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AN ELECTROMECHANICAL FISHING AND COUNTING FENCE USED IN IRELAND

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ABSTRACT

On Ireland's River Shannon salmon are fished by a large permanent weir which contains fish traps. The weir extends across the river and a carefully regulated escapement is counted through at frequent intervals during the entire run. Electric counting devices are used to count the escapement and electric shocking devices are used to kill the fish taken.

INTRODUCTION

Salmon are permitted to escape to upriver fisheries and spawning, and a regulated percentage is then killed electrically after being caught in stationary traps in the River Shannon at Thomond near the southwest coast of Ireland. This installation of the Electricity Supply Board of Ireland is of particular interest because the most effective regulation of a salmon stock is possible when the escapement to an individual river can be carefully controlled. The principle of controlled fishing of the river mouth is similar to one employed by the Soviets and described previously in Commercial Fisheries Review, July 1957 p. 32.

The fence or weir of this Shannon fishery extends completely across the river and contains traps in which are electric fishing or electric fish-counting equipment. The river at Thomond is moderately large being in the order of 180-300 cubic meters per second. The annual run to the Shannon has been estimated to be 20,000 salmon a year of which approximately 13,000 reach the weir. Of these latter the Electricity Supply Board, which owns the fishery, takes 28 percent for commercial purposes. In Ireland the fishing rights are private property and go with the land on the river shore. Excerpts from a series of personal letters from S. Drummond Sedgwick, former Fisheries Manager of the Electricity Supply Board, and J. A. Williams, his successor, describe the installation in greater detail. The individual photographs were supplied by the writers indicated, from the files of the Electricity Supply Board.

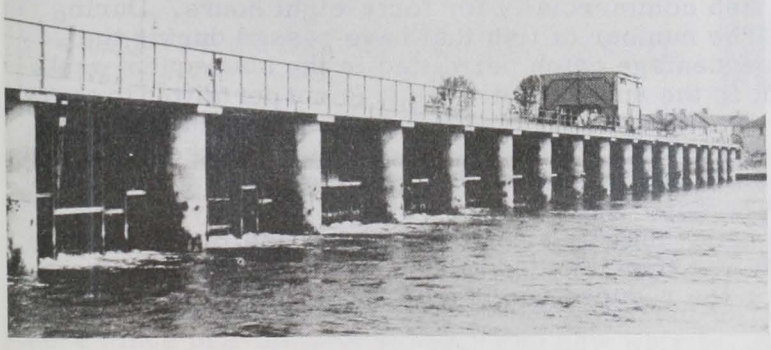

Fig. 1 - The Thomond counting fence and salmon fishing weir on the River Shannon in Ireland. The weir gantry raises the counters and trap floors. Salmon are counted through traps and 28 percent are removed as the catch.

"One of our fisheries employs a counting fence of which I enclose photographs (fig. 1). This is a very heavy arrangement spanning a wide river and is used for commercial fishing

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as well as for counting. The entire run of Atlantic salmon entering the river is counted continuously and a proportion of them (28 percent at present) are taken commercially by controlled trapping. The traps are fitted with electrodes which kill the fish instantaneously when the traps are fished (figs. 5 and 6). This counting fence is in fresh water but there is a tidal change of up to 15 feet. This leads to considerable complication in underwater (counting) gear using a standard tube-type detector tunnel. Arrangements had to be made for the tunnel to rise and fall according to tide changes if the fish were to find it easily on the levels in which they were moving. In fact, as you know, the fish tend to move against the current, consequently it was found that a wide change in settings of the detector tunnel was not required. The flow of the river is very strong at this point . . . and the (hydraulic) action of the tube itself under maximum flows presented some obstacle to fish. (Sedgwick, May 20, 1958.)

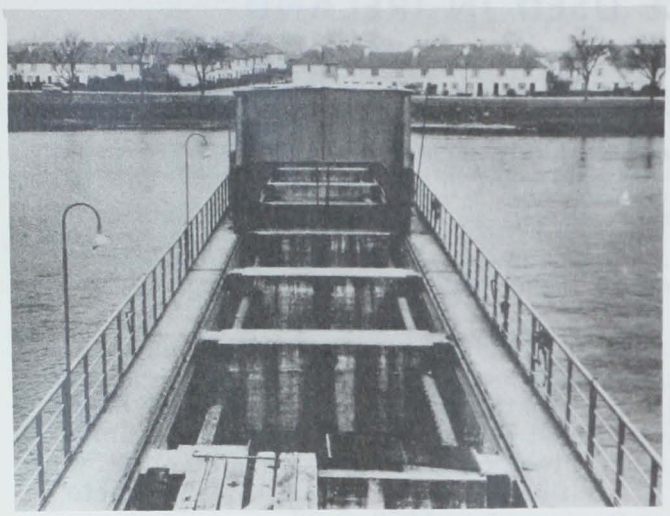

Fig. 2 - Top of weir. This gantry runs on rails across the top of weir. Four traps are visible in the foreground. Note light safety screens in position on the gantry. These operate interlock switches so that the killing apparatus cannot be switched on until screens are in position.

"The figure of 28 percent was arrived at in rather a strange way. There was a weir fishery for salmon near the site of the present counting and catching device. This old fishery operated on the standard British method of cruive fishing. A number of traps were built into a stone wall extending across the river; at the point of maximum flow a statutory gap equal to one-third of the width of the river had to be left as a free passage for salmon. The number of fish taken in the traps depended on a proportion of the run of fish passing in the weir finding their way into the traps rather than through the gap. When the new fishing weir was built it was decided, arbitrarily, to count all the fish passing through the weir and to take one-third of the total commercially. The method of arriving at the correct number of fish to catch was worked out retrospectively. For example, 200 salmon were visually counted as they swam through the port opened in the weir over a white painted plate. The gap was then closed and the entrances to traps in other parts of the weir were opened. These fished until approximately 100 salmon had been caught, the trap entrances were then closed and counting began. At the weekends the weir is not allowed to fish commercially for forty-eight hours. During this period, the fish are visually counted. The number of fish that have passed during the weekend are allowed to count towards the percentage catch permitted in the subsequent week. If the requisite percentage cannot be caught in the subsequent week it is not permitted to carry-over the remainder into a following week. The Electricity Supply Board of Ireland who constructed the fishing weir at Thomond also had other rights for salmon fishing in the estuary of the river. These rights permitted the use of pound nets very similar to the type used on the Miramichie in New Brunswick. When Thomond Weir was built, the Electricity Supply Board waived its right to operate the fixed nets. Shortly after the last war the Board decided to start fishing again with the fixed nets. It was then decided to reduce the percentage from one-third to 28 percent in compensation for the reduced number of fish which might reach Thomond. (Sedgwick, November 22, 1960.)

"Up until eighteen months ago, only one electronic counter was in use. This was sited to pass clean through the fishing weir grids so that fish could swim freely upstream through the counter. The fish used the counter satisfactorily although it represented only 1 yard of width in a distance of approximately 150 yards. At times when large numbers of fish were running, the electronic counter was assisted by visual counting. The weir is at the head of tide and is in fact subject to a very considerable tidal rise and fall although the water is fresh. There is, therefore, a reverse flow through the weir at high tide. It has been found from experience that salmon do not make any attempt to pass through the weir or even to run up to it from approximately half flood to half ebb, consequently the periods in which counting was re-

quired are materially reduced. The main purpose of the electronic counter was to avoid the necessity for employing staff on visual counting at weekends. . . . It should be clearly understood that the fish to be counted are not trapped in any way, but are counted as they swim freely through gaps or through the electronic counter in the weir. While counting is in progress the traps are closed and fish cannot enter them. It is only when a worthwhile number of salmon have passed through the weir that the counter arrangements are closed off and the fish enter the traps. (Sedgwick, November 22, 1960.)

"The weir was completed in 1940. Originally, prior to hydro-electric development, the Shannon had a very much larger run of salmon, probably in the region of 50,000 to 100,000 fish a year. The effect of the hydro-electric scheme was to divert the river from its old course; no fish pass was provided on the diversion, salmon entered the diversion in thousands in the initial years and found nowhere to spawn. Eventually, practically speaking, the entire middle and upper reaches of the river became denuded of a stock of salmon. My own work in Ireland was primarily to seek to restore the run of salmon, involved the design and construction of a new fish lift on the diversion side of the river and the construction of a salmon smolt rearing station and hatchery. The hatchery has a capacity of approximately 6 million eggs and the rearing station of approximately 500,000 parr. The hatchery and rearing station are being used to repopulate the middle and upper reaches of the river. (Sedgwick, November 22, 1960.)

"The new fish pass on the Shannon is working well and salmon are now reaching upstream, spawning in middle and headwater tributaries where none have been seen for 30 years." (Sedgwick, November 22, 1960.)

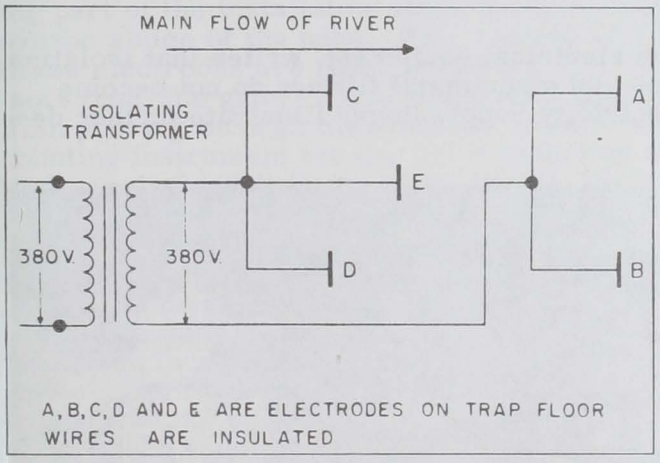

Fig. 3 - Schematic wiring diagram for shocking electrodes. An isolation transformer confines the electric field to the vicinity of the electrodes. The voltage gradients are sufficient to stun the fish between pairs C and D and A and B, and to kill them between E and A and B.

Fig. 4 - Reaction of salmon after switching on power. The surface gradient of 80 volts per meter (with a load of 4 amperes) is sufficient to kill in 15 seconds.

J. A. Williams, in June 1961, supplied further information:

"As regards the weir, this replaced an old weir on the River Shannon which was probably there since pre-historic times. The new weir is, generally speaking, a modern version of an old weir which was in operation until 1935. The type of salmon trap used is basically the same. In principle, the trap consists of two sets of screens spanning between adjacent piers, one at the upstream end of the piers and the other at the downstream end. These screens have 2" bar spacing except the special 'V' shaped screen in the centre of the downstream set which has one central opening $5\frac{1}{2}$" wide. Salmon enter the traps through this $5\frac{1}{2}$" opening and lie with their noses against the upstream screens. They are removed from the traps when they are required for marketing. As you know, a salmon weir in Ireland usually extends right across the river from bank to bank except for the free gap which, according to Law, must occupy at least 1/10th of the width of the river and must be placed in the most favourable location for the passage of salmon. The weir then consists of a number of trap gaps covering the known

passage where salmon normally run, the free gap (this is sometimes known as the King's gap or the Queen's gap) and a number of stop gaps which block off the remaining section of the river. In order to use the weir as a scientific tool of fisheries management, permission was obtained by the Board to block the free gap and instead all fish are counted as they arrive at the weir. This counting is sometimes carried out by visual observation of the fish passing a white board and sometimes by an electronic counter. The fish are not stopped or taken out or handled in any way. The recording is to all intents and purposes automatic. 72 percent of the 'run' are released upstream for propagation purposes and for angling. The remaining 28 percent are marketed. Special trays with mechanical lifting equipment are provided in the traps for the purpose of lifting fish out. All the screens are interchangeable so that the position of the traps can be altered at any time if considered necessary. In recent years new smaller screens $1\frac{1}{2}$" wide are used in the summer in the traps, except in the heck and inscales i.e. the 'V' shaped section, as it was found that some of the smaller grilse in the Shannon were able to pass through the 2" gaps. As a further effort in improving the efficiency of the weir, in June 1956 experiments were carried out to determine the most suitable method of killing fish using the lowest voltage in the shortest time possible. The electrical equipment was installed in the crane-house for raising and lowering the trays and electrodes were placed on the trays in the traps. Final tests showed that 380 volts was most effective and operated in 15 seconds, and this arrangement was decided upon for future use. The fish, therefore, in the weir are killed electrically and as they are in first class condition, they commond top prices in the salmon markets. (Williams, July 14, 1961.)

"To eliminate the possibility of anyone entering the gantry or trap while killing was in progress, electrical protection was devised. The system of electrodes has given continuous satisfaction." (Williams, July 14, 1961.)

Patrick J. Sharkey of Dublin, who installed the electrical equipment, writes that isolation transformers are used to insure that trash screens and other metal fittings do not become part of the circuit (fig. 3). Photographs of the Electricity Supply Board illustrate further details (figs. 2, 4, 7, and 8).

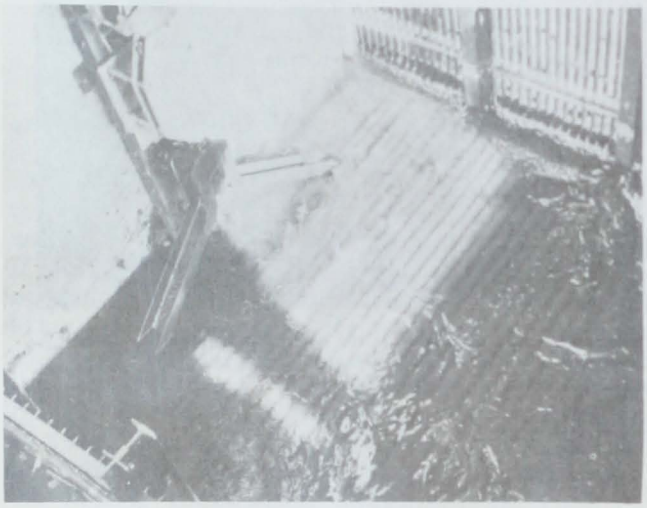

Fig. 5 - Salmon just after killing on trap floor. The trap is in the down position.

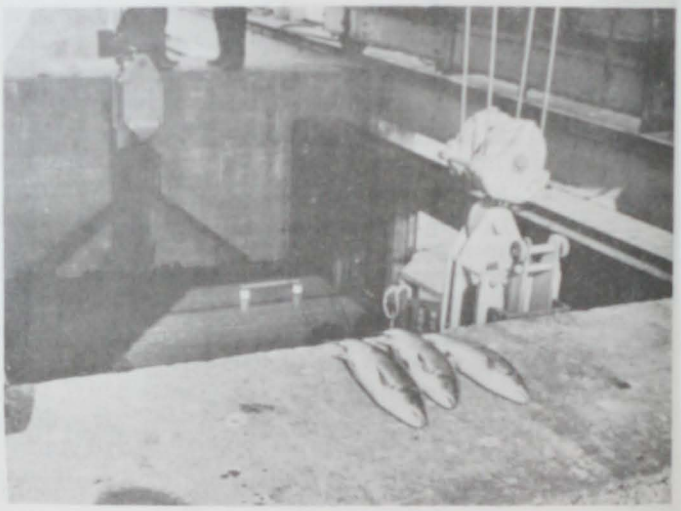

Fig. 6 - Trap floor. The electrodes for killing fish are energized to 380 volts by an alternating current.

Electric fish counters have been under operational development for a number of years in Scotland (Lethlean 1953), Ireland (Jackson 1953), Japan (Suetake 1955), and in the United States (Rockwell and Chur 1959; vanHaagen 1959; vanHaagen and Rockwell 1960).

Describing those counters J. A. Williams writes.

"As regards the electronic fish counters, these have been pioneered in Ireland by the Board and a small electronic firm. Information is required on the movements of fish in the

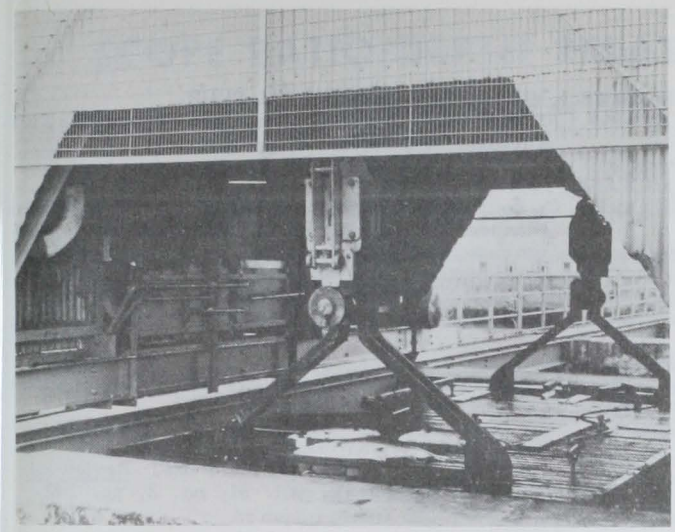

Fig. 7 - Raised trap. The trap floor is raised after kill. Note electrodes. The safety screen is in a raised position.

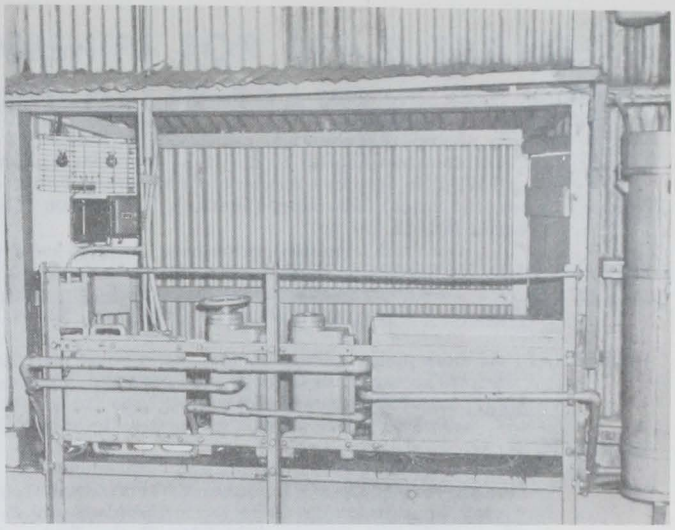

Fig. 8 - Control panel of shocking apparatus. The warning lights and the controls for the electrical killing apparatus (top left-hand corner) are located in the control cabin of the gantry.

fish passes of the Board's hydro dams and all the fish passes have been equipped with electronic counters. You are no doubt familiar with the counter designed by Mr. Lethlean in Scotland. The Board's counters are rather similar to some extent. The counter, therefore, was specially developed for use in the Borland-type fish pass. The under-water fish detecting part of the installation takes the form of a channel secured to the upstream side of the escape sluice of the pass. This channel is 6 ft. long, 3 ft. wide and 18 inches deep. Three brass electrodes are fitted transversely at 1 ft. 8 ins. centres in the end of the channel remote from the gate. These electrodes sensitise about 16 cubic feet of water in the channel. Fish passing through the sensitive area of water cause electrical currents to be fed into the counting instrument via the interconnecting cable. From the sequence in which these currents arrive and from their magnitude, the instrument can (a) sense the direction in which fish are moving, for example, upstream or downstream, and (b) determine the size of the fish. These currents from the under-water gear are henceforth referred to as signals. Spurious signals due to wave action in the reservoir or arising from the automatic level control equipment on the gate will not interfere with the proper functioning of the instrument or cause it to make up false counts. The counter is uni-directional and will not operate on descending fish or on incomplete passages by either ascending or descending fish. Kelts tailing downstream into the sensitive area of water and sawing backwards and forwards across the electrodes will not cause a succession of false counts as the instrument is designed to lock-off under these conditions. Frequently as many as 100 fish may be raised to reservoir level in a single operation of the lift. As soon as the water level in the stilling pool permits, the salmon escape across the sill of the sluice gate, through the counter channel and into the open waters of the reservoir. When such large numbers are lifted, salmon go through the channel in rapid succession and the counter must be able to deal with them at the rate of 5 per second. The counter instrument itself may be divided into 5 units, the bridge energizing oscillator, the amplifier, the bridge circuits, logic circuits, and the power supply. The counters, which were designed originally experimentally, are now working very satisfactorily and give the Board a fairly accurate indication of the runs of fish at the various passes. This information is vital in fisheries management."

The method of escapement regulation illustrated is similar in principle to one used in Russia (Chernigan 1956, and U. S. Bureau of Commercial Fisheries 1957) for both provide methods of fishing the stocks of separate rivers separately, and provide incentive for more effective river management.

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