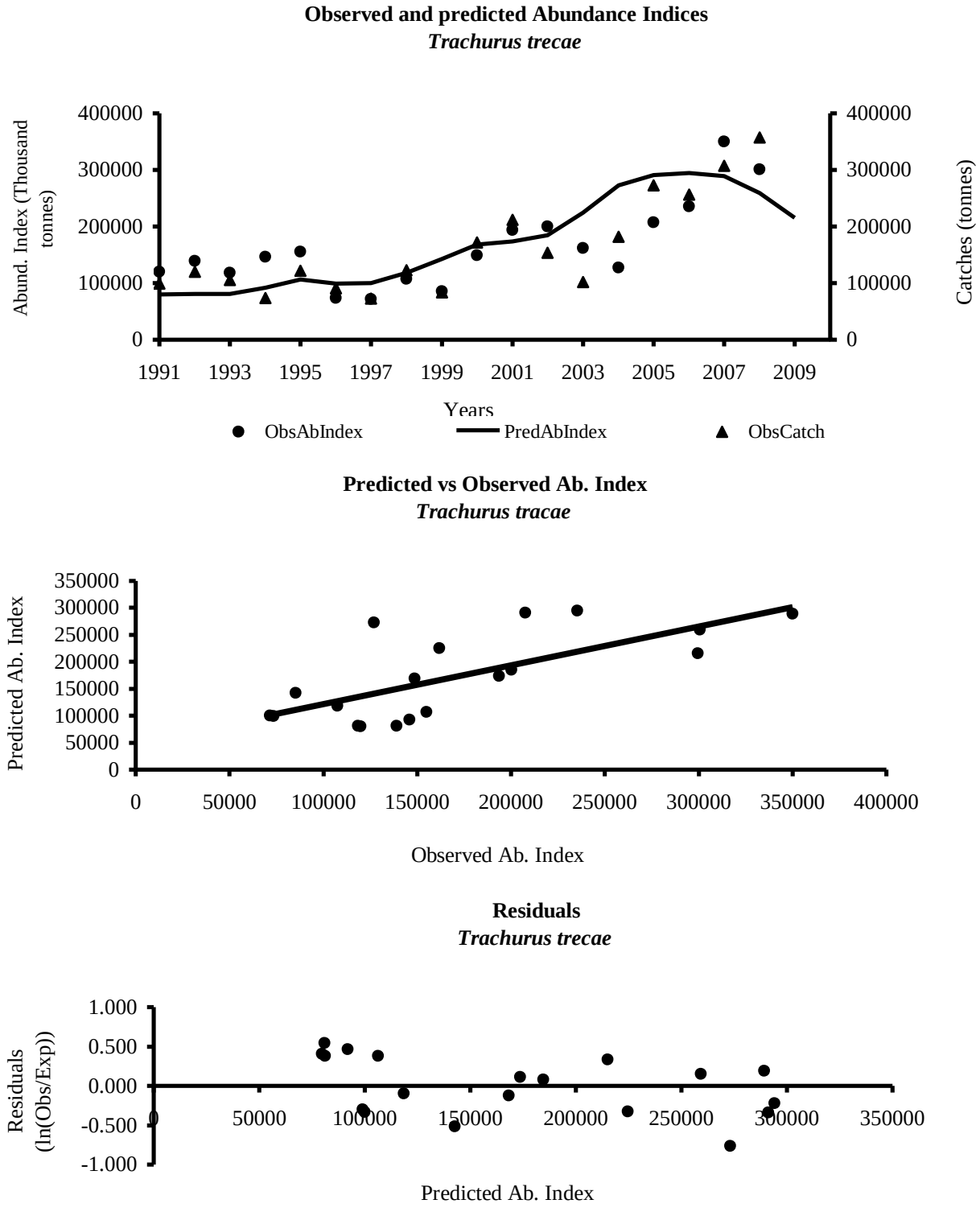


Figure 4.6.4a: Observed and predicted abundance indices for *T. trecae* using biomass estimates from NANSEN series and diagnostics of the model fit/
Indices d'abondance observés et prévus pour *T. trecae* en utilisant les estimations de biomasse de la série NANSEN et les diagnostics du modèle

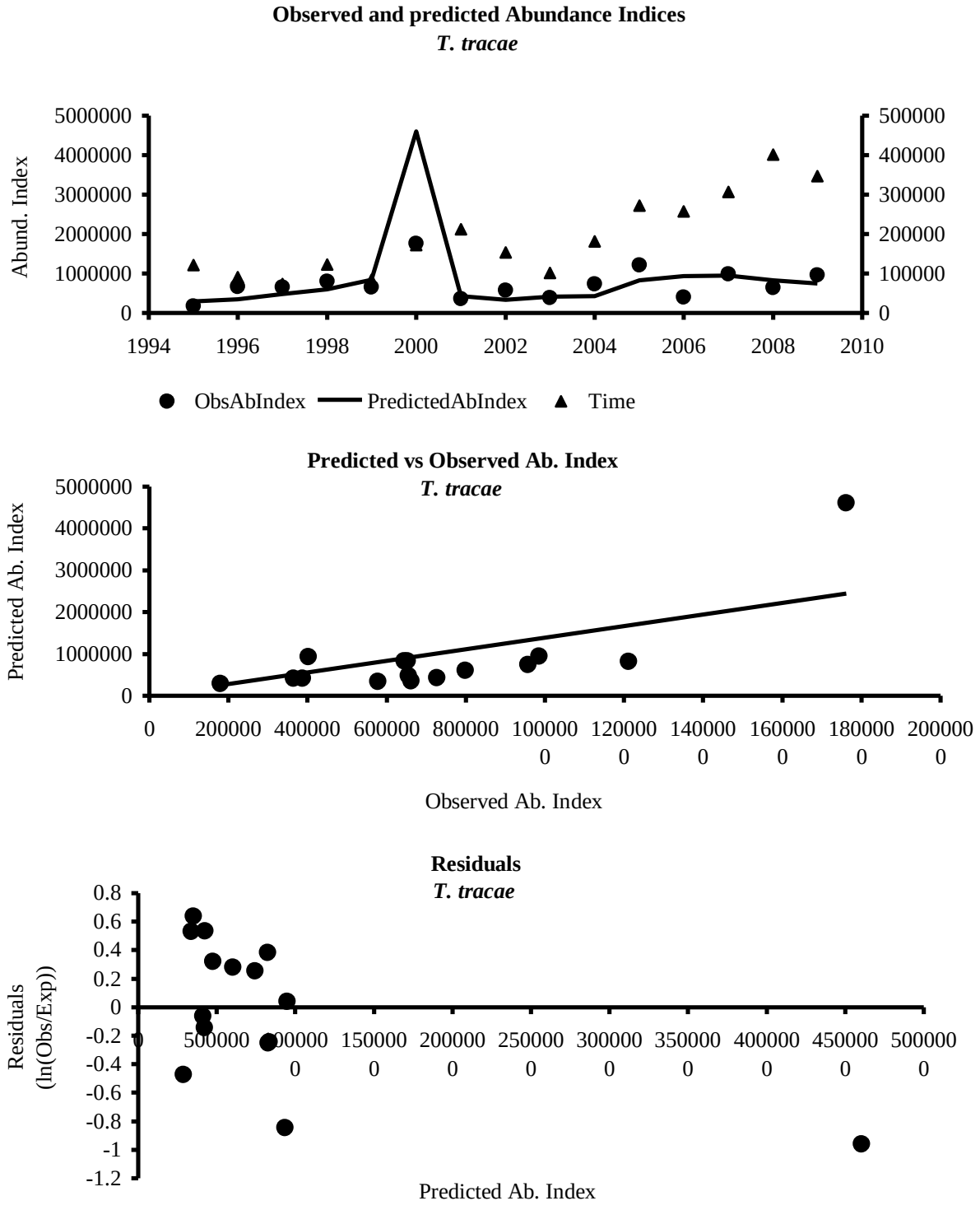
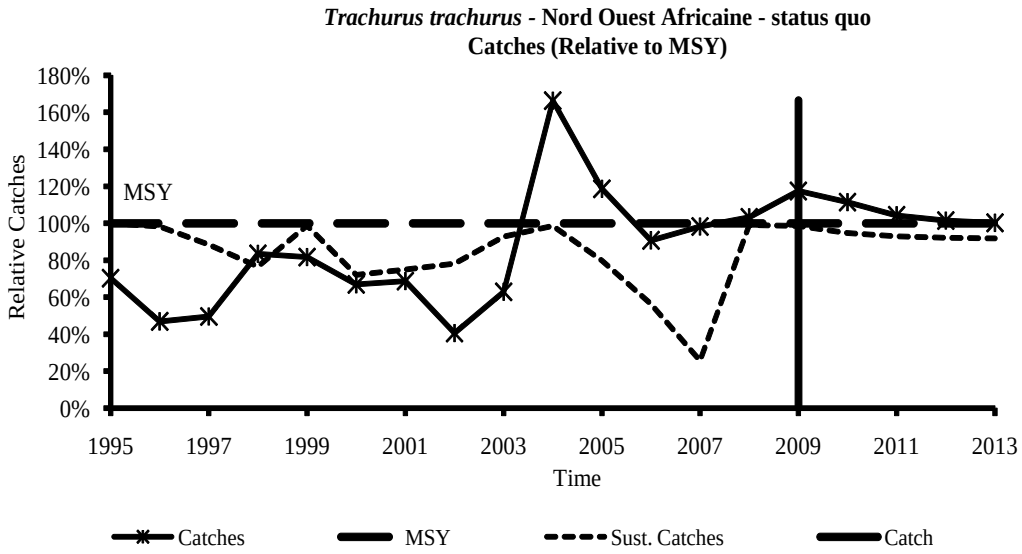


Figure 4.6.4b: Observed and predicted abundance indices for *T. trecae* using biomass estimates from Russian CPUE series and diagnostics of the model fit/
Indices d'abondance observés et prévus pour *T. trecae* en utilisant les estimations de biomasse de la série russe et les diagnostics du modèle



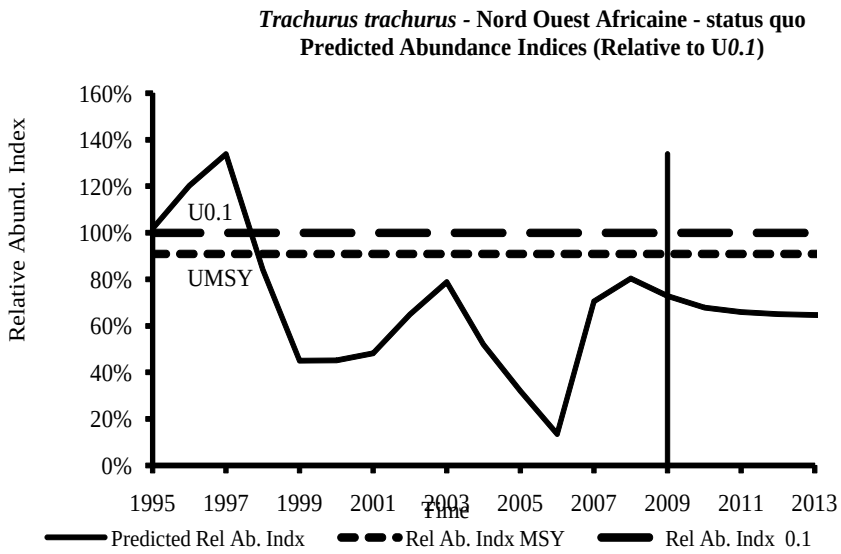
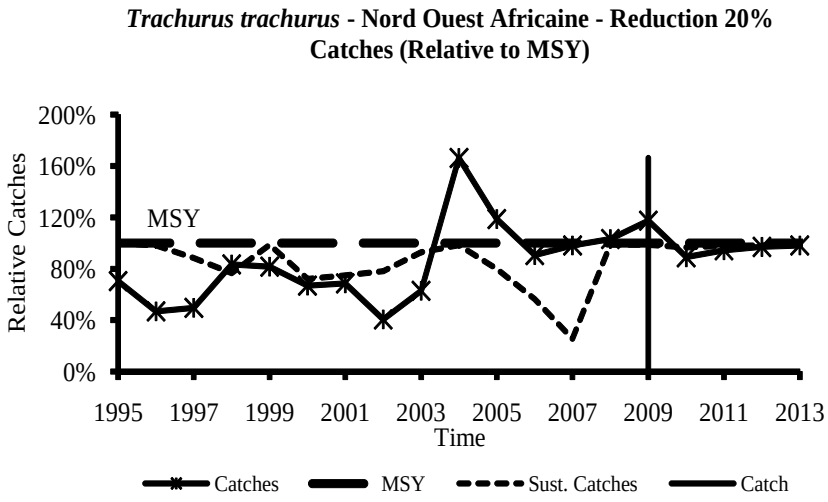


Figure 4.7.1a: Projected trends in catches and abundance of *T. trachurus* – Scenario I (status quo)/
Prédiction des tendances dans les captures et de l'abondance pour *T. trachurus* – Scénario I (status quo)



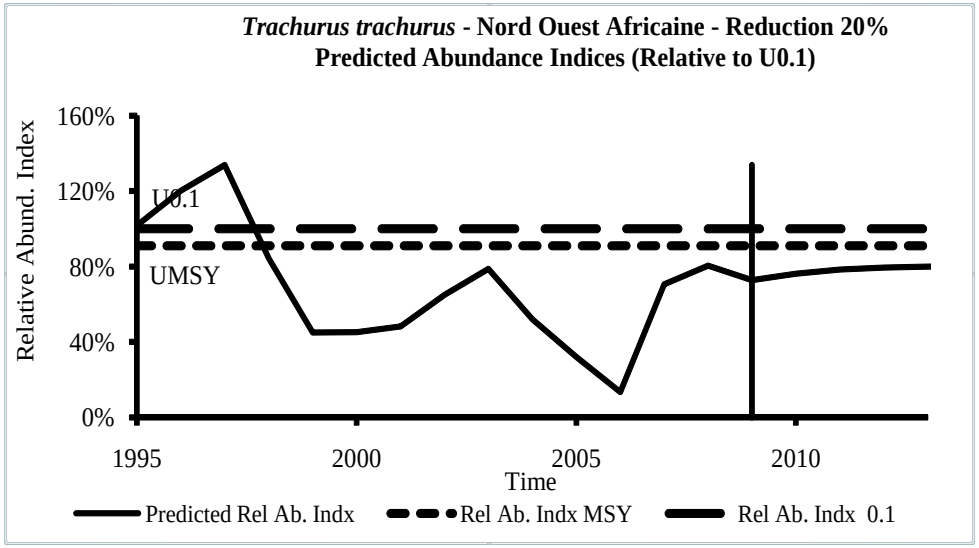
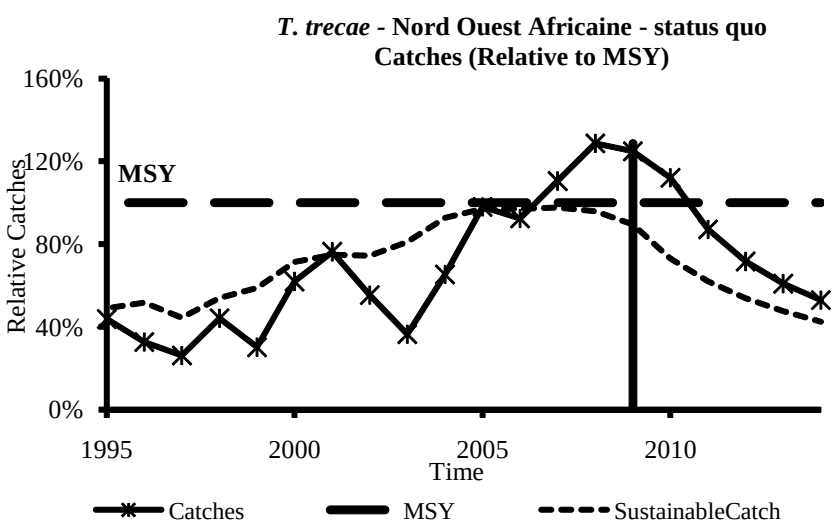
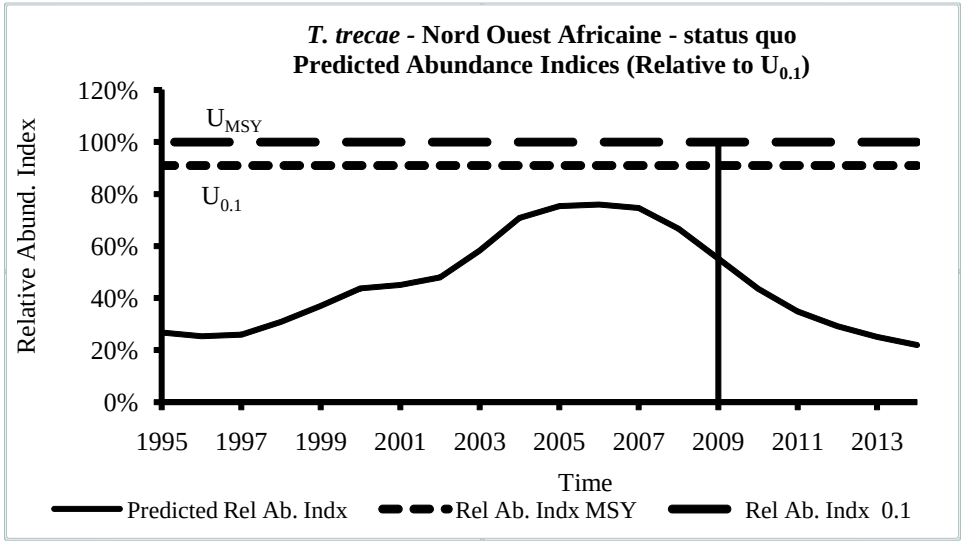
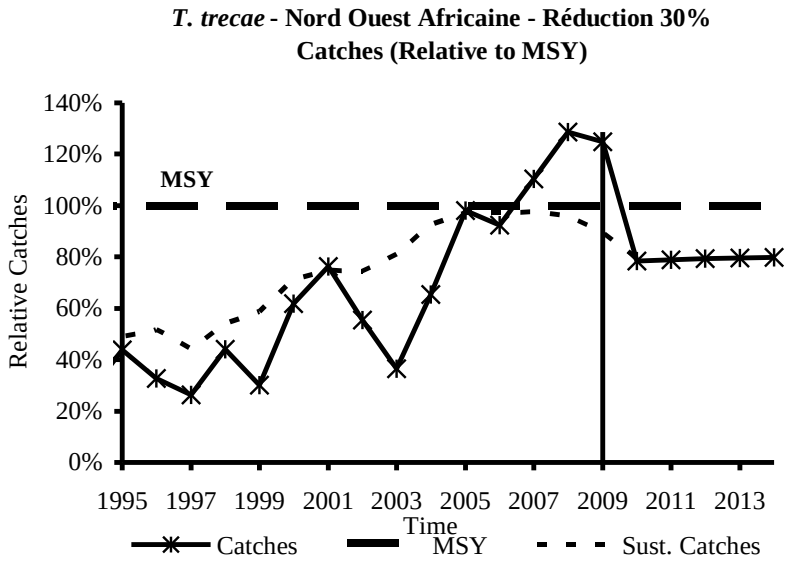


Figure 4.7.1b: Projected trends in catches and abundance of *T. trachurus* – Scenario II (20 percent decrease in effort)/
Projection des tendances dans les captures et de l'abondance pour *T. trachurus* – Scénario II (diminution de 20 pourcent de l'effort)





Figures 4.7.2a: Projected trends in catches and abundance of *T. trecae* – Scenario I (status quo)/
Projection des tendances dans les captures et de l'abondance pour *T. trecae* – Scenario I (status quo)



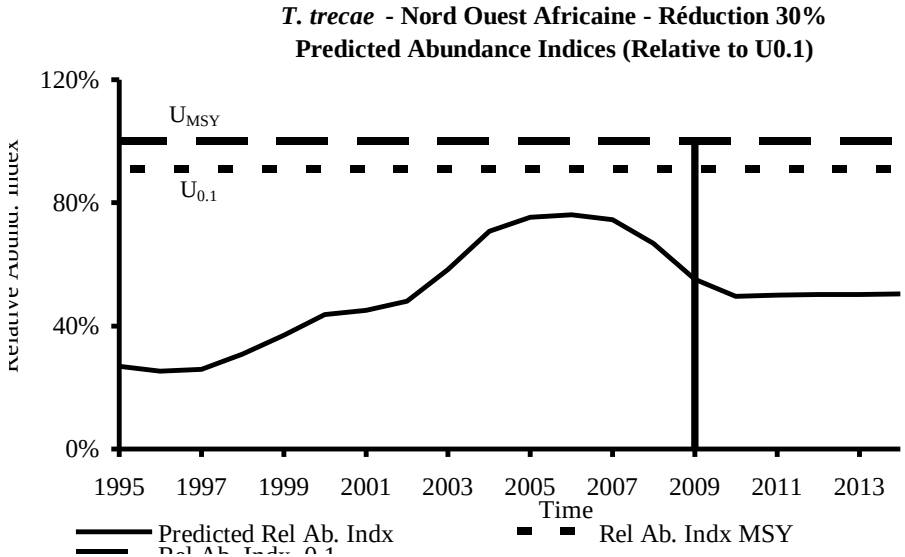


Figure 4.7.2b: Predicted trends in catches and abundance of *T. trecae* – Scenario II (20 percent decrease in effort)/
Projection des tendances dans les captures et de l'abondance pour *T. trecae* – Scénario II (diminution de 20 pourcent de l'effort)

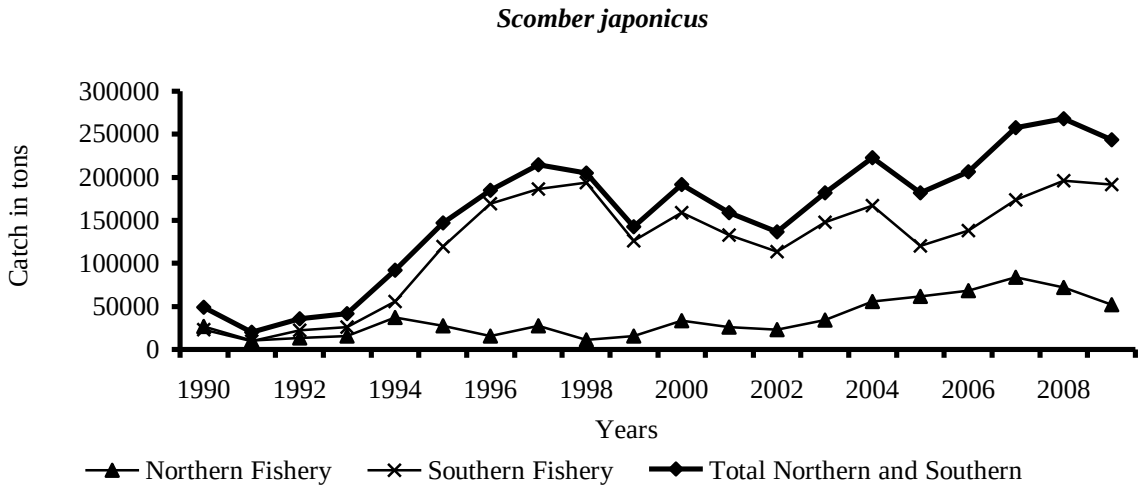


Figure 5.2.1: Total catches (tonnes) of *Scomber japonicus* in the subregion by fishery and year (1990–2009)/ Captures totales (en tonnes) de *Scomber japonicus* dans la sous-région par pêcherie et par année (1990-2009)

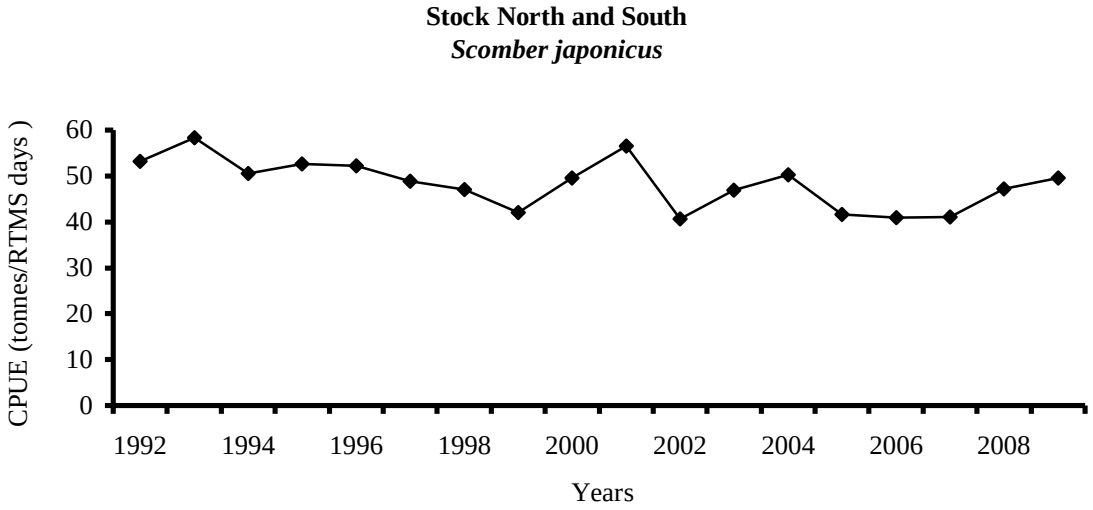


Figure 5.3.1: Standardized CPUE from Russian fleets of *Scomber japonicus*, (tonnes/RTMS day)/ CPUE standardisées de la flottille russe de *Scomber japonicus* (tonnes/jours RTMS)

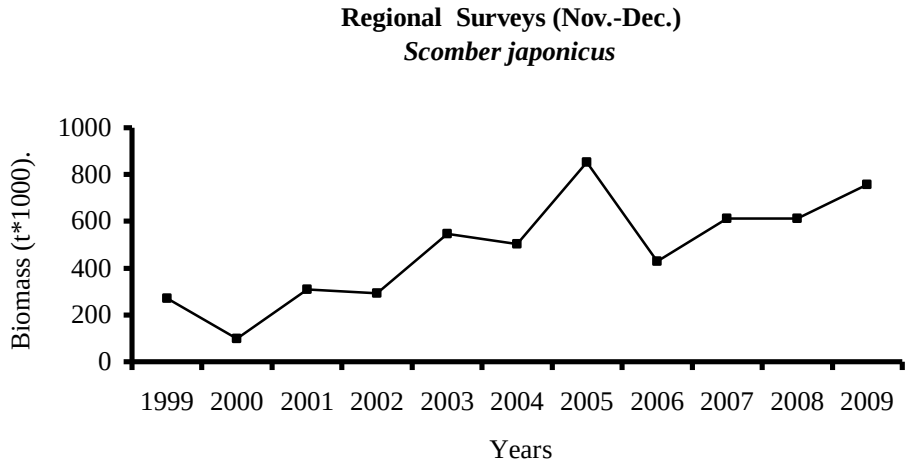


Figure 5.3.2a: Biomass estimates of *Scomber japonicus* by the regional surveys/ Estimations de la biomasse du *Scomber japonicus* à partir des campagnes de recherche régionales

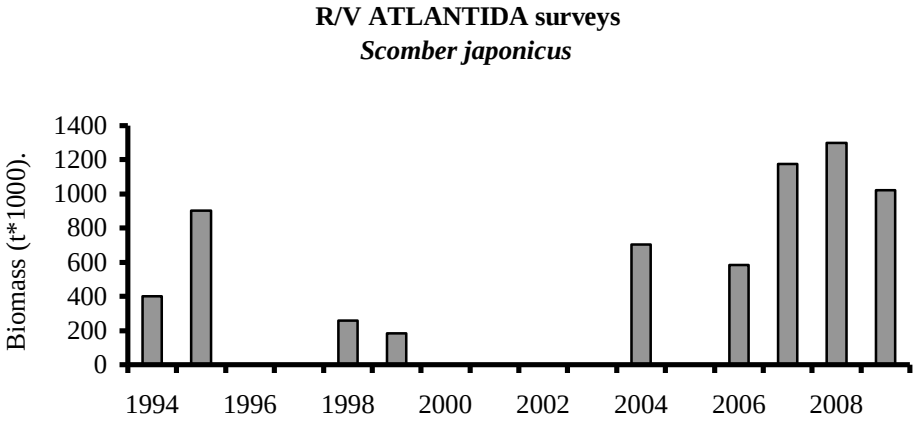


Figure 5.3.2b: Biomass estimates of *Scomber japonicus* from the R/V ATLANTIDA surveys/
Estimations de la biomasse du *Scomber japonicus* à partir des campagnes du N/R ATLANTIDA

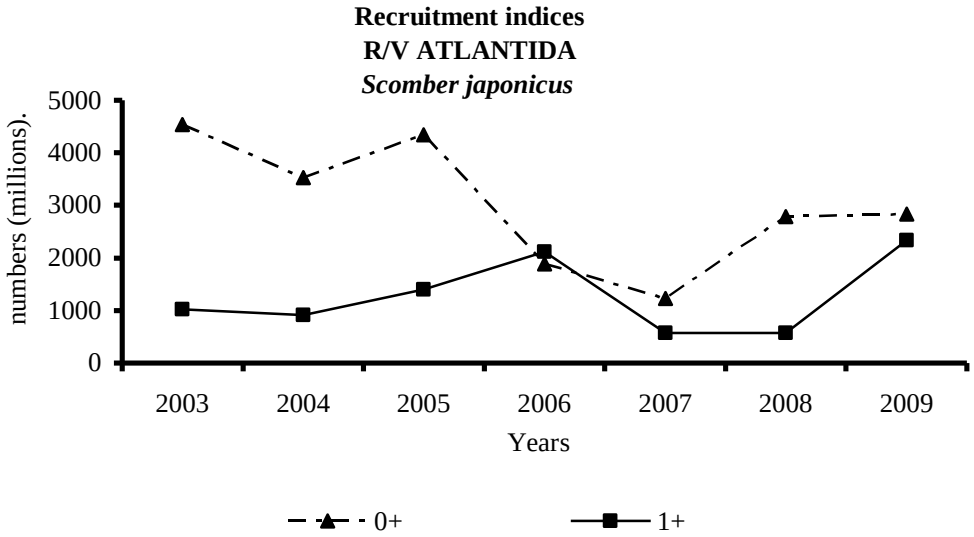


Figure 5.3.2c: Recruitment indices of *Scomber japonicus* from the R/V ATLANTIDA surveys (November–January)/
Estimations des indices de recrutement du *Scomber japonicus* à partir des campagnes de recrutement du N/R ATLANTIDA (novembre-janvier)

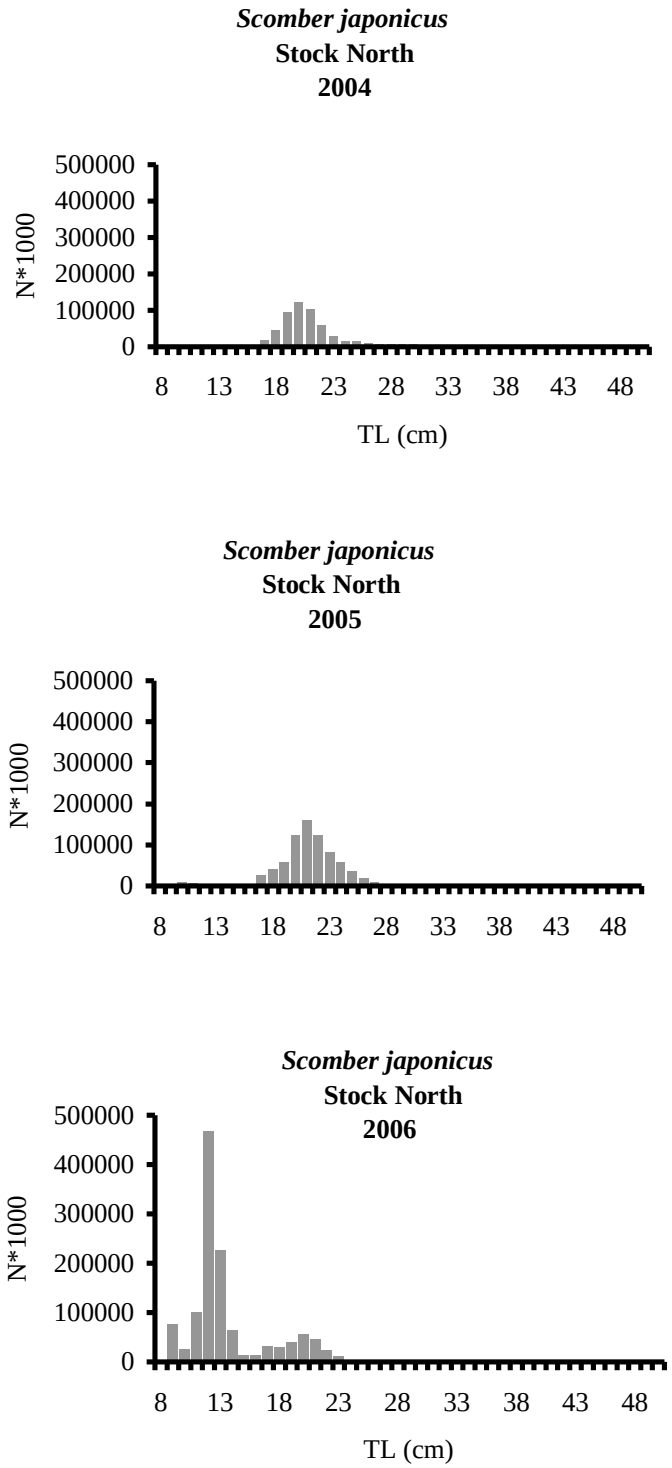
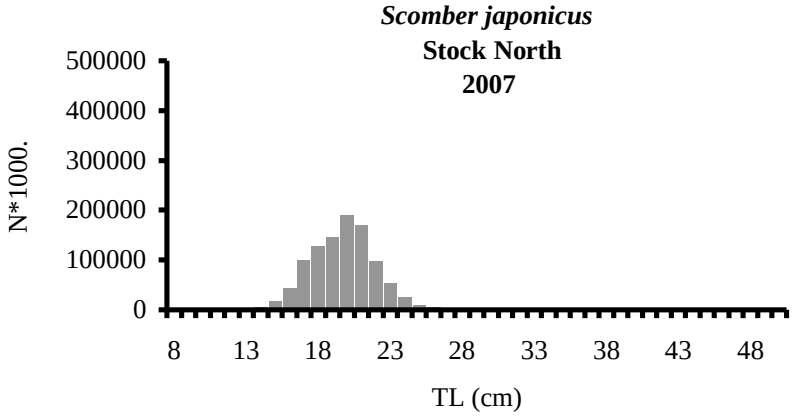
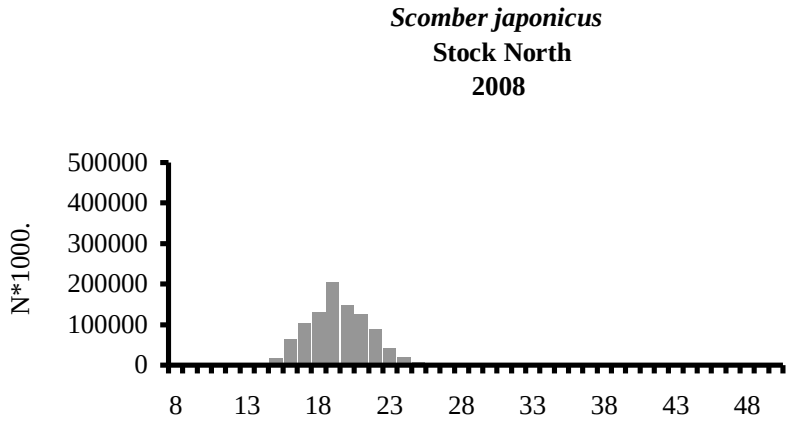


Figure 5.5.1a: Length composition of landings of *Scomber japonicus* in the northern stock/ Composition des tailles dans les débarquements de *Scomber japonicus* dans le stock nord





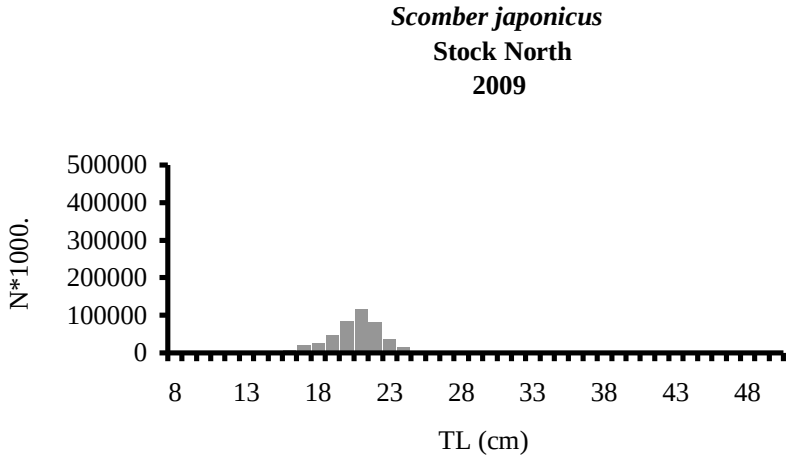


Figure 5.5.1a (cont.): Length composition of landings of *Scomber japonicus* in the northern stock/ Composition des tailles dans les débarquements de *Scomber japonicus* dans le stock nord

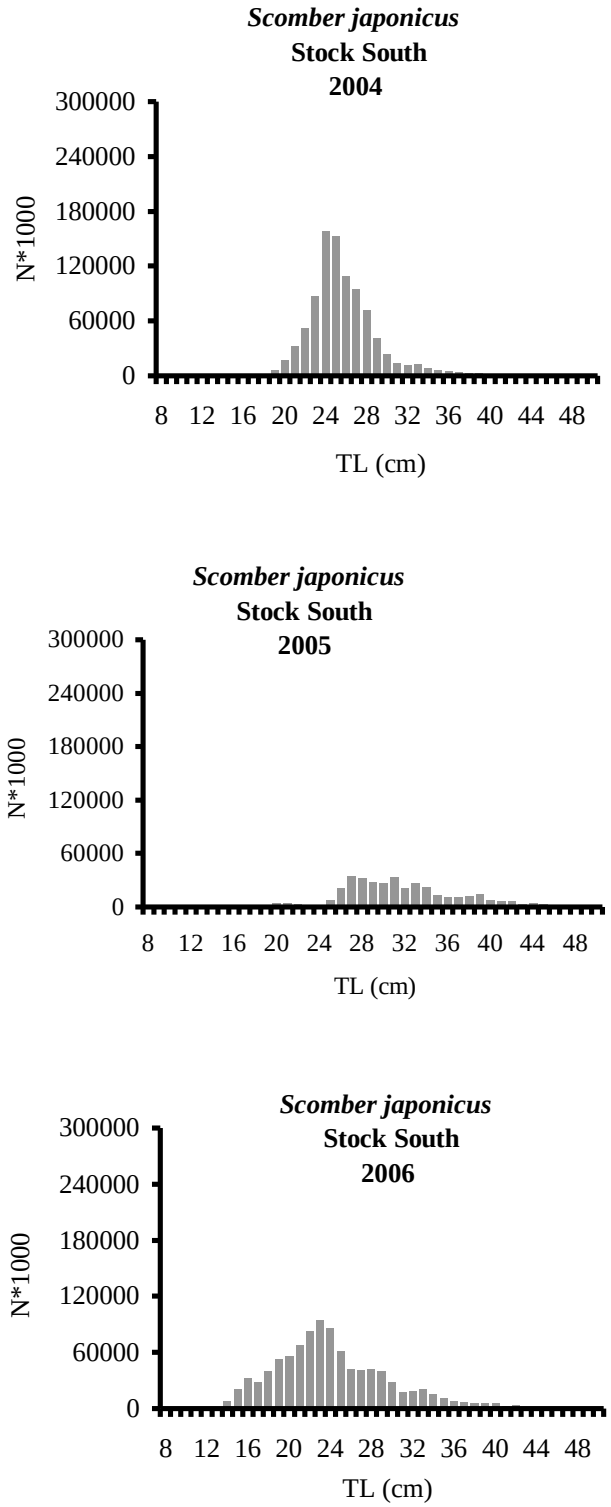
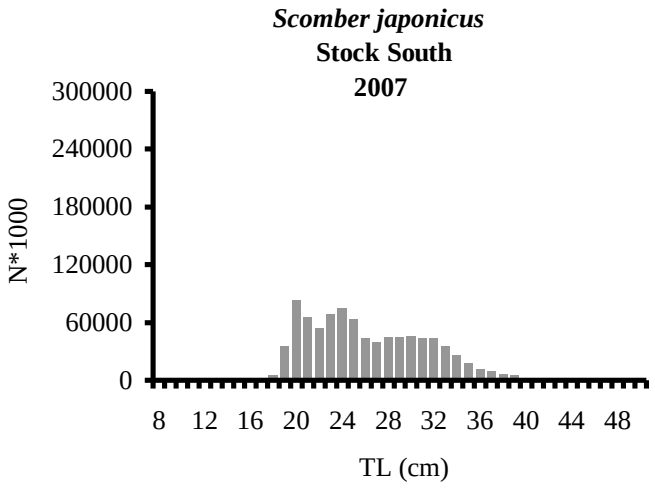
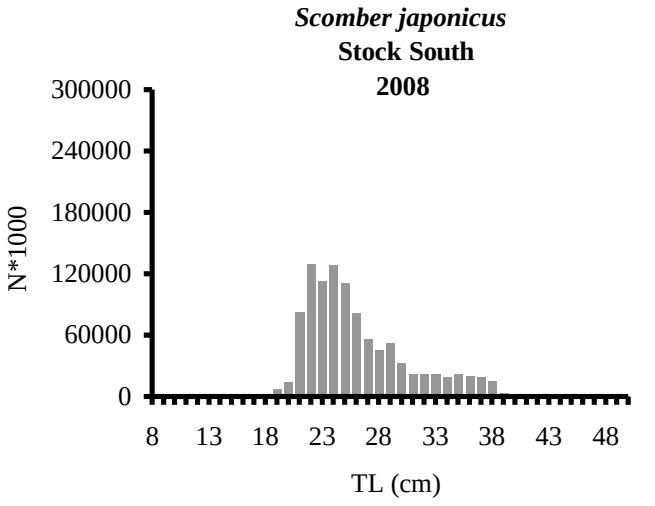


Figure 5.5.1b: Length composition of landings of *Scomber japonicus* in the southern stock/ Composition des tailles dans les débarquements de *Scomber japonicus* dans le stock sud





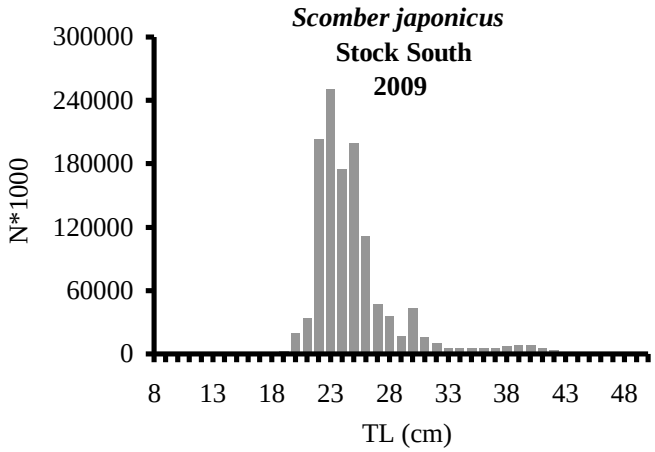


Figure 5.5.1b (cont.): Length composition of landings of *Scomber japonicus* in the southern stock/
Composition des tailles dans les débarquements de *Scomber japonicus* dans le stock sud

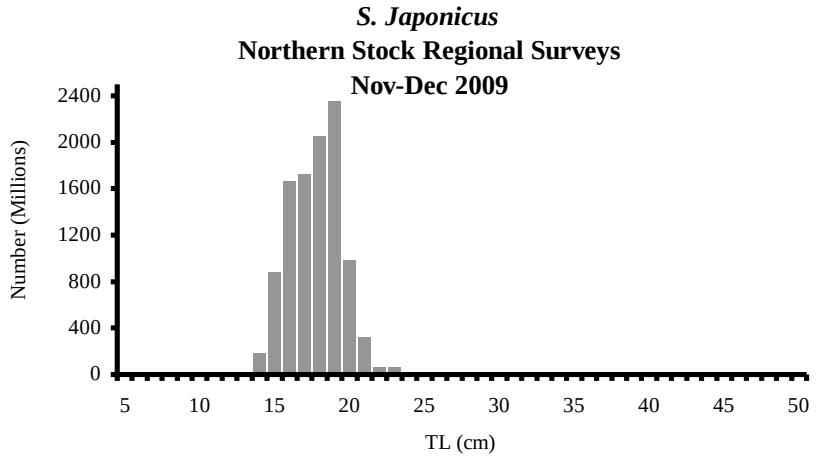


Figure 5.5.2a: Length composition of *Scomber japonicus* in the northern stock from the coordinated surveys/(in millions of fish)/
Composition des tailles de *Scomber japonicus* dans le stock nord à partir des campagnes coordonnées (en millions de poissons)

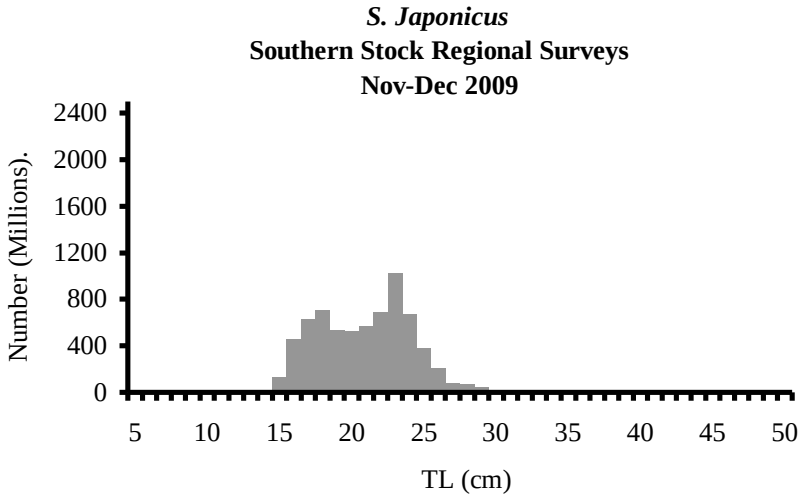


Figure 5.5.2b: Length composition of *Scomber japonicus* in the southern stock from the coordinated surveys/(in millions of fish)/
Composition des tailles de *Scomber japonicus* dans le stock sud à partir des campagnes coordonnées (en millions de poissons)

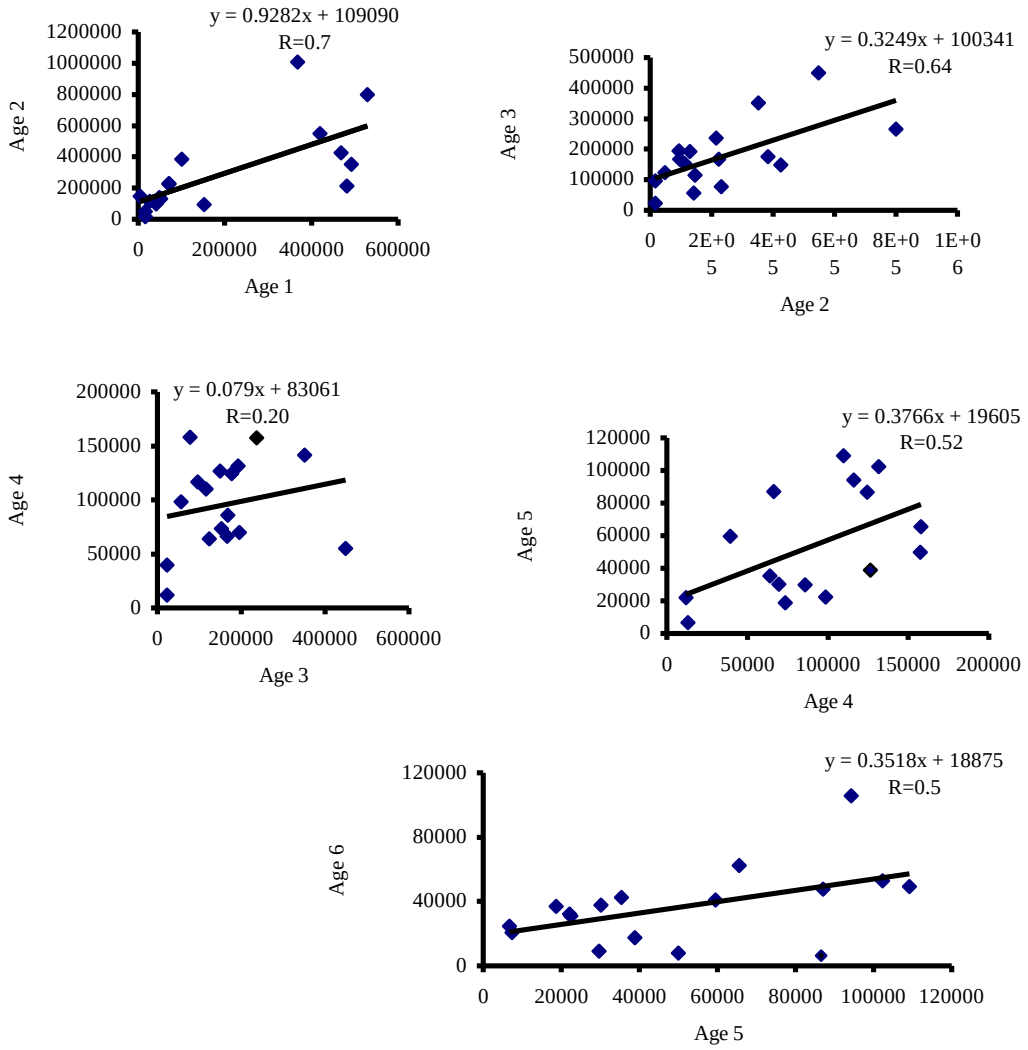


Figure 5.6.1: Exploratory analyses of the data for *Scomber japonicus* stock north + south/ Analyses exploratoires des données de *Scomber japonicus* stock nord + sud

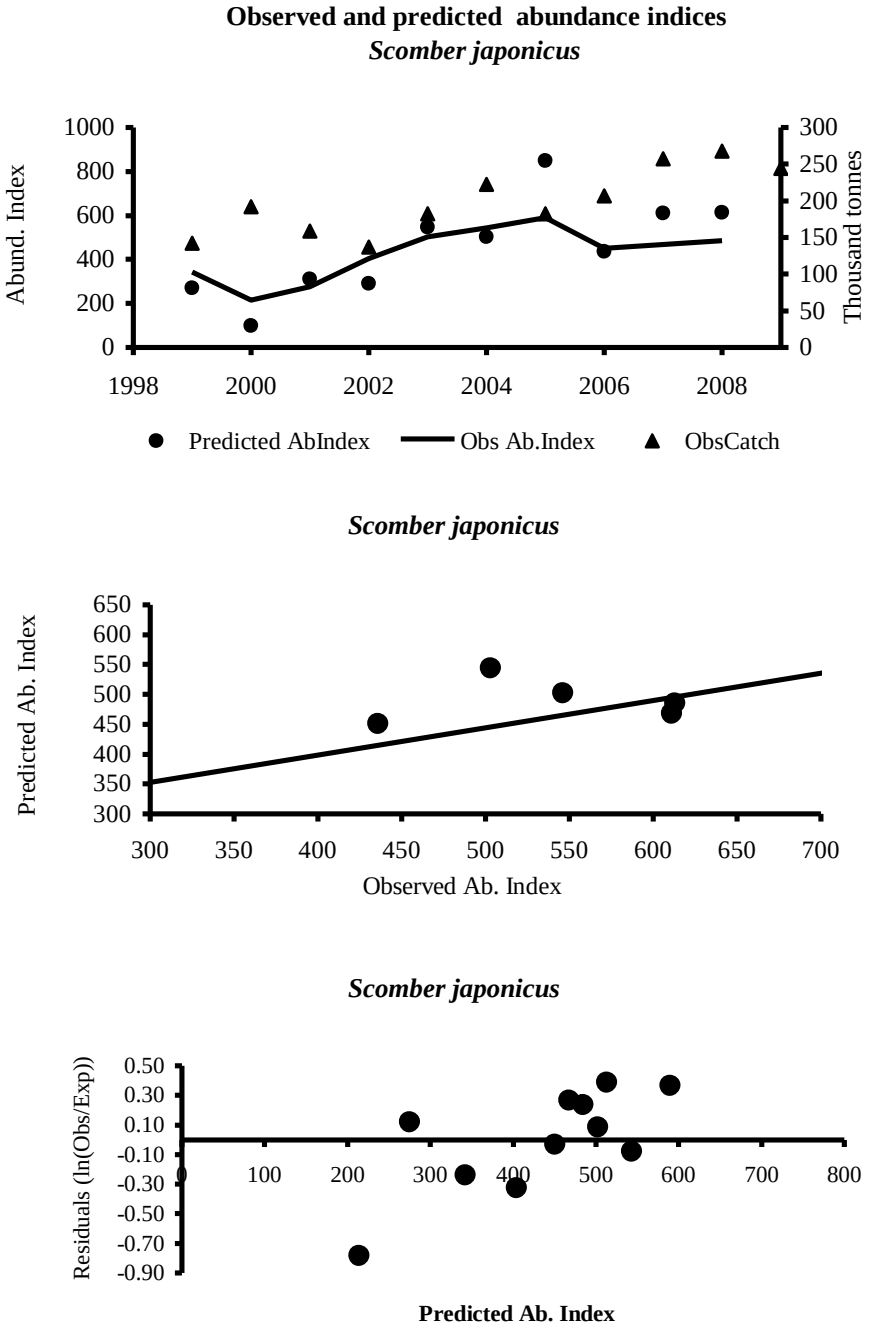


Figure 5.6.2: Observed and predicted abundance indices for *Scomber japonicus* using biomass estimates from R/V DR. FRIDTJOF NANSEN and coordinated national surveys and diagnostics of the model fit/
Indices d'abondance observés et prévus pour *Scomber japonicus* à partir des estimations de biomasse du N/R DR. FRIDTJOF NANSEN et des campagnes de recherche nationales coordonnées ainsi que des diagnostics du modèle

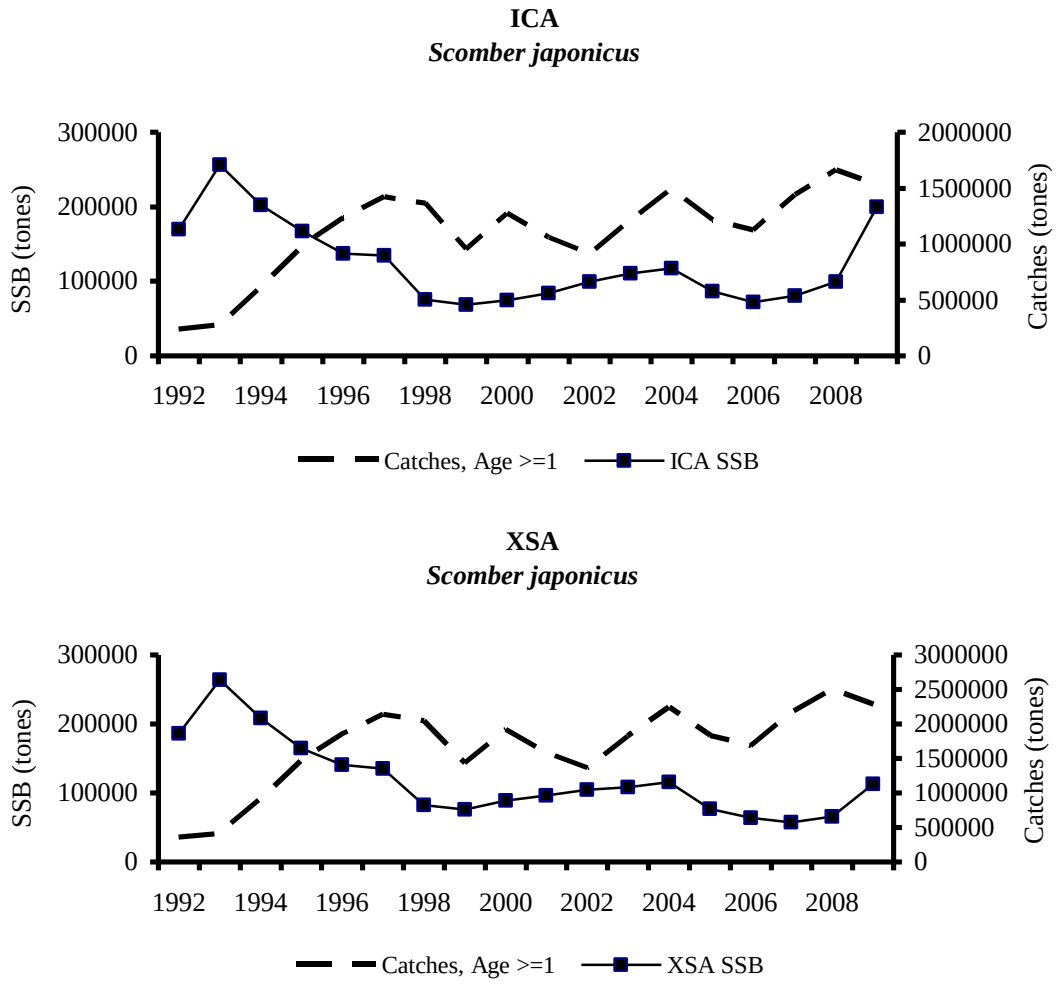


Figure 5.6.3: Observed catches and predicted biomass for *Scomber japonicus* using the models ICA and XSA/
Indices d'abondance observés et prévus pour *Scomber japonicus* en utilisant les modèles ICA et XSA

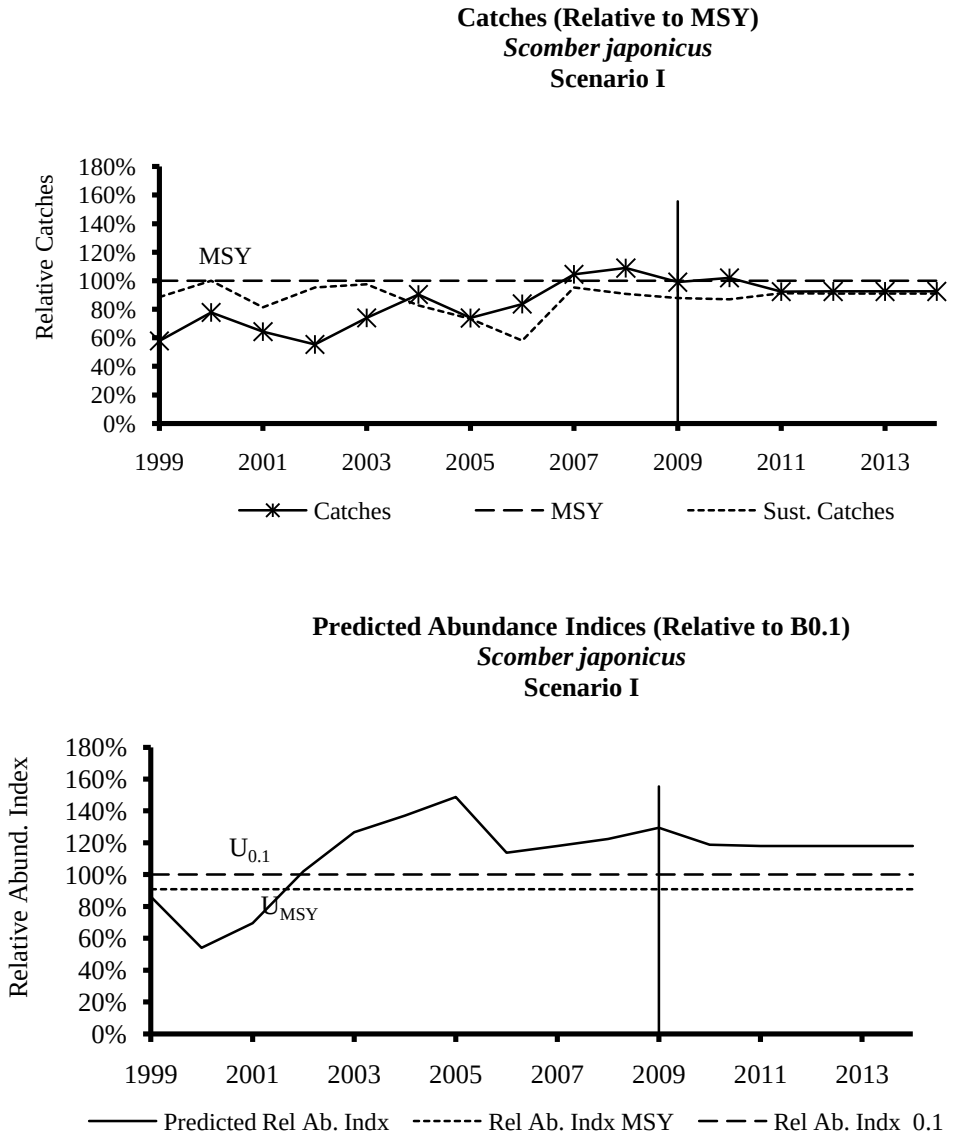


Figure 5.7.1a: Predicted catches and abundance of *Scomber japonicus* in stock north and south – Scenario I (status quo)/
Prédictions des captures et de l'abondance de *Scomber japonicus* dans le stock nord et sud – Scénario I (status quo)

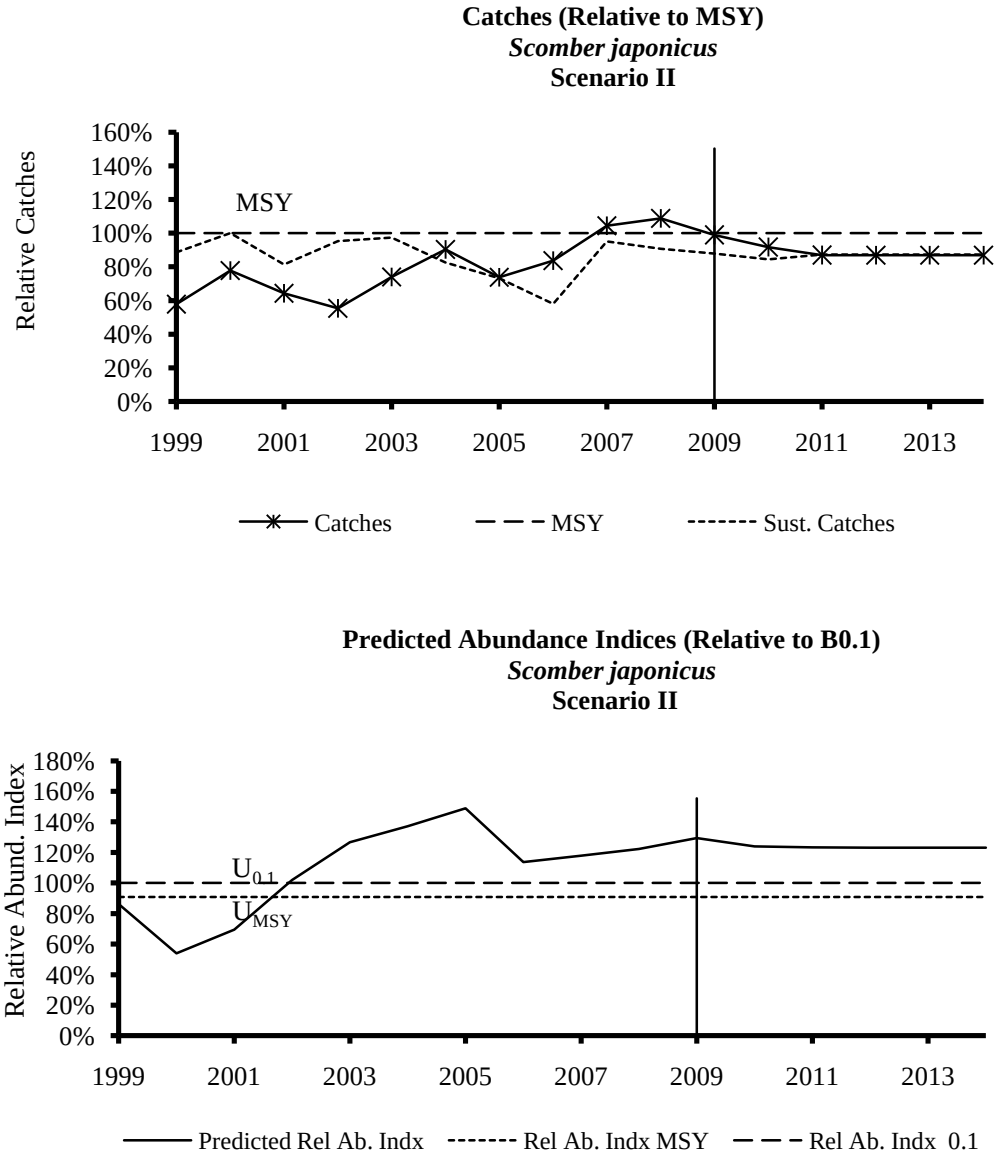


Figure 5.7.1b: Predicted catches and abundance of *Scomber japonicus* in stock north and south – Scenario II (10 percent reduction)/
Prédictions des captures et de l'abondance de *Scomber japonicus* dans le stock nord et sud – Scénario II (10 pour cent de réduction)

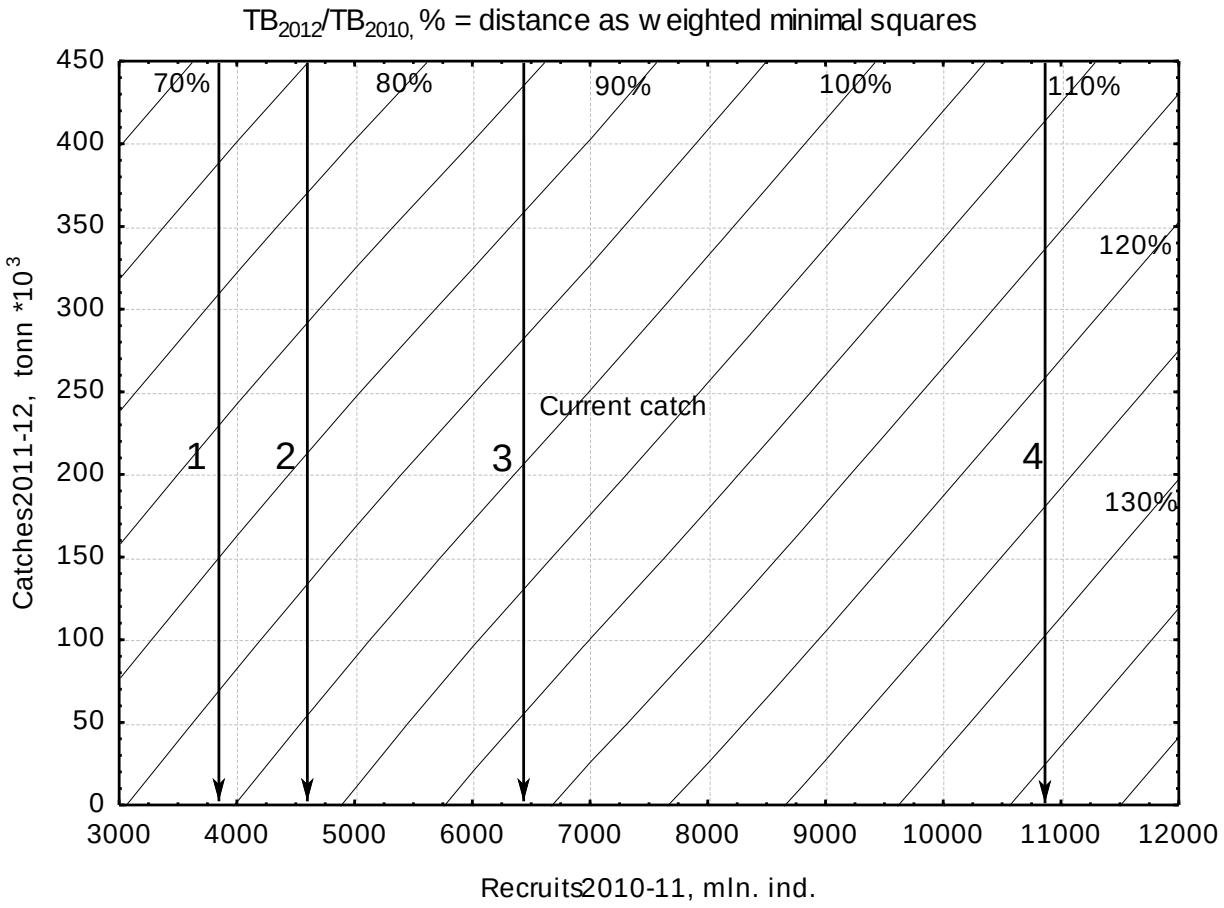


Figure 5.7.2: Chub mackerel management scenarios according to various catch and recruitment in 2010–2011 by ICA/
Scénarios de gestion du maquereau en fonction des diverses captures et du recrutement en 2010-2011 par l'ICA

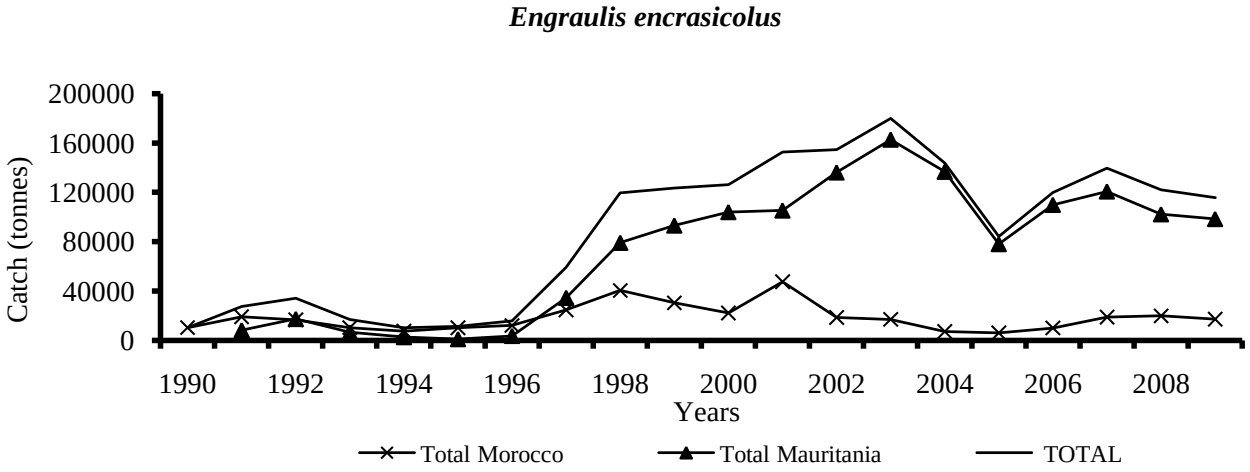


Figure 6.2.1: Total catches (tonnes) of *Engraulis encrasicolus* in the subregion by country and year (1990–2009)/
Captures totales (en tonnes) d'*Engraulis encrasicolus* dans la sous-région par pays et année (1990-2009)

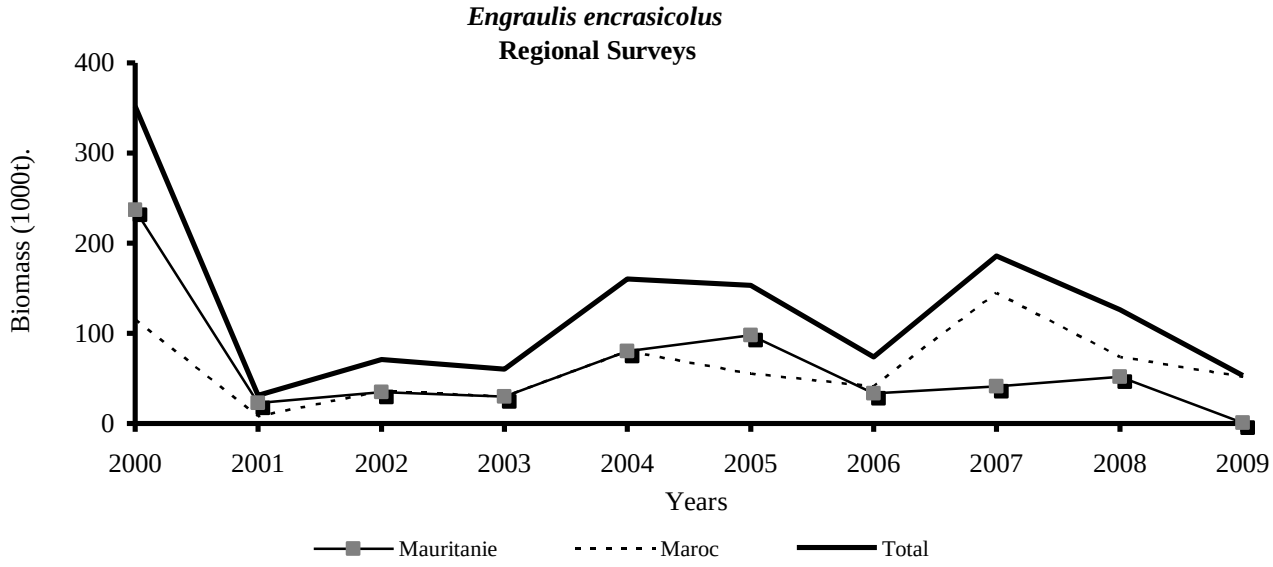


Figure 6.3.1: Biomass estimates of *Engraulis encrasicolus* (2000–2009) for Mauritania and Morocco from R/V DR. FRIDTJOF NANSEN and regional surveys (local research vessels)/
Estimations de la biomasse d'*Engraulis encrasicolus* (2000-2009) en Mauritanie et au Maroc par le N/R DR. FRIDTJOF NANSEN et les campagnes de recherche régionales

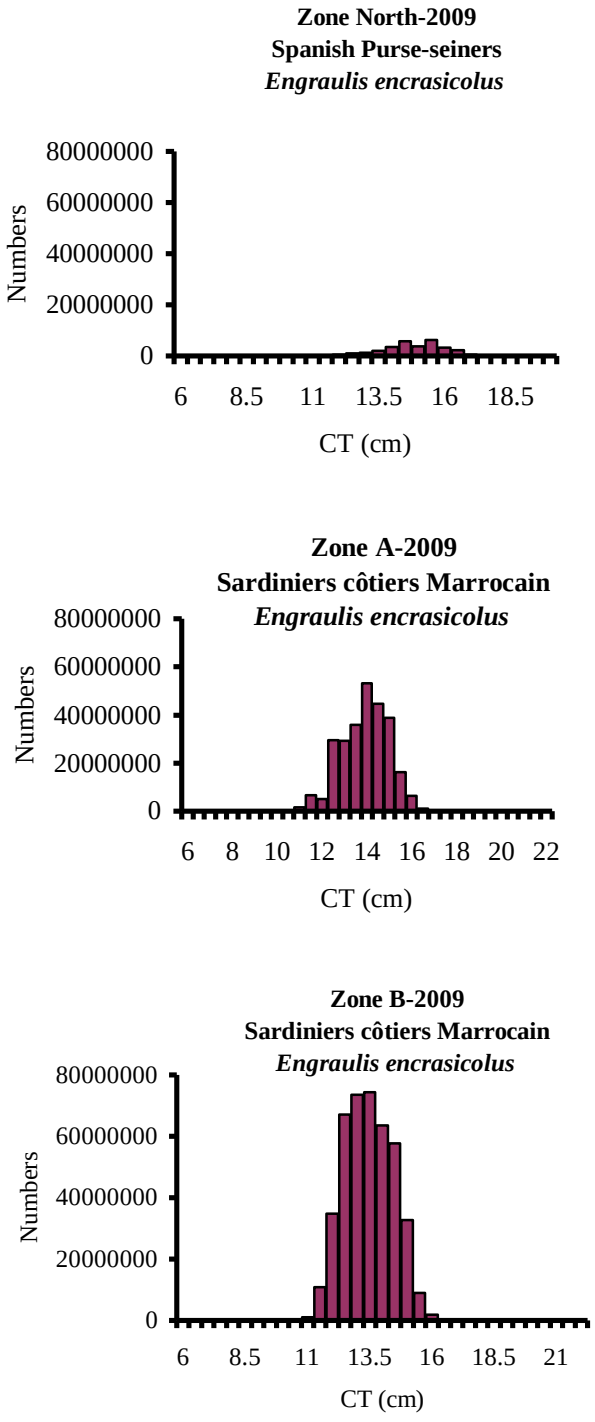


Figure 6.5.1: Length composition of catches of *Engraulis encrasicolus* in Zone North, A and B/ Composition par taille d'*Engraulis encrasicolus* dans les zones Nord, A et B

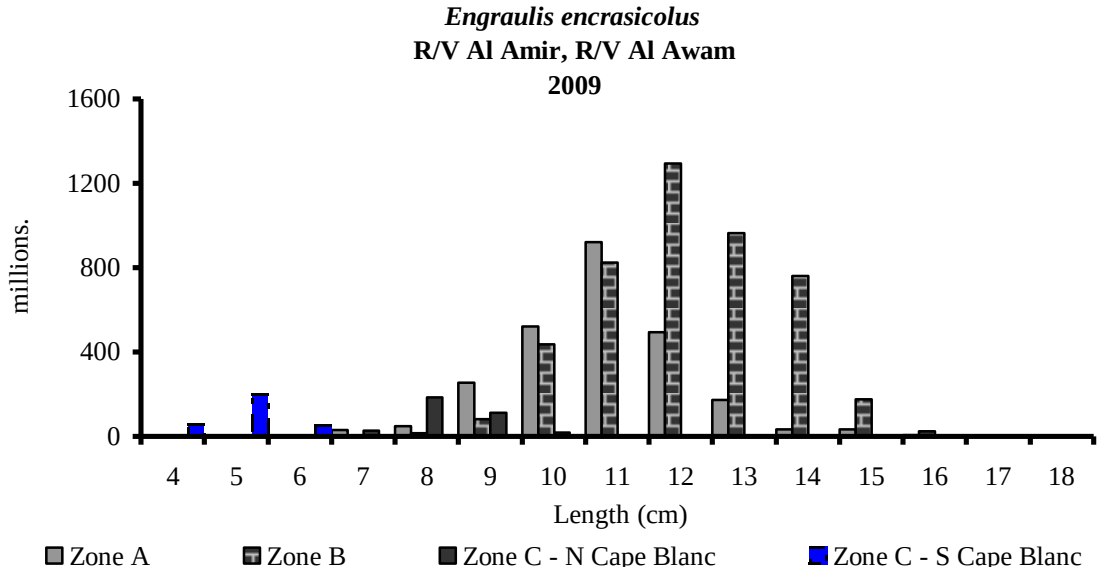


Figure 6.5.2: Length frequency and total number estimates for *Engraulis encrasicolus* in the subregion in 2009 (R/V AL AMIR, R/V AL AWAM)/
Estimations de la taille et du nombre d'individus d'*Engraulis encrasicolus* dans la sous-région en 2009 (N/R AL AMIR, N/R AL AWAM)

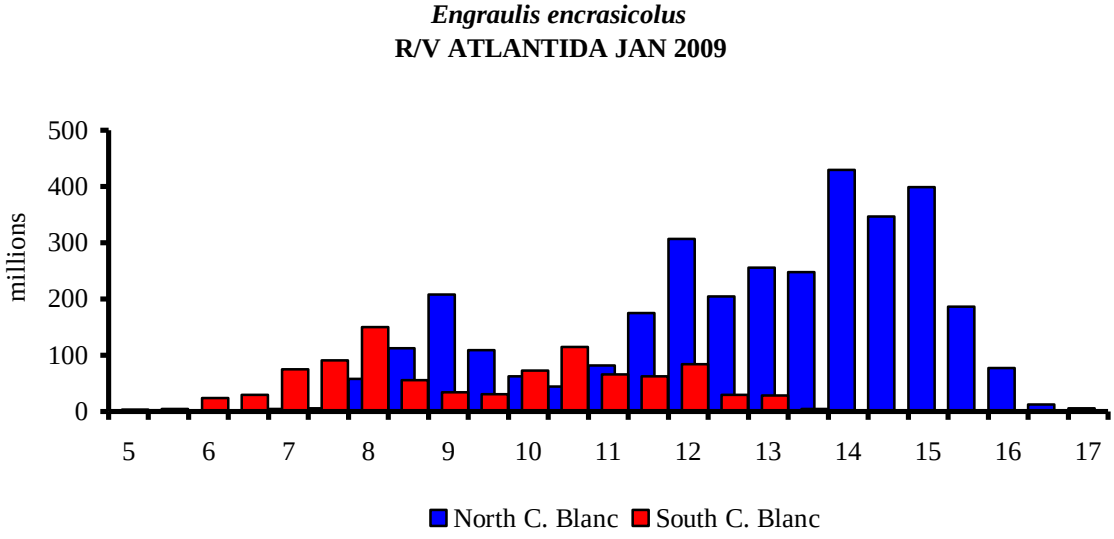


Figure 6.5.3: *Engraulis encrasicolus* length frequency in the subregion recruitment surveys – January 2009 (R/V ATLANTIDA)/
Fréquence de taille d'*Engraulis encrasicolus* dans la sous-région lors des campagnes de recrutement en janvier 2009 (N/R ATLANTIDA)

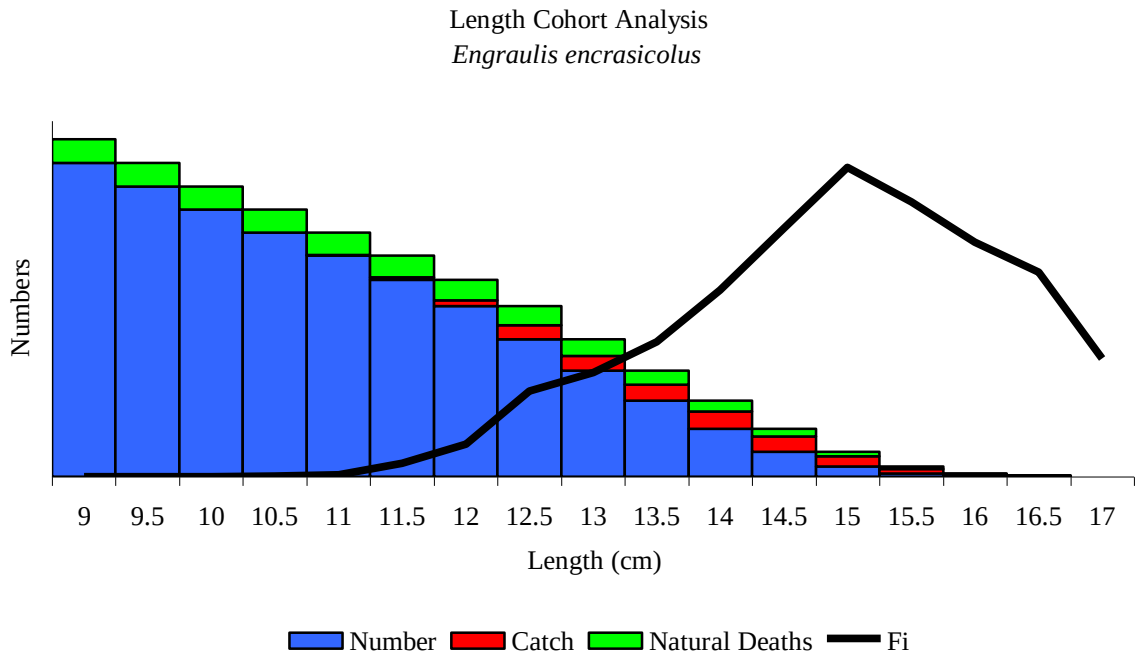


Figure 6.7.1: *Engraulis encrasicolus* – Number of survivors at beginning of the year, catch in number during the year, number of natural deaths and fishing mortality during the period of analysis 2008–2009/
Engraulis encrasicolus – Nombre de survivants au début de l'année, captures en nombre pendant l'année, nombre de morts naturelles et mortalité par pêche au cours de la période d'analyse 2008-2009

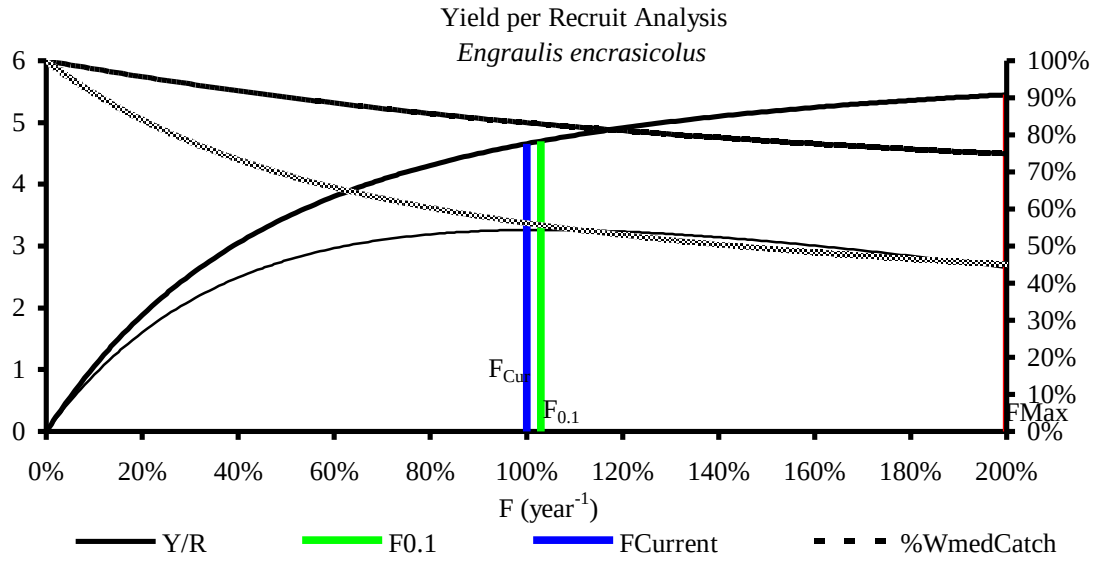


Figure 6.7.2: *Engraulis encrasicolus* - Yield per recruit analysis/
Engraulis encrasicolus – Analyse du recrutement par recrue

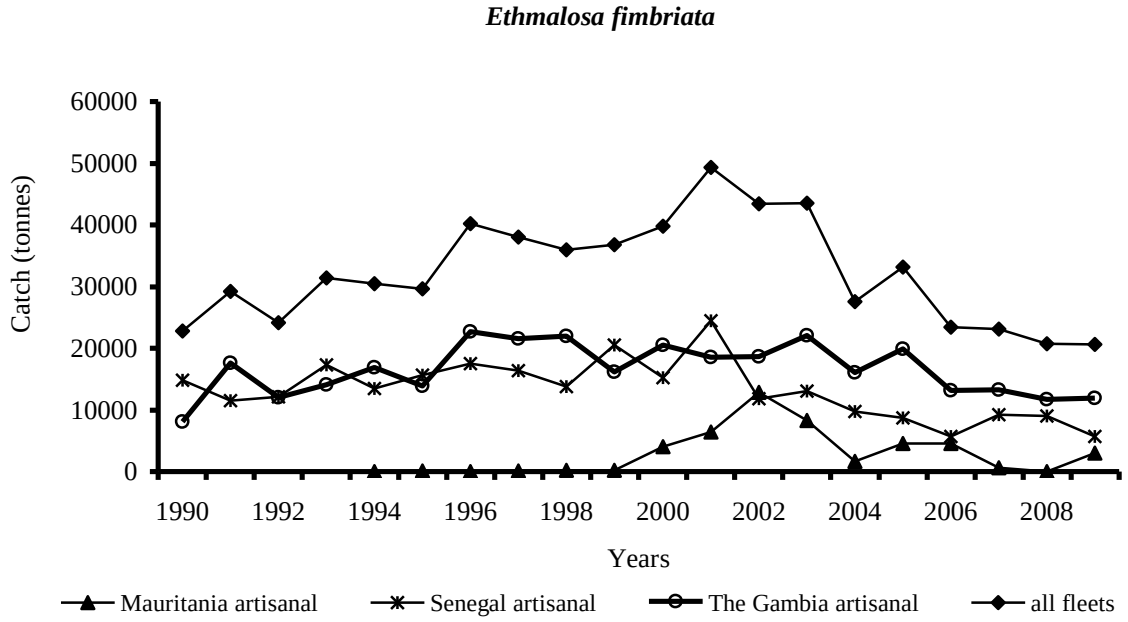


Figure 7.2.1: Catches (tonnes) of *Ethmalosa fimbriata* (1990–2009) by country, fleet and year/
Captures (en tonnes) d'*Ethmalosa fimbriata* (1990-2009) par pays, flottille et année

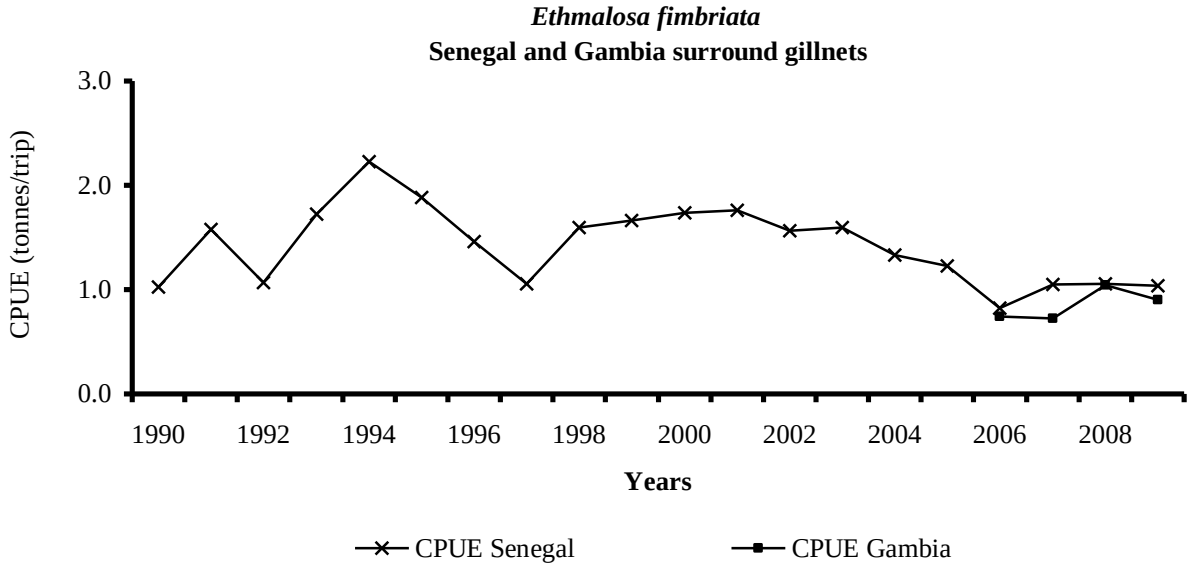


Figure 7.3.1: CPUE (tonnes/trips) of *Ethmalosa fimbriata* (1990–2009) of Senegalese and Gambian surrounding gillnets/
CPUE (tonnes/sorties) d'*Ethmalosa fimbriata* (1990-2009) des filets maillants tournant sénégalais et gambiens

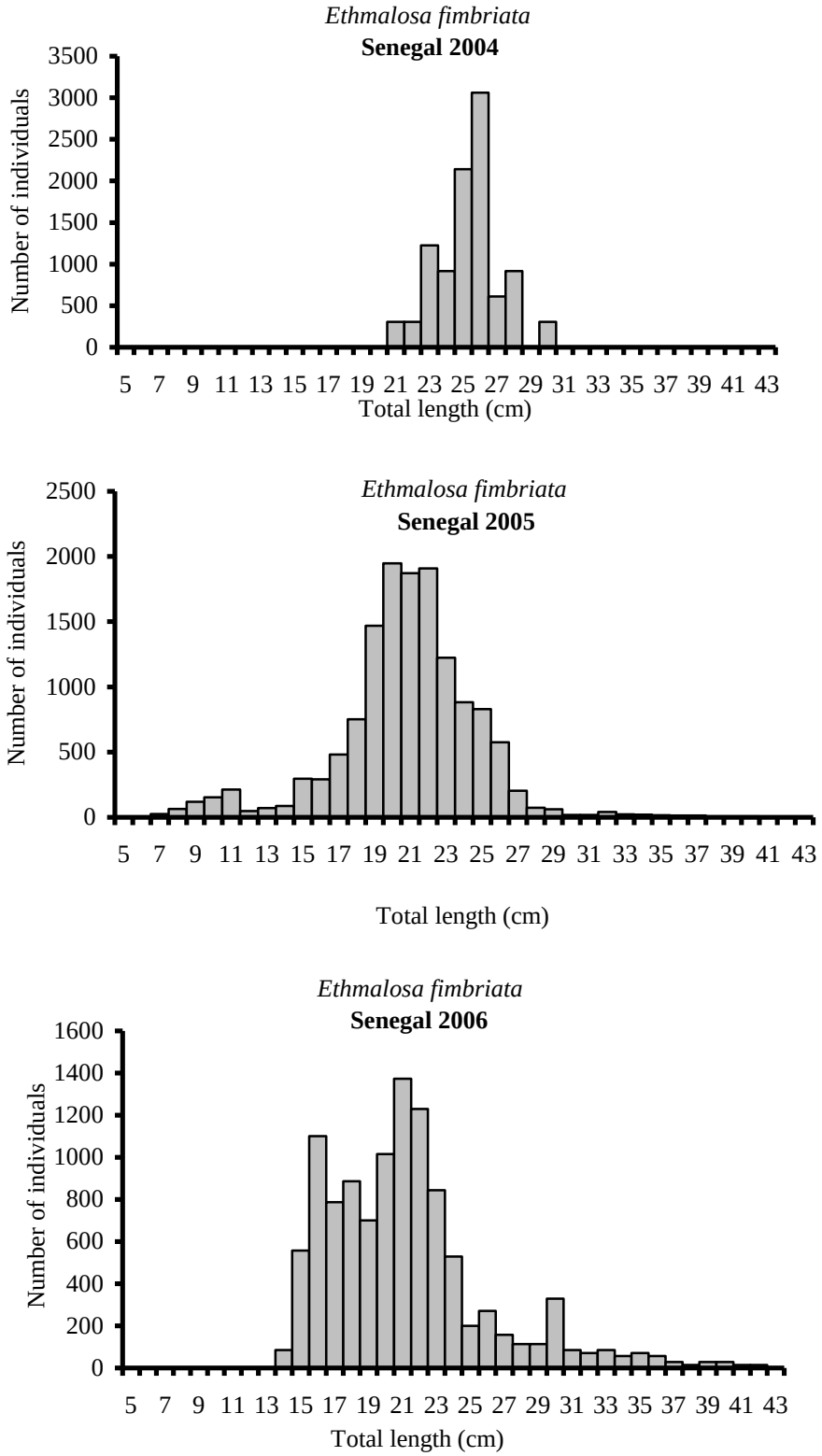
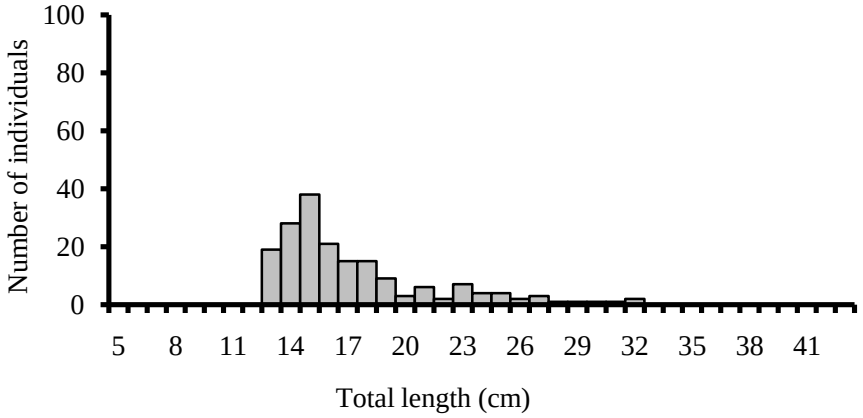


Figure 7.5.1: Length composition of *Ethmalosa fimbriata* in Senegal in 2004–2009/ Composition en taille d'*Ethmalosa fimbriata* au Sénégal (2004-2009)

Ethmalosa fimbriata
Senegal 2008



Ethmalosa fimbriata
Senegal 2009

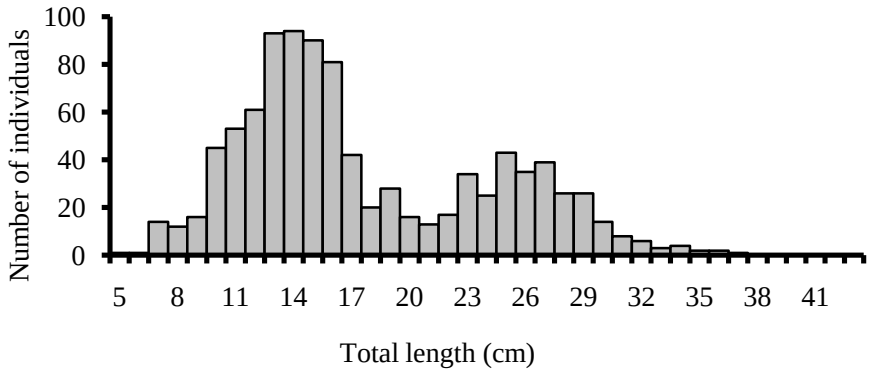


Figure 7.5.1 (cont.): Length composition of *Ethmalosa fimbriata* in Senegal in 2004–2009/ Composition en taille d'*Ethmalosa fimbriata* au Sénégal (2004-2009)

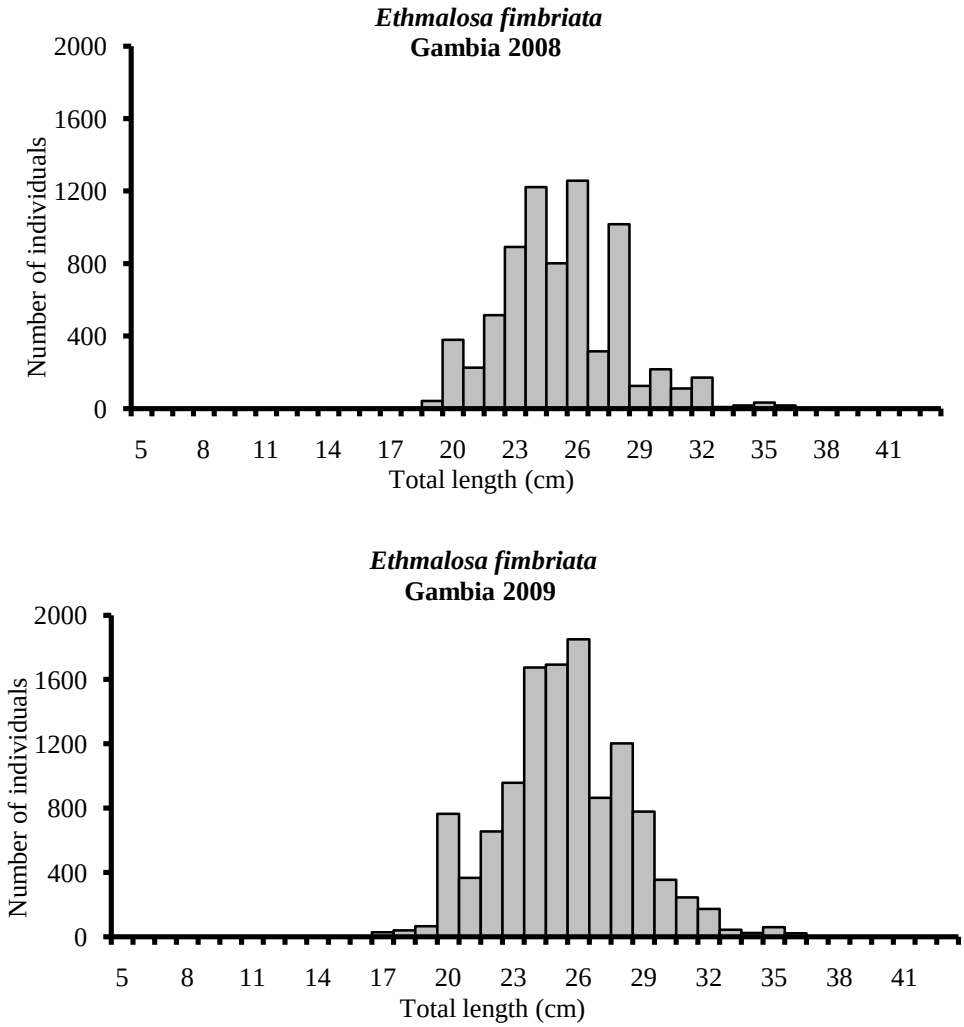


Figure 7.5.2: Length composition of *Ethmalosa fimbriata* in Gambia in 2004–2009/ Composition en taille d'*Ethmalosa fimbriata* en Gambie (2004-2009)

APPENDIX I

List of participants Small Pelagics Working Group 2010 / Liste des participants groupe de travail Petits pélagiques 2010

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APPENDIX/ANNEXE II – PART 1

Biomass dynamic model with environmental effects
User instructions

by Pedro de Barros

1) General instructions

a) Data entry

Data and initial parameter estimates should be entered only in the cells coloured green (Figure 1). All other cells are either not used, or used to calculate quantities used by the model. Data must be entered for all the data columns coloured green, and also for initial values of the parameters. Additionally, the model control settings may be entered (in the cells coloured orange – Figure 1). If these control settings are not changed, they may be left at their default values.

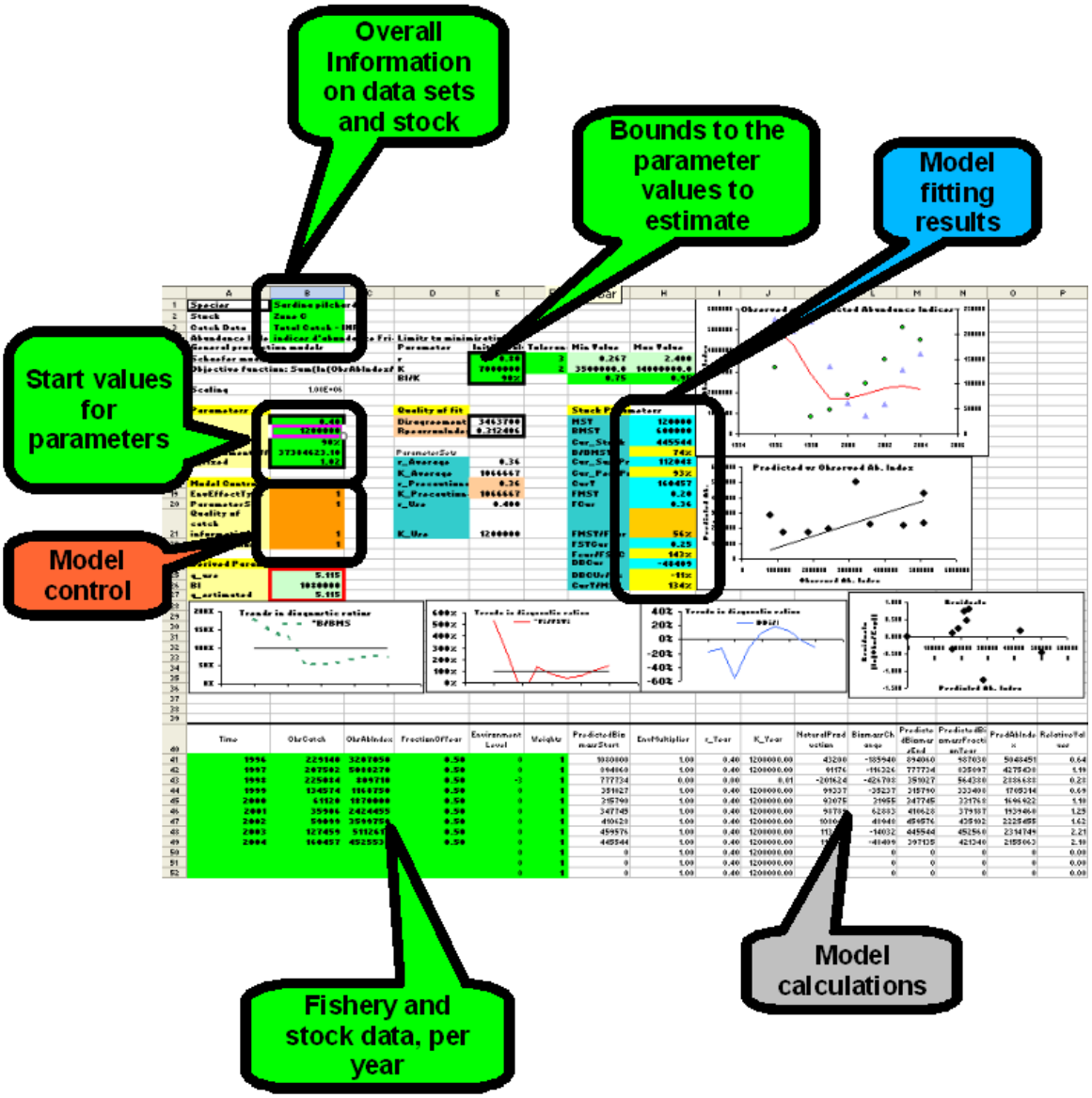


Figure 1. The main areas in the model worksheet

b) Defining the parameters to be estimated non-linearly (using Solver)

The non-linear estimation procedures suffer from a number of limitations, of which the most important is probably that the estimates obtained will depend on the start values defined. Therefore, one should try to keep the number of parameters to be estimated non-linearly to the minimum possible values.

As a minimum, one must estimate r and K by fitting the model to the data using the solver algorithm.

When defining the parameters to estimate, one should as much as possible set constraints (maximum and minimum values) so that the algorithm is limited to reasonable values, defined by the researchers. Use the spreadsheet area of Minimum and Maximum values to define these.

2) Detailed instructions

Entering data

The following data MUST be entered in the appropriate cells of the worksheet (Figure 2):

i) Years of the data (Year)

All years from the first to the last in the data set should be entered, consecutively. The first year should be entered in the cell immediately below the header "Year" and run consecutively until the last one. No empty cells should exist between the data, only after the last year.

ii) Total catch per year (ObsCatch)

Total catch is REQUIRED for ALL years in the data series. The model will fail if catch data is missing for any of the years (the reason is that catch is essential to calculating stock abundance the following year). This column should be filled like the one for year.

iii) Abundance index (ObsAbIndex)

This column should be filled like the previous ones. However, if there is no abundance index for a given year, this can be left blank. The model will still run correctly without a few years of data of Abundance indices (if there are many, however, the reliability of results will be doubtful).

iv) Timing of the abundance index (FractionOfYear)

When the abundance index corresponds to e.g. a scientific survey, or to a fishery concentrated in a short season, it will not represent the average abundance of the stock during the year, but rather this same abundance at the time of the survey or fishery. The values in this column represent the timing of the abundance index as a fraction of year (0.5 = July 1st). It should be set to a value corresponding roughly to the mid-point of the survey or of the fishing season. If the abundance index corresponds to a CPUE from a year-long fishery, this value should be set to 0.5 (mid-year).

v) Environment level

This column will include any index that can be considered to represent a deviation of the average growth conditions of the stock in each year. If a series of environmental indices exist (e.g. a series of upwelling indices) these can be used as the environmental level. If not, and there is external scientific evidence that there were particular years with exceptional conditions, then an arbitrary positive (for good growth) or negative (for poor growth) environmental level can be set for that year. If there is no information on environmental elements affecting the carrying capacity and/or the intrinsic growth rate of the stock, or it is considered that these parameters do not vary significantly, then the values in this column can be left at their default values of 0.

vi) Weights

Is some cases, there are doubts about the reliability or the representativeness (compared with the rest of the series) of one or a few of the abundance indices used (e.g. if there is a year with less complete coverage, or with uncommon distribution conditions). In these cases, the corresponding value of the abundance index will not be as reliable as the remaining of the series. These points can be given less weight in the fitting of the model, by setting a value less than **1** in the corresponding row of the column Weights.

Notes:

The number of consecutive non-empty cells in column Year is used to define the number of years in the data to fit. Therefore, only years for which catch data is available must be entered, and all cells below these must be empty (use "Delete").

In the calculated columns (to the right of the column "Weights") the rows below the last year of data should NOT be deleted. The worksheet will ignore those below the last year of data. Deleting these rows will force one to rebuild them when a new data point is entered.

Time	ObsCatch	ObsAbIndex	Environment Level	Weights
1996	229140	3207050	0	1
1997	207502	5088270	-3	1
1998	225084	809710	0	1
1999	134574	1168750	0	1
2000	61120	1870000	0	1
2001	35906	2424455	0	1
2002	59099	3599750	0	1
2003	127459	5112613	0	1
2004	160457	4525538	0	1
			0	1
			0	1
			0	1
			0	1
			0	1

Figure 2. Spreadsheet section for entering the data for model fitting

Initial parameter values

Enter the initial values (initial "guesstimates") of the parameters in the appropriate cells. As a minimum, initial values for the parameters **r** (intrinsic rate of growth), **K** (Carrying capacity, or Virgin Biomass) and **BI/K** (Stock Biomass at the start of the data series, as a proportion of the Virgin Biomass) are required.

Defining appropriate start values to these parameters may be difficult, and may require a bit of trial and error. However, setting adequate initial values is essential for the success of the estimation procedure.

One should start by defining an adequate value for BI/K. To start the model running, it is necessary to give it a start point, the stock status at the start of the data series, BI (Initial Biomass). It is often very difficult to provide reasonable values for this parameter, but it may be easier to provide, from the knowledge of the scientists involved with the stock, a first estimate of the level of depletion of the stock at start of the data series available. This approach is similar to the idea of using the Exploitation Ratio (E) to start the calculation in a VPA, as suggested by Cadima (2004). The first estimate of this value will be named $\mathbf{BI/K_{Guess}}$.

A start value for r is usually found by setting r to a value similar to the natural mortality coefficient assumed for the stock.

A start value for K is usually more difficult, but a value consistent with the remaining parameters can also be found using a simple reasoning, as follows;

1- "Guess" the value of average stock Biomass during the period included in the assessment, (B_{Guess});
2- Calculate the average value of the Abundance Index used in the same period, ($AI_{Average}$). Make sure to include only real values of the abundance index, and to ignore any missing values;
3- Calculate a first estimate for the catchability coefficient **q**, as $q_{Guess} = AI_{Average} / B_{Guess}$;
4- Calculate a first estimate of the stock Biomass at the start of the series, (**B_{Start}**), using the value of the abundance Index at the start of the series, (**AI_{Start}**), and the first estimate of the catchability coefficient **q**, q_{Guess}, as **BStart = AIStart/qGuess**;
5- The first estimate of K (**K_{Guess}**) is then given by **$K_{Guess} = B_{Start} / (BI/K_{Guess})$**

This procedure is implemented in the worksheet "InitialValues", within the workbook supplied (Figure 3).

6			
7	AbIndexFirst	3207050	
8	BI/K	90%	This is arbitrated and depends on external information about wha
9			
10	AverageBiomass	3000000	"Guessed" from external information
11	AverageAbIndex	3089571	From real supplied data
12	CatchabilityGuess	1.029857	
13	BiomassFirst	3114073	
14	K_Guess	3460082	
15			

Figure 3. Estimation of the initial value for K implemented in the worksheet "InitialValues"

b) Setting limits to the estimation

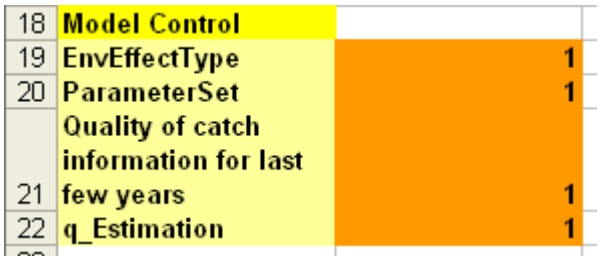
When using non-linear estimation, it is advisable to set limits to the values the parameters may take. To do this, enter the appropriate values in the "tolerance" column for the estimation of **r** and **K**. If **BI/K** is to be estimated by the model, the upper and lower limits should be entered directly. Whenever the initial values for the parameters are modified, the values in cells InitialValues should be set to the same values entered in the cells used for the model parameters (Figure 4)

Initial Value	Tolerance	Min Value	Max Value
1.00	4	0.250	4.000
4993858	6	832309.6	29963145.4
90%		0.75	0.95

Figure 4. Process of defining the limits to the estimation in the model worksheet

c) Model control

In its current version, the model implementation allows the user to choose 3 main aspects of the calculation, (1) the type of environmental effect (simple multiplicative or exponential), (2) to estimate or not the catchability coefficient (q) and (3) the set of parameters to use for calculating the reference points and the current status of the stock relative to these reference points.



18	Model Control	
19	EnvEffectType	1
20	ParameterSet	1
21	Quality of catch information for last few years	1
22	q_Estimation	1

Figure 5. Cells of the spreadsheet used to control the options in the calculations of the model

i) Choice of environmental effect type:

The model includes two different formulations for the effect of the environment level on the r and K parameters of each year.
To select the type of environmental effect, set the value in cell EnvEffectType (Figure 5) to one of the following values:
0 – No effect
1 – Additive formulation: EM=1+(EE*|EL|^SIGN(EL))
2 - Exponential formulation: $EM=e^{(EE*EL)}$
EM: Environmental multiplier
EE: Environmental effect: Measures the overall intensity of the environmental effect. Usually estimated by Solver as a part of the fitting routines;
EL: Environmental level: Indicator of level of environment, for each year (normally, will be deviations from the average).

ii) Use of q

The user may choose to estimate the catchability coefficient **q**, or set it as fixed.
To select whether to estimate or to use the fixed value, set the value in cell **q_Estimation** (Figure 5) to one of the following values:
0 – Use the fixed value set for the start
1 – Estimate the catchability coefficient
The user should **never** include q as one more parameter to be estimated by Solver. If it is meant to be estimated, it should be estimated using the linear approximation given in the worksheet (just set q_estimation to 1).

iii) Estimation of current (in the last year of data) Biomass

Even if the absolute Biomass values are not used directly (and they may be misleading, given the degree of uncertainty involved in their estimation), they are necessary to estimate the F-values, since these are calculated as F=B/Y.

The stock Biomass in the last year of data, that is used as a main element in calculating the current status of the stock or the fishery, may be calculated in one of two ways: Either taken directly from the model, as the Biomass value predicted by the model, or using the observed abundance index for that year, and the estimated q, to calculate B=U/q.

The choice of the best option is not straightforward. However, if the quality of the total catch data in the last few years is low, this will affect strongly the reliability of the Biomass estimates from the model. In this case, it is better to calculate the Biomass using the Abundance Index for last year and the overall q. To achieve this, set **Quality of catch information for last few years** (Figure 5) to 0 (bad quality). Otherwise, set it to 1, to use the Biomass estimates from the model.

Notes: The quality referred to here is not of the LAST catch data point (it has no effect) but rather the few years before the last.

iv) Variable r and K (depending on environment level of each year)

When using the option of introducing an environmental level indicator, different values of r and K are calculated for every year in the data set. In this situation, it becomes difficult to choose which is the best value of the parameters to use in the calculation of the overall reference points. The best option will depend on the situation at hand. To define the option to use, set the value in cell "Parameter set" (Figure 5) to one of the following values:
1 – Overall r (estimated by the fitting procedure, independent of the environmental effects used in the fitting);
2 – Average value of the r-values estimated for each year in the data series (using the environmental levels for each year);
3 (or other value): Precautionary option – the smallest of the two previous values.

d) Running the model (estimating the parameters)

This is usually done using the "Solver" tool in Excel.

Call the tool (Figure 6).

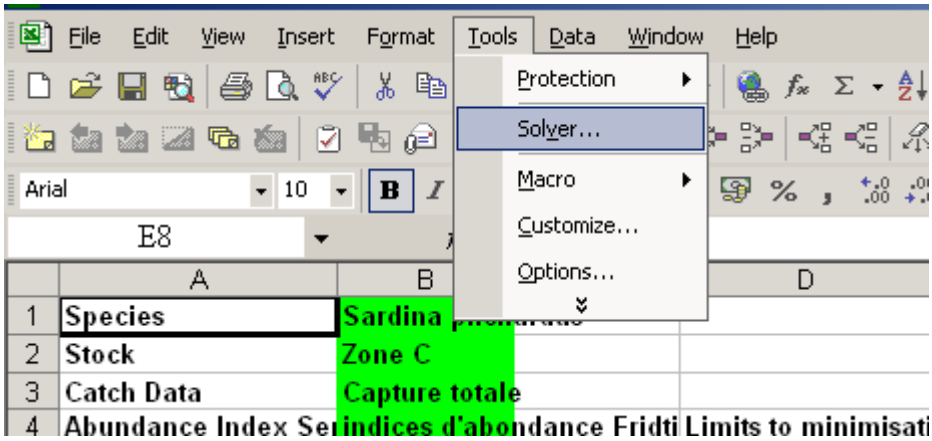


Figure 6. Starting the solver routine, for parameter estimation

Define the cell whose value is to be minimized Target cell (Objective Function) – Figure 7, and the cells that are to be manipulated for achieving this (By changing cells). You may choose all 4 parameters r, K, BI/K and EnvironmentEffect (if an environment effect is being estimated), or only a subset of these. You should not set the model to estimate q, as this is usually not defined enough by the data. Set also, as much as possible, the constraints – use the constraints area in the spreadsheet. Do not set constraints for the Environment effect.

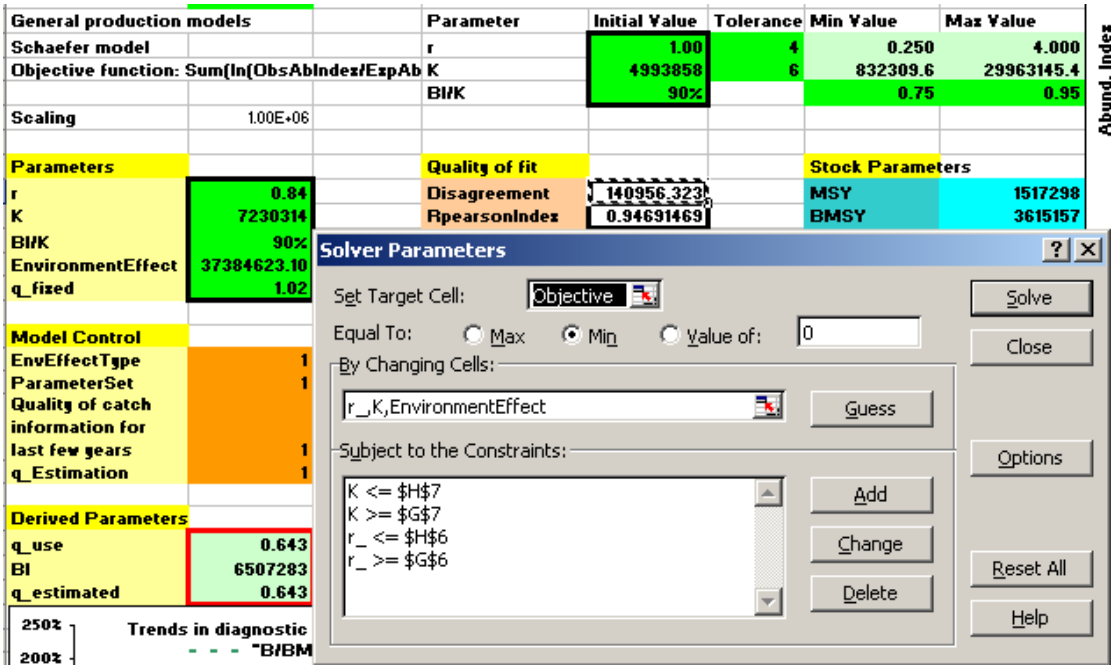


Figure 7. Setting the parameters for the solver routine.

After pressing “Solve”, the following dialog should be seen.

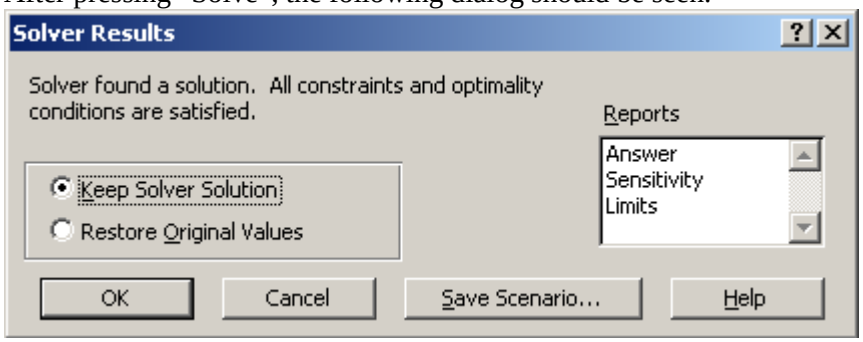


Figure 8. Dialog indicating the successful completion of the model fitting procedure

After pressing the OK button, the diagnostics can be assessed.

3) Diagnostics of fit

Like any model fitted to data, it is essential to assess the quality of the fit of the model to the particular data set used in each run. The model will almost always produce an estimate, but the reliability of the model fitting that produced these estimates should always be checked before accepting the results.
There may be several reasons why a production model may not fit well a particular data set. Some of the most common ones are;

- Lack of contrast in the data
- “One-Way trip”
- Abundance index does not represent the whole stock
- Catch data are not representative of all catches, but come from only a part of the fleet, or are fixed estimates

To help assess the quality of this fit, a few indicators are provided.

a) Objective function

The actual value of the objective function (Figure 9) is the first measurement of the goodness-of-fit of the model. High values indicate a better fit. However, it is difficult to evaluate exactly what is “high”, and this is thus not usual as a diagnostics statistic.

Quality of fit	
Disagreement	1498416.332
RpearsonIndex	0.848396537

Figure 9. Cells holding the values of the objective function of the model fit, and of the Pearson linear correlation coefficient r.

b) Pearson linear regression coefficient between the predicted and observed abundance indices

This coefficient (Figure 9) will not detect a non-linear relation but will measure how closely the predicted abundance indices follow the observed ones. High values should be aimed for.

c) Plot of Predicted vs Observed Abundance Indices

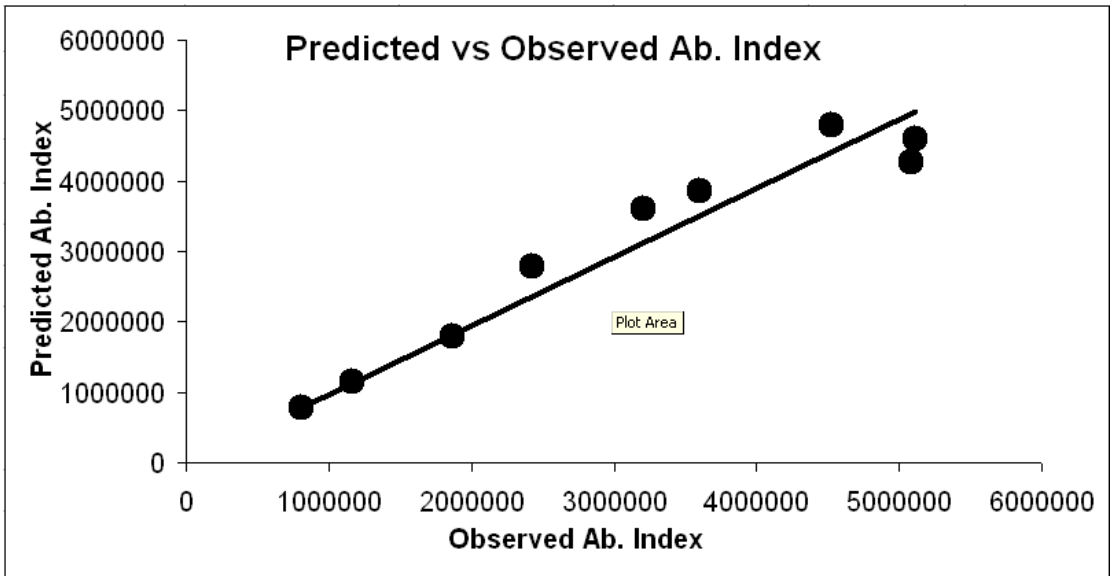


Figure 10. Plot of the relation between the predicted and the observed abundance indices. This plot can be used to detect severe deviations from the linear relationship between the observed abundance indices and those predicted by the model

This plot presents, in a graphical way, the relation between the Abundance Index observed (or given to the model) and the Abundance index estimated by the model, on the basis of the estimated biomass.
The desirable characteristics for this plot is a linear relation between the predicted and observed indices, with slope 1.

Undesirable characteristics include:
a) a flat plot (no relation between predicted and observed);
b) A non-linear relation (cyclic, asymptotic or curved relation)

d) Residual plot

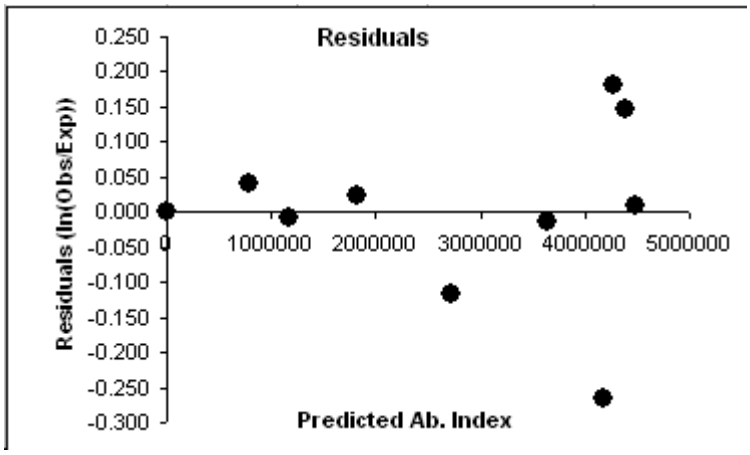


Figure 11. Plot of residuals used to assess if there are indications of any lack of fit in the adjustment of the model to the data

The residual plot is used to evaluate whether there are trends in the deviations between the observed and predicted abundance indices data. As long as the residuals are reasonably well-dispersed, with no patterns, there is usually no reason to concern. Unusually large or small residuals concentrated at a given range of the predicted abundances, however, should be looked into carefully, as they may indicate a model misspecification, or problems with the data

e) Trends in Biomass Indices and total catch data

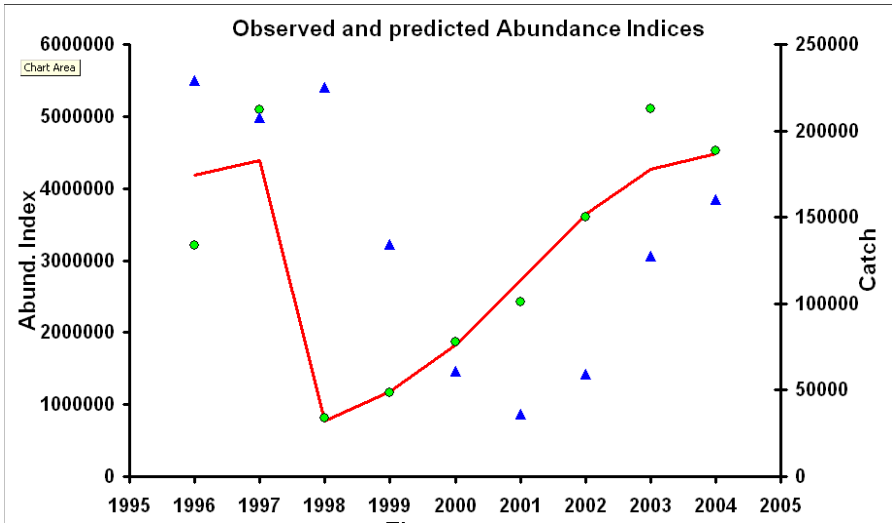


Figure 12. Plot of the trends in observed and estimated abundance indices, as well as of the reported catches, for each year in the period analysed.

The model is based on the assumptions that stock biomass tends to grow to a maximum level that can be sustained by the environment, and that this growth is decreased by the catches taken from it.
So, generally speaking, stock biomass trends should reflect the catches taken from it. A year with very high catches should see a reduction in stock biomass the following year, and vice-versa, a year with low catches should be followed by an increase in stock biomass.

Therefore, checking the plot of catches and stock abundance indices for these patterns gives a first indication of the reliability of the fit of the model to the data. A pattern where similar catch levels at similar Biomass levels are followed by both increases and decreases in biomass will in general

indicate a contradiction between the data and the model. This may indicate several difficulties with the data, of which the most common are incomplete or inaccurate catch data, or abundance indices that do not represent the whole stock (e.g. they miss the larger adults or the juveniles). In some cases, however, a sudden change in the reaction of the stock to exploitation may also indicate that there was an environmental change or pulse that modified the average biomass growth rate of the stock (e.g. exceptional conditions that lead to a peak in recruitment). If the change in environmental conditions can be demonstrated by other, external data (e.g. similar anomalies arising simultaneously in several stocks, or Sea Surface Temperature data, or precipitation indices) then this can be included in the model by the introduction of an Environment level, for that year, that will account for the positive or negative changes in the growth conditions (intrinsic rate of increase and carrying capacity) observed or assumed for that year.

4) Interpretation of results

Once the model is satisfactorily fitted to the data, it is important to interpret the results from this fit. The model implementation provides several auxiliary ways to view and interpret the data.

a) Current (last year) situation

Usually, stock assessment scientists and managers are most concerned with the status of the stock in the last year of data. So, the model implementation computes several numerical and graphical diagnostics of the condition of the stock and the fishery in the last year (Figure 13).

Stock Parameters	
MSY	120000
BMSY	600000
Cur_Stock	445544
B/BMSY	74%
Cur_SustProd	112048
Cur_PercProd	93%
CurY	160457
FMSY	0.20
FCur	0.36
FMSY/Fcur	56%
FSYCur	0.25
Fcur/FSYCur	143%
DBCur	-48409
DBCUr/Bcur	-11%
CurY/MSY	134%

Figure 13. Summaries of the status of the stock and the fisheries in the last year of data

Of the different indices presented, the ones highlighted in yellow are the ones most important for the stock diagnostics, and of these, special importance is given to the ratios B/BMSY and FCur/FSYCur.

The first of these ratios indicates the current status of the stock biomass relative to the Biomass that would provide the Maximum sustainable yield, and provides an indication of the current stock status relative to a target stock status. In most situations, one would want the stock to be slightly above BMSY, i.e., with a B/BMSY ratio slightly above 1.

The second indicates the value of the yield currently being extracted from the stock, relative to the yield the same stock can provide while keeping its abundance constant for next year, i.e. to the

sustainable yield of the stock. Values of this ratio below 1 indicate that the stock biomass will tend to grow, while values above 1 indicate a situation leading to a decline in stock biomass.

To ease the interpretation of the results for the last year of data, the estimated stock Biomass for the last year of data and the corresponding catch are presented relatively to the Biomass that would produce the Maximum Sustainable Yield and to the Sustainable Yield, respectively, in the plot in the chart sheet "CurrentSituation" (Figure 14).

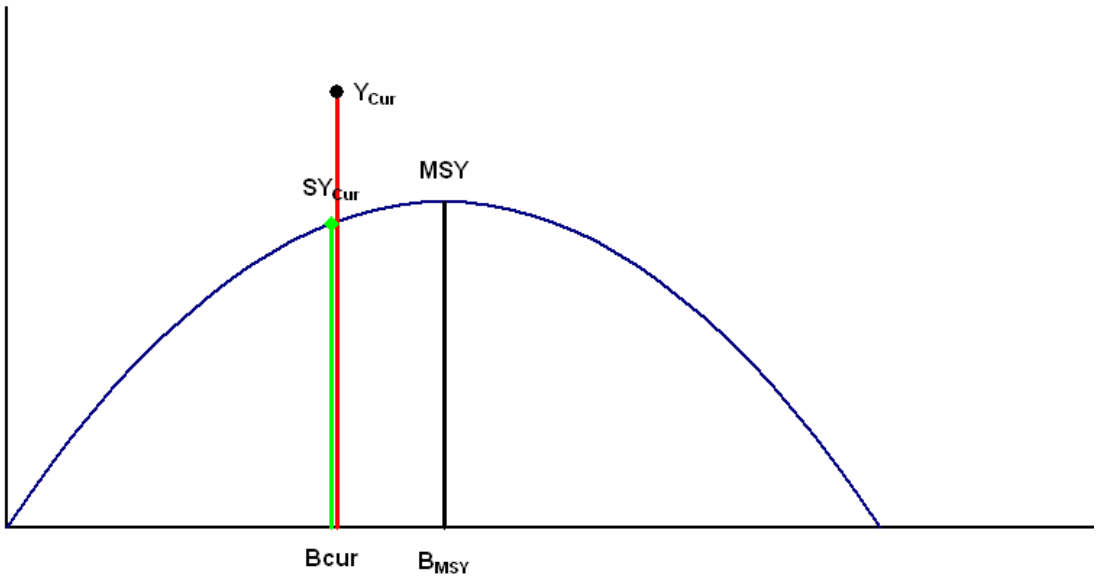


Figure 14. Graphical presentation of the status of the stock and the fishery in the last year of available data, relatively to the Reference Points estimated for the stock

b) Time-patterns

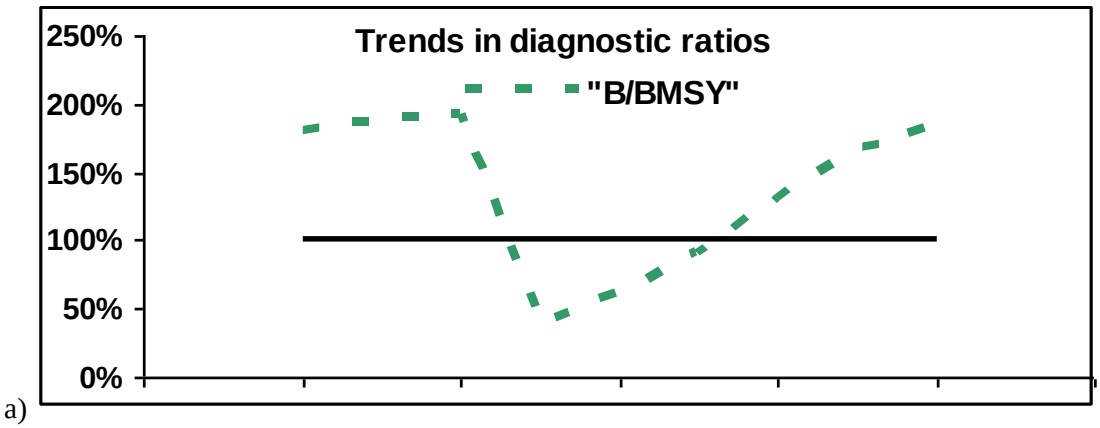
Besides the situation in the last year of data, it may be useful to assess the trends in these indices along the period analysed. All these indices are calculated for each year in the main spreadsheet, but for ease of presentation and interpretation they are also presented graphically (Figure 15).

Three main indicators are presented:

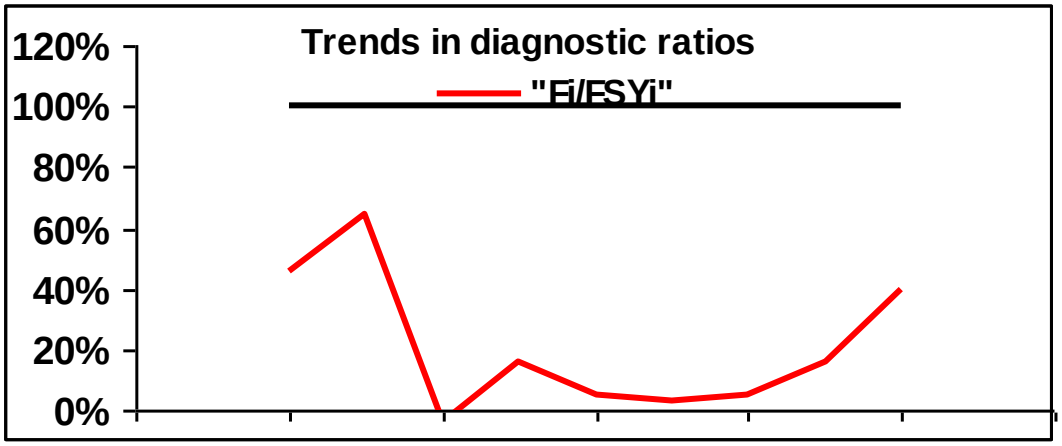
a) Ratio B_i/B_{MSY}. This ratio indicates whether the estimated stock biomass, in any given year, is above or below the Biomass producing the Maximum Sustainable Yield;

b) Ratio F_i/F_{SYi}. This ratio indicates whether the estimated fishing mortality coefficient, in any given year, is above or below the fishing mortality coefficient producing the sustainable yield in that year. Values below 100% indicate that the catch taken is lower than the natural production of the stock, and thus that stock biomass is expected to increase the following year, while values above 100% indicate a situation where fishing mortality exceeds the stock natural production, and thus where stock biomass will decline.

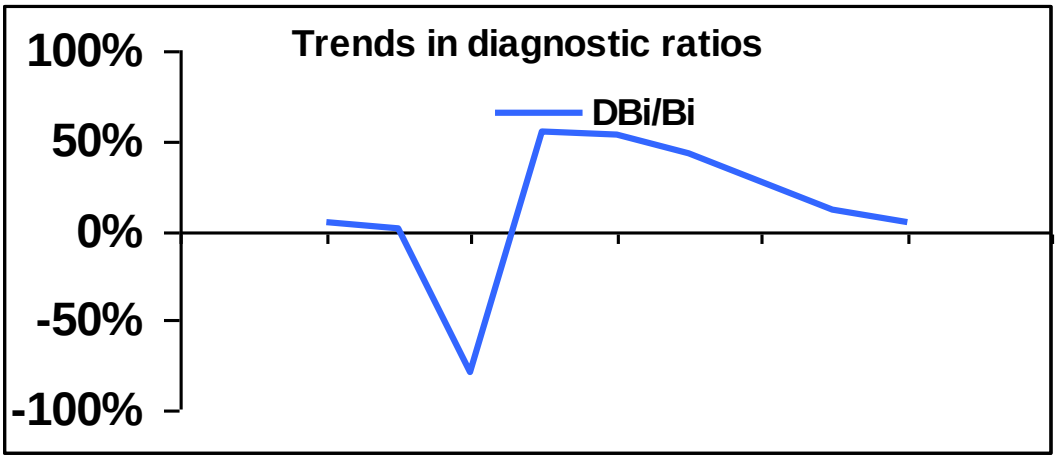
c) Ratio DB_i/B_i. This ratio indicates the change in estimated Biomass relative to current Biomass (in any given year). Positive values indicate a year of increase in Biomass, while negative values reflect years of declining biomass.



a)



b)



c)

Figure 15. Graphical presentation of the evolution of the main stock status diagnostics along the period included in the analysis. a) Ratio $B_i/B_{MSY;}$ b) Ratio F_i/F_{SYi}; c) Ratio DB_i/B_i.

APPENDIX/ANNEX II – PART 2

Projections of future yields and stock abundance using dynamic surplus production models - General concepts and implementation as excel spreadsheets

by Pedro de Barros

1. INTRODUCTION

a) Management measures available to fisheries managers

Fisheries managers have at their disposal a wide array of management measures that are usually classified into three groups, (a) input control measures; (b) output control measures and (c) technical measures. Input and output control measures aim to control the overall fishing level, i.e., the total mortality applied to the stock, while technical measures intend to control the way how this total mortality is distributed by the different size- or age-groups of the stock.

Input control measures include all the management measures that limit the fishing effort applied to the fishery, and include limitations of fishing licences, of total number of fishing days, or any other similar measures;

Output control measures are those measures that limit the total catch removed from the stock, usually as total biomass removed, but sometimes also as numbers of individuals. Limitations of Total Allowable Catch (TAC) are the most common form of these measures.

Finally, technical measures include those measures like mesh size limitations, minimum landing sizes, or closed areas and seasons.

The advantages and disadvantages of different management measures are discussed by several reference books, like e.g. Hilborn and Walters (1992) or Hogarth *et al.* (2006).

b) Projections in the fish stock assessment process

The fish stock assessment process includes in general at least four main steps, besides the data collection steps:

1. Deciding the best model to represent the dynamics of the stock and the fisheries, based on (i) the characteristics of the stock and the fishery, (ii) the management measures considered, and (iii) the data available on the fishery and the catches;
2. Estimating the parameters of the model (fitting the model to the data available) and calculating, where possible, the Biological Reference Points (BRP's);
3. Assessing the current status and the historical trends of the stock and the fishery (in Biomass, Fishing Mortality, Average Size or any other indicator of stock status) relative to the BRP's chosen to manage the stock;
4. Evaluating the likely consequences, for the stock and the fishery, of alternative management options. This most often involves projecting the development of the stock and of the catches, as well as of other statistics of the stock and the fishery, under different options for management or future scenarios.

The projection of stock and fishery status under different assumptions regarding the dynamics of the stock and the management measures applied is an essential step in the provision of management advice, as it allows managers to evaluate the likely consequences, for the stock and the fishery, of the different management options at their disposal.

Projections can be done for the long-term, medium-term or short-term. Each of these has different purposes and properties that must be considered carefully when deciding which ones to carry out.

Long-term projections, also called equilibrium projections, are used to assess the average long-term relation between the main indicators of stock and fishery status on one hand and fishing level, or other quantities defining a fishery, on the other. They require the assumption that all conditions are kept constant for a time-period at least as long as the life-span of the target species, and do not depend on the current state of the stocks, which is not taken into account. Also, they do not include time as a variable. As such, they can not be used to assess management measures that vary with time (e.g. a policy of decreasing TAC progressively), nor do they allow one to predict the status of stocks or fisheries at any defined point in time. These projections are mostly used to estimate the values of Biological Reference Points, estimate desirable states of the fisheries and compare the long-term merits of alternative management measures.

Short-term projections, on the other hand, are usually made for a period of 1-2 years after the current year/period. They depend strongly on the current state of the stock and the fishery, and assess their evolution at different times after the current moment/time. Because they consider time explicitly, they can be used to assess the effects of management measures varying with time, and to predict the status of the stocks and fisheries at different points in time within the time-frame they consider.

Finally, mid-term projections are usually made for a period of 3-10 years from current time. They use the same equations as short-term projections, prolonging them for a longer period. They can thus be used for the same purposes as short-term projections. As they extend farther from the current year, however, they become more and more dependent on the assumptions of the model, and less on the estimates of current stock and fishery status. As such, particular care must be exercized when interpreting the results of such projections. This effect is more marked the shorter the life-span of the stocks being analysed, since with long-lived species the individuals currently present in the stock will influence its total abundance for a longer number of years.

Both long-term and short-term projections can be carried out based on production or structural models. However, only projections based on structural (age-, length- or stage-structured models) can be used to assess the effect of technical measures.

When the data available for a fishery are only total catch and effort, or catch and abundance indices, only production models can be used, and thus the only management measures that can be assessed are those based on input or output control.

When using and fitting Production Models, like the Schaefer logistic model, the estimation of the parameters leads in almost all cases to carrying out a long-term projection, since the average long-term response of the stock and the fishery to changes in fishing level are direct functions of the stock parameters.

Carrying out short-term and medium-term projections, however, requires carrying forward the dynamic version of the models, under different assumptions for the catches taken from the stock, as a consequence of different input or output control management measures. Even though the equations used for this forward projection of the stock and the fishery are the same as used for the population model of the fitting version, it is usual to separate the task of fitting the model to data (i.e. estimating its parameters) from the task of using the estimated parameters to analyse the consequences of different management measures. This is mostly because the calculations used to fit the models using

the dynamic version of these models require intensive computations, and it is thus usually desired to keep the corresponding programmes as simple and light as possible.

It should be noted that projections, either long-term or short-term, should not be taken for predictions of actual stock abundance or catch values. As such, they should not be used to actually predict stock abundance or catch at any period. Rather, they should be used to assess the relative merits of alternative competing management options, and as such inform better the process of deciding which management measures are more likely to drive the stock and the fishery in the direction desired by managers.

2. WORKBOOKS FOR PROJECTIONS USING THE PRODUCTION MODELS

The spreadsheets used for fitting the dynamic version of the Schaefer logistic model are not meant for doing projections. In fact, the need of running numerical optimization routines for the estimation of the parameters implies that one should avoid very complicated sheets.

Accordingly, a new workbook was prepared, to run projections based on the data available and the parameters estimated for the stock and the fishery. It should be noted that this sheet should not be used for estimating parameters, but rather to analyse the likely consequences of different management options (set as changes in effort or total catch relative to current levels) on the future trends in catches and stock abundance.

This workbook is meant for doing deterministic projections, i.e., projections where the results are always the same for a given set of (a) initial conditions (stock size at the start of the projection period) (b) stock dynamics parameters and (c) stock exploitation strategy (TAC or Fishing Effort control).

3. POSSIBLE ANALYSES

The model implementation in the workbook can run projections with the following main characteristics:

a) Dynamic projections based on the Schaefer model;
b) Deterministic projections. Running a simulation with the same data and parameters will always produce the same results. Accordingly, this workbook will not produce stochastic simulations, and thus cannot be used for running e.g. risk analysis;
c) The stock dynamics are based on the Schaefer model parameters provided to the model;
d) The start point of the simulations is the stock status estimated by the model for the last year of available data;

It should be noted that because the simulation is based on a surplus production model, the workbook can not be used to simulate management strategies based on technical measures.

a) Management strategies simulated

The implementation of the model can currently simulate the following management strategies:

i) Constant exploitation strategies

In this kind of projection, it is assumed that the exploitation strategy (either total catch or total fishing mortality) is constant for all years being projected. The management measures under this type of can be defined as (1) TAC fixed at the same constant level for all years in the projection or (2) fishing mortality fixed at the same constant level for all years in the projection.

(1) Constant TAC

In this type of projection/simulation, total catch is fixed at the TAC level established by management from the first to the last year of the projection. It is assumed that there are no enforcement/declaration problems, so that the catch actually taken corresponds exactly to the TAC specified. For simplification, the TAC is given as a percentage of the average catch in the reference period (a period of the last 1 to 5 years of available data).

(2) Constant fixed total fishing mortality

This projection mode corresponds to a management option of fixing total effort, in the assumption that there is no change in catchability, and therefore that fishing mortality is effectively proportional to fishing effort. The actual management measures that will achieve this control of total fishing mortality are not specified, but the simulation assumes that fishing mortality is effectively controlled. For simplification, the fishing mortality for the projection is given as a percentage of the fishing mortality estimated for the last year of data available.

ii) Variable exploitation strategies

In this set of strategies, managers can allow for varying TAC or fishing mortality at each year in the projection time. This requires specifying the TAC or the fishing mortality (both as values relative to the average values in the reference period) for each time-period covered by the projection. Otherwise, the projection proceeds as for the case of the constant TAC or fishing mortality strategies.

An important issue to remember when defining the management strategy to simulate is how catch is related to stock abundance. When using TAC management control, the total catch taken each year is fixed externally. This catch does not depend on stock abundance or other aspects of stock status. When an effort control strategy is chosen, however, the total fishing effort exerted on the stock each year is fixed. In this system, total catch is determined by the effort applied to the average stock abundance during the year, and thus depends on stock abundance.

4. ORGANIZATION/STRUCTURE OF THE WORKBOOK

The workbook is divided into several sheets that correspond to different parts of the operation of the simulation:

a) Data Input and projection control

The input of the stock and fisheries data, as well as the definition of the conditions for the projection, is separate from the calculations or the presentation of output. This way, it is possible to allow the users to specify the input data and parameters, as well as the conditions for the simulation, in a simpler setup than if this input was joined with the calculations. All input and control parameters are entered into the same sheet, sheet “Input”.

i) Sheet "Input"

This sheet is used to enter the model parameters estimated for the stock, historical data available for the stock and the fishery, and for defining the conditions for the projections. The following information is entered into this sheet:

a) Historical data
b) Stock model parameters
c) Model control parameters
d) Projection control parameters

b) Calculations

The calculations for the historical part of the model are separated from those of the projection part. This is done for logical reasons, but also to allow dimensioning separately each of the components of the calculations. Two sheets are used to do these calculations. Sheet "ObservedPast" holds all calculations for the historical part of the model, while sheet "Projected" contains the calculations for the projection part. These data are joined together in a sheet "DataPlots" that organizes the data into a single set, for the plots.

c) Output

The output is presented mostly in graphical form, in the plot sheets "Abundance" (Figure 10) and "Catches" (Figure 11). In both of these, the estimated and projected trends in stock abundance and catches are presented as values relative to adequate reference points. So, abundance is represented by the value of the estimated abundance index as a percentage of the value of this abundance index at the target biomass $B_{0.1}$, while catches are presented as a percentage of MSY.

ii) Sheet "Data Plots"

This sheet contains the calculations for the plots of catches and stock abundance. It is not meant to be modified by the user, and it is protected to avoid accidental modifications to the workbook.

5. OPERATING INSTRUCTIONS

a) Setting overall options

The presentation of the data from the workbook relies on some Visual Basic procedures. Therefore, for the workbook to function properly, it is necessary to configure Excel in order to allow running macros. The following procedure should be used:

Open Excel with a blank worksheet

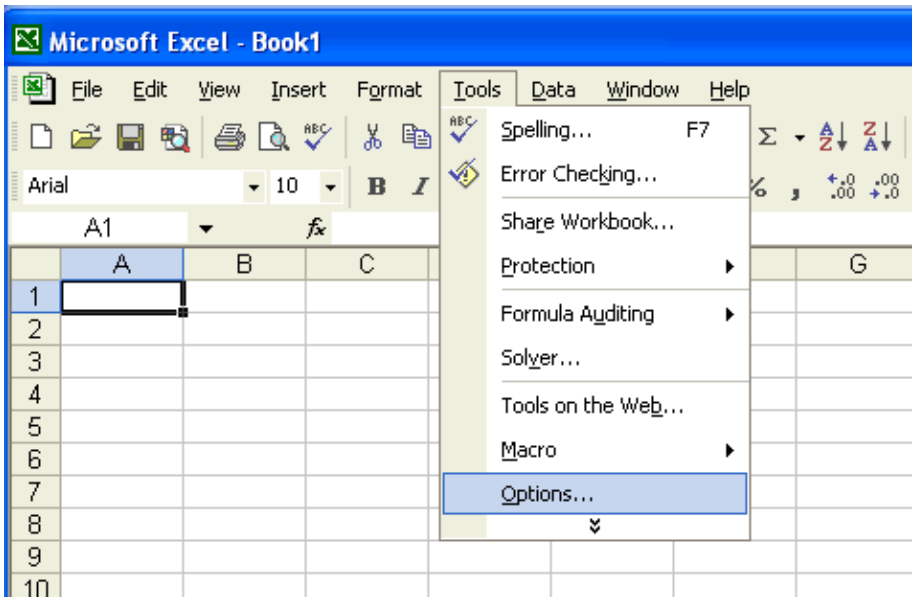


Figure 1- Selection of the “Options” dialogue

Under the menu item “Tools”, choose “Options”
Then in the “Security” tab click on “Macro security”

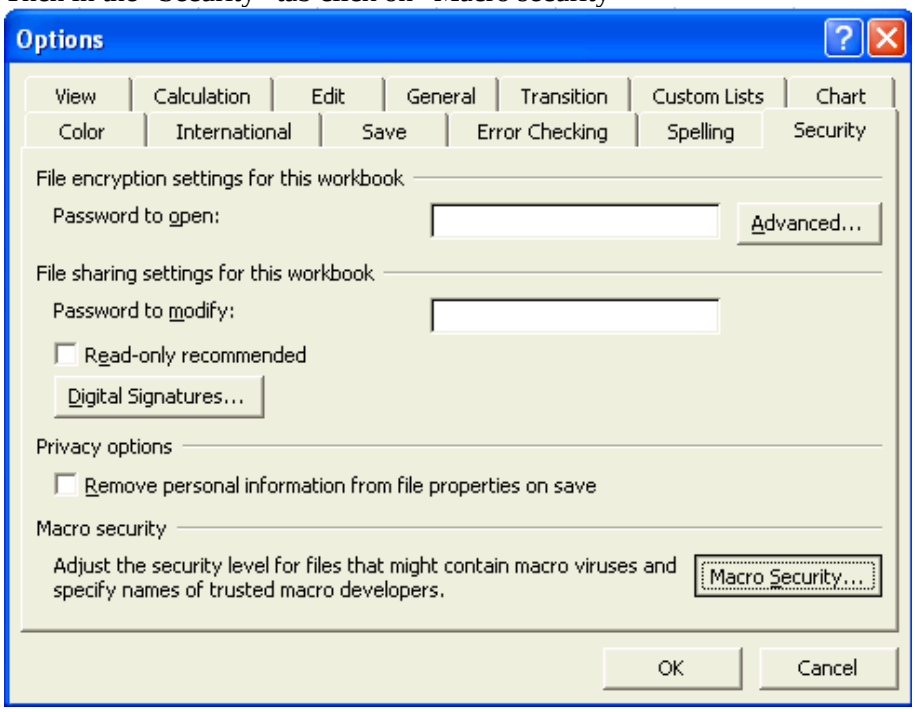


Figure 2. The “Security” tab under the “Options” dialogue

In the “Security Level” tab, choose “Medium” (Figure 3). This setting will allow you to permit running the macros in the worksheet without compromising the overall security of your computing environment.

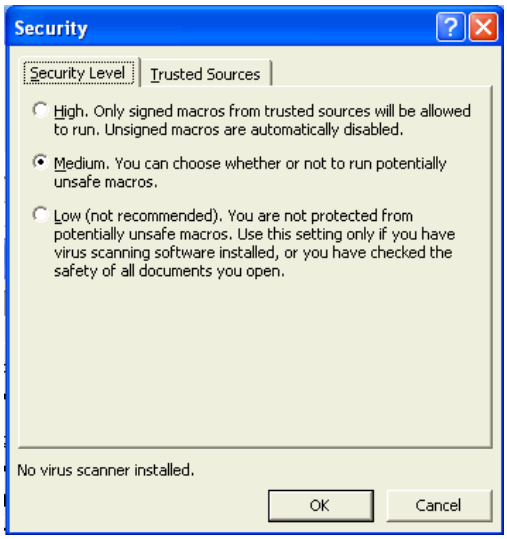


Figure 3. Setting the macro security level to “Medium”.

When opening the workbook, a warning message will appear, asking whether to allow the macros to run (Figure 4). Choose “Enable Macros” in this dialogue, and the sheet will load properly.

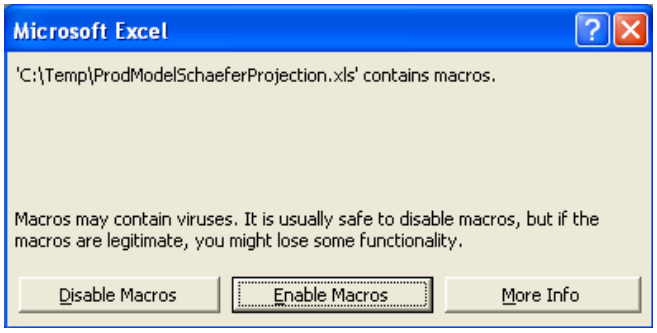


Figure 4. Dialogue that should appear when opening this workbook

Note: Under newer versions of Microsoft Excel, the procedure may be different from the one described above. In all cases, however, it will be necessary to set the macro security level to a level allowing selected macros to run, with previous user approval.

b) Data Entry

All data (for the historical period) and parameter estimates should be entered in the worksheet “Input”.

Data and parameter estimates (that may have been estimated by fitting the model to data using the fitting workbook) should be entered only in the cells coloured green (Figure 5). All other cells are either not used, or used to calculate quantities used by the model.

The parameters for the projection, including the number of years to project, and the values of catch or fishing effort to simulate (relative to the current “base” values) should also be set in this sheet.

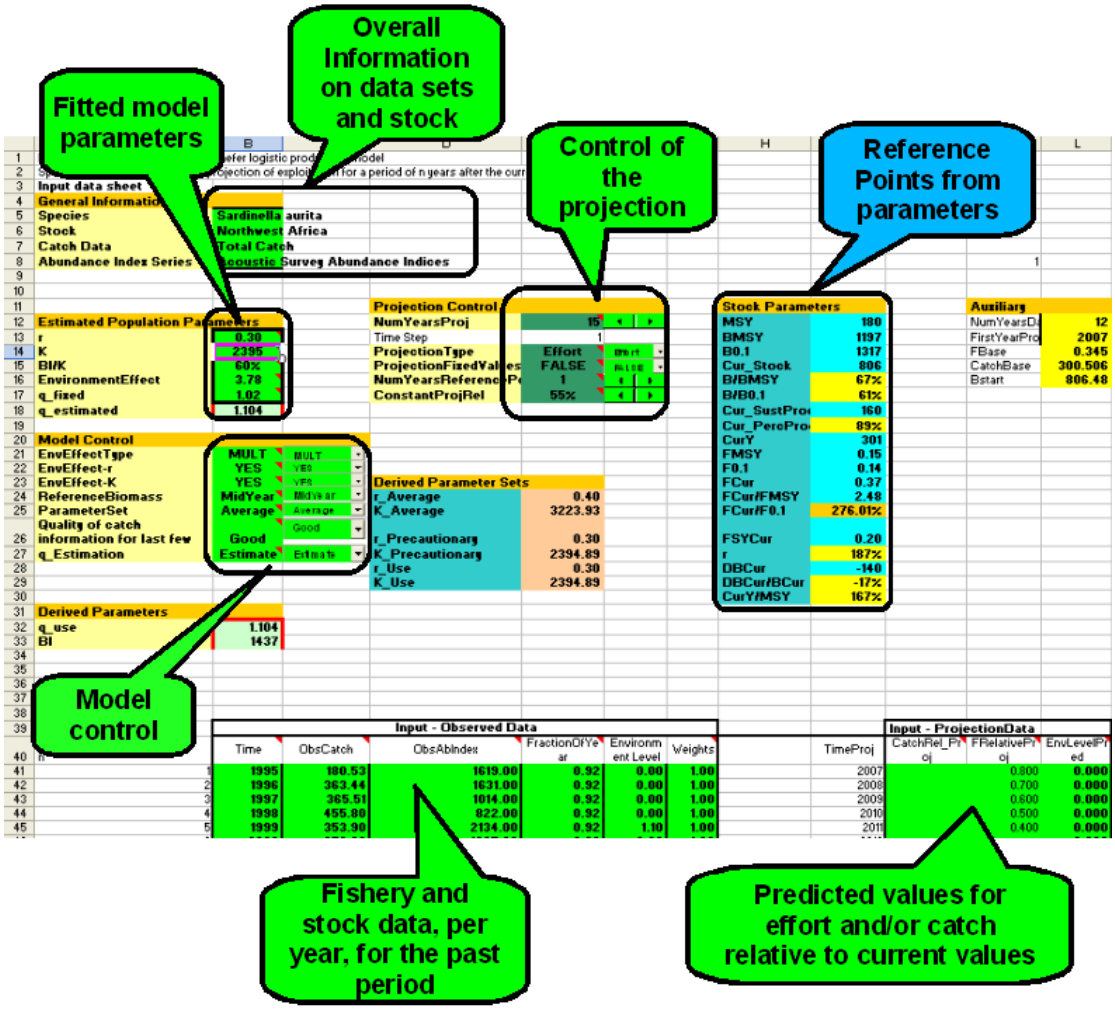


Figure 5. The main areas in the worksheet for model input and projection control

i) Entering historical data

The data for the historical period should be entered first (Figure 6). These data correspond to the data available to fit the model, and should be entered exactly as used for the fitting process. They will be used to replicate the estimated trends of catch and stock abundance in the historical period, and establish the base conditions to which the projection values are related.

Input - Observed Data					
Time	ObsCatch	ObsAbIndex	FractionOfYear	Environment Level	Weights
1995	180.00	1500.00	0.92	0.00	1.00
1996	353.00	1600.00	0.92	0.00	1.00
1997	430.00	1001.00	0.92	0.00	1.00
1998	500.00	800.00	0.92	0.00	1.00
1999	400.00	2020.00	0.92	1.00	1.00
2000	356.00	190.00	0.92	0.00	1.00
2001	298.00	1800.00	0.92	0.00	1.00
2002	280.00	1499.00	0.92	0.00	1.00
2003	345.00	1546.00	0.92	0.00	1.00
2004	264.00	3423.00	0.92	0.00	1.00
2005	305.00	3000.00	0.92	0.00	1.00

Figure 6. Section of the worksheet to enter the historical data

The settings in this section should be set exactly to the same values entered when fitting the model (estimating the parameters).

(1) Years of data (Time)

All years from the first to the last in the historical data set should be entered, consecutively. The first year should be entered in the cell immediately below the header "Year" and run consecutively until the last one. No empty cells should exist between the data, only after the last year. Note that the worksheet uses the number of consecutive non-empty cells in this column to define the time interval of the historical part of the modelling, and failing to fill this properly will result in inadequate calculations.

(2) Total Catch per year (ObsCatch)

Total catch is REQUIRED for ALL years in the historical data series. The model will fail if catch data is missing for any of these years (the reason is that catch is essential to calculating stock abundance the following year). This column should be filled like the one for year;

(3) Abundance Index (ObsAbIndex)

This column should be filled like the previous ones. It will contain an Index of stock abundance for as many years as possible, of the series of years considered. Only one index series can be entered, because it is considered impossible, or at least unreliable, to combine adequately several index series without detailed information on each of them. If it is desired to include information on more than one abundance index, these should be combined in a separate analysis that should take into account the relative reliability of each of the indices.

(4) Timing of the abundance index (FractionOfYear)

When the abundance index corresponds to e.g. a scientific survey, or to a fishery concentrated in a short season, it will not represent the average abundance of the stock during the year, but rather this same abundance at the time of the survey or fishery. The values in this column represent the timing of the abundance index as a fraction of year (0.5 = July 1st). It should be set to a value corresponding roughly to the mid-point of the survey or of the fishing season. If the abundance index corresponds to a CPUE from a year-long fishery, this value should be set to 0.5 (mid-year).

(5) Environment Level

This column contains an index of "relative environmental quality" for each year in the data series. This index should reflect, as much as possible, the overall quality of the environment for stock growth relative to the "average" years. Years considered as "average" should have the value "0" for this index, while years more favourable than the average will have a positive value, and years less favourable will have negative values. This column will include any index that can be considered to represent a deviation of the average growth conditions of the stock in each year. If a series of environmental indices exist (e.g. a series of upwelling indices) these can be used as the environmental level. If not, and there is external scientific evidence that there were particular years with exceptional conditions, then an arbitrary positive (for good growth) or negative (for poor growth) environmental level can be set for that year. If there is no information on environmental elements affecting the carrying capacity and/or the intrinsic growth rate of the stock, or it is considered that these parameters do not vary significantly, then the values in this column should be left at their default value of 0.

(6) Weights

This column will include the weights given to each estimate of the abundance index in the fitting procedure. These weights should be proportional to the reliability of the different estimates. This may mean that they should be proportional to the variance of the estimates, if this is available, but they may be used simply to downweigh some particularly troublesome or doubtful points. In some cases, there are doubts about the reliability or the representativeness (compared with the rest of the series) of one or a few of the abundance indices used (e.g. if there is a year with less complete coverage, or with uncommon distribution conditions). In these cases, the corresponding value of the abundance index will not be as reliable as the remaining of the series. These points can be given less weight in the

fitting of the model, by setting a value less than **1** in the corresponding row of the column Weights. The weights are not used in the projection sheet, but should be entered, to establish a record to the fitting procedure used to obtain the current parameter estimates.

Notes:

The number of consecutive non-empty cells in column Year is used to define the number of years in the data to fit. Therefore, only years for which catch data is available must be entered, and all cells below these must be empty (use "Clear contents");

In the calculated columns (to the right of the column "Weights") the rows below the last year of data should NOT be deleted. The worksheet will ignore those below the last year of data. Deleting these rows will force one to rebuild them when a new data point is entered.

ii) Estimated stock parameters

The values estimated for the main stock parameters should be entered in the section headed "Estimated Population Parameters" (Figure 7). Values must be entered for **r** (intrinsic rate of growth), **K** (Carrying capacity, or Virgin Biomass) and **BI/K** (Stock Biomass at the start of the data series, as a proportion of the Virgin Biomass. The estimated value of the constant of proportionality between the estimated biomasses ad the corresponding abundance indices, **q** (sometimes called the catchability coefficient) should also be set. If an environment effect was used for fitting the model, the value of the estimated coefficient should also be entered in the appropriate cell.

It should be noted that the value of the parameters in this section should be set exactly to the same values estimated from fitting the model to the historical data.

Estimated Population Parameters	
r	0.14
K	4270
BI/K	50%
EnvironmentEffect	7.97
q_fixed	1.02
q_estimated	0.363

Figure 7. Spreadsheet area for entering the population parameters

iii) Model fitting control

The parameters of model fitting (figure 8) should also be entered in the appropriate section of the input sheet.

Model Control		
EnvEffectType	MULT	MULT
EnvEffect-r	YES	YES
EnvEffect-K	YES	YES
ReferenceBiomass	StartYear	StartYear
ParameterSet	Average	Average
Quality of catch information for last few years	Good	Good
q_Estimation	Fixed	Fixed

Figure 8. Spreadsheet area for entering the model control parameters

1) Type of Environment Effect: Select how the environment level affects the model parameters r and K. Select NONE (no effect), MULT (Multiplicative effect) or EXP (Exponential effect);
2) Environment Effect on r: Set to YES if the environment is assumed to affect the growth capacity of the stock (r);

3) Environment Effect on K: Set to YES if the environment is assumed to affect the maximum (virgin) stock Biomass (K);
4) Reference Biomass: Specifies whether the Biomass natural growth rate is assumed to depend on Biomass at the start of the year or at mid-year;
5) Parameter set: Specify which set of parameters to use for estimating the Biological Reference Points. When using the option of introducing an environmental level indicator, different values of r and K are calculated for every year in the data set. In this situation, it becomes difficult to choose which is the best value of the parameters to use in the calculation of the overall reference points. The best option will depend on the situation at hand. Three options are available: Fixed- Use the overall r and K parameters estimated by the model fitting; Average – Use the average of the year-specific r and K calculated for the series of years; Precautionary – Use the smallest of the two previous sets. It should be noted that all these sets will be equal if there is no Environment Effect;
6) Quality of catch information for the last years. Set to Good, if these data are reliable, or Poor otherwise. This parameter will influence the estimation of the abundance on the last year of data. If the catch data during the last years is considered good, the abundance on this last year is that calculated by the Schaefer model; However, if the quality of the total catch data in the last few years is poor, this will affect strongly the reliability of the Biomass estimates from the model. In this case, it is better to calculate the Biomass using the Abundance Index for last year and the overall coefficient of proportionality q, as B=U/q;
7) q estimation: Set to Fixed if the coefficient of proportionality q should be fixed (set to the value given by the user or estimated numerically); Set to Estimate if q should be estimated linearly from the series of estimated abundances and abundance indices;

The settings in this section should be set exactly to the same values/options used when fitting the model to the historical data. This way, the historical part of the fitted model will reproduce exactly the fitting procedure, and the projection will reflect the average conditions observed during the period used to fit the model.

iv) Projection control

To run the projection simulation, it is necessary to define the main aspects of this simulation,

Projection Control		
NumYearsProj	15	◄ ►
Time Step	1	
ProjectionType	Effort	Effort ▼
ProjectionFixedValues	FALSE	FALSE ▼
NumYearsReferencePeriod	1	◄ ►
ConstantProjRel	88%	◄ ►

Figure 9. Spreadsheet section used to control the options for the projections

The settings in this section define the options available for running the projections.

1) Number of years to project: This option simply defines the number of years (from the year immediately after the last year in the historical data series) to use for the projection;
2) Projection type: Set to Effort if it is intended to simulate a management strategy based on limitation of fishing mortality (effort); Set to Catch if the projection is based on a TAC-based management strategy;
3) Use Fixed Values: Set to TRUE if fixed Catch or Fishing Mortality values (in percentage of current values) are given for each year of the projection; Set to FALSE if a constant TAC or Fishing Mortality (both given as a percentage of the corresponding average value in the reference period) is used instead;
4) Number of Years in Reference Period: Number of years (in the end of the data series) to use as the Reference Period for the calculations of the relative changes in Catch or Fishing Mortality;
5) Constant value (in % of the values in the reference period) of the values of Catch or Fishing Mortality (depending on the projection type chosen) for the projection, if a Constant TAC or Fishing Mortality is chosen for the projection;

a) Output

The model outputs the projections of stock abundance and total catch for all years in the period covered by the projections.

In all cases, these are presented as values relative to the reference points adopted ($B_{0.1}$ and MSY). The main tools offered to analyse these projections are the plots in sheets "Abundance" (Figure 10) and "Catches" (Figure 11). In both of these, the current year, and thus the separation between the historical and the projected periods is indicated by a vertical line, allowing a better visualisation of the two periods that must be interpreted separately.

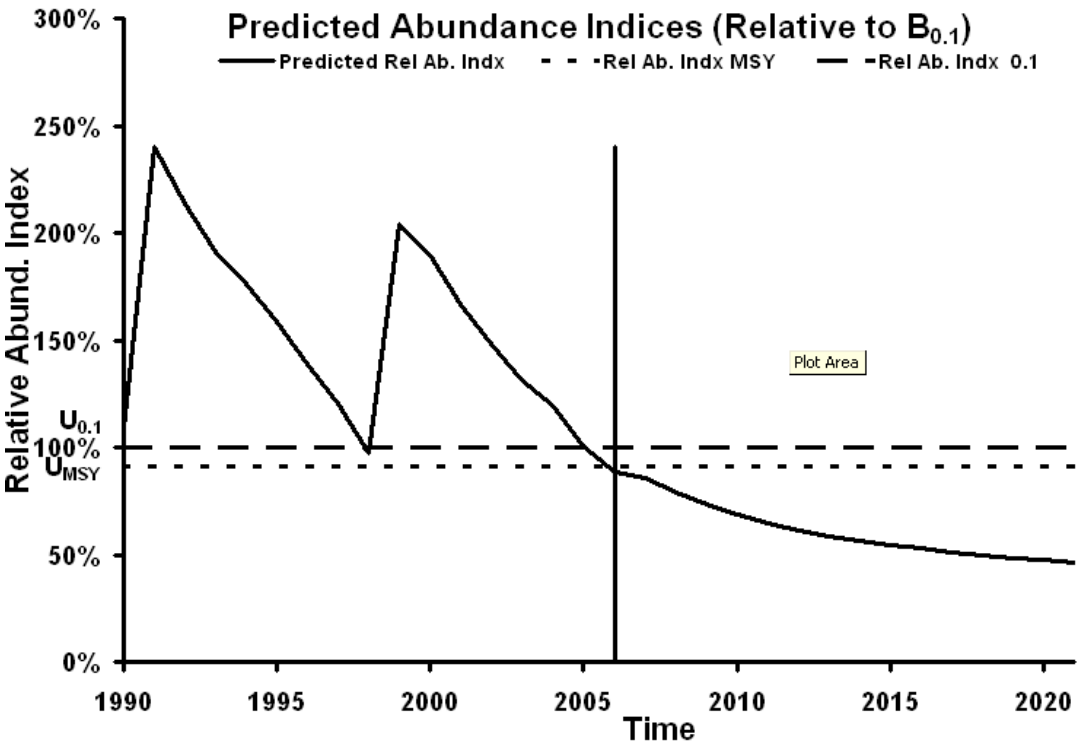


Figure 10. Spreadsheet Plot of the trends in observed and projected Abundance Indices (Relative to $U_{0.1}$)

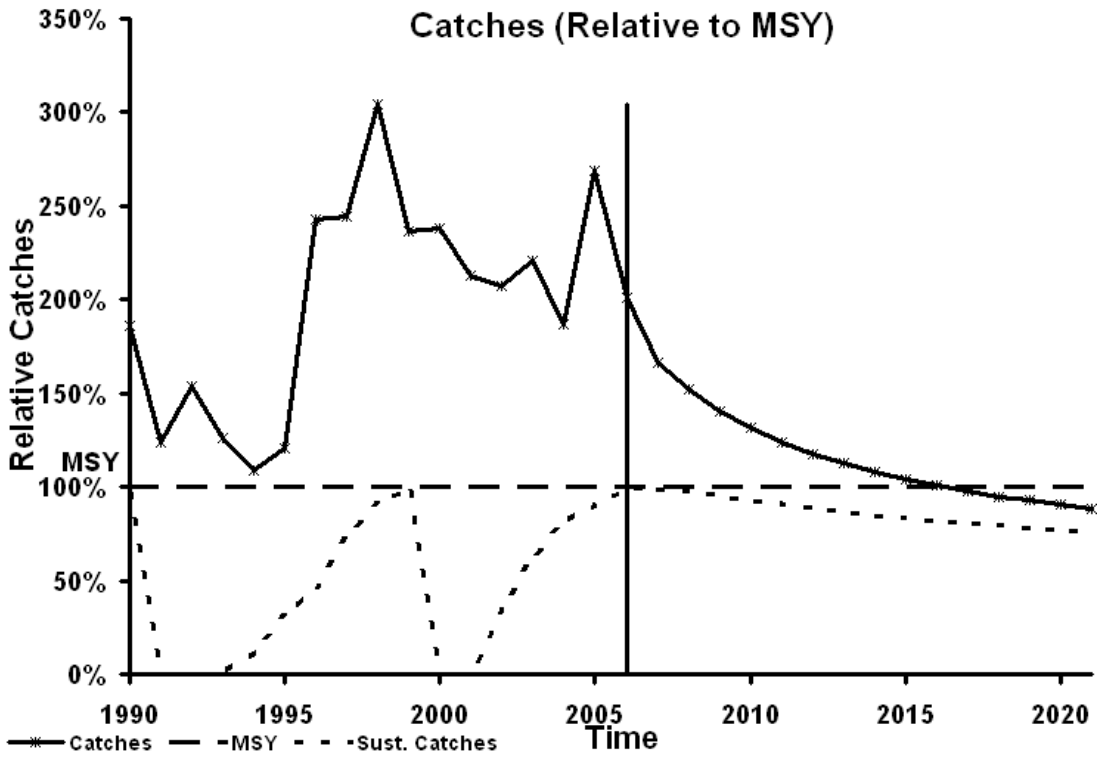


Figure 11. Spreadsheet Plot of the trends in observed and projected catches (Relative to MSY)

6) Editing the WorkBook

With the exception of the cells shown in green on sheet "Input", it is assumed that the user will not need to edit any part of the workbook. Therefore, most of the sheets are protected, to avoid accidentally modifying the formulas or the structure of the workbook. However, if any user wants to modify any sheet, it is enough to select "Unprotect sheet" from the menu item "Protection" (Figure 12). Users are urged to make a copy of the workbook before doing this, however, as they might accidentally modify the formulas or the structure of the workbook.

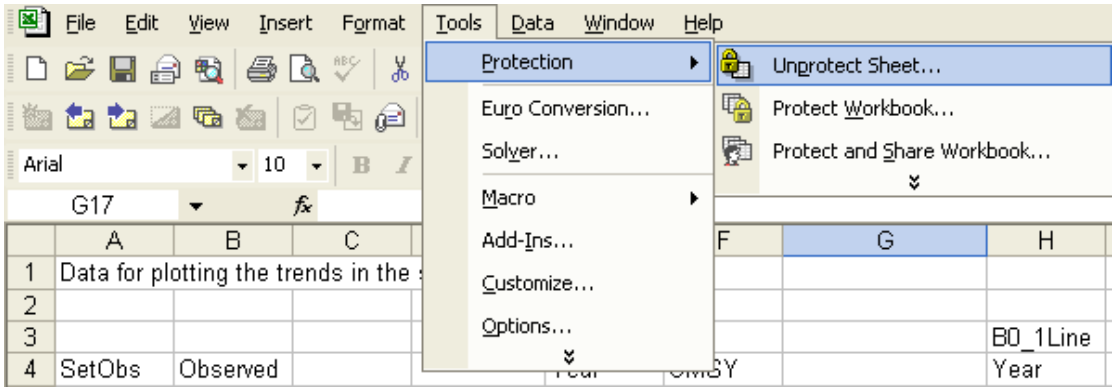


Figure 12. Procedure for unprotecting the worksheet "DataPlots"

7) Interpretation of results

The interpretation of the projection results should be done with caution. As mentioned in the introduction, projections are not forecasts, and should not be used as such.

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APPENDIX/ANNEXE III

Estimation biomasses of *Sardiella aurita*, *Sardinella maderensis* and *Trachurus trecae*, in Senegal-Gambia, NovemberDecember 2009

1) Correlation test between the biomass in SeneGambia and the biomass north of St. Louis: Pearson Coefficient.

Species	Coeff.Pearson	tr	$tr_{\mu}(\alpha=5\%)$	$tr_{\mu}(\alpha=1\%)$
Sardinella aurita	-0.007	0.024	0.576	0.708
Sardinella maderensis	-0.197	0.698	0.576	0.708
Trachurus trecae	-0.360	1.335	0.576	0.708

2) Considering 3 other factors in the biomass estimation in SeneGambia (B):
   - Environnemental factor:
     - Upwelling index in SeneGambia in the winter seasons of the period 1995-2009 (UP)
   - Annual Catch in SeneGambia during 1995-2009 (C)
   - Biomass north of St Louis (Morocco+Mauritania) (Bnorth)

3) Processing by statistical tools:

   - B=model(Bnorth, UP,C)
   - Model = Multiple regression with data 1995 to 2008

4) Conclude the biomass of target species:

Applying the model to the Upwelling (UP) and Catch (C) of 2009.

The tenth meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa was held in Banjul, the Gambia, from 18 to 22 May 2010. The overall objective of the Working Group is to assess the state of the small pelagic resources in northwest Africa and make recommendations on fisheries management and exploitation options aimed at ensuring optimal and sustainable use of small pelagic fish resources for the benefit of coastal countries. The Group assessed the status of the small pelagic resources in northwest Africa and made projections on the development of the stocks and on future effort and catch levels. The advice for the stocks is given in relation to the agreed reference points $F_{0.1}$, F_{MSY}, $B_{0.1}$ and B_{MSY} and on the basis of the projections for the next five years. Total catch of small pelagic fish for the period 1990 to 2009 has been fluctuating with an average of around 1.7 million tonnes. Although important changes were observed in the abundance and exploitation level for some of the stocks, the overall general situation with respect to the state of the different stocks was found to be similar to that of 2009, with the exception of the Atlantic horse mackerel (*Trachurus trachurus*), which this year (2010) was considered overexploited. The Cunene horse mackerel (*T. trecae*) remains overexploited, and the Small Pelagic Working Group recommends a decrease in catch and effort on the horse mackerels to ensure sustainable harvesting of this stock. With the exception of sardine (*Sardina pilchardus*) in Zone C, the other small pelagic fish stocks in the region are considered to be fully or overexploited. The catches of round sardinella (*Sardinella aurita*) are high for the last three years, probably associated with a good recruitment of year class 2005. The estimated abundance index for 2009 was also high. However, given the uncertainties associated with the last year's abundance indices, the lack of evidence of another good year class since 2005 and the high observed catches in recent years which exceed what the stock can sustain in the long run, the Working Group continues to be concerned about this stock and still considers it as overexploited. The Working Group reiterates its recommendation to reduce effort on this species and to respect the previously recommended catch levels. Chub mackerel (*Scomber japonicus*), anchovy (*Engraulis encrasicolus*) and bonga (*Ethmalosa fimbriata*) were also found to be fully exploited. For the two latter species, the Working Group noted that, although the information available to the Group has improved, some deficiencies still remain.

La dixième réunion du Groupe de travail de la FAO sur l'évaluation des petits pélagiques au large de l'Afrique nord-occidentale s'est réunie à Banjul, la Gambie, du 18 au 22 mai 2010. L'objectif général du Groupe de travail est d'évaluer l'état des ressources en petits pélagiques en Afrique nord-occidentale et d'établir des recommandations relatives à la gestion des pêches et aux options d'exploitation afin d'assurer la meilleure utilisation durable de ces ressources pour le plus grand bénéfice des pays côtiers. Le Groupe a examiné l'état actuel des ressources de petits pélagiques en Afrique nord-occidentale et fait des projections sur le développement, l'effort et les niveaux de capture futurs des stocks. Des conseils concernant l'état des stocks sont donnés par rapport aux points de référence convenus $F_{0.1}$, F_{MSY}, $B_{0.1}$ et B_{MSY} et sur la base des projections pour les cinq prochaines années. La capture totale de petits pélagiques au cours de la période 1990–2009 a fluctué avec une moyenne d'environ 1,7million de tonnes. Même si on a pu observer d'importants changements dans les niveaux d'abondance et d'exploitation de certains stocks, la situation générale a été jugée dans l'ensemble identique à celle de l'an passé, exception faite pour le stock du chinchard d'Europe (*Trachurus trachurus*) qui a été considéré surexploité cette année (2010). Le chinchard du Cunène (*Trachurus trecae*) demeure surexploité et le Groupe de travail sur les petits pélagiques recommande de réduire les captures et l'effort sur les chinchards de façon à garantir une pêche durable de ces stocks. À l'exception de la sardine (*Sardina pilchardus*) dans la zone C, les autres stocks de petits pélagiques dans la région sont pleinement exploités ou surexploités. Les captures de sardinelle ronde (*Sardinella aurita*) sont élevées ces trois dernières années, probablement en raison d'un bon recrutement en 2005. L'indice d'abondance estimé en 2009 est également élevé. Cependant, en raison des incertitudes au sujet des indices d'abondance de la dernière année, de l'absence de preuves d'une autre bonne classe d'âge depuis 2005 et des captures élevées des dernières années qui dépassent ce que le stock peut soutenir sur le long terme, le Groupe de travail continue d'être préoccupé par ce stock dans la région et le considère toujours comme surexploité. Le maquereau (*Scomber japonicus*), l'anchois (*Engraulis encrasicolus*) et l'ethmalose (*Ethmalosa fimbriata*) sont également considérés comme pleinement exploités et le Groupe de travail a remarqué que même si l'information disponible à leur sujet s'est améliorée, des manques perdurent.

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