NATIONAL RIVERS AUTHORITY

NORTH WEST REGION

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RIVER WYRE

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CONTENTS

RIVER WYRE

1. Terms of Reference

This report has been prepared in response to a request from the National Rivers Authority, North West Region to:-

1.1 Produce a broad assessment of the River Wyre as a migratory salmonid river based on a site visit and the documentation provided.

1.2 Comment on the objectives of the Wyre Salmon and Sea Trout Restoration Group and the strategy by which it is proposed to meet these objectives.

1.3 Comment upon the objectives of the proposed spawning habitat enhancement and restoration project. Help to define relevant sub-projects and identify suitable contractors.

1.4 Recommend other possible means of habitat improvement and fisheries management development for the River Wyre.

2. Introduction

2.1 The Wyre catchment drains the eastern side of the Bowland Fells in Lancashire and from its headwaters to the point where it flows into Morecambe Bay at Fleetwood is some 53 km in length. The lowermost 15 km downstream from Great Ecclestone are tidal.

2.2 In addition to the two tributaries (Tarnbrook Wyre and Marshaw Wyre) which join near Abbeystead to form the River Wyre, the two other major tributaries are the Calder and Brock which join the main stem north

of Catteral and at St Michaels respectively.

2.3 Extensive flood defence works have been carried out in the lower reaches particularly between Churchtown and Great Ecclestone. In addition to creating two flood basins, these works have canalised the river and destroyed all the spawning and nursery habitat preferred by salmonids which may have previously existed in this area (Plate 1). Much of the habitat preferred by coarse fish has also been lost.

2.4 The catchment is largely agricultural with extensive pasture for sheep and cattle. The headwaters drain moorland and rough pasture used mainly for shooting grouse and pheasant. There is also some forestry.

2.5 Grass is widely and intensively cultivated and is grazed by the numerous herds of milk cows or made into silage for winter feed. The intensive rearing of animals for milk production and the manufacture of silage for winter food frequently produces large volumes of slurry and silage liquor which may enter watercourses during disposal and cause serious pollution. Cultivating the high quality grass necessary for these uses requires relatively heavy applications of high nitrogen fertilisers at regular intervals during the growing season. In this above average rainfall part of the country much of the fertiliser may end up in the watercourse. Slurry is also sprayed on the land to boost grass production and a proportion can enter watercourses and be another source of enrichment.

2.6 Overall water quality, however, is generally of a high standard, either Class 1A or 1B. Acid rain is known to affect the headwaters. There are problems in Tarnbrook Wyre both with low pH (3.7) and wide fluctuations (3.7 - 8.2) (Walsingham 1993).

2.7 Two treatment plants discharge into the Wyre and the chemical works at Hillhouse discharge into the estuary. However, the industrial estuarine pollution which is reported to have threatened the survival of the Wyre stock in the late forties and early fifties has largely been removed (Anon 1994a).

2.8 The upland grazings have been improved by increasing land drainage. Normally as a result, spates tend to be of shorter duration, but of enhanced velocity and volume, while minimum flows are depressed and their percentage occurrence more frequent.

2.9 Natural flow patterns in the Wyre catchment have been affected by direct abstraction from the river, from boreholes and by water transfer schemes. The tributaries most affected are Tarnbrook Wyre, Damas Gill, Grizedale Beck and Calder Wyre. Borehole abstractions reduce the flow in the lower Wyre downstream of the River Brock. Between Abbeystead and Garstang, the River Wyre conveys water abstracted from the River Lune as part of the Lancashire Conjunctive Use Scheme. This water, together with some additional Wyre water, is then abstracted at Garstang when conditions permit.

2.10 The uninterrupted passage of salmon within the catchment may be affected by weirs and dams even although fish passes have sometimes been provided (Plates 2 & 3). These fish passes eg Churchtown weir appear to be inefficient but with scope for improvement (Plates 4 & 5).

2.11 A high dam, incorporating a fish pass which has scope for improving its efficiency, has been built across the river at Abbeystead to create a reservoir (Plates 6 and 7). There was no evidence of regular flushing through the scour valve and large volumes of silt and gravel have accumulated behind this dam as evidenced by the growth of weed. The quantity of silt now accumulated may be too great to flush through the scour valve without degrading the habitat downstream. In any event, if the silt is removed by this route, removal should be timed to coincide with spates occurring outwith the period October to April when the developing salmonids are likely to be most at risk in gravel redds.

2.12 The passage of upstream migrating fish may also be hindered, if not completely stopped, at road bridges where the total flow enters a single or series or relatively narrow diameter pipes set parallel with each other under the road (Plate 8). At a number of sites, the upstream movement of fish has also been impeded by timber jams and the remains of fences washed into the water-course (Plate 9). Obstructions of this type can cause active bank

erosion.

2.14 Although the variation in the annual number of salmon reported caught each year in 1926 - 93 was wide, ranging from 0 in both 1955 and 1959 to 149 in 1967, there was little evidence of an underlying trend. Each year the majority of the fish were caught towards the end of the fishing season and spinning was the most successful method. Catches seldom reflect stock abundance because they can be affected by changes in fishing effort, angler and tackle efficiency and environmental factors including flow. In addition, the recent shift in run-timing across the North Atlantic towards the second half of the year has reduced the proportion of the stock available for exploitation within fishing seasons. Based on the mean weight, one sea-winter fish are likely to be the dominant sea age group

2.15 Sea trout catches also varied widely ranging from 0 in 1959 to 185 in 1948. Salmon and sea trout catches fluctuated independently of each other.

2.16 Wide variations in annual catches are a common feature of salmonid fisheries and because they occur for a number of reasons, a low catch in a particular year must not be assumed to be evidence of a decline in the stock though increased catches can ususally be related to an increase in the number of catchable fish. Nevertheless, angling success in spate rivers like the Wyre also depend on the required physical

conditions produced by adequate rainfall during the fishing season.

2.17 Juvenile salmon and trout densities in the Wyre catchment from Tarnbrook and Marshaw Wyre downstream to St Michaels were estimated in the summer of 1992 and the results have been described by Walsingham (1993). The distribution of juvenile salmon throughout the catchment, including the main stem, was erratic and where they occurred the density was low and generally less than 25 fish $100m^{-2}$. They were absent from Tarnbrook Wyre, Damas Gill and Foxhouses Beck. The absence of juvenile salmon from Tarnbrook Wyre reflects both the difficulty which spawners may have entering this stream, particularly when gravid, and if they have been successful, the high mortality on any offspring produced probably as a result of the wide fluctuations in and low pH. At some sites lower down the catchment juvenile salmon densities may have been limited by the physical quality of the habitat. The high trout densities at some sites in Marshaw and Tarnbrook Wyre probably reflect the greater resistance of juvenile trout to acid stress (Walsingham 1993).

2.18 The growth rate of the 0+ juvenile salmon was good with the fastest growers attaining 84 mm in length by early autumn. The length-frequency data suggest that although the majority of the juveniles will smoltify at two years-old, small numbers will

migrate at one and three years-old. Such a spread conveys a number of advantages to the population should disaster strike.

2.19 The Wyre is a spate river and therefore the quality of its angling will not match that of its bigger neighbours. Nevertheless, it has sufficient capacity and potential to give enjoyment to a substantial number of anglers particularly those staying locally who can judge when conditions for fishing are favourable. However, it will first be necessary to repair the damage to the habitat caused by many years of neglect and lack of maintenance, modern agricultural practices and unsympathetic in-river works before the conditions preferred by juvenile salmonids can be recreated and that potential realised. In order to speed recovery it may be cost effective to release parr measuring not less than 90mm in the late autumn and/or smolts in the spring. The age of these fish should not significantly differ from that of the native fish at the equivalent life history stage.

2.19 Fish may have difficulty crossing some weirs except at particular flows and access into some spawning burns may be restricted because of permanent or temporary obstructions.

2.20 Although water quality monitoring in the headwaters has detected both low and a wide range of pH values, the extent of the problem has not been assessed and no mitigation measures have been

undertaken. Although, the loss of any potential nursery area should be avoided, any loss in this particular section of the catchment is particularly important because the smolts which would be produced would probably return in the first rather than the second half of the fishing season and thereby provide anglers with sport over an extended period.

2.21 Active erosion of banks continues to occur in some areas (Plates 10 & 11). This erosion is frequently associated with overgrazing the bankside vegetation. Along some stretches, the products were observed to have smothered the bed in a layer of relatively fine silt destroying the habitat preferred by salmonids and many of the invertebrates on which they feed. Silt has also accumulated on stretches of quality substrate where the water velocity has been reduced sufficiently to allow the smaller particles to fall out of suspension by the growth of weeds and algae, perhaps stimulated by fertilisers leaching into the stream in these areas. (Plate 12).

2.22 In some areas where the habitat and flow conditions are otherwise suitable, sufficient gravel, containing the range of sizes preferred by Wyre salmon for redd construction, is lacking (Plate 13). Clarke (pers comm) suggests that these conditions prevail because the normal transport of gravel from the upper reaches to replenish losses further downstream no longer occurs beyond the reservoir at Abbeystead. Vehicular traffic and cattle crossing

between fields or entering the watercourse to drink have compacted the gravel in some areas (Plate 11). Where this has occurred the habitat has been degraded and it is no longer suitable for redd construction.

2.23 The full potential of the Wyre will not be realised until these problems have been resolved.

3. Objectives of the Wyre Salmon and Sea Trout Restoration Group and other Possible Means of Fisheries Management Development for the River Wyre.

3.1 Presently there appears to be at least two totally independent factors exercising considerable control over the number of salmon being caught. The first is the increase in natural mortality at sea and the other is the decline in the quantity and quality of the freshwater habitat preferred by adults and more especially the juveniles. As suggested earlier, the latter is mainly due to changes in land use and water management and the lack of river maintenance. Although little control can be exercised over the sea phase, it should be possible to redress much of the effect of habitat degradation in freshwater. Therefore, the primary objective should be to maximise smolt production. This action may also compensate, at least in part, for the increased mortality presently being experienced in the sea. All the present data suggest that density dependent mortality does not operate in saltwater so the higher the smolt production the more adults there

should be to return.

3.2 In the longer term, the most effective way to attain these objectives, is to improve the quality and increase the quantity of the spawning and nursery habitat. If the habitat has been extended to include virgin areas above permanent barriers there will be a need to release hatchery-reared fish. Where temporary barriers have been removed and where there are insufficient native spawners, there may also be a need to release hatchery-reared fish in the short term.

3.3 All hatchery-reared fish released into the wild, except when the numbers are too small to give a significant result, should be tagged. On the other hand, if the numbers are very large it may be necessary to limit tagging to a sample. The analysis of recapture data may provide sufficient information to assess the biological and economic effectiveness of stocking hatchery-reared fish compared with other management strategies.

3.4 Survival from egg to smolt is commonly estimated to be less than 1%. If that survival can be increased to 1.5% or 2%, which is thought to be attainable in the Wyre catchment by improving the habitat, smolt production would be doubled and what is vitally important, there would be no change in the gene complex of these additional fish. Hatchery-reared juveniles, on the other hand, tend to smoltify at a younger age, even if they have been released at the

fry stage and if they migrate to sea at one year, the bulk of the survivors will return as adults towards the end of and even after the fishing season has closed in October (Shearer 1992).

3.5 Based on relatively scant data, the survival of hatchery-reared smolts is generally less than that recorded for the wild equivalent. Present data suggest that the release of 5000 smolts in 1994 may produce an additional 100 fish back to homewaters, and even if all these fish survive and enter freshwater during the fishing season, one could reasonably expect an additional 10 rod caught salmon. Of greater value to managers, however, is the data which will become available from the tagging of these 5000 smolts provided all the recaptures are recorded.

3.6 The Restoration Group should initially (phase 1) channel the bulk of their available resources into maximising smolt production in those streams where water quality and quantity are not a problem. Some minor in-river works will be necessary. These works will include the stopping of bank erosion where it is active and releasing large volumes of silt into the watercourse, replenishing spawning fords with the preferred size and depth of gravel and upgrading the quality of the existing nursery and spawning areas. Any work in streams where water quantity and quality and access are likely to be a problem should be delayed until phase 1 of the programme has been

completed. For example, where acidity and the absence of juvenile salmon have been linked, it will first be necessary to identify the source of the pollutant before deciding whether remedial action is feasible and likely to be cost effective.

3.7 Although catch and release has been proposed to conserve existing stocks, this technique may not be appropriate in all circumstances. Few studies of the survival following catch and release of sea-run Atlantic salmon have been conducted (Anon 1994b). Canadian studies indicate that catch and release has minimal impact on the survival of the fish or their reproduction. However, personal experience in Scotland and in Canada has shown that Canadian salmon are less liable to fungal infection after handling than Scottish fish. The effects of catch and release on fish caught in January to June has not been evaluated and the UDN outbreak in the late 1960s is a vivid reminder not to take any risks. The adoption of a catch and release policy by the owner of a Scottish west coast river has failed to significantly increase subsequent angling catches. The underlying catch trend has remained similar to those calculated for adjacent rivers (Data source - Scottish Office catch statistics). Nevertheless, releasing coloured females caught towards the end of the fishing season may augment juvenile production where egg deposition has been shown to be a limiting factor. If a catch and release policy is adopted,

anglers would also have to agree to modify their tackle in order to minimise both stress and loss of potential energy. Catch and release may also attract the attention of organisations opposed to angling. Therefore, the value of catch and release as a management tool has still to be assessed.

3.8 The need for more accurate and comprehensive catch data cannot be overemphasised. It should include effort data and type of lure fished in addition to environmental and physical information eg water height and air and water temperature at the time of capture. Nil catches should also be recorded.

3.9 Man-made and natural obstructions were identified on the main stem and on some tributaries. Some were total while others were partial. Although some have been provided with fish passing facilities, their efficiency should be assessed over a range of flows using radio tracking and where found unacceptable improved, eg Churchtown weir. Other observed obstructions which in some instances may be partial included fallen trees and sections of fences which had fallen into the stream. Piping the water under road crossings may also prevent easy access. These obstacles should be removed and where this action is impractical, the passage for fish should be improved.

3.10 A stock recruitment curve is essential for the meaningful long-term management of the Wyre Salmon Stock. Three basic pieces of information are

necessary, a) the estimated annual smolt production and its age structure, b) the number and age (river and sea) of the spawning stock each year, together with lengths and sex in order to compute egg deposition and c) the number and ages (river and sea) of Wyre salmon caught in the various fisheries.

3.11 Much of these data can be obtained by installing a reliable fish counter in the main river downstream of the lowermost spawning ford and the confluence of the tributary nearerst the estuary provided it is above the head of tide. The weir at Churchtown is probably the best available site as the proposed budget would not be sufficient to cover the cost of the construction of a purpose-built weir. A fish trap must be incorporated in the structure to facilitate the sampling of the emigrating smolts and immigrating salmon.

3.12 Smolt production would be estimated using the standard tag and recapture technique. The recapture of adults which had been tagged as smolts will allow the contribution which Wyre stock makes to the various fisheries to be estimated.

3.13 In a number of catchments in Scotland with which I have some association, changes in rainfall pattern appear to have limited the period available to spawners to enter the spawning burns. As a result, they tend to remain in main stems and when conditions are acceptable enter the preferred tributary and spawn in the lowermost ford before

dropping back into the main river frequently within 24 hours of having first entered that tributary. This behaviour pattern usually concentrates redds in a relatively small area near the confluence and may result in above average mortalities while many kilometres of good quality spawning gravel upstream remains barren.

3.14 Spawning burns should be kept under surveillance at spawning time. If the above situation is likely to occur, excess fish should be lifted off the lowermost spawning ford, stripped, their eggs fertilised and then buried in prepared redds at the uppermost limit of suitable habitat. At emergence, these fish will drop downstream and populate the burn thereby maximising juvenile production merely by decreasing natural mortality.

4. Spawning Habitat Enhancement and Restoration Project.

4.1 More information describing the spawning requirements of Wyre salmon should become available when the contents of the M Phil study, presently incomplete, have been published. My own experience indicates that salmon can and do spawn successfully in a wide range of gravel sizes. In Scottish rivers, harnessed for hydro-electric production, no scarcity of preferred gravel sizes has occurred downstream of dams but the physical structure of these rivers is markedly different to that found in the Wyre.

4.2 Three main elements require investigation but these

may require to be slightly modified to take account of the results contained in the M Phil thesis when they become available.

a) The size and depth of gravel preferred by Wyre salmon in relation to their length and age and the water depth and velocity.

b) The movement of gravel downstream from Abbeystead reservoir. Although time on site was insufficient to investigate, in any detail, the logistics of this proposal, differences in the composition of gravels from various sources, coupled with a detailed and regular mapping of in-river gravel banks, are presently being used to study the source and movements of gravel in a major tributary of the North Esk.

c) The construction and stabilisation of gravel fords to create the physical and hydrological conditions required by salmon for spawning, the incubation of their eggs and the successful emergence of the fry. This study should include an element to identify the most appropriate angle and shape of croy which will change flow patterns and create, where required, gravel fords of the type preferred by Wyre salmon for spawning.

4.3 Tree trunks set into the bed across the width of small streams and secured by digging into the bank on either side have been used to accumulate gravel at preferred spawning sites. These low dams also

create pools and maintain the wetted-area during periods of drought. Thus they provide the type of habitat preferred by fry and by parr of both species.

4.4 At present, the extensive but degraded spawning and nursery habitat in Marshaw Wyre and to a lesser extent in Tarnbrook Wyre (judged on the basis of a single visit) (Plate 14) is producing trout but no juvenile salmon. This could be due to poor water quality. As a first step, the existence of an acidity problem should be investigated by installing continuous recording pH meters. Establishing whether such a problem actually exists, and if so its extent, will allow the feasibility and cost of the most appropriate method of liming together with other mitigation measures to be investigated. However, a word of caution. It is understood that smolts reared in Norwegian lime treated streams suffer above average mortalities soon after entering saltwater due to the failure of their osmo-regulatory system to cope with salinity changes.

4.5 Smolts successfully reared in these headwater tributaries, have still to overcome the problems associated with the weir across Tarnbrook Wyre at Lee's Bridge and migration through and exit from Abbeystead reservoir. Most emigrating smolts will drop over the dam rather than exit via the fish pass. Therefore to lessen the height of the drop it would be necessary to raise the tail-water level

below the dam by building a low weir across the river at that point (Plate 15). Injecting more water into the lowermost pools of the fish pass would increase the attraction. Any work involving in-river construction can be costly. Therefore, it is necessary to examine the feasibility and cost of the works necessary to ensure the safe emigration of any smolts produced upstream of Abbeystead before embarking on a comprehensive enhancement programme. This study should not be limited to modifying natural and man-made obstructions but should also examine and cost alternative methods eg trapping and trucking the migrants downstream of the problem sites. Although trucking has had limited success in Scotland, it is widely used in North America.

4.6 Initially, it will be necessary to seed barren stretches. Ideally, the parent stock should be caught as close as possible to where their offspring will eventually be released. When this universally accepted code of practice cannot be followed it will be necessary to match the native gene complex as closely as possible. Data from Canada indicates that it does not always follow that stock from adjacent rivers will satisfy this criterion.

4.7 Discharges, including those from farm drains and ditches draining agricultural land, should be regularly checked to detect pollutants entering the water course. Silage liquor is most likely to be a problem in early summer particularly in years when

rainfall in the couple of weeks preceding harvest has been above average. Now that the gravel extraction works have ceased production, the risk of pollution from that source has receded.

4.8 Unfortunately, my knowledge of suitable contractors is limited. The FBA laboratory at Windermere should have the necessary expertise in all the required disciplines. If they are not interested in a contract, a university should be approached. Lancaster and Liverpool are suggested merely because of their proximity. Provided access to people with experience is readily available for guidance and help with the analyses and interpretation of the data and the results, much of the initial investigative study could be undertaken by a team of senior students. This method is probably the most cost effective method because the proposed study is labour intensive. However, the need to fit the field-work into university vacations may extend the study beyond the proposed dead-line.

5 Conclusions

5.1 Some of the problems causing the below average salmonid production in the River Wyre catchment have already been addressed by Walsingham (1993) and Clarke (unpublished data). While Walsingham evaluated the habitat and juvenile salmonid densities at various sites throughout the catchment, Clarke examined the spawning fords and identified the size of gravel preferred by Wyre salmon. He

suggested that Abbeystead Reservoir was preventing the natural replenishment of gravel in the main river downstream of the dam and that the lack of suitable spawning gravel was limiting salmonid production in these areas.

5.2 Both the above studies require to be extended to include a complete audit of the Wyre catchment. The critical elements should include:-

a) the identification of all the barriers to fish migration and how best the problem can be eased if not eliminated;

b) the reason(s) for i) the lack of juvenile salmon, ii) low juvenile salmon density and iii) erratic distribution;

c) the identification of stretches where additional spawning habitat can be created by forming new spawning fords;

d) the identification of areas where the present spawning, fry and parr habitat can be upgraded by simple in-river work eg stopping bank erosion, loosening compacted gravel, desilting spawning fords and placing boulders in the stream to create more territories;

e) estimating the present level of exploitation by angling on the various stock components;

f) the construction of a stock recruitment curve for salmon. This will require the building of a fish counter and trap at Churchtown weir. A similar curve for sea trout cannot be constructed because

the contribution which the resident trout population makes annually to sea trout smolt production cannot presently be evaluated.

5.3 The construction of a comprehensive management plan must await the results of these studies. In the interval, the release of limited numbers of hatchery- reared fish is recommended, eg the release of the 5000 smolts.

5.4 Although sea trout have seldom been mentioned specifically, much of the foregoing advice also applies to them. However, the preferred habitat of the two species differs. The preferred habitat of sea trout is frequently found in the smaller tributaries where water velocity is less rapid than in main stems and where the smaller gravels can be found. Provided quality gravel is present, sea trout frequently spawn in the ditches draining arable land. Therefore, it is essential to warn farmers not to clean ditches between October and May and the operation of mechanical diggers should be restricted to the removal of silt, leaving the gravel intact. When trout fry leave a redd, they occupy the pools rather than the riffle areas and the parr are frequently found under overgrown banks and in holes around tree stumps. Therefore, providing more pools and preventing the degeneration of the bankside vegetation can increase trout numbers. Largely because of this behavioural difference juvenile trout tend to suffer much more

than salmon of the same age during periods of prolonged drought.

6. BIBLIOGRAPHY

Anon (1994a) Annual Report of The Lune and Wyre Fishery Association, December 1993, 44pp.

Anon (1994) North Atlantic Salmon Conservation Organisation. Report of the Eleventh Annual Meeting of the Council, 209 pp.

Shearer W.M. (1992) The Atlantic Salmon. Natural History, Exploitation and Future Management. Blackwell Scientific Publications Ltd, Oxford, 244pp.

Walsingham M.V. (1993) Report on the 1992 Stock Assessment of the Wyre Catchment. NRA/NW/FTR 93/14

7. Appendix

Plate 1 Lower main river

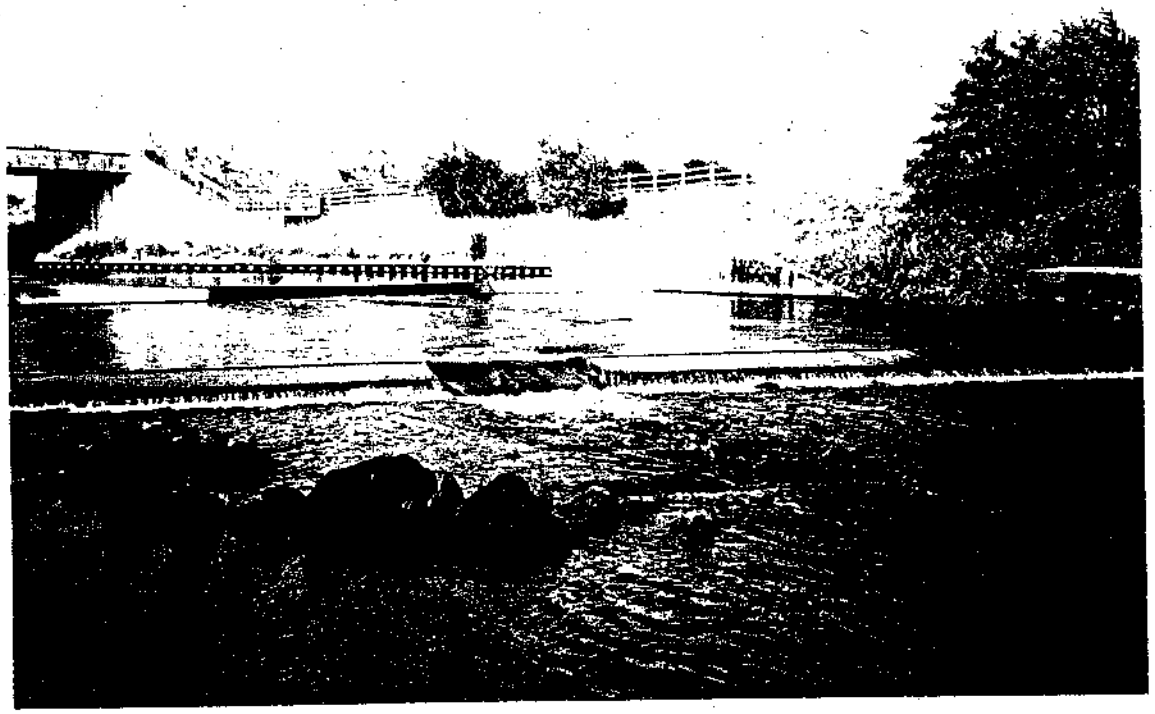

Plate 2 Garstang counter weir

Plate 3 Abbeystead dam

Plate 4 Churchtown weir

Plate 5 Churchtown fish pass

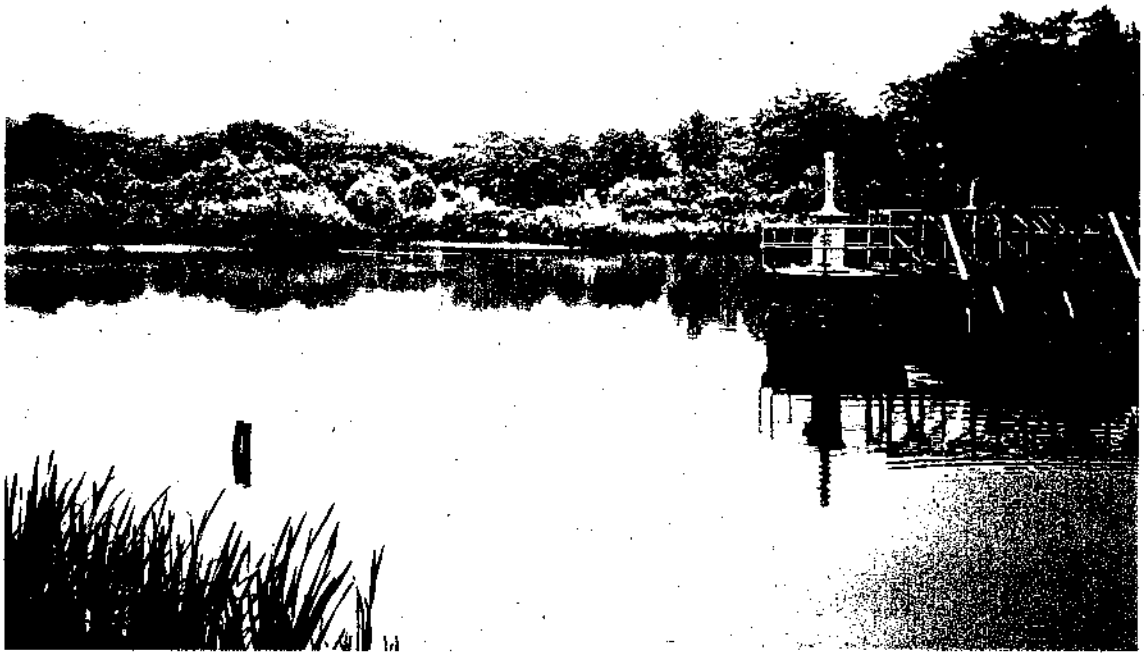

Plate 6 Abbeystead reservoir

Plate 7 Abbeystead fish pass

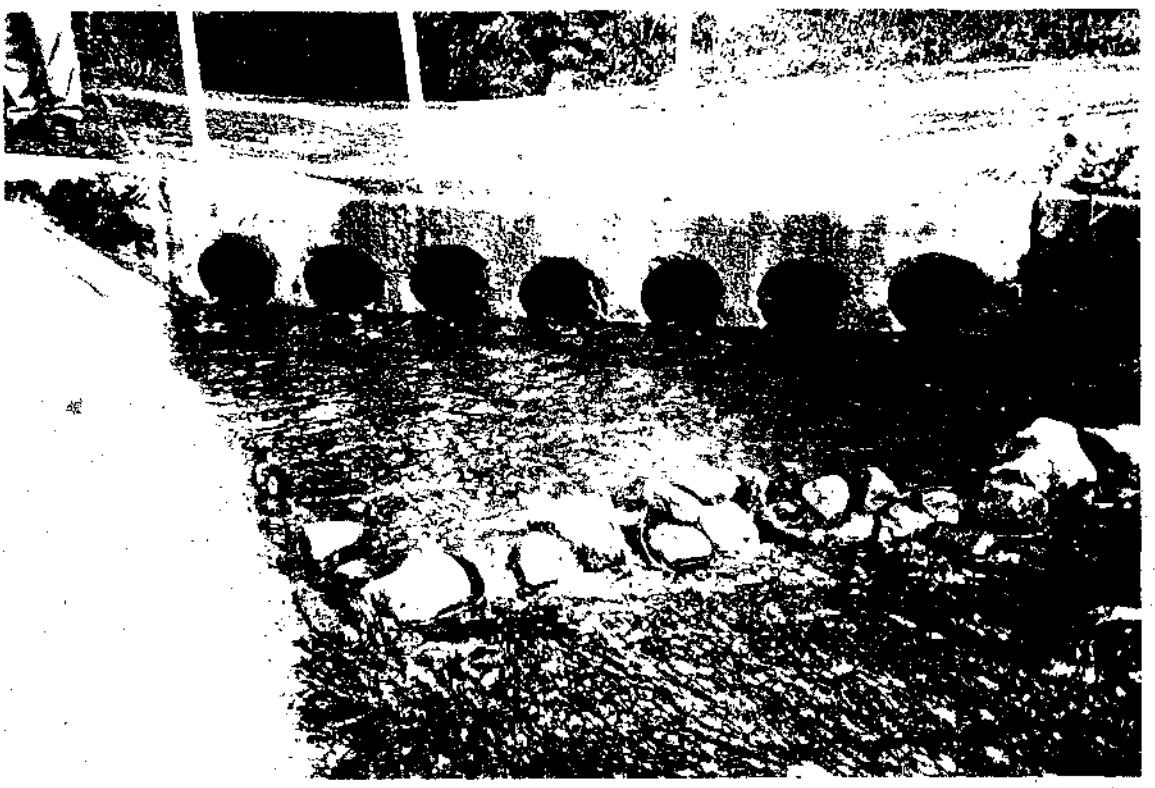

Plate 8 Partial obstruction

Plate 9 Timber jam

Plate 12 Spawning ford, Gubberford Bridge

Plate 13 Potential spawning area but lacking gravel of the preferred size

Plate 10 Active erosion

Plate 11 Active erosion on a larger scale

Plate 14 Tarnbrook Wyre

Plate 15 Abbeystead Spillway