Environment Agency

Fish Monitoring in Solent & South Downs, 2011

Dom Longley, Analysis & Reporting Team

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Published by:

Environment Agency
Horizon house, Deanery Road
Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

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Foreword

Welcome to our annual fish monitoring report, which presents the results of all the fish population monitoring we carried out in Solent & South Downs (SSD) in 2011. Above all, the report aims to: i) present this year data, ii) to compare the data between related survey sites and iii) to compare data between years.

Fish monitoring in Solent & South Downs was influenced by two major factors in 2011. Firstly, the Environment Agency reviewed its fish monitoring programme across the whole of England and Wales in order to establish regular, long-term fish monitoring for the Water Framework Directive (WFD). This was the most far-reaching review of the National Fish Monitoring Programme ever implemented and involved the design of a network of survey sites for assessing the status of fish communities in waterbodies that are monitored for fish (a waterbody is a sub-catchment of a river) Not all waterbodies are monitored for fish: there are 294 waterbodies in SSD, 129 of which are currently monitored for fish.

The time and labour required for this significant amount of additional fish survey work has been made available by reducing the frequency with which we monitor most Principal Coarse Fisheries from an annual to a triennial basis. In addition annual Salmon Action Plan surveys will now be biennial. A great advantage of this change is that our fish data will now drive improvements to fish habitats over a far wider area than just those parts of rivers where regular fishing takes place. At the same time, all our river fisheries are included in the WFD programme, so must be brought to “Good Ecological Status”, as well as being maintained, improved and developed as fisheries.

The second major development in 2011 was the redrawing of Area boundaries in what was Southern Region, to form the new Environment Agency South East Region. SSD is one of four Areas within this new Region and was significantly enlarged by the addition of East Sussex. This has brought the Pevensey Levels, Cuckmere and Sussex Ouse catchments into the SSD fish monitoring programme, which led to an extremely busy 2011 fish survey season, the key elements of which were as follows:

- The first ever extensive survey of the River Meon Principal Brown Trout Fishery.
- The second round of biennial Eel Index surveys on both the Itchen and Ouse.
- Surveying of the Western Rother and Ouse Principal Coarse Fisheries
- The first year of surveys investigating the “less than good” status of fish populations in certain WFD waterbodies

Please note that details and results from all surveys listed are available on request from: dominic.longley@environment-agency.gov.uk

Executive summary

- Coarse fish abundance on the Western Rother and Sussex Ouse was generally relatively low and there is evidence that this was largely due to the series of cool summers and cold winters in recent years. It is expected that other local coarse fish populations were similarly affected.

- Abundance of juvenile salmon and trout was also generally found to be relatively low and there is evidence that this is generally associated with low flows in late 2010 and early 2011.

- Biennial Eel Index monitoring on the Itchen and Ouse showed that eel distribution was largely similar to that recorded in 2009, but with some notable changes in abundance at certain sites.

- Relationships between fish abundance and weather patterns described in this report suggest that the unusual weather patterns experienced in spring and early summer 2012 may result in a poor coarse fish year class due to persistent low temperatures and a fairly sudden increase in flow immediately prior to the spawning period. The effect on juvenile salmonids is less easy to predict, but it is likely that fry survival may have been reduced while the survival of last year's young may improve as a result of the restoration of flows and generally cool conditions.

Acknowledgements

We would like to thank all the landowners, fishing clubs, river keepers, farmers and land agents who kindly allowed us access to the river reaches on their land so that we could complete the 2011 fish monitoring programme.

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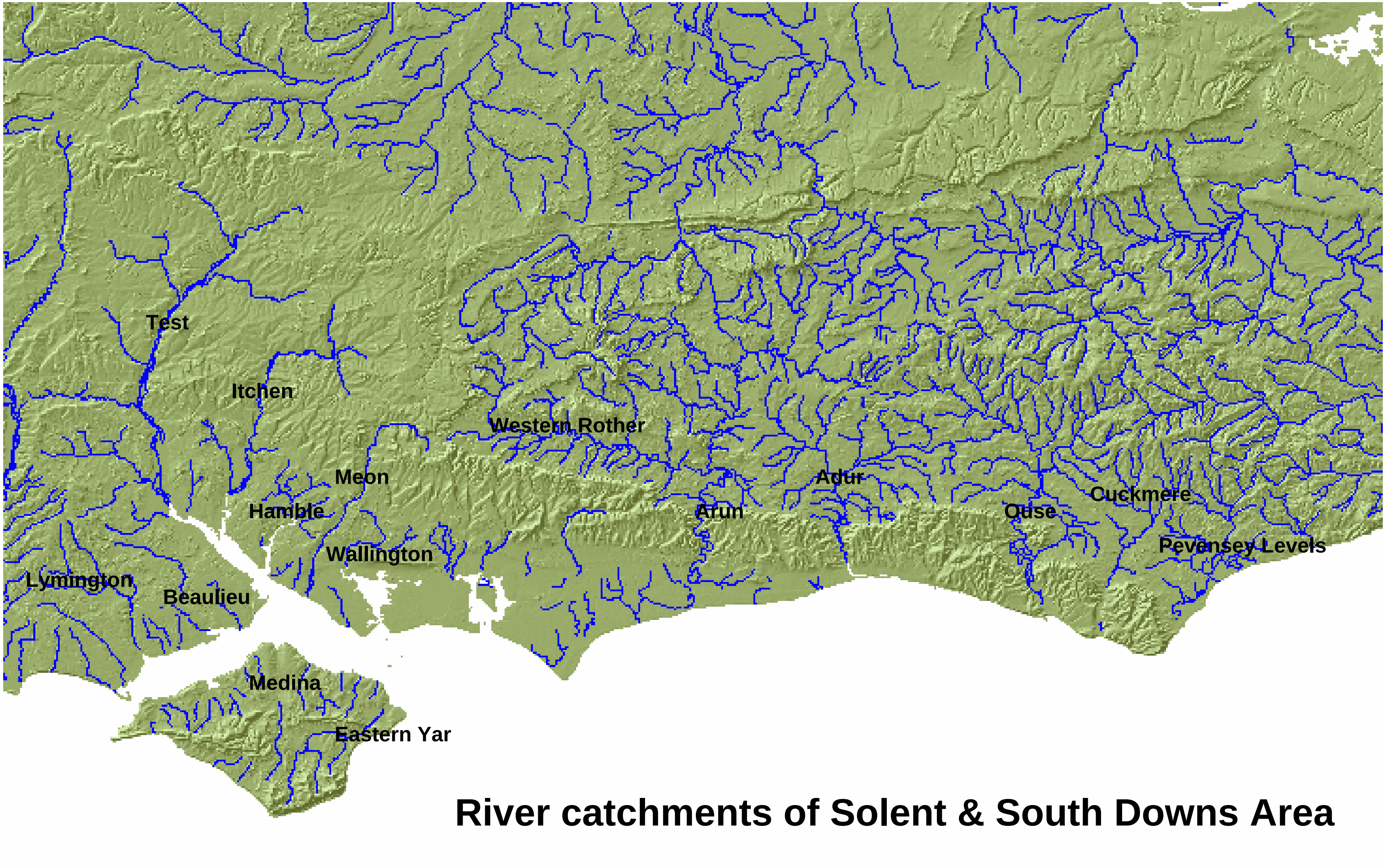


River catchments of Solent & South Downs Area

Fish populations, rainfall and temperature

In any given year, provided that there has been no major, one-off impact to a river system, such as a pollution incident or a large scale engineering project, fish populations will be predominantly affected by climatic conditions. Therefore, from the point of view of an individual angler, a fishing club committee or a river manager, an understanding of the link between climate and fish populations and a knowledge of climate patterns in recent years is very useful.

Fish populations in rivers are primarily influenced by temperature and rainfall through the following mechanisms:

1. Warm summers tend to produce strong year classes of coarse fish because growth increases due to higher metabolism and greater food supply, meaning that more survive. Conversely, a series of cool summers is likely to result in an overall drop in coarse fish abundance and size. Salmonids grow at lower temperatures than coarse fish, so are less reliant on warm summers. In fact, in some circumstances unusually high temperatures can stress salmonids and restrict growth.

2. Winter flow affects the survival of juvenile coarse fish: high winter flows tend to deplete numbers as a result of physical displacement by high water velocities (commonly referred to as "winter washout"). Conversely, high winter flows may benefit salmonids by easing upstream migration (obstructions tend to be more passable in high flows) and by increasing the area of suitable spawning gravels. However, under certain circumstances, high winter flows may reduce salmonid egg survival by washing more suspended sediment into the river.

3. Severely cold winters may increase juvenile coarse fish mortality. This is less likely to affect salmonids, which are tolerant of lower water temperatures.

The impacts of all three of the above factors are related to fish habitat quality: high quality, diverse habitat is likely to mitigate some of the negative effects and enhance some of the positive.

Figure RT1 below is based on the Central England Hadley long temperature record, for the period 2000-2011. The red line shows the number of degree days above 12°C in each year - this is approximately the minimum temperature at which most coarse fish species spawn and grow, so is a reliable general indicator of the best and worst years for coarse fish reproduction and growth. A "degree day" is a hypothetical measurement of one day at one degree. So, for example, two days with average daily temperatures of 15°C represents 6 degree days above 12°C.

The upper line shows the number of degree days below 0 °C in the preceding winter (October to March), indicating which winters were exceptionally mild or harsh.

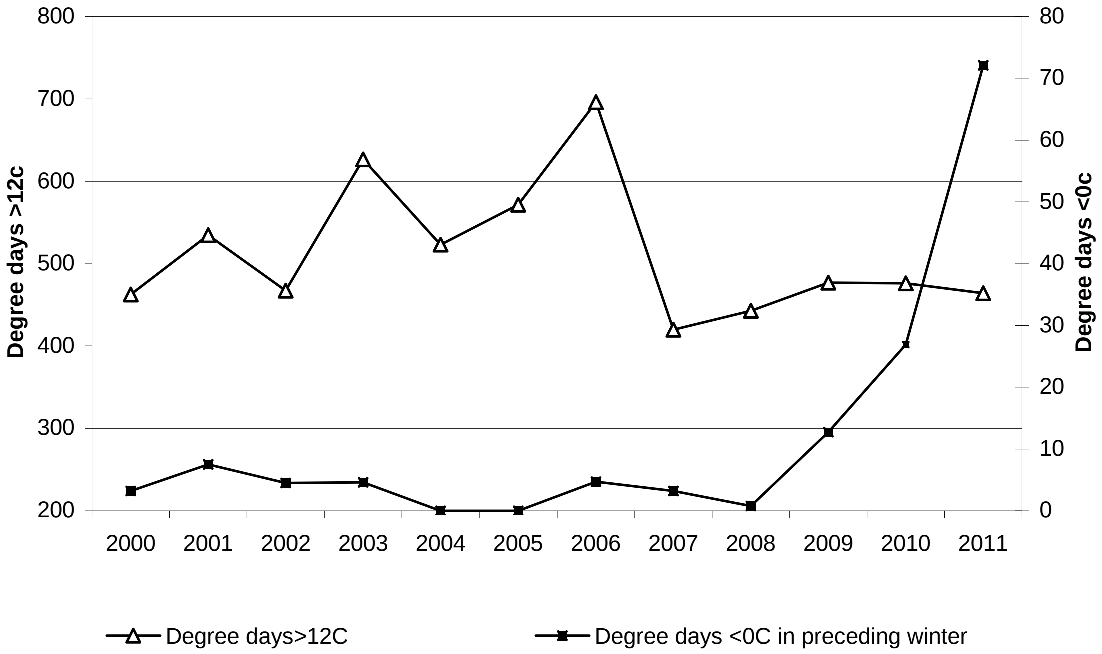


Figure RT1: degree days above 12°C. and below 0°C, 2000-2011.

Figure RT 2, below, shows average rainfall (recorded at the Eastbourne gauging station) for the periods May – September and the preceding winter in each year (October – March).

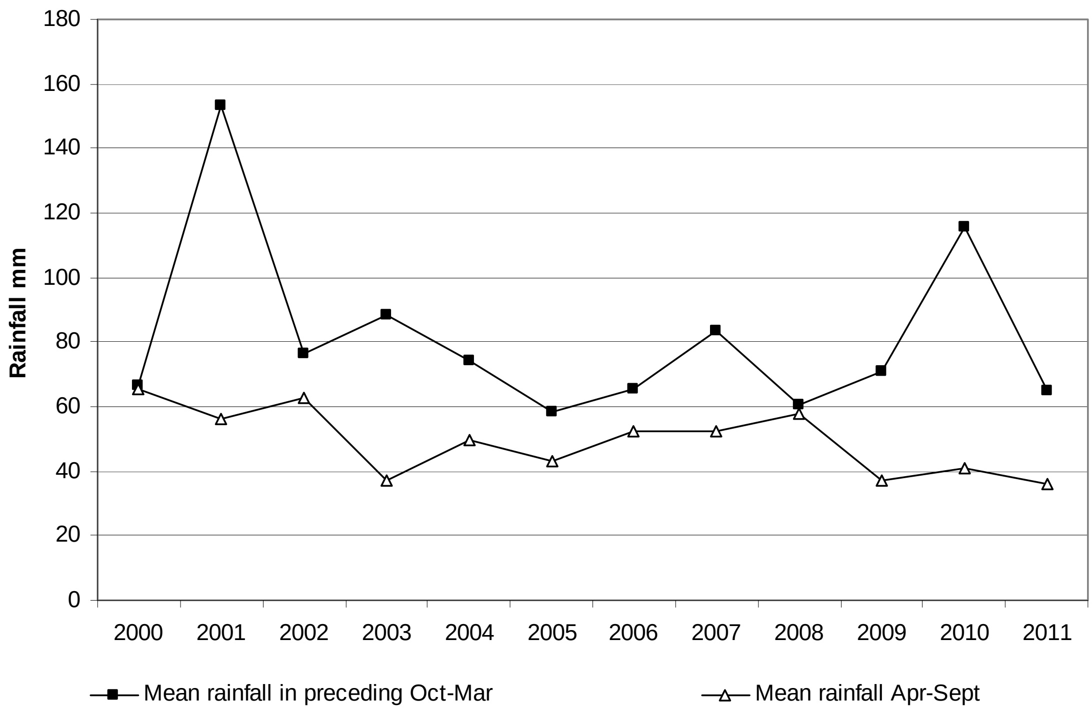


Figure RT2: Mean rainfall in summer and in the preceding winter, 2000-2011

The two figures provide clear indications of climatic conditions likely to have affected fish populations. The graph for degree days above 12°C shows peaks in 2001, 2003 and 2006 and a period of consistently cool summers from 2007 to the present, with a particularly cool summer in 2007.

The graph for degree days below 0° C highlights the significance of the succession of unusually cold winters in 2008/9, 2009/10 and 2010/11 the latter being particularly harsh. It also shows that winters in the period 2000-2008 were relatively mild, especially 2004 and 2005, during which not one day had an average temperature below 0° C.

Notable features of the rainfall chart are the exceptionally high rainfall in winter 2000/2001, and the relatively wet winter of 2009/2010. Relatively dry winters are likely to lead to better over winter survival for juvenile coarse fish and in this respect, the winters of 2004/2005 and 2007/2008 are of interest. In addition, winter and summer rainfall were roughly equal in 2000 and 2008 whilst notably dry summers occurred in 2003, 2005, 2009, 2010 and 2011.

Temperature and river flow records rivers are compared with fish population data for specific rivers in the relevant sections of this report. However, on the basis of these temperature and rainfall records, the following general observations can be made:

i) The best years for coarse fish reproduction, growth and survival were probably 2003 and 2006 because of the high summer temperatures.

ii) Relatively dry, mild winters in the middle of the period are likely to have improved over- winter survival of juvenile coarse fish – combined with high summer temperatures, conditions were probably favourable for coarse fish reproduction growth and survival.

iii) Every summer since 2007 has been relatively cool, which is likely to have restricted coarse fish reproduction, growth and survival.

iv) High rainfall in the winters of 2000/2001 and 2009/2010 is likely to have reduced over winter survival of juvenile coarse fish.

v) Exceptionally low temperatures in the last three winters may have increased mortality of juvenile coarse fish.

vi) The combination of low summer and winter temperatures and the high winter flows of 2009/2010 strongly suggest that conditions for coarse fish reproduction, growth and survival have been especially poor for the last five years.

v) Factors affecting salmon and brown trout recruitment success in local rivers are less well understood and are more likely to vary between rivers. Therefore general observations cannot be made until sufficiently long datasets are collected and analysed.

River reports from East to West

1 East Sussex

1.1 Pevensey levels

In 2011 one fish population survey was conducted in the Pevensey Levels, which was at Middle Bridge on the Waller's Haven. This survey was aimed at improving our confidence in the Water Framework Directive classification for this waterbody by obtaining a more reliable record of the fish community. The watercourse is wide, deep and difficult to survey and the previous survey here may not have captured fish from across the full width of the channel very effectively.

The table below provides details of the survey and its likely impact on waterbody status for fish:

Waterbody name	**Waller's Haven Between Windmill Hill and A259**		
Waterbody ID	GB107041012460		
Original fish status (2009)	Poor		
Reason for 2011 survey	Lack of confidence in survey data due to low catch efficiency in 25m wide channel		
Expected change to status:	Likely to improve to Moderate		
2011 survey details	Site name	NGR	Date
	Middle Bridge	TQ6679906818	09.09.11
Catch:	Perch	2	
	Pike	2	
	Roach	28	

Fish survey site at Middle Bridge, Pevensey levels. The strip net down the middle is to confine fish and improve the electric fishing team's catch efficiency.

1.2 Cuckmere

The five Principal Coarse Fishery survey sites on the Cuckmere have now changed to a triennial programme and will be surveyed in 2012. No fish survey work was conducted in the catchment in 2011.

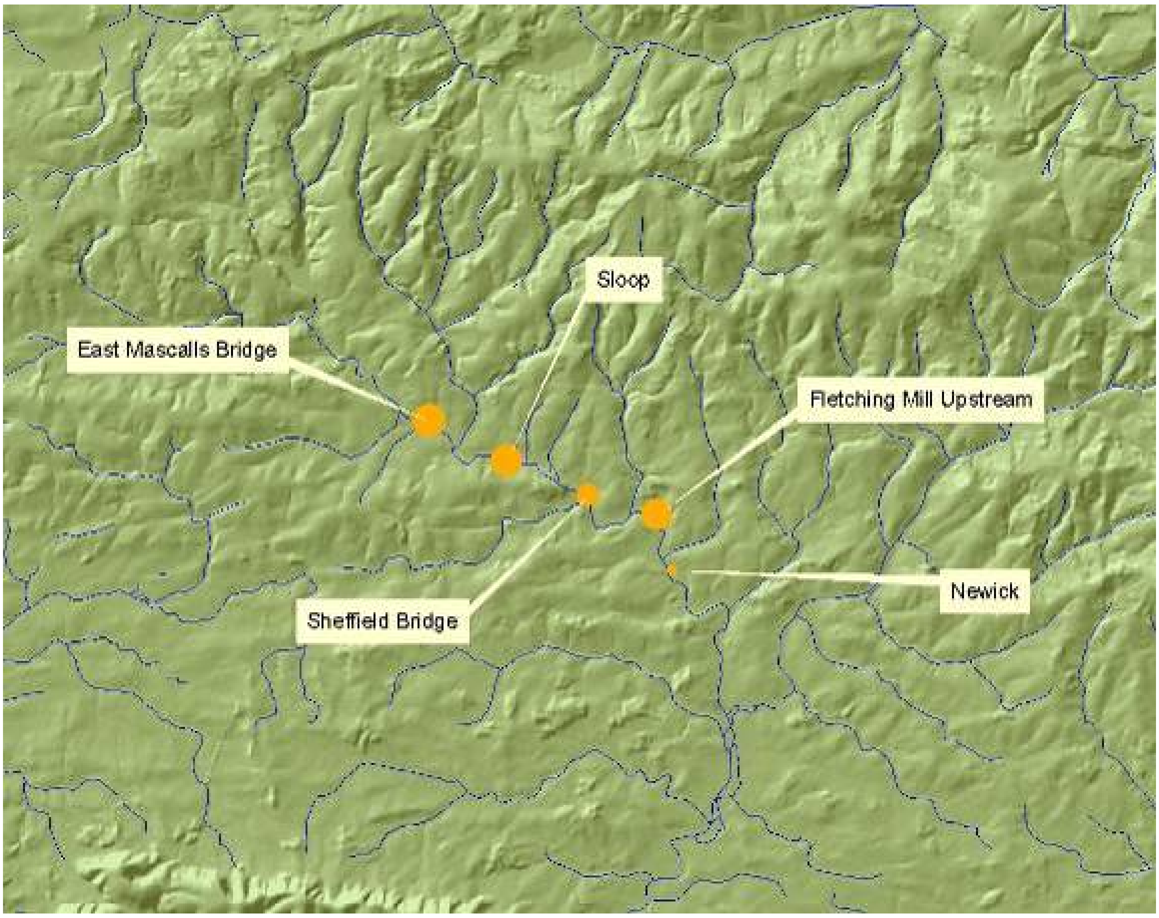
1.3 Ouse

The Ouse is routinely monitored as a Principal Coarse Fishery, a Principal Brown Trout Fishery and an Eel Index river. Two trout fishery sites are surveyed annually and five coarse fishery monitoring sites are surveyed biennially. These seven sites are all included in the Eel Index programme, which is biennial and requires ten sites, so three additional eel sites are also surveyed. A detailed survey of the wild brown trout population is carried out every six years and is programmed for 2013.

In 2011, the two annual wild brown trout, five coarse fishery, and three additional eel monitoring sites were surveyed. Nine WFD surveys were also undertaken.

Coarse fish

The main focus of this section is to report the results of the Principal Coarse Fishery surveys, which are likely to be of most interest to River Ouse anglers. The map below shows the locations of the five coarse fishery survey sites, with the markers sized relative to the total weight of fish of all species caught per 100m^2 (also known as the biomass or "standing crop") recorded at each site in 2011:



Map Ouse 1: River Ouse Principal Coarse Fishery survey sites, 2011

Figures and Ouse 2 show the relative abundance and biomass, respectively, of fish species caught at each site in 2011. Note that minor fish species are not included.

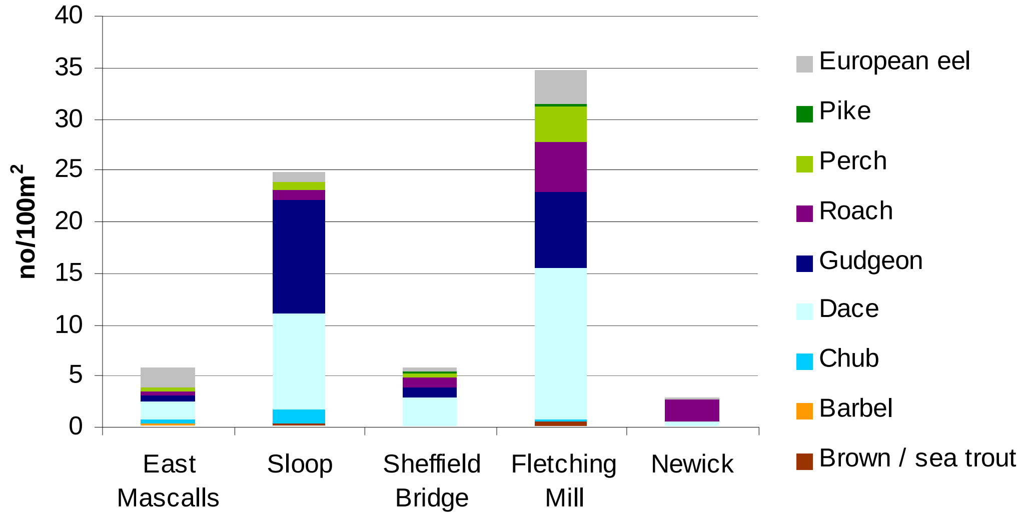


Figure Ouse 1: Estimated density by species and site, 2011

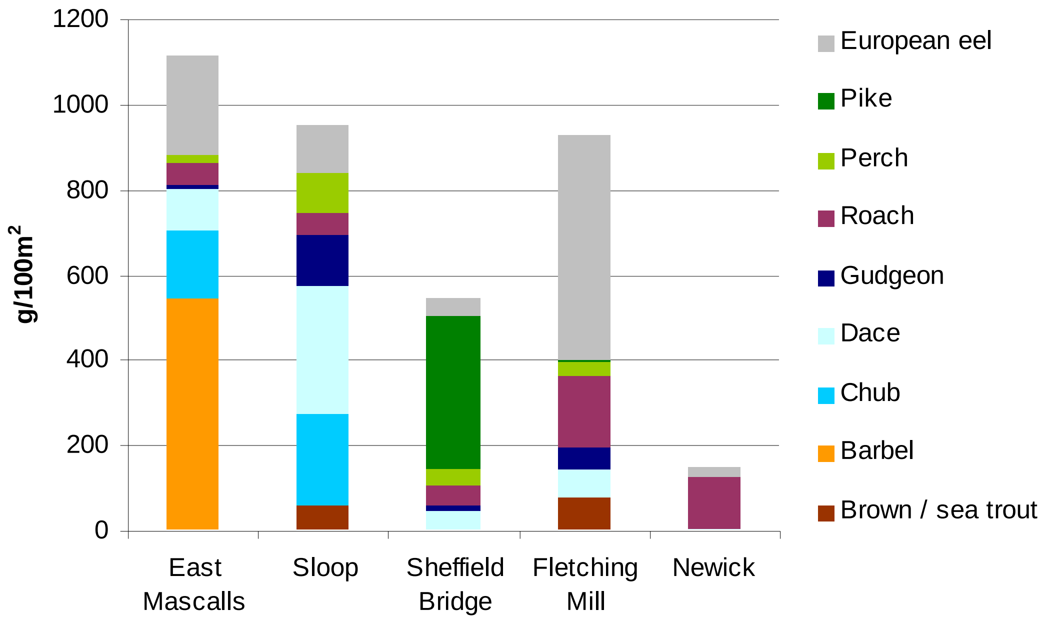


Figure Ouse 2: Estimated biomass(standing crop) by species and site, 2011

Figure Ouse 3 shows the mean estimated density of dace, roach and chub recorded annually since 2001 at East Mascalls, Sheffield Bridge and Sloop survey sites, plotted against mean summer flow and the previous winter's mean flow at Goldbridge gauging station. Newick and Fletching Mill are not included because they have not been sampled for the whole period:

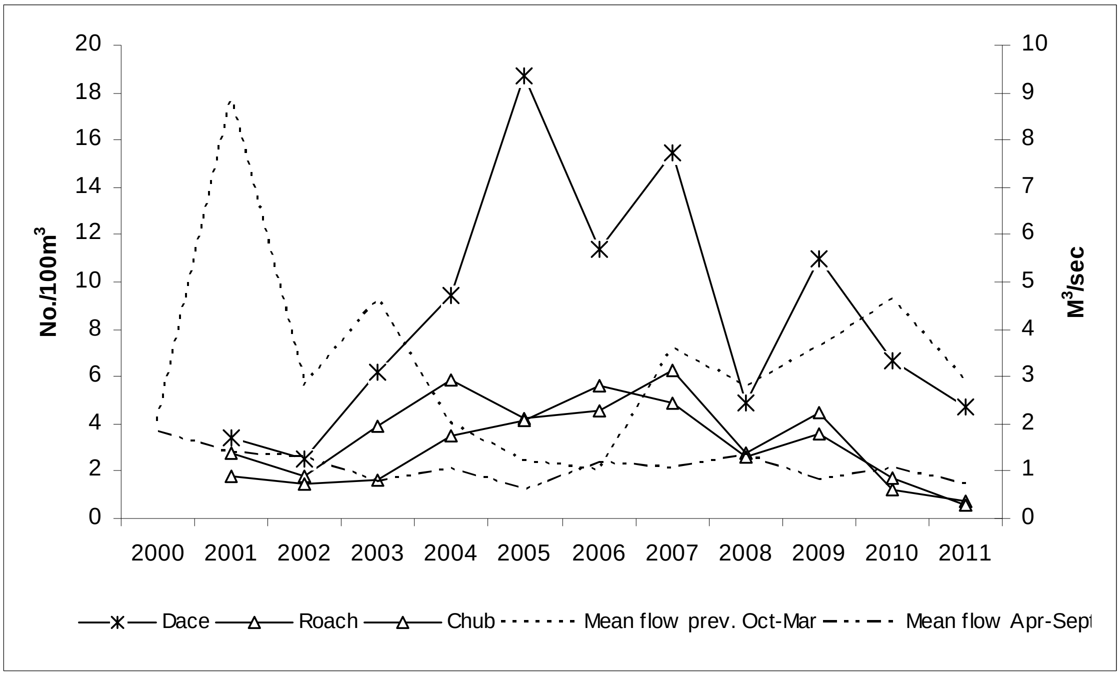


Figure Ouse 3: Coarse fish abundance and seasonal flow at Goldbridge GS

Figure Ouse 4 shows the mean estimated density of dace, roach and chub recorded annually since 2001 at East Mascall's, Sheffield Bridge and Sloop survey sites, plotted against the number of degree days above 12°C:

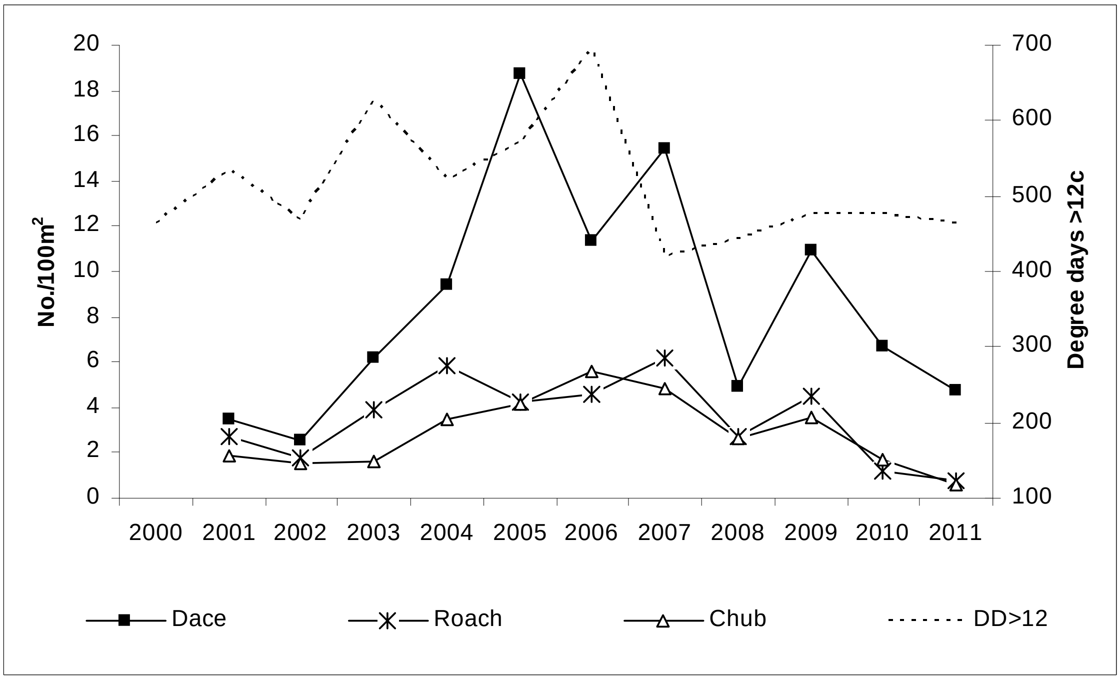


Figure Ouse 4: Coarse fish abundance and degree days above 12°C

Figure Ouse 5 shows the mean estimated density of dace, roach and chub recorded annually since 2001 at East Mascall's, Sheffield Bridge and Sloop survey sites, plotted against the number of degree days below 0°C:

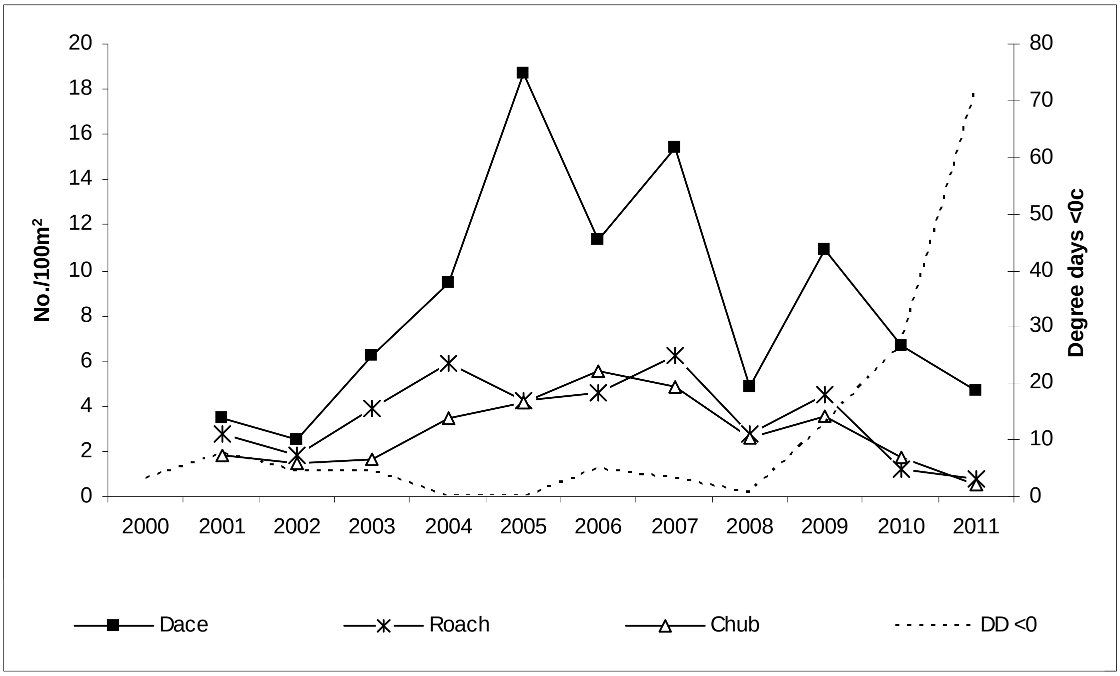


Figure Ouse 5: Coarse fish abundance and degree days below 0°C

Table Ouse 1 lists the correlation coefficient values describing the relationship between dace, roach and chub estimated density and flow and temperature factors from 2000-2011. Note that these values have not been tested for statistical significance and are intended as a general indication of the strength and direction (positive or negative) of any correlation:

Table Ouse 1: Ouse coarse fish correlation coefficients

Ouse	Dace	Roach	Chub
Mean flow in preceding Oct-Mar	-0.48	-0.27	-0.47
Mean flow 2 winters prev.	-0.60	-0.50	-0.59
Mean flow Apr-Sept	-0.52	-0.11	-0.02
Degree days>12°c	0.19	0.23	0.33
Degree days>12°c in prev. summer	0.52	0.66	0.59
Degree days <0°c in preceding winter	-0.32	-0.64	-0.56

Figures Ouse 6,7 and 8 on the following page show the length frequency distribution for all dace, roach and chub respectively, caught at all five Ouse coarse survey sites in 2011. The axes ranges are the same on each chart to allow comparison:

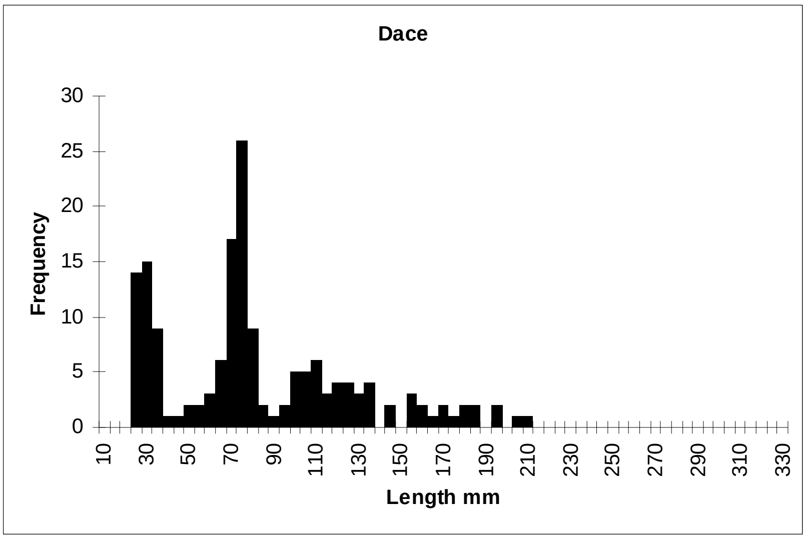


Figure Ouse 6: Dace length frequency, 2011, all sites combined

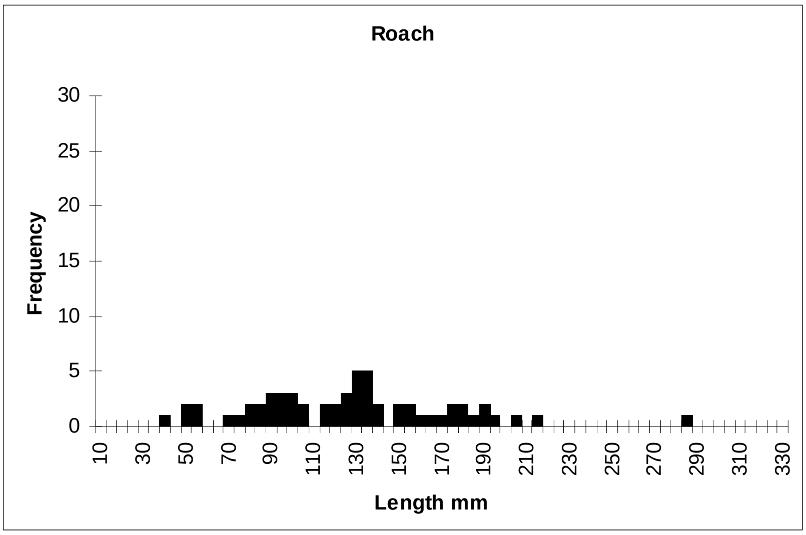


Figure Ouse 7: Roach length frequency 2011, all sites combined

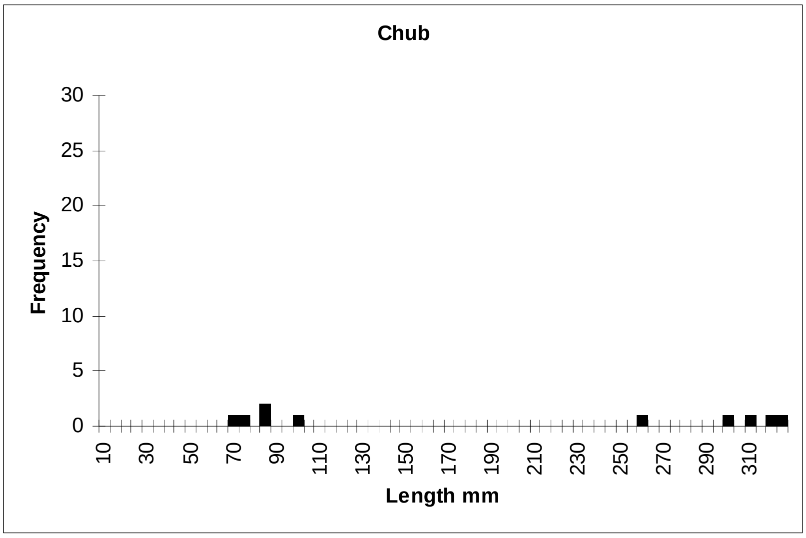


Figure Ouse 8: Chub length frequency 2011, all sites combined

Coarse fishery discussion:

Abundance and biomass were both relatively high at Sloop and Fletching Mill in 2011, suggesting that these sites have better fish habitat and consequently a higher carrying capacity than the other three sites. Fish abundance was low at East Mascalls, Sheffield Bridge and Newick, with biomass also low at Sheffield Bridge and Newick. The biomass value for East Mascalls was relatively high but this mostly comprised of two adult barbel.

Figure Ouse 3 puts the 2011 survey results into the context of the survey record since 2001 and demonstrates that dace, roach and chub abundances have varied considerably throughout the period and were at relatively low levels in 2011, especially compared to the period 2004-2007. This chart suggests that the abundance of all three species is affected by winter flow. Table Ouse 1 shows sets out correlation coefficients indicating that the estimated density of these three species is negatively correlated, to a greater or lesser degree, with flow in the previous winter, flow in the winter before that and also with summer flow. Of these flow periods, it is the flow two winters before the survey year that appears to have the greatest influence. This reflects the fact that survey catches typically comprise a significant proportion of fish in their second year (termed 1+ fish).

Figure Ouse 4 shows that summer temperature also appears to be influential in determining dace, roach and chub abundance at these survey sites. The low flow period 2003 to 2006 was also a period of unusually warm summers and coincided with a marked increase in abundance in all three species. This is reflected in the correlation values, which show a positive relationship between all three species and the number of degree days above 12°c in the survey year, but a stronger relationship with the value for the previous year, related to the proportion of fish in their second year in the catch. Figure Ouse 5 was included to emphasise the possibility that recent harsh winters may have suppressed coarse fish abundance. The graph indicates the number of degree days below 0°C in each winter (the winter preceding the summer fish survey) and shows that the winters 2003/2004 and 2004/2005 were relatively mild, whereas the winters 2008/2009, 2009/2010 and 2010/2011 all had relatively high numbers of sub-zero days, with the last of these being exceptionally cold.

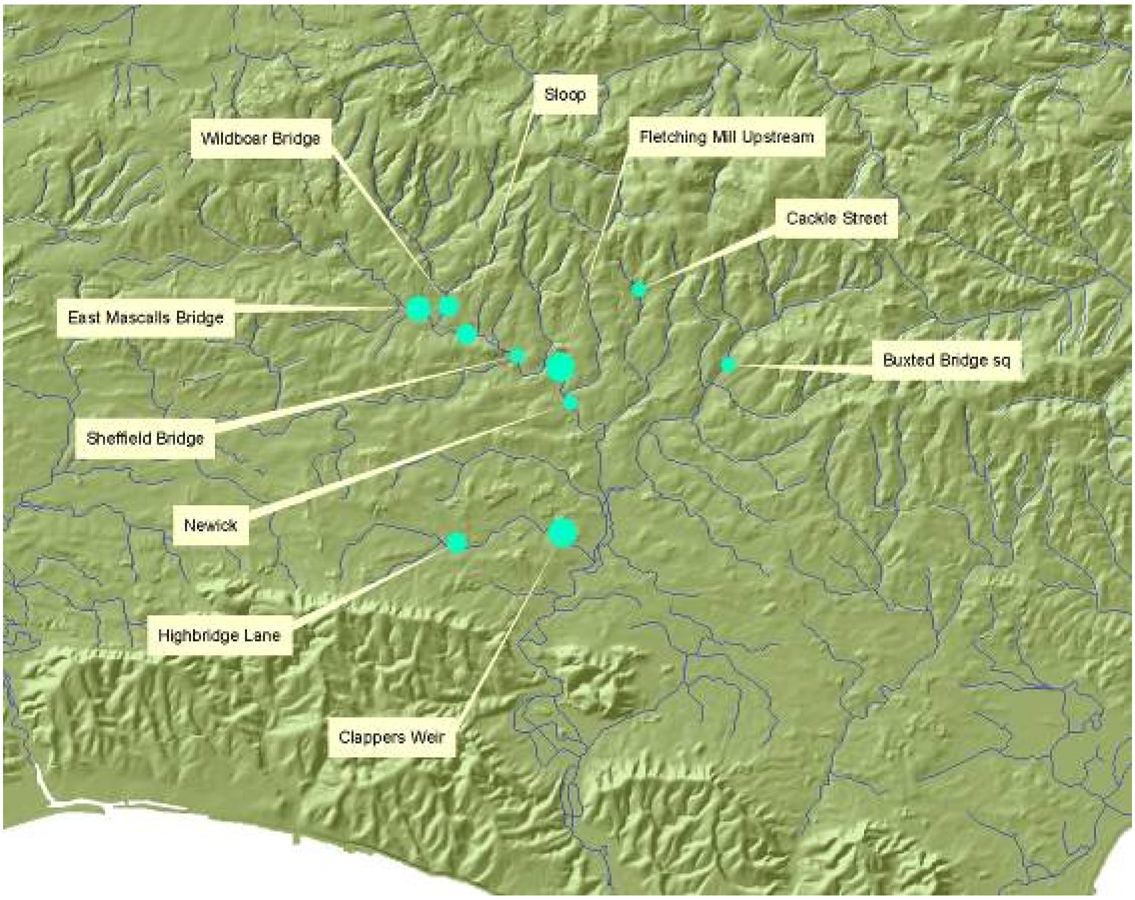
These relationships are complex because so many other factors affect fish populations simultaneously and also because same-species fish of different ages will be affected differently by various environmental factors. In addition, the relative importance of such factors is likely to vary in different parts of the river. However, the general pattern is best demonstrated by the peaks for the graph for dace in 2005 and 2007, which coincide with, or follow, low flow winters and warm summers.

Such relationships have implications for fishery management on the Ouse by emphasising that juvenile coarse fish appear to be particularly vulnerable to "winter washout" and to sub-optimal summer water temperature. Both factors are likely to affect the quality of the fishery by influencing recruitment success. Whilst climate is clearly beyond immediate control, fishery managers have the opportunity to mitigate the negative effects of high winter flows and cool summers simultaneously by establishing low velocity winter refuges that also serve as shallow, easily warmed fry habitat in summer. The evidence that flow and temperature exert such an influence on Ouse coarse fish abundance, especially dace, may indicate that suitable juvenile habitat may be lacking currently. In some reaches, this is likely to be associated with channel modification, especially canalisation (dredging and straightening) and flow regulation at impounding structures.

One of two adult barbel caught at East Mascalls Bridge in 2011

Ouse eel index monitoring

The map below shows the locations of the ten eel index sites sampled in 2011 – these include the five coarse sites shown in the previous map. The markers are sized proportionally to the estimated density of eels recorded in order to a general indication of relative eel abundance:



Map Ouse 2: Eel index survey site locations

Figure Ouse 9 shows the estimated eel density at each of the ten eel index survey sites in 2009 and 2011. Figures Ouse 10 & 11 show the length frequency histograms for all eels caught at these sites in 2009 and 2011 respectively:

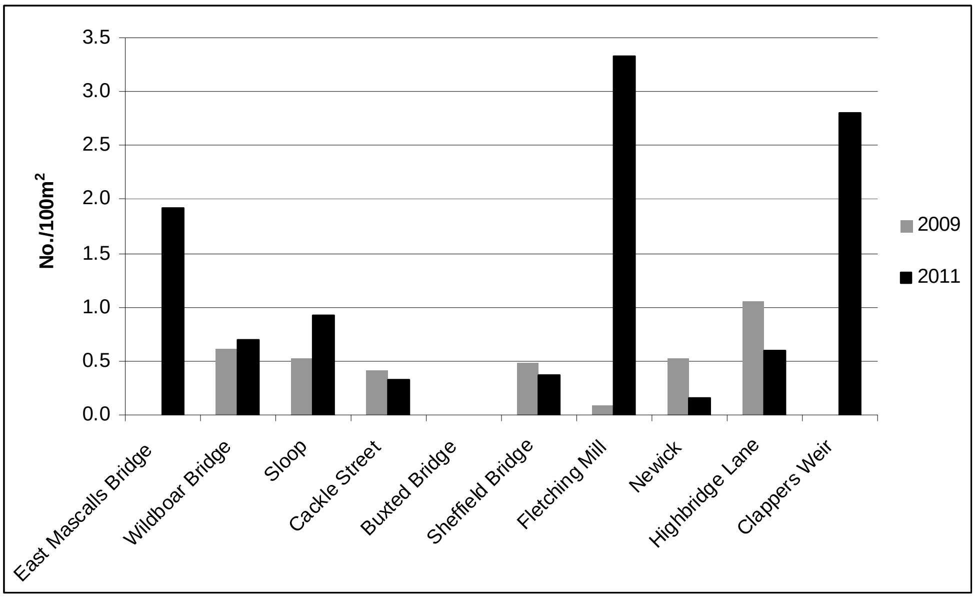


Figure Ouse 9: Estimated eel density at eel index sites, 2009 & 2011

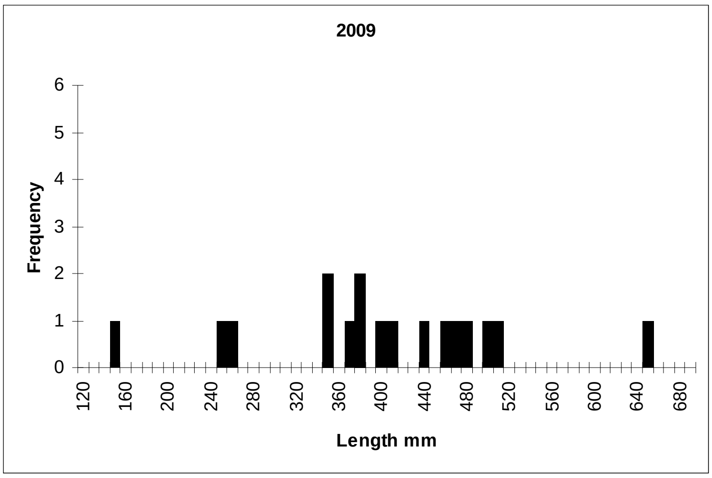


Figure Ouse 10: Eel length frequency, 2009 (n=17)

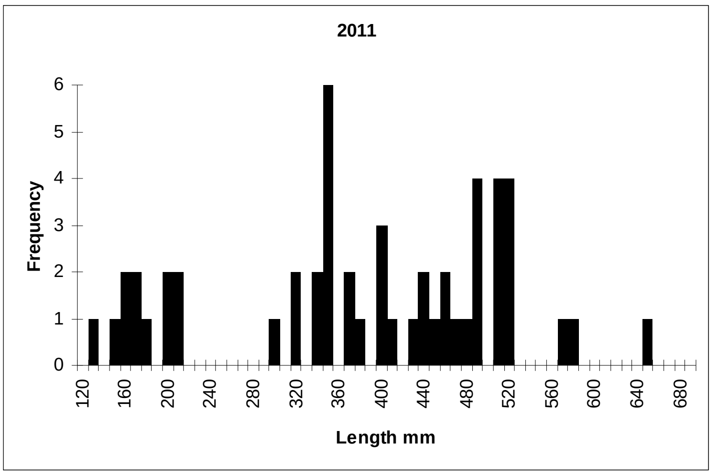


Figure Ouse 11: Eel length frequency, 2011 (n=52)

Eel discussion

Figure Ouse 9 shows some interesting similarities and differences in eel abundance between 2009 and 2011. No eels were caught at Buxted Bridge in either year but in 2009 they were also absent from the catches at East Mascalls Bridge and Clappers Weir, whereas eels were relatively abundant at both these sites in 2011. This may be due to the higher number of electric fishing runs completed at these sites in 2011 rather than a genuine change to eel abundance.

The site with highest eel abundance in 2011 was Fletching Mill, where the estimated density was much greater than in 2009. This notable increase is almost certainly a result of the removal of a major weir in August 2010, which transformed the reach within which the survey site is situated from a slack, impounded environment into an free-flowing, shallower reach with significantly higher water velocity. Fish population records for other flow-loving species show a similar increase in abundance at the site, especially dace. This increase in eel abundance at Fletching Mill helps sheds light on the misconception that the species prefers slow, muddy environments, when survey data from various SSD rivers indicates that they actually thrive best in physically diverse, unmodified and unregulated river reaches.

At the remaining eel sites, 2009 and 2011 abundances were similar, but with slight increases at Wildboar Bridge and Sloop and slight decreases at Cackle street, Sheffield Bridge, Newick and Highbridge Lane.

There is no clear change to eel length frequency between 2009 and 2011 but any trend would be difficult to appreciate given the low overall numbers of eels caught.

Brown trout temporal sites

We conduct annual surveys at Highbridge Lane, on the Bevern Stream, and at Buxted Bridge on the River Uck in order to monitor the abundance of wild brown trout close to their spawning grounds - the surveys are specifically aimed at recording the density of young of the year (0+) trout. Both these sites are also eel index sites and their locations are given in map Ouse 2.

In 2011 only one brown trout was caught at Highbridge lane and five at Buxted bridge. Figure Ouse 12 shows the density and the age classes of these catches:

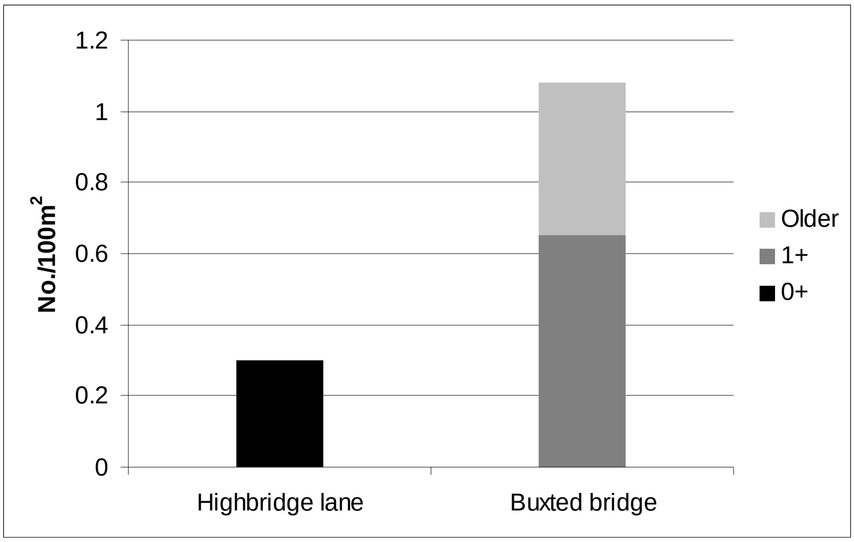


Figure Ouse 12: Brown trout density and age class at Ouse brown trout temporal sites, 2011

Brown trout discussion:

The brown trout temporal site at Buxted Bridge has only been surveyed in three non-consecutive years and, although the Highbridge Lane site has been surveyed in most years since 2001, the exact location of the survey has varied. Therefore, we do not have a consistent record of brown trout density in the Ouse over several years to compare with temperature and flow records. However, by ensuring a consistent approach to sampling at both sites in future we aim to develop such a long term dataset.

2 West Sussex

2.1 Adur

The triennial surveys of the Adur Principal Coarse Fishery will be conducted in summer 2012 and in 2011 the only fish monitoring that took place was in connection with the investigation of waterbodies failing to meet Good Ecological Status for fish under the Water Framework Directive (WFD).

Details of these surveys are provided in the following tables:

Waterbody name	**Herrings Stream**		
Waterbody ID	GB107041012150		
Original fish status (2009)	Poor		
Reason for 2011 survey	Lack of confidence in survey data due to inappropriate sampling technique		
Expected change to status:	Likely to improve to Moderate/good		
2011 survey details	Site name	NGR	Date
	Hornesdene Farm	TQ2727519349	24.08.11
Catch:	3 Spined Stickleback	1	
	Brown trout	1	
	Bullhead	87	
	Chub	11	
	Dace	15	
	European eel	1	
	Gudgeon	1	
	Roach	6	
	Stoneloach	6	

Waterbody name	**Black Sewer**
Waterbody ID	GB107041012040
Original fish status (2009)	Moderate
Reason for 2011 survey	Lack of confidence in survey data due to age of data
Expected change to status:	Uncertain, possible improvement to good, will know more following additional survey site in 2012

2011 survey details	Site name	NGR	Date
	Black Sewer Upper Q	TQ1763112346	03.08.11

Catch:	3 Spined Stickleback	18
	Brown trout	50
	European eel	1
	Roach	3
	Stone loach	2

Waterbody name	**Honeybridge Stream**
Waterbody ID	GB107041012120
Original fish status (2009)	Poor
Reason for 2011 survey	Lack of confidence in survey data due to single, unrepresentative site
Expected change to status:	Likely to improve to Moderate/good

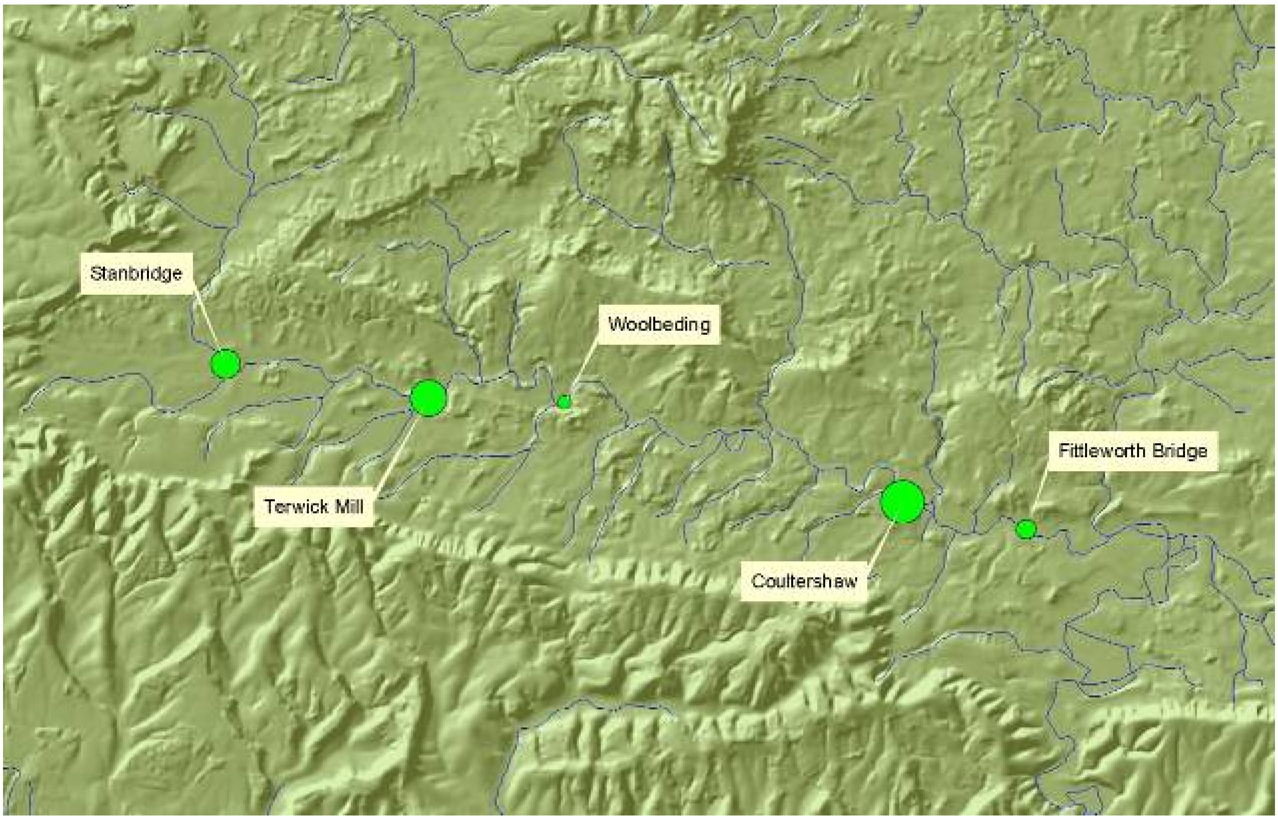
2011 survey details	Site name 1	NGR	Date
	D/s Daylands Farm	TQ1602416788	10.08.11
	Brown trout	7	
	Bullhead	50	
	Chub	2	
	Dace	2	
	European eel	7	
	Stoneloach	1	
2011 survey details	Site name 2	NGR	Date
	U/s Daylands Farm	TQ1571916393	10.08.11
	Brown trout	3	
	Bullhead	52	
	Chub	2	
	European eel	9	
	Gudgeon	1	
	Stoneloach	6	

2.2 Arun

No fish population monitoring was conducted in the Arun catchment in 2011. The triennial surveys of the Arun Principal Coarse Fishery will be conducted in summer 2013.

2.3 Western Rother

The Western Rother is monitored as a Principal Coarse Fishery and has five temporal survey sites, which have been surveyed consistently since 2002. In addition, the river is classed as a national coarse fishery reference river, meaning that our catch data is used to represent coarse fish populations in similar types of river.



Map Western Rother 1: Principal Coarse Fishery survey site locations

Figure WR1 shows the estimated density (number per 100m^2) of fish species at each of the five Western Rother principal coarse fish survey sites - note that minor species such as bullhead and minnow are not included. Chart WR2 shows estimated biomass, or standing crop (g/100m^2).

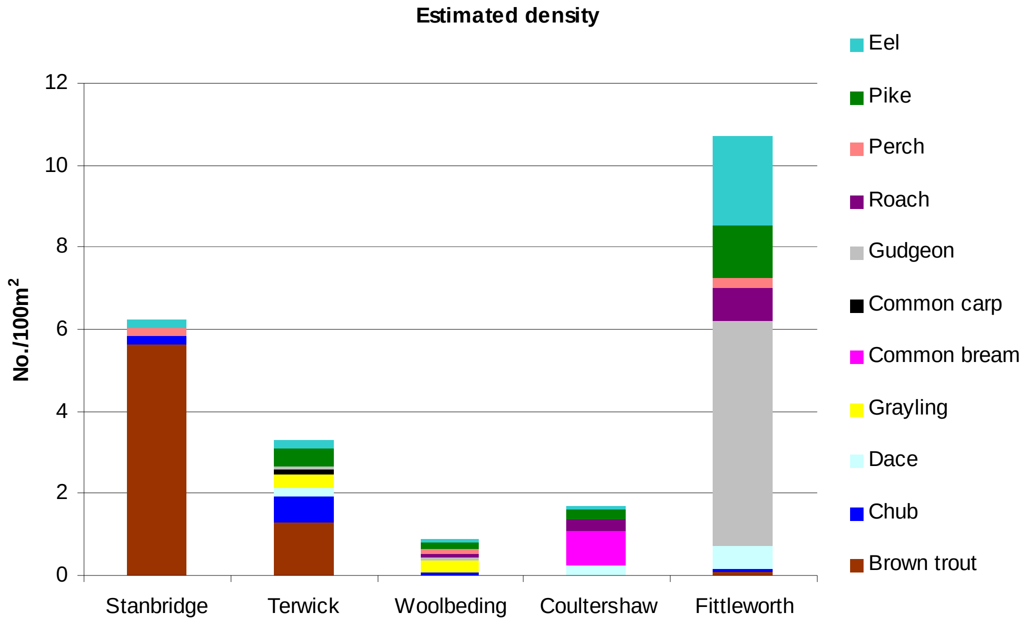


Figure WR1: estimated density, Western Rother, 2011

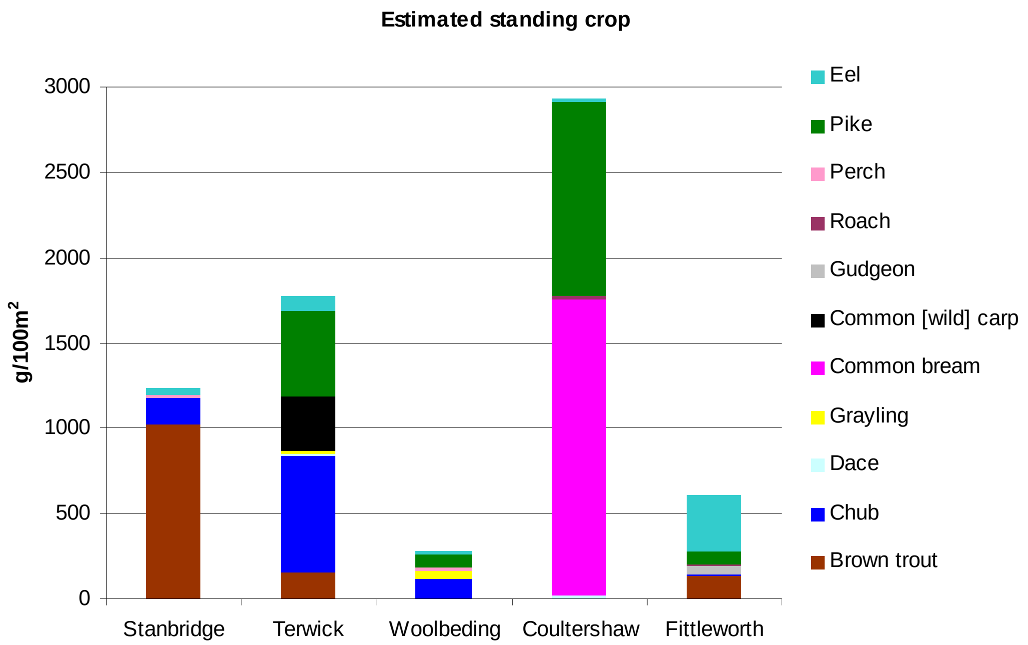


Figure WR2: estimated standing crop, Western Rother, 2011

Figures WR3-5 are length frequency histograms for all dace, roach and chub, respectively, caught at Western Rother surveys in 2011:

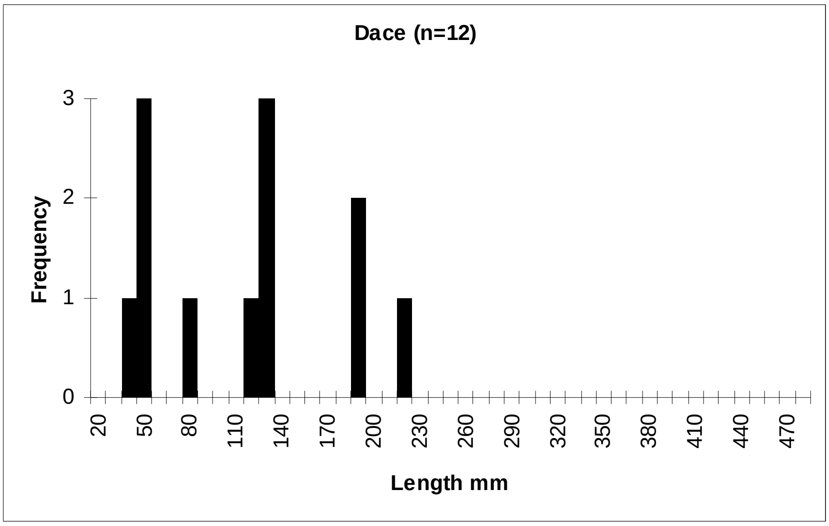


Figure WR3: dace length frequency, Western Rother, 2011

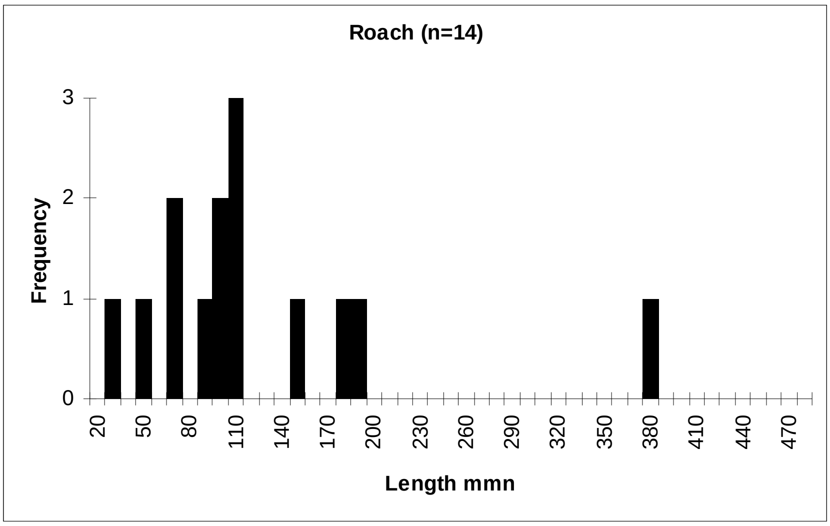


Figure WR4: Roach length frequency, Western Rother, 2011

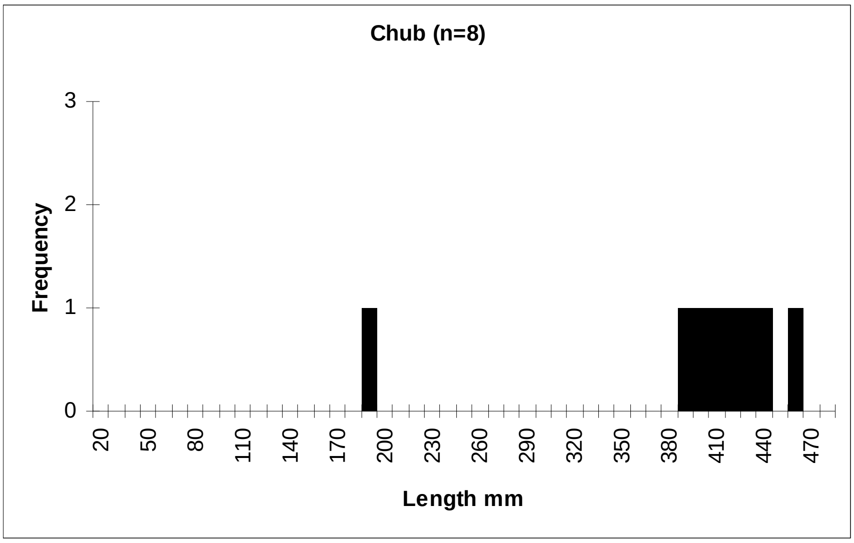


Figure WR5: dace length frequency, Western Rother, 2011

Figures WR6, WR7 and WR8 show the mean estimated density of dace, roach and chub at Western Rother survey sites in all survey years up to 2011, compared to various key environmental parameters: WR6 plots the fish densities against mean flow at Hardham gauging station in the winter period October - March and the summer period, April to September. WR7 includes the graph for the number of degree days above 12°c and WR8 shows the graph for the number of degree days below 0°c.

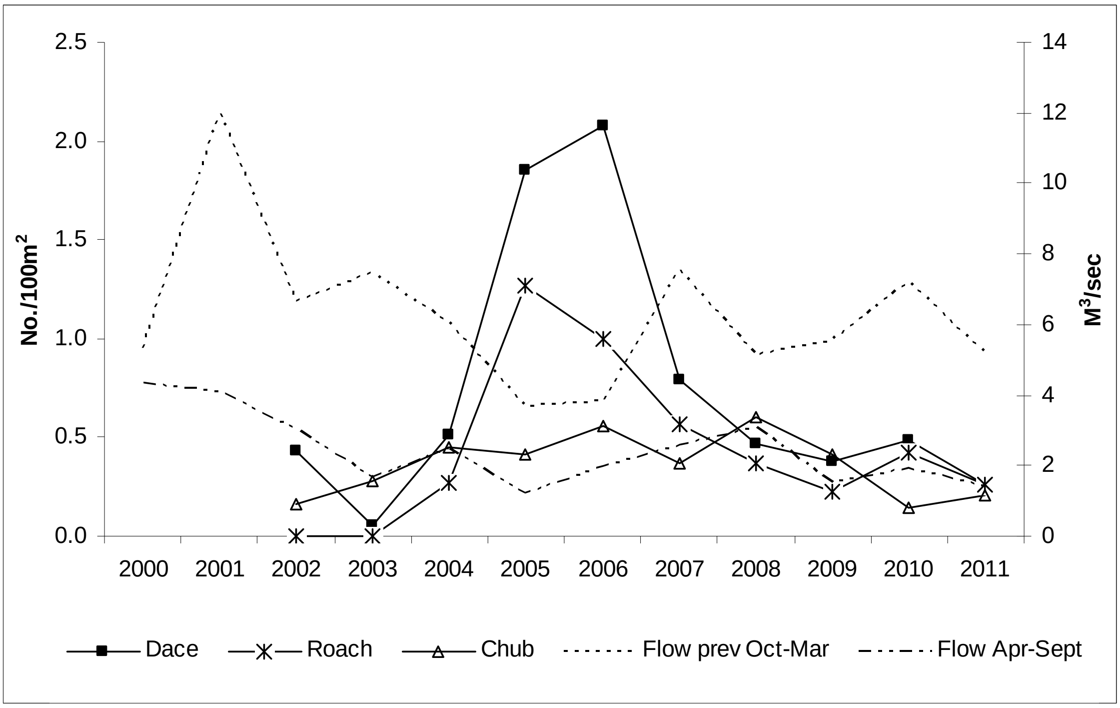


Figure WR6: Western Rother coarse fish abundance and flow, 2002-2011

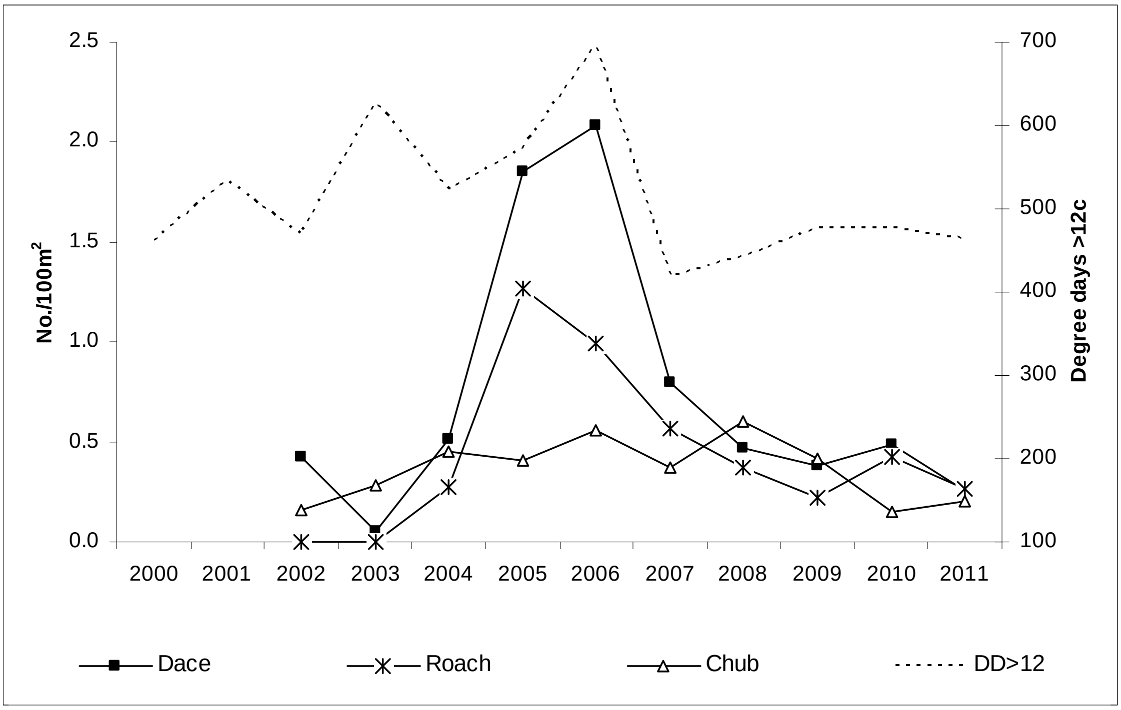


Figure WR7: Western Rother coarse fish abundance and degree days >12°c, 2002-2011

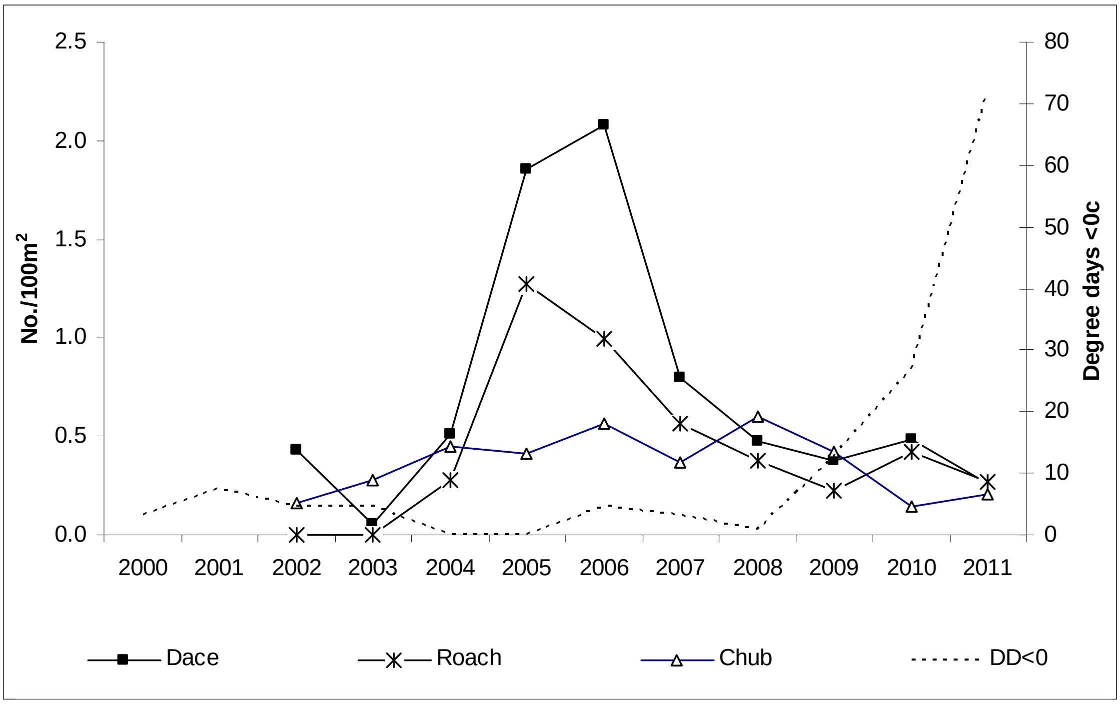


Figure WR8: Western Rother coarse fish abundance and degree days <0°c, 2002-2011

Table WR 1: Correlation between coarse fish mean estimated densities and environmental parameters, Western Rother

Western Rother	Dace	Roach	Chub
Degree days >12°c	0.56	0.39	0.28
Degree days >12°c prev. summer	0.33	0.26	0.09
Degree days <0°c in preceding winter	-0.32	-0.20	-0.51
Mean flow in preceding Oct-Mar	-0.71	-0.69	-0.56
Mean flow Apr-Sept	-0.21	-0.33	0.18

Western Rother coarse fishery discussion;

Figure WR1indicates that coarse fish densities in 2011 were generally low. Fittleworth had the highest total estimated density which, at just over ten fish per 100m^2, is still remarkably low. Estimated biomass was particularly high at Coultershaw but this reflects the presence of a small number of adult pike and common bream in the catch. Conversely, estimated biomass at Fittleworth is low because the relatively high density comprised a large number of gudgeon, with a low combined weight.

The relationship between dace, roach and chub densities with temperature and flow between 2002 and 2011 appear to be quite consistent in figures WR6-8 and in correlation table WR1. The correlation values indicate that the greatest influence over the abundance of all three species is flow in the winter preceding the survey and this trend is clear in chart WR6. The second most influential environmental factor appears to be summer temperature expressed as degree days above 12°c. All three species abundances are positively correlated with degree days above 12°c in the preceding summer and negatively with summer flow and the number of degree days below 0°c in the previous winter.

The influence of winter flow and summer temperature is most clearly demonstrated by the very low densities of dace, roach and chub following the exceptionally high winter flows in 2000/2001 and 2002/2003 and also in the very high densities recorded in the period of high summer temperatures and low winter flows in 2005 and 2006.

Since 2007, the combination of successive cool summers and relatively high winter flows in 2006/2007 and 2009/2010, as well as cold winters in 2008/2009 and an exceptionally harsh winter in 2010/2011, appear to have adversely affected growth and recruitment of dace, roach and chub. The result of this is that abundances are at approximately the same low levels that they were during the period of high winter flows at the beginning of the decade.

As discussed in the Ouse coarse fish section, it is important for fishery managers to recognise the importance of good habitat management in mitigating the potentially negative effects of climatic variables, especially high winter flows, on coarse fish populations in the Western Rother.

Large pike being returned at Coultershaw on the Western Rother.

Western Rother sea trout

Western Rother WFD:

In 2011 two fish population surveys were conducted to investigate the failure of the River Lod waterbody for fish under the WFD. The table below sets out the details and results of both surveys:

Waterbody name	**River Lod**		
Waterbody ID	GB107041012830		
Original fish status (2009)	Moderate		
Reason for 2011 survey	Lack of confidence in survey data due to poor fishing conditions (Salmons Bridge) and old data (Lickfold)		
Expected change to status:	Likely to improve to Good		
2011 survey details	Site name 1	NGR	Date
	Salmons Bridge	SU9414823459	31.8.2011
Catch:	Brown trout	1	
	Bullhead	32	
	Chub	2	
	European Eel	2	
	Minnow	32	
	Perch	1	
	Pike	2	
	Rudd	2	
	Stone loach	20	
2011 survey details	Site name 2	NGR	Date
	Lickfold	SU9087426605	31.8.2011
Catch:	Brown trout	1	
	Bullhead	2	
	Chub	17	
	Common carp	1	
	Gudgeon	1	
	Minnow	6	
	Perch	7	
	Pike	1	
	Roach	2	
	Stone loach	5	

3 Hampshire

3.1 Wallington

The two Principal Coarse Fishery survey sites on the Wallington have now changed to a triennial programme and will be surveyed in 2012. No fish survey work was conducted in the catchment in 2011.

3.2 Meon

Wild brown trout

The river Meon is designated a Principal Brown Trout Fishery, so our fish monitoring programme consists of a detailed survey (11 sites) once every six years, and surveys at two "temporal" sites annually (Titchfield and Mislingford). This programme design came into effect in 2007 and this is the first year that the 6-yearly, detailed survey has been conducted. All surveys are single run only.

The aim of the 2011 survey was to provide an assessment of the distribution, abundance and population structure of wild brown trout throughout the Meon catchment, which would indicate whether or not the fishery was in a healthy, self-sustaining condition and would also indicate also major problems with habitat, water quality and fish passage, should any exist.

The map below shows the location of each survey site, while the markers are sized according to the abundance of brown trout caught:

Map Meon 1: Density of wild brown trout at each survey site (number/100m2)

Figure Meon 1 shows the density (number per 100m^2) of wild brown trout caught at each survey site, in order from north (left) to south (right). Note that the mean is 8.1 trout per 100m^2.

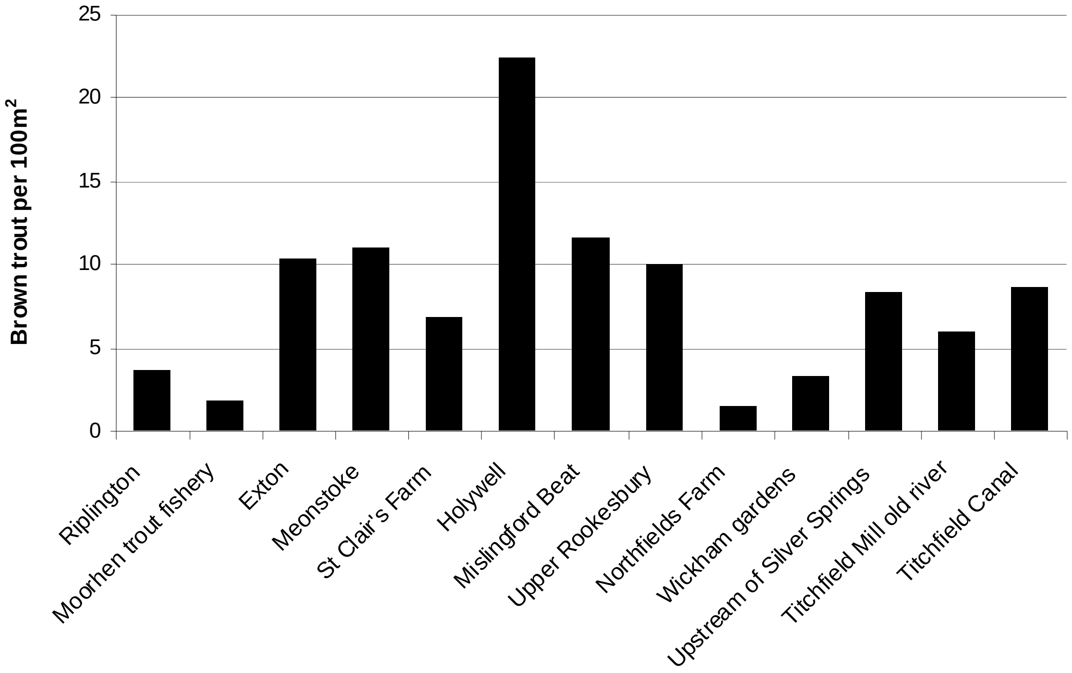


Figure Meon 1: Brown trout density from upstream to downstream

Figure Meon 2 is a length frequency histogram showing the number of brown trout in each size range. The figure includes all brown trout caught at every Meon site surveyed in 2011.

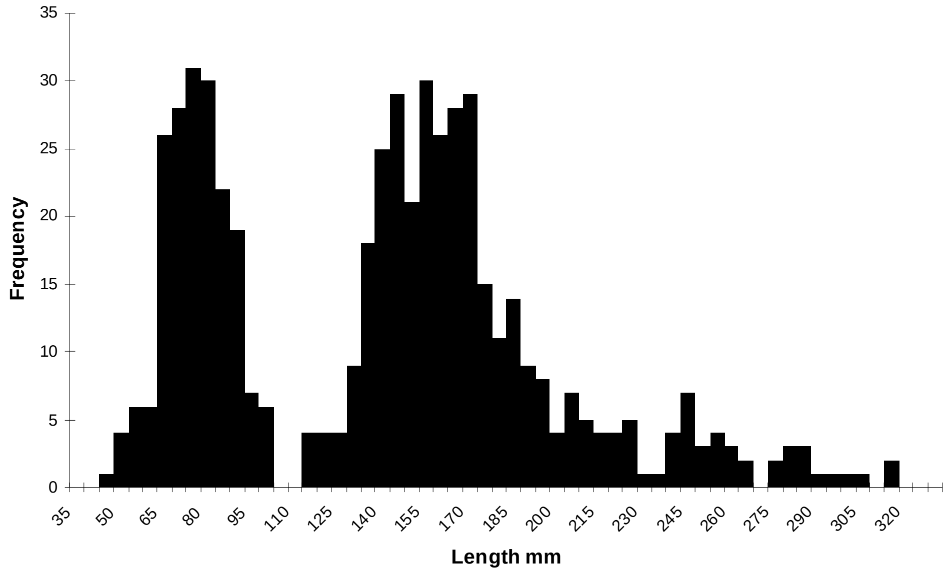


Figure Meon 2: brown trout length frequency distribution, 2011

Figure Meon 3 shows the total number of trout caught at each site, in upstream to downstream order, with the columns shaded to indicate the relative proportions of 0+ (young of the year), 1+ (fish in their second year) and older brown trout - these classes were identified by plotting individual length frequency histograms for each site and identifying the break points between age classes

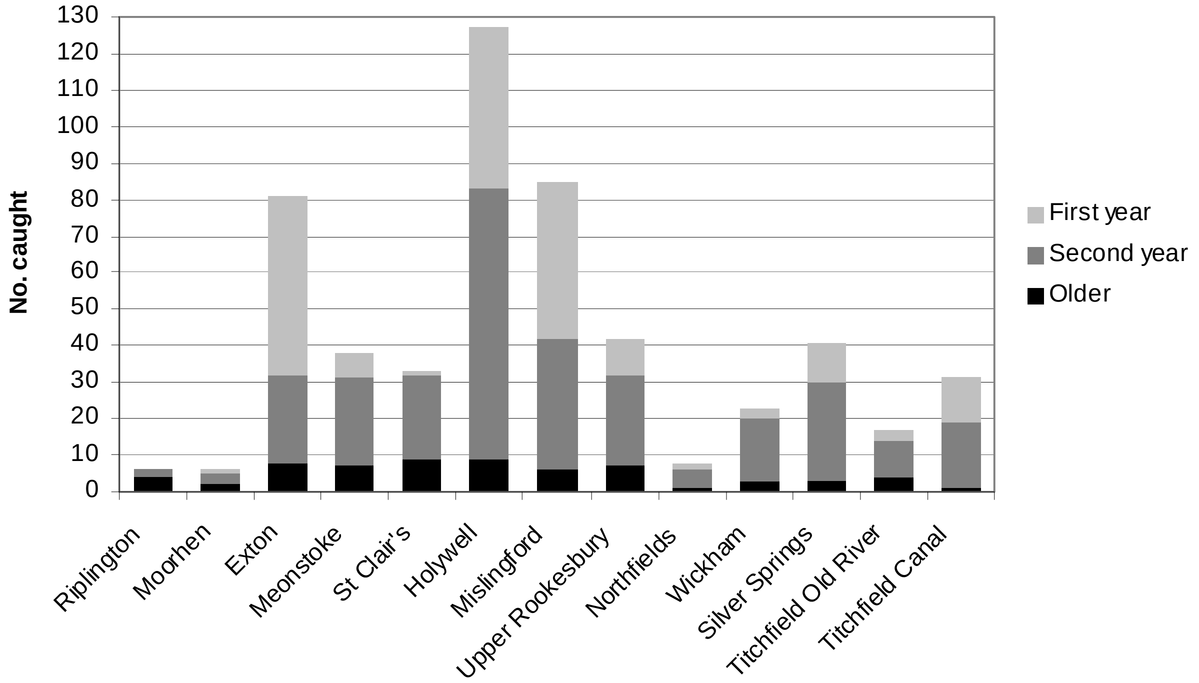


Figure Meon 3: approximate brown trout ages at each site

Figures Meon 4 and Meon 5 show the abundance and diversity of the fish community (including minor species) at our routine, temporal survey sites on the Meon, Mislingford and Silver Springs, from 2007-2011:

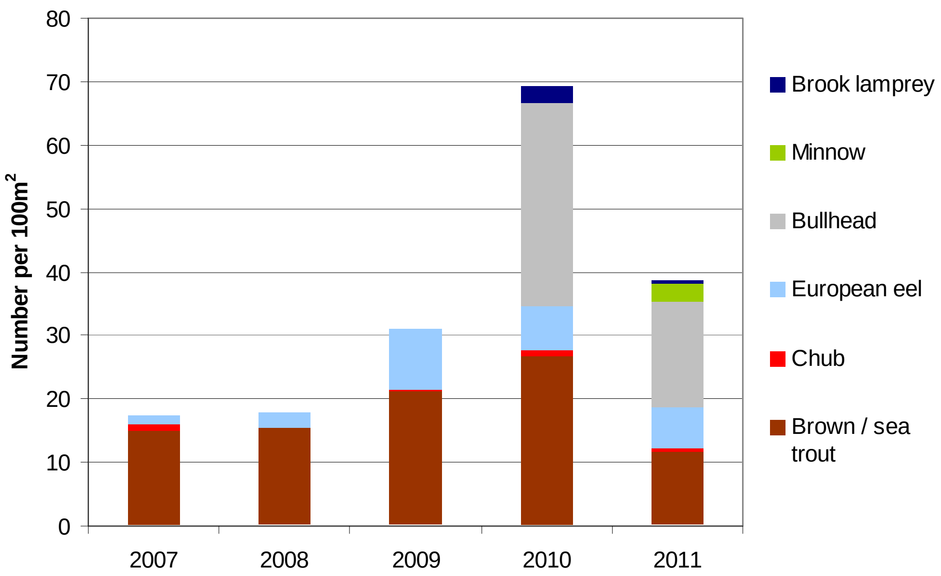


Figure Meon 4: Mislingford fish community, 2007-2011

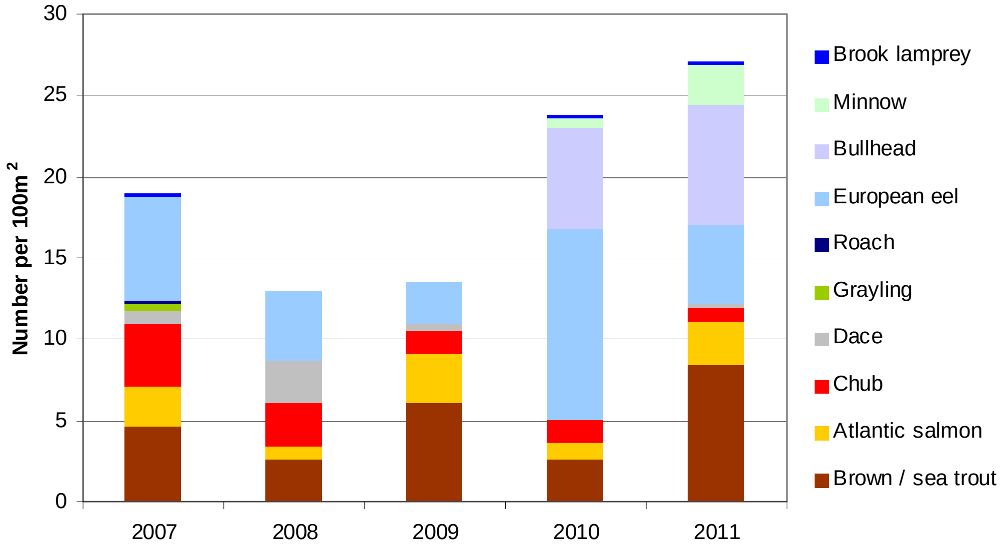


Figure Meon 5: Silver Springs fish community, 2007-2011

Table Meon 1 sets out the correlation values that describe the relationship between brown trout abundance and mean length at Mislingford and various environmental variables. Data from Silver Springs is not used because relatively few juvenile brown trout are typically caught there, which would reduce the quality of the correlation analysis. As such, Mislingford is a better representation of a productive, brown trout dominated reach located in the typical "trout zone".

Note that these values have not been tested for statistical significance and are provided as a general indication of which variables are most likely to be correlated, as well as the strength and direction (positive or negative) of any apparent correlation.

Table Meon 1: Brown trout and environmental variables at Mislingford

Mislingford	0+ dens	0+ mean length	1+ dens	1+ mean length
Degree days >12°c	0.58	-0.80	0.18	-0.87
Degree days Jan-Mar	-0.90	0.66	-0.16	0.60
Mean flow Apr-Sept	0.17	0.59	-0.02	0.90
Mean flow preceding Oct-Dec	-0.09	0.51	0.99	0.17
Mean flow Jan-Mar	0.52	0.49	0.31	0.51
0+ density		-0.44		
1+ density				0.10

On the following pages are several figures that clarify some of the most notable correlations suggested in the table above. Data from Silver Springs is included in these charts for comparison with Mislingford.

Figure Meon 6 shows the relationship between the density of 0+ trout and the number of degree days in the incubation period, January to March (calculated from the Central England Temperature Hadley record):

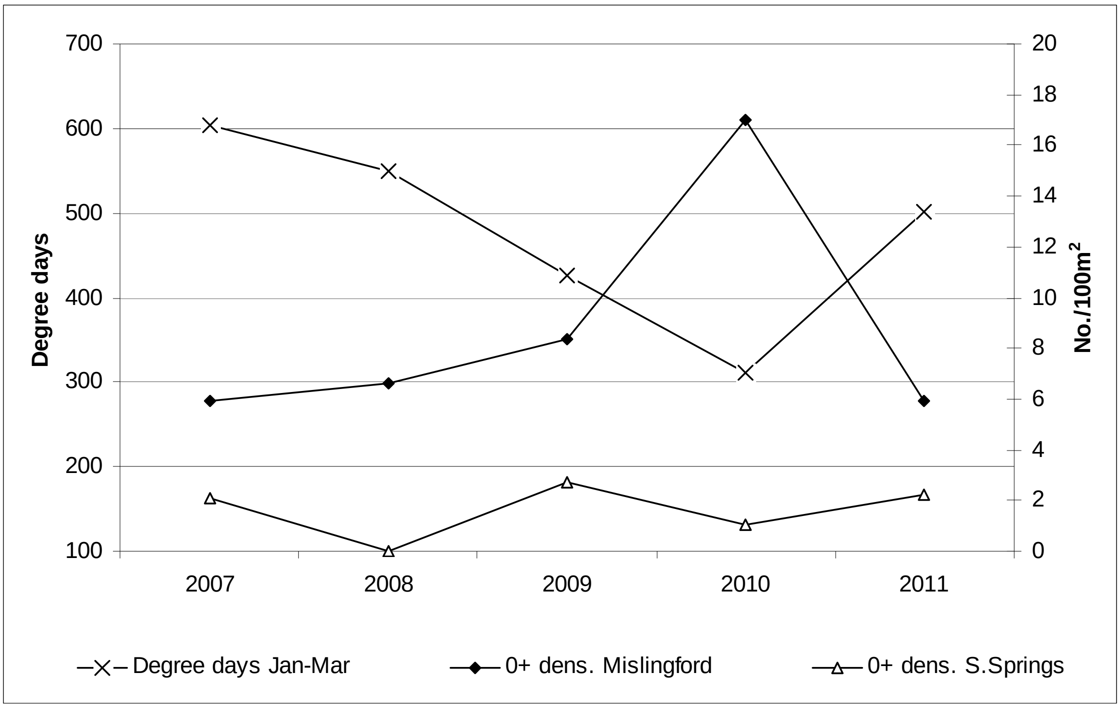


Figure Meon 6: 0+ brown trout density and degree days in Jan-Mar

Figure Meon 7 shows the relationship between the density of 0+ brown trout and mean flow at Mislingford gauging station in the egg incubation period, January to March:

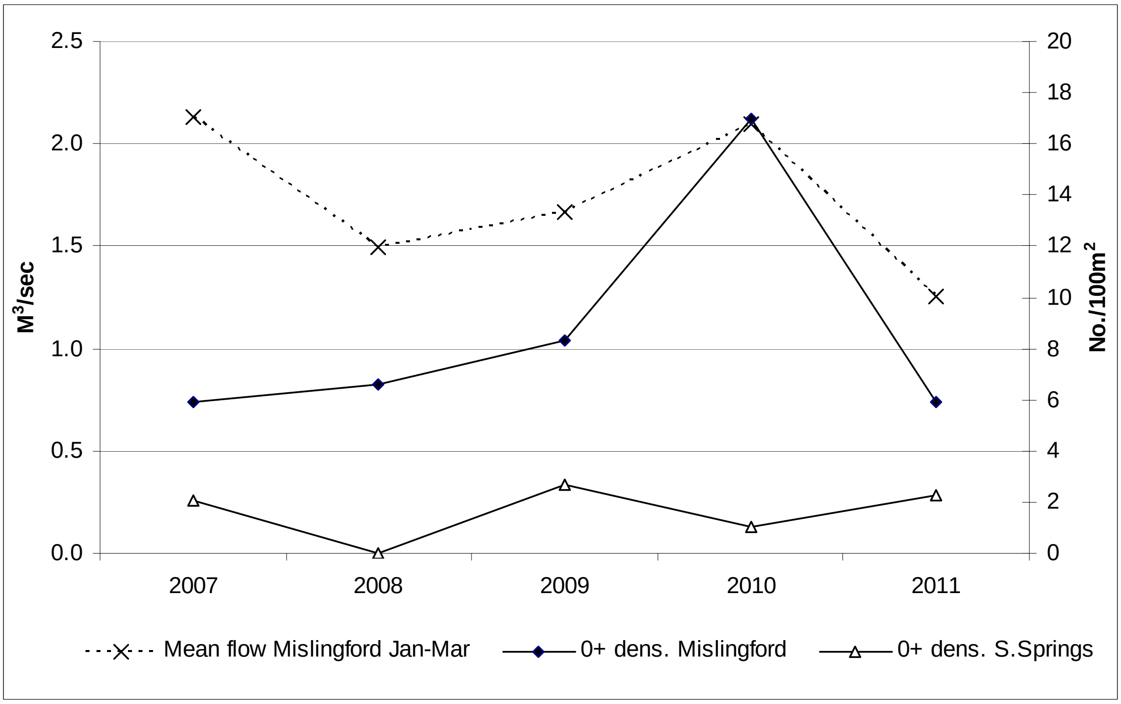


Figure Meon 7: 0+ brown trout density and flow in Jan-Mar

Figure Meon 8 shows the relationship between the density of 1+ brown trout and mean flow at Mislingford gauging station in the period October to December the previous year:

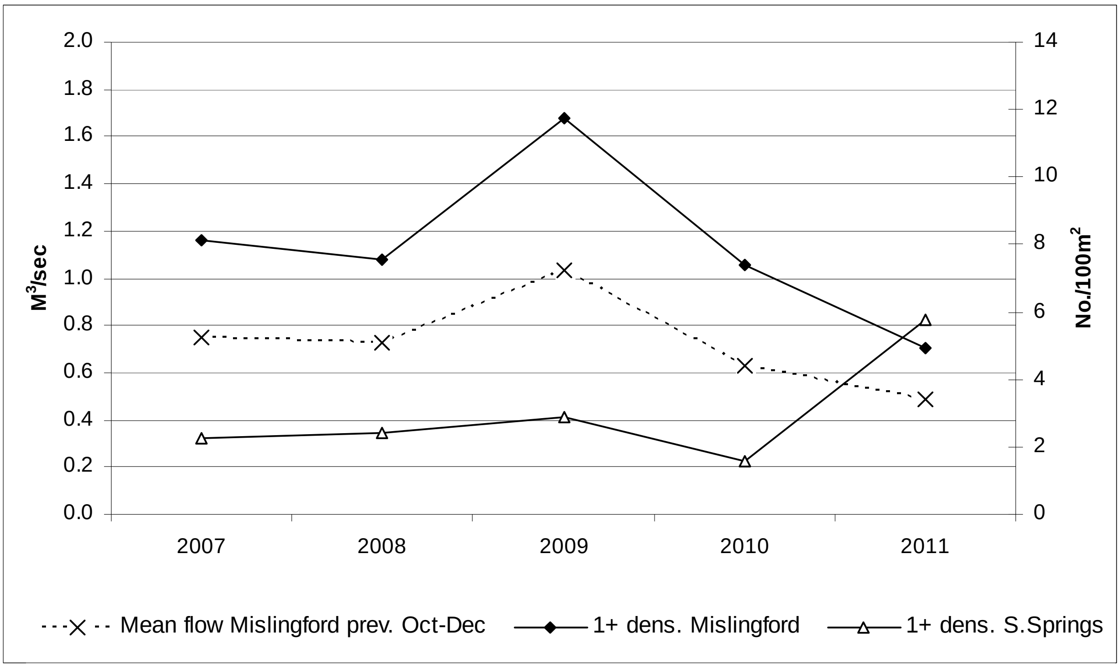


Figure Meon 8: 1+ brown trout density and flow in the previous Oct-Dec

Figure Meon 9 shows the relationship between mean 1+ brown trout length and mean flow at Mislingford gauging station in the April to September period:

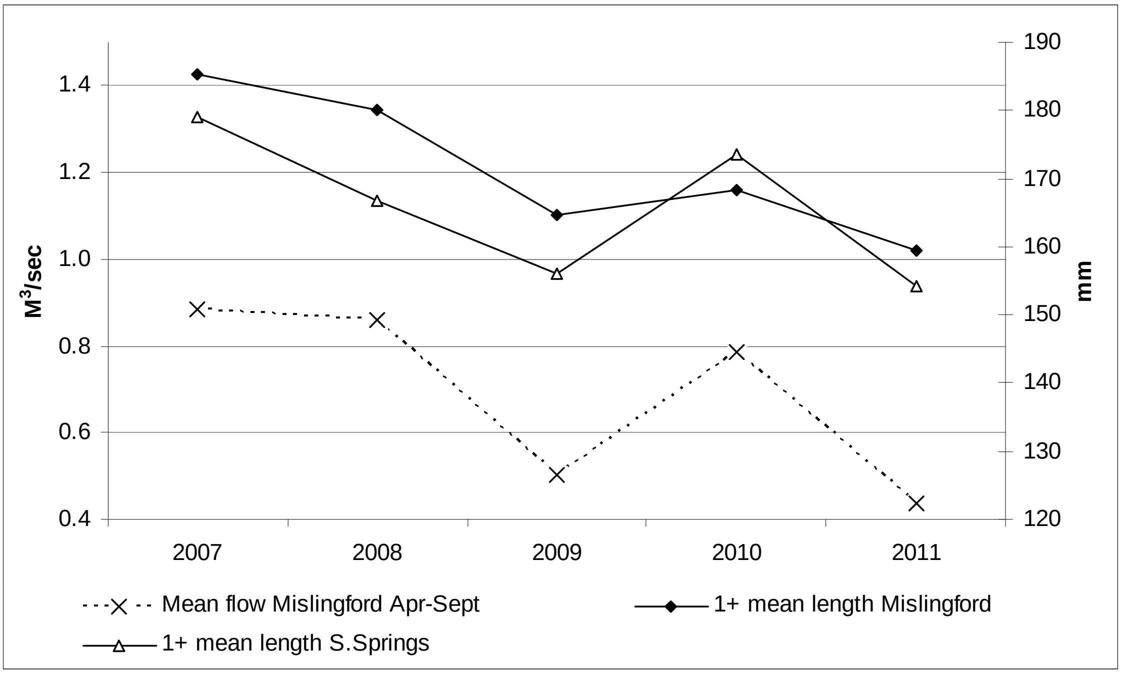


Figure Meon 9: Mean 1+ brown trout length and flow in Apr-Sept

Meon wild brown trout discussion:

Figure Meon 1 provides a clear overview of the pattern of distribution of brown trout in the river. The mean number of trout per 100m^2 is 8.1. The highest density recorded was at Holywell (22.5), which is comparable to the densities often recorded other productive chalkstream reaches in the headwaters of the Test and Itchen. Holywell is the section of the Meon that experiences peak flow, meaning that under dry conditions, flow does not increase between Holywell and the sea - this is the reason that Soberton waterworks is situated on the river at this point. Flow and excellent riparian management are probably the two principal reasons that this reach supports the highest abundance of brown trout.

The lowest densities were at Northfields farm, Moorhen trout fishery and Riplington. However, there are sound reasons for this: Moorhen and Riplington lie in the upstream reaches that are vulnerable to drying out in low flow summers and both sites were experiencing relatively low flows at the time of the surveys. The Northfields Farm site receives reduced flow because it is adjacent to an on-line lake (Chiphall trout fishery) but this alone probably doesn't account for the very low density of trout recorded here. The site is relatively heavily shaded and at the time of the survey, submerged weed was completely absent, resulting in very little cover available for trout.

Figure Meon 2 illustrates that the overall brown trout population consists predominantly of 0+ (young of the year) and 1+ (fish in their second year), with progressively fewer older year classes. This pattern reflects the fact that the Meon typically produces high numbers of juveniles annually and also includes a high proportion of migratory trout (sea trout) in its breeding stock. Sea trout use the nutrition they accumulate in the marine environment to grow large and produce far higher numbers of eggs than smaller, non-migratory trout would. This increased egg deposition results in the abundant juvenile year classes apparent in the length frequency chart, but also in the low numbers of adults, because these are generally present in the sea or in the deeper parts of the lower river reaches at the time of the surveys.

Figure Meon 3 shows the proportions of 0+, 1+ and older trout caught at each survey site. The varying proportions reflect the type of habitat found at each site, as the three classes depend on quite different combinations of water velocity, depth and bed substrate. In general, the chart suggests that habitat is diverse at the majority of sites, because all three classes of trout are present. Just as importantly, the figure confirms that brown trout spawning and recruitment occurs throughout the length of the river - a surprising result illustrating this is the density of 0+ trout in the Titchfield canal, which is an artificial (but historic) channel, not far upstream from the tidal limit.

Figure Meon 4 indicates that after a gradual increase in trout density at Mislingford since 2007, the 2011 density was lower than any previous year. Figure Meon 5 shows that this is in contrast to Silver Springs, which produced the highest density recorded since 2007. However, the number of trout recorded at Silver Springs is always far lower than at Mislingford and variation in the density between years is likely to be more random.

Table Meon 1 and the figures that follow it explore the influences of varying flow and temperature on juvenile trout abundance and length at Mislingford, both of which are directly related to the production of adult trout of catchable size for the fishery. The factor that appears to most influence the abundance of 0+ trout in each year is the number of degree days in the incubation period, January to March, which is a negative relationship. The data suggest that the higher the temperature during the incubation period, the fewer young of the year trout are present at the end of their first summer. The most likely explanation for is that warm incubation periods lead to earlier hatching, at a time when less food is available, and that this results in higher mortality of the juvenile trout, probably as a result of starvation. However, this observation would require a great deal more investigation to confirm.

Density of 0+ trout also seems to be positively correlated with the number of degree days above 12°c. 0+ trout occupy slow velocity marginal areas where they feed predominantly on zooplankton. Warmer summers may increase food supply and survival, leading to higher densities when the surveys are conducted towards the end of summer. There is only a weak positive correlation with flow between April and September, which emphasises this effect. However, there is a negative correlation between the number of degree days above 12°c and average 0+ trout length, which suggest that although survival may be better in warmer summers, growth may not be. This is likely to be associated with increased competition between juveniles, which may reduce growth when density is high and space is limited. Table Meon 1 provides evidence for this explanation by showing that 0+ trout density is negatively correlated with 0+ mean length.

0+ trout density at Mislingford is also positively correlated with the mean flow between January and March, which suggests that higher flows in the incubation period do not induce higher egg mortality by increasing suspended solid levels, which has been suggested as a cause of salmon egg mortality on the river Test. Instead, higher flows appear to increase egg survival.

Abundance of 1+ brown trout shows a remarkably strong positive correlation with mean flow in the previous October to December period, as illustrated in figure Meon 8. There is no obvious explanation for this but it does suggest that the autumn and early winter period is a critical time for the survival of 1+ trout at this site and that low flows late in the year may reduce the abundance of trout likely to reach catchable size.

The difference in the graph for Silver Springs indicates that low flow in autumn might affect 1+ fish differently at this site - note that 1+ density in 2011 was at its lowest since 2007 at Mislingford but was at its highest at Silver Springs. Again, it is unknown why this apparent difference should occur but it is likely to be to do with the contrasting physical habitat at the sites (Silver Springs is heavily wooded) and their respective distances upstream from the river mouth.

The mean length of 1+ trout appears to be closely linked to flow in the summer period, April to September, with higher flows resulting in larger fish, on average. There is also a positive correlation with flow in January to March. Figure Meon 9 indicates that the same trend exists at Silver Springs and emphasises that low flow summers are likely to affect the fishery by reducing the average size of catchable fish.

Similarly to 0+ trout, the mean length of the 1+ year class is also negatively correlated with the number of degree days above 12°c but, with the 1+ class, competition does not appear to restrict growth because, unlike the 0+ class, there is no apparent link between 1+ density and mean length. This suggests that the growth of 1+ trout at Mislingford may be most directly restricted by elevated summer temperatures.

In conclusion, prevailing flow and temperature conditions appear to be highly influential over the abundance and growth of juvenile brown trout in the river Meon. However, the situation is complex because 0+ and 1+ trout respond differently to certain variables and the effects on both are likely to vary between different parts of the river. This preliminary analysis highlights that if such interactions are to be better understood, additional data years and more precise multivariate analysis are required.

Coarse fish and eels

Figure Meon 9, below, shows the density of eels recorded at each Meon survey site, from upstream to downstream:

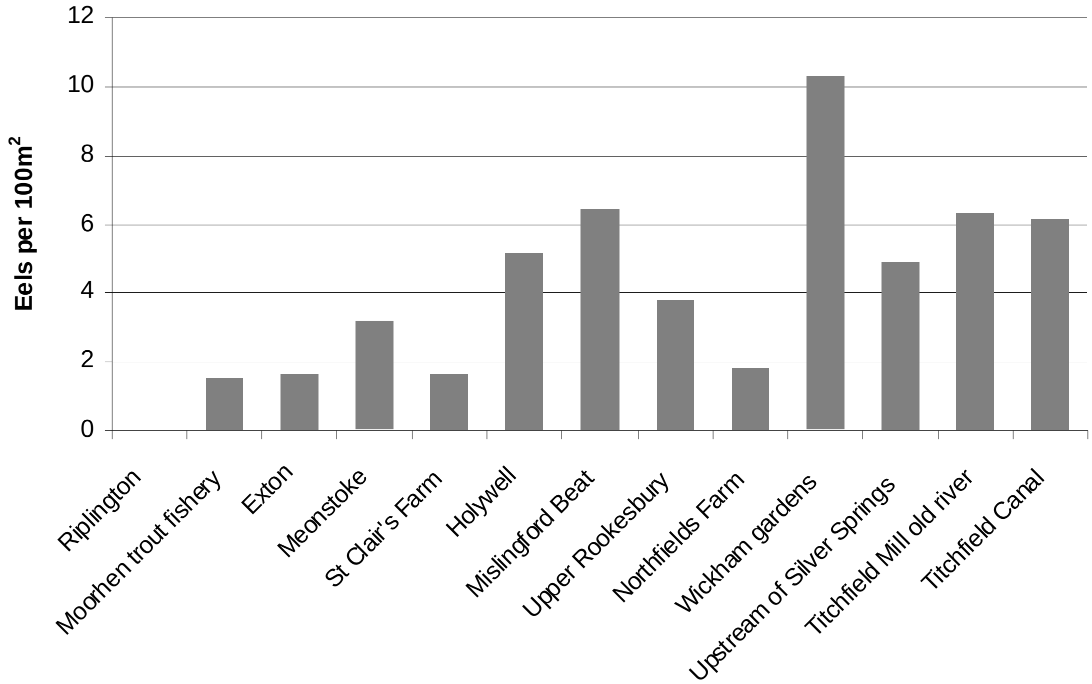


Figure Meon 9: Eel density from upstream to downstream

Figure Meon 10, below, shows the relative abundance of fish species other than brown trout and eels caught at each site. Note that where a colour indicated in the key cannot be seen in the chart, only a very low number of that particular species were caught (for example, mirror carp, one of which was caught at Wickham Gardens). However, the figure is useful in providing a complete list of fish species recorded.

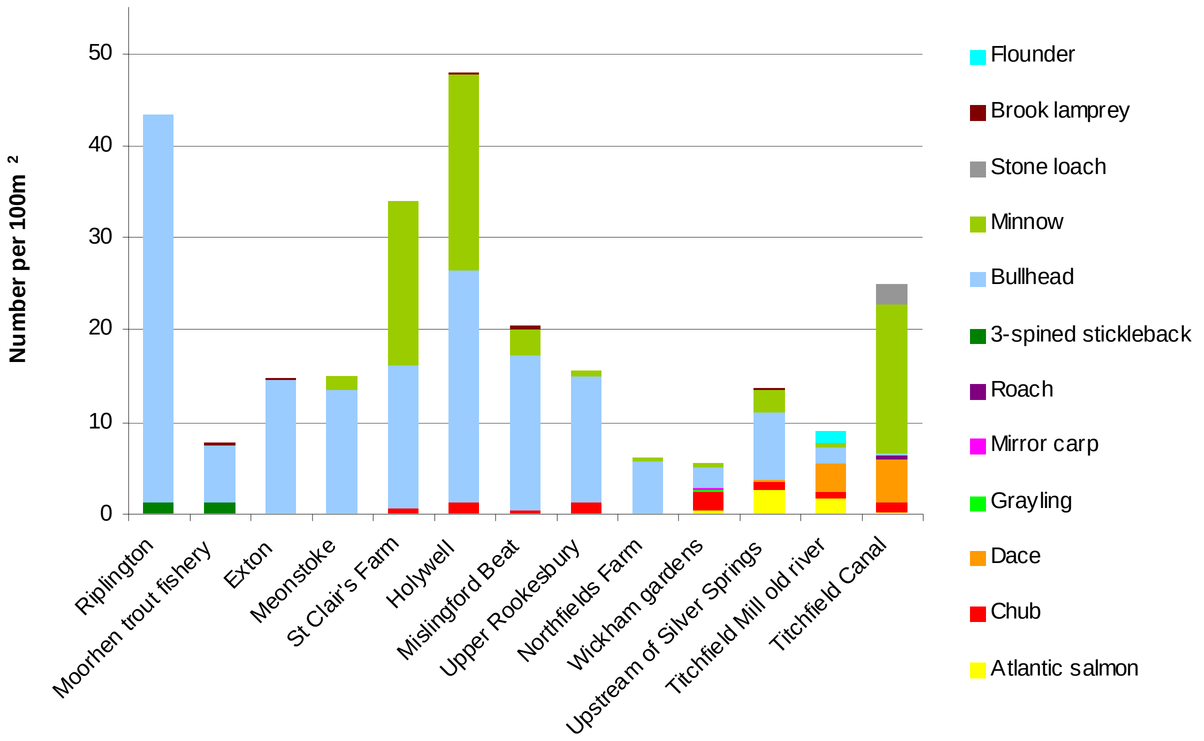


Figure hart Meon 10: Other fish species at Meon sites, 2011

Figure Meon 11 is the length frequency histogram for all chub caught on the Meon in 2011:

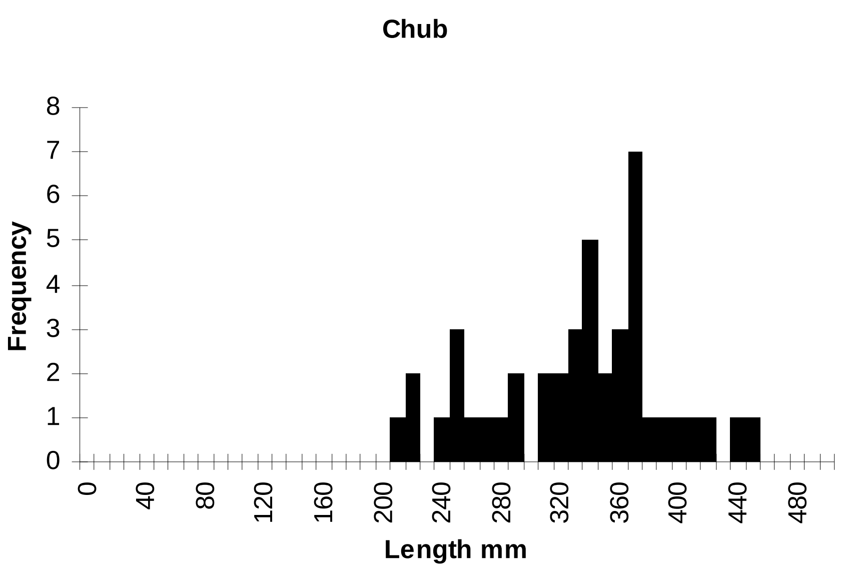


Figure Meon 11: Chub length frequency distribution, 2011 (n=43, mean =327mm)

Meon coarse fish and eels discussion

Figure Meon 9 illustrates that eels are relatively abundant and widely distributed on the Meon. In fact, eel density at Wickham Gardens was similar to that recorded at the sites of highest eel density on the Itchen in 2011. The general pattern of decreasing abundance with increasing distance from the tidal limit is typical of a river with good habitat and few significant obstructions to upstream eel migration. However, eels are dependent on diverse habitat, especially submerged cover, which is likely to be the reason for the lower densities recorded at Northfields Farm (heavily shaded with no submerged weed) and St. Clair's Farm (very little submerged or overhead cover and susceptible to bank erosion by livestock).

Figure Meon 10 indicates some interesting points regarding the Meon's community of coarse and minor fish species. Bullhead and minnow densities are high closest to the region of peak flow in the middle reaches, with another very high bullhead density in the headwaters at Riplington. Chub were recorded as far upstream as St. Clair's Farm but were not numerous at any site.

Figure Meon 11 demonstrates that no juvenile chub were caught - the smallest, at over 200mm in length, were likely to be between 2 and 4 years old, while chub of the average length, 327mm, are likely to be between 8 and 12 years old. The longest chub caught was 450mm and was probably in the region of 12 to 14 years old. This length frequency distribution suggests that conditions suitable for effective chub spawning and recruitment only occur rarely. Many of the fish caught in 2011 may have been produced during the generally warm and dry period between 2003 and 2006 and the lack of younger year classes may be attributable to the succession of cool summers since 2007. At all sites where chub occurred, they were restricted to one or two deep, slow pools.

Survey in progress at Exton on the Meon

3.3 Hamble

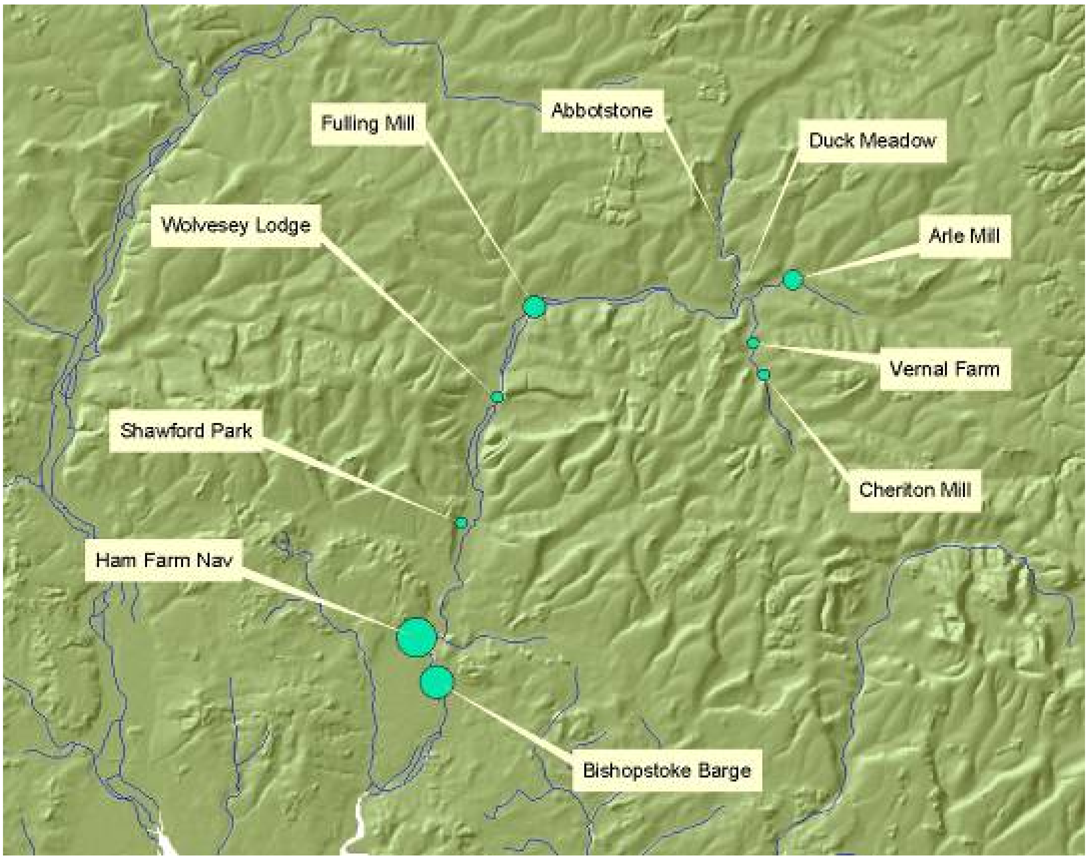
The two Principal Coarse Fishery survey sites on the Hamble have now changed to a triennial programme and will be surveyed in 2012. No fish survey work was conducted in the catchment in 2011.

3.4 Itchen

In 2011 we surveyed at the Itchen's ten biennial eel index sites, which include the two principal brown trout fishery temporal sites (Abbotstone & Vernal Farm) and the two principal salmon fishery temporal sites (Shawford & Bishopstoke).

Eel index

Map Itchen 1 shows the locations of the eel index survey sites, with the markers sized according to the density of eels recorded:



Map Itchen 1: eel index sites

Figure Itchen 1, below, shows the estimated densities of eels recorded at each site in 2011, compared with 2009, which was the first round of eel index sampling.

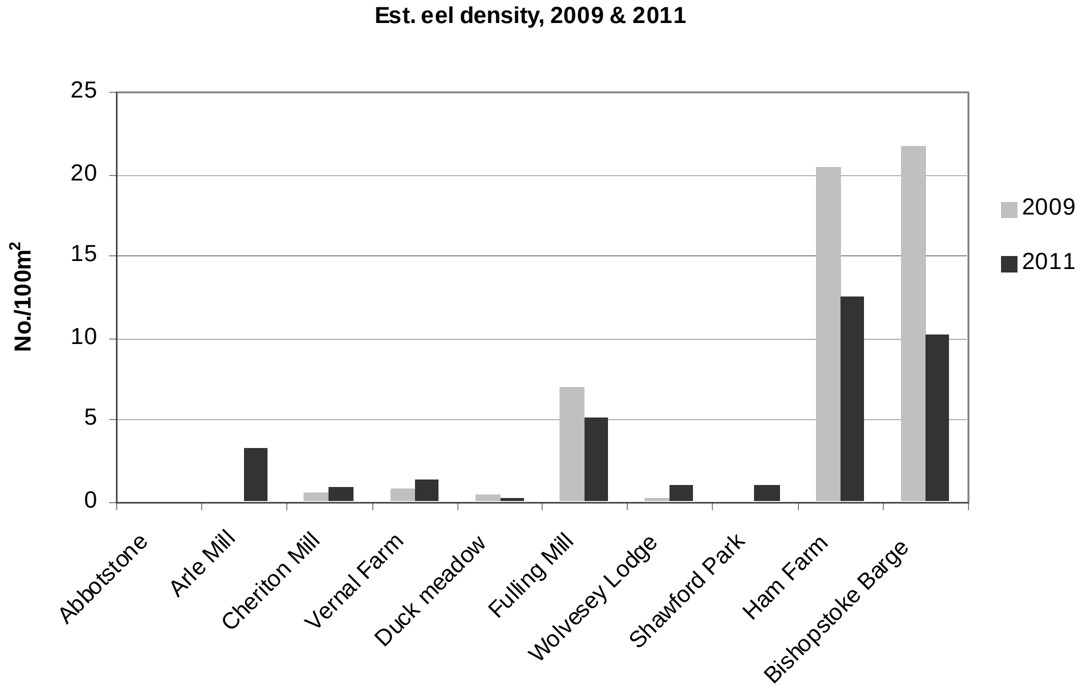


Figure Itchen 1: Estimated eel density, 2009 & 2011

Figures Itchen 2 and 3 show the eel length frequency distribution for 2009 and 2011, respectively:

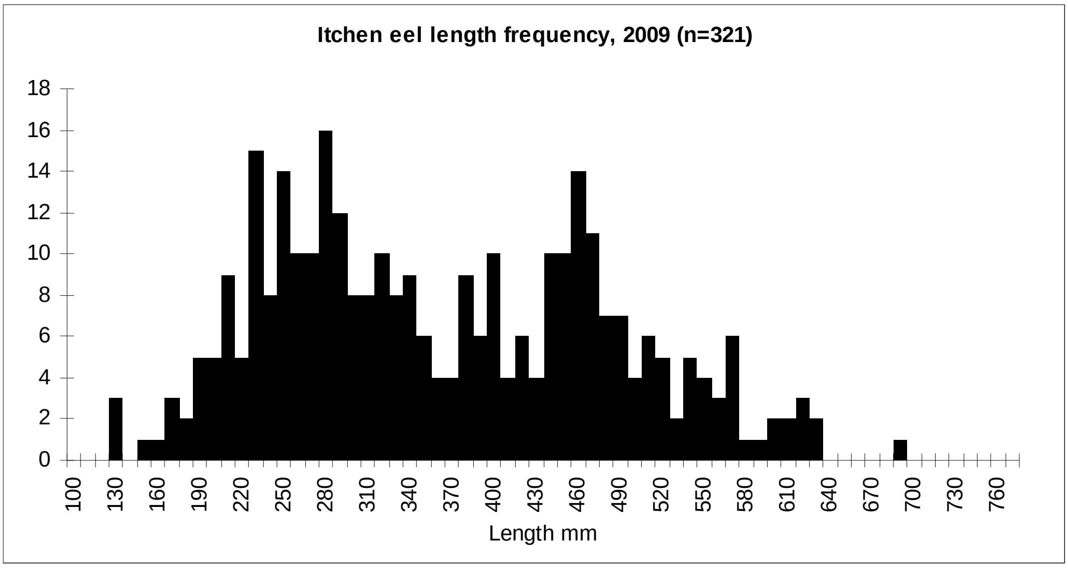


Figure Itchen 2: eel length frequency, Itchen 2009

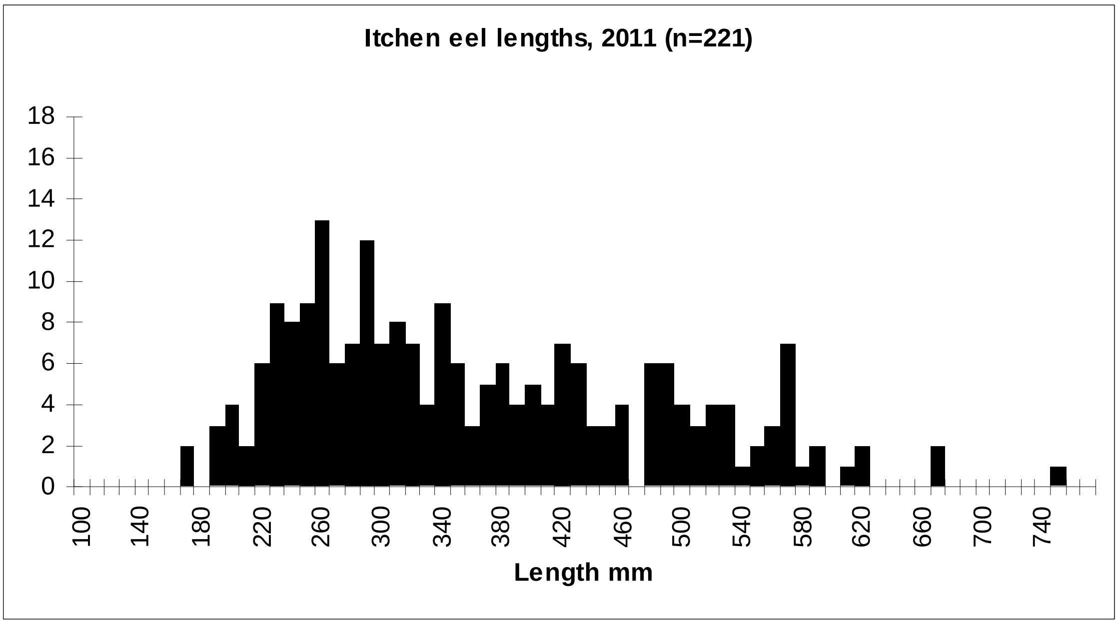


Figure Itchen 3: eel length frequency, Itchen 2011

Itchen eel discussion

The most significant result shown by figure Itchen 1 is that at the two sites where eel density is typically highest, Bishopstoke Barge and Ham Farm, density in 2011 was almost half what it was in 2009. Eel abundance at Fulling Mill remained high compared to other sites, but this too was lower than in 2009. The slight increases in eel abundance at several of the remaining sites represents differences of only a few eels and may be insignificant.

The length frequencies shown in figure Itchen 2 and 3 suggest that numbers of eels of all sizes were fewer in 2001 but that larger eels, of around 430-500mm, had reduced in abundance most.

Our eel data is used primarily to contribute to a national eel monitoring dataset reported to the European Union in order to detect trends on a European scale. Little is understood about eel population dynamics in general and it is unclear whether or not fluctuations in abundance of yellow eels in rivers actually signify changes to the size of the overall population. In addition, there is currently no knowledge of the effects of natural temperature and flow variation on local eel survey results.

Therefore, the only firm conclusion we can draw regarding the difference between catches in 2009 and 2011 is that we must progress with eel conservation measures already in place, such as fishery regulation and construction of eel passes, and to continue top collect and analyse data from our biennial eel index survey programme.

Itchen salmon temporal

Figure Itchen 4 shows the estimated density of fish species caught at the two temporal salmon surveys sites in 2011:

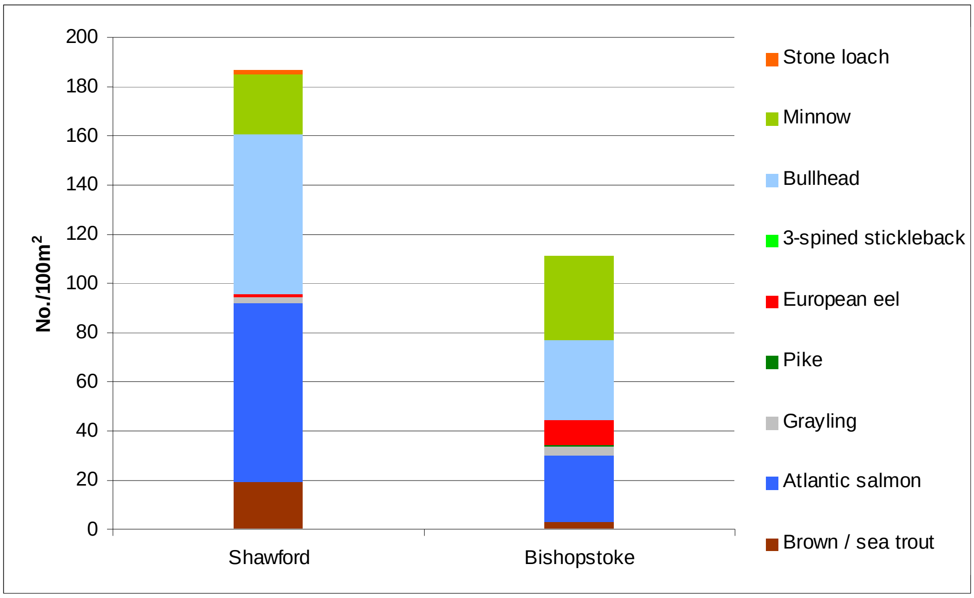


Figure Itchen 4: Estimated density by species at Itchen salmon temporal sites, 2011

Figure Itchen 5 shows the total density of salmon recorded in the first run at both sites in all years that they have been surveyed.

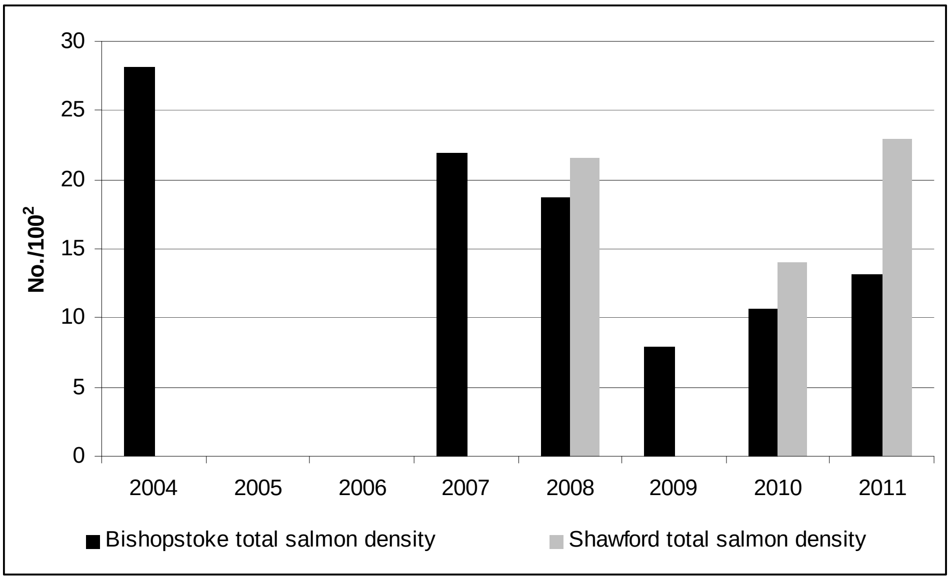


Figure Itchen 5: Total salmon density at Bishopstoke Barge and Shawford

Table Itchen 1 sets out the correlation values describing the relationships between juvenile salmon and various environmental variables at Bishopstoke Barge survey site. Data form the Shawford site has not been included in this analysis because it has only been routinely surveyed for the past two years. Note that these values have not been tested for statistical significance and are provided as a general indication of which variables are most likely to be correlated, as well as the strength and direction (positive or negative) of any apparent correlation.

Table Itchen 1: relationships between juvenile salmon density and length at Bishopstoke Barge with temperature and flow variables

Bishopstoke Barge only	0+ dens	Mean 0+ length	1+ dens	Mean 1+ length
Mean flow prev. Oct-Dec	-0.75	-	0.16	-0.53
Mean flow Jan-Mar	-0.14	-0.41	0.42	-0.45
Mean flow Apr-Sept	0.05	-0.01	0.40	-0.09
Mean flow Jun-Aug	0.19	0.05	0.59	-0.09
Degree days >18°c	0.23	0.64	-0.70	0.64
Degree days <0°c	-0.42	-0.31	-0.38	-0.10
Degree days Jan-Mar only	0.55	0.09	0.68	-0.08
Mean prev. winter temp	0.50	-	0.04	-0.24
Spawning escapement (no. adults)	-0.60	-	-	-
0+ density	-	0.58	-	-
1+ density	-	-	-	-0.71

The following charts illustrate some of the correlations suggested by the values in Table Itchen 1. Figure Itchen 6 shows the apparent negative association between the density of 0+ salmon caught at Bishopstoke Barge in late summer and the mean flow at Allbrook / Brambridge gauging station in the previous October to December period.

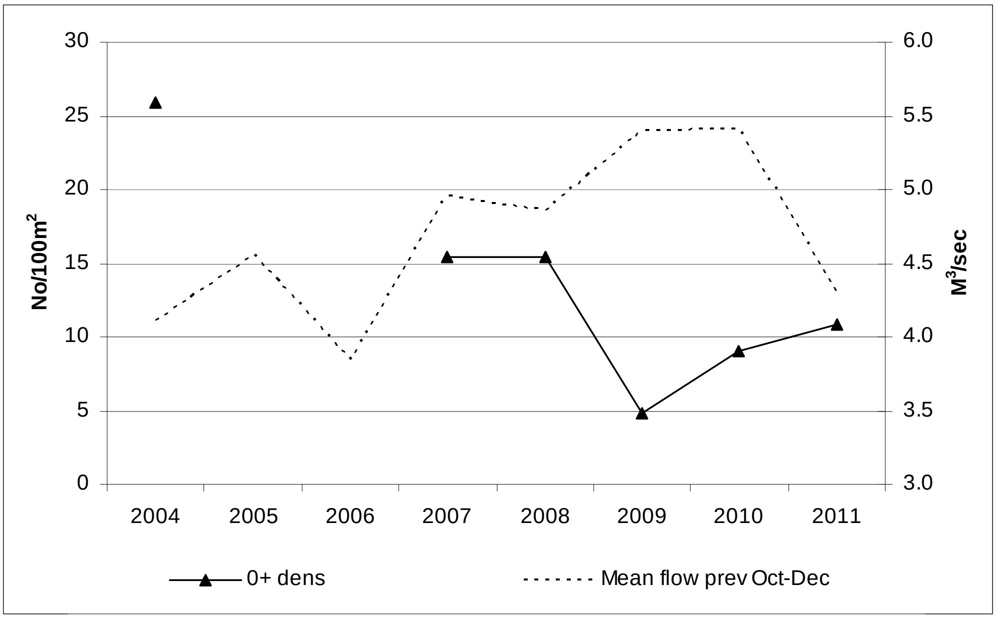


Figure Itchen 6: Density of 0+ salmon at Bishopstoke Barge and mean flow October-December

Figure Itchen 7 compares 0+ and 1+ salmon density at Bishopstoke with the number of degree days above 18°c:

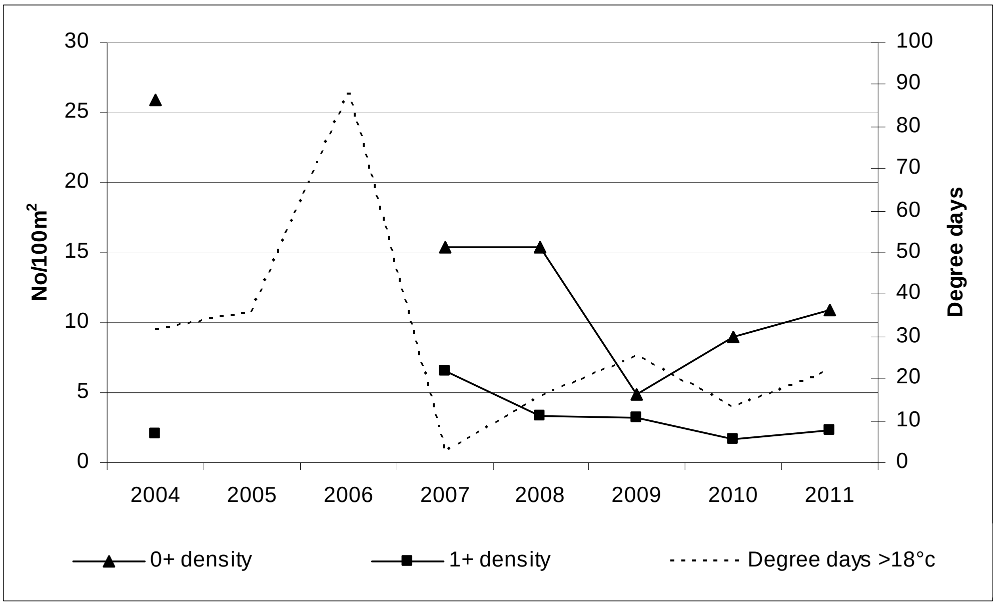


Figure Itchen 7: 0+ and 1+ salmon density compared to number of degree days above 18°c.

Figure Itchen 8 compares the graphs for the density of 0+ salmon at Bishopstoke Barge with the number of adult salmon counted on the electronic fish counter located at Gater's Mill, close to the Itchen's tidal limit, in the previous year:

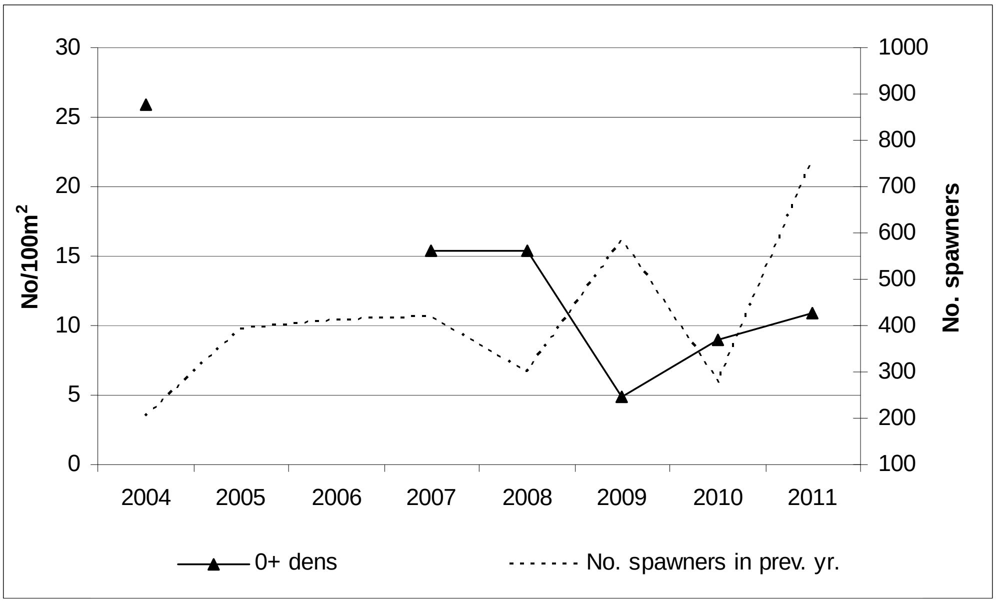


Figure Itchen 8: Density of 0+ salmon at Bishopstoke Barge and number of adult salmon counted in previous year

Figure Itchen 9 shows the relationship between the density of 1+ salmon at Bishopstoke Barge and mean flow in the high summer period June to August.

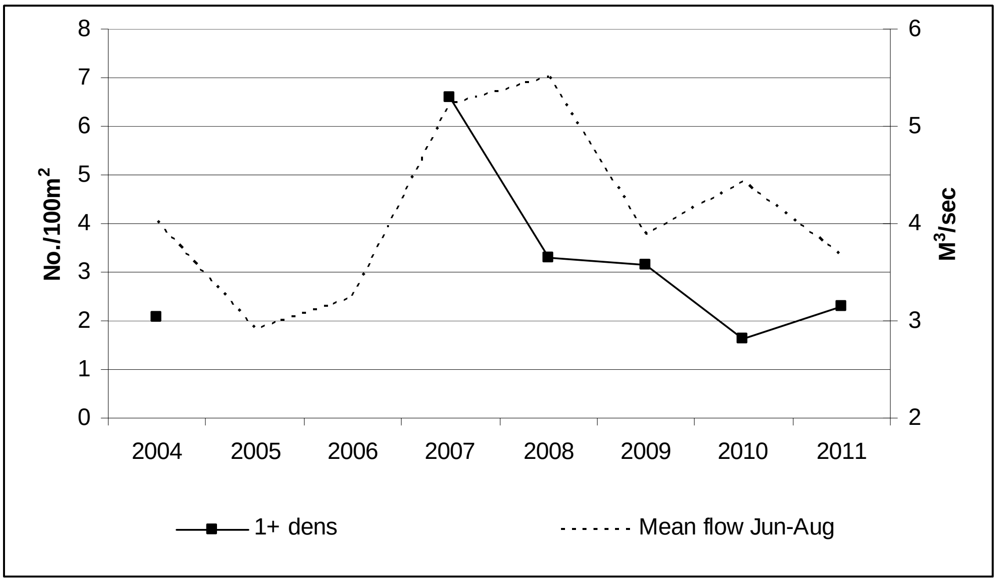


Figure Itchen 9: Density of 1+ salmon at Bishopstoke Barge and mean flow in June - August

Figure Itchen 10 shows the apparent positive correlation between the density of 0+ salmon caught at Bishopstoke Barge with their mean length.

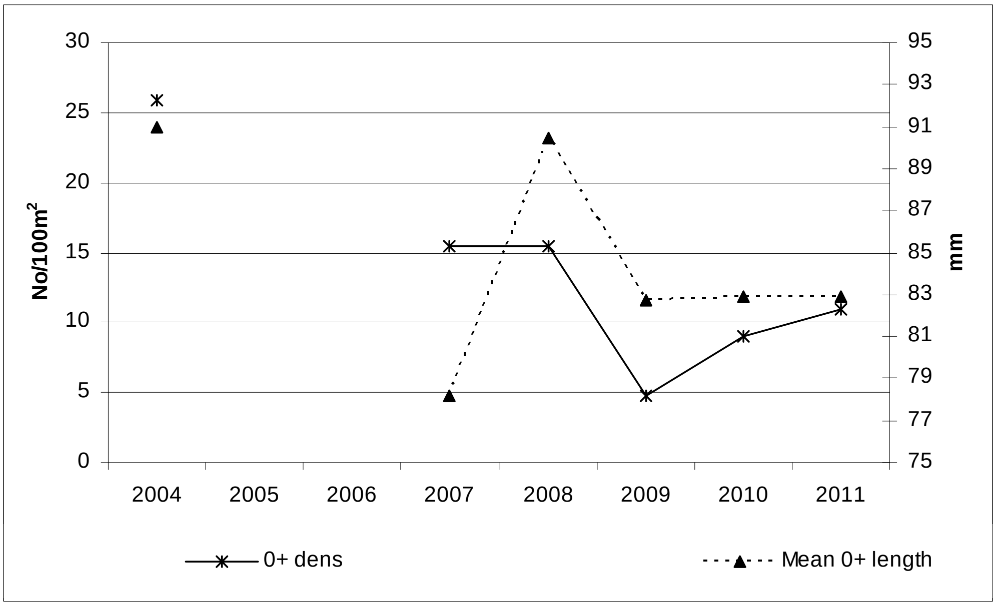


Figure Itchen 10: 0+ salmon density and 0+ salmon mean length at Bishopstoke Barge

Figure Itchen 11 shows the apparent negative correlation between 1+ salmon caught at Bishopstoke Barge and their mean length.

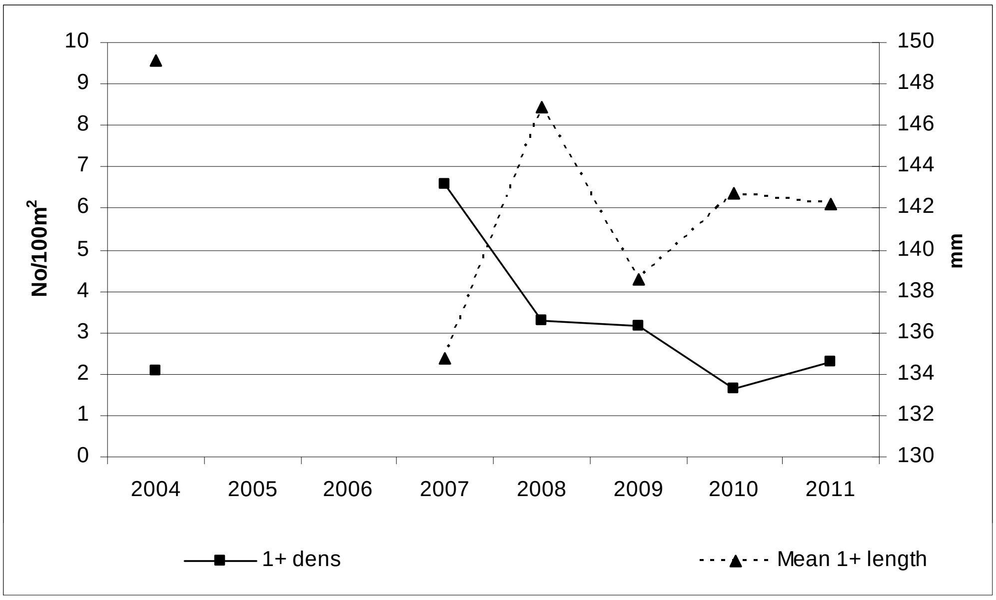


Figure Itchen 11: 1+ salmon density and 1+ salmon mean length at Bishopstoke Barge

Itchen salmon temporal sites discussion

Figure Itchen 4 shows that both the temporal salmon monitoring sites on the Itchen, support high densities of fish, comprising a diverse range of species, with salmon being amongst the most numerous.

Figure Itchen 5 shows that the Bishopstoke Barge site has been surveyed annually for the past five years and was also surveyed in 2004. Shawford Park has been surveyed contiguously for only the past two years and was also surveyed in 2008. For this reason, it is omitted from the time series and correlation analysis. This figure shows that the total salmon density at Shawford in 2011 was higher than either of the two previous surveys, whilst the total salmon density at Bishopstoke in 2011 was roughly average compared to previous surveys.

In general, the correlation values set out in Table Itchen 1 do not identify any single period of flow or temperature that has a particularly strong influence on the density of 0+ or 1+ salmon at Bishopstoke Barge survey site. This suggests that densities are influenced by a complex combination of factors, some of which are likely to be linked to the behaviour and number of adult salmon returning to spawn. Despite the lack of clarity amongst the correlation values, some interesting associations are suggested and these are illustrated in more detail in figures Itchen 6-11.

Figure Itchen 6 shows what appears to be a genuine negative correlation between the density of 0+ salmon recorded and mean flow in the October to December period in the previous year. This figure suggests that the higher the flow in this period, the lower the density of 0+ salmon recorded at the end of the following summer. During this period, these salmon exist as eggs within the returning females migrating upstream to spawn. It has been suggested that in higher flows, a man-made obstruction to salmon passage a short distance upstream of the survey site may be easier to pass and therefore the majority of adults are able to continue farther upstream, limiting spawning activity at Bishopstoke (and vice versa in low flows).

Figure Itchen 7 suggests that warm summers may be associated with lower densities of 1+ salmon. The graph for degree days above 18°c is very similar to that of mean summer temperature but provides a slightly more refined measure of years when salmonids are more likely to be negatively impacted by elevated temperature.

Figure Itchen 8 shows another apparent negative correlation involving 0+ salmon density, this time with the number of adult salmon recorded migrating upstream through the fish counter at Gater's Mill, located on the Lower Itchen fishery at Swaythling. This figure suggests that the more adults enter the river, the lower the density of 0+ salmon recorded in the Bishopstoke Barge survey at the end of the following summer. There is no obvious explanation for this observation, but it has been suggested that high numbers of spawning salmon in the vicinity of Bishopstoke may "overcut" each other's redds and it is possible that this behaviour may reduce eggs survival, leading to reduced 0+ density in late summer.

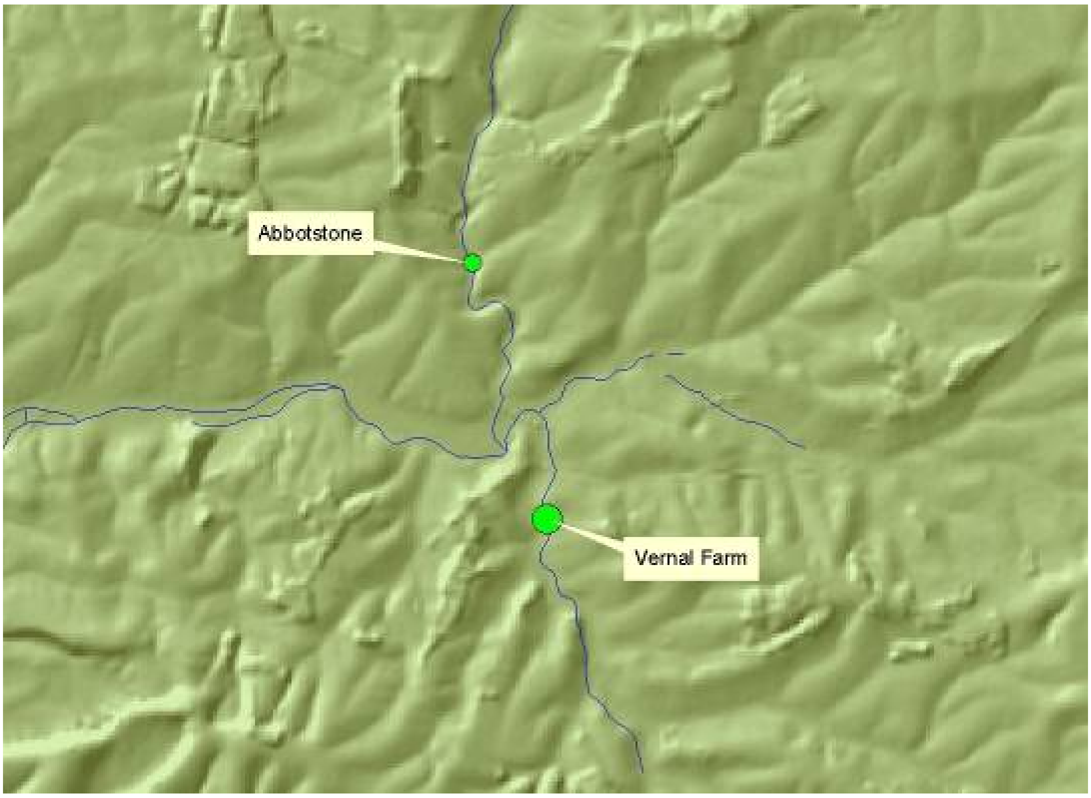
The next figure, Itchen 9, illustrates the suggested positive correlation between 1+ salmon density and flow in high summer, June -August. Because of high mortality amongst juvenile salmon, far fewer 1+ salmon are caught than 0+ and this means that correlations suggested for 1+ salmon are likely to be less clear and more random, as seems to be the case in this graph.

Figures Itchen 10 and 11 aim to explore whether or not the abundance of 0+ and 1+ salmon, respectively, affects their mean length - such a relationship might suggest that growth is "density dependent"; that is, having to compete with other salmon might restrict growth. The graphs for 0+ salmon (and the correlation value) indicate that there is a positive relationship between density and mean length, suggesting that high density does not lead to reduced growth amongst the young of the year. The graph for 1+ salmon indicates the opposite, so it may be the case that competition amongst 1+ salmon is sufficient to restrict their growth when density is high enough. These contrasting observations probably reflect the increasing tendency with age towards establishing and defending larger territories.

Upper Itchen brown trout temporal

The Itchen headwaters comprise three streams; the Candover, the Arle and the Tichborne or Cheriton stream. Together, these are classed as a Principal Brown Trout fishery and were the country's first Wild Trout Protection Zone, designated under the EA's Trout and Grayling Strategy. For details of the 6 yearly spatial surveys of this fishery, please see the 2009 annual fish monitoring report.

In 2011, the temporal sites at Abbotstone on the Candover Brook and Vernal Farm on the Cheriton stream were surveyed. Map Upper Itchen 1 shows the locations of these sites, with the markers sized to indicate the relative densities of brown trout recorded:



Map Upper Itchen 1: Site locations and relative brown trout density

Figure Upper Itchen 1 shows the estimated densities of fish species at Abbotstone and Vernal Farm in 2011:

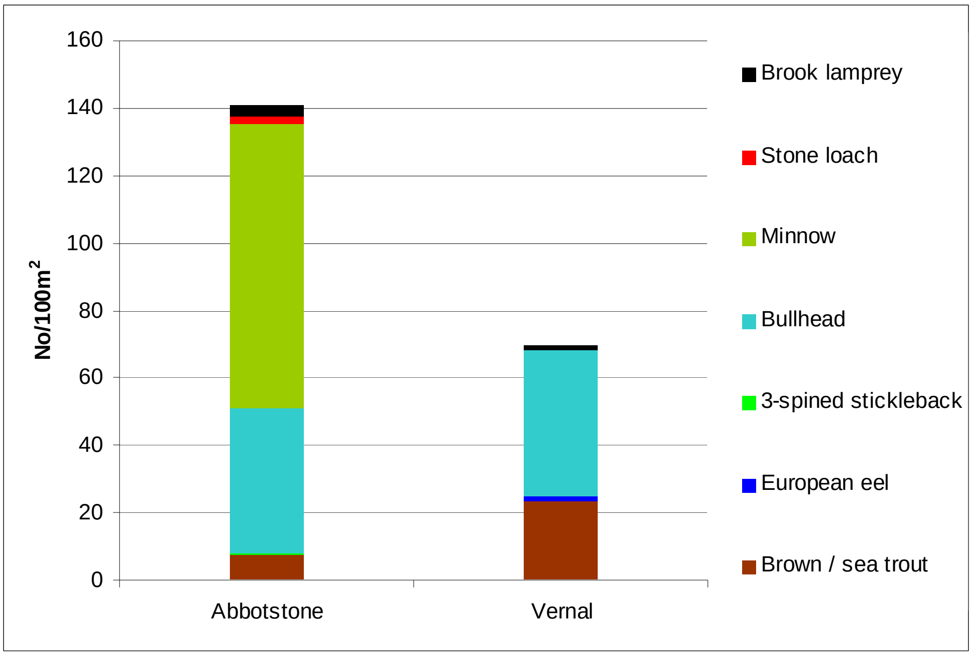


Figure Upper Itchen 1: 2011 survey catches

Table Upper Itchen 1 sets out the correlation values describing the relationships between brown trout densities based on 11 survey years at Abbotstone and 5 at Vernal Farm.

Table Upper Itchen 1: Correlation values between Upper Itchen trout densities and environmental variables

	Abbotstone density	Vernal density
Mean flow in preceding Oct-Mar	0.41	0.97
Mean flow prev Oct-Dec	0.30	0.65
Mean flow Jan-Mar	0.48	0.99
Mean flow April-Sept	0.56	0.78
Degree days >18°c	-0.6	-0.56
Degree days <0°c	0.11	-0.77
Degree days Jan-Mar only	-0.20	-0.24

Figure Upper Itchen 2 shows the graphs for brown density at Abbotstone and Vernal Farm for all survey years, compared with graphs for mean flow on the Cheriton stream (Seward's Bridge gauging station) for the period January to March and mean flow on the Candover Brook (Borough Bridge gauging station) for the periods October to March (previous to survey) and April to September.

Note that the following two figures indicate density based on first run catch only - this is because surveys in some years were single run only, while others were three run. By using only the first run data, all survey years can be compared.

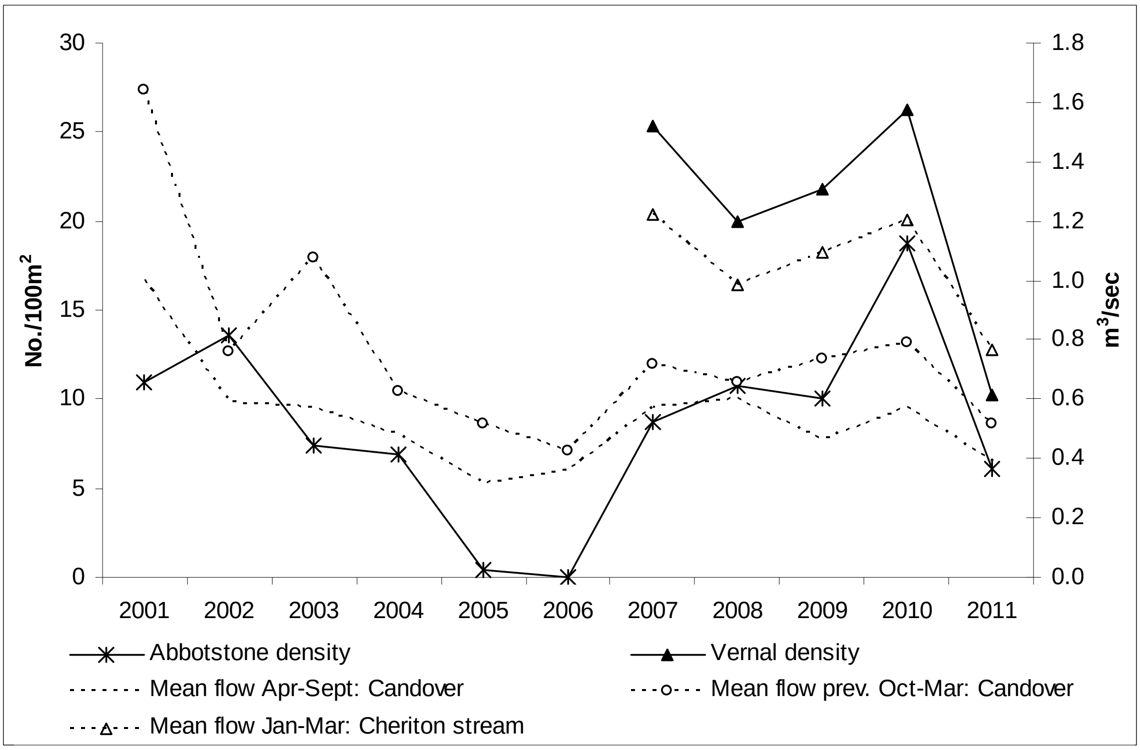


Figure Upper Itchen 2: First run brown trout densities compared to flow, Candover Brook and Cheriton stream

Figure Upper Itchen 2 shows brown trout densities on both streams compared to the number of degree days above 18°c:

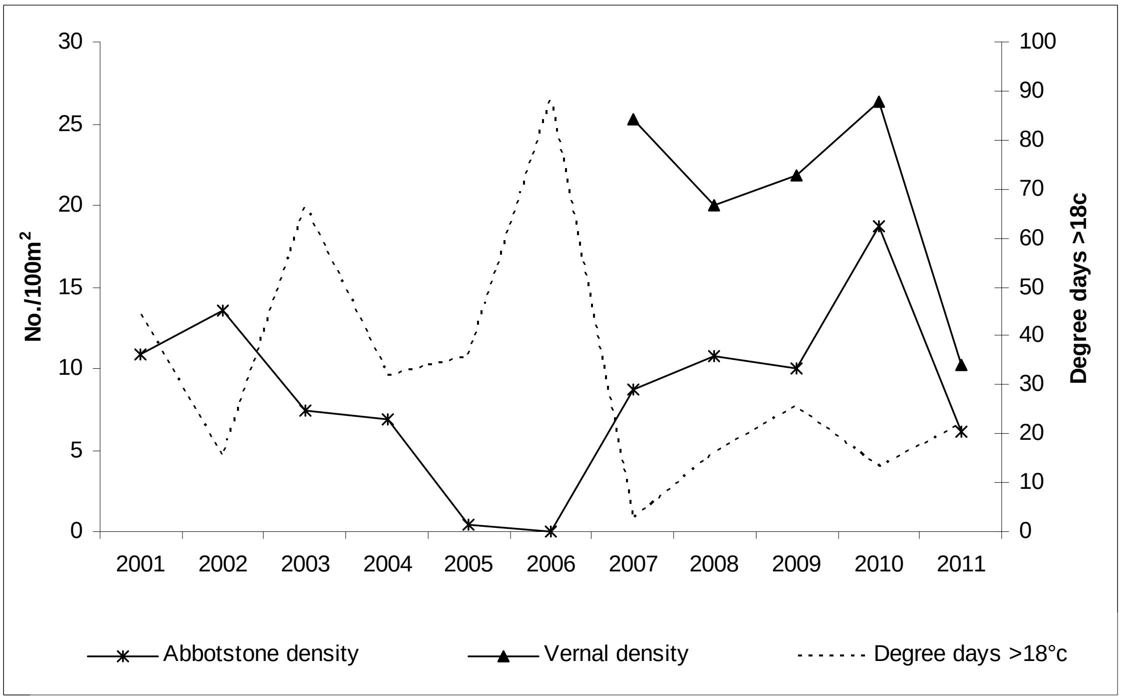


Figure Upper Itchen 3: First run brown trout densities compared to degree days above 18°c (Central England Temperature)

Upper Itchen brown trout discussion

Figure Upper Itchen 1 indicates a low estimated density of brown trout for Abbotstone in 2011, but a much higher one for Vernal Farm, at more than 20 fish per 100m^2.

Figure Upper Itchen 2 compares brown trout density calculated from the first electric fishing run only, for all survey years at Abbotstone and Vernal Farm and shows that both 2011 catches were lower than the respective catches in 2010. For Vernal Farm, the 2011 density was the lowest since sampling began in 2007 but for Abbotstone, brown trout density was much lower in 2005 and 2006.

The graphs for flow illustrate the remarkably close correlation between brown trout density at Vernal and mean flow at Seward's Bridge gauging station during the period January to March. Table Upper Itchen 1 shows that this relationship is a near-perfect correlation and that brown trout density at this site is also very closely correlated with mean flow in the previous October to December, the winter period as a whole and the summer period; April to September.

At 11 years, the dataset for Abbotstone is much longer than for Vernal and includes the very high flow winters of 2000/2001 and 2002/2003. Figure Upper Itchen 2 indicates that brown trout abundance at Abbotstone is positively correlated with mean summer and winter flow on the Candover, except for in these two years when the relationship appears to have reversed. This is confirmed by recalculating the correlation values for trout abundance at Abbotstone and mean winter and summer flows but excluding the 2001 and 2003 data, which provides figures of 0.9 and 0.84 respectively. Therefore, our data strongly suggest that trout densities on both streams are largely dependent on flow, both in winter and summer, but that there is a limit to this relationship and in exceptionally high winter flows, trout density may be reduced rather than increased.

Figure Upper Itchen 3 illustrates the negative correlation between brown trout abundance at both sites and the number of degree days above 18°c each year. In general, flow correlates negatively with summer temperature (hot summers are usually dry summers) but the relationship is surprisingly inconsistent, especially as low flows in the Candover are occasionally mitigated with augmentation pumping from boreholes. Therefore, the summer temperature / trout abundance correlation is likely to be valid in its own right to some extent, rather than simply being a reflection of the correlation with flow. This appears to be more true for Abbotstone, where the correlation value for degree days above 18°c is slightly greater than that for summer flow. Abbotstone is strikingly different to Vernal in physical terms, as there are no bankside trees or shrubs whatsoever, whereas Vernal has a diverse, patchy combination of open and shaded areas.

In conclusion, flow and summer temperature appear to be the factors most contributing to the variation in abundance of brown trout on the Candover and Cheriton streams. The very low density of trout at Abbotstone in 2005 and absence in 2006 are clear warnings that the spring 2012 drought, affecting most of the South East, is likely to reduce trout densities significantly if does not abate before summer. The degree of impact is likely to be related to summer temperature and reaches with little or no shade are likely to be particularly vulnerable to decreases in trout abundance in warm summers in general.

Itchen WFD fish monitoring:

One WFD fish survey was carried out in the Itchen catchment in 2011 and the details are given in the table below:

Waterbody name	**Bow Lake**			
Waterbody ID	GB107042016630			
Original fish status (2009)	Not classified 2009; Poor 2010			
Reason for 2011 survey	WB required second classification survey site			
Expected change to status:	None: catch clearly demonstrates poor status			
2011 survey details	Site name	NGR		Date
	Leyland's Farm	SU4816920858		01/09/2011
Catch:	3 sp. stick	31	Eel	2
	Gudgeon	5	Roach	8
	Stone loach	4	Tench	3

Brown trout holding station at Fulling Mill on the Itchen.

River Itchen annual salmon data summary:

The following table is self-explanatory and provides key data on the estimated salmon run, catch and egg deposition for each year since 1990:

Adult Return Year	**Returning Stock**	**Rod Catch**	**Catch and Release Rate**	**Spawning Escapement**	**Egg Deposition**
			(%)		(millions)
1990	367	187	-	106	0.26
1991	152	69	-	37	0.09
1992	357	95	-	230	0.56
1993	852	357	-	495	1.21
1994	378	183	14	219	0.53
1995	880	241	0	664	1.62
1996	433	261	13	275	0.67
1997	246	95	14	204	0.50
1998	453	161	44	414	1.01
1999	213	92	46	176	0.43
2000	208	168	66	189	0.46
2001	217	190	99	214	0.52
2002	239	188	99	202	0.49
2003	222	78	100	204	0.50
2004	410	149	100	393	0.96
2005	411	87	100	411	1.00
2006	419	121	100	419	1.02
2007	302	224	100	301	0.73
2008	609	282	100	584	1.42
2009	276	205	100	276	0.67
2010	757	361	100	749	1.83
2011	697**	295	100	697	1.70
Salmon egg conservation limit				1.63 M	
Salmon egg management target				1.97 M	
Notes					
**	*Likely to be a slight underestimate due to fish counter sensitivity fault in May and June*				

3.5 Test

The only electric fishing surveys carried out in the Test catchment in 2011 were related to WFD. The extensive 6 yearly spatial Salmon Action Plan (SAP) surveys were completed in 2010 and SAP temporal monitoring now occurs biennially - 6 SAP temporal sites are programmed for 2012.

All nine of the WFD surveys detailed in the tables below were conducted in order to improve our confidence in the fish classification for the relevant waterbody. All of these surveys suggest that the waterbody status for fish is actually better than the formal classification calculated in 2009, with the exception of the Fairbourne Stream to Fishlake Meadows - the fish community in this waterbody is constrained by numerous physical modifications to the watercourse.

Waterbody name	**Pilhill Brook**			
Waterbody ID	GB107042022790			
Original fish status (2009)	Moderate			
Reason for 2011 survey	Minor species not recorded: bullhead driving failure			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Anna Valley	SU3413244010		28/06/2011
Catch:	Brown trout	26	Eel	2
	Bullhead	7	Grayling	4
	Stone loach	1		

Waterbody name	**Pilhill Brook**			
Waterbody ID	GB107042022790			
Original fish status (2009)	Moderate			
Reason for 2011 survey	Minor species not recorded: bullhead driving failure			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Little Anne	SU3309743776		28/06/2011
Catch:	Brown trout	10	10 sp. Stick.	3
	Bullhead	29	Brook lamprey	1
	Stone loach	1	Grayling	1

Waterbody name	**Blackwater**			
Waterbody ID	GB107042016790			
Original fish status (2009)	Poor			
Reason for 2011 survey	No stop nets & minors not recorded			
Expected change to status:	Likely to improve to "Good"			
2011 survey details	Site name	NGR		Date
	Upper Whinwhistle	SU3043419707		20/09/2011
Catch:	Brown trout	12	Brook lamprey	10-99
	Bullhead	23	Dace	2
	Eel	13	Grayling	3
	Gudgeon	2	Pike	4
	Roach	14	Rudd	1
	Stone loach	47		

Waterbody name	**Blackwater**			
Waterbody ID	GB107042016790			
Original fish status (2009)	Poor			
Reason for 2011 survey	No stop nets & minors not recorded			
Expected change to status:	Likely to improve to "Good"			
2011 survey details	Site name	NGR		Date
	Broadlands	SU3464116376		20/09/2011
Catch:	Brown trout	3	Brook lamprey	10-99
	Bullhead	37	Dace	27
	Chub	7	Minnow	7
	Eel	20	Grayling	2
	Gudgeon	6	Pike	4
	Roach	38	Roach x bream	1
	Perch	11		

Waterbody name	**Dever**			
Waterbody ID	GB107042022770			
Original fish status (2009)	Moderate			
Reason for 2011 survey	No stop nets & minor species not recorded			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Egypt	SU4655039986		30/08/2011
	Brown trout	20	Brook lamprey	10-99
	Bullhead	55	3 sp. Stick.	8
	Eel	7	Minnow	32
	Stone loach	24	Grayling	2
	Pike	1		

Waterbody name	**Dever**			
Waterbody ID	GB107042022770			
Original fish status (2009)	Moderate			
Reason for 2011 survey	No stop nets & minor species not recorded			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Hunton	SU4816439586		30/08/2011
	Brown trout	70	Brook lamprey	10-99
	Bullhead	12	Stone loach	7
	Eel	1		

Waterbody name	**Fairbourne stream to Fishlake meadows**			
Waterbody ID	GB107042016480			
Original fish status (2009)	Poor			
Reason for 2011 survey	Only Romsey Barge canal sampled – Fairbourne sample needed			
Expected change to status:	None: survey confirmed Poor status			
2011 survey details	Site name	NGR		Date
	Brook Farm	SU3530623751		01/09/2011
	Bullhead	100-999	Eel	1
	Minnow	3	Stone loach	100-999

Waterbody name	Wallop Brook			
Waterbody ID	GB107042022650			
Original fish status (2009)	Moderate			
Reason for 2011 survey	No stop nets			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Roake Farm	SU3199031740		10/05/2011
	Brown trout	18	Bullhead	8
	Eel	4	Minnow	84

Waterbody name	Wallop Brook			
Waterbody ID	GB107042022650			
Original fish status (2009)	Moderate			
Reason for 2011 survey	No stop nets			
Expected change to status:	Likely to improve to “Good”			
2011 survey details	Site name	NGR		Date
	Wallop House	SU2975736797		10/05/2011
	Brown trout	24	Bullhead	22

A fine dace from the River Blackwater

River Test annual salmon data summary:

The following table is self-explanatory and provides summary data on the estimated salmon run, catch and egg deposition for each year since 1990:

Adult Return Year	**Returning Stock**	**Rod Catch**	**Catch and Release Rate**	**Spawning Escapement**	**Egg Deposition**
			(%)		(millions)
1990	790	288	-	505	1.23
1991	538	139	-	405	0.99
1992	614	151	-	471	1.15
1993	1155	335	-	870	2.12
1994	775	247	14	560	1.37
1995	647	167	0	465	1.13
1996	623	146	13	496	1.21
1997	361	49	14	319	0.78
1998	898	204	44	784	1.91
1999	867	159	46	781	1.91
2000	595	147	66	545	1.33
2001	410	215	99	398	0.97
2002	1046	342	99	1044	2.55
2003	367	164	100	367	0.90
2004	1129	449	100	1129	2.75
2005	1150	357	100	1150	2.81
2006	1058	210	100	1058	2.58
2007	664	258	100	664	1.62
2008	1487	424	100	1487	3.63
2009	903	185	100	903	2.20
2010	833	225	99	831	2.03
2011	980*	312	100	979	2.39
Salmon egg conservation limit				*3.40 M*	
Salmon egg management target				*3.88 M*	
Notes					
*	*Returning stock estimate based on historic relationship with rod catch due to fish counter faults*				

3.6 New Forest

The Lymington and Beaulieu rivers are both monitored routinely as Principal Brown Fisheries. In 2011 the four temporal sites were surveyed; two on each river. The large number of spatial sites were last surveyed in 2007 and will be surveyed for the second time in 2013.

Map New Forest 1, below, shows the locations of the four temporal sites, with the markers sized in proportion to the density of brown trout recorded in 2011:

Map New Forest 1: Lymington and Beaulieu temporal site locations

Figures New Forest 1 and 2 show the density of brown trout recorded annually since 2007 on the Lymington and Beaulieu Rivers respectively.

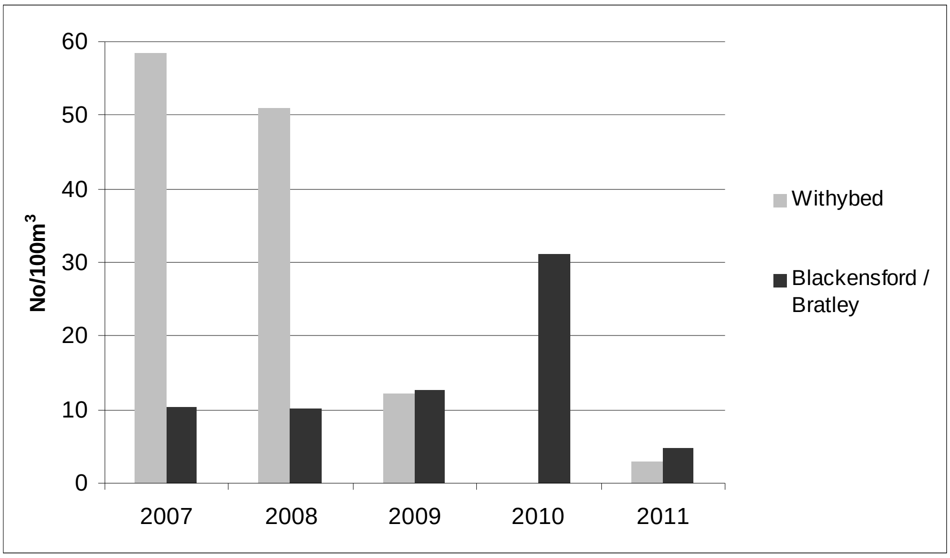


Figure New Forest 1: Lymington River brown trout densities in all survey years

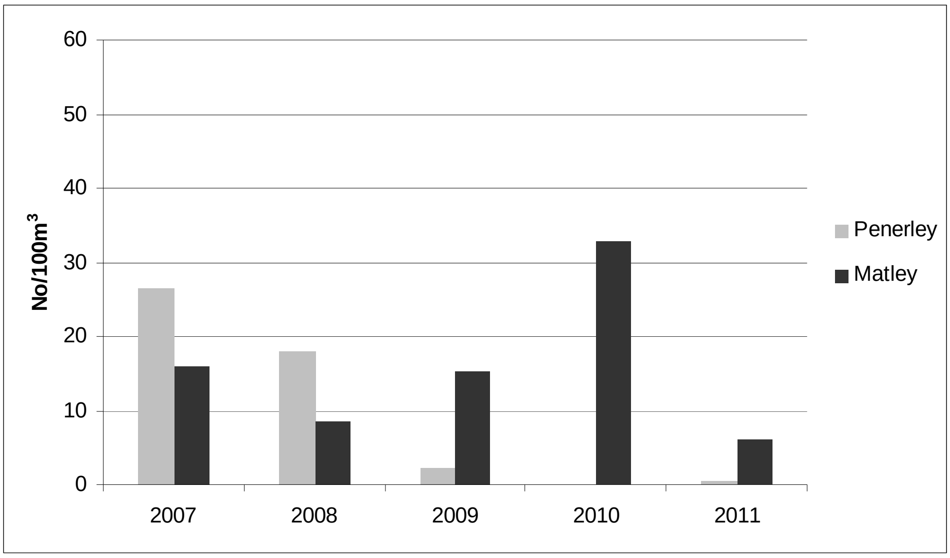


Figure New Forest 2: Beaulieu River brown trout densities in all survey years

Table New Forest 1 shows the correlation values between brown trout density at the four New Forest temporal survey sites and various flow and temperature parameters:

Table New Forest 1: New Forest brown trout abundance correlations

	Withybed density	Blackens./ Bratley density	Penerley density	Matley density
Mean flow prev Oct-Dec	-0.17	0.90	-0.06	0.95
Mean flow Jan-Mar	0.52	0.32	0.58	0.48
Mean flow Apr-Sept	0.86	-0.24	0.80	-0.32
Degree days >18°c	-0.64	-0.18	-0.76	-0.29
Degree days Jan-Mar only	0.82	-0.81	0.81	-0.75

Figure New Forest 3 shows the relationship between mean flow in the period April to September at Brockenhurst gauging station and brown trout density at Withybed Bottom (Lymington River) and Penerley Water (Beaulieu):

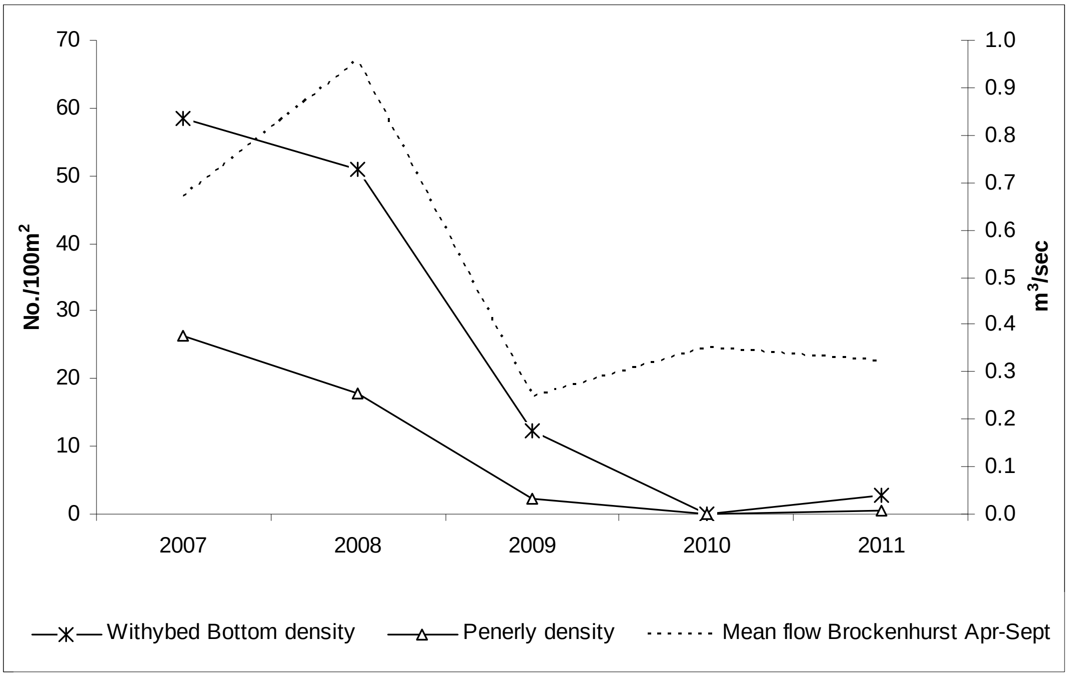


Figure New Forest 3: Brown trout density and mean summer flow, Withybed and Penerley

Figure New Forest 4 shows the relationship between mean flows in October to December and January to March at Brockenhurst gauging station with brown trout density at Matley (on the Beaulieu) and Blackensford / Bratley (on the Lymington).

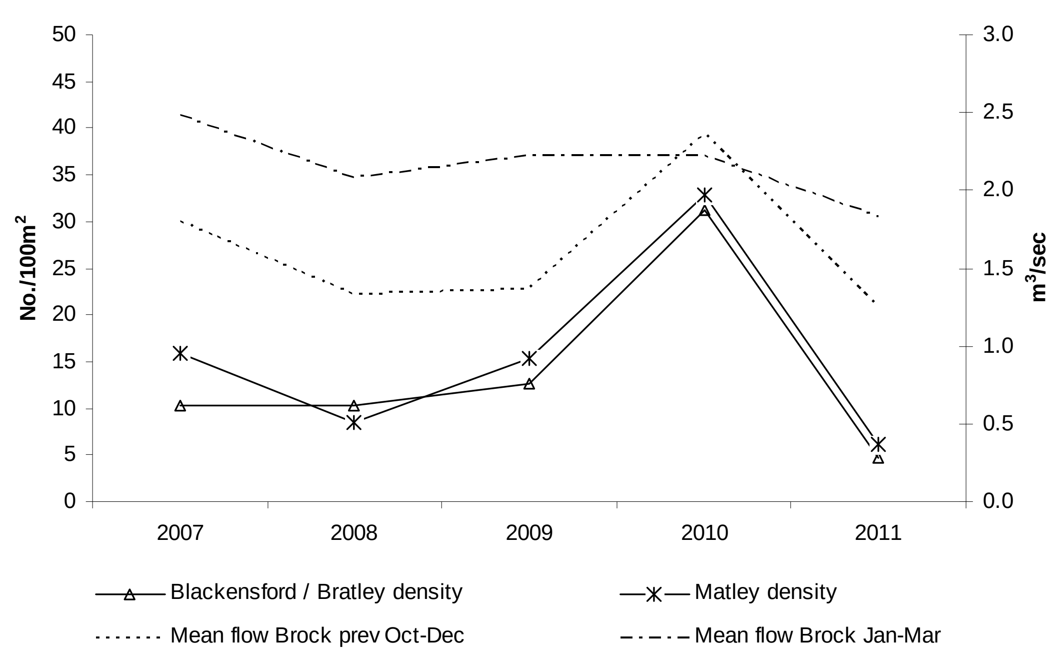


Figure New Forest 4: Brown trout density and mean flow, Oct-Dec & Jan-Mar, Withybed and Penerley

New Forest brown trout discussion

Figures New Forest 1 and 2 show that densities of brown trout recorded at the four New Forest temporal survey sites were exceptionally low in 2011. This pair of figures shows striking similarities between the variation in trout abundance at the sites prone to drying out in low flow years: Withybed Bottom on the Lymington and Penerley on the Beaulieu and the pair of sites not prone to drying out: Blackensford / Bratley on the Lymington and Matley Passage on the Beaulieu.

Not only are the trout densities at these pairs of sites similar in the each year but the pattern for the headwater sites prone to drying out is virtually the opposite of the middle reach sites that have been flowing in every survey year. The contrasting results for 2010 are particularly notable as both Withybed Bottom and Penerley were dry (hence "zero catch" for brown trout), whilst Blackensford/Bratley and Matley Passage produced the highest brown trout densities recorded in since sampling began in 2007.

However, the generally opposing nature of results from these two pairs of sites didn't apply to 2011, with low trout abundance at all four sites. The causes are clarified by the correlations set out in Table New Forest 1 and by the graphs in figures New Forest 3 and 4. The key factor that appears to determine brown trout abundance in the sites prone to drying out is summer flow. Obviously, when a site is dry, no trout will be recorded but chart New Forest 3 shows that there even when the site isn't dry, trout density is generally proportional to flow. Note that the summer flow graph represents a mean flow over a six month period, within which there is often quite marked variation. Hence, chart New Forest 3 shows a lower mean summer flow in 2009 than in 2010, but it was only in 2010 that both Withybed Bottom and Penerley Bridge sites were found to be completely dry at survey time. Likewise, in 2011 there was flow at both sites but they were known to have been virtually dry earlier in the summer.

For the sites that have never been observed dry at survey time, the key factor determining trout abundance appears to be mean flow in the period between October and December in the previous year - figure New Forest 4 shows a remarkably close correlation and the coefficient values given in Table New Forest 1 support this, with 0.9 for Blackensford/Bratley and 0.95 for Matley Passage.

New Forest WFD:

Two WFD surveys were carried out in the New Forest in 2011, both in the Ober Water waterbody. These were required because the formal 2009 classification of this waterbody as "Moderate" was thought to have been caused by failure to accurately record bullhead. As the two tables below show, the two 2011 surveys demonstrated that bullhead were present at both sites. However, it is not certain that this will improve the waterbody status because so few trout were recorded.

Waterbody name	**Ober Water**			
Waterbody ID	GB107042011360			
Original fish status (2009)	Moderate			
Reason for 2011 survey	Minor species not recorded: bullhead driving failure			
Expected change to status:	Uncertain: plenty of bullhead but low trout catch			
2011 survey details	Site name	NGR		Date
	Puttle's Bridge	SU2710002858		12/05/2011
Catch:	Brown trout	2	Minnow	41
	Bullhead	28	Pike	1
	Chub	35	Roach	1
	Eel	2	Stone loach	14
	Brook lamprey	2		

Waterbody name	**Ober Water**			
Waterbody ID	GB107042011360			
Original fish status (2009)	Moderate			
Reason for 2011 survey	Minor species not recorded: bullhead driving failure			
Expected change to status:	Uncertain: plenty of bullhead but low trout catch			
2011 survey details	Site name	NGR		Date
	Red Rise	SU2439803842		12/05/2011
Catch:	Brown trout	4	Minnow	16
	Bullhead	15	Pike	3
	Eel	14	Stone loach	25
	Brook lamprey	11		

A young of the year brown trout from the New Forest

4 Transitional and coastal water monitoring

In 2011 we completed our routine transitional and coastal (TrAC) fish surveys in Southampton water and the Adur estuary, which allows each estuary's' ecological status to be classified for the Water Framework Directive.

Note that our sampling techniques are selective for small fish, so our catch is almost entirely composed of juveniles and small species.

4.1 Southampton Water

The Southampton Water TrAC programme in 2011 included the routine beach seine and beam trawl surveys at five sites and beach seine only samples at two sites (sites where the ground is too rough for trawling). In addition, a fyke net survey was carried out in autumn near to Fawley power station - the addition of a third sampling technique will increase the confidence level of the WFD classification. The 2011 classification for Southampton Water for fish was "High", but with a confidence level of "Uncertain" (because two, rather than three sampling methods had been employed to date).

Figure SW1 shows the total number of each species caught in spring and autumn 2011 in Southampton Water- note that where there appears to be no column for a species, very few individuals were caught.

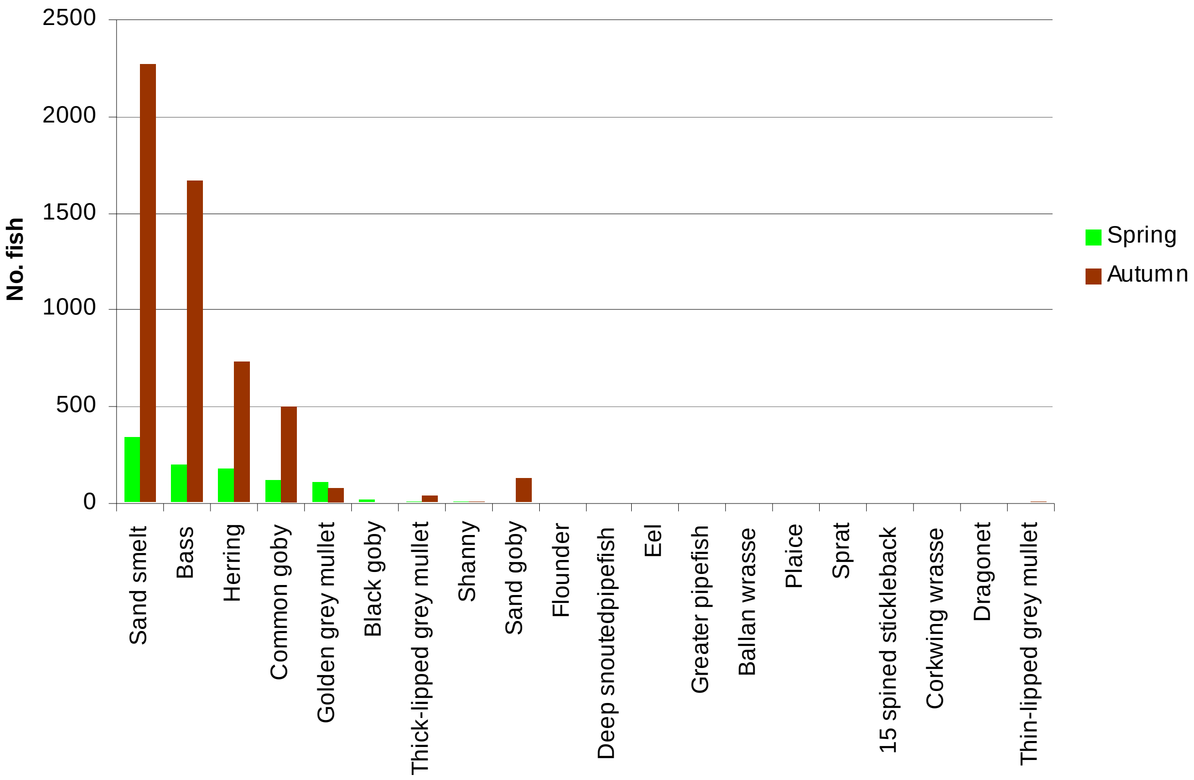


Figure SW1: Spring and autumn catches, Southampton Water, 2011

Figure SW2 compares the 2011 total spring and autumn catches with those in the previous four years:

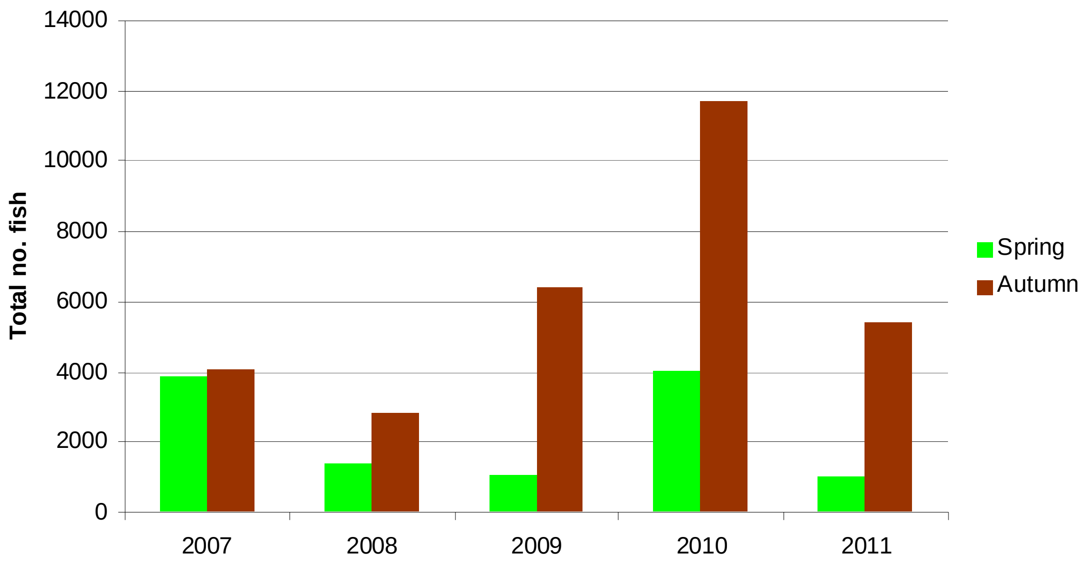


Figure SW2: Total number of fish caught Southampton water, 2007-2012

Figure SW3 illustrates the close correlation between mean winter sea temperature recorded at Hayling Island buoy and the total number of bass caught at the five Southampton Water spring TrAC surveys that have been sampled routinely since 2007.

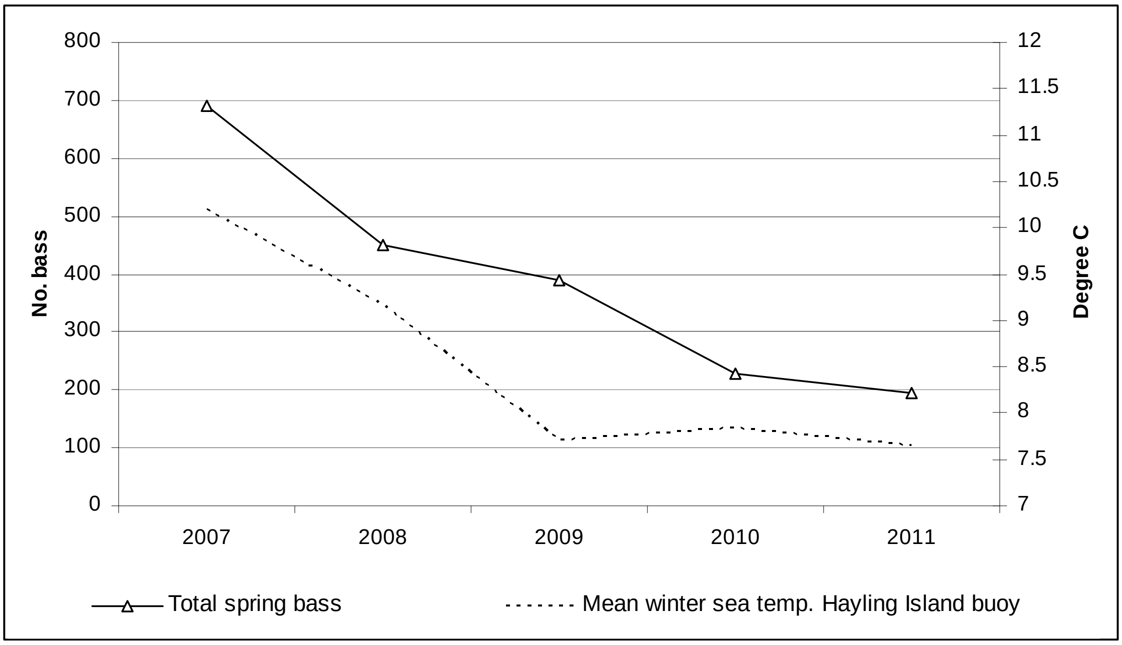


Figure SW3: Total bass caught in spring surveys in relation to mean winter sea temperature at Hayling Island buoy (Correlation = 0.92)

Figure SW4 shows the correlation between mean summer sea temperature recorded at Hayling Island buoy and the total number of bass caught at the five autumn TrAC survey sites that have been sampled routinely since 2007.

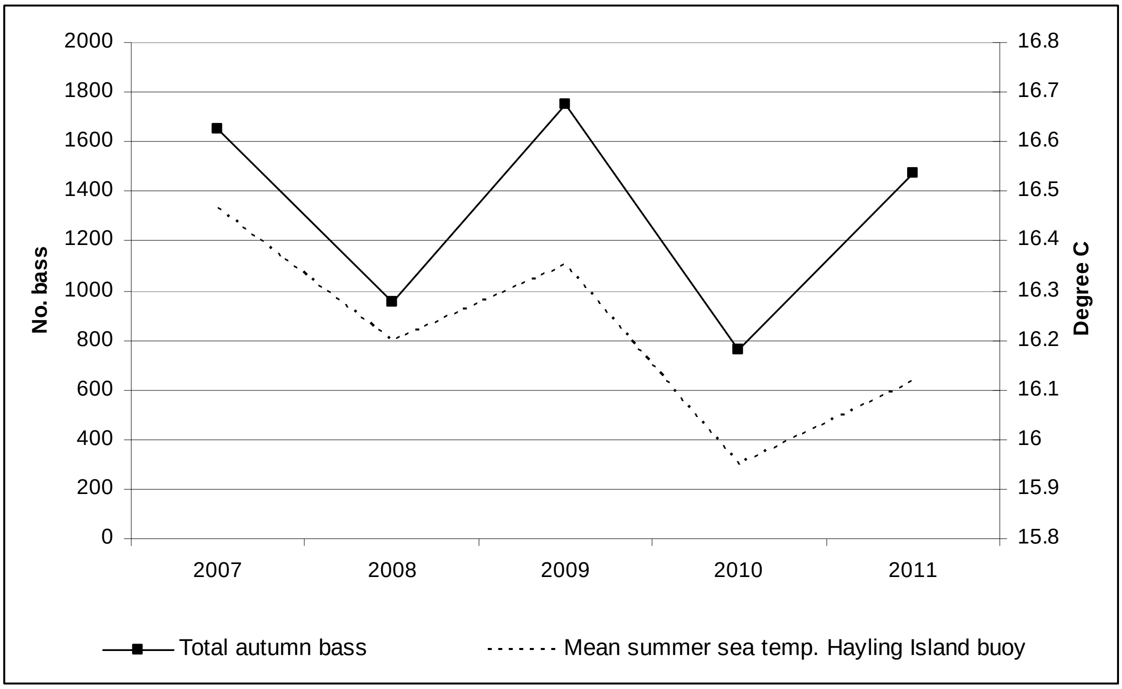


Figure SW4: Total bass caught in autumn surveys in relation to mean summer sea temperature at Hayling Island buoy (Correlation = 0.8)

Southampton Water TrAC discussion:

In 2011 we caught a total of 20 species in Southampton Water, which was an increase from 19 caught in 2010. The additional species was a dragonet, *Callionymus lyra*, caught at Calshot in autumn. The total number of fish caught in spring was greatly reduced from last year and was the lowest recorded over our five year sampling period. This was almost certainly linked to the relatively harsh winter of 2010/11, which resulted in an unusually low mean winter water temperature in the Solent in 2010/11(Chart SW3). However, the total autumn catch was approximately average for the five year sampling period and Figure SW4 sows that the bass catch was relatively high.

A further year's sampling and access to a local sea surface temperature dataset allow us to make further analysis of the apparent link between juvenile bass catches and water temperatures that was discussed in last year's report. Sea surface temperatures were taken from the Hayling Island buoy and there was found to be a strong positive correlation (0.92) between the mean winter temperature (November to April inclusive) and the total number of bass caught at the five Southampton Water survey sites that have been sampled routinely since 2007. The number of bass caught at the same five sites in autumn was found to be strongly positively correlated (0.8) with the mean summer sea surface temperature (May to October inclusive) at the Hayling Island buoy.

Last year's report identified that our spring bass catches are typically dominated by juvenile fish born in the previous summer that have over wintered in inshore waters. The correlation described by figure SW3 indicates that mild winters result in more of these fish surviving into their second summer. Autumn catches are typically dominated by young of the year bass, which drift into inshore waters in early summer (after our spring surveys) and figure SW4 shows that there is a tendency for their abundance to be increased by warm summers.

Both these observations suggest that unusually cold winters and cool summers probably reduce the numbers of bass being recruited to local commercial and recreational fisheries in subsequent years.

Grey mullet from the Hamble estuary

Deep-snouted pipefish, also from the Hamble estuary

Adur estuary

In 2011 our three routine sample sites were monitored on the river Adur, all of which were subject to seine net and beam trawl methods. Figure Adur 1 shows the total number of each species caught in spring and autumn:

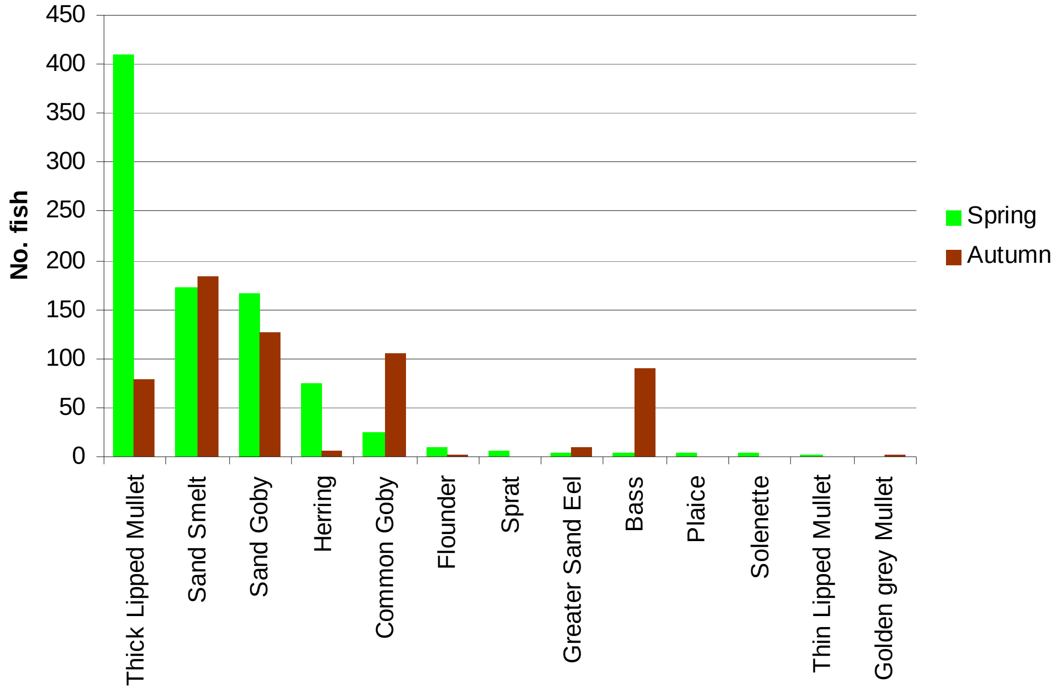


Figure Adur 1: Total catch per species, all Adur sites combined, 2011

Figure Adur 2 compares the total catch in spring and autumn in each survey year at the Ladywell site, which has been surveyed consistently since 2005:

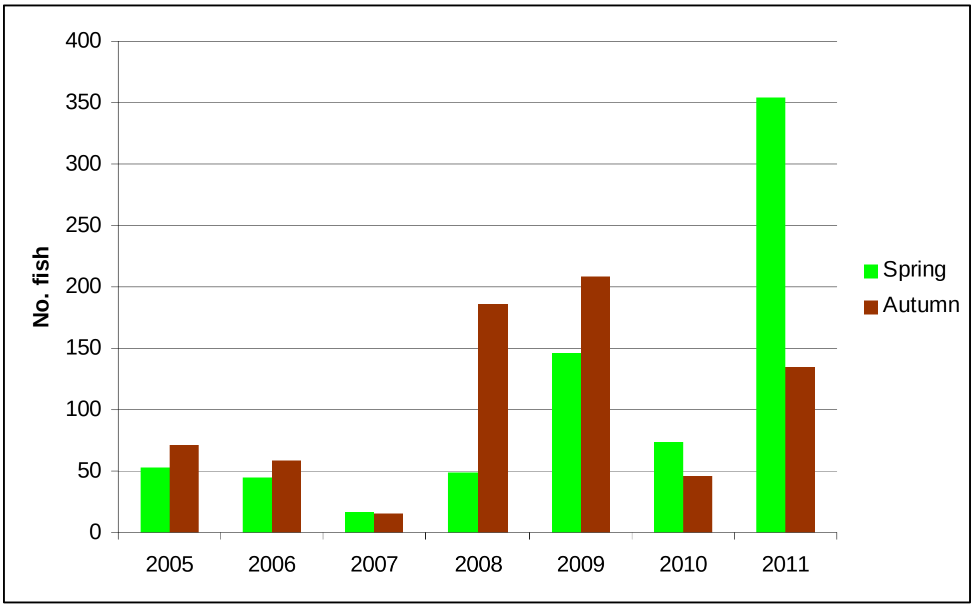


Figure Adur 2: Total catch at Ladywell, 2005-2011

Figure Adur 3 shows the apparent relationship between the total number of mullet caught each spring at Ladywell and the mean winter air temperature, based on Central England Temperature Hadley.

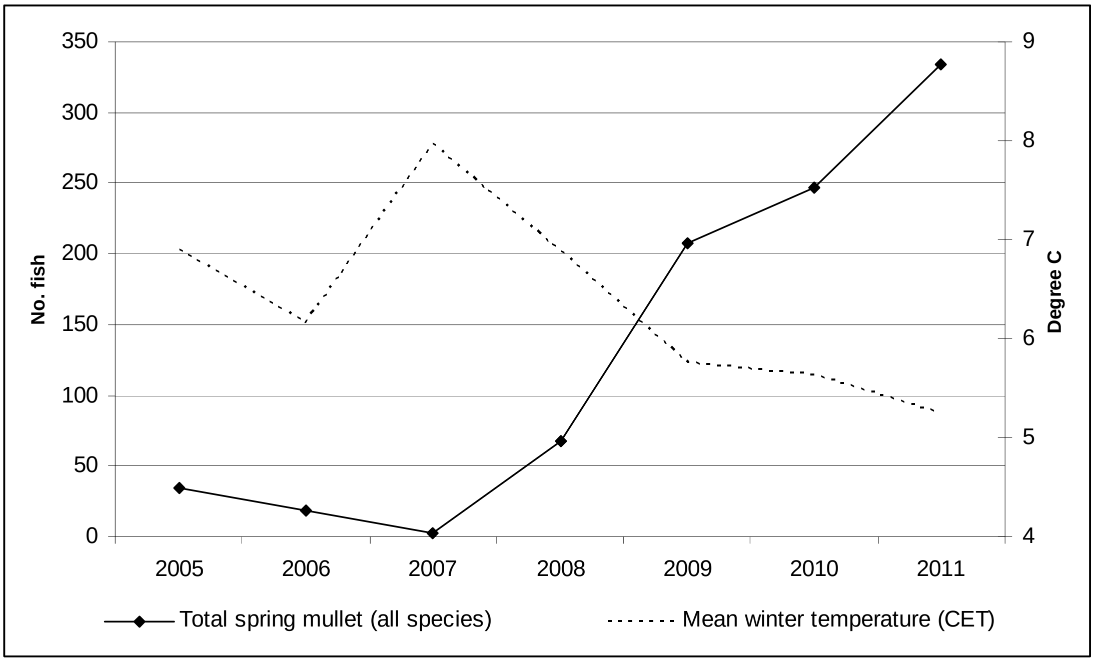


Figure Adur 3: Total mullet catch at Ladywell in spring and mean winter air temperature (CET) (Correlation: -0.84)

Figure Adur 4 shows the total number of bass caught at Ladywell each autumn and the mean summer flow at Sakeham gauging station, located close to the Adur's tidal limit.

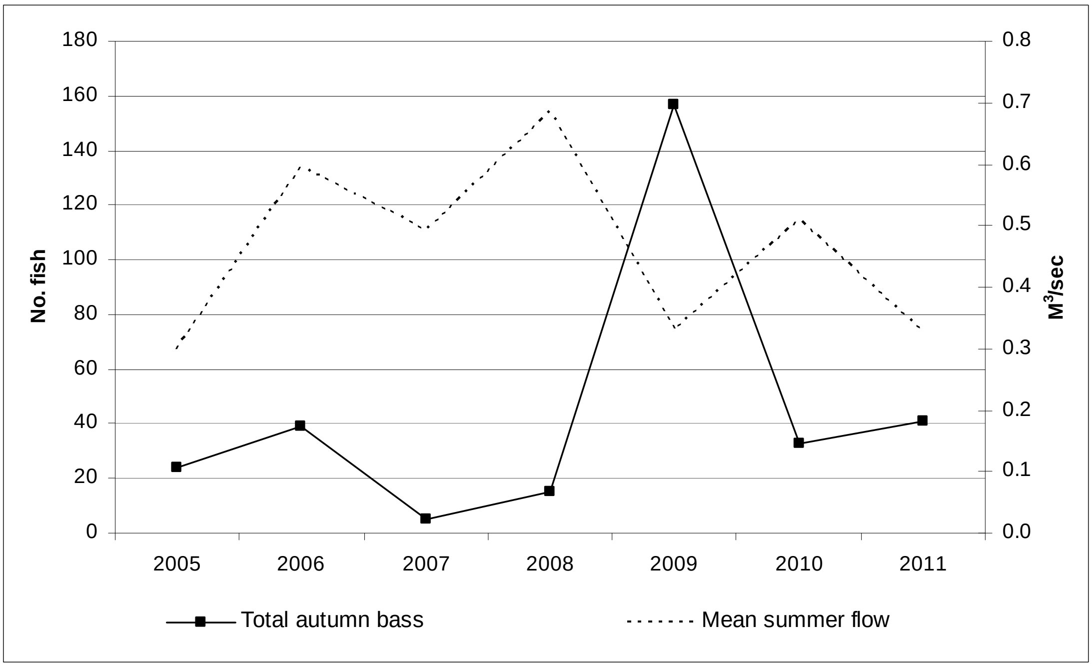


Figure Adur 4: Total bass at Ladywell in autumn and mean summer flow (Correlation: -0.44)

Adur estuary TrAC discussion:

In 2011 we caught 13 species of fish in our Adur estuarine survey, two more than were captured in 2010. Chart Adur 1 shows that the most abundant species where thick lipped grey mullet, sand smelt and sand goby. However, the three survey sites range from adjacent to the open sea at Kingston Beach, to narrow river channel at Ladywell, with the Old Tollbridge between the two. As a result, salinity, temperature, flow and substrate conditions vary considerably, leading to different fish communities at each site. For example, the Kingston Beach catch is generally dominated by sand smelt, whereas at Ladywell, thick lipped mullet is the dominant species.

Of the three sites, only Ladywell has been sampled annually for long enough to indicate any trends. Figure Adur 2 shows the total number of fish caught in spring and autumn at Ladywell annually since 2005 and indicates that the spring 2011 catch was the highest for the whole period, whilst the autumn catch was only exceeded by the 2008 and 2009 autumn catches.

Because of the major physical differences between the three Adur sites, it is likely that the fish communities at each are affected differently by the flow and temperature. For example, fish at Kingston Beach are more likely to be affected by sea temperature than any other variable whilst those at Ladywell are more likely to be affected by river temperature and flow.

Figure Adur 3 shows that the numbers of mullet (all three species combined) caught in spring have increased annually since 2007. The environmental variable that this appears to be linked to is mean sea surface temperature (recorded at Hayling Island buoy): in general, the colder the sea in winter, the more mullet are caught at Ladywell in spring. The most likely reason for this relationship is that the difference between river and sea temperatures at the time of the spring surveys (June) is likely to be greatest following an unusually cold winter - the relatively warmer river temperature may attract juvenile mullet farther upstream.

Thin-lipped grey mullet from the Adur estuary at Ladywell.

5 Looking forward

At the time of writing, the 2012 Solent & South Downs fish monitoring programme has already commenced and a significant number of WFD surveys have been completed in various catchments. However, the abrupt end to drought conditions in April led to many surveys being postponed until river levels drop.

The key fisheries monitoring components for 2012 are as follows:

Cuckmere & Adur Principal Coarse Fisheries: 5 sites each, monitored triennially.

Western Rother Principal Coarse Fishery (national index river): 5 sites monitored annually.

Wallington & Hamble Principal Coarse Fisheries: 2 sites each, monitored triennially

Ouse, Meon, Upper Itchen, Lymington & Beaulieu Principal Brown Trout Fisheries temporal monitoring: 2 sites each monitored annually.

Test Salmon Action Plan Fishery: 6 sites monitored biennially

General Coarse Fishery monitoring: approximately 12 sites across various catchments, monitored 6 yearly

The key Water Framework Directive fish monitoring programme components for 2012 are as follows:

TrAC WFD monitoring: 9 sites in Southampton Water; 4 sites in the Adur estuary, all sampled once in spring and again in autumn.

WFD Key Performance Indicator investigations surveys: large number of surveys across various catchments to investigate waterbodies failing for fish, and which have KPI's set for them (KPI's are self-imposed work deadlines or standards).

WFD new fisheries monitoring sites: a large number of new sites across various catchments that are needed to provide more accurate fish classifications for certain waterbodies.

List of abbreviations

KPI: Key Performance Indicator

SAP: Salmon Action Plan

SSD: Solent and South Downs (Environment Agency administrative area)

TrAC: Transitional and Coastal

WFD: Water Framework Directive

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