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Report of the Study Group on Sea Bass

By Correspondence

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1 INTRODUCTION

1.1 Terms of reference

The Bass Study Group (SGBASS) was established by ICES at the Statutory Meeting in 2000 in order to respond to questions posed by the European Commission on the status of bass (*Dicentrarchus labrax*) stocks, their sustainability and management requirements of their fisheries in Community waters of the Northeast Atlantic. The report of the first meeting of this Group in March 2002 (ICES CM 2002/ACFM:11 Ref.G) provides a compilation of information on European fisheries in which sea bass are taken, the identity of stock assessment units and information pertinent for assessment of stock status and management options based on data provided mainly by France and UK in relation to this request. In 2003, the Group provided preliminary assessments of the status and demography of stocks in Sub-area VII, summarised in the SG report (ICES CM 2004/ACFM:04). This year, SGBASS is not required to meet formally, but ACFM has agreed that we should carry out further analysis of these data in order to reduce uncertainties about stock status in Sub-areas IV and VII, though substantial additional data are required before assessments can be made for Sub-areas VIII or IX.
The Terms of Reference for 2004 are to:

1) expand the SURBA analysis to a fully statistical age structured model for bass in stock areas IVb,c; VIId; VIIe (north); and VIIa,f,g, modelling the gear groups separately to better estimate selectivity patterns and F-trends over time. The results should allow a more adequate examination of stock dynamics and how the stocks might respond to changes in the fisheries.
2) report on the need for additional assessment data, especially biological data, for bass catches in ICES Sub-areas VIII (or IX), in Ireland and in recreational fisheries, in order to inform an appropriate review of the EU Data Collection Regulation.

SGBASS will report by 31 August 2004 for the attention of ACFM and the Living Resources Committee.

1.2 Contributors

The contributors to the 2004 report of SGBASS were:

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The report was compiled in Lowestoft by Mike Pawson and Graham Pickett, and circulated to all the above for comments, amendments and agreement before being submitted to ICES on 19 August 2004.

1.3 Background

IFREMER and CEFAS scientists met at Lowestoft in September 2003 to agree the necessary data compilation and analytical tasks in relation to **TOR a)**.. The data requirements identified were: catch-at-age data for each metier in each stock; accurate effort data for each metier in each stock; biological information on maturity, weight-at-age; and environmental information, mainly sea temperature, information on tagging and recruitment, and anecdotal evidence from the fishery, to help verify the modelling results. The aim of inter-sessional work carried out by CEFAS has been to develop a model that assesses the bass fishery as a whole for the four stocks (IVb,c; VIId, VIIe,h; VIIa,f,g) around England and Wales and northern France, taking into account the different stocks' recruitment dynamics and exploitation patterns. Although we are aware that environmental components modify the biological parameters, it was not expected to be able to incorporate these in the models, but to make a post-assessment examination of the likely influence of

environmental factors (essentially, temperature) with a view to eventually using them in a predictive capacity (or for interpolation).

The assessment carried out last year showed that there is considerable contrast in year-class strength (through time, rather than spatially), suggesting that a catch-at-age-based model may be the most suitable candidate to assess the stocks. A separable model could be used with catchabilities for each gear type, which may be metier-groups within which there are gears with differing selectivities being used in different temporal and spatial patterns and frequencies, but for which we have only combined data sets. Since recruitment patterns and migration patterns are likely to be influenced by a combination of environmental factors and differences in stock status between stocks, the initial plan was to develop a separate model for each stock. These could then be combined to determine parameters that control movement into and out of a particular stock by modelling boundary effects, such as emigration and immigration for each stock. If we tried to link stocks, errors associated with one stock would affect the precision of adjacent stock assessments, and we may have less of a feel for the confidence we can place in the assessments. These effects can be verified using tagging information, fisheries knowledge and recruitment indices. The aim was to develop a relatively simple model and with few parameters to estimate, and which could easily be used as a management tool.

Clearly, progress depends chiefly on the availability of data in relation to the requirements of potential models, and we have had considerable difficulty in extending the England and Wales catch at age and effort data for stock areas IVb,c and VIIa,f,g. Section 4. describes an approach that makes the most of the available data using a fully statistical age-structured model for VIId and VIIe (north) and VII (offshore). The Study Group still considers that these assessments are insufficiently robust to permit calculation of meaningful biological reference points, particularly as the bass population in the Channel and North Sea appears to be expanding and we have no idea of "carrying capacity". Nevertheless, we have attempted to indicate whether the current exploitation of bass is sustainable in order to advise ACFM of the need for management of the involved fisheries.

In relation to TOR b), there has been little response from any country in reply to my request to explain the need for additional assessment data, especially biological data, for bass catches in ICES Sub-areas VIII (or IX), around Ireland, and in recreational fisheries, in order to inform an appropriate review of the EU Data Collection Regulation. We have, therefore, provided an account of the sea bass data collection programme used in England and Wales in Section 5, with a commentary on how well (or not) this has provided information on recruitment, fishery and stock demography and our ability to assess stock status and give advice.

Section 6 provides the Study Group's comments to ACFM in relation to the stock status of bass, management needs and Section 7 recommends future work.

2 Catch and Effort

2.1 Catch and effort data availability

Table 2.1 presents a summary of the data that were available for use by SGBASS. Data on fishing effort expended by vessels taking bass are not available for all countries and years for which bass landings are given. The quality of the data is patchy, but bass fisheries in the English Channel appear to have been generally well sampled in recent years.

2.1.1 France

France has effort data for 8 métiers, by groups of ICES Division (covering VIId,e and VIIIa,b) for all years 1985 – 2003. Data quality is good for pelagic trawls since 1986 and for bottom trawls since 1993. The data for lines and nets are of poorer quality. Landings data are available for the above métiers for all years – price/grade data are good throughout. Landed weight and value/division are good for pelagic trawls since 1996 and other métiers since 1993. There are some data on discards of bass in French fisheries: mid-water trawling targeting bass in the Bay of Biscay and English Channel and some western bottom trawl and net fisheries (Morizur et al., 1996). Discards of bass are negligible (though a high proportion of bass caught by the recreational sector might be released alive), and landings can be generally considered as total catches for all gears. Since 1999, the data are available from a logbook database containing estimates of catch and fishing effort.

Last year, French CPUE were calculated using only those boats for which fishing effort data (days at sea) of sufficient quality was found. However, for coastal fisheries (nets, lines, longlines), the fishing effort unit is the catch-selling day, which sometimes includes several fishing days. This should not introduce a bias in the series of annual abundance indices, as the number of selling days per week is more or less constant if the composition of boats landing to a market is the same through the time series. In order to check this point, CPUE index of coastal métiers will be assessed in the future by separating the markets or ports.

2.1.2 UK

The UK (England and Wales, no bass landings reported into Scotland or Northern Ireland) has catch and effort data for 13 métier groups, covering 4 groups of ICES Divisions – IVb,c, VIId, VIIe,h and VIIa,f,g. These data include a regional fleet census from 1985 to 2003. The effort data for UK >10 m vessels are recorded as number of trips, days at sea, days on the ground, number of hauls etc and are obtained from the Fisheries Activity Database. Data from this source for the < 10 m fleet are considered unreliable, but effort estimates derived from the CEFAS log-book scheme are available from 1985 to 2003 for all métiers taking bass. Due to the wide range of gears used for bass - up to 3 per boat in one day - it is almost impossible to derive accurate gear-specific effort (e.g. soak-time). A distinction also has to be made whether the gear is targeted at bass. The most reliable measure of effort for the UK bass <10m fleet is the boat-day (Pickett, 1990) and for the >10m sector the standard measure is days on the fishing ground. Effort data are classed as good for gill nets and longlines from 1985, commercial rod and line and handlines from 1986, and for mid-water (pelagic) trawls from 1994. The rest of the data for trawling métiers is of poor quality.

The UK has good landings data by division and rectangle for mid-water (pelagic) trawls and by division for all other métiers. Other data by rectangle are of poor quality and there are no data by rectangle for recreational angling. Data on catch value per division and price per grade data are now moderate or good for most métiers and some price data for commercial lines are available.

The best estimates of annual catch and effort for bass have been obtained by integrating official statistics derived from landings declarations and local market sales at major ports with those from a voluntary, paid log-book system administered by CEFAS for the <10 m fleet which covers the bass fishery in England and Wales. The CEFAS logbook system has provided daily catch records from a sample of 45-60 inshore fishing vessels, including charter angling boats, since 1985. Estimates of total landings by this sector are obtained from the sampled catch and effort, raised to numbers of active vessels, and stratified by gear, boat-type and division, derived from an annual fleet census. Catches by gear-type, derived from each system, have been compared by 'stock area' on an annual basis for 1985 - 1995, and quarterly since 1996, and the higher values chosen. Best estimates of quarterly and annual landings are a composite of these figures. Catch per effort series, expressed in kg/boat day are obtained separately for >10m (official data – mainly trawlers) and <10m (log-book system) vessels.

The CEFAS log-book scheme also provides estimates of catch and effort by UK charter and casual angling boats and, when these are included in landings estimates for the commercial bass fishery, the combined landings of 1,045 t of bass in 1987 were over eight times as great as those recorded in official statistics. By 1993, combined landings were six times greater than the official data. Good quality data on recreational catch and effort were obtained for 1986/7 and

1992/3 as a result of two MAFF-sponsored economic studies by CEMARE (Portsmouth University; Dunn et al., 1989 and 1994) and show similar landings values for these years (around 415 t). It appears that most variability in the fishery arises on the commercial side.

Limited discard data are available for angling and commercial handlines via the CEFAS voluntary bass log-book system, but most of these fish are expected to survive being returned to the sea. There is no reliable data on discards for other métiers.

2.1.3 Ireland

Ireland has had no legal commercial bass fishery since 1990, but a time series of angler success, expressed as number of bass by age group caught per rod-day, is available for 1963 – 2003.

2.1.4 Spain (Basque Country)

Information on sea bass landings and landings per unit effort made by the Spanish fleets landing into the Basque Country ports, extending from 1994 to 2003, is presented in a working document to SGBASS (Lucio *et al*., 2004). There is less detailed information from other important Spanish regions. The Basque Country data, obtained from EC log-books, skippers' logbooks and *ad hoc* monitoring of the trips and landings into Basque ports, cover more than 14 commercial métiers, in four sea areas: Sub-area VI; Sub-area VII (mainly VIIh,j); Divisions VIIIa,b,d and Division VIIIc (eastern part). Economic values per year in recent years are available for all métiers and sea areas considered together. Fishing effort data are expressed in "days fished" and are available since 1994 for "Baka" bottom otter trawls in Div. VIIIa,b,d, and also for other trawling métiers and for longlines and trammel nets. As bass are generally a by-catch in these fisheries, the effort information must be viewed with caution. AZTI monitoring for bass in 1994 and 1995 did not include landings of the main fleets operating in Div. VIIIc, particularly longline and gillnet; thus total landings reported for those years in this area are underestimated. In 1991-1992, *ad hoc* sampling, conducted by AZTI to study the artisanal métiers in the inshore waters of the Basque Country coast (eastern Div. VIIIc and southern Div. VIIIb), produced data on bass catches, effort and length compositions for surface longline and trammel net (Puente, 1993).

The best estimator of sea bass abundance trends (LPUE) in the period 1994-2003 is based on landings into the Basque port of Ondarroa by the "baka" otter bottom trawl fleet working in Div. VIIIa,b,d. This fleet takes the highest bass catches in that area and its fishing effort is well quantified, though bass is only an economically interesting by-catch for this metier during the 1st and 4th quarters of the year.

No bass discards were observed in the 292 hauls sampled in the 2000 observer survey, conducted by AZTI (EU DG XIV Study Contract Nº 98/095) on board "Baka" trawls in Sub-area VII and in Divisions VIIIa,b,d, as well as in pairtrawls with VHVO nets in Div. VIIIa,b,d and in Div. VIIIc.

There is very little information on sea bass taken by the recreational rod and line fishery close to the Basque coast and in the rivers mouths (eastern Div. VIIIc and southern Div. VIIIb), but their catches might be considered of very low importance (possibly less than 3 t per year). The main catches are taken in autumn (September to November) (L. Arregi, pers. com.), although most effort is applied in summer months (holidays season).

2.1.5 Spain (other than BC)

Statistics were provided of bass landings by Spanish vessels outside the Basque Country for 2000 - 2002 by sea area and gear. No associated effort data were available.

2.1.6 Portugal

In Portuguese continental waters (ICES, division IXa), more than 90% of the bass landings are caught by the artisanal fleet using mainly gillnets, hooks and traps. Landings by gear are available for 1986-2003.

2.1.7 Other countries

No bass fisheries information has been supplied for other countries.

2.2 Catch by country

Official statistics and the Study Group's estimates of total landings (difference shown as "unallocated") of bass by country over the period 1984 to 2003 are presented in Table 2.2. More detailed catch data by stock assessment areas identified last year are given in Tables 2.3.1-2.3.7.

2.2.1 France

The quality of data on bass landings by French vessels has been improved since last year. Total landings were around 2000 t during the period 1986-95 and have increased to around 4,000 t in recent years. The landings from Sub-area VIII are always higher than in Sub-area VII. The observed increase of landings in the recent period is mainly due to the catch in Divisions IVc and VIId (mainly the latter): for example, bass landings in Boulogne increased from 130 t in 1997 to

540 t in 2003. In Divisions VIIe,h, there were peaks in landings in 1987 and 1996 (the consequences of the arrival of strong year classes in the pelagic fisheries), and a smaller increase was also noted in 1992. The picture is quite different in Sub-area VIII, where there was less variation in landings during the period after 1986, except for a decrease in 1998 followed by an increase over the three following years. The major part of landings from VIII in the recent period came from VIIIa, reaching a maximum of 2300 t in 2003. Since 1996, the French landings in Sub-areas VII and VIII are of the same magnitude, whereas previously the landings of Sub-area VII were less than the third of the VIII landings.

Most of the French catches in Sub-area VII are taken by trawling, whereas lines, long-lines and nets take the greater part of the catch from Sub-area VIII. Details of recent French landings of bass by métier in Sub-areas VII and VIII are available in ICES files. The nominal landings of mid-water and bottom trawlers reach a maximum in spring in VII, and in winter in VIII, which reflects the different spawning periods in the two areas and confirms that trawlers mainly exploit pre-spawning and spawning concentrations.

Recreational catch

A preliminary study on recreational fishing in France was carried out by IFREMER and BVA at the beginning of 2003. Representative samples of the French population > 15 years old were interviewed by telephone, using the "quota method" stratified at a national level and taking into account geographical and socio-economical characteristics of the population. A total of 2008 people (in 2 representative samples of approx. 1 thousand) were asked about their fishing activity in 2002. From the responses, the declared catch of 30 fishermen, who fished for bass on at least 5 days in 2002 (11 taking a total of 49 kg in the English Channel and 19 taking 152 kg in the Atlantic) was raised to the corresponding French population (48 million), giving an estimate of 1200 t for the English Channel and 3 600 t for the Atlantic. These first estimates indicate that the recreational catch of bass in France could be as high as the commercial catch.

A second study using the same method with two samples of 1000 persons was carried out in January 2004 . The results showed the same order of magnitude of activity during 2003 as the previous study, with 1.3 % of the population having fished for bass on more than 5 days in the year. Only 4 % of these fishermen are registered in recreational fishing associations.

Another study in progress will concern the activity in years 2003 and 2004, with a target of 14,000 interviews distributed through in 2004. The main objective is to build up a representative panel of bass fishermen for more detailed studies on the development of fishing effort and fishing power as well as on economical assessment.

2.2.2 UK (England and Wales)

The official total bass landings in England and Wales from Sub-areas IV and VII rose from 106 t in 1985 to 660 t in 1995, and have ranged around 500 t since then. Much of the bass catch landed into the UK is taken by small inshore vessels in a mixed gear fishery and does not go through major ports: these figures are therefore underestimates. The total catch taken by mid-water trawlers targeting bass over the winter/spring in 2003/ 04 was 137 t - higher than in 2002/03 due to an increase in the numbers of vessels involved in this fishery and not to higher catch rates. A combination of the official UK statistics and landings derived from a voluntary log-book scheme run by CEFAS have been used to provide the "best estimates" given in Table 2.2.2. These suggest that landings remained around 600 t between 1985 and 1992, rose rapidly to 2200 t in 1994 (as the strong 1989 year class recruited), and then fluctuated between 1050 and 1900 t (mean around 1500 t) until 2003. During the whole period, sea bass landings into England and Wales arose mainly from netting and line metiers.

2.2.3 Ireland

Landings of bass into Ireland after 1985 are very low, and there are no landings data for the commercial fishery after 1990. No estimate of recreational catches is available.

2.2.4 Spain (Basque Country)

In 2003, annual landings amounted to 46 t (18 t less than in 2002 (64 t)), the lowest value of the period 1996-2003. As no bass are discarded, landings might be considered as catches. As in previous years, practically all catches were obtained in the Bay of Biscay: around 84% in Div. VIIIa,b,d and 16% in Div. VIIIc taken chiefly between September-October and March. Though bass catches were previously reported from Sub-areas VI and VII, less than 0.1 % of the Basque total catch came from Sub-area VII (Celtic Sea) in 2003, taken in late autumn by trawl and longline.

The bass catches (landings) of the Basque "baka" bottom otter trawl fleet in 2003, as in previous years, were obtained mainly on the shelf off the mouth of the River Gironne (44º30'-46º30'N and 01º-03ºW). About 70% of the Basque landings reported from the eastern part of Div. VIIIc, i.e. off the Basque Country coast, are taken by artisanal longlines, with gillnet 15% and purse seine 10%, again mainly in autumn and winter, though with a less precise seasonality than in the rest of the Bay of Biscay.

Summaries of the total catches by sea area and gear (summarized into four groups: bottom trawl, longline, set net and purse seine) are presented in Table 2.2.4. During the period 1994 - 2003 the main catches of bass were taken by bottom trawl (around 75%, split baka" otter trawl (62%) and VHVO pair bottom trawl (38%)) and by longline (around 18%); the remainder by set net (5%) and purse seine (2%). A decrease in the "baka" trawl catches compared with the

pair trawl catches was observed in 2003 in relation to previous years (they amounted to about 85% and 15% respectively in 2002 and before). "Bou" otter trawl and twin nets trawl working in Div. VIIIa,b,d, reported around 2% of total trawl catches up to 2000; since when these two metiers have not operated.

2.2.5 Spain (Atlantic Coast outside Basque Country)

Landings data by gear and sea area for each quarter in 2000-02 were made available to the Group. Though some landings were made from Sub-area VII (<0.6 t, on lines), bass are mainly taken from Divisions VIIIa,b (up to 53 t pa), VIIIc (74 - 133 t) and IX (49 - 105 t). The largest catches were made by the artisanal fishery, followed by hook and line, trawl and gill net, and the main bass fishery season is in the 4th and 1st quarters.

2.2.6 Portugal

Portuguese landings peaked in 1989 at around 500 t, and have been below the mean of the whole period (321 t) in the last three years (at 280 t) (Table 2.2.6).

2.2.7 Other countries

Only the Channel Islands, with landings of between 12 and 108 t taken from Div. VIIe, regularly accounts for bass in their official statistics, though the Netherlands has recently begun to take them in Divisions IVc and VIId,e (40 t in 1998).

2.3 Catch trends by sea area

2.3.1 Divisions IVb,c and VIId (Table 2.3.1)

Total international landings of bass from the southern North Sea and eastern Channel were relatively stable at around 500 t over the period 1984 - 1990, and then rose to a peak of 1900 t in 1994, since when they have fluctuated between 1210 and 1810 t. According to national official statistics, annual landings have recently been higher for France than for England, but inclusion of estimates of the landings of English inshore boats obtained through a voluntary log-book scheme (see 2.1.2) indicate that the English catch until 2000 was higher than that reported by France. Recorded bass landings by Netherlands boats have been negligible until 1998. UK landings peaked in 1994, 1997 and 1999, whereas French landings have increased from 1993 onwards.

2.3.2 Divisions VIIe,h (Table 2.3.2)

Landings of bass from the western Channel and Western Approaches fluctuated between 260 and 520 t over the period 1984 - 1993 (except for 980 t in 1987), rose to a peak of 1440 t in 1997 and then reached approximately 1600 t in 2003. French vessels have accounted for the main part of the annual landings - usually at least 50% - whilst English vessels landed most of the remainder. The landings by vessels from other countries, chiefly the Channel Islands who took between 5 and 10 % of the total each year, peaked in 1989 and then increased from 1992 until 1999.

For assessment purposes, the Group has treated the winter offshore fishery in VIIe as a separate 'stock', since tagging indicates that this fishery takes a mixture of fish from different UK fisheries. The UK vessels fish almost exclusively in the UK sector and may be considered to be fishing on this stock. Few, if any fish from the Channel Islands or Brittany have been recorded in this fishery, and it may be more appropriate to include catches taken south of the Hurd Deep in VIIe with Biscay (Sub-area VIII).

2.3.3 Divisions VIIa,f&g (Table 2.3.3)

Total international landings of bass from the Irish Sea, eastern Celtic Sea, and Bristol Channel fluctuated between 110 and 310 t over the period 1984 - 1992, and then rose to a peak of 850 t in 1994, since when they have fluctuated between 360 and 680 t. According to national official statistics, these landings have been equally shared between France and England and Wales, but estimates of the landings of UK inshore boats obtained through the CEFAS log-book scheme indicate that the English and Welsh catch comprises at least 90% of total international landings in most years.

2.3.4 Divisions VIa,b and VII b,c,j,k (Table 2.3.4)

Offshore catches of bass are occasionally reported from Sub-area VI and the western divisions of Sub-area VII, amounting to an annual average of less than 0.5 t for France and the UK in the period 1994-2002, though increasing in recent years. Spanish landings of up to 40 t are occasionally reported from this area, though the provenance of these data is questionable.

2.3.5 Divisions VIIIa,b &d (Table 2.3.5)

Landings of bass from the Bay of Biscay increased rapidly to 1550 t from 1984 to 1987, since when they have fluctuated between 1300 and 1680 t until 1999, rising to around 1900 t in 2000-01 and to more than 2300 t in 2003. French vessels appear to have accounted for around 90% of the annual landings.

Offshore catches of bass reported by Spain (only the Basque Country) from Divs. VIIIa,b,d were relatively constant, amounting to an annual average of around 50 t in the period 1994-2002 (range 29-60 t) and mostly due to the "Baka" otter trawl and longline fisheries. A very regular and marked seasonality (main catches in the 4th and 1st quarters) is observed in the Basque landings. There is a small UK catch of bass reported from this region.

2.3.6 Division VIIIc (Table 2.3.6)

Between 1988 and 1998, Spain consistently reported landings of between 250 and 400 t of bass from the southern Bay of Biscay, Div. VIIIc, but landings declined to 110 t by 2002 and were higher (150t) in 2003. Inshore catches reported by the Basque Country have amounted to an annual average of 9 t in the period 2000 - 2003 (range 5-14 t). The seasonality in the main catches (4th and 1st quarters) in the south-eastern Biscay is not as marked as in Divisions VIIIa,b,d.

2.3.7 Division IXa (Table 2.3.7)

Landings of bass reported from the western coast of Spain and Portugal have been revised since last year's report. Total landings reached a peak of 600 t in 1989, and have since fluctuated between 360 and 540 t without an apparent trend. The Spanish catch from this area reached a peak in 1997 (184 t) and has fallen below 100 t since 2000, whilst the Portuguese catch peaked at over 500 t in 1989 and has since remained around 300t.

2.4 Fishing effort

Fishing effort for fleets which target bass or for which bass is a reliable by-catch (for LPUE estimates) are available for three countries, France, the UK and Spain (Basque country), by métier and sea area.

2.4.1 France

In 1996, 288 boats were recorded as targeting bass from French ports located in Sub-area VII, and 683 boats were registered as fishing for bass from ports in Sub-area VIII. Some pelagic trawlers from the Biscay ports move to Sub-area VII to fish for bass in the spawning season. Trends in nominal effort of the pelagic pair-trawl fleet vary between Sub-areas VII and VIII, with a peak in VII in 1987, followed by a decline until 1995 and then a rapid increase, whereas effort in VIII peaked in 1991 and has declined thereafter. No update of this time series is available due to changes in the databases in 1999.

2.4.2 UK (Table 2.4.2)

In 1985, it was estimated that 185 UK boats were involved in fishing for bass in Sub-area IV, increasing to 493 in 1994 decreasing to 232 in 1996 and rising to 321 in 2003. In Sub-area VII, 1791 boats were involved in fishing for bass in 1985, rising to a peak of 1966 in 1994, with 1485 in 1996 and 1861 in 2003.

Total UK nominal effort (all areas combined) increased in the demersal trawl fleet from an annual mean of around 6,000 days during 1984-90 to a mean of 22,000 days during 1991-95. Lower effort was estimated for the demersal trawl fleet during the period 1996-2003, with a mean of 16,000 days. These fishing effort data are only indicative, having been compiled in various ways over the years.

Effort in the netting fleets has varied considerably with no real trend over the period 1984-2003, reaching a peak in most regions in 1993 and a trough in 1998/99. Effort in the line fleets were relatively constant from 1985 to 1990, after which they increased to a peak in 1992, fell across the years 1994-96, and have since shown a slight increase.

Up to 7 pairs of mid-water trawlers targeted bass over the winter/spring 2003/04, and spent a total number of 412 boat-days fishing, more than the previous highest (270 days), recorded in 2002/03.

2.4.3 Spain

In 1994, it was estimated that 81 Spanish boats landed a by-catch of bass in the Basque ports from Divisions VIIIa,b,d and Sub-areas VI and VII; most of them being bottom trawlers. In 1999, fewer than 60 boats fished in the same sea areas. No estimate is available for the artisanal fleet working mainly in eastern Div. VIIIc and southern Div. VIIIb and catching bass, but their number is likely to have decreased between 1994 and 2000.

Revised effort values are available for the "baka" bottom trawl fleet operating in Div. VIIIa,b, mainly off the central western French coast (Table 2.4.3). The effective fishing effort (fishing days, the number of trips of the fleet multiplied by the mean number of fishing days by trip in Div. VIIIa,b,d by quarter) has decreased by more than 60% between 1994 and 2002, due mainly to a reduction in the number of boats of this Basque fleet. In 2003 a slight increasing has been observed in relation to 2002 (9%).

2.5 Landings per unit of effort (LPUE)

In last year's report, bass CPUE (= LPUE) series were presented over the period 1986 - 2002 for gears and sea areas where the Group considered that they provide a useful index of stock abundance. These were used in the SURBA analysis (see 4.1.1 below), the results of which are presented in ICES (2004). These data have not been updated in this report, though Table 2.5.1 gives LPUE (kg day^{-1}) of bass by gear in the UK (England and Wales, all areas combined, 1985 - 2003) fishery, and LPUE values for Baka trawls (Basque Country, 1994 - 2003) are given in Table 2.4.3.

Most LPUE series for the UK fisheries in which bass are caught show a declining trend from 1985 to 1992, followed by a strong increase to a peak in 1994, and then generally high but fluctuating catch rates until 2003. As indices of abundance, these series suggest that production of bass in north European fisheries has remained higher in the mid-late 1990s than in the late 1980s, probably due to the recruitment of the very strong 1989 year class and several subsequent year's of good recruitment.

Whilst sea bass LPUE values for the Basque Country "baka" bottom trawl fleet suggest a similar pattern in Divisions VIIIa,b,d, the increase in recent years coincides with the drastic diminishing of hake LPUE in the same area for the same fleet (Lucio *et al*., 2004), and it is possible that this fleet has subsequently directed more of its effort to other species not subject to the TACs and Quotas system.

Table 2.1 Summary of availability and quality of data on Bass by area (for all métiers) - quality relates to how well landings in each sea area have been sampled.

		North Sea (IVb,c)		Channel (VIId,e,h)		Irish/Celtic Seas (VIIa,f,g)		Biscay (VIII)	
Data type		Quality	Year span	Quality	Year span	Quality	Year span	Quality	Year span
Effort		*	84-03	**	85-03	**	85-03	*	84-02
Landings	wt/Div	*	84-03	**	85-03	**	85-03	*	84-03
	wt/Rect	*	84-03	*	85-03	*	85-03	*	84-02
	value/Div	**	84-03	**	85-03	*	85-03	**	84-02
	price/grade	*	84-03	*	85-03	*	85-03	**	84-02
Discards	any data	*	84-03	*	85-03	*	85-03	*	95
Biological	length comp'	*	85-03	**	85-03	**	85-03	*	00-03
	age comp'	*	85-02	**	85-03	**	85-03	*	00-02
	fish wts	*	85-03	**	85-03	*	85-03		
	sex ratio	*	82-93	**	82-93, 99,00	**	82-93		
	maturity	**	82-93	**	82-93, 99,00	**	82-93		
	condition	**	82-93	**	82-93, 99,00	**	82-93		
	growth	**	82-93	**	82-93	**	82-93		
Recruit Index		**	75-03	**	77-02	**	72-01		
Spawning	timing	**	81-84, 03	**	81-84, 89,00	*	82-91, 99-03		
	distribution	*	81-84,89	**	81-84, 89	*	82-91(3yr)		

Quality Key: ** = good data quality; * = some data but poor quality; blank = no data available.

Table 2.2 Summary of nominal landings (t) of bass by country of landing (all sea areas).

Year	Channel Islands[3]	Denmark[1]	France	Ireland[1]	Netherlands[1]	Portugal[4]	Scotland[1]	Spain[1]	UK (Engl. & Wales)	Unallocated[2]	Total
1984	25		575					430	124	1063	2217
1985	18		1091					364	106	473	2052
1986	15		1765			181		388	129	493	2971
1987	14		2404	3		127		402	130	660	3740
1988	12		1871		8	351		451	190	394	3277
1989	48	1	1970		2	508		92	202	332	3155
1990	25	<0.5	1710			412		146	191	364	2848
1991	16	<0.5	2059			379		111	263	476	3304
1992	36	<0.5	2161			345		94	156	454	3246
1993	45		1933			289		104	246	914	3531
1994	49	1	1956			373		134	546	2202	5261
1995	69	1	2033			316	1	112	661	873	4066
1996	56	1	2988		8	381		158	576	680	4848
1997	74	1	2599		1	229		184	572	1700	5360
1998	79	2	2446		48	273		115	489	980	4432
1999	108	2	3312		32	308		134	680	1083	5659
2000	19		3925		67	361		299	406	974	6051
2001	na	na	3898		87	332		256	355	919	5847
2002	na	na	3627		111	326		271	500	1047	5882
2003*		na	4400*		180	279		274	574	1153*	6860*

1. Source: Official Statistics
2. Landings estimated by the Study Group.
3. Source: ICES Bulletin Statistique, and estimates for Jersey 1996-00.
4. Revised figures

* = Provisional

na = not available

Table 2.2.2 UK sea bass catch best estimates (t), all areas

Year	Drift and Gill Nets	Lines	Other	Trawls (excluding pair trawls)	VII offshore pair trawls**	Total
1985	176	408	1	61		646
1986	190	321	3	30		544
1987	326	341	7	49		723
1988	330	226	2	70		628
1989	188	323	2	100		613
1990	198	281	+	98		577
1991	216	323	1	79		620
1992	165	287	1	68		522
1993	462	686	2	103		1253
1994	1143	800	11	246		2201
1995	525	449	40	220	+	1234
1996	357	557	17	153	87	1172
1997	565	1127	15	159	41	1907
1998	302	469	14	157	113	1056
1999	447	841	23	150	220	1682
2000*	537	438	39	156	76	1246
2001*	395	588	15	160	66	1225
2002	580	567	40	188	128	1503
2003	561	573	11	293	112	1550
2004					137	

* no logbook estimates for trawls

** Includes landings in previous Q4

Table 2.2.4 Total sea bass landings (in kg) in the Spanish Basque Country ports 1994-2003 by sea area and gear (trawl, longline, set net and purse seine).

Gear	Area	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average
All Trawl	VI	0	0	0	0	735	0	64	0	0	0	80
	VII	26	0	0	42	29	16	98	15	2	13	24
	VIIIabd	42386	17602	23198	20525	23498	41120	39900	38442	46219	34344	32723
	VIIIc	4	0	10	318	40	50	32	17	0	7	48
	Total	42416	17602	23208	20885	24302	41186	40094	38474	46221	34363	32875
All Longline	VI	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	1038	2	21	0	15	108
	VIIIabd	18087	11169	27606	16867	18839	9768	6284	394	1002	2885	11290
	VIIIc			8035	6127	4995	2078	3720	6493	10916	5598	5995
	Total	18087	11169	35641	22994	23834	12884	10006	6907	11918	8498	16194
All Set nets	VI	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	0	4215	7855	5573	11452	2543	2559	603	3480
	VIIIc			1077	1919	659	608	713	969	1999	1588	1191
	Total	0	0	1077	6134	8514	6181	12165	3512	4557	2191	4433
All Purseine	VI	0	0	0	0	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0	0	0	0	0
	VIIIabd	0	0	141	26	13	358	328	174	59	593	169
	VIIIc			12197	410	1999	452	396	437	1289	391	2196
	Total	0	0	12338	436	2012	810	724	611	1348	984	1926
Others	Total	0	0	176	30	0	0	25	0	86	0	32
Grand Total		60503	28770	72440	50479	58662	61061	63014	49505	64130	46036	55460

Table 2.2.6 Portuguese landings of sea bass by gear (t)

Year	Trawl	Artisanal	Seine	Total
1986	5.7	115.9	59.5	181.1
1987	3.9	89.2	33.6	126.8
1988	6.9	293.7	50.4	351.0
1989	9.5	384.9	113.6	508.0
1990	4.9	397.5	9.2	411.6
1991	2.0	343.5	33.0	378.5
1992	2.7	313.0	29.5	345.2
1993	6.0	244.2	38.8	289.0
1994	4.8	354.6	13.9	373.3
1995	4.2	299.5	11.9	315.6
1996	1.4	345.8	33.8	381.0
1997	1.2	211.2	16.8	229.3
1998	0.8	264.5	7.2	272.6
1999	2.4	287.9	17.6	308.0
2000	1.6	345.0	14.7	361.3
2001	2.8	322.3	6.8	331.9
2002	1.8	318.3	5.5	325.6
2003	1.7	273.8	3.7	279.3

Table 2.3.1 Nominal landings (t) of Bass by country in Divisions IVb,c and VIId.

Year	Denmark[1]	France	Netherlands[3]	Scotland[1]	UK (Engl. & Wales)	Unallocated[2]	Total
1984		21			77	577	752
1985		175			76	170	496
1986		151			92	149	485
1987		85			86	194	451
1988		104	8		102	211	527
1989	1	147	2		91	150	482
1990	<0.5	131			71	185	459
1991	<0.5	161			168	212	709
1992	<0.5	180			83	253	599
1993		262			145	346	898
1994	1	260			356	915	1888
1995	1	298		0.5	413	367	1492
1996	1	417	4		318	267	1325
1997	1	290	1		321	688	1622
1998	2	369	32		282	323	1290
1999	1	628	32		335	598	1594
2000		695	61		217	378	1351
2001		772	76		202	160	1210
2002		914	105		242	457	1718
2003		1100	169		268	277	1814

1. Source: ICES Bulletin Statistique
2. Landings estimated by the Study Group.
3. Official statistics

Table 2.3.2 Nominal landings (t) of Bass by country in Divisions VIIe,h.

Year	Channel Islands[4]	Denmark[1]	France	Netherlands[1]	Spain[1]	UK (Engl. & Wales)	Unallocated[2]	Total
1984	25		171			39	283	518
1985	18		98			19	213	348
1986	15		128			22	99	264
1987	14		744			16	209	983
1988	12		228			30	103	373
1989	48	1	131			39	55	274
1990	25		157			91	59	332
1991	16		202			45	80	343
1992	36		337			40	54	467
1993	45		252			50	88	435
1994	49		163			66	422	700
1995	69		269			100	112	550
1996	56		959	4		162	49	1230
1997	74		774			150	439	1437
1998	79		580	16		162	88	925
1999	108		756			311	94	1269
2000	19		684	<0.5	1	139	172	1015
2001			786	4		72	233	1095
2002			624	2		127	206	959
2003			1050	5		233	310	1598

1. Source: ICES Bulletin Statistique
2. Landings estimated by the Study Group.
3. Provisional.
4. Source: ICES Bulletin Statistique, except estimates for Jersey 1996-00.

Table 2.3.3 Nominal landings (t) of Bass by country in Divisions VIIa,f&g.

Year	France	Ireland[1]	Scotland[1]	UK (Engl. & Wales)	Unallocated[2]	Total
1984	1			8	203	212
1985	13			11	90	114
1986	2			11	245	258
1987	24	3		23	257	307
1988	7			43	80	130
1989	14			62	127	203
1990	14			27	120	161
1991	75			27	184	286
1992	43			24	147	214
1993	14			32	480	526
1994	9			110	735	854
1995	40		<0.5	141	264	445
1996	41			82	234	357
1997	31			88	443	562
1998	195			42	439	676
1999	28			32	391	451
2000	70			50	424	544
2001	53			81	410	544
2002	80			131	213	424
2003	40			73	382	495

1. Source: ICES Bulletin Statistique
2. Landings estimated by the Study Group.
3. Provisional.

Table 2.3.4 Nominal landings (t) of Bass by country in Divisions IVa, VIa, VIIb,c,j&k and XII.

Year	Denmark[1]	France	Ireland[1]	Netherlands[1]	Portugal	Scotland[1]	Spain[1]	Spain (BC)[2]	UK (Engl. & Wales)	Total
1984		1							0	1
1985		<0.5							<0.5	<0.5
1986		<0.5							0	<0.5
1987		<0.5	1						<0.5	1
1988		<0.5		3					0	3
1989		0.5	1						0	1.5
1990	<0.5	<0.5	1						0	1
1991	<0.5	1							<0.5	1.5
1992		1.5							1	2.5
1993		0.7							1	1.7
1994	<0.5	<0.5							<0.5	1
1995	<0.5	<0.5				<0.5			8	8
1996		0.5			3				5	8.5
1997	<0.5	<0.5							<0.5	<0.5
1998	<0.5	0.5					40		10	51
1999	<0.5	0					1		1	2
2000		3						<0.5	<0.5	0.5
2001		1						<0.5		1
2002							1	<0.5		1
2003								<0.5		<0.5

1. Source: ICES Bulletin Statistique
2. Estimates for Spain (Basque Country).
3. Provisional.

Table 2.3.5 Nominal landings (t) of Bass by country in Divisions VIIIa,b&d.

Year	France	Spain[1]	Spain (BC)[2]	UK (Engl. & Wales)	Unallocated[3]	Total
1984	381	0		0		381
1985	805	0		1		806
1986	1478	0		4		1482
1987	1547	0		5		1552
1988	1512	0		15		1527
1989	1673	0		10		1683
1990	1407	0		2		1409
1991	1611	17		23		1651
1992	1601	14		9		1624
1993	1404	14		19		1437
1994	1393	17	60	14	130	1554
1995	1283	0	29	7	130	1420
1996	1344	0	51	14	130	1488
1997	1345	0	42	12	130	1487
1998	1142	27	50	3	130	1302
1999	1602	11	57	2		1672
2000	1824	50	58	0		1932
2001	1855	2	42			1899
2002	1618	15	50			1683
2003	2300	39	38			2377

1. Source: ICES Bulletin Statistique
2. Estimates for Spain (Basque Country).
3. Landings estimated by the Study Group.
4. Provisional.

Table 2.3.6 Nominal landings (t) of Bass by country in Division VIIIc.

Year	France	Portugal	Spain[1]	Spain (BC)[2]	UK (Engl. & Wales)	Total
1984	0		180			180
1985	0		200			200
1986	5		206			211
1987	3		208			211
1988	12	<0.5	358			370
1989	1	1	325			327
1990	1		395			396
1991	9	1	300			310
1992	0		254			254
1993	0	<0.5	247			247
1994	0	1	306			307
1995	1	<0.5	334		<0.5	335
1996	1	<0.5	376			377
1997	0	<0.5	290			290
1998	0	<0.5	258			258
1999	9	<0.5	221			222
2000	20			5		25
2001	1		122	8		131
2002	1		107	14		122
2003	0		152	8		160

1. Source: ICES Bulletin Statistique
2. Estimates for Spain (Basque Country).
3. Provisional.

Table 2.3.7 Nominal landings (t) of Bass by country in Division IXa.

Year	Portugal*	Spain	Total
1984		250	250
1985		164	164
1986	181	182	363
1987	127	194	321
1988	351	93	444
1989	507	92	599
1990	412	146	558
1991	378	111	489
1992	345	94	439
1993	289	104	393
1994	372	134	506
1995	316	112	428
1996	378	158	536
1997	229	184	413
1998	273	115	388
1999	308	134	442
2000	361	83	444
2001	332	102	434
2002	326	49	475
2003	279	83	362

*revised data set 2004

Table.2.4.2 Nominal fishing effort UK (England and Wales) by gear (days fished).

Year	IVb,c + VIId				VIIe				VIIa,f,g		
	Trawls[1]	Nets	Lines	Pelagic trawls	Trawls[1]	Nets	Lines	Pelagic trawls	Trawls[1]	Nets	Lines
1984	2010	22287	10023		2219	2216	7419		612	9032	5210
1985	8569	17206	19310		2728	7861	19350		73	11412	11679
1986	3234	18251	22203		638	9593	10746		287	21526	20223
1987	4331	21995	29524		886	11799	12498		506	12703	22213
1988	3234	19252	23850		580	9503	11375		680	26743	21809
1989	4704	15522	31722		1050	5687	12794		1369	11823	16927
1990	4381	18608	20541		9813	5659	7268		1836	11038	17214
1991	9364	25832	32802		8251	2347	9820		1727	15717	23544
1992	14273	24723	55003		5771	4887	17431		2263	15839	23035
1993	15123	41994	30675		5835	8266	7841		2589	49321	21059
1994	21158	33165	45962		285	12364	14044		3233	17914	22545
1995	14776	21103	47464		2411	9402	21929		3784	23075	21592
1996	6465	9536	28312	12	6602	4281	16961		2405	38192	13920
1997	5897	27789	33406	0	7312	18592	24244		2960	17161	20944
1998	6491	11144	25889	25	6914	3937	12243		2226	24446	25440
1999	6417	15916	43018	53	5987	763	10302	163	1478	25277	20553
2000	7612	20053	16243	10	7997	9816	14762	114	6812	36233	46138
2001	7710	6974	16120		7373	1051	24470	137	2510	38734	24470
2002	6066	11698	20675		7273	1814	13534	159	2387	37095	15223
2003	7364	11736	16465	65	7535	1754	21151	317	3015	9974	19797

1. UK trawl effort estimates are days fished where bass recorded for the period 1984-1996 (first record). All data for 1996 – 2002 have been revised and replace values given in 2002 report.
2. 2003 provisional

Table 2.4.3 Bass catches (kg), effective effort indices (trips*(days/trip)) and CPUE (kg/day) by quarter and year, for "Baka" bottom otter trawls fishing in Divisions VIIIa,b,d, and landing in Ondarroa (Basque Country, Spain), in the period 1994-2003.

VIIIa,b,d	**LANDINGS** (kg)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	Quarter 1	12832	6781	12452	11588	10500	10204	21290	21172	30582	14636
	Quarter 2	13	62	100	25	4	198	0	0	32	790
	Quarter 3	459	293	177	182	100	33	5	39	0	9
	Quarter 4	15214	6691	5100	4917	3952	22065	11441	8145	7265	5717
BAKA-ON	TOTAL	**28518**	**13827**	**17829**	**16712**	**14556**	**32500**	**32736**	**29356**	**37879**	**21152**
VIIIa,b,d	**EFFORT** (days)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	Quarter 1	1596	1229	1459	1345	1097	855	969	856	847	906
	Quarter 2	1283	1006	883	1223	655	384	295	323	510	695
	Quarter 3	1230	825	699	770	384	316	219	151	202	176
	Quarter 4	1509	1414	1337	949	865	782	745	788	548	519
BAKA-ON	TOTAL	**5619**	**4474**	**4378**	**4286**	**3002**	**2337**	**2227**	**2118**	**2107**	**2296**
VIIIa,b,d	**LPUE** (kg/day)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	Quarter 1	8,0	5,5	8,5	8,6	9,6	11,9	22,0	24,7	36,1	16,2
	Quarter 2	0,0	0,1	0,1	0,0	0,0	0,5	0,0	0,0	0,1	1,1
	Quarter 3	0,4	0,4	0,3	0,2	0,3	0,1	0,0	0,3	0,0	0,1
	Quarter 4	10,1	4,7	3,8	5,2	4,6	28,2	15,4	10,3	13,3	11,0
BAKA-ON	TOTAL	**5,1**	**3,1**	**4,1**	**3,9**	**4,8**	**13,9**	**14,7**	**13,9**	**18,0**	**9,2**

Table 2.5.1 Catch of Bass per unit of effort (kg day^{-1}) from the CEFAS log-book scheme for inshore UK (Engl.&Wales) fishing vessels. All areas combined.

	GEAR								
YEAR	Trawl	Drift net	Gill net	Trammel net	Long-line	Angling	Hand-line	All nets	All lines
1985	5.1	34.1	4.0	2.4	5.3	11.1[1]		13.5	5.5
1986	3.0	26.1	9.0	2.2	12.1	11.7[1]		12.4	7.9
1987	3.0	20.4	8.8	3.3	9.1	8.4	8.9	10.8	8.8
1988	15.5	18.0	8.8	3.0	9.4	9.8	7.8	9.9	9.0
1989	3.7	14.0	5.6	2.4	8.7	6.0	12.4	7.3	9.0
1990	7.2	5.1	6.0	2.7	9.2	10.5	7.5	4.6	9.1
1991	6.2	8.8	5.5	3.3	13.3	8.2	8.9	5.9	10.1
1992	7.0	7.2	3.7	1.1	5.4	4.7	7.2	4.0	5.8
1993	4.3	5.9	7.8	4.3	5.9	7.8	11.5	6.5	8.8
1994	9.3	34.1	12.7	4.6	5.9	3.1	22.3	19.3	12.0
1995	10.0	30.3	8.0	6.7	6.9	2.6	17.8	12.2	11.8
1996	6.9	11.9	8.4	4.7	5.3	2.6	19.2	8.2	9.4
1997	9.9	17.1	5.7	11.1	6.0	3.2	21	8.2	10.7
1998	10.0	25.3	8.1	6.2	6.1	4.6	16.0	9.4	8.8
1999	10.8	30.2	7.1	15.5	5.1	8.2	13.9	11.9	9.1
2000	8.9	28.3	4.0	4.9	5.3	4	18.5	7.8	10.1
2001	9.1	15.8	7.4	8.0	3.1	10.5	18.5	8.3	11.7
2002	11.9	60.2	6.7	5.6	4.4	6.4	18.4	16.0	10.3
2003*	16.36	40.1	9.2	10.5	7.3	7.3	15.0	18.0	9.7

1. Angling and hand-lines combined.
Revised figs used for 2000
* Provisional

3 Recruitment

3.1 Pre-recruit surveys

The annual variability in local abundance of 0-group and older juvenile bass has been remarked upon in previous reports, and four of the seven survey data series presented in the 2003 SGBASS report have been updated: the Solent (VIId), Westerschelde (IVc east), Tamar (VIIe) and South-east Ireland surveys, the last three to 2003 (Table 3.1). In comparison with years before the exceptionally strong 1989 year class, there has been an increased frequency of above-average year classes through the 1990s, and there is increasing evidence to suggest that 0-group bass were locally very abundant in 2002. Relatively small numbers of 0-group fish were produced in 1996 and 2001.

Recognising stronger year classes in the aged catch is straightforward since mortality tends to be highest at the age at full recruitment (ICES, 2003). An account of year class strength based on analysis of catch-at-age per unit effort data is presented in section 4.3.2.

Table 3.1 Recruitment indices for Bass based on surveys.

Area	Netherlands	UK (England and Wales)					Ireland
	Westerschelde	East (Thames)	South (Solent)x100	South (Tamar)	West (Camel)	West (Severn)	
Division	IVc	IVc	VIId	VIIe	VIIf	VIIf	VII
Year class	0 group Beam trawl survey[4]	0 group PS screens[2]	2-4 group Trawl survey	0-group Seine survey	0-group Seine survey[3]	0 group PS screens[1]	0 group Seine/Stop-net survey
1972	1					3	
1973	0					4	
1974	0					1	
1975	0	78				15	
1976	2	100				127	
1977	0	6	10			-	
1978	0	5	20			-	
1979	1	5	170			-	
1980	1	37	23			9	
1981	0	21	74		002	216	
1982	0	56	111		123	83	
1983	0	83	432		30	226	
1984	4	62	9		134	8	
1985	0	76	1	213	022	11	
1986	0	14	6	2	1	3	
1987	0	116	34	10	31	96	
1988	1	54	38	477	48	98	
1989	0	610	334	754	112	446	
1990	0	433	56	333	89	25	
1991	1	64	48	24	50	300	
1992	69	104	55	712	25	280	
1993	0	131	28	325	22	202	
1994	708	26	98	375	134	-	
1995	0	27	216	744	-	-	
1996	0		19	33	119	242	15
1997	22		294	359	102		1
1998	8		70	669	264		5
1999	231		130	390	56		2
2000	60		43	109	133		0
2001	4		3	113			3
2002	349			674			93
2003	271			310			1

1. discontinued 1997
2. discontinued 1996
3. discontinued 2001
4. series revised July 2004

4 Assessing the status of seabass stocks

4.1 Previous approach

Last year, the Group presented the results of a SURBA analysis using UK and French data on bass catch-at-age per unit of effort for three fishing métiers (trawls, nets and lines) for four stocks (IVc, VIId, VIIe, VIIa,f,g) for which sufficient biological sampling information was available over the period 1984-2002 (data sets available in ICES files). The newest implementation of the SURBA program, presented to ICES WG on Methods of Fish Stock Assessments 2003 (Appendix B, ICES, 2003), was designed for the evaluation of stock trends from survey indices, independent of catch data from a fishery. It is not usually used in conjunction with commercial CPUE data, because of the assumptions of constant survey selectivities, which is likely to be violated in commercial landing information. However, given the uncertainty in the total landings information for several of the bass stocks, that would be required for a full catch-at-age analysis, the implementation of the SURBA analysis, using indices of relative abundance, was deemed to be preferable.

Initial analysis of separate CPUE trends pre and post 1990, when the implementation of a new minimum landing size is expected to have reduced the selectivity for younger bass and may have violated the assumption of constant catchability at age, indicated a small effect in comparison to the overall contrast in the data. Consequently, the final analyses were carried out on the full time series in order to attain better estimates of the relevant stock parameters. Note that the analyses of the different métiers represent fully independent assessments of the status of each stock, and give a further method for assessing the suitability of the model with the available data.

The analysis of the 12 datasets (3 métiers for each of 4 stocks) indicated common features of the SSB trends within stocks and recruitment patterns within and between stocks. Estimates of fishing mortality using SURBA were considered to be less informative, largely due to a lack of independence between the selectivities of the fishery and that of the CPUE indices used.

4.2 This year's approach

In response to this year's TOR b): "expand the SURBA analysis to a fully statistical age structured model for bass in stock areas IVb,c; VIId; VIIe (north); and VIIa,f,g, modelling the gear groups separately to better estimate selectivity patterns and F-trends over time", intercessional work focussed on two of the data sets used last year (VIId and VIIe north, data for UK metiers only) which offered sufficiently high data quality to be used in a multi-fleet, fully statistical, separable model (Kupschus, WD2).

The model assumes a linear relationship between effort and fishing mortality, and explicitly uses effort and catch-at-age information, with the sum of landings by fleet being equal to the total landings. Parameters in the model are fit by autodifferentiation functions developed in AD-Modelbuilder. Catchability at age, which is constant across years, is fitted for each age, except the plus group, for which it is assumed to be the same as the previous age. The age with the largest catchability for a given fleet is assumed to be fully selected, and its selectivity is set to 1.0, and catchability for the gear set to the catchability at that age. Selectivities for other ages captured in the same gear are rescaled accordingly between 0 and 1. Parameter fits are determined primarily by maximisation of the Gaussian log-likelihood, given differences between observed catches at age and predicted catches at age using the given parameters. In cases where catch at age information is not available for a given fleet and year combination, predicted catches at age are summed and expressed as landings to be minimised against observed landings for a given fleet. Although this represents more of a biomass dynamic model that contains substantially less information than the catch at age component, it does allow for the model to be applied to data with gaps in the age information, enabling a much longer time series to be used and giving better information on stock dynamic trends than would be possible in either a pure catch-at-age model, or a simple biomass dynamic model.

As is the case with most catch-at-age models, F and SSB, or fishing mortality at age and numbers at age in their unadulterated form, are highly correlated. This frequently leads to estimations of high SSB and very low F, when using the log-likelihood maximisation. To constrain the model away from very low F's, catch curves were used to roughly estimate total F from all gears at maximally selected ages and then penalise the model for departures from this total F. Therefore, the total penalty function is made up of the sum of the catch log-likelihood, the landings log-likelihood (where applicable) minus the penalty function for departures from the total F. Generally, the latter penalty function has been kept to less than 0.1% of the total penalty function. However, the choice of the penalty weighting is subjective, so that values of recruitment, F-at-age and numbers-at-age are more precise on the relative scale, and less reliance should be put on the absolute values indicated by the model.

The model is heavily reliant on the accurate determination of effort levels and to the assumption of linearity between fishing mortality rate and effort, as well as constant catchability by fleet. The latter is questionable for some fleets such as the netter fleet which has been observed to target strong year classes of bass. Precision in the catch at age information is less critical, as the model assumes error in the catch-at-age matrix. Additionally, the inclusion of landings data as well as the large number of year classes in most bass fisheries tend to smooth out variability in the

catch-at-age data. Further model development is necessary to derive better estimates of absolute values for F and stock size through reparameterisation of the model in such a way as to reduce the correlation between the two parameters.

This year we have treated the part of the bass population that is exploited in the winter offshore fishery in VIId,e,h as a separate 'stock' for assessment purposes. This seasonal fishery is prosecuted mainly during November-April, and, where possible, data for quarter's 4 in year t and 1 and 2 in year t+1 were summed to give "annual" values. Where there are gaps in the data, particularly length distributions, age information or isometric weights, the most appropriate value or data set from other seasons or years was substituted.

UK landings and catch numbers and weight at age data are available quarterly for 1994 - 2003. Catch numbers at length were converted to catch number at age using a combined ALK, and annual weights at age were calculated weighted by numbers at age landed by quarter. Where the UK data lacked length and age samples in a quarter, all data for Qs 4, 1 and 2 were summed for each season. An examination of length and weight at age by quarter and year suggested that growth did not differ between years, and it was assumed that combining data across years to increase the size of datasets, particularly with respect to creating ALKs, was valid. The relatively poor UK age data for the 2001/ 02 season were manipulated in the same way as the French data, below.

Except for the most recent years, the French data generally lack length distributions and length and weight at age data, and UK data were substituted under the assumption that the French fishery operated in a similar manner to the UK fishery and is fishing the same population. Catch and length distribution data were available for both French and UK fleets for the 2002/03 season, and these show similar patterns in numbers at age in UK and French landings. French landed weight data for Q4 , Q1 and Q2 (1994 – 2002) were converted to an ALD using corresponding UK length values and a single ALK constructed by combining the UK Q 1 ALK's for the years 1999, 2000, 2001and 2003. Catch numbers at age were calculated by summing the ALD array, and catch weights at age derived using a general isometric weight at length. As with the UK data, catch numbers in a given season were calculated by summing the catch numbers from each quarter and catch weights were calculated using a weighted average.

A full effort dataset from Q4 1998 to Q2 2004 for the UK fleet, recorded as 'days on the ground', was standardised with the French data by multiplying days x 21 (based on 3 x 7 h tows per day) to give 'hours fished'. French quarterly landings from Sub-area VII were used to produce seasonal values as described above, and seasonal effort values (h fished) by port of landing were used to calculate lpue as kg/hr/season. There is good agreement between the two fleets, with French seasonal catch rates consistently higher (possibly due to the adjustment made to the UK effort figures), Figure 4.2. The higher lpue for both fleets in 2001/02 does not appear to be a year-class effect (see annual age compositions) and may be due to variation in the spatial distribution of pre-spawning and spawning bass.

The data sets used in the analysis were fully raised numbers at age for both French and UK landings for 1997-2003, isometric weights at age in landings, and annual lpue for both fleets from 1998/99 onwards. These data sets are presented in Annex 1, together with the model code and detailed output, from which the following results have been summarised.

4.3 Results

The model results for the assessment of bass stocks in VIId, VIIe north and VIId,e,h offshore are shown in Figures 4.3.1 - 4.3.3 for the respective stocks. Due to the short time series and difficulty in obtaining accurate values for effort in the VIIe offshore fishery, only tentative conclusions can be drawn from these results.

4.3.1 Landings

Landings estimates for the inshore fisheries in VIId and VIIe north and the offshore fishery in VIId,e,h are generally consistent with observed landings, both in scale and pattern, though the higher predicted values for VIIe between 1988 and 1993 suggest that biomass and/or F is overestimated in the assessment over that period. Landings in the inshore fisheries rose to a peak in the mid-1990s, at around 1000 t in VIId and 600 t in VIIe, and have since fallen but remain higher than in the late 1980s. Landings from the offshore fishery have declined from around 700t to 500 t between 1998 and 2002.

4.3.2 Recruitment

Recruitment estimates from the models indicate a similar pattern of year class strength in both stocks, in which the large 1989, 1994 and 1995 year classes are identifiable, with low abundance estimates for the 1985, 1986, and 1996 year classes. In general, recruitment has increased from 1989 onwards, though the estimates from the 1997 year-class onwards are likely to less precise, due to the low and variable selectivity for all gears at age 3. For VIId, the pattern of year class strength between 1984 and 1997 is very similar to the recruitment index derived independently from the Solent survey (covering the main nursery areas for bass in VIId and directed at 2-4 year old bass), and there is a reasonable match between the survey indices and the recruit pattern for VIIe (north). Model recruitment estimates for the offshore fishery in VIId,e,h are unlikely to be indicative of the true pattern of year class strength, as selectivity for younger ages are very low and thus highly susceptible to error.

4.3.3 Fishing mortality

Estimated trends in F differ between the two stocks in line with fluctuations in the effort of the different fleets, due to the assumption of a linear relationship between fishing mortality rate and effort. In VIId, F peaked (0.3 - 0.4) between 1992 and 1995, but otherwise fluctuated around a value of 0.2. A similar peak in F was indicated for VIIe, occurring later, between 1994 and 1997, otherwise F fluctuated between 0.2 and 0.3 over the period 1985 – 2000. F in the offshore fishery appears to have varied around 0.2 between 1998 and 2002.

The results of this analysis are an improvement on those obtained last year (ICES, 2003), when any trends in F determined in the SURBA analysis were considered questionable, and it was considered that using commercial CPUE data to determine relative year-class strength did not lend itself well to the setting of absolute or even relative F-reference points that might be considered for a long-term management strategy.

4.3.4 Spawning stock biomass.

SSB has increased over the period 1985 – 2000, climbing first in VIIe north in the late 1980s and stabilising since 1989 at a level of about 700 t. SSB in VIId appears to have been higher, over 1000 t, and remained stable until 1996 after which it increased to over 2000 t by 2000. Note that this continued expansion appears to be associated with some uncertainty regarding effort levels and recruitment in the most recent years in the VIId time series. The assessment for the VIId,e,h offshore fishery indicates that SSB has fallen slightly, from around 2000 t in 1998 to 1500 t since 2000.

These results compare well with last year's estimates, which suggested that SSB had increased compared to levels observed in the mid 1980's, though there is no indication of a decline in VIIe since 1998 (the 1994 and 1995 cohorts now look much stronger), and the increase in SSB in the more eastern stock (VIId) now appears to have taken place in the mid -late 1990s, rather than having been maintained since the early 90's, given the higher levels of F in the latter period.

4.3.5 Selectivity

Selectivity patterns for the different fleets are largely consistent with our understanding of the operation of the different metiers, and the dip in selectivity at age 7-9 for the net fishery in VIIe could be due to the use of two or more gears with different selectivities (e.g. peaking at ages 5/6 and 8/9) within this metier-group. Selectivities are best estimated for inshore trawl fisheries, where targeting of year classes is minimal as bass mostly represent a by-catch in these fleets. Selectivity in the offshore fishery is very low at the youngest ages, increasing sharply from age 9 to a maximum at age 11. However, this fishery targets pre-spawning and spawning aggregations, to which it seems likely that recruitment is maximum at age 8 (corresponding to the maturity ogive given in Table 4.2). The apparent increase in selectivity could be associated with immigration of adult bass from other areas and a strong reduction in the number of fish age 9 and older in this spawning area..

4.4 Conclusions

Although further model development, incorporating several stocks into a single model capable of parameterising the extent of migrations between them, should lead to a better understanding of the stock dynamics and exploitation patterns of all bass stocks, the results presented here are probably sufficient as a basis for management advice. The model's estimates clearly map independent observations of landings and recruitment patterns in VIId and, less precisely, in VIIe north, which thus suggests that the trends in fishing mortality and SSB are representative of the "stocks" involved. The main features are the increased level of recruitment from 1989 onwards which, despite an associated temporary increase in fishing mortality in the mid-1990s, lead to a substantial increase in spawning stock biomass. If overall F is around 0.2 (a value consistent with analyses carried by SGBASS in previous years; ICES, 2002, 2003), SSB of bass in the English Channel rose from around 1500 t in 1985 to over 2000 t by 2000.

The above values are based on the premise that the bass populations in VIId and VIIe mix considerably, as late juveniles recruiting to the fishery (age 4-6, Pickett *et al*., 2004), and as migrating pre- and post-spawning adults (Pawson *et al*., 1987). The respective SSB values are, therefore, not entirely additive, and those for the VIId inshore and VIIe offshore "stocks" probably represent the same population, to a large degree.

The prognosis for sea bass stocks in the Channel, therefore, is that fishing mortality levels are sustainable (at around F=0.2), spawning stock biomass levels are as high or higher now than they have been over the last 20 years, and that strong year classes continue to be sufficiently frequent to ensure that recruitment maintains both yields and stock. Last year the Study Group's analyses suggested that the abundance of bass in north European fisheries had remained higher in the mid-late 1990s than in the late 1980s, probably due to several years of good from 1989. Whilst SSB had increased in all stocks, there was some indication of a decline in the two western stocks (VIIe, VIIa,f,g) since 1998, whereas SSB in the two eastern stocks (IVc, VIId) seemed to be increasing and there was an expansion of the bass population into the North Sea.

The current assessment results indicate a positive correlation between recruitment and SSB, which is clearly driven by recruitment and not by SSB, as one would expect in an expanding stock under relatively low exploitation. The recruitment time series for the different stocks show common features regarding year class strengths, indicating that these stocks are either linked biologically or that their recruitment is controlled by large-scale environmental patterns.

There is a good predictability of the progression of year classes identified by 0-group and pre-recruit surveys into the fishery, and year class strength signals are clear and consistent within the fisheries' catch-at-age data. Peak recruitment in the 1990s has been around ages 5 or 6, and cohorts are still recognisable in landings at age 15+.

Table 4.2 Mean weight-at-age and proportion mature at age for bass, as used in the separable analyses.

Age	Proportion mature	Mean weight-at-age (kg)
3	0.03	0.462
4	0.23	0.578
5	0.43	0.683
6	0.57	0.878
7	0.9	1.112
8	1	1.460
9	1	1.568
10	1	1.756
11	1	2.194
12	1	2.424
13	1	2.710
14	1	3.066
15+	1	3.469

Figure 4.2. UK and French lpue (kg/hour fished) for the winter offshore bass fishery in Sub-area VII over each of the seasons Q4 1998 - Q2 1999 to Q4 2003 - Q2 2004.

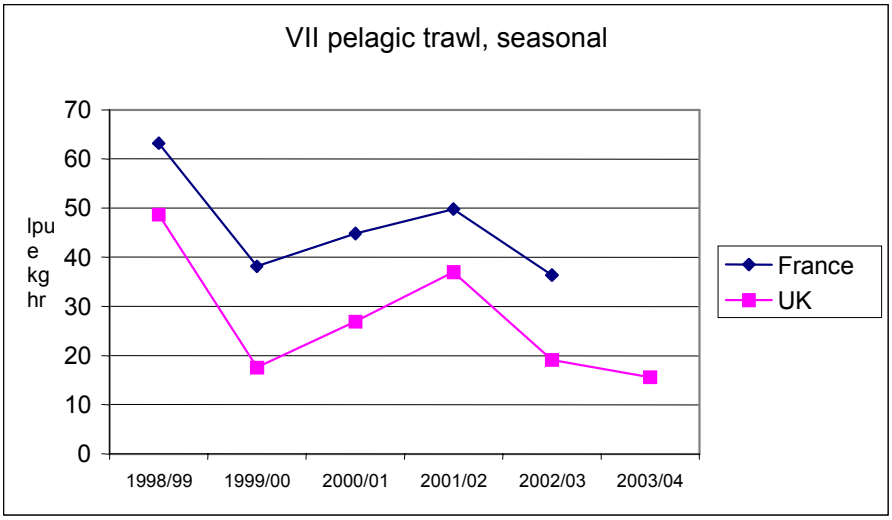


Figure 4.3.1 Estimated catch, recruitment (age 3), fishing mortality and spawning biomass of bass in VIId, together with recorded landings and recruit indices from the Solent pre-recruit (ages 2-4) trawl survey, 1985 – 2001, and model fit residuals.

Figure 4.3.1 (Cont'd)

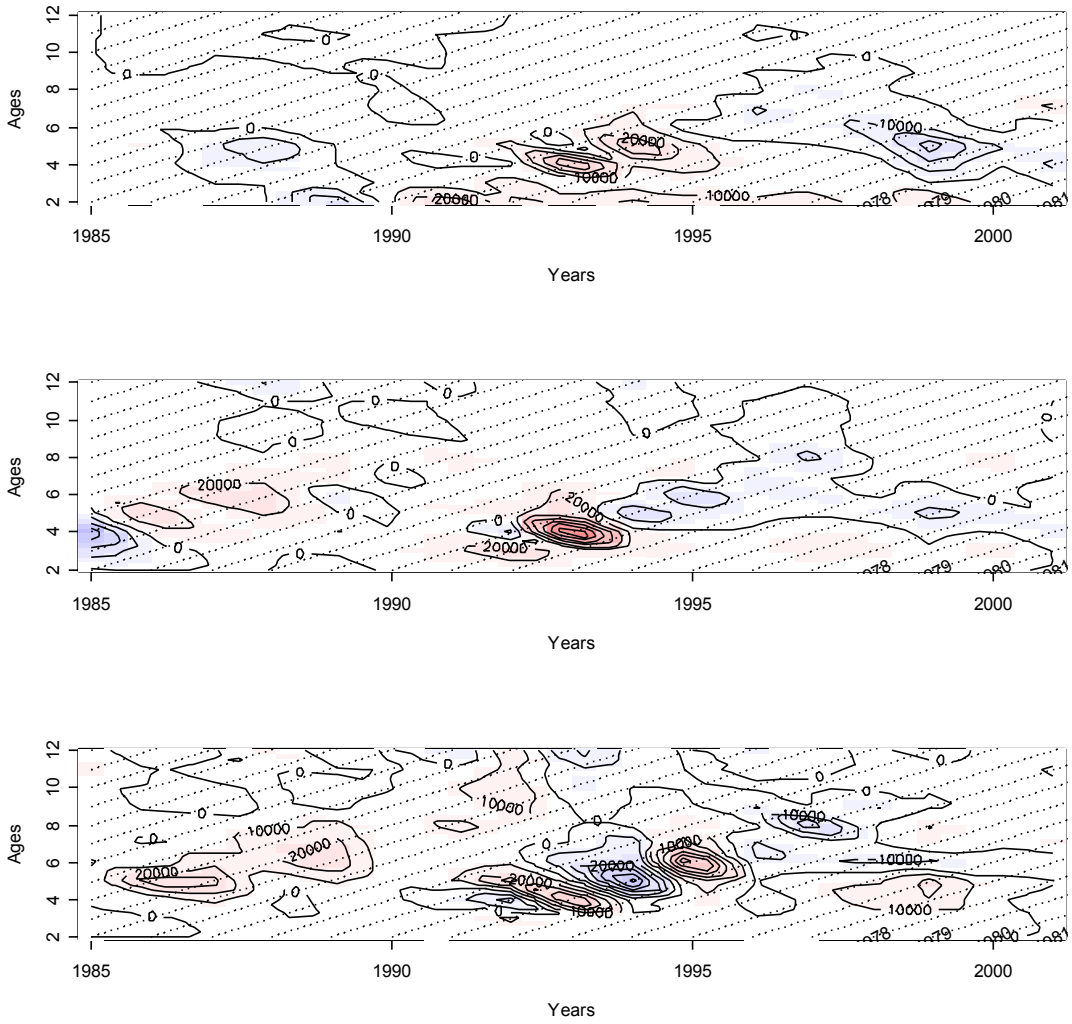


Figure 4.3.2. Estimated catch, recruitment (age 3), fishing mortality and spawning biomass of bass in VIIe north, together with recorded landings and recruit indices from the Solent pre-recruit (ages 2-4) trawl survey, 1985 - 2001, and model fit residuals.

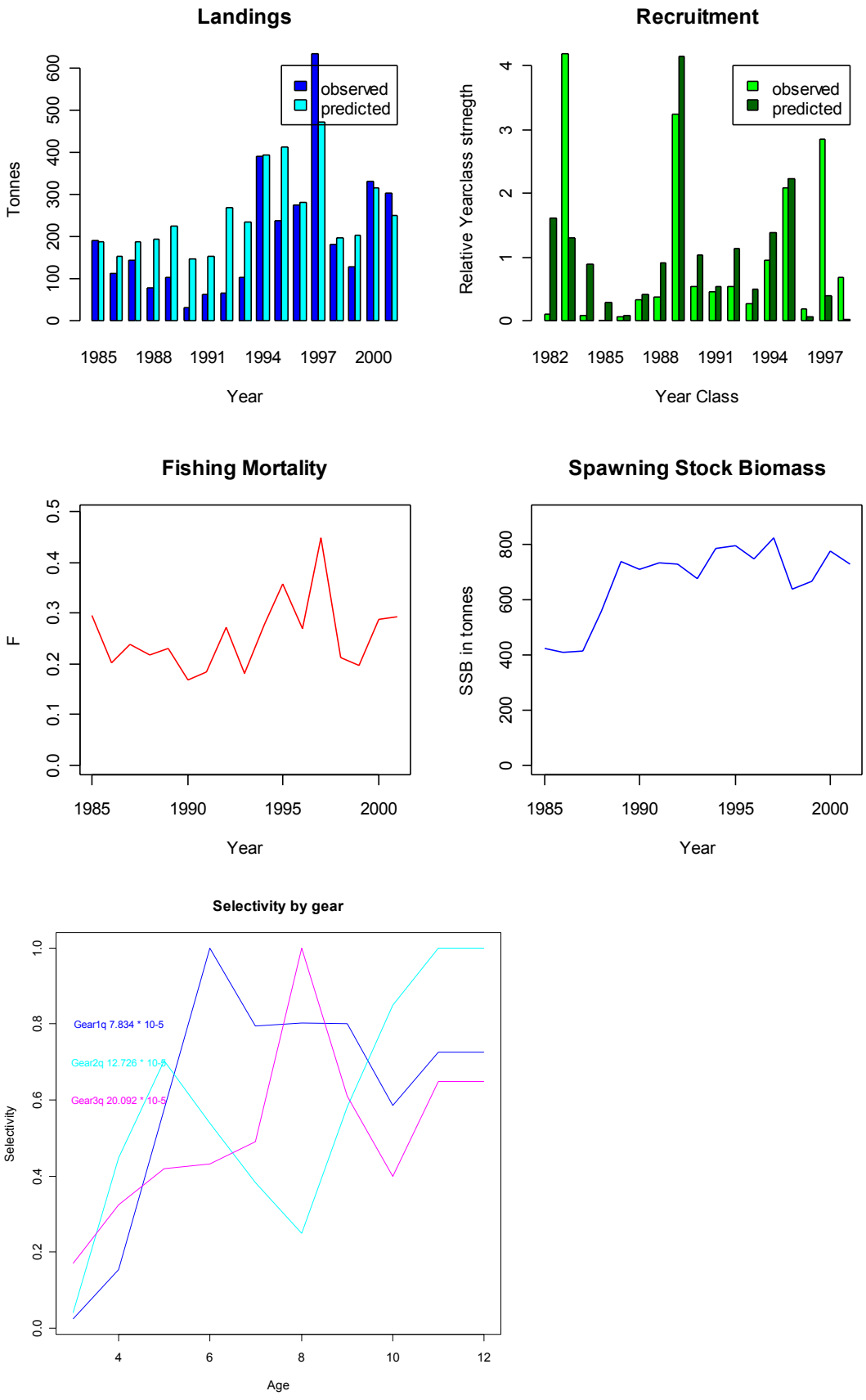


Figure 4.3.2 (Cont'd)

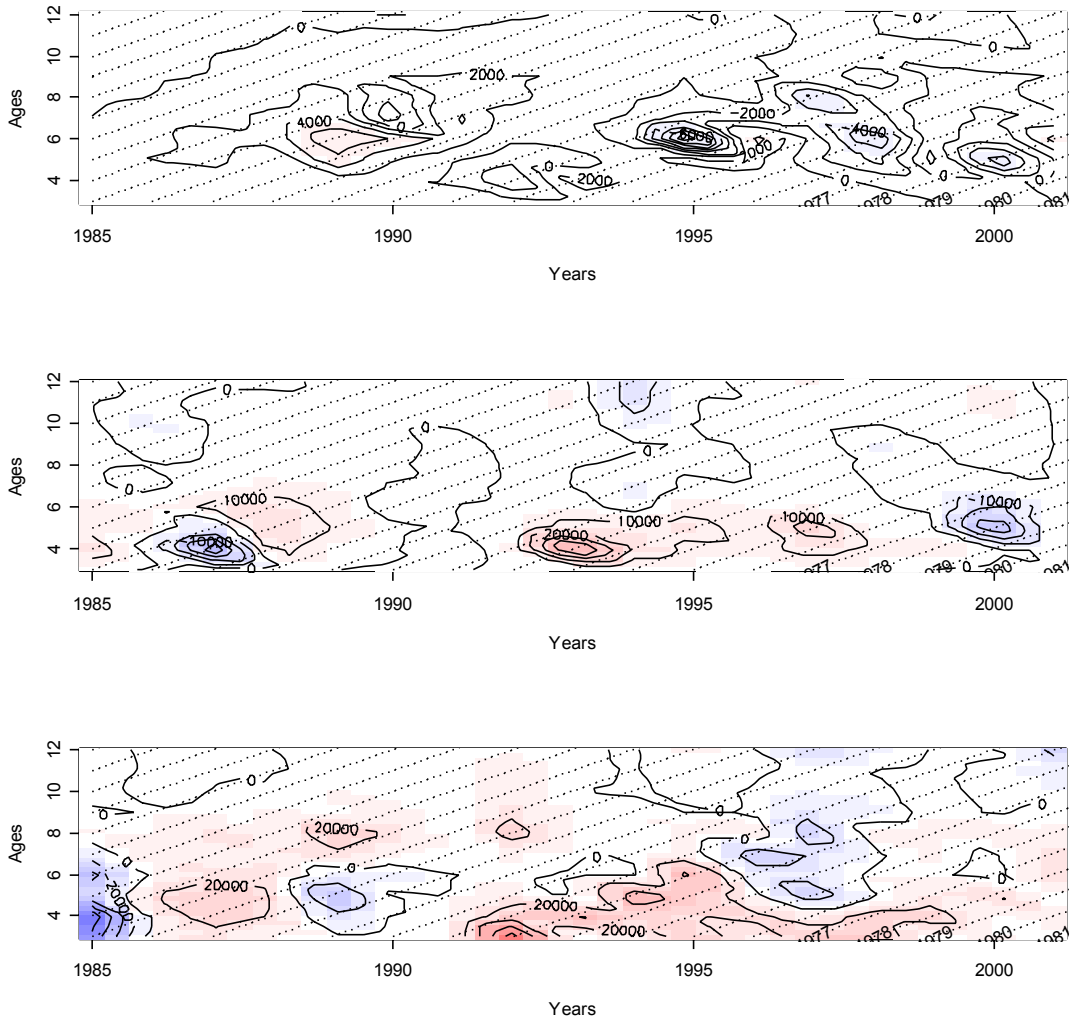
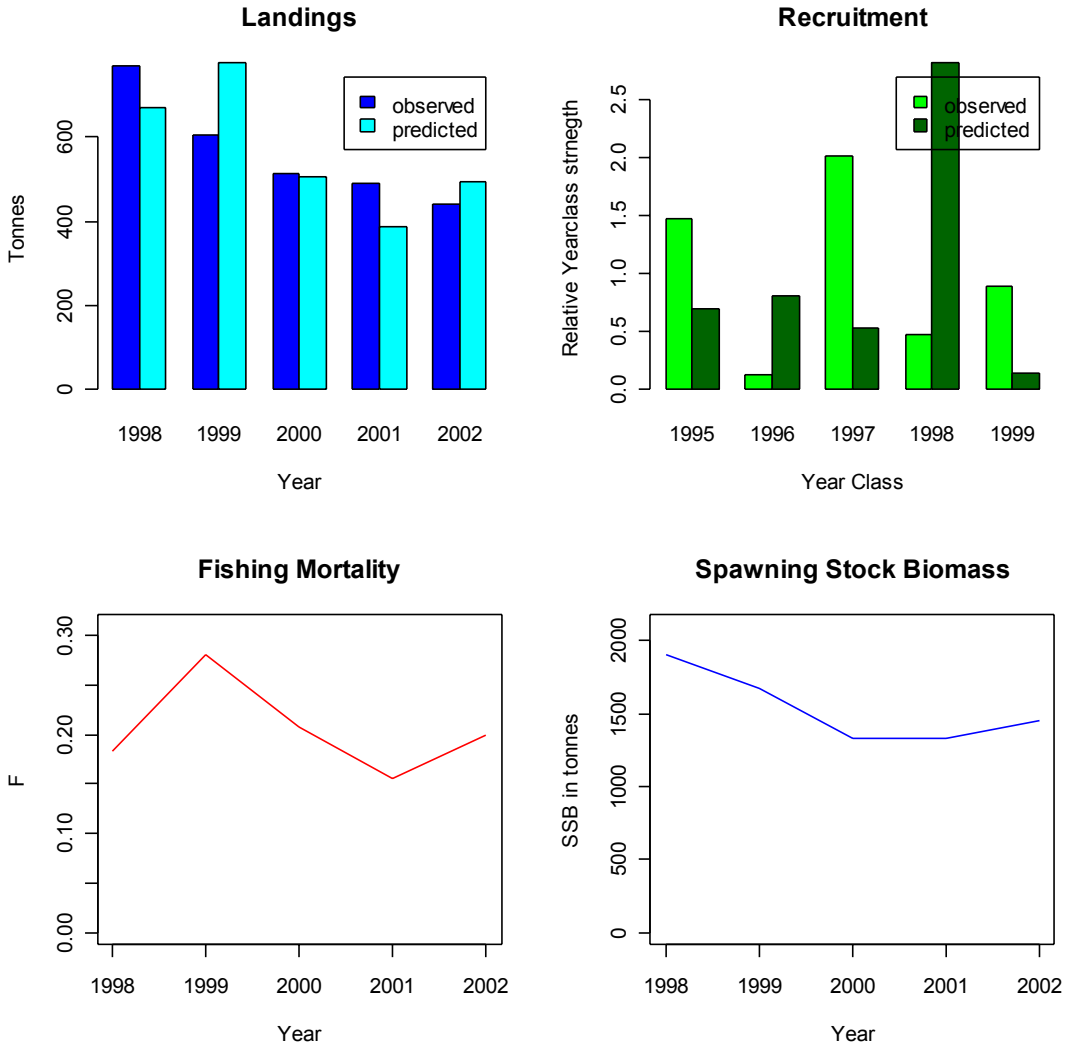


Figure 4.3.3 Estimated catch, recruitment (age 3), fishing mortality and spawning biomass of bass in VIId,e,h offshore, together with recorded landings, 1985 - 2001, and model fit residuals.



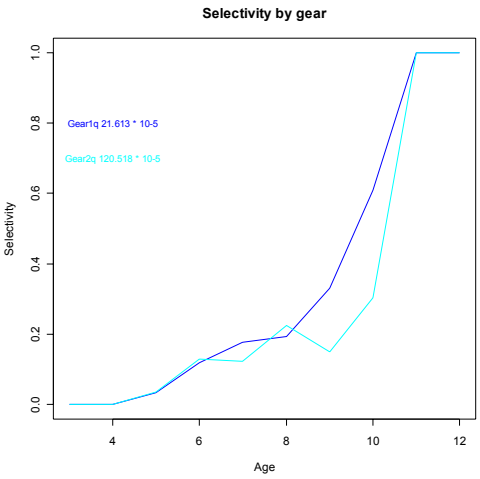
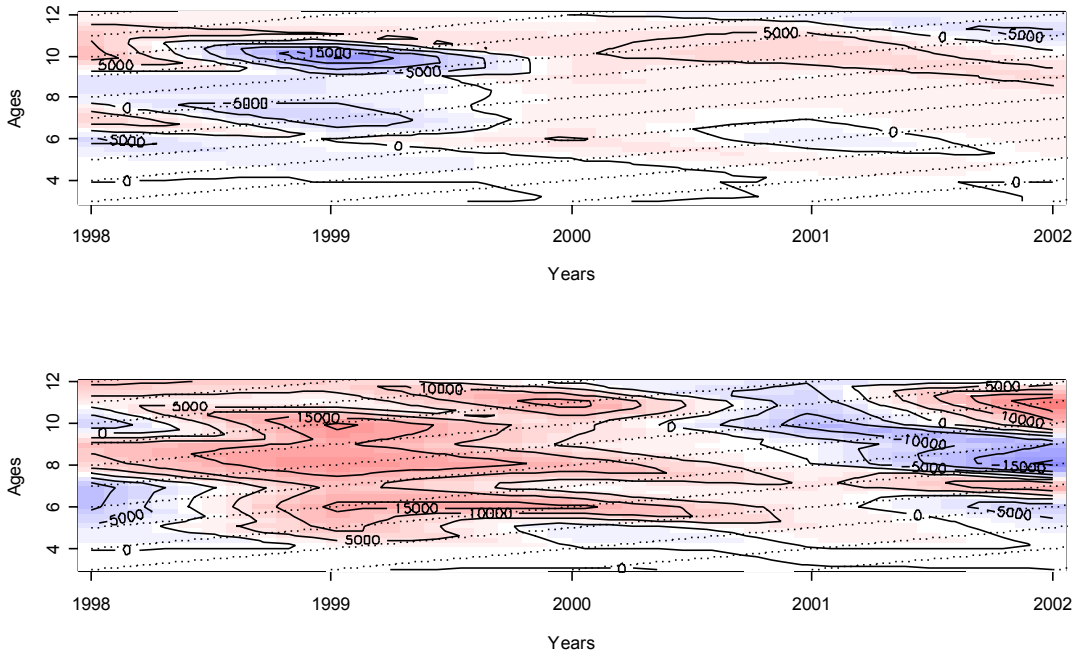


Figure 4.3.3 (Cont'd)



5 Assessment Data Collection and Recommendations for Sampling Schemes

5.1 Bass catches in ICES Sub-areas VII, VIII (or IX)

Section 2.1 provides details of the methods used in each country to estimate landings and fishing effort in fisheries taking sea bass (where appropriate). We recommend that biological sampling programmes are planned in conjunction with methods to estimate catch and effort, taking into account the characteristics of the national fisheries and the pathway through which landed bass reach merchants or the consumer.

5.2 Biological data

The life history traits of bass vary across their environmental range, with fish at the cooler, northern extremes usually exhibiting slower growth, later maturity and longer maximum life spans than those from warmer environments (Pickett and Pawson, 1994). In the sea areas covered by this Study Group, however, the biological parameters of bass are relatively consistent. Around Britain and Ireland, male bass mature at a length of 31-35 cm, aged 4-7 years, and females at 40-45 cm, aged 5-8 years, (Kennedy and Fitzmaurice, 1972; Pawson and Pickett, 1996), and data from the southern part of the Bay of Biscay (Lam Hoai, 1970, Stequert, 1972) indicate that male matures at a length of 35 cm (age 4) and females at 42 cm (age 6). Data provided by Masski (1998) from samples taken from VIIe bottom trawlers (41 females) indicate that 40 % and 82 % of females were mature at age 6 and 7 respectively, with a very small percentage mature at age 5. It is, therefore, unlikely that further work aimed at improving estimates of biological parameters is cost-effective (in relation to other assessment needs).

Nevertheless, the value of the assessments presented in this report depends greatly upon the strong year-class signals observed in the catch-at-age data, which persist from pre-recruit survey series through recruitment to the fishery and for several years of exploitation (up to 15 years of age). Thus, there is considerable reliance of the models used on robust ageing data for surveys and landings, and emphasis must be put upon collection of suitable samples. The following summarises the sampling that is presently carried out, and at **Section 5.5** we make recommendations sampling levels that have been shown to provide a basis for robust assessments.

5.3 Recreational fisheries

Length compositions of bass taken by French recreational fishermen (including some angling competition data) were collected from May 1999 until the end of 2001, distinguishing fishing from the shore and from a boat in the Atlantic and English Channel–North Sea. The analysis of catch curves shows a systematic release of animal under the MLS, and a hypothetical retention ogive was applied to total catch length compositions to estimate more realistic retained catch compositions. The weight of samples were computed using a length-weight relationship. A similar method was used to estimate catch length composition of bass taken by spear gun, using the length composition taken by boat anglers in the Atlantic and applying a selection ogive for length classes around MLS.

Length and age data have been obtained from recreational catches around the UK since the mid 1980s via charter boat skippers and specialist boat anglers, some of whom provided catch data via the CEFAS bass logbook scheme. These data are included in the 'lines' metier gear group (it assumed that selectivity patterns of commercial and recreational line boats are similar), for which the recreational component of catch age compositions has been around the 20-30% level. It is estimated that the level of sampling of the recreational catch is approximately 10% of that for the commercial catch in this category, based on the respective estimates of total "lines" catch for these sectors.

5.4 Commercial fisheries

5.4.1 UK

Lengths are measured from samples of commercial landings of sea bass in English and Welsh fisheries, where a sample is either the whole landing or >50 fish from each commercial (size) category. Targets are set for minimum numbers of length samples by metier-group (groups of metiers using similar gears, e.g. gill nets), within which selectivity may vary by virtue of mesh-size or how the gear is operated. There are over 20 specific gear-types that take bass and obtaining representative sampling for each of these is not practical. In each stock area, length-stratified 'all gears' scale samples are used to provide ALKs. Targets for the number of ages (scale samples) are stratified to ensure a minimum of 5 fish sampled per 1 cm group across the length range in each stock area. To ensure complete coverage of the fishery, including the recreational boat sector, additional samples are collected outside the commercial market system. For

example, samples from UK pair-teams working in the winter offshore fishery have been obtained since 1999, with targets of 500 length and 100 ages met in the winter 2002/03. Length and age samples are entered separately onto the CEFAS Biological Sampling System, following age-determination, checking, and quality control.

Half-yearly (Qs 1,4 – non-growing period and Qs 2,3 – growing period) length samples (target: at least 50 fish/month/metier-group/stock) are then raised, where samples are adequate, to equivalent total landings. This level of sampling enables all-gears, half-yearly, 2 cm grouped ALKs to be constructed, and most contain at least 150 individual fish's ages (>300 fish per year, although more than 1200 have been achieved in some years). Where sampling is sparse (usually because of sampling difficulties with scattered landings), annual ALKs may be used, although this is avoided if possible in the main growth period, Qs 2 and 3. Good length and age composition data are available at the metier-group level for four sea areas (Divisions IVb,c; VIId; VIIe,h; VIIa,f,g) and for the winter offshore pelagic fishery in Sub-area VII. "Stock" files compiled for the period 1985-2002 include age-length distributions, data on mean fish weight by age and by year, and maturity at age, and annual age compositions for these stocks have been worked up using various regional combinations of 4 metier-groups – demersal trawls, gill-nets, lines and pelagic trawls (Sub-area VII divisions combined). Sex ratio, maturity, growth, condition and TL to FL conversion factors are largely derived from biological sampling carried out between 1982 and 1990 (see 5.2 above), and from sampling of the UK offshore fishery in 1999 and 2000. Since 1992, annual UK sampling in the two stock areas processed for analyses covered in this report (VIId, VIIe,h) achieved over 1000 length samples per metier/stock area, and these appear sufficient for assessment purposes (ref. quality of model output).

5.4.2 France

Good biological sampling data (length and age) are available for all métiers in VIIe (except pelagic trawls) for one year, 1989-90, and for all métiers by quarter in VIId,e for 1994-95. Since 2000, a quarterly ALK has been produced for Sub-area VII based on 250 aged individuals, allocated 5 per 1 cm length interval, based on samples from liners' landings at Audierne and from some pelagic trawls catches sampled in winter. Length samples for Div. VIId were combined by commercial category, and then raised to landings by quarter and commercial category for each gear. However, for 2003, the data from Boulogne were separated from other ports in VIId, due to differences in length compositions. Length samples for VIIe were combined and raised by gear where samples were adequate, but where samples were not sufficient, data were aggregated and raised by commercial category, as for VIId. Further studies are required with the available information to provide raised length compositions using the 3 commercial categories found in the statistics.

An annual ALK was applied to the raised length distributions. As with the UK, all ALKs contained at least 150 ages. Currently, the weaknesses in the French data are the lack of an ALK for Sub-area VIII and some difficulties in sampling the offshore fishery. Differences were observed between ALKs constructed for Sub-area VIII (la Rochelle) and for Subarea VII, suggesting that a combined ALK would not be sufficient for the two areas.

5.4.3 Ireland

Biological samples from the Irish bass fishery are available from almost 900 fish caught by anglers since 1996, as scales for ageing and measurements of length, collected chiefly from counties Kerry, Cork, Waterford and Wexford. These catch-at-age data enable stock trends to be visualised, and indicate the passage and durability of strong year classes in the population.

5.4.4 Spain

There are isolated data sets on bass length distributions for catches taken in Spanish jurisdictional waters (for example, for January 1991-July 1992, mainly from Divs VIIIb,c; Puente, 1993), but there are no length distribution or age data of the Basque Country's (or other Spanish) commercial catches of bass in the period 1996-2003.

5.5 Recommendations

Experience of sampling bass catches in the UK and France suggests that a bass sampling programme should produce quarterly (preferably, to avoid bias due to growth or recruitment) or half-yearly all-gear ALKs with a yearly minimum of 300 fish ages (stratified by 2 cm intervals). For some seasonal fisheries (e.g. offshore winter fishery) it may be necessary to merge data for quarters 4 and 1.

For lengths, at least one sample of a minimum of 50 fish by commercial size category or 100 fish if unsorted in landings per month in the bass season from each of the metier groups (trawls, possibly split bottom and mid-water; lines and nets) provides a satisfactory basis for estimating catch-numbers-at-age. The length distributions should be boat-raised in proportion to the weight in each category. The sampling protocol set out above for England and Wales provides guidance, and suggests ways in which the inevitable gaps in data might be circumvented. The major problem with sea bass is that a considerable proportion of national landings comes from small-boat, artisanal fisheries and the recreational sector, which are not well (if at all) sampled through the usual market system for the main commercial quota species. Each country has, therefore, to design a sampling programme around the characteristics of the national fisheries that take bass, bearing in mind that the objective is to derive age structures that represent (through gear selectivity) the population structure of the stock being exploited. Last year's report contains a rationale for designating

"assessment" stock areas for sea bass. Clearly, each country exploiting bass in any one of these areas should endeavour to carry out complimentary sampling that neither duplicates nor leaves important metiers unsampled.

The approach to assessment developed for this report, requires, in addition to appropriate biological sampling, consistent landings and effort data, and attempts should be made to improve coverage of all the main metiers in each stock area. In particular, units of effort may be different for each super metier but are consistent over time, and a better definition is required. Recreational fisheries, because of their potentially high aggregate catches, should be included in future assessments, where possible, but these (especially shore angling, where individual catches may be small) are difficult to sample. With possible changes in management regimes that may favour this sector, it is all the more important to devise appropriate methods for obtaining essential data and France is making rapid progress in this area.

6 Management considerations

The results of this year's assessment support those reported in ICES (2004), that bass stocks in Divisions IVb,c, VIId, VIIe,h and VIIa,f,g, appear to be fished with an exploitation pattern and at a fishing mortality level that causes little growth overfishing, both combining to give a near maximum yield per recruit. The large variability in recruitment strength (with no sign of recruit overfishing) and the intermittent nature of recruitment would indicate that bass stocks require a long-term management strategy of moderate and stable fishing mortalities, thus avoiding the 'boom & bust' scenarios associated with the rapid depletion of good year classes in high F fisheries. Management achieving a moderate level of fishing mortality would lead to a higher average spawning stock biomass and lower fluctuations in yield.

The SGBASS reiterates its advice that implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted, and that 'output' controls (such as TACs) are inappropriate. Climate warming strongly favours bass recruitment and production and, given the uncertainties in the assessment, the precautionary approach indicates that effort should not be allowed to increase.

Uniquely, for a European marine fish species, bass is equally important to inshore artisanal fishermen, offshore fisheries, and recreational anglers, and has a high socio-economic value. Considerations of the management and regulation of bass fisheries must take this into account and, in ICES (2004, section 7), SGBASS presented the results of indicative analyses in which the effects of a number of management options on the various sectors have been explored.

7 Recommendations for future work

1) The compilation and analysis of the available data on bass for stock areas VIId; VIIe (north); and VIIe (offshore) was taken as far as possible prior to the preparation of this report, and the fully statistical age structured assessments for these areas clearly indicate that there is consistent information on year class strength, and on fishing mortality and biomass trends. Last year's results, indicating a higher abundance of bass in north European fisheries in the mid-late 1990s than in the late 1980s, have been validated for VIId and VIIe north, though it would be useful to extend this analysis to IVb,c and VIIa,f,g to further examine whether the increase is more marked in the two eastern stocks (IVc, VIId) and especially in the North Sea.
2) There are insufficient data to carry out analytical assessments of bass in waters in Sub-areas VIII (or IX), and SGBASS recommend that the collection of biological data is strengthened for bass landings in these areas and for bass catches in Ireland, where landings data from a commercial fishery are not available. The insights gained by such an analysis in conjunction with further examination of the linkages between bass stocks should allow for a more adequate examination of the dynamics of the bass population in North-west Europe and how the stocks might respond to changes in the fisheries.
3) It is important that contracts between Member States and the EU in response to the Data Collection Regulation ensure that adequate assessment data are collected by ICES divisions, and that bass catches taken in recreational fisheries should be included. A summary of data needs in relation to potential analytical approaches is given in Section 5.
4) The SGBASS re-iterates its recommendation that every attempt is made to maintain and improve monitoring of 0-group and pre-recruitment abundance, and to improve our understanding of environmental effects on bass distribution and abundance.

8 Working Documents

WD 1. Lucio, P., Díez, D., Quincoces, I., Santurtún, M. & Iriondo, A., 2004. Notes on the Basque fishery on sea bass (*Dicentrarchus labrax*) in the Northeastern Atlantic waters in 2003. Working Document presented to the ICES Study Group on Bass. June 2004.
WD2. Kupschus, S., 2004. A description of the separable catch-at-age model used to assess the status of the three sea bass (*Dicentrarchus labrax*) stocks (VIIe inshore, VIIe offshore and VIId), input data and output. Working document presented to the ICES Study Group on Bass, July 2004. (at ANNEX 1)

9 References

Dunn, M.R. and Potten, S., 1994. National Survey of Bass Angling: Report to the Ministry of Agriculture, Fisheries and Food. University of Portsmouth, Centre for the Economics and Management of Aquatic Resources. 45pp + appendices.

Dunn, M., Potten, S., Radford, A. and Whitmarsh, D., 1989. An Economic Appraisal Of the Fishery for Bass in England and Wales. Report to the Ministry of Agriculture, Fisheries and Food. University of Portsmouth. 217 pp.

ICES, 2002. Report of the Study Group on Sea Bass. ICES CM 2002/ACFM: 11 Ref G.

ICES, 2004. Report of the Study Group on Bass, Lowestoft, England 18-22 August 2003, ICES CM 2004/ACFM:04, 73 pp

Kennedy, M. and Fitzmaurice, P., 1968. Occurrence of eggs of bass, *Dicentrarchus labrax*, on the southern coasts of Ireland. *Journal of the Marine Biological Association of the U.K.*, 48: 585-592.

Lam Hoai Thong., 1970. Contribution à l'étude des Bars de la région des Sables d'Olonne. *Trav. Fac. Sci. Rennes, Ser. Océanogr. Biol.,* 3: 39-68.

Masski, H., 1998. Identification de Frayères et Etude des Structures de Population de Turbot (Psetta maxima L.) et du Bar (Dicentrarchus labrax L.) en Manche Ouest et dans les Zones Avoisinantes. Thèse présentée a la Faculte des Sciences de Brest. Universite de Bretagne Occdentale. 136pp + annexes.

Morizur Y., Tregenza N., H. Heessen, S. Berrow and S. Pouvreau, 1996. By-catch and discarding in pelagic trawl fisheries. DGXIV-étude bioéco/93/017, 124pp + annexes.

Pawson, M. G., D. F. Kelley and Pickett, G. D., 1987. "The distribution and migrations of bass *Dicentrarchus labrax* L. in waters around England and Wales as shown by tagging". J. mar. biol. Ass. UK, **67**: 183-217.

Pawson, M.G. and Pickett, G.D., 1996. The annual pattern of condition and maturity in bass (*Dicentrarchus labrax* L.) in waters around England and Wales. *Journal of the Marine Biological Association of the U.K.*, 76: 107 – 125.

Pickett, G. D., 1990. Assessment of the UK bass fishery using a log-book based catch record system. MAFF Tech. Rep. DFR Lowestoft (90) : 33 pp.

Pickett, G. D. and Pawson, M. G., 1994. Sea Bass, Biology, exploitation and management. Chapman and Hall, London, Fish and Fisheries Series 12: 358pp.

Pickett, G. D., D. F. Kelley and M. G. Pawson (2004). The patterns of recruitment of sea bass, *Dicentrarchus labrax* L. from nursery areas in England and Wales and implications for fisheries management. Fisheries Research, **68**, 329-342.

Puente, E., 1993.- La pesca artesanal en aguas costeras vascas. Publicaciones del Gobierno Vasco. Colección Itsaso nº 11.Vitoria-Gasteiz, 1991. 191 p.

Stequert, B., 1972. Contribution à l'étude du bar *Dicentrarchus labrax* (L.) des reservoirs à poissons de la région d'Arcachon. Th. 3ème cyear classle: Faculté des Sciences.

ANNEX 1

A Description of the Separable Catch-at-Age Model used to assess the status of the three Bass Stocks (VIIe Inshore, VIIe Offshore and VIId), Input Data and Output

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Model basis

The model is based on the stock synthesis framework described by Methot (1990). In this implementation it represents a separable catch-at-age model, assuming a linear relationship between effort and fishing mortality, with natural mortality assumed to be 0.1 (as in all previous sea bass assessments). Catch numbers at age are assessed without aging error (stage 1 synthesis model in Methot,1990). Effort (assumed to be known without error) and catch-at-age information are used explicitly in the model, with the sum of landings by fleet being equal to the total landings. The following parameters are estimated by means of the autodifferentiation functions developed in AD-Modelbuilder (ADM code and data files area attached):

1. q vulnerability to each gear
2. s selectivity at age for each gear (selectivity for the plus group assumed equal to the previous age group)
3. recruits
4. numbers at age in the first year

The model is constrained by the assumption of constant vulnerability for each gear and constant selectivity at age within a gear. Selectivities are constrained between 0 and 1 to avoid correlation with vulnerability. Fishing mortality at age is the product of effort, vulnerability and selectivity. Parameter fits are determined primarily by maximisation of the Gaussian likelihood, given differences between observed catches at age and predicted catches at age in relation to the parameters. In cases where catch at age information is not available for a given fleet and year combination, predicted catches at age are summed and expressed as landings, taking into account differences between the expected landings and observed landings. Residuals landings are minimised in the same way as residual catches-at-age. Although this represents more of a stock-reduction model containing substantially less information than the catch at age component, it does allow for the model to be applied to data with gaps in the age information, resulting in much longer usable timeseries and better information regarding stock dynamic trends than would be possible in either model separately.

As is the case with most catch-at-age models, F and SSB, or fishing mortality at age and numbers at age in their unadulterated form are highly correlated. This frequently leads to estimations of high SSB and low F. To constrain the model away from very low F's when using the log-likelihood maximisation, catch curves are used to roughly estimate total fishing mortality from all gears at maximally selected ages and then penalise the model for departures from this total F. Therefore, the total penalty function is made up of the sum of the catch log-likelihood, the landings log-likelihood (where applicable), minus the penalty function for departures from the total F. Generally, the proportion of the total penalty function due to the latter penalty function has been kept to less than 0.1%. However, the choice of the penalty weighting is subjective, so that values of recruitment, F-at-age and numbers-at-age are more accurate on the relative scale, and less reliance should be put on the absolute values indicated by the model.
The model code is given below, along with the input and output data for the three stocks assessed this year (VIId, VIIe inshore and VIIe offshore).

It is intended that further model development will allow the inclusion of the uncertainty regarding age sampling and length sampling using multinomial likelihood penalty functions, as described in the more advanced models (stage 2/3 in Methot, 1990). In addition, there is a need to incorporate several stocks into a single model capable of parameterising the extent of migrations between them, which should lead to a better understanding of the stock dynamics and exploitation patterns of all stocks.

Caveats:

The model is heavily reliant on the accurate determination of effort levels and to the assumption of linearity between fishing mortality rate and effort, as well as constant catchability by fleet. The later is questionable for fleets such as the netters, where targeting of strong year classes has been observed in the fishery. Precision in the catch-at-age information is less critical than most catch-at-age models, due to the inclusion of landings data as well as the large number of year classes in most bass fisheries, which tend to smooth out variability in the catch-at-age data. Further model development is necessary to derive better estimates of absolute values for F and stock size by reparameterising the model in such a way as to reduce the correlation between the two parameters.

References:

Methot, R.D. 1990. Synthesis model: An adaptable framework for analysis of diverse stock assessment data. *Proceedings of the Symposium on Application of Stock Assessment Techniques to Gadids*. 1990 pp. 259-277, I.N.P.F.C. Bull., no. 50.

```
AD model builder template for stock synthesis model used in bass assessments for SGBASS 2004
DATA_SECTION
  init_int gears
  init_int nyrs
  init_int nages
  init_int first_year
  init_int first_age
  init_matrix effort(1,gears,1,nyrs)
  init_3darray obs_catch_at_age(1,gears,1,nyrs,1,nages)
  //3darray obs_catch_at_age(1,gears,1,nyrs,1,nages)
  init_matrix Landings(1,gears,1,nyrs)
  init_matrix weight_at_age(1,nyrs,1,nages)
  init_vector maturity(1,nages)
  init_number M
  init_number startF
  init_number f_penalty
INITIALIZATION_SECTION
  log_qs -12.7
  log_year1 6
  log_recruit 9
PARAMETER_SECTION
  init_bounded_vector log_qs(1,nages*gears-gears,-30.,0.,1)
  init_bounded_vector log_year1(1,nages-1,-15.,35.,3)
  init_bounded_vector log_recruit(1,nyrs,-15.,35.,2)
  matrix log_sel(1,gears,1,nages)
  vector log_initpop(1,nyrs+nages-1)
  //init_bounded_dev_vector effort_devs1(1,nyrs,-5.,5.,4)
  //init_bounded_dev_vector effort_devs2(1,nyrs,-5.,5.,4)
  //init_bounded_dev_vector effort_devs3(1,nyrs,-5.,5.,4)
  //matrix effort_devs(1,gears,1,nyrs)
  matrix sel(1,gears,1,nages)
  vector q(1,gears)
  3darray F(1,gears,1,nyrs,1,nages)
  matrix F_tot(1,nyrs,1,nages)
  matrix Z(1,nyrs,1,nages)
  matrix S(1,nyrs,1,nages)
  matrix N(1,nyrs,1,nages)
  3darray C(1,gears,1,nyrs,1,nages)
  vector SSB(1,nyrs)
  vector TSB(1,nyrs)
  matrix CatchWeight(1,gears,1,nyrs)
  vector PredictedLandings(1,nyrs)
  number tempF
  number avg_F
  number penalty
  number CATtest
  matrix missCAT(1,gears,1,nyrs)
  number LandError
  number CatchError
  3darray residuals(1,gears,1,nyrs,1,nages)
  matrix residualLand(1,gears,1,nyrs)
  number test
  3darray test1(1,gears,1,nyrs,1,nages)
  3darray test2(1,gears,1,nyrs,1,nages)
  objective_function_value f
```

```
PRELIMINARY_CALCS_SECTION
  //effort = effort/(sum(effort)/double(size_count(effort)));
  //for (int g=1; g <= gears;g++)
  //{  meanCatch(g)= sum(obs_catch_at_age1(g))/(nyrs*nages);
  //   for (int i=1; i <= nyrs; i++)
  //   {  for ( int j=1; j <= nages; j++)
  //      {  obs_catch_at_age(g,i,j)=(obs_catch_at_age1(g,i,j)/(meanCatch(g)));
  //}  }  }
  //Landings = Landings/(sum(Landings)/double(size_count(Landings)));

PROCEDURE_SECTION
  // example of using FUNCTION to structure the procedure section
  get_mortality_and_survivial_rates();

  get_numbers_at_age();

  get_catch_at_age();

  calculate_TSB_SSB();

  check_for_missing_years();

  evaluate_the_objective_function();

  calc_predicted_landings();

FUNCTION get_mortality_and_survivial_rates
  // calculate the selectivity from the sel_coffs
  for (int g=1; g <= gears; g++)
  {  for (int j=1; j <= nages; j++)
     {  if(j < nages)
        {  log_sel(g,j)=log_qs((g-1)*(nages-1) + j);
        }
        else
        {  log_sel(g,j)=log_sel(g,j-1);
  }  }  }

  //effort_devs(1) = effort_devs1;
  //effort_devs(2) = effort_devs2;
  //effort_devs(3) = effort_devs3;

  for (int g=1; g <= gears; g++)
  {  for (int j=1;j <= nages;j++)
     {  for (int i=1;i <= nyrs;i++)
        {  F(g,i,j)=exp(log_sel(g,j)) * (effort(g,i)); // + effort_devs(g,i));
  }  }  }

  F_tot = 0;
  for (int j=1;j <= nages;j++)
  {  for (int i=1;i <= nyrs;i++)
     {  for (int g=1; g <= gears; g++)
        { F_tot(i,j)+=F(g,i,j);
  }  }  }

  // get the total mortality
  Z=F_tot+M;
  // get the survival rate
  S=mfexp(-1.0*Z);

  for (int g=1; g <= gears; g++)
  {  q(g)=max(exp(log_sel(g)));
     sel(g)=exp(log_sel(g))/q(g);
  }
```

```
FUNCTION get_numbers_at_age
  for (int i=1;i<=nyrs;i++)
  {
   N(i,1)=mfexp(log_recruit(i));
  }
  for (int j=2;j<=nages;j++)
  {
   N(1,j)=mfexp(log_year1(j-1));
  }
  for (int i=1;i<nyrs;i++)
  {
    for (int j=1;j<nages;j++)
    {
      if(j == nages-1){
        N(i+1,j+1)=N(i,j)*S(i,j) + N(i,j+1)*S(i,j+1);
      }
      else{
        N(i+1,j+1)=N(i,j)*S(i,j);
  }  }  }

FUNCTION get_catch_at_age
  for (int g=1; g<= gears; g++)
  {  for (int i=1; i <= nyrs; i++)
     {  for ( int j=1; j <= nages; j++)
        {  C(g,i,j)=(F(g,i,j)/Z(i,j))*(1-S(i,j))*N(i,j);
  }  }  }
  residuals = C-obs_catch_at_age;

FUNCTION calculate_TSB_SSB
  TSB = 0;
  SSB = 0;
  for (int i=1;i <= nyrs; i++)
  {  for (int j=1; j <= nages; j++)
     {  SSB(i)+=N(i,j)*weight_at_age(i,j)*maturity(j);
        TSB(i)+=N(i,j)*weight_at_age(i,j);
  }  }

  for (int g=1; g<= gears; g++)
  {  for (int i=1; i <= nyrs; i++)
     {  CatchWeight(g,i) = sum(elem_prod(C(g,i),weight_at_age(i)));
  }  }

FUNCTION check_for_missing_years

  for (int g=1; g <= gears; g++)
  {  for (int i=1; i <= nyrs; i++)
     {  CATtest = 0;
        for ( int j=1; j <= nages; j++)
        {  if(obs_catch_at_age(g,i,j) < 0)
           {   residuals(g,i,j) = 0.;
               CATtest+=1;
           }
           if (CATtest == nages)
           {  missCAT(g,i) = 1.;
  }  }  }  }

FUNCTION calc_predicted_landings
  PredictedLandings = 0;
  for (int i=1; i <= nyrs; i++)
  {  for (int g=1; g<= gears; g++)
     {  for ( int j=1; j <= nages; j++)
        {  PredictedLandings(i)+= C(g,i,j)*weight_at_age(i,j);
  }  }  }
```

```
FUNCTION evaluate_the_objective_function
  // penalty functions to ``regularize '' the solution
  //f+=.01*norm2(log_recruit);//penalizes large fluctuations in the relative
                        //population size.
  tempF = 0.0;
  for (int i=1; i <= nyrs; i++)
  {  for (int j=3; j <= (nages-1); j++)
     {  tempF+=F_tot(i,j);
  }  }
  avg_F=tempF/(nyrs*(nages-3));

  if (last_phase())
  {     // a very small penalty on the average fishing mortality
    penalty= f_penalty*square(square(log(avg_F/startF)));
    f+=penalty;
  }
  else
  {
    penalty= 10e15*square(square(log(avg_F/startF)));
    f+=penalty;
  }

  //----- if catch at age missing for years use Landings for miniisation -----

  residualLand = 0.;
  for (int g=1; g <= gears; g++)
  {  for (int i=1; i <= nyrs; i++)
     {  residualLand(g,i)=(CatchWeight(g,i)-Landings(g,i));
  }  }
  dvar3_array var = 0.01+(C);
  dvar3_array r=residuals;
  CatchError =0.5*sum(log(var))+0.5*sum(elem_div(square(r),var));
  dvar_matrix var2 = 0.01+(CatchWeight);
  dvar_matrix rLand = residualLand;
  LandError = 0.5*sum(log(var2))+0.5*sum(elem_div(square(rLand),var2));
  f+=CatchError+LandError;

   //+ 0.1*norm2(effort_devs1) + 0.1*norm2(effort_devs2) + 0.1*norm2(effort_devs3);
   // + 20*norm2(effort_devs1) + 20*norm2(effort_devs2) + 20*norm2(effort_devs3);
```

```
REPORT_SECTION
  report << gears << endl;
  report << nyrs << endl;
  report << nages << endl;
  report << first_year << endl;
  report << first_age << endl;
  report << endl;
  report << "PopulationNumbers " << endl;
  report << N << endl;
  report << "CatchNumbers " << endl;
  for (int g=1; g<= gears; g++)
  {  report << "Gear" << g << endl;
    report << C(g) << endl;
  }
  report << "ObservedCatch" << endl;
  for (int g=1; g<= gears; g++)
  {  report << "Gear" << g << endl;
    report << obs_catch_at_age(g) << endl;
  }
  report << "FishingMort " << endl;
  for (int g=1; g<= gears; g++)
  {  report << "Gear" << g << endl;
    report << F(g) << endl;
  }
  report << "Residuals" << endl;
  for (int g=1; g<= gears; g++)
  {  report << "Gear" << g << endl;
    report << residuals(g) << endl;
  }
  report << "qs" << endl;
  for (int g=1; g<= gears; g++)
  {  report << "Gear" << g << endl;
    report << log_sel(g)  << endl;
  }
  report << "Residual Landings" << endl;
  report << residualLand << endl;
  report << "Zero Catch" << endl;
  report << missCAT << endl;
  report << "Catch weights" << endl;
  report << CatchWeight << endl;
  report << "Landings" << endl;
  report << Landings << endl;
  report << "PredictedLandings" << endl;
  report << PredictedLandings << endl;
  report << "TotalMort" << endl;
  report << Z << endl;
  report << "TSB" << endl;
  report << TSB << endl;
  report << "SSB" << endl;
  report << SSB << endl;
  report << "weights at age" << endl;
  report << weight_at_age << endl;
  report << "mortality" << endl;
  report << M << endl;
  report << "proportion due to penalty" << endl;
  report << penalty/f << endl;
  report << "penalty  " << penalty << endl;
  report << "Average F " <<  avg_F << endl;
  report << "Z" << Z << endl;
  report << "LandingsError " << LandError << endl;
  report << "Catch at Age Error " << CatchError << endl;
  report << "ratio L C error " << LandError/CatchError << endl;
```

Input Data for Assessment for VIId Bass Stock

```
#7d bass data for catage8q
3
17
11
1985
2
#Effort Trawls
0       2610    2929    4116    4810    3678    3963    6751    7762    11290   10695   3909    3931    4481    4420    5165    5507
#Effort Nets
13911   14032   18062   13662   10190   13405   19000   16884   25998   24100   13832   4984    14591   6938    7489    9557    2592
#Effort Lines
16670   17777   22386   17611   21307   13428   24878   45180   20685   33102   30131   17168   18310   17702   31495   8038    9361

#CatchNumbers Trawls
0       0       0       0       0       0       0       0       0       0       0
0       232     754     534     219     778     230     377     1859    437     1397
0       190     15199   19816   5116    307     603     0       204     1046    2528
0       173     11725   34981   8513    2524    77      269     361     0       2019
40778   5460    327     3223    10274   2903    1062    588     485     0       4829
0       269     457     647     1246    9925    6217    1856    569     344     2458
0       43      9611    406     71      250     1755    2485    1219    0       4806
0       3588    18248   8804    277     0       454     1499    208     0       1422
0       140     28387   37082   10767   191     119     234     1206    605     799
0       902     4204    137898  9290    2445    150     20      78      588     1502
0       70      2167    9403    103859  3628    2067    172     114     0       2181
0       187     3090    8315    11019   36405   1508    825     52      66      914
0       95      1881    14487   11991   5362    30573   934     342     56      571
0       190     10372   14710   26974   11294   3943    12090   470     141     140
87      0       40930   65615   12563   9107    1568    712     3913    100     0
0       2062    1147    55447   19231   1645    1009    289     65      157     383
223     1325    42460   8778    41551   6509    988     1529    304     382     1194

#CatchNumbers Nets
0       41012   104666  11557   855     305     1282    2686    0       3662    0
0       18022   13830   15566   2744    4797    84      880     2434    191     4621
0       291     17596   67855   7473    1671    785     785     336     1009    10427
0       0       157     23117   4351    5478    2726    3514    2556    242     32134
2727    933     1111    6441    38412   6271    1788    232     50      0       0
0       2778    3591    4033    3408    26630   17619   2966    3397    1076    2683
0       139     24678   1164    0       2171    9880    8408    4320    299     10810
0       18478   59329   35454   588     69      117     196     131     49      258
0       513     76886   62638   18068   567     110     597     2327    1732    2722
8       379     13414   415030  46057   17672   1385    190     1234    5357    20475
0       996     14860   40449   163052  2133    890     27      5       135     1312
0       97      7251    17023   14021   44734   2224    1144    70      51      858
0       441     7410    54977   37118   14306   96894   5981    2822    1001    4095
0       221     15068   20680   13209   5348    2087    7312    610     180     255
40      0       35417   74082   17372   10780   1639    762     3068    154     713
0       1790    882     96566   34686   2927    1863    574     145     1089    557
119     693     24310   2737    24808   7274    1166    1231    888     291     988

#CatchNumbers Lines
0       9336    11906   3934    6231    629     2439    9457    2266    1322    4091
0       2183    13895   10818   2512    6888    1547    2676    15264   3345    24814
0       81      7678    21444   14447   4402    2201    4534    3264    7201    21009
0       0       5063    44114   7436    4493    956     1656    581     503     7458
0       0       0       0       0       4215    9483    3161    6322    0       27394
0       175     642     1103    3055    19394   13162   4505    2004    1524    7798
0       316     27220   1422    150     1747    12923   10636   5184    201     29545
0       11717   71666   61804   1433    1073    1947    5556    3957    1226    3837
0       173     33565   47680   43192   2462    581     3850    19553   14993   38607
0       289     21417   424164  69169   46926   2662    268     2112    13007   27774
0       140     7422    19842   74495   3772    4618    176     892     325     18130
0       488     20841   30686   21805   97912   10174   12553   227     1169    19182
0       712     8031    39123   28582   14371   113542  6044    4159    1502    11218
0       258     9655    18058   38452   18958   9686    47314   4664    1894    5251
55      0       44810   110505  39814   37530   14679   9619    62123   4024    17910
0       1034    726     43397   26917   4722    5475    2581    951     6357    2222
184     796     23836   3979    43476   16848   3519    5089    2909    2424    10361

#Landings Trawls
35330   11760   26350   40760   43080   30710   35060   27870   51660   95430   96010   52040   56990   75700   91670   54870   69330
#Landings Nets
102300  45290   86420   123570  43510   123570  82430   64580   121640  438560  149500  76820   219930  52520   112340  98780   48000
#Landings Lines
43870   128140  124720  53220   124410  53220   128660  135000  300670  522430  146960  248780  245390  186870  415940  91130   48780
#Weight at age
0.1     0.2806  0.532   0.6035  0.697   0.949   1.564   1.777   1.774045455     2.4465  2.595
0.1     0.2806  0.462   0.69    0.8165  0.918   1.3155  1.7375  1.6695  2.5755  2.6965
0.1     0.423   0.5275  0.542   0.601   0.7595  0.948   1.263   1.9635  1.2715  2.812
0.1     0.2806  0.608   0.6495  0.744   0.884   1.083   1.5045  1.852   2.6075  2.394
0.1     0.2806  0.5845  0.681   0.928   0.958   1.403   1.6065  1.8825  2.621   3.1885
0.1     0.2806  0.472   0.7015  0.7985  0.8265  1.3095  1.479   1.871   2.079   2.5305
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.1     0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
#Maturity
0       0       0.03    0.23    0.43    0.57    0.9     1       1       1       1
#M
0.1
#Start F
0.2
#F penalty
2000
```

Results for VIId Bass Stock

```
#7d bass results from catage8q
3.00
17.00
11.00
1985.00
2.00

PopulationNumbers
       795323.00      759298.00      679844.00      89174.60       89977.60       43649.70       31699.30       193109.00      43887.90       189874.00      129674.00
       176049.00      718856.00      675873.00      574008.00      65876.60       68329.70       32478.50       23163.40       156544.00      35030.20       260918.00
       38543.30       158039.00      638298.00      563978.00      412084.00      48762.60       49513.00       23061.50       18450.10       123231.00      239368.00
       133010.00      34560.70       139631.00      521607.00      381239.00      289503.00      33353.30       33009.60       17782.70       14010.00       284772.00
       792230.00      118938.00      30661.20       116029.00      371273.00      279939.00      208221.00      23493.60       26148.80       13963.70       241397.00
       924584.00      707279.00      105762.00      25546.10       82721.90       273844.00      200781.00      146272.00      18437.80       20241.60       204755.00
       4143450.00     827749.00      628267.00      88665.40       18712.80       62175.60       202910.00      146077.00      118285.00      14845.90       185169.00
       507514.00      3704980.00     729746.00      507994.00      58179.80       12813.90       41317.90       131097.00      110608.00      88129.50       154847.00
       596305.00      450514.00      3255500.00     569846.00      296250.00      36288.80       7507.8023288.80      90373.00       73407.10       173242.00
       826513.00      527700.00      393420.00      2555390.00     350700.00      190520.00      22900.50       4583.6317284.50      67062.70       189570.00
       482808.00      724742.00      459468.00      300833.00      1448330.00     211021.00      110307.00      12735.90       3189.5111905.30      187230.00
       1387310.00     424328.00      638120.00      365307.00      189042.00      956921.00      134144.00      67960.80       9263.442292.12151042.00
       1854350.00     1241950.00     379808.00      545688.00      279825.00      148557.00      734161.00      101432.00      55320.20       7447.32126882.00
       150075.00      1658840.00     1100850.00     314567.00      384651.00      203734.00      105863.00      511915.00      79974.50       43199.50       108006.00
       2007440.00     134131.00      1481090.00     932889.00      235419.00      295944.00      153065.00      78234.20       412348.00      63706.00       124112.00
       230929.00      1794210.00     119447.00      1227000.00     644578.00      170026.00      204205.00      103124.00      59351.30       303902.00      145563.00
       203760.00      206005.00      1599220.00     101633.00      943097.00      504495.00      132159.00      156555.00      85638.40       49481.20       380756.00
CatchNumbers
Gear1
       0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
       1137.50 1476.27 5993.13 10524.50 1133.31 1115.37 567.79  259.77  1032.41 147.34  1097.45
       279.32  363.34  6287.78 11280.90 7761.67 869.32  943.10  285.76  134.22  573.50  1113.98
       1352.71 111.88  1948.62 15021.20 10303.70 7426.20 916.07  582.26  184.73  92.88   1887.92
       9408.04 450.46  500.68  3907.77  11751.20 8380.58 6674.66 482.11  315.27  107.79  1863.37
       8407.29 2047.25 1324.57 666.37   2020.08  6366.18 5003.57 2328.55 173.23  120.99  1223.85
       40571.90 2572.08 8331.05 2366.55 471.18   1479.65 5153.54 2427.84 1153.76 92.84   1157.97
       8435.35 19579.90 16210.50 21877.50 2389.62 490.19  1679.30 3550.56 1740.47 902.82  1586.30
       11378.20 2729.14 83354.40 28919.90 14189.20 1651.39 363.85  750.92  1723.23 896.00  2114.58
       22836.20 4643.00 14469.20 181675.00        23694.40 12122.60 1547.14 208.52  462.81  1161.46 3283.16
       12650.90 6073.71 16309.70 21239.50 96787.60 13276.30 7396.64 560.44  82.53   198.97  3129.04
       13406.80 1310.26 8576.09  10345.30 5011.94  24038.50 3618.59 1153.49 92.43   14.60   962.04
       18014.70 3838.14 5054.07  14939.70 7193.84  3623.57  19166.10 1704.91 547.38  47.04   801.50
       1661.20  5864.59 16885.30 10099.30 11572.30 5808.47  3238.08 9909.78 910.70  314.18  785.51
       21918.40 467.15  22163.20 28449.00 6779.20  7994.42  4421.26 1451.54 4462.76 444.56  866.10
       2943.64  7305.28 2115.94  45988.00 22536.40 5678.89  7326.58 2335.18 796.35  2586.88 1239.07
       2768.72  897.14  30479.70 4151.06  35897.90 18298.50 5158.73 3802.37 1229.98 451.60  3475.01
Gear2
       728.40  9924.48 27309.50 8540.65  8114.17  3660.70  2896.48  6790.36 1290.51 5989.44  4090.49
       162.09  9466.14 27230.10 54707.40 5919.83  5708.17  2953.17  814.66  4612.35 1109.53  8264.16
       45.65   2672.29 32768.80 67259.70 46503.20 5102.97  5626.31  1027.89 687.77  4953.51  9621.85
       119.01  442.92  5466.17  48207.00 33228.70 23464.10 2941.62  1127.35 509.52  431.82   8777.25
       528.28  1138.19 896.41   8004.34  24187.50 16900.60 13679.80 595.78  555.01  319.84   5529.23
       812.17  8899.26 4079.86  2348.22  7153.28  22086.80 17642.30 4950.47 524.64  617.63   6247.70
       5155.71 14707.60 33755.60 10970.20 2194.82  6752.86  23903.20 6789.77 4596.57 623.45  7776.12
       559.17  5804.40 34262.60 52902.00 5806.53  1166.99  4063.10  5179.75 3617.13 3162.61  5556.84
       1010.12 10902.30 235946.00         93654.90 46174.80 5265.20  1178.98 1467.12 4796.20  4203.50 9920.34
       1292.05 11820.90 26102.60 374961.00        49141.70 24633.00 3195.02 259.64  820.95  3472.66 9816.37
       433.67  9368.85 17826.50 26559.20 121620.00         16344.80 9254.64 422.80  88.70   360.43  5668.29
       453.04  1992.33 9240.19  12752.20 6208.14  29173.00 4463.08  857.82  97.92   26.07   1717.92
       1772.32 16991.50 15854.10 53615.40 25943.20 12803.20 68823.60 3691.37 1688.34 244.58  4166.96
       68.17   10829.10 22092.90 15117.80 17407.20 8560.29  4849.94  8949.47 1171.64 681.31  1703.39
       984.34  944.03  31735.90 46605.30 11159.90 12894.00 7247.16  1434.61 6283.40 1055.05  2055.44
       144.37  16121.90 3308.82  82274.00 40515.20 10002.60 13115.20 2520.45 1224.46 6704.46  3211.31
       34.53   503.53  12121.70 1888.70  16412.90 8196.91  2348.55  1043.75 480.98  297.66   2290.49
Gear3
       93.92   1822.96 15982.70 7063.43  5667.96  3731.49  2918.55  12355.30 3637.93 11662.00 7964.59
       22.10   1838.25 16848.00 47833.50 4371.73  6151.44  3145.91  1567.10 13746.10 2283.96 17011.70
       6.09    507.68  19834.90 57532.50 33596.90 5379.91  5863.45  1934.39 2005.26 9975.49  19376.70
       16.51   87.52   3441.22  42887.20 24968.30 25728.50 3188.41  2206.55 1545.06 904.44   18384.00
       118.86  364.80  915.41   11551.00 29481.20 30060.10 24051.70 1891.54 2730.00 1086.66  18785.50
       87.54   1366.44 1995.95  1623.42  4176.91  18819.90 14860.00 7529.66 1236.30 1005.28  10168.90
       726.38  2951.86 21585.80 9913.39  1675.20  7521.26  26317.00 13499.00 14158.40 1326.40  16543.80
       161.00  23955.70 44776.60 97699.10 9057.17  2656.32  9142.11  21045.80 22769.40 13750.80 24160.70
       86.48   1329.62 91682.70 51427.30 21415.40 3563.45  788.75   1772.42 8976.98  5434.23  12824.90
       190.95  2488.74 17509.80 355444.00         39345.30 28780.30 3690.03 541.50  2652.60  7750.16 21907.80
       101.65  3128.29 18965.10 39929.20 154433.00         30286.40 16951.40 1398.46 454.54  1275.73 20062.80
       167.93  1052.02 15545.80 30318.40 12466.40 85485.90 12927.80 4486.96 793.54  145.92   9615.83
       239.30  3268.27 9716.18  46433.60 18976.90 13666.40 72619.20 7033.44 4983.94 498.68   8496.23
       18.72   4235.54 27531.90 26623.10 25891.50 18580.30 10405.90 34674.10 7032.89 2824.75  7062.35
       445.42  608.55  65182.10 135270.00         27358.00 46126.00 25627.40 9160.88 62162.60 7209.41 14045.40
       13.07   2078.43 1359.12  47756.90 19863.20 7156.16  9275.09  3218.76 2422.63 9162.23  4388.53
       13.42   278.80  21384.30 4708.48  34559.10 25186.10 7133.28  5724.69 4087.07 1747.04  13443.40
ObservedCatch
Gear1
       0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
       0.00    232.26  754.40  534.03  219.08  778.15  230.23  377.48  1858.71 436.64  1396.81
       0.00    189.90  15199.50 19816.40 5115.78 307.00  602.59  0.00    203.79  1045.54 2528.45
       0.00    172.74  11725.40 34980.90 8512.88 2523.56 76.77   268.70  360.83  0.00    2019.09
       40777.70 5460.03 326.90  3223.16  10274.20 2903.49 1061.51 588.48  484.94  0.00    4828.79
       0.00    269.25  456.92  647.15   1246.15  9924.54 6217.36 1855.79 568.98  343.99  2457.96
       0.00    42.60   9610.93 406.16   70.59    250.49  1754.90 2484.64 1219.38 0.00    4805.71
       0.00    3588.46 18248.20 8804.46 276.64   0.00    454.20  1499.45 208.18  0.00    1422.04
       0.00    140.28  28386.80 37081.80 10767.00 190.54  118.79  233.65  1205.56 604.55  799.00
       0.00    902.48  4204.34  137898.00         9290.04 2445.16 150.39  20.00   78.01   587.70  1502.17
       0.00    70.30   2167.04  9402.86  103859.00         3627.68 2067.43 171.82  113.91  0.00    2181.12
       0.00    187.05  3089.92  8314.71  11019.10 36404.80 1508.33 824.75  51.58   66.23   913.87
       0.00    95.49   1880.61  14487.10 11990.70 5361.57  30572.80 933.80  341.83  55.73   571.22
       0.00    190.19  10372.20 14709.70 26973.90 11293.70 3943.35 12089.70 469.64  140.52  139.56
       87.24   0.00    40929.80 65615.20 12563.30 9106.64  1567.87  711.99  3912.62 100.25  0.00
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        0.00    2061.96  1146.71  55447.00 19231.40 1645.19  1008.74  288.60   65.42    156.77   382.58
        222.50  1325.30  42460.40 8778.15  41550.60 6508.76  988.21   1528.52  303.56   381.87   1193.86
Gear2
        0.00    41012.00 104666.00         11556.60 854.54   305.19   1281.81  2685.69  0.00     3662.31  0.00
        0.00    18022.40 13830.10 15566.10 2743.91  4797.48  83.67    880.35   2433.58  191.41   4621.15
        0.00    291.06   17595.60 67854.90 7473.36  1670.79  784.85   784.85   336.37   1009.10  10427.30
        0.00    0.00     157.29   23116.80 4351.44  5477.85  2726.19  3513.72  2555.65  242.29   32133.80
        2726.60 932.68   1110.71  6441.34  38412.20 6271.25  1787.66  231.93   49.70    0.00     0.00
        0.00    2777.79  3591.49  4033.04  3407.95  26630.50 17619.20 2965.69  3397.31  1076.11  2683.09
        0.00    138.97   24677.90 1164.34  0.00     2171.13  9880.12  8408.47  4320.22  298.54   10809.50
        0.00    18477.90 59328.70 35453.80 588.37   69.21    117.09   195.81   130.57   48.67    257.83
        0.00    513.08   76885.60 62637.80 18068.20 567.10   109.79   596.68   2326.64  1732.24  2721.76
        7.78    378.68   13414.00 415030.00         46056.90 17672.20 1385.23  189.70   1233.92  5357.20  20474.80
        0.00    995.92   14859.60 40449.40 163052.00         2133.35  890.11   27.02    5.32     134.88   1312.34
        0.00    97.20    7251.13  17023.20 14021.20 44734.30 2224.34  1144.02  70.06    50.90    858.44
        0.00    440.93   7410.03  54977.40 37118.00 14306.20 96893.80 5981.45  2822.44  1000.86  4095.30
        0.00    220.94   15068.50 20679.70 13208.60 5348.18  2087.34  7312.38  609.65   180.49   255.39
        40.46   0.00     35417.30 74081.80 17372.20 10780.30 1638.54  761.70   3067.56  153.88   713.43
        0.00    1790.15  881.70   96566.00 34685.80 2927.48  1863.35  573.50   145.19   1089.41  557.32
        118.60  693.22   24309.80 2737.00  24808.10 7274.38  1166.28  1231.02  887.66   290.63   988.04
Gear3
        0.00    9336.19  11906.30 3933.79  6231.12  629.41   2438.95  9456.83  2265.86  1321.75  4091.14
        0.00    2183.26  13894.70 10818.40 2512.29  6888.08  1547.43  2676.44  15264.30 3345.06  24814.30
        0.00    80.94    7677.89  21443.50 14446.60 4402.24  2201.45  4533.52  3264.23  7201.23  21009.10
        0.00    0.00     5062.78  44113.80 7436.19  4492.54  956.31   1655.68  580.82   502.79   7458.14
        0.00    0.00     0.00     0.00     0.00     4214.53  9482.70  3160.90  6321.80  0.00     27394.50
        0.00    174.96   641.50   1103.45  3055.19  19393.70 13161.50 4504.57  2004.42  1523.73  7798.27
        0.00    316.05   27219.50 1422.12  150.50   1746.94  12923.00 10636.30 5184.17  200.66   29544.80
        0.00    11716.60 71666.10 61804.10 1432.85  1073.03  1947.31  5555.59  3956.92  1226.10  3836.75
        0.00    173.23   33565.40 47680.10 43192.40 2462.07  580.73   3850.35  19552.90 14993.20 38606.50
        0.00    289.36   21416.60 424164.00         69168.60 46926.00 2662.39  267.55   2111.60  13006.60 27774.50
        0.00    139.59   7422.15  19842.10 74495.20 3771.99  4617.94  175.62   891.54   324.86   18130.00
        0.00    488.18   20841.10 30685.60 21805.00 97911.50 81173.90 12552.60 227.11   1169.42  19182.40
        0.00    711.77   8031.00  39123.20 28581.90 14370.70 113542.00         6044.04  4158.78  1502.39  11218.50
        0.00    257.51   9655.26  18058.50 38452.00 18958.10 9685.79  47314.30 4664.09  1893.94  5251.05
        54.84   0.00     44810.40 110505.00         39813.90 37529.60 14679.00 9618.59  62122.60 4023.80  17909.70
        0.00    1034.05  726.03   43397.10 26916.90 4721.66  5475.19  2581.06  950.84   6357.29  2221.66
        184.09  796.46   23835.90 3979.44  43475.50 16847.90 3518.65  5089.02  2909.46  2423.56  10360.70
FishingMort
Gear1
        0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
        0.01    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.01     0.00     0.00
        0.01    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.01     0.01     0.01
        0.01    0.00     0.02     0.03     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.01    0.00     0.02     0.04     0.04     0.04     0.04     0.02     0.01     0.01     0.01
        0.01    0.00     0.01     0.03     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.01    0.00     0.01     0.03     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.02    0.01     0.03     0.06     0.05     0.05     0.05     0.03     0.02     0.01     0.01
        0.02    0.01     0.03     0.06     0.06     0.06     0.06     0.04     0.02     0.01     0.01
        0.03    0.01     0.04     0.09     0.09     0.08     0.09     0.05     0.03     0.02     0.02
        0.03    0.01     0.04     0.09     0.08     0.08     0.08     0.05     0.03     0.02     0.02
        0.01    0.00     0.01     0.03     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.01    0.00     0.01     0.03     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.01    0.00     0.02     0.04     0.03     0.03     0.04     0.02     0.01     0.01     0.01
        0.01    0.00     0.02     0.04     0.03     0.03     0.03     0.02     0.01     0.01     0.01
        0.01    0.00     0.02     0.04     0.04     0.04     0.04     0.02     0.01     0.01     0.01
        0.01    0.00     0.02     0.05     0.04     0.04     0.04     0.03     0.02     0.01     0.01
Gear2
        0.00    0.01     0.04     0.11     0.10     0.10     0.11     0.04     0.03     0.03     0.03
        0.00    0.01     0.04     0.11     0.10     0.10     0.11     0.04     0.03     0.04     0.04
        0.00    0.02     0.06     0.14     0.13     0.13     0.14     0.05     0.04     0.05     0.05
        0.00    0.01     0.04     0.11     0.10     0.10     0.10     0.04     0.03     0.03     0.03
        0.00    0.01     0.03     0.08     0.08     0.07     0.08     0.03     0.02     0.03     0.03
        0.00    0.01     0.04     0.11     0.10     0.09     0.10     0.04     0.03     0.03     0.03
        0.00    0.02     0.06     0.15     0.14     0.13     0.15     0.05     0.04     0.05     0.05
        0.00    0.02     0.05     0.13     0.13     0.12     0.13     0.05     0.04     0.04     0.04
        0.00    0.03     0.08     0.21     0.19     0.18     0.20     0.07     0.06     0.07     0.07
        0.00    0.02     0.08     0.19     0.18     0.17     0.18     0.07     0.06     0.06     0.06
        0.00    0.01     0.04     0.11     0.10     0.10     0.11     0.04     0.03     0.03     0.03
        0.00    0.00     0.02     0.04     0.04     0.03     0.04     0.01     0.01     0.01     0.01
        0.00    0.01     0.05     0.12     0.11     0.10     0.11     0.04     0.03     0.04     0.04
        0.00    0.01     0.02     0.06     0.05     0.05     0.05     0.02     0.02     0.02     0.02
        0.00    0.01     0.02     0.06     0.06     0.05     0.06     0.02     0.02     0.02     0.02
        0.00    0.01     0.03     0.08     0.07     0.07     0.07     0.03     0.02     0.02     0.02
        0.00    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.01     0.01     0.01
Gear3
        0.00    0.00     0.03     0.09     0.07     0.10     0.11     0.07     0.09     0.07     0.07
        0.00    0.00     0.03     0.10     0.08     0.11     0.11     0.08     0.10     0.07     0.07
        0.00    0.00     0.03     0.12     0.10     0.13     0.14     0.10     0.12     0.09     0.09
        0.00    0.00     0.03     0.10     0.08     0.10     0.11     0.07     0.10     0.07     0.07
        0.00    0.00     0.03     0.12     0.09     0.13     0.14     0.09     0.12     0.09     0.09
        0.00    0.00     0.02     0.07     0.06     0.08     0.09     0.06     0.07     0.05     0.05
        0.00    0.00     0.04     0.14     0.11     0.15     0.16     0.11     0.14     0.10     0.10
        0.00    0.01     0.07     0.25     0.20     0.27     0.29     0.19     0.25     0.18     0.18
        0.00    0.00     0.03     0.11     0.09     0.12     0.13     0.09     0.11     0.08     0.08
        0.00    0.01     0.05     0.18     0.14     0.20     0.21     0.14     0.18     0.13     0.13
        0.00    0.00     0.05     0.17     0.13     0.18     0.19     0.13     0.17     0.12     0.12
        0.00    0.00     0.03     0.09     0.07     0.10     0.11     0.07     0.10     0.07     0.07
        0.00    0.00     0.03     0.10     0.08     0.11     0.12     0.08     0.10     0.07     0.07
        0.00    0.00     0.03     0.10     0.08     0.10     0.11     0.08     0.10     0.07     0.07
        0.00    0.00     0.05     0.17     0.14     0.19     0.20     0.13     0.17     0.13     0.13
        0.00    0.00     0.01     0.04     0.03     0.05     0.05     0.03     0.04     0.03     0.03
```

```
        0.00    0.00    0.01    0.05    0.04    0.06    0.06    0.04    0.05    0.04    0.04
Residuals
Gear1
        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
        1137.50 1244.01 5238.74 9990.44 914.23  337.22  337.56  -117.71 -826.30 -289.30 -299.37
        279.32  173.43  -8911.68 -8535.54 2645.90 562.32  340.50  285.76  -69.57  -472.04 -1414.47
        1352.71 -60.85  -9776.81 -19959.70         1790.83 4902.64 839.29  313.56  -176.10 92.88   -131.17
        -31369.60       -5009.57 173.79  684.61  1476.97 5477.09 5613.16 -106.36 -169.68 107.79  -2965.42
        8407.29 1777.99 867.65  19.22   773.94  -3558.36 -1213.79 472.76  -395.75 -223.00 -1234.11
        40571.90 2529.48 -1279.88 1960.39 400.59  1229.16 3398.64 -56.80  -65.62  92.84   -3647.74
        8435.35 15991.40 -2037.73 13073.10 2112.98 490.19  1225.11 2051.11 1532.29 902.82  164.26
        11378.20 2588.86 54967.60 -8161.84 3422.19 1460.85 245.06  517.28  517.67  291.45  1315.58
        22836.20 3740.53 10264.80 43777.80 14404.40 9677.41 1396.75 188.53  384.81  573.75  1780.99
        12650.90 6003.42 14142.70 11836.60 -7071.56 9648.58 5329.20 388.61  -31.37  198.97  947.92
        13406.80 1123.21 5486.17 2030.63  -6007.18 -12366.20        2110.26 328.75  40.85   -51.63  48.17
        18014.70 3742.65 3173.46 452.58   -4796.88 -1737.99 -11406.70        771.11  205.56  -8.69   230.27
        1661.20 5674.40 6513.08 -4610.41 -15401.70        -5485.22 -705.27 -2179.89 441.07  173.66  645.95
        21831.10 467.15 -18766.60       -37166.20        -5784.10 -1112.22 2853.38 739.55  550.15  344.31  866.10
        2943.64 5243.33 969.24  -9459.03 3305.02 4033.70 6317.84 2046.58 730.93  2430.12 856.49
        2546.22 -428.16 -11980.70       -4627.08 -5652.69 11789.70 4170.52 2273.85 926.43  69.73   2281.15
Gear2
        728.40  -31087.60       -77356.90       -3015.97 7259.63 3355.51 1614.68 4104.66 1290.51 2327.14 4090.49
        162.09  -8556.25 13400.10 39141.30 3175.91 910.69  2869.51 -65.70  2178.77 918.12  3643.01
        45.65   2381.22 15173.20 -595.18  39029.90 3432.19 4841.46 243.04  351.41  3944.41 -805.47
        119.01  442.92  5308.89 25090.20 288777.30 17986.30 215.43  -2386.37 -2046.14 189.52  -23356.60
        -2198.32 205.51 -214.30 1563.00  -14224.70        10629.30 11892.10 363.85  505.31  319.84  5529.23
        812.17  6121.47 488.37  -1684.82 3745.32 -4543.70 23.15   1984.77 -2872.67 -458.47 3564.60
        5155.71 14568.60 9077.75 9805.81 2194.82 4581.74 14023.10 -1618.70 276.36  324.92  -3033.43
        559.17  39926.50 -25066.10        17448.20 5218.15 1097.79 3946.00 4983.95 3486.56 3113.93 5299.00
        1010.12 10389.30 159060.00       31017.00 28106.60 4698.10 1069.19 870.44  2469.57 2471.26 7198.58
        1284.27 11442.20 12688.60 -40068.80        3084.84 6960.74 1809.79 69.94   -412.97 -1884.54 -10658.40
        433.67  8372.93 2966.96  -13890.20        -41431.90        14211.40 8364.53 395.79  83.38   225.55  4355.95
        453.04  1895.13 1989.06  -4270.99 -7813.02 -15561.30        2238.74 -286.21 27.86   -24.83  859.48
        1772.32 16550.50 8444.03 -1362.00 -11174.80       -1503.03 -28070.20        -2290.08 -1134.09 -756.28 71.67
        68.17   10608.20 7024.45 -5561.89 4198.55 3212.11 2762.59 1637.09 561.99  500.82  1448.01
        943.88  944.03  -3681.42 -27476.50        -6212.24 2113.66 5608.62 672.91  3215.84 901.17  1342.01
        144.37  14331.80 2427.12 -14292.00       5829.38 7075.13 11251.80 1946.94 1079.27 5615.05 2653.99
        -84.07  -189.69 -12188.10       -848.30 -8395.15 922.53  1182.27 -187.27 -406.68 7.03    1302.45
Gear3
        93.92   -7513.23 4076.47 3129.64 -563.16 3102.09 479.60  2898.51 1372.07 10340.30 3873.45
        22.10   -345.01 2953.34 37015.10 1859.44 -736.64 1598.48 -1109.34 -1518.24 -1061.10 -7802.57
        6.09    426.74  12157.10 36089.00 19150.20 977.66  3662.00 -2599.14 -1258.96 2774.26 -1632.35
        16.51   87.52   -1621.56 -1226.62 17532.10 21236.00 2232.10 550.87  964.25  401.65  10925.80
        118.86  364.80  915.41  11551.00 29481.20 25845.60 14569.00 -1269.36 -3591.80 1086.66 -8608.94
        87.54   1191.48 1354.45 519.97  1121.71 -573.81 1698.47 3025.08 -768.12 -518.46 2370.67
        726.38  2635.80 -5633.75 8491.27 1524.70 5774.32 13394.00 2862.72 8974.19 1125.74 -13001.00
        161.00  12239.00 -26889.50       35895.10 7624.32 1583.29 7194.81 15490.20 1881.50 12524.70 20324.00
        86.48   1156.39 58117.20 3747.22 -21777.00        1101.38 208.02  -2077.93 -10575.90        -9558.97 -25781.70
        190.95  2199.38 -3906.79 -68720.50       -29823.30        -18145.70        1027.64 273.95  541.00  -5256.45 -5866.67
        101.65  2988.70 11543.00 20087.10 79937.30 26514.40 12333.50 1222.83 -437.00 950.87  1932.78
        167.93  563.85  -5295.25 -367.25  -9338.62 -12425.60        2753.92 -8065.60 566.42  -1023.50 -9566.60
        239.30  2556.50 1685.18  7310.41  -9604.98 -704.30 -40922.70        989.41  825.16  -1003.71 -2722.26
        18.72   3978.03 17876.60 8564.62  -12560.50        -377.79 720.06  -12640.20        2368.80 930.82  1811.30
        390.58  608.55  20371.70 24765.10 -12455.90        8596.38 10948.40 -457.71 40.05   3185.62 -3864.28
        13.07   1044.37 633.09  4359.86  -7053.69 2434.51 3799.90 637.70  1471.79 2804.94 2166.87
        -170.67 -517.66 -2451.58 729.04  -8916.42 8338.23 3614.63 635.67  1177.61 -676.52 3082.75
qs
Gear1
        -12.86 -14.00 -12.50 -11.70 -11.78 -11.83 -11.75 -12.25 -12.77 -13.23 -13.23
Gear2
        -16.49 -13.82 -12.67 -11.74 -11.81 -11.87 -11.78 -12.79 -12.96 -12.90 -12.90
Gear3
        -18.72 -15.70 -13.39 -12.11 -12.35 -12.04 -11.95 -12.37 -12.10 -12.41 -12.41
Residual        Landings
        -35330.00       7008.60-6032.13       -8449.49       -3168.85       -7658.77       -6384.01       25960.80       49328.40       93509.70       43934.70       -494.45-1900.27       -17214.80       -23138.90       29109.50       24677.10
        -26475.80       55927.00       41616.80       -15371.30       41136.80       -44952.20       28708.70       65604.20       188657.00       -45603.70       27401.10       -15546.00       -29325.20       26409.60       -7440.71       56070.40       -5700.63
        59081.50        3948.2620528.90       74077.90       44930.00       28874.10       20442.00       152554.00       -122099.00       -114457.00       126423.00       -73707.60       -48836.50       -10418.90       -9116.73       18343.80       82074.80
Zero    Catch
        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
Catch   weights
        0.00    18768.60        20317.90        32310.50        39911.20        23051.20        28676.00        53830.80        100988.00       188940.00       139945.00       51545.60        55089.70        58485.20        68531.10        83979.50        94007.10
        75824.20        101217.00       128037.00       108199.00       84646.80        78617.80        111139.00       130184.00       310297.00       392956.00       176901.00       61274.00        190605.00       78929.60        104899.00       154850.00       42299.40
        102951.00       132088.00       145249.00       127298.00       169340.00       82094.10        149102.00       287554.00       178571.00       407973.00       273383.00       175072.00       196554.00       176451.00       406823.00       109474.00       130855.00
Landings
        35330.00        11760.00        26350.00        40760.00        43080.00        30710.00        35060.00        27870.00        51660.00        95430.00        96010.00        52040.00        56990.00        75700.00        91670.00        54870.00        69330.00
        102300.00       45290.00        86420.00        123570.00       43510.00        123570.00       82430.00        64580.00        121640.00       438560.00       149500.00       76820.00        219930.00       52520.00        112340.00       98780.00        48000.00
        43870.00        128140.00       124720.00       53220.00        124410.00       53220.00        128660.00       135000.00       300670.00       522430.00       146960.00       248780.00       245390.00       186870.00       415940.00       91130.00        48780.00
PredictedLandings
        178776.00       252074.00       293604.00       267807.00       293898.00       183763.00       288917.00       471569.00       589857.00       989869.00       590229.00       287892.00       442248.00       313866.00       580254.00       348304.00       267161.00
TotalMort
        0.10    0.12    0.17    0.30    0.28    0.30    0.31    0.21    0.23    0.20    0.20
        0.11    0.12    0.18    0.33    0.30    0.32    0.34    0.23    0.24    0.21    0.21
        0.11    0.12    0.20    0.39    0.35    0.38    0.41    0.26    0.28    0.24    0.24
        0.11    0.12    0.19    0.34    0.31    0.33    0.35    0.23    0.24    0.21    0.21
        0.11    0.12    0.18    0.34    0.30    0.33    0.35    0.24    0.26    0.22    0.22
        0.11    0.12    0.18    0.31    0.29    0.30    0.32    0.21    0.22    0.19    0.19
        0.11    0.13    0.21    0.42    0.38    0.41    0.44    0.28    0.29    0.26    0.26
        0.12    0.13    0.25    0.54    0.47    0.53    0.57    0.37    0.41    0.34    0.34
        0.12    0.14    0.24    0.49    0.44    0.46    0.49    0.30    0.30    0.26    0.26
        0.13    0.14    0.27    0.57    0.51    0.55    0.59    0.36    0.37    0.32    0.32
        0.13    0.13    0.23    0.46    0.41    0.45    0.48    0.32    0.33    0.28    0.28
        0.11    0.11    0.16    0.27    0.24    0.26    0.28    0.21    0.22    0.19    0.19
        0.11    0.12    0.19    0.35    0.32    0.34    0.36    0.24    0.25    0.22    0.22
        0.11    0.11    0.17    0.29    0.26    0.29    0.30    0.22    0.23    0.20    0.20
```

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       0.11   0.12   0.19   0.37   0.33   0.37   0.39   0.28   0.31   0.25   0.25
       0.11   0.12   0.16   0.26   0.25   0.25   0.27   0.19   0.18   0.17   0.17
       0.11   0.11   0.14   0.22   0.20   0.21   0.22   0.17   0.17   0.15   0.15
TSB
       2083850.00     2182260.00     1939860.00     1823230.00     2007650.00     1725120.00     2455240.00     3559580.00     3793250.00     3544560.00     2908240.00     2755010.00     3176950.00     3552970.00     3798280.00     3959850.00
       4042440.00
SSB
       1340470.00     1293180.00     1145400.00     1181690.00     1475910.00     1210710.00     1180710.00     1112990.00     1054320.00     1325570.00     1310850.00     1316260.00     1628280.00     1675430.00     1851860.00     1998270.00
       2213230.00
weightsat     age
       0.10   0.28   0.53   0.60   0.70   0.95   1.56   1.78   1.77   2.45   2.60
       0.10   0.28   0.46   0.69   0.82   0.92   1.32   1.74   1.67   2.58   2.70
       0.10   0.42   0.53   0.54   0.60   0.76   0.95   1.26   1.96   1.27   2.81
       0.10   0.28   0.61   0.65   0.74   0.88   1.08   1.50   1.85   2.61   2.39
       0.10   0.28   0.58   0.68   0.93   0.96   1.40   1.61   1.88   2.62   3.19
       0.10   0.28   0.47   0.70   0.80   0.83   1.31   1.48   1.87   2.08   2.53
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
       0.10   0.44   0.64   0.72   0.82   1.00   1.18   1.46   1.71   2.13   2.43
mortality
0.10
proportion    due    to     penalty
0.00
penalty15072.90
AverageF      0.20
Z      0.10   0.12   0.17   0.30   0.28   0.30   0.31   0.21   0.23   0.20   0.20
       0.11   0.12   0.18   0.33   0.30   0.32   0.34   0.23   0.24   0.21   0.21
       0.11   0.12   0.20   0.39   0.35   0.38   0.41   0.26   0.28   0.24   0.24
       0.11   0.12   0.19   0.34   0.31   0.33   0.35   0.23   0.24   0.21   0.21
       0.11   0.12   0.18   0.34   0.30   0.33   0.35   0.24   0.26   0.22   0.22
       0.11   0.12   0.18   0.31   0.29   0.30   0.32   0.21   0.22   0.19   0.19
       0.11   0.13   0.21   0.42   0.38   0.41   0.44   0.28   0.29   0.26   0.26
       0.12   0.13   0.25   0.54   0.47   0.53   0.57   0.37   0.41   0.34   0.34
       0.12   0.14   0.24   0.49   0.44   0.46   0.49   0.30   0.30   0.26   0.26
       0.13   0.14   0.27   0.57   0.51   0.55   0.59   0.36   0.37   0.32   0.32
       0.13   0.13   0.23   0.46   0.41   0.45   0.48   0.32   0.33   0.28   0.28
       0.11   0.11   0.16   0.27   0.24   0.26   0.28   0.21   0.22   0.19   0.19
       0.11   0.12   0.19   0.35   0.32   0.34   0.36   0.24   0.25   0.22   0.22
       0.11   0.11   0.17   0.29   0.26   0.29   0.30   0.22   0.23   0.20   0.20
       0.11   0.12   0.19   0.37   0.33   0.37   0.39   0.28   0.31   0.25   0.25
       0.11   0.12   0.16   0.26   0.25   0.25   0.27   0.19   0.18   0.17   0.17
       0.11   0.11   0.14   0.22   0.20   0.21   0.22   0.17   0.17   0.15   0.15
LandingsError 62410900000.00
Catch  at     Age    Error  1447280.00
ratio  L      C      error  43122.80
```

Input Data for Assessment for VIIe inshore Bass Stock

```
#7e bass data for catage8q
3
17
10
1985
3
#Effort Trawls
2728    2462    2694    3552    7021    7363    8251    5771    5835    5444    6018    6602    7312    6914    5987    7997    7373
#Effort Nets
7861    9593    11799   9503    5687    5659    2347    4887    8266    12364   9402    4281    18592   3937    6007    9816    1051
#Effort Lines
19350   10746   12498   11375   12794   7268    9820    17431   7841    14044   21929   16961   24244   12243   10302   14762   20221

#CatchNumbers Trawls
0       218     472     2320    386     853     3293    537     446     1268
252     1457    1312    141     771     189     436     1631    391     773
0       871     1707    1347    104     719     94      108     699     618
0       29      5056    4805    1035    302     420     28      148     842
0       21      685     4297    4262    1644    238     1284    73      2519
0       128     285     3191    11703   9002    1870    676     489     3294
153     1491    547     373     1314    3096    3518    1348    187     3336
913     6240    4046    505     665     430     944     1028    373     1681
0       5518    7461    1938    53      137     231     719     861     1728
75      321     21438   8201    2026    145     71      288     560     787
84      774     3432    46347   6922    1662    316     109     172     2787
0       1357    876     3043    21310   1849    527     92      167     2031
18      627     9219    5163    7589    19549   2394    585     176     2189
60      3778    8050    17085   5667    4056    10826   832     375     959
8       6105    5375    1853    2798    1200    1183    3968    477     891
1112    404     27243   16991   3280    3647    1028    2064    2654    750
0       826     759     16799   7172    2198    2456    1292    2218    5099

#CatchNumbers Nets
511     1606    803     1983    304     311     1871    189     822     713
3078    31027   17046   1429    7634    568     4198    12245   1990    4818
0       77646   50557   6203    344     2612    442     534     4086    3435
0       63      2957    2165    805     234     299     42      101     4781
0       159     820     1923    336     22      23      140     187     1796
1067    34      2015    10681   5020    1278    198     61      5       11
2447    7464    813     809     2506    4759    5419    1396    206     1129
209     2682    2245    8       128     184     290     721     230     453
0       1745    1690    463     44      112     187     784     1013    1195
500     3181    93230   17592   9852    1798    1053    11842   21127   27312
92      1007    3512    33879   3563    2468    1010    473     1907    11244
0       769     502     1835    9547    951     362     58      97      1210
31      753     10077   5147    6508    14173   1836    327     109     4682
17      1000    1843    3760    1379    2089    10757   1319    418     962
0       14687   16098   3675    4524    1279    2067    5689    562     914
2565    781     88336   40131   5180    1820    13      17      13      116
41      1067    438     5186    816     324     424     357     1294    2954

#CatchNumbers Lines
114296  146260  38645   74300   11356   2177    17851   0       0       3570
4596    24972   8058    1004    3529    624     1530    6100    1858    4211
0       2876    8513    7244    505     3894    701     957     5871    7607
0       170     6480    10525   6652    1987    3769    461     1472    5427
0       23365   68003   35043   5830    553     38      68      0       272
1313    0       2632    17212   6707    2769    0       0       0       0
-1      -1      -1      -1      -1      -1      -1      -1      -1      -1
175     2322    4276    878     987     1165    1764    3406    1039    5387
9418    18743   19219   6244    392     576     1043    3774    4186    5120
267     1334    62008   22334   7865    1431    660     5413    8323    15159
2190    2899    6296    74553   17375   8504    2081    518     2437    15374
0       13804   11064   36126   105619  11527   4296    989     989     12048
10808   12642   79423   30116   43839   166193  28271   7385    2273    34469
27      4892    10514   12606   7914    7046    31886   5049    1292    10043
287     17579   14714   4534    5467    1411    2162    6041    709     2645
687     599     42560   34877   11380   14774   5883    8001    17516   3005
0       4511    2874    46918   17705   8837    9893    7905    14123   43722

#Landings Trawls
13353   9875    7439    7901    22777   5075    16438   19559   21558   28312   43159   36759   45830   40245   24686   55779   46286
#Landings Nets
9248    43414   79218   25510   10053   5686    15004   7061    11135   230057  59845   19093   44039   24457   50597   99359   18129
#Landings Lines
169646  58904   57643   46252   69783   20205   30512   40650   69638   132101  133427  218218  544433  116228  54606   176949  239842
#Weight at age
0.2806  0.532   0.6035  0.697   0.949   1.564   1.777   1.774   2.4465  2.595
0.2806  0.462   0.69    0.8165  0.918   1.3155  1.7375  1.6695  2.5755  2.6965
0.423   0.5275  0.542   0.601   0.7595  0.948   1.263   1.9635  1.2715  2.812
0.2806  0.608   0.6495  0.744   0.884   1.083   1.5045  1.852   2.6075  2.394
0.2806  0.5845  0.681   0.928   0.958   1.403   1.6065  1.8825  2.621   3.1885
0.2806  0.472   0.7015  0.7985  0.8265  1.3095  1.479   1.871   2.079   2.5305
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
0.439   0.637   0.718   0.8195  1.0045  1.182   1.4595  1.7055  2.1275  2.4275
#Maturity
0       0.03    0.23    0.43    0.57    0.9     1       1       1       1
#M
0.1
#Start F
0.5
#F penalty
384
```

Results for VIIe inshore Bass Stock

```
#7e bass results from catage8q

3.00
17.00
10.00
1985.00
3.00

PopulationNumbers
        639993.00         473511.00         107272.00         205122.00          28864.90 28241.70 87629.20 14297.50 10266.40 29633.30
        511507.00         539266.00         359862.00          75919.40 145501.00          20427.30 16608.10 58024.20 10046.40 24996.90
        348530.00         443576.00         429400.00         269933.00          57463.10 111305.00          14225.10 12083.60 42929.80 24059.40
        114847.00         300064.00         344728.00         310840.00         197839.00          42682.10 74198.20 9951.48  8598.39  43652.50
        36826.90 99363.80 237759.00         256161.00         232146.00         149458.00          29157.20 53241.10 7296.11  35401.70
        166800.00         31749.90 79385.50 177844.00         188788.00         172435.00          98269.90 20695.80 39581.70 29230.80
        364440.00         146559.00         26291.40 62129.40 137171.00         147770.00          126430.00         74491.50 16063.70 50545.20
        1635260.00        317915.00         121500.00         20662.50 47616.60 105827.00          103439.00         94666.20 58472.20 49115.70
        406743.00         1388400.00        247921.00         88526.80 14852.40 34189.00 64055.20 70328.70 68789.90 70545.20
        217575.00         356294.00         1130620.00        189942.00         67538.50 11522.80 24813.60 47749.50 53199.70 99126.90
        449753.00         186175.00         272323.00         79389.4.00        133907.00          48436.50 7305.55  16672.50 32935.00 95088.30
        195215.00         375083.00         137361.00         183266.00         530997.00          89839.30 26362.10 4539.32  11116.20 74641.70
        545552.00         166041.00         294120.00         100650.00         131963.00          382180.00         54713.40 18014.30 3320.06  56746.40
        884939.00         449082.00         114332.00         177731.00         61317.50 82078.10 191276.00         30623.10 10611.40 30008.40
        28591.10 765106.00          363737.00         87318.10 133318.00         46217.30 54908.60 138562.00         23315.50 28656.50
        153302.00         24862.50 620949.00          278347.00         66149.60 101981.00          32124.70 40347.60 105231.00         36820.50
        7937.19  130967.00          19131.40 438318.00         194529.00         46945.00 63225.30 21457.60 28110.90 89438.80
CatchNumbers
Gear1
        299.70   1371.81  1115.01  3710.01  414.27   376.16   1227.42  151.04   127.05   366.71
        219.22   1441.82  3470.03  1277.97  1955.52  265.53   219.45   566.86   117.08   291.32
        162.87   1282.69  4454.90  4896.52  833.30   1551.15  201.90   126.81   534.28   299.43
        70.93    1154.73  4774.37  7501.06  3813.25  793.28   1405.19  139.66   143.68   729.42
        44.88    758.84   6529.29  12141.90 8773.55  5393.56  1085.89  1486.69  242.16   1174.98
        215.17   258.72   2336.22  9034.10  7671.94  6868.53  3959.65  618.64   1424.20  1051.76
        524.96   1339.03  868.78   3525.94  6203.49  6453.15  5675.35  2508.74  648.89   2041.75
        1625.93  1972.58  2708.58  795.56   1455.60  3021.39  3103.13  2149.39  1563.38  1313.21
        415.18   8893.52  5723.29  3545.18  476.29   1074.03  2029.15  1645.63  1932.06  1981.36
        204.85   2065.50  23365.20 6835.97  1946.54  317.03   698.35   997.90   1311.62  2443.93
        462.29   1173.19  6098.52  30814.80 4134.77  1374.15  219.19   379.11   869.97   2511.73
        222.24   2669.46  3512.50  8078.89  18590.70 2942.57  906.87   118.27   341.46   2292.78
        677.05   1230.55  7614.05  4546.02  4780.05  12690.10 1901.67  470.05   99.42    1699.23
        1063.52  3399.71  3122.73  8365.87  2298.02  2940.45  7082.92  851.69   351.75   994.74
        29.84    5020.41  8610.82  3575.85  4357.09  1459.66  1772.58  3332.98  670.59   824.20
        211.86   212.41   18897.20 14655.20 2786.74  4079.35  1324.43  1244.50  3826.22  1338.80
        10.04    1039.04  545.83   21455.40 7530.68  1670.74  2405.43  625.90   961.75   3059.95
Gear2
        2430.81  18548.60 6386.91  9379.70  937.08   547.15   4179.32  1023.75  820.32   2367.80
        2404.28  26361.10 26876.80 4368.86  5981.21  522.27   1010.34  5195.30  1022.21  2543.41
        2007.85  26360.60 38785.00 18815.50 2864.89  3429.33  1044.84  1306.40  5243.25  2938.50
        534.16   14496.20 25391.20 17607.20 8008.36  1071.32  4442.22  878.87   861.31   4372.74
        102.33   2884.15  10513.00 8628.81  5578.54  2205.29  1039.32  2832.52  439.51   2132.55
        465.48   933.04   3569.26  6091.86  4628.62  2664.74  3595.99  1118.39  2452.68  1811.29
        420.31   1787.23  491.24   879.96   1385.17  926.58   1907.55  1678.54  413.58   1301.35
        3875.54  7838.12  4559.44  591.08   967.60   1291.53  3105.05  4281.30  2966.48  2491.80
        1655.51  59117.20 16116.80 4406.29  529.65   768.03   3396.61  5483.47  6132.83  6289.32
        1309.53  22011.60 105485.00         13621.40 3470.28  363.46   1874.08  5330.85  6674.74  12437.00
        2032.92  8600.48  18939.60 42238.40 5070.84  1083.70  404.63   1393.15  3045.50  8792.81
        405.64   8122.30  4527.57  4596.23  9462.95  963.17   694.85   180.39   496.13   3331.35
        4845.67  14681.90 38485.10 10141.70 9540.96  16288.10 5713.61  2811.35  566.43   9681.39
        1704.59  9083.72  3534.67  4179.53  1027.19  845.20   4765.69  1140.74  448.81   1269.20
        84.27    23636.00 17174.00 3147.80  3431.68  739.28   2101.51  7865.96  1507.61  1852.97
        731.93   1223.31  46106.30 15781.80 2684.99  2527.45  1920.85  3592.94  10523.10 3682.03
        4.03     694.99   154.67   2683.33  842.66   120.22   405.16   209.86   307.19   977.37
Gear3
        39177.60 52319.90 14781.60 29170.60 4645.84  8519.05  17017.00 1871.61  2067.20  5966.81
        17634.40 33838.30 28307.20 6183.21  13494.80 3700.52  1872.12  4322.36  1172.27  2916.77
        13925.50 31996.60 38626.50 25180.50 6112.07  22976.50 1830.71  1027.75  5685.77  3186.51
        4186.41  19883.70 28575.90 26627.70 19307.20 8111.25  8795.58  781.32   1055.47  5358.44
        1507.28  7435.21  22237.10 24526.10 25277.20 31381.10 3867.63  4732.77  1012.24  4911.53
        3914.34  1373.18  4310.02  9885.04  11973.20 21647.60 7639.54  1066.81  3224.86  2381.54
        11514.80 8569.03  1932.49  4651.71  11673.10 24522.40 13202.30 5216.13  1771.55  5574.26
        90509.90 32036.40 15290.40 2663.65  6951.21  29138.30 18319.80 11341.60 10832.20 9098.86
        10282.30 64260.30 14374.10 5280.83  1011.92  4608.21  5329.60  3863.23  5955.68  6107.65
        9739.40  28650.70 112654.00         19548.20 7939.30  2611.35  3521.23  4497.24  7761.77  14462.50
        31045.80 22986.50 41533.20 124469.00         23821.20 15987.70 1561.10  2413.32  7271.96  20995.20
        10522.60 36875.10 16865.30 23006.80 75511.70 24137.10 4553.73  530.80   2012.29  13511.90
        41372.20 21938.40 47183.40 16708.30 25058.10 134345.00         12324.10 2722.73  756.15   12924.20
        34708.60 32370.60 10335.00 16421.60 6433.85  26625.30 24515.10 2634.75  1428.86  4040.73
        946.19   46448.10 27691.10 6820.30  11853.20 8019.17  5961.39  10018.70 2646.84  3253.16
        7207.28  2108.18  65193.50 29986.80 8132.92  24042.50 4778.42  4013.16  16201.50 5668.92
        507.68   15322.40 2797.82  65227.10 32654.20 14630.30 12894.40 2998.82  6050.66  19251.00
ObservedCatch
Gear1
        0.00     218.00   472.00   2320.00  386.00   853.00   3293.00  537.00   446.00   1268.00
        252.00   1457.00  1312.00  141.00   771.00   189.00   436.00   1631.00  391.00   773.00
        0.00     871.00   1707.00  1347.00  104.00   719.00   94.00    108.00   699.00   618.00
        0.00     29.00    5056.00  4805.00  1035.00  302.00   420.00   28.00    148.00   842.00
        0.00     21.00    685.00   4297.00  4262.00  1644.00  238.00   1284.00  73.00    2519.00
        0.00     128.00   285.00   3191.00  11703.00 9002.00  1870.00  676.00   489.00   3294.00
        153.00   1491.00  547.00   373.00   1314.00  3096.00  3518.00  1348.00  187.00   3336.00
        913.00   6240.00  4046.00  505.00   665.00   430.00   944.00   1028.00  373.00   1681.00
        0.00     5518.00  7461.00  1938.00  53.00    137.00   231.00   719.00   861.00   1728.00
        75.00    321.00   21438.00 8201.00  2026.00  145.00   71.00    288.00   560.00   787.00
        84.00    774.00   3432.00  46347.00 6922.00  1662.00  316.00   109.00   172.00   2787.00
        0.00     1357.00  876.00   3043.00  21310.00 1849.00  527.00   92.00    167.00   2031.00
        18.00    627.00   9219.00  5163.00  7589.00  19549.00 2394.00  585.00   176.00   2189.00
        60.00    3778.00  8050.00  17085.00 5667.00  4056.00  10826.00 832.00   375.00   959.00
        8.00     6105.00  5375.00  1853.00  2798.00  1200.00  1183.00  3968.00  477.00   891.00
        1112.00  404.00   27243.00 16991.00 3280.00  3647.00  1028.00  2064.00  2654.00  750.00
        0.00     826.00   759.00   16799.00 7172.00  2198.00  2456.00  1292.00  2218.00  5099.00
Gear2
        511.00   1606.00  803.00   1983.00  304.00   311.00   1871.00  189.00   822.00   713.00
        3078.00  31027.00 17046.00 1429.00  7634.00  568.00   4198.00  12245.00 1990.00  4818.00
```

```
        0.00    77646.00 50557.00 6203.00  344.00   2612.00  442.00   534.00   4086.00  3435.00
        0.00    63.00    2957.00  2165.00  805.00   234.00   299.00   42.00    101.00   4781.00
        0.00    159.00   820.00   1923.00  336.00   22.00    23.00    140.00   187.00   1796.00
        1067.00 34.00    2015.00  10681.00 5020.00  1278.00  198.00   61.00    5.00     11.00
        2447.00 7464.00  813.00   809.00   2506.00  4759.00  5419.00  1396.00  206.00   1129.00
        209.00  2682.00  2245.00  8.00     128.00   184.00   290.00   721.00   230.00   453.00
        0.00    1745.00  1690.00  463.00   44.00    112.00   187.00   784.00   1013.00  1195.00
        500.00  3181.00  93230.00 17592.00 9852.00  1798.00  1053.00  11842.00 21127.00 27312.00
        92.00   1007.00  3512.00  33879.00 3563.00  2468.00  1010.00  473.00   1907.00  11244.00
        0.00    769.00   502.00   1835.00  9547.00  951.00   362.00   58.00    97.00    1210.00
        31.00   753.00   10077.00 5147.00  6508.00  14173.00 1836.00  327.00   109.00   4682.00
        17.00   1000.00  1843.00  3760.00  1379.00  2089.00  10757.00 1319.00  418.00   962.00
        0.00    14687.00 16098.00 3675.00  4524.00  1279.00  2067.00  5689.00  562.00   914.00
        2565.00 781.00   88336.00 40131.00 5180.00  1820.00  13.00    17.00    13.00    116.00
        41.00   1067.00  438.00   5186.00  816.00   324.00   424.00   357.00   1294.00  2954.00
Gear3
        114296.00        146260.00         38645.00 74300.00 11356.00 2177.00  17851.00 0.00     0.00     3570.00
        4596.00 24972.00 8058.00  1004.00  3529.00  624.00   1530.00  6100.00  1858.00  4211.00
        0.00    2876.00  8513.00  7244.00  505.00   3894.00  701.00   957.00   5871.00  7607.00
        0.00    170.00   6480.00  10525.00 6652.00  1987.00  3769.00  461.00   1472.00  5427.00
        0.00    23365.00 68003.00 35043.00 5830.00  553.00   38.00    68.00    0.00     272.00
        1313.00 0.00     2632.00  17212.00 6707.00  2769.00  0.00     0.00     0.00     0.00
        -1.00   -1.00    -1.00    -1.00    -1.00    -1.00    -1.00    -1.00    -1.00    -1.00
        175.00  2322.00  4276.00  878.00   987.00   1165.00  1764.00  3406.00  1039.00  5387.00
        9418.00 18743.00 19219.00 6244.00  392.00   576.00   1043.00  3774.00  4186.00  5120.00
        267.00  1334.00  62008.00 22334.00 7865.00  1431.00  660.00   5413.00  8323.00  15159.00
        2190.00 2899.00  6296.00  74553.00 17375.00 8504.00  2081.00  518.00   2437.00  15374.00
        0.00    13804.00 11064.00 36126.00 105619.00         11527.00 4296.00  989.00   989.00   12048.00
        10808.00 12642.00 79423.00 30116.00 43839.00 166193.00         28271.00 7385.00  2273.00  34469.00
        27.00   4892.00  10514.00 12606.00 7914.00  7046.00  31886.00 5049.00  1292.00  10043.00
        287.00  17579.00 14714.00 4534.00  5467.00  1411.00  2162.00  6041.00  709.00   2645.00
        687.00  599.00   42560.00 34877.00 11380.00 14774.00 5883.00  8001.00  17516.00 3005.00
        0.00    4511.00  2874.00  46918.00 17705.00 8837.00  9893.00  7905.00  14123.00 43722.00
FishingMort
Gear1
        0.00    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.02     0.02
        0.00    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.01     0.01
        0.00    0.00     0.01     0.02     0.02     0.02     0.02     0.01     0.02     0.02
        0.00    0.00     0.02     0.03     0.02     0.02     0.02     0.02     0.02     0.02
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.04     0.04
        0.00    0.01     0.03     0.06     0.05     0.05     0.05     0.03     0.04     0.04
        0.00    0.01     0.04     0.06     0.05     0.05     0.05     0.04     0.05     0.05
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.03     0.03
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.03     0.03
        0.00    0.01     0.02     0.04     0.03     0.03     0.03     0.03     0.03     0.03
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.03     0.03
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.04     0.04
        0.00    0.01     0.03     0.06     0.05     0.05     0.05     0.03     0.04     0.04
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.04     0.04
        0.00    0.01     0.03     0.05     0.04     0.04     0.04     0.03     0.03     0.03
        0.00    0.01     0.04     0.06     0.05     0.05     0.05     0.04     0.05     0.05
        0.00    0.01     0.03     0.06     0.05     0.05     0.05     0.03     0.04     0.04
Gear2
        0.00    0.04     0.07     0.05     0.04     0.02     0.06     0.08     0.10     0.10
        0.01    0.05     0.09     0.07     0.05     0.03     0.07     0.10     0.12     0.12
        0.01    0.07     0.11     0.08     0.06     0.04     0.09     0.13     0.15     0.15
        0.00    0.05     0.09     0.07     0.05     0.03     0.07     0.10     0.12     0.12
        0.00    0.03     0.05     0.04     0.03     0.02     0.04     0.06     0.07     0.07
        0.00    0.03     0.05     0.04     0.03     0.02     0.04     0.06     0.07     0.07
        0.00    0.01     0.02     0.02     0.01     0.01     0.02     0.03     0.03     0.03
        0.00    0.03     0.04     0.03     0.02     0.02     0.04     0.05     0.06     0.06
        0.00    0.05     0.07     0.06     0.04     0.03     0.06     0.09     0.11     0.11
        0.01    0.07     0.11     0.08     0.06     0.04     0.09     0.13     0.16     0.16
        0.00    0.05     0.08     0.06     0.05     0.03     0.07     0.10     0.12     0.12
        0.00    0.02     0.04     0.03     0.02     0.01     0.03     0.05     0.05     0.05
        0.01    0.11     0.17     0.13     0.09     0.06     0.14     0.20     0.24     0.24
        0.00    0.02     0.04     0.03     0.02     0.01     0.03     0.04     0.05     0.05
        0.00    0.03     0.05     0.04     0.03     0.02     0.04     0.06     0.08     0.08
        0.01    0.06     0.09     0.07     0.05     0.03     0.07     0.11     0.12     0.12
        0.00    0.01     0.01     0.01     0.01     0.00     0.01     0.01     0.01     0.01
Gear3
        0.07    0.13     0.16     0.17     0.19     0.39     0.24     0.16     0.25     0.25
        0.04    0.07     0.09     0.09     0.11     0.22     0.13     0.09     0.14     0.14
        0.04    0.08     0.11     0.11     0.12     0.25     0.15     0.10     0.16     0.16
        0.04    0.07     0.10     0.10     0.11     0.23     0.14     0.09     0.15     0.15
        0.04    0.08     0.11     0.11     0.13     0.26     0.16     0.10     0.17     0.17
        0.03    0.05     0.06     0.06     0.07     0.15     0.09     0.06     0.09     0.09
        0.03    0.06     0.08     0.09     0.10     0.20     0.12     0.08     0.13     0.13
        0.06    0.11     0.15     0.15     0.17     0.35     0.21     0.14     0.23     0.23
        0.03    0.05     0.07     0.07     0.08     0.16     0.10     0.06     0.10     0.10
        0.05    0.09     0.12     0.12     0.14     0.28     0.17     0.11     0.18     0.18
        0.08    0.14     0.18     0.19     0.22     0.44     0.27     0.18     0.29     0.29
        0.06    0.11     0.14     0.15     0.17     0.34     0.21     0.14     0.22     0.22
        0.08    0.16     0.20     0.21     0.24     0.49     0.30     0.19     0.32     0.32
        0.04    0.08     0.10     0.11     0.12     0.25     0.15     0.10     0.16     0.16
        0.04    0.07     0.09     0.09     0.10     0.21     0.13     0.08     0.13     0.13
        0.05    0.10     0.12     0.13     0.15     0.30     0.18     0.12     0.19     0.19
        0.07    0.13     0.17     0.18     0.20     0.41     0.25     0.16     0.26     0.26
Residuals
Gear1
        299.70  1153.81  643.01   1390.01  28.27    -476.84  -2065.58 -385.96  -318.95  -901.29
        -32.78  -15.18   2158.03  1136.97  1184.52  76.53    -216.56  -1064.14 -273.92  -481.69
        162.87  411.69   2747.90  3549.52  729.30   832.15   107.90   18.81    -164.72  -318.57
        70.93   1125.73  -281.63  2696.06  2778.25  491.28   985.19   111.66   -4.32    -112.58
        44.88   737.84   5844.29  7844.90  4511.55  3749.56  847.89   202.69   169.16   -1344.02
        215.17  130.72   2051.22  5843.10  -4031.06 -2133.47 2089.65  -57.36   935.20   -2242.24
        371.96  -151.97  321.78   3152.94  4889.49  3357.15  2157.35  1160.74  461.89   -1294.25
        712.93  -4267.42 -1337.42 290.56   790.60   2591.39  2159.13  1121.39  1190.38  -367.79
        415.18  3375.52  -1737.71 1607.18  423.29   937.03   1798.15  926.63   1071.06  253.36
        129.85  1744.50  1927.20  -1365.03 -79.46   172.03   627.35   709.90   751.62   1656.93
        378.29  399.19   2666.52  -15532.20         -2787.23 -287.85  -96.81   270.11   697.97   -275.27
        222.24  1312.46  2636.50  5035.89  -2719.31 1093.57  379.87   26.27    174.46   261.79
        659.05  603.55   -1604.95 -616.98  -2808.95 -6858.86 -492.33  -114.95  -76.58   -489.77
        1003.52 -378.29  -4927.27 -8719.13 -3368.98 -1115.55 -3743.08 19.69    -23.25   35.74
        21.84   -1084.59 3235.82  1722.85  1559.09  259.66   589.58   -635.02  193.59   -66.80
        -900.14 -191.59  -8345.84 -2335.77 -493.26  432.35   296.44   -819.50  1172.22  588.80
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         10.04    213.04   -213.17  4656.39  358.68   -527.26  -50.57   -666.10  -1256.25 -2039.05
Gear2
         1919.81  16942.60 5583.91  7396.70  633.08   236.15   2308.32  834.75   -1.68    1654.80
         -673.72  -4665.87 9830.84  2939.86  -1652.79 -45.73   -3187.66 -7049.70 -967.79  -2274.59
         2007.85  -51285.40         -11772.00         12612.50 2520.89  817.33   602.84   772.40   1157.25  -496.50
         534.16   14433.20 22434.20 15442.20 7203.36  837.32   4143.22  836.87   760.31   -408.26
         102.33   2725.15  9693.05  6705.81  5242.54  2183.29  1016.32  2692.52  252.51   336.55
         -601.52  899.04   1554.26  -4589.14 -391.38  1386.74  3397.99  1057.39  2447.68  1800.29
         -2026.69 -5676.77 -321.76  70.96    -1120.83 -3832.42 -3511.45 282.54   207.58   172.35
         3666.54  5156.12  2314.44  583.08   839.60   1107.53  2815.05  3560.30  2736.48  2038.80
         1655.51  57372.20 14426.80 3943.29  485.65   656.03   3209.61  4699.47  5119.83  5094.32
         809.53   18830.60 12254.60 -3970.63 -6381.72 -1434.54 821.08   -6511.15 -14452.30          -14875.00
         1940.92  7593.48  15427.60 8359.44  1507.84  -1384.30 -605.37  920.15   1138.50  -2451.19
         405.64   7353.30  4025.57  2761.23  -84.05   12.17    332.85   122.39   399.13   2121.35
         4814.67  13928.90 28408.10 4994.66  3032.96  2115.13  3877.61  2484.35  457.43   4999.39
         1687.59  8083.72  1691.67  419.53   -351.81  -1243.81 -5991.31 -178.26  30.81    307.20
         84.27    8948.96  1075.99  -527.20  -1092.32 -539.72  34.51    2176.96  945.61   938.97
         -1833.07 442.32   -42229.70         -24349.20         -2495.01 707.45   1907.85  3575.94  10510.10 3566.03
         -36.97   -372.02  -283.33  -2502.67 26.66    -203.78  -18.84   -147.14  -986.81  -1976.63
Gear3
         -75118.40         -93940.10         -23863.40         -45129.40         -6710.16 6342.05  -834.03  1871.61  2067.20  2396.81
         13038.40 8866.31  20249.20 5179.21  9965.82  3076.52  342.12   -1777.64 -685.73  -1294.23
         13925.50 29120.60 30113.50 17936.50 5607.07  19082.50 1129.71  70.75    -185.23  -4420.49
         4186.41  19713.70 22095.90 16102.70 12655.20 6124.25  5026.58  320.32   -416.53  -68.56
         1507.28  -15929.80         -45765.90         -10516.90         19447.20 30828.10 3829.63  4664.77  1012.24  4639.53
         2601.34  1373.18  1678.02  -7326.96 5266.25  18878.60 7639.54  1066.81  3224.86  2381.54
         0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
         90334.90 29714.40 11014.40 1785.65  5964.21  27973.30 16555.80 7935.59  9793.18  3711.86
         864.31   45517.30 -4844.89 -963.17  619.92   4032.21  4286.60  89.23    1769.68  987.65
         9472.40  27316.70 50646.10 -2785.82 74.30    1180.35  2861.23  -915.76  -561.23  -696.52
         28855.80 20087.50 35237.20 49915.60 6446.23  7483.75  -519.90  1895.32  4834.96  5621.23
         10522.60 23071.10 5801.26  -13119.20         -30107.30         12610.10 257.73   -458.20  1023.29  1463.88
         30564.20 9296.42  -32239.60         -13407.70         -18780.90         -31848.10         -15946.90         -4662.27 -1516.85 -21544.80
         34681.60 27478.60 -179.04  3815.57  -1480.15 9579.32  -7370.93 -2414.25 136.86   -6002.27
         659.19   28869.10 12977.10 2286.30  6386.18  6608.17  3799.39  3977.74  1937.84  608.16
         6520.28  1509.18  22633.50 -4890.25 -3247.08 9268.52  -1104.58 -3987.84 -1314.52 2663.92
         507.68   10811.40 -76.18   18309.10 14949.20 5793.28  3001.41  -4906.18 -8072.34 -24471.00
qs
Gear1
         -15.49   -13.62   -12.31   -11.76   -11.99   -11.98   -11.98   -12.29   -12.08   -12.08
Gear2
         -14.46   -12.08   -11.62   -11.89   -12.23   -12.66   -11.81   -11.44   -11.27   -11.27
Gear3
         -12.58   -11.94   -11.68   -11.65   -11.53   -10.82   -11.31   -11.73   -11.25   -11.25
Residual Landings
         -4587.35 -1150.38 2792.57  10226.40 18289.80 31931.50 20916.40 4750.18  7740.31  9246.64  2114.93  4151.59  -7841.28 -7777.43 5439.46  -6905.77 -4053.40
         30833.30 17649.50 -7892.39 42309.70 30220.20 26661.80 -434.80  30083.50 86496.40 -68426.30          31904.30 14384.50 70061.00 3008.39  7915.35  -6278.77 -10410.60
         -29732.60         24867.60 48138.60 61495.40 74569.10 56727.50 71377.50 165290.00          38785.70 62822.30 142325.00         -10131.70         -225146.00         19743.40 61569.50 -2422.75 -40763.20
Zero     Catch
         0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
         0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
         0.00     0.00     0.00     0.00     0.00     0.00     1.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
Catch    weights
         8765.65  8724.62  10231.60 18127.40 41066.80 37006.50 37354.40 24309.20 29298.30 37558.20 45273.90 40910.60 37988.30 32467.60 30125.00 48873.20 42232.60
         40081.30 61063.50 71325.60 67819.70 40273.20 32347.80 14569.20 37144.50 97631.40 161631.00          91749.00 33477.50 114100.00          27465.40 58512.70 93079.90 7718.44
         139913.00         83771.60 105782.00         107747.00         144352.00         76932.50 101889.00          205940.00         108424.00         194923.00         275752.00         208086.00         319287.00         135971.00         116175.00         174526.00         199078.00
Landings
         13353.00 9875.00  7439.00  7901.00  22777.00 5075.00  16438.00 19559.00 21558.00 28311.60 43159.00 36759.00 45829.60 40245.00 24685.50 55779.00 46286.00
         9248.00  43414.00 79218.00 25510.00 10053.00 5686.00  15004.00 7061.00  11135.00 230057.00          59844.70 19093.00 44038.80 24457.00 50597.30 99358.60 18129.00
         169646.00         58904.00 57643.00 46252.00 69783.00 20205.00 30512.00 40650.00 69638.00 132101.00         133427.00         218218.00         544433.00         116228.00         54605.80 176949.00         239842.00
PredictedLandings
         188760.00         153560.00         187339.00         193694.00         225692.00         146287.00         153813.00         267394.00         235353.00         394112.00         412775.00         282475.00         471375.00         195904.00         204813.00         316479.00         249029.00
TotalMort
         0.17     0.27     0.35     0.34     0.35     0.53     0.41     0.35     0.47     0.47
         0.14     0.23     0.29     0.28     0.27     0.36     0.32     0.30     0.38     0.38
         0.15     0.25     0.32     0.31     0.30     0.41     0.36     0.34     0.43     0.43
         0.14     0.23     0.30     0.29     0.28     0.38     0.33     0.31     0.39     0.39
         0.15     0.22     0.29     0.31     0.30     0.42     0.34     0.30     0.38     0.38
         0.13     0.19     0.25     0.26     0.24     0.31     0.28     0.25     0.31     0.31
         0.14     0.19     0.24     0.27     0.26     0.36     0.29     0.24     0.30     0.30
         0.16     0.25     0.32     0.33     0.33     0.50     0.39     0.32     0.42     0.42
         0.13     0.21     0.27     0.27     0.25     0.32     0.29     0.28     0.34     0.34
         0.16     0.27     0.35     0.35     0.33     0.46     0.40     0.37     0.47     0.47
         0.18     0.30     0.40     0.40     0.40     0.61     0.48     0.41     0.54     0.54
         0.16     0.24     0.31     0.33     0.33     0.50     0.38     0.31     0.41     0.41
         0.19     0.37     0.50     0.50     0.47     0.69     0.58     0.53     0.69     0.69
         0.15     0.21     0.27     0.29     0.28     0.40     0.32     0.27     0.35     0.35
         0.14     0.21     0.27     0.28     0.27     0.36     0.31     0.28     0.34     0.34
         0.16     0.26     0.35     0.36     0.34     0.48     0.40     0.36     0.46     0.46
         0.17     0.25     0.31     0.34     0.35     0.56     0.40     0.31     0.42     0.42
TSB
         993858.00         1082410.00        1089470.00        1147930.00        1179200.00        981646.00         1104030.00        1753530.00        1899890.00        1842850.00        1693910.00        1464080.00        1478610.00        1487720.00        1456820.00        1373030.00        1116530.00
SSB
         422387.00         410566.00         414082.00         554689.00         735756.00         706806.00         733216.00         729313.00         674577.00         782846.00         796473.00         745093.00         824725.00         639332.00         666582.00         776426.00         727231.00
weights  at       age
         0.28     0.53     0.60     0.70     0.95     1.56     1.78     1.77     2.45     2.60
         0.28     0.46     0.69     0.82     0.92     1.32     1.74     1.67     2.58     2.70
         0.42     0.53     0.54     0.60     0.76     0.95     1.26     1.96     1.27     2.81
         0.28     0.61     0.65     0.74     0.88     1.08     1.50     1.85     2.61     2.39
         0.28     0.58     0.68     0.93     0.96     1.40     1.61     1.88     2.62     3.19
         0.28     0.47     0.70     0.80     0.83     1.31     1.48     1.87     2.08     2.53
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
         0.44     0.64     0.72     0.82     1.00     1.18     1.46     1.71     2.13     2.43
mortality
0.10
proportion        due      to       penalty
0.01
```

penalty	21121.10									
Average	F	0.26								
Z	0.17	0.27	0.35	0.34	0.35	0.53	0.41	0.35	0.47	0.47
	0.14	0.23	0.29	0.28	0.27	0.36	0.32	0.30	0.38	0.38
	0.15	0.25	0.32	0.31	0.30	0.41	0.36	0.34	0.43	0.43
	0.14	0.23	0.30	0.29	0.28	0.38	0.33	0.31	0.39	0.39
	0.15	0.22	0.29	0.31	0.30	0.42	0.34	0.30	0.38	0.38
	0.13	0.19	0.25	0.26	0.24	0.31	0.28	0.25	0.31	0.31
	0.14	0.19	0.24	0.27	0.26	0.36	0.29	0.24	0.30	0.30
	0.16	0.25	0.32	0.33	0.33	0.50	0.39	0.32	0.42	0.42
	0.13	0.21	0.27	0.27	0.25	0.32	0.29	0.28	0.34	0.34
	0.16	0.27	0.35	0.35	0.33	0.46	0.40	0.37	0.47	0.47
	0.18	0.30	0.40	0.40	0.40	0.61	0.48	0.41	0.54	0.54
	0.16	0.24	0.31	0.33	0.33	0.50	0.38	0.31	0.41	0.41
	0.19	0.37	0.50	0.50	0.47	0.69	0.58	0.53	0.69	0.69
	0.15	0.21	0.27	0.29	0.28	0.40	0.32	0.27	0.35	0.35
	0.14	0.21	0.27	0.28	0.27	0.36	0.31	0.28	0.34	0.34
	0.16	0.26	0.35	0.36	0.34	0.48	0.40	0.36	0.46	0.46
	0.17	0.25	0.31	0.34	0.35	0.56	0.40	0.31	0.42	0.42
LandingsError		509982.00								
Catch	at	Age	Error	1325820.00						
ratio	L	C	error	0.38						

Input Data for Assessment for VIIe offshore Bass Stock

```
#bass offshore pelagic in 7e for catage8q
2
5
10
1998
3
#Effort UK
12114   16257   12873   10612   14740
#Effort France
8691    13863   9996    7273    9070

#Catch numbers UK
2       52      4146    16845   2543    14748   23233   3386    3578    4743
0       0       9510    13684   24810   14582   21121   48307   5382    3664
7       94      4392    9087    8834    7157    5011    9804    7260    1754
0       0       461     12599   13509   5553    7909    1203    2136    6241
3       228     2627    11810   11022   12059   6042    11738   14887   5361
0       3125    2500    14166   3125    20024   16225   417     1406    2760

#Catch numbers France
18      940     20037   57397   44166   45395   22361   41962   48601   14158
33      816     21222   55465   40416   40774   21066   40644   50968   14514
41      691     21966   52096   35026   31173   14451   25454   29646   8694
34      666     11351   36494   31861   33792   16402   31110   39468   14538
0       3250    14064   63650   19494   81269   35084   12136   3347    12215

#Landings UK
220467  75508   66116   127606  111822
#Landings France
549153  529086  448095  362272  329685

#Weight at age
0.59    1.15    0.83    1.04    1.23    1.38    1.77    2.01    2.33    3.59
0.56    1.1     0.87    1       1.12    1.32    1.63    1.92    2.15    3.38
0.57    1.12    0.79    0.98    1.07    1.28    1.52    1.76    2.25    3.15
0.54    1.15    0.84    0.96    1.13    1.3     1.61    1.99    2.26    2.72
0.81    0.89    1.02    0.92    1       1.26    1.63    2.21    2.17    2.82

#Maturity
0       0.03    0.23    0.43    0.57    0.9     1       1       1       1
#M
0.1
#Start F
0.18
#F penalty
2000
```

Results for VIIe offshore Bass Stock

```
#bass offshore pelagic in 7e results from catage8q
2.00
5.00
10.00
1998.00
3.00

PopulationNumbers
        545823.00       666195.00       457345.00       388839.00       278563.00       273469.00       255233.00       131854.00       90335.00 45085.30
        624299.00       493857.00       601827.00       394976.00       297742.00       211484.00       186060.00       180981.00       74035.60 33086.50
        412942.00       564846.00       445723.00       506706.00       276022.00       206031.00       122994.00       116649.00       79651.10 12830.70
        2192170.00      373624.00       510150.00       382560.00       379430.00       204934.00       134897.00       84718.80 61826.10 18993.00
        105614.00       1983480.00      337612.00       443785.00       300652.00       295891.00       145782.00       99196.90 51100.50 24199.10
CatchNumbers
Gear1
        3.36    57.31   3883.97 10705.10 11286.90 11461.30 18734.90 15974.20 12683.00 6329.94
        5.15    56.99   6774.57 13974.30 15494.90 11063.90 17305.60 26419.70 10790.30 4822.19
        2.70    51.63   4010.30 14667.20 11759.10 9013.05  9463.80  14632.80 11125.10 1792.10
        11.81   28.16   3808.70 9342.01  13641.40 7683.11  8824.66  9288.99  8238.46  2530.86
        0.79    207.63  3482.53 14776.50 14712.30 14940.70 12864.40 14307.60 8394.35  3975.21
Gear2
        21.93   964.47  15944.80 46265.40 31443.90 53251.10 33918.10 31826.00 50737.10 25322.40
        40.00   1139.92 33056.60 71784.30 51308.30 61099.70 37239.30 62564.30 51306.70 22928.90
        19.08   940.42  17819.00 68608.20 35457.10 45324.50 18544.30 31554.00 48169.60 7759.47
        73.69   452.71  14936.60 38569.00 36304.30 34101.10 15262.10 17679.30 31483.60 9671.80
        4.43    2996.62 12262.10 54772.50 35153.70 59538.00 19975.50 24448.80 28801.80 13639.30
ObservedCatch
Gear1
        2.12    51.59   4146.48  16845.10 2543.46  14747.50 23232.80 3386.31  3577.99  4743.06
        0.00    0.00    9509.89  13683.60 24810.10 14582.40 21121.30 48306.70 5381.69  3663.72
        6.65    93.77   4392.45  9087.41  8834.46  7156.55  5010.98  9803.54  7260.05  1753.84
        0.00    0.00    461.13   12599.30 13509.00 5553.46  7909.12  1203.27  2135.87  6240.73
        2.54    228.18  2626.96  11810.00 11022.20 12058.60 6041.78  11738.30 14886.80 5360.59
Gear2
        17.75   939.77  20037.00 57396.80 44166.40 45395.00 22361.00 41961.80 48600.60 14157.90
        33.09   816.10  21222.20 55464.50 40415.80 40773.80 21066.30 40643.70 50967.90 14514.30
        40.54   691.44  21966.30 52095.60 35026.50 31173.30 14450.60 25453.60 29645.50 8693.80
        34.36   665.84  11350.70 36493.80 31860.50 33792.30 16401.80 31110.50 39467.70 14537.70
        0.00    3250.30 14063.70 63650.30 19493.50 81269.40 35084.40 12136.30 3347.04  12215.30
FishingMort
Gear1
        0.00    0.00    0.01    0.03    0.05    0.05    0.09    0.16    0.26    0.26
        0.00    0.00    0.01    0.04    0.06    0.07    0.12    0.21    0.35    0.35
        0.00    0.00    0.01    0.03    0.05    0.05    0.09    0.17    0.28    0.28
        0.00    0.00    0.01    0.03    0.04    0.04    0.08    0.14    0.23    0.23
        0.00    0.00    0.01    0.04    0.06    0.06    0.11    0.19    0.32    0.32
Gear2
        0.00    0.00    0.04    0.14    0.13    0.23    0.16    0.32    1.05    1.05
        0.00    0.00    0.06    0.22    0.21    0.37    0.25    0.51    1.67    1.67
        0.00    0.00    0.04    0.16    0.15    0.27    0.18    0.37    1.20    1.20
        0.00    0.00    0.03    0.11    0.11    0.20    0.13    0.27    0.88    0.88
```

```
        0.00    0.00    0.04    0.14    0.13    0.24    0.16    0.33    1.09    1.09
Residuals
Gear1
        1.24    5.72    -262.51 -6139.99 8743.41 -3286.25 -4497.94 12587.90 9104.96 1586.88
        5.15    56.99   -2735.32 290.71  -9315.16 -3518.50 -3815.77 -21887.00        5408.63 1158.47
        -3.95   -42.14  -382.15 5579.81  2924.69 1856.50 4452.82 4829.26 3865.04 38.26
        11.81   28.16   3347.57 -3257.31 132.49  2129.65 915.54  8085.72 6102.59 -3709.87
        -1.75   -20.55  855.57  2966.50 3690.11 2882.07 6822.58 2569.33 -6492.41 -1385.38
Gear2
        4.18    24.70   -4092.25 -11131.40        -12722.50        7856.14 11557.20 -10135.80        2136.51 11164.50
        6.91    323.82  11834.40 16319.70 10892.50 20325.90 16173.00 21920.60 338.73 8414.66
        -21.46  248.98  -4147.31 16512.60 430.65  14151.20 4093.67 6100.43 18524.10 -934.34
        39.33   -213.13 3585.97 2075.24 4443.73 308.77  -1139.78 -13431.20        -7984.06 -4865.89
        4.43    -253.68 -1801.59 -8877.77 15660.10 -21731.40        -15109.00        12312.60 25454.80 1424.02
qs
Gear1
        -21.35  -18.71  -14.10  -12.86  -12.47  -12.39  -11.85  -11.24  -10.74  -10.74
Gear2
        -19.14  -15.56  -12.35  -11.07  -11.12  -10.52  -10.92  -10.22  -9.02   -9.02
Residual Landings
        -58798.10       94816.60 46419.70 -31801.10       21062.10
        -41388.30       79483.40 -53217.20       -69569.30       33610.40
Zero    Catch
        0.00    0.00    0.00    0.00    0.00
        0.00    0.00    0.00    0.00    0.00
Catch   weights
        161669.00       170325.00       112536.00       95804.90 132884.00
        507765.00       608569.00       394878.00       292703.00       363295.00
Landings
        220467.00       75508.00 66116.00 127606.00       111822.00
        549153.00       529086.00       448095.00       362272.00       329685.00
PredictedLandings
        669434.00       778894.00       507414.00       388508.00       496179.00
TotalMort
        0.10    0.10    0.15    0.27    0.28    0.39    0.34    0.58    1.41    1.41
        0.10    0.10    0.17    0.36    0.37    0.54    0.47    0.82    2.12    2.12
        0.10    0.10    0.15    0.29    0.30    0.42    0.37    0.63    1.58    1.58
        0.10    0.10    0.14    0.24    0.25    0.34    0.31    0.51    1.21    1.21
        0.10    0.10    0.15    0.28    0.29    0.41    0.37    0.63    1.51    1.51
TSB
        3681290.00      3345820.00      2887640.00      3681560.00      3912950.00
SSB
        1908250.00      1669650.00      1331070.00      1330700.00      1450620.00
weights at      age
        0.59    1.15    0.83    1.04    1.23    1.38    1.77    2.01    2.33    3.59
        0.56    1.10    0.87    1.00    1.12    1.32    1.63    1.92    2.15    3.38
        0.57    1.12    0.79    0.98    1.07    1.28    1.52    1.76    2.25    3.15
        0.54    1.15    0.84    0.96    1.13    1.30    1.61    1.99    2.26    2.72
        0.81    0.89    1.02    0.92    1.00    1.26    1.63    2.21    2.17    2.82
mortality
0.10
proportion      due     to      penalty
0.01
penalty 1402.27
Average F       0.45
Z       0.10    0.10    0.15    0.27    0.28    0.39    0.34    0.58    1.41    1.41
        0.10    0.10    0.17    0.36    0.37    0.54    0.47    0.82    2.12    2.12
        0.10    0.10    0.15    0.29    0.30    0.42    0.37    0.63    1.58    1.58
        0.10    0.10    0.14    0.24    0.25    0.34    0.31    0.51    1.21    1.21
        0.10    0.10    0.15    0.28    0.29    0.41    0.37    0.63    1.51    1.51
LandingsError   73952.00
Catch   at      Age     Error   125564.00
ratio   L       C       error   0.59
```

Technical Minutes

Study Group on Sea Bass

ACFM Meeting October 2004

Review Group: SGBASS (by correspondence)

Review group Chair: Gary Shepherd
Study Group Chair: Mike Pawson
Reviewers: Bengt Sjostrand, Eero Aro

General Issues:

The Study Group should be commended for their continuing efforts to compile the appropriate fisheries information necessary to produce a stock assessment. It is clear from the report that some serious data deficiencies remain and should be addressed before further evolution of the assessment is possible.

The report notes previous work which identifies four stocks of sea bass within the assessment area. Although the basic fishery information is presented in this report in several summaries, it would be helpful if future reports are organized using stock area as the first level for data summary, then country or area within each stock unit.

Assessment Units

The SG has assessed the bass in VIId, VIIe (north) and in VIId,e,h offshore fisheries. There is not much discussion on the exclusion of the North Sea bass (IVb,c), nor an explicit reason for creating a new "stock". Table 2.1 on availability and quality of data indicates, however, that landings and effort data in the North Sea is of poor quality. The quality of data in VIIa,f,g is said to be good, but the SG points out that it "had considerable difficulty in expanding the England and Wales catch at age and effort data for this area". No further details are given. What is needed to overcome these difficulties?

Catch/effort data

Measurements of catch and effort, and consequently CPUE, are critical in the assessment model chosen for sea bass. The quality of the data is noted in qualitative terms in the text and table 2.1. Some basis for these qualitative assignments should be provided. For instance, in the text for section 2.1 the number of métiers with available

data is identified, but there is no information on what percentage this represents of all métiers catching sea bass. It would also be helpful to have a table listing the available métiers for sea bass and the type and quality of catch and effort data available for each.

Landings data

A summary of nominal landings (t) in table 2.2 provides landings by country for all sea areas. Clearly France and unallocated landings account for the largest percent of removals. It was not clear how the unallocated landings were estimated by the study group. In addition, the sum of landings for France in tables, by area, is less than the total for France in table 2.2.

Also, it was unclear in the Report how the input data to the model (landings, effort, CANUM, WECA) was compiled for the units VIId and VIIe north. Is only UK effort data used? If not, how is French effort for 1999-2003 estimated?

Recruitment

Recruitment indices in table 3.1 should have units stated. It is unclear if these are actual numbers of fish or catch per unit effort. Unfortunately there is little redundancy of surveys within areas for comparison of recruitment signals. The survey in Division VIId lists the year classes as ages 2-4. The Study group might consider some division of this index into year class specific values using either age data or slicing of the length distributions.

Assessment

The input information for the SURBA model has been provided in the appendix but would be easier to interpret if provided in a labeled table. There is also no mention of the quality or quantity of age data used in developing the catch at age input. As clearly stated in the text, the modeling approach has several key assumptions, particularly the linear relationship between effort and F and the measurement of effort without error. Also the assumption is made that catchability by age and fleet is constant over time. Since the assumption of no measurement error for effort is clearly violated, as is generally the case with effort data, the results would benefit from some analyses to evaluate the sensitivity to violation of the assumption concerning effort measurement. Since effort is a key

variable in the model, some mention should be made if consideration was given to the potential change in efficiency over the time series.

The model uses catch curve information as a penalty function to constrain F. The catch curve information should also be provided to reviewers for evaluation, even though the model penalty is relatively minor.

Selectivities are best estimated for inshore trawl fisheries, which do not target sea bass (section 4.3.5). However, since the effort was measured for a fishery with sea bass as a by-catch, the measure of effort can not be considered reliable metric for use in this model. Resulting selectivity estimates should not be considered best estimates.

Conclusions

The SGBASS concluded that the analysis produced an adequate level of accuracy to provide managers with the advice that the stock is fished at a sustainable level, biomass is high, and strong year classes continue to be produced. Management of the bass is obviously not a straightforward task due to the multinational, multi-fleet nature of the fisheries in which bass are both a target and a by-catch, fished by different categories of fishers. Minimum landing size, closed areas and limited effort and entrance are the suggestions from the SG. It would be difficult for ACFM to give any specific advice based on this report.

Although the conclusions are reasonable, the uncertainty associated with the input data and model structure should be emphasized. As noted by the group, the results are more appropriately presented in relative terms and the estimates of F and SSB should be referred to as relative F and relative SSB. Any model such as this which relies heavily on commercial effort and LPUE should be viewed with caution. There remains an unknown level of error in effort measurements and a reliance on a limited subset as representative of the stock conditions, missing or estimated catch (particularly since no discards estimates were included for non-hook fisheries and a relatively unknown level of catch in the recreational sector), and ageing error (catch at age information should be provided in the report as well as CPUE at age).

The Study Group should continue with their efforts to include migration information into the model (other models may provide structural framework for inclusion

into SURBA). In addition, it would be recommended that existing tag recovery information be examined (if not already done) as an alternative method for exploitation estimation. The recommendation for additional recruitment surveys and fisheries sampling would be strongly encouraged if there are any realistic expectation for improvements in this assessment. In addition, possible development of any fisheries independent indices would be recommended.