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Trends in Scottish salmon and grilse catches, 1952-1971¹

by

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The main purpose of this report is to up-date the data given in 'Recent Trends in Scottish Salmon and Grilse Catches' (ICES/ICNAF Salmon Doc. 70/13) and to report on the results of a statistical analysis of the trends in the salmon and grilse catches over the twenty-year period 1952-1971. The 1972 catch data are also included but have not been used in this analysis.

Methods

Trends were calculated by fitting linear regression lines to the data for the twenty-year period. The principal statistics given are 'R', the regression coefficient which shows by how much the catch has changed from year to year and 'P', which is the probability that the calculated trend is simply due to chance. 'R' values are positive or negative for an increase or a decrease in catches, respectively, and 'P' values less than 5% ($P < 0.05$) are regarded as being significant.

Salmon

a) Annual trends

The annual catches of salmon from 1952-1972 are given in Table 1. From this Table, it appears that there have been wide fluctuations in annual catches. However, there is a suggestion of a recent downward trend from 1967 to 1971.

Table 2 gives the results of the analysis of the trends in the annual salmon catch, which suggest that there has been no significant trend over the twenty-year period.

b) Seasonal trends

Commercial catches have been selected for the analysis of seasonal trends in salmon catches, because the majority of the fish in them are taken soon after their arrival on the coast or on entering fresh-water. Monthly commercial salmon catches are given in Table 3.

These commercial catch data have been examined for evidence of a decrease in 'spring' fish, by calculating the trends for the combined catches in February, March and April (when catch samples indicate that few fish showing 'plus growth' on their scales are present) and for the catches for each subsequent month. The results of this analysis are given in Table 4.

From this analysis, it is evident that catches of 'spring' salmon show a highly significant decline over the period 1952-1971, while catches of summer and later-running fish (July, August and September) show highly significant increases of varying magnitude. As there is no evidence of a statistically significant trend in the total annual salmon catch, it may well be that the decline in 'spring' salmon has been compensated for by an increase in later running fish, suggesting that there has been a gradual change in the timing of the arrival of the various runs.

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The question of increases in salmon catches from July onwards is complicated by the inclusion of large grilse in these catches, because the fishermen use arbitrary weight limits in separating their catches into salmon and grilse. As yet, no satisfactory method of correcting total salmon catches for the numbers of 'over-weight' grilse included in them, is available. However, the relevant monthly catches on the Rivers Tweed, Tay and Spey for 1969, 1970 and 1971 have been corrected for this error, on the basis of commercial catch samples, without altering the significance of the observed trends of an increase in catches in these months.

Grilse

a) Annual trends

There has been a marked increase in annual grilse catches over the twenty-year period (Table 1), with peaks in 1967 and 1969. It is not, therefore, surprising that the calculated trend in the annual grilse catch shows a highly significant increase (Table 2). This increase in the grilse catch is reflected in the total catch, which also shows a significant increase.

The increasing number of grilse caught is reflected in the percentage of grilse in the total catch (Table 5), which shows a highly significant trend ($R = +1.3$, $P < .001$).

b) Seasonal trends

Went, in a report to I.C.E.S. (CK 1969/M:2) drew attention to a tendency towards later runs of grilse in Ireland in recent years. Table 6 gives details of monthly commercial grilse catches in Scotland for the period 1952-1972. The calculation of trends in these catches show highly significant increases in July, August and September (Table 4).

c) Changes in Average Weight

Went (loc. cit.) also suggested that, as a result of the later entry of grilse in Ireland, there had been an increase in the average weight of these fish in recent years.

Table 7 gives the average weight of salmon and grilse in the annual catch over the twenty-year period. There has been a significant trend in the average weight of grilse ($R = +0.04$; $P = .001$), despite the exclusion of 'overweight' grilse which were classed as salmon by the use of arbitrary weight limits. There is no significant trend in the average weight of salmon ($R = -0.01$; $P = >.6$) although a significant decrease might have been expected, particularly in recent years, due to the inclusion of 'overweight' grilse, which would be expected to weigh less than the average salmon.

Table 1 Annual Scottish Catches 1952-1972

<u>Year</u>	<u>No. of Salmon</u>	<u>No. of Grilse</u>	<u>Total</u>
1952	236,285	151,157	387,442
1953	211,935	141,782	353,717
1954	256,401	117,916	374,317
1955	252,109	136,015	388,124
1956	200,425	117,275	317,700
1957	217,572	196,974	414,546
1958	224,820	202,703	427,523
1959	270,006	115,962	385,968
1960	201,753	184,631	386,384
1961	179,926	156,257	336,183
1962	213,436	280,826	494,262
1963	267,280	166,922	434,202
1964	269,566	286,462	556,028
1965	219,999	213,826	433,825
1966	227,707	220,920	448,627
1967	261,534	342,597	604,131
1968	213,993	213,879	427,872
1969	209,965	348,781	558,746
1970	174,070	243,226	417,296
1971	161,078	262,744	423,822
1972	210,570	249,729	460,299
1952-72 Average	222,877	207,170	430,048

Table 2 Trends in the Annual Catches of Salmon and Grilse 1952-71

Salmon	R ^a	+1.73
	P	> .2
Grilse	R ^a	+9.03
	P	< .001
Total	R ^a	+7.29
	P	< .01

a R, Regression Coefficient in 1000's of fish.

Table 3 Monthly Commercial Salmon Catches 1952-1972

Year	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1952	26,850	24,971	34,892	41,506	36,139	25,953	9,608	983	200,902
1953	20,644	21,971	23,455	35,997	25,060	29,200	10,670	695	167,692
1954	17,729	33,602	43,406	37,401	29,490	30,742	9,886	637	202,893
1955	6,438	24,679	34,961	33,088	44,762	41,631	18,339	1,517	205,415
1956	5,714	21,521	19,904	27,570	34,818	31,442	9,354	728	151,051
1957	6,497	20,642	20,935	31,525	33,557	31,105	10,019	544	154,824
1958	6,528	16,623	21,053	33,782	31,103	37,114	15,836	758	162,797
1959	34,218	27,140	27,083	30,686	40,356	39,056	21,608	2,308	222,455
1960	5,892	18,017	15,277	28,403	26,532	34,397	17,626	2,338	148,482
1961	6,048	15,789	16,674	22,482	25,934	26,833	14,880	2,232	130,872
1962	5,370	10,931	9,946	22,058	31,247	43,750	25,057	2,919	151,278
1963	11,023	34,363	22,774	32,100	33,675	33,363	26,527	3,461	197,286
1964	9,934	13,171	13,233	23,744	35,804	57,678	43,213	5,453	202,230
1965	7,884	15,823	14,911	18,167	30,517	43,407	22,285	2,549	155,543
1966	4,931	13,479	15,620	18,905	24,952	45,469	36,245	4,554	164,155
1967	4,755	10,809	10,912	14,372	37,178	65,862	48,012	6,736	198,636
1968	7,252	12,478	9,441	13,712	33,018	51,221	34,887	6,319	168,318
1969	3,237	4,796	7,731	10,746	21,779	60,406	50,576	7,940	167,211
1970	3,126	7,584	9,758	10,541	20,436	41,432	29,795	5,151	127,823
1971	3,128	6,226	5,933	13,634	23,328	44,523	21,591	2,495	120,858
1972	3,106	5,738	8,568	15,765	22,730	57,467	41,145	6,886	161,405

1952-72

Average 9,538.3 17,159.7 18,403.2 24,580.2 30,591.2 41,526.2 24,626.6 3,199.2 169,624.6

Table 4 Trends in Monthly Catches of Salmon and Grilse

		Feb./Mar./Apr.	May	June	July	Aug.	Sept.
Salmon	R ^a	-32.9	-15.1	-4.8	+13.5	+16.8	+3.1
	P	<.001	<.001	>.05	<.001	<.001	<.001
Grilse	R ^a	-	+4.04	+1.4	+51.1	+32.9	+21.
	P	-	>.4	>.7	<.001	<.001	<.001

a R, Regression coefficient in 100's of fish.

3.

Table 5 Grilse Catch as a Percentage of Total Catch, 1952-1972

<u>Year</u>	<u>Percentage</u>
1952	39.0
1953	40.1
1954	31.5
1955	35.0
1956	36.9
1957	47.5
1958	47.4
1959	30.0
1960	47.8
1961	46.5
1962	56.3
1963	38.4
1964	51.5
1965	49.3
1966	49.2
1967	56.7
1968	50.0
1969	62.4
1970	58.3
1971	62.0
1972	54.3
1952-72 Average	47.2

Table 6 Monthly Commercial Grilse Catches 1952-1972

<u>Year</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Total</u>
1952		1	32	1,060	39,458	94,502	9,846	192	145,091
1953		5	14	583	18,098	96,622	19,728	459	135,509
1954	1		2	246	9,580	83,633	19,243	358	113,063
1955		1	3	134	15,556	89,467	26,228	581	131,970
1956			7	372	13,954	75,370	19,315	282	109,300
1957	33		13	677	32,339	116,231	37,378	307	186,978
1958		3	11	411	14,346	129,797	43,274	646	192,588
1959			6	311	5,841	67,847	37,623	890	112,518
1960		1	22	701	12,116	111,737	47,088	1,766	173,431
1961	13	3	83	344	11,538	96,198	40,476	1,372	150,027
1962	11	2	9	583	20,413	177,165	70,269	1,883	270,335
1963		26	55	207	5,471	91,218	58,908	1,790	157,675
1964	913	914	922	1,255	13,548	140,377	109,222	5,084	272,235
1965	8		7	309	12,475	142,857	47,623	1,835	205,115
1966	135		3	169	4,650	115,253	89,312	3,024	212,546
1967			8	300	26,657	197,199	100,395	3,588	328,147
1968	200	250	329	905	14,757	124,457	63,247	3,033	207,178
1969	7	1	36	902	34,963	226,105	74,185	4,492	340,691
1970			7	453	20,860	148,024	58,840	3,494	231,678
1971	31		23	926	32,308	177,908	41,262	2,411	254,869
1972		7	55	702	32,158	159,025	49,386	2,111	243,444
1952-72 Average	64	58	78	550	18,623	126,714	50,612	1,886	198,780

Table 7 Average Weights (lb.) of Scottish Salmon and Grilse, 1952-1972

<u>Year</u>	<u>Salmon</u>	<u>Grilse</u>
1952	11.0	4.8
1953	10.4	5.3
1954	10.3	5.4
1955	9.8	5.0
1956	10.4	5.0
1957	9.7	5.1
1958	10.3	5.1
1959	10.2	5.2
1960	10.5	5.7
1961	10.1	5.3
1962	10.5	5.7
1963	10.6	5.4
1964	9.9	5.4
1965	10.7	5.7
1966	10.3	5.5
1967	10.5	5.7
1968	10.5	5.6
1969	10.4	6.0
1970	10.2	5.6
1971	9.8	5.9
1972	10.3	6.2