Institute of Freshwater Ecology

Planning and design for the restoration of fish habitat in the Wallers Haven and Pevensey Haven.

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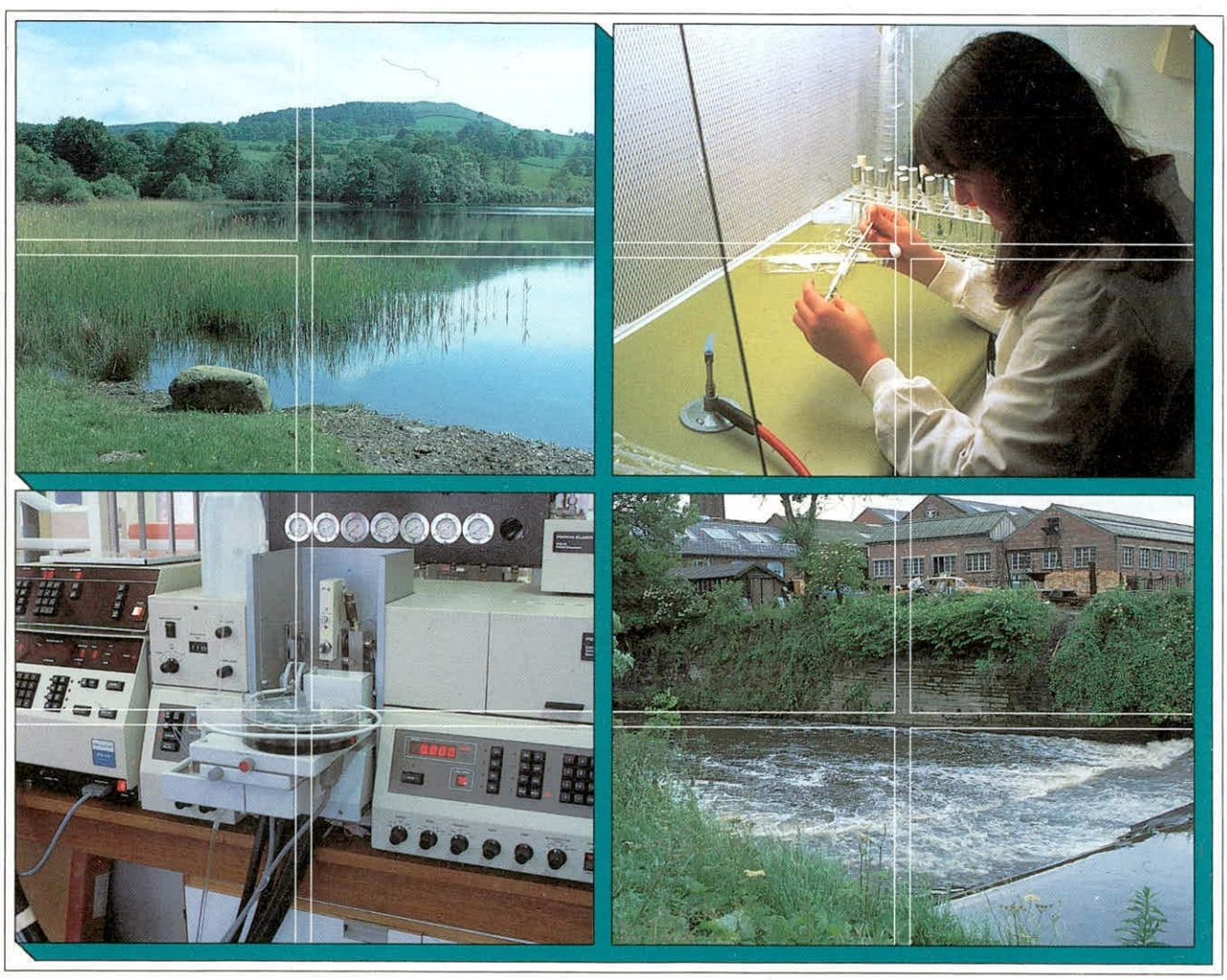

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PLANNING AND DESIGN FOR THE RESTORATION OF FISH HABITAT IN THE WALLERS HAVEN AND PEVENSEY HAVEN

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PLANNING AND DESIGN FOR THE RESTORATION OF FISH HABITAT IN THE WALLERS HAVEN AND PEVENSEY HAVEN.

Introduction.

The Wallers Haven and the Pevensey Haven are used for land drainage purposes. The channels are both steep sided and deep with very little shallow marginal habitat. They are dredged to keep them open and are surrounded by embankments. The water levels are controlled by sluices. On the Wallers Haven water can overflow the sluices but during excessive floods they are raised allowing water to flow under them. The level in the Pevensey Haven is often lowered prior to expected precipitation to increase the capacity for flood water storage.

Recent surveys of these water bodies suggest that the biomass of fish carried by them is low. Further, in the Wallers Haven, growth of both common bream *Abramis brama* and roach *Rutilus rutilus* was slower than other local and national populations. After the raising of the sluices, numbers of fish, in particular bream, have been found on the beach suggesting that fish may be lost in significant numbers through this process.

This report gives the specifications for a number of structures that could be used to improve the fish habitat in the Wallers Haven and the Pevensey Haven. Some estimate is made of the likely fishery benefit of each structure. The report is based on a one day site visit and information supplied by NRA Fisheries Staff on the management, chemistry and biology of the two water bodies.

There are a large number of flood defence and water resource issues which need to be taken into account when incorporating structures into water bodies such as these. Often this serves to constrain and restrict the structures that can be used. It is felt that these are largely an internal matter for the NRA and therefore this report takes very little account of these and only discusses them in a general context.

Identifying the problems.

Completed fisheries surveys have reported that both water bodies carry a low biomass of fish and that the Wallers Haven bream and roach grow slowly when compared with other local and national populations. Whilst there is good evidence that growth rates are low, biomass is notoriously difficult to estimate in deep, wide channels without the use of highly specialised fish sampling techniques, and the tendency is always to under-estimate the density of fish present. This appears to have happened during the past fishery surveys associated with these water bodies and thus it is not possible to say with certainty that the fish population is limited in terms of numbers. However, there is an overriding view that biomass is on the low side, and in the absence of any evidence to the contrary it has to be assumed that this is the case.

There is very little information on the factors limiting the fish populations. A visual inspection of the sites and measures of the channel profile would suggest that they are associated with the homogenous, straight and generally deep, nature of the channels. Over and above the morphological state of the fisheries, is the operation of sluices for flood control purposes in an environmentally unfriendly manner.

Using the information that is available and having discussions with the experienced NRA Fisheries Staff it is possible to put together a list of potential deficiencies and problems of the two water bodies which have led to the limitation of the fish populations. Individual habitat improvement techniques can then be assessed in terms of their contribution to replacing features required by fish and solving the problems of population limitation.

In total six separate deficiencies and problems were identified. These were:-

1) There is a lack of flooded vegetation for phytophilous species to spawn on.
2) The regime of water level control results in the stranding of fish eggs.
3) There is a lack of shallow, weeded marginal habitat considered to be important for juvenile fish.
4) There is no refuge from high flows, caused by the operation of the sluices during flood conditions.
5) There is a lack of in-stream structure, leading to low invertebrate production, particularly in the Wallers Haven.
6) The quantity of habitat is reduced in the summer by stratification.

Although, all six of these may be appropriate to the water bodies in question, detailed evidence is lacking for some of them. In particular this refers to the contribution of the stranding of fish eggs and loss of fish through the sluices, to failed recruitment. Whilst both these events undoubtedly occur, they need to be put into context by comparing losses with egg and juvenile population numbers.

In a stagnant and productive water body which is three metres deep, stratification would not be unusual, but knowledge of when, and the level at which it stratifies might enable better management of water levels to reduce the probability of its occurrence.

Target Species.

As well as addressing deficiencies and problems, the design of any improvements must take into account the requirements of the target species. The fish communities of the two water bodies are very similar and are dominated by bream, roach and perch *Perca fluviatilis*. Fisheries interest is concentrated on these species, although there is also an eel *Anguilla anguilla* fishery and the Wallers Haven is known to produce specimen pike *Esox lucius*. There are, however, a number of other fish species present such as carp *Cyprinus carpio*, rudd *Scardinius erythrophthalamus* and tench *Tinca tinca* which, past fishery surveys would suggest, are not very abundant. The implications of each habitat structure will be considered for these as well as the dominant species.

Very little is known about the specific habitat requirements of each fish species, however it is possible to consider the general requirements at each life stage.

1) Spawning:- This fish community can be divided into two groups. There are the phytolithophils (bream, roach and perch), which can lay eggs on any submerged item or substrate, although they generally prefer plant material. The other group are the phytophils (carp, rudd, tench and pike), which are obligatory plant spawners. Both these groups have species which spawn in the spring (roach; perch, rudd and pike) and species that spawn in the

summer (bream, carp and tench).

The lack of plant growth in these water bodies may be the biggest single factor contributing to the dominance of the phytolithophils in this community. Both the presence of spawning structures and their seasonal availability will need to be taken into account in the restoration plan.

2) Juveniles:- Juveniles are most sensitive to severe flow conditions and the fry of most species require lentic shallow habitat at least in their early stages. Further, all the species in this community show some association with plant material at some stage in their first year (Copp, 1992). The length of the spawning season of this fish community (i.e from February to July) means that both weeded and clear shallow, lentic areas will need to be available from Spring to Autumn.

Much less is known of the winter habitat of these juveniles but it is felt that they retreat into deeper, slow flowing areas, at this time of year.

3) Adults:- The adult stages of this community can be divided into two groups. There are the generalists (pike, carp, eel, roach, bream and perch), which utilise both river and backwater habitats. The other group are the lentic species (rudd and tench), which tend to use connected or disconnected lentic habitats with well developed submerged vegetation.

The low abundance of this latter group may be related to the absence of lentic habitats.

Differences have been noted in the efficiency of feeding of young adults of some species with roach and bream being more successful feeders in open water, whilst rudd and perch are more efficient amongst structure (Winfield, 1986; Diehl, 1988).

<u>The most appropriate options for the restoration of fish habitat in the Wallers Haven and Pevensey Haven.</u>

This section summarises the more detailed analysis of the various options found in Annex A, attached to this report. In this analysis each option is only assessed in terms of its ability to replace or cure the six deficiencies or problems listed above. No account is taken of the political or economic constraints, except to point to what some of these might be.

Of all the options listed in Annex A, only two provide solutions to all six deficiencies or problems listed above. These are the use of multi-stage channels, rather than the single flood relief channel, or the use of artificial backwaters and ponds. The fact that both of these can be constructed to provide an infinite variety of habitats, means that the requirements of every life stage, of every species, currently present can be incorporated into their design. In addition, it should be possible to add other species such as chub *Leuciscus cephalus*, if this were ever thought appropriate. However, the construction of a multi-stage channel is a far greater undertaking and uses much more land than artificial backwaters and ponds would. Additionally, such a design would not fit well with the single channel sluice system currently in operation. All the other options are far more specific in their value and none satisfactorily mitigates the problem associated with the stranding of eggs.

The only disadvantage of incorporating such out-stream structures into the floodplain is the loss of farm land that they represent. With careful planning and management there would be no flood relief or water resource problems, since they can be constructed within flood banks, and so that they only fill under flood conditions. The loss of land can be compensated for by the revenue obtained from letting the increased water surface area to anglers, and by the increased value of the fishery resulting from the removal of the current obstacles to fish production.

Combinations of the other options will be required if all the deficiencies and problems listed above are to be dealt with adequately. The only structures that can provide flow refugia are the dams, weirs and wing dams, These all involve placing large wooden or stone structures in the main channel and their installation would be far more costly and laborious than the provision of the previously discussed backwaters. To effect any major improvement to the main channel these would have to combined with other options such as the creation of wider berms to deal with the lack of marginal weed, and the addition of a variety of fish attractors to increase the amount of structure. There may also need to be some mechanism incorporated for reducing the stranding of eggs, such as the use of artificial buoyant weed clumps, or 'off - river supplementation units' (ORSU), and if these are to be constructed it is just as convenient to create artificial backwaters.

The creation of wider berms would be a simple and cheap habitat improvement, which could be incorporated into the habitat improvements whether backwaters and ponds are constructed or not. They would add significantly to the value of the main channel which, by area, will still be the largest habitat. It must be remembered that wider berms will only deal with the lack of marginal vegetation.

In conclusion, it is recommended that a variety of artificial connected and seasonally unconnected backwaters and ponds are constructed, together with a widening of the marginal area in the main channel. If this cannot be achieved then the alternatives consist of installing wing dams in combination with fish attractors and wider berms. Some brief descriptions of the form that all these structures may take are given in Annex A.

Evaluation.

Wherever possible any measures taken to restore the fisheries in these two water bodies should be evaluated, and the results from this made widely known.

This evaluation must make use of sampling techniques which will provide the data on abundance that is required, and so avoid under-estimation of population densities.

Management of the Wallers Haven and Pevensey Haven.

Clearly, the restoration of the habitat in these two water bodies is only part of the necessary management required. If it is shown that loss of fish through the sluices is having a significant impact on the fish populations, then its operation should take account of the escape and swimming behaviour of fish in the region of the sluices. Sensitive level control between February and August will reduce the chances of stranding the egg and early larval stages.

Additionally, their operation could be reduced if catchment aspects included the facility for flood storage in more environmentally friendly structures such as ponds and lakes.

References.

Copp, G.H. 1992. Comparative microhabitat use of cyprinid larvae and juveniles in a lotic floodplain channel. Environmental Biology of Fishes. **33**. 181-193.

Diehl, S. 1988. Foraging efficiency of three freshwater fishes: effects of structural complexity and light. Oikos. **53**. 207-214.

Winfield, I.J. 1986. The influence of simulated macro-phytes on the zooplankton consumption rate of juvenile roach, Rutilus rutilus, rudd, Scardinius erythrophthalmus, and perch, Perca fluviatilis. J. Fish Biology. **29** (Suppl. A). 37-48.

ANNEX A.

OPTIONS FOR RESTORATION

OF THE FISHERIES IN

WALLERS HAVEN &

PEVENSEY HAVEN

IN-STREAM STRUCTURES.

A.) FISH ATTRACTORS

What situations do they mitigate?

They are used in situations where the channel has become denuded of structure and habitat diversity i.e. in homogenous flood relief channels.

Description.

Fish attractors is the collective name for a man-made in-stream structure, and includes hides, shelters, artificial covers and reefs. There is no limitation to the form that these can take and the material that can be used to construct them. They tend to be used by fish more in the summer than in the winter.

Common materials used include rubber tyre, brush material, discarded pipes, cement blocks or balls, building rubble, automobiles and boats. Essentially the material is either bundled up with rope, wire or in log frames and is then staked to the channel sides or substrate. It is important that inert non-toxic material is used, both for filling and binding.

Consequences of installation.

They represent obstacles to navigation. They may move during periods of high flow. They have a limited life and may start to break up.

They will concentrate fish, increasing anglers catches near them, but may also act as snags to anglers hooks.

Maintenance requirements.

They need to be periodically checked for decay and break up, and so may need some facility for recovering them, particularly during periods of high flow.

Relevance to Wallers Haven and Pevensey Haven.

Provides for greater zooplankton and other invertebrate productivity and increased feeding for fish. This will have a knock on effect of increasing pressure on algal blooms and thus a small effect on reducing the chance of stratification in the summer.

They will provide for some increased habitat for juvenile fish, particularly rudd and perch.

Suggested construction.

The cavities in these structures will determine how and the size of fish that will use them. Use of a single structure such as concrete balls will tend to favour particular species and size groups. Therefore it is recommended that a variety of these is constructed.

Whilst there is no limit to the form that these could take, the following are a few examples that could be used on the Pevensey Levels.

1) Simple bundles of brush could be fixed to the steep sided banks, close to the surface. Alternatively, whole trees can be dropped into the water and fixed to the steep sides by their trunks.

2) Any number of wooden frames or cribs could be constructed, and these can be filled with any cheap material such as brush, ceramic pipes, building rubble so long as the frames are strong enough to hold them. These can then be fixed to the substrate to prevent movement.

3) A series of concrete shapes ranging from balls to flat roofed shelters can be cast from a mold and simply lifted into the water.

4) Mid-water structures can be installed, using buoyant material, and suspended at any depth by the use of a mooring system. These could be constructed from fibreglass in cone or tent shapes.

It is strongly recommended that any such structures are marked so that they may be easily retrieved if necessary.

References.

Schnick, R. A. *et al.* (1982). Mitigation and enhancement techniques for the upper Mississippi river system and other large river systems. U.S. Department of the Interior, Fish and Wildlife Service. Resource Publication 149. Washington, D.C. Pages 234-243.

Information required before installation.

1) The level and frequency of stratification at the installation sites.
2) The maximum force that they will experience in high flows.

B.) ARTIFICIAL WEED

What situations do they mitigate?

Channels which are short of structure and in particular structure provided by macro-phytes.

Description.

Usually these are constructed of buoyant plastic strips. These are cut 5 cm wide and 2 or 3 m long. Clumps are held together by a base weight.

Consequences of installation.

They may move during periods of high flow. Can snag anglers hooks.

Maintenance requirements.

Sediment and attachment organisms can cause the artificial plastic to collapse, and therefore need regular removal for cleaning and maintenance.

Relevance to Wallers Haven and Pevensey Haven.

In addition to the advantages of fish attractors, a dozen of these would provide artificial spawning sites for phytophilous spawners. They have the advantage that they collapse with changes in water levels, so that eggs do not become stranded.

Suggested construction.

Strips of buoyant plastic (3 x 0.05 m), ie with air bubbles incorporated into the sheets should be embedded into concrete blocks (2 x 2 m), and fixed to the substrate.

References.

Schnick, R. A. *et al.* (1982). Mitigation and enhancement techniques for the upper Mississippi river system and other large river systems. U.S. Department of the Interior, Fish and Wildlife Service. Resource Publication 149. Washington, D.C. Pages 239.

Information required before installation.

1) The maximum force that they will experience in high flows

C.) ARTIFICIAL COVERS.

What situations do they mitigate?

Channels with no cover.

Description.

Covers are usually flat wooden boards that line the river bank above or under the water surface. Wooden structures need bracing and this involves driving piles into the substrate and/or banks.

Consequences of installation.

These may be washed away in high floods.

Maintenance requirements.

The wooden structures have a limited life, and may require replacement.

Relevance to Wallers Haven and Pevensey Haven.

These structures are mostly relevant to cover orientated riverine fish such as chub. This fish species is not present in either water body and thus these structures are not strictly relevant.

Suggested construction.

Plywood boards (1 m width) fixed near the water surface over deep water.

References.

Swales, S. 1982. Notes on the construction, installation and environmental effects of habitat improvement structures in a small lowland river in Shropshire. Fisheries Management. 13. 1-10.

Information required before installation.

1) The level and frequency of stratification at the installation sites.
2) The maximum force that they will experience in high flows

D.) ADDING SUBSTRATE

What situations do they mitigate?

This is particularly useful after dredging works when a clay substratum has been exposed.

Description.

This has rarely been tried but a stony substratum can be created by adding rubble with a particle size between 5 and 30 cm. Any material can be used including flints, limestone and brick.

Consequences of installation.

If the channel is regularly dredged the rubble will need replacing.

Maintenance requirements.

If the rubble becomes covered in silt, it loses its value, so the substrate will need to be periodically scoured.

Relevance to Wallers Haven and Pevensey Haven.

An increase in bottom roughness in selected places could greatly improve invertebrate productivity, provided the water body does not become stratified. However, with static water flow the substrate could very quickly become covered in silt. Areas of mud and silt should be left for carp and tench.

Suggested construction.

Any quantity of stone material could be laid to cover the substrate at intervals

References.

Spillett, P.B. *et al.* 1985. Ameliorative methods to reinstate fisheries following land drainage operations. *In* (ed. J.S. Alabaster) Habitat modification and freshwater fisheries. pp 124-130.

Information required before installation.

1) The level and frequency of stratification at the installation sites.

E.) DAMS AND WEIRS

What situations do they mitigate?

These are most commonly used to re-create a riffle-pool sequence, or to keep the water level at a minimum level.

Description.

These are simple retaining walls placed across the river, the height of which depends on the purpose of the structure. They are usually constructed of stone or concrete.

Consequences of installation.

They can interfere with flood water run-off, and the efficiency of flood control.

Maintenance requirements.

This depends on the material and method of construction. Some weirs are designed for removal in periods of flooding, and therefore tend to require a greater amount of maintenance than those installed permanently.

Relevance to Wallers Haven and Pevensey Haven.

There might be some advantage in installing weirs to maintain a head of water when the sluices are open. It may reduce the amount of spawn that becomes stranded during such events. However, it is likely that they will have to be very high in the water column to achieve this aim. They will contribute little to the re-creation of riffle-pool sequences, since both water bodies are low flowing for most periods.

Suggested construction.

The size of the channels under consideration would require substantial stone or concrete weirs, and their design is out side the scope of this report.

References.

Swales, S. 1982. Notes on the construction, installation and environmental effects of habitat improvement structures in a small lowland river in Shropshire. Fisheries Management. 13. 1-10.

RSPB, NRA and RSNC. 1994. The new rivers and wildlife handbook. pages 225-230.

Information required before installation.

1) Their likely influence on the efficiency of flood control.

F.) WING DAMS AND CURRENT DEFLECTORS

What situations do they mitigate?

These mitigate areas of river which have no barriers to severe flow or do not have a variety of velocities. They are used to contract the river flow and provide a self cleaning effect, reducing the necessity for repeated dredging.

Description.

These are incomplete dams set across the water flow, usually at an angle to the river bank. They are often constructed of stone and can be set at a variety of heights depending on the desired effect. They can have notches in their walls to concentrate flow through them, and so keep the region behind them clean of silt. If they are built above the water level and have no notches they can be used to build up a marginal habitat behind them.

They can be constructed in pairs or series to create a wide variety of effects.

Consequences of installation.

As with dams and weirs they may effect the efficient control of flood water. They result in angled flow which can erode river banks below them. If notches are not placed properly, they effectively act to narrow the river bank by causing sedimentation behind them.

Maintenance requirements.

Notches need to be checked for blockages, but if they are constructed of solid material there is very little maintenance.

Relevance to Wallers Haven and Pevensey Haven.

These structures would be most useful in providing cover from extreme flows when the sluices are opened. As the flow starts to increase in flood conditions it would be expected that fish will move into the low flow areas behind these structures. If there are sufficient numbers of these structures then low flow will be within reach of burst swimming fish responding to the sudden increase in flow as the sluices are raised.

They provide areas of low flow adjacent to areas of high flow (shear zones) which can increase the supply of food to fish.

They are unlikely to be of any use in the summer since high flow is not important at this stage, although they have a small similar effect as reefs and fish attractors.

Suggested construction.

These should be constructed of stone at a low angle to the river bank, so that they interfere with flood control as little as possible. They should installed in a staggered pattern on alternate banks, so that angled flow bounces off the next deflector. Notches and heights of the deflectors will need careful consideration taking account of flow and resultant erosion problems.

References.

RSPB, NRA and RSNC. 1994. The new rivers and wildlife handbook. pages 221-224.

Schnick, R. A. *et al.* (1982). Mitigation and enhancement techniques for the upper Mississippi river system and other large river systems. U.S. Department of the Interior, Fish and Wildlife Service. Resource Publication 149. Washington, D.C. Pages 299-311.

Information required before installation.

1) Historical river levels, flows and velocities.

OUT-STREAM STRUCTURES

A.) BAYS, BACKWATERS, AND PONDS.

What situations do they mitigate?

Where the natural flood plain aquatic features have been lost to a single drainage channel.

Description.

These can vary in size and shape enormously. Small 2-3 m shallow bays or indentations in flood banks are easily created on the outside of bends, or at erosion points created by wing dams. Other larger backwaters can serve the same purpose as oxbow lakes, and can be any shape and size desired.

Partially connected ponds can be created which are isolated from the main river during summer low flows and only become connected to it during periods of flooding. This is usually effected by the use of a second channel with a base height between low and high flows. They have a secondary function, by acting as flood storage areas, and only take water from the main river when there is no resource shortage.

Consequences of installation.

There is a loss of farmland. Increased water loss through evapo-transpiration during summer months, unless they are designed for winter storage.

Maintenance requirements.

These are essentially areas of low flow and therefore can become silted up quickly, requiring intermittent clearing.

Relevance to Wallers Haven and Pevensey Haven.

These are very relevant to these two water bodies. Small bays or indentations in the flood banks will not be as useful as larger backwaters and ponds. Their small size will make it difficult to incorporate a wide variety of habitats and effectively they become nothing more than marginal areas. For greatest value, backwaters should mimic disused main channel and would need to be at least half the width of the current channel and 40-50m in length. Alternatively, a pond of similar area is suitable.

These would represent an enormous increase in the availability of high quality habitat. There is no doubt that the species found in the rivers would use these structures for spawning and during juvenile stages and, because of the high productivity, as adult feeding areas. The biomass of fish in these structures could be as much as 10x that found in the main river channel.

Shallow weeded areas would supply substrate for phytophilous spawners and habitat for juveniles. Levels would be more stable, reducing the chances of eggs becoming stranded.

During periods of high flow fish would naturally migrate in and out of these structures and could use them as refuges from increased velocities.

Anglers could use them and their presence would increase the area of fishing available.

In summary the creation of these structures represents the replacement of the natural types of water bodies that existed in flood plains before many were converted into single flood relief channels. With proper management and control there is no reason why these cannot be re-established without the problems of flood control and water resource use associated with natural flood plains.

Suggested construction.

To facilitate all the fish species at every life stage each structure should contain a wide variety of habitats as measured by depth, substrate and presence/absence of macro-phytes. Preferably both connected and partially connected depressions should be constructed. They should incorporate bays, rather than being uniformly round, and some parts of the banks can be planted with trees.

If possible each pond should be unique in its shape and size to increase their aesthetic

qualities and their habitat diversity.

Simple weirs and channels can be used to control their inundation and draining, to ensure that they do not contribute to flooding and water resource problems.

References.

RSPB, NRA and RSNC. 1994. The new rivers and wildlife handbook. pages 189-194.

Schnick, R. A. *et al.* (1982). Mitigation and enhancement techniques for the upper Mississippi river system and other large river systems. U.S. Department of the Interior, Fish and Wildlife Service. Resource Publication 149. Washington, D.C. Pages 250-255.

Information required before installation.

1.) Historical water levels

B.) OFF-RIVER SUPPLEMENTATION UNITS

What situations do they mitigate?

Used in situations of low recruitment. These have been an attempt to replace short-term and expensive stocking with increased natural recruitment combined with habitat improvement.

Description.

These differ from backwaters and ponds only in that their primary use is for breeding and juvenile rearing. They are essentially ponds separated from the main river by a series of sluices and used for aqua-culture of the desired species. They can incorporate brood ponds and breeding areas as well as juvenile rearing sites. Their operation and design varies greatly.

Consequences of installation.

They use up farm land.

Maintenance requirements.

They can contain a large number of sluices, channels and pond areas which need occasional replacement and clearing.

Relevance to Wallers Haven and Pevensey Haven.

These have some of the advantages of the bays, backwaters and ponds previously described, but would be more appropriate at specifically targeting species with proven low recruitment. This might be the case for some of the phytophilous species, such as pike.

Suggested construction.

Construction would depend on the species they are targeted at. It is suggested that backwaters and ponds are used in preference, and ORSU's are only considered if recruitment of a desirable species is still low.

References.

Linfield, R.S.J. 1985. The effects of habitat modification on freshwater fisheries in lowland areas of eastern England. *In* (ed. J.S. Alabaster) Habitat modification and freshwater fisheries. pp 124-130.

Information required before installation.

1) Recruitment levels for individual species.

ALTERATIONS TO DREDGING PRACTICES AND CHANNEL STRUCTURE.

A.) CHANNEL NARROWING

What situations do they mitigate?

Where previous flood drainage channels are no longer required for flood defence, because of reduced flow resulting from, for example, abstractions.

Description.

Usually a false bank is installed with pilings and the area behind it is back-filled, and planted with vegetation to give it support.

Consequences of installation.

The channel is no longer as effective for flood relief.

Maintenance requirements.

Provided the bank does not suffer excessive erosion there is very little maintenance required.

Relevance to Wallers Haven and Pevensey Haven.

Such a methodology probably has no relevance to either of these water bodies with the current flood relief regime.

Information required before installation.

1) Historical and future predictions of flow levels.

B.) MULTI-STAGE CHANNELS

What situations do they mitigate?

The creation of homogenous single channelled drainage channels.

Description.

Flood banks are set much further back from the main channel, and between the flood banks there can be more than one channel, together with land that lies at a variety of heights. The main channel can meander between the flood banks, and backwaters and isolated ponds can also be present.

Consequences of installation.

There is a large loss of farmland

Maintenance requirements.

Some dredging may be required.

Relevance to Wallers Haven and Pevensey Haven.

This would restore much of the channel to its natural state and with the increased habitat diversity offered by backwaters and ponds would increase fish productivity enormously. There would be aesthetic and conservation advantages from the incorporation of a wide variety of vegetation, wet land and trees. It would offer the chance for a much richer conservation area.

However, with the presence of a single channel sluice, multi-stage channels may be difficult to incorporate, whilst retaining the ability to control floods efficiently.

References.

RSPB, NRA and RSNC. 1994. The new rivers and wildlife handbook. pages 195-201.

Information required before installation.

Historical and future flow levels

C.) BERMS

What situations do they mitigate?

The lack of shallow marginal areas in drainage channels.

Description.

Berms are essentially inundated ledges within the channel often created by cutting into the flood bank and placing the spoil further back. The excavation technique can vary to provide berms of different shapes and form.

Consequences of installation.

A small amount of farmland is lost.

Maintenance requirements.

These can become heavily silted with thick reed growth that is too dense for fish fry to utilise efficiently, so areas of free water may need to be created annually by weed cutting. Dense weed also filters out sediment, and this requires periodic dredging.

Relevance to Wallers Haven and Pevensey Haven.

These structures would supply the shallow marginal areas necessary for fish fry. These are severely lacking, particularly on the Wallers Haven, and would be relatively simple to construct and maintain, with minimum disturbance to current users of the channel.

Suggested construction.

Where any flood bank has no valuable structure, it should be re-profiled to create submerged berms with a width of 5 m. A mixture of levels and shapes should be incorporated so that some parts are at a level equal to the lowest level expected in the channel, and others are set at levels up to a maximum of 1 m below the lowest level. These berms should be maintained in future dredging operations.

References.

RSPB, NRA and RSNC. 1994. The new rivers and wildlife handbook. pages 172, 185-188.

Information required before installation.

1) Minimum water levels.


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