

Marine  
Laboratory  
Aberdeen

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## SCOTTISH FISH FARMS

Annual Production Survey, 1993



THE SCOTTISH OFFICE

Agriculture and Fisheries Department

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## **FOREWORD**

Responses from Scottish rainbow trout and Atlantic salmon farming companies to a SOAFD questionnaire covering the period January-December 1993 are summarised in this report.

The format of the Report this year has been altered to include additional information from previous years to facilitate comparison and identify trends between years. Unlike all previous years when companies were asked to record production from January to November and estimate December production, this year's survey records actual production, January-December. Copies of the questionnaires are included in Appendix I(a-c).

The cooperation of the fish farming industry in completing the questionnaire is gratefully acknowledged.

## SUMMARY

### Rainbow Trout

Some 52 companies using 74 sites produced 4,023 metric tonnes in 1993 much the same tonnage as in 1992. More bigger fish were produced in the categories 1-2 lbs and greater than 2 lbs, most are produced with pink flesh and 8%, mostly in the larger categories, were used for restocking. Some 94% of the 1993 eggs were laid down as all female or triploid fish. The industry relied heavily on foreign supplies of ova (89%). Numbers of staff employed at 134 full time and 73 part time were similar to 1992.

### Atlantic Salmon

Some 132 companies operating 283 sites harvested 48,691 metric tonnes in 1993 the greatest production yet achieved by the Scottish salmon farming industry and up from 36,101 tonnes in 1992. The increase was due to greater harvest numbers (54% compared to 44%) and weight at harvest (up 22%) of the 1992 smolt year class whereas the harvest component from the 1991 smolt year class was similar in number and weight to the previous year. All regions showed increases in production but Western Isles (74%), Highland (45%) and Strathclyde (34%) were the greatest. The increased production is attributed to greater disease control, especially of furunculosis. There was a loss of 3,549 tonnes of salmon slaughtered due to the MV *Braer* oil spill. Farmers estimated that their combined production would be 58,000 tonnes in 1994. Numbers of smolts put to sea in 1993 were 20.5 million similar to the previous three years. There was increasing interest in S½ and S1½ smolts. The industry resumed importing ova from foreign sources now allowed under EC regulations. The industry employed less full time and part time staff in salmon production whereas in smolt production there was also a downward trend in full time staff but increases in part time staff. Production per man was 40 tonnes with considerable variation shown between companies.

## **I. RAINBOW TROUT (*Oncorhynchus mykiss*)**

The survey of rainbow trout production in Scotland in 1993 was sent to all 57 companies currently registered as being actively engaged in the industry. A return was received from all the companies and information supplied for 80 rainbow trout sites. When compiling the 1993 data the opportunity was taken to revise the 1992 survey data. Where reference is made in this report to 1992 data they relate to the revised data and not those published in the 1992 report.

An analysis of the 1993 survey is given in Tables 1-7 and the accompanying paragraphs. Trends in production and employment over 1985-93 are illustrated in Figures 1 and 2. Company and site data, staffing levels and production by method of culture are listed in Tables 1a-c. The numbers and sources of ova laid down are recorded in Table 2a-b whilst the numbers of fry and fingerlings bought and sold are given in Table 3. The number of sites using vaccines is recorded in Table 4. Annual production, including that for the table trade and for restocking, are given in Tables 5a-c. Production by region is given in Table 6 and production grouped by method of culture in Table 7.

TABLE 1a  
Numbers of companies and sites in 1993 and 1992

Year	Number of companies			Number of sites		
	Producing	Non-producing	Total	Producing	Non-producing	Total
1992	53	4	57	72	4	76
1993	52	5	57	74	6	80

The number of producing companies decreased by one in 1993. An additional four sites were reported on, two of which were in production and one being new to the industry.

TABLE 1b  
Number of staff employed in 1993 and 1992

Year	Full time	Part time	Total
1992	135	73	208
1993	134	73	207

The number of staff employed was 207, one less than in the previous year.

TABLE 1c  
Numbers of production systems in 1993 and 1992

Year	1992	1993
Hatcheries	14	13
Pond and raceways	20	21
Tanks	20	24
Fresh water cages	14	12
Sea water cages	4	4
Total	72	74

The number of producing hatchery and fresh water cage sites decreased by one and two respectively whilst the numbers of producing pond plus raceway and tank sites increased by one and four respectively. The number of sea water cage sites remained constant.

TABLE 2a  
Ova sources and numbers (000s) in 1993 and 1992

Year	UK broodstock			Foreign			Combined total
	Own stock	Other UK stock	Total UK	Northern hemisphere	Southern hemisphere	Total foreign	
1992	3,078	7,044	10,122	5,830	5,456	11,286	21,408
1993	1,830	405	2,235	12,815	4,694	17,509	19,744

In 1993 the total number of ova laid down for hatching decreased by 1.7 million (8%) compared with 1992. There was a significant change in the source of ova in 1993, from broad parity between Great Britain and foreign sources in 1992 (10.1 to 11.3 million respectively) towards foreign imports (2.2 to 17.5 million). Foreign imports originated principally from northern hemisphere sources, namely Northern Ireland, Isle of Man and an area within Denmark, all of which have Approved Health Zone Status for IHN and VHS under EC Directive 91/67. A smaller quantity of ova originated from the southern hemisphere (South Africa). The substitution by foreign ova indicates severe problems for GB producers of ova and may reflect disease risks associated with keeping broodfish rather than ova quality problems.

TABLE 2b  
Numbers (000s) and proportions (%) of ova types laid down in 1993 and 1992

Year	Total	All female diploid		Triploid		Mixed sex diploid	
		Nos	(%)	Nos	(%)	Nos	(%)
1992	21,408	18,099	(85%)	796	(4%)	2,513	(12%)
1993	19,744	17,261	(87%)	1,396	(7%)	1,087	(6%)

As in previous years most of the ova laid down were all female diploids (87%). Compared with 1992 the numbers of all female ova and mixed sex diploids laid down in 1993 were fewer whereas the number of triploid ova laid down was increased. Although triploids comprised only 7% of the total number of ova laid down in 1993 (4% in 1992) they indicate a trend in that suppression of maturity is important to farmers.

TABLE 3  
Fry and fingerlings - numbers (000s) bought and  
sold in 1993 and 1992

Year	Fry and fingerlings brought						Sold	
	All female diploids		Triploid		Mixed sex diploids		Total number	Total number
	Nos	(%)	Nos	(%)	Nos	(%)		
1992	8,993	(84%)	617	(6%)	1,101	(9%)	10,711	10,447
1993	8,395	(73%)	917	(8%)	2,239	(19%)	11,551	9,823

Compared with 1992 the number of fry and fingerlings bought increased by 0.8 million (8%) whilst the number sold decreased by 0.6 million (6%). As in previous years all female diploids were dominant but to a lesser degree in 1993 (73%) than in 1992 (84%). Conversely there was a small increase in the proportion of triploids bought and the number of mixed sex diploids bought increased x2.

TABLE 4  
Numbers of sites using vaccines over 1985 to 1993

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
No of sites	-	16	20	21	21	27	30	33	28

The number of sites using vaccines dropped by five to 28 in 1993. To improve the quality of these data the actual number of fish vaccinated was recorded in 1993 - the number was 16.9 million. This figure suggests a much higher proportion of fish are vaccinated than the proportion of sites recorded as using vaccine (38%). Although no information on the nature of the vaccine was asked in the questionnaire it is understood from industry sources that the enteric redmouth (ERM) vaccine accounted for most vaccinates.

TABLE 5a  
Total rainbow trout production (tonnes) over 1985 to 1993 and %  
change relative to the 1985 production level

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Tonnes	2,256	2,316	3,207	3,556	3,512	3,183	3,334	3,953	4,023
% change	-	+3	+42	+58	+56	+41	+48	+75	+78

Using 1985 as a base line the quantity of rainbow trout produced annually increased steadily over the period 1985-88 before dropping slightly over 1989-90. Since 1991 the quantity produced has again increased and in 1993 was the greatest ever recorded in Scotland. A breakdown of the quantities produced for the table trade and for restocking is given in Tables 5b-c below.

TABLE 5b  
Production for the table trade (tonnes) in 1993 and 1992

Year	<1 lb	1-2 lbs	>2 lbs	Total
1992	2,666	144	646	3,455
1993	2,481	272	764	3,517

Production for the table trade increased overall by 2% in 1993 compared with 1992. There was a reduction of 7% in the quantity of small fish (>1 lb) sold but increases of 89% for fish weighing 1-2 lbs and of 18% for fish >2 lbs. It is understood that a large proportion of the bigger fish were sold for smoking.

TABLE 5c  
Production for the restocking trade (tonnes) in 1993 and 1992

Year	<1 lb	1-2 lbs	>2 lbs	Total
1992	187	256	55	498
1993	124	346	36	506

Production for restocking in 1993 increased by 1%. Overall restocking accounted for 13% of the total trout production in 1993, this is similar to that of 1992.



TABLE 6  
Rainbow trout production by region in 1993

Region	Staff		Eyed eggs (000s)			Ova (000s) triploid and all female	Total production (tonnes)		Fry and fingerlings vaccinated (000s)
	F/T	P/T	Own	GB	Foreign		Table	Re-stocking	
Borders	8	5	320	30	330	630	338	8	659
Central	21	13	-	-	-	-	624	73	2,365
Dumfries & Galloway	25	10	472	-	6,260	6,220	849	124	1,477
Fife	-	3	-	-	-	-	3	11	-
Grampian	3	10	30	-	25	25	18	22	61
Highland	10	5	-	-	400	400	268	34	841
Lothian	9	3	100	-	60	60	11	45	28
Strathclyde	43	15	898	375	1,940	2,878	1,024	124	3,392
Tayside	14	9	10	-	8,444	8,440	381	65	8,060
Western Isles	1	-	-	-	50	-	-	-	-
All Scotland	134	73	1,830	405	17,509	18,657	3,516	506	16,883

In 1993 the greatest trout producing region was Strathclyde closely followed by Dumfries and Galloway. Lesser quantities were produced in Central, Tayside and Borders Regions. Manpower employed, eggs bought and fingerling production reflect the levels of production in the regions.

TABLE 7  
Analysis of rainbow trout farms by method and scale of production in 1993

Method	Production grouping (tonnes)							Totals		
	0*	<10	10-25	26-50	51-100	101-200	>200	Tonnes	Number of sites*	% contribution
FW cages	2	3	3	0	1	1	4	1,489	14	37
FW ponds & raceways	0	3	4	3	4	6	1	1,506	21	37
FW tanks	21	7	8	2	1	2	0	602	41	15
SW cages	0	0	0	1	1	2	0	425	4	11
All methods	23	13	15	6	7	11	5	4,022	80	100

\* Includes sites not in production plus hatcheries and on-growing sites.

The numbers of sites per production grouping (tonnes) and the percent contribution by production method is broadly similar to those of 1992.

## II. ATLANTIC SALMON (*Salmo salar*)

### 1. Ova and Smolts

The survey of Atlantic salmon smolt production in 1993 was sent to all 86 companies currently believed to be engaged in the industry. A return was received from all the companies and information supplied for 176 sites.

An analysis of the 1993 survey is given in Tables 8-14 and the accompanying paragraphs. Trends in employment and production over 1985-93 are illustrated in Figures 1 and 3. Company and site data are listed in Table 8a whilst the number of staff employed, total smolt production and smolt production per man are recorded in Table 8b. Numbers of production systems are given in Table 10. The number of ova produced and the number and source of ova laid down for hatching are given in Tables 10a-b. The movements of fry and parr are listed in Table 11a and the number of sites using vaccines in Table 11b. Smolt production by age grouping and future estimates of smolt production are given in Tables 12a-b. Smolt sites grouped by scale of production over 1988-93 are listed in Table 13. Ova and smolt production by local government region are given in Table 14.

TABLE 8a  
Numbers of companies and sites in 1993 and 1992

Year	Number of companies			Number of sites		
	Producing	Non-producing	Total	Producing	Non-producing	Total
1992	74	11	85	137	31	168
1993	73	13	86	138	38	176

In 1993 the number of companies in production decreased by one whilst the number of sites in production increased by one. The greater number of companies and sites reported in 1993 reflects additional information supplied by industry. There was an increase in the number of companies recording no production, possibly an indication of poor trading prospects and of company buy-outs.

TABLE 8b  
Numbers of staff employed and smolts produced (000s)  
per man over 1985 to 1993

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Staff - full time	126	196	248	344	330	285	271	266	233
- part time	45	92	90	119	87	93	79	93	115
- total staff	171	288	338	463	417	378	350	359	348
Total number (000s) smolts produced	6,177	7,030	13,294	22,499	25,825	24,875	22,404	20,527	21,043
Mean number (000s) produced per man	24.2	24.4	39.3	48.6	61.9	65.8	64.0	57.2	60.5

The total number of staff employed in smolt production dropped by 11 (3%) in 1993 over 1992, continuing the downward trend in overall staffing since 1988. There is a trend showing less full time staff and more part time staff in employment, which is not apparent from the sum of them both.

The mean production per man in 1993 was 60,500, an increase of 3,300 compared with 1992 but 5,300 less than the peak level of 65,800 recorded in 1990.

TABLE 9  
Method of smolt production in 1993

Method	No of sites		Total capacity (cubic metres)		Smolt production (000s)	
	1992	1993	1992	1993	1992	1993
Year						
Hatcheries/tanks/ponds	83	83	46,502	41,546	9,286	10,181
Cages	54	55	218,297	213,524	11,542	10,862
Total	137	138	264,799	255,070	20,828	21,043

The number of sites classed by method of production was similar in 1993 and 1992. Hatchery, tank and pond capacity decreased by 11% and cage capacity by 2%. Total smolt production in 1993 increased by 1% compared with 1992.

TABLE 10a  
Total egg production (000s) in 1993 and 1992

Year	1991-92	1992-93
No of eggs	137,432	93,517

The number of eggs produced in the 1992-93 season decreased by approximately one third (32%). The numbers given above include eggs sold for export.

TABLE 10b  
Egg sources and numbers (000s) laid down for hatching in 1993 and 1992

Year	Own stock	Other GB farm stock	UK wild	Foreign	Total	Estimate 1993-94
1991-92	32,824	23,722	310	-	56,857	54,415
1992-93	44,524	19,281	514	4,381	68,699	49,064

The total number of eggs laid down in 1992-93 season increased by 21% over 1991-92. The numbers of eggs originating from companies' own stock increased by 36% whilst eggs from other GB stocks decreased by 19%. There was a slight increase in the numbers of eggs derived from wild fish stocks but was still less than 1% of the total number. Following changes in legislation in 1993 a number of foreign egg imports were made. Most foreign eggs originated from Eire and Northern Ireland, both EC Approved Health Zones, but a number also came from Tasmania.

TABLE 11a  
 Movement of fry and parr (000s) in 1993 and 1992

Year	In	Out
1992	32,018	29,444
1993	33,330	30,778

The numbers of fry and parr moved into/out of sites was slightly greater in 1993 than in 1992 and probably is more indicative of movements from hatchery and tank sites to fresh water cages than commercial trade in this group.

TABLE 11b  
 Use of vaccine (number of sites) over 1985 to 1993

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
No of sites	-	3	8	29	65	59	61	71	73

There was an increase of two in the number of sites using vaccines in 1993 compared with 1992, continuing the upward trend recorded over the last seven years. Indications from industry are that vaccination against furunculosis is likely to become an increasingly common practice.

TABLE 12a  
Smolt production (000s) by age grouping in 1993 and 1992

Year	Produced as					Sold as				Total
	S½	S1	S1½	S2	Total	S½	S1	S1½	S2	
1992	-	20,121	-	707	20,828	-	9,751	-	173	9,925
1993	686	19,698	202	457	21,043	280	9,391	188	374	10,233

A record of the numbers of smolt produced as S½, S1, S1½ and S2 was compiled in 1993 to reflect current trends in production of smolts by age grouping.

TABLE 12b  
Ova and smolt production records and estimates over 1985 to 1993

	1985	1986	1987	1988	1989	1990	1991	1992	1993
<b>Hatching ova ('000s)</b>									
Actual	16,151	38,652	60,107	80,386	75,327	64,559	50,720	56,857	68,699
Producers estimate for following year	None	58,573	67,475	85,077	90,839	50,406	60,442	54,415	49,064
<b>Smolts ('000s)</b>									
Salmon growers data	5,585	6,595	12,858	20,921	23,839	21,408	20,277	20,527	20,541
Smolt producers current data	6,177	7,030	13,294	22,499	25,825	24,874	22,404	20,828	21,043
Smolt producers estimate for following year	None	15,119	23,094	28,740	26,242	24,058	21,503	21,756	22,130
Smolt producer estimate for two years ahead	None	21,697	28,213	33,621	28,011	26,363	22,290	24,422	24,064

The numbers of smolts produced in 1993, 21.043 million, was 0.21 million more than that produced in 1992 and 0.71 million less than the producers' 1992 estimate. Producers' forward estimates, which tend to optimism, are broadly similar to previous years and suggest that smolt production is likely to be fairly constant in the next two years.

TABLE 13  
Grouping of smolt producing sites by the scale of production  
(000s) over 1988 to 1993

Year	1-10	10-25	26-50	51-100	101-250	251-500	501-1,000	>1,000	Nos of sites in production	Annual no (000s) smolts produced
1988	6	18	23	28	30	13	12	1	131	22,499
1989	7	18	20	16	37	20	10	3	131	25,825
1990	3	15	19	20	29	19	9	4	118	24,874
1991	2	11	17	22	26	26	5	2	111	22,404
1992	3	8	14	17	41	23	4	0	110	20,828
1993	1	9	15	17	32	21	9	0	104	21,043

This table refers only to sites producing smolts; sites holding only ova, fry and/or parr are excluded. The peak period of smolt production in Scotland was 1989 when 25.8 million smolts were produced from 131 sites. Since 1989 the number of sites producing smolts has decreased annually. The current results show a trend to concentrate production around 100,000 to one million smolts per site.

TABLE 14  
Atlantic salmon - ova and smolt production by region in 1993

Region	Staff		Number (000s) and source of eyed ova laid down for hatching in 1993					1993 smolts (000s)				1994 smolt estimate (000s)		1995 smolt estimate (000s)
	F/T	P/T	Own farmed	Farmed GB	Wild GB	Foreign	Total	Produced as		Sold as		S1'	S2	
								S1'	S2	S1	S2			
Combined*	16	9	-	2,362	360	-	2,992	1,155	194	1,026	186	866	120	1,290
Highland	107	50	36,777	9,394	150	1,331	47,652	10,185	90	4,391	90	11,518	177	12,089
Orkney	4	11	300	330	4	-	634	484	13	339	-	405	30	495
Shetland	10	13	100	2,865	-	50	3,015	1,284	15	1,009	-	1,260	-	1,515
Strathclyde	52	22	4,447	2,010	-	1,900	8,357	4,640	-	2,676	-	5,380	25	5,214
Western Isles	44	10	2,900	2,050	-	1,100	6,050	2,837	146	417	98	2,342	6	3,461
All Scotland	233	115	44,524	19,281	514	4,381	68,700	20,585	457	9,859	374	21,771	358	24,064
England	-	-	-	-	-	-	-	-	-	1,100	-	-	-	-

# includes S½ and S1½

\* combined regions consist of Central, Dumfries and Galloway and Tayside

Highland Region, followed by Strathclyde and the Western Isles continue to be the principal smolt producing regions in Scotland. 1993 is significant in that there was a total lack of production of female triploid ova, indicating that the salmon farmers currently have no requirement for this stock type.

## II. ATLANTIC SALMON (*Salmo salar*)

### 2. Production Fish

The survey of Atlantic salmon production in 1993 was sent to all 144 companies currently believed as being actively engaged in the industry. A return was received from all the companies and information supplied for 369 sites.

An analysis of the 1993 survey is given in Tables 15-25 and the accompanying paragraphs. Trends in employment and production 1985-93 are illustrated in Figures 1 and 4. Company, site and employment data are listed in Tables 15a-b, production by method of culture in Table 16a and the number of sites holding broodstock in Table 16b. The number of smolts put to sea is given in Table 17 and grilse, pre-salmon and salmon production data in Tables 18a-d. Loss of fish due to oil spillage in 1993 at Shetland is given in Table 19. Trends in production and proportions of year classes recovered (harvested) are listed in Table 20. Production and recovery data by local government region are given in Tables 21 and 22. Sea sites are grouped by scale of production and by the length of fallowing period in Tables 23a-b and the number of sites operated by companies is given in Table 24. The levels of productivity by company, grouped by scale of production, and by manpower are given in Table 25.



TABLE 15a  
 Salmon and grilse production data 1993 and 1992

Year	Number of companies			Number of sites		
	Producing	Non-producing	Total	Producing	Non-producing	Total
1992	140	6	146	279	68	347
1993	132	12	144	283	86	369

Questionnaires were sent to all 144 companies believed to be actively trading, the number being two less than in 1992. A total of 12 companies reported no production in 1993 - an increase of six over 1992. The number of sites for which information was supplied was 369 (22 more than in 1992). A total of 86 sites were reported as being "not in production" (68 in 1992) whilst the number "in production" was 283 (279 in 1992). These data include information from companies which had entered into contract growing arrangements, either in full or in part, and from companies with other types of leasing arrangements for sites.

TABLE 15b  
 Numbers of staff employed over 1985-93

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Staff - full time	408	527	608	991	1,102	1,165	1,014	985	976
- part time	148	206	198	329	316	326	272	275	248
Total staff	550	773	806	1,320	1,418	1,491	1,286	1,260	1,224

In 1993 staffing levels decreased by 36 (3%) compared with 1992. Since 1990 the total number of staff employed has dropped by 267 (18%) - full-time staff dropping from 1,165 to 979 (16%) and part-time staff from 326 to 248 (24%).

TABLE 16a  
Method of production, production capacity and tonnes  
produced in 1993 and 1992

Method of production	Number of sites		Total capacity (cubic metres)		Production (tonnes)	
	1992	1993	1992	1993	1992	1993
Sea water tanks	8	7	55,540	45,900	741	668
Sea water cages	271	276	6,597,812	6,481,976	35,360	48,023
Total annual production (tonnes)					36,101	48,691

Sea water cages continue to be the main method of production. In 1993 the capacity (volume) of cages decreased by 2% relative to 1992 but production in cages increased by 12,590 tonnes (35%). The ratio of standing cage capacity to each tonne of fish produced in 1993 was 135 cubic meters compared with 187 cubic meters in 1992. Although an indirect measure of stocking density this evidence does not suggest the increased survival and harvest weights recorded in 1993 were due to policies related to reduced stocking density.

TABLE 16b  
Number of sites holding broodstock over 1985 to 1993

1985	1986	1987	1988	1989	1990	1991	1992	1993
-	38	35	31	44	35	27	15	21

The number of sites holding broodstock increased by six over 1992 but was still less than half the total number of broodstock sites reported in 1989. Egg production in 1993 was 93.5 million (Table 10a) compared with 137.4 million in 1992. It is unlikely that the number of broodstock sites available and their potential for egg production are limiting factors as regards any further expansion of the industry.

TABLE 17  
Numbers(000s) of smolts put to sea in 1993 and 1992

Year	S1	S2	Total
1992	19,418	1,109	20,527
1993	19,843	698	20,541

The numbers of smolts put to sea in 1993 was similar to that in 1992 but the proportion of S1s to S2s tended to be greater. The number of smolts bought from England, included in the above, was 1.1 million in 1993 compared with 0.9 million in 1992.

TABLE 18  
Production (tonnes) from:

a) 1993 smolt input harvested in 1993

Year	Number (000s)	Tonnes	Mean weight (kg)
1993	46,500	78	1.7

b) 1992 smolt input harvested in 1993

Year	Jan-Aug			Sep-Dec			Jan-Dec		
	Number (000s)	Tonnes	Mean weight (kg)	Number (000s)	Tonnes	Mean weight (kg)	Number (000s)	Tonnes	Mean weight (kg)
1993	4,969	12,739	2.56	6,133	19,999	3.26	11,102	32,738	2.95

c) 1991 smolt input harvested in 1993

Year	Jan-Dec		
	Number (000s)	Tonnes	Mean weight (kg)
1993	4,675	15,875	3.40

d) Total harvest in 1993

48,691 tonnes
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The total weight of salmon (all ages) harvested in 1993 was the highest ever recorded in Scotland, see Figure 3, reversing the downward trend recorded in 1992. It was reported in 1993 for the first time that fish of the year of input (zero sea winter) were harvested. The numbers of fish harvested in January-August increased by 56% and in September-December by 9%. The mean weight of the fish harvested also increased - from 2.11 kg to 2.56 kg in January-August and from 2.41 kg to 3.25 kg in September-December, giving an overall mean weight of 2.94 kg. These figures show a significant increase in mean weight in both groups from the 1992 smolt input and taken with the information in table 20 on survival explain the origin of the large increase in production in 1993.

The number and mean weight of older fish harvested in 1993 (1991 smolt input) was similar to those harvested in 1992 from the 1990 smolt input.

The greater weight of grilse and pre-salmon shown in the 1993 figures are considered to be a measure of the reduced stress on fish as a result of greatly improved control of furunculosis. Management schemes to avoid infection eg fallowing, group agreements on common stocks (year class) of smolts, the use of smolts free of infection and for vaccinated smolts are seen as the principal factors here.

TABLE 19  
Weight (tonnes) and numbers of salmon slaughtered at Shetland  
due to the MV *Braer* oil spill in 1993

Year class	1991	1992	Total
Tonnes	1,740	1,809	3,549
Number	398,500	565,182	963,682

There was a serious loss of salmon at Shetland due to oil spillage in 1993. On 6 January the MV *Braer* went aground at the southwestern tip of Shetland. A total of 86,000 tonnes of oil was released into the marine environment. The area affected by this oil spillage was restricted to southwest Shetland but included 20 salmon sea sites. Arrangements were made for stocks on these sites to be slaughtered and disposed of (as feed for mink). It was not possible to remove all fish from the affected area during 1993 and a portion was held over into 1994. In 1993 a total of 3,549 tonnes (963,682 fish) was slaughtered, a breakdown by year class is given in Table 19 above. These fish are included in the production totals given in this report for Scotland and above the Shetland Region.

TABLE 20  
Atlantic salmon production record by smolt year class over 1984 to 1993

Year of smolt input	No of smolts input (000s)	Year of harvest	No of grilse & pre-salmon (000s)	Weight (tonnes)	Mean fish weight (kg)	% of fish recovered as grilse and pre-salmon	Year of harvest	No of salmon (000s)	Weight (tonnes)	Mean fish weight (kg)	% of fish recovered as salmon	Total % of fish (all ages) recovered	Year class weight (tonnes)
1984	3,628	1985	1,970	4,262	2.163	54.3	1986	1,168	4,350	3.723	32.2	86.5	8,612
1985	5,586	1986	2,409	5,988	2.486	43.1	1987	1,522	5,521	3.627	27.3	70.4	11,508
1986	6,595	1987	3,285	7,200	2.143	49.8	1988	1,750	6,086	3.480	26.5	76.3	13,286
1987	12,858	1988	5,167	11,866	2.300	40.2	1989	3,267	10,312	3.156	25.3	65.5	22,178
1988	20,921	1989	7,890	18,240	2.312	37.7	1990	5,382	14,891	2.770	25.7	63.4	33,131
1989	23,829	1990	7,683	17,459	2.272	32.2	1991	6,123	19,567	3.196	25.7	57.9	37,026
1990	21,408	1991	8,877	21,026	2.368	41.5	1992	4,315	14,728	3.413	20.1	61.6	35,754
1991	20,227	1992	8,864	21,373	2.410	43.8	1993	4,675	15,875	3.396	23.1	66.9	37,248
1992	20,527	1993	11,102	32,816	2.945	54.1	-	-	-	-	-	-	-
1993	20,541	-	-	-	-	-	-	-	-	-	-	-	-

The overall performance of each smolt year class is compared in Table 20. The last complete year, 1991, shows an increased survival, 66.9%, a modest improvement over the previous two years, 61.6% and 57.9% respectively, when survivals were at their poorest. Recovery of 54.1% of the 1992 year class compared to 43.8 of the 1991 population raises an interesting question of how many fish are left for harvesting in 1994. Reports suggest that overall survival could be as high as 85% giving a 30% recovery in 1994 as salmon. Reports also suggest good survival in the 1993 year class, comparable to the 1992 year class, suggesting a production greater than in 1993 for 1994.

TABLE 21  
Production and manpower of sea sites by region in 1993 and 1992

Region	Staff		Annual production (tonnes)	Tonnes produced	Grilse			Pre-salmon			Salmon			
	F/T	P/T			Tonnes	Nos (000s)	Mean wt (kg)	Tonnes	Nos (000s)	Mean wt (kg)	Tonnes	Nos (000s)	Mean wt (kg)	
Highland	1992	372	63	13,980	32	3,352	1,538	2.17	5,791	2,217	2.61	4,837	1,447	3.34
	1993	372	52	20,279	48	7,177	2,336	2.53	7,303*	2,324*	3.24	5,800	1,730	3.35
Orkney	1992	35	21	1,046	19	163	67	2.43	412	169	2.43	471	167	2.81
	1993	38	16	1,245	23	212	91	2.33	428	145	2.95	605	208	2.91
Shetland	1992	213	96	10,679	34	851	332	2.56	4,636	1,680	2.75	5,192	1,335	3.89
	1993	191	116	11,659	38	1,246	488	2.55	6,013	1,854	3.24	4,400	1,135	3.88
Strathclyde	1992	206	46	6,458	26	1,154	569	2.02	2,108	786	2.68	3,196	986	3.24
	1993	199	32	8,675	38	2,107	745	2.83	3,366	922	3.65	3,202	981	3.26
Western Isles	1992	159	49	3,938	19	1,203	684	1.75	1,703	822	2.07	1,032	380	2.71
	1993	176	32	6,834	33	1,998	808	2.45	2,968	934	3.12	1,868	620	3.01
All Scotland	1992	985	275	36,101	29	6,723	3,190	2.11	14,650	5,675	2.58	14,728	4,315	3.41
	1993	976	248	48,691	40	12,740	4,969	2.56	20,077	6,179	3.24	15,875	4,675	3.40

\* includes 46,500 fish weighing 78 tonnes (mean weight 1.7 kg) of 1993 smolt intake harvested in 1993

Table 21 shows significant increases in production in all areas but especially in Western Isles (74%), Highland (45%) and Strathclyde (34%). The reasons for this can be seen in this table in the increased weights at harvest and the increased survivals shown in Table 22. Highland Region was the largest employer, had the greatest production per man and produced the greatest tonnage in each of the grilse, pre-salmon and salmon categories. Shetland, followed by Strathclyde, were second and third ranking with regard to the numbers of staff employed and the total tonnage produced. Shetland retained its position as producer of the heaviest grilse and salmon but was overtaken by Strathclyde as the producer of the heaviest pre-salmon. Mean production per man increased in all regions in 1993.

TABLE 22  
Recovery of 1991 and 1992 smolt year classes by region (000s)

Region	Smolts to sea		Recoveries								Total number recovered		Total production in 1993 (tonnes)	Estimated production in 1994 (tonnes)
	Year	Number	Grilse and pre-salmon				Salmon				Number	%		
			Year	Number	%	Year	Number	%						
Highland	1991	11,107*	1992	3,755	33.8	1993	1,730	15.6	1993	5,485	49.4	20,279	21,190	
	1992	7,650	1993	5,160	67.5									
Orkney	1991	746	1992	236	31.6	1993	208	27.9	1993	444	59.5	1,245	1,886	
	1992	681	1993	236	34.7									
Shetland	1991	4,643	1992	2,012	43.3	1993	1,135	24.4	1993	3,147	67.8	11,659	14,179	
	1992	5,014	1993	2,342	46.7									
Strathclyde	1991	4,597	1992	1,355	29.5	1993	981	21.3	1993	2,336	50.8	8,675	13,152	
	1992	3,989	1993	1,667	41.8									
Western Isles	1991	2,946	1992	1,506	55.1	1993	620	21.0	1993	2,126	72.2	6,834	7,870	
	1992	3,195	1993	1,742	54.5									

Recoveries by year class and age at harvest varied between regions. Variation at age of harvest is considered to be due to marketing demand and strategies employed by the producer companies. Overall recovery by region of the 1991 smolt year class showed considerable variation. Very marked improvements were shown in the 1992 year class in Highland and Strathclyde Regions for grilse and pre-salmon, which are believed to be due to the control of furunculosis. No large outbreaks of disease or excessive loss due to escapes were reported. The mean percentage recovery for grilse and pre-salmon in 1993 (from the 1992 smolt input) was 54%. This year's questionnaire asked farmers to estimate production in 1994. A gross figure of 58,000 tonnes was recorded confirming that survival is greatly improved and that mean weights will continue at current high level.

TABLE 23a  
Grouping of Atlantic Salmon sea farm sites by  
the scale of production in 1993

Production (tonnes)	0	<10	10-25	26-50	51-100	101-200	201-300	301-400	401-500	>500	Total sites	Total tonnes
No of sites in 1993	144	9	18	26	44	50	36	11	14	17	69	48,691
% share of production	0.0	0.1	0.7	2.0	6.8	14.4	18.0	7.4	12.9	37.7	-	-

The number of sites producing >500 tonnes in 1993 was 17. These sites accounted for 38% of the total tonnage produced compared with 16 sites producing >500 tonnes and accounting for 30% of the total tonnage in 1992. Sites producing <100 tonnes contributed approximately 9% of production (13% in 1992) whilst sites producing 100-500 tonnes accounted for 53% of production (56% in 1992).

TABLE 23b  
Number of sea water cage sites employing a fallow period in 1993

Fallowing period (weeks)	0	<4	4-8	8-26	26-51	=>52	Total
Sea water cage sites	135	7	47	74	13	86	362

A total of 86 sites were fallowed throughout 1993, recorded earlier as "not in production". Most of these sites were fallowed as part of a growing cycle but a small number were not worked due cash flow and other related problems. SOAFD continues to advise companies to incorporate a fallow period in their site growing cycle to break any cyclical disease that might be present. It is unclear from the survey data how many of the 135 sites not being fallowed held one or more year classes.



**TABLE 24**  
Grouping of companies by number of sea sites operated in 1993

Number of sites per company	1	2	3	4	=>5
Number of companies	54	40	26	15	9
Percentage	38	28	18	10	6

The above table includes the 12 companies and 86 sites not in production in 1993. A significant number of companies operated a single site.

**TABLE 25**  
Productivity (tonnes/man) by companies grouped by scale of production in 1993

Total tonnage	<1-50	51-100	101-200	201-300	301-400	401-500	501-700	701-950	951-2,000	<2,000	Total
No companies	39	18	26	20	6	6	5	4	4	4	132
No tonnes	793	1,342	3,670	4,967	2,098	2,585	3,017	3,321	4,996	21,902	48,691
Manpower (part time)	62	35	40	29	13	9	15	20	19	6	248
(full time)	56	49	121	103	56	43	76	67	87	318	976
Manpower (total)	118	84	161	132	69	52	91	87	106	324	1,224
Productivity (tonnes/man)	7	16	23	38	30	50	33	38	47	68	40
Range in production (tonnes/man)	<1-32	7-85	10-66	16-128	20-66	24-84	25-44	26-74	24-80	40-169	<1-169

Productivity (tonnes/man) was compared between companies grouped by scale of production. The mean productivity per man compared by company production indicates that larger producers are more efficient but the ranges in productivity show some small producers can equal the productivity per man of the larger producers. These data suggest that there is considerable scope for certain companies to increase their manpower productivity.

## CONCLUSIONS

### Rainbow Trout

The significant increase in trout production recorded in 1992 was sustained in 1993 with a further modest increase. More bigger trout are being produced and a significant proportion of production is for the restocking trade.

The numbers of imported ova showed a very significant increase at the cost of home grown ova. Although the survey does not explain the change it is believed to be due to fears that mature ova are often from farms with unprotected water supplies and thus open to disease risks. The industry continued to show preference for all female and triploid fish.

### Atlantic Salmon

#### Smolts and ova

Production of smolts has been reasonably consistent for the last few years with apparently up to 10% oversupply when growers and smolt producers' data are compared. S $\frac{1}{2}$  and S1 $\frac{1}{2}$  production is increasing and numbers are reported for the first time. Although not reported here it is apparent that smolt size has been increasing with many fish in the range 60-80 g, which clearly helps growers to produce bigger fish and/or more and earlier marketing options. There is a trend in the manpower figures towards less full time and more part time staff. The numbers of home produced ova are adequate for all needs nevertheless some growers took advantage of relaxed regulations to import ova from foreign sources.

#### Production fish

Production in 1993 at 48,691 tonnes was the greatest yet recorded although 3,549 tonnes had to be destroyed due to the MV *Braer* oil spill incident. This tonnage was achieved with much the same cage capacity and smolt input as in previous years. The remarkable increase in tonnage was due solely to the grilse and pre-salmon harvest of the 1992 smolt input, the salmon component of the 1991 smolt input being similar to that of 1992. The returns show that 54% of the 1992 smolt input has been harvested and the mean weight of the fish is up 22%. Industry comment has indicated that a dramatic control of furunculosis has increased survival and reduced stress and inappetence allowing fish to grow faster. What proportion of the 1992 year class remains to be harvested and at what size will be of considerable interest for

the 1994 Report. As the 1993 year class appears to be growing and surviving as well as the 1992 year class the indications are for a bigger tonnage in 1994.

It is noticeable that the increased tonnage and numbers harvested on a regional basis are not uniform but centred on Highland, Western Isles and Strathclyde. These regions appear now to be reaching the levels attained in Shetland which is maintaining its previous high standard. However, there is scope in all regions to strive to attain even greater survival. In individual cage populations survivals greater than 90% are often recorded and this should be the standard for all sites within the industry. Because disease control is clearly so important the number of sites apparently not following following principles is clearly of concern.

Manpower productivity is shown in the survey to be highly variable between companies. The highest productivities are only achieved with a significant degree of costly mechanisation but nevertheless the great range of values suggests the operation of some companies could be improved in this area.

A L S Munro  
J A Gauld

April 1994

Figure 1

Numbers of staff employed in Fish Farming 1985 -93

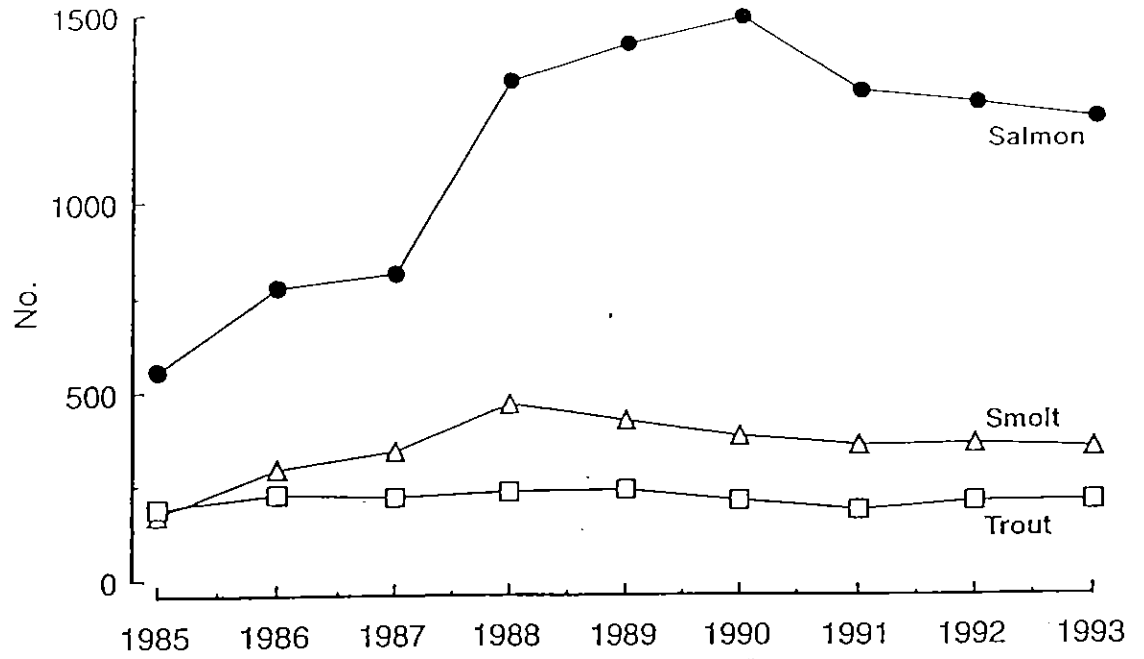


Figure 2

Rainbow Trout Production

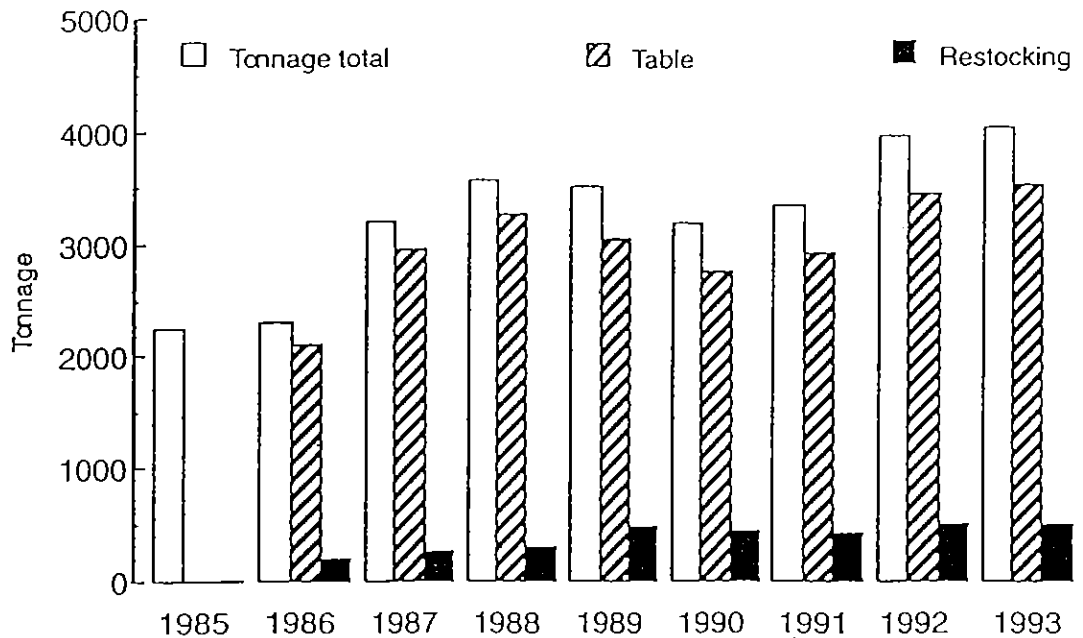


Figure 3

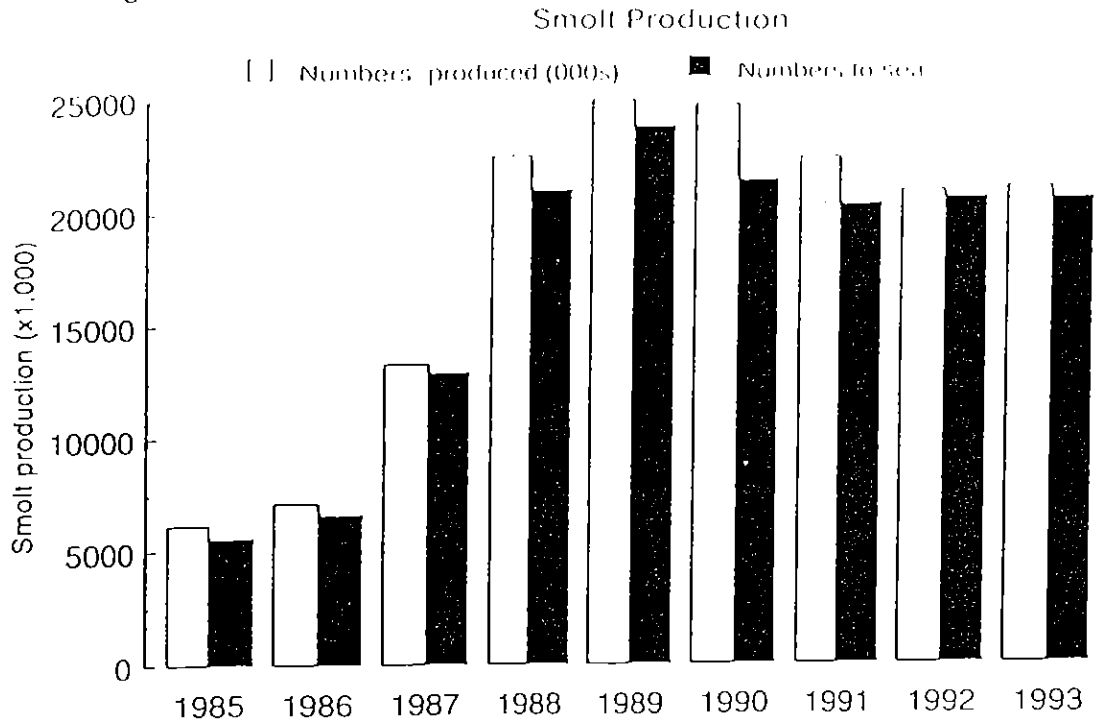
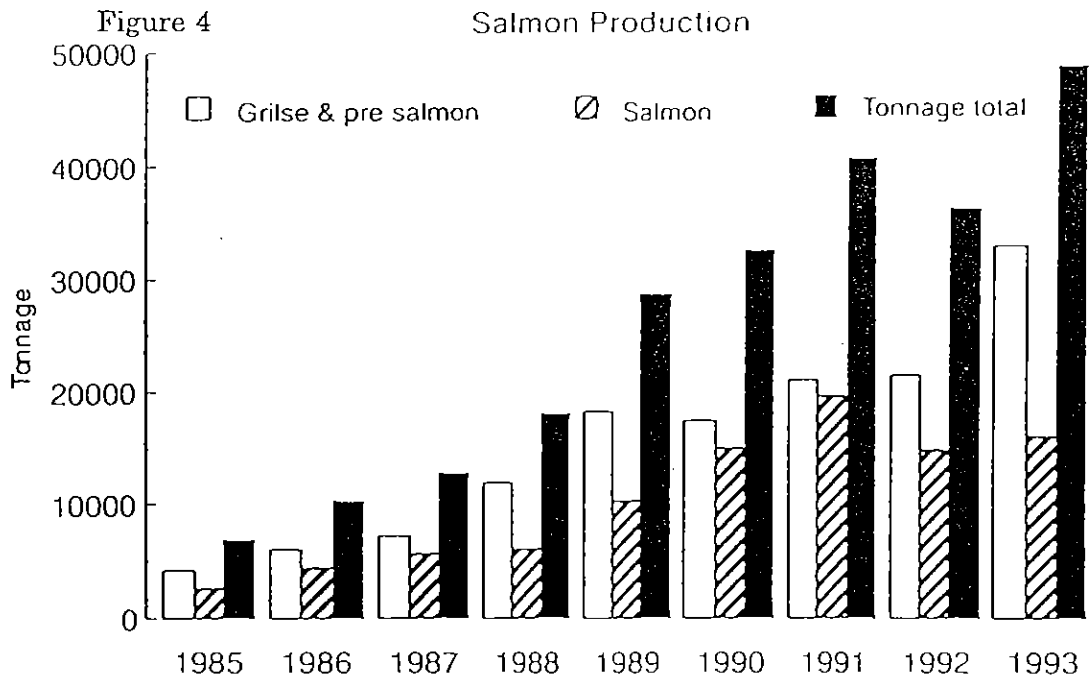
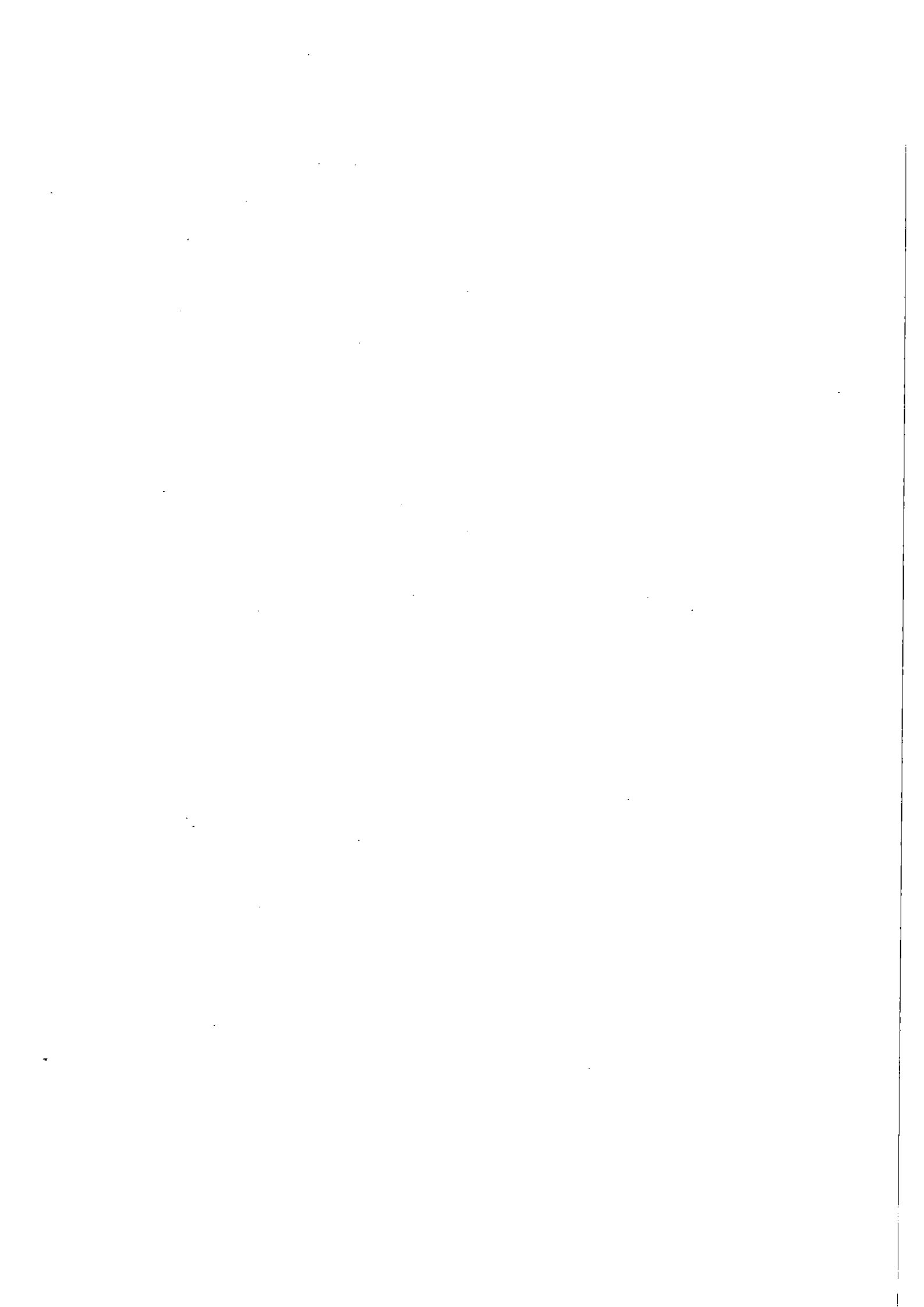
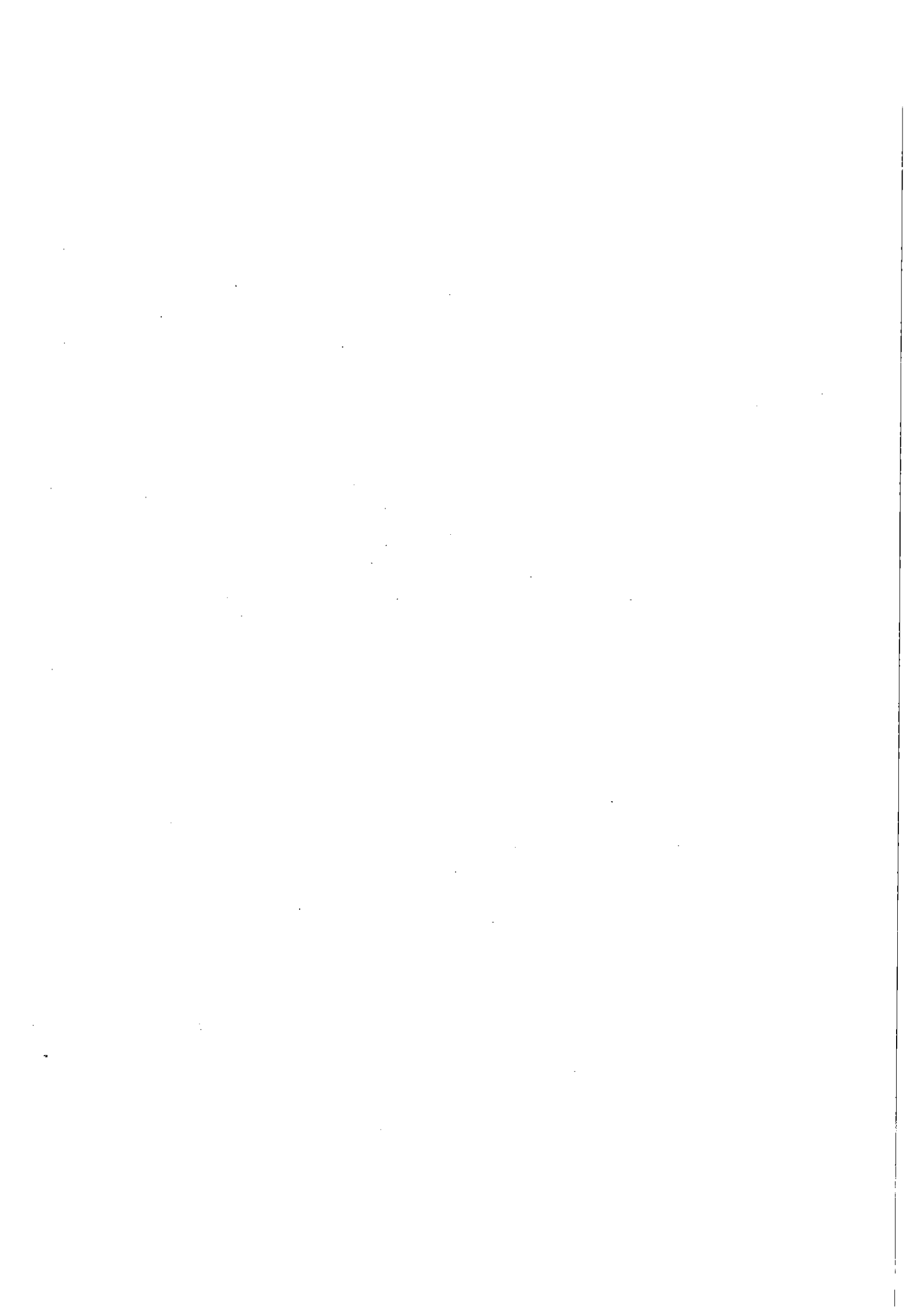


Figure 4











**ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS  
ATLANTIC SALMON - SMOLT DATA**

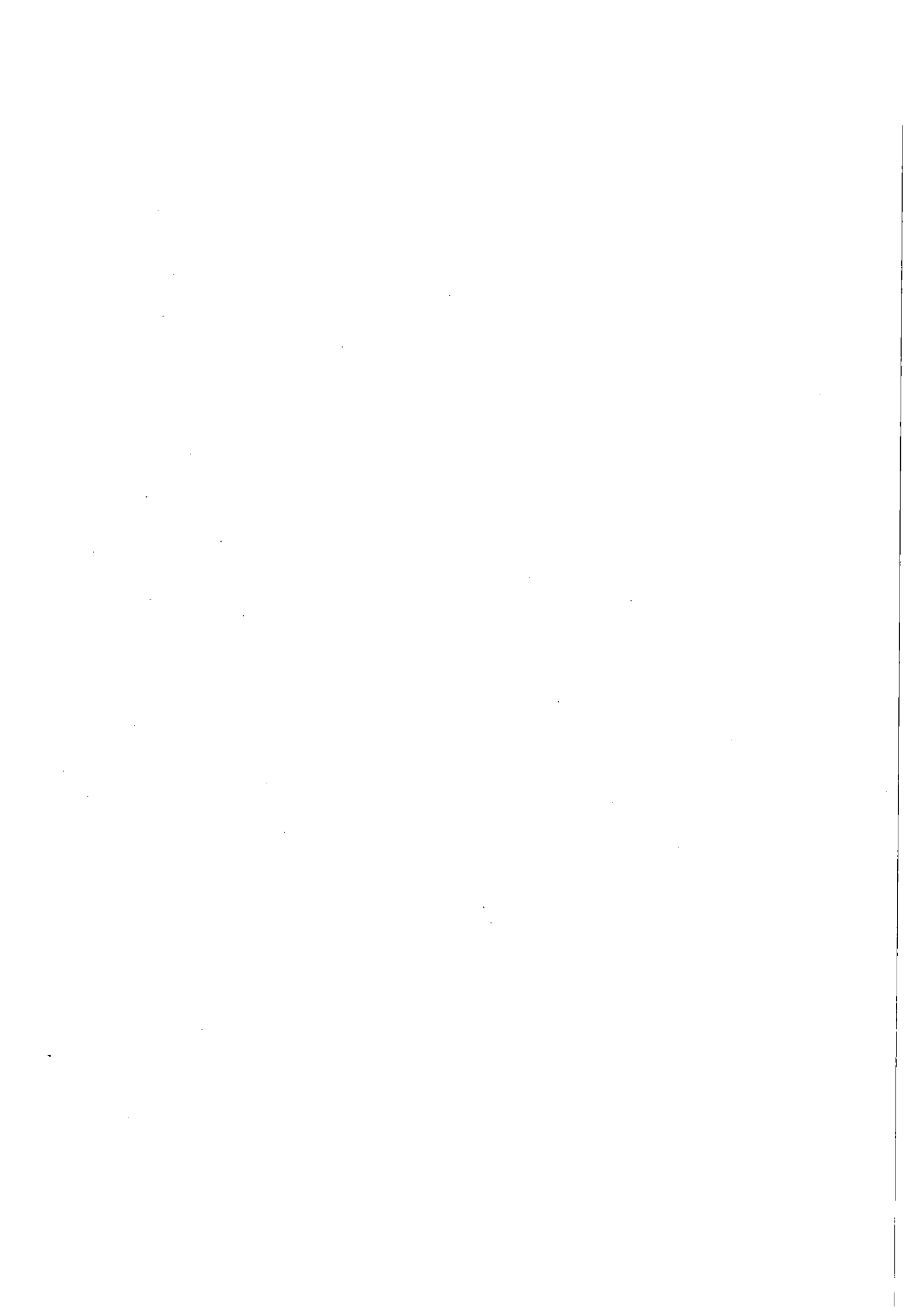
Please complete and return by 10 January 1994 to J Gauld, SOAFD Marine Laboratory  
PO Box 101, Victoria Road, Aberdeen, AB9 8DB

1~  
2~  
3~  
5~  
6~  
7~

Reg No SF/ 4~

1 Name of site	2 Please correct site name here (if necessary)	3 Please correct main method of production on each site (if necessary) ie fresh water cages or tanks
8~	9~	10~
11~	12~	13~
14~	15~	16~
17~	18~	19~

1 How many staff in total worked on the above site	Full time <input type="text"/>	Part time <input type="text"/>	
2 How many ova were produced (winter of 1992/1993)	Whole company total <input type="text"/>		
3 How many eyed eggs were laid down for hatching (winter of 1992/93)	Site 1	Site 2	Site 3
a From own farmed broodstock	<input type="text"/>	<input type="text"/>	<input type="text"/>
b From other UK farmed broodstock	<input type="text"/>	<input type="text"/>	<input type="text"/>
c From UK wild broodstock	<input type="text"/>	<input type="text"/>	<input type="text"/>
d From foreign sources	<input type="text"/>	<input type="text"/>	<input type="text"/>
4 How many ova were all female triploids	<input type="text"/>	<input type="text"/>	<input type="text"/>
5 How many eyed eggs do you expect to hatch this winter (1993/94)	<input type="text"/>	<input type="text"/>	<input type="text"/>
6 How many fry or parr (pre-smolt) were	<input type="text"/>	<input type="text"/>	<input type="text"/>
a Transferred into the site	<input type="text"/>	<input type="text"/>	<input type="text"/>
b Transferred out of the site	<input type="text"/>	<input type="text"/>	<input type="text"/>
7 How many smolts were produced as	<input type="text"/>	<input type="text"/>	<input type="text"/>
a S1s	<input type="text"/>	<input type="text"/>	<input type="text"/>
b S2s	<input type="text"/>	<input type="text"/>	<input type="text"/>
8 How many smolts were sold as	<input type="text"/>	<input type="text"/>	<input type="text"/>
a S1s	<input type="text"/>	<input type="text"/>	<input type="text"/>
b S2s	<input type="text"/>	<input type="text"/>	<input type="text"/>
9 How many smolts do you expect to produce for sea winter on-growing next spring (1994) as	<input type="text"/>	<input type="text"/>	<input type="text"/>
a S1s	<input type="text"/>	<input type="text"/>	<input type="text"/>
b S2s	<input type="text"/>	<input type="text"/>	<input type="text"/>
10 How many smolts do you plan to produce in the spring of 1995	<input type="text"/>	<input type="text"/>	<input type="text"/>
11 What is the fish holding capacity of each site in cubic metres	<input type="text"/>	<input type="text"/>	<input type="text"/>
12 If a fallow period was used in 1993 please indicate duration in weeks (cage sites only)	<input type="text"/>	<input type="text"/>	<input type="text"/>
13 In the past year have you used a fish vaccine	YES/NO	YES/NO	YES/NO



**ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS  
ATLANTIC SALMON - PRODUCTION DATA**

Please complete and return by 10 January 1994 to J Gauld, SOAFD Marine Laboratory  
PO Box 101, Victoria Road, Aberdeen, AB9 8DB

- 1~
- 2~
- 3~
- 5~
- 6~
- 7~

Reg No SF/4~

1 Name of site	2 Please correct site name here (if necessary)	3 Please correct main method of production on each site (if necessary) ie fresh water cages or tanks
8~	9~	10~
11~	12~	13~
14~	15~	16~
17~	18~	19~

1 How many staff in total worked on the above site	Full time	<input type="text"/>	Part time	<input type="text"/>
	Site 1	Site 2	Site 3	Site 4
2 How many smolts were put into the site in 1993 as:				
a S1s (1,000s)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
b S2s (1,000s)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
3 How many smolts came from England	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
4 Total smolt input proposed in 1994	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
5a How many tonnes of last year's (1992) smolt intake were harvested before 31 August (ie grilse production)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
b How many fish does this tonnage represent	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
6a How many tonnes of last year's (1992) smolt intake were harvested between 1 Sep and 31 Dec (pre-salmon production, best estimate)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
b How many fish does this tonnage represent	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
7a How many tonnes of the 1991 smolt intake were harvested during 1993 (ie salmon production)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
b How many fish does this tonnage represent	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
8 How many tonnes of fish do you expect to produce in 1994	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
9 Were brood fish produced in 1993	YES/NO	YES/NO	YES/NO	YES/NO
10 What is the current fish holding capacity of each site in cubic metres	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
11 If a fallow period was used in 1993 please indicate duration in weeks (cages sites only)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

