Assessment of recreational fisheries for seabass

Mike Armstrong (contract lead), Tessa van der Hammen and Ronan Goff

Independent scientific experts, UK, Netherlands and France

December 2014

Prepared under contract to the European Commission.

Executive Summary

The potential effect of increases in minimum landing size (MLS) of seabass and/or imposition of daily bag limits (BL) for recreational fishing, were explored using trip-level data from recreational fishery surveys carried out in recent years by France, Netherlands and England. The use of MLS is particularly appropriate for hook-and line fishing, because with careful handling it is expected that the majority of released fish will survive. Seabass in the North Sea, Channel, Celtic Sea and Irish Sea are overexploited and declining towards the lowest observed spawning stock biomass observed. Roughly a quarter of the total removals from the stock in recent years were by recreational fishing.

During the years of the recreational fishery surveys, the MLS was 36cm. Length at 50% retention was close to 36cm in France, and 40cm in England. Length data for released fish were not provided by the Netherlands, but on-site sampling of anglers from 2010 to 2014 indicated that 32% of the retained catch comprised fish smaller than 36cm compared with around 5% in France and England. An increase in MLS to 42cm will already be in place in France and the Netherlands in 2015. Assuming full compliance, a 42cm MLS applied to the recreational fishery survey data reduced the retained catch numbers by 35% in France, 23% in the UK and 64% in the Netherlands. A 45cm MLS reduced the retained catch numbers in the surveys by 49% in France, 48% in England, and 74% in the Netherlands. The reductions in 2015 may be less than this because the length range 36 – 45cm is expected to be dominated by fish of the weak 2008 – 2012 year classes, according to ICES.

The combined effect of MLS and bag limits can only be estimated from the French survey data, because length data from all respondents at the trip level were only available in this data set. In France, an MLS of 45cm with no daily bag limit would have reduced the retained catch by the same amount as a 42cm MLS with a bag limit of two fish. In England, a 45cm MLS with no bag limit would have reduced the retained catch by the same amount as a one-fish-per-day bag limit without any change to MLS. In the Netherlands, full compliance with a 45cm MLS would have caused a much larger (74%) reduction than a bag limit of one fish applied to the surveys, as 32% of the retained catch was already below the36cm MLS. These findings reflect the fact than many recreational anglers catch only small numbers of seabass per trip, and many of the fish are smaller than 45cm.

The table overleaf summarises the percentage reduction in retained catch numbers for combinations of MLS and bag limits applied to recreational survey data assuming full compliance. Reductions are in relation to the estimated total retained catches during the surveys, which reflect the MLS and retention patterns in those years. The effect of combinations of MLS and bag limits for UK and Netherlands are given as “>x” where x is the greater of the two individual measures applied on their own. No bag limit calculations were available for France for the theoretical condition of maintaining a 36cm MLS with bag limits. A major conclusion of this analysis is that, with full compliance, an increase in MLS to 45cm (to approximately the length at maturity) can achieve a reduction in overall retained catch numbers of 50% or more, which could only be achieved by very restrictive bag limits on their own or in combination with smaller MLS.

The diffuse and often remote distribution of recreational fishing is an extreme challenge for enforcement agencies. Excessive non-compliance could have large negative impact on the quality of recreational fishery survey data and the ability to monitor the effectiveness of measures and the state of the stock. Any measures introduced at this stage should be part of a well-planned process of reducing fishing pressures and impacts on seabass, in a way that reduces non-compliance as far as

possible and allows continued collection of data to monitor the outcomes of management measures. This may be best achieved using an MLS as high as 45cm, which is well understood and supported by anglers to reduce catches of fish that have not yet spawned. Releasing fish below 45cm will also provide protection to the incoming 2008-2012 year classes which are very weak. Very small bag limits such as the 1 fish per day proposal by the Commission are likely to have more unpredictable outcomes and greater non-compliance.

***Executive summary Table 1**: Summary of % reduction in retained catch numbers for combinations of MLS and bag limits applied to recreational survey data. Figures in bold are for MLS or bag limits on their own.*

MLS	Country	Bag limit					
		1	2	3	4	5	none
36cm	France	-	-	-	-	-	**4**
	UK	**52**	**32**	**19**	**12**	**8**	**5**
	Netherlands	**59**	**38**	**25**	**18**	**13**	**32**
42cm	France	61	46	39	36	35	**34**
	UK	>52	>32	>23	>23	>23	**23**
	Netherlands	>64	>64	>64	>64	>64	**64**
45cm	France	68	56	50	48	47	**47**
	UK	>52	>48	>48	>48	>48	**48**
	Netherlands	>74	>74	>74	>74	>74	**74**

Based on the present analysis, it is proposed that an increase in MLS to 45cm should be considered, but combined with a daily bag limit of 4 fish to eradicate, as far as possible, large catches of seabass landed by small numbers of recreational fishers for personal consumption, distribution or sale. These large catches may go unrecorded during recreational fishing surveys for various reasons. For the great majority of survey respondents, an MLS of 45cm could reduce retained catches by around 50%, whilst a bag limit of 4 fish applied at the same time would seldom be limiting but would help prevent excessively large catches. A communications campaign is needed to raise awareness of the measures and why they are needed. The combination of these actions should drive European recreational fisheries towards more responsible and sustainable activities. Increasing restrictions will inevitably lead to more non-compliance, even with good communication, and data will be needed from inspection activities to compare with the results of surveys that involve self-reporting of catches.

The MLS should be set regionally according to the biology of the stocks, and remain unchanged while a long term management plan is established to implement additional measures to attain management goals for recreational and commercial fishing. These measures could include spatial, seasonal or interannual adjustment of bag limits, and introduction of maximum landing sizes (slot sizes). It is vital that all such approaches are developed during in-depth consultation between recreational and commercial fishing stakeholders, scientists, enforcement agencies and local and national government, and harmonized as far as possible across EU countries fishing the same stock, so that the measures are well understood and complied with.

There was insufficient time in the very short time available to address a Commission request to advise on the establishment of areas for catch-and-release only. However it is noted that 37 Bass Nursery Areas are designated in the UK, where all boat fishing for seabass is prohibited for all or part of the year, and where catch-and-release is promoted for shore angling.

1. Introduction

This paper addresses a request from the European Commission for an evaluation of the impacts of several possible measures to reduce the recreational fishing mortality on European seabass in the North Sea, Channel, Celtic Sea and Irish Sea. The report is to inform STECF in evaluating: i) The effect a restriction of a limit of 1, 2 or 3 seabass per day per person would have on the overall catches (for each Member State and cumulative); ii) the effect that a minimum landing size of 36, 42 and 45 cm applied only to recreational fisheries would have on current catch and mortality levels. If possible STECF is also asked to identify, where possible, periods and locations of higher catches from recreational angling and comment on the use of a closure prohibiting the retention of seabass to reduce overall mortality. Annex 1 gives the detailed request for services from the Commission .

The benchmark assessment carried out on seabass by ICES in 2012 (ICES 2012a) proposed that the population in the North Sea, Channel, Celtic Sea and Irish Sea (ICES Divisions IVb,c and VIIa,d-h) should be treated as a single stock for the purposes of assessment (Annex 2). A benchmark assessment was agreed at the 2012 meeting, but did not include any of the recreational fishery catch estimates from nationwide surveys carried out by France and the Netherlands. The ICES assessment issued in 2013 (ICES 2013a) was based on this benchmarked assessment approach and indicated that the stock was in decline due to overfishing and recent poor recruitment.

In 2014, the assessment was benchmarked again (ICES 2014a) and this time, an additional recreational fishing mortality was included that was consistent with the recent survey estimates of recreational harvest in France, Netherlands, England and Belgium. The updated assessment using the new benchmark model gave a mean recreational fishing mortality (for ages 5 – 11) of 0.09, compared with an average commercial fishing mortality of 0.24 for 2011 – 2013 (ICES, 2014b). Hence recreational F was around a quarter of the total F. The new assessment indicated again that the stock was declining rapidly due to overfishing in relation to MSY (recent total F = 0.33; F_{MSY} proxy = 0.13) combined with a series of below-average recruitment from the 2008 year class onwards (see Annex 3 for details). The biomass trends from the assessment have relatively wide confidence intervals, but the ICES evidence since 2013 of overfishing and stock decline has been considered strong enough for the Commission to instigate a process of consultation with Member States to try and agree conservation measures.

During 2014, the Commission drafted some proposed some measures to reduce commercial fishing mortality on mature fish during spring, and to reduce recreational F by means of a bag limit of one fish per person per day. Subsequently, the Commission was made aware that data existed on numbers of bass retained per angler per day from the recent recreational fishery surveys in France, England and Netherlands, and these data could provide some direct evidence of the potential reductions in recreational catch associated with a range of bag limits. The Commission therefore issued the present request to analyse these data, and also to look at the effects of different MLS.

It is important to note that France and Netherlands will already have introduced a national MLS of 42cm by 2015, whereas the UK is subject only to the EU MLS of 36cm, though with some small regional increases. The evaluation of the effect of a bag limit must therefore take into account that a reduction in catch in 2015 will already be attained for France and Netherlands due to the increased MLS.

2. Methods and results

2.1 Surveys used

Data were extracted from the recreational fishery survey data bases held by France, Netherlands and the UK (England). The surveys used were as follows:

France: 2009/10 and 2011/12 telephone screening surveys and completion of catch diaries by randomly selected respondents. The data are trip-level retained catches and length compositions, to evaluate bag limits and MLS at trip level. Data are predominantly for sea angling and a very small number of spearfishing trips, and the analysis is done separately for Area VII and Bay of Biscay, and combined.

Netherlands: 2012/13 online screening survey and completion of catch diaries by selected respondents stratified by avidity, location, age and gender. The data are trip-level retained catches to evaluate bag limits, and aggregate length compositions of retained fish from separate on-site surveys between 2010and 2014 combined to evaluate MLS. Surveys cover recreational angling only, in ICES Area IV. Catch numbers available separately for shore, private boat and charter boat. Results are given for the combined methods.

England: 2012/13 charter boat survey and onsite surveys of shore and private boat anglers. Surveys cover recreational angling only, covering ICES Areas IV and VII. Data are trip level data on numbers of fish retained per angler per day, to evaluate bag limits, and aggregate length compositions to evaluate MLS. Catch numbers were available separately for shore, private boat and charter boat, but results are given for the combined methods.

2.2 Evaluation of potential effects of MLS of 42cm and 45cm

The potential effect of an increase in MLS was investigated using length frequency data from the national recreational fishing surveys. The length frequency of retained recreational catches estimated during the years of the nation-wide recreational fishery surveys is a combination of the length composition of the total catches and the proportion of fish released in each length class. The length compositions tend to be very noisy due to small sample sizes (Fig.1a,c&d), and the tendency for recording of sizes to the nearest 5 cm is evident in the UK (England) survey data in particular (mainly a feature of self-recording by charter boat skippers). The length compositions for retained catches of seabass in the sea angling survey in England are generally similar to the compositions for UK commercial line fishing in 2010 – 2012 (mainly hand line or rod and line; Fig. 1b).

During the years of the surveys, the recreational fisheries in France show a clear pattern of releases around the EU MLS, with 50% release rate close to 36cm (Fig. 2). The 50% release rate for English anglers was closer to 40cm for shore and private boat angling, and 42cm for charter boat angling. It should be noted that the English data on release rates by fish length have a large uncertainty due to many released fish being counted and not measured by shore and private boat anglers, and due to the conversion from weight to length on charter boats using average weights for multiple fish.

The release rate by length is not available for Netherlands survey data, but there appear to be relatively more retained fish in length classes below the EU MLS of 36cm. It is not clear why such a difference should occur unless Dutch anglers are less aware of the regulations, or the regulations are not enforced. The Dutch data are also reliant on independent on-site surveys of fish lengths between 2010 and 2014 rather than data reported by anglers during the diary survey.

An approximate indication of the reduction in catch numbers that would have occurred in the years of the surveys, had MLS of 36cm, 42cm or 45cm been strictly enforced, is shown in Table1. This also includes the impact on the commercial retained length frequency for line fisheries in England in 2010-12, for comparison with the result from the sea angling estimates.

Table 1. Estimates of the reduction in catch numbers of seabass that would have been expected in the years of the surveys, if minimum landing sizes (MLS) of 36cm, 42cm or 45cm had been imposed with 100% compliance. Estimates are made based on the raised length compositions for retained fish shown in Fig. 1(a). Equivalent figures are given for UK commercial line fishery length frequencies in 2010-12. The column "Netherlands rescaled to 0 for 36cm" is the result for 42cm and 45cm MLS had the 36cm MLS been fully complied with by the surveyed anglers.

	Percentage reduction in catch by caused by MLS				
MLS	France recreational (includes Biscay)	Netherlands recreational	Netherlands rescaled to 0 for 36cm	UK recreational	UK commercial lines 2010-12
36 cm	4%	32%	-	5%	0%
42 cm	35%	64%	46%	23%	23%
45 cm	49%	74%	62%	45%	43%

The survey data for France and England give a similar reduction in retained catch if there was full compliance with the 36cm MLS (5% or less reduction) and 45cm (40-50% reduction). However the predicted impact of a 42cm MLS differs more (23 – 35%) for England and France (Table 1). The recreational and commercial hook-and-line data for the UK show similar reductions associated with 42 and 45cm MLS values. The length compositions obtained by independent on-site surveys in the Netherlands (i.e. not part of the online– diary survey) indicate a large percentage (32%) of the catch was below the 36cm MLS. Hence the strict compliance with the MLS would have reduced the catch by this amount. This relatively large retained catch below 36cm also means that larger MLS of 42cm and 45cm cause a greater reduction in overall catch than is the case using the UK and French data. Even if the reduction in catch numbers for a 42cm and 45cm MLS is expressed relative to the numbers at 36cm and above in the Netherlands data, the percentage reduction in retained catch is still much larger than for the UK and France (Table 1).

It is concluded that, if the size composition of seabass in 2015 is similar to composition in the years of the surveys, and if the MLS is 100% complied with, the national 42cm MLS now in operation in

France and the Netherlands would reduce the total retained catch numbers by 35% in France and by 64% in the Netherlands compared to the retention pattern at the time of the surveys. A 42cm MLS applied in England would reduce the numbers caught by a smaller amount of 23%, due to the higher observed length at 50% retention. Increasing the MLS further to 45cm would reduce the retained catch numbers by almost 50% in France and England, and by 74% in the Netherlands, compared to the retention patterns at the times of the surveys. The reduction in total catches caused by applying an MLS of 42cm or above in 2015 will probably be less marked than has been calculated from the survey data in years up to 2012, because of incoming very weak 2008 – 2012 year classes, as estimated by ICES WGCSE (ICES 2014a). This is illustrated in Fig. 3 which shows the length-at-age distributions from sampling of seabass from commercial catches all around England and Wales, and surveys of young fish in the Solent (southern England) area since the 1980s. During recreational fishery surveys in 2012/13 and earlier, the majority of fish of these year classes will have been below the 36cm EU MLS, with only the 2008 year class having significant numbers above 36cm in 2012. In 2015, these year classes will dominate fish between 36cm and 45cm. This implies that increasing the MLS from 36cm to 42cm or 45cm will have a smaller impact on total retained catch numbers than predicted from the recreational fishery surveys. However, because these weak year classes are expected to have a major negative effect on future spawning stock biomass, there would be benefits in providing as much protection as possible which in 2015 would be consistent with an MLS of 45cm.

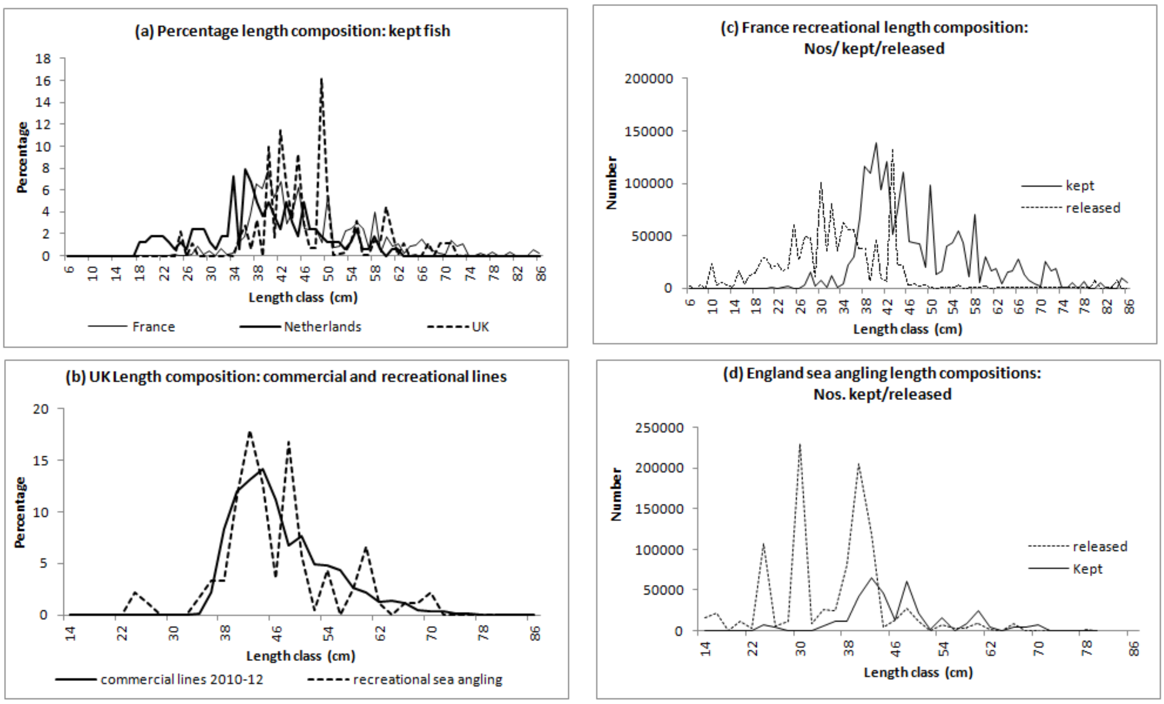


Fig. 1. Length compositions of seabass taken by recreational fishing in recent surveys. (a) Retained fish in UK (England; 2012), France (average for 2009/10 and 2011/12 – includes Biscay) and Netherlands (2010-14) (1cm length classes). (b) comparison between length compositions of seabass retained by sea angling in England and commercial line fishing in the UK (2 cm classes); (c) and (d): length compositions of released and retained seabass in recreational fishing surveys in France and England.

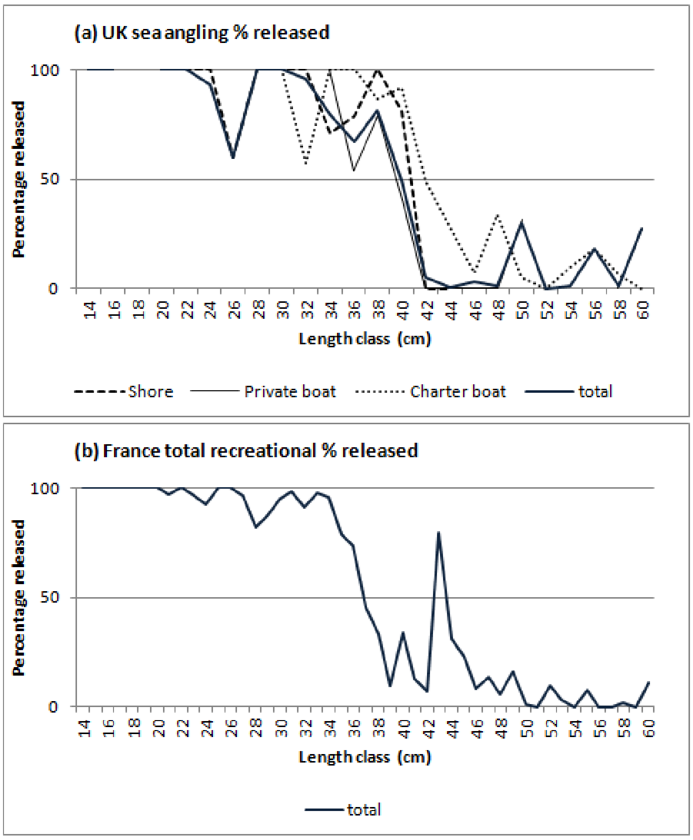


Fig. 2. Percentage of seabass released by UK (England) sea anglers, by method (2-cm length classes) and for all French recreational fishing (1-cm classes) during recent surveys.

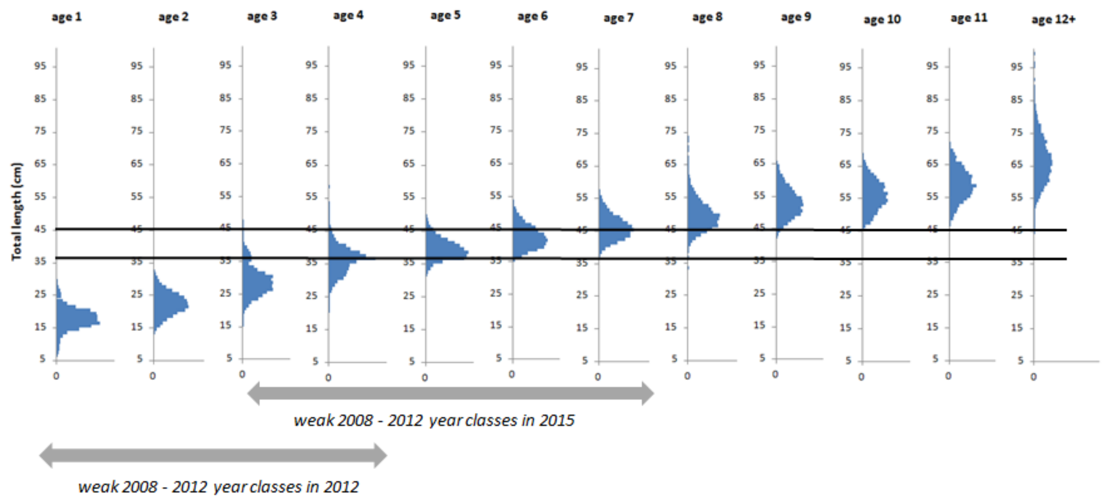


Fig. 3. Length-at-age distributions for seabass from fishery and survey sampling in the UK since the 1980s. The two horizontal black lines indicate 36cm and 45cm. The ages that correspond to the apparently very weak 2008 – 2012year classes (ICES 2014a) in 2012 and 2015 are indicated.

2.3 Evaluation of bag limits

2.3.1 Methods: France

Recreational fisheries surveys in France are a combination of a nationwide random-digit-dialling surveys to estimate total numbers of recreational fishers, and random selection of respondents to keep 12-month diaries from which annual retained and released catches per fisher are obtained (data are documented per trip). Trip data on numbers of seabass retained per person per day were extracted from individual catch diaries. The lengths of individual seabass retained or released during each trip were also available. In the time available it was not possible to carry out this analysis separately for shore, private boat and charter boat, and a combined analysis is presented. An important consideration for France is that a national MLS of 42cm will already be in place in 2015. Hence, any bag limit imposed in 2015 will add to the reduction in catch already caused by the 42cm MLS. Two calculations were therefore done: firstly to calculate the additional reduction in catch, over and above what is achieved with a 42cm MLS, caused by a bag limit or a bag limit and additional increase in MLS of 45cm; and secondly to evaluate the reduction in catch caused by bag limits and MLS of 42cm and 45cm compared with the retained catches with no bag limits and MLS of 36cm. The latter indicates the potential reduction in fishing mortality compared with recent years before the 42cm MLS came into force.

The method used to calculate the impact of bag limits of 1 – 5 fish was as follows:

i) For each trip in the two surveys where seabass were caught in Area VII or Biscay, the number of fish of 42cm and above was determined. The total annual numbers of retained bass from each survey was then calculated, assuming 100% compliance with a 42cm MLS, and including the sample selection probabilities for each annual catch diary.
ii) The calculation was then repeated for a 42cm MLS with all retained catches in excess of a specified bag limit re-set to the bag limit (e.g. if 6 fish of 42cm and over were retained, this would be re-set to 2 for a bag limit of 2). The total annual catch numbers at the population level were then compared with the base case (42cm MLS and no bag limit) to obtain the percentage reduction in retained catch numbers for bag limits of 1, 2, 3, 4 or 5 fish.
iii) The MLS was then raised to 45cm, and steps (i) and (ii) were repeated.
iv) For the combined data set including Bay of Biscay, steps (i) and (ii) were repeated, but comparing the resultant retained catches with the catches with no increase in MLS to 42cm and no bag limit (i.e. reduction catch over and above what was estimated during the surveys when an MLS of 36cm was in place)

2.3.2 Methods: Netherlands

The lengths of individual bass recorded by anglers in the surveys are considered by IMARES (the laboratory running the surveys) to be biased in comparison with on-site sampling carried out at the same time. Separate on-site length data from anglers between 2010 and 2014 (combined) were therefore used for evaluating the impact of different MLS on total catch numbers (see Section 2.2). As length frequencies and catch numbers were obtained from separate surveys and not available for each fishing trip, the effects of MLS and bag limits could be examined on their own, but not in combination. The method adopted was:

i) The total retained catch number at the population level was calculated, without consideration of any bag limit, and including the sample selection probabilities for each annual catch diary. This was done separately for shore, private boat and charter boat angling, and for all angling methods combined.
ii) The calculation in (i) was repeated for bag limits of 1,2,3,4 or 5 applied at the individual trip level and the total annual catch numbers at the population level were tabulated and compared with the catch from step (i). This gives the catch reduction in comparison with the total retained catches at the time of the surveys, when there was no bag limit and a 36cm MLS was in place with significant retention also occurring below MLS.
iii) The effect of an MLS of 42cm (which will already be in place in 2015) or 45cm was estimated from the combined length composition of retained fish obtained by separate on-site surveys in 2010-14.
iv) The results from steps (ii) and (iii) were compared, with the assumption that a combination of increased MLS and a bag limit will generate a catch reduction at least as great as the largest value achieved by each method on its own.

This analysis included only data from sea anglers and excluded an estimated 500 people who fished recreationally with nets.

2.3.3 Methods: England

The calculation was more complex for England because a separate charter boat diary survey was conducted using a list-frame of known charter boats, and the shore and private boat surveys were carried out as on-site intercepts to estimate mean CPUE combined with effort estimates from a nationwide opinions survey (face-to-face surveys at stratified random residential addresses). The shore survey used a roving creel approach, whereas boat survey data were for completed trips. The calculation methods were as follows:

i) Charter boats: Data for individual day-trips were extracted. This comprised the total number of people fishing, and the total number of bass retained. The daily retained catch limit was calculated on each trip as the number of anglers multiplied by the bag limit per person per day.
ii) Private boats: data were also typically for parties on boats and the same method was applied as for charter boats.
iii) Shore angling: numbers caught and retained per angler (or party of anglers) for the trip at the time of interview were expanded to the expected total trip catch using angler's intended total trip duration on the day.
iv) The total raised catches for retained seabass for the whole of England were calculated for each fishing method and for all methods combined, using the sampling probabilities.
v) The number of fish that would have been retained on each fishing trip if a bag limit of 1,2,3,4 or 5 fish was imposed and complied with, was calculated for each method and all methods combined.
vi) The effect of an increase in MLS to 42cm or 45cm was estimated from the combined length composition of retained fish from the surveys in 2012.
vii) The results from steps (v) and (vi) were compared, with the assumption that a combination of increased MLS and a bag limit will generate a catch reduction at least as great as the largest value achieved by each method on its own.

2.3.4 Catch reductions

Based on the analyses of the recent recreational fishery surveys, the catch reductions that would have occurred if bag limits (BL) of 1,2,3,4 or 5 fish per person per day had been imposed are given below, and also summarised in Table 3.

- For England, there is currently no planned change in MLS for seabass from 36cm in 2015. Had bag limits been imposed in the year of the surveys (2012) the retained catch would have been reduced by 52% (BL = 1), 32% (BL = 2) and 19% (BL = 3) (Table 2a). Length data were not adequate at the trip level for all fishing methods, so it was not possible to explore the effect of a combined application of MLS and bag limits. Based on the overall combined survey length composition, MLS of 42cm and 45cm would have reduced retained catches by 23% and 45% assuming full compliance. It can be assumed that the combination of increased MLS and bag limits would lead to a greater reduction in overall retained catch than bag limits alone, but this cannot be calculated from the data provided.

- For the Netherlands, the MLS for seabass is already increased to 42cm in 2015. Length data were not used from the surveys at the trip level, because the onsite sampling was considered to be more reliable than the lengths from the logbooks, so it was not possible to explore the effect of a combined application of a 42cm or 45cm MLS and bag limits. The application of bag limits to the observed retained catches per trip in the surveys (when a 36cm MLS was in place) causes a reduction of 59% (BL = 1); 38% (BL = 2); and 25% (BL = 3), similar to the results for the surveys in England (Table 2a). Applying an MLS of 42cm and 45cm to the survey data with no bag limits resulted in a 64% and 74% reduction in retained catch numbers, assuming full compliance. It can be assumed that the combination of MLS of 42cm or 45cm and bag limits would lead to a greater reduction in overall retained catch than bag limits alone, but this cannot be calculated from the data provided. It should be noted that the on-site length compositions comprised 165 individual retained fish collected from a large number of anglers.

- For France, the MLS is already increased to 42cm in 2013. Based on data for Area VII and Biscay combined, a 42cm MLS on its own caused a 35% reduction in retained catch when applied to the recent survey data. A further increase to 45cm would have reduced the retained catch by 49%. A combination of MLS = 42cm and bag limits results in the following reduction in retained catch numbers compared to the estimated catches during the surveys when MLS was 36 cm: 61% (BL = 1); 46% (BL = 2); 39% (BL = 3) (Table 2a). The equivalent reductions in catch for a further increase in MLS to 45cm are 68% (BL = 1); 56% (BL = 2); 50% (BL = 3) (Table 2a).

  Given that a 42cm MLS is already in place in France from 2014, the additional reduction in catch caused by bag limits, over and above the reductions caused by the MLS alone can be calculated from the survey data as 44% (BL = 1), 19% (BL=2) and 6% (BL = 3) (Table 2b). Bag limits combined with a further increase in MLS to 45cm causes reductions in catch of 53% (BL = 1), 32% (BL=2) and 22% (BL = 3). When an increased MLS is applied at the same time as bag limits, some fish longer than the previous MLS that would have been released under a bag limit alone will now be released as undersized, so the catches due to each method alone are not additive.

The results for bag limits or MLS on their own, or in combination, are summarised in Table 3. For bag limits up to 3, and MLS of 36 – 45cm, the reductions in retained catch numbers vary from 19% to >74% depending on country and combination of measures. For France, which has the largest recreational catch, the range is 39%-68%. In comparison, the use of a 42cm MLS on its own reduced the catch by 23% (UK), 35% (France) and 64% (Netherlands), and a 45cm MLS reduced the catch by 49% (France), 45% (UK and 74% (Netherlands).

All these scenarios assume that in 2015, the frequency distribution of numbers caught per trip, and the size compositions of the catches will be comparable to what was observed in the recreational fishery surveys up to 2012/13. This will probably not be the case due to incoming weak year classes (see Fig. 3) which will dominate the length range 36 – 45cm (at least in Area VII) and result in a reduction in catches in this size range.

The bulk of the recreational fishery (retained) catch of seabass in Area VII estimated from surveys is taken by France. The estimated total kept weights of seabass recreational fisheries in the North Sea, Channel, Celtic Sea and Irish Sea were 940t for France in 2009/10; 230-44t in England in 2012, 138t in Netherlands in 2010/11 and 60t in Belgium in 2013 (Annex 3). The combined, international effect of MLS and bag limits would therefore be driven mainly by the French and UK data.

Table 2. Estimated percentage reduction in retained catch caused by a combination of MLS and bag limits, had these been applied with full compliance during the years of the recreational fishery surveys in each country. (a) shows the reduction compared with the catch that was estimated during the surveys – i.e. without bag limits and prior to an increase in MLS to 42cm in France and Netherlands (MLS in the UK has not increased). Data for France are for Area VII and Bay of Biscay. (b) shows, for France, the impact of the bag limit and additional increase in MLS to 45 cm, compared to the catches with a 42cm MLS already in place.

(a) % reduction in catch compared with retention pattern at time of surveys (EU MLS of 36cm, with observed retention below MLS) and no bag limit

	36cm MLS		**42 cm MLS**	**45 cm MLS**
Bag limit	Netherlands	UK	France (incl. Biscay)	France (incl. Biscay)
1	59	52	61	68
2	38	32	46	56
3	25	19	39	50
4	18	12	36	48
5	13	8	35	47
none	0	0	35	49

(b) Additional % reduction in catch compared with MLS of 42 cm and no bag limits

	42 cm MLS		**45 cm MLS**	
Bag limit	France (incl Biscay)	France (Area VII)	France (incl Biscay)	France (Area VII)
1	40	44	51	53
2	18	19	33	32
3	7	6	24	22
4	3	3	21	19
5	2	2	20	17
none	0	0	19	17

Table 3. Summary of % reduction in retained catch numbers for combinations of MLS and bag limits applied to recreational survey data from the three countries. Figures in bold are for MLS or bag limits on their own. The effect of combinations of MLS and bag limits for UK and Netherlands are given as ">x" where x is the greater of the individual measures applied on their own. (No bag limit calculations available for France for the theoretical condition of maintaining a 36cm MLS).

MLS	Country	Bag limit					
		1	2	3	4	5	none
36cm	France	-	-	-	-	-	**4**
	UK	**52**	**32**	**19**	**12**	**8**	**5**
	Netherlands	**59**	**38**	**25**	**18**	**13**	**32**
42cm	France	61	46	39	36	35	**35**
	UK	>52	>32	>23	>23	>23	**23**
	Netherlands	>64	>64	>64	>64	>64	**64**
45cm	France	68	56	50	48	47	**49**
	UK	>52	>48	>48	>48	>48	**48**
	Netherlands	>74	>74	>74	>74	>74	**74**

2.3.5 Equivalence of MLS and bag limits

Using the survey data, equivalent combinations of MLS and bag limits can be identified which give the same overall reduction in retained catch numbers (see Table 3):

- For France, an MLS of 45cm, without bag limits, is approximately equivalent to an MLS of 42cm with a daily bag limit of two fish (46% reduction).
- For England, increasing the MLS from 36cm to 42cm MLS without bag limits, is approximately equivalent to an MLS of 36cm with a BL of 2 – 3 fish (23% reduction). A 45cm MLS is equivalent to a 36cm MLS with BL=1 (48% reduction).
- For the Netherlands, the 42cm MLS with no bag limits gives a reduction of 64% in retained catch, greater than achieved with an MLS of 36cm and BL of 1 fish. A 45cm MLS with no bag limit gives an even greater reduction of 74%.

An MLS of 42 – 45cm implies delaying of harvesting until roughly 50 – 80% of females are mature, based on sampling in the UK since the 1980s (Fig. 4). There is some evidence from recent sampling in the Netherlands and the UK that seabass may be maturing at a smaller size in recent years than in the 1980s and 1990s, but this does not alter the conclusion that an MLS of 42 – 45cm would substantially reduce the numbers of immature female seabass killed.

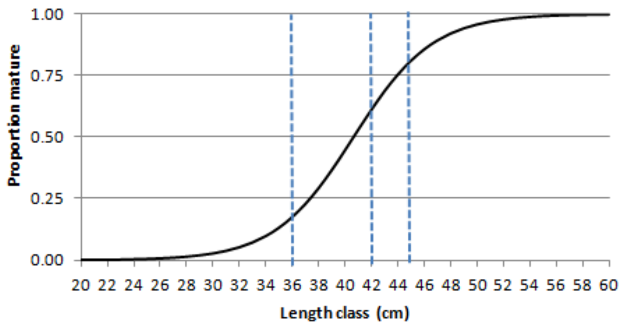


Fig. 4. Maturity ogive for female seabass based on sampling carried out by the UK since the 1980s, and as used by ICES for stock assessment (ICES 2014b). MLS of 36, 42 and 45cm are indicated.

2.3.6 Slot sizes vs MLS

A slot size refers to the application of a minimum and a maximum size limit, with the intention of reducing the fishing mortality on young fish as well as on large fish which may contribute disproportionately to annual egg production. Seabass exhibit some sexual dimorphism in growth, females reaching a larger maximum size. It is not known if the natural mortality rate differs between sexes because of this. However, the result is that the larger size classes of seabass contain relatively more females than at smaller sizes (Fig. 5).

The effectiveness of a slot size was examined using the raised length compositions of retained bass from the French surveys in Area VII and Biscay combined (Table 4). Maximum slot sizes of 65 – 70cm would correspond to lengths at which 70% or more of the fish caught would be mature females. A maximum of 65cm would lead to an additional 10% reduction in numbers retained. Larger slot sizes naturally lead to smaller reductions as fish above this length are rarer.

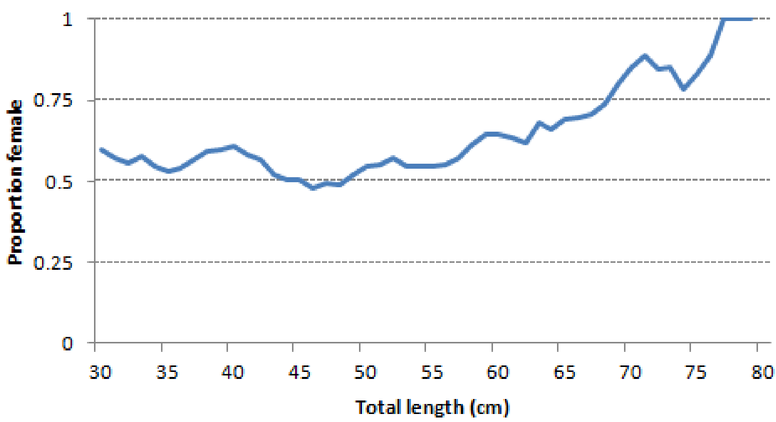


Fig. 5. Proportion of seabass in each 1-cm length class that were recorded as female, based on sampling of over 80,000 fish in the UK since the 1980s.

Table 4. Percentage reduction of retained catch numbers in the French recreational fishery surveys (Area VII and Biscay combined) by implementation of a slot size (MiniLS = minimum landing size; MaxiLS – maximum landing size).

	MiniLS	
MaxiLS	42cm	45cm
65cm	44%	57%
70cm	41%	54%
75cm	37%	51%
no maximum	35%	49%

2.3.7 Hooking mortality rates

The US National Marine Fisheries Service has in the past used an average hooking mortality of 9% for striped bass, estimated by Diodati and Richards (1996). Striped bass are very similar to European sea bass in terms of morphology, habitats and angling methods. A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.) The mean hooking mortality rate was 0.19 (standard deviation 0.19). Direct experiments are needed on European sea bass to estimate hooking mortality for conditions and angling methods typical of European fisheries. Hooking-related fishing mortality on released fish is a major issue in relation to effectiveness of bag limits and minimum landing sizes which result in changes in numbers of released fish, if the release mortality is unknown.

3. Longer term benefits of improved selectivity in seabass fisheries

The analyses presented in this report are intended to answer the question of how a change to MLS or bag limits would immediately reduce the seabass catch. An MLS is simply a way of reducing the cumulative fishing mortality on each year class of fish, but targeted at smaller fish that still have large growth potential. It is well known that a sudden increase in MLS, if complied with, will lead to a short-term loss in landings in the fisheries affected. However the theory behind MLS is that the additional release of undersized fish leads to a subsequent progressive increase in landings, if the growth rate of the individual fish exceeds the losses due to natural mortality. For the same fishing effort, total landings (per recruit) may eventually exceed the landings at a smaller MLS. If the MLS is increased so that it coincides with the length at 50% maturity or above, the numbers of fish recruited to the spawning stock as first-time spawners will be as large as possible from a year class.

The benefits of an increased MLS will be undermined under two key conditions – firstly if the fish at sizes between the old and new MLS are only released after interaction with a fishing gear (e.g. caught but released dead or moribund, or alive but consumed by predators following a boat), or secondly if fishing effort can increase in an uncontrolled way to catch more fish over the MLS to compensate for the lost undersized fish, and hence keep the cumulative fishing mortality higher than intended. For commercial and recreational hook and line fishing, some improvement in selectivity in line with an increased MLS can be obtained by changes in fishing methods, for example larger hooks or avoiding areas with small fish. Post release survival can be enhanced by improved handling and use of gear such as circle hooks that are more likely to avoid deep hooking. For trawls and nets, aligning the selectivity of the gear with an increased MLS for seabass would require alterations in gear and fishing practices, such as larger mesh size, use of escape devices such as square mesh panels, or avoiding areas with small bass below the MLS. However, a much larger proportion of the seabass are taken as by-catches in commercial bottom trawling and netting operations than is the case for line fishing, which is more targeted at seabass (Armstrong and Drogou, 2014), although some targeting of seabass does take place.

The ability to compensate for immediate losses in catch due to an increased MLS, by increasing the targeting of fish above MLS, or increasing the fishing effort, is likely to be more limited for recreational fishing than for commercial fishing. The possibility for commercial fisheries depends on the costs and ability to re-target fishing or to increase the effective effort (e.g. by additional trawl tows or setting more or longer gillnets). The smaller the contribution of seabass to the catch, the less incentive there would be to avoid capture of undersized fish as any changes would impact the catches of the other target species. It is not clear if or how seabass would be included in the Landings Obligation regulations for demersal fisheries from 2016 onwards.

In all fisheries, the effectiveness of MLS (or any measure such as bag limits that forces release of caught fish) depends critically on post-release survival. Repeat captures of tagged seabass released by angling suggests that survival of hooked fish can be high if the fish are hooked and handled in a way that minimises injuries and exposure to air. Direct studies on seabass are urgently needed to estimate post-release survival rates from different types of fisheries (see Section 2.3.7).

The most recent study on the effects of different sizes at first capture of seabass on the total yield and spawning stock biomass (SSB) that can be obtained from an individual year class over its lifespan (yield per recruit, and SSB per recruit), was carried out by the UK following the ICES IBP-NEW meeting in 2012. The analysis used commercial fishery selectivity patterns estimated from a fleet-disaggregated stock assessment model (Stock Synthesis). Unlike the most recent version of this assessment (ICES 2014a,b), the IBP-NEW one did not include a recreational fishing mortality, but a version of the model had been run incorporating commercial fishery discards. The bulk of the discards are in the trawl fisheries using 80mm mesh, especially the eastern Channel. The general results are given in Annex 4 (extract from Armstrong and Drogou, 2014). Given the parameters and assumptions of that model, a length at first capture of 45cm would achieve at least the same yield per recruit as a 36cm MLS for F-multipliers of 0.5 and over. With an F-multiplier of around 1.0, it would also achieve the goal of delivering SSB per recruit equivalent to 40% of the SSB in the absence of fishing, which was considered as a possible management target (ICES currently uses a 35% depletion for defining a proxy for fishing mortality for this seabass stock at MSY). In this scenario the bulk of the catch at an MLS of 45cm are mature fish.

Since recreational fisheries comprised only about a quarter of the total retained catch at the time of the recent surveys, the overall gains to the stock from an increase in MLS in only the recreational fisheries (assuming high survival of released fish <MLS) would be much less than if all commercial and recreational fisheries were able to release all fish below this MLS with high survivability. Currently, this could be the case for commercial rod-an-line or handline fisheries in cases where undersized fish can be unhooked and released with minimal injury. It is likely that fish caught by

longline will have lower post-release survival if hooks have been swallowed or the fish has been hooked for a lengthy period before retrieval. Observations on these fisheries are needed to determine the condition of fish brought aboard. Gill nets, including drift nets, fixed nets, drifting trammel nets etc., tend to have well-defined domed selection ogives. Field experiments by Revill et al (2009) indicated that a 120mm mesh would be needed for gill nets to achieve a small probability of meshing seabass below 45cm. The situation for otter trawls is more complex because the selectivity is a function of several aspects of gear design including the use of selectivity devices such as square mesh panels.

For all fishing gears, overall selectivity is also affected by fishing location, for example if fishing is close to nursery areas. The European Commission has stated in recent meetings with Member States that an increase in MLS is feasible for commercial and recreational hook and line fisheries where there is a good chance to release undersized fish alive, but is not currently appropriate on its own as a way to improve selectivity of towed and fixed nets since seabass are commonly a by-catch in fishing operations targeted at other species, and any undersized fish would mainly be discarded dead. Selectivity of these fisheries is expected to evolve as a consequence of the landings obligation (discard ban) as this is introduced progressively to demersal fisheries from 2016 onwards. Implications for seabass would need to be considered in terms of the overall evolution of these fisheries towards elimination of discards.

The European Commission should however be mindful that there is not much difference between an under-10m commercial fishing boat catching seabass on rod and line or handline, and a charter boat or private boat fishing alongside using the same gear. Figure 1b shows that the retained length compositions are similar for UK commercial and recreational line fishing. If the recreational fishers are subject to a larger MLS, and have to return fish that the commercial boat is keeping, this will lead to strong conflict between the sectors and make it extremely difficult to get buy-in for the measures. To an extent, this inequality will be also expressed with commercial trawl and net fisheries, but there are clearly more difficult technical issues to be resolved for these fisheries that cannot be resolved in the very short term and need to be considered within a longer term management plan for seabass. In the case of commercial hook and line fisheries, these are small-scale artisanal fleets that are the most economically dependent on seabass of all commercial fleets (Armstrong and Drogou, 2014). A sudden increase in MLS to 45cm may well threaten the economic viability of this sector if implemented along with any additional catch limits that may be decided in the short term. A more progressive increase in MLS may be more appropriate for this fishery, again to be built into the development of the long term management plan.

4. Compliance and enforcement of bag limits and MLS

The effectiveness of bag limits and minimum landing sizes or slot sizes depends critically on the extent of compliance. Three elements of compliance are: i) awareness of regulations; ii) willingness to comply (where the fishermen accept the need for conservation measures and wish to contribute actively to conserving the stock), and iii) fear of prosecution. In the third case, the likelihood of non-compliance depends on the perceived trade-off between likelihood of detection and the size of the penalty that would be imposed, such as a fine or confiscation of tackle. Surveillance of recreational fishing is the responsibility of the local authorities which have jurisdiction over maritime areas and inshore waters in each country.

In England, the ten Inshore Fisheries and Conservation Authorities (IFCAs) have this responsibility. They have to deal with a very wide range of human activities in maritime areas and coastal waters out to 6 nautical miles, and adopt a risk-based approach to determine how to prioritise allocation of resources to different types of inspection. This risk-based approach uses a matrix of impacts (threat posed by an activity to a stock or to the marine environment, or to the fisheries/conservation management system and reputation) vs the likelihood of occurrence. For example, where there is a major threat to the marine environment or stock and it is a common occurrence, this would be categorised as high risk and action would be necessary. Where there is no immediate threat to the marine environment or stock, but it could occur, this is a lower risk and light-touch approaches such as education, self-regulation or even taking no action and just monitoring the situation could be considered. If measures are seen as legitimate and are well publicised then increased voluntary compliance is expected. If compliance relies on enforcement then the measures may be ineffectual and not achieve their aims and result in diminished legitimacy in the regulatory framework. Given limited resources available to the IFCAs, actions are therefore taken to increase compliance with regulations by involving fishing and other stakeholders in decision making. Each IFCA has recreational and commercial fishing appointees on its committee, and these people are able to contribute to development of IFCA policy, express views of the wider fishing communities, and help disseminate information to them. Currently, the risk profile of recreational sea angling is seen as much lower than for commercial fishing, and additional enforcement of recreational fishing would require substantial additional resources or redirection of resources from other inspection activities.

An important question is therefore the extent to which recreational fishers in each country will buy in to measures such as bag limits and minimum landing sizes. The sea angling community has for many years called for an increase in MLS for seabass in all fisheries, to bring the size at first capture in line with the size at maturity and to prevent targeting of small size classes of seabass. The European Anglers Alliance currently calls for an immediate increase in MLS to 42cm in all fisheries. The concept of an MLS can be easily understood by fishermen (“allow fish to spawn at least once”) whereas highly restrictive bag limits (particularly the 1 fish per day limit currently proposed by the Commission) are seen as not equitable in comparison with measures proposed for the much larger commercial fishery, and the basis for a particular limit is hard to understand. In Ireland, the 2014 Inland Fisheries Ireland bass policy[1] advocates a 50cm MLS and a bag limit of 1 fish per day, but in Ireland commercial fishing is banned, and the value of the seabass resource lies in the quality of sport fishing and its contribution to the economy.

In terms of enforcement, recreational fishing involves a large and diffuse population, often fishing at times and places not currently covered by fishery inspection activities. In the case of shore fishing or inspection of recreational fishing boats at sea, the fishing trip is not completed and it can only be ascertained if the retained catch at that time exceeds the bag limit and no fish are below MLS. Without a substantial increase in the resources available for inspection, the likelihood of detection of illegal activities may be perceived as low, leading to reduced compliance. This places even greater importance on encouraging widespread buy-in by recreational fishers for any conservation measure. At present this seems far more likely for an increased MLS than for daily bag limits.

[1] http://www.fisheriesireland.ie/policies/453-inland-fisheries-ireland-bass-policy

An additional problem with bag limits is the potential for high grading. A fisherman (whether angling, spearfishing or recreational netting) may retain fish above the MLS up to the bag limit but may continue fishing either for sport (catch-and-release angling) or to try and catch bigger fish. Smaller fish caught earlier may then be discarded dead if this can be done unobserved, and replaced with larger fish caught later. Another possible effect highlighted by angling stakeholders in the UK is that in the absence of a bag limit, if anglers catch relatively small fish above the MLS at the start of a trip, they may release these in the hope or expectation of catching larger fish later for retention. If there is a very small bag limit, anglers may be more likely to retain the fish caught first. In many cases, however, the angler may not catch another fish. If this occurred regularly, the total retained catch by all anglers could conceivably exceed the catch in the absence of a bag limit. This is more likely for very small limits (e.g. 1 or 2 fish) than for large ones. Another potential issue is that many anglers already practice catch-and-release of sea bass for conservation reasons, and a bag limit in excess of what is normally retained could lead to some anglers retaining more fish on the assumption that this is acceptable from a conservation point of view. Bag limits are also potentially problematic for recreational netting or long-lining, if catches in excess of the limit are made and the fish are dead or moribund when the gear is retrieved.

Minimum landing sizes (or slot sizes) also have some disadvantages. Firstly it increases the number of small fish released, and these may be more susceptible to post-release mortality due to hooking injuries or poor handling. Secondly, it may prove difficult for people spearfishing to accurately estimate the size of a fish before spearing it. If the intention is to spear the largest fish, a maximum landing size could also prove difficult to adhere to. For recreational netting or long-lining, undersized fish may be retrieved dead or moribund and have to be discarded. However, there is a possibility to mitigate some of these problems, for example by using nets with larger mesh size, and by effective publicity and education programmes. At least in the UK, a large proportion of anglers do not belong to angling clubs, or may not buy angling magazines or read material on websites. Achieving near-100% awareness of bag limits or MLS, or any other regulations, would require a media campaign and extensive deployment of posters or signs at the many access points for fishing around the coast, explaining the regulations and why they are needed.

A final issue is the potential effect of non-compliance on the results of recreational fishing surveys. Fishermen who knowingly retain fish in excess of the bag limit, or high-grade their catches, or discard dead fish, may be unwilling to declare these in catch diaries or if interviewed on site, or may refuse to participate in a survey. As a result, retained catches may be underestimated, and the measures would appear to be more effective than they actually were. In contrast, there may be less of a problem in accurately recording retained catches in excess of MLS, and the numbers of undersized fish released, given the greater acceptance of MLS as a conservation measure by recreational sea anglers. Bias in survey results induced by management measures is a potentially serious issue given the accumulating costs of the existing series of surveys or costs of any new surveys. It may also reduce the legitimacy of the results amongst the recreational fishing community, causing a vicious circle affecting participation in surveys.

Potential for identifying areas for catch-and-release only

Tagging studies show that adult seabass have a tendency to return to the same location on the coast after spawning each year, although this site fidelity behaviour appears less marked at the edges of the geographic range (Pawson *et al*., 2008). The latter authors considered that this behaviour, also termed philopatry, could allow the designation of areas for catch-and-release fishing for seabass only. The rationale was that the improved survival would increase the numbers of large bass locally, and hence improve the quality of sea angling, because the bass would predominantly spend their time within the designated area when not migrating offshore to spawn. This would not of course protect the fish from mortality caused by offshore fleets targeting spawning aggregations of seabass, although a substantial reduction in the offshore fishery would reduce the problem.

A pilot study to identify some test case areas was established in England in 2007, and two sites (Blackwater estuary in Kent and the Exe estuary in Devon) were identified. Unfortunately this project failed to go to completion. However, 37 bass nursery areas are defined in England and Wales where fishing for seabass from boats is prohibited for all or part of the year, and voluntary return of all shore caught bass is encouraged. Hence the UK has already established a network of areas which are essentially catch-and-release only although there is still room to extend this approach to other areas. This is more appropriate as a goal for developing a longer term management plan for seabass rather than for emergency reductions in fishing mortality. Other approaches could be seasonal and spatial variations in bag limits (including zero, i.e. all catch and release), although the more complex such systems become, the harder they are to implement and ensure adequate awareness amongst recreational fishers, and to provide adequate surveillance by fisheries inspectors.

Discussion

The use of recreational fishery survey data to investigate the potential impact of bag limits and minimum landing sizes is appropriate due to the randomised nature of the surveys which cover the whole year. However the results are conditional on the catch rates and size compositions at the time of the survey. In 2015, according to the ICES (2014b) assessment of seabass in the North Sea, Channel, Celtic and Irish Sea, the spawning stock will have been reduced by 50% compared with 2012 and the catches and biomass will be strongly depressed by the incoming weak 2008 – 2012 year classes. In the time available for this report, it was not possible to set up a more detailed model to forecast the impacts of bag limits and MLS on the recreational catches given the expected trends in numbers at age to 2015 given by the ICES assessment. Hence, the use of survey data from 2010-2013 to investigate catch reductions due to increased MLS and bag limits will probably overestimate the reductions that would be achieved by these measures in 2015.

The analysis of the three recreational survey data sets up to 2012/13 indicates that the retained catch numbers could have been reduced by around 50% or more through the application of a 45cm MLS without bag limits. In France this would have been equivalent to a 42cm MLS combined with a bag limit of 2 fish, and in England a 36cm MLS combined with a bag limit of 1 fish per day. In the Netherlands, a 45cm MLS causes a much larger (74%) reduction than could be achieved by even a 1 fish per day limit. These findings for MLS and combinations of MLS and bag limits reflect the fact than many recreational fishermen catch only small numbers of seabass per trip, and many of the fish are smaller than 45cm.

The use of MLS and bag limits is appropriate for recreational sea angling, and with careful handling it is expected that the majority of released fish will survive, higher than for gillnets or longlines (depending on soaking time). For spearfishing, avoiding capture of fish below MLS or outside of a slot-size range, requires accurate evaluation of fish size before spearing. However this cannot be 100% accurate.

When choosing the value of a MLS alone, or a combination of MLS and a bag limit to attain a target reduction in catches, the Commission should take into account that this decision will be the first one regulating recreational catches over and above the existing EU-wide MLS of 36cm, and that the diffuse and often remote distribution of recreational fishing is an extreme challenge for enforcement agencies already stretched to maintain surveillance of commercial fisheries. Any measures introduced at this stage should be part of a well-planned process of reducing fishing pressures and impacts on seabass, in a way that reduces non-compliance as far as possible and allows continued collection of data to monitor the outcomes of management measures. Any measures that have very unpredictable outcome in terms of compliance and data quality may worsen the situation and undermine the development of an effective longer term management plan for seabass. The initial (and urgent) step in this process is a reduction in fishing mortality using measures that can successfully be put in place in the short term. The subsequent development of a long term management plan (LTMP) should include measures to ensure commercial and recreational fishing mortality does not exceed the management goals (e.g. F_{msy} or other goals) under different periods of stock productivity.

In view of the difficulties of enforcement, it is vital that the recreational fishing community is effectively engaged in conservation through consultations with government, scientists and fisheries authorities, and through widespread campaigns using web or other media and posters or signs at fishing localities to provide information on regulations and why they are needed. Local fisheries authorities should work with charter boat skippers and local angling bodies to develop codes of practice, including voluntary elements, in order to achieve catch reductions and improved handling of released fish without deterring people from going fishing, which would have an undesirable economic impact for businesses dependent on recreational fishing. Nonetheless, it is inevitable that additional restrictions will lead to some increase in non-compliance given the nature of recreational fisheries. It is possible that future surveys that rely on self-reporting by recreational fishers may suffer from non-participation, or censoring or reported data, by people who are retaining fish below the MLS or in excess of the bag limit. Some method is needed to determine the bias caused by this. Data sets documenting incidence of retention below MLS or catches in excess of the bag limit should be built up from regular inspection activities in each country, for comparison with the results in catch diaries. This will be easier for MLS, because it will be difficult to know if bag limits have been circumvented by high grading, disposal of fish at intervals during the day or other means. Many fishing trips on shore or inspected at sea will not represent a completed day's catch. These factors lend support to MLS as a better means to limit catches for most fishers at this stage.

From views expressed over many years by the recreational sea angling community, it would appear that the basis for an increase in MLS is well understood and accepted. Typically anglers consider the MLS should be large enough to allow most seabass to spawn at least once. This would require MLS of 42 – 45cm. Using data from recreational fishery surveys, it is shown that MLS in this range can already reduce total retained catch numbers by a large amount, up to 50% or more for a 45cm MLS that is fully complied with. In contrast, anglers find it harder to comprehend the basis for restrictive bag limits and how they are computed, and are more likely to see this as an inequitable additional burden. This may lead to widespread non-compliance, including practices such as high-grading, given that surveillance activities can only cover very limited areas and time periods when recreational fishing takes place. Many anglers already practice catch-and-release of sea bass for conservation reasons, and a bag limit in excess of what is normally retained could lead to some anglers retaining more fish on the assumption that the bag limit is a legitimate and acceptable catch from a conservation point of view.

The concept of MLS is connected in the anglers' minds to a biological reality (size at maturity), and they would not easily understand that different MLS could be taken in the different countries of the European Union, unless there were clearly demonstrated differences in biology of the stocks. They would also not understand how MLS could be altered at intervals in the future to adapt recreational landings to changes in stock biomass and productivity (although this approach is used in the USA). It therefore makes sense for the Commission to fix a MLS for each region (e.g. northern and southern), based on well-founded scientific knowledge of the biology of the stocks, and maintain it throughout the development of the long term management plan.

In the short term, it is likely that the most successful approach for reducing recreational fishing mortality on the seabass stock in the North Sea, Channel, Celtic and Irish Seas, and probably also in the Biscay area, will be an increase in MLS to 45cm (to achieve a substantial reduction in catch numbers using a method likely to have good compliance) combined with a daily bag limit of 4 fish, the intention of which is to eradicate, as far as possible, large catches of bass that are landed at intervals by recreational fishers for personal consumption, distribution or sale, which may be legal or illegal depending on whether a motorized vessel is used. These large catches may at present go unrecorded during recreational fishing surveys for various reasons. At the same time, a nationwide communications campaign is needed to raise awareness of the measures and why they are needed. This campaign should aim to ensure that the present levels of voluntary catch-and-release are maintained to minimize the retained catch of fish above MLS, so that the bag limit is not seen as a legitimate target.

The recreational surveys indicate that for the great majority of respondents, a bag limit of 4 fish per day would seldom limit catches, and an MLS of 45cm would be more effective than a bag limit for reducing the retained catches of these fishers. A bag limit of this size would render illegal the large catches that are made by some fishers and which currently are unlikely to be recorded in surveys. The combination of these actions should drive European recreational fisheries towards more responsible and sustainable activities.

An additional benefit of an MLS of 45cm is that from 2015, it would force the release of fish of the incoming very weak 2008 – 2012 year classes which are expected to progressively enter the recreational catches between 36 and 45cm for the next few years. In conjunction with measures to reduce commercial targeting of adult bass in the spawning season, this would help to maximize the numbers of fish from these year classes spawning in the coming years. An important question is how the same protection can be afforded to bass under 45cm in the commercial fisheries.

With the proposed measures in place, the development of the LTMP should consider what additional measures are needed to attain the fishing mortality goals, and how recreational and commercial fishing activities can, together, be adjusted in a balanced way in response to changes in stock abundance and fishing mortality. In the longer term, the ability to alter recreational fishing mortality from year to year to try and maintain the mortality within sustainable limits would require an analytical assessment approach which includes time-series of recreational catch estimates. This is the approach adopted for example in the USA for many years using the Marine Recreational Information Program[2] surveys. In this case it could be possible to try and adjust recreational catches using a variable bag limit, alongside adjustments to commercial fishing catches, either up or down depending on stock trends. This approach will also require time series of recreational survey estimates of catches and releases, with sufficient precision. This is currently a DCF requirement, but it does not cover all sea areas with recreational seabass fisheries. Additional measures for recreational fisheries could include specifying areas and/or seasons with different bag limits (including zero as an option – i.e. catch and release only) as required, interannual adjustments to bag limits (up or down), and introduction of maximum landing sizes (slot size). It is vital that all such approaches are developed during in-depth consultation between recreational and commercial fishing stakeholders, scientists, enforcement agencies and local and national government, and harmonized as far as possible across EU countries fishing the same stock, so that the measures are well understood and complied with.

The results of the analyses presented in this report are also subject to uncertainties related to the quality of the underlying recreational fishery survey data. Whilst every effort is made to ensure that survey respondents are a representative sample of all recreational fishers, there is likely to be some residual bias due to factors such as avidity, or incomplete coverage of sampling frames or strata, which cannot be corrected for. People fishing illegally or catching large numbers may not respond to the surveys. The numbers of respondents who catch seabass, or numbers of trips with retained seabass catches may be relatively low, reducing precision. Collection of length data is also problematic when self-reporting is involved. For the UK and the Netherlands, length data at the trip level were considered inadequate for the combined analysis of MLS and bag limits. In the case of the Netherlands, the length data were from a separate on-site sampling from 2010 - 2014 and the data suggested unusual numbers of undersized fish compared to sampling during the surveys in France and England. In England, size data from charter boats was mostly in terms of weight, and many fish were clustered as being of similar size and weighed as a group.

References

Armstrong, M.J. and Drogou, M. 2014. Seabass fisheries in Europe and their management. Commission request for services SI2. 680348. 83pp.; presented also to STECF July 2014 plenary.

Diodati, P. and R.A. Richards. 1996. Mortality of striped bass hooked and released in salt water. Transactions of the American Fisheries Society. 125: 300–307.

Herfaut J., Levrel H., Drogou M. and Véron G. 2010. Monitoring of recreational fishing of sea bass (*Dicentrarchus labrax*) in France: output from a dual methodology (telephone survey and diary) ICES CM 2010/R: 05.

Herfaut, J., Levrel, H., Thébaud, O. and Véron, G. 2013. The nationwide assessment of marine recreational fishing: A French example. Ocean & Coastal Management 78 (2013) 121-131.

[2] http://www.st.nmfs.noaa.gov/recreational-fisheries/index

ICES. 2012a. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012). ICES CM 2012/ACOM:45.

ICES. 2013a. Report of the Working Group for Celtic Seas Ecoregion (WGCSE), 8–17May 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:12. 1986 pp.

ICES. 2014a. Report of the Inter-Benchmark Protocol for Sea Bass in the Irish Sea, Celtic Sea, English Channel, and Southern North Sea (IBP–Bass). By correspondence. ICES CM 2014/ ACOM:46.

ICES. 2014a. Report of the Working Group for the Celtic Seas Ecoregion (WGCSE), 13–22 May 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:12.

Pawson, M.G., Brown, M., Leballeur, J. and Pickett, G.D. 2008. Will philopatry in sea bass, *Dicentrarchus labrax*, facilitate the use of catch-restricted areas for management of recreational fisheries? Fisheries Research 93 (2008) 240–243.

Revill, A., Wade, O., Holst, R., Ashworth, J. and Stead, N. 2009. Programme 8: Bass gillnet selectivity. Fisheries Science Partnership report. http://www.cefas.defra.gov.uk/media/168267/fsp_2008_09_prog_08_bass_gill_net_selectivity_final_report.pdf

Rocklin D, Levrel H, Drogou M, Herfaut J, Veron G (2014) Combining Telephone Surveys and Fishing Catches Self-Report: The French Sea Bass Recreational Fishery Assessment. PLoS ONE 9(1): e87271. doi:10.1371/journal.pone.0087271

Van der Hammen, T and de Graaf, M. 2012. Recreational fishery in the Netherlands: demographics and catch estimates in marine and freshwater. IMARES Wageningen UR, Report Number C147/13.

Annex 1: Statement of work required

Background

STECF has been requested to provide a further assessment of recreational fisheries for seabass.

Terms of Reference

Following on from previous examination by the STECF, the Commission seeks to provide an urgent reduction in seabass mortality in 2015 by reducing the key fisheries for the stock of seabass in the Celtic Sea, Channel, Irish Sea and North Sea.

This is an urgent request and a prompt response sought to facilitate discussion with Member States. It is noted that the output of this contract must still be subject to STECF review before adoption as STECF advice; however this is considered as additional work to the previous request and the output paper is to inform discussions.

For this stock recreational fishing has been identified (STECF Plenl4-02) as a key contributor to fishing mortality; the Commission seeks to introduce proportional reductions in both commercial and recreational fisheries and has made a proposal to that end.

Using the legal instrument of the Fishing Opportunities for 2015 the Commission has proposed a limitation on recreational angling of 1 fish per day. Reaction from the recreational sector has identified several concerns with this approach. To fully identify the potential reduction in mortality that can be achieved it is urgently required to analysis further the recreational data for the respective Member States, using a common methodology.

The Fishing Opportunities for 2015 Regulation is the remit of the Council of Ministers. Technical Measures and management plans must be developed under co-decision; this restricts actions under the Fishing Opportunities, however this timing for this regulation is conducive to taking some action in 2015. The option for additional action under other legal instruments is not excluded and the Commission would like to, if possible, identify alternative measures that would also reduce the recreational mortality of seabass, such as limited closures, the operation of a weekly catch limit and increases in MLS.

STECF is asked to note the current MLS applied to MS's seabass fisheries, and any assessment of these impacts that is available.

Request for STECF

STECF is asked to via the contacts for national bass surveys, to analyse the data on bass caught and released by recreational anglers and identify;

• The effect a restriction of a limit of 1,2 or 3 seabass, per day, per person would have on the overall catches (for each MS and cumulative);

• The effect that a MLS of 36, 42 and 45 cm applied only to recreational fisheries would have on current catch and mortality levels.

If possible STECF is also asked to identify where possible periods and locations of higher catches from recreational angling and comment on the use of a closure prohibiting the retention of seabass to reduce overall mortality.

Taking into consideration the work required to prepare and compile the needed data and the current status of this data it would seem advisable to have the final analysis of data from each MS undertaken centrally.

You are therefore contracted to lead the delivery of this report as outlined above and to ensure that information where available is obtained from the respective MS.

Annex 2. Stock definition and status of seabass in the North Sea, Channel, Celtic Sea and Irish Sea

Stock definition and management areas

At ICES IBP-NEW (2012a), it was agreed that sea bass in the North Sea (IVb&c) and in the Irish Sea, Channel and Celtic Sea (VIIa,d,e,f,g&h) would be treated as a functional stock unit for assessment purposes, as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units. It was proposed based on previous ICES bass study group reports to allocate sea bass in VIa, VIIb and VIIj to a separate stock, although it is recognised that sea bass in Irish coastal waters of VIIg and VIIa are likely to be from the same stock as in VIIj. Farther south, populations of sea bass in the Bay of Biscay (VIIIa,b) and in Spanish and Portuguese waters (VIIIc, IXa) are treated also as separate stocks although exchanges are known between Bay of Biscay and the more northerly stock. Supporting information can be found in the IBP-NEW (ICES 2012a) report.

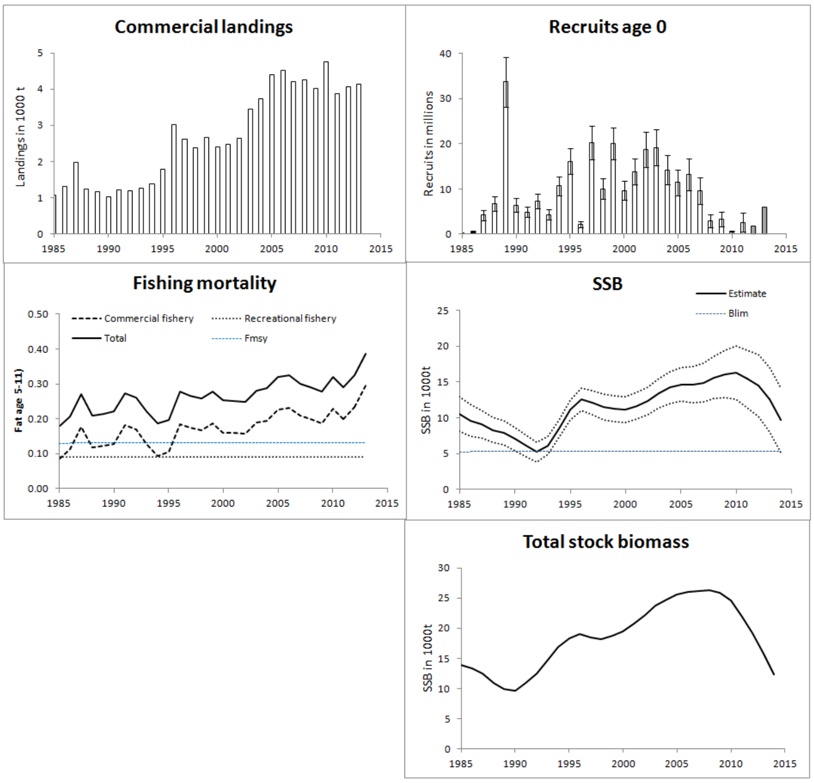
Status of the stock in IVb,c and VIIa,d-h

The trends and status of the stock have been estimated since 2012 using an integrated analytical assessment framework (Stock Synthesis 3) developed for sea bass by ICES IBP-NEW in 2012, updated by ICES WGCSE in 2013, then further developed by IBP-Bass in 2014 (ICES 2014a) and updated at the 2014 meeting of WGCSE (ICES 2014b).

The latest assessment includes the following key data: i) landings data from 1985 – 2013 for four fleets for which selectivity is modelled (UK combined trawls, nets & lines; UK midwater pair trawl; France- all fleets; Other countries/gears); ii) age compositions for UK fleet landings, and length compositions for the French fleet; iii) trends in total abundance and length composition from the French Channel Groundfish Survey CGFS (1988 onwards); iv) trends in recruitment from a UK survey in and near the Solent bass nursery area; v) estimates of recreational fishery harvests from recent surveys in the UK, France, Netherlands and Belgium. The IBP-Bass inter-benchmark assessment in 2014 revised the fleet aggregations, improved the modelling of selectivity (including allowing a domed selectivity for UK inshore trawls and nets), added the CGFS, reduced the base value of natural mortality M to 0.15 but added a vector of recreational fishing mortality at age that was included in the model as an additional "M" but treated as F in the results. The recreational F vector was adjusted until the estimated recreational harvests in 2012 were around 1,500t, which is roughly the total of estimates from recent national surveys. WGCSE (2014b) updated the IBP-Bass model with the most recent fishery and survey data.

This treatment of recreational fishing as a year-invariant F vector is a novel approach for ICES, but in the absence of a time series of estimates, was considered the only option to allow recent fishing mortality to be split between commercial and recreational fishing in a way that reflects observations, whilst preventing all the historical F (based on age compositions of the catches) being attributed to the commercial fishery. For 2012, the split of F(5-11) between recreational and commercial fishing was: recreational F = 0.09; commercial F = 0.24; total F = 0.33; i.e. recreational fishing was responsible for around a quarter of total F. This split is approximate, as the recreational estimates are not complete (no survey data for Wales), and are subject to estimation error (CVs > 0.20). Assessment runs carried out by IBP-Bass including different recreational F vectors from zero to 0.092 showed the same relative stock trends and total F – the effect of the recreational F vector is to scale up the stock numbers and biomass, and increase the proportion of total F due to recreational fishing, without changing trends. IBP-bass also looked at the sensitivity of the assessment to known underestimation of bass landings by under-10m vessels due to legally-allowed disposal of landings up to 30kg per trip without documentation. This also did not change the relative trends in biomass, or the total fishing mortality, but increased the proportion of total fishing mortality due to the commercial fisheries and hence reduced the recreational fishing mortality (by around 20%).

The assessment results show that total biomass and SSB are in decline due to a combination of progressively increasing commercial fishing mortality and an extended recent period of very poor recruitment from 2008 – 2011 and expected to extend to 2012 (Annex 2 Fig. 1). The revised assessment gives a shallower trend of increasing F than in the WGCSE 2013 assessment. The trend of increase occurs against a backdrop of rapidly increasing landings from the mid 1990s to mid 2000s, driven by the very strong 1989 year classes and a series of above-average recruitments formed during an extended period of warmer sea conditions that occurred from the late 1980s. The F appears to have increased in 2012 and 2013 despite stable landings. This is interpreted as the fishery maintaining catches despite declining biomass, and hence inflicting higher F. This is plausible because some large fisheries target spawning aggregations. However, the recent biomass estimates (and hence also F's) have relatively wide confidence intervals (Annex 2, Fig. 1) so the recent pattern should not be over-interpreted.



Annex 2, Fig 1.. Stock trends for sea bass in IVbc and VIIa,d-h from final update assessment carried out by ICES WGCSE 2014. Recruitment in 2012 is short term (2008-2011) geometric mean and in 2013 is the long term geometric mean. The F_{MSY} proxy is $F_{35\%SPR}$ = 0.13. Error bars on recruitment plot and dotted lines on SSB plot are $\pm$ 2 standard errors.

Annex 3: Description of national recreational fisheries

France

Estimating the number of marine recreational fishers in France is a challenge. This activity is free and no licensing system exists at this time. In accordance with previous work on recreational fishery surveys, France adopted in 2009/2010 and in 2011/2012 a dual method combining two large-scale telephone surveys with a fishing diary survey, where the fishing diaries were filled by the recreational fishers themselves. Herfaut et al., 2010, 2013; Rocklin et al. 2014)

For the two telephone surveys, the phone numbers were randomly selected in an existing database constituted by the landline and cell phone numbers of French telephone subscribers appearing in the national telephone directory. The sampling design used to contact each household was based on the principle that it should offer to each of them the same and non-negative probability to be contacted. For not inducing bias in the representativeness of the sample, not only the households easily reachable (those often present at their house) were interviewed. Thus, a strict and rigorous call process was used, following these assumptions: (1) the call numbers appeared in a random order (no pool); (2) the calls were done with the same insistence; and (3) the call hours permitted to contact the whole population. Each phone number was therefore called at different hours and days until it was reached or was definitely abandoned after 12 unsuccessful calls.

The first telephone survey, sea bass-specific, was conducted in June and November 2009 in the French coastal departments of the considered study. 172,054 telephone numbers were exploited to obtain a representative sample of 15,091 interviewed households (9%). The 91% non-interviewed households comprised, among others, to an occupied number (37%), a clear refusal to answer the interview (29%), or the non-response to the call (10%). At least one sea bass recreational fisher (here by definition a fisher targeting the sea bass and who has caught at least one sea bass during the last 12 months) was present in 535 (3.5%) of the 15,091 households successfully interrogated. These sea bass fishers were asked if they would agree to continue the interview and 467 of them did so (87.3%). The interview permitted collection of socio-professional information on recreational fishers targeting sea bass during their fishing trips, as well as general information on their fishing activity during the previous year (gear, shore or boat, areas, period, catches…).

This survey made it possible to identify and describe the main characteristics and practices of recreational sea bass fishers.

At the end of this telephone survey, sea bass fishers were asked to join a panel, which is a group of recreational fishers who agreed to voluntarily fill in a fishing diary to report their catches information, during one year. 256 (54.8%) of the 467 sea bass fishers agreed to join the panel. We sent the fishing diaries to the volunteers (one every three months or every 20 fishing trips), as well as a species identification guide describing the main characteristics of the commonly fished species, a spring balance and a measuring tape.

For each fishing trip, various items of information were to be recorded: date, main gear used (the hypothesis was that they only used one type of gear during a fishing trip), whether they fished from a boat or from the shore, the travel duration (from home to the fishing site, and travel duration by boat if used), the fishing site (town and fishing sector, based on precise sectors on an attached map), the port of departure, the fishing duration, the description of the sea bass catches (weight, length, whether kept or not), and the description of the other catches (species common name, weight and number of both kept and released individuals).

The panel methodology offers the possibility of obtaining precise information about released catches, which can generally not be inspected during on-site surveys, and about night fishing. 190 (74.2%) of the 256 fishers constituting the initial panel returned at least 1 fishing diary and 40 fishers (15.6%) returned the whole-year set of diaries, providing a seasonal picture of the fishery.

The same dual protocol was used in 2011/2012: 16000 households were contacted by phone and 181 volunteers were recruited to join the new panel. They sent back 960 fishing trips reports (with 2852 catches).

From the 2009/10 survey, the estimated recreational catch of bass in the Bay of Biscay and in the Channel was 3170t of which 2350t was kept and 830t released (Annex 3, Table 1). The estimates for Area IV&VII were 940t kept and 332t released. The precision of the combined Biscay & Channel estimate was moderate (relative standard error RSE =26%). This gives mean and 95% confidence intervals of 3170t [1554t; 4786t] for the whole area IV, VII and VIII. The main gears used, in order of total catch, were fishing rod with artificial lure, fishing rod with bait, handline, longline, net and spear fishing. Approximately 80% of the recreational catch was taken by sea angling (rod and line or handline). For the 2011/12 survey, the estimated recreational catch of bass in the Atlantic area (Bay of Biscay and Channel) in 2012 was 3,922t of which 3,146t was kept and 776t released. At this time results have to be considered as provisional (results split between Bay and Biscay and Channel are not available yet with relative standard error).

Netherlands

A recent survey by IMARES investigated the amount of sea bass caught by recreational fishers (van der Hammen and de Graaf, 2012) from March 2010 to February 2011. Estimates of sea bass recreational catches were obtained from a panel of 1043 recreational fishermen recruited during a screening online survey of 109,293 people. Revised estimates were provided to WGCSE 2013 (ICES, 2013a). The catch weights are estimated with a limited amount of length frequency data, and are therefore less reliable than the estimates in numbers (and may also be adjusted if more data are available). For the same reason, there are no estimates by weight for returned fish. The estimated total recreational catch of sea bass was 366 000 fish (RSE 30%), of which 234 000 were retained, equivalent to 138 t (Annex 3, Table 1). These results are mainly applicable to Subarea IV.

The next survey from March 2012 to February 2013 used the same methods. The screening survey also involved a survey of over 100,000 people, from which participants were selected for the logbook survey based on residence, fishing avidity, gender and age. A small number were recruited by recreational fisheries websites. Roughly 2,500 participants were recruited. On site surveys were carried out to collect length frequency data. If less than 8 months of diary data are returned, the fisher is excluded from the survey. If between 8 and 12 months of diary data were returned, any missing data were imputed using a donor from the data set with similar avidity (frequency of fishing). Recreational catch estimates from the latest survey are still under review.

There are around 500 recreational gill net fishers. IMARES is collecting data in 2014 to estimate the catches by gillnetters.

UK (England)

A new survey programme *Sea Angling 2012* was carried out in 2012 to estimate fishing effort, catches (kept and released) and fish sizes for shore based and boat angling in England (Anon. 2013). The survey does not cover other forms of recreational fishing. Results are available at: http://webarchive.nationalarchives.gov.uk/20140108121958/http:/www.marinemanagement.org.uk/seaangling/documents/finalreport.pdf

The surveys adopted, where possible, statistically-sound, probability-based survey designs, building on knowledge gained through participation in the ICES Working Group on Recreational Fishery Surveys (WGRFS). Two survey approaches were adopted: firstly a stratified random survey of charter boats from a list frame covering ports in England, and secondly an on-site stratified random survey of shore anglers and private boat anglers to estimate mean catch per day, combined with annual effort estimates derived from questions added to a monthly Office of National Statistics household survey covering Great Britain.

A list of almost 400 charter boats was compiled for the charter boat survey, and 166 skippers agreed to participate. Each month over a 12-month period in 2012 and 2013, 34 randomly-selected skippers completed a diary documenting their activities, catches and sizes of fish. A diary was completed whether or not any fishing took place. Data from 5300 anglers were collected. Total annual catches were estimated by raising the monthly catches per vessel from the diaries to all vessel-month combinations in the frame, and raising this to all vessels including refusals. The estimated total annual charter boat catch of sea bass for the entire coast of England was 44t (RSE 31%) of which 31t was kept. The release rate by number was 37%. The charter boat survey has potential bias due to the large non-response rate, if non respondents have different catch rates to respondents.

The Office of National Statistics (ONS) household survey covered 12 000 households during 2012, and from this it was estimated that 2.2% of adults over 16 years old went sea angling at least once in the previous year. The surveys estimated there are 884 000 sea anglers in England. Estimation of fishing effort by shore and private boat anglers proved very difficult due to the overall low number of households with sea anglers in the survey. A range of methods was explored to estimate annual and seasonal effort using the ONS data alone, and combining it with observations from on-site and on-line surveys. It has not been possible yet to agree on a best estimate of effort, and for that reason the estimates of total catch (CPUE × effort) for shore and private boat angling are given as a range of plausible values. Estimates at the lower end of the range are based on effort estimates derived only from the ONS survey and make the fewest assumptions, but are the least precise.

The survey of anglers fishing from the shore and private boats to estimate CPUE was carried out throughout 2012 using on-site interviews. A stratified random design was adopted to select shore sites and boat landing sites on a weekly basis from site lists stratified into low-activity and high-activity sites. The shore survey used roving-creel methods (collecting data from partial angling trips), and the private boat survey a roving access-point survey (data from completed trips). Visits were made to 1475 shore sites and 425 private boat sites, and 2440 anglers were interviewed. The mean daily catch rate of kept and released fish of each species was estimated based on the survey design, and sizes of caught fish were recorded. The CPUE for shore angling was estimated using catches for the observed trip duration and estimates of expected total trip duration for that day. A length-of-stay bias correction was applied based on expected total trip duration. The catch-per-day estimates were combined with the ONS survey estimates of total annual fishing effort (days fished) to estimate total annual catches. Release rates, by number, were 82% for shore angling and 57% for private boats. Non-response rates were very low (<10%) in this survey. The range of point estimates for shore-caught bass was 98 – 143t (total) and 38 – 56t (kept), and for private and rented boats was 194 - 546t (total) and 142 - 367t (kept).

Combining the catch estimates for charter boats, private boats and shore angling, the point estimates of annual kept weights of sea bass ranged from 230t – 440t (Annex 3, Table 1), compared with total UK commercial landings of almost 900t in 2012. The combined estimates of bass catches had precision (relative standard error) estimates of 26% - 38% for the different effort estimation methods. The precision is reduced by the very skewed nature of sea bass catches with many records of zero fish and occasional large catches.

Belgium

A recreational fishing survey was conducted in 2013 in Belgium by the Belgian Fisheries Institute, using a questionnaire approach, in order to meet DCF requirements. The estimated retained catch of sea bass was 60t. (Further details not available.)

Total recreational catch

The recent estimates of total recreational removals of sea bass for France, Netherlands, England and Belgium in Subareas IV and VII amount to 1300 – 1500t. Assuming a 20% hooking mortality rate (see section 2.3.7), an additional quantity of around 110-130t of releases will have died, assuming the same release rate in the Netherlands as in England (release rates by number in England and the Netherlands were similar). The total recreational removals were therefore around 1400t – 1600t compared with total reported commercial fishery landings of 4100t on average during 2009-2012. From information available, the precision of the combined international estimate is likely to be moderate, with relative standard errors of at least 20%. There may also be issues around bias, e.g. related to self-reporting of data in catch diaries and collection of length data. However, the ratio of recreational removals estimates in each country is a very consistent proportion of the combined recreational and reported commercial fishery landings (France: 25%; England: 28%; Netherlands: 26%; Belgium: 29%) giving greater confidence in the estimates. The recreational catch estimates exclude figures for Wales or any other European countries without surveys that could report sea bass catches.

The proportion of fishery landings comprising recreational removals has additional uncertainty due to any bias in reported commercial fishery landings. One bias is underestimation of total commercial removals due to exclusion of dead discards. An additional bias is unreported landings associated with the allowance under Article 65(2) of the EU Control regulation 1224/2009 that allows disposal of up to 30kg of fish for personal consumption without supplying sales slips. For small-scale, low-volume fisheries catching sea bass, this legal missing catch could be significant except in countries such as France where log-book schemes require reporting of all landings in under-10m fleets.

It is concluded that recreational fishing may account for around a quarter of total fishery removals and fishing mortality, and this represents a significant missing catch from the assessment. ICES IBPbass (ICES 2014a) developed a method to reflect this additional mortality in the Stock Synthesis assessment model. The historical trends in recreational catches are unknown, but they are likely to differ from commercial catch trends. It is possible that, before the large growth in biomass of the stock in the 1990s, recreational fishing may have been a much larger proportion of total fishery removals than at present.

Annex 3, Table 1 Estimates of annual recreational fishery catches of sea bass in France, Netherlands and UK (England) from surveys in recent years. RSE = relative standard error (given as a ratio or as a percentage). An additional 60t of removals was estimated by Belgium in 2013.

<table>
<tr><th colspan="2">(a) France</th><th>Kept</th><th>RSE</th><th>Released</th><th>RSE</th><th>Total</th><th>RSE</th><th>Release rate</th></tr>
<tr><td rowspan="2">2009-2011</td><td>Total Atlantic</td><td>2,343t</td><td></td><td>830t</td><td></td><td>3,173t</td><td>26%</td><td>26%</td></tr>
<tr><td>ICES areas IV & VII</td><td>940t</td><td></td><td>332t</td><td></td><td>1,272t</td><td>>26%</td><td>26%</td></tr>
<tr><td>2010-2011</td><td>Total Atlantic</td><td>3,146t</td><td></td><td>776t</td><td></td><td>3,922t</td><td></td><td>20%</td></tr>
</table>

RSE was 26% for area VII and VIII combined; area VII represented 40% of total.
~ 80% by weight in 2009/11 was recreational sea angling

<table>
<tr><th colspan="2">(b) Netherlands</th><th>Kept</th><th>RSE</th><th>Released</th><th>RSE</th><th>Total</th><th>RSE</th><th>Release rate</th></tr>
<tr><td rowspan="2">March 2010-Feb 2011</td><td>By number</td><td>234000</td><td>0.38</td><td>131000</td><td>0.27</td><td>366000</td><td>30%</td><td>64%</td></tr>
<tr><td>By weight</td><td>138t</td><td>0.37</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

98% by weight is recreational sea angling

<table>
<tr><th colspan="2">(c) England</th><th>Kept</th><th>RSE</th><th>Released</th><th>RSE</th><th>Total</th><th>RSE</th><th>Release rate</th></tr>
<tr><td>2012</td><td>By weight</td><td>230– 440t</td><td></td><td>150-250t</td><td></td><td>380 – 690t</td><td>26-38%</td><td>36-39%</td></tr>
</table>

Survey covered only recreational sea angling

Annex 4. Effect of Minimum Landing Size on fishery yield and spawning biomass per recruit.

The following is an extract from a report prepared by the present senior author for the Commission under Commitment No. SI2.680348 to prepare a paper on seabass management for STECF July 2014 (Armstrong and Drogou, 2014).

Modelling the effects of changes in selectivity and MLS

The current selectivity of fishing gears for sea bass can be evaluated from a fleet disaggregated stock assessment. The most recent sea bass assessments by ICES for Areas IVb,c and VIIa,d-h have not included data on discards, which are considered to represent only around 5% by weight of the total commercial catch. Hence the selectivity of all fisheries cannot be accurately represented. However, during the first benchmark assessment of sea bass (IBP-NEW, ICES 2012a), some runs of the Stock Synthesis model were carried out including the available discards estimates and size compositions.

Based on this model run, the UK subsequently examined the impact on yield per recruit (YPR) and spawning biomass per recruit (SPR) of shifting the selectivity curves for all the fisheries so that the probability of capture of fish below a range of possible MLS values was around 5%. The IBP-NEW Stock Synthesis model differed from the current ICES model in using a natural mortality value of 0.20 rather than 0.15 as at present, and not including a mortality component for recreational fishing. However, the general effect on YPR and SPR of altering selectivity should be similar in both cases even if the absolute values differ, as growth rates and size at maturity are the same in both models.

For each length at first capture explored (36cm, 40cm, 44cm, 48cm and 54cm, the yield per recruit and SSB per recruit was calculated for a range of multipliers applied to the current fishing mortality at age (*note: as estimated by IBP-NEW – recent F from the current ICES assessment is lower*), from zero (no fishing) to 2.0 (double the fishing mortality at each age). This was done to illustrate the relative effects of selectivity changes versus changes in overall fishing effort applied to sea bass. The results are given in Fig. Annex 4.1. Assuming the MLS and associated selectivity changes are applied to all international fleets, MLS of 40 – 48cm lead to improved yield per recruit for all the fleets compared to the current selectivity patterns, for the F-multipliers of around 0.8 and over. Increases in MLS also lead to large improvements in SSB per recruit and in the proportion of the catch comprising mature fish. The current selectivity pattern and fishing mortality (F-multiplier = 1.0) results in a very low SSB per recruit compared to the value in the absence of fishing, due to the relatively large F estimated by IBP-NEW. A commonly-used biological reference point for sustainable fishing is the fishing mortality giving SSB per recruit equal to 35-40% of the value for an unexploited stock. For the current selectivity pattern and current F estimated by IBP-NEW, fishing mortality would need to be reduced by almost 70% (F-multiplier 0.3) to achieve 40%SPR (*note: as estimated by IBP-NEW – recent F from the current ICES assessment is lower*). At the current fishing mortality estimated by IBP-NEW, the MLS and length at first capture would have to be increased to 44cm to achieve 40%SPR. As expected, an increase in selectivity results in an immediate short-term loss of yield and a subsequent recovery as the stock biomass improves due to the reduced overall fishing mortality. The recovery rate also depends on incoming recruitment. These results are intended to be indicative only, to illustrate how changes in selectivity could affect the long term YPR and SPR for sea bass. An update of this evaluation using the more recent ICES model configuration, with discards included, would provide results differing in detail, but the general conclusions may be similar.

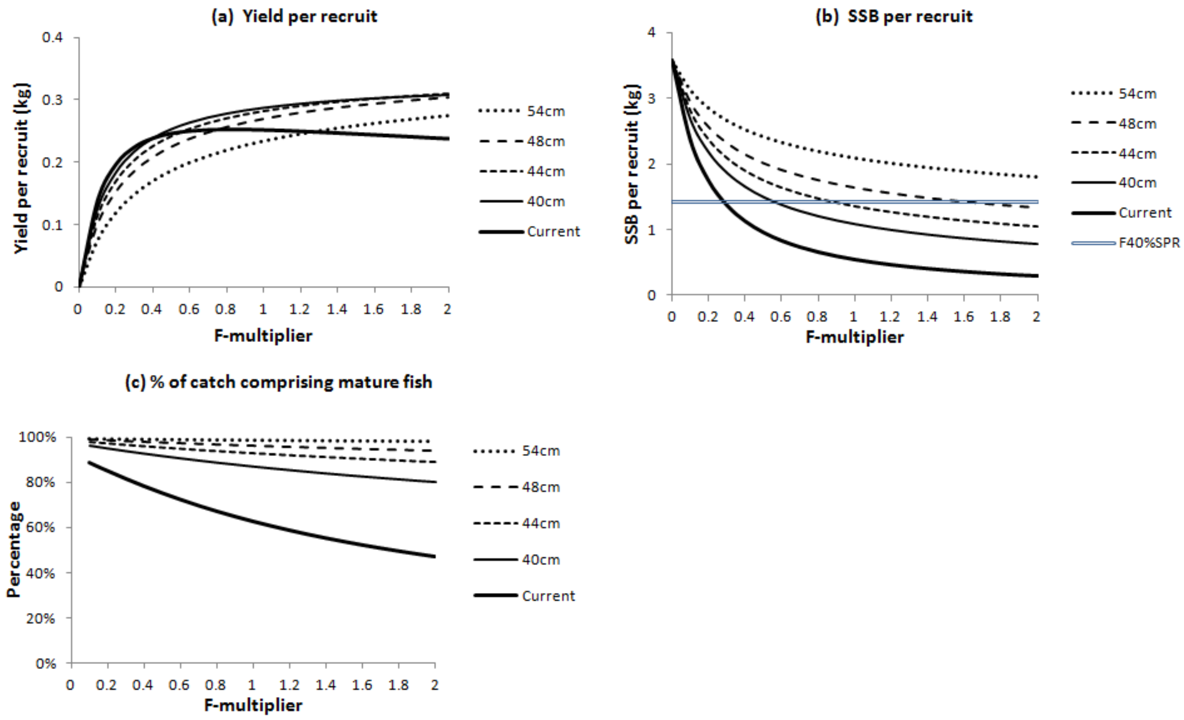


Fig. Annex 4.1. A yield per recruit and SSB per recruit analysis for sea bass based on the results of a run of the IBP-NEW benchmark assessment model (ICES 2012a) for sea bass in IVb,c and VIId,e-h, with discards estimates included, and with the fishery selection curves adjusted to correspond to MLS of 40, 44, 48 and 54cm.