International Council for the
Exploration of the Sea

C.M.1968/M:4
Anadromous and Catadromous Fish Committee

The Effects of River Flows on the Migration of Salmon at Ballyshannon Power Station

by

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The Power Station with its associated dam on the lower River Erne at Ballyshannon is situated at the head of tidal water and is equipped with a fish pass of 73 pools of the submerged orifice type. All ascending and descending salmon must use the fish pass and are counted. The discharge water from the power station enters the estuary through a tailrace 16m wide and 1.6 km long.

The Electricity Supply Board, which owns and operates the power station, also operates a salmon fishery there. From the fishery records together with hydrometric records from the power station, it has been possible to investigate some aspects of the passage of salmon into the River Erne in relation to the flows in the river and through the power station.

In the course of a more general investigation of the movement of salmon in the lower River Erne for the years 1955 to 1960 inclusive, some features were found in the migration of the ascending salmon - in the Erne these are predominently grilse. Two of these features were associated with different types of flow into the river system and through the power station (Jackson & Howie, 1967).

1. When heavy rain produced a considerable rise in the inflow to the river system - such as would have caused a spate before the construction of the power station - this usually was followed after an interval of some days by larger daily runs of salmon.

2. Prolonged periods of sustained high discharges from the power station were accompanied by marked reductions in the numbers of salmon reaching the power station. In each case a recovery in numbers followed the return to intermittent operation of the turbines. In two instances, the sustained high flows lasted more than a week and were followed by peaks in the run of fish.

Both these features were prominent in 1955 when a June flood gave rise to 19 days of steady high flows. The daily run then dropped from about 105 fish per day to about 24 fish per day. A peak (299 fish) occurred in the run at the start of the flood and again when intermittent running of the turbines was resumed (483 fish).

The purpose of this paper is to review these results in the light of additional data since 1960, and to examine the records for evidence of any association between river flows and the arrival of spent salmon (kelts) at the Ballyshannon power station, and also of the effects of river flows on the estuary draft net fishery.

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In the period 1961-1967 there were only two relevant periods of sustained high flow comparable with the year 1955 in magnitude and duration (in August/September 1962 and in September 1967). On both these occasions there was a reduction in the daily run of salmon into the fish pass as long as the steady high flows lasted. However, in both cases the periods occurred after the end of the main run, and because of the small daily migration, this feature was not prominent. Nevertheless a period of 8 days did occur during the main run at the end of June 1965 when the flow was steady and high as the result of a small summer flood. This depressed the daily numbers of salmon reaching the power station. Despite the short period of sustained high flow, the pattern of events was much the same as on other similar occasions, although the features were less prominent than in 1955.

The sequence of events in 1965 may be followed in Table 1 (page 4). Heavy rain on June 14 and 15 was followed by increased inflows to the river system on June 15 and 16. To control this spate, the generation of electricity was increased on June 16 resulting in high discharges of water from the power station. Although the discharge was steady only on June 17 and June 21 when it was at the maximum output of the turbines (90 cbm/sec each), nevertheless it was sufficiently sustained to depress the numbers of fish reaching the power station. On June 23 one of the two turbines was taken out of commission for overhaul and the other remained on full and steady load until June 30. Rain on June 22, 23 and 24 gave rise to increased inflows on June 23 to 26 which were followed by a good run of fish on June 25 to 27. This good run occurred in spite of the sustained high flow and the author suggests that this was in response to spate water. The interval of three or four days between the rain and the run of fish seems to be the time taken for the spate water to reach the power station. From June 28 until July 1 the numbers of fish reaching the power station were again reduced, but they recovered to form a peak on July 3 following a return to lower, fluctuating, flows on July 1. It is apparent that sustained high flows from the Ballyshannon power station are accompanied by a reduction in daily migration when the salmon are running in moderate or large numbers. However, from the good run on June 25 to 27, which occurred during a period of high steady flow, it is clear that the salmon have no difficulty in reaching the power station in times of sustained high flows. It has also been found from the records and from observations, that in very low flows, the result of a drought, the salmon are also reluctant to leave the estuary. These conditions are in contrast with the usual summer operation of the power station which gives intermittent or widely fluctuating yet moderate discharges, and the pattern of the migration of the salmon into the fish pass under these conditions is now regarded as normal.

It has not been found possible to trace any connection between flows and the fluctuations in the numbers of salmon entering the fish pass within a single day.

On the Erne it is not possible to count the smolts. Except in very dry seasons, the great majority of the smolts do not use the fish pass but descend unharmed through the turbines (McGrath & Twomey, 1959) and are first noticed in large numbers in the estuary. The turbines are of the Kaplan type with a head of 30 m. It is not possible, therefore, to make any useful observations on the migration of salmon smolts in the Erne.

Regarding the question of spent salmon (kelts) we might expect the river flows in the Erne to have some effect on the survival of kelts or on the time of their arrival at Ballyshannon. It has been possible to examine this aspect in the records for 8 years, but no firm connection could be detected.

There is a draft net fishery in the estuary of the River Erne. During a drought, the nets take a considerable greater proportion of the run of salmon than during a period of high average flow (Table 2). At least three factors seem to be involved. These are:-

1. The reluctance of salmon to enter fresh water during a drought.
2. The fact that some of the salmon taken by the Erne nets belong to rivers other than the Erne, and it may be that more fish belonging to other rivers are present in the Erne estuary in times of drought. However, the numbers appear to be small (Went, 1964).
3. Draft net fishing becomes more difficult with increasing flows. ~~It is the~~ author's opinion that all these factors contribute to the inverse relation that is found to exist between the magnitude of the flow and the catch by the netsmen.

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The author acknowledges permission granted by the Electricity Supply Board to quote the fishery and power station records, and by the Minister for Agriculture and Fisheries to quote the numbers of salmon taken by the estuary netsmen. Any views expressed are the author's and not necessarily those of the Electricity Supply Board.

References

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Table 1. The effects of river flows and turbine discharges on the migration of Salmon at Ballyshannon Power Station, 1965.

Date	Rain mm	Inflow to river system cbm/sec	Average discharge from turbines cbm/sec	Hours run per day by turbines	Number of turbines used and type of discharge	Daily run of salmon Number
June						
6	-	54	33	24	2 Fluctuating	175
7	4	41	34	24	2 Fluctuating	120
8	-	33	40	20	2 Intermittent	112
9	-	21	39	23	2 Intermittent	200
10	8	43	29	15	2 Intermittent	129
11	4	1	39	24	2 Fluctuating	171
12	8	77	32	21	2 Intermittent	267
13	2	32	38	24	2 Fluctuating	170
14	19	53	47	18	2 Intermittent	167
15	15	223	56	24	2 Fluctuating	105
16	1	110	132	24	2 Fluctuating	106
17	5	63	186	24	2 Steady	89
18	5	92	152	24	2 Fluctuating	12
19	2	115	89	24	2 Fluctuating	45
20	4	52	146	24	2 Fluctuating	70
21	2	43	175	24	2 Steady	37
22	9	98	117	24	2 Fluctuating	55
23	10	106	78	24	1 Steady	86
24	11	97	81	24	1 Steady	80
25	5	218	91	24	1 Steady	254
26	1	108	92	24	1 Steady	611
27	-	87	87	24	1 Steady	278
28	1	68	91	24	1 Steady	33
29	-	58	87	24	1 Steady	57
30	-	27	74	24	1 Steady	55
July						
1	-	37	54	24	1 Fluctuating	17
2	-	26	40	24	1 Fluctuating	315
3	-	42	33	24	1 Fluctuating	544
4	-	13	43	24	1 Fluctuating	277
5	2	47	32	24	1 Fluctuating	171
6	1	15	35	24	1 Fluctuating	70
7	-	32	32	24	1 Fluctuating	224
8	2	25	25	22	1 Intermittent	104
9	3	14	32	24	2 Fluctuating	98
10	10	14	30	21	2 Intermittent	184
11	2	23	24	21	2 Intermittent	336
12	7	27	28	20	2 Intermittent	190
13	4	31	31	24	1 Fluctuating	173

Notes:- (1) The run of salmon (mainly grilse) commenced in early June.

(2) Because of the location of the fish counter and because of the operation of the commercial fishery in the fish pass, the figure given for the run on any date many not be a true indication of the number of fish entering the fish pass on that date; some may be included in the previous day or following day.

Table 2. The effect of flows on the proportion taken by the nets from the total numbers of salmon entering the estuary during the fishing season.

Year	Total run into estuary	Catch by nets	Proportion of run taken by nets	Average flow during fishing season
	Number	Number	%	cbm/sec
1956	6220	970	16	59
1957	2690	960	36	11
1958	-	No fishing	-	-
1959	2150	580	27	14
1960	3270	1000	30	36
1961	-	No fishing	-	-
1962	9620	4150	43	10
1963	520	240	46	9
1964	5380	2020	38	16
1965	10990	1950	18	60
1966	12450	2020	16	63
1967	10020	5600	56	28

Notes:-

(1) The figures are approximate.

(2) The total run into the estuary is the number of salmon taken by the nets in addition to the run into the fish pass during the net fishing season.

(3) Fishing was restricted in the years 1958 - 1964 inclusive.

(4) The average flow in the years of unrestricted fishing is taken for the period when the bulk of the salmon usually run, that is, during the last two weeks of June and the month of July.