Fisheries survey report of the River Cam: Littlebury to Trumpington

Anglian Central – Fisheries Monitoring Programme

2013

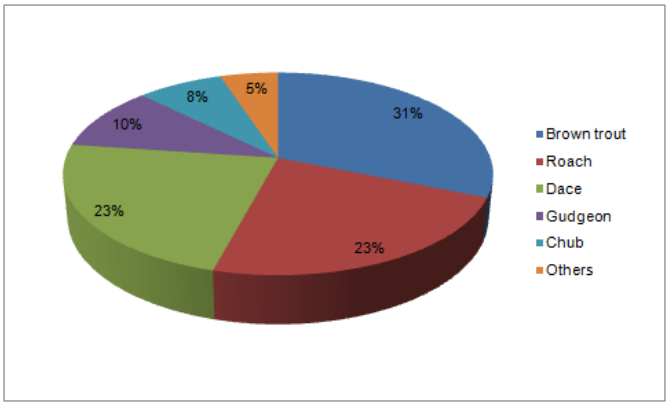
SUMMARY

- Five sites were surveyed on the upper River Cam between Littlebury and Trumpington between the 2nd and 26th of July 2013.

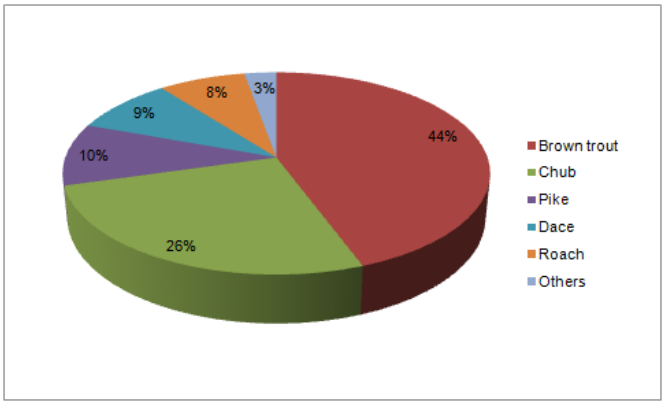
- The sites were fished against the flow using Pulsed DC electric fishing equipment. Fish were measured and scales taken for ageing and growth analysis. Results are reported utilising fish greater than 99mm as this method has been shown to be inefficient below 99mm. Further information can be found at www.environment-agency.gov.uk

- **List of all species caught:**

3-spined stickleback [*Gasterosteus aculeatus*]
Brook lamprey [*Lampetra planeri*]
Brown Trout [*Salmo trutta*]
Bullhead [*Cottus gobio*]
Chub [*Leuciscus cephalus*]
Dace [*Leuciscus leuciscus*]
Gudgeon [*Gobio gobio*]
Minnow [Phoxinus phoxinus]
Perch [*Perca fluviatilis*]
Pike [*Esox lucius*]
Roach [*Rutilus rutilus*]
Spined loach [*Cobitis taenia*]
Stone loach [*Barbatula barbatula*]



Species density composition (>99mm)



Species standing crop composition (>99mm)

- The average density (**number of fish in a given area**) of all species (>99mm) over the five sites surveyed was 9.46 Ind./100m^2 in 2013.

- Total average standing crop (**weight of fish in a given area**) of all species (>99mm) over the five sites surveyed was 1183.3 g/100m^2 in 2013.

- The largest fish from the survey included a 440mm brown trout, a 252mm roach and a 250mm dace from U/s Hinxton / Ickleton (site 4498), a 572mm pike and 240mm perch from P.B.I (site 4503) and a 492mm chub from Sawston Paper Mill (site 4501).

Preliminary Assessment:

Brown trout are the dominant species by both standing crop and density, having been caught at all five survey sites, with the strongest aggregation recorded at Sawston Paper Mill (site 37) comprising of 85 fish.

Figure 1. U/s River Cam spatial survey sites 2013.

FISHERIES SURVEY RESULTS

Five sites were surveyed on the U/s River Cam between the 2nd and 26th July 2013, (Table 1).

Table 1. Site details (measurements in metres).

Site Name	Reference	Survey Date	Length (m)	Width (m)	Area (m^2)	Midstream NGR	Survey Methods
Littlebury	CAM31	02.07.2013	190	8.5	1615	TL51863 39730	DC Electric Fishing
U/s Hinxton / Ickleton	CAM34	03.07.2013	200	8	1600	TL49500 44420	DC Electric Fishing
Pampisford Mill	CAM35	04.07.2013	255	6	1530	TL48700 47600	DC Electric Fishing
Sawston Paper Mill	CAM37	05.07.2013	255	5	1275	TL47200 49400	DC Electric Fishing
P.B.I	CAM39	26.07.2013	220	7	1540	TL43200 53600	DC Electric Fishing

Electric Fishing Methodology:

Electric fishing uses the physiological effect of an electric field in water to attract and immobilise fish. Electrodes, immersed in the water, stimulate a fishes nervous system so that it swims towards the operator, or is unable to swim away, and can be caught. Image 1 shows the typical components of an electric fishing system.

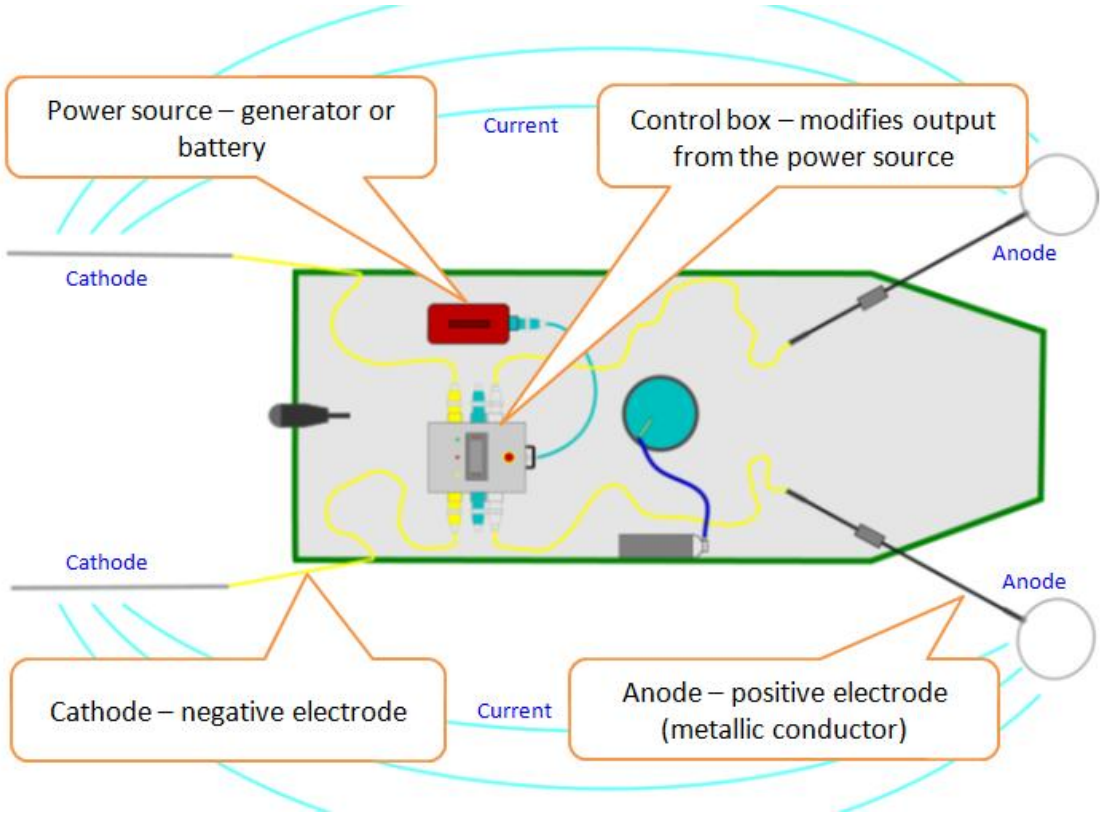


Image 1

In shallow streams it is generally possible to wade upstream within the channel using generator powered equipment towed within a small boat, (Image 2). When rivers deepen or site depth is variable, electric fishing from a boat using generator powered equipment is often the preferred method. The boat is manoeuvred downstream via an electric or petrol outboard engine or on ropes by an operative on either bank controlling the speed, direction and channel positioning, (Image 3).

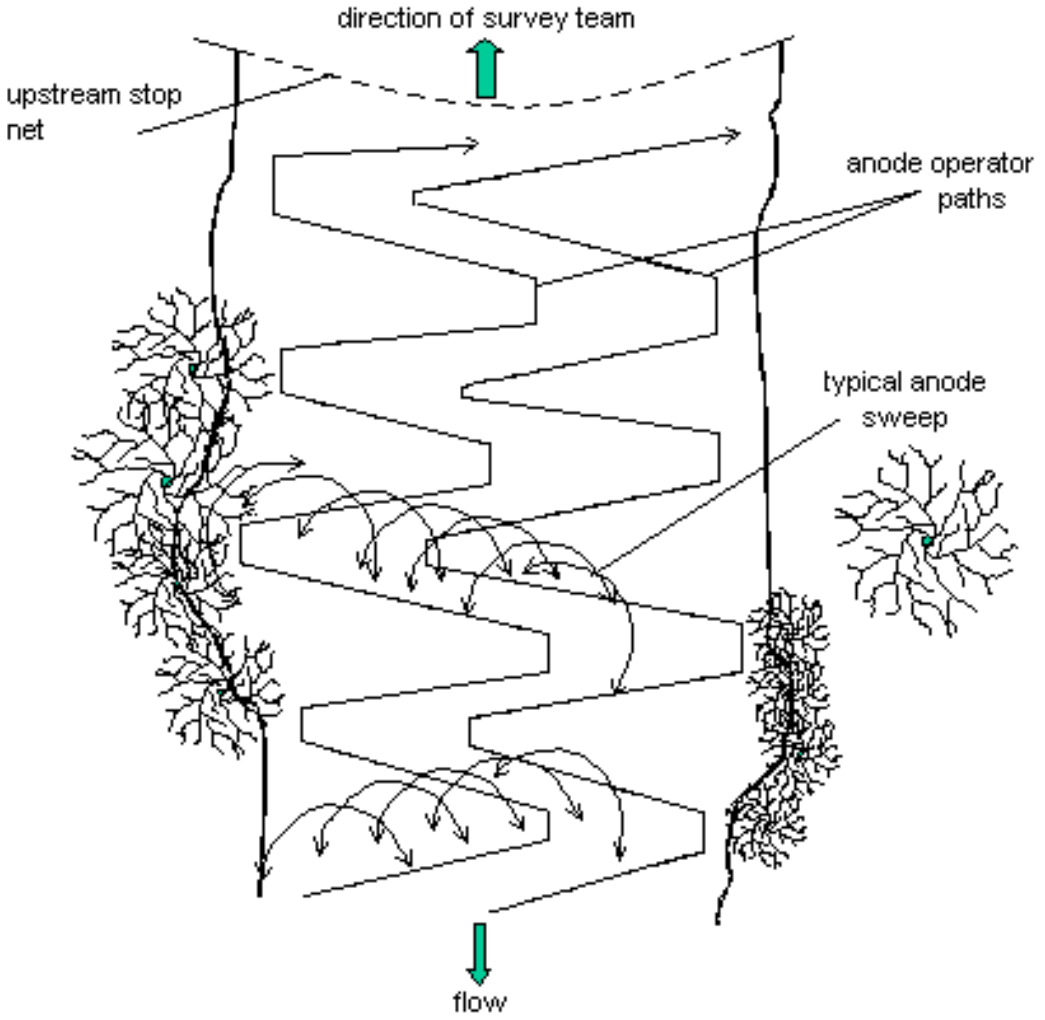


Image 2

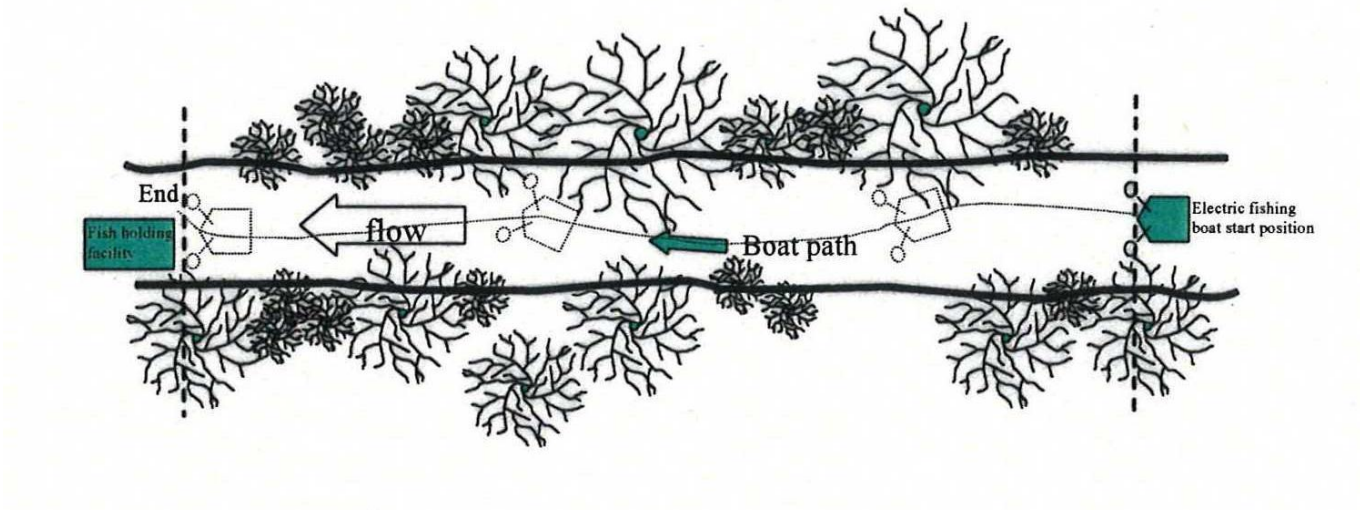


Image 3

Stop nets are positioned across the channel isolating the survey site preventing fish from migrating into and out of the survey area. The electric fishing operation is repeated until a 50% reduction in the total number of fish caught has been achieved. The captured fish are then measured and scales removed from a sub sample of fish for age, growth and other statistical analyses at the National Fish Laboratory in Brampton.

Thirteen species were recorded over the 5 sites surveyed.

Density and standing crop of individual fish species are calculated using the number / weight of fish in each site and then a mean (average) calculated for the reach, in this case five sites. Density is reported as the number of individuals of that particular species that might be found in $100m^2$ of the river. Similarly, standing crop is the weight, or grams, of that fish species that might be found in the same area.

The average density (**number of fish in a given area**) of all species (>99mm) over the five sites surveyed was 9.46 Ind./$100m^2$ in 2013.

Total average standing crop (**weight of fish in a given area**) of all species (>99mm) over the five sites surveyed was 1183.3 g/$100m^2$ in 2013.

The largest individual and number of fish are recorded for brown trout, chub, roach, dace, perch and pike site level, (Table 2).

Table 2. Site specific population estimate (all fish) and largest length (mm) for selected species.

Site	Brown trout		Chub		Roach		Dace		Perch		Pike	
	No.	Largest	No.	Largest	No.	Largest	No.	Largest	No.	Largest	No.	Largest
Littlebury	33	375	-	-	133	177	40	203	-	-	-	-
U/s Hinxton / Ickleton	17	440	2	365	17	252	66	250	7	156	7	527
Pampisford Mill	83	407	33	450	49	194	65	218	-	-	-	-
Sawston Paper Mill	85	435	8	492	-	-	8	213	-	-	-	-
P.B.I	7	199	12	458	10	153	11	165	6	240	4	572

The largest fish from the survey included a 440mm brown trout, a 252mm roach and a 250mm dace from U/s Hinxton / Ickleton (site 4498), a 572mm pike and 240mm perch from P.B.I (site 4503) and a 492mm chub from Sawston Paper Mill (site 4501).

Table 3. Total number of fish present at site level from the U/s River Cam 2013.

Species	Survey Site Reference Number					Total
	Littlebury	U/s Hinxton / Ickleton	Pampisford Mill	Sawston Paper Mill	P.B.I	
	CAM31 (02/07/2013)	CAM34 (03/07/2013)	CAM35 (04/07/2013)	CAM37 (05/07/2013)	CAM39 (26/07/2013)	
Minnow	-	70	79	111	46	306
Bullhead	82	28	44	80	4	238
Brown trout	33	17	83	85	7	225
Roach	133	17	49	-	10	209
Dace	40	66	65	8	11	190
Gudgeon	18	27	93	-	2	140
Stone loach	50	11	4	-	6	71
Chub	-	2	33	8	12	55
3-spined stickleback	7	3	5	-	-	15
Perch	-	7	-	-	6	13
Pike	1	7	-	-	4	12
Spined loach	-	-	-	-	6	6
Brook lamprey	-	-	2	1	-	3
Total	**364**	**255**	**457**	**293**	**114**	**1483**

Table 4. Density estimates for (all fish) recorded at site level from the U/s River Cam 2013.

Species	Survey Site Reference Number					Mean
	Littlebury	U/s Hinxton / Ickleton	Pampisford Mill	Sawston Paper Mill	P.B.I	
	CAM31 (02/07/2013)	CAM34 (03/07/2013)	CAM35 (04/07/2013)	CAM37 (05/07/2013)	CAM39 (26/07/2013)	
Minnow	-	4.38	5.18	10.79	2.30	4.53
Bullhead	4.32	1.75	2.89	7.01	0.20	3.23
Brown trout	1.84	1.06	5.58	7.17	0.35	3.20
Roach	7.63	1.06	3.35	-	0.50	2.51
Dace	2.11	4.25	4.40	0.63	0.55	2.39
Gudgeon	1.00	1.88	6.37	-	0.10	1.87
Stone loach	2.63	0.75	0.26	-	0.30	0.79
Chub	-	0.13	2.23	0.63	0.65	0.73
3-spined stickleback	0.37	0.19	0.33	-	-	0.18
Perch	-	0.44	-	-	0.30	0.15
Pike	0.05	0.44	-	-	0.20	0.14
Spined loach	-	-	-	-	0.30	0.06
Brook lamprey	-	-	0.13	0.08	-	0.04
Total	**19.95**	**16.31**	**30.71**	**26.30**	**5.75**	**19.80**

Table 4a. Standing crop estimates for (all fish) recorded at site level from the U/s River Cam 2013.

Species	Survey Site Reference Number					Mean
	Littlebury	U/s Hinxton / Ickleton	Pampisford Mill	Sawston Paper Mill	P.B.I	
	CAM31 (02/07/2013)	CAM34 (03/07/2013)	CAM35 (04/07/2013)	CAM37 (05/07/2013)	CAM39 (26/07/2013)	
Brown trout	353.0	372.7	812.4	1096.2	10.4	528.9
Chub	-	81.3	891.0	391.3	190.1	310.7
Pike	30.5	276.1	-	-	282.2	117.8
Dace	99.4	208.6	162.0	53.3	19.8	108.6
Roach	190.6	164.8	100.7	-	17.2	94.7
Gudgeon	20.6	28.8	94.1	-	1.1	28.9
Bullhead	17.5	7.7	15.4	33.2	1.0	15.0
Perch	-	11.6	-	-	47.0	11.7
Minnow	-	4.6	6.3	13.0	1.9	5.2
Stone loach	8.9	2.0	1.2	-	1.2	2.7
3-spined stickleback	0.7	0.2	0.6	-	-	0.3
Brook lamprey	-	-	0.7	0.4	-	0.2
Spined loach	-	-	-	-	0.9	0.2
Total	**721.1**	**1158.4**	**2084.4**	**1587.4**	**572.9**	**1224.8**

Table 5. Density estimates for fish (>99mm) at site level from the U/s River Cam 2013.

Species	Survey Site Reference Number					Mean
	Littlebury	U/s Hinxton / Ickleton	Pampisford Mill	Sawston Paper Mill	P.B.I	
	CAM31 (02/07/2013)	CAM34 (03/07/2013)	CAM35 (04/07/2013)	CAM37 (05/07/2013)	CAM39 (26/07/2013)	
Brown trout	1.74	1.06	5.18	6.61	0.15	2.95
Roach	6.47	1.06	2.89	-	0.45	2.17
Dace	2.05	3.50	4.13	0.63	0.55	2.17
Gudgeon	0.68	1.00	3.15	-	-	0.97
Chub	-	0.13	2.17	0.63	0.65	0.71
Pike	0.05	0.44	-	-	0.20	0.14
Perch	-	0.31	-	-	0.30	0.12
Bullhead	0.21	-	-	0.32	-	0.11
Stone loach	0.26	-	0.07	-	0.05	0.08
Brook lamprey	-	-	0.13	0.08	-	0.04
3-spined stickleback	-	-	-	-	-	-
Minnow	-	-	-	-	-	-
Spined loach	-	-	-	-	-	-
Total	**11.47**	**7.50**	**17.72**	**8.27**	**2.35**	**9.46**

Table 5a. Standing crop estimates for fish (>99mm) at site level from the U/s River Cam 2013.

Species	Survey Site Reference Number					Mean
	Littlebury	U/s Hinxton / Ickleton	Pampisford Mill	Sawston Paper Mill	P.B.I	
	CAM31 (02/07/2013)	CAM34 (03/07/2013)	CAM35 (04/07/2013)	CAM37 (05/07/2013)	CAM39 (26/07/2013)	
Brown trout	353.9	372.7	801.5	1085.5	9.2	524.5
Chub	-	81.3	890.9	391.3	190.1	310.7
Pike	30.5	276.1	-	-	282.2	117.8
Dace	98.8	201.3	157.8	53.3	19.8	106.2
Roach	176.7	164.8	94.8	-	17.0	90.7
Gudgeon	17.2	19.9	59.4	-	-	19.3
Perch	-	10.8	-	-	47.0	11.6
Bullhead	3.0	-	-	4.6	-	1.5
Stone loach	3.0	-	0.6	-	0.5	0.8
Brook lamprey	-	-	0.7	0.4	-	0.2
3-spined stickleback	-	-	-	-	-	-
Minnow	-	-	-	-	-	-
Spined loach	-	-	-	-	-	-
Total	**683.0**	**1126.8**	**2005.7**	**1535.0**	**565.8**	**1183.3**

Figure 2 and 2a display the mean density and standing crop for the main species present (>99mm) from the U/s River Cam 2013.

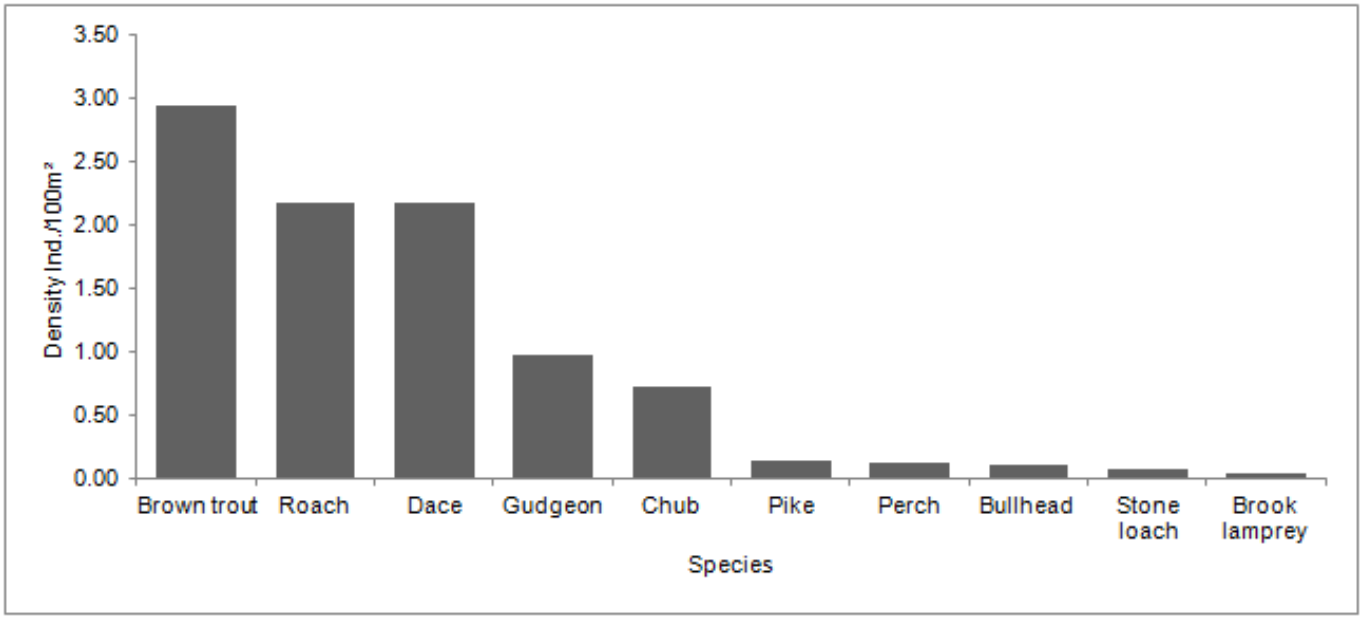


Figure 2: Mean density of fish (>99mm) from the U/s River Cam 2013

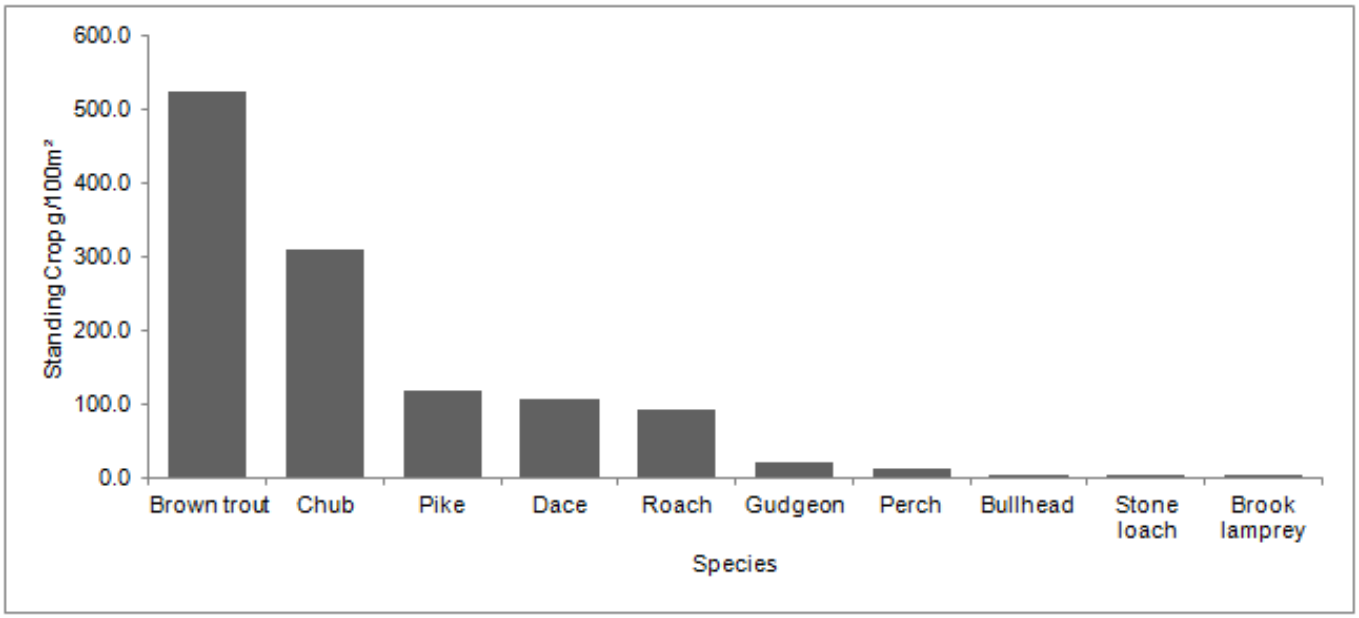


Figure 2a: Mean standing crop of fish (>99mm) from the U/s River Cam 2013

Figure 2 indicates that brown trout were the most common fish (>99mm) over the five sites, with a maximum density estimate of 2.95 individuals for every 100m^2 of river surveyed, equivalent to a 31% share of the total population. Roach and dace were subdominant, both contributing 25% to the overall population.

Figure 2a shows that brown trout are also the dominant species' by weight with a mean standing crop estimate of 524.5g for every 100m^2 of the river sampled. Chub were subdominant with 310.7g/100m^2, followed by pike with a standing crop estimate of 117.8g/100m^2.

Figure 3 and 3a display density and standing crop for individual species at site level from the D/s River Cam 2013.

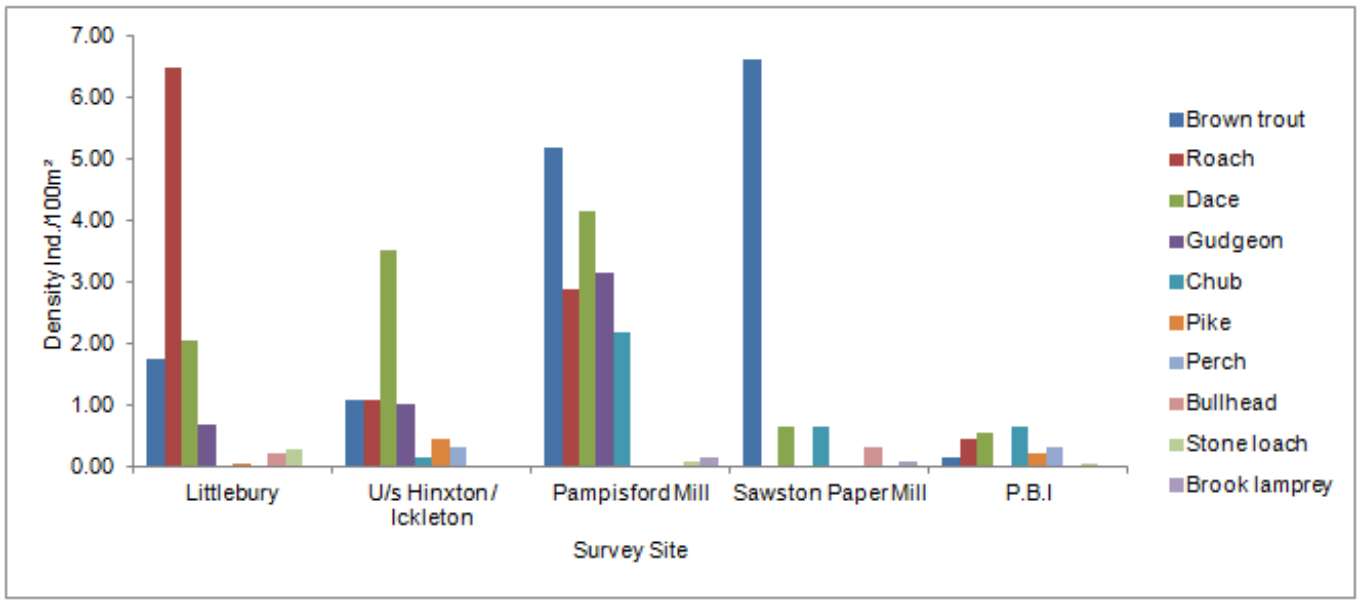


Figure 3: Density of fish (>99mm) at site level from the U/s River Cam 2013

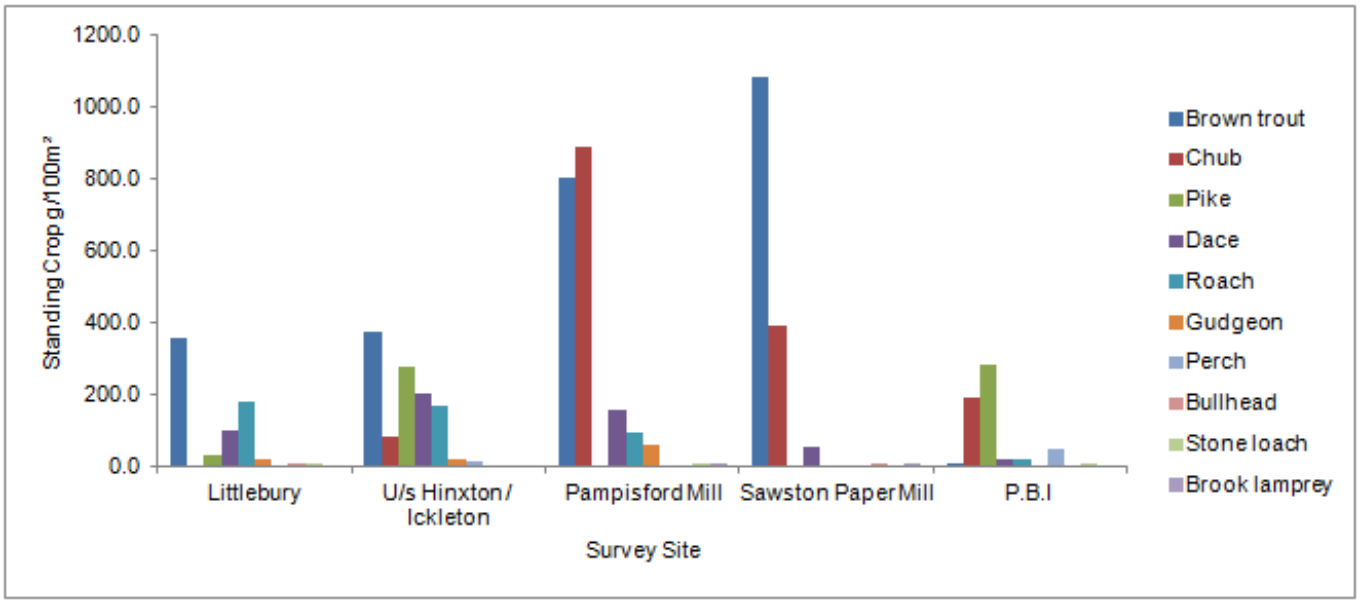


Figure 3a: Standing crop of fish (>99mm) at site level from the U/s River Cam 2010

Figure 3 displays density at site level for the major fish species present within the U/s River Cam in 2013. Immediately apparent is the capture of 133 roach from Littlebury and 85 brown trout from Sawston Paper Mill, recording density estimates of 6.47 and 6.61 Ind./100m² respectively. In terms of numbers of fish present Pampisford Mill would seem to offer the greatest angling potential, with a total of 457 fish recorded comprising of ten different species.

Figure 3a shows a similar graph, this time displaying standing crop at site level from the U/s River Cam during 2013. Brown trout were the dominant species at three of the five sites surveyed, the exceptions being Pampisford Mill and P.B.I.

Site Name: Littlebury
Survey Date: 02.07.2013
Local Site Ref: CAM31

Image 4: Littlebury survey site

A total of 1615m^2 of channel was sampled using electric fishing apparatus and was fished in an upstream direction between a stop net and gauging weir confining fish within the survey area. The site at Littlebury averaged 50cm deep and 8.5m wide with a substrate consisting primarily of gravel (65%), with sand (20%), silt (10%) and cobbles (5%) also present.

A basic habitat assessment carried out at the time of the survey to establish suitable habitat for fish populations to utilise identified riparian tree cover, woody debris and tree roots as all being present. A wide variety of flow types were also recorded with riffle, pool, glide and slack all observed. Submerged and emergent macrophytes were both noted as being sparse in distribution, with species present including; starwort (*Callitriche),* reed sweet-grass (*Glyceria maxima*), yellow flag iris (*Iris pseudacorus*) and reedmace (*Typha sp.*).

Despite the habitat seeming to suit rheophilic fish, species which favour shallow, fast flowing water with areas of gravel substrate, the 2013 survey was dominated by roach, with dace sub-dominant.

Figure 4 displays the historic dataset for all species (>99mm) recorded at Littlebury between 1991 and 2013. Fish populations were seemingly at their strongest during 1996. Survey data collected in the 2013 survey cycle indicates a total population density comparable to that seen during the early 1990's. Of the

five historic surveys, only the 1996 survey achieved a density estimate greater than the mean average recorded at this location.

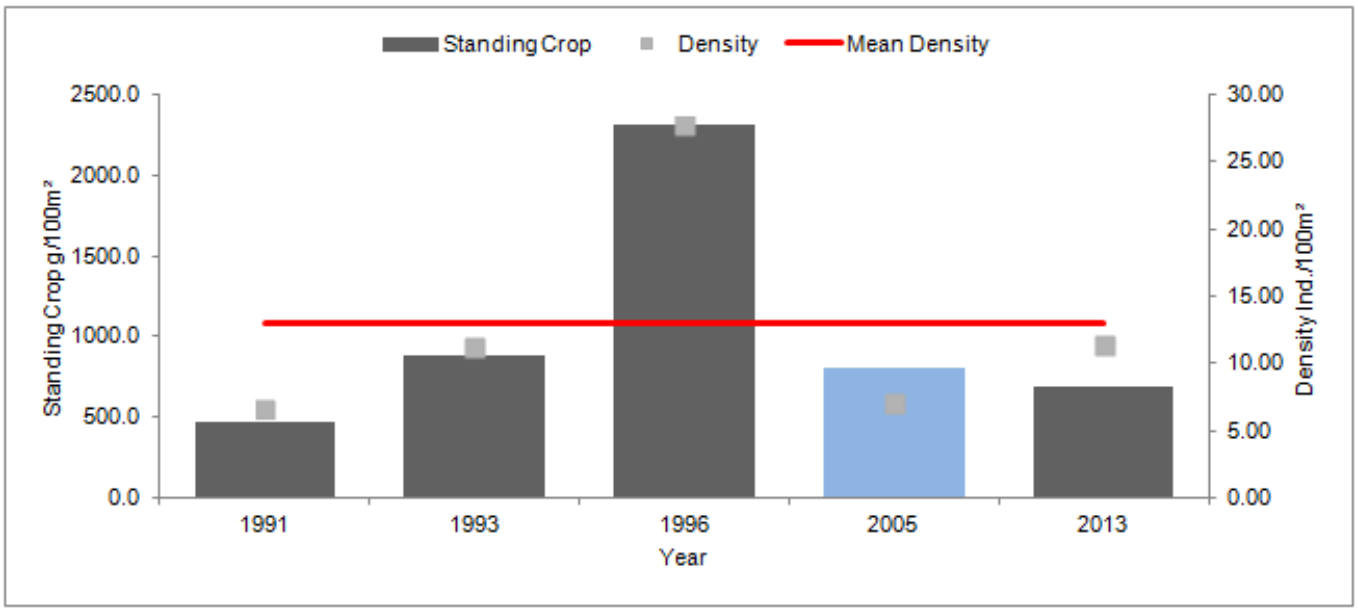


Figure 4: Historic standing crop and density (>99mm) recorded at Littlebury 1991 – 2013
*(*2005 = single catch survey)*

Figure 4a displays the historic density data for the key angling species (>99mm) from Littlebury between 1991 and 2013. Dace populations at this site have declined since the 2005 survey cycle and are significantly lower than recorded in 1996.

Roach populations at Littlebury have increased significantly since 2005 and currently represent the highest density estimate to date at this location. In total 133 fish were caught during the 2013 survey cycle with the largest individual measuring 177mm in length.

Brown trout density is currently higher than that recorded during the 1990's and is comparable to the 2005 survey cycle when the population peaked at 1.81 Ind./100m².

Since peaking in 1993, the perch population has shown a declining trend, with this species absent during the most recent survey in 2013. This decline may be a combination of stock manipulation and lack of suitable habitat throughout the upper reaches of this watercourse.

Pike have been poorly represented at Littlebury, with only three reported captures during the five spatial surveys, totalling 3 fish, one in 1993, one in 2005 and one in 2013. As with perch, the limited number of pike present is possibly attributed to coarse fish removals and insufficient habitat.

Chub have only been recorded once since 1991, with the capture of 3 fish during the 2005 survey cycle. At present it's difficult to accurately ascertain the reasoning behind this low number of chub recorded at this location, as habitat certainly seems favourable.

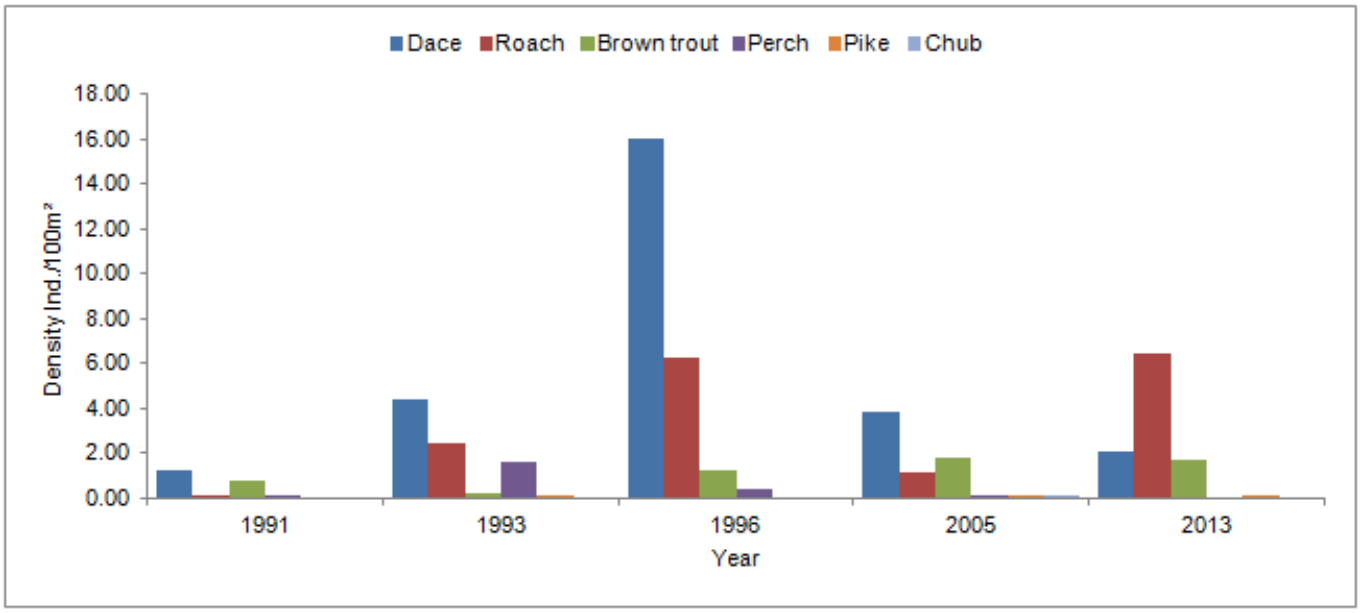


Figure 4a: Historic density (>99mm) for the key angling species at Littlebury 1991 – 2013

Image 5: A 375mm brown trout caught from the Littlebury survey site

Site Name: U/s Hinxton / Ickleton
Survey Date: 03.07.2013
Local Site Ref: CAM34

Image 6: U/s Hinxton / Ickleton survey site

The survey site at U/s Hinxton / Ickleton averaged around 50cm deep and 8m wide with a substrate consisting primarily of gravel (80%), with sand (15%) and silt (5%) also present. In total 1600m^2 of channel was sampled using electric fishing apparatus and fished in an upstream direction between stop nets.

Emergent and submerged macrophytes were both observed as being abundant, with extensive coverage of reed sweet grass (*Glyceria maxima*), branched bur-reed (*Sparganium erectum*) and water crowfoot (*Ranunculus sp.*). Intermittent riparian tree cover, woody debris and two relatively deep pools provided essential cover and were utilised by the larger chub and brown trout present. Flow diversity consisted of riffle, pool, run and glide habitats.

The habitat throughout this section of watercourse seems suited to rheophilic fish species and the 2013 survey data seems to reflect this, dominated by dace with brown trout and roach subdominant.

Figure 5 displays the historic dataset for U/s Hinxton / Ickleton between 1991 and 2013. Standing crop has remained relatively consistent over the course of the six spatial surveys density however, has shown some degree of fluctuation, with the most recent survey in 2013 recording a density estimate marginally lower than the mean average.

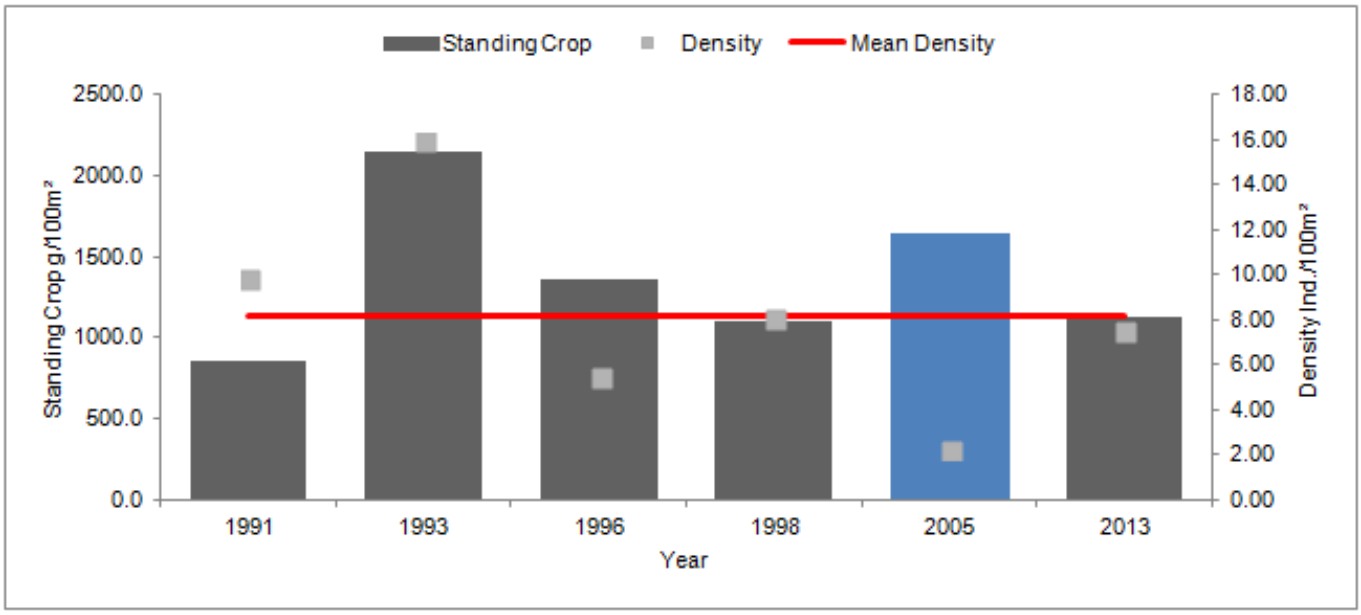


*Figure 5: Historic standing crop and density (>99mm) recorded at U/s Hinxton / Ickleton 1991 – 2013 (*2005 = single catch survey)*

Figure 5a displays the historic density data for the key angling species (>99mm) from U/s Hinxton / Ickleton between 1991 and 2013. Dace were absent in the 2005 survey cycle and the population has shown considerable fluctuation at this site; whether this has been due to stock migration, season aggregation, poor spawning years or historic manipulation of stock is uncertain but all are plausible.

Brown trout density remains comparable to the 1991 and 1998 survey cycles and an improvement over 2005. While the surveys in 1993 and 1996 produced significantly higher density estimates it is not possible to say what impact stocked fish have had on these results. As the bulk of these fish were of a similar length, it is possible that stocked fish influenced these catches.

Pike have only been present during four of the six surveys at U/s Hinxton / Ickleton, with the population seemingly peaking in 2005 with the capture of 23 fish. The population declined by 69% in 2013.

Perch have been recorded during the previous five surveys, with the 2013 survey cycle recording the highest density estimate to date since the population peaked in 1993, albeit a meagre 0.31 Ind./100m².

Roach populations at U/s Hinxton / Ickleton have increased since 2005 and currently represent the highest density for the species recorded at this location. It should be noted however that this seemingly significant improvement only equates to a total of 17 individuals captured.

Chub had been absent from this site in historic surveys but were found during 2005 with the capture of 10 fish and then again in 2013 when 2 fish were caught. The 2005 survey covered a larger area than routinely surveyed and as such the higher figure in that survey may represent the wider variety of habitat sampled as chub have a close affiliation to the presence of overhead cover.

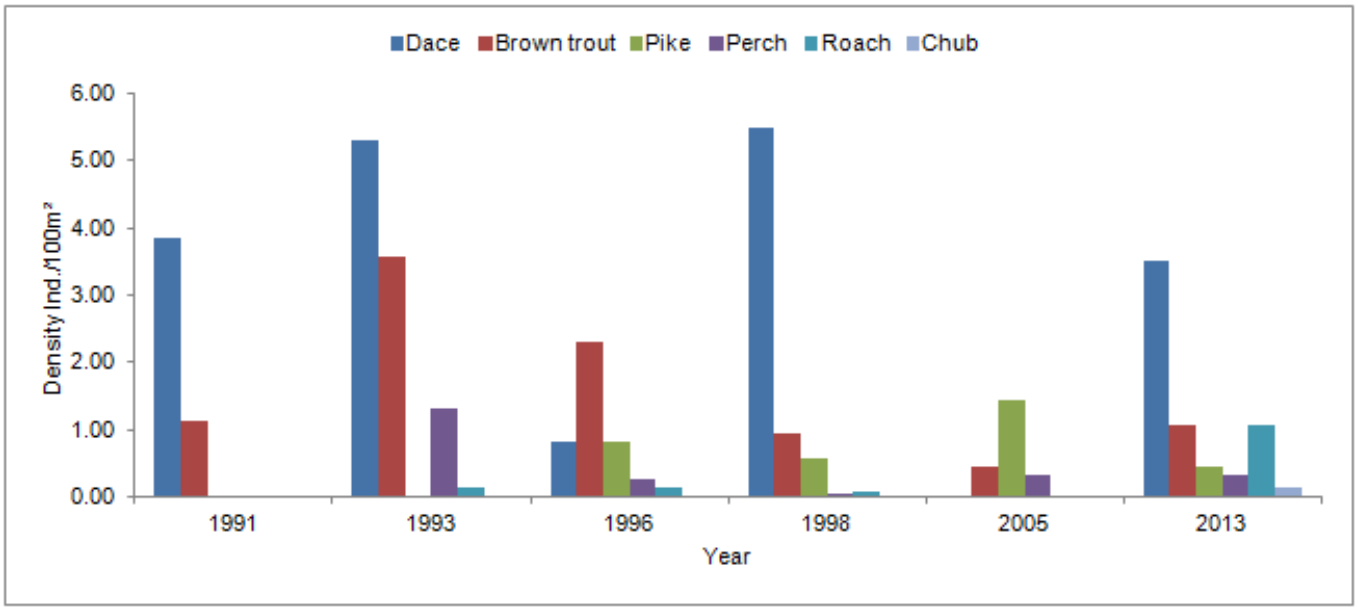


Figure 5a: Historic density (>99mm) for the key angling species at U/s Hinxton / Ickleton 1991 – 2013

Image 7: One of the 17 roach caught from U/s Hinxton / Ickleton survey site

Site Name: Pampisford Mill
Survey Date: 04.07.2013
Local Site Ref: CAM35

Image 8: Pampisford Mill survey site

The survey site at Papimsford Mill averaged 6m wide and 250m in length, with approximately 1530m² of channel sampled with electric fishing apparatus between stop nets. The substrate comprised primarily of gravel and pebbles (75%) with sand (20%) and areas of silt (5%) also present.

Abundant submerged macrophytes, intermittent riparian tree cover, woody debris and tree roots were all present and are essential habitat for fish to utilise. Flow diversity consisted of riffles, pools, runs and glides.

The 2013 survey was dominated by rheophilic fish species, with brown trout accounting for 29% of the overall catch, followed by dace with 23% and gudgeon with 18%. Of the five sites sampled in 2013, Papmisford Mill recorded the highest overall standing crop and density estimates.

Historically both pike and perch have been poorly represented at Pampisford Mill, with the 2013 survey cycle no exception with both species absent. Brook lamprey an important BAP species were present, albeit in low numbers.

Figure 6 displays the historic dataset for Pampisford Mill between 1991 and 2013. Total fish density and standing crop has increased steadily since 1998 however the most recent data collected in 2013 remains significantly lower than recorded during the 1990's.

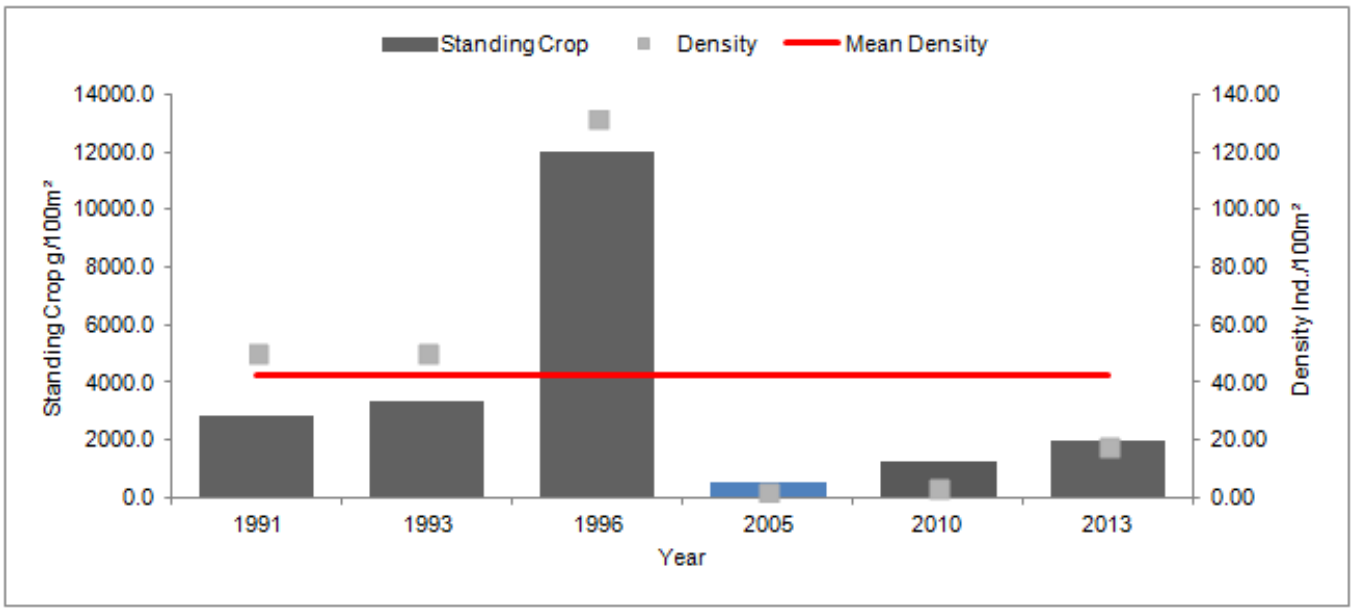


*Figure 6: Historic standing crop and density (>99mm) recorded at Pampisford Mill 1991 – 2013 (*2005 = single catch survey)*

Figure 6a displays the historic density data for the key angling species (>99mm) from Pampisford Mill between 1991 and 2013. Roach populations appear to have fared particularly poorly at Pampisford Mill, however slight improvements have been recorded since 2005. It is not possible to conclude the cause of this decline in the population due to a lack of monitoring between 1996 and 2005.

Much of the decline in fish density noted at Pampisford Mill can be attributed to a decline in chub populations. Historic surveys at this location have recorded some very large aggregations of the species with the 1996 survey recording 366 fish, the majority of which were young fish.

Dace populations are much improved when compared to the 2005 and 2010 surveys and are currently at their highest since 1996 and comparable to that found during the 1993 survey cycle.

Brown trout density is currently the highest level recorded at this location with a catch of over 80 individuals in 2013. The majority of these fish were larger individuals but some juvenile fish were also found.

Perch have only been observed once since 1991 at Pampisford Mill in 1993 with the capture of 2 individuals, the largest of which measured 193mm.

As with perch, pike have also only ever been recorded once at Pampisford Mill, during 2010 with the capture of 1 individual fish measuring 670mm in length.

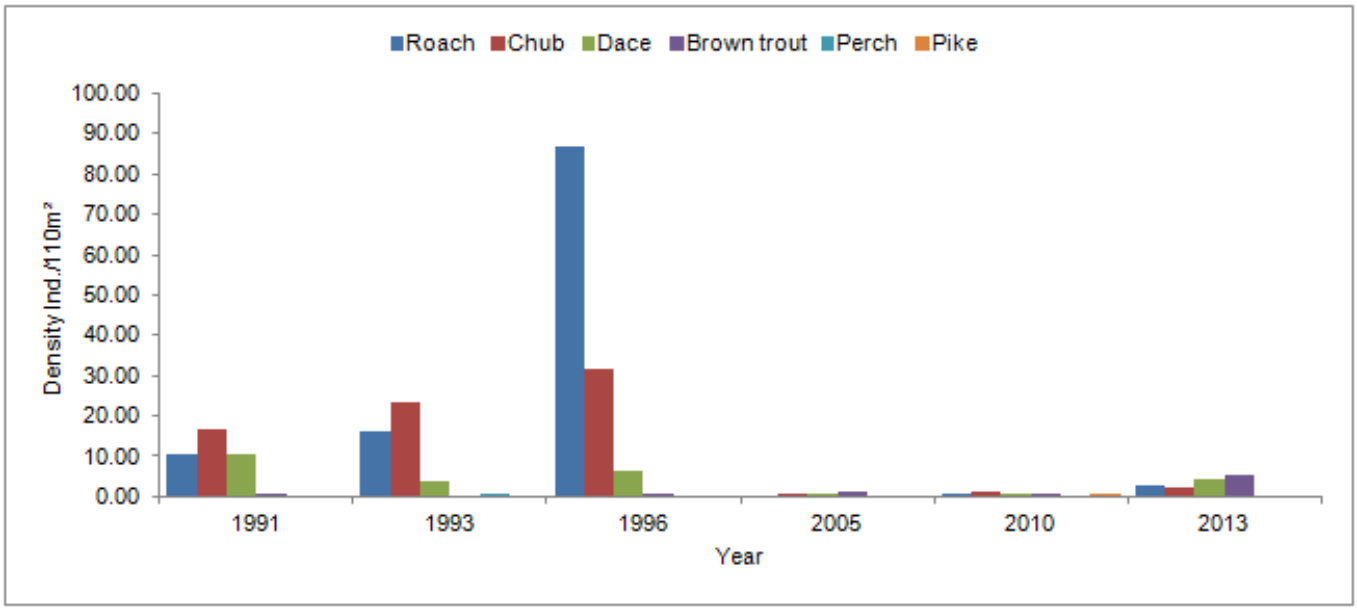


Figure 6a: Historic density (>99mm) for the key angling species at Pampisford Mill 1991 – 2013

Image 9: A 407mm brown trout caught from Pampisford Mill survey site

Site Name: Sawston Paper Mill
Survey Date: 05.07.2013
Local Site Ref: CAM37

Image 10: Sawston Paper Mill survey site

The survey site at Sawston Paper Mill is approximately 255m long and 5m wide covering 1275m² of channel. The substrate chiefly comprised of gravel and pebbles (65%), with sand (29%), silt (5%) and clay pan (1%) also present.

Emergent macrophytes were sparse in distribution, whereas submerged macrophytes were noted as being abundant dominated by large beds of water-crowfoot (*Ranunculus sp*.). Sparse overhead riparian tree cover and woody debris was all observed and provided essential cover, utilised by the large specimen sized brown trout.

Species composition at Sawston Paper Mill comprised entirely of rheophilic fish species, dominated by brown trout, with chub and dace subdominant. Of the five sites sampled in 2013 Sawston Paper Mill recorded the highest brown trout density estimate at 6.61 Ind./100m², consisting of 85 fish, the largest of which measuring 435mm.

Pike and perch were absent at Sawston Paper Mill during 2013. At present its difficult ascertain the reasoning behind their absence, however further monitoring should identify whether this could be cause for concern or the result of unsuitable habitat and historic coarse fish removals. One brook lamprey was also recorded, the only other site to record the presence of this species.

Figure 7 displays the historic dataset for Sawston Paper Mill between 1991 and 2013. Despite the overall number of fish present in 2013 increasing when compared to the previous survey in 2010, mean standing crop and density has declined by 33 and 36% respectively. This decline is primarily attributed to a reduction in the number of dace and chub caught.

Since the 1996 spatial survey, Sawston Paper Mill has failed to achieve a density estimate equal to or greater than the mean recorded density estimate of 24.31 individuals for every 100m² of river surveyed.

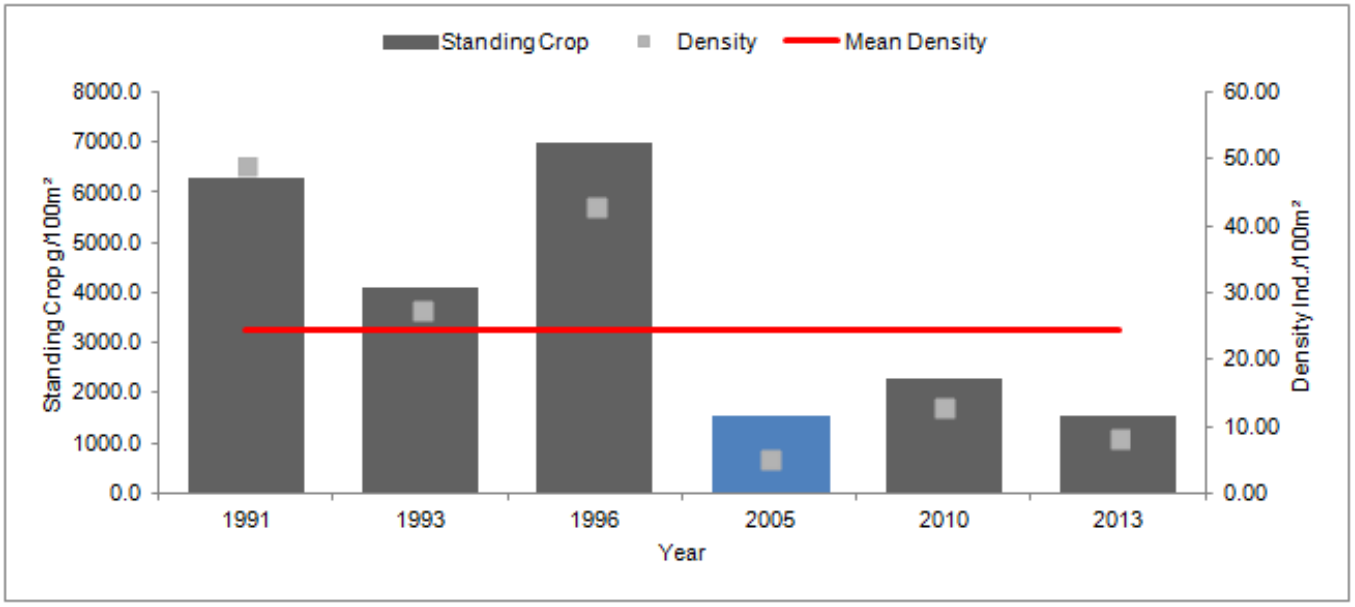


*Figure 7: Historic standing crop and density (>99mm) recorded at Sawston Paper Mill 1991 – 2013 (*2005 = single catch survey)*

Figure 7a displays the historic density data for the key angling species (>99mm) from Sawston Paper Mill between 1991 and 2013. Chub populations at Sawston Paper Mill show a similar pattern to that seen at Pampisford Mill with populations building between 1991 and 1996 and then declining significantly by 2005. The 2013 survey cycle saw recorded chub density decline further, with the density estimate falling from 1.97 to 0.63 Ind./100m². No evidence of recent recruitment was present, the smallest fish being 169mm (standard growth suggests this fish would be 3+ years old).

Since peaking in 1996 with the capture 130 fish, dace have been poorly represented with only 47 fish captured in total over the following three spatial surveys. Habitat certainly seems favourable for this rheophilic species and it is possible that successive coarse fish removals have impacted negatively upon the population and will take several years to recover.

Roach have been absent from Sawston Paper Mill since 2005. As with dace, this species has also been impacted by historic coarse fish removals however unlike dace, habitat may be influencing roach distribution to areas of the watercourse which offer better protection from predators and areas of slower, deeper water.

Brown trout density at Sawston Paper Mill has increased significantly since 2005. In terms of the total number of fish present, the 2013 survey caught 11 more fish than in 2010 however the poor catch efficiency in that survey cycle led to a higher overall density estimate. It is not known to what extent stocking is bolstering this population, however some evidence of juvenile recruitment was apparent with six fish <99mm in length recorded.

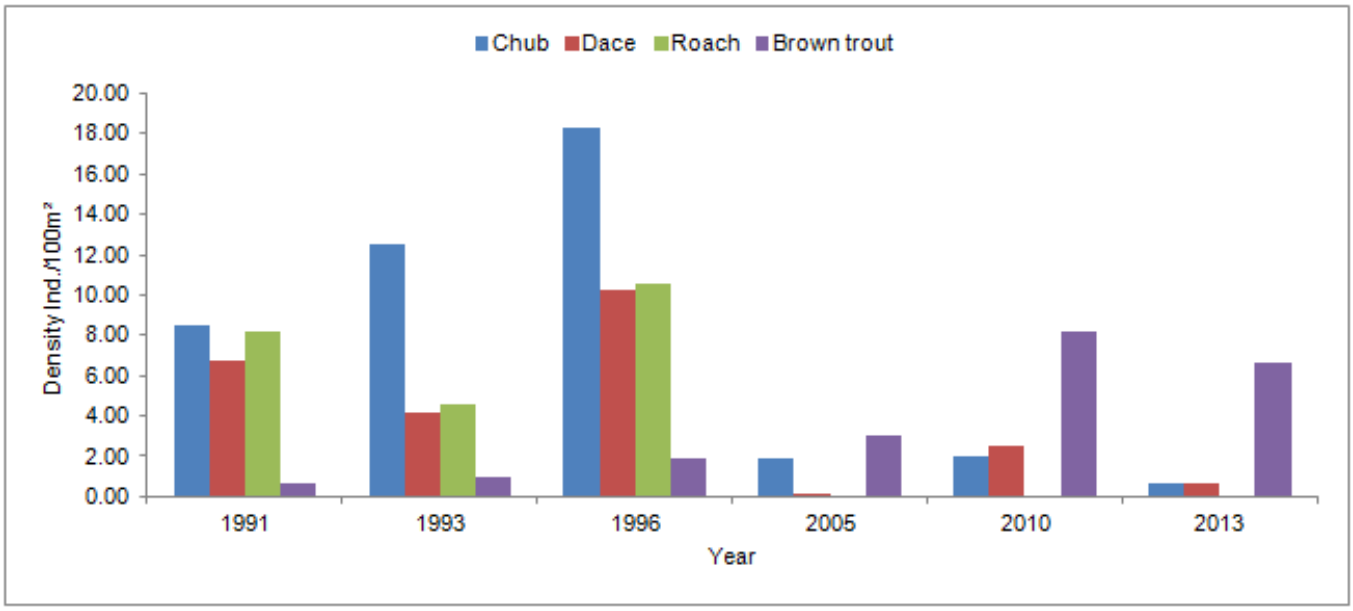


Figure 7a: Historic density (>99mm) for the key angling species at Sawston Paper Mill 1991 – 2013

Image 11: A 435mm brown trout caught from Sawston Paper Mill survey site

Site Name: P.B.I
Survey Date: 26.07.2013
Local Site Ref: CAM39

Image 12: P.B.I survey site

A total of 1540m^2 of channel was sampled using electric fishing apparatus and fished in a downstream direction between stop nets confining fish within the survey area. The P.B.I survey site averaged 120cm in depth and 7m in width with a substrate consisting primarily of silt (60%) with gravel / pebbles (40%) or present.

Available habitat for fish populations to exploit at this location includes woody debris, tree roots, overhead riparian tree cover and emergent and submerged macrophytes. Flow diversity consisted of runs, glides and areas of slack water. The varying habitat observed during 2013 is the result of recent habitat enhancement works carried out throughout the lower reaches of the River Cam watercourse.

Over 1200 new homes are due to be built near Trumpington Meadows and the programme of river enhancement work has been undertaken as part of this construction phase to establish an adjacent Riverside Community Park of around 60 hectares in size. Habitat enhancement work was undertaken by Rob Mungovan of South Cambridgeshire District Council in association and part funded by the Environment Agency.

Investigative monitoring was undertaken at four locations in 2008 to provide baseline data prior to the habitat restoration. Three surveys were undertaken within the P.B.I reach, one pre habitat monitoring survey and two post habitat monitoring surveys, (Table 6).

Table 6. Pre and post habitat monitoring data at P.B.I 2008 to 2010.

Species	Pre Habitat Monitoring CAM39 (17/09/2008)	Post Habitat Monitoring CAM39 (16/03/2010)	Post Habitat Monitoring CAM39 (11/11/2010)	Total
Minnow	7	47	18	72
Bullhead	-	21	11	32
Spined loach	1	7	4	12
Gudgeon	1	3	5	9
Brow n trout	-	-	6	6
Pike	4	-	2	6
Perch	4	-	1	5
European eels	2	-	1	3
Stone loach	-	3	-	3
Roach	2	-	-	2
Brook lamprey	-	-	1	1
Chub	1	-	-	1
Total	**22**	**81**	**49**	**152**

The two post habitat surveys were undertaken to assess changes in the fish population's following the completion of in-channel improvements which included:

- Re-grading of the rivers banks to restore a historically dredged section of channel.
- Installation of wooden revetments, faggoting and timbers positioned over 330m of river to increase habitat diversity.
- Creation of eight gravel shoals and four flow deflectors to increase water velocity and to scour silt from the channels bed.
- Provision of backwater habitat by the installation of two new sluices which retain a greater depth of water in an adjoining ditch system providing habitat suitable for spawning, nursery areas and protection from high flows.
- The river bed being raised to compensate for the historic dredging operations which have over deepened the river.

Figure 8 displays the historic dataset for P.B.I between 1991 and 2013. The 2013 survey recorded the highest standing crop and density estimates since 1996 however, density remains significantly lower than the mean recorded average at this site. It would seem that habitat improvement work and the opening of a fish bypass channel at Byron's Pool are possible factors which have influenced the increased fish densities at this site in 2013 and which has likely to have been further bolstered by a general upturn in coarse fish populations such as those observed at several other sites sampled on the upper River Cam in 2013.

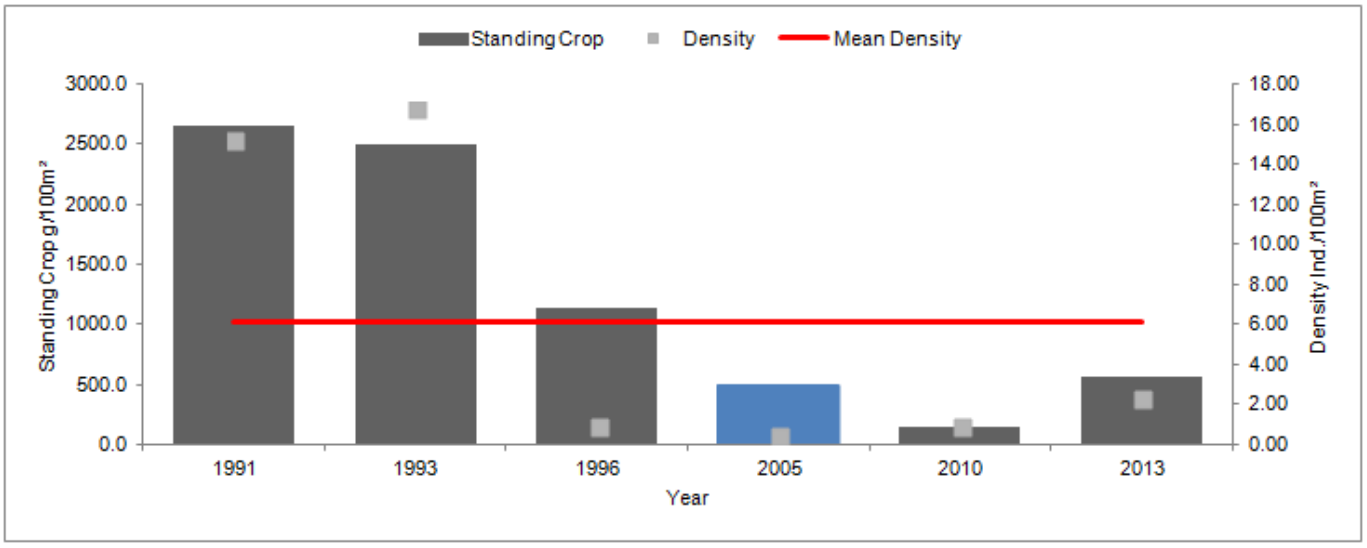


Figure 8: Historic standing crop and density (>99mm) recorded at P.B.I 1991 – 2013
*(*2005 = single catch survey)*

Figure 8a displays the historic density data for the key angling species (>99mm) from P.B.I between 1991 and 2013. Roach had not been recorded at this survey site since 1993 and a total of only three individuals were found nearby during the investigative surveys, as such the inclusion of 11 roach in the 2013 survey cycle is encouraging. The 1993 survey data should be viewed with caution as this survey was undertaken during the winter months and it cannot be discounted that seasonal aggregation had caused a skewed distribution of roach stocks.

Pike populations have historically been greater in the early 1990's, which is of no surprise due to the number of prey fish (roach and dace) present during these two surveys.

The 2013 survey cycle recorded the second highest chub density to be caught at this site with twelve individuals present. The population was composed of 3 large fish to over 400mm in length and 9 fish from younger year classes between 120—160mm in length.

Dace had not been recorded at this site since 1993 when a single individual was found, although low densities had been recorded nearby during the investigative surveys in 2008 and 2010. In 2013 the dace population was composed of 11 individuals between 102 and 165 mm in length.

Brown trout have only been recorded at the P.B.I survey site since 2010. It is possible that the previously discussed habitat improvement works has proven favourable for this species offering more suitable habitat for fish to utilise.

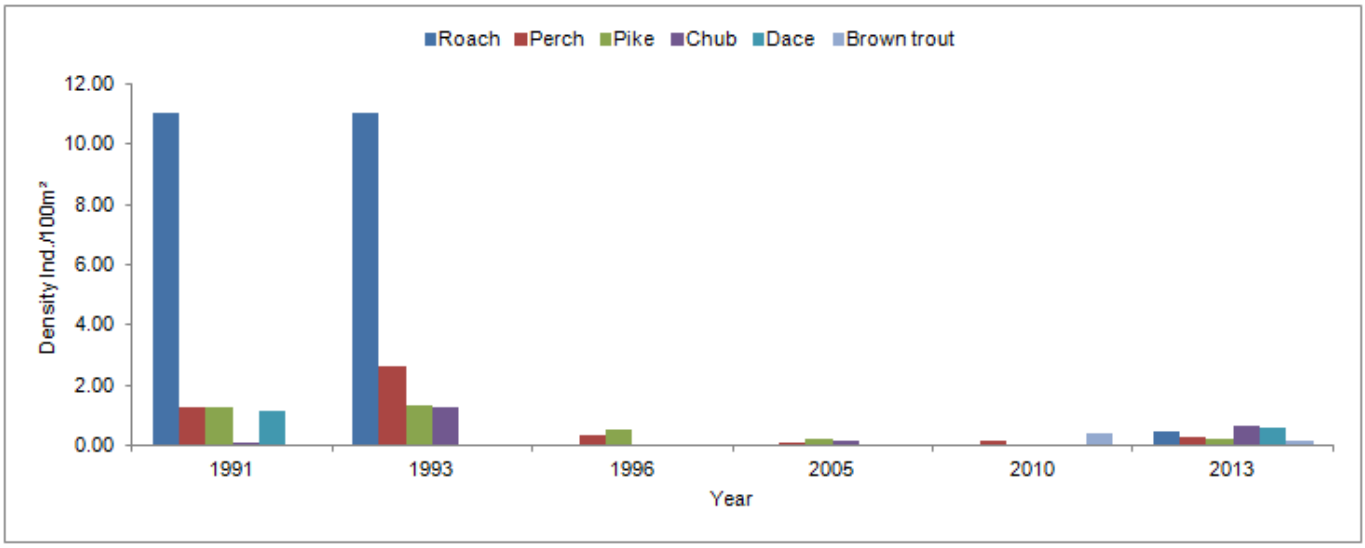


Figure 8a: Historic density (>99mm) for the key angling species at P.B.I 1991 – 2013

Length frequency distributions. The lengths of fish measured during the survey programme can be collated to produce a frequency distribution. These can be used to identify population age structure and potential strong year classes, (Figures 9, 9a and 9b).

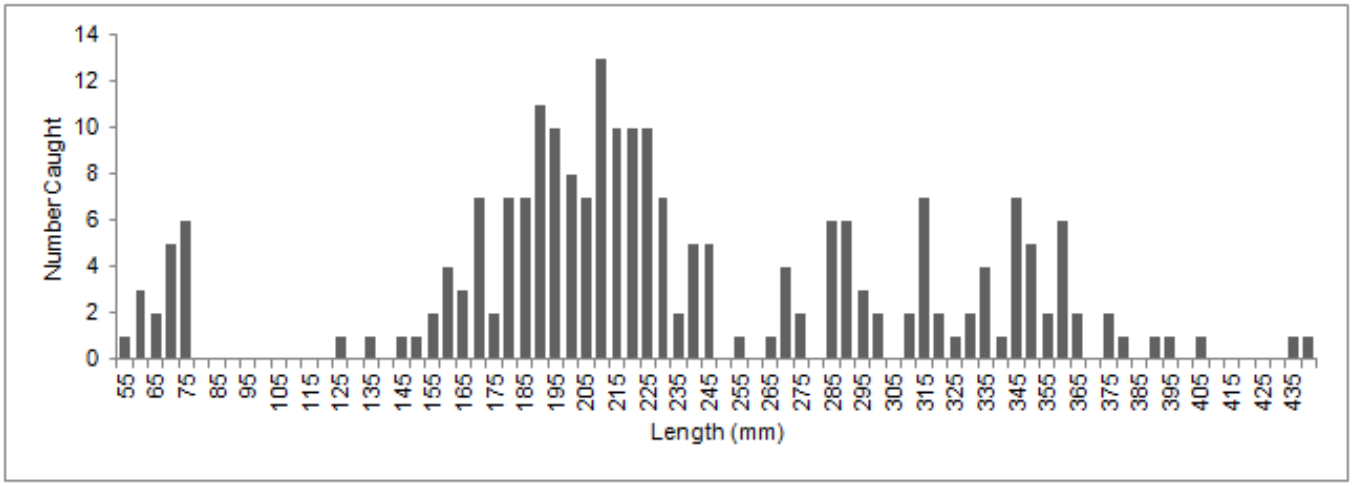


Figure 9: Brown trout length frequency data. The bulk of brown trout caught measured between 160 and 230mm in length. Note the gap in juvenile year classes.

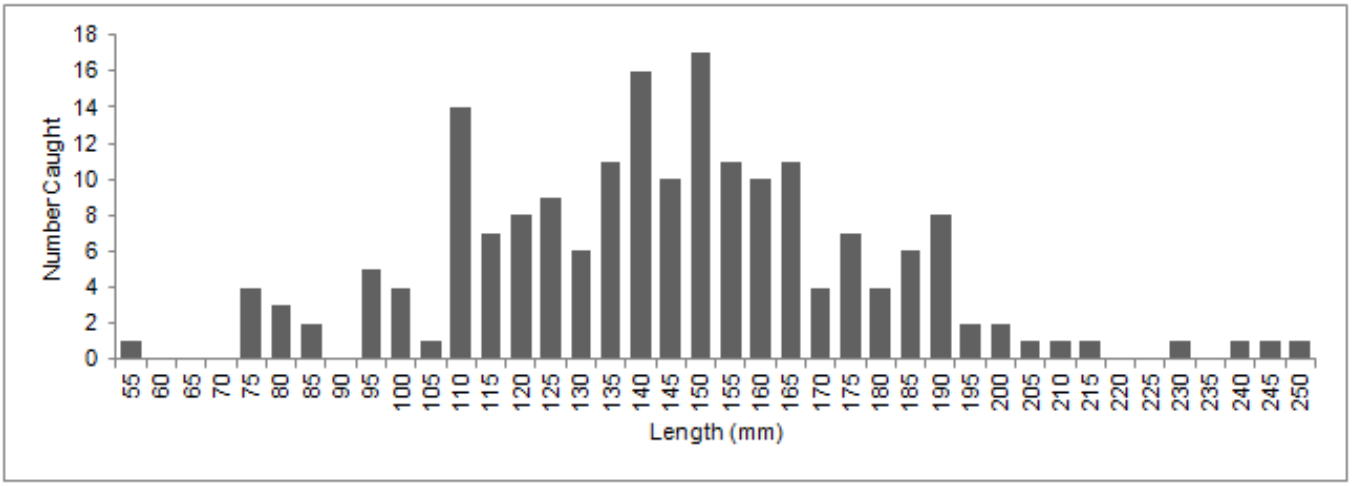


Figure 9a: Dace length frequency data. The majority of dace caught measured between 110 and 190mm in length

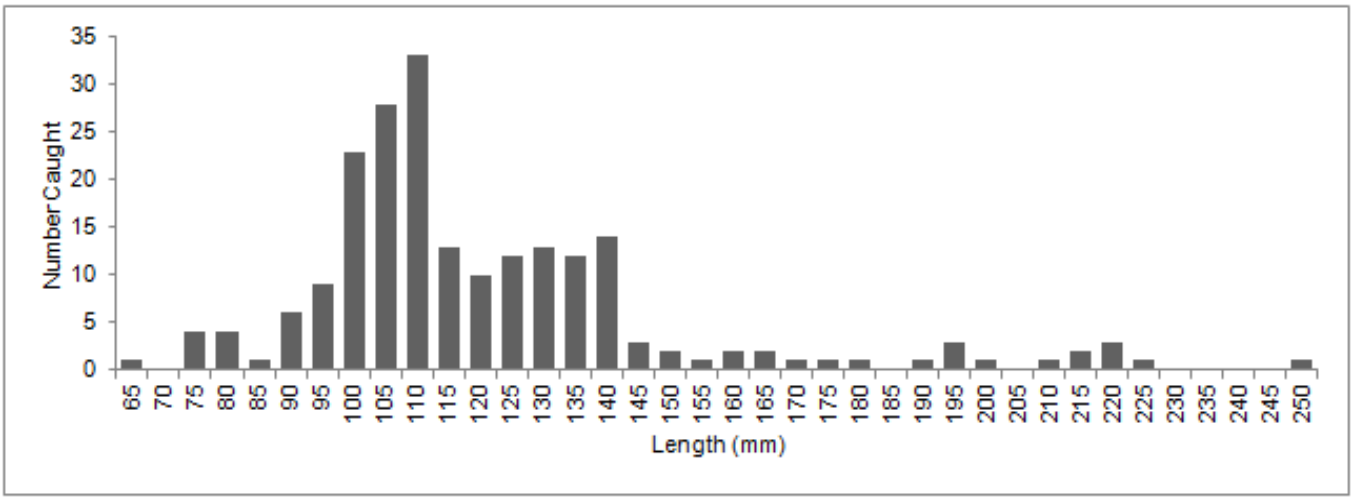


Figure 9b: Roach length frequency data. The bulk of roach caught measured between 95 and 140mm in length

DISCUSSION

In terms of recorded fish density it would appear that fish populations have increased at four of the five sites sampled in 2013, the exception being Sawston Paper Mill. Fish stocks at some locations remain lower than have been recorded historically with recent catches at Pampisford and Sawston Paper Mill much reduced when compared to those made in the 1990's.

The decline in population density at Pampisford and Sawston Paper Mill is primarily due to decreased numbers of roach, dace and chub. Changes to the fisheries monitoring programme led to a lack of sampling between 1996 and 2005, the critical time during which the decrease in fish populations occurred.

The historic 1990 surveys were carried out at differing times of the year meaning that further uncertainty is introduced to the dataset. The largest catch made at Pampisford Mill was recorded in 1996, however in this instance the survey was conducted during the winter potentially allowing seasonal aggregation to skew the results in favour of this survey year. The other 1990's surveys were undertaken in May and September.

It is interesting to note that the 1991, 1996 and 2005 surveys occurred during periods of low flow or drought conditions which may also imply that stock distribution had been influenced by these environmental factors.

The 1996 survey, which produced the highest catches of roach and chub, found that the dominant year classes for these species were spawned in the second year of a drought period in 1991/1992. It is feasible that the juvenile coarse fish spawned during this period thrived in the warm low flow conditions and were able to grow on rapidly and survive their critical first year.

It was surprising to note that the 1993 survey found the most numerous year class present for dace was also 1992. This is slightly counter intuitive as a successive drought period seems more likely to be detrimental to dace recruitment through sedimentation of vital spawning media. The 1993 survey also found strong representation from the 1990 and 1992 year classes of roach.

The U/s Hinxton / Ickleton and Pampisford Mill survey sites have both shown gradual improvements to the fish population since the 2005 survey cycle when dace, gudgeon and chub were absent and roach represented by a single individual. The 2013 survey at U/s Hinxton / Ickleton found that dace populations were composed of 66 individuals of several year classes and both gudgeon and chub were present with 27 and 2 individuals recorded respectively. Roach numbers had increased to 17, predominantly dominated by larger individuals ranging between 122mm – 252mm in length. There was no evidence of recent recruitment to the population. Both of the chub captured were also large individuals with a measured fork lengths of 365mm.

Fish populations at Pampisford Mill have also shown steady improvement since 2005 and while population densities are far lower than recorded in the 1990's increasing chub, dace and roach populations have been recorded. Stone loach and minnow, two key species absent in 2005, were found to be present in 2013 with 4 and 79 individuals recorded respectively. Perch and pike remained absent.

Sawston Paper Mill does not appear to have shown a similar increase in coarse fish and species composition at this site remains low. Chub density has declined from that recorded in 2004 and 2010. The current fish population is dominated by brown trout and conversation with members of the survey team suggests that this site is no longer suited to hold a large population of roach being predominantly shallow and fast flowing.

The upper River Cam is stocked with brown trout to support an angled salmonid fishery however some natural recruitment of wild stock does occur. Bio manipulation of coarse fish populations has occurred in the upper reaches of this watercourse with coarse fish species selectively removed by the Environment Agency and its predecessors at the request of controlling angling clubs, further reducing confidence in the historic datasets.

During these operations unwanted coarse fish species are removed by electric fishing from the beats where trout angling occurs. These fish are then reintroduced where they would be of benefit to coarse anglers, this may have been in the lower River Cam, Bourn Brook or a different river catchment to supplement fish populations, for example following a pollution incident.

Although some historic data relating to fish numbers removed has been lost, data shows that since the 1984 approximately 27000 coarse fish have been removed from the upper River Cam between Audley End and Duxford, (Table 7).

Table 7. Estimated number of coarse fish removed from the upper River Cam between 1984 and 2011

Species	Total No. Removed
Dace	11776
Roach	7576
Gudgeon	5448
Pike	927
perch	906
Common bream	297
Silver bream	115
chub	110
Eel	11
Stone loach	8
Ruffe	8
Rudd	3
Tench	1
Total	**27186**

This practice was last conducted in 2011 when 226 coarse fish were removed from the Littlebury beat. The manipulation of fish stocks to exclude coarse fish species has now ceased.

Several barriers are present throughout the upper reaches of this watercourse and may be limiting or denying fish migration and isolating populations. Since the previous survey in 2010, one of these barriers has been addressed at Byron's Pool through the provision of a bypass channel which is being utilised by fish stocks.

Prior to the creation of the Byron's Pool bypass channel, less than 2km from the P.B.I survey site, fish passage was a significant issue. A "nature like" bypass channel some 110 meters long was constructed by Ellis Selway whilst working for Cambridge City Council, part funded and in conjunction with the Environment Agency.

Created between the 16th of December 2010 and 30th March 2011 the channel restored connectivity between the upper and lower river at this location. Monitoring by the Environment Agency indicated that fish stocks rapidly moved into this channel and over four surveys a total of 11 species were found to be utilising the new channel, (Table 8).

Table 8. Date of survey and total number of fish caught in Byron's Pool Bypass Channel.

Species	CAMSI11 (04/04/2011)	CAMSI11 (09/05/2011)	CAMSI11 (01/06/2011)	CAMSI11 (04/07/2012)	Total
Minnow	66	78	220	140	504
Gudgeon	35	57	145	11	248
Dace	80	-	-	13	93
Stone loach	-	3	37	8	48
Bullhead	-	-	2	42	44
Brown trout	-	6	7	12	25
Roach	2	-	-	17	19
3-spined stickleback	-	-	13	3	16
Chub	2	4	-	-	6
Spined loach	-	4	-	1	5
Perch	1	1	-	-	2
Total	**186**	**153**	**424**	**247**	**1010**

Cameras positioned at the upstream limit of the channel recorded minnow and gudgeon exiting into the upper river and it is reasonable to suggest that if this feat is manageable by minor species such as minnow, larger coarse fish species such as dace, roach and chub should have similar success. It is interesting that in the initial survey following the channels connection a large catch of dace were caught. This species was absent in the subsequent two surveys suggesting these fish may have also have passed through into the upper river.

The recent survey data would seem to imply that habitat enhancement work and the creation of fish passage has been followed by increases in fish density and species composition, suggesting that whilst these aren't the sole cause, they are significant factors limiting fish populations and distribution in the upper River Cam.

The U/s River Cam has subsequently been moved onto a 6 year rolling monitoring programme and at present is next due to be surveyed in 2019.

If you have any questions regarding anything in this report, please contact the fisheries team on Tel: 01480 483818

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