SHORT ARTICLES AND REVIEWS

THE STORY OF A SMALL TROUT FISHERY

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Introduction

Shorter working hours and rising life expectancy provide more people with more leisure time to indulge in pastimes such as angling. There is also a tendency for followers of "coarse" fishing, which is usually a sedentary activity, to indulge in "game" fishing which entails more activity. Thus the demand for "fly-only" trout fishing is increasing and quite a lot of new fisheries are being created to meet that demand. As "still waters", to use the anglers' expression, usually hold water which would otherwise run directly away to sea, this development fits quite well with the current demand for conservation of water. It also provides new areas and new problems for freshwater biologists, and for the advisory services which are required.

Apart from large reservoirs, many of which provide important trout fishing, most new fisheries are created by damming small streams, and some by excavating areas adjacent to large streams with inlets and outlets. They may contain a natural population of brown trout *(Salmo trutta)* but with few exceptions are stocked mainly with rainbow trout *(Onchorhynchus mykiss,* formerly called *Salmo gairdneri).* With farming currently at a very low ebb financially, such fisheries can be a useful form of "diversification" as recommended by government, and if appropriately managed they amount to man-made nature reserves. This article relates the experience of creating and developing one such fishery

in southern England. The fishery was made from a tiny stream which dries up from time to time and marked the boundary between a Sussex farm and a large coniferous forest, with Ashdown Forest to the north and Sheffield Park to the south.

The idea is born

In 1957, settling with family into a farm in Sussex after years in Africa, we had a problem. The farm and its ancient house were beautiful, and water was supplied from a spring, but there was no other water except for a minute swimming pool, a muddy pond, and drinking troughs for stock. However, fields sloped down to the boundary against a large block of Forestry Commission land, marked by a tiny stream called Anne Wood Brook, which dried up at intervals. Would it be possible to impound water from that stream to make a small lake?

At that time the favoured practice on farm land was to get rid of surplus water quickly. Meandering streams were straightened, ditches deepened, swamps and wet fields drained. Since then the environmental revolution has modified the policy. Fresh water is now recognised as a precious though diminishing resource, and is often conserved rather than being induced to run away. This however is no new idea in Sussex, for the Anne Wood Brook, after being reinforced by another tributary of the Sussex River Ouse, flows into an ancient Hammer Pond, impounded for the iron-industry of long ago. Later, Capability Brown impounded water to beautify landscapes, while now the usual reasons are for domestic and industrial supply. Fishing has rarely been a primary reason, except perhaps for the provision of Friday's dinner in monasteries.

Storing water in the upper reaches of a river is generally more friendly to the environment and causes less damage to land than in the lower reaches. It helps to even out the peaks and troughs of river flow, and the natural channel can be used as a pipe-line, delivering water where it is most needed, usually near the estuary. E.B.W. had been involved in the application of this simple principle in the case of the River Tees in County Durham, and also the River Nile in Uganda. Along the Mediterranean coast of what is now Libya the ancient Romans had applied it on the flash-flood wadis in the hills to supply their coastal towns. The Italians, during their pre-war colonial enterprise, had neglected the principle to their cost. In Britain, engineers had tended to favour sites for reservoirs in middle or lower reaches of rivers but, during the River Tees controversy in 1962, a letter in "The Times" by W. H. Pearsall, Lord Hurcomb and E.B.W. had some influence.

Now, here at our doorstep was the opportunity for a very personal experience in the same mode, with a trout fishery as its main objective.

Preparation

First, the best site had to be selected for a dam where the depth of water would be up to 10-12 feet (3-4 metres) and the maximum area of water could be obtained with a minimum size of dam.

This done, a well-known water engineer, Mr R. C. S. Walters, came to look at the site. He had sat on the Council of the FBA during my time as Director, and was the Chief Engineer for Weir Wood Reservoir (to the north of us) which is on much the same geological formation as our farm. Having probed the soil and subsoil he pronounced it suitable for an earth dam, and sketched a plan and cross-section on the back of an envelope.

Next, the project had to be approved by several authorities. A dam to impound three acres in Sussex might nearly have been the High Dam at Aswan considering the amount of form-filling, advertising and permission-seeking that was involved. Moreover, as the Anne Wood Brook was our boundary with the Forestry Commission's forest, the lake would flood a piece of their land as well as our own. Fortunately the foresters concerned were keen on the wild-life which would be attracted to their boundary, and also appreciated the availability of water in case of fire, so we were able to buy the area to be inundated and a strip of access land alongside. The MAFF and the County authorities concerned were also amenable, so we got to work.

Creation

First, the area to be occupied by the dam, and the concrete spillway to be laid on undisturbed subsoil, was pegged out, as was the future top water-level of the lake-to-be. All woody vegetation within the pegged area was cut, useful timber and firewood put to one side, and the rest was burned. Two skilled drivers with earth-moving machines were hired and advice was sought from a local contractor.

Then surface soil was scraped off the area of the dam and also from a strip of land below top water-level, from which subsoil was to be dug to make the dam. The topsoil was later spread over the completed dam to encourage its rapid cover by vegetation. Next, the stream bed where it crossed the dam area was straightened and deepened with a 60-foot length of 12 inch pipe (18 m x 25 cm) laid in it. This took care of the flowing water while making the dam and, with an iron flap-door at the upstream end, would allow for emptying the lake when necessary.

There followed a fortnight of work with a big scraper, capable of moving several tons of subsoil at a time, and a bulldozer. Strip after strip of subsoil, some of it containing clay and blocks of sandstone, was spread on the dam area which was about 50 yards long (45 m) and 20 yards wide (18 m) at the centre, tapering to 5 yards at the sides. Clay was packed around the pipe, for that is where leaks are most liable to occur.

Each layer of subsoil, not more than 12 inches thick, was squeezed down by the bulldozer while the scraper collected the next load. This continued, with the area of the layers reduced in order to leave a slope of 1:2 at each side, until the top of the dam was 2 feet above top water-level with a 10 foot width (3 m) as a track-way. Some areas of the lake's floor were bulldozed and deepened, with the spoil pushed up to form three islands where birds could breed immune from foxes. The islands were subsequently planted with trees: alders *(Alnus glutinosa)* and spruce *(Picea abies).*

The spillway, of course, had to take a maximum flood from the catchment of about one square mile in area (2.6 km^2), nearly all forested. The spillway was made of concrete 1 foot thick, 12 feet wide and with walls 3 feet high (0.3 x 3.6 x 1 m). The walls were slotted to take water boards and fish grills, and they supported a bridge of oak trunks and railway sleepers which provided for wheeled access to both sides of the lake.

The stream's outlet at the deepest place was shut on 17 February 1967 and by 15 March there was an attractive sheet of water some 200 yards long by 50 yards wide (ca. 200 x 50 m), dotted with islands, and with grassland leading to the near shore and woodland beyond. It was named Lake Starton and left for a couple of months, with some starwort *(Callitriche stagnalis)* and water buttercup or crowfoot *(Ranunculus aquatilis)* planted, so that algal flora and invertebrate fauna could develop. Then on 27 March, 200 yearling brown trout and 50 yearling rainbow trout were introduced and two months later 50 young mallard ducks *(Anas platyrhynchos)* were released on one of the islands.

Early experience

During the first year, trout flourished and grew rapidly, as commonly occurs on newly-flooded land. Fishing commenced and brown trout, stocked at half a pound in weight, were taken up to one pound (450 grams) and rainbow trout to over one and a half pounds. Stomach contents were dominated by chironomid (midge) larvae, pupae and adults, but large cladocerans (waterfleas), corixids (water boatmen) and *Asellus* (water lice) were frequent, and so were tipulids (daddy-longlegs) and other terrestrial insects that occasionally fall into the water.

During the second year, 1968, to replace those we had caught some additional fish were introduced in the ratio of one brown trout to ten rainbow trout, as the latter had performed better. Then disaster struck. On 20 June, trout were rising and feeding. Two days later many were gasping at the surface and fifteen dead brown trout but no rainbow trout were collected, confirming the greater resistance of rainbow trout to pollution. We had, of course, tested the water previously but failed to predict the smaller dilution of our farm effluent during a dry spell of

weather. The effluent entered the affluent stream some 50 metres above Lake Starton. Fortunately rain came and some of the trout survived, but what was the long-term answer other than an expensive treatment plant?

We recalled early studies by the Metropolitan Water Board on the beneficial effects of storage on Thames river-water, so the solution to our problem was to make another lake upstream. Back came the chain saw and bulldozer, and another load of pre-mixed concrete was ordered for a spillway. Soon there was a second lake, named Bella Pool, much smaller than Lake Starton but adding to the beauty of landscape and variety of fly-casting. Since then there has been no trouble from pollution even in dry spells of weather.

Expansion

The trouting became popular among our friends and visitors, so a third lake, named Bircheham after a Doomesday Book entry for this area, was constructed downstream from Lake Starton. Techniques of construction were similar to the other two lakes but Bircheham is much the largest, being some 250 metres long and 80 metres at the widest point, with a more varied shoreline and depth. Like Starton it has a spring which helps to supply water when the stream runs dry. Lake Bircheham (Plate 1, facing page 16) was first filled in the autumn of 1974 and, in the spring of 1975, it was stocked with brown and rainbow trout in the proportion 1:10, like the other lakes since 1968.

Before these lakes were made the Anne Wood Brook was practically devoid of fish life. Although it allegedly contained occasional small brown trout which could survive in relict pools when the brook had no flowing water, breeding was all but impossible. ^However, the short stretches of stream between our three lakes have rapid water which washed away mud and has left gravel sufficient for a few brown trout to make spawning redds. Trout fry were seen in these places and young trout appeared in the lakes; some have now reached takable size of about one pound (450 grams), popular in a basket of non-breeding exotic rainbow trout.

Up to 1972 we were lucky to have no coarse fish other than eels *(Anguilla anguilla)* in these lakes. However, in 1972 a few rudd *(Scardinius erythrophthalmus)* were observed in Bella Pool, in 1973 they were all over Lake Starton, and in Lake Bircheham as well in 1974, in vast numbers. This caused a major setback, not only because trout lost condition seriously as their usual food organisms were devoured by rudd, but also because the anglers' artificial flies were nibbled by rudd almost as soon as they touched the water. The problem was beyond us so the Southern Water Authority was called in and, after some ineffectual netting, we drained Lake Starton in 1980 and Lake Bircheham in 1982.

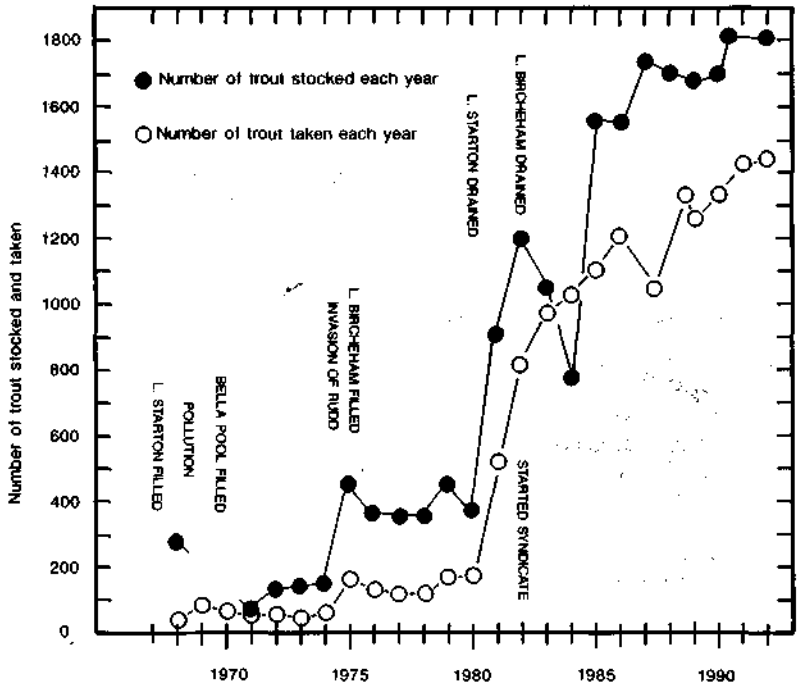

FIG. 1. The total numbers of trout stocked and taken each year, 1968-1992.

Bailiffs took away an estimated 5,000 rudd from Starton and 7,000 from Bircheham, in oxygenated tanks. These rudd were used to stock public fishing ponds in the area. Our lakes were left dry over the winter and then filled and restocked with trout in the following spring, since when only a single rudd has been reported.

Records of fish caught

A fishery, however small, is apt to collect a mass of records and ours is no exception. Fig. 1 shows the annual catch compared with the number of trout stocked, and Fig. 2 shows the average weight of individual fish and average numbers of fish taken per fishing visit.

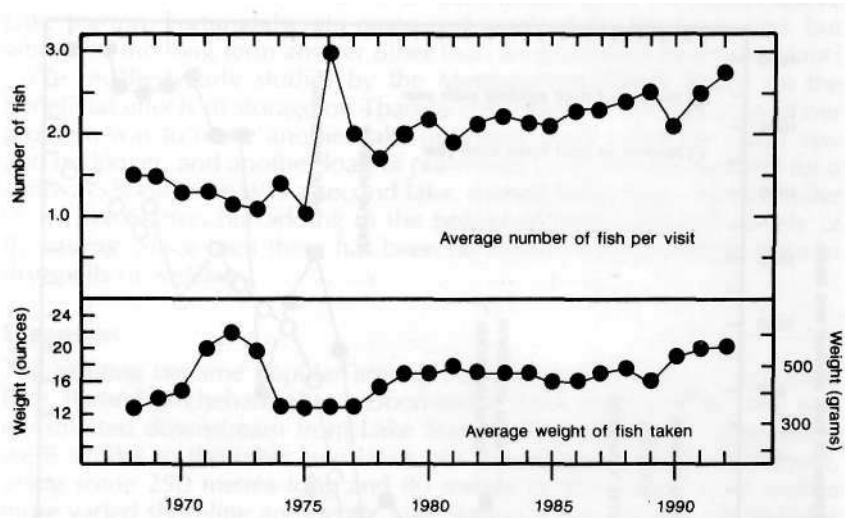

FIG. 2. The annual average numbers of fish taken per visit and their average weights, 1968-1992.

Management of the fishery

For the first thirteen years, fishing was on a small informal scale but in 1982, with the potential doubled by the creation of Lake Bircheham, a syndicate was formed with a membership which rose to about 50. It consists of "rods", entitled to 30 fishing visits during the season, and "half-rods" entitled to 15 visits. The season is from April to October inclusive; any brown trout caught in October are returned to the water. Rules are kept to a minimum: fly fishing with only one fly which may be dry, wet or nymph, but no large "lures" such as are used on large reservoirs; a maximum of four trout taken per visit; guests welcomed; all fish taken to be weighed and recorded.

In management the objective has been to retain about 100 trout per acre of water or approximately 250 per hectare, a proportion which early studies by the FBA had indicated would provide natural food for maintenance and some growth. No artificial food is used on the lakes but some of the smaller trout which come in the stocking lorry, originally once a year but now four or five times each year, are retained in the farm pond and an additional "stew" pond (Plate 1, facing page 16), and these are fed for a week or two before being released into the lakes. Most fish are stocked at 1-2 years of age, although a few are older, but we do not

use the "monster" rainbow trout that are illustrated in fishing magazines, stuffed with artificial food and quite incapable of supporting themselves in the wild.

Another objective has been to ensure that a reasonable proportion of the stock in the lakes at any one time includes older fish which have been in the lakes for at least 1-2 years, as well as the newly-stocked fish. Some of these older survivors take to feeding on other fish when available and they grow rapidly. They are more frequent now that the lakes contain small home-bred brown trout. Thus in 1992 the largest trout yet taken from this fishery, a cock rainbow trout weighing 7 lb 2 oz (3.2 kg), was caught with a tiny fly on the opening day of the season. Other "best fish" of the season have exceeded 3 lb (1.35 kg) in every year since 1983, and in four of those years individuals of over 5 lb (2.25 kg) were recorded.

Performance of the fishery

A useful measure of how the fishery has progressed, not shown in Figs 1 and 2, is the number taken which weigh more than one and a half pounds (675 grams). These are recorded as "good fish" and their number taken annually has increased rapidly in recent years, from 81 in 1984 to 226 in 1991. The average weight of all fish taken in each year (Fig. 2) was close to three quarters of a pound in the early years, but with the addition of Lake Bircheham and removal of the rudd infestation it rose to over one pound (450 g) and has remained so ever since, with a significant rise since 1989. The important factors in this are the size of fish introduced and the time they spend growing in the lakes. High average weights in 1971 to 1973 (Fig. 2) perhaps reflect rapid growth of the original stock in Lake Starton, following the flooding of virgin land. Scale readings for some of the larger rainbow trout that have been caught showed that none had lived for more than 5 years. This was to be expected as rainbow trout rarely live longer, whereas brown trout may grow on into their 'teens.

The number of trout taken per visit is another useful indicator. It ranges from 0 to 4 and depends, of course, on the skill and knowledge of the angler as well as the behaviour of the fish. The records include a number of zeroes but the average shows a slight rise since 1977, which suggests that, except in times of highly inclement weather such as storms or hot summer days, the fly-fisher could expect to take home at least his supper. 1976, which shows a peak in the graph of numbers caught per visit (Fig. 2), was a year of drought when water was drawn from the lakes for agricultural irrigation; the water levels were low and the number of anglers small.

Finance

If a fishery of this kind is designed and created on the DYS principle, hiring labour and machines when necessary, the completed cost need not be high. In our case the earthworks, pipe and outfall for draining, and concrete spillway, cost a total of £1,200 for Lake Starton in 1967 and £2,060 for Lake Bircheham in 1974. In subsequent years, at some additional expense, a fishing hut was erected alongside each lake, a bulldozer, hymac or dragline was hired occasionally to remove silt or increase depth in places, and trees were planted, fishing paths cleared and foot-bridges constructed. The main recurrent expense was and continues to be for high quality trout for stocking. However, the running expenses are adequately covered by the Members' subscriptions. Moreover the inclusion of a trout fishery in a farm such as Colin Godmans adds significantly to its capital value.

Aquatic plants

Apart from phytoplankton which was quick to appear after impoundment, there were no large macrophytes in Lake Starton until some starwort *{Callitriche)* and water crowfoot *(Ranunculus)* were planted. The latter soon disappeared because the water was relatively soft. Later, when chalk was put into the affluent stream, *Ranunculus* appeared spasmodically on its own but has never become a nuisance, nor have several species of *Potamogeton.* The aquatic macrophyte that did so was Canadian pondweed *{Elodea canadensis),* which established itself after the first year and became a real pest for angling, especially when associated in late summer with growth of the filamentous alga *Cladophora* (blanket-weed). Against this, cutting and raking were ineffective, but the nuisance was largely overcome by a light dressing of diquat sprayed from a boat rowed slowly over the affected areas. Some water-weed is, of course, desirable as food and cover for invertebrates on which trout feed, and as a refuge for trout themselves, but without a modicum of chemical control, carefully applied (diquat can be toxic to some invertebrates), a fishery like ours is difficult to manage.

Of marginal vegetation some clumps of the great reedmace *{Typha latifolia),* yellow flags *{Iris pseudacoris),* common alder *(Alnus glutinosa),* primroses *(Primula vulgaris)* and marsh marigolds *(Caltha palustris)* came naturally and, with a few "weeping willows" *(Salix* sp.), do much to enhance the prospect.

PLATE. 1. *(Facing page 16). Above:* Lake Bircheham photographed from its dam, with Colin Godmans farm buildings and house in the background. *Below:* A small stew pond used for feeding small trout before stocking them in the lakes.

Invertebrates

Populations of aquatic insects took a year or two to develop a seasonal succession. One of the first to attract the attention of both trout and anglers, in April, is a little brown gnat, followed by a series of species, mainly chironomid flies, which have not been identified. Small species of *mayflies* (Ephemeroptera) appear before the appearance *of "the* mayfly" *Ephemera danica,* which took 3-4 years to establish significant numbers owing to its long nymphal life in the bottom sediments. Mayflies are followed by our main insects, several species of damselflies (Odonata, Zygoptera) which tend to dominate the water until autumn and are imitated by fly-dressers both as adults and nymphs; on occasion an inch (2.5 cm) of bright blue wool attached to a small dry fly has proved effective. With the damselflies are several species of larger dragonflies (Anisoptera) whose big black nymphs are often found in the stomachs of trout.

Sedges or caddis (Trichoptera) are rather spasmodic. In some years the shallow water is acreep with case-bearing caddis larvae or nymphs ("caddis worms"), which are eaten by rainbow trout, sticks and all; in other years they are seldom abundant, either as nymphs or as adults at the surface during the evening rise. Daddy-longlegs (Tipulidae) and other terrestrial insects landing on the water may become important in late summer, and the season then continues during October which, in favourable weather, can be surprisingly abundant in aquatic life. *Notonecta* and corixids (water boatmen), and several kinds of water beetles, are then favoured trout food.

Other than insects, the water louse *(Asellus)* became very abundant soon after rooted vegetation was established, but then quickly died down to a small population, probably because they are eaten avidly by trout. Of other crustaceans, freshwater shrimps *(Gammarus)* are rarely seen. The larger kinds of planktonic Crustacea, e.g. the waterflea *Daphnia,* are important ingredients of trout diet here as elsewhere. Several species of Mollusca, small bivalves as well as gastropod snails, are sometimes abundant but then apparently disappear, perhaps as a result of predation by trout.

Birds

The variety of resident and visiting birds to the area has of course been greatly enhanced by our lakes. The birds range in size from mute swans *(Cygnus olor),* of which there are regularly one and sometimes two pairs in residence, to dabchicks or little grebes *{Tachybaptus furicollis)* which visit from time to time. In 1992 a pair of mute swans had six young, but usually foxes take the cygnets one by one until none survive. Canada geese *{Branta canadensis)* come and go, sometimes in such numbers that

they are a real nuisance, interfering with angling and fouling the banks. Usually one or two couples nest on the islands, and the sight of mother goose followed in file by eight or nine goslings, with the gander defending the rear, entertains anglers when trout are not rising.

A few families of mallard ducks are reared each year, sometimes also tufted ducks *{Athya fuligula)* and once a family of teal *(Anas crecca),* while some other species visit during winter. The duck population used to be augmented by a hundred or so mallard ducklings, but large numbers of ducks do not go well with trout fishing because they stir up sediment and produce muddy water.

During two years a coot *(Fulica atra)* reared young and once a great crested grebe *(Podiceps cristatus)* looked like settling in, but the area of water is not enough for these two species to settle permanently, whereas we have numbers of moorhens *(Gallinula chloropus).*

During the years when the lakes were over-run by rudd, kingfishers *{Alcedo atthis)* were more or less resident, but now they are limited to feeding on small brown trout they pay only fleeting visits. Yellow wagtails *(Motacilla flava),* however, find the shady corners by the lake outlets much to their liking for nests. Less popular to us are the large fish-eating birds mentioned later under the heading of predators.

Other animals

When first made these lakes were inhabited by water voles *{Arvicola terrestris)* but none have been seen for the past ten years. The only other indigenous aquatic mammal here is the charming little water shrew *(Neomys fodiens)* which has been seen occasionally in the shallows. Grass snakes *{Natrix natrix)* often swim across the lakes which also support plenty of frogs *(Rana temporaria),* toads *{Bufo bufo)* and smooth newts *(Triturus punctatus).*

The lakes provide useful watering points in very dry weather when the Anne Wood Brook dries out, and are used as such by fallow deer *(Dama dama)* and muntjac *(Muntiacus reeves!)* which live in the neighbouring forest, and by domestic stock on the farm.

Predators

Legitimate anglers are, of course, the chief predators in our lake ecosystems, and it is questionable whether human poachers or herons *(Ardea cinerea)* come second in causing the discrepancy between the numbers offish stocked and cropped (Fig. 1). Human poachers certainly take a toll and are the cause of frequent incidents. They come through the forest on the south side of the lakes in early morning or late evening, with rods, cans of worms or "gentles" (blow-fly maggots), and floats - some of which are phosphorescent for night-time visibility. When

disturbed the poachers disappear into the forest, sometimes leaving behind their cans of bait, empty beer cans and even the fish they have caught, and are difficult to apprehend. Fortunately the local police are on our side and twice recently have had hunts for gangs, aided by dogs and a helicopter. Once a group of three, caught red-handed and marched to the farm-house, were prosecuted and brought before the Magistrates, who let them off with a trifling fine and gave them back their rods and equipment! One gang of ten poachers ran off carrying their rods and fish caught in Bella Pool, which they seemed to have just about cleaned out.

Losses from fish-eating birds are likewise difficult to assess, but they get more sympathy from us. Cormorants *(Phalacrocorax carbo)* come from the sea some sixteen miles (26 km) away but fortunately for us not very often, as they can eat their own weight of fish each day. Herons hunt using less energetic techniques but have been seen to swallow trout up to nearly two pounds in weight. We sometimes have three or four fishing at the same time, but their main feeding place in this part of Sussex is Weir Wood Reservoir, where 20 or 30 herons at a time can be seen sometimes fishing in the nature reserve at the head of the reservoir. That is only eight miles from Colin Codmans as the heron flies.

Apart from these two fish-eating birds, feral mink *(Mustela visori)* visit us from the lower reaches *oi* the Sussex River Ouse and occasionally breed on our lakes. During the infestation by rudd they settled in, but were easy to trap. On one occasion we accounted for a large female and three half-grown minks on four successive days.

Once an osprey *(Pandion haliaetus)* was seen hovering over our fishery. We long for the day when he or she returns and swoops to take a fat trout, with our blessing!