THE FECUNDITY OF CLYDE PLAICE

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(Text-fig. 1)

In early 1956 and again in 1957 small samples of mature female Plaice *Pleuronectes platessa* L. were collected for fecundity estimates to be compared with Simpson's (1951) results for the North Sea populations, and the data from elsewhere that Simpson summarizes.

The fish were collected on 22 and 27 February 1956 and 7 January 1957 by trawling off Mountstuart House, Isle of Bute, at *ca.* 40 m. The treatment, of the fish was similar to that of the Long Rough Dabs collected for fecundity estimation and which has been described in detail (Bagenal, 1957*a*). This paper on Long Rough Dabs should be consulted for details of the collection and treatment of the fish, and of the laboratory methods for the estimation of the egg numbers and also of the statistical analysis of the data.

RESULTS

The data are shown in full in the Appendix, and summarized in Table 1. The relation of fecundity and length of the plaice is shown in the scatter-diagram (Fig. 1), in which the curves for Simpson's North Sea Southern Bight and Flamborough grounds, and the curve for Kändler & Pirwitz's (1957) Baltic plaice from the Bornholm area, are also shown. Kändler & Pirwitz unfortunately, do not give the raw data for each fish and the curve in Fig. 1 has been calculated from the mean values they give.

From Table 1 it can be seen that the fecundity adjusted to a common length was greater in 1957, but the 'condition' of the fish (as expressed as the expected weight of a 37 cm. plaice) was greater in 1956 (cf. Bagenal 1957*b*). However, neither the general level of fecundity nor the condition was significantly different. This is shown in Table 2 which summarizes the covariance analyses of the regressions of the logarithms of length and weight on log fecundity and also that of log length on log weight, for both sets of data. None of the regressions are significantly different and the data may be pooled. Comparisons with the results of other workers are shown in Table 3. It is clear that the Clyde plaice fecundity adjusted for length is considerably
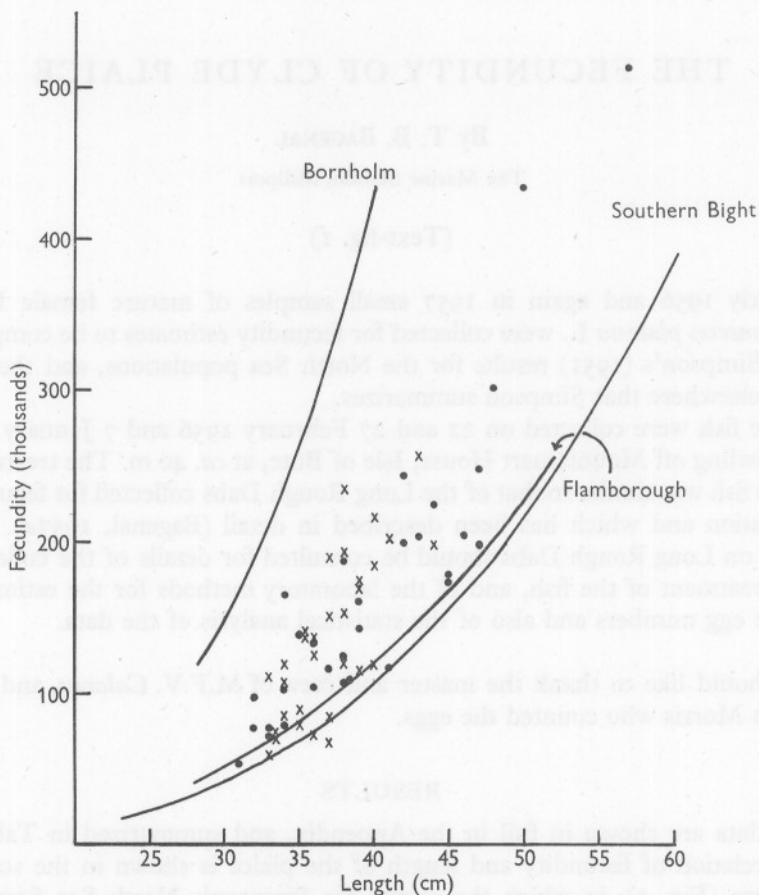
Fig. 1. Scatter diagram showing the relation of fecundity and length of plaice from the Clyde, and the calculated curves for Flamborough, Southern Bight and Bornholm fish (from Simpson, and Kändler & Pirwitz). ●, 1956; ×, 1957.

TABLE 1. SUMMARY OF CLYDE PLAICE FECUNDITY
DATA GIVEN IN THE APPENDIX

Year	1956	1957
Number of fish	31	31
Mean length (cm)	39·76	36·91
Mean weight (g)	653·1	518·6
Mean age (years)	5·4	5·1
Mean fecundity	171,080	136,611
$\hat{W}$ for 37 cm	530·7	522·2
$\hat{F}$ for 37 cm	136,693	137,840

higher than that of the North Sea, and much lower than the Baltic plaice fecundity. These differences are statistically significant. Simpson (1957) has recently given a preliminary account of the fecundity of plaice from the Irish Sea; this appears to be similar to that of the Clyde fish given here.

TABLE 2. SUMMARY OF THE ANALYSIS OF COVARIANCE TESTING THE FECUNDITY-LENGTH, FECUNDITY-WEIGHT AND LENGTH-WEIGHT RELATIONS FOR CLYDE PLAICE IN 1956 AND 1957

Source	Fecundity on length	Regression of fecundity on weight	Length on weight
Due to total regression	**	**	**
Difference between means regression and average within subgroups regression	−	−	N.S.
Between adjusted subgroup means	−	−	N.S.
Between regression coefficients	N.S.	N.S.	−

**, indicates significance at 1% probability level.

N.S., indicates not significant at 5% probability level.

−, indicates mean square less than that against which it is tested.

TABLE 3. MEAN FECUNDITY ADJUSTED FOR FISH OF 37 CM, AND THE RE-GRESSION COEFFICIENTS OF THE REGRESSIONS OF LOG FECUNDITY ON LOG LENGTH

(From data given in this paper, by Simpson, and by Kändler & Pirwitz (1957).)

Author	Region	Date	$\hat{F}$ for 37 cm	Regression coefficient
This paper	Clyde	1956	136,693	3·11
	Clyde	1957	137,840	3·81
Simpson	North Sea Southern Bight	1947/48	82,996	3·13
	North Sea Southern Bight	1948/49	87,152	3·28
	Flamborough	1948/49	96,492	2·85
Kändler & Pirwitz	Kieler Bucht	1952/53	370,954	3·12
	Bornholm area	1952/53	322,771	3·58

Simpson (1951) showed that, among the 1947/48 and 1948/49 Southern Bight fish of the same length, there was only a negligible increase in fecundity with age, whereas for fish of the same age there was a considerable fecundity increase with length. He concludes: 'Thus age alone, apart from its relation to size, appears to have played an insignificant part in determining the fecundity of these fish.' This applied to fish of the same population. On the other hand, when comparing different populations (from the Southern Bight and Flamborough) he showed that the faster-growing Flamborough fish were more fecund. 'These observations lend weight to the view already expressed that fast growing, well fed fish have a higher mean fecundity than slow growing fish.' Age of course comes into this, since fast-growing fish are younger for a given length than slow-growing ones. In Table 4 the mean lengths and fecundities are given for each age group of the Southern Bight, Flamborough

and Clyde plaice. Here Simpson's remarks are confirmed and shown to apply to the Clyde fish also, which are faster growing and more fecund than even the Flamborough fish.

TABLE 4. THE MEAN LENGTH AND MEAN FECUNDITY (TO THE NEAREST THOUSAND) FOR DIFFERENT AGE GROUPS OF SOUTHERN BIGHT, FLAMBOROUGH AND CLYDE PLAICE

Region ...		Southern Bight			Flamborough			Clyde	
Age group	No.	Mean length (cm)	Mean fecundity (thousands)	No.	Mean length (cm)	Mean fecundity (thousands)	No.	Mean length (cm)	Mean fecundity (thousands)
II	4	24·4	23	1	31·1	47	—	—	—
III	19	28·4	32	3	32·1	66	3	34·4	84
IV	43	30·5	43	6	34·1	72	16	34·6	108
V	15	32·2	52	3	37·2	78	21	36·5	136
VI	11	35·5	61	2	37·0	87	6	39·9	176
VII	24	37·6	78	1	42·2	96	5	41·6	182
VIII	31	40·2	106	5	42·9	162	2	43·6	209
IX	23	42·9	127	4	45·3	189	1	49·5	434
X	13	43·7	123	3	50·6	194	1	40·0	118
XI	16	42·6	112	3	45·0	129	—	—	—
XII	7	42·6	127	1	51·8	284	—	—	—
XIII	6	46·4	163	—	—	—	—	—	—
XIV	3	47·0	174	1	45·0	144	—	—	—
XV	4	47·7	172	—	—	—	—	—	—
XVI	2	50·3	142	—	—	—	—	—	—

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TABLE 5. THE LENGTH, WEIGHT, AGE AND EGG COUNTS OF FEMALE CLYDE PLAICE

Fish no.	Total length (cm)	Weight (g)	Age group	Egg count 1	2	3	4	Fecundity estimate
				22 and 27 February 1956				
1	33·8	443	IV	396	400	382	402	79,000
2	34·4	412	IV	844	801	839	809	164,650
3	40·5	596	Illegible	523	573	639	606	117,050
4	38·2	603	IV	933	948	1028	849	187,900
5	33·4	389	IV	414	327	421	374	76,800
6	42·0	796	Illegible	1039	877	1067	1021	200,200
7	35·8	498	IV	532	481	517	552	104,100
8	39·2	607	VI	814	684	692	672	143,100
9	42·5	845	V	1063	959	1060	1004	204,300
10	46·3	853	VII	1010	1053	1019	1011	204,650
11	48·3	1056	Illegible	1601	1479	1490	1479	302,450
12	49·5	1328	IX	2236	2017	2230	2204	434,350
13	56·6	1743	Illegible	2460	2388	2581	2826	512,750
14	32·1	344	IV	544	443	447	503	96,850
15	38·1	503	V	492	464	540	644	107,000
16	35·4	465	IV	791	609	695	689	139,200
17	31·7	321	IV	486	363	316	378	77,150
18	45·1	792	Illegible	828	921	917	918	179,200
19	37·9	529	IV	671	652	527	622	123,600
20	38·1	535	V	634	696	543	594	123,350
21	46·5	930	Illegible	988	1083	1056	858	199,250
22	39·3	575	VI	871	793	841	707	160,600
23	44·2	812	VII	1060	1105	1189	1150	225,200
24	44·9	772	VIII	975	847	819	843	174,200
25	37·1	491	IV	689	531	595	499	115,700
26	30·5	243	V	283	260	328	206	53,850
27	33·8	365	IV	527	508	486	511	101,600
28	46·7	870	Illegible	1249	1144	1137	1423	247,650
29	42·2	786	VIII	1192	1366	1179	1147	244,200
30	32·8	314	X	378	292	370	375	70,750
31	35·6	431	V	670	622	731	634	132,850
				7 January 1957				
1	38·9	545	V	866	841	894	858	172,950
2	34·8	445	V	633	739	682	678	136,600
3	39·9	743	V	1205	1041	1041	1039	216,300
4	34·7	418	V	368	404	378	427	78,850
5	36·5	416	V	512	401	386	379	83,900
6	36·5	518	V	705	744	733	837	150,950
7	37·0	490	III	300	354	277	402	66,650
8	36·2	470	VII	336	369	355	381	72,050
9	33·3	367	III	364	347	402	395	75,400
10	34·2	395	V	550	587	517	482	106,800
11	36·4	480	V	689	628	664	514	124,750
12	38·6	598	V	872	850	789	932	172,150
13	36·4	478	V	704	763	652	644	138,150
14	37·1	594	V	917	968	943	971	189,950
15	33·0	339	III	565	564	514	571	110,700
16	37·8	585	VI	1094	1184	1232	1189	234,950
17	32·7	337	IV	338	340	249	246	58,650
18	32·9	339	IV	360	404	320	333	70,850
19	35·0	447	IV	664	732	658	737	139,550
20	40·0	615	X	633	587	543	587	117,500
21	38·4	544	VI	526	547	618	684	118,750
22	38·7	567	IV	702	583	504	516	115,250
23	38·4	625	VII	681	825	793	755	152,700
24	39·8	684	V	984	974	939	809	185,300
25	34·5	470	V	414	430	429	512	89,250
26	33·8	404	IV	427	427	391	458	85,150
27	33·6	394	V	579	561	562	670	118,600
28	43·0	774	VII	1246	1214	1301	1386	257,350
29	37·7	557	V	871	1146	933	934	194,200
30	43·8	786	VI	1025	943	1090	900	197,900
31	40·7	652	VI	959	1097	1058	943	202,850