8.5 BFT – ATLANTIC BLUEFIN TUNA

BFT-1. Biology

There has been some progress in our knowledge of bluefin tuna biology, but the complex behaviour of this species, means that much research still needs to be carried out. At this meeting, we focused on potential changes in stock productivity related to updated growth and maturity parameters that differ from the ones previously used. Currently, our understanding is that fish in the Mediterranean mature at 4-5 years of age (approximately 25 kg), whereas fish are believed to mature at 8 years of age (196 cm) or older in the Gulf of Mexico. Recent research in reproductive biology, demographic modeling and age determination (SCRS/2007/143, SCRS/2007/135) indicates that western bluefin tuna may be less resilient to fishing than previously thought.

The Committee is also concerned about issues of mixing identified in previous SCRS documents, and in particular, the inability to quantify the kind and extent of mixing for use in assessment models. Evidence indicates that movement across the current assumed east/west boundary in the Atlantic does occur and that movements can be extensive and complex. While the importance of these migrations are noted, the quantitative proportions are uncertain. Recognizing that quantitative knowledge of mixing rates is an important aspect of assessment models that explicitly attempt to describe the dynamics of migratory fish stocks, there is a need to integrate recent and anticipated advances in otolith microconstituent analyses, age determination, archival tagging and genetics into the next assessment and management evaluation processes.

BLUEFIN TUNA - WEST

BFTW-2. Fishery indicators

The total catch for the West Atlantic including discards has stabilized due to the imposition of Total Allowable Catch (TAC) quotas since 1981 (**BFT-Table 1**, **BFT-Figure 1**). During 1983-2001 the lowest was 2,113 t in 1994 and the highest was 3,011 t in 1988. At this meeting, the annual catch data was reviewed for 2002-2004. Data for 2005 was only available from Canada and US although Japan did provide a very preliminary estimate for 2005 (302 t) for use in projections; that data was provisional and will be updated in the future. The total catch for the West in 2002 (3,319 t) was the highest since 1981, and all three major fishing nations indicated higher catches. After that year, the Canadian landed catch was stable at 500-600 t (733 t in 2006) as were Japanese catches in with the exception of 2003, which was low for regulatory reasons. However, the United States did not catch its quota in 2004, 2005 and 2006 with landed catches of 899 t, 717 t and 468 t, respectively. Early indications show that the trend of the United States under-catching its quota by about half will continue in 2007. It was noted that some nations have adopted a fishing year that is different from the calendar year to manage their quota. Thus, their calendar year annual catches do not match their allocated quota.

BFTW-Figure 4 shows the distribution of bluefin catches in the Atlantic and Mediterranean since 1950, by decade.

BFTW-3. State of the stock

The 2006 assessment is consistent with previous analyses in that spawning stock biomass (SSB) declined rapidly in the early 1970s followed by a more gradual decline in SSB through the early 1990s (**BFTW-Figure 2**) to about 21% of the 1975 level. During the period of 1994-1998 it appears that SSB recovered somewhat to about 28% of the 1975 level in 1998. However, the 2006 assessment indicates gradual declines since then to about 19% of the 1975 level by the year 2004 (**BFTW-Figure 2**). Conversely, after the large decline in recruitment in the early 1970's (**BFTW-Figure 2**), recruitment since then has varied from year to year without trend.

While the large decline in SSB since the early 1970s is clear from the assessment, the potential for rebuilding is less clear. The 1994 year class (recruitment in 1995) continues to be estimated as a relatively strong one, although it is still much less than the recruitment that occurred in the early 1970s. The Committee remains uncertain as to the causes of the relatively poor recruitment since 1976 and, therefore, is less certain about the outlook for recruitment in the future.

Also, note that the 2006 assessment incorporated data through 2004, since 2005 data were not fully available. Therefore, projections were made using preliminary catches for 2005. These data indicate that in 2005, about one third of the TAC was not taken, which is by far the largest shortfall since a TAC was established in 1981. Most of the shortfall was by the United States rod and reel fishery in terms of landings.

The plausible explanations for relatively low catch by the United States since 2004 are (1) that availability of fish to the United States fishery was abnormally low, and/or (2) the overall size of the population in the Western Atlantic declined substantially from the level of recent years. The fact that Canada and Japan did not have abnormally low catches in 2005 and 2006 supports the first explanation. Also, the CPUE series from the Gulf of St. Lawrence has been at high levels since 2004. On the other hand, other fishery indicators in 2005 (some abundance indices, declining size composition in some areas, small changes in the fishing mortality rate suggested by tagging data despite declining catches) support the second explanation. For more detail see SCRS/2007/171.

The SCRS in 2006 had no strong evidence to favor either explanation over the other, but it noted that the failure of a fishery to take about third of its TAC, particularly for a valuable species like bluefin tuna, is a reason for concern. The continuation of this trend in 2006, and probably 2007, and other new evidence reviewed by the committee, heightened concern that the estimate of stock status from the 2006 assessment may be optimistic (i.e., gives further weight to the second explanation above). It noted that this phenomenon has been seen in other fisheries prior to it becoming clear that they were in trouble. It should also be noted that the relatively low catch in 2005 was incorporated into short term projections (from 2004 to 2005). This leads to somewhat of an increase in projected abundance in the first few years of the projections. If the second explanation is correct, this is an overly optimistic outlook.

The SCRS cautioned that the conclusions of the 2006 assessment do not capture the full degree of uncertainty in the assessments and projections. An important factor contributing to uncertainty is mixing between fish of eastern and western origin. Furthermore, the projected trends in stock size are strongly dependent on estimates of recent recruitment, which are a particularly uncertain part of the assessment.

BFTW-4. Outlook

A short-term (five-year) outlook evaluation for changes in spawning stock size and yield under various management options was conducted in 2006. This period was selected to cover the time until a new assessment might be commissioned. Moreover, more than five years would be required before changes in regulations resulted in appreciable changes in spawning biomass. Accordingly, future recruitment is expected to fluctuate around recent recruitment levels and five-year projections assumed this.

In general, the outlook for bluefin tuna in the West Atlantic (**BFTW-Figure 3**) is more pessimistic than that presented in the previous assessment (Anon. 2003a) primarily because the 1994 and 1997 year classes, which were estimated to be about twice the average, are now estimated to be average. Projections show predictable degrees of short-term response in SSB, depending upon the amount of catch extracted. In contrast, projections using an alternative assessment methodology, i.e., BSP (SCRS/2007/143), are even more pessimistic than the 2006 assessment and suggest substantially lower short-term sustainable yield than indicated in **Table 1**.

BFTW-5. Effects of current regulations

Recommendation 06-06 is expected to result in a rebuilding of the stock towards the convention objective with fishing mortality rates at about the estimated MSY level. New evidence suggests that current regulations may be insufficient to achieve the objectives, however the committee will be unable to further evaluate this until the next assessment. The ability to achieve the convention objectives would be further hampered by future use of accumulated unused quota, particularly given the large amount involved for western bluefin tuna.

BFTW-6. Management recommendations

The Committee gave the following advice for consideration by the Commission in 2006:

1) Given the current recruitment that has been exhibited by western Atlantic bluefin, it is extremely unlikely that SSB can recover to levels that were exhibited in the 1970's in the next 15 years or so without reducing catch to near zero.
2) The current TAC (2,700 t) is not expected to result in major changes in SSB from 2007-2009 (small declines on the order of 3% per year).
3) Fishing at F_{MSY}(conditional on current recruitment) during the period 2007-2009 would be expected to increase SSB over that period by about 1.5% per year.
4) A constant TAC over the period 2007-2009 which would produce gains in SSB equivalent to those gains in 3) would be about 2,100 t.
5) The constant TAC over the period 2007-2009 which would be expected to maintain SSB at 2006 levels would be about 2,300 t.

The Commission responded positively by recommending option 4. However, the Committee is even more concerned about the status of the western stock than it was a year ago (as discussed above). Further advice will be provided after the next assessment (2008).

The SCRS notes that evidence is accumulating which indicates that both the productivity of western Atlantic bluefin and western Atlantic bluefin fisheries are linked to the eastern Atlantic and Mediterranean stock. One plausible explanation for the failure of the fishery in the west to take its TAC in recent years is that it is partly dependent on fish of eastern origin, and the population of eastern origin fish has become less available to the west. Therefore, management actions taken in the eastern Atlantic and Mediterranean are likely to impact the recovery in the western Atlantic, because even small rates of mixing from East to West can have significant effects on the West due to the fact that Eastern plus Mediterranean resource is much larger than that of the West. Further evaluations of management options that address mixing issues, about which the Commission has asked advice, were completed and are addressed under SCRS 2006 Agenda Item 15.6.

WEST ATLANTIC BLUEFIN TUNA SUMMARY
(Catches and Biomass in t)

Current (2006) Catch (including discards)	1,929 t [4]
Short-term Sustainable Yield	~2,300 t
Maximum Sustainable Yield (MSY|R[1,2])	3,200 (3,000-3,400)[2]
Relative Stock Biomass	
SSB_{2004}/SSB_{1975}	0.18
$SSB_{2004}/SSB_{MSY\|R}$	0.41 (0.29-0.54)[2]
Relative Fishing Mortality[3]	
$F_{2004}/F_{MSY\|R}$	1.7
$F_{2004}/F_{0.1}$	3.1
F_{2004}/F_{max}	1.7
Management Measures:	TAC of 2,100 t from 2007 including dead discards [Rec. 06-06]. TAC of 2,700 t from 2003 including dead discards [Rec. 02-07]. 30 kg (115 cm FL) minimum size with 8% tolerance [Rec. 98-07]. No directed fisheries in Gulf of Mexico [Rec. 98-07].

1 MSY calculated conditional that recruitment remains at recent (1976-2001) levels.
2 Median and approximate 80% confidence interval from bootstrapping from the assessment.
3 F_{2004} is taken to be the geometric mean of the estimates for 2001-2003.
4 Estimates for 2006 are preliminary.

BFT-Table 1. Estimated catches (t) of northern bluefin tuna (*Thunnus thynnus*) by major area, gear and flag.

			1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
TOTAL			23853	24344	26717	24645	21374	20792	27128	23819	26045	29420	34131	36636	48853	49714	53302	49485	42375	35228	36541	37390	37089	33458	33483	37575	28789
AT.E+MEDI			22408	21802	24425	21960	19052	18200	24117	20952	23247	26429	31849	34268	46740	47291	50807	47151	39718	32456	33766	34605	33770	31163	31376	35671	26861
	AT.E		6702	8152	7393	4757	4492	4436	6950	5324	6040	6556	7619	9367	6930	9650	12663	13539	11376	9628	10528	10086	10347	7232	7406	8974	8111
	MEDI		15706	13650	17032	17203	14560	13764	17167	15628	17207	19872	24230	24901	39810	37640	38144	33612	28342	22828	23238	24519	23424	23931	23970	26697	18750
AT.W			1445	2542	2292	2685	2322	2592	3011	2867	2798	2992	2282	2368	2113	2423	2495	2334	2657	2772	2775	2785	3319	2295	2107	1905	1928
Landings	AT.E	Bait boat	831	1882	2262	2004	1414	1821	1936	1971	1693	1445	1141	3447	1980	2601	4985	3521	2550	1492	1822	2275	2567	1241	1790	2018	1116
		Longline	2705	2626	1538	535	770	904	1169	853	1496	3197	3817	2717	2176	4392	4788	4534	4300	4020	3736	3303	2896	2750	2070	2651	2593
		Other surf.	190	1425	949	501	973	668	1220	1020	562	347	834	1548	932	1047	646	511	621	498	703	712	701	560	402	1014	3401
		Purse seine	655	262	373	86	276	0	0	0	54	46	462	24	213	458	323	828	692	726	1147	150	884	490	1078	871	153
		Sport (HL+RR)	13	0	0	1	1	3	1	2	1	0	0	0	0	0	0	162	28	33	126	61	63	109	87	11	4
		Traps	2309	1956	2271	1630	1057	1040	2624	1478	2234	1522	1365	1631	1630	1152	1921	3982	3185	2859	2996	3585	3235	2082	1978	2408	844
	MEDI	Bait boat	53	0	1699	278	0	0	0	0	25	148	158	48	0	206	5	4	11	4	0	0	1	139	17	5	
		Longline	1550	980	1196	1228	678	799	1227	1121	1026	2869	2599	2342	7048	8475	8171	5672	2749	2463	3317	3750	2614	2476	2564	2988	1641
		Other surf.	521	674	1738	3211	3544	2762	2870	3289	1212	1401	1894	1607	3218	1043	1197	1033	1880	2976	1067	1096	990	2536	1106	480	333
		Purse seine	12131	10484	9888	11219	9333	8857	11198	9450	11250	13245	17807	19297	26083	23588	26021	24178	21291	14910	16195	17174	17656	17167	18785	22475	16335
		Sport (HL+RR)	87	194	275	507	322	433	838	457	1552	738	951	1237	2257	3556	2149	2340	1336	1622	1921	1321	1647	1392	1339	634	313
		Traps	1364	1318	2236	760	683	913	1034	1311	2142	1471	821	370	1204	772	601	385	1074	852	739	1177	515	221	159	115	129
	AT.W	Bait boat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Longline	363	829	835	1245	764	1134	1373	678	739	895	674	696	539	466	528	382	764	914	859	610	730	176	626	573	737
		Other surf.	323	514	377	293	166	156	425	755	536	578	509	406	307	384	433	295	344	281	283	202	108	140	97	90	85
		Purse seine	232	384	401	377	360	367	383	385	384	237	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4
		Sport (HL+RR)	459	808	676	750	518	726	601	786	1004	1083	586	854	804	1114	1028	1179	1106	1124	1120	1656	2035	1398	1139	924	1005
		Traps	68	7	3	20	0	17	14	1	2	0	1	29	79	72	90	59	68	44	16	16	28	84	32	8	3
Discards	AT.W	Longline	0	0	0	0	514	192	215	248	133	199	211	88	83	138	167	155	123	160	222	105	211	232	181	131	94
		Other surf.	0	0	0	0	0	0	0	14	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	
		Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	0	0	0	0	0	
Landings	AT.E	Cape Verde	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		China P.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	103	80	68	39	19	41	24	
		Chinese Taipei	16	2	0	0	0	0	0	0	0	0	0	6	20	8	61	226	350	222	144	304	158	0	0	10	4
		EC.Denmark	0	0	1	2	1	0	0	0	0	0	0	37	0	0	0	0	1	0	0	0	0	0	0	0	
		EC.España	2857	4587	4804	3628	2876	2479	4567	3565	3557	2272	2319	5078	3137	3819	6174	6201	3800	3360	3474	3633	4089	2138	2801	3102	2033
		EC.France	150	400	602	490	348	533	724	460	510	565	894	1099	336	725	563	269	613	588	542	629	755	518	561	818	1218
		EC.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EC.Greece	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EC.Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	21	52	22	8	15	3	1	1	2
		EC.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EC.Portugal	41	174	34	29	193	163	48	3	27	117	38	25	240	35	199	712	323	411	441	404	186	61	26	17	85
		EC.Sweden	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EC.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	12	0	0	0	0	0	0	0
		Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	104	118	0	0	0	0	0	
		Guinée Conakry	0	0	0	0	0	0	0	0	0	0	0	0	330	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	27	0	0	1	0	0	0	
		Japan	2573	2609	1514	420	739	900	1169	838	1464	2981	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	2413
		Korea, Republic of	0	3	0	77	0	0	0	0	0	0	0	0	4	205	92	203	0	0	6	1	0	0	0	0	1
		Libya	0	0	0	0	0	0	0	0	0	0	312	0	0	0	576	477	511	450	487	0	0	0	0	0	
		Maroc	993	365	171	86	288	356	437	451	408	531	562	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2354
		NEI (ETRO)	0	0	6	3	4	0	5	6	74	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	85	144	223	68	189	71	208	66	0	0	0	0	0	0	0	
		Norway	50	1	243	0	31	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	
		Panama	12	0	17	22	11	4	0	0	0	0	0	0	1	19	550	255	0	13	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	118	0	0	0	0	
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		U.S.A.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

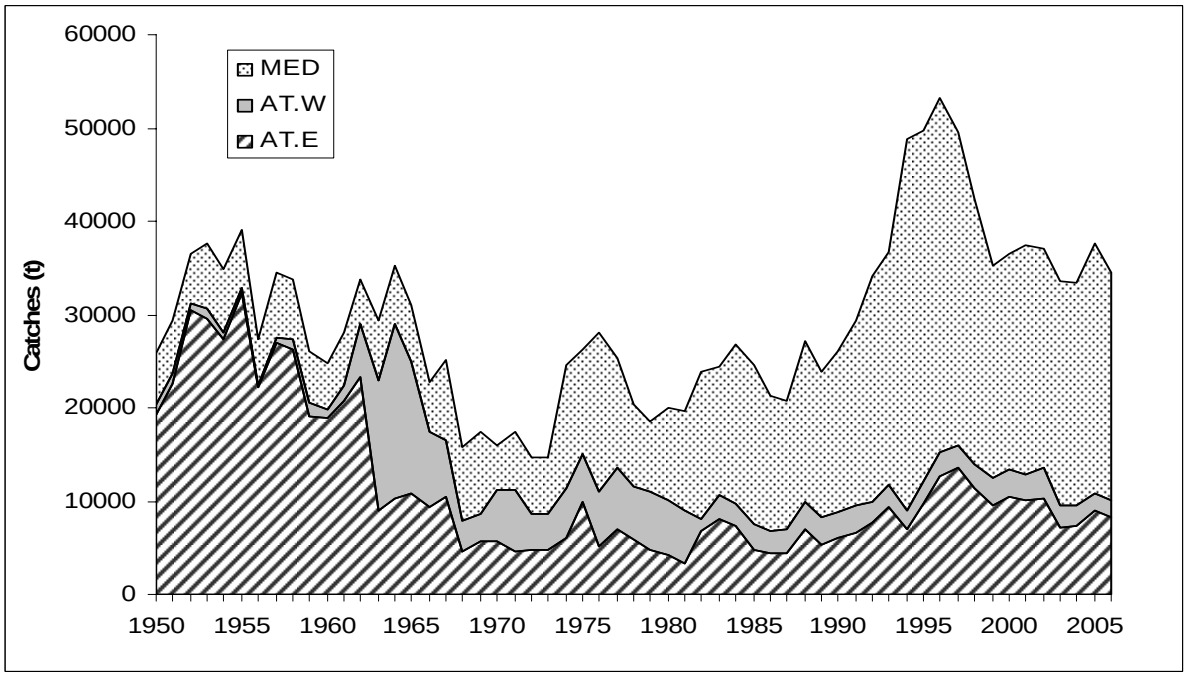
BFT. Table 1.

			1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	MEDI	Algerie	250	252	254	260	566	420	677	820	782	800	1104	1097	1560	156	156	157	1947	2142	2330	2012	1710	1586	1208	1530	1038
		China P.R.	0	0	0	0	0	0	0	0	0	0	0	0	97	137	93	49	0	0	0	0	0	0	0	0	
		Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	328	709	494	411	278	106	27	169	329	508	445	51	267	5
		Croatia	0	0	0	0	0	0	0	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	827	1017	1022
		EC.Cyprus	10	10	10	10	10	10	10	10	10	10	10	14	10	10	10	10	21	31	61	85	91	79	105	149	110
		EC.España	989	812	2743	1460	701	1178	1428	1645	1822	1392	2165	2018	2741	4607	2588	2205	2000	2003	2772	2234	2215	2512	2353	2758	2689
		EC.France	4878	3660	3600	5430	3490	4330	5780	4434	4713	4620	7376	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5989	6471	8638	7663
		EC.Greece	0	0	0	11	131	156	159	182	201	175	447	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255
		EC.Italy	6658	5865	7140	7199	7576	4607	4201	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3279	3845	4377	4628	4973	4686	4841	4695
		EC.Malta	40	31	21	21	41	36	24	29	81	105	80	251	572	587	399	393	407	447	376	219	240	255	264	346	263
		EC.Portugal	0	0	0	0	0	0	0	0	0	278	320	183	428	446	274	37	54	76	61	64	0	2	0	0	11
		Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	
		Japan	961	677	1036	1006	341	280	258	127	172	85	123	793	536	813	765	185	361	381	136	152	390	316	638	265	161
		Korea, Republic of	0	0	0	0	0	0	0	0	0	0	0	0	684	458	591	410	66	0	0	0	0	0	700	1145	
		Libya	310	270	274	300	300	300	300	84	328	370	425	635	1422	1540	812	552	820	745	1063	1941	638	752	1300	1091	
		Maroc	0	1	4	12	56	116	140	295	1149	925	205	79	1092	1035	586	535	687	636	695	511	421	760	819	92	32
		NEI (ETRO)	1	0	19	0	168	183	633	757	341	1750	1349	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	427	639	171	1066	825	140	17	0	0	0	0	0	
		NEI (combined)	0	0	0	0	0	0	0	0	0	0	0	0	773	211	0	101	1030	1995	109	571	508	610	709	0	
		NEI-2	0	0	0	0	0	0	0	0	19	49	49	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	72	67	0	74	287	484	467	1499	1498	2850	236	0	0	0	0	0	0	0	0	
		Serbia & Montenegro	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	4	0	0	0	0	0	
		Tunisie	298	293	307	369	315	456	624	661	406	1366	1195	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	
		Turkey	825	557	869	41	69	972	1343	1707	2059	2459	2817	3084	3466	4220	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806
		Yugoslavia Fed.	486	1222	755	1084	796	648	1523	560	940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	AT.W	Argentina	0	0	0	6	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
		Brasil	1	1	0	1	0	2	0	2	1	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	
		Canada	291	433	264	142	73	83	393	619	438	485	443	459	392	576	597	503	595	576	549	524	604	557	537	600	733
		Chinese Taipei	11	2	3	3	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	
		Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	0	0	
		EC.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EC.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	62	18
		EC.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	10	5	
		Japan	292	711	696	1092	584	960	1109	468	550	688	512	581	427	387	436	322	691	365	492	506	575	57	470	378	549
		Korea, Republic of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	52
		Mexico	14	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	8	14	29	10	12	22	9	10	14
		NEI (ETRO)	14	1	0	0	0	0	0	30	24	23	17	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	429	270	49	0	0	0	0	
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta. Lucia	0	0	0	0	0	1	3	2	14	14	14	2	43	9	3	0	0	0	0	0	0	0	0	0	
		Trinidad and Tobago	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		U.S.A.	807	1394	1320	1424	1142	1352	1289	1483	1636	1582	1085	1237	1163	1311	1285	1334	1235	1213	1212	1589	1840	1426	899	717	468
		UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	1	1	0	0	0	
		Uruguay	3	0	9	16	6	0	2	0	0	1	0	1	0	2	0	0	0	0	0	0	1	0	0	0	
Discards	AT.W	Canada	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	6	16	11	46	13	37	14	15	0	2
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.A.	0	0	0	0	514	192	215	248	133	199	211	88	83	138	171	155	110	149	176	92	174	218	167	131	91

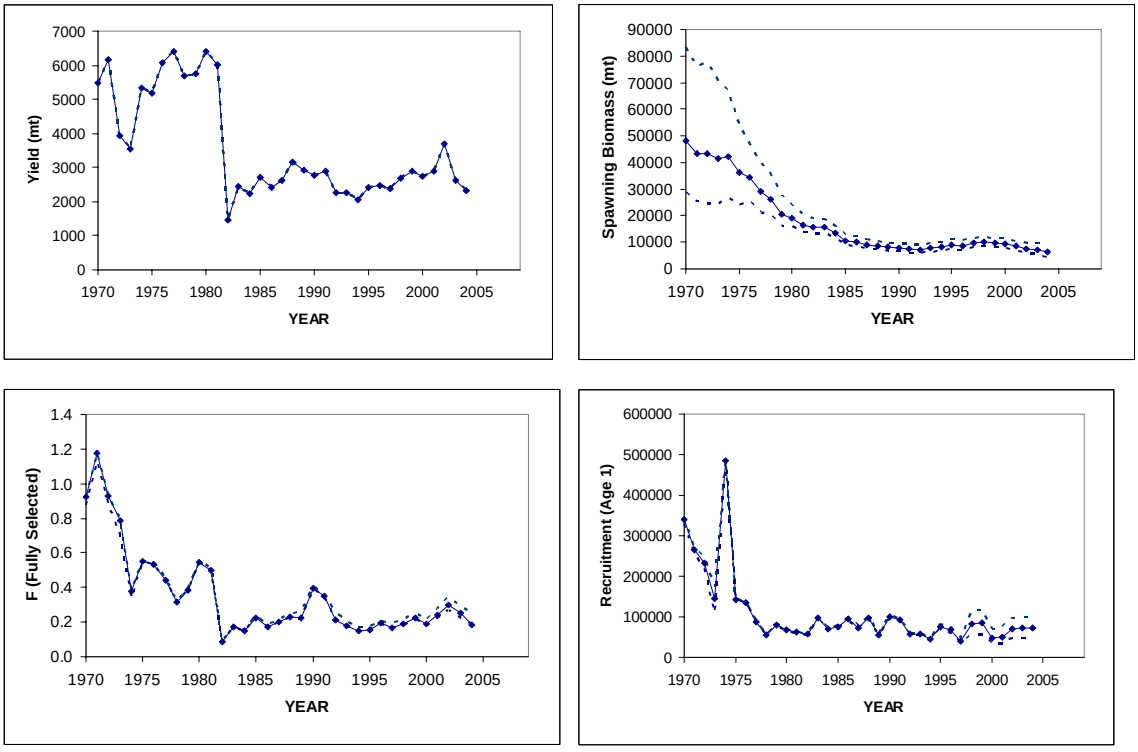
[1] The total yield for 2006 only includes reported catches at the date of the meeting. It may be seen as provisional because of the lack of catches for some important fisheries. A first approximation of the total 2006 yield is given in the text and the summary table.

[2] National Report of China PR mentioned 42 tonnes of BFT catches in the East Atlantic in 2006.

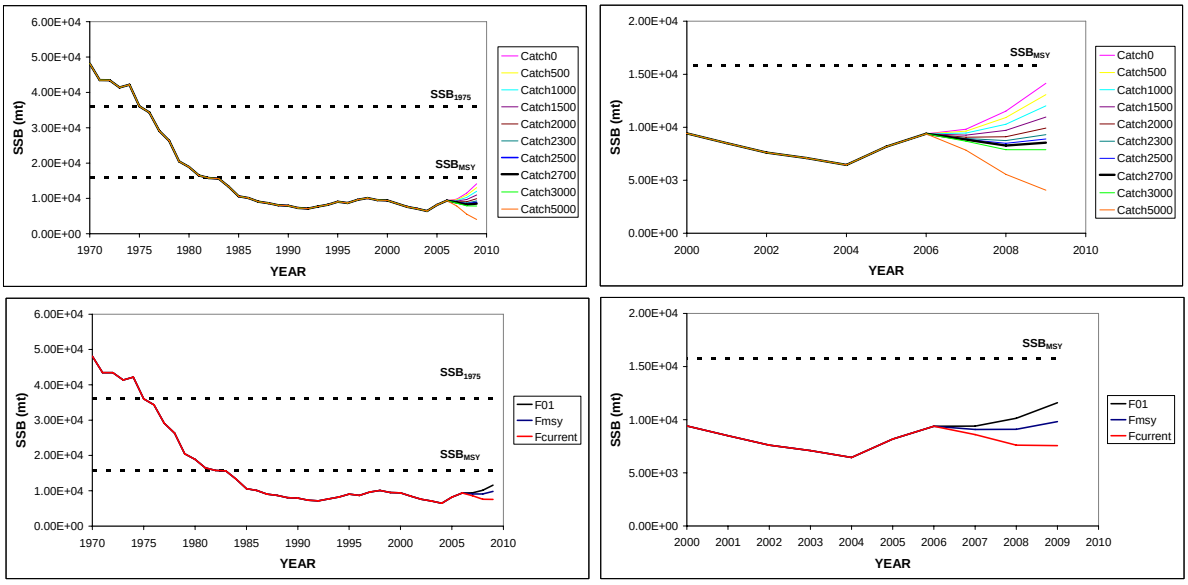
[3] During the plenary Libya reported 1280 tonnes of BFT catches in the Mediterranean in 2006 and 47 for the Atl.East.



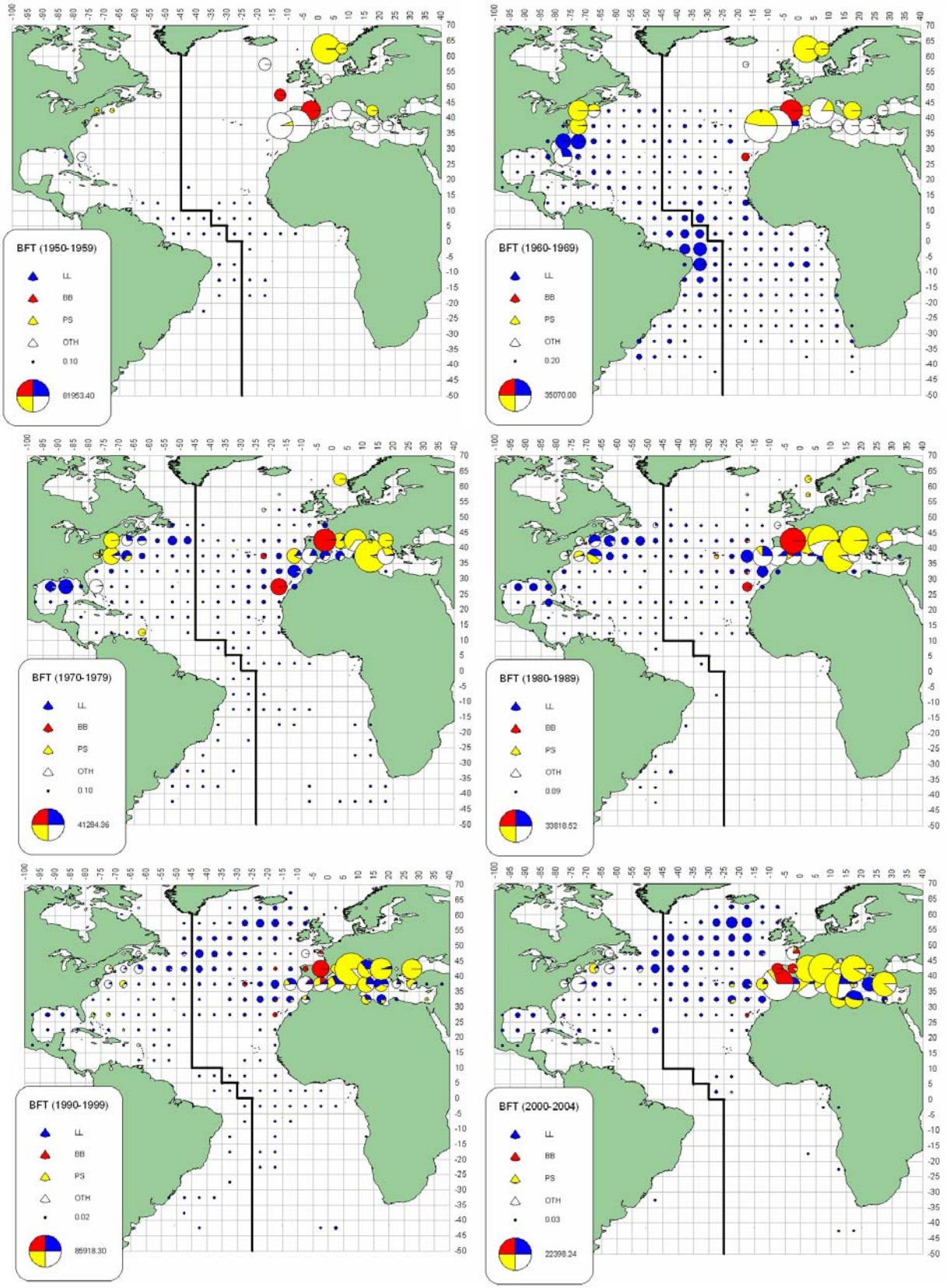
BFT-Figure 1. Atlantic bluefin catches (in t., including discards) by region.



BFTW-Figure 2. Median estimates of yield, spawning biomass, fishing mortality and recruitment for the base VPA model. The 80% confidence intervals are indicated with dotted lines.



BFTW-Figure 3. Western Atlantic bluefin tuna: Median projections of spawning stock biomass (SSB) for the Base Case assessment under various levels of constant catch (top) and under various levels of constant fishing mortality rate (bottom). The figures in the right hand side are restricted to the more recent time period. NOTE: Lines are arranged sequentially in the same order as the legends.



BFT-Figure 4. Geographical distribution of bluefin tuna catch by major gears and decade.

BLUEFIN TUNA – EAST

BFTE-2.Fishery Indicators – East Atlantic and Mediterranean

It is well known that introduction of farming activities into the Mediterranean in 1997 and good market conditions resulted in rapid changes in the Mediterranean fisheries for bluefin tuna. Currently, nearly all of the declared Mediterranean bluefin fishery production is exported overseas. Declared catches in the East Atlantic and Mediterranean reached a peak of over 50,000 t in 1996 and, then decreased substantially, stabilizing around TAC levels established by ICCAT for the most recent period **(BFT-Table 1 and BFTE-Figure 1)**. Both the increase and the subsequent decrease in declared production occurred mainly for the Mediterranean **(BFTE-Figure 1)**. In 2003 and 2004, total declared catches for the East Atlantic and Mediterranean were 31,163 t and 31,376 t, respectively, of which about 24,000 t were declared for the Mediterranean. In 2005, reported catches were 35,671 t (8,974 t and 26,697 t for the East Atlantic and the Mediterranean, respectively). In 2006, reported catches were incomplete at the time of the meeting, but a first estimate indicates that they could be at around 32,660 t. Information available reinforces our belief that catches of bluefin tuna from the eastern Atlantic and Mediterranean have been seriously under-reported in recent years. The group thinks that this under-reporting is likely to originate from both Contracting and non-Contracting Parties. An estimate made by the Committee, based on the number of vessels operating in the Mediterranean Sea and their respective catch rates, indicates that the volume of catch taken in recent years likely significantly exceeded TAC levels and probably is close to the levels reported in the mid-1990s, *i.e.* about 43,000 t in the Mediterranean and thus about 50,000 t in the East Atlantic and Mediterranean in recent years, including 2005 and 2006 **(BFT-Figure 1, BFTE-Table 2)**. This apparent lack of compliance with the TAC and underreporting of the catch will undermine conservation of the stock.

Available indicators from small fish fisheries in the Bay of Biscay did not show any consistent trend since the mid 1970s **(BFTE-Figure 2)**. This result is not particularly surprising because of inter-annual variation in year class strength, which makes trend detection difficult for young ages. Indicators from fisheries taking spawning aged fish show evidence of recent decline for older fish and one indicator shows a general decline since the mid-1970s **(BFTE-Figure 2)**.

BFTE-3. State of the stock

The 2006 assessment used ICCAT Task I catch data from 1970 to 2004, which likely represents significant underestimates of total catch in recent years (see above). Therefore, methods that assume that the catch-at-size/age is known exactly, such as VPA, are likely to be biased to some extent. Consequently, the group has based its overall advice on a large variety of methods and not mostly on VPA outputs as done in the past. Even so, the assessment results indicate that the spawning stock biomass (SSB) continues to decline while fishing mortality is increasing rapidly, especially for large fish.

The decline in SSB is evident from the results of an age-structured model that used reported catch and CPUE information, which estimates that recent (2000-2004) SSB is 48% of the estimated level at the start of the time series (1970-1974). The decline in SSB appears to be more pronounced during the more recent four or five years **(BFTE-Figure 3)**. Although model estimates for recent years should be judged with caution due to increasing uncertainties about catch, the decline in SSB is also evident from fishery indicators such as the drop in catch rates of Moroccan and Spanish fixed traps located in the eastern Atlantic that capture large bluefin (generally ages 10 and older) as they enter the Mediterranean for spawning. Catches of giant bluefin made by some sport fisheries have also declined abruptly over the most recent years.

The increase in mortality estimated with the age-structured model for large bluefin is consistent with a shift in targeting towards larger individuals destined for fattening/farming. Independent year-class analyses which do not rely upon fishery-wide data conducted with Spanish trap and Japanese longline data (both of which capture primarily large bluefin) also indicate that total mortality on large spawners has increased.

This result is especially of concern since large spawners contribute more to recruitment success than medium-size spawners. Estimates of current recruitment are uncertain, but there is some indication of a recent decline **(BFTE Figure 3),** which makes increasing fishing pressure on spawners even more worrisome.

This view of stock status presented above only accounts for the limited information available through 2004. Developments since 2004 could have accelerated the recent patterns described.

BFTE- 4. Outlook

During the last decade, there has been an overall shift in targeting towards large bluefin. As the majority of these fish are destined for fattening/farming operations, their size and age composition are becoming more difficult to determine precisely, which in turn affects the quality of the analyses. Furthermore, to the detriment of the assessment, unenforced TACs were allowing under-reporting of overall catches, and incomplete compliance with size limit regulations may have affected information on catches of small bluefin. With these factors combined with the lack of reliable historical information for many fleets, the stock cannot be monitored with confidence and therefore severe over-fishing can easily go undetected. A collapse in the near future is a possibility given the 2006 stock assessment estimations of the SCRS of the fishing capacity of all fleets combined and current fishing mortality rates, unless adequate management measures are implemented and enforced **(BFTE-Table 2, BFTE-Figure 3)**.

It should be noted that if the overall selectivity pattern has indeed shifted towards larger fish **(BFTE-Figure 3)**, this could result in improved yield-per recruit levels. For example, the equilibrium yield-per-recruit obtained with the 2003-2004 fishing mortality pattern is 25% higher than the value that was computed at the 2002 assessment using the selectivity pattern for 2000. In practice, such changes in yield-per recruit would take many years to translate into changes in actual equilibrium yield due to the longevity of the species; their realization would also depend on the constancy of recruitment and stability in the selectivity of all fleets combined.

The current selectivity and overall fishing mortality pattern estimated in this assessment imply that current fishing mortality is more than 3 times the level which would permit the stock to stabilize at the MSY level (approximated by $F_{max,}$ see **BFTE-Table 3**). Current fishing is expected to drive the spawning per recruit relative to virgin levels (%SPR), and thus the spawning stock biomass, to very low levels; i.e. about 6% SPR and about 17% of the spawning biomass per recruit estimated for 1970. This combination of high F and low SPR is considered to result in a high risk of fisheries and stock collapse.

A suite of per-recruit analyses that can be considered as long-term evaluations of alternative minimum size and closure options, based on the monthly catches pattern **(BFTE-Figure 4)**, were conducted to provide advice to the Commission on their likely impacts on the stock and on the fisheries. The results show that only scenarios considering the closure of the entire Mediterranean around the spawning season (i.e. mid-May until early July) together with increasing size limits for both the East Atlantic and the Mediterranean (minimum sizes of 10, 25 and 30 kg overall) are able to significantly reduce fishing mortalities and to rebuild the SSB up to levels that are considered safe enough to avoid fishery and stock collapse (**BFTE-Table 3** and **BFTE-Figure 5**). Most of these scenarios further induce significant gain in global YPR (and thus higher catch in the long-term under current assumptions), but with contrasting results depending on the fleets. An assumption of these analyses is that reduction in fishing effort resulting from time/area closures is not redirected to make up for the foregone catch. If this effort is redirected, the analyses may be optimistic in terms of conservation benefits.

BFTE-5. Effect of current regulations

Catch limits have been in place for the eastern Atlantic and Mediterranean management unit since 1998. In 2002, the Commission fixed the Total Allowable Catch (TAC) for the East Atlantic and Mediterranean bluefin tuna at 32,000 t for the years 2003, 2004, 2005 and 2006 [Rec. 02-08]. Reported catches for 2003 and 2004 are slightly below that level, but these of 2005 are substantially higher. First estimate of total reported catches in 2006 would be slightly higher. As indicated earlier, however, the Committee strongly believes, based on the knowledge of the fisheries and fattening/farming practices, that substantial under-reporting is occurring and that actual catches are well above TAC. The SCRS estimates for the recent years (including 2005 and 2006) actual catches were probably close to the levels reported in the mid-1990s, *i.e.* about 43,000 t in the Mediterranean and thus about 50,000 t in the East Atlantic and Mediterranean. Based on our analysis, it is apparent that the TAC regulation until 2006 was not respected and was largely ineffective in controlling overall catch.

In 2006, the Commission has adopted a 15 year recovery plan for the East Atlantic and Mediterranean bluefin tuna stock [Rec. 06-05]. This plan includes various conservation measures, mostly a TAC, extended time/area closures and minimum size whose effects are investigated below. The plan also includes multiple elements related to monitoring, control and surveillance whose effects cannot be yet evaluated but, are expected to improve significantly the quality and quantity of catch data in near future.

During the 2007 species BFT group meeting, the effects of recent conservation measures on stock status have been investigated. The interpolations of the yield-per-recruit outcomes (i.e. assuming equilibrium and constant fishing mortality rates) from the 2006 stock assessment indicate that the biomass would be at about 50% of B_{MSY} while F would remain twice the F_{MSY} proxy (**Figure BFTE-5**), indicating that such F levels would not achieve Convention objectives (SCRS/2007/151). Additionally, the Committee examined non-equilibrium constant F and catches projections through simulation models to examine the effects of these regulations in a more dynamic context (SCRS/2007/147, SCRS/2007/169).

Overall, preliminary results indicate that the current measures are a step in the right direction, but are unlikely to fully fulfil the objective of the plan to rebuild to the MSY level in 15 years with 50% probability. This depends on several factors, particularly how well regulations are implemented (including severe reduction in fishing effort by 2023) and future recruitment. If implementation is perfect and if future recruitment is at about the 1990s level and is unaffected by recent spawning biomass level, there is about 50% probability of rebuilding by 2023 under the current regulations. However, perfect implementation is unlikely because, even with perfect enforcement, the committee thinks that it is not feasible to avoid totally discard mortality of small fish (in excess of tolerance) and while continually and severely reduce fishing effort to very low levels to achieve the objectives of the rebuilding plan. With other plausible assumptions (either imperfect implementation or recruitment that decreases from recent levels as spawning biomass decreases, or both) the objectives of the rebuilding plan will not be met.

Note that the above projections do not take into account for the possibility that fishing behaviour (e.g. such as the recent observed displacement of the fishing effort from Western to Southern and Eastern Mediterranean) may change in comparison to that of the early 2000s. After the next stock assessment (in 2008), the Committee should be able to update its advice, providing that new and reliable information are available for the meeting.

BFTE-6. Management recommendations

The Committee stands by the advice given in 2006 which follows. The available information indicates that the 2003-2004 fishing mortality rate (under the current overall fishing pattern) may have been more than three times the level which would permit the stock to stabilize at the MSY level. This level of fishing is expected to drive the spawning biomass to a very low level. Those low levels are considered to give rise to a high risk of fishery and stock collapse.

In order to reverse these declines and to initiate rebuilding, substantial reductions in fishing mortality and catch need to be implemented. The SCRS evaluated a number of alternative management scenarios which might be used to begin recovery **(BFTE-Table 3)**. The only scenarios which have potential to address the declines and initiate recovery are those which (in combination) close the Mediterranean to fishing during spawning season and decrease mortality on small fish through fully enforced increases in minimum size. Realized catches during the next few years implied by *fully implementing* these actions are expected to be in the order of 15,000 t. The long-term gain resulting from these actions could lead to catches of 45,000 t or more with substantial increases in spawning biomass. For a long lived species such as bluefin tuna, it will take some time (> 10 years) to realize the benefit. In the short-term, actions like those above should be taken to reduce the catch to a level that will reverse the decline in spawning biomass and initiate rebuilding.

Clearly, an overall reduction in fishing effort and mortality is needed to reverse current trends. Current fishing capacity largely exceeds the current TAC. Overcapacity is known to impair management actions, therefore further steps to mitigate the impacts of overcapacity will be needed to achieve the recovery plan. In 2006 the Commission agreed on a number of management measures which are viewed by the Committee as unlikely to rebuild the stock to the Convention objectives in 15 years with 50% probability, unless additional actions are taken, such as described in previous paragraph.

EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY

Current (2006) Yield	Reported: 32,665[1] t	SCRS Estimate: **50,000 t**
Short-term F_{MSY} Yield[2]	On the order of 15,000 t	
Long-term potential yield[3]	~45,000 t or more	
Relative biomass		
$SSB_{2000-2004}/SSB_{1970-74}$	0.48	
Relative fishing mortality		
F_{2004}/F_{max}	3.1	
TAC (annually, 2003-2006)[4]	32,000 t	

[1] Some contracting parties had not reported their 2006 yields at the time of the meeting. Therefore, these missing yields have been approximated by carrying over the 2005 yields.

[2] Approximated from the short-term yields obtained in the YPR analyses for which %SPR were > 20% **(see BFTE-Table 3).**

[3] Approximated as yield at Fmax and conditional on the 2003-2004 recruitment level **(BFTE-Table 3)**.

[4] In 2006, a 15-year recovery plan has been adopted that includes a large variety of conservation, monitoring and control measures, see [Rec. 06-05]. A TAC of 29,500; 28,500; 27,500 and 25,500 tonnes/year has been adopted for 2007, 2008, 2009 and 2010, respectively.

BFTE-Table 2. Top table: Estimations of the total number of vessels fishing bluefin tuna (as a targeting or as a by-catch) in the Mediterranean Sea during the most recent years (2004 and 2005), together with catch estimates by vessel (PS large and LL large are vessels > 30 m long; multi-species vessels are vessels targeting other species during at least part of the fishing season). The total number of vessels by category and catch rates by category (in t/year) were extracted from the ICCAT Vessel Record, databases from national surveys, and from the knowledge of national experts.

Table below: Estimations of total yearly catch (in t) in the Mediterranean Sea estimated from the number of vessels and catch estimates by vessel.

Vessel category	*Number of Vessels*	*Low estimate / Vessel*	*Best estimate / Vessel*	*Max estimate / Vessel*
PS large	41	200 t/yr	**300 t/yr**	400 t/yr
PS medium	103	100 t/yr	**150 t/yr**	200 t/yr
PS mult-ispecies	170	10 t/yr	**40 t/yr**	60 t/yr
LL large	56	20 t/yr	**50 t/yr**	70 t/yr
LL medium	25	6 t/yr	**30 t/yr**	40 t/yr
LL multi-species	352	1 t/yr	**3.5 t/yr**	8 t/yr
Handline	390	0.5 t/yr	**3 t/yr**	5 t/yr
Trap	6	7 t/yr	**30 t/yr**	60 t/yr
Artisanal	564	0.3 t/yr	**4.3 t/yr**	6 t/yr
Sport & recreational	10663	0.01 t/yr	**0.03 t/yr**	0.06 t/yr
Total commercial vessels	**1707**			
Total commercial & recreational vessels	**12370**			

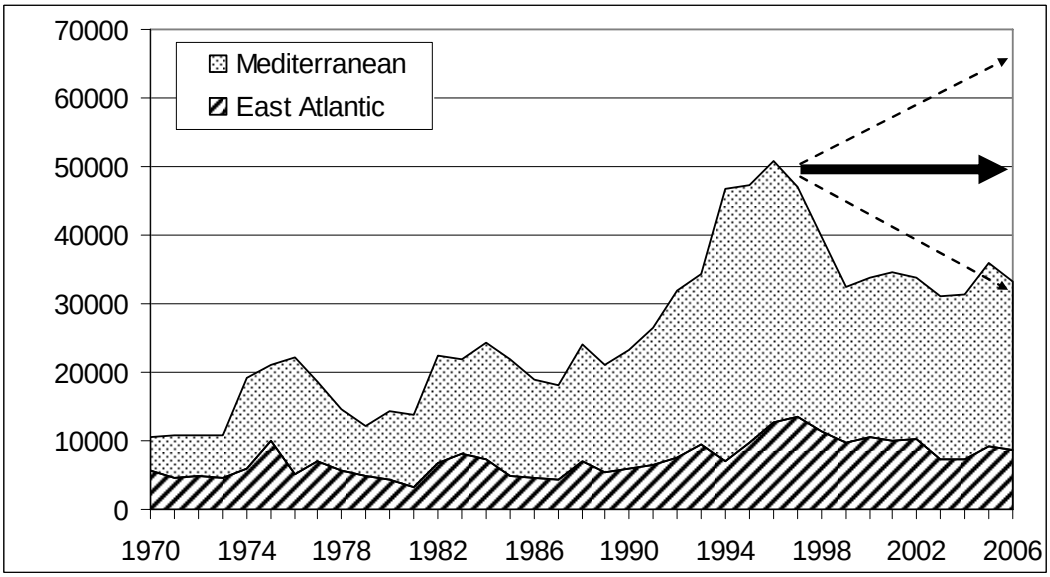
Estimated yield from commercial vessels	22,228 t	**43,107 t**	60,630 t
Estimated yield from commercial & recreational vessels	22,376 t	**43,417 t**	61,316 t

BFTE-Table 3. The modeled cases ranked by expected spawning biomass per recruit relative to virgin levels (%SPR) and change in effort needed to achieve F corresponding to long term potential yield[1]. SQ: statu quo (situation corresponding to Rec. [02-09]). MED: Mediterranean. EA: Eastern Atlantic.
Cases in the red (darkest shading) zone (danger zone, substantial risk of severe decline and stock collapse) are those for which result in a %SPR level lower than the threshold of 20% and additional effort reductions would be required. The cases in the yellow (lightest shading) zone (caution zone, over-fishing/overfished) are those which would, if perfectly implemented, result in %SPR levels at or above the threshold but would still require additional effort reductions to achieve MSY fishing levels. The cases in the green (medium shading) zone (safely sustainable) are those which, if perfectly implemented, would achieve %SPR at or above the threshold and fishing mortality rates at or somewhat below the MSY level. Also indicated are projected annual transitional yield expectations for the modeled cases assuming recruitment remains at recent levels and spawning biomass remains sufficient to permit catch. levels indicated.

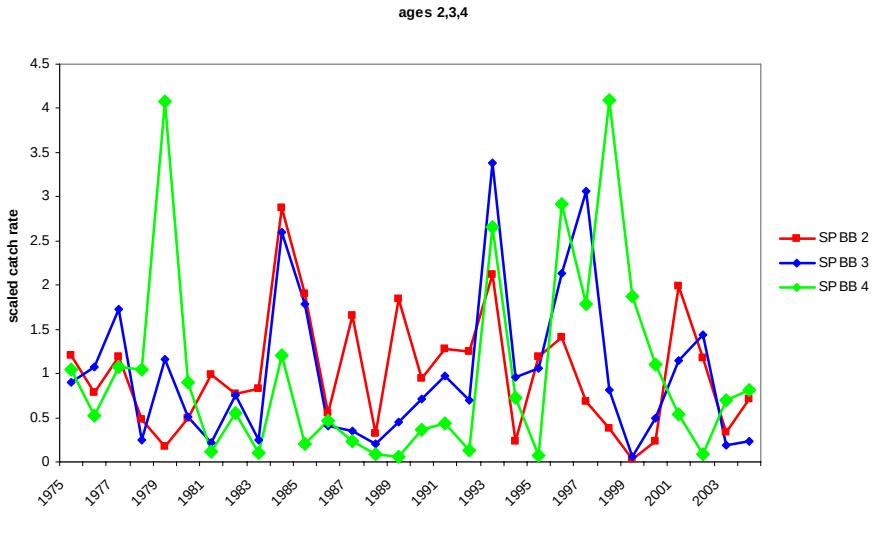
		Closure			Benchmarks		Further %Reduction in F needed to Reach F_{max}	Expected Catch (t) in Outyears Indicated under F Level Modeled					Long-term[1] Potential Yield
case	Min Size	Area	Months	Gears	Fmax/F	%SPR		Projected year 1	Projected year 2	Projected year 3	Projected year 4	Projected year 5	
1	SQ	SQ	SQ	SQ	0,32	6,0%	68%						
16	10kg	SQ	SQ	SQ	0,35	7,4%	65%						
2	SQ	MED	J	PS	0,45	9,7%	55%						
3	SQ	MED	J	ALL	0,46	10,0%	54%						
10	SQ	MED.EA	JJ	PS	0,50	11,2%	50%						
4	SQ	MED	JJ	PS	0,50	11,2%	50%						
17	10kg	MED	J	PS	0,52	11,8%	48%						
18	10kg	MED	J	ALL	0,52	12,2%	48%						
5	SQ	MED	JJ	ALL	0,54	12,6%	46%						
6	SQ	MED	MJJ	PS	0,55	12,8%	45%						
12	SQ	MED.EA	MJJ	PS	0,55	12,8%	45%						
31	25kg	SQ	SQ	SQ	0,49	13,4%	51%						
25	10kg	MED.EA	JJ	PS	0,58	13,7%	42%						
19	10kg	MED	JJ	PS	0,58	13,7%	42%						
8	SQ	MED	JJAS	PS	0,56	13,9%	44%						
14	SQ	MED.EA	JJAS	PS	0,56	13,9%	44%						
11	SQ	MED.EA	JJ	ALL	0,58	14,6%	42%						
20	10kg	MED	JJ	ALL	0,62	15,2%	38%						
46	30kg	SQ	SQ	SQ	0,55	15,3%	45%						
21	10kg	MED	MJJ	PS	0,65	15,6%	35%						
27	10kg	MED.EA	MJJ	PS	0,65	15,6%	35%						
23	10kg	MED	JJAS	PS	0,65	16,3%	35%						
29	10kg	MED.EA	JJAS	PS	0,65	16,3%	35%						
7	SQ	MED	MJJ	ALL	0,71	16,8%	29%						
9	SQ	MED	JJAS	ALL	0,66	17,3%	34%						
26	10kg	MED.EA	JJ	ALL	0,69	17,5%	31%						
24	10kg	MED	JJAS	ALL	0,76	19,7%	24%						
32	25kg	MED	J	PS	0,78	20,1%	22%	13.927	16.500	19.432	21.957	24.479	48.892
22	10kg	MED	MJJ	ALL	0,84	20,2%	16%	15.259	17.959	20.412	22.141	23.826	39.981
33	25kg	MED	J	ALL	0,79	20,4%	21%	13.662	16.231	19.160	21.687	24.209	48.917
15	SQ	MED.EA	JJAS	ALL	0,78	21,6%	22%	13.010	15.546	17.616	19.484	21.576	42.941
34	25kg	MED	JJ	PS	0,88	22,1%	12%	12.588	15.089	17.857	20.322	22.951	48.867
40	25kg	MED.EA	JJ	PS	0,88	22,1%	12%	12.588	15.089	17.857	20.322	22.951	48.867
38	25kg	MED	JJAS	PS	0,91	22,6%	9%	12.211	14.594	17.309	19.821	22.514	49.230
44	25kg	MED.EA	JJAS	PS	0,91	22,6%	9%	12.211	14.594	17.309	19.821	22.514	49.230
35	25kg	MED	JJ	ALL	0,96	23,7%	4%	11.564	14.012	16.733	19.167	21.756	48.983
42	25kg	MED.EA	MJJ	PS	0,99	24,2%	1%	11.302	13.757	16.492	18.981	21.548	48.787
36	25kg	MED	MJJ	PS	0,99	24,2%	1%	11.302	13.757	16.492	18.981	21.548	48.787
30	10kg	MED.EA	JJAS	ALL	0,94	24,4%	6%	11.484	14.176	16.735	18.759	20.951	46.194
13	SQ	MED.EA	MJJ	ALL	1,00	24,7%	0%	13.885	15.773	17.132	18.424	19.785	33.671
41	25kg	MED.EA	JJ	ALL	1,03	25,4%	-3%	10.531	12.858	15.386	17.704	20.321	49.363
39	25kg	MED	JJAS	ALL	1,07	25,9%	-7%	10.273	12.532	15.132	17.558	20.144	49.536
45	25kg	MED.EA	JJAS	ALL	1,24	29,1%	-24%	8.635	10.681	12.984	15.208	17.754	50.134
28	10kg	MED.EA	MJJ	ALL	1,24	29,5%	-24%	11.724	14.184	16.338	17.805	19.300	37.968
37	25kg	MED	MJJ	ALL	1,35	30,2%	-35%	8.991	11.254	13.785	16.076	18.400	47.934
43	25kg	MED.EA	MJJ	ALL	2,04	41,0%	-104%	6.496	8.352	10.356	12.186	14.150	46.581

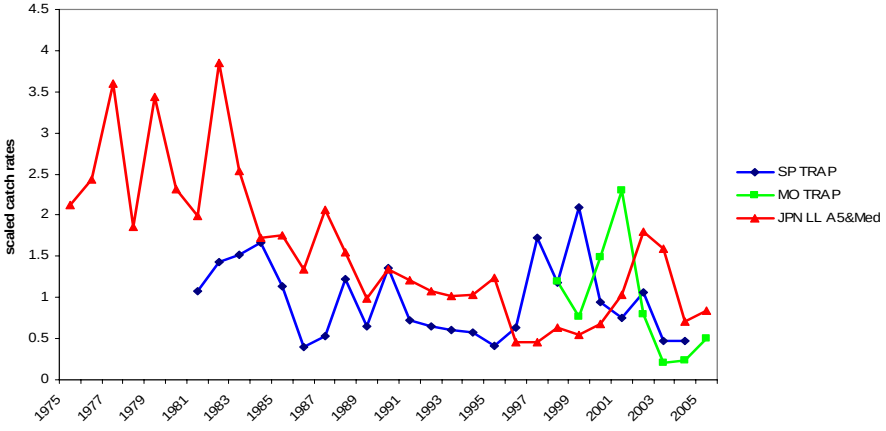
Notes: Case numbers are shown in the associated figures.
Min Size modeled: SQ (status quo) represents the currkg minimum, 25kg is a 25kg stock-wide minimum, and 30Kg is a 30kg stock-wide minimum
Areas modeled for additional closures: SQ, present time/area/gear closures as measured in 2003-2004, MED is all of Mediterranean, EA is all of Eastern Atlantic, MED.EA is all of Mediterranean and Eastern Atlantic.
Months modeled for additional closures: SQ is present time/area/gear closure as measured in 2003-2004, J is June, JJ is June and July, MJJ is May, June and July, JJAS is June, July, August and September.

[1] Approximated as yield at F_{max} and conditional on 2003-2004 recruitment

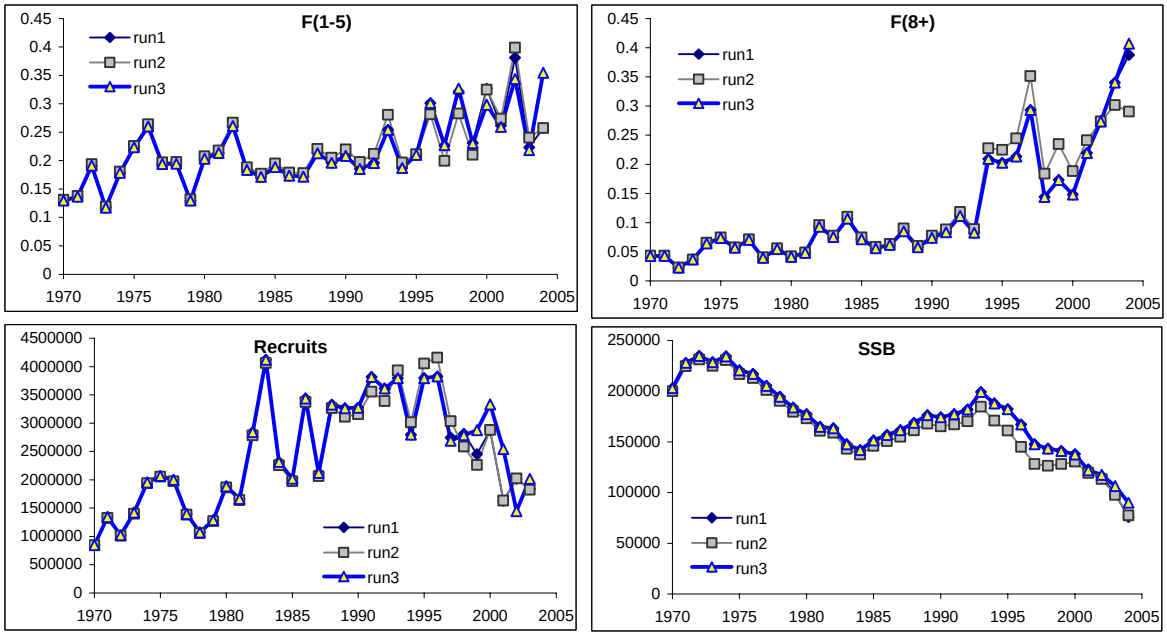


BFTE-Figure 1. Total bluefin tuna Task I for the Mediterranean Sea and east Atlantic. SCRS 'best' estimate (with a high and low range) of actual Mediterranean catch is about 43,000 t and is superimposed with the east Atlantic reported catch for 2004, resulting in a total for the East stock of about 50,000 t. For reference, TAC was set at 32,000 t for years 2003-2006.

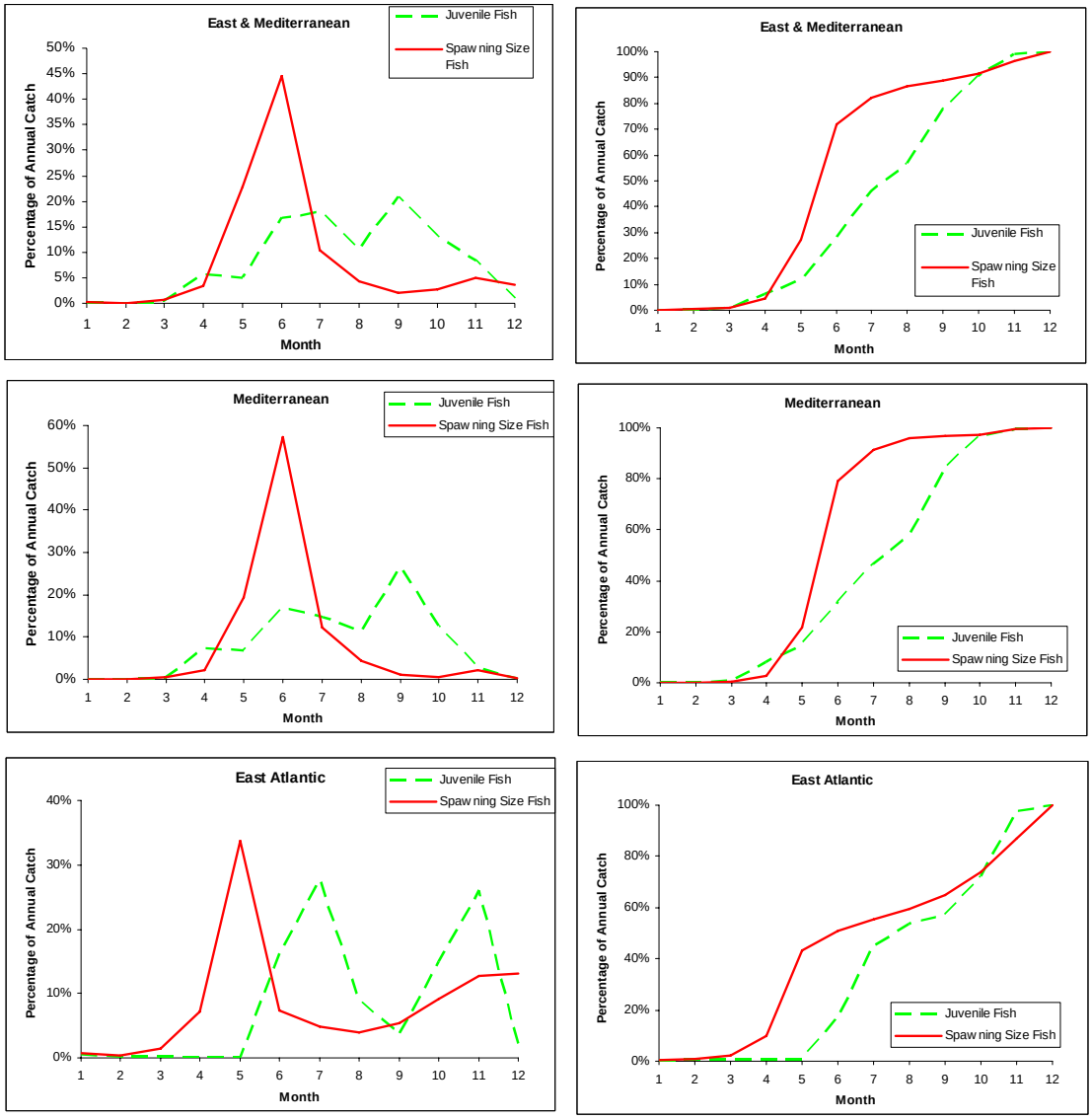




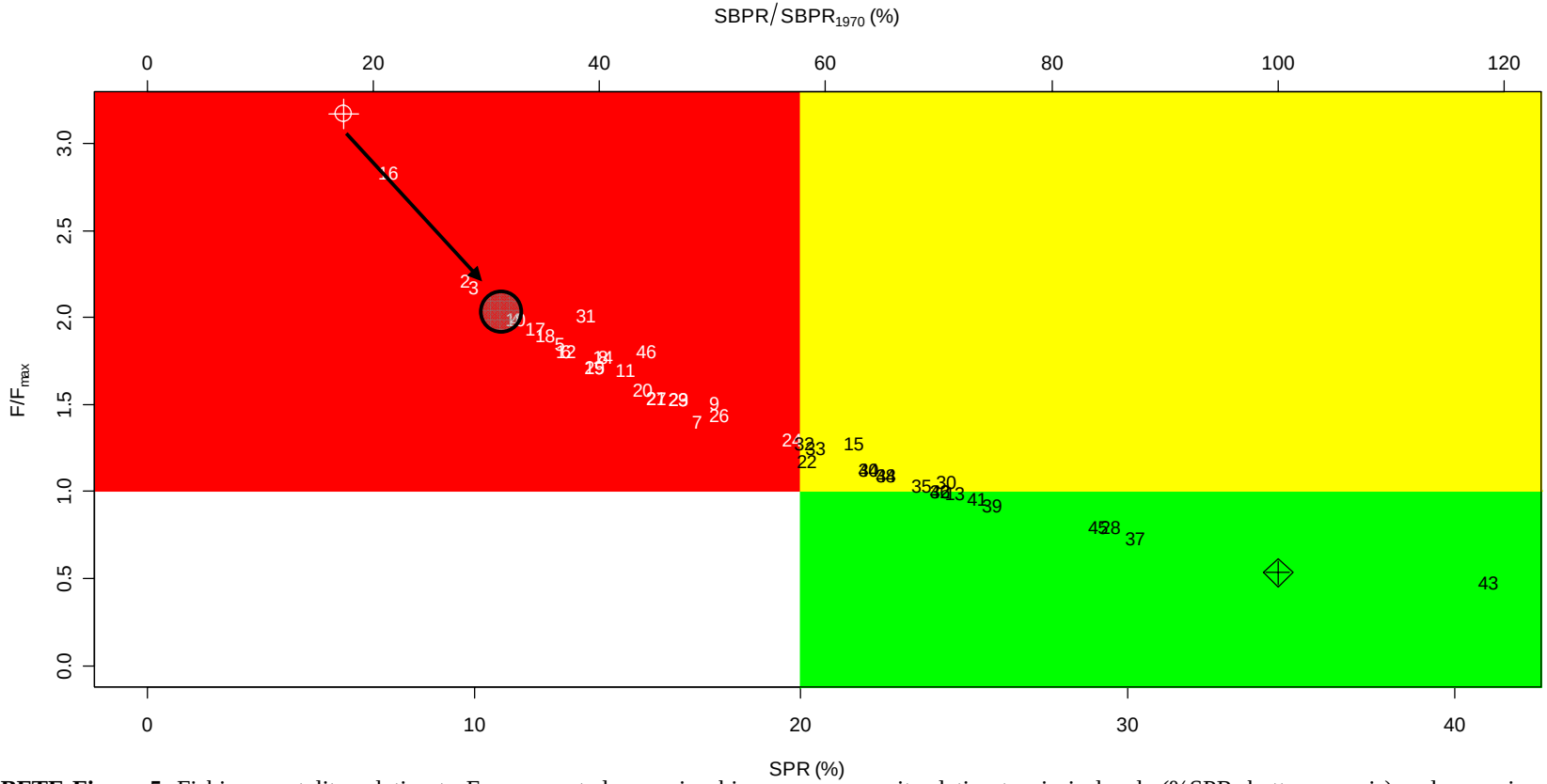
BFTE-Figure 2. Standardized catch rate indicators from fisheries harvesting small (left hand panel) and large (right hand panel) bluefin in the east Atlantic and Mediterranean.



BFTE-Figure 3. Comparison between the estimates obtained with the three VPA runs applied to east Atlantic and Mediterranean bluefin. The top figures show average fishing mortality for ages 1 to 5, and 8. and older. The bottom figures show trends in recruitment and SSB. (NOTE: these figures are based upon analyses that assumed that reported catches were not underreported)



BFTE-Figure 4. Estimated temporal pattern in monthly catches of spawning size (>130 cm FL) and juvenile (< 130 cm FL) bluefin tuna in the east Atlantic and Mediterranean fisheries in combination (upper panels), the Mediterranean alone (center panels) and the east Atlantic alone (lower panels). Calculations are based on the 2003 and 2004 catches which are further been used for YPR analyses. Figures on the left represent monthly proportional catches by size category, when those on the right represent the cumulative proportional catches over the year.



BFTE-Figure 5. Fishing mortality relative to F_{max}, expected spawning biomass per recruit relative to virgin levels (%SPR, bottom x-axis) and spawning biomass per recruit relative to spawning biomass per recruit in 1970 (top x-axis, $SBPR/SBPR_{1970}$) for each management scenarios described in **BFTE-Table 3**. Cross overlaid on circle represents the current management at the time of the stock assessment (i.e. June 2006), cross overlaid on diamond represents stock status in 1970 if fishing mortality rates would have continued into the future. Black circle represents the effects of the 2006 management measures on stock status if fishing mortality rates from 2007 through 2010 would continue into the future. Cases in the red (darkest shading) zone (danger zone, substantial risk of severe decline) are those for which result in a spawning biomass per recruit relative to virgin spawning biomass per recruit lower than the threshold of 20% and additional effort reductions would be required. The cases in the yellow (lightest shading) zone (caution zone, overfishing/overfished) are those which would, if perfectly implemented, result in spawning biomass per recruit at or above the threshold but would still require additional effort reductions to achieve MSY fishing levels. The cases in the green (medium shading) zone (safely sustainable) are those which, if perfectly implemented, would achieve spawning biomass at or above the threshold and fishing mortality rates at or somewhat below the MSY level.