#2

8.5 BFT – ATLANTIC BLUEFIN TUNA

The SCRS conducted a comprehensive assessment of bluefin tuna in the Atlantic and the Mediterranean in 2010. In the assessment, the available data included catch, effort and size statistics through 2009. As previously discussed, there are considerable data limitations for the eastern stock up to 2007. While data reporting for the eastern and Mediterranean fisheries has substantially improved since 2008 and some historical statistical data have been recovered, most of the data limitations that have plagued previous assessments remain and new approaches will be required in order to improve the scientific advice the Committee can offer.

The Atlantic-wide Bluefin Tuna Research Program (GBYP) research plan outlined the research necessary for improving the scientific advice that the Committee provides to the Commission. This plan was presented to and approved by the Commission and the GBYP was started in 2010. The Committee continues to strongly and unanimously support the GBYP, and welcomes the Commission's continued commitment to the Program. In the absence of such a significant and sustained effort, it remains highly unlikely that the Committee will improve its scientific diagnosis and management advice in the foreseeable future.

BFT-1. Biology

Atlantic bluefin tuna (BFT) mainly live in the pelagic ecosystem of the entire North Atlantic and its adjacent seas, primarily the Mediterranean Sea. Bluefin tuna has a wide geographical distribution and is one of the only large pelagic fish living permanently in temperate Atlantic waters (**BFT-Figure 1**). Archival tagging and tracking information confirmed that bluefin tuna can sustain cold as well as warm temperatures while maintaining a stable internal body temperature. Until recently, it was assumed that bluefin tuna preferentially occupy the surface and subsurface waters of the coastal and open-sea areas, but archival tagging and ultrasonic telemetry data indicate that bluefin tuna frequently dive to depths of 500m to 1,000m. Bluefin tuna is also a highly migratory species that seems to display a homing behavior and spawning site fidelity in both the Mediterranean Sea and Gulf of Mexico, which constitute the two main spawning areas being clearly identified today. Less is known about feeding migrations within the Mediterranean and the North Atlantic, but results from electronic tagging indicated that bluefin tuna movement patterns vary considerably between individuals, years and areas. The appearance and disappearance of important past fisheries further suggest that important changes in the spatial dynamics of bluefin tuna may also have resulted from interactions between biological factors, environmental variations and fishing. Although the Atlantic bluefin tuna population is managed as two stocks, conventionally separated by the 45°W meridian, its population structure remains poorly understood and needs to be further investigated. Recent genetic and microchemistry studies as well as work based on historical fisheries tend to indicate that the bluefin tuna population structure is complex.

Currently, bluefin tuna is assumed to mature at approximately 25 kg (age 4) in the Mediterranean and at approximately 145 kg (age 9) in the Gulf of Mexico. Juvenile and adult bluefin tuna are opportunistic feeders (as are most predators). However, in general, juveniles feed on crustaceans, fish and cephalopods, while adults primarily feed on fish such as herring, anchovy, sand lance, sardine, sprat, bluefish and mackerel. Juvenile growth is rapid for a teleost fish (about 30cm/year), but slower than other tuna and billfish species. Fish born in June attain a length of about 30-40cm long and a weight of about 1 kg by October. After one year, fish reach about 4 kg and 60cm long. Growth in length tends to be lower for adults than juveniles, but growth in weight increases. At 10 years old, a bluefin tuna is about 200 cm and 170 kg and reaches about 270 cm and 400 kg at 20 years. Bluefin tuna is a long lived species, with a lifespan of about 40 years, as indicated by recent studies from radiocarbon deposition.

The information on natal origin derived from otolith microchemistry received by the SCRS, which was based on limited samples, indicated that the contribution of eastern origin fish to the western fisheries decreases with size (i.e. up to 62% for fish in the 69-119 cm size class, but negligible for fish greater than 250 cm). In contrast, other western fisheries supported by the largest size classes had minimal or no eastern component in the catch. However, there remains considerable uncertainty and therefore additional samples are needed to improve our understanding of the relative contribution of the two stocks to the different fisheries over time. An issue that can hardly be resolved without better understanding of Atlantic bluefin tuna population structure.

In 2009, the SCRS received considerable new information on maturity, growth, and the spatial dynamics of Atlantic and Mediterranean bluefin (see SCRS/2009/192). Following key developments are summarized below.

The SCRS had extensive discussions concerning the choice of maturity schedules for both the eastern and western stocks. Uncertainty in age at maturity remained a significant issue for the stock assessment, and obliged the Group to consider alternative scenarios during their modeling work. Improving current understanding of the maturity schedules for bluefin tuna should be a priority area for research within the GBYP and other collaborative research programs with the SCRS.

The SCRS implemented a new growth curve for western stock that was derived from advanced analytical techniques. The adoption of the new growth curve that is nearly identical to that for the eastern stock has resulted in significant changes to some of the benchmark for the western stock and consequently management advice. For the Eastern Atlantic and Mediterranean stock, new information indicated that for farming operations, when applying the weight gain rates adopted by SCRS in 2009, the back calculated fish weights at initial capture seemed to show unrealistic size distributions, in that more fish of a smaller size are calculated as having been caught than would be expected given existing controls.

The SCRS also received several contributions related to electronic tagging within the Eastern Atlantic and Mediterranean stock. While most of the new studies are reporting work in progress, the new information appears to indicate a greater level of complexity in the migratory patterns of the eastern fish than was previously understood, as a significant fraction of the eastern fish (juveniles and spawners) seem to stay within the Mediterranean all year long.

BFTE-2. Fishery trends and indicators – East Atlantic and Mediterranean

It is very well known that introduction of fattening and farming activities into the Mediterranean in 1997 and good market conditions resulted in rapid changes in the Mediterranean fisheries for bluefin tuna mainly due to increasing purse seine catches. In the last few years, nearly all of the declared Mediterranean bluefin fishery production was 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)**. For 2006-2009, declared catch was, at the time of the meeting, 30,689 t, 34,516 t, 24,057 t and 20,228 t for the East Atlantic and Mediterranean, of which 23,154 t, 26,479 t, 16,409 t and 13,527 t were declared for the Mediterranean for those same years **(BFT-Table 1)**.

Information available has demonstrated that catches of bluefin tuna from the East Atlantic and Mediterranean were seriously under-reported between the mid-1990s through 2007. The Committee views this lack of compliance with TAC and underreporting of the catch as having undermined conservation of the stock. The Committee has estimated that realized catches during this period could have been on the order of 50,000 t to 61,000 t per year based on the number of vessels operating in the Mediterranean Sea and their respective catch rates. Estimates for 2008 and 2009 using updated vessel capacity and performance statistics from the various reports submitted to ICCAT under [Rec. 08-05] results in estimates that are significantly lower than the corresponding reported Task I data (see Bluefin tuna Data Preparatory Meeting). Although care is needed considering estimates of catch using these capacity measures, the Committee's interpretation is that a substantial decrease in the catch occurred in the eastern Atlantic and Mediterranean Sea in 2008 and 2009.

Available indicators from small fish fisheries in the Bay of Biscay did not show any clear trend since the mid-1970s (**BFTE-Figure 2**). This result is not particularly surprising because of strong inter-annual variation in year class strength. However, aerial survey results conducted in 2009 indicated a higher abundance or higher concentration of small bluefin in the northwestern Mediterranean than found in surveys conducted in 2000-2003. Indicators from Japanese longliners and Spanish and Moroccan traps targeting large fish (spawners) in the East Atlantic and the Mediterranean Sea displayed a recent increase after a general decline since the mid-1970s **(BFTE-Figure 2)**. Indicators from longliners targeting medium to large fish in the northeast Atlantic were available since 1990 and showed an increasing trend in the recent years (**BFTE-Figure 2**). This index becomes more valuable since the major part of Japanese catch come from this fishing ground in recent years, while the activities of longliners in the East Atlantic (south of 40°N) and Mediterranean Sea were reduced. Two historical indicators before 1980 in the Bay of Biscay were also available. The Group recognized that the recent compliance to the regulatory measures affect significantly the CPUE values (e.g. Spanish baitboat and Japanese longline indices) through the change of operational pattern and target sizes. Recent tendency in indicators are likely to reflect positive outcomes from recent management measures. However, the Committee found it difficult to derive any clear conclusion from fisheries indicators over such a short period after the implementation of new regulations and in the absence of more precise information about the catch composition, effort and spatial distribution of the purse seine fisheries. Fisheries-independent indicators (scientific surveys) and a large scale tagging program are needed to provide more reliable stock status indicators. The Committee reaffirmed the importance of pursuing these research elements under the now-funded GBYP.

BFTE-3. State of the stock

In spite of improvements in the data quantity and quality for the past few years, there remain considerable data limitations for the 2010 assessment of the stock. These included poor temporal and spatial coverage for detailed size and catch-effort statistics for many fisheries, especially in the Mediterranean. Substantial under-reporting of total catches was also evident, especially during 1998-2007. Nevertheless, the Committee assessed the stock in 2010 as requested by the Commission mainly applying the methodologies and hypotheses adopted by the Committee in previous assessments and further tried alternative approaches. The Committee believes that while substantial improvements can be made for in catch and effort statistics into the future, it appears unlikely that such substantial improvements can be made regarding historical fishery performance. Because of this, the Committee believes that assessment methodologies applied in the past must be modified to better accommodate the substantial uncertainties in the historical total catch, catch-at-age and effort data from the main fleets harvesting bluefin. This process has been initiated, but will require at least three years to complete in terms of robustness testing of the methodologies envisioned. The Commission should take this into account in establishing management controls (cf. a TAC for three years). Furthermore, any change in exploitation or management will take several years to have a detectable effect on the biomass because bluefin tuna is a long lived species and our ability to quantify recent management impacts on stock status are limited due to variability in stock status indicators in the most recent years.

The assessment results upon which the Committee's main advice is provided indicated that the spawning stock biomass (SSB) had been mostly declining since the 1970s. The recent SSB tendency has shown signs of increase/stabilization in some runs while it continues to decline for others, depending on the models specifications and data used (see BFT detailed report, **BFTE-Figure 3)**. Trend in fishing mortality (F) displayed a continuous increase over the time period for the younger ages (ages 2-5) while for oldest fish (ages 10+) it had been decreasing during the first 2 decades and then rapidly increased during the 1990s. Fishing mortalities have declined on the oldest fish in recent years, but these for younger (ages 2-5) are more uncertain and display higher variability (**BFTE-Figure 3**). General trends in F or N were not strongly affected by the historical catches assumptions (i.e. reported *versus* inflated), except in recent years. These analyses indicated that recent (2007-2009) SSB is about 57% of the highest estimated SSB levels (1957-1959). Recent recruitment levels remain very uncertain due to the lack of information about incoming year class strength and high variability in the indicators used to track recruitment and the low recent catches of fish less than the minimum size. The absolute values estimated for F and SSB remained sensitive to the assumptions of the analysis and could lead to a different perception in the whole trend in SSB. However, it is noteworthy that the historical Fs for older fish were consistent between different types of models which made use of different assumptions. For the years 1995-2007, Fs for older fish are also consistent with a shift in targeting towards larger individuals destined for fattening and/or farming.

Estimates of current stock status relative to MSY benchmarks are uncertain, but lead to the conclusion that although the recent Fs have probably declined, these values remain too high and recent SSB too low to be consistent with the Convention objectives. Depending on different assumed levels of resource productivity current F show signs of decline reflecting recent catch reductions, but remained larger than that which would result in MSY and SSB remained most likely to be about 35% (from 19% to 51% depending on the recruitment levels) than the level needed to support MSY **(BFTE-Figure 4)**.

BFTE- 4. Outlook

During the last decade, there has been an overall shift in targeting towards large bluefin tuna, mostly in the Mediterranean. As the majority of these fish are destined for fattening and/or farming operations, it is crucial to get precise information about the total catch, the size composition, the area and flag of capture. Progress has been made over the last years, but current information that consists in individual weight after fattening remain too uncertain to be used within stock assessment models. Therefore, real size samples at time of the catch are still required and the SCRS strongly encourages the use of dual camera system or other technology that could provide sizes of fish entering into cages.

The shift towards larger fish should result in improved yield-per-recruit levels in the long-term if F were reduced to $F_{0.1}$. However, such changes would take several years to translate into gains in yield due to the longevity of the species. Realization of higher long-term yields would further depend on future recruitment levels.

Even considering uncertainties in the analyses, the outlook derived from the 2010 assessment has improved in comparison to previous assessments, as F for older fish seem to have significantly declined during the last two years. However, estimates in the last years are known to be more uncertain and this decline (as the Fs for younger ages which remains more variable) needs to be confirmed in future analyses. Nonetheless, F_{2009} still remains largely above the reference target $F_{0.1}$ (a reference point more robust to uncertainties than F_{MAX}, as used in the past) while SSB is only about 35% of the biomass that is expected under a MSY strategy (**BFTE-Figure 4**).

The Committee also evaluated the potential effects of [Rec. 09-06]. Acknowledging that there is insufficient scientific information to determine precisely the productivity of the stock (i.e. the steepness of the stock-recruitment relationship), the Committee agreed to perform the projections with three recruitment levels while taking into account for year-to-year variations. These levels correspond to the 'low' and 'high' scenarios as defined in the 2008 assessment plus a 'Medium' scenario that corresponds to the geometric mean of the recruitment over the 1950-2006 years. For the projections, the group investigated 24 scenarios (see bluefin tuna detailed report) which were assessed against the range of constant catch from 0 to 20,000 t. The results indicated that the stock is increasing in all the cases, but the probability to achieve $SSB_{F0.1}$ (i.e. the equilibrium SSB resulting in fishing at $F_{0.1}$) by the end of 2022 depend on the scenarios (run 13 leads to slower rebuilding than run 15 while the recruitment levels affect both the speed of rebuilding and the level of overfishing, see BFT detailed report). Overall, the SSB would be equal or greater than $SSB_{F0.1}$ by the end of 2022 for a catch = 0 to 13,500 t, but not when the catch is greater than 14,000 t (**BFTE-Table 2, BFTE-Figure 6**). It is finally worth noting that a $F_{0.1}$ strategy starting in 2011 would not allow the rebuilding of the stock to $SSB_{F0.1}$ by 2022, but later on.

Projections are known to be impaired by various sources of uncertainties that have not yet been quantified. Although the situation has improved regarding recent catch, there are still uncertainties about stock status in 2009, population structure and migratory rates as well as a lack of knowledge about the level of IUU catch and key modeling parameters on BFT productivity. Acknowledging these limitations, the overall evaluation of [Rec. 09-06] indicated that the rebuilding of BFTE at $SSB_{F0.1}$ level with a probability of at least 60% could be achieved by 2019 with zero catch and by 2022 with catch equal to current TAC (i.e. 13,500 t). However, this 60% probability level is unlikely to be attained by the end of 2022 with a catch greater than 14,000 t. Finally, it should be noted that the incorporation of additional uncertainties into the overall analysis could change the estimates of rebuilding probability.

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 to 2006 [Rec. 02-08] and at 29,500 t and 28,500 t for 2007 and 2008, respectively [Rec. 06-05]. Subsequently, [Rec. 08-05] established TACs for 2009, 2010, and 2011 at 22,000 t, 19,950 t, and 18,500 t, respectively. However, the 2010 TAC was revised to 13,500 t by [Rec. 09-06] which also established a framework to set future (2011 and beyond) TAC at levels sufficient to rebuild the stock to B_{MSY} by 2022 with at least 60% probability.

The reported catches for 2003, 2004 and 2006 were about TAC levels, but those for 2005 (35,845 t) and 2007 (34,516 t) were notably higher than TAC. However, the Committee strongly believes, based on the knowledge of the fisheries and trade statistics, that substantial under-reporting was occurring and that actual catches up to 2007 were well above TAC. The SCRS estimates since the late-1990s, catches were close to the levels reported in the mid-1990s, but for 2007, the estimates were higher *i.e.* about 61,000 t in 2007 for both the East Atlantic and Mediterranean Sea. As noted, reported catch levels for 2008 (24,057 t) and 2009 (20,228 t) appear to largely reflect the removals from the stock when comparing estimates of catch using vessel capacity measures, although the utility of this method has diminished for estimating catch. The reported catches for 2008 and 2009 are 10,000 t to 15,000 t lower than the 2003-2007 reported catches (**BFTE-Table 1, BFTE-Figure 1**). Although care is needed considering estimates of catch using capacity measures, the Committee's interpretation is that a substantial decrease in the catch occurred in the Eastern Atlantic and Mediterranean Sea through implementation of the rebuilding plan and through monitoring and enforcement controls. While current controls appear sufficient to constrain the fleet to harvests at or below TAC, should it not be the case, the Committee remains concerned about substantial excess capacity remains which could harvest catch volumes well in excess of the rebuilding strategy adopted by the Commission.

Recent analyses of the size and age composition of reported catches show important changes in selectivity patterns over the last three years for several fleets operating in the Mediterranean Sea or the East Atlantic. This partly results from the enforcement of minimum size regulations under [Rec. 06-05] which led to much lower reported catch of small fish and subsequently a steep increase in the annual mean-weight in the catches since 2007 (**BFTE-Figure 5**). Additionally, higher abundance or higher concentration of small bluefin tuna in the northwest Mediterranean detected from aerial surveys could also reflect positive outcomes from increase minimum size regulation.

While several fishery indicators have shown some positive tendency in the most recent fishing seasons, the available catch effort statistics are not yet sufficient to permit the Committee to quantify the extent of impact of the recent regulations on the overall stock with precision. The Committee's view is that it will take additional years under constrained fishing before to measure it more precisely.

BFTE-6. Management Recommendations

In [Rec. 09-06] the Commission established a total allowable catch for eastern Atlantic and Mediterranean bluefin tuna at 13,500 t in 2010. Additionally, in [Rec. 09-06] the Commission required that the SCRS provide the scientific basis for the Commission to establish a three-year recovery plan for 2011-2013 with the goal of achieving B_{MSY} through 2022 with at least 60% of probability.

A Kobe II strategy matrix reflecting recovery scenarios of eastern Atlantic and Mediterranean bluefin tuna in accordance with the multiannual recovery plan is given in **BFTE-Table 1** and **BFTE-Figure 6.**

The implementation of recent regulations through [Rec. 09-06, and previous recommendations] has clearly resulted in reductions in catch and fishing mortality rates. But, since the fishery is currently adapting to these new management measures, the Committee is unable to fully understand the implications of the measures on the stock. The Commission might consider a probability of rebuilding standard different from that envisaged in [Rec. 09-06] considering the unquantified uncertainties. However, the Committee notes that maintaining catches at the current TAC (13,500 t) or less under the current management scheme, for 2011-2013, will likely allow the stock to increase during that period and is consistent with the goal of achieving F_{MSY} and B_{MSY} through 2022 with at least 60% of probability, given the quantified uncertainties.

EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY

Current (2009) Yield[1]	Reported: 19,701 t	SCRS estimate: 18,308 t
Short-term Sustainable Yield according to Rec.[09.06]	13,500 t or less	
Long-term potential yield [2]	about 50,000 t	
$SSB_{2009}/SSB_{F0.1}$ (SSB_{2009}/SSB_{FMAX})[3]		
Medium recruitment (1950-2006)	0.35 (0.62)	
Low recruitment (1970s)	0.51 (0.88)	
High recruitment (1990s)	0.19 (0.33)	
$F_{2009}/F_{0.1}$ (F_{2009}/F_{MAX})[4]		
Reported and Inflated catches	2.9 (1.53)	
TAC (2009 - 2010)	19,950 t - 13,500 t	

[1] Corresponds to the reported catches on the October 07, 2010. SCRS estimate is based on updated vessel capacity and vessel catch rates information (see BFT data prep. Report). Note that the 2009 catch estimate used in the 2010 stock assessment was 20,228 t due to estimations of missing reports at the date of the meeting (see **BFT-Table 1**).

[2] Approximated as the average of long-term yield at $F_{0.1}$ that was calculated over a broad range of scenarios including contrasting recruitment levels and different selectivity patterns (estimates from these scenarios ranged between 29,000 t and 91,000 t).

[3] The Committee decided, on the basis of current published literature, to adopt $F_{0.1}$ as the proxy for F_{MSY} instead of F_{MAX}. $F_{0.1}$ has been indeed shown to be more robust to observation errors and uncertainty about the true dynamics of the stock than F_{MAX}. However, references to F_{MAX} are also given in parentheses for comparison purposes.

[4] The recruitment levels do not impact $F_{2009}/F_{0.1}$ or F_{2009}/F_{MAX}.

BLUEFIN TUNA - WEST

BFTW-2. Fishery indicators

The total catch for the West Atlantic peaked at 18,671 t in 1964, mostly due to the Japanese longline fishery for large fish off Brazil and the U.S. purse seine fishery for juvenile fish **(BFT-Table 1, BFTW-Figure1)**. Catches dropped sharply thereafter with the collapse of the bluefin tuna by-catch longline fishery off Brazil in 1967 and decline in purse seine catches, but increased again to average over 5,000 t in the 1970s due to the expansion of the Japanese longline fleet into the northwest Atlantic and Gulf of Mexico and an increase in purse seine effort targeting larger fish for the sashimi market. The total catch for the West Atlantic including discards has generally been relatively stable since 1982 due to the imposition of quotas. However, since a total catch level of 3,319 t in 2002(the highest since 1981, with all three major fishing nations indicating higher catches), total catch in the West Atlantic declined steadily to a low of 1,638 t in 2007 and then increased in 2008 to 2,000 t. and slightly decreased in 2009 to 1,935 t **(BFTW-Figure 1).** The decline through 2007 was primarily due to considerable reductions in catch levels for U.S. fisheries. Since 2002, the Canadian annual catches have been relatively stable at about 500-600 t (733 t in 2006); the 2006 catch was the highest recorded since 1977. The 2009 Canadian catch was 530 t. Japanese catches have generally fluctuated between 300-500 t, with the exception of 2003 (57 t), which was low for regulatory reasons. However, Japanese landings for 2009 corresponded to only 162 t.

The average weight of BFT taken by the combined fisheries in the West Atlantic were historically low during the 1960s and 1970s **(BFTW-Figure 2)**, for instance showing an average weight of only 33 kg during the 1965-1975 period. However, since 1980 they have been showing a quite stable trend and at a quite high average weight of 93 kg.

The overall number of Japanese vessels engaged in bluefin fishing has declined from more than 100 vessels to currently less than 10 vessels in the West Atlantic. After reaching 2,014 t in 2002 (the highest level since 1979), the catches (landings and discards) of U.S. vessels fishing in the northwest Atlantic (including the Gulf of Mexico) declined precipitously during 2003-2007. The United States did not catch its quota in 2004-2008 with catches of 1,066, 848, 615, 858 and 922 t, respectively. However, in 2009 the United States fully realized its base quota with total catches (landings including dead discards) of 1,228 t.

The indices of abundance used in this year's assessment were updated through 2009 **(BFTW-Figure 3)**. The catch rates of juvenile bluefin tuna in the U.S. rod and reel fishery fluctuate with little apparent long-term trend, but exhibit a pattern that is consistent with the strong year-class estimated for 2003. The catch rates of adults in the U.S. rod and reel fishery continue to remain low, increasing only slightly in 2008 and decreasing once again in 2009. The catch rates of the Japanese longline fishery increased markedly in 2007, decreased in 2008 back to the levels observed in 2005 and 2006 and it increased once again in 2009. The catch rates from the U.S. Gulf of Mexico longline fishery continue to show a gradual increasing trend, whereas the Gulf of Mexico larval survey continues to fluctuate around the low levels observed since the 1980s. The catch rates in the Gulf of St. Lawrence have increased rapidly since 2004 and the catch rates in is the highest in the time series. The catch rates in southwest Nova Scotia have continued to follow a slightly increasing trend since 2000, with catch rates in 2009 being amongst the highest since the early 1990s.

BFTW-3. State of the stock

A new assessment was conducted this year, including information through 2009. The most influential change since the 2008 assessment was the use of a new growth curve that assigns fish above 120 cm to older ages than did the previous growth curve. As a result, the base model estimates lower fishing mortality rates and higher biomasses for spawners, but also less potential in terms of the maximum sustainable yield. The trends estimated during the 2010 assessment are consistent with previous analyses in that spawning stock biomass (SSB) declined steadily from 1970 to 1992 and has since fluctuated between 21% and 29% of the 1970 level (**BFTW-Figure 4**). In recent years, however, there appears to have been a gradual increase in SSB from the low of 21% in 2003 to an estimated 29% in 2009. The stock has experienced different levels of fishing mortality (F) over time, depending on the size of fish targeted by various fleets (**BFTW-Figure 4**). Fishing mortality on spawners (ages 9 and older) declined markedly after 2003.

Estimates of recruitment were very high in the early 1970s (**BFTW-Figure 4**), and additional analyses involving longer catch and index series suggest that recruitment was also high during the 1960s. Since 1977, recruitment has varied from year to year without trend with the exception of a strong year-class in 2003. The 2003 year-class is estimated to be the largest since 1974, but not quite as large as those prior to 1974. The 2003 year class is expected to begin to contribute to an increase in spawning biomass after several years. The Committee expressed concern that the year-class estimates subsequent to 2003, while less reliable, are the lowest on record.

A key factor in estimating MSY-related benchmarks is the highest level of recruitment that can be achieved in the long term. Assuming that average recruitment cannot reach the high levels from the early 1970s, recent F (2006-2008) is 70% of the MSY level and SSB_{2009} is about 10% higher than the MSY level (**BFTW-Figure 5**). Estimates of stock status are more pessimistic if a high recruitment scenario is considered (F/F_{MSY}=1.9, B/B_{MSY}=0.15).

One important factor in the recent decline of fishing mortality on large bluefin is that the TAC had not been taken during this time period until 2009, due primarily to a shortfall by the United States fisheries (until 2009). Two plausible explanations for the shortfall were put forward previously by the Committee: (1) that availability of fish to the United States fishery has been abnormally low, and/or (2) the overall size of the population in the Western Atlantic declined substantially from the level of recent years. While there is no overwhelming evidence to favor either explanation over the other, the base case assessment implicitly favors the first hypothesis (regional changes in availability) by virtue of the estimated increase in SSB. The decrease indicated by the U.S. catch rate of large fish is matched by an increase in several other large fish indices (**BFTW-Figure 3**). Nevertheless, the Committee notes that there remains substantial uncertainty on this issue and more research needs to be done.

The SCRS cautions that the conclusions of this 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. Limited analyses were conducted of the two stocks with mixing in 2008, but little new information was available in 2010. Based on earlier work, the estimates of stock status can be expected to vary considerably depending on the type of data used to estimate mixing (conventional tagging or isotope signature samples) and modeling assumptions made. More research needs to be done before mixing models can be used operationally for management advice. Another important source of uncertainty is recruitment, both in terms of recent levels (which are estimated with low precision in the assessment), and potential future levels (the "low" vs. "high" recruitment hypotheses which affect management benchmarks). Improved knowledge of maturity at age will also affect the perception of changes in stock size. Finally, the lack of representative samples of otoliths requires determining the catch at age from length samples, which is imprecise for larger bluefin tuna.

BFTW-4. Outlook

A medium-term (10-year) outlook evaluation of changes in spawning stock size and yield over the remaining rebuilding period under various management options was conducted. Future recruitment was assumed to fluctuate around two alternative scenarios: (i) average levels observed for 1976-2006 (85,000 recruits, the low recruitment scenario) and (ii) levels that increase as the stock rebuilds (MSY level of 270,000 recruits, the high recruitment scenario). The Committee has no strong evidence to favor either scenario over the other and notes that both are reasonable (but not extreme) lower and upper bounds on rebuilding potential.

The outlook for bluefin tuna in the West Atlantic with the low recruitment scenario (**BFTW-Figure 6**) is more optimistic with respect to current stock status than that from the 2008 assessment (owing to the use of improved information on the growth of bluefin tuna). A total catch of 2,500 t is predicted to have at least a 50% chance of achieving the convention objectives of preventing overfishing and maintaining the stock above the MSY level. The outlook under the high recruitment scenario (**BFTW-Figure 6**) is more pessimistic than the low recruitment scenario since the rebuilding target would be higher; a total catch of less than 1,250 t is predicted to maintain F below F_{MSY}, but the stock would not be expected to rebuild by 2019 even with no fishing.

BFTW-Table 1 summarizes the estimated chance that various constant catch policies will allow rebuilding under the high and low recruitment scenarios for the base-case. The low recruitment scenario suggests the stock is above the MSY level with greater than 60% probability and catches of 2,500 t or lower will maintain it above the MSY level. If the high recruitment scenario is correct, then the western stock will not rebuild by 2019 even with no catch, although catches of 1,100 t or less are predicted to have a 60% chance to immediately end overfishing and initiate rebuilding.

The Committee notes that considerable uncertainties remain for the outlook of the western stock, including the effects of mixing and management measures on the eastern stock

BFTW-5. Effects of current regulations

The Committee previously noted that Recommendation 06-06 was expected to result in a rebuilding of the stock towards the convention objective, but also noted that there has not yet been enough time to detect with confidence the population response to the measure. This statement is also true for Recommendation 08-04, which was implemented in 2009. Some of the available fishery indicators **(BFTW-Figure 3)** as well as the current assessment suggest the spawning biomass of western bluefin tuna may be slowly rebuilding.

BFTW-6. Management recommendations

In 1998, the Commission initiated a 20-year rebuilding plan designed to achieve B_{MSY} with at least 50% probability. In response to recent assessments, in 2008 the Commission recommended a total allowable catch (TAC) of 1,900 t in 2009 and 1,800 t in 2010 [Rec. 08-04].

The current (2010) assessment indicates similar historical trends in abundance as in previous assessments. The strong 2003 year class has contributed to stock productivity such that biomass has been increasing in recent years.

Future stock productivity, as with prior assessments, is based upon two hypotheses about future recruitment: a 'high recruitment scenario" in which future recruitment has the potential to achieve levels that occurred in the early 1970's and a "low recruitment scenario" in which future recruitment is expected to remain near present levels. Results in previous assessments have shown that long term implications of future biomass are different between the two hypotheses and this research question remains unresolved. However, the current (2010) assessment is also based on new information on western bluefin growth rates that has modified the Committee's perception of the ages at which spawning and maturity occur. Maturity schedules remain very uncertain, and, thus, the application of the new information in the current (2010) assessment accentuates the differences between the two recruitment hypotheses.

Probabilities of achieving B_{MSY} within the Commission rebuilding period were projected for alternative catch levels **(BFTW-Table 1, BFTW-Figure 7)**. The "low recruitment scenario" suggests that biomass is currently sufficient to produce MSY, whereas the "high recruitment scenario" suggests that B_{MSY} has a very low probability of being achieved within the rebuilding period. Despite this large uncertainty about the long term future productivity of the stock, under either recruitment scenario current catches (1,800 t) should allow the biomass to continue to increase. Also, catches in excess of 2,500 t will prevent the possibility of the 2003 year class elevating the productivity potential of the stock in the future.

The SCRS notes that the 2010 assessment is the first time that this strong 2003 year-class has been clearly demonstrated, likely as a result of age assignment refinements resulting from the growth curve and additional years of data; more observations from the fishery are required to confirm its relative strength. A further concern is that subsequent year-classes, although even less well estimated, are the lowest observed values in the time series. The Commission may wish to protect the 2003 year class until it reaches maturity and can contribute to spawning. Maintaining catch at current levels (1,800 t) may offer some protection.

As noted previously by the Committee, both the productivity of western Atlantic bluefin and western Atlantic bluefin fisheries are linked to the eastern Atlantic and Mediterranean stock. Therefore, management actions taken in the eastern Atlantic and Mediterranean are likely to influence 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.

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

Current (2009) Catch (including discards)	1,935 t
Assuming Low Potential Recruitment	
Maximum Sustainable Yield (MSY)	2,585 (2,409-2,766)[1]
Relative Spawning Stock Biomass:	
$B_{2009}/B_{MSY|R}$	1.1 (0.89-1.35)[1]
Relative Fishing Mortality[2]:	
$F_{2006\text{-}2008}/F_{MSY|R}$	0.73 (0.59-0.91)[1]
$F_{2006\text{-}2008}/F_{0.1}$	1.11 (0.91-1.31)[1]
$F_{2006\text{-}2008}/F_{max}$	0.57 (0.48-0.68)[1]
Assuming High Potential Recruitment	
Maximum Sustainable Yield (MSY)	6,329 (5,769-7,074)[1]
Relative Spawning Stock Biomass:	
$B_{2009}/B_{MSY|R}$	0.15 (0.10-0.22)[1]
Relative Fishing Mortality[2]:	
$F_{2006\text{-}2008}/F_{MSY|R}$	1.88 (1.49-2.35)[1]
$F_{2006\text{-}2008}/F_{0.1}$	1.11 (0.91-1.31)[1]
$F_{2006\text{-}2008}/F_{max}$	0.57 (0.48-0.68)[1]
Management Measures:	[Rec. 08-04] TAC of 1,900 t in 2009 and 1,800 t in 2010, including dead discards.

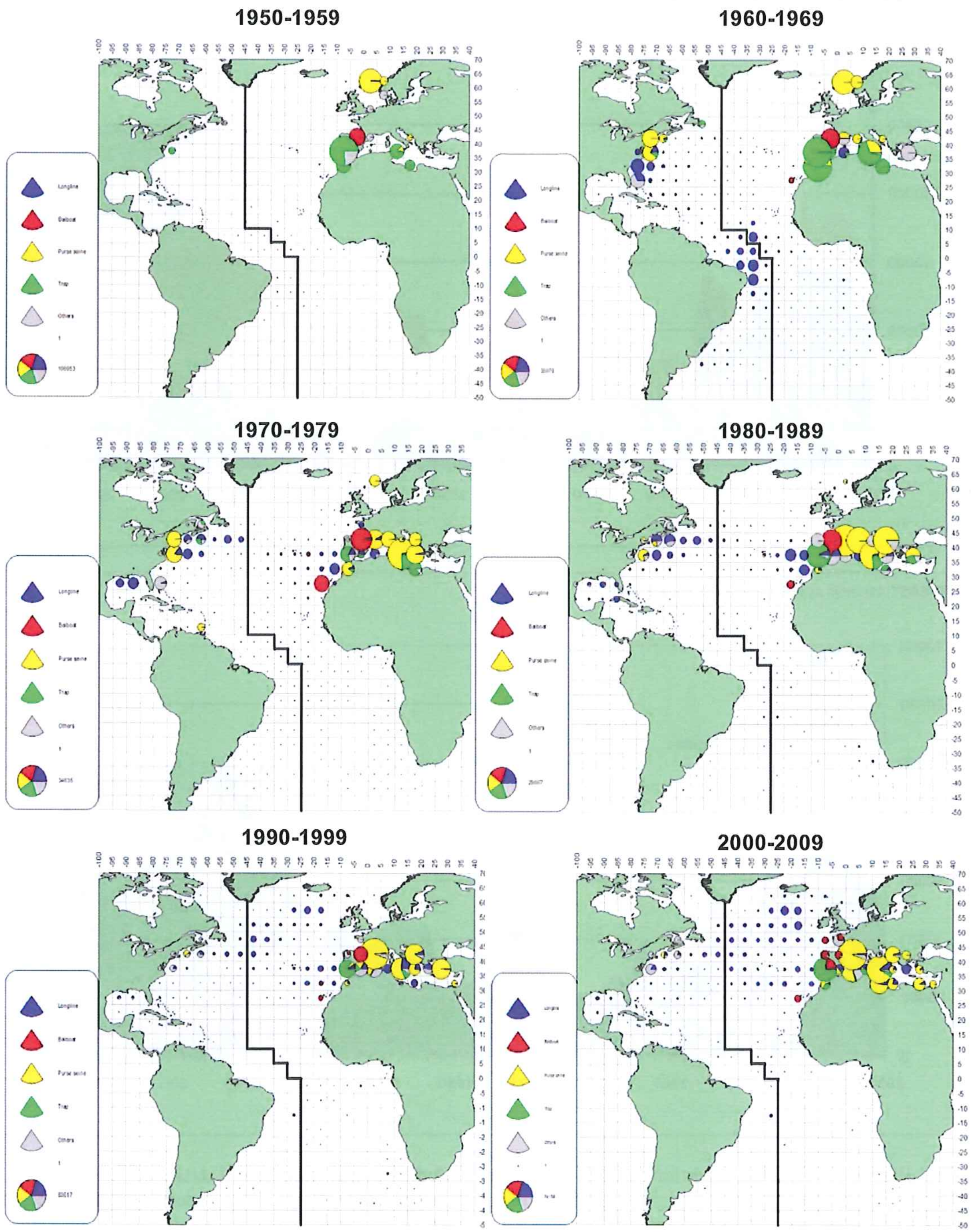
[1] Median and approximate 80% confidence interval from bootstrapping from the assessment.
[2] $F_{2006\text{-}2008}$ refers to the geometric mean of the estimates for 2006-2008 (a proxy for recent F levels).

BFT-Table 1. Estimated Catches (t) of Northern bluefin tuna *(Thunnus thynnus)* by area, gear and flag, used in the assessment (2008 and 2009 catches in Italic are estimations adopted by the WG).

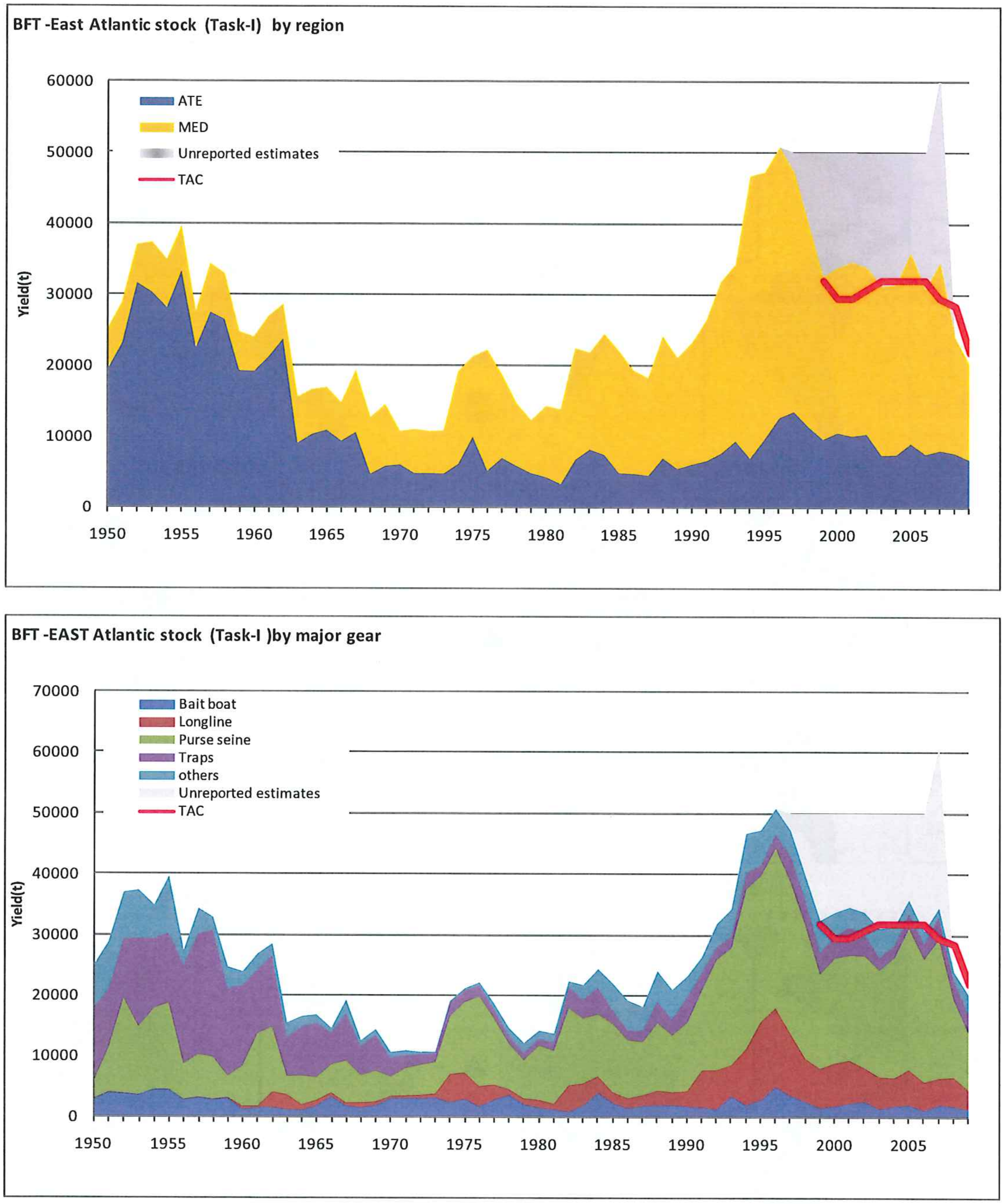
			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	*2008	*2009
TOTAL			24695	21570	20723	27016	23819	26027	29350	34131	36636	48853	49714	53320	49489	42375	35228	36541	37390	37089	33469	33505	37602	32501	36154	*26053*	*22163*	25849	21636
ATE+MED			22010	19247	18220	24118	21061	23247	26429	31849	34268	46740	47291	50807	47155	39718	32456	33766	34605	33770	31163	31381	35845	30689	34516	*24054*	*20228*	23849	19701
ATE			4807	4687	4456	6951	5433	6040	6556	7619	9367	6930	9650	12663	13539	11376	9628	10528	10086	10347	7362	7410	9036	7535	8037	7645	*6701*	7645	6684
MED			17203	14560	13764	17167	15628	17207	19872	24230	24901	39810	37640	38144	33616	28342	22828	23238	24519	23424	23801	23971	26810	23154	26479	*16409*	*13527*	16205	13016
ATW			2685	2322	2503	2898	2759	2780	2921	2282	2368	2113	2423	2514	2334	2657	2772	2775	2784	3319	2306	2125	1756	1811	1638	2000	1935	2000	1936
Landings	ATE	Bait boat	2004	1414	1821	1936	1971	1693	1445	1141	3447	1980	2601	4985	3521	2550	1492	1822	2275	2567	1371	1790	2018	1116	2032	1794	1260	1794	1260
		Longline	551	967	924	1169	962	1496	3197	3817	2717	2176	4392	4788	4534	4300	4020	3736	3303	2896	2750	2074	2713	2448	1706	2491	*1955*	2491	1960
		Other surf.	536	972	668	1221	1020	562	347	834	1548	932	1047	646	511	621	498	703	712	701	560	402	1014	1047	502	187	*366*	187	298
		Purse seine	86	276	0	0	0	54	46	462	24	213	458	323	828	692	726	1147	150	884	490	1078	871	332	0	0	0	0	0
		Sport (HL+RR)	1	1	3	1	2	1	0	0	0	0	0	0	162	28	33	126	61	63	109	87	11	4	10	6	2	6	2
		Traps	1630	1057	1040	2624	1478	2234	1522	1365	1631	1630	1152	1921	3982	3185	2859	2996	3585	3235	2082	1978	2408	2588	3788	3166	*3118*	3166	3164
	MED	Bait boat	278	0	0	0	0	25	148	158	48	0	206	5	4	11	4	0	0	1	9	17	5	0	0	0	0	0	
		Longline	1228	678	799	1227	1121	1026	2869	2599	2342	7048	8475	8171	5672	2749	2463	3317	3750	2614	2476	2564	3101	2202	2656	*2249*	*1211*	2254	1213
		Other surf.	3211	3544	2762	2870	3289	1212	1401	1894	1607	3218	1043	1197	1037	1880	2976	1067	1096	990	2536	1106	480	301	699	1022	*2566*	1022	169
		Purse seine	11219	9333	8857	11198	9450	11250	13245	17807	19297	26083	23588	26021	24178	21291	14910	16195	17174	17656	17167	18785	22475	20020	22952	*12858*	*9468*	12641	11345
		Sport (HL+RR)	507	322	433	838	457	1552	738	951	1237	2257	3556	2149	2340	1336	1622	1921	1321	1647	1392	1340	634	503	78	*128*	*139*	137	146
		Traps	760	683	913	1034	1311	2142	1471	821	370	1204	772	601	385	1074	852	739	1177	515	221	159	115	129	95	152	144	152	144
	ATW	Longline	1245	764	1138	1373	698	739	895	674	696	539	466	547	382	764	914	858	610	730	186	644	425	565	420	606	*364*	606	366
		Other surf.	293	166	156	425	755	536	578	509	406	307	384	432	293	342	281	284	202	108	140	97	89	85	63	82	*122*	82	121
		Purse seine	377	360	367	383	385	384	237	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	11
		Sport (HL+RR)	750	518	726	601	786	1004	1083	586	854	804	1114	1029	1181	1108	1124	1120	1649	2035	1398	1139	924	1005	1023	1130	1251	1130	1251
		Traps	20	0	17	14	1	2	0	1	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	23	23
Discards	ATW	Longline	0	514	99	102	119	115	128	211	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	163	159	163
		Other surf.	0	0	0	0	14	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0		0	
		Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	
Landings	ATE	Cape Verde	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	
		China P.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	119	42
		Chinese Taipei	16	197	20	0	109	0	0	0	6	20	8	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	
		EU.Denmark	37	0	0	1	0	0	0	0	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.España	3628	2876	2479	4567	3565	3557	2272	2319	5078	3137	3819	6174	6201	3800	3360	3474	3633	4089	2138	2801	3102	2033	3276	2938	2409	2938	2409
		EU.France	490	348	533	724	460	510	565	894	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	253	366
		EU.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		0	
		EU.Greece	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	
		EU.Ireland	0	0	0	0	0	0	0	0	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	1	1
		EU.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		0	
		EU.Portugal	29	193	163	48	3	27	117	38	25	240	35	199	712	323	411	441	404	186	61	27	79	97	29	36	*60*	36	53
		EU.Sweden	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	*10*	0	1
		Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	
		Guinée Conakry	0	0	0	0	0	0	0	0	0	330	0	0	0	0	0	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	2	27	0	0	1	0	0	0	0	0	0	0	0	
		Japan	420	739	900	1169	838	1464	2981	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	2351	1904
		Korea Rep.	77	0	0	0	0	0	0	0	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	
		Libya	0	0	0	0	0	0	0	312	0	0	0	576	477	511	450	487	0	0	0	0	0	47	0	0	0	0	
		Maroc	86	288	356	437	451	408	531	562	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2196	2418	1947	1909	1947	1909
		NEI (ETRO)	3	4	0	5	6	74	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	85	144	223	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	
		Norway	0	31	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	
		Panama	22	11	4	0	0	0	0	0	0	1	19	550	255	0	13	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	
		U.S.A.	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	
	MED	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*50*	0	
		Algerie	260	566	420	677	820	782	800	1104	1097	1560	156	156	157	1947	2142	2330	2012	1710	1586	1208	1530	1038	1511	1311	*262*	1311	
		China P.R.	0	0	0	0	0	0	0	0	0	97	137	93	49	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Chinese Taipei	0	0	0	0	0	0	0	0	328	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	
		Croatia	0	0	0	0	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	*927*	*767*	834	619
		EU.Cyprus	10	10	10	10	10	10	10	10	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	132	2
		EU.España	1460	701	1178	1428	1645	1822	1392	2165	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	2465	1769
		EU.France	5430	3490	4330	5780	4434	4713	4620	7376	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10157	2670	3087	2670	3087
		EU.Greece	11	131	156	159	182	201	175	447	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	350	373
		EU.Italy	7199	7576	4607	4201	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3279	3845	4377	4628	4973	4686	4841	4695	4621	2234	2735	2234	2735
		EU.Malta	21	41	36	24	29	81	105	80	251	572	587	399	393	407	447	376	219	240	255	264	346	263	334	296	263	296	263
		EU.Portugal	0	0	0	0	0	0	278	320	183	428	446	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	

			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	*2008	*2009
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	50	
		Israel	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	1006	341	280	258	127	172	85	123	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	80	18
		Korea Rep.	0	0	0	0	0	0	0	0	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	335	102
		Libya	300	300	300	300	84	328	370	425	635	1422	1540	812	552	820	745	1063	1941	638	752	1300	1091	1280	1358	1318	1082	1318	1082
		Maroc	12	56	116	140	295	1149	925	205	79	1092	1035	586	535	687	636	695	511	421	760	819	92	190	641	531	369	531	369
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	427	639	171	1066	825	140	17	0	0	0	0	0	0	0	0	0	0	
		NEI (MED)	0	168	183	633	757	360	1799	1398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (combined)	0	0	0	0	0	0	0	0	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	
		Panama	0	0	72	67	0	74	287	484	467	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Serbia & Montenegro	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	
		Syria Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	***50***	41	
		Tunisie	369	315	456	624	661	406	1366	1195	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	2622	2679	1932	2679	1932
		Turkey	41	69	972	1343	1707	2059	2459	2817	3084	3466	4220	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	***990***	665	879	665
		Yugoslavia Fed.	1084	796	648	1523	560	940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	Argentina	6	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Brasil	1	0	2	0	2	1	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	
		Canada	142	73	83	393	619	438	485	443	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	575	530
		Chinese Taipei	3	3	4	0	20	0	0	0	0	0	0	0	2	0	0	0	0	0	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	74	11	19	27	19	0	0	0	0	
		EU.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		0	
		EU.Portugal	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	0	
		EU.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	0	0	
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	3	2
		Japan	1092	584	960	1109	468	550	688	512	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	492	162
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	4	0	19	2	8	14	29	10	12	22	9	10	14	7	7	10	7	10
		NEI (ETRO)	0	0	0	0	30	24	23	17	0	0	0	0	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	0	0	2	0	0	429	270	49	0	0	0	0	0	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		0	
		Panama	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	0	
		Sta. Lucia	0	0	1	3	2	14	14	14	2	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Trinidad and Tobago	1	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.	1424	1142	1352	1289	1483	1636	1582	1085	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	764	1068
		UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0.3
		Uruguay	16	6	0	2	0	0	1	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
Discards	ATW	Canada	0	0	0	0	14	0	0	0	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	1	3
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	
		U.S.A.	0	514	99	102	119	115	128	211	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	160	158	160

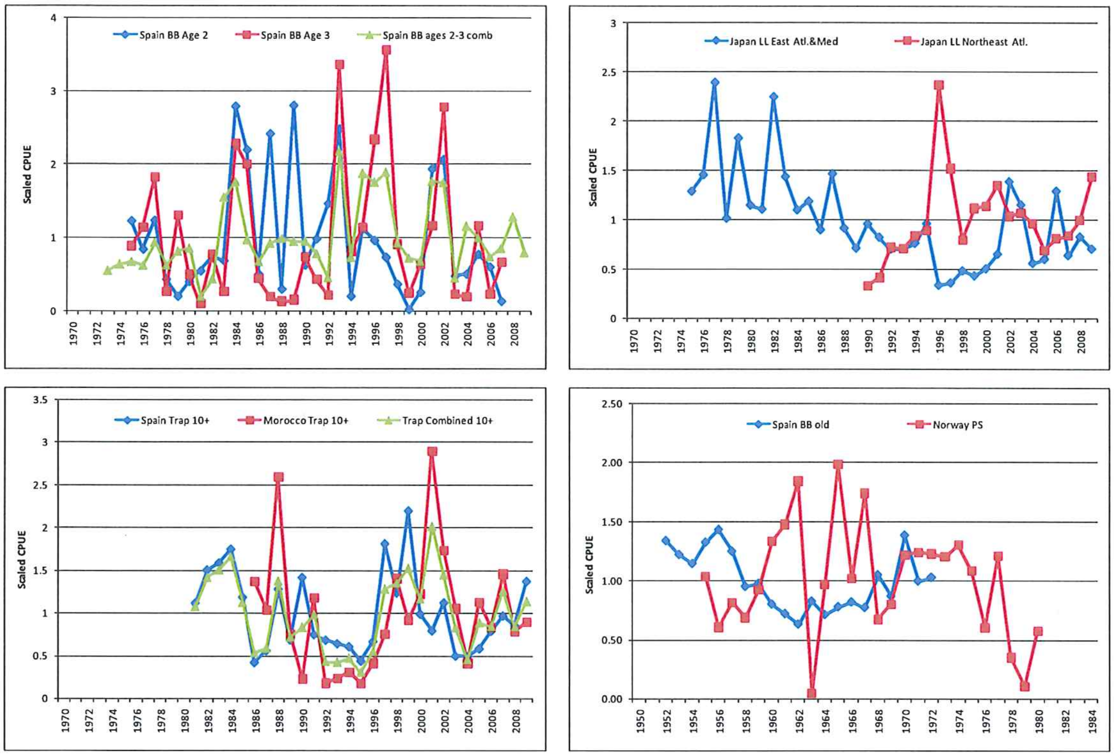
* Current Task I figures (2008 and 2009) where the shaded cells indicate which catches have changed since the assessment.



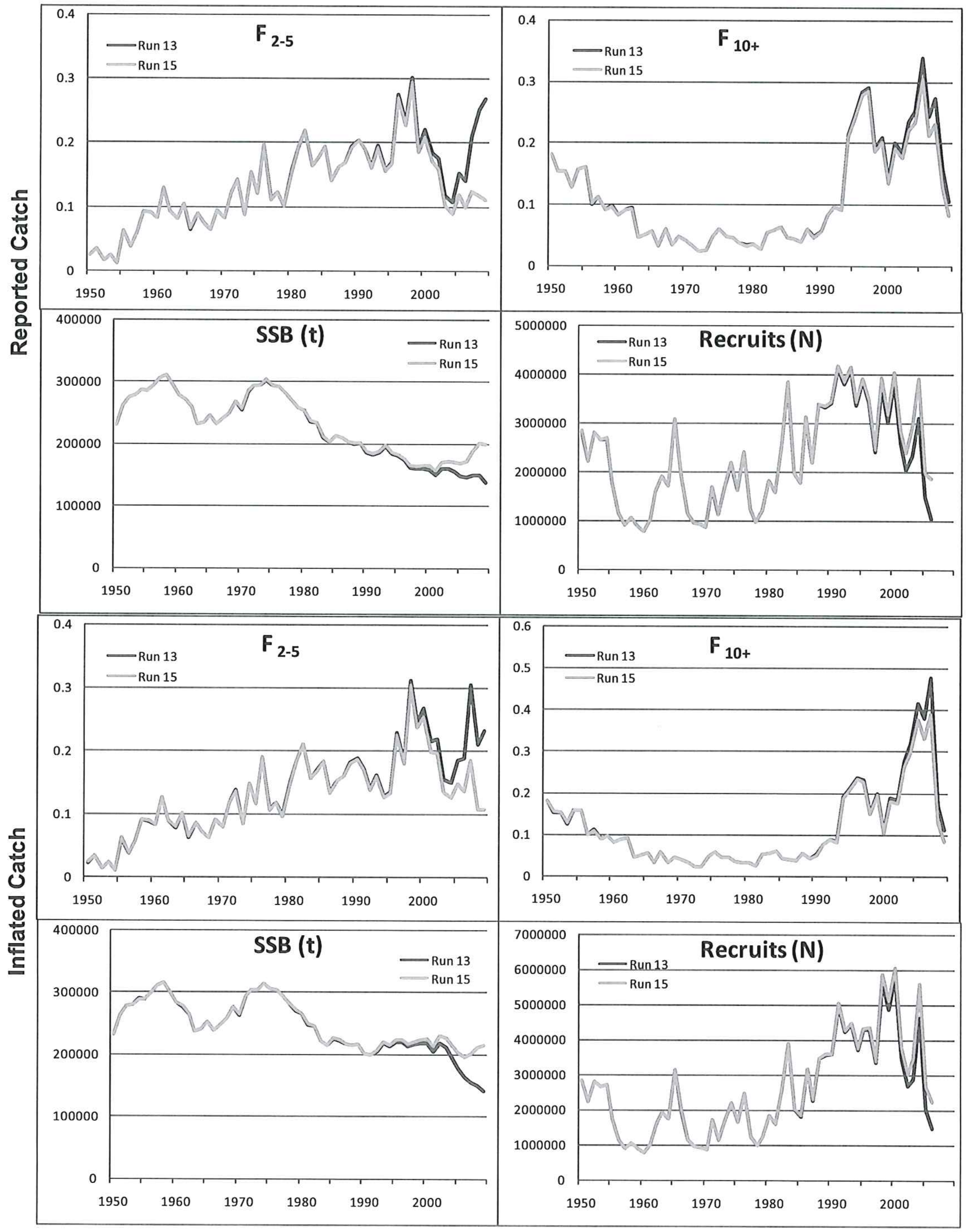
BFT-Figure 1. Geographic distribution of bluefin tuna catches per 5x5 degrees and per main gears.



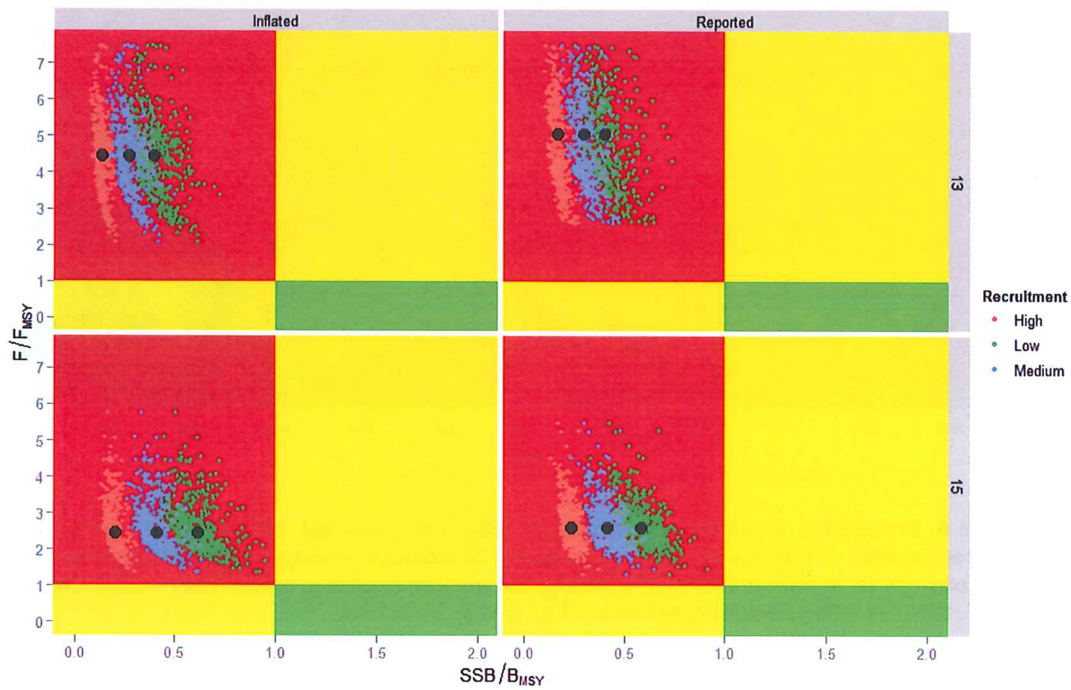
BFTE-Figure 1. Reported catch for the East Atlantic and Mediterranean from Task I data from 1950 to 2009 split by main geographic areas (top panel) and by gears (bottom panel) together with unreported catch estimated by the Committee (using from fishing capacity and mean catch rates over the last decade) and TAC levels since 1998.



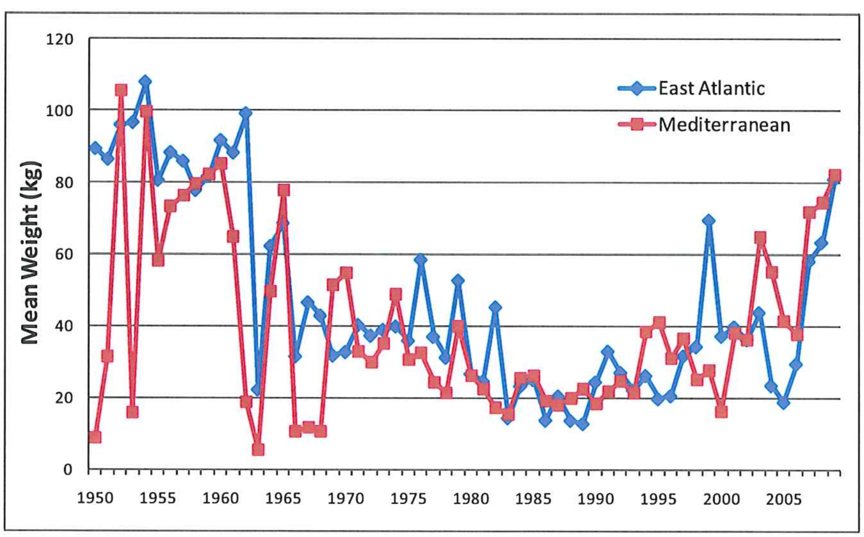
BFTE-Figure 2. Time series of fishery indicators (CPUE) for the East Atlantic and Mediterranean bluefin tuna stock. All the CPUE series are standardized except the nominal Norway PS series.



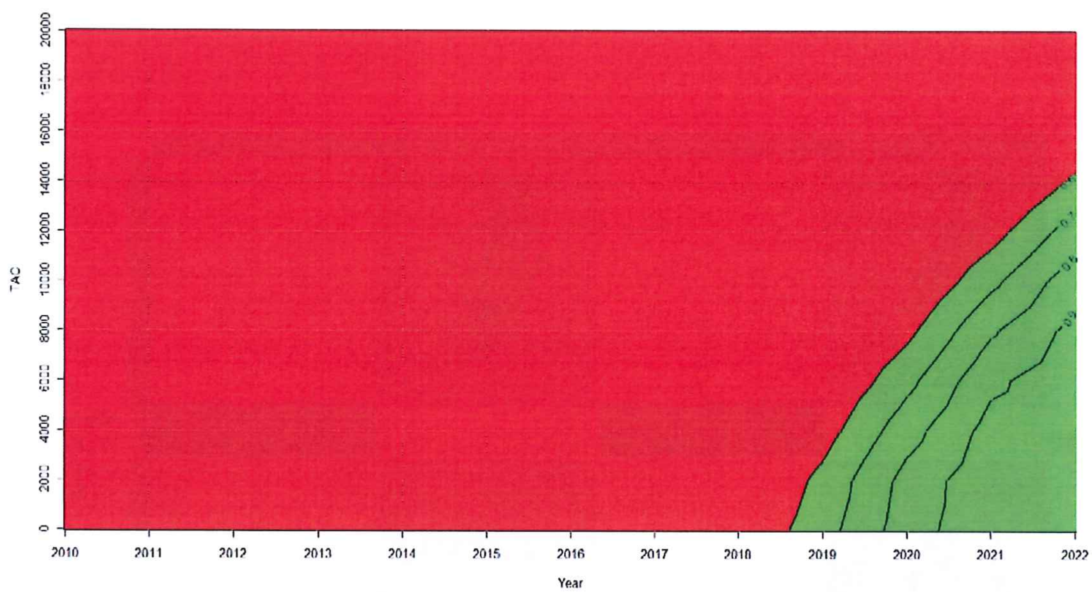
BFTE-Figure 3. Fishing mortality (for ages 2 to 5 and 10+), spawning stock biomass (in tons) and recruitment (in number of fish) estimates from VPA runs 13 and 15. Top panel: reported catch; bottom panel: inflated catch.



BFTE-Figure 4. Stock status in the terminal year (2009) estimated from VPA runs 13 and 15 with reported and inflated catch and considering low, medium and high recruitment levels. Clouds of symbols represent the distribution of the terminal year obtained through bootstrapping.



BFTE-Figure 5. Plots of the annual mean weight from the catch-at-size data per main area from 1950 to 2009.



BFTE-Figure 6. Probabilities plot of stock rebuilding at $SSB_{F0.1}$ by years and TAC levels (the probabilities combine the results obtained from the stochastic runs after the 24 scenarios investigated). According to Rec. [09-06], red area corresponds to probabilities < 60% while green area corresponds to probabilities > 60%. Contours for 60%, 70%, 80% and 90% probabilities are further displayed by black lines.

BFTE-Table 1. Probabilities of stock rebuilding at $SSB_{F0.1}$ by years and TAC levels (the probabilities combined the results obtained from the stochastic runs over the 24 scenarios being investigated). The difference in grey colour underlines the catch (TAC) at which the 60% probability would not be anymore achieved.

TAC	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
0	0%	0%	0%	2%	6%	14%	25%	38%	52%	69%	89%	98%	99%
2000	0%	0%	0%	1%	5%	12%	21%	33%	46%	62%	83%	97%	99%
4000	0%	0%	0%	1%	4%	9%	18%	28%	40%	55%	75%	93%	99%
6000	0%	0%	0%	1%	3%	7%	14%	23%	34%	47%	66%	86%	97%
8000	0%	0%	0%	0%	2%	6%	11%	19%	29%	40%	56%	77%	92%
10000	0%	0%	0%	0%	2%	4%	9%	15%	23%	33%	46%	65%	84%
12000	0%	0%	0%	0%	1%	3%	6%	11%	18%	26%	37%	53%	73%
13500	0%	0%	0%	0%	1%	2%	5%	9%	14%	21%	30%	45%	63%
14000	0%	0%	0%	0%	1%	2%	4%	8%	13%	20%	28%	42%	59%
16000	0%	0%	0%	0%	0%	1%	3%	6%	9%	14%	20%	31%	46%
18000	0%	0%	0%	0%	0%	1%	2%	4%	6%	10%	15%	22%	34%
20000	0%	0%	0%	0%	0%	0%	1%	2%	4%	6%	10%	15%	24%

BFTW-Table 1. Kobe II matrices giving the probability that the spawning stock biomass (SSB) will exceed the level that will produce MSY in any given year for various constant catch levels under the low recruitment, high recruitment, and combined scenarios.

Low recruitment scenario (two-line)

TAC	2011	2012	2013	2014	2015	2016	2017	2018	2019
0 mt	67.8%	98.4%	99.4%	99.4%	99.8%	100.0%	100.0%	100.0%	100.0%
250 mt	66.8%	98.2%	98.8%	98.8%	99.8%	99.8%	100.0%	100.0%	100.0%
500 mt	66.0%	98.0%	98.8%	98.8%	99.0%	99.8%	99.8%	100.0%	100.0%
750 mt	65.6%	97.4%	98.4%	98.0%	98.8%	99.0%	99.4%	99.6%	100.0%
1000 mt	64.6%	97.0%	97.6%	97.0%	98.2%	98.8%	99.0%	99.0%	99.4%
1250 mt	63.8%	96.4%	97.0%	96.2%	97.8%	98.2%	98.4%	98.4%	98.8%
1500 mt	63.2%	96.2%	96.4%	95.2%	95.8%	97.0%	97.6%	97.4%	97.6%
1750 mt	61.6%	95.2%	95.4%	93.2%	93.6%	94.0%	94.4%	95.0%	95.8%
2000 mt	60.6%	94.8%	94.6%	90.4%	91.0%	91.8%	92.0%	92.4%	92.6%
2250 mt	59.6%	94.4%	93.2%	87.4%	87.8%	86.8%	86.4%	86.6%	86.2%
2500 mt	58.8%	93.2%	91.4%	84.2%	81.8%	81.2%	81.2%	78.6%	78.2%
2750 mt	57.6%	92.8%	88.6%	78.4%	76.4%	74.0%	73.4%	69.6%	68.0%
3000 mt	56.4%	91.2%	86.4%	74.0%	69.0%	66.2%	62.4%	59.8%	56.8%
3250 mt	54.6%	89.6%	83.2%	68.2%	62.2%	57.4%	53.0%	48.2%	44.0%
3500 mt	54.2%	87.2%	79.0%	61.4%	55.4%	49.0%	43.6%	38.2%	34.0%

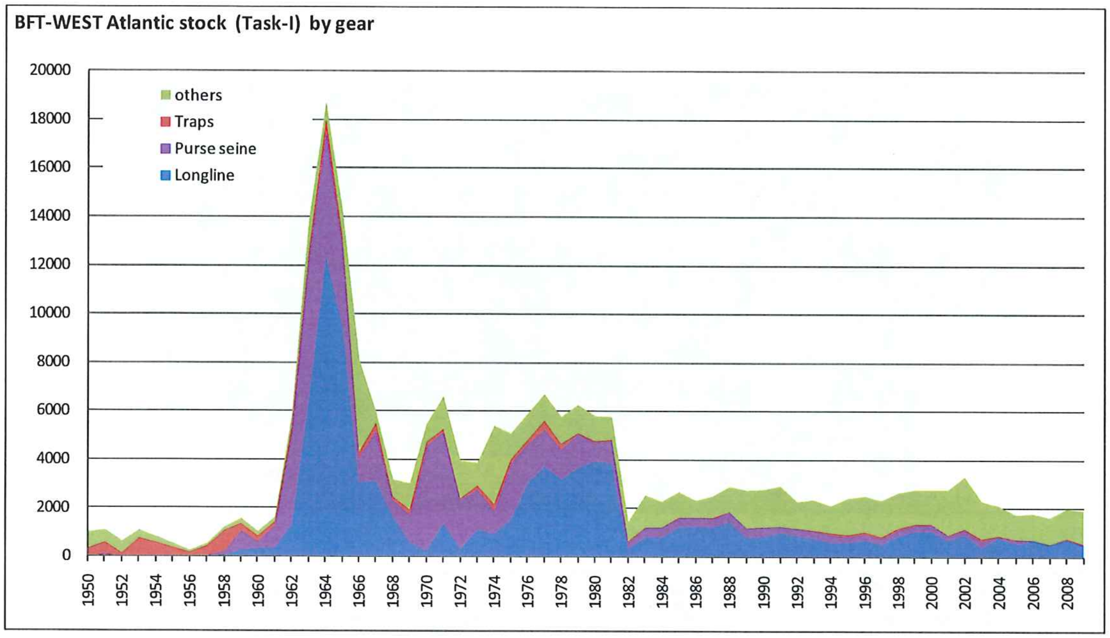
High recruitment scenario (Beverton-Holt)

TAC	2011	2012	2013	2014	2015	2016	2017	2018	2019
0 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
250 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
750 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1250 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1750 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2250 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2750 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3250 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

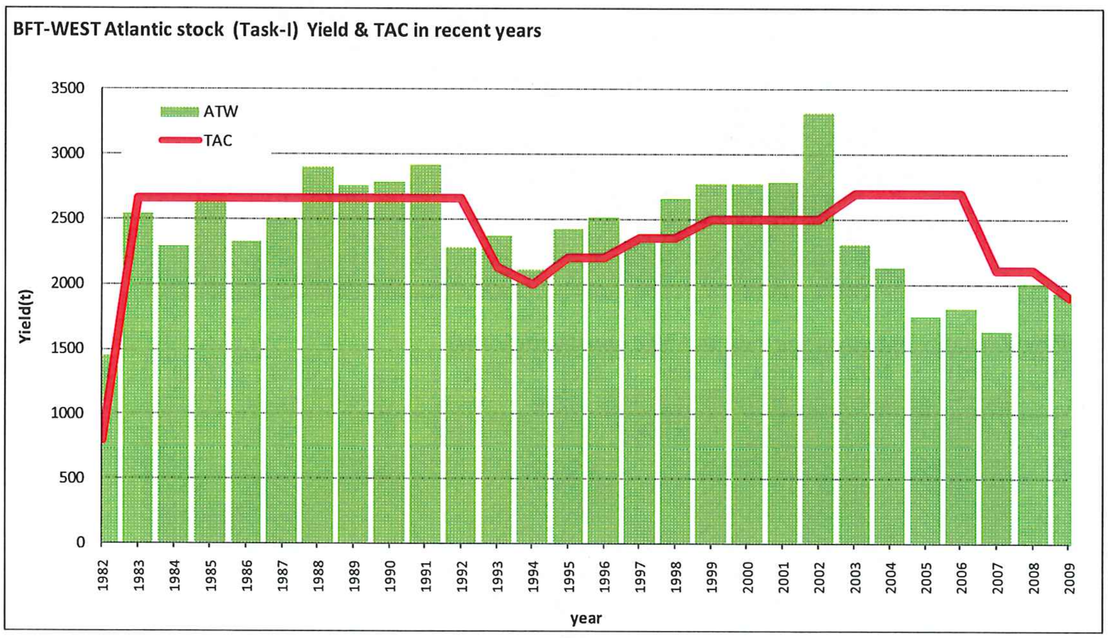
Combined recruitment scenarios (low and high equally probable)

TAC	2011	2012	2013	2014	2015	2016	2017	2018	2019
0 mt	33.9%	49.2%	49.7%	49.7%	49.9%	50.0%	50.0%	50.0%	50.0%
250 mt	33.4%	49.1%	49.4%	49.4%	49.9%	49.9%	50.0%	50.0%	50.0%
500 mt	33.0%	49.0%	49.4%	49.4%	49.5%	49.9%	49.9%	50.0%	50.0%
750 mt	32.8%	48.7%	49.2%	49.0%	49.4%	49.5%	49.7%	49.8%	50.0%
1000 mt	32.3%	48.5%	48.8%	48.5%	49.1%	49.4%	49.5%	49.5%	49.7%
1250 mt	31.9%	48.2%	48.5%	48.1%	48.9%	49.1%	49.2%	49.2%	49.4%
1500 mt	31.6%	48.1%	48.2%	47.6%	47.9%	48.5%	48.8%	48.7%	48.8%
1750 mt	30.8%	47.6%	47.7%	46.6%	46.8%	47.0%	47.2%	47.5%	47.9%
2000 mt	30.3%	47.4%	47.3%	45.2%	45.5%	45.9%	46.0%	46.2%	46.3%
2250 mt	29.8%	47.2%	46.6%	43.7%	43.9%	43.4%	43.2%	43.3%	43.1%
2500 mt	29.4%	46.6%	45.7%	42.1%	40.9%	40.6%	40.6%	39.3%	39.1%
2750 mt	28.8%	46.4%	44.3%	39.2%	38.2%	37.0%	36.7%	34.8%	34.0%
3000 mt	28.2%	45.6%	43.2%	37.0%	34.5%	33.1%	31.2%	29.9%	28.4%
3250 mt	27.3%	44.8%	41.6%	34.1%	31.1%	28.7%	26.5%	24.1%	22.0%
3500 mt	27.1%	43.6%	39.5%	30.7%	27.7%	24.5%	21.8%	19.1%	17.0%

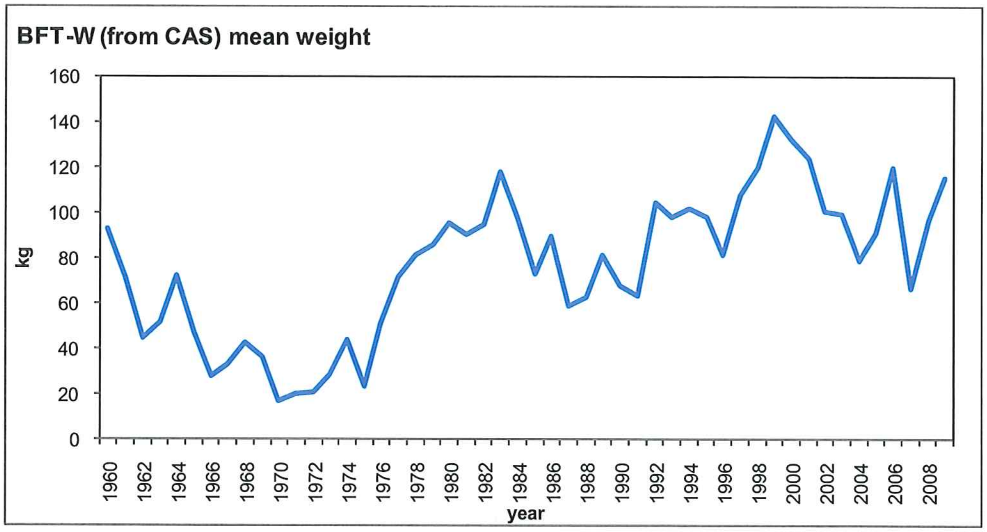
(a)



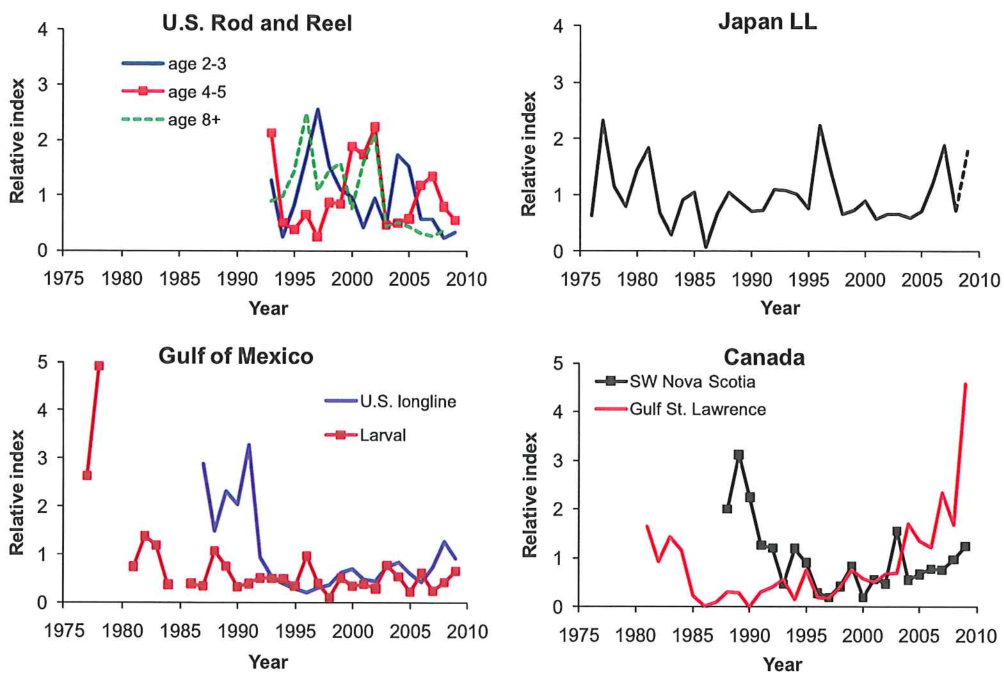
(b)



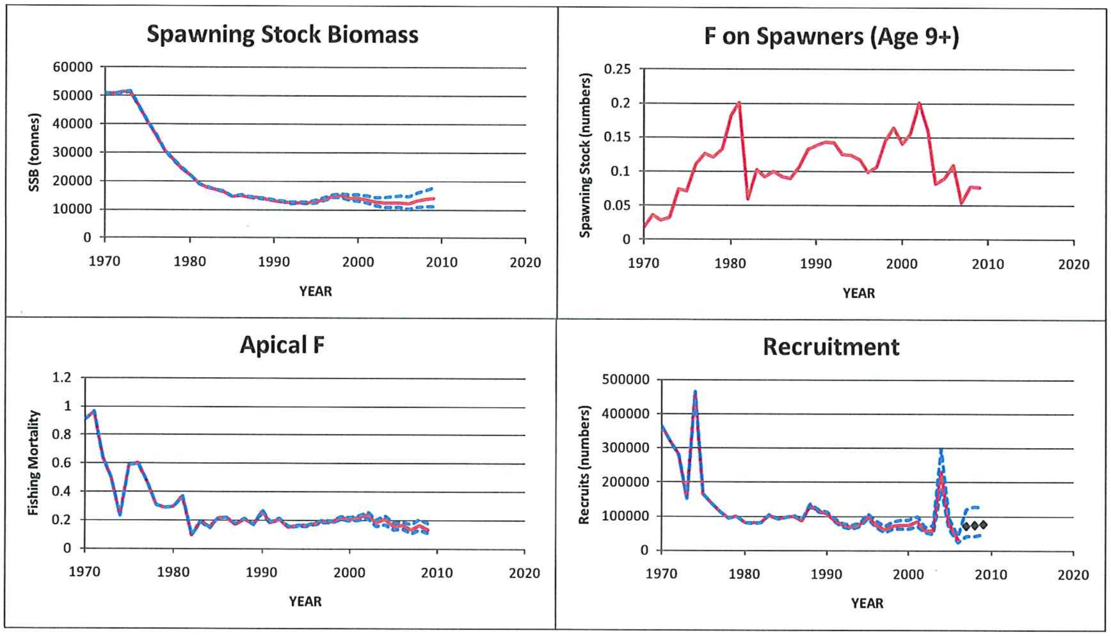
BFTW-Figure 1. Historical catches of western bluefin tuna: (a) by gear type and (b) in comparison to TAC levels agreed by the Commission.



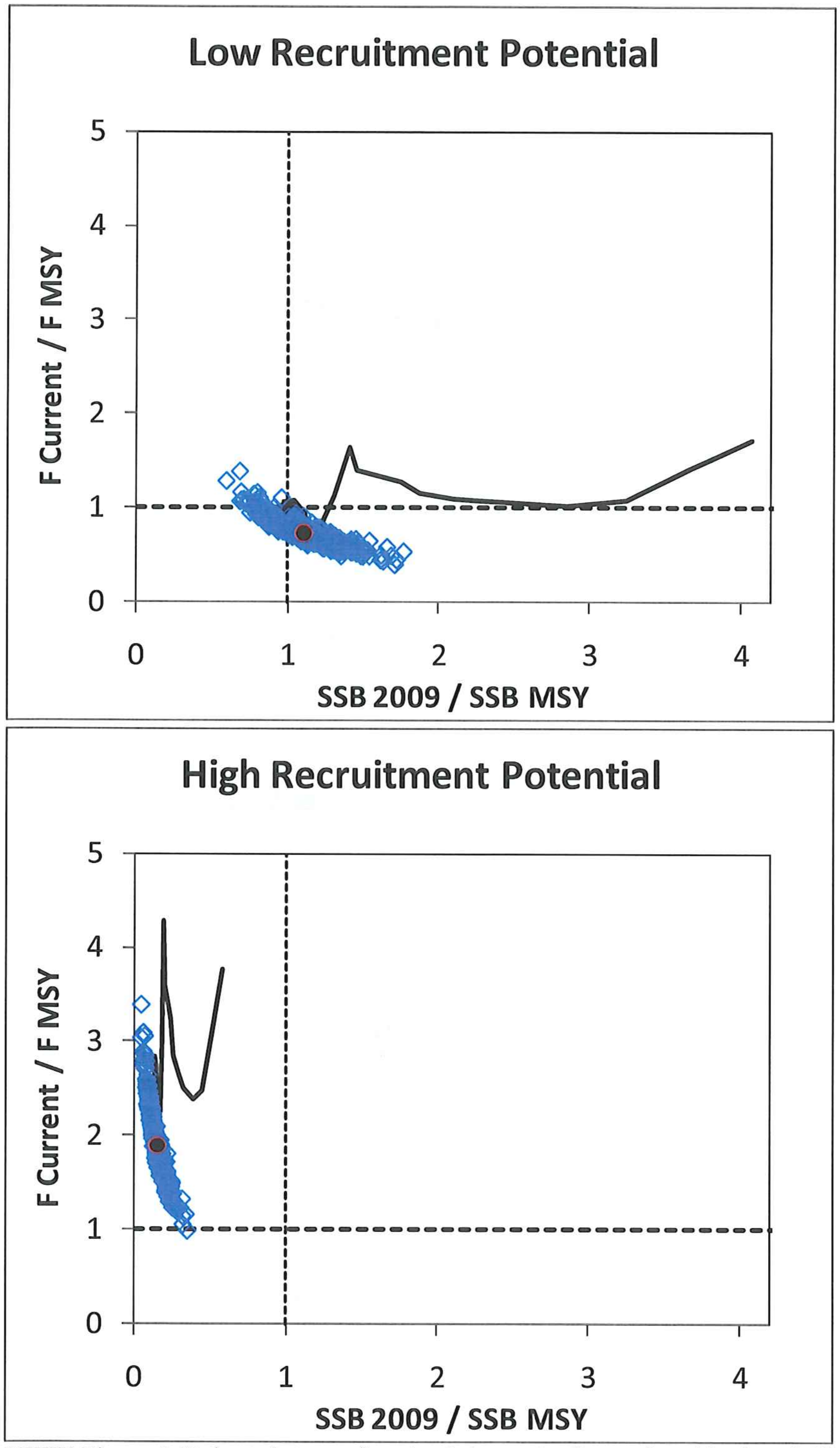
BFTW-Figure 2. Historical average weight of bluefin tuna caught by fisheries operating in the western management area.



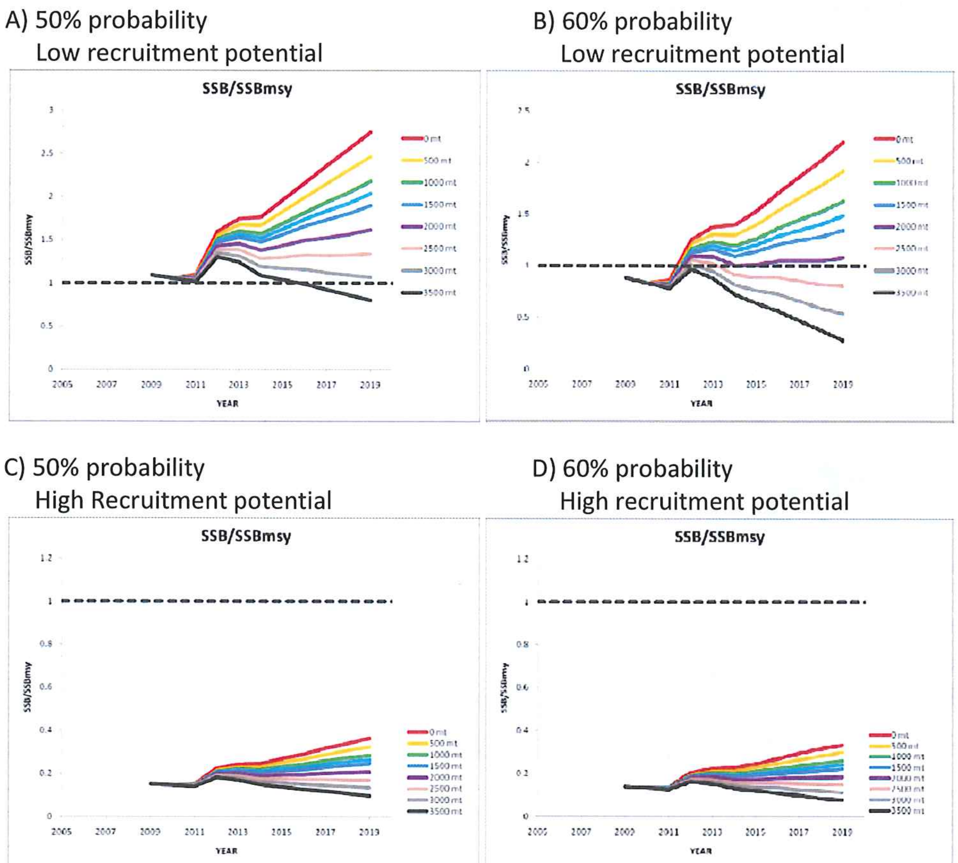
BFTW-Figure 3. Updated indices of abundance for western bluefin tuna. The dashed portion of the Japanese longline series represents the trend estimated in 2009, which was considered unreliable by the 2010 SCRS.



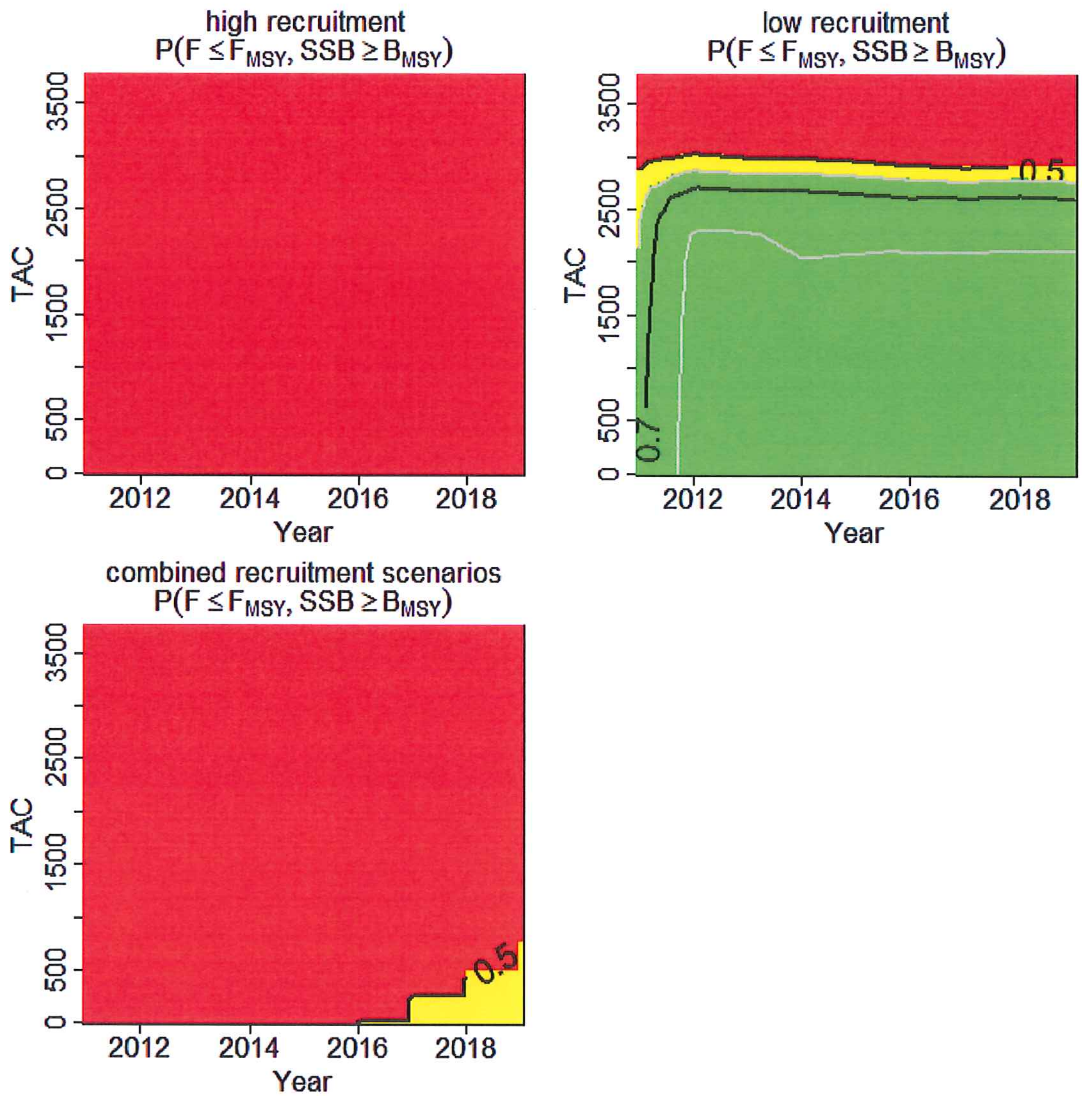
BFTW-Figure 4. Median estimates of spawning biomass (age 9+), fishing mortality on spawners, apical fishing mortality (F on the most vulnerable age class) and recruitment for the base VPA model. The 80% confidence intervals are indicated with dotted lines. The recruitment estimates for the last three years of the VPA are considered unreliable and have been replaced by the median levels corresponding to the low recruitment scenario.



BFTW-Figure 5. Estimated status of stock relative to the Convention objectives (MSY) by year (1970 to 2009). The lines give the time series of point estimates for each recruitment scenario and the cloud of symbols depicts the corresponding bootstrap estimates of uncertainty for the most recent year. The large black circle represents the status estimated for 2009.



BFTW-Figure 6. Projections of spawning stock biomass (SSB) for the Base Case assessment under low recruitment potential (top panels) and high recruitment potential (bottom panels) and various levels of constant catch. The labels "50%" and "60%" refer to the probability that the SSB will be greater than or equal to the values indicated by each curve. The curves corresponding to each catch level are arranged sequentially in the same order as the legends. A given catch level is projected to have a 50% or 60% probability of meeting the convention objective (SSB greater than or equal to the level that will produce the MSY) in the year that the corresponding curve meets the dashed horizontal line.



BFTW-Figure 7. Kobe II matrices giving the chance that the spawning stock biomass (SSB) will exceed the level that will produce MSY in any given year under various constant catch levels for the Base Case assessment under the low recruitment, high recruitment, and combined scenarios. The red, yellow and green regions represent chances of less than 50%, 50-59% and 60% or better, respectively.