Institute of Freshwater Ecology

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Report To: British Waterways Board
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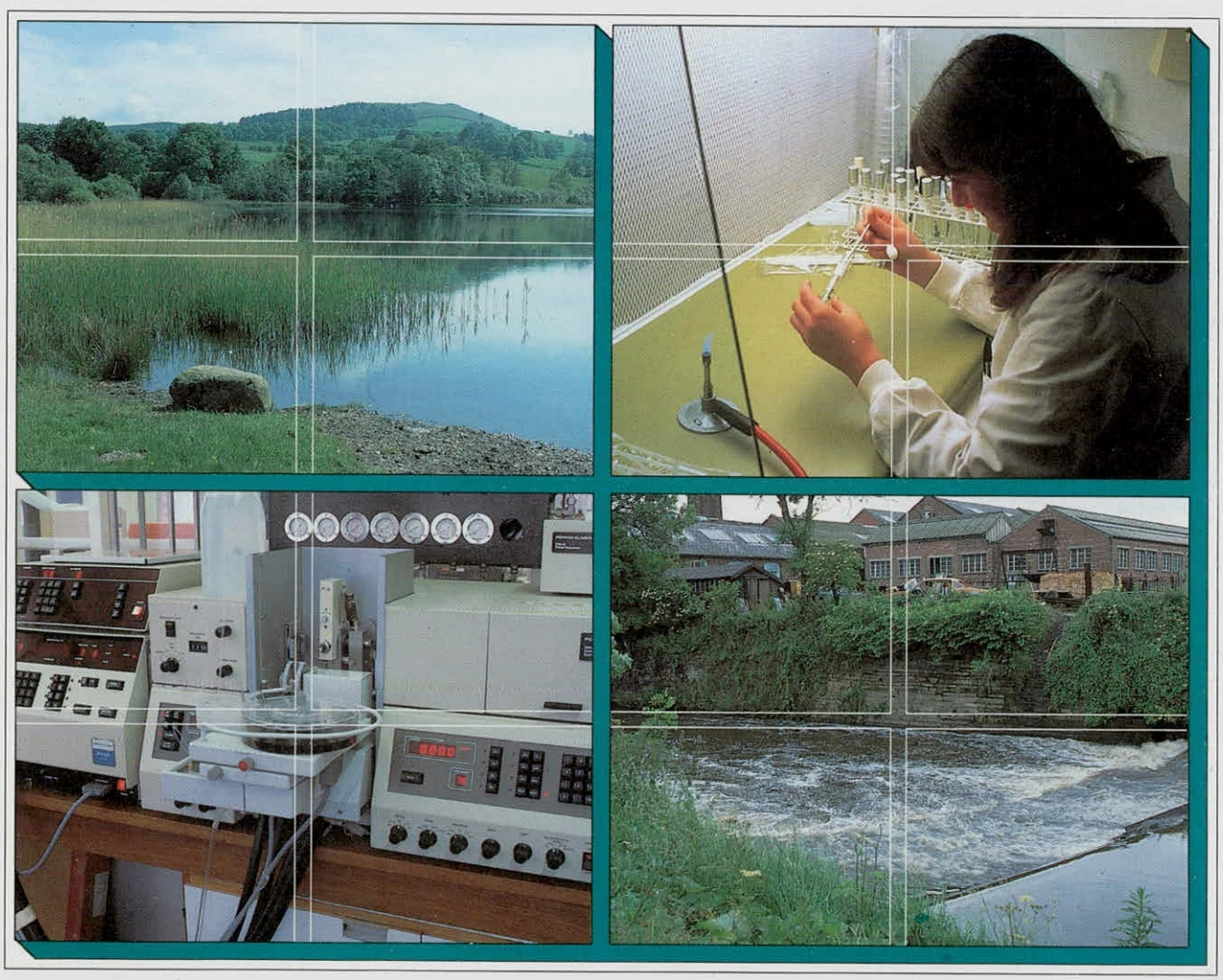

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FUTURE REQUIREMENTS FOR THE DEVELOPMENT OF A FISHERY AT LOWER GAILEY RESERVOIR.

Executive summary

1. Lower Gailey Reservoir was visited on 10 July 1995 and surveyed visually.

2. It is recommended that British Waterways Board (BWB) do not commission a fisheries survey, as this is unlikely to lead to any conclusions that are substantially different to those included in this report.

3. It is probable that there has been a high mortality of fish stocked into Lower Gailey Reservoir, and that the most likely cause is avian predation.

4. Lower Gailey Reservoir does have the potential to make a successful fishery, provided that a method can be found for reducing the impacts of avian predation sufficiently.

5. It is suggested that BWB should now invite a contractor to make detailed proposals for reducing the impacts of avian predators, and developing the fishery.

Introduction

British Waterways Board (BWB) had contracted the Institute of Freshwater Ecology (IFE) to prepare a specification for a fishery survey designed to evaluate the fishery at Lower Gailey Reservoir. After visiting the site it was concluded that a fishery survey would not be of value to BWB. This report describes the reasoning behind the decision for not completing a fishery survey; discusses the probable limitations to fish populations in the reservoir; asks whether it has the potential to make a successful fishery and describes the requirements for the future management and development of the fishery.

Methods

Lower Gailey Reservoir was visited by Dr Anton Ibbotson on 10 July 1995. During the visit the reservoir was surveyed visually, and information on its past management and history was collected from Mr Roger Herrington, Waterway Manager; Mr Keith Fisher, Regional Fisheries Manager and Dr Paul Beckwith, Environmental Scientist.

Results

Description

Lower Gailey Reservoir is the middle and largest of three adjacent reservoirs close to the M6 motorway, within 15 km of the centre of Birmingham. Most of the reservoir is shallow (< 3 m deep), although there is a small area close to the outlet believed to be approximately 7 m in depth. The reservoir's island has a large heronry on it. The water from these reservoirs is used to maintain levels in the Staffordshire and Worcestershire Canal, although this does not have a serious impact on reservoir water levels. Lower Gailey Reservoir has varied only 30 cm in depth in the last year (pers. comm. Mr Roger Herrington). Other users of the reservoir include a sailing club. All three reservoirs have at some time been used as fisheries. Upper Gailey Reservoir is currently a trout fishery and Calf Heath Reservoir is a coarse fishery. No anglers fish Lower Gailey Reservoir at the moment.

Background

The most recent history of the fishery starts with the draining of the reservoir for maintenance purposes in February/March 1993. During this process numbers of bream *Abramis brama*, tench *Tinca tinca*, carp *Cyprinus carpio*, eel *Anguilla anguilla* and pike *Esox lucius* were rescued. Details of the catch are in Table 1. In addition, 20 lb of small 0+ fish of different species were captured. Apart from the fry no fish smaller than 4 lb were found. The pike were reported to be emaciated, and in poor condition.

Table 1. Numbers, weight by species of fish removed from Lower Gailey Reservoir in 1993.

Species	Number	Total Weight (lb)	Ave Weight (lb)
Bream	48	520	10.8
Tench	62	320	5.2
Carp	2	40	20.0
Eel	30	160	5.3
Pike	90	495	5.5

After refilling in early 1993 numbers of carp, barbel *Barbus barbus* and roach *Rutilus rutilus* were stocked. The details are in Table 2.

Table 2. Dates, species, number and weight of fish stocked into Lower Gailey Reservoir since refilling in 1993.

Date	Species	Size	Number	Weight
Apr/May 93	Carp	4"-6"	32,000	
Dec 93	Barbel	10-12 cm	2,600	
Mar 94	Roach	4"-6"		370 lbs
	Carp	2"-4"	5,000	
May 94	Carp	2"-4"	12,400	

Towards the end of the fishing season in 1993 a small number of carp were captured by anglers. These are thought to have shown signs of healthy growth. During the winter following the first stocking Mr Keith Fisher reported finding 5 or 6 dead carp per day all of which had wounds on their bodies, which were presumed to have caused their death. During the 1994 season, at least one 30 peg match took place on the reservoir, when no fish were caught.

Gill nets (25 m; 4" mesh) were set in the reservoir for six weeks during November and December 1993 by Mr Keith Fisher. The total catch from that period was 9 rainbow trout, presumably escapees from Upper Gailey Reservoir.

Discussion and conclusions

Is there value in completing a fishery survey?

There is a large body of evidence suggesting that there has been a high mortality of the fish stocked into the reservoir and that if there are any survivors these are at low densities. This evidence is as follows:

- Carp are generally conspicuous fish when they are feeding, and if there are large numbers in a reservoir of this size one would expect to see signs of them. During the visit made to the reservoir on 10 July, a visual search was made from a boat, from the perimeter of both the east and south shores and from the two boat jetties. The weather on that day was hot and sunny. The only fish observed were stickleback *Gasterosteus aculeatus*, around the edges and from the boat jetties. No other fish or fish activity was observed.

- A similar lack of fish activity is also an observation of Mr Keith Fisher.

- During the winter of 1993/1994 Mr Keith Fisher observed quite large numbers of dead carp, all of which had wounds on them.

- Angling matches held at the reservoir, during 1994 realised no fish.

Assuming then, that there has been a large mortality of the fish, a standard survey of the fishery could result in a number of scenarios as follows:

- A small number of the stocked fish are caught. From this it would be possible to conclude that some of the stocked fish remain, and the growth rate and condition of the fish could be calculated. However, unless large numbers of fish are caught, it would not be possible to estimate the level of mortality without completing a much more difficult, and thus expensive, mark/recapture experiment. It is unlikely that large numbers would be captured (see above). Further, some information on growth rates is already available, from the small number of catches made by anglers in 1993. Mr Keith Fisher has stated that these fish had grown at a rate which was not unusually low.

- None of the stocked fish are caught. Provided that the survey was extensive in both area and methods used it could be concluded that mortality was high. However, it could never be proved that the fishery was devoid of stocked fish.

- If large numbers of juveniles are captured, then one could conclude that the stocked fish had spawned, but if only small numbers of, for example, roach are captured these could represent escapement from Upper Gailey Reservoir. When juveniles are present in reasonable numbers these are usually highly visible. None were observed during the site visit on 10 July.

It is not possible to be certain that the mortality of the stocked fish has been very high without an extensive survey. However, the overwhelming body of evidence available to date

supports that view, and there is no evidence to contradict it. There is a high probability that the stocked fish are no longer present or only present at very low densities. Thus it is concluded that a fishery survey would be unlikely to produce any worthwhile information and it would be better to concentrate resources on discovering the reasons for the high mortality and counteracting them if possible.

What is the cause of high mortality in the stocked fish?

There are many potential sources and causes of mortality in fish. Those associated with declines in water quality and deoxygenation, tend to be catastrophic, resulting in large numbers of dead and dying fish. Such an event, if it had occurred, is quite likely to have been noticed, particularly as the other two neighbouring reservoirs are regularly visited. In addition, spot checks of water quality in 1990 showed this to be acceptable. Therefore this would seem to be an unlikely cause of mortality.

Disease has been known to cause high mortalities in carp, most notably Spring Viraemia of Carp. This disease results in a darkening of the skin, swollen eyes, abdominal swelling, protruding anus and trailing faecal casts. It tends to manifest itself as water temperature rises in the spring, leading to a peak of mortality at this time, followed by low level mortality. The timing of the presence of dead fish in the winter by Mr Keith Fisher does not fit with the typical patterns of this disease and no sick fish were observed. It is improbable that disease was a cause of mortality.

It has been suggested that avian predation may have caused the loss of at least some of the fish. Exactly how much is difficult to assess, but in the case of Lower Gailey Reservoir bird predation could have resulted in significant losses for the following reasons:

- There is a large heronry present on an island in the reservoir, and cormorants *Phalacrocorax carbo* have been observed roosting during the period November to March.

- The population structure of the fish rescued after the draining is consistent with heavy predation (Bronmark *et al.*, 1995). Extremely large fish, such as those found are difficult for avian predators to handle. These large fish are able to reproduce, hence the presence of fry, but there is little or no recruitment from this stage to larger sizes because of predation. The presence of emaciated pike could be the result of competition for food. Avian predators would be favoured in this situation, because they are not dependent on food from one habitat. A pike population on the other hand is dependent on the one source of food. When this source becomes depleted, avian predators can maintain population growth by exploiting some other resource, but a pike population would decline.

- The fish stocked were all of the same size as those fish which were missing from the pre-draining population. They were of a size which both herons *Ardea cinerea* and cormorants would find easy to handle.

- Mr Keith Fisher found a number of dead fish with wounds in the winter following the stocking. It is possible that these wounds were inflicted after death and mortality was

caused by some other factor, but if this was the case one would expect to find some dead fish without wounds.

- The reservoir itself is generally shallow and relatively flat bottomed without any permanent forms of cover. This type of habitat favours predators in a predator/prey relationship, because there is no refuge from predation. Much of the reservoir is deeper than herons would normally forage (max 30 cm depth), but cormorants would find foraging easy in the existing large areas of shallow open water.

Both the neighbouring reservoirs support fisheries, and if predation has had such an major effect on Lower Gailey Reservoir, we might expect similar effects on both Upper Gailey Reservoir and Calf Heath Reservoir. However, Upper Gailey Reservoir is a 'put-and-take' trout fishery, with stocking occuring in spring and angling in the summer. This fishery would be less affected by the predation from cormorants which takes place in the winter. Mr Keith Fisher is of the opinion that the coarse fishery in Calf Heath Reservoir is also declining, but because the fish population is mature it is likely that the population size structure is similar to the pre-draining population in Lower Gailey Reservoir.

After considering all the evidence that is currently available it is probable that avian predation, in particular cormorant predation, is the most likely and most serious limitation to fish populations in Lower Gailey Reservoir. Calculations in Annex A suggest that in a worst case scaenario it is possible for cormorants to have consumed 37,000 carp during the winters of 1993/1994 and 1994/1995. This figure can only be considered as a rough guide, since much of the data used in the calculations is assumed. However, even when it is assumed that cormorant numbers increase steadily to a maximum and then decline the calculations are still at a level that could explain the greater part of the disappearance of stocked fish from the reservoir.

Obviously to demonstrate this more clearly and to validate the figures used, it would be necessary to conduct a very expensive experiment, involving further stocking and observations of fish and birds. This is not a viable option.

Does Lower Gailey Reservoir have the potential to make a successful fishery?

Provided that something can be done to reduce the threat of avian predation, there is no apparent reason that the reservoir should not sustain a healthy population of fish and thus has the potential for a successful fishery.

Previous attempts to inhibit avian predation have included scaring, shooting, roost management and adjustment of fish stocking strategies i.e. timing and size. Quantitative data on the beneficial impacts of these techniques is scant, but generally it is felt that they have small long term impacts, and in the case of scaring, shooting and roost management are also environmentally undesirable. One potential mechanism for inhibiting avian predation, which to our knowledge has not been tried extensively is the manipulation of the fishery habitat, to reduce the area which favours foraging by the predator in question and to increase the quantity of available prey refuge. The current shallow and open nature of Lower Gailey Reservoir would obviously favour the foraging behaviour of cormorants, and thus the greatest

reduction in their impacts may come from habitat alteration.

The reservoir is, geographically, well situated, being close to a large number of conurbations, and easily accessible from local main routes. There are other, potentially conflicting, activities such as sailing and the requirements of the Staffordshire and Worcestershire Canal. Provided that the levels of the reservoir do not vary much and any habitat alterations do not obstruct the activities of the sailors these are not serious conflicts.

It is estimated by the managers that income from this fishery could reach £25,000 per annum, and, although not guaranteed, once the fishery has matured this could be achievable.

Requirements for future management and fishery development of Lower Gailey Reservoir

If it is accepted that avian predation is the major factor limiting the fish population in Lower Gailey Reservoir, then future management will have to be directed at reducing the impacts of this. There is obviously some financial risk associated with this course of action, since it is not possible to be 100% certain that this is the only cause of the apparent decline of the fishery. However, the costs of achieving certainty would themselves be expensive and cause further time delay. For example a thorough survey of the fish populations is likely to cost approaching £6K. To estimate mortality accurately with mark/recapture experiments, and to perform experiments with stocked fish and avian predators could cost between £10K and £20K, and neither is likely to be completed until spring 1996. The probability is that any work of this nature would lead to the same conclusions as this report.

There is additional financial risk to investing in measures aimed at reducing the impacts of avian predation, since there is little quantifiable data on the effectiveness of such methods as well as an absence of a prescribed method for producing the desired effects. In this context, British Waterways would be attempting previously untested techniques. A national research programme assessing the effectiveness of different management measures in controlling damage by fish-eating birds has recently commenced. Unfortunately, its objectives only focus on modifying roosting and loafing areas, bird scaring methods, shooting and fishery management (size and timing of restocking), not fish habitat management. This is in spite of some expert opinion that views such management as the one of the most potentially beneficial strategies for dealing with avian predation. However, despite the lack of guidance, available or intended, there is enough information published on avian foraging strategies, to make informed judgements on the type of measures that would be most effective.

Recommendations

BWB should now invite a contractor to make detailed proposals for reducing the impacts of avian predators, and developing the fishery. The proposals should include the following:

- A description of the reservoir, with a map of the current depths, profiles and distribution of vegetation.

- The detailed proposals themselves, together with a description of the likely future maintenance requirements.

These proposals should be supported with:

- A description of the potential methods for achieving the primary objectives.

- An assessment of the likely success of each of the methods.

- The reasoning behind the selection of the suggested proposals.

References

Bronmark C., Paszkowski C.A., Tonn W.M. & Hargeby A. 1995. Predation as a determinant of size structure in populations of crucian carp (*Carassius carassius*) and tench (*Tinca tinca*). *Ecology of Freshwater Fish.* 4. 85-92.

Sato K., Hwang-Bo J. & Okumura J. 1988. Food consumption and basal metabolic rate in common cormorants *Phalacrocorax carbo*. *Lab. Anim. Physiol. Nagoya Univ.* 8. 58-62.

Annex A. An estimate of cormorant predation in Lower Gailey Reservoir.

This annex describes an estimate of the damage that cormorants could have caused to the stocked fish in Lower Gailey Reservoir.

Assumptions.

From energetic calculations the daily food requirement has been estimated at 26% (Sato *et al.*, 1988) of body weight. This translates to approximately 520g per day. I have assumed that the cormorants are present from November to March, a total of 151 days. The average weight of individual fish, taking into account growth from the time of stocking, is assumed to have been 200g during the winter of 1993/1994 and 400g in 1994/1995. It is not known what the average number of cormorants foraging per day was during either the winter of 1993/1994, or the winter of 1994/1995 but maximum counts supplied by Mr Roger Herrington, and Mr Keith Fisher were 70 for 1993/1993 and 48 for 1994/1995. Two scenarios are presented, the first of which is a worst case where the maximum number of cormorants were assumed to be present throughout the 151 days. The second represents a scenario where the number of birds steadily increases to the maximum in each year and then steadily declines throughout the 151 days; in effect this will be half the value of the worst case scenario.

Calculations are as follows:

$$(A \times B_1 \times C) = D_1 \quad (A \times B_2 \times C) = D_2 \qquad (D_1/E_1) + (D_2/E_2) = F$$

where
- A = daily food requirement of cormorants (g)
- B_1 = average number of cormorants foraging per day in 1993/1994
- B_2 = average number of cormorants foraging per day in 1994/1995
- C = number of days cormorants visit reservoir
- D_1 = total weight of fish consumed in 1993/1994 (g)
- D_2 = total weight of fish consumed in 1994/1995 (g)
- E_1 = average weight of individual fish in 1993/1994(g)
- E_2 = average weight of individual fish in 1994/1995 (g)
- F = total number of fish consumed in 1993/1994 and 1994/1995

Worst case scenario.

F = 36, 904 (27,482 in 1993/1994; and 9,422 in 1994/1995)

Average case scenario.

F = 18, 452 (13,741 in 1993/1994; and 4,711 in 1994/1995)

Note.

It is important to note that these calculations are based on a number of assumptions, in particular the number of cormorants present on the reservoir, and the true values of the parameters are not known. Thus the accuracy of these values should treated with caution.


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