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**An appraisal of the UK bass fishery
and its management**

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SUMMARY

The fishery

1. The fish resource considered comprises stocks of bass (*Dicentrarchus labrax*) exploited by fisheries landing their catch in England and Wales. Three different 'stocks' have been used for assessment purposes:
 - South-east (southern North Sea and eastern English Channel),
 - South-west (western English Channel),
 - West coast (Celtic Sea and Irish Sea).

Recruitment of bass appears highly variable. The 1984-86 year-classes were poor but year-class strength improved from 1987. The 1989 year-class was exceptionally large.

2. The fishery is exploited by commercial fishermen and recreational anglers. It is estimated that in 1992 there were around 272 full-time commercial vessels employing about 430 fishermen and over 1,000 part-time vessels. The estimated first sale value of commercial bass landings in 1993 was £7.9 million, with a wholesale value of £9.9 million. The recreational sector is an important element in the fishery. It is estimated that there were around 361,000 bass anglers in England and Wales in 1992, spending £18.3 million on their activities.
3. The real wholesale price of bass in the UK has been falling since 1990 with a substantial fall of over 15% in 1993. The main factor has been increasing quantities of farmed bass available in the various European markets. This situation is likely to be sustained, to the longer term benefit of UK consumers.
4. Prior to 1990, control of the exploitation of bass was by means of minimum landing sizes only. In the mid-1980s, there seemed to be an increasing tendency for small bass to be exploited in situations where they were particularly vulnerable. This trend was one of the main factors leading to a package of national management measures which were introduced in 1990.

The measures

5. The objectives of the measures were to maintain or increase yields from the bass fishery in England and Wales and to safeguard the bass spawning stock. The measures adopted were:
 - an increase in the minimum landing size of bass from 32 cm to 36 cm total length.
 - a prohibition on the use of gill-nets and similar enmeshing nets with mesh sizes between 65 mm and 89 mm, south of a line between Donna Nook in Lincolnshire and Haverigg Point in Cumbria within the 12-mile fishery limit;
 - a prohibition on bass fishing from any vessel in 34 specified nursery areas for all or part of the year.

The minimum landing size is the basic tactic which the other two measures support.

Effectiveness and impact

6. The assessment of the effectiveness and impact of the management measures was complicated by a number of developments unrelated to the measures but which nonetheless affected the fishery significantly. First, the presence of the strong 1989 year-class was recognised by many commercial and recreational participants as “more fish in the water”, which they may have attributed wrongly to the management measures. Second, the fall in real bass price levels has obscured the market and price effects of the measures. Third, any effects can only be attributed to a combination of national and local legislation which has come into effect since 1990 including some measures not aimed directly at bass.
7. The slow-growing nature of bass also means that whilst most of the negative impacts in economic terms are already apparent, the main positive impacts will not emerge until later when the biological benefits feed through into the fishery.
8. The effect of the minimum landing size (MLS) has been to reduce the proportion of small bass in catches in most areas. In the commercial fishery, the proportion has declined from 24% prior to the measures to less than 10% afterwards. In the recreational fishery, retained landings per angler have also declined. However, in order to comply with the measure both sectors have had to increase discarding. The MLS has been undermined to some extent by the presence of small imported farmed bass, making it difficult to secure convictions for handling undersized bass. In this regard it is worth noting that DFR have identified a means of distinguishing between farmed and wild bass. It is intended to test this in the courts at the earliest opportunity.
9. Mesh size restrictions support the MLS by preventing large scale landings of undersize bass by gill nets. Compliance has generally been good (apart from a few areas in the south and west) and as a result the proportion of undersize bass in landings has generally been less than 10%. The derogation allowing the use of mesh sizes in the banned range of 65-89 mm on the South coast between Beachy Head in Sussex and Rame Head in Cornwall has, however, sometimes been abused.
10. In years of average abundance bass up to 35 cm are found mainly in nursery areas so that the protection afforded by the designated areas is compatible with the current MLS of 36 cm. However, large year-classes do tend to spread outside of nursery areas at a smaller size resulting in some discarding by both the commercial and recreational fisheries. Compliance is good in most areas but enforcement is limited by the need to prove “fishing for bass” and by-catches remain an enforcement difficulty.
11. At the time of their introduction the measures were somewhat controversial. However the study showed that there is now widespread support for them from both commercial and recreational fishermen, and from bass merchants. In general, respondents felt that the measures should be strengthened and more effectively enforced.

Future management implications

12. Improved management in the future requires some modification to existing measures, and probably the introduction of some new measures. Compliance needs to be improved by adapting measures to facilitate enforcement.
13. The MLS seems broadly correct at present but the labelling and/or full documentation of all imported bass could be required so as to prevent the measure being undermined. The mesh size measure also seems satisfactory except that the derogation allowing the use of 65-89 mm

nets along the South coast should be rescinded. Nursery area controls require some modification including some possible new nursery areas. Options for consideration include changing the legislation so that all bass on board a vessel in a bass area are deemed to have been caught inside the nursery area, controlling methods that result in a high bass by-catch being taken in nursery areas, and changing boundaries to some bass nursery areas.

14. Fishing effort on bass is currently uncontrolled. An increase in the fishable stock and hence in the profitability of fishing resulting from the success of the management measures might lead to an increase in fishing effort and consideration should be given to the desirability of effort control in the future. In theory one option would be to implement, through a proposal from the European Commission, a Total Allowable Catch (TAC) for inshore and offshore fisheries in the UK and France. In practice, though, this would require the establishment of a bureaucratic system of collection of landings data from both the commercial and recreational fisheries, including anglers. Another option would be a special licence system for both commercial and recreational fishermen.

Future research implications

15. The study has identified a number of areas for future research including the need to maintain and develop the current monitoring programme, to evaluate discard mortality, to examine the changing economics of the bass market and to review long term management strategies. The biological sampling programme should be expanded to include data from other EU countries and from the recreational fishery in assessments.
16. Assessment of management measures of the kind undertaken in this study has been shown to be successful given the constraints under which it has taken place. A further assessment would be valuable once the full impact of the measures has been felt. However, a much better evaluation could be made by carrying out on-going economic monitoring rather than the intermittent approach which currently has to be used.

Conclusions

17. The study has highlighted the true value of the commercial and recreational fisheries for bass and the importance of the biological and economical background within which fisheries and management operate. Variability is a key feature of the fishery; in recruitment, effort and market. Such variability will have to be taken into account in future management.
 18. The national management measures that have been put into place so far have proved to be generally effective but require some modification mainly to ensure improved compliance. The main problem facing the MLS is the presence in the UK of undersized fish from abroad, mainly farmed fish. It is suggested that this problem might be dealt with by requiring origin marking for farmed imports and by increasing the MLS in the Mediterranean. The mesh size regulations seem adequate at present for bass but consideration should be given to revoking the derogation for nets with mesh sizes in the banned range (65-89 mm). The nursery area legislation should be amended to improve enforceability, in particular to make it an offence to be in possession of bass in a nursery area, irrespective of where the fish was caught. Changes to the boundaries of some nursery areas seem desirable and there are some potential new nursery areas. Effort control, particularly in the offshore bass fishery may have to be considered.
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1. INTRODUCTION

In 1989, the Ministry of Agriculture, Fisheries and Food (MAFF) agreed that scientists at the Directorate of Fisheries Research (DFR), Lowestoft would monitor and review the impact of new national bass fishery legislation to be introduced in 1990.

The general approach adopted was for DFR to assess bass stocks around England and Wales and to monitor changes in yields to the fishery over recent years. In order to evaluate fully the costs and benefits of the new conservation package to the main users of the bass resource, including the recreational fishery, DFR's work was supported by a Further Appraisal of the Bass Fishery undertaken by the Centre for the Economics and Management of Aquatic Resources (CEMARE) at the University of Portsmouth. This study followed earlier work by CEMARE in 1987-1988 (Dunn *et al.*, 1989) and uses the years 1992-1993 for comparison. An extension to CEMARE's contribution, a National Survey of Bass Angling (NSBA), was agreed in 1993 with the primary aim of generating catch data for the recreational sector.

The joint study represents an innovative approach to the problems associated with the management and monitoring of local fisheries with a large recreational component, in that it attempts to:

- assess the impact/effectiveness of national management measures;
- integrate economic aspects in an appraisal of marine fisheries management options, and;
- evaluate the marine recreational fishing (MRF) component of a fishery.

This appraisal is developed from the collaborative studies between the DFR and CEMARE. It summarises the main conclusions that are reached by the studies, focusing especially on the impact of the management measures. This leaflet begins in Section 2 by presenting background data concerning the fishery (the resource, the commercial and recreational fisheries as well as the market for bass), the goals of management and the management measures adopted. Section 3 then moves on to consider the effectiveness and impact of the package of measures on the main participants in the fishery, including the fish stock itself. Section 4 discusses some issues that have arisen as a result of management or which may be expected to play an important role in the future. Section 5 suggests some ways in which the current management package might be improved, and outlines some areas where more research seems necessary. Section 6 concludes the appraisal.

2. BACKGROUND TO THE REVIEW

In order to assess the impact of the management measures, it is important to understand the development of the fishery and its position prior to their introduction. This section begins by giving a brief overview of the fish resource and the fishing activities it supports. The objectives of the management package are then considered together with the measures that were originally proposed and those that were eventually adopted. The section concludes by looking at the responsibilities of different agencies for the implementation of the measures.

2.1 The fishery

2.1.1 *The fish resource*

The fish resource considered in this leaflet comprises stocks of the bass (*Dicentrarchus labrax*) which are exploited by fisheries landing their catch in England and Wales, south of a line between

the Wash on the east coast and the Scottish border on the west coast. Some bass are caught in the English Channel and landed into France and the Channel Islands, but the extent to which these fish come from the same bass stocks as are exploited by UK fleets is unclear and they have consequently been omitted from the analysis.

The growth of bass is slow and full sexual maturity is not reached until aged 5-8, when bass will have left the protection of inshore nursery areas and recruited to the adult stock. Previous studies (e.g. Pawson and Pickett, 1987) have shown that there are distinct patterns of movement and migration of bass which give rise, in part, to characteristic regional fishing patterns. Three different 'stocks' have been used for assessment purposes.

The 3 assessment units (stocks) are as follows:

- South-east – within ICES divisions IVc and VIIId (southern North Sea and Eastern English Channel), from north Norfolk to Swanage in Dorset. Tagging has shown that there is a regular inter-change of bass between these areas as part of the pattern of normal recruitment and seasonal migrations.
- South-west – within ICES division VIIe (western English Channel) and including offshore catches from VIIIh, from Swanage to Penzance. This bass stock is present all year but receives winter migrants from both the south-east and west coasts.
- West coast – within ICES divisions VIIIf+g (Celtic Sea) and VIIa (Irish Sea), from Penzance to Whitehaven (Cumbria). Tagging has shown that bass move freely between these divisions, particularly on spring and autumn migrations.

The regions used for assessments and component ICES divisions are shown in Figure 1.

2.1.2 The commercial fishery

The commercial fishery for bass covered in this study encompasses all those vessels fishing for bass, either as a target species in season or as part of an array of commonly caught species. Characteristically, bass are part of the coastal, multi-method fishery which relies on a small range of seasonally available species e.g. cod, sole, bream and bass.

The fishery is based on 4 main gear-groups: trawls, nets, longlines and handline/angling. In the mid-1980s, bass fishing effort was focused on young (3-5) age groups, and in 1987 an estimated 0.5 million 5 year-olds were caught. Around 28% of bass measured by DFR in 1986 were aged 5 years or less. Indeed, one of the main concerns leading to the introduction of the 1990 management package was the increasing tendency by parts of the fishery to exploit small bass in situations where they were particularly vulnerable, e.g. shoaled in inshore nurseries. This practice was encouraged by the increasing market demand for small bass.

The economic importance of the fishery has been studied by CEMARE for the two years 1987 and 1992. Whilst the results obtained were dependent on conditions existing in these particular years, they provide an overview of the economics of the fishery.

The fishing fleet comprises both full-time and part-time or occasional vessels. Full-time designation applies here to those fishing for bass as their major occupation during the local bass season, typically at least 3 days a week. Some indicative data for this sector are presented in Table 1. In addition, there are a significant number of vessels that fish part-time (2 days a week or less, during

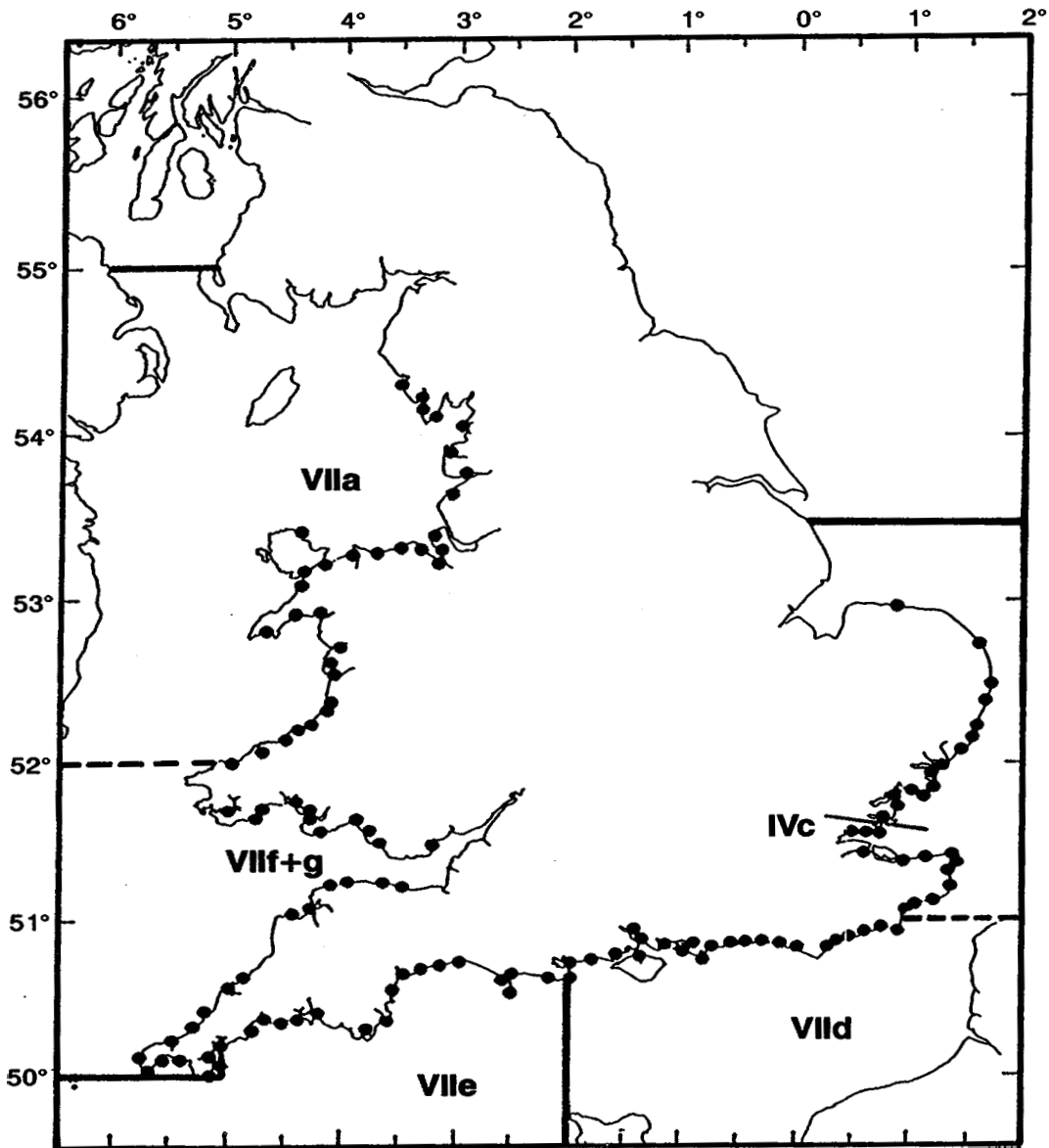


Figure 1. ICES divisions and areas used in bass stock assessments (bounded by solid lines) showing ports where catch and effort data are collected

the season) or on an occasional basis for bass. These include full-time vessels which catch bass as part of a wider array of species. In 1992, 1,099 such vessels were identified. Their characteristics are very similar to the full-time fleet for the most part. The major difference, apart from target species, is the number of trips that they made for bass. In 1987 it was estimated that a typical part-time vessel made 72 bass trips whereas in 1992 only 37 such trips were made. Performance on a trip basis was similar whether the vessel was considered part-time or full-time. The variability of part-time effort presumably reflects the greater opportunities open to such fishermen elsewhere.

Commercial bass fishing is undertaken throughout the year, albeit with a main period between May and October, whilst pair trawlers fish more during the winter months. For individuals the length of the bass season varies, with bi-modal peaks at 2-3 months and 6-7 months. The CEMARE survey revealed that some 75% of trips were of less than 12 hours duration, and over 90% involved travelling less than 5 miles off-shore.

Table 1. Characteristics of full-time commercial bass fishing vessels (constant 1987 prices)

	1987	1992
Physical characteristics of a typical vessel:		
Length (metres)	7.4	7.1
Power (kw)	44	55
Age (years)	12.5	13.3
Crew (number)	1.9	1.6
Economic characteristics of a typical vessel:		
Resale value (£)	8,375	8,936 (12,000)
Gear value (£)	1,375	2,105 (2,845)
Annual fishing activity of a typical vessel:		
Number of trips	124	97
Landed weight (tonnes)	1.2	0.8
Landed value (£)	7,400	4,620 (6,250)
Full-time bass-fishing fleet:		
Number of vessels	192	272
Capital value of vessels (£)	1.7 million	2.4 million (3.3 m)
Capital value of gear (£)	0.3 million	0.6 million (0.8 m)

Note: Italicised values in parentheses are non-deflated 1992 values

In 1993 the estimated first sale value of commercial bass landings was some £7.9 million, with a wholesale value of some £9.9 million. The main outlets for boats landing bass are to fish merchants direct, followed by landings to fish markets, with the remainder sold mainly direct to hotels and restaurants. It was estimated that some 72% of the bass landed went to merchants, some 22% was sold through markets, and 5% was sold direct to hotels and restaurants.

Bass fishing is a very significant source of income. The average dependency of full-timers was around 64% of total earnings from bass fishing in 1992 (the same as in 1987), whilst average dependency of part-timers was some 18%. Whilst the picture is variable, there is little doubt that the fishery is a significant contributor to the inshore sector, both full-time and part-time, particularly in being a non-quota fishery into which effort can move when prospects seem good (as happened in 1993 and may be expected to happen again in the future when strong year-classes appear). Movement may also occur into the bass fishery when prospects in other fisheries are poor. This movement of effort from species to species is an important feature of the inshore sector and reflects its diverse nature.

Total employment in the bass fishery is estimated at some 435 full-time, 1,868 part-time and at least a further 50 in the pair and mid-water trawling sector, giving a total of just over 2,350 fishermen deriving some livelihood from the commercial bass fishery, an increase of about 17% since 1987 (bearing in mind though, that many have only a partial involvement in the fishery). The total number of trips made also increased, from 116,440 boat days in 1987 to 185,372 boat days in 1993, mainly as a result of the increase in the number of boats fishing for bass.

Also involved commercially are charter boats although this sector is difficult to appraise. It includes both dedicated charter boats and part-time commercial boats. Involvement in chartering in the bass fishery was essentially minor; CEMARE estimated that 205 boats had some involvement during 1992, of which only 44 were full-time. Although this represented an increase of some

18% on the number of vessels involved in 1987, employment generated by charter boat bass fishing activities was not thought to have changed much from the 300 estimated in 1987. The dependence on bass fishing specifically was very varied (0% - 75% income); hence, whilst this was an important activity for some, most earned less than 5% of charter income from bass trips (much the same as the proportion of bass in their total catches). Approximately 10% of the commercial boats also took out recreational fishermen, but even when they did, this was usually a minor source of income (less than 4%).

2.1.3 The recreational fishery

The recreational sector is an important element in the fishery, given the considerable popularity of bass as a sport fish. It is estimated that the number of bass anglers in England and Wales increased from around 300,000 in 1987 to 361,000 in 1992, an increase of some 20% over this five year period. This increase is all the more remarkable when set against an estimated decline of 32% in the number of sea anglers in England and Wales over the period 1979-1992, to an estimated total of 1.22 million sea anglers. The National Angling Survey (National Opinion Polls, 1980) suggested that there were then 1.79 million sea anglers. On a national basis, it was estimated that 269,000 bass shore anglers made 1,076,000 trips and 135,000 bass boat anglers made 270,000 trips (note that some anglers fished both from the shore and from boats).

Results from survey work in 1992 demonstrated some remarkable similarities with results generated during 1987. For example, in both 1987 and 1992 roughly 10% of interviewed anglers were fishing for the first time in that year, suggesting that the rate of recruitment to recreational fishing had remained relatively unchanged. The main observed differences between the two years are a reduction in the numbers of shore anglers and a switch towards boat angling. Furthermore, the frequency of shore angling has declined quite markedly, whilst the frequency of boat angling has increased slightly.

An important feature of the fishery is the high and increasing popularity of the bass amongst recreational fishermen. Bass appears to have been the most fished for summer species by shore anglers in England and Wales in 1992 (in 1987 it was third), and to have been the third most popular species across the year as a whole (behind cod and mackerel) : for boat anglers, it came behind cod, mackerel and pollack and level with whiting as the fourth most popular species targeted specifically (but it may be noted that the National Survey of Bass Angling (NSBA) revealed that over two thirds of both shore and boat anglers admitted to fishing for “anything”).

In this connection, the motivations of sea anglers were studied in both the NSBA and the Further Appraisal, and a very clear pattern emerged. Both studies revealed that to “have fun and relax” was the most important single factor, followed by the “challenge of catching fish” and “getting away from the pressure of work/daily routine”, with “enjoying the water and waterside scenery” also highly rated. Actually “catching fish” was not that important to the general set of sea anglers, although there are indications that this is more significant for those much involved in bass angling.

Using the estimated numbers of bass shore and boat anglers, survey data regarding gross expenditures on bass angling (the economic impact value of this activity) have been used to estimate that in 1992, £13.1 million was spent on shore bass angling and £5.2 million was spent on boat bass angling, for a combined estimate of £18.3 million. This value compares with estimated bass angling expenditures of £9.7 million in 1987. When 1992 expenditures are deflated to 1987 prices for comparison, expenditures apparently rose by almost 40% between the two years, which even with a 20% increase in the numbers of bass anglers, represents a significant increase in the amount of money spent on bass angling.

2.1.4 The market for bass

Where fish merchants deal in bass, they mostly do so on a small scale. In 1992, an estimated 84% of merchants derived 5% or less of total turnover from bass sales. The highest proportion encountered in the CEMARE survey was 15% of turnover. The main sources of bass supplies were direct from fishermen (50.1%) and from fish auction markets (18.0%), with imports the third most important source and growing (14.1%). The main outlet for bass sales was to wholesalers (32.7%), followed by outlets to export, especially to France (18.2%) and Italy (16.2%), and then sales to hotels and restaurants (17.1%).

As can be seen from Table 2, the real wholesale price of bass in the UK rose between 1982 and 1987 at around 10% p.a., remained fairly steady between 1987 and 1989, but has been falling since then. There was a substantial fall of over 15% in 1993 (nominal prices falling by a similar percentage), with wholesale prices in fact falling much faster than quayside prices. Wholesale prices were typically some 40% higher than quayside prices, until signs of significant changes late in 1993 (possibly associated with imported supplies).

Table 2. Average nominal and real wholesale prices for bass: 1976-1993

Year	Nominal price (£/kg)	Price Change (%)	Real price (£/kg)	Price Change (%)
1976	2.18	-	2.18	-
1981	4.05	+ 85.8	2.16	+ 0.9
1982	4.40	+ 8.6	2.16	0.0
1983	5.11	+ 16.1	2.40	+ 10.9
1984	5.87	+ 14.9	2.62	+ 9.2
1985	7.05	+ 20.1	2.97	+ 13.4
1986	7.91	+ 12.2	3.22	+ 8.4
1987	8.80	+ 11.3	3.51	+ 9.0
1988	9.14	+ 3.9	3.48	- 0.9
1989	10.07	+ 10.0	3.56	+ 2.3
1990	10.47	+ 4.0	3.38	- 5.1
1991	10.90	+ 4.1	3.32	- 1.8
1992	10.72	- 1.7	3.14	- 5.4
1993	9.18	- 15.0	2.65	- 15.6

Source: *Bass prices from Fishing News (EMAP Heighway Ltd)*
Real prices deflated by RPI data (Central Statistical Office): 1974 = 100

It is apparent from research that the European market for bass has been transformed since 1990 by the advent of increasing quantities of farmed bass moving onto the various European markets. This development has reduced prices and this is likely to be sustained, to the longer term benefit of UK consumers. This issue is discussed more fully in Section 4.

Domestic landings on their own have only a small influence on quayside prices: a 10% increase in landings would result in a fall in quayside prices of less than 1%. It seems likely therefore that the availability of substantial quantities of farmed fish will increasingly set the price of bass in the UK.

2.1.5 Management

Control of the exploitation of bass up to 1990 was by means of minimum landing sizes only, based wholly on biological criteria. Subsequently, measures were extended to include controls of gill-net

mesh sizes and a prohibition on bass fishing in specified nursery areas. Policy was amended to manage the fishery for the benefit of both commercial and recreational sectors taking account of economic and social factors.

2.2 Objectives of management

The stated objectives of the package of national management measures introduced in 1990 were to maintain or increase yields from the bass fishery in England and Wales and to safeguard the bass spawning stock.

More precisely, the measures aimed:

- to increase size at which bass recruited to the fishery
- to improve yields
- to increase recruitment to the spawning stock.

2.3 The management measures proposed in 1987/88

Earlier studies concluded that a size of recruitment to the fishery of around 38 cm was needed to conserve bass stocks and to improve long-term yields. However, given the character of the bass fishery, it was felt that a national minimum landing size of 36 cm would suffice, provided that catching opportunities on bass below 38 cm were reduced where these fish were most vulnerable. In order to achieve this reduction two additional measures were initially proposed: a *100 mm minimum* mesh size for gill-nets and the establishment of *24 nursery areas* which would be seasonally closed to fishing methods catching immature bass.

The intention of nursery areas is to limit fishing effort on undersize bass. This is important because the juveniles aggregate close inshore for a long period – for example, because of the relatively slow growth of the species, it is common to find 5-year-old bass still in harbours and estuaries. Protecting these immature fish from fishing should help conserve the spawning stock and increase yields (in weight and value) from the fishery. The economic gain may be increased further if the recreational fishermen were to concentrate on larger fish, and the commercial sector to receive a higher price per kilogram for the larger bass. During the study period the size/price relationship was in fact variable, and whilst a higher price for smaller fish (1-2 kg) has been generally more typical, the situation was reversing with the advent of small imported farmed bass and the strength of the European export market for larger fish.

2.4 The management measures adopted in 1990

Following consultation, a revised set of management measures was introduced by statutory instrument in 1990. The package consisted of:

- an increase in the minimum landing size (MLS) of bass from 32 cm to *36 cm total length*, simultaneously adopted at EC level (Council Regulation (EEC) No. 3094/86 as amended by Council Regulation (EEC) No. 4056/89), effective from 1 January 1990,
- prohibition on the use of gill-nets and similar enmeshing nets between *65mm and 89mm* (The Seafish (Specified Sea Area) (Regulation of Nets and Prohibition of Fishing Methods) Order 1989: SI No. 1284), effective from 1 January 1990, and
- prohibition on bass fishing from any vessel in *34 specified nursery areas* for all or part of the year (The Bass (Specified Sea Areas) (Prohibition of Fishing) Order 1990: SI No. 1156), effective from 27 June 1990.

Under the EC MLS, it is an offence for any undersize bass taken from regions 2 and 3 of Community waters (which includes all seas surrounding the UK) to be landed, stored, sold, displayed or offered for sale. The minimum landing size is the basic tactic which the other measures support, and applies to commercial fishermen, anglers and merchants.

The national regulation relating to mesh sizes of gill-nets and similar enmeshing nets applies south of a line between Donna Nook in Lincolnshire and Haverigg Point in Cumbria within the 12-mile fishery limit. Local legislation can be more restrictive than EC, or national legislation. For instance the South Wales Sea Fisheries Committee has a single minimum mesh size of 100 mm for gill-nets and the North Western and North Wales Sea Fisheries Committee has one of 89 mm. A derogation to the national regulation allows the use of attended drift nets, beach seines and ring nets with mesh sizes between 65 and 89 mm within the 3 mile limit between Rame Head in Cornwall to Beachy Head in Sussex. This derogation was arranged to allow the continuance of the fishery for golden-grey mullet (*Liza aurata*) which was said to depend on smaller mesh sizes than those used for legal size bass.

Following consultation, and because the MLS was increased to only 36 cm (not 38 cm) and the minimum mesh size (MMS) to 89 mm (not 100 mm), it was decided to designate as nursery areas 34 rather than 24 of the most important areas where fishing was a threat to immature bass, with seasonal restrictions on fishing for bass. Figure 2 shows the distribution of bass nursery areas in England and Wales. A list giving local details of each area can be found in a MAFF booklet 'Bass – Nursery Areas and other conservation measures' (MAFF, 1990).

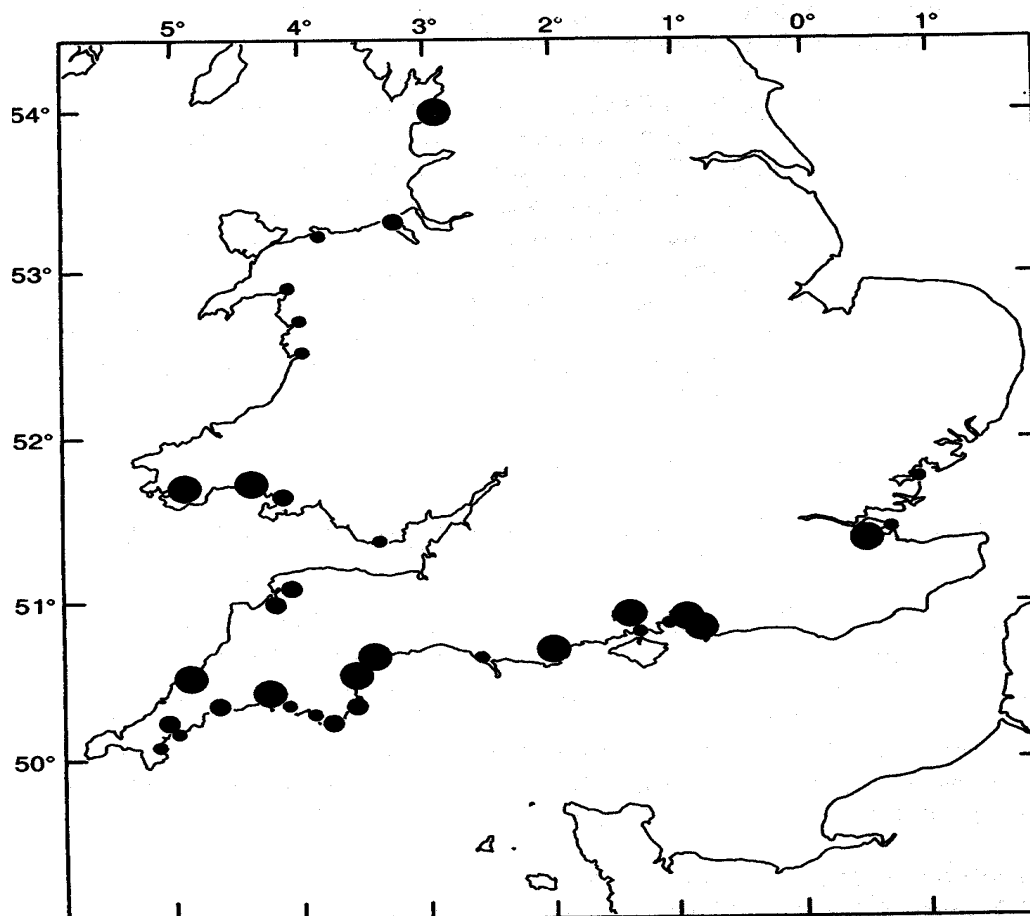


Figure 2. Bass nursery areas

In addition, supportive legislation was required to control fishing methods in nursery areas that would take undersize bass and Sea Fisheries Committees (SFCs) were invited to consider appropriate measures. Without such supportive legislation bass would still be vulnerable to fishing aimed at other species and might be illegally landed or suffer damage, or mortality, on being discarded. Under the national legislation by-catches of bass, of whatever size, cannot be retained if taken inside a nursery area. Unfortunately though, bass found on board a vessel inside a nursery area, cannot necessarily be deemed to have been caught in that nursery area.

The proposed measures generated a fair degree of controversy and hostility from the fishing community during the consultation period prior to their introduction. Many people expressed the view that the measures were unnecessary, although this view perhaps disguised the true worry which was that the measures might affect the competing commercial and recreational sectors adversely, each being concerned that they were about to suffer for the benefit of the other.

2.5 Implementation responsibilities

Responsibility for enforcement of the measures rests with Fisheries Departments and MAFF Sea Fisheries Inspectorate (SFI), assisted by officers of local Sea Fisheries Committees who are empowered to enforce both national and EU legislation. For nursery areas specifically, SFC and National Rivers Authority (NRA) staff have been trained as British Sea Fisheries Officers (BSFOs).

For simplicity and certainty of action the nursery area prohibition was introduced as national legislation. Potential difficulties in enforcing a prohibition on fishing for bass *per se* were recognised and Sea Fisheries Committees were recommended to make suitable bye-laws controlling fishing methods likely to catch small bass within nursery areas, according to local need.

3. THE EFFECTIVENESS AND IMPACT OF THE MANAGEMENT MEASURES

This section presents the available evidence on the changing state of the bass fishery and stocks and assesses the impact of the management measures.

In attempting to assess the impact of management measures, researchers have to resolve a number of difficult questions. First, what is the likely time-scale for the impacts to show themselves, and where do we stand at present on that scale? Second, what factors apart from the management measures may have influenced the performance of the fishery? Third, where are the impacts most likely to be felt and hence how should the assessment of the measures be undertaken?

Dealing briefly with each of these issues in turn, it must first be noted that because of the slow-growing nature of bass the full effects of the measures will not yet have been fully felt. Moreover, whilst some of the main negative impacts in economic terms are apparent, the main positive impacts will not emerge until later when the biological benefits feed through into the fishery. From the introduction of the measures it was expected to take at least 5 years for their full impact to be realised (Pawson and Pickett, 1987).

On the second issue, three external influences have been confounded with the impact of the bass management measures. First, the presence of the particularly strong 1989 bass year-class was recognised by many commercial and recreational participants as “more fish in the water” and they may have attributed this wrongly to the management measures. Second, the market situation post-1990 has been substantially affected by the major increase in the quantities of farmed bass coming

on to European markets and a subsequent fall in real price levels. This development has tended to obscure any economic effects that the measures may have had in market and price terms, certainly in 1992 and particularly in 1993. Third, at the national level, any effects shown can only be attributed to a combination of national and local legislation which has come into effect since 1990. These include some measures not aimed directly at bass but which may have affected fishing activity on bass.

On the third issue, it is possible to identify as many as twenty five separate stakeholders or interest groups, who might possibly be affected economically by the management measures. These vary from rather narrow groups (e.g. bait diggers/suppliers, fish market operators) to very wide groups (e.g. shore anglers, inshore net fishermen). For practical purposes, however, it is necessary to focus on the major impacts, particularly on the three main stakeholder groups: commercial fishermen, recreational fishermen, and fish merchants.

Subject to the various caveats expressed above, the remainder of this section presents an assessment of the management measures in terms of the fish resource, the commercial and recreational fisheries, and the bass market.

Although the impact of the measures is evident through the stock and the fishery, the implementation of the measures raises a wide range of issues. The most important of these are discussed in Sections 4 and 5.

3.1 The approach adopted

Studies of the impact of the management measures were undertaken by two teams. One team from DFR concentrated on the fish resource, whilst the other from CEMARE concentrated on the recreational fishery and the bass market. Both teams considered the commercial fishery. This section briefly outlines the approaches adopted by the two teams.

3.1.1 DFR methodology

The state of the bass fishery and of stocks around England and Wales have been monitored on the regional pattern described in Section 2.1.1, by two parallel courses of action:

- **An annual assessment of catch and effort** in the bass fishery is carried out which provides an indication of the abundance of the exploited bass population. Each year an effort sample of around 60 bass fishermen keep logbooks of their fishing activity, and an effort census is conducted which enables the sample results to be scaled up to the fleet as a whole (Pickett, 1990). Standard fish stock assessment techniques have been applied to data from the commercial fishery. The recreational fishery is not included in the assessment at present, due to a lack of yearly landings statistics and biological sampling data.

The voluntary logbook system is the main source of catch, landings and fleet activity data for the UK commercial bass fishery. It provides daily records of the catch, in numbers and in weight, of bass and by-catch species, the gear used and the area fished, from which effort frequency and catch per effort for the sampled fleet is directly calculated. The unit of effort used is the boat-day, regardless of the gear used, because of the difficulties encountered in standardising effort. Total effort is then expressed as the sum of boat-days fished by all vessels catching bass in each region. However, vessels over 10 m registered length are not generally included in the bass logbook scheme,

although this is not a major problem in that most of these vessels tend not to target bass. Some usable effort data is available for these vessels and is taken from the MAFF Fisheries Statistical Database (FSD).

The effort census of the bass fishery provides an estimate of the number of vessels fishing for bass according to boat size/type, main gear, number of crew and part/full time designation. Biological sampling then provides information on the way in which different fleets exploit the fish stock (in terms of age and length of fish caught).

FSD statistics for bass landings are consistently lower than the data generated by the system above although results are closer for some ports than others.

- **Recruitment levels are assessed** to answer the question as to whether the spawning stock will be able to continue to produce sufficient recruitment to the fishery to sustain yields. Bass become exploitable between ages three and six but it is possible to monitor recruitment at younger ages. For fish in their first year of life (0-group), abundance indices have been calculated from coastal power station intake screen monitoring at Oldbury (west coast) and Thurrock/Tilbury (east coast). For the 1-5 age groups, abundance is monitored by regular small-mesh trawl surveys in the Solent and adjoining natural harbours. Estimates of the relative strengths of successive year-classes have been obtained by establishing time series of data collected in a consistent manner. The possible causes and consequences of any trends in year-class strength have been examined.

3.1.2 CEMARE methodology

The work undertaken by CEMARE has been on the basis of detailed studies of two separate years of operation of the fishery (1987 and 1992) rather than on the basis of on-going monitoring as in the case of DFR. It is important to recognise that, in the absence of regular economic monitoring, the CEMARE studies can only provide “snapshots” of the fishery in the study years. There is some evidence to suggest that both years were in some ways atypical.

CEMARE data on the commercial fishery were generated from four groups :

- a 10% random sample of all owners of fishing vessels with registered lengths of 10 metres and under registered at ports in England and Wales (550 potential respondents),
- a sample of identified pair and mid-water trawler owners believed to have participated in the bass fishery (150 potential respondents),
- those vessel owners who co-operated with the 1987 CEMARE study and indicated a willingness to participate in future studies (31 potential respondents),
- all those who had participated in DFR’s log-book scheme (126 potential respondents).

These groups were sent postal questionnaires with postage-paid reply envelopes to generate the required data. In total, from the 857 potential respondents, usable responses were received from a total of 242 vessel owners, which represents a broad response rate of some 28.2%. Replies from the last two samples were combined for analysis, given their size and evident similarity. Of the replies employed, 62% came from the 10% random sample, 24% from the combined 1987 contacts/log book sample, and 14% from the pairs sample.

In the case of the recreational fishery, survey work consisted of substantial on-site interviews with anglers in 1992, replicating as far as possible the methodology used in 1987. Over 400 interviews were conducted during the main three months of the bass fishing season. These were followed-up in 1993 by postal surveys of all those anglers interviewed and samples of bass anglers known to CEMARE and DFR from a range of sources, including those who had participated in survey work in 1987, MAFF log book holders and members of the Bass Anglers Sportfishing Society (BASS). A total of over 1,000 questionnaires were sent out (including reminders) and the overall response rate received was 47%.

A separate National Survey of Bass Angling (NSBA) was conducted in order to generate data on the total population of bass anglers. Drawing from a commercial database, 15,000 random respondents interested in fishing were contacted by postal questionnaire regarding their general angling activities, producing a 39.2% response rate. From these, 1,146 were then contacted again concerning their sea angling in 1992 and 1993, with a 59.3% response rate. The improved angler population estimates obtained enabled some re-working of the original 1987 results (Dunn *et al.*, 1989) concerning recreational bass angling. These earlier survey results had previously of necessity been grossed up to national levels on the basis of the 1980 National Angling Survey data, but with the benefit of the NSBA studies, it proved possible to rework these data to produce revised estimations of the 1987 situation.

In addition to calculating the amount of bass landed by recreational fishermen, it was also important to estimate the quantity of fish caught by anglers and then returned to the water either as undersize fish or for 'conservation' motives. Such 'discards' may have lower survival rate if caught on baited hooks rather than lures so the estimated landings values probably represent an absolute minimum estimate for bass mortality due to recreational activity.

To supplement other available information, data on the market sector were generated by both postal and telephone surveys of fish merchants known or believed to deal in bass. These were identified from two sources. Firstly, those identified by DFR (38 merchants) and secondly those firms indicating that they trade in bass in the Seafood International Directory (82 merchants). Responses were received from 25 merchants with a wide variety of trade in bass undertaken. The results provide a valuable insight into what is otherwise an uncharted activity.

3.2 The fish resource

Catch per unit of effort (cpue) series are often used as indices of abundance for fish stocks. However, since the assessments of bass stocks have not included an allowance for discards, such indices have been based upon landings per unit of effort (lpue). Figures 3(a-d) show the estimated landings and lpue for the main assessment areas. The calculated lpue between 1985 and 1992 varied from around 7 kg per day to less than 4 kg per day, suggesting an overall decline in stock abundance between these years. A short-term improvement was experienced in 1987 to over 8 kg per day, associated with the large 1982 and 1983 year-classes being heavily exploited, but 1992 produced the lowest estimates of lpue to date (3-5 kg per day). The provisional estimates for 1993 indicate a recovery in the abundance of the bass stock.

However, changes in stock abundance are only one interpretation that might be given to changes in lpue in this fishery, given that it has not yet been possible to standardise fishing effort. In this situation, variations in lpue could arise for a number of reasons, especially the change in the composition of fishing effort that has occurred (see Section 3.3.1).

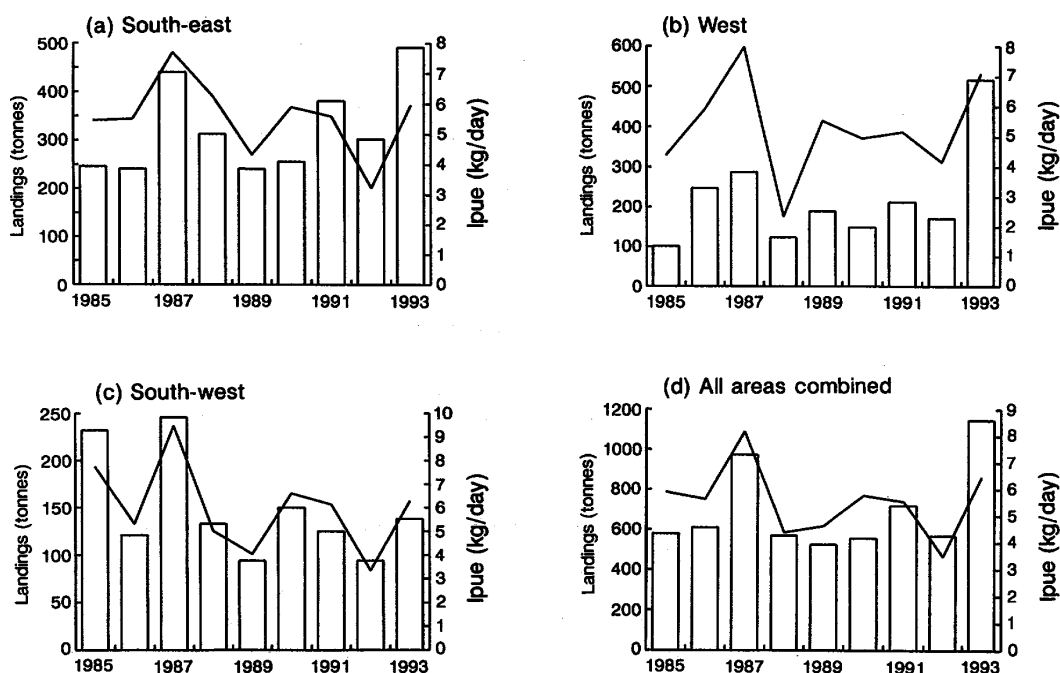


Figure 3. Bass landings (bars) and landings per unit of effort indices by assessment area for the period 1985-1993, all gears combined

Analytical assessments also suggest that the bass stock has increased in the early 1990s. This includes increased recruitment to the spawning stock as the large year-classes of the late 1980s have matured. This has been evident particularly in the south-east and west (Figure 4). In the south-east fishing mortality (F) remains highest on 5 and 7 year-old fish (Figure 5) and although fishing effort has increased since 1990, overall fishing mortality has not increased significantly due to the increase in stock.

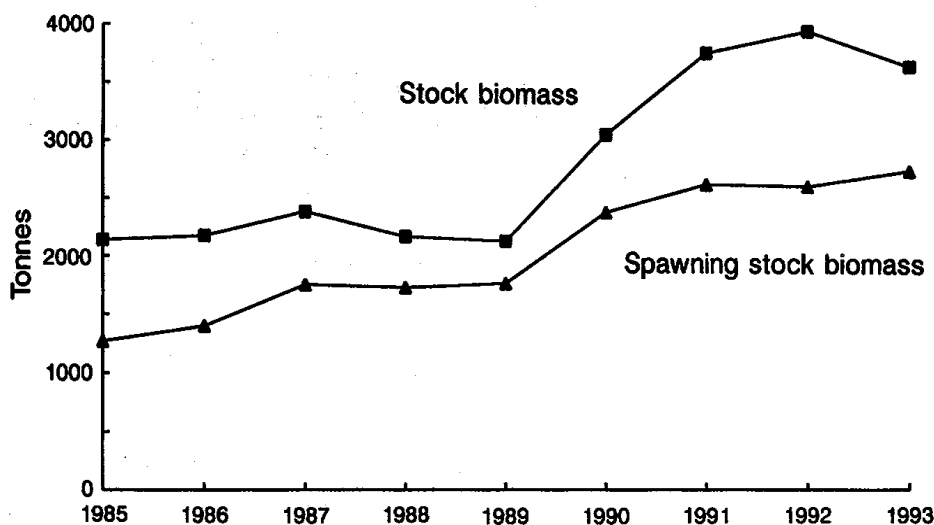


Figure 4. Estimates of bass stock abundance and spawning stock abundance for the south-east area, 1985-1993

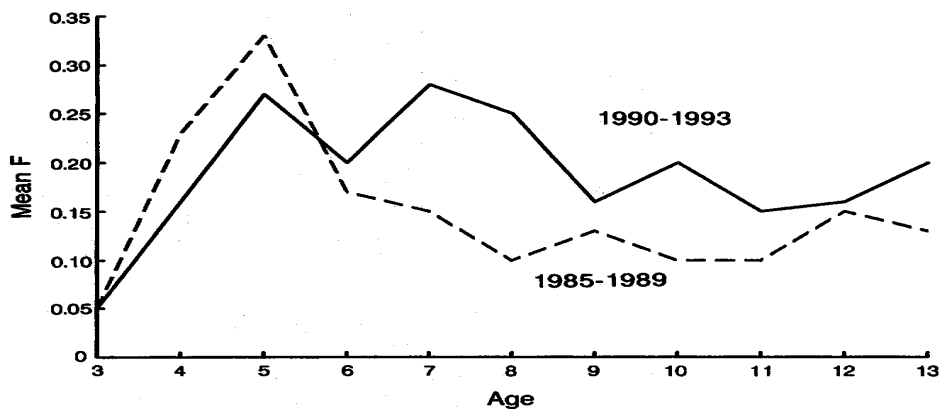


Figure 5. Estimated mean F at age in the south-east area over the periods 1985-1989 and 1990-1993

Recruitment to the bass stock and the subsequent impact of year-classes on the fishable stock have been assessed by DFR studies. Recruitment of bass appears highly variable and is possibly cyclical and/or related to climatic trends. Thus, the year-classes of 1984-86 were poor but improved from 1987; 1989 was an exceptionally large year-class. Many fish from this year-class have now matured and have helped to replenish the spawning stock. Although recruitment since 1989 has reduced somewhat, levels are still relatively high compared with pre-1989 values. The pattern of recruitment, based on sampling at coastal power-stations, is shown in Figure 6.

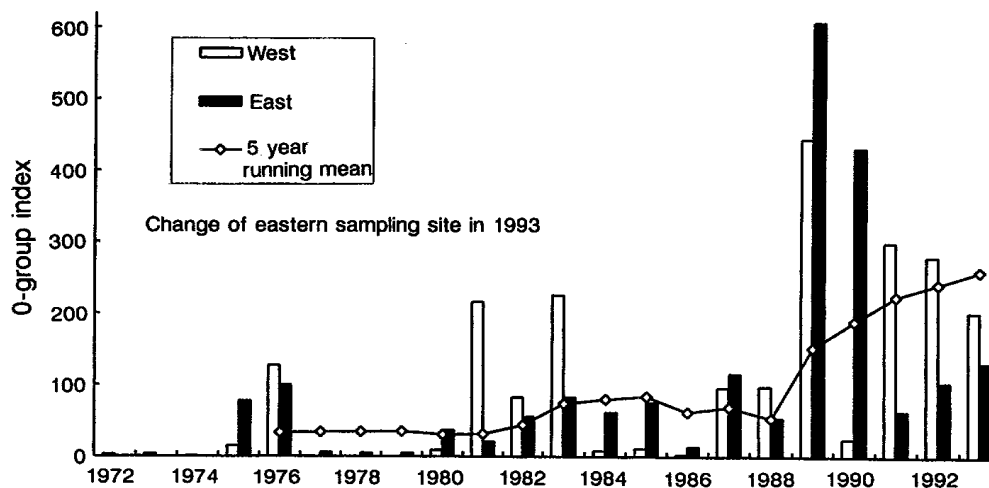


Figure 6. Bass 0-group abundance index from power station screen sampling

3.2.1 The MLS change

Following the introduction of the new minimum landing size in 1990, the pattern of exploitation in the fishery has improved. This is shown by a comparison of length distributions of UK bass landings over the periods 1987-89 and 1990-93 (Figure 7). The proportion of juvenile bass being taken has been significantly reduced with exceptionally good results over the period 1990-1992. In 1993 the proportions increased, although they remain well below the levels observed before the implementation of the management measures. The results are summarised in Table 3.

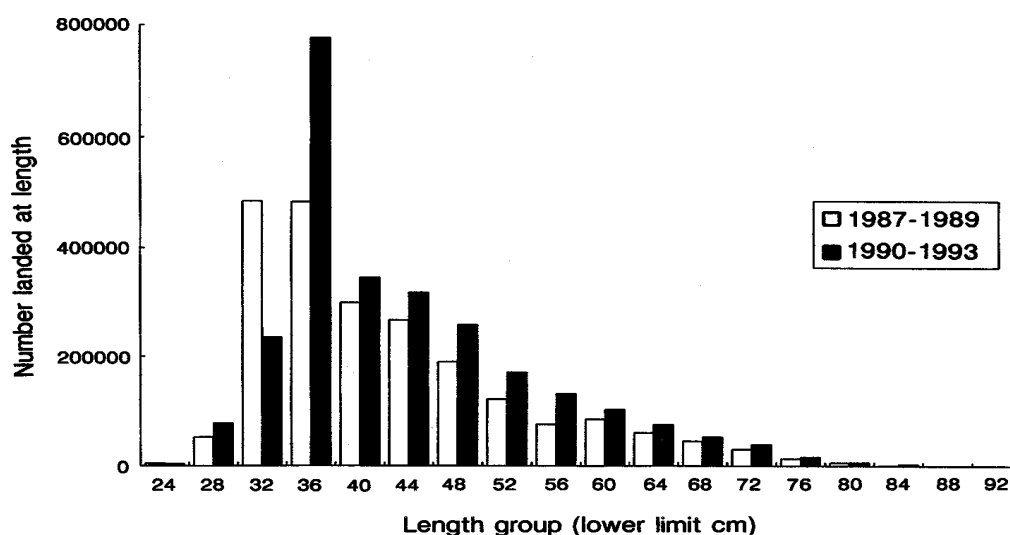


Figure 7. Length distributions of UK (England and Wales) bass landings over the periods 1987-1989 and 1990-1993

Table 3. Proportion of juvenile bass in landings

	1987-1989	1990-1992	1993
% < 32 cm	2.6	0.0	1.3
% < 36 cm	24.4	4.6	9.3

The increase in 1993 seems due to a combination of the strong 1989 year-class (and hence increased availability of juvenile bass) and the increase in gill-netting activity (see Section 3.3.1).

However, the renewed tendency to land undersize bass noted in 1993, which has continued in 1994, does give some cause for concern that the immature stock could be increasingly exploited. The 1988 and 1989 year-classes, which should be the mainstay of the fishery for the foreseeable future, already provide the bulk of the catch, and future yields and spawning stock levels could be reduced if effort were to increase further.

The principal technical management measure has been the minimum landing size. Although the measure has had beneficial effects, in both yield and recruitment to the spawning stock, these would have been greater with stricter observance and enforcement (see Section 4.2).

3.2.2 The mesh size change

Following the introduction of the mesh size regulations in 1990, the mesh sizes generally available and in use in the bass fishery were 3⁵/₈" (91.5 mm), 3³/₄" (92.25 mm) and 4" (101.6 mm), with local variation. The use of these mesh sizes would result in approximately 10% of bass captured being under 36 cm (Figure 8).

Gill-nets can be highly selective (Figure 9) and up to 1992 the proportion of undersize bass landed by gill-netters remained low, averaging less than 5%. This was partly the result of observance of the mesh size regulations but also of poor year-classes during the period 1984-86. In 1993 and

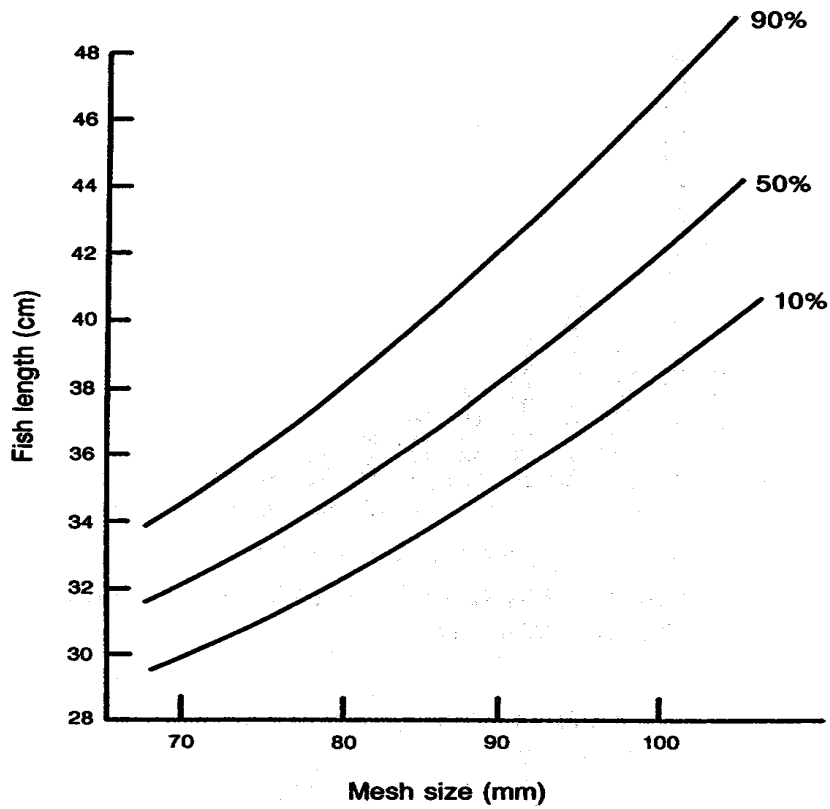


Figure 8. The proportions of bass at different lengths retained by various gill-net mesh sizes

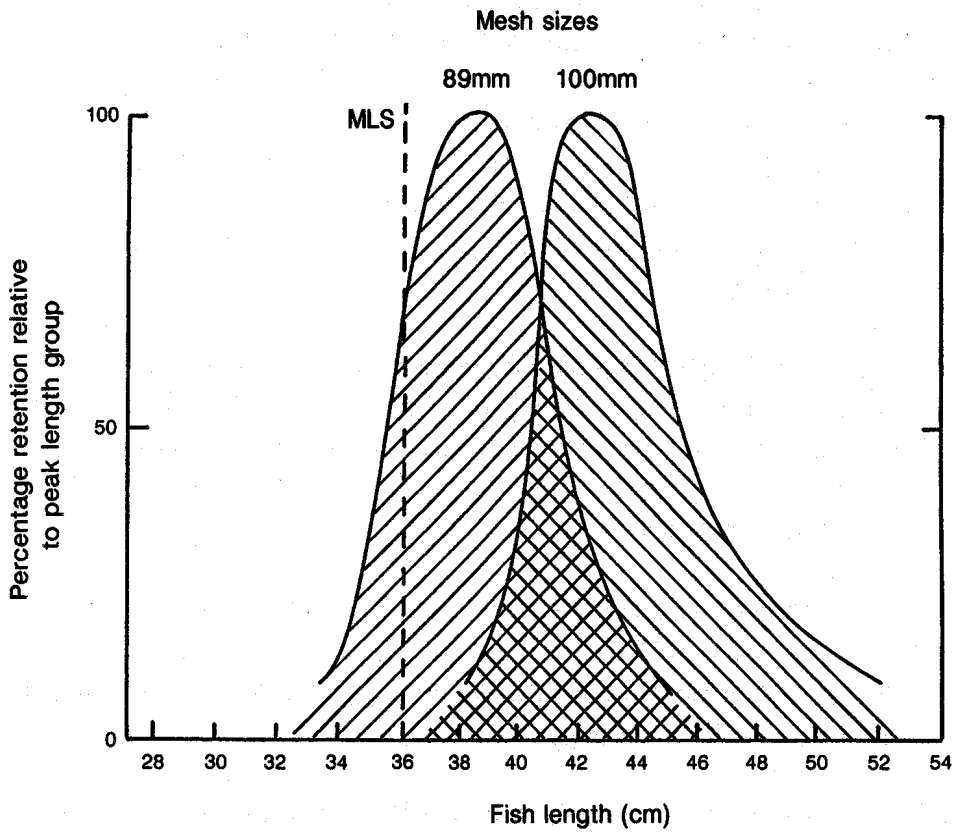


Figure 9. Theoretical gill-net retention curves for mesh sizes of 89 and 100 mm

1994, following entry to the fishery of the strong 1988 and 1989 year-classes, the proportion of undersize bass in gill-net landings increased to 8% in the Thames Estuary and to almost 20% in samples from South Wales. In 1993 and 1994 both MAFF and SFC Fishery Officers reported incidents where bass had been targetted using nets with mesh sizes in the range 65-89 mm, permitted under the derogation for attended mobile gears between Beachy Head and Rame Head. Because these activities took place mostly at night, the enforcement agencies had great difficulty in countering them and as a result Sussex SFC have proposed a new bye-law to ban the use of drift-nets with mesh sizes within the range 65-89 mm. In South Wales undersize bass appear to have been taken with mesh sizes below the national (and local) legal minima for gill-nets (possibly in herring drift-nets which typically have mesh sizes between 30 and 60 mm).

Although it is concluded that the mesh size regulations have been largely effective in controlling the proportion of undersized bass landed, the study has shown that there is considerable fluctuation in the usage of gill-nets in the bass fishery and in the landings taken by this method. With current fishing patterns, gill-nets account for only about 30% of the UK total bass landings and a higher mesh size would only offer protection to a relatively small proportion of the bass population as other methods also catch undersize bass. The derogation for attended mobile gears between Beachy Head and Rame Head, with mesh sizes in the range 65-89 mm, is open to abuse and its revocation should be considered.

3.2.3 The introduction of nursery areas

The protection afforded to immature bass by the minimum landing size is reinforced by the nursery areas. It was not within the scope of this project to carry out a full evaluation of the effects and effectiveness of all 34 nursery areas. However, the general principle of closed nursery areas as a tactic to protect juvenile bass from unwanted fishing effort appears to be borne out by the size distributions of bass inside and outside the areas, which show that fish above the 36 cm minimum size disperse to become available to the fisheries outside the nursery areas (Figures 10 and 11).

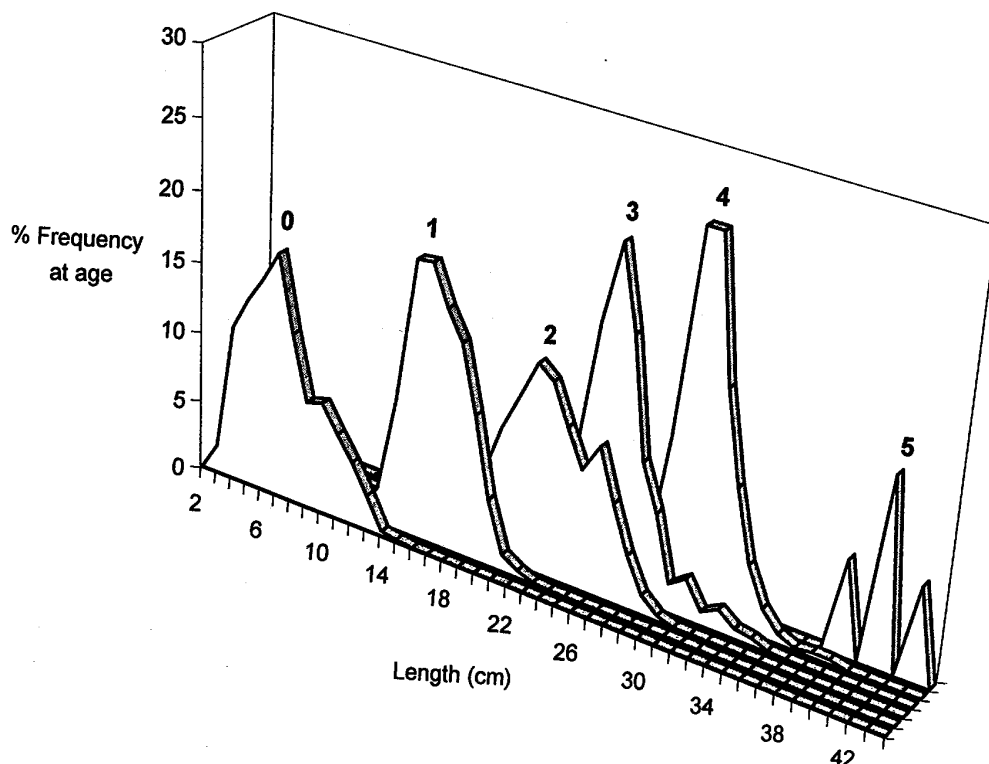


Figure 10. *The combined (1989-1993) length frequency distributions at age of bass from September surveys in the Solent nursery areas*

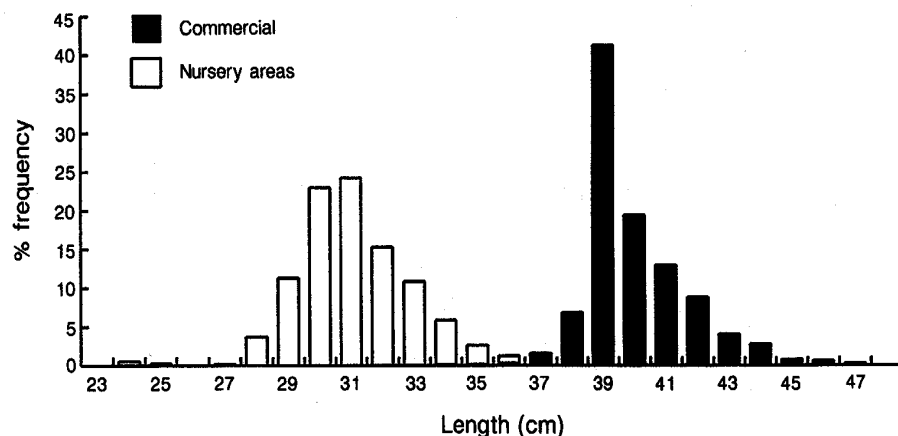


Figure 11. A comparison of the length frequency distributions of the 1989 year-class in the Solent nursery areas and in commercial landings from the West Sussex and Hampshire area in 1993

Juvenile bass of large year-classes tend to be distributed over much wider areas than are covered by the designated nurseries, leaving mainly the minimum landing and mesh size regulations as protection. Consequently more undersize fish are exposed to the fishery, which may result in a higher rate of discarding in such year-classes. However, bass normally frequent nurseries up to a maximum size of 35 cm (about 4 years old). The designated bass nursery areas therefore accord well with the current minimum landing size of 36 cm.

Of all the measures introduced, the nursery area concept was the most radical. However, responses to questionnaires sent out by CEMARE in 1993 have revealed widespread support for the principle of nursery areas and there is believed to be a high level of compliance with the measure. Local contacts and enforcement agencies have reported greatly reduced commercial fishing activity in some areas such as the Camel estuary and the Plymouth rivers complex. In other areas however, such as the Exe estuary, activity continues and has been the cause of local conflict between various groups of fishermen. There is also the possibility that the identification and designation of nursery areas may have resulted in some of them being deliberately targeted by certain unscrupulous elements of the fishing community, particularly in areas where enforcement is less rigorous.

Observations of fishing activity in 8 of the 34 designated nursery areas have shown that in 1992, two years after their introduction, bass fishing still occurred in some of them, especially by recreational anglers. Table 4 shows the amount of observed and estimated gross monthly bass fishing activity in the eight areas during the main summer fishing period.

Observed reductions in gill-netting activity in nursery areas cannot be attributed to the nursery area legislation alone if bye-laws erected under the 1986 Salmon Act also apply. Estuaries in Devon, Cornwall and Wales all fall into this category. In areas where SFC bye-laws have been introduced with the express purpose of supporting the nursery area measures, then bass fishing activity from boats seems either to have ceased or at least been drastically reduced e.g. the Burry Inlet in South Wales.

No local controls on fishing from the shore have yet been introduced in nursery areas, with the exception of a few locations with private access. Shore angling appears to be widely practised within the majority of nursery areas.

Table 4. Bass fishing activity in nursery areas in 1992 as observed on sampling days, and grossed for the months indicated

Nursery		Boat days		Shore anglers
		Commercial	Recreational	
Langstone (Jul, Aug, Oct)	Observed	11	32	104
	Gross	137	361	1082
So'ton Water (Aug, Sep)	Observed	0	138	263
	Gross	0	1916	4030
Fawley (Aug, Sep)	Observed	0	1	0 (no shore boundary)
	Gross	0	10	0
Poole (Aug)	Observed	10	25	60
	Gross	102	254	629
Plymouth (Aug, Sep)	Observed	0	2	251
	Gross	0	30	3770
Fal (Aug, Sep)	Observed	3	10	4
	Gross	63	118	51
Camel (Jul, Aug, Sep)	Observed	8	24	48
	Gross	74	247	380
Burry Inlet (Jul, Aug, Sep)	Observed	0	0	247
	Gross	0	0	2838

3.3 The commercial fishery

3.3.1 Fishing effort and activity

Fishing effort might be considered to comprise two elements:

- the size and structure of the participating fleet (this might be considered as 'potential effort');
- and the activity of this fleet over the bass season (fishing frequency measured in boat-days).

From 1985 to 1991, the number of vessels fishing for bass appears to have been remarkably stable, but a steep increase was apparent in 1992 in the south-east and in 1993 in the west (Figure 12(a) and (b)). In these areas the increase has been mainly in vessels designated as fishing full-time for bass.

Figure 13 shows trends in nominal bass fishing effort since 1985 in each of the 3 assessment areas. Overall fishing effort in the south-east almost doubled in 1991-92 (from around 50,000 to 90,000 boat-days) following stability since 1985. The fleet size fell in the south-west, but effort has remained steady because of an increase in activity by the remaining boats. Effort in the west peaked in 1988 at 49,000 boat-days, declined in 1989-90 to 30,000 boat-days, and has since recovered to over 70,000 boat-days.

The increase in nominal effort since 1990 appears to have resulted from the twin effects of greater fleet size, especially liners, and of more fishing trips for full-time vessels in 1992 and 1993. However, fishing mortality does not appear to have risen proportionately and this is possibly due to the use of nominal effort which does not account for changes in the fishing power of vessels prosecuting the bass fishery.

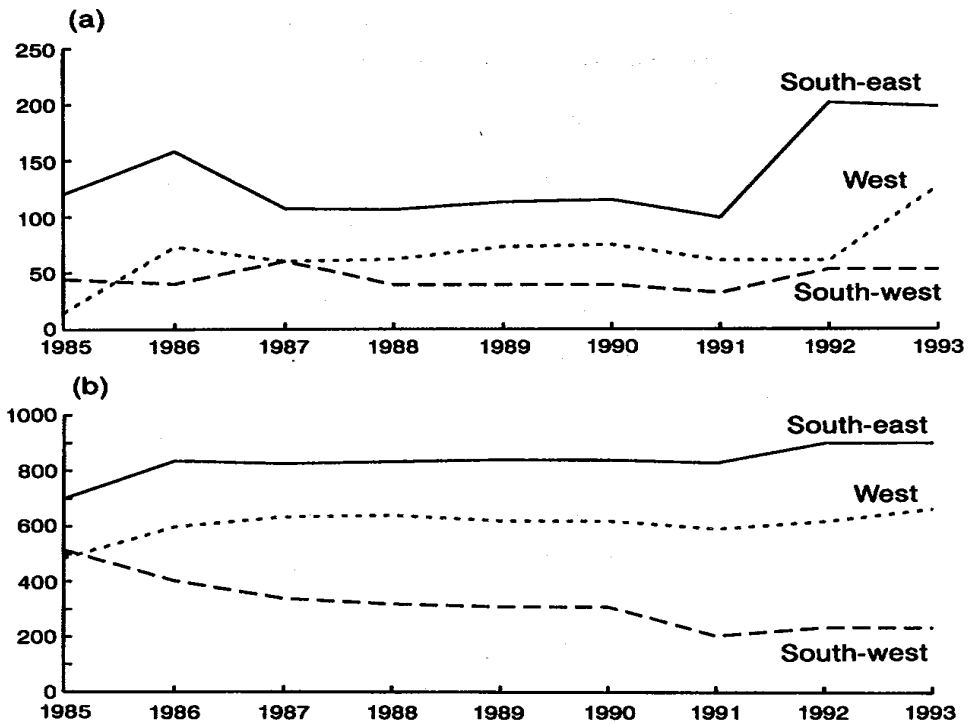


Figure 12. *Bass fleet census, 1985-1993, by assessment area; (a) full-time vessels, (b) part-time vessels*

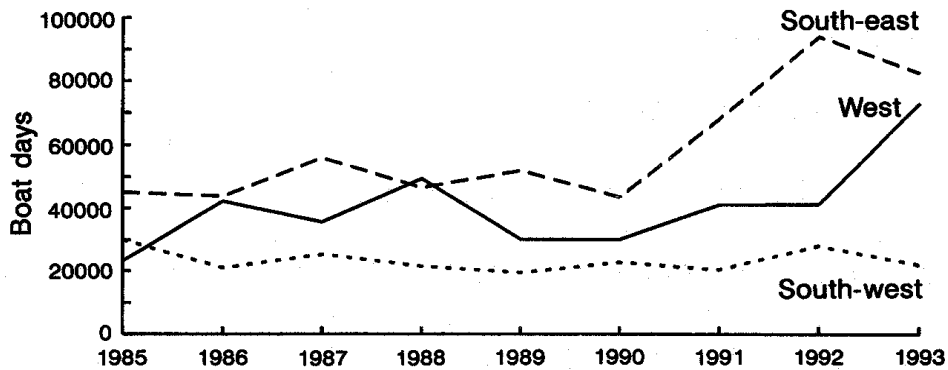


Figure 13. *Estimated gross bass fishing effort in boat-days for 1985-1993 by assessment area*

One noteworthy feature is the variability in the composition of fishing effort over time. For example, prior to 1990, around 32% of bass landings were made with gill-nets but the proportion fell to 18% over 1990-1992 (Table 5). Although tempting to ascribe the decline in the share of the overall catch taken by gill-nets to the mesh size regulations, it was probably due to other factors. In particular, because the gill-net fishery in most areas appears to target fish in the 36-45 cm range, falls in catch rate may reflect the low availability of fish of this size in the 1990-1992 period. Statistics for 1993 however, reveal a reversion to gill-netting in all areas, probably as a result of the 1988-1989 year-classes entering the favoured size range. An estimated 40% of the commercial landings in 1993 was taken by gill-nets nationally but this level is unlikely to be maintained as bass grow out of optimal selection size for the range of gill-net mesh sizes generally used, unless recruitment continues at the 1987-1989 levels.

Economic data also indicated the volatility of fishing effort. As many as half of the fishermen involved in 1992 were not fishing for bass in 1987 (i.e. were new entrants to the fishery) and at least

Table 5. Average annual landings (kg) of bass from all gill-nets, and as a percentage of the total commercial landings, by ICES division for the periods 1987-1989, 1990-1992 and in 1993

	IVc	VIIId	VIIe	VIIIfg	VIIa
1987-89					
Landings	37531	59164	51385	12851	25253
% by gill-net	49	32	38	12	32
1990-92					
Landings	15012	32654	12766	15484	29936
% by gill-net	18	15	14	16	38
1993					
Landings	76595	127054	43148	107468	117607
% by gill-net	60	37	29	38	49

one third of all respondents were not using the same vessel as in 1987. Both figures suggest a substantial turn-over of participants/vessels over the intervening period, which is concealed by the basic data. Moreover, this turnover was significantly greater than in the comparable period prior to the 1987 study (e.g. in 1987 only 14% of the fishermen involved had not been fishing for bass in 1982).

The CEMARE study was also able to make direct comparisons of certain fishermen involved in the bass fishery in both 1987 and 1992. Generally, those involved in 1992 were less so than in 1987, with those fishing for bass less often in 1992 being in the ratio of 2:1 against those fishing for bass more often. Worsening catches were cited as the main reason, but with less than one in ten citing the management measures specifically.

3.3.2 Landings and yields

Landings in the commercial bass fishery (including some boats used for charter and casual angling) have been monitored by DFR since 1983. Subtracting the small element of recreational boat catch included in the DFR figures gives estimates of annual commercial landings. Figures for the years 1985-1993 are shown in Table 6.

Data for the landings of the entire recreational fishery exist only for 1987 and 1993 based on the two studies by CEMARE. The significance of the recreational component in landings (and fishing mortality exerted by this sector) has in the past been largely ignored in fisheries assessments of marine species in Europe. When recreational landings are included, the combined landings of 1,045 tonnes in 1987 were over eight times as great as those recorded officially on the MAFF Fisheries Statistics Database. By 1993, combined landings were around 43% higher, six times greater than the official data. The main reason for the discrepancy in these figures is the pattern of bass landings, which are made at numerous minor ports and beaches, often being sold direct to small merchants, hotels or restaurants. Such landings are inevitably under-reported to MAFF's Sea Fisheries Inspectorate.

The similarity of recreational landings between the two years is noteworthy. It is tempting (but dangerous) to assume that landings have remained at a constant level over this period. In the absence of further information, it would appear that most variability in the fishery arises on the commercial side. Comparison of row 4 and row 1 shows how much of an underestimate official data provides of the importance of this fishery. Once recreational fishing is included (row 8) the disparity becomes even greater.

Table 6. UK bass landings (tonnes)

	1985	1986	1987	1988	1989	1990	1991	1992	1993
1 FSD Landings	106	103	125	177	174	189	237	147	239
2 DFR All Boats	579	617	785	570	524	556	717	566	1144
3 Recreational			155					53	65
4 Commercial			630					515	1079
5 Boat Anglers			219						217
6 Shore Anglers			196						195
7 Recreational			415						412
8 Total	?	?	1045	?	?	?	?	?	1491

Notes to Table 6: Row 1 : official FSD estimates of landings from this fishery
 Rows 2-4 : derived from the DFR study of the fishery
 Row 2 : data from the DFR system, (includes some boats engaged in recreational fishing)
 Row 3 : estimates of recreational boat catches included in the DFR data.
 Row 4 : commercial boat activity (Row 2 minus Row 3)
 Rows 5-7 : derived from the CEMARE study of the fishery
 Row 5 : estimates by CEMARE of recreational boat catches
 Row 6 : estimates by CEMARE of recreational catches by shore anglers
 Row 7 : estimates by CEMARE of total recreational catches
 Row 8 : total catch for the two study years combining DFR and CEMARE estimates (Row 4 plus Row 7)

Combining commercial landings data with economic data collected by CEMARE during the two study years enables calculation of the value of landings (see Table 7). Between 1987 and 1992, the total value of commercial landings declined, in real terms, by approximately 27% under the combined influence of a decrease in landed weight and a fall in prices. In 1993, however, the dramatic increase in landings resulted in a substantial increase in the total value of bass landings although the price continued to fall. In real terms, the first sale price of bass fell by 9% over the period 1987-1992, but when 1993 is included the fall since 1987 is 15%. The real wholesale price of bass fell by some 11% in the 1987-1992 period but again when 1993 is included the fall is 24%. Real (and even nominal) prices have therefore been falling dramatically in the wholesale market since 1991.

Table 7. Weight and value of commercial bass landings (constant 1987 prices)

	1987	1992	1993
Commercial landings	630 tonnes	515 tonnes	1,079 tonnes
First sale prices	£6.19 per kg	£5.63 per kg (£7.48 per kg)	£5.27 per kg (£7.27 per kg)
First sale value	£3.9 million	£2.9 million (£3.9 million)	£5.7 million (£7.9 million)
Wholesale prices	£8.80 per kg	£7.77 per kg (£10.72 per kg)	£6.65 per kg (£9.18 per kg)
Wholesale value	£5.5 million	£4.0 million (£5.5 million)	£7.2 million (£9.9 million)

Note: *Italicised figures in parentheses indicate actual (non-deflated) values for 1992 and 1993*

Over the 2 periods 1985-89 and 1990-93, average annual yields, yield per recruit (YPR) and spawning stock biomass have increased, particularly in the south-east and western areas (Figures 14, 15 and Table 8).

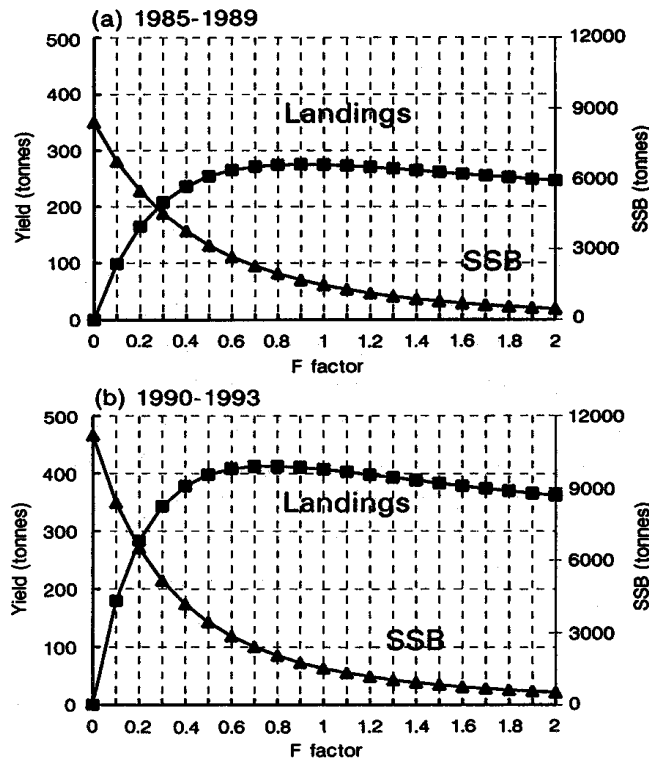


Figure 14. Calculated theoretical yields (landings and spawning stock biomass) for the south-east region (a) before and (b) after the introduction of the bass legislation. F factor 1.0 = observed level of fishing mortality for period

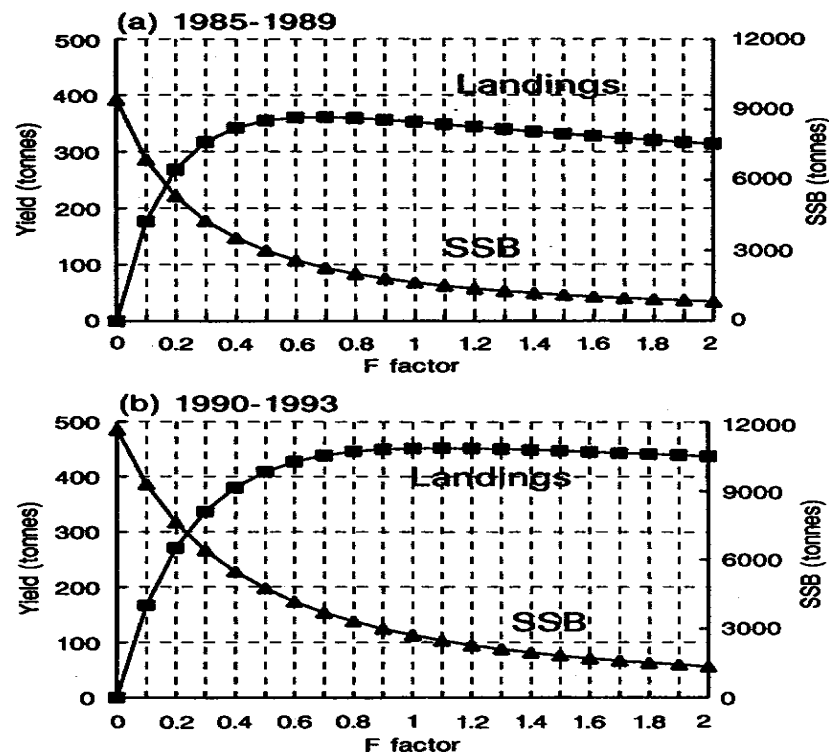


Figure 15. Calculated theoretical yields (landings and spawning stock biomass) for the west region (a) before and (b) after the introduction of the bass legislation. F factor 1.0 = observed level of fishing mortality for period

Table 8. Yield per recruit estimates, before and after the introduction of the bass measures, for each of the three assessment areas

	1985-89	1990-93	% increase
South-east	590 g	880 g	49
South-west	580 g	850 g	46
West	660 g	830 g	38

The scale of these increases (average YPR up by 48%) is due, in part, to the effect of improved recruitment and growth which, in the south-east area, accounted for around half of the increase. Due to the short time scale of the studies, the full benefits have yet to be realised and further improvements in yield are likely as more year-classes recruit to the fishery at the higher size (36 cm+). Long-term yields can be maintained with current exploitation levels, given moderate recruitment, but increases in bass mortality due to fishing will reduce the spawning stock (Figures 14 and 15). Predictions of yield per recruit with current exploitation patterns suggest that fishing mortality is just beyond its maximum sustainable level. In this context, it is of some concern that since 1990 there has been a steep increase in bass fishing effort, particularly by the rod and line commercial fleet, and in 1993 a resurgence of gill-netting.

3.4 The recreational fishery

CEMARE's estimate of recreational landings at 412 tonnes in 1993 (Table 6) was very similar to the 1987 estimate. However, since the number of bass anglers increased by 20% between the two years, retained landings per angler must have declined. This result suggests that the increase in the minimum landing size in 1990 has had some impact on the recreational bass fishery. It is supported by the National Survey of Bass Angling which showed that overall only an estimated 32% of the numbers of shore-caught bass and 36% of boat-caught bass were retained. Indeed, it is estimated that the weight of bass returned in 1993 (369 tonnes) was probably not far short of the total weight of bass retained and landed (412 tonnes). This represents a marked change from 1987, where it was estimated that anglers retained some 43% of the bass caught by numbers, and returned 218 tonnes whilst landing 415 tonnes. These low levels of retention were probably due to a combination of factors, including the relatively high minimum landing size (in comparison with other species), the proliferation of juvenile bass in areas fished (particularly by shore anglers), and the popular conservation ethic amongst anglers regarding bass. Potentially, this is good news for the fishery, as anglers can gain substantial satisfaction from their activity, without causing fish mortality, and hence maximising their benefits from the use of the stock. However, this result depends on the mortality rate of returned bass, something which is, as yet, poorly understood.

The appraisal also attempted to address the issue of changes in the value placed on recreational fishing by participants in the activity. The valuation of non-market goods such as marine recreational fishing raises very significant methodological challenges, as there is no "market price" paid by participants. Hence some other estimate of value must be employed. One commonly used measure is the size of gross expenditure made by participants in the fishery: although this is not a true measure of social welfare value, it does give some indication of the economic impact of the fishery. In 1987, gross expenditure on bass angling is estimated to have been some £9.7 million; in 1992, the estimate was that some £18.3 million was spent in nominal terms. In real terms, this can be deflated to £13.5 million (at 1987 prices), and this represents an increase of some 40% over the

period. However, it must be recognised that, had the bass fishery not existed in 1992, CEMARE research suggested that some 90% of those involved would have still made the same number of sea fishing trips that year, moving on to other species (and hence possibly with much the same gross expenditure taking place).

An alternative approach is to create an ‘artificial market’ through the use of the Contingent Valuation Method (CVM), asking respondents questions concerning their willingness to pay for their involvement in the fishery (Potten *et al.*, 1994). A simple form of this technique was employed in 1987, and repeated in the same form for comparability in 1992. Whilst results from such studies must be treated with caution, the outcome suggested that participants attributed a significantly higher total value to their involvement in the bass fishery in 1992. Overall, whilst total recreational landings did not change significantly between 1987 and 1992, the numbers of anglers involved increased by some 20%, and the estimated real value attributed by these to the fishery by substantially more than this (at least 68%). No doubt to some extent this will have been influenced by the perceived decline in the quality of other sea angling opportunities over this period, but part will be attributable to the nature of the bass fishery itself. A further illustration of the change was that, whilst only 18.8% of all sea shore anglers in general considered that their catches were better in 1993 than in 1992, as many as 53.2% of bass shore anglers thought that bass catches had improved (the comparable figures for boat anglers were 21.3% and 43.5% respectively).

The changes in recreational value attached to the bass fishery could in part be due to the fact that bass from the abundant 1989 year-class have been becoming highly visible. However they may equally be attributable to the bass management measures, which may be perceived by anglers as confirming the Ministry’s stated intention of managing the fishery to the benefit of both commercial and recreational user groups, thereby protecting their interests in the fishery.

Overall, these results confirm the very considerable significance of the recreational sector of the fishery, in both biological and economic terms.

3.5 Perceptions of fishermen and anglers

The CEMARE study sought to establish the extent to which changed involvement in the commercial fishery could be attributed to the management measures. From the survey, in comparing the original study year 1987 with 1992, generally involvement had fallen. Of the variety of reasons given, only in some 7% of those replying were the management measures cited specifically, in all cases producing a reduced involvement.

The study asked commercial fishermen a standard set of questions (which were also put to recreational fishermen) to elucidate their reaction to the bass management measures. Two-thirds reported that the measures have had little or no effect on their activities. A few individuals did indicate significant losses, but overall only 6.6% felt that landings had deteriorated because of the measures, and a further 1% had stopped fishing for bass: on the other hand, 3% felt that landings had improved. The impact had also been felt in terms of changed locations (10% of respondents) and catching more undersized bass (12%), although only 4.4% reported that they had needed to change their gear, with a consequent financial cost.

Regarding compliance, two thirds or more of the fishermen felt that the commercial sector was observing the measures “largely or completely”, whereas only 30% felt that anglers were doing likewise. They felt that only 10% or less of commercial fishermen were observing the measures “not at all”, whilst suspecting that a quarter of anglers did likewise.

Similarly, two thirds felt that the measures were being “completely or largely” enforced for commercial fishermen, but only a quarter felt that the same was true for anglers. Reactions as to whether the measures had helped conserve juvenile bass were rather mixed, but some three-quarters of respondents felt that more actions were needed, proposing adjustments to existing measures as well as different measures and better enforcement policies: more policing, restrictions on netting and changes to the MLS/MMS were the most common proposals. Interestingly, the view that more restrictions were needed on commercial fishing was more widely held overall than the view that more restrictions were needed on angling.

On a similar range of questions, responses received from the charter sector suggested that little impact had been felt. There was, however, general support for the measures, including nursery areas as well as MLS, and many felt that tighter enforcement would be needed in future. There was also general support for further measures, if these were considered to be appropriate.

As with commercial fishermen, recreational anglers were asked questions to elicit their views on the management measures. These questions were asked as part of both the National Survey of Bass Angling (responses from 680 anglers to an open-ended question) and the main Further Appraisal survey (responses from 233 anglers to the same set of questions as posed to commercial fishermen). The results clearly indicate that the measures have generally had very little effect on their fishing activities. First, the NSBA revealed that nearly 95% of non-bass anglers had felt no effect at all. Second, the NSBA and the main survey suggested independently that just over three quarters of bass anglers themselves had also felt no impact. Those anglers reporting an impact noted mainly changes in their fishing locations and/or bass catches: taking all responses from bass anglers together, approximately 10.5% felt that catches had been affected. However, opinions as to whether catches had declined or improved were split in the ratio of approximately 2:1 respectively. Those noting changes in fishing locations were, as might be expected, mainly boat anglers. Some 8.4% noted an increase in catches of undersize bass.

As regards compliance, half of the survey recreational respondents felt that anglers were complying with the regulations “largely or completely” whereas only 20% felt that commercial fishermen were doing so. They felt that only 5.5% of anglers were complying “not at all” (blamed mainly on young and holiday anglers), unlike a suspected quarter of commercial fishermen.

In contrast to the commercial sector, only a quarter of anglers felt that the measures were being “completely or largely” enforced for anglers, only a little more than was felt to be true with regard to the commercial sector. Over 30% felt that the regulations were not being enforced “at all” for either the recreational or commercial sectors: 20% suggested that there were too few fishery officers/patrols. Reactions as to whether the measures had helped conserve juvenile bass were again mixed, although predominantly positive, but as with the commercial sector a clear majority felt that more actions were needed. These included proposed adjustments to existing measures as well as different measures and better enforcement policies: more policing, restrictions on netting and an increase in the MLS/MMS were the most common proposals, virtually the same agenda as the commercial respondents. The view that more restrictions were needed on commercial fishing was more widely held overall than the view that more restrictions were needed on angling. This balance of views contrasts with that expressed by the commercial sector.

The very widespread support for the measures expressed by both the commercial and recreational sectors is particularly encouraging given the mixed reception that greeted the introduction of the measures (see Section 2.4).

3.6 The bass markets and merchants

The impact of the management measures on the bass market has been obscured by other factors which seem to have contributed to the fall in real prices experienced after 1990. The major factor explaining this price fall has been the increase in supplies of small farmed bass in the European market. Certainly, UK merchants have been able to turn to imports for supplies to an extent that would have been impossible prior to 1990. The establishment of a legitimate market for small bass has probably encouraged a few fishermen and anglers to land undersize bass, with some merchants prepared to buy and sell them under the cover of farmed imports.

Unfortunately in this respect little can be learnt about imports or exports of bass from official trade statistics, as no usable data are collected on trade in fresh bass, and the data on frozen bass imports are unreliable and clearly inconsistent (by imputed unit values, and by being inclusive of *Dicentrarchus punctatus*, the spotted bass, as well as *Dicentrarchus labrax*). It is known that UK merchants have exported fresh bass to the strong European markets for years (see Section 2.1.4), and it is believed that since 1990 significant quantities of small farmed bass (to which the 36 cm MLS does not apply) have come from European aquaculture operations, affecting market prices in the UK.

Regarding the impact of the 1990 management measures, 80% of merchants surveyed reported no identifiable effect on trade. For the remaining 20%, the loss in trade varied from minor to as much as 75% of previous bass trade. Bearing in mind that bass trade was usually no more than 5% of turnover, the implied loss in overall trade amongst this 20% therefore varied typically from negligible to perhaps 4%, although in the extreme it amounted to a maximum of just over 10%. Even among the 20% of traders who did experience some loss of trade, the general view of the management measures was positive, in that such measures were considered necessary, and that benefits could be expected to emerge in the longer run. Indeed, some believed that the increasing levels of fishing effort in 1993 would require additional measures to protect bass and further restrict effort.

Econometric analysis suggests that, as in 1987, domestic landings have a small but statistically significant influence on quayside prices. One conclusion that can be drawn is that, other things being equal, if management measures do improve the stock situation such that catch per unit effort is increased (and the unit costs of bass fishing are largely independent of catch), then nearly all the economic benefits of increased landings would be reaped by the fishermen.

However, on a more pessimistic note, it seems likely that there will be a sustained downward trend in real bass prices due to farmed bass. Although official data are not collected, it is apparent from research that the European market for bass has been transformed since 1990 by the advent of increasing quantities of farmed bass in the smaller size range (often under the MLS), moving onto the various European markets (particularly from Greece, but also Turkey, Italy, France and Malta). The impact of this on prices has been dramatic, and is likely to be sustained. As a result UK fishermen's earnings from the domestic fishery will decline, particularly from landings of smaller bass. Such a development could have a number of impacts. On the one hand, lower prices could encourage an increase in effort in an attempt to maintain earnings. On the other hand, the imported cheap supplies could relieve some pressure on the fishery, if lower prices encourage some fishermen to switch to other fisheries or to larger bass.

4. ISSUES

The previous sections have considered the impact of the management measures on different sectors. This section discusses some other issues that have arisen in the implementation of the measures or may affect management in the future.

4.1 The changing nature of the European bass market

As outlined in Section 3.6 above, the key factor in understanding events in the European market in recent years is the rapid development of the aquaculture of bass. This was fuelled by strong demand and high prices in the mid-1980s, which produced a considerable surge in investment in fish farms in Europe and elsewhere during the later 1980s. The effects of this became particularly apparent from 1992 onwards.

Bass is a premium food fish species in European markets, especially in Italy which takes some 80% of total bass production in Europe. Bass supplies from European capture fisheries have remained more or less constant since 1987 at about 9,000 tonnes per annum. In contrast, the output from aquaculture has risen steeply: from less than 1,000 tonnes in 1987 it accelerated to over 20,000 tonnes in 1993 and will reach an estimated 25,000 tonnes in 1994. The main sources of supply are listed in Table 9.

Table 9. Bass production from aquaculture in Europe in 1992 and 1993 (tonnes)

Country of Production	1992	1993
Greece	7,000	10,000
Turkey	-	2,800
Italy	1,700	2,000
France	1,000	2,000
Malta	700	1,500
Spain	100	500
Tunisia	350	450
Morocco	-	400
Croatia	-	400
Portugal	250	350
Cyprus	-	120
Total	11,100	20,520

The impact of this increased production on prices has been equally dramatic. In the key Italian markets, prices rose in the 1987-1989 period, peaking at about £14.00/kilo but then fell to £6.50/kilo in 1993 and are expected to fall further, possibly to average less than £5.00/kilo in 1994. Figure 16 summarises bass production over 1987-1994, and traces the dramatic changes in the Italian market price (Paquotte, 1994).

Such a market situation is strongly reminiscent of events surrounding salmon farming, but the process has happened much earlier in the development phase with bass farming and has been more dramatic. The reasons probably lie in that salmon producers adapted to demand rapidly by creating a large range of products (fillets, slices, smoked, etc.) – in the case of bass, the market is so limited to fresh whole bass as a premium product that creating alternative products has so far received little

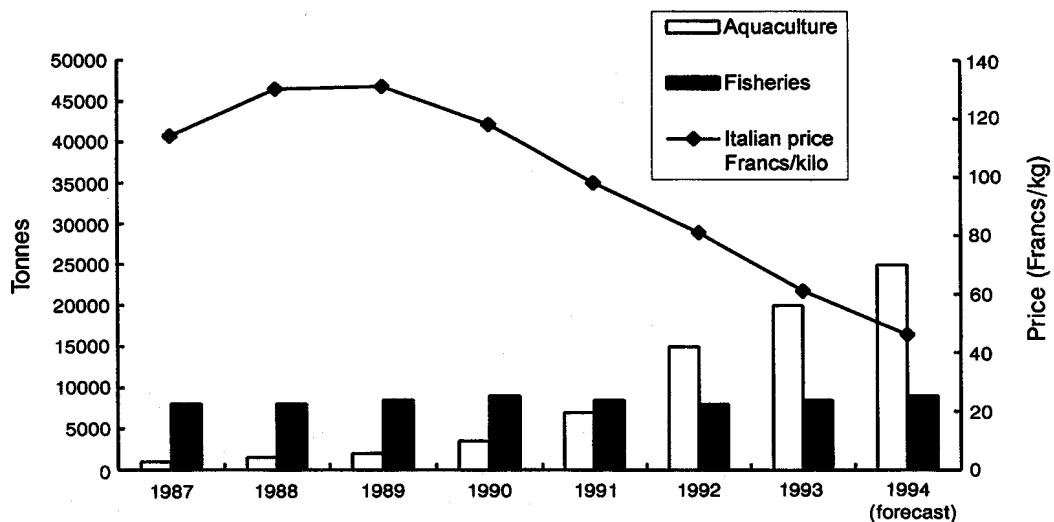


Figure 16. Evolution of sea-bass (*Dicentrarchus labrax*) production (Europe and Mediterranean sea) and sea-bass price on Italian market. (Source: EAFE, IFREMER, FAO)

attention. Moreover, it is difficult to produce large bass for fillets from farming. Indeed, there is no real market for processed bass in Europe, virtually all the fish being sold whole: the only exception at present is a trend in southern Europe towards the purchase of gutted rather than whole fish.

European experience suggests that a segmented market for larger bass (which must come from capture fisheries) is likely to remain and command a price premium, but for smaller bass a very competitive market is rapidly emerging. The apparent costs of production of cultured bass imply that a market wholesale price of around £5.00/kg (under £2.50/lb) or even less may well emerge and could be sustainable (although it is not clear whether the extent to which some EU producers have received investment assistance to establish farms when prices were high may leave them vulnerable to this price decline). The market price for capture fish will be drawn down by these developments, although it may be possible for producers to establish a premium for high quality, line-caught fish, if ways can be found of distinguishing these for consumers and if they are prepared to pay the premium (which seems unlikely in the UK, although the French have had some success).

Overall, the markets for fresh fish generally are not expanding in Europe and may be contracting. There is little or no prospect for the development of a wider market for processed bass in the short run. Moreover, the reduction in price and the advent of farmed bass is threatening to destroy the “market image” of bass as a special, premium meal.

It is difficult to predict the impact that these market developments may have in the UK bass fishery. However some points may be made:

- The quantities of farmed bass now coming onto the UK market (as in the rest of Europe somewhat earlier) will establish a larger market at a lower price for this fish than has hitherto been the case. The possible decline in real price is likely to have a significant impact on the catching sector, possibly encouraging fishermen to fish harder on stocks in the smaller size range in order to maintain income levels.

- Whilst these fish are depressing market prices, to an extent this will stimulate the overall market for bass, increasing consumer awareness (bass having hitherto not been a significant feature of fish consumption patterns). This market development process may then offset to some extent the price decline, in that fishermen may then be able to command a premium for larger and/or better quality fish, particularly line-caught.
- Combined, the first two hypotheses suggest that a more developed market for bass with markedly lower real prices for small bass could have a significant impact on UK fishing activities: it is not impossible to conjecture increased effort on both small bass (to maintain incomes) and larger bass (to seek premium prices).
- Alternatively, the existence of substantial potential supplies of small farmed bass might relieve pressures on the stocks of relatively small bass in the UK fishery; given the lower prices that these will in future command, effort may switch elsewhere. This presupposes a transfer of fishing activities to other stocks, which may be unrealistic (especially given the visibly strong bass year-classes beginning to enter the fishery).
- The advent of large quantities of small farmed bass (which can legally be below the UK MLS) is already adding to difficulties of enforcing size limits.

Overall, it is possible to conclude that, with the impact of the rapid change in market conditions during 1993-1994 due to farmed supplies, the role of the bass in UK (and EU) inshore fisheries will be substantially changed thereafter.

4.2 Compliance

A major problem in the implementation of the measures has been the difficulty of their enforcement. A lack of adequate deterrence has been noted in some areas due to the low fines imposed and costs awarded on successful prosecutions which have been brought to court, and other unsuccessful prosecutions. This has discouraged some SFCs from continuing to prosecute, especially where the nursery area legislation is involved. In turn, this may encourage illegal fishing since one night's landing of under-size bass may be of greater value than the eventual fine and costs combined.

Clearly the effectiveness of the management measures is dependent to a large extent on compliance by the fishery and to a lesser extent on direct enforcement. Enforcement can only expect to catch a small proportion of offenders but enforcement by deterrence (threat of ultimate prosecution) may raise the level of compliance.

Since 1993 a situation has developed where a few fishermen and merchants persistently deal in undersize bass. This problem requires addressing with more effective enforcement of the current minimum landing size. In this regard it is worth noting that DFR have identified a means of distinguishing between farmed and wild bass. It is intended to test this in the courts at the earliest opportunity.

Some weaknesses in the current nursery area legislation and how it is applied have become apparent:

- it is almost impossible to secure convictions under the national legislation because "fishing for bass" *per se* is difficult to prove and any bass found on board a vessel inside a nursery area cannot be deemed to have been caught there:

- there is no compulsion on local enforcement agencies to bring in supportive legislation in the form of local bye-laws, and few have done so;
- some nursery area boundaries are inappropriate or ill defined;
- no means has been found to prevent bass fishing from the shore in nursery areas.

In addition there are local difficulties in enforcing the nursery areas due to lack of manpower or lack of marking or notification of nursery areas. The latter aspect has been addressed in parts of Devon and Cornwall by the local SFC and MAFF SFI, with the production and display of maps and notices plus high-level publicity. In a few areas, local SFCs are less able to assist in enforcing the nursery area legislation. This is well understood by the local fishing communities, particularly the less responsible elements, as shown by the high level of bass fishing activity recorded in nursery areas in these districts in 1992. In other areas enforcement is carried out rigorously, particularly where there is support from local NRA divisions with staff trained as BSFOs.

4.3 Discards

Since the management measures centre on the minimum landing size, one probable effect would be to increase the numbers of fish returned to the sea as undersize (discards). An increase in the level of discarding in the bass fishery after 1990 would tend to indicate compliance with the management measures, although in terms of conservation of juvenile bass it would be better if they were not caught at all. Nursery areas and mesh size regulations were introduced to help reduce discarding, but due to recent heavy recruitments, undersize bass have been present outside nurseries and trawling and rod and line methods in particular have inevitably encountered them.

The level of discarding is particularly important if the survival rate is low and the proportion of the catch discarded is high. Before 1990, discarding in the bass fishery was thought to be relatively unimportant because few undersize bass were caught in directed bass fisheries. Also, bass were thought to be a fairly robust fish, able to survive capture and release in many cases.

Evidence from the CEMARE and DFR studies suggests that discarding by commercial boats is lower than by recreational boats overall as might be expected, but that in both cases the proportion rose in 1990 and stayed above the average level for the 1986-1989 period. This was due in part to the increased numbers of juvenile bass in the stock resulting from the strong 1988 and 1989 year-classes but also suggests compliance with minimum landing sizes. In 1993 CEMARE estimated that 64% of bass caught on recreational angling boats were discarded (DFR sample estimated 48%), along with 68% of bass caught from the shore. Fleets directing effort at other species, e.g. herring drift-netters, are also known to catch and discard undersized bass but no quantitative data are available.

Discard mortality has not been estimated and may be high for some gear-groups or methods; this requires further investigation.

4.4 Distribution of the benefits of management

There has been concern about who would ultimately benefit from the measures, and the movements and dispersion of bass from nursery areas were studied in part to answer such concerns. Unfortunately, returns of tagged fish to date have generally been low at 5% of the numbers released and few bass tagged in this study as juveniles have yet been captured as adults.

Nonetheless, the pattern of recaptures suggests that although the whole fishery will receive some benefit from nursery area closures, most will accrue to the local fishery in the short-term, i.e. within

2 years of leaving nurseries. Around 80% of legal size bass captured in this period will be in the home region, within 50 miles of their nurseries (Table 10).

Table 10. The numbers of, and distance travelled by, bass tagged and released in some major nursery areas and subsequently recaptured at a size above the current MLS

	km travelled			Total
	<10	10 - 50	>50	
Bradwell	-	4	3	7
Medway	1	3	3	7
Solent harbours	8	10	5	23
Poole	45	10	7	62
River Fal	-	1	3	4
River Camel	3	-	1	4
Heysham	-	-	1	1
Total	57	28	23	108
%	53	26	21	-

Less than 5% of the total recaptures of tagged bass over 36 cm were taken by non-England and Wales vessels. However, this result could be due to the fact that bass do not adopt their regular migrations to deeper offshore waters until they are mature whereas the majority of bass recaptured in this study were immature. Earlier studies found that in 1983-1984 around 50% of winter recaptures of adult bass tagged in the Thames estuary were taken by French vessels fishing mainly in the western English Channel. The seasonal pattern of the fisheries suggest that during the winter and spring, mature bass are found beyond the 12 mile limit where a pair trawl fishery exists for the species.

Ultimately enforcement is most effective when the management measures are supported by the majority of the fishing community and the measures are seen to be fair and the benefits equally available. At present, the inshore fishery bears the main burden of management as far as bass is concerned and the potential impact of international offshore fishing on the bass stock needs to be considered.

4.5 Limits of the review

The review that has been undertaken has a number of limits.

The dynamic nature of the fishery means that some (perhaps most) of the benefits arising from the management measures will appear only in medium to long term (5-10 years). The effects of management identified in this report represent the immediate impact of the measures. In the longer run, it is to be expected that improvements to the present management regime will generate further benefits.

However, at the same time there is a need to consider the way in which the fishermen and other stakeholders will respond to the benefits generated by the management system. Unfortunately economic data are currently poor, especially concerning costs and earnings of the commercial sector and the economic behaviour of participants in the UK inshore fishery generally. Without such data it is difficult to make predictions about the likely future course of the fishery. The lack of

such data also means that economic studies almost always have to be conducted on a survey basis, whereas on-going monitoring of economic variables is essential if economic dimensions of the fishery are to be analysed in a timely fashion.

The review has also been limited by a lack of usable international data on bass landings. In particular, the offshore fishery has not been properly assessed nor has it been possible to assess the impact that additional EU national vessels fishing around England and Wales would have on the UK fishery or bass stocks.

Finally, the analysis of the resource has been undertaken at a regional level. It is possible that some important localised impacts may have been overlooked. The assessment of yields in the south-west area, for example, hides the complete decline of the traditional handline fishery at the Runnel-Stone, near Lands End in Cornwall. In the 1980s this fishery sustained up to 16 vessels, fishing for bass in season, but since 1992 hardly any bass have been caught. By contrast, in some other areas, bass fishing has improved.

5. ADMINISTRATIVE AND POLICY IMPLICATIONS

The survival of bass to enter the fishery at legal size and then to join the spawning stock is dependent upon reducing the exploitation of juveniles. In the short term, this appears to have been achieved, and it is important to ensure that improvements in the bass fishery are sustainable and that the measures in force are sufficient to achieve this end.

5.1 Future management

5.1.1 Minimum landing size

Some SFCs are seeking to increase the MLS for bass locally. Most angling bodies would support an increase to at least 40 cm. Although this would, theoretically, further improve the exploitation pattern of bass and increase yields and recruitment to the spawning stock, it would also increase the level of discarding, with unknown (but probably harmful) consequences, and create further enforcement difficulties. In addition, tagging has shown that from 36 cm upwards there is a tendency for some bass to move away from the home region as they mature and become available for exploitation by other national fleets. Local fisheries may not, therefore, get the full benefit of their adherence to a higher minimum landing size. Moreover an increase would, to be effective and acceptable to the industry, need to be an EU regulation and our EU partners are thought to be unlikely to agree to a further increase on the current 36 cm size. There are also a range of problems associated with effective enforcement of the current minimum size and these will need attention before any increase is contemplated.

MLS enforcement has been hampered, in the last 2 years especially, by merchants' claims that bass less than 36 cm on their premises are either farmed bass or wild from the Mediterranean and are therefore exempt from the EU 36 cm MLS, which applies only in northern waters.

In order to improve the effectiveness of enforcement of the minimum size in both the UK and other EU countries, the following actions have been considered:

- (a) a review of the MLS in force for EU states in the Mediterranean, which is only 23 cm at present, although increased recently by national measure to 25 cm in French waters;
- (b) the labelling and/or full documentation of all imported bass, giving source (farmed or wild caught) and place of origin through all points of distribution and sale.

To pursue (a), action would be required at EU level and it is unlikely that UK representations could result in any changes in fishing practices in the Mediterranean in the short term.

There are difficulties in introducing and enforcing a labelling scheme for imported farmed bass. Such a scheme would need to comply with EU labelling laws. However, as documentation should be completed for all import transactions, it should be incumbent upon those in possession of bass under 36 cm to prove that those fish are indeed exempt from the MLS by giving proof of origin. Where the origin of bass remains in doubt, however, it is possible using techniques recently developed at DFR, Lowestoft, to distinguish between farmed and wild bass (see Section 4.2).

5.1.2 Mesh size

In general the mesh size regulation is appropriate to the current MLS. It is relatively easy to enforce and has been well adopted by the fishery, with the exceptions noted at Section 3.2.2. Given the current MLS and exploitation patterns observed, there is no need for adjustment to the mesh size regulations in respect of the bass fishery at present. However, in some areas, such as South Wales, where there is a more restrictive local MMS (see page 16), there may be a case for a concomitant increase in MLS.

The main weakness in the national legislation, in terms of the potential effect on juvenile bass, is the derogation for attended mobile nets with mesh sizes within the banned range (65-89 mm) on the south coast between Beachy Head and Rame Head. This derogation was introduced to permit the continuation of a fishery for golden-grey mullet in places such as Poole Harbour. It is estimated that between 40 and 100 vessels, mostly part-time, legitimately use the derogation. Other vessels are reputed to use it in order to target the much more valuable and easily obtainable under-size bass, thus depriving the legitimate fishery of potential recruits. The first sale values of bass and all three grey mullet species landed in the derogation area in 1993 were estimated at £2.1 million and £70,000 respectively (DFR statistics). The annual landed weight of grey mullet species in the derogation area is around 100 tonnes. Of this it is estimated that mobile gears catch 60%, the majority of which is taken using 90 mm mesh. Revoking the derogation would probably mean an initial loss to the mullet fishery of about 16 tonnes per annum with a first sale value less than £12,000. The loss to the legitimate bass fishery, consequent upon retaining the derogation, is potentially much greater. This, taken together with the implications for the bass stock, indicates that the derogation may no longer be justified.

5.1.3 Nursery area legislation

In framing this legislation consideration was given to the closure to all fishing methods of small, key areas (special protection zones), or alternatively large areas where dispensations for “harmless” gears could be given. The final outcome was neither one solution nor the other but a mixture of large and small areas where only fishing for bass was prohibited. It was left to Sea Fisheries Committees to control “harmful” methods by making appropriate bye-laws but, to date, of the 34 nursery areas established only 6 have had supportive legislation introduced by SFCs. Specifying all controlled or allowed methods was ruled out as an option for national legislation, being deemed too detailed and clumsy. This option would have also been unpopular with local non-bass fishing interests and may explain why few local bye-laws have been introduced. Legal advice was that there was a right to fish from the shore which went back to Magna Carta.

Under the existing legislation pertaining to bass nursery areas it is illegal to:-

- (a) fish for bass from a boat, by whatever method;

- (b) retain any bass caught accidentally inside a nursery area whilst pursuing other legitimate fishing activities.

It must be stressed that under the current national legislation (Section 5 of the Sea Fish Conservation Act (1967), under which SI 1990/1156 relating to bass nursery areas is made) it is permissible to fish inside bass nursery areas provided that the fishing is not directed at bass, and that any caught accidentally are immediately returned to the water.

Although it has been concluded that nursery areas are, in principle, a useful management tactic, consideration needs to be given to how to make them more enforceable. Problems of enforcement have arisen when trying to prove that:-

- (a) fishing was being directed at bass,
- (b) any bass found in the possession of persons fishing inside a nursery area had in fact originated there.

In order therefore to increase the effectiveness and enforceability of the bass nursery areas, consideration should be given to the following options:-

1. The possession or retention of bass on board any vessel fishing inside a bass nursery area, regardless of where it was caught, could be made an offence. We understand that this would necessitate the introduction of primary legislation.
2. The introduction of further controls in bass nursery areas, either by means of SFC bye-laws or national legislation, of methods which take a high by-catch of bass. Such methods include small mesh trawls, gill-nets, seines and angling with various types of live bait (e.g. sand-eel). For smaller nursery areas, especially those centred on power station installations, prohibition of all fishing activity is suggested as there are few fishery interests, other than bass, associated with these sites.
3. Changes to the boundaries of some nursery areas, mainly by extending the seaward limit. This would be in consultation with the SFI, SFCs and NRA units. Under review at the moment are the Taw-Torridge, Camel and Conwy estuaries, all of which are known to have concentrations of small bass and attendant effort just beyond existing nursery area seaward boundaries. Various options for new boundaries that would give protection to those bass and also be more clearly identifiable from fishing vessels are being considered.
4. Possible restrictions on shore fishing (mainly angling) in nursery areas. It is premature to suggest that regulations controlling shore angling (and netting) should be introduced in all nursery areas. However, in locations where under-size bass are often concentrated in large numbers, particularly around industrial warm water discharges, restriction of shore fishing is already merited. In general this would require consultation between SFCs and the companies concerned.

Following reports of fishing activity directed at under-size bass some additional sites have been identified as potential bass nursery areas. These include the warm water discharge areas at Blyth and Dungeness power stations, and the Teifi estuary in Cardigan Bay, Wales. Further evaluation is required before proposals can be drawn up.

5.2 Fishing catch and effort controls

Fishing effort is currently uncontrolled but consideration will need to be given to the desirability of control in the future.

Bass tagging studies show that adult stocks around the UK are shared with other EU countries, mainly France at present, although this has not been quantified. Other EU nations, including Spain, are seeking a foothold in the fishery. Spain already has access rights to Areas VIId and VIIe and the bottom of Areas VIIf and VIIg though no Spanish vessels have been sighted east of 5°W in the past five years. She will continue to be excluded from that part of the Area VIIf which is within the Irish Box. She will, however, as a result of the new arrangements gain access from 1.1.96 for the first time to the northern part of Area VIIg. Fleets from other EC countries are capable of producing a massive increase in effort on the bass spawning stocks. The development of pair-trawling for bass has already caused conflicts between inshore and offshore sectors in France, and competition for the resource by opposing fleets is likely to increase.

At present there are no effort controls or quota restrictions on bass. Unregulated effort is not in the long-term interests of the bass fishery around the UK, or north-west Europe in general. The possibility of further increases in fishing pressure is great for a combination of reasons: the displacement of effort from other fisheries, the accession of new international fleets, the current abundance of bass, and the continued demand for the species.

One approach could be through the EU by the establishment of precautionary effort quotas for both inshore and offshore sectors of the fishery in the UK and France. With this, the inshore sector may be concerned that the offshore sector could be benefiting at its expense as the current technical measures apply largely to the inshore fishery. Similarly, further unilateral action to protect bass stocks by the UK alone may run the risk of unfairly disadvantaging UK commercial fleets.

There are however a number of important questions that would need to be answered before this approach could be adopted:

- At what levels should any quota be set?
- How could landings or effort be monitored in (a) commercial fleets and (b) the recreational sector?
- How could quotas be set and allocated to (a) commercial fleets and (b) the recreational sector?
- How could quotas be enforced on (a) commercial fleets and (b) the recreational sector?

Clearly the setting and monitoring of quotas would require more effort to be applied to collecting data for both the offshore sector and recreational fisheries in both the UK and France. It will be necessary to improve substantially stock assessments with increased biological sampling. This implies significantly increased resources devoted to management and international cooperation in data collection, analysis and enforcement.

Alternatively, bass could be designated a pressure stock and licences be granted only to current participants. This could involve setting individual catch or effort quotas through the EU. Whilst this is relatively easy to apply to the commercial sector, this approach would raise a number of issues in the recreational sector, not least the lack of any precedent in the UK (although there are precedents

elsewhere). Studies of how the allocation problem has been addressed in other countries would be essential in the development of such a scheme.

5.3 Future research

This review has highlighted a number of areas where more information is required if rational fishery management policies are to be pursued. The following areas have been identified:

- there is a requirement for adequate monitoring and assessment of the international fishery for bass, particularly in Area VII;
- there is a need for a study of effective and nominal effort so that effort may be standardised enabling improved interpretation of stock abundance indicators;
- the DFR monitoring system should be continued so that a consistent data set can be acquired. In the long run this system might be replaced by official data, but the review indicates that at present the FSD data for bass are neither adequate nor reliable;
- a study on the impact of shore fishing in nursery areas is required so that appropriate controls can be considered, if required;
- additions to the list of nursery areas need to be individually assessed;
- a study is required of discarding, in particular to assess the mortality associated with it. At present very little is known about the survival of discards, but this appraisal has revealed the probable significance of this in estimating fishing mortality;
- the snapshot approach that has been adopted to the study of the recreational fishery means that annual catch data cannot be presented for the fishery. Ways should be sought to provide an annual (less-detailed) assessment of the recreational fishery;
- an attempt should be made to improve understanding of the economic objectives and behaviour of bass fishermen, and those factors responsible for causing effort switches between bass and other species;
- a review should be undertaken of systems which have been or might be used around the world in the management of joint commercial and recreational fisheries, and consideration should be given to their potential applicability to the UK bass fishery;
- the management implications of farmed supplies for the European industry and particularly the UK bass fishery cannot yet be predicted with any certainty but the impact is likely to be significant: this is an area which merits further research.

6. CONCLUSIONS

The available evidence to date suggests that the management measures have been successful in achieving their objectives which were to maintain or increase yields from the bass fishery and to safeguard the spawning stock. This success has been reinforced by the fortuitous appearance of a very good year-class at the right time but **it is important to note that had the management measures not been in place this year-class could not have been protected** from excessive

exploitation levels. The measures have been effective at controlling exploitation patterns in the inshore fishery. However, more benefits of the management package are expected in the future as the full biological growth gains are realised.

A major feature of the studies has been to demonstrate the value of the bass fishery. According to official FSD data, commercial landings in 1993 were just 239 tonnes which at a first-hand price of £7.27 per kg suggests a total value for the fishery of only £1.7 million. However, the DFR data on commercial landings suggests that landings were in fact 1079 tonnes giving a total landed value of £7.9 million. Using Sea Fisheries Industry Authority Key Indicators data, this would place bass as the fourth most valuable landed species in England and Wales that year, behind only cod, plaice and sole. Even allowing for 1993 being a somewhat exceptional year, the more typical results for 1992 show a fishery which, given the DFR landings estimation of 515 tonnes, was worth nearly £4.0 million at first hand; this placed it seventh by value in the fisheries “league table”. In addition, CEMARE data on the recreational fishery estimates a landings figure of a further 412 tonnes in 1993, and that the gross expenditures on bass angling were some £18.3 million. Whilst the DFR and CEMARE values cannot be added to produce a total figure (because of significant methodological differences in the construction of the values), they do both indicate that fisheries managers are dealing with a significant fishery (certainly far more so than would be thought by inspecting the FSD official data).

The study has also been important because it is the first to attempt to assess the combined biological and economic impact of the management of a joint commercial and recreational fishery. The approach adopted by the study has been shown to be successful given the constraints under which it took place. A further assessment would be valuable once the full impact of the measures has been felt in 3-4 years time. However, if progress is really to be made then there is a need for on-going economic monitoring rather than the snapshot approach which currently has to be used.

Nonetheless, the study has highlighted the true value of the commercial and recreational fisheries for bass and the importance of the biological and economic background within which the fisheries and their management operate. Variability is a key feature of all aspects of the fishery (recruitment, effort and markets) and will have to be taken into account in the development of future management. The national management measures that have been put into place have so far proved to be generally effective, but require some modification, mainly to ensure improved compliance. The main problem facing the MLS is the presence in the UK of undersize, mainly farmed bass from abroad. It is suggested that this problem might be dealt with by requiring origin marking for farmed imports and by increasing the MLS for bass in the Mediterranean area. In the meantime, DFR have developed a method of discriminating between farmed and wild bass, which may help simplify enforcement of the MLS. The mesh size regulations seem adequate at present for bass, but consideration should be given to revoking the derogation for attended mobile nets with mesh sizes in the banned range (65-89 mm) between Beachy Head and Rame Head. The nursery area legislation should be amended to improve enforceability, in particular by making it an offence to be in possession of bass whilst in a nursery area, irrespective of where the fish was caught. Changes to the boundaries of some nursery areas seem desirable and there are some potential new nursery areas which merit consideration.

For the future, the question ‘are technical measures enough?’ must be addressed. A concern identified in this study is the absence of any controls on effort or landings. There is a strong possibility that fishing effort in the offshore fishery will expand, either because of displacement away from quota species or as a result of agreed access arrangements to Area VII which may allow access for additional fleets. It may soon be necessary therefore to consider effort and/or landings

controls to supplement those measures already in place. It is important that the benefits gained in the short-term, through better management of the UK bass fishery, should be maintained by taking action early to prevent over-fishing of the stock in the long-term.

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