EA - South West BOX 12

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Environment Agency - South West Region

Fisheries of the middle and lower Wylye and factors affecting their performance

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1. INTRODUCTION

The second phase of the "Upper Hampshire Avon Groundwater Study", by Sir William Halcrow and Partners, looked in detail at the impact of groundwater abstraction on the River Wylye. During the conduct of the study it became clear that the most dramatic impacts on flows were taking place in the upper reaches and tributaries. The main focus of the ecological and fisheries studies was therefore on these reaches. It was only when the groundwater modelling was completed that it became apparent that flows in the middle and lower reaches of the Wylye were also significantly impacted. This, coupled with the recent poor performance of fisheries throughout the river suggested that this area represented a significant "gap" in the environmental coverage of the Halcrow investigation.

Following a meeting in Blandford in March 1996 with the NRA, the Halcrow team and fishing interests, Dr Solomon proposed to the newly formed EA that a minor study be commissioned to plug this gap in coverage. The proposal was for the most of the study to be based upon a questionnaire survey of riparian owners and tenants, who collectively represented an enormous reservoir of knowledge and experience of the river and its fisheries. The EA subsequently suggested that the results of past and recent electric fishing surveys be incorporated. As some were scheduled for the autumn of 1996 this delayed the preparation of this report somewhat, but it did mean that the coverage was far more comprehensive and up to date.

The overall aim of this study have therefore been to describe the Wylye fisheries from Norton Bavant to Wilton, their performance and recent history, and the factors that may be affecting them by reference to:

- the knowledge and experience of riparian owners and tenants, accessed through a questionnaire;
- population surveys conducted by electric fishing;
- other relevant sources including reports of earlier investigations and other published sources.

It was agreed that a report of the investigation would be made available to all those responding the questionnaire as well as the EA and other interested parties. This report fulfils this role.

2. THE QUESTIONAIRE

Names and addresses of owners, tenants and club officials were supplied by the Wiltshire Fishery Association. Thirty one questionnaires were sent out; eighteen replies were received covering 15 fisheries. These fisheries cover the great majority of the river between Norton Bavant and Wilton.

The text of the questionnaire is reproduced in Annex 1. Questions 1-3 covered factual details of name and address, fishery location etc. The responses to questions 4 to 16 are analysed below.

Q. 4. Do you have records of catches?

Although most fisheries have records of catches in recent years (and some going back for many years), detailed analysis of the overall catch of the river is beyond the scope of this investigation. However, a number of general points can be made.

From the fisheries that did make returns, totalling about 1700 fish, it is clear that the river total will be in excess of 2000 fish per year. Of these, about 64% are returned to the river alive, and this proportion is steadily increasing. One major club fishery reported that over 80% of the catch is now returned, in contrast to about 10% in the 1970's.

Q. 5. Can you give an indication of the level at which the water is fished, e.g. number of club members, approximate number of rod-days per months?

All fisheries were able to supply some information, from "only lightly fished" through to full details of rod-days fished each year. Some provided estimates of rod-days, while others were only able to give numbers of syndicate members.

Fortunately the fisheries with clearly the greatest fishing effort could provide fair or good records. From an analysis of the number of days fished per member of those fisheries that could provide all the required data, an estimate has been made of the number of days that are likely to have been fished on waters where only the number of members was available:

a) fisheries that could supply both membership and effort data:-
   224 members fished 1658 days = 7.4 rod days per member per year.
b) fisheries could supply membership data only
   43 members. Assumed to fish 7.4 rod days each = 318 days per year
c) fisheries that could supply rod effort data only
   926 days per year

The total rod days accounted for by these fisheries is 2902 per annum. Allowing for those fisheries that were "only lightly fished" and those not accounted for in this exercise, the total rod effort between Heytesbury (i.e. upstream end of Piscatorial Society water) and the confluence with the Nadder is of the order of 3500 rod days per annum.

(Rod days = rod visits, even if the period fished is less than a full day. Some fisheries provided estimates appropriate for recent years, which are used here. Where annual figures were provided a mean for 1993-95 was used).

Q. 6. What are the best months for trout fishing on your water? What is responsible for any poorer parts of the season?

The almost unanimous response to this was that May, June and July are the best months. Reasons given included the mayfly season and adequate river flows.

Most respondents stated that fishing was poor later in the season due to diminished flows, and associated problems of lack of weed, grazing of *Ranunculus* by swans and poor fly hatches. However, one reported that July and August were "often excellent, especially in the evenings", and another that in low water the fish "lie under banks.... this makes challenging fishing".

Several fisheries reported that fishing could be quite good late in September and October.

Q. 7. Is the water regularly stocked? When did the practice start? What size of fish are stocked?

Virtually all the serious fisheries (as opposed to short "garden" reaches) are stocked with brown trout. Although some returns of numbers were incomplete a clear picture emerges of annual stocking of about 2500 fish of 1-1¾ lb., a few larger fish to 2½ lb., a "few thousand" fry, and about 1000 yearlings. It is therefore apparent that most fisheries are heavily dependent upon stocking of takeable fish. Others are largely dependent upon wild fish or fish grown from stocked fry.

Q. 8. Do you have any information about natural breeding of trout?

The responses to this question divided the river into distinct zones. Downstream of the Till confluence the unanimous view is that while there may be some natural recruitment it is at a much lower level than in former years. Upstream of there reports varied from "good and improving", "still good" and "consistent", to "getting poorer" and "many fewer". Some fisheries returned "no information".

Most of the returns made on this question inferred natural reproduction from the presence of fish smaller than those stocked on that fishery. In some cases it is possible that these fish have migrated into the area as fry or parr and are derived from natural spawning or small-fish stocking upstream.

The circumstantial nature of much of the evidence offered in response to this question, and the number of "no information" returns, highlights the extent to which most fisheries have become dependent upon restocking. Only two fishery returns stated that their catches were heavily dependent upon naturally reproducing fish.

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Q. 9. Can you describe if and how the quality of the trout fishing has changed over the years?

No fishery return suggests that trout fishing in the Wylye has improved in recent years! Generally the lower river, from Wylye downstream but particularly from Langford downstream, has experienced the greatest perceived decline. The almost unanimous view is that things went badly wrong in 1989/90, and have failed to recover fully since. The main suggested cause is the low flow/ poor *Ranunculus* growth situation. Other factors widely mentioned are cloudy water in the spring and a lack of hatches of small fly - mayfly hatches appear still to be good.

Q 10. What species of fish are present, and has their status changed in recent years?

Brown trout are of course reported as present throughout the area under consideration. Rainbow trout have occurred in the Warminster area as a result of intentional introduction and escapes from a fish farm.

Salmon spawn in the lower reaches, up to the Langford area. Several respondents noted a scarcity of salmon and/or their redds in recent years.

Grayling are abundant throughout, and eels are mentioned throughout the area. Small numbers of roach, dace, perch, chub and carp occur throughout the river from Boyton to Wilton. Pike also occur throughout this zone, but appear to be most numerous in the lower reaches.

Q. 12. Have swan numbers increased in recent years? Has this had an effect?

There was a unanimous verdict that swan numbers were very high, and causing considerable problems, but conflicting views of recent trends in numbers. It would appear that there has been little increase or decrease overall in the last few years.

Many respondents provided graphic descriptions of swans stripping long reaches of river completely bare of weed, especially *Ranunculus*. However, several made the point that the damage by swans was much more severe in years of low flow and poor weed growth; the birds had easier access to a resource that was already reduced.

Two fisheries reported an improved situation associated with a dominant pair or cob keeping other birds away from a reach.

Q 13. Has weed growth, particularly Ranunculus changed in recent years? Have your weed cutting practices changed?

"Prior to 1990, cutting and clearing down weed was a major task for our keeper. Since 1990 very little weed has been cut on our water".

"Weed cutting since 1990 has not been necessary".

"We hardly ever cut weed now!"

"It used to take five days to cut the weed. This year it took 2½ hours".

"*Ranunculus* has disappeared. Ribbon weed has grown dramatically."

These extracts from the questionnaire return typify the responses at least from Wylye downstream. The serious decline in *Ranunculus* appears to have occurred in 1990, perhaps as a result of very low flows in 1989 followed by severe floods in February 1990. The effect appears to have been less dramatic further upstream.

Low flows and swan grazing are mentioned by many respondents as the main causes of the failure of *Ranunculus* to recover since 1990. However, three fisheries have reported some recovery in *Ranunculus* during 1996. Another fishery reported that the weed growth has remained healthy in a carrier with maintained flow, in contrast to the flow-depleted main river. This is strongly suggestive of a link with flow, and indicates that water quality (e.g. herbicides) is not implicated.

Q 14. Have riverbank management practices changed e.g. cutting of bankside vegetation, access by livestock, fencing of banks?

Damage caused by grazing, animals having unimpeded access to the river occurs in places throughout the river and is widely recognised:-

".... more bankside vegetation has been encouraged to grow. This aim has been frustrated in places by more intensive grazing of adjacent fields. Lack of suitable sheep fencing has cleared vegetation other than short grass down to the waters edge."

".... fencing has been allowed to deteriorate up and down the river, and bank erosion has worsened noticeably as a result. This needs immediate attention...."

"... cattle damage to banks has increased."

However, in many places good bankside fencing is seen to have beneficial effects:-

"We have fenced out cattle and bank-side cover is greatly encouraged, trying to get the river to find its natural width and providing cover for fish. This, we feel, has been successful."

"Some fencing has been done with good results, but more needs to be done".

"Increased livestock fencing has taken place and this is now virtually complete."

Q 15. Has any within-channel work been undertaken?

No respondents reported any major land-drainage work in recent years, though several references were made to extensive work in about 1941 and 1965. Work undertaken by the fisheries themselves ranged from none or very little (most fisheries), through "some narrowing", to "extensive channel narrowing has taken place and will continue". Channel narrowing is said to be effective at improving the habitat for both *Ranunculus* and trout.

Several fisheries reported some gravel cleaning, mostly carried out by water jet pumping by the NRA/EA but some by raking or horse-drawn plough. No information was offered on the effectiveness of these practices.

Q. 16. Have you observed any changes in the insect and fly life of the river?

The respondents were almost unanimous in the judgement that the mayfly (*Ephemera danica*) hatches were excellent. Equally, however, there was an almost universal judgement that the smaller Ephemeroptera (or upwing flies) had greatly declined, at least in the middle and lower reaches. Several fisheries reported that hatches of sedges (caddis) were good.

3. THE HISTORICAL PERSPECTIVE

3.1 The chalkstream environment

Although considered by many people to be among our loveliest and most English of sceneries, the classic chalkstream such as the Wylye is in fact a rather artificial and highly managed environment. In its natural form the river would have occupied a much braided series of channels across the valley floor, surrounded by swamps dominated by alder and willow. For well over a thousand years the stream and its valley have been manipulated for milling, cress production, agriculture (including land drainage and watermeadow operation), water supply for crops, livestock and humans, sheep washing, flood prevention, fishing, visual landscaping and wartime defence. Clearly the balance and influence of these interests have changed over the years, particularly so in recent decades. The influence of each may persist, albeit in a modified form, for many years after their active management for their original purpose has cased; examples that spring to mind are mills and watermeadows. Any consideration of the impact of a particular activity (such as groundwater abstraction) must be seen against the influence, and the changes in influence, of the other activities listed above.

3.2 Water meadows

The system of flooding water-meadows was probably introduced into the Wylye Valley early in the 17th century; the earliest published record is in Aubreys "Natural History of Wiltshire", written between 1656 and 1691:-

> "The improvement of watering meadows began at Wylye, about 1635, at which time, I remember, we began to use them at Chalke".

The practice spread to almost all areas of suitable land in the valley. Although flooding of the meadows is no longer undertaken in the Wylye valley, the evolving management of the valley floor still has a major impact upon the ecology of the river. A brief summary of the changing use and management of the meadow is therefore relevant here.

The main value of watermeadows originally was to provide good grazing for sheep early in the year, when the hill pastures were exhausted and had not yet started to grow. The agricultural economy of the area was based on a sheep/corn combination, with the sheep being placed overnight on the cereal fields in the appropriate season so that their droppings fertilised the land. The rich feeding of the watermeadows, which were ultimately being fertilised by water-borne material, represented a very important input to this cycle. (Bettey 1978).

The meadows would be flooded twice during the winter, and both the fertilising effect of silt and dissolved nutrients, and the soil warming effect, encouraged early growth of grass. They were then drained, and sheep were grazed during March and April. The meadows were then flooded again to encourage the hay crop. After the hay was cut, they were once again flooded for a few days, and then cattle were pastured on the meadows until late autumn when flooding again commenced (Fry 1937, Moon and Green 1940).

This pattern and management changed gradually during the 19th century. The availability of fertilisers made the sheep-fold arrangement less critical for good grain crops, and in turn cheap imports of grain made production on the more difficult hillsides uneconomic. The hay crop became less attractive as machines were developed which greatly sped-up mowing but which could not operate in the tight confines of a working watermeadow. Increasingly root and other fodder crops were used for the sheep. Cattle therefore replaced sheep as the main stock on the meadows and the pattern of watering changed to become much more frequent in summer.

Eventually of course the whole system of flooding meadows, which was highly labour intensive, became uneconomic, and they fell into disuse. By 1937 watering was considered the exception rather than the rule, and the last watermeadows in the Wylye valley were probably abandoned in the 1950's.

3.3 Land drainage and agriculture

Whatever the good or bad effects of watermeadow operation were for trout (e.g. stranding of juveniles on the fields, provision of good habitat in the carriers for fish and invertebrate food) they are now history and beyond the scope of this report. However, one effect of the operation of watermeadows and watermills was the high level of water-table maintained on the valley floor, with head-retaining mills and hatches. The river had been engineered for hundreds of years to be appropriate for these structures. Their disappearance due to neglect or deliberate removal and the associated fall in water levels has had a major effect on the river.

The first major impact of this sort was around 1941, when much of the river was dredged. H. H. Bashford (1946) provided a graphic description of the impact around Boyton:-

> ".... in 1941 I discovered to may horror that the whole of the upper part of the fishing was in the hands of the excavators. There were rumours that the Wylye was being converted into a tank trap. There were others that this devastation was deemed necessary for the better irrigation [drainage?] of the surrounding farms. Every willow had vanished from the river side in the meadow immediately below Boyton Bridge. A bank of gravel had buried every trace of herbage and made the stream look like a canal. With grief in my heart I turned back to the yet-untouched waters below the mill pool...."

The extent of the war-time work is uncertain, but reference to the damage done by the "tank-trap" dredging as made by several questionnaire respondents throughout the river.

Later work was also done to lower the water table. Major-General Robin Brockbank reports:

> "Two major works for draining and "improvement" were completed by the Water Authority in 1965. One was the elimination of a large bend in the main stream above my property and its redirection into a newly cut channel. The second was the removal of two large hatches, one abounding my property and the other further upstream. The effect of these works - as intended - was to lower the surface water table considerably and thus both to dry up previous channels that drained into the river and to reduce

> flooding to a minimum in adjacent meadows after heavy rain. None of these observations by me were, of course, measured scientifically, but many of the Wylye Club fishermen recorded similar observations. Similar works were carried out on other stretches of the river and farmers were eventually able to plough up and level the ancient meadows to grow arable crops."

Further land drainage work was carried out by the Water Authority up the mid 1970s, which had the effect of lowering the water table and thus lowering the surface level of the river. Other head-retaining structures were removed for other reasons; for example the weir at South Newton was removed when the A36 road was widened. It is stressed that this work did not affect the net volume of flow of water from the valley, but it is likely to have decreased the proportion flowing above ground (i.e. stream-flow), generally increased the speed of current, and decreased the depth of water.

Brayshaw (1960) emphasised the potential overall habitat improvement represented by removal of hatches from chalk streams:

> "Most chalk-streams are still in the stranglehold of the old system whereby every inch of fall was pressed into service to drive water-mills and irrigate pasture. This was all well and good while the labyrinthine channels were maintained so that Salmonidae could spawn in the drawns and mill-tails but now the mills are derelict and all that remains is the one main watercourse of the river whereas the ancient hatches, usually inoperable, accumulate foul mud in the mill heads and squander the precious few feet per mile of fall in great gouts at each obstruction.
>
> Removal of hatches (accompanied if necessary by grading of the bed upstream to secure a uniform slope) is almost invariably immensely beneficial as has now been demonstrated times without number. On the upper Avon, Wylye, Frome and Piddle to mention but a few examples miles of water, formerly deep muddy haunt of pike and coarse fish have been converted in a couple of seasons into clear-flowing, well weeded water about 2ft. to 3ft. deep (the fact that most hatchways are substantially narrower than the main watercourse is sufficient protection against the advent of too-fast, shallow water upstream), and now provide the very cream of wild chalk-stream trout fishing as well as providing, and maintaining, much more precious spawning ground".

However, hatches and other head-retaining structures created two distinct habitats conducive to holding large trout; the hatch pool below, with a scoured deep hole and eddies, and the slow, retained water above. Removal of the hatch destroys both these features. While this returns the natural slope to the stream and increases flow rates, in many cases the channel had been widened and a broad, shallow habitat is created with little suitable area for larger fish. In several areas channel narrowing has recently been carried-out with good results.

3.4 Angling

A major change that has taken place over the past decades has been the increase in angling pressure on the Wylye. Before the last war, most of the fishing was retained by the estates or let to small local syndicates, and the fishing pressure was light. H. Bashford in his book

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"Fisherman's Progress" described in detail a two mile stretch of the river he fished between Boyton and Codford in the 1930's. His sister-in-law rented the fishing from Boyton House and he was generally the only person fishing the whole stretch;

> "... day after day, I had the river and its meadows and coppices - and all its beauty of water and wildlife - to my self, or shared only with my wife...."

Much of this stretch is now controlled by the Piscatorial Society and although not over fished by any means, it must receive very much more attention than in Bashford's day.

An interesting picture of the increase in angling pressure comes from a report prepared by Pat Hoare entitled "A brief history of the Wylye Fly Fishing Club, 1951-86." This describes successive rises in the membership ceiling from 18 in 1951 to 30 in 1986 (the current level), and a fall in the minimum distance from Wylye at which members must reside from 29 miles to 15 miles.

Similarly, the Wilton Fly Fishing Club has grown considerably. The Club has fished the river since 1891, but for many years membership was restricted at a very low level; in 1950 it stood at 15, and catches were running at about 80 fish per year (Mackie, 1994). The membership is now 47, and the mean catch was around 500 per year in the 1970's and early 1980's, and has been around 400 in the last few years - though most are now returned alive.

More evidence for the increase in angling pressure on a wider front comes from the numbers of trout licences issued by the Avon and Dorset River Board (and its successor the A+D.R.A.). In 1952, 535 were sold. By 1967 the number had increased more than five-fold to 2781.

4. ELECTRIC FISHING SURVEYS

4.1 Introduction

Examination of the fish population by electric fishing have been carried-out on the Wylye at various times since 1971. These provide a most valuable indication of the changes in structure of the trout populations.

The surveys of interest here fall into two series. One is a set of detailed quantitative surveys on a reach at Norton Bavant. The second is a semi-quantitative survey of the whole river conducted in 1991 and 1996.

4.2 The Norton Bavant Surveys

A reach of about 385 m in length immediately upstream of Norton Bavant Bridge (divided into four sections) was surveyed on the following occasions:

Dates	Authority	Source
Oct 19-21 1971	Avon + Dorset RA	Greenwood 1973
Sept. 11 1972	"	"
Nov 8-14 1972	"	"
Sept. 1992	Wessex Region, NRA	G.Lightfoot, pers.comm.
Aug. 29 1996	Game Conservancy	Game Conservancy 1996

On each occasion the sections were fished two or three times to obtain a quantitative estimate of the populations. All fish caught were measured. The catches and population estimates were:

Dates	Catch 0+	Catch >0+	Population estimate
Oct 19-21 1971	40	84	139
Sept. 11 1972	5	93	97
Nov 8-14 1972	33	111	146
Sept. 1992	0	47	48
Aug. 29 1996	35	123	159

The length-frequency distributions for each year are shown in Fig 1. A number of points are apparent from these results. First, the differing results from the two 1972 surveys, made only two months apart, indicate that care is needed in interpreting the results of a single survey as an indicator of the status of stocks. The main discrepancy is the number of 0+ fish recorded, which increased from 5 in September to 33 in November. Had only the September survey been conducted it would have been concluded that 1972 was a poor year for recruitment; on the other hand, had only the November survey been undertaken, the conclusion would have been that it was a good year. It is possible that the extra fish had recruited to the reach between the surveys, but the lack of 0+ fish less than about 6 months old in this reach is not an invariable phenomenon as indicated by the good numbers recorded in August 1996.

Generally, the population in 1971, 1972 (November) and 1996 were similar. However, it will be noted from Fig 1that the fish in1992 and 1996 tended to be larger, with many fish over 40 cm compared to the earlier years. This is likely to be as a result of restocking with large fish, so again care is needed in interpreting the figures as an index of the performance of the wild stocks.

It is likely that most of the fish below about 28 cm (11inches) are derived from natural recruitment; generally this size group represents the 0+ (8-16 cm) and 1+ (20-26 cm) age classes in late summer/early autumn. These results would therefore indicate very poor spawning in 1991/92 (the missing 0+ class in 1992) and poor spawning in 1990/91 (the low numbers of 1+ fish in 1992). Numbers of 0+ and 1+ fish in 1996 were broadly comparable with 1971 and 1972.

4.3 The whole-river surveys

The second series of surveys is a "once through" survey of the whole length of the river (with minor gaps), undertaken by the NRA in 1991 and the EA in 1996; both were undertaken in September. The numbers of fish recorded in each 300 m section are indicated in Figs 2 (0+ trout), Fig 3 (older trout) and Fig 4 (0+ salmon). As the numbers recorded are the result of a single "sweep" by electric fishing, they should be considered as a relative index of abundance rather than as a population estimate. An indication of the "efficiency" of the operation we can compare the numbers sampled by this exercise in 1996 in the reach at Norton Bavant with the quantitative survey there at about the same time. This exercise recorded 9 0+ and 23 older fish, compared to the quantitative total population estimates of about 35 0+ and 124 older fish. Comparison of the results of the surveys in 1991 and 1996 is of considerable interest.

The overall pattern of distribution of 0+ trout in the two years is broadly similar, with a clear "good" zone between about reaches 52 and 74. Other "peaks" in common between the two years are around 11-18, 26 and 40. While overall numbers were very similar, the distribution was somewhat different:

	Total numbers		**Mean per 300 m reach***	
Sections	**1991**	**1996**	**1991**	**1996**
1-50	345	176	6.90	3.57
51-75	378	477	15.12	19.08
76-126	112	198	2.20	4.30
Total	**835**	**851**	**6.63**	**7.07**

*takes account of short reaches not sampled.

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Thus numbers in the upper reaches had declined, and those in the middle and lower reaches had increased somewhat between 1991 and 1996. Numbers in the lower zone of the river remain low, however, compared to the middle zone.

The picture for older trout is somewhat different:

	Total numbers		Mean per 300 m reach	
Sections	**1991**	**1996**	**1991**	**1996**
1-50	606	1282	12.12	25.99
51-75	396	674	15.84	26.96
76-126	514	399	10.84	8.67
Total	**1489**	**2355**	**11.82**	**19.57**

Thus while the numbers overall, and in the upper and middle reaches, had increased substantially, those in the lower reaches had declined. A consideration of the overall length/frequency distributions (not reproduced here) suggests that the considerably increased numbers of older fish in 1996 was overwhelmingly due to an increase in numbers of 1+ fish. This indicates that recruitment from the 1994-95 spawning was good throughout most of the river, but poor in the lower reaches. This conclusion is consistent with the views of fishery interests responding to the questionnaire (see section 2).

The situation regarding 0+ salmon parr is shown in Fig 4; there are relatively few 1+ parr (most emigrating at one year of age) and these show a similar distribution. It is clear that salmon do not penetrate beyond the lower reaches; this is consistent with the results of a salmon radio-tracking exercise conducted in 1985-89, in which the furthest upstream record on the Wylye was at Steeple Langford. The main concentrations of parr occur just upstream of the Till confluence, and around Stoford, but numbers are not generally high compared to those that occur in more typical salmon nursery streams.

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5. EXMAMINATION OF FACTORS THAT MAY BE AFFECTING FISHERIES.

5.1 Summary of the status of fisheries

There appear to be two predominant "problems" with the trout fisheries of the Wylye at present. These are

- the interrelated factors of low flow, low water level, poor weed growth and weed grazing by swans, which are affecting the habitat for larger trout and angling conditions.
- poor recruitment throughout the river in 1991 and 1992 and perhaps other years, and in the lower river in more recent years also.

Other problems mentioned by fishery interests include a decline in the numbers of upwing flies, and a decline in numbers of large trout. The factors that may be contributing to these problems are discussed below.

5.2 Low flows and poor weed growth

5.2.1 Abstraction

Abstraction for public water supply takes place at seven locations in the Wylye catchment, the greatest takes being at Brixton Deverill, Heytesbury, Chitterne and Codford. The total licensed quantity for PWS is 18,200 Ml/year, equivalent to about 50 Ml/d. Until the mid 1970's abstraction took place at a relatively low level (averaging about 3 Ml/d throughout the year) with the exception of 1972 when experimental pumping tests increased the take for a few months to around 40 Ml/d. The take started to increase in 1975, reaching a plateau at around 13 Ml/d between 1979 and 1988. It then steadily increased, reaching the current level of about 36 Ml/d (about 75% of the licensed maximum) in 1992. Of the order of 75% of the abstracted water is exported from the catchment and is thus not returned to the river or the aquifer as effluent. The total annual recharge to the aquifer from rainfall is equivalent to about 388 Ml/d.

The phase 2 Halcrow Report (1996) presented the results of a validated model of groundwater and river flow. This indicated that river flow was increased above the natural level around Kingston Deverill by the pumped augmentation flow, but from Brixton Deverill downstream the abstraction represents a net loss to the river flow. At Hill Deverill summer flows are reduced by some 50-60% by the current levels of abstraction. In the middle reaches summer flows can be reduced by up to 25%, at South Newton the loss is about 20%. The above figures refer to the situation created by the current level of abstraction; an increase up to the licensed limit would increase the impact. The situation is illustrated graphically in Fig 5.

5.2.2 Drought

Periods of low rainfall have a major impact upon river flow. In a surface-water fed river the effect is almost immediate but short-term, with significant rainfall event immediately "resetting the clock". In a groundwater-fed system such as the Wylye, the response is very much slower, but may be extended over a considerable period, so that the effects of separate "surface water" droughts may combine; this is indeed what happened in the dry years 1989-92. Of this period Professor W B Wilkinson, Director of the Institute of Hydrology, wrote:

> "The drought which, at one time or another, embraced much of Europe can be traced back to the Spring of 1988 in much of the English lowlands. It was punctuated by a number of wet interludes but by early 1992 had become exceptionally protracted and, in groundwater terms, more severe than any this century."
>
> (Foreword to Marsh *et al* 1994).

The impact of the drought was of course added to that of abstraction in terms of river flow, but earlier droughts at times of little or no groundwater abstraction also had a major impact. The flow at South Newton Gauging Station fell to 48 Ml/d in August 1976, and that at Norton Bavant GS was less than 20 Ml/d in July of that year. The flow at Wylye was said to be "just a trickle" at the height of the drought in 1934.

5.2.3 *Ranunculus* and swans

The water crowfoot, *Ranunculus*, is of course the archetypical chalkstream macrophyte, growing in profusion in flowing water. Unchecked it can grow to virtually choke a stream, causing flooding even at low stream flows, and making angling very difficult. It is therefore regularly selectively cut and removed from the river. Properly managed, *Ranunculus* is a most important part of the chalkstream environment in terms of substrate and food for invertebrates, maintaining depth and current speed, and providing cover for fish.

As is clearly indicated by the responses to the questionnaire (Section 2), the normal growth cycle of *Ranunculus* has largely broken down in the Wylye since 1989. This was clearly linked in its initiation with low stream-flows, but the failure to recover fully with more normal flows is a matter of concern. Heavy cropping by groups of immature swans is clearly implicated, but the exact processes involved are unclear. The dense stands of *Ranunculus* itself have a role in maintaining the water depth and current speeds required for healthy growth as discharge falls during the summer. Thus it would appear that the plant is having difficulty in breaking out of viscous circle of poor growing conditions of low flows, low current speed and shallow water, and grazing by swans.

There is a clear and urgent requirement for investigation to unravel the complex inter-relationships of causes and effect - only then can the most effective steps be taken to reduce or mitigate for the adverse impacts.

5.3 Poor spawning and recruitment

5.3.1 Conditions in the main river.

It is likely that the predominant factor associated with poor recruitment success lies in the spawning and incubation habitat of the riverbed gravels. A flow of water through the gravel is required to ensure a constant supply of oxygen to the eggs and alevins (the young trout and salmon which remain in the gravel after hatching, living off their yolk sacs). It is likely that both low flows and fine solid material (silt) are implicated here. Low river flows of course reduce the intra-gravel flow *per se*, reduce the area of suitable gravel that is covered with an adequate depth of water, and allow the build-up of sediment within the gravel. It is concluded that the poor recruitment of both salmon and trout during the 1989-91 drought was caused by a combination of low flows and sediment build-up.

The electric fishing surveys in 1996 indicate a healthier level of recruitment in the middle reaches of the river, but still a poor situation in the lower river from Wylye downstream. This is likely to reflect poor gravel conditions due to fine solid material, exacerbated by the reduction in flow due to naturally dry years and abstraction. The problem of silt is likely to have been increased in the last ten years due to changes in agricultural practices. Agricultural activity has dominated the management of the catchment for hundreds of years, but as described in Section 3.3 this has been changing in recent years.

The draining of the water meadows allowed a switch from grazing and hay production to arable crops. This trend peaked around 1992, when much of the valley floor was ploughed and planted with a range of crops including cereals and linseed (Fig 6). In many places ploughing and planting took place virtually to the waters edge, resulting in bank damage and allowing considerable volumes of soil to enter the river. It is now generally accepted that high silt levels in the gravel of chalkstreams is a major limiting factor in salmonid reproduction there. As long ago as 1960, John Brayshaw, fisheries officer for the Avon and Dorset River Board wrote:

> "The chalk-streams are on the very fringe of true salmon and trout rivers. They are in fact understocked by virtue of their silt content and sluggish flows".

The low-flows period of 1989-92, coupled with the increased input of fine solid material from valley-floor cultivation appears to have been associated with poor recruitment of both trout and salmon in the Wylye. It is encouraging to note something of a recovery in the 1996 electric fishing surveys (Section 4), though the situation in the lower river is still a matter of concern.

Even when the meadows are grazed rather than ploughed problems occur where livestock has unrestricted access to the river bank. Little bankside vegetation is able to grow to any size to provide cover and insect food for fish, and trampling of the margins makes the stream wider and shallower, and introduces fine solid material to the water. Many fishery owners have recognised this problem and have taken steps to fence the banks to prevent access by livestock except at dedicated drinking points.

There are now a number of initiatives in agricultural policy and advice that recognise the problems of streams such as the Wylye and should be of great benefit if fully implemented. These include the EA "Land Care" scheme, which is aimed at limiting the input of silt and other diffuse land-based pollutants throughout the Avon catchment, and the MAFF "Habitat Scheme for Water Fringe Areas". The upper Avon, Wylye and Nadder form one of the only six areas nation-wide where this scheme operates. It involves taking land adjacent to the watercourse out of intensive agricultural production and managing it in a manner that is sympathetic to wildlife.

However, the situation in the lower Wylye remains of significant concern for the well-being of stocks of both trout and salmon. It is strongly recommended that an annual series of electric fishing surveys is commissioned covering several sites from Wylye downstream, to monitor salmonid stocks, in particular juveniles. Further, an investigation of the status of spawning gravels in this area should be undertaken to both establish the degree of the problems involved and to monitor the effectiveness of gravel cleaning and the progressive agricultural schemes described above. It is understood that an EA National R+D project has been launched to examine the causes of decline of salmon in chalk streams, and it is recommended that the Wylye is included in the areas surveyed.

5.3.2 The role of the tributaries.

It is well known that, at times, considerable numbers of adult trout ascend the main tributaries (River Till, Chitterne Brook and Heytesbury Bourne) to spawn. Many of the young fish deriving from this spawning recruit to the main river population. Could part of the reason for poor recruitment in the main river lie in a failure of production in the tributaries?

First we should examine what we know of spawning there in historical terms. Greenwood (1973) ran a trap in the lower reaches of the Chitterne Brook and undertook electric fishing surveys in the Chitterne and Heytesbury Brooks between 1971 and 1975. While good numbers of adult trout were trapped ascending and juveniles descending the Chitterne, many young became imprisoned in pools in the drying winterbourne and had to be rescued by electric fishing in order to make a contribution to the mainstream stock. In 1972, 371 trout were recorded emigrating through the trap, and a further 397 were rescued from upstream by electric fishing. Similarly, in 1973, 423 were recorded at the trap and 101 were removed from upstream. Both these years were rather dry. While it was felt that the presence of the trap itself may have been contributing to the imprisonment of fish in the stream, in fact fish "rescues" were an annual event on the Chitterne from the 1960's through to the 1980's, the fish thus obtained being stocked into the lower river below the Till confluence. Numbers of trout rescued by such exercises in 1969, 1970 and 1971 were 376, 714 and 2164 respectively, the great majority of which were 0+. It is not of course known how many fish had successfully emigrated before the remainder became stranded. This phenomenon of stranding is a surprising aspect of the trout's life cycle, representing a very poor survival strategy! It is possible that the Chitterne Brook represents a rather extreme example by virtue of its topography and pattern of drying. In any event, juveniles from the Chitterne Brook contributed to the main river stock both naturally and via the fish rescue operations.

Greenwood discontinued surveys on the Heytesbury Bourne after one year (1971-72) as relatively few fish were found there. It would therefore appear that this stream was very much less important as a spawning and nursery area than the Chitterne Brook.

Greenwood's surveys did not cover the Till, but electric fishing surveys have been conducted there in 1992 by the NRA and 1996 by the Game Conservancy. Both surveys indicated numbers of 0+ fish were present, with many more in the latter year. In both years 1+ fish were poorly represented, with greater numbers of 2+ and older fish present. This is indicative of a spawning and nursery area, with most of the 0+ fish migrating downstream to the main river and mature (2+ and older) fish entering the stream to spawn. While the numbers of 0+ fish in the Till are relatively low, the population in 1996 was of a similar order of magnitude to that in the Wylye from the Till confluence downstream. The River Till has a much lower tendency to drying out than the Chitterne Brook, and if it does so it is later in the year. Natural redistribution of 0+ fish, recruiting to the adult growing areas, normally takes place in chalkstreams during the autumn and winter (Solomon and Templeton 1976) and it is likely that emigration from the Till is a much more efficient process than from the Chitterne. However it is not possible to say to what extent the Till is important for trout recruitment in the lower river, or whether it was more important in past times.

Whatever the importance of the tributaries for recruitment to the main river, spawning there is clearly vulnerable to low flows - in particular, delay in break-through of groundwater springs much beyond the New Year. In very dry years the Chitterne Brook may not flow at all, and 0+ numbers of fish in the Till were very low in 1992. The Halcrow Report suggests that the current level of abstraction makes little difference to the pattern of flows in the Chitterne in dry years (when there is little flow naturally, and poor trout production,). However, in average years, such as 1993, it would cause flows to start two months later and cease two months earlier. This is likely to virtually preclude effective trout reproduction in such years. On the Till, present levels of abstraction are calculated to have shifted the perennial head about 500 m downstream, and reduced flows throughout the stream. The greatest relative impact is in the more upstream reaches around Berwick St. James, where considerable numbers of 0+ trout were recorded in the 1996 survey. The impact of these flow reductions on trout production in the Till are uncertain, but some impact is indicated by the observation reported above that production was considerably greater in 1996 than in the dry year of 1992.

5.4 Decline in upwing flies.

Many questionnaire respondents commented on a great reduction in upwing flies (smaller Ephemeroptera) in recent years, though numbers of anglers mayflies (*Ephemera danica*) and sedges (Trichoptera) are largely unchanged.

This is likely to reflect the changes in the stream habitat, in particular the reduction in *Ranunculus* which harbour dense populations of larvae. *E. danica* of course has burrowing, silt-loving larvae so recent conditions have suited them. A return of large numbers of the other species is to be expected as and when *Ranunculus* cycle is fully restored.

5.5 Decline in numbers of large trout.

The removal of hatches is likely to have reduced the areas suitable for holding very large trout as described in Section 3.3, and this may partly explain the lack of such fish in catches in recent years. Equally, however, the greatly increased angling effort (Section 3.4) may be implicated in the lack of large fish, and in this respect it will be of interest to see if the growth of the catch and release ethos will lead to any increase in large fish.

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Another factor that may be implicated is the disappearance of native crayfish from the river in the 1980's, as a result, it is believed, of an infectious disease known as "crayfish plague". Large trout are known to eat considerable numbers of crayfish in some chalkstreams, and it is possible that in their absence growth of large fish is reduced. Attempts have been made to re-introduce native crayfish to the Wylye but it is not known if they have been successful.

6. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The results of the questionnaire and electric fishing surveys indicate that trout fisheries in the middle and lower Wylye have performed poorly in recent years. The indicators are:

- evidence of poor trout spawning and recruitment throughout the study area in 1991 and 1992 at least;
- evidence of poor trout spawning and recruitment in the lower river (from Wylye downstream) in more recent years also;
- low stream flow, low water levels, poor weed growth and grazing of weed by swans
- a lack of some species of fly
- a lack of large trout

It is concluded that the 1989-92 drought, exacerbated by flow depletion due to abstraction, was largely responsible for poor performance during these years. Increased inputs of solid material as a result of changes in agricultural activity are also believed to be implicated. The continued poor recruitment from natural spawning, and poor growth of *Ranunculus*, are a matter of concern and warrants further investigation.

It is recommended that three further investigations are considered:

- an investigation of the relationships among stream flow, water depth, growth of *Ranunculus* and grazing by swans
- an annual electric fishing survey of several sites on the lower Wylye to monitor recruitment success;
- a study of the state of spawning gravels in the lower river, to establish the degree of the problem and to monitor the effects of schemes to improve the situation;

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7. ACKNOWLEDGEMENTS

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9. TEXT OF QUESTIONAIRE

Middle and Lower Wylye fisheries investigations Questionnaire

Background. The aim of this questionnaire is to gather information to describe the fisheries in the middle and lower Wylye, including their recent history, catches, restocking, management and problems, and to consider these against a background of changes in river flow regime, river management and land use.

1. Name, address and status of person filling in this form:

   Name, Address, Status (e.g. owner, tenant, club secretary):

2. Name and location of fishery (a copy of a map would be ideal).

3. Type of fishery (e.g. private, syndicate, club etc.)

4. Do you have records of catches? How far do these go back? Could they be made available for this investigation?

5. Can you give an indication of the level at which the water is fished e.g. number of club members, approximate number of rod-days per month.

6. What are the best months for trout fishing on your water? What is responsible for any poorer parts of the season?

7. Is the water regularly stocked? When did the practice start? Do you have records of restocking that could be made available? What size of fish are stocked?

8. Do you have any information about natural breeding of trout e.g. fishery depends upon it (no stocking), presence of small fish etc.? Has the level of wild production changed in recent years?

9. As objectively as possible, can you describe if and how the quality of the trout fishing has changed over the years?

10. What species of fish are present in your water, including coarse fish. Has the status of these changed over the years?

11. Can you suggest causes for any of the changes described in your answers to Q. 8, 9 and 10?

12. Have swan numbers increased in recent years? Has this had an effect?

13. Has weed growth, particularly *Ramunculus*, changed in recent years? Have your weed-cutting practices changed?

14. Have riverbank management practices changed e.g. cutting of bankside vegetation, access by livestock, fencing of banks?

15. Has any within-channel work been undertaken in recent years e.g. dredging, silt removal, channel narrowing, gravel clearing etc.?

16. Have you observed any changes in the insect and fly life of the river?

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Figure 1. Length/frequency of trout populations sampled at Norton Bavant.

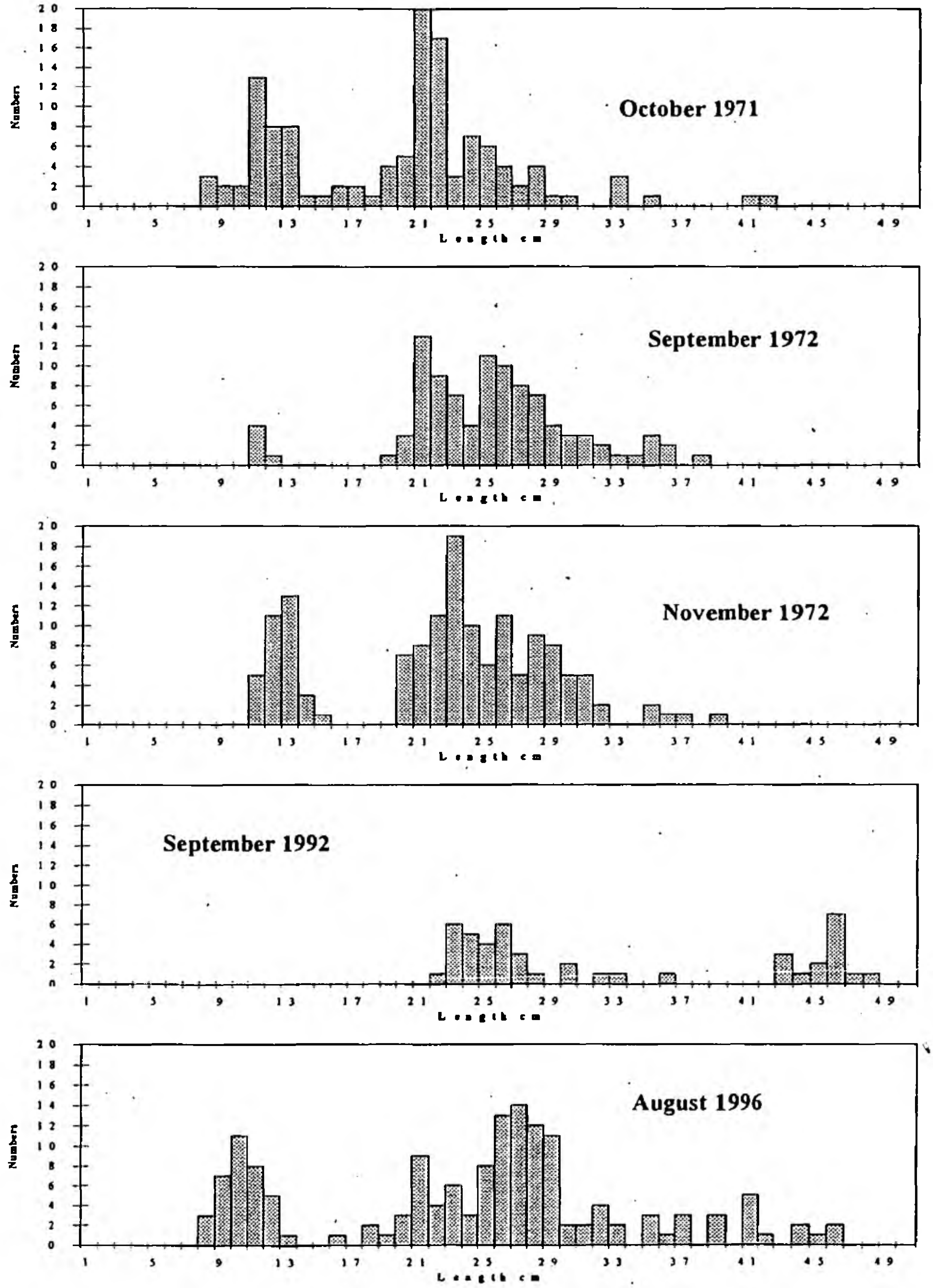

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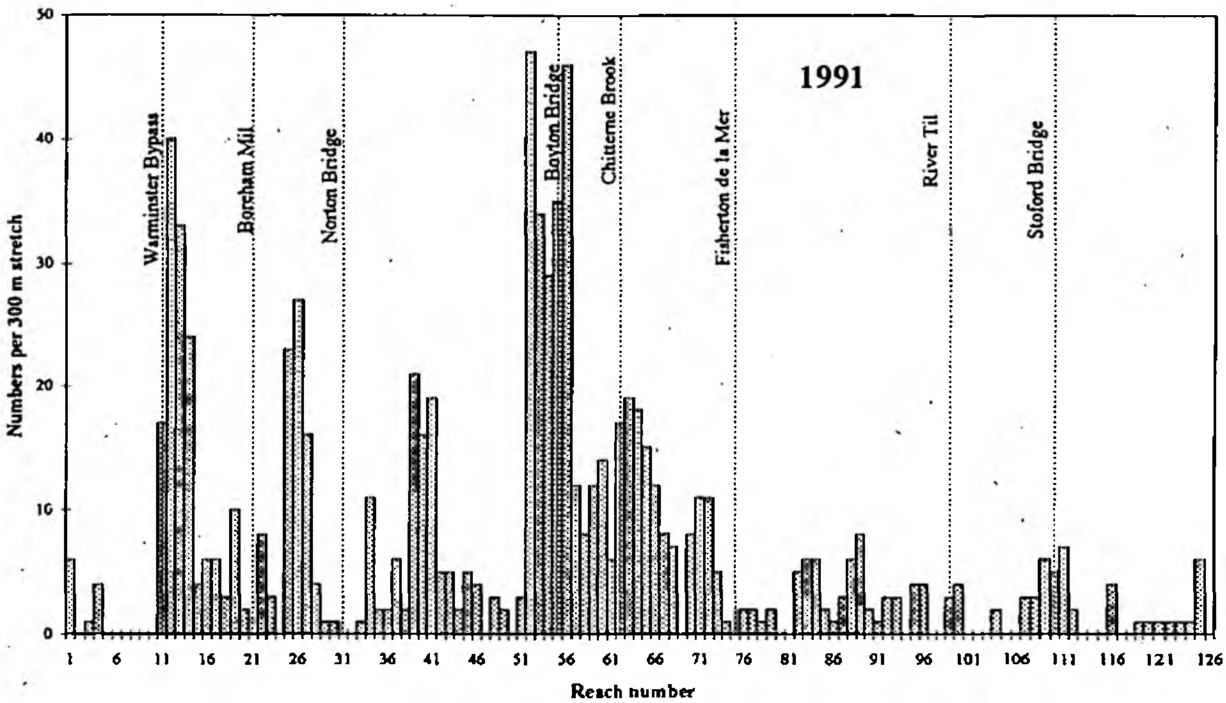
Figure 2. Distribution of 0+ trout parr sampled in whole-river surveys in 1991 and 1996.



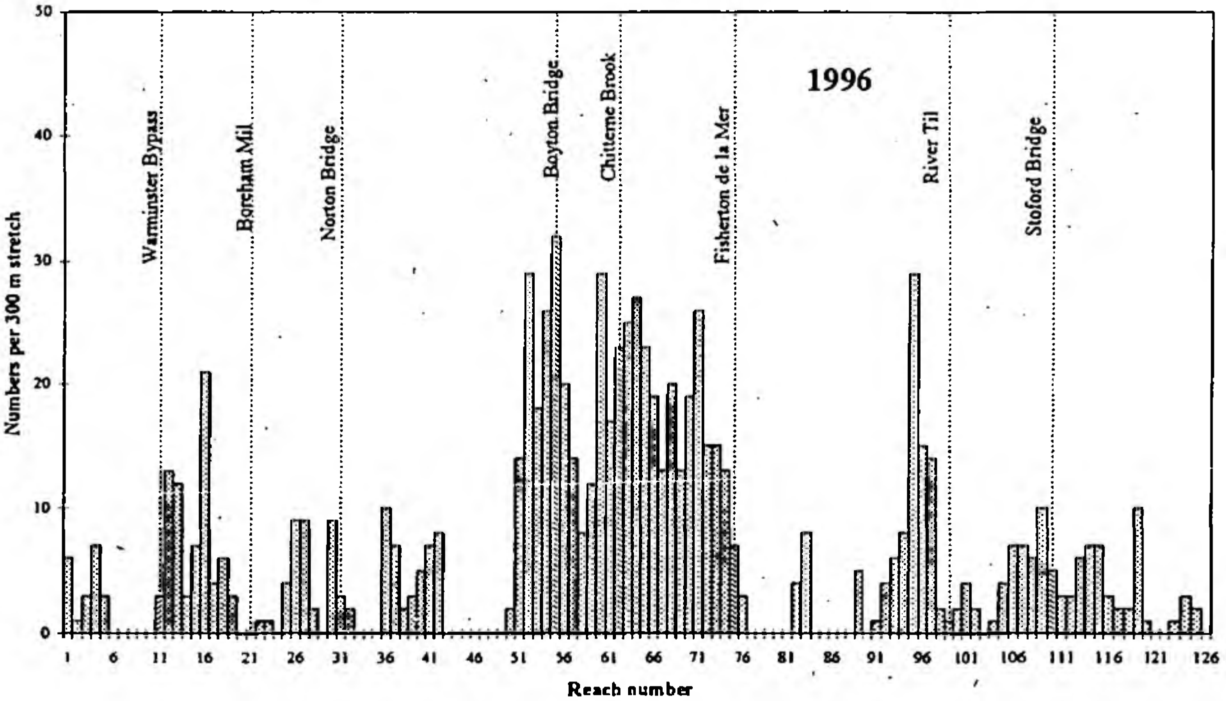


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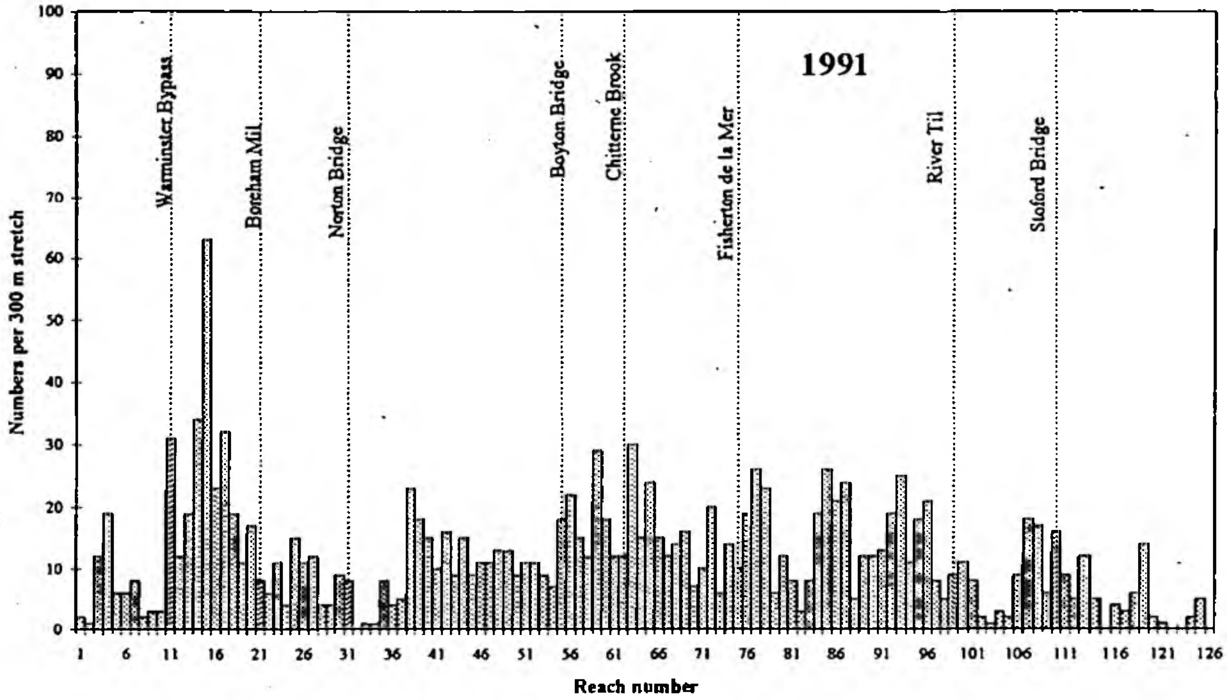
Figure 3. Distribution of trout older than 0+ sampled in whole-river surveys in 1991 and 1996.



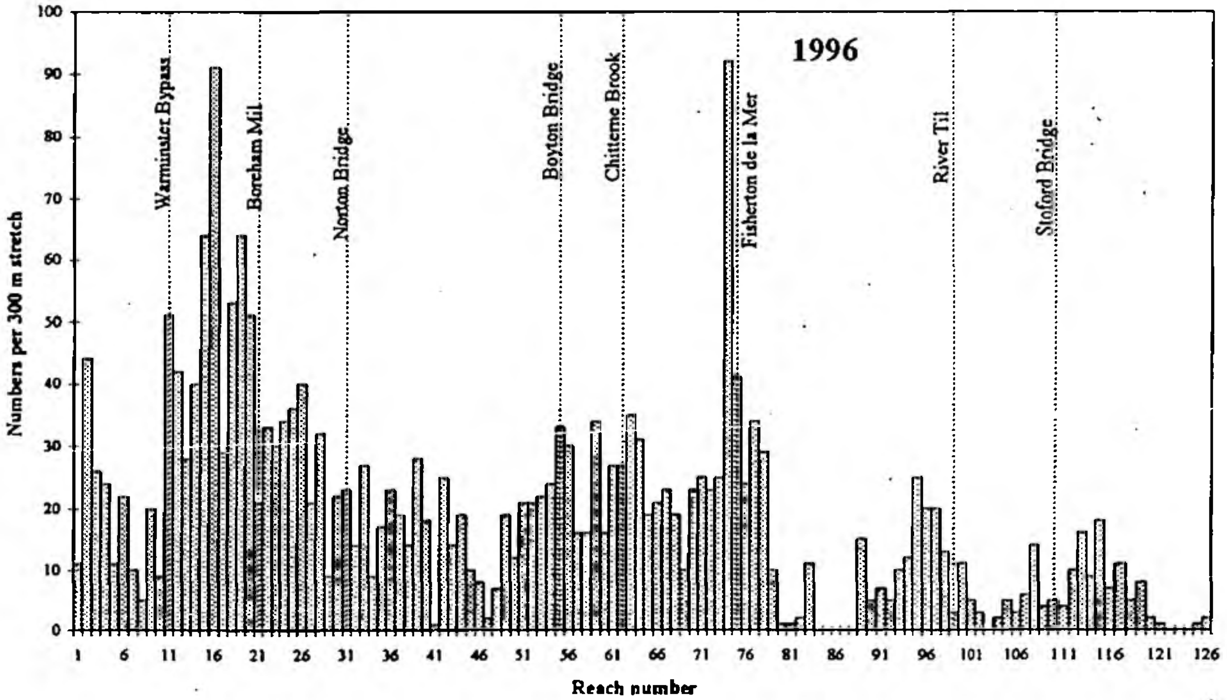


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Figure 4. Distribution of 0+ salmon parr sampled in whole-river surveys in 1991 and 1996.

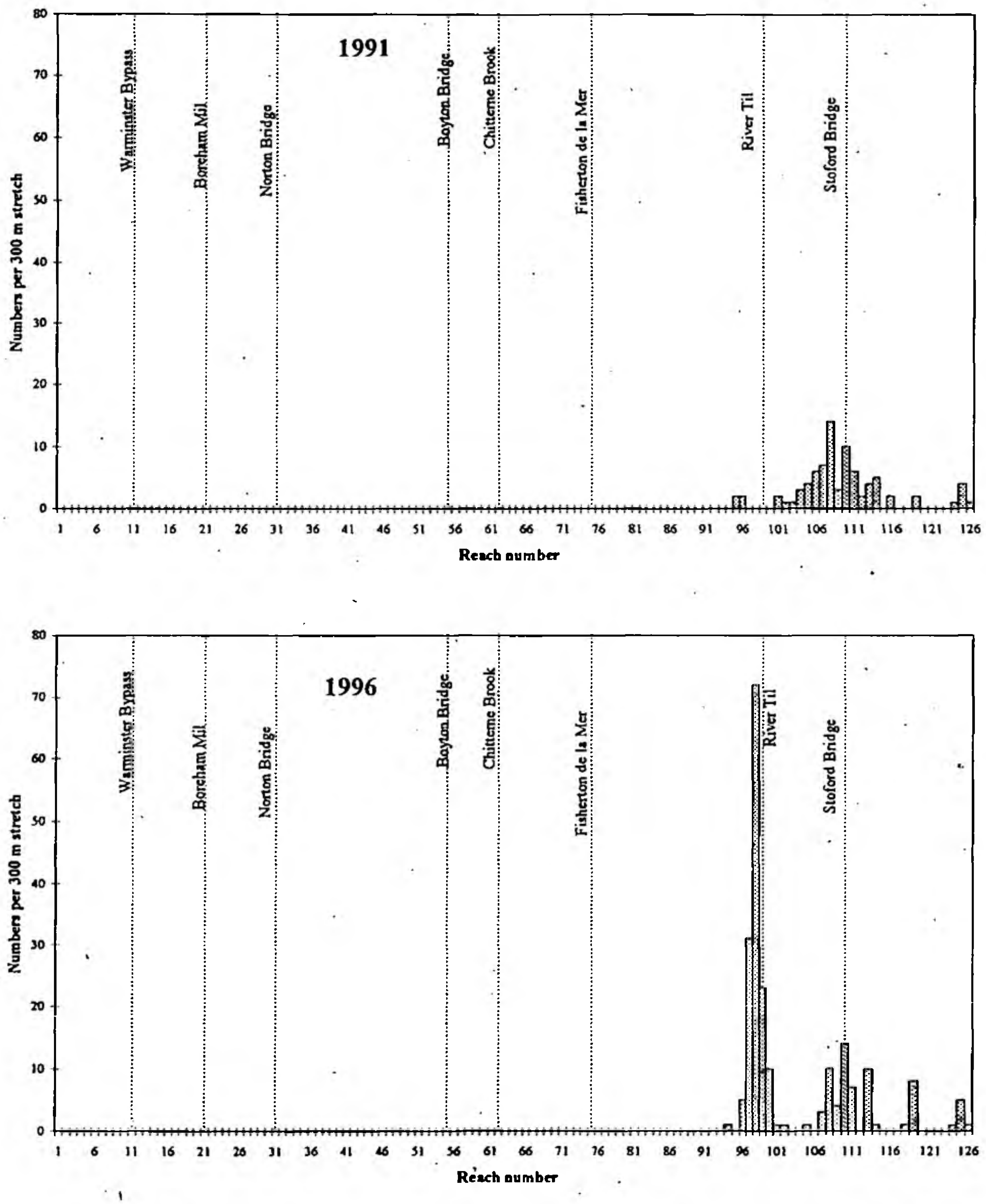

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Figure 5. Effect on the flow in the Wylye in August 1992 of the historical abstraction and the potential full licensed abstraction as indicated by the Halcrow Model.

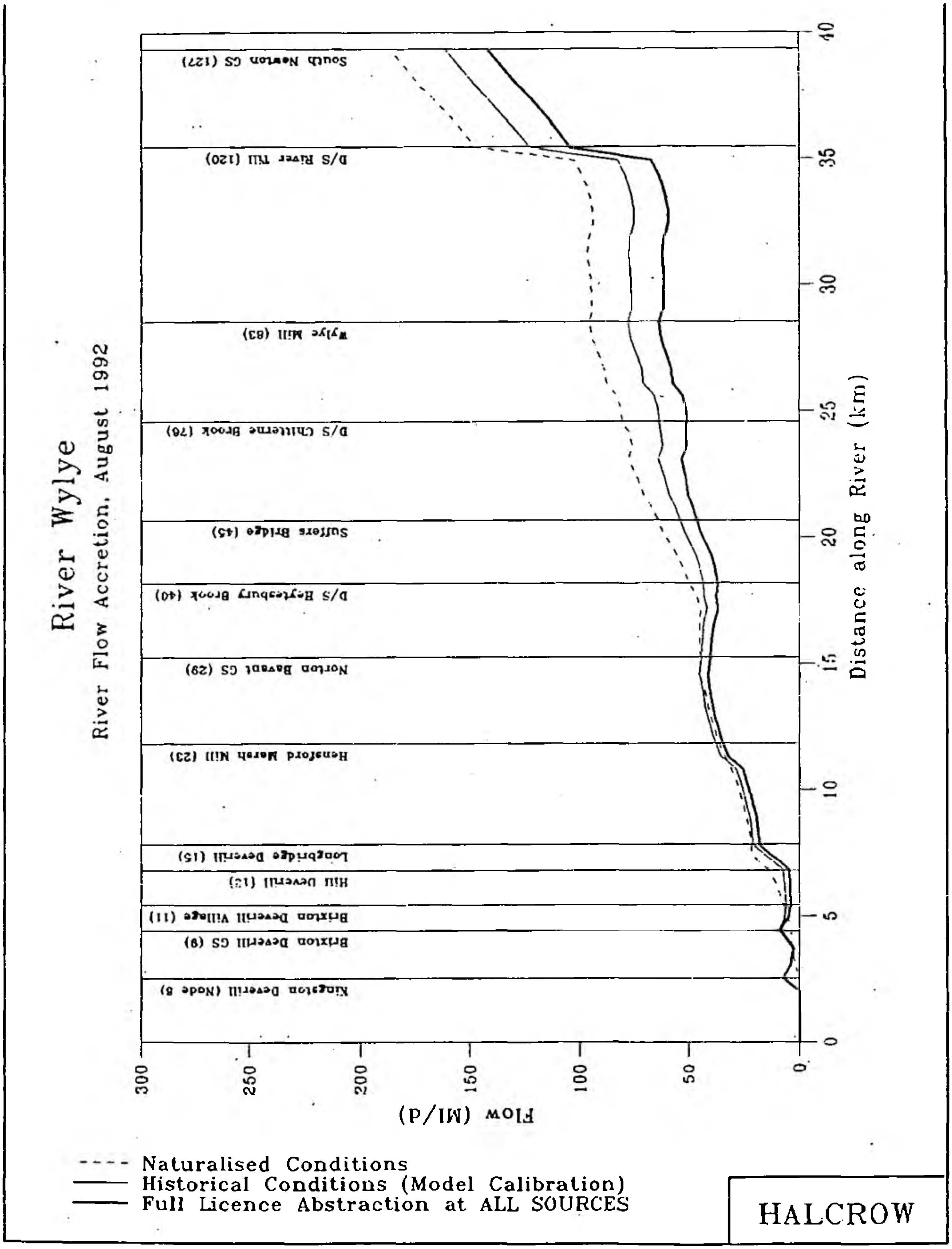

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Figure 6. Changing land-use in the Wylye Valley.
Above: Great Wishford (SU 074 357), old watermeadow ploughed and planted with cereal crop to within a few metres of the river edge, June 1992.
Below: Little Langford; water meadows ploughed and planted with Linseed, April 1992.