SCOTTISH FISH FARMS

Annual Production Survey 2000

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FOREWORD

The annual production survey of fish farms in Scotland for 2000 was carried out on behalf of the Scottish Executive Environment and Rural Affairs Department (SEERAD) by Fisheries Research Services (FRS). FRS is the official reference source for data in this report.

Responses from Scottish rainbow trout and Atlantic salmon farming companies covering the period 1 January - 31 December 2000 are summarised in this report. Copies of the questionnaires are included in Appendix 1(a-d). The report is structured to allow readers to follow trends within the trout and salmon industries, in addition to providing information on production in 2000. Where available, statistics are given for the 10 year period 1991-2000. Data from previous years have been reassessed and updated where necessary. To allow direct comparison to data provided in previous reports, production information by region is presented in SEERAD defined areas.

Under the terms of the Registration of Fish Farming and Shellfish Farming Business Order 1985, all persons engaged in the practice of fish farming in Scotland are required to register with SEERAD within two months of the commencement of business. FRS maintains a register on behalf of SEERAD. Under the terms of the Diseases of Fish Act 1937, as Amended, the contents of a register cannot be made public except under specific circumstances. However, company and site information can be published in summary form and this is displayed in the appropriate tables.

This survey is concentrated upon the production of Atlantic salmon and rainbow trout in both fresh water and sea water. Other fish species are cultured in Scotland. These production data are summarised in section four.

Since 1993, conditions for trade in live fish, ova and gametes have been determined by EC Directive 91/67/EEC. Northern Ireland, the Isle of Man, the Republic of Ireland and parts of Denmark have achieved similar health status to the United Kingdom with regard to freedom from VHS and IHN. A limited number of farms in mainland Europe has also been granted approved health status.

Additional guarantees have also been granted to the UK in 1996 under Decision 96/490/EEC, whereby imports of live salmonids, including ova, are further controlled from areas in which the parasite *Gyrodactylus salaris* is present, as well as for other List III diseases. These rules are established to maintain the high health status of UK wild fish. Companies and aquaculture establishments wishing to import ova or live fish from approved areas MUST GIVE PRIOR NOTICE of any shipment into Scotland to Fisheries Research Services, Aberdeen. No imports are permitted from EU member states or farms not having approved health status. Imports from other countries outwith the EU, such as South Africa, are only permitted under licence, following stipulated tests by the official authorities in the country of origin and according to the Third Country rules developed by the EC, and mean that trade in fish or fish products is regulated.

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

RM Stagg
CET Allan

September 2001

SUMMARY

The contents of the annual production survey are summarised below. For detailed information on this year's and previous year's production please refer to the specific sections within this report.

Rainbow Trout (*Oncorhynchus mykiss*)

		1999	2000
Total production	tonnes	5,834	5,154
Production for the table	tonnes	4,857	4,311
Production for restocking	tonnes	977	843
Number of staff employed		177	168
Mean productivity	tonnes/person	33.0	30.68
No. ova laid down to hatch	million	18.6	20.9
Number of ova imported	million	17.4	18.7

In 2000 rainbow trout production decreased by 680 tonnes. Employment decreased by nine staff and productivity per person decreased to 30.68 tonnes per person. There was an increase of over two million ova laid down to hatch and an increase in the number of ova imported.

Atlantic Salmon (*Salmo salar*)

Smolts

		1999	2000
No. ova produced	million	122.6	124.6
No. ova laid down to hatch	million	82.7	78.5
No. ova exported	million	33.0	17.2
No. ova imported	million	0.74	5.11
No. smolts produced	million	39.8	45.6
No. smolts put to sea	million	41.1	45.6
Number of staff employed		424	444
Mean productivity (000s smolts/person)		93.8	102.7

The production of ova increased by two million in 2000, but the number of ova laid down to hatch decreased by over four million. Imports of ova increased and exports of ova fell significantly. Smolt production increased by 14%. The number of staff employed increased by 20 and mean productivity also increased.

Production Fish

		1999	2000
Total production	tonnes	126,686	128,959
Production of 0-year fish	tonnes	2,763	2,673
Production of grilse	tonnes	41,259	45,229
Production of pre-salmon	tonnes	42,564	44,734
Production of salmon	tonnes	40 ,100	36,323
Mean fish weight 0-year	kg	2.8	3.5
Mean fish weight grilse	kg	3.3	3.6
Mean fish weight pre-salmon	kg	4.2	4.2
Mean fish weight salmon	kg	4.4	4.3
Number of staff employed		1,304	1,397
Mean productivity	tonnes/person	97	92.3
Total smolt survival	%harvested	89.6	69.1

Production tonnage increased by 1.8% with an increased harvest at some stages of production. Staff numbers increased by ninety three. Mean productivity decreased by almost 6% and smolt survival by 20%.

Other Species

		1999	2000
Total production	tonnes	99	165.2
Number of staff employed	full-time	54	73
	part-time	18	25
Number of ova laid down to hatch	millions	18	53
Number of ova imported	millions	1	0.8

Production in other species increased by over 66 tonnes in 2000. As may be expected in an emerging sector, all elements examined were increasing, except the use of imported ova, which decreased by 200,000 on the 1999 figure.

1. RAINBOW TROUT (*Oncorhynchus mykiss*)

Annual production surveys were sent to all 54 companies registered with the Scottish Executive as being actively engaged in the production of rainbow trout in Scotland during 2000. Returns were received from all 54 companies, covering all 63 sites currently in production.

Production

Table 1a: Total Production (Tonnes) of Rainbow Trout during 1991-2000

Year	Tonnes	Year	Tonnes
1991	3,334	1996	4,630
1992	3,953	1997	4,653
1993	4,023	1998	4,913
1994	4,263	1999	5,834
1995	4,683	2000	5,154

Production decreased in 2000 by 680 tonnes, a decrease of almost 12%. Within the table trade, decreases were seen in the smaller and larger sized fish. In the restocking trade the production of small fish showed a marked decrease.

Table 1b: Production (Tonnes) for the Table Trade during 1994-2000 According to Weight Category

Year	<450 g	450-900 g	>900 g	Total
1994	2,376	288	1,038	3,702
1995	2,736	199	1,149	4,084
1996	2,701	181	1,002	3,884
1997	2,646	104	1,098	3,484
1998	3,009	173	887	4,069
1999	3,151	144	1,562	4,857
2000	3,005	203	1,103	4,311

Production for the table was 4,311 tonnes, a decrease of 546 tonnes (11%) over the 1999 total and accounted for 83% of the total production, a similar proportion to that seen in 1999. Supply was mainly of the smaller sized fish weighing up to 450g, comprising 69% of total production.

Table 1c: Production (Tonnes) for the Restocking Trade during 1994-2000 According to Weight Category

Year	<450 g	450-900 g	>900 g	Total
1994	125	337	99	561
1995	107	411	81	599
1996	188	484	74	746
1997	97	589	119	805
1998	69	538	237	844
1999	237	553	187	977
2000	41	609	193	843

Production for the restocking of angling waters increased annually until 2000 and accounted for 16% of total rainbow trout production in 2000. In 2000, production totalled 843 tonnes, a decrease of 136 tonnes (14%) on the 1999 total. These figures represent the tonnage of fish supplied to angling waters for restocking purposes, they do not account for the catch taken by anglers.

Escapes

There were six escape events reported from rainbow trout farms in 2000, resulting in an estimated total loss of 63,440 fish.

Production by Farm

Table 2: Numbers of Farm Sites categorised by size (tonnes produced per annum) during 1994-2000

Year	Number of sites per production category (tonnes)			Total number of sites
	<1-25	26-100	101-200	>200	
1994	25	15	12	4	56
1995	26	15	13	5	59
1996	24	14	12	6	56
1997	19	22	12	4	57
1998	26	14	8	8	56
1999	18	14	8	9	49
2000	16	12	8	8	44

Production was reported from 44 farms. The number of producers in all size categories, with the exception of 101-200 tonnes, decreased in 2000. These figures do not include those sites specialising in the production of ova or young fish for on-growing.

Production by Method

Table 3: Distribution of Production Methods a) According to the Numbers of Farm Sites Categorised by Sizes (tonnes produced per annum) and b) According to the Total Tonnage Produced and the Total Number of Sites in 1999 and 2000.

a) Production method	Production grouping (tonnes) in 2000					b) Total tonnage & (%) by method		No.* of sites	
	<10	10-25	26-50	51-100	>100	1999	2000	1999	2000
FW cages	0	2	1	0	6	2,245 (38)	2,258 (44)	9	9
FW ponds and raceways	3	6	3	6	7	2,399 (41)	1,972 (38)	29	25
FW tanks and hatcheries	3	2	1	1	0	112 (2)	140 (3)	6	7
SW cages	0	0	0	0	3	1,075 (18)	784 (15)	4	3
SW tanks	0	0	0	0	0	3 (<1)	0	1	0
Total	6	10	5	7	16	5,834	5,154	49	44

Freshwater production accounted for 4,370 tonnes (85%) and seawater production for the remaining 784 tonnes (15%). The main rearing facilities were cages, tanks, ponds and raceways. There was a decrease in production in seawater cages, no production in seawater tanks and a decrease in pond and raceway production.

The number of farms having different facilities* in 2000 were as follows:

Hatchery units	23 sites
Ponds and raceways	37 sites
Tanks	35 sites
Freshwater cages	10 sites
Seawater cages	4 sites
Seawater tanks	2 sites

*Not all of these facilities were in use in 2000.

Company and Site Data

Table 4: Number of Companies and Sites in Production during 1991-2000

Year	No. of companies	No. of sites
1991	56	69
1992	53	72
1993	52	74
1994	56	72
1995	54	69
1996	52	69
1997	51	69
1998	51	71
1999	54	68
2000	54	63

The number of companies registered with the Scottish Executive as being actively engaged in rainbow trout production was 54. The number of sites registered and in production was 63, a decrease of five from 1999.

Staffing and Productivity

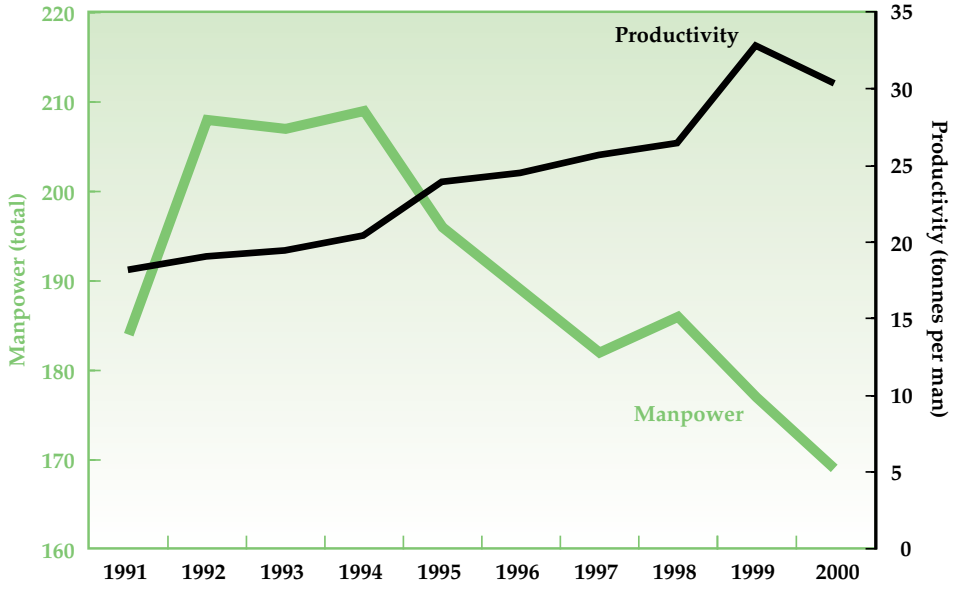
Table 5: Number of Staff Employed and Productivity Per Person during 1991-2000

Year	Full-time	Part-time	Total	Productivity (tonnes/person)
1991	133	51	184	18.12
1992	135	73	208	19.00
1993	134	73	207	19.43
1994	139	70	209	20.40
1995	132	64	196	23.89
1996	129	60	189	24.50
1997	130	52	182	25.56
1998	137	49	186	26.41
1999	126	51	177	32.96
2000	121	47	168	30.68

The overall number of staff employed in 2000 decreased by nine to 168 in 2000. The number of full-time staff decreased by five, whilst the number of part-time employees decreased by four.

Productivity, measured as tonnes produced per person, decreased by almost 2.3 tonnes per person in 2000. No distinction was made between full and part-time employees when calculating productivity.

Figure 1. Manpower and Productivity in Rainbow Trout Production during 1991-2000



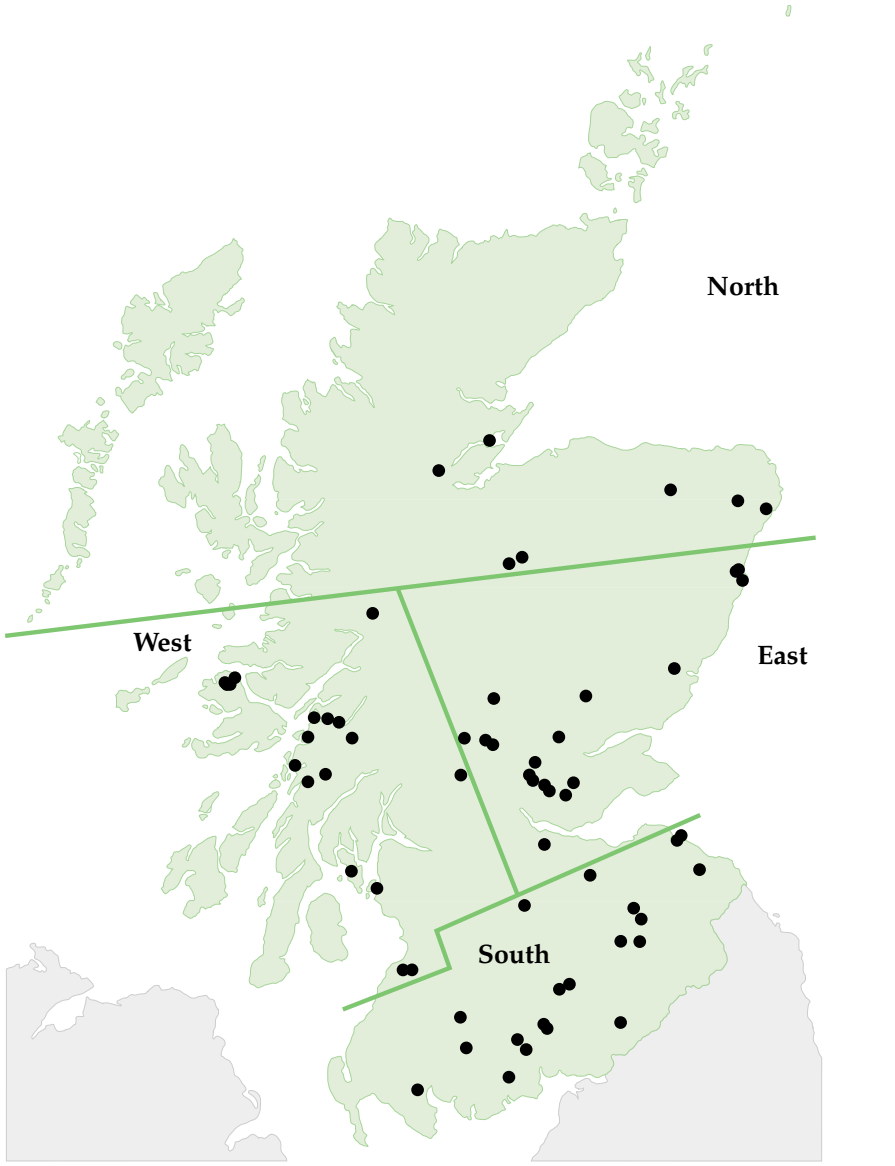
Production by Area

Table 6: Production and Staffing by Area in 2000

Area	No. sites	Production (tonnes) Table	Tonnes/ Restocking	Mean tonnes per Site	Staffing F/T	Staffing P/T	Staffing Total	Productivity tonnes/ person
North	7	414	136	78.6	16	8	24	22.9
East	19	975	305	67.4	40	16	56	22.86
West	17	2,134	128	133.1	39	13	52	43.50
South	20	788	274	53.1	26	10	36	29.50
All	63	4,311	843	81.8	121	47	168	30.86

Productivity per site was greatest in the west, (133.1 tonnes per site). Productivity per person was also greatest in the west, at 43.50 tonnes.

Figure 2. Distribution of Active Rainbow Trout Sites in Scotland in 2000



Type of Ova Laid Down

Table 7: Number and Types of Ova Laid Down to Hatch during 1993-2000

Year	All female diploid No.s (%)	Triploid No.s (%)	Mixed sex diploid No.s (%)	Total ova (000s)
1993	17,261 (87)	1,396 (7)	1,087 (6)	19,744
1994	18,105 (92)	1,134 (6)	365 (2)	19,604
1995	19,546 (94)	1,170 (6)	119 (<1)	20,835
1996	21,308 (94)	935 (4)	435 (2)	22,678
1997	21,117 (90)	1,386 (6)	1,000 (4)	23,503
1998	23,222 (92)	1,515 (6)	504 (2)	25,241
1999	16,324 (88)	1,853 (10)	456 (2)	18,633
2000	17,264 (82)	1,202 (6)	2,513 (12)	20,979

All-female diploid stock was the predominant stock laid down to hatch in 2000 (82%). Triploid stock was produced mainly for the restocking trade, where they have the advantage of not maturing, allowing greater growth potential.

Source of Ova Laid Down

Table 8: Number (000s) and Sources of Ova Laid Down to Hatch during 1993-2000

Year	GB ova Own stock	GB ova Other stock	GB ova Total	Imported ova Northern hemisphere	Imported ova Southern hemisphere	Imported ova Total imported	Total ova laid down to hatch
1993	1,830	405	2,235	12,815	4,694	17,509	19,744
1994	479	625	1,104	13,055	5,445	18,500	19,604
1995	165	360	525	12,485	7,825	20,310	20,835
1996	420	988	1,408	13,247	8,023	21,270	22,678
1997	1,232	837	2,069	11,594	9,840	21,434	23,053
1998	2,559	60	2,619	11,038	11,595	22,633	25,252
1999	878	392	1,270	11,415	5,946	17,361	18,631
2000	1,397	900	2,297	10,161	8,525	18,686	20,983

In 2000, the total number of eyed-ova laid down to hatch increased by over 2 million (13%) on the 1999 figure. The proportion of ova from GB broodstock increased to 11% of the total, but the rainbow trout industry remained reliant on imported ova.

Data on importation of ova into Scotland are also available from the import licences and are shown in Table 9(a). These data show slightly larger imports than those figures provided by the industry in Table 8.

Imports of Ova from Official Import Licences

Table 9a: Number (000s) and Sources of Ova Imported Into Scotland during 1995-2000

Source	1995	1996	1997	1998	1999	2000
Northern Ireland	6,285	4,095	2,425	2,065	3,335	1,085
Isle of Man	3,550	4,182	4,205	3,273	4,222	5,842
Denmark	2,650	5,075	5,354	5,700	4,546	4,225
South Africa	7,825	8,023	9,450	11,585	6,036	7,762
Others (EU)	-	220	-	-	-	-
Totals	20,310	21,595	21,434	22,623	18,139	18,914

Table 9b: Seasonal Variation in Number (000s) and Consignments ( ) of Ova Imported into Scotland in 2000 from different sources

Month	Northern Ireland	Isle of Man	Denmark	South Africa
January	210(1)	1,400(4)	-	-
February	100 (1)	480(2)	1,200 (2)	-
March	-	-	2,450(4)	-
April	-	50 (1)	200(1)	-
May	-	5 (1)	150(1)	300(1)
June	5(1)	-	-	700 (3)
July	-	-	-	4,050(8)
August	-	-	-	2,312(5)
September	500(1)	-	-	400 (1)
October	270(2)	50 (1)	-	-
November	-	1,720 (3)	-	-
December	-	2,137(4)	225(1)	-
Totals	1,085(6)	5,842 (16)	4,225(9)	7,762(18)

Imports for 2000 included a quantity of milt and fingerlings imported from Northern Ireland. Denmark, the Isle of Man and Northern Ireland accounted for 59% of ova imported into Scotland during 2000 (66% during 1999), the remainder being sourced in South Africa. By using a mixture of ova from the northern and southern hemispheres, producers are able to regulate production throughout the year and produce a constant supply of fish for the markets.

Trade in Fry and Fingerlings

Table 10: Number (000s) of Fry and Fingerlings Traded during 1993-2000

Year	Fry and fingerlings bought (000s)			Total number bought	Total number sold
	All female diploids 000s (%)	Triploid 000s (%)	Mixed sex diploids 000s (%)		
1993	8,395 (73)	917 (8)	2,239 (19)	11,551	9,823
1994	9,854 (90)	1,017 (9)	47 (<1)	10,918	10,379
1995	12,449 (95)	683 (5)	0	13,132	10,912
1996	12,174 (93)	572 (4)	283 (2)	13,029	11,578
1997	15,028 (94)	889 (5)	98 (1)	16,015	10,330
1998	13,035 (96)	410 (3)	80 (1)	13,525	11,000
1999	11,264 (94)	90 (1)	616 (5)	11,970	9,759
2000	13,410(92)	287(2)	892(6)	14,589	12,505

The established trade between hatcheries and on-growing farms continued in 2000. Some companies specialised in the production of fry and fingerlings. The total number of fry and fingerlings purchased by producers decreased by 11%, whilst the total number sold by producers decreased by 11%. The disparity between supply and demand is met by supplies being bought in from England, Wales and Northern Ireland, although the shortage in supply was less than in previous years.

Use of Vaccines

Table 11: Number of Sites Rearing Fish Vaccinated Against Enteric Redmouth Disease (ERM) during 1990-2000

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. of sites	27	30	33	28	35	31	33	35	31	40	35

Vaccines continued to be widely used as a preventative treatment against ERM, a potentially serious bacterial disease, caused by the bacterium *Yersinia ruckeri*. A total of 18.2 million fish were vaccinated. Vaccination is generally carried out as a bath treatment at the fingerling stage although some vaccines were administered by intra peritoneal injection.

Conclusions

Rainbow trout (*Oncorhynchus mykiss*)

The production of rainbow trout was directed solely at the table and restocking markets. Production of rainbow trout in 2000 decreased by 11%. Portion sized fish for the table trade accounted for the bulk of production. Staff numbers decreased, and productivity per person fell, indicating a reduction in efficiency within the industry.

Increases in the number of ova imported and in the number of ova laid down to hatch were recorded in 2000. Approximately 11% of these ova were sourced within the UK; the remainder was imported from other northern and southern hemisphere countries.

The stock of choice within the industry continued to be all female diploid, with a small minority of ova being either mixed sex diploid or triploid. There was a continuing trade in fingerlings, although an increasing proportion were being sourced within Scotland.

A high percentage of stocks were vaccinated against ERM, indicating producers' awareness of the risk of infectious diseases.

2. ATLANTIC SALMON (*Salmo salar*) OVA AND SMOLTS

Annual production surveys were sent to all 60 companies registered with the Scottish Executive as being actively engaged in the freshwater production of Atlantic salmon in Scotland during 2000. Returns were received from all companies, covering the 184 sites currently in production.

Company and Farm Data

Table 12: Number of Companies and Sites in Production during 1994-2000

Year	No. of companies	No. of sites
1994	68	147
1995	69	162
1996	67	166
1997	65	171
1998	64	177
1999	65	189
2000	60	184

In 2000 the number of companies registered with the Scottish Executive as being actively engaged in the freshwater production of Atlantic salmon decreased by five to sixty. A total of 279 freshwater sites were registered comprising the following types of facility:

Hatchery	74
Tanks	97
Ponds and raceways	7
Cages	88

Of the registered sites, 77 sites were inactive and 202 active. Of these active sites 184 were in commercial production, the difference being accounted for by farms which were not used during 2000.

Production and Staffing

Table 13: Number (000s) of Smolts Produced, Staff Employed and Smolt Productivity during 1991-2000

Year		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number (000s) of smolts produced		22,404	20,827	21,043	23,117	26,539	33,619	38,187	44,853	39,763	45,583
Staffing	Full-time	271	266	233	245	279	308	344	318	300	341
	Part-time	79	93	115	133	117	133	166	96	124	103
	Total	350	359	348	378	396	441	510	414	424	444
Productivity, 000s of smolts per person		64.0	58.0	60.5	61.2	67.0	76.2	74.9	108.3	93.8	102.7

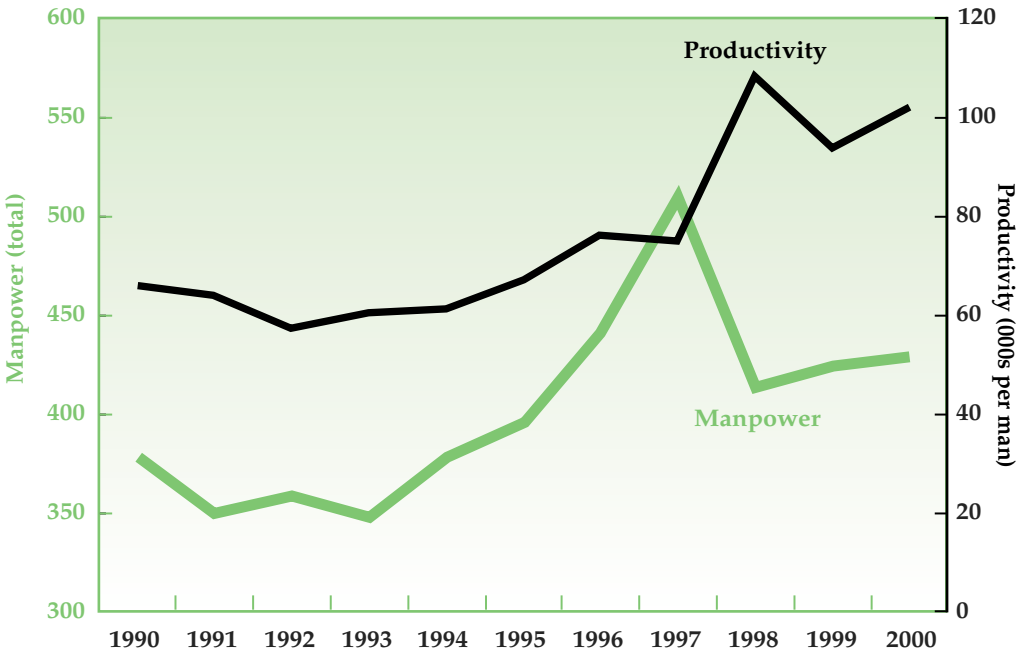
Smolt production in 2000 increased by over 5 million, an increase of 15% compared to 1999.

The number of staff employed increased by 20 and productivity increased by 9%, to a figure of 102,700 smolts produced per employee.

Escapes

There was one reported escape incident from a freshwater Atlantic salmon farm in 2000, involving the loss of 9,108 fish.

Figure 3. Manpower and Productivity in Smolt Production 1990-2000



Type of Smolts Produced

Table 14: Number of Smolts (000s) Produced by Type during 1993-2000

Year	S$^1/_2$	S1	S1$^1/_2$	S2	Total
1993	686	19,698	202	457	21,043
1994	1,672	20,712	511	222	23,117
1995	2,663	22,705	365	806	26,539
1996	6,298	26,334	523	464	33,619
1997	9,333	27,679	692	483	38,187
1998	8,478	35,383	686	306	44,853
1999	10,770	28,345	586	62	39,763
2000	11,841	33,722	0	20	45,583

In 2000 production was dominated by S1 smolts, and numbers increased by 19%. The production of S$^1/_2$ smolts increased by 10% reflecting the increasing trend in the S$^1/_2$ smolts used by the industry. There was a continued decrease in the production of S1$^1/_2$ and S2 smolts, with no production of S1$^1/_2$s reported.

Production Systems

Table 15: Number and Capacity of Production Systems during 1997-2000

System	No. of sites with systems				Total capacity (000s) cubic metres			
Year	1997	1998	1999	2000	1997	1998	1999	2000
Cages	70	80	86	85	326	343	457	344
Land-based systems	101	97	103	99	45	40	39	45
Total	171	177	189	184	371	383	496	389

There are two principal types of facility used for the production of smolts in freshwater land-based systems (tanks, ponds and raceways) and freshwater cages. In 2000, the number of land-based farms decreased by four, and the number of farms employing cages decreased by one. In terms of volume, tank capacity increased by 6,000 m^3, whilst cage volume decreased by 113,000 m^3. This resulted in a net decrease in volume of 107,000 m^3 available for the production of smolts in Scotland during 2000.

Table 16: Number (000s) of Smolts Produced and Stocking Densities by Production Systems during 1997-2000

	Number of smolts produced (000s)				Stocking densities (smolts/m^3)			
	1997	1998	1999	2000	1997	1998	1999	2000
Cages	19,942	25,049	22,242	24,052	61	73	49	70
Land-based	18,245	19,804	17,521	21,531	405	495	449	478
Total	38,187	44,853	39,763	45,583	-	-	-	-

The average stocking densities of both cages and tanks increased compared to 1999; in the case of cages from 49 to 70 fish per m^3 and in the case of tanks, from 449 to 478 fish per m^3.

Ova Production

Table 17: Number (000s) of Salmon Ova Produced during 1993/94-1999/00 Spawning Periods

Year	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00
No. of ova	98,900	89,556	122,665	186,470	151,841	122,649	124,619

The stripping of broodstock generally takes place between October and January. As a result, the data presented here relate to the 1999/00 stripping season. Over 124 million ova were stripped, an increase of 1.97 million (1.6%) on the 1998/99 season.

Table 18: Source and Number (000s) of Ova Laid Down to Hatch during 1992/93 - 1999/00

Year	In-house broodstock	Out-sourced GB broodstock	GB wild broodstock	Imported ova	Total	Previous year's estimate
1992/93	44,524	19,281	514	4,381	68,700	54,415
1993/94	25,883	14,991	450	5,347	46,671	49,064
1994/95	37,176	25,063	475	2,160	64,874	46,538
1995/96	46,545	23,784	65	8,045	78,439	71,635
1996/97	60,421	23,308	323	1,750	85,802	76,629
1997/98	49,207	19,085	0	1,010	69,302	69,632
1998/99	52,122	25,804	4,291	500	82,717	68,644
1999/00	38,674	33,592	1,605	4,660	78,531	69,220
2000/01	-	-	-	-	-	83,458

The number of ova laid down to hatch was in excess of 78.5 million, a decrease of over 4 million (5%) on the 1998/99 figure. The majority of the ova (49%) was derived from producers' own broodstock, the proportion being less than that seen in 1998/99. Supplies from other producer's broodstock were proportionally larger, with a small proportion being derived from sources outside Great Britain. Producers' estimates for the number of ova to be laid down in 1999/00 shows a projected increase. The ova derived from wild stocks are generally held and hatched for wild stock enhancement, in co-operation with the wild fisheries and the farming industry.

Smolts Produced and Put to Sea

Table 19: Actual and Projected Smolt Production and Smolts put to Sea (Millions) during 1993-2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Actual smolts put to sea	20.5	22.0	26.8	30.8	42.8	45.9	41.1	45.2		
Smolts produced	21.0	23.1	26.5	33.6	38.2	44.8	39.8	45.6		
Estimated* production	21.8	22.1	25.2	31.8	41.6	45.3	49.6	42.1	50.2	54.5
Ratio of ova laid down to smolts produced	3.3	2.0	2.4	2.3	2.2	1.5	1.7	1.8		

*based on farmers' estimates

The figure for the number of smolts put to sea includes smolts produced in England and fish imported from the Republic of Ireland whereas smolt production data relate only to those produced in Scotland. Farmers estimate putting 50.2 million smolts to sea in 2001.

The ratio of ova laid down to hatch to smolts produced increased slightly in 2000.

Scale of Production

Table 20: Number of Smolt Producing Sites Categorised by Production Quantity (000s of Smolts) during 1991-2000

Year	Quantity of production (000s)								Total no. of sites in production	Total no. smolts produced (000s)
	1-10	10-25	26-50	51-100	101-250	251-500	501-1,000	>1,000		
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
1994	4	5	13	24	37	17	13	0	113	23,117
1995	1	6	15	29	30	26	14	1	122	26,540
1996	1	7	13	29	33	26	17	3	129	33,619
1997	0	3	13	22	39	24	18	6	125	38,187
1998	1	3	12	24	33	29	20	8	130	44,853
1999	1	1	15	25	29	24	21	7	123	39,763
2000	1	2	10	17	36	24	24	9	123	45,583

Note: These data refer only to sites producing smolts. The sites holding only ova, fry or parr are excluded.

There has been no change in the number of sites producing smolts since 1999, however the number of sites producing less than 100,000 smolts has decreased by 12, with an equal rise in the number of sites producing more than 100,000 smolts.

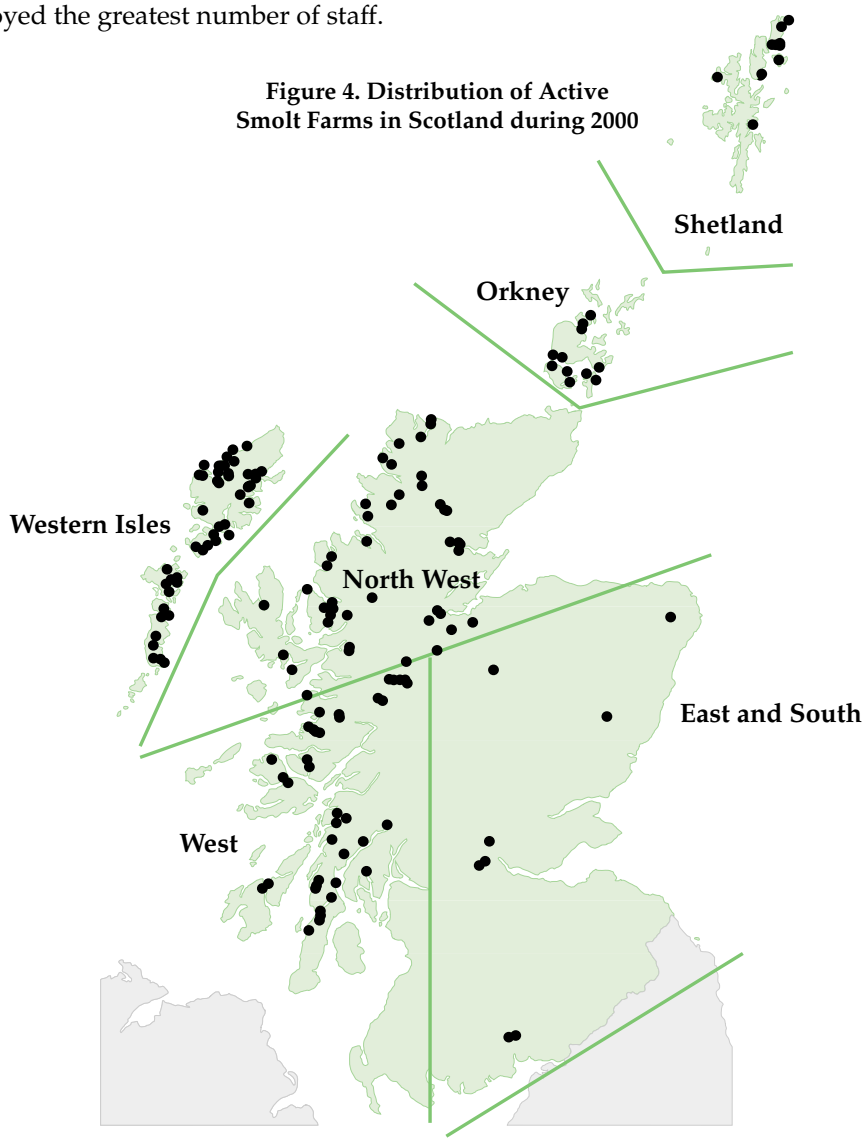
Production of Ova and Smolt by Production Area

Table 21: Staffing, and Ova Laid Down to Hatch, during 1999-2000, Smolt Production and Projected Production 2001-2002 by Region

	Number of staff employed in 2000		Ova laid down to hatch (000s)		Smolt production (000s)		Estimated smolt production (000s)	
REGION	F/T	P/T	1998	2000	1999	2000	2001	2002
Northwest	154	55	47,273	41,119	21,661	24,902	27,676	29,081
Orkney	13	3	1,435	1,017	940	673	1,000	2,441
Shetland	24	20	4,979	5,906	1,825	1,981	3,380	3,050
West	63	13	12,543	10,733	6,461	8,011	7,240	8,513
Western Isles	75	6	13,341	16,872	6,863	8,282	8,569	8,965
East and South	12	6	3,147	2,884	2,014	1,734	2,331	2,488
All Scotland	341	103	82,718	78,531	39,763	45,583	50,196	54,538

The north west, west and the Western Isles were the main ova and smolt producing areas in 2000, and employed the greatest number of staff.

Figure 4. Distribution of Active Smolt Farms in Scotland during 2000



International Trade in Ova

Since the introduction of the EU single market on 1 January 1993 and the associated Fish Health Regulations common to all member states, a trade in live salmon and ova has been established. Trade with third countries has also been established, but imports are permitted only under licence, from sources which have met rigorous health testing requirements. Exports to countries outside the EU are subject to the health conditions placed by the importing country. The Fisheries Research Services advises potential exporters to ascertain with the importing country any specific health testing requirements that may be a condition of import.

Imports and Exports

Table 22a: Source and Number (000s) of Ova Imported during 1993-2000 Derived from Import Licences

Import year	EU member states	Australia	Total	Parr and smolts EU member states
1993	4,439	470	4,909	-
1994	5,823	240	6,063	72
1995	1,470	600	2,070	2,662
1996	6,690	1,355	8,045	2,553
1997	2,305	1,200	3,505	2,168
1998	260	750	1,010	2,140
1999	244	500	744	900
2000	0	500	5,110*	3,436

***This figure includes the import of 4,610,000 ova from Iceland.**

Table 22b: Destination and Number (000s) of Salmon Ova Exported during 1994-2001 from Broodstock Spawned in the Previous Year Derived from Export Certificates

Export year	Farmed origin			Total	Wild origin total
	Chile	EU	Others		
1994	9,467	7,540	40	17,047	50
1995	22,691	7,242	40	29,973	50
1996	17,542	7,937	20	25,499	60
1997	28,545	13,729	-	42,274	60
1998	34,165	7,289	20	41,474	50
1999	34,885	13,024	-	47,909	492
2000	17,472	15,496	-	32,968	50
2001	10,378	6,787	0	17,165	0

The import of ova increased almost seven fold. This is almost entirely due to the import of ova from Iceland, used in the main to produce out of season smolts. The number of parr imported increased to replace losses in home produced parr.

In 2001 a total of 17.2 million ova stripped were exported. Exports to other EU member states decreased by 56% to under 7 million. Exports to Chile fell by 40% to just over 10 million, the lowest level since 1994, mainly due to difficulties in meeting the criteria set by the Chilean authorities. Overall, exports were down by 48% based on the 2000 figure.

Vaccines

Table 23: Number of Sites Using Vaccines during 1991-2000 and Number of Fish Vaccinated during 1991-2000

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
No. of sites	61	71	73	85	102	112	118	122	115	114
No. of fish vaccinated	-	-	-	19.4	25.3	31.8	39.7	43.7	43.9	45.8

Vaccines were used to provide protection against furunculosis, a disease caused by the bacterium *Aeromonas salmonicida*, which was the cause of serious losses within the fish farming industry in the late 1980s and early 1990s. Vaccination is normally carried out at the pre-smolt stage by intra peritoneal injection. In addition, some sites vaccinated fish against enteric redmouth disease (ERM) and *Vibrio* spp. bacteria. In some cases vaccination against infectious pancreatic necrosis (IPN) was also undertaken under animal test certificates (ATCs) authorised by the Veterinary Medicines Directorate (VMD).

3. ATLANTIC SALMON (*Salmo salar*) - PRODUCTION

Company and Farm Data

Table 24: Number of Companies and Sites Engaged in Salmon Production during 1993-2000

Year	Number of companies			Number of active sites		
	Producing	Non-producing	Total	Producing	Non-producing	Total
1993	132	12	144	283	86	369
1994	119	12	131	262	101	363
1995	108	12	120	268	91	359
1996	106	1	107	278	56	334
1997	98	3	101	275	65	340
1998	95	11	106	289	54	343
1999	94	1	95	264	87	351
2000	68	22	90	163	183	346

The number of companies registered with SEERAD and actively producing salmon in 2000 was 68, a decrease of 26 since 1999. Twenty one of these companies remained active and registered, although not producing salmon for harvest in 2000. This continued the trend of salmon production being concentrated within fewer companies. These 90 companies have 346 registered active sites, although not all active sites may have produced fish for harvest in 2000.

Production

Production survey information was collected from all 90 companies actively involved in Atlantic salmon production, farming 346 active sites. This figure represents the entire industry operating in Scotland.

Table 25: Annual Production of Salmon (tonnes) during 1986-2000 and Projected Production in 2001

Year	Tonnes	Year	Tonnes
1986	10,337	1994	64,066
1987	12,721	1995	70,060
1988	17,951	1996	83,121
1989	28,553	1997	99,197
1990	32,351	1998	110,784
1991	40,593	1999	126,686
1992	36,101	2000	128,959
1993	48,691	2001	158,479*

***farmers' estimate based on stocks currently being on-grown**

The total production of Atlantic salmon during 2000 was 128,959 tonnes, an increase of 2,273 tonnes (1.8%) on 1999 production. This is the eighth consecutive annual increase in production.

Escapes

There were twenty one reported escape incidents from seawater Atlantic salmon farms in 2000, involving the loss of a total 411,433 fish.

Figure 5. Showing the Size and Number of Esacpe Events from Scottish Seawater Atlantic Salmon Farms during 2000.

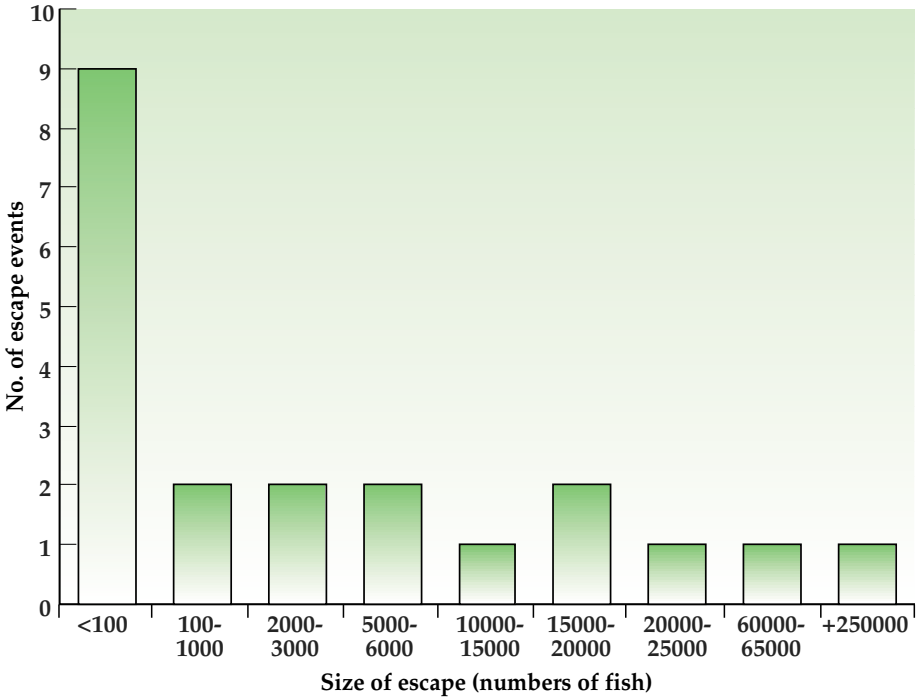


Table 26: Number (000s) and Production (tonnes) of Salmon Harvested and Mean Fish Weight (kg) per Year Class during 1994-2000

	Year of smolt input	Year of harvest	Number (000s)	Production (tonnes)	Mean weight (kg) at harvest
Harvest in year 0 (ie in year of input)	1994	1994	261	388	1.5
	1995	1995	207	369	1.8
	1996	1996	315	638	2.0
	1997	1997	282	585	2.1
	1998	1998	696	2,048	2.9
	1999	1999	1,000	2,763	2.8
	2000	2000	765	2,673	3.5
Harvest in year 1	1993	1994	13,446	41,865	3.1
	1994	1995	14,420	47,775	3.3
	1995	1996	17,132	57,998	3.4
	1996	1997	20,245	71,349	3.5
	1997	1998	29,014	86,783	3.0
	1998	1999	22,556	83,823	3.8
	1999	2000	23,077	89,963	3.9
Harvest in year 2	1992	1994	5,096	21,812	4.3
	1993	1995	5,137	21,916	4.3
	1994	1996	5,408	24,485	4.5
	1995	1997	6,195	27,263	4.4
	1996	1998	5,148	21,953	4.3
	1997	1999	9,027	40,100	4.4
	1998	2000	8,450	36,323	4.3

Table 27: Number, Production and Average Weight of Grilse and Pre-salmon Harvested during 1994-2000

Year	Grilse (Jan - Aug)			Pre-salmon (Sep - Dec)		
	Number 000s	Production Tonnes	Average weight (kg)	Number	Production Tonnes	Average weight (kg)
1994	6,435	17,386	2.7	7,011	24,479	3.5
1995	7,610	22,235	2.9	6,809	25,540	3.8
1996	8,669	25,776	3.0	8,462	32,222	3.8
1997	10,489	34,227	3.3	9,756	37,122	3.8
1998	16,740	38,963	2.3	12,275	47,820	3.9
1999	12,448	41,259	3.3	10,109	42,564	4.2
2000	12,561	45,229	3.6	10,516	44,734	4.2

Table 28: Proportion % (by Weight) of Annual Production as Grilse, Pre-salmon and Salmon Harvested during 1994-2000

Year	1994	1995	1996	1997	1998	1999	2000
Growth stage							
Input year fish	<1	<1	<1	<1	2	2	2
Grilse	27	32	31	35	35	32	35
Pre-salmon	38	36	39	37	43	34	35
Salmon	34	31	29	27	20	32	28

Survival and Production in Smolt Year Classes

Table 29: Survival and Production in Year Classes during 1990-2000

Year of smolt input	Smolt input (000s)	HARVEST YEAR 0				HARVEST YEAR 1				HARVEST YEAR 2				% survival of year class	Year class production (tonnes)	Yield per smolt (kg)
		Number (000s)	Weight (tonnes)	Mean weight (kg)	% Harv-ested	Number (000s)	Weight (tonnes)	Mean weight (kg)	% Harv-ested	Number (000s)	Weight (tonnes)	Mean weight (kg)	% Harv-ested			
1990	21,408	-	-	-	-	8,877	21,026	2.4	41.5	4,315	14,728	3.4	20.1	61.6	35,754	1.67
1991	20,227	-	-	-	-	8,864	21,373	2.4	43.8	4,675	15,875	3.4	23.1	66.9	37,248	1.84
1992	20,527	-	-	-	-	11,102	32,738	3.0	54.1	5,096	21,812	4.3	24.8	78.9	54,550	2.65
1993	20,541	46	78	1.7	0.2	13,446	41,865	3.1	65.5	5,135	21,916	4.2	25.0	90.7	63,859	3.10
1994	21,953	260	388	1.5	1.2	14,420	47,775	3.3	65.7	5,408	24,485	4.5	24.6	91.5	72,629	3.31
1995	26,786	206	269	1.8	0.8	17,132	57,998	3.4	64.0	6,195	27,263	4.4	23.1	87.8	85,530	3.19
1996	32,906	315	638	2.0	1.9	20,245	71,349	3.5	61.5	5,148	21,953	4.3	15.6	78.1	93,940	2.85
1997	42,766	282	585	2.1	0.7	29,014	86,783	3.0	67.8	9,027	40,098	4.4	21.1	89.6	127,466	2.98
1998	45,870	696	2,048	2.9	1.5	22,556	83,823	3.7	49.2	8,450	36,323	4.3	18.4	69.1	122,194	2.66
1999	41,106	1,000	2,763	2.8	2.4	23,077	89,963	3.9	56.1							
2000	45,185	765	2,673	3.5	2.1											

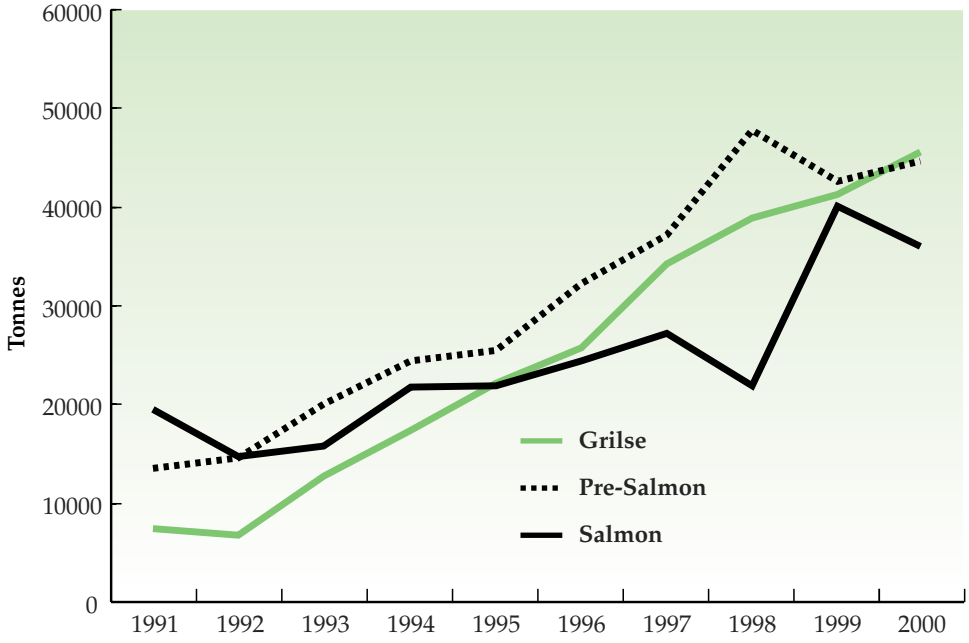
[1] Percentage survival is calculated from the total number of fish havested from that year class.
[2] Year class production is calculated from the number and weights of fish harvested from year class.
[3] Yield per smolt expresses the weight (kilos) harvested per smolt put to sea.

In 1998, the last year for which survival can be calculated, the survival rate from smolt input to harvest was 69.1%. The 1998 year class displayed a lower survival than seen in the last few years. This is due to several factors including mortality and culling associated with the ISA outbreak, mortality associated with clinical IPN outbreaks, losses associated with plankton blooms, an increase in the number of escapes and losses incurred during sea lice treatment.

Of the 1999 year class, 58.5% of the input has been harvested, an increase of 6.9% compared with the 1998 input, and the average weight increased by 0.2kg to 3.9kg. This may indicate a decreased harvest in 2001 of two sea winter (2SW) fish, or an increase in the survival rate of the 1999 year class as a whole.

In 2000, the harvest of fish from the 2000 smolt input was 2.1%, a decrease of 0.3% compared with the proportion of fish harvested from the same year class in 1999.

Figure 6. Production (tonnes) of Salmon Harvested by Age Grouping 1991 -2000



Smolts to Sea

Table 30: Number (000s) and Origin of Smolts put to Sea during 1993-2000

Year	Smolts to sea (000s)				Scottish	English origin		Other origin		Total no.
	S1/2	S1	S11/2	S2	origin %	(000s)	%	(000s)	%	used (000s)
1993	-	19,843	-	698	96	827	4	-	-	20,541
1994	1,865	19,701	113	274	93	1,451	7	-	-	21,953
1995	2,442	23,081	589	674	97	852	3	-	-	26,786
1996	5,527	26,157	180	974	89	1,166	4	2,138	6	32,838
1997	8,936	33,274	182	374	88	2,957	7	2,028	5	42,766
1998	12,796	32,649	190	235	92	2,714	6	1,080	2	45,870
1999	11,585	29,119	335	68	95	2,221	5	0	0	41,107
2000	9,517	35,176	399	93	91+	3,396	8	300	<1	45,185

The total number of smolts put to sea in 2000 was over 45 million. The smolt input comprised mainly S1 smolts (78%), and the proportion of photoperiod adjusted fish (S2 smolts and S12 smolts) input decreased to 22%. Approximately 8% of smolts input into Scottish salmon farms were sourced from outwith Scotland. This is an increase compared with the proportion observed in recent years.

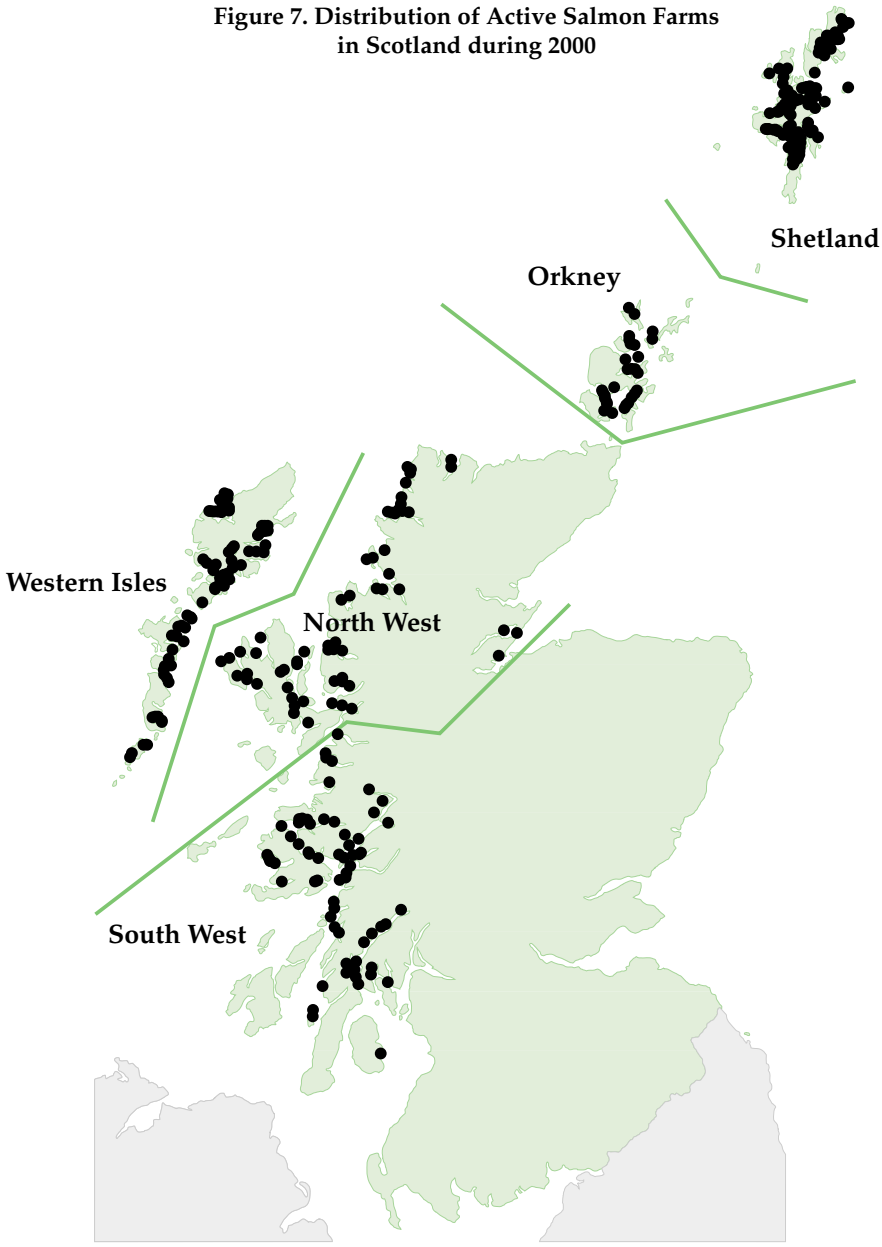
Survival and Production in Smolt Year Classes by Production Area

Table 31: Number (000s) of Smolts put to Sea and Year Class Survival by Area* during 1992-2000

Region	Smolts to sea (000s)		Harvest in Year 0			Harvest in Year 1			Harvest in Year 2			Total harvest (= survival)	
	Year	No.	Year	No.	%	Year	No.	%	Year	No.	%	No.	%
North West	1992	7,650	1992	-	-	1993	5,160	67.5	1994	1,647	21.5	6,807	89.0
	1993	7,684	1993	47	0.6	1994	5,405	70.3	1995	1,927	25.1	7,379	96.2
	1994	7,914	1994	108	1.4	1995	4,721	59.7	1996	1,438	18.2	6,267	79.2
	1995	9,428	1995	60	0.6	1996	7,500	79.6	1997	1,153	12.2	8,713	92.4
	1996	12,438	1996	99	0.8	1997	8,335	67.0	1998	1,818	14.6	10,252	82.4
	1997	11,228	1997	112	1.0	1998	7,253	64.6	1999	2,183	19.4	9,548	85.0
	1998	17,808	1998	315	1.7	1999	9,075	50.9	2000	1,614	9.1	11,004	61.8
	1999	11,393	1999	288	2.5	2000	9,422	82.7					
	2000	11,308	2000	457	4.0								
Orkney	1992	681	1992	-	-	1993	236	34.7	1994	217	31.9	453	66.6
	1993	726	1993	-	-	1994	478	65.8	1995	176	24.2	654	90.0
	1994	754	1994	-	-	1995	399	52.9	1996	222	29.4	621	82.3
	1995	1,127	1995	-	-	1996	508	45.1	1997	430	38.1	938	83.2
	1996	1,175	1996	-	-	1997	428	36.4	1998	291	24.2	719	61.2
	1997	1,506	1997	-	-	1998	971	64.5	1999	257	17.1	1,228	81.6
	1998	2,409	1998	75	3.1	1999	986	40.9	2000	259	10.8	1320	54.8
	1999	3,235	1999	10	0.3	2000	1,614	49.9					
	2000	2,604	2000	0	0								
Shetland	1992	5,014	1992	-	-	1993	2,342	46.7	1994	1,248	24.9	3,590	71.6
	1993	4,491	1993	-	-	1994	3,354	73.1	1995	993	21.6	4,347	94.7
	1994	5,012	1994	24	0.5	1995	3,055	61.0	1996	1,846	36.8	4,925	98.3
	1995	5,811	1995	41	0.7	1996	3,021	52.0	1997	2,622	44.4	5,643	95.5
	1996	6,234	1996	-	-	1997	3,828	61.4	1998	1,141	18.3	4,966	79.7
	1997	13,276	1997	-	-	1998	7,265	54.7	1999	3,835	28.9	11,100	83.6
	1998	12,617	1998	78	0.6	1999	5,498	43.6	2000	4,783	37.9	10,359	82.1
	1999	12,663	1999	65	0.5	2000	5,576	44.0					
	2000	15,096	2000	0	0								
South West	1992	3,989	1992	-	-	1993	1,667	41.8	1994	1,182	29.6	2,849	71.4
	1993	5,131	1993	-	-	1994	2,300	44.8	1995	1,215	23.6	3,515	68.5
	1994	4,614	1994	-	-	1995	2,994	64.9	1996	1,460	31.6	4,454	96.5
	1995	6,437	1995	25	0.4	1996	3,268	50.8	1997	1,349	21.0	4,642	72.1
	1996	9,924	1996	64	0.6	1997	3,317	33.4	1998	1,408	14.2	4,789	48.2
	1997	11,540	1997	-	-	1998	4,126	35.8	1999	2,305	20.0	6,431	55.8
	1998	6,505	1998	41	0.6	1999	2,543	39.1	2000	1,501	23.1	4,085	62.8
	1999	5,370	1999	226	4.2	2000	1,626	30.3					
	2000	7,851	2000	110	1.4								
Western Isles	1992	3,195	1992	-	-	1993	1,742	54.5	1994	802	25.1	2,544	79.6
	1993	2,805	1993	-	-	1994	1,909	68.1	1995	825	29.4	2,734	97.5
	1994	4,002	1994	125	3.1	1995	3,252	81.3	1996	442	11.0	3,819	95.4
	1995	3,983	1995	80	2.0	1996	2,836	71.2	1997	641	16.1	3,557	89.3
	1996	5,137	1996	152	3.0	1997	4,340	84.5	1998	491	9.6	4,983	97.1
	1997	5,274	1997	170	3.2	1998	3,900	73.9	1999	447	8.5	4,517	85.6
	1998	6,559	1998	187	2.8	1999	4,455	67.9	2000	294	4.5	4,936	75.2
	1999	8,445	1999	411	4.9	2000	4,839	57.3					
	2000	8,325	2000	198	2.4								

*See figure 7.

Figure 7. Distribution of Active Salmon Farms in Scotland during 2000



Staffing

Table 32: Number of Staff Employed in Salmon Production during 1992-2000

Year		1992	1993	1994	1995	1996	1997	1998	1999	2000
Staff	F/T	985	976	1,003	1,104	1,150	1,088	1,117	1,036	1,141
	P/T	275	248	242	251	241	207	192	268	256
Total staff		1,260	1,224	1,245	1,355	1,391	1,295	1,309	1,304	1,397
Productivity (tonnes/person)		28.7	39.8	51.4	51.7	59.8	76.6	84.6	97.2	92.3
Production (tonnes)		36,101	48,691	64,066	70,060	83,121	99,197	110,784	126,686	128,959

The total number of staff employed in salmon production in 2000 was 1,397 an increase of ninety three. In addition, the proportion of full-time to part-time positions increased when compared to 1999. The staff figures collected refer specifically to the production of salmon and do not include processing or marketing activities. Productivity dipped to 92.3 tonnes production per-person, breaking a trend evident since 1992. A number of sites have recently re-opened following the extended fallowing due to the ISA outbreak in 1998. The increase in employment may be attributed to these sites re-opening.

Production Methods

Table 33: Number of Fish Farms, Capacity and Production for Tank and Cage Culture Methods, Tonnage during 1998-2000

Method	Number of sites			Total capacity (000s cubic metres)			Production (tonnes)		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
Seawater tanks	4	3	2	27	15.5	15.5	317	194	129
Seawater cages	320	336	344	11,636	13,596	14,423	110,467	126,492	128,830

Almost all of the fish, 128,830 tonnes (99.8%) were produced in seawater cages, the proportion from seawater tanks, 0.2%, remaining the same as in 1999. This figure reflects continued high installation and running costs incurred in operating seawater tank systems. Forty-eight active seawater tank sites were registered in Scotland. Only two were actively producing salmon. Most seawater tank capacity has now been re-deployed for the production of other species.

Sea cage capacity increased by over 800,000 m^3 in 2000, reflecting the rise in the number of sites in production and a decrease in the stocking densities. Production efficiency in cages, measured as the ratio of fish weight in kilograms produced per cubic metre, decreased by 0.4kg in 2000. This reduction may have a positive impact on fish welfare and stock performance. Calculation of the ratio of production (Kg) by cage capacity indicates that stocking densities were 9.5, 9.3 and 8.9 Kg/m^3 in 1998, 1999 and 2000 respectively.

Scale of Production by Site

Table 34: Tonnage Produced from Farms of different sizes and for Proportion of Total Production from Farms in Each size Category during 1994-2000

		Size of farm (tonnes) produced						Total		
		0	1-50	51-100	101-200	201-500	501-1,000	>1,000	Sites	Tonnes
No. of sites	1994	154	29	31	49	64	27	9	363	64,066
	1995	162	24	23	37	68	32	13	359	70,060
	1996	125	20	28	49	66	25	21	334	83,121
	1997	120	21	22	41	63	43	28	338	99,197
	1998	130	32	16	31	66	39	29	343	11,784
	1999	158	21	17	21	53	42	39	351	126,686
	2000	183	8	20	15	40	40	40	346*	128,959
Proportion of total tonnage (%)	1994	0	1	4	12	33	31	19	-	-
	1995	0	1	2	8	31	32	26	-	-
	1996	0	1	3	9	27	22	39	-	-
	1997	0	1	2	6	20	28	43	-	-
	1998	0	<1	1	4	21	23	50	-	-
	1999	0	1	1	2	13	24	59	-	-
	2000	0	<1	1.4	1.9	10.9	25.1	60.5		

***Includes farms stocked but having no production.**

In 2000, there was a decrease (13) in the number of sites producing less than 50 tonnes. There was an increase (9) in those sites producing in excess of 500 tonnes. This trend toward large sites has been continuing over several years.

Company Productivity

Table 35: Number of Companies, Production (tonnes), Manpower and Productivity (tonnes per person) from Farms of Different Sizes during 1999-2000

Total tonnage		0-100	101-200	201-400	401-700	701-1,000	1,001-2,000	>2,000	Total
No. of Companies	1999	26	8	14	14	8	11	13	94
	2000	30	6	11	9	7	12	15	90
No. of tonnes	1999	574	1,151	3,856	7,552	6,801	16,236	90,516	126,686
	2000	536	886	3,487	5,235	6,198	16,950	95,667	128,959
Manpower (total)	1999	119	31	75	106	100	123	750	1,304
	2000	104	33	63	68	124	166	839	1,397
Productivity (tonnes/ person)	1999	5	37	51	71	68	132	121	
	2000	5	27	55	77	50	102	114	

Productivity can be used as a measure of efficiency, and was found to be related to the scale of production. The greatest productivity (114 tonnes per person) was achieved in those companies having a production in excess of two thousand tonnes and the least (five tonnes per person) in the companies producing the smallest tonnages.

Overall production was dominated by 15 companies in 2000, which between them accounted for 74% of the salmon production in Scotland.

Manpower and Production by Production Area

Table 36: Manpower and Production (tonnes) (as Grilse, Pre-salmon and Salmon) and Producitivy per Person by Area during 1994-2000 and Projected Production in 2001

Region	Year	Staff		Year of Input		Grilse		Pre-salmon		Salmon		Annual production*	Productivity (t/pers.)
		F/T	P/T	Tonnes	Mean wt (kg)	Tonnes	Mean wt (kg)	Tonnes	Mean wt (kg)	Tonnes	Mean wt (kg)		
North west	1994	407	59	170	1.6	7,392	2.7	9,991	3.7	7,450	4.5	25,003	54
	1995	401	54	99	1.6	7,291	2.7	7,433	3.6	7,686	4.0	22,509	49
	1996	405	45	200	2.0	14,824	3.1	10,789	3.9	6,469	4.5	32,282	72
	1997	392	40	221	2.0	14,879	3.2	14,669	3.9	5,449	4.7	35,218	82
	1998	396	43	1,139	3.6	12,847	3.0	10,973	3.8	7,254	4.0	32,213	73
	1999	403	72	670	2.3	18,618	3.1	12,538	4.0	7,809	3.6	39,635	83
	2000	365	62	1,795	3.9	20,360	3.5	16,374	4.4	6,957	4.3	45,486	106
	2001											39,354*	
Orkney	1994	48	19	-	-	371	2.5	957	3.0	780	3.6	2,108	31
	1995	58	11	-	-	392	2.7	849	3.4	662	3.8	1,903	28
	1996	55	13	-	-	511	2.5	1,023	3.3	910	4.1	2,444	36
	1997	36	20	-	-	277	2.6	1,119	3.5	1,667	3.9	3,063	67
	1998	66	15	150	2.0	1,884	3.4	1,378	3.3	1,073	3.4	4,485	55
	1999	78	20	22	2.2	1,162	3.2	2,486	4.0	1,232	4.8	4,902	50
	2000	91	15	0	-	3,338	3.6	2,089	3.1	943	3.6	6,370	60
	2001											8,318*	
Shetland	1994	193	106	23	1.0	3,371	2.6	5,967	2.9	4,918	3.9	14,279	48
	1995	201	109	59	1.4	4,204	3.2	6.908	3.9	4,352	4.4	15,523	50
	1996	209	114	-	-	2,042	2.8	8,814	3.9	8,854	4.8	19,710	61
	1997	224	83	-	-	3,207	2.9	10,002	3.7	11,421	4.4	24,630	84
	1998	218	93	222	2.8	11,162	1.5	16,690	4.2	5,330	4.7	33,404	107
	1999	227	100	221	3.4	4,449	2.7	15,111	4.0	16,447	4.3	36,228	111
	2000	258	77	0	-	7,189	3.7	16,360	4.5	19,584	4.1	43,133	129
	2001											54,257*	
South West	1994	173	35	5	1.0	3,277	2.8	4,249	3.8	5,653	4.8	13,184	63
	1995	247	51	47	1.9	4,641	3.0	5,505	3.8	5,584	4.6	15,777	53
	1996	273	44	68	1.1	3,889	2.8	6,895	3.7	6,371	4.4	17,223	54
	1997	197	19	-	-	6,186	3.2	4,705	3.4	6,303	4.7	17,194	80
	1998	223	14	88	2.1	8,783	3.2	8,936	3.8	5,915	4.2	23,722	100
	1999	108	26	741	3.3	5,064	3.4	5,594	5.2	12,530	5.4	23,929	179
	2000	166	87	325	3.0	2,894	3.4	3,385	4.3	7,484	5.2	14,088	55.7
	2001											29,713*	
Western Isles	1994	182	23	191	1.5	2,976	2.7	3,316	4.2	3,011	3.8	9,494	46
	1995	197	26	164	2.0	5,707	2.9	4,845	3.8	6,632	4.4	14,348	64
	1996	208	25	370	2.4	4,510	2.8	4,701	3.8	1,881	4.3	11,462	49
	1997	239	45	364	2.1	9,678	3.5	6,627	4.2	2,413	3.8	19,082	67
	1998	214	27	449	2.4	4,287	3.2	9,843	3.8	2,494	5.1	17,073	71
	1999	220	50	1,109	2.7	11,966	4.1	6,835	4.5	2,082	4.7	21,992	81
	2000	261	15	553	2.8	11,448	3.7	6,526	3.8	1,355	4.6	19,882	72
	2001											26,837*	
All Scotland	1994	1,003	242	389	1.5	17,386	2.7	24,479	3.5	21,812	4.3	64,066	51
	1995	1,104	251	368	1.8	22,235	2.3	25,540	3.8	21,916	4.3	70,060	52
	1996	1,150	241	638	2.0	25,776	3.0	32,222	3.8	24,485	4.5	83,121	60
	1997	1,088	207	585	2.0	34,227	3.3	37,122	3.8	27,263	4.4	99,197	77
	1998	1,117	192	2,048	2.9	38,963	2.3	47,820	3.9	21,953	4.3	110,784	85
	1999	1,036	268	2,763	2.8	41,259	3.3	42,564	4.2	40,100	4.4	126,686	97
	2000	1,141	256	2,673	3.5	45,229	3.6	44,734	4.2	36,323	4.3	128,959	92
	2001											158,479*	

***Production in 2001 is based on farmers' own estimates**

Fallowing

Table 37: Number of Seawater Cage Sites Employing a Fallow Period during 1994-2000

Year	Fallow period (weeks) 0	<4	4-8	8-26	26-51	≥52	Total
1994	118	13	48	64	12	103	358
1995	110	14	60	73	6	91	354
1996	112	12	71	70	13	56	334
1997	122	6	54	77	11	65	335
1998	118	10	55	84	22	54	343
1999	94	12	49	90	33	73	351
2000	74	23	61	86	25	75	344

Of the 344 cage sites recorded as being active in 2000, 184 farms were fallow for a variable period, whilst 75 farms were fallow for the whole of 2000. The accepted normal production cycle in sea water varies in length between 18 months and two years, and a fallow period at the end of production can break the cycle of disease or parasitic infections. There were 74 sites that had no fallow period in 2000. These may have been stocked late in 1999 with out of season smolts, or may not have used a fallow period.

It is a recommendation of FRS Marine Laboratory that a minimum fallow period of six weeks is used between on-growing cycles. In May 2000, Scottish Executive announced that it was going to consider the possibility of mandatory fallowing at seawater production sites in the future.

Broodstock Farms

Table 38: Number of Sites Holding Broodstock during 1991-2000

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Broodstock sites	27	15	21	24	18	28	37	25	20	18

In 2000, the number of sites holding broodstock, including freshwater and seawater farms was 18, a decrease on the 1999 figure. The number of sites holding broodstock in any one year is variable, as can be seen from the previous years' figures, which indicate no obvious trend. Seventeen thousand, eight hundred and fifty four female fish were stripped, yielding almost 125 million ova, compared with 122 million in 1999, which can be calculated to show an average ova yield per fish of 7,001.

Conclusions

Atlantic salmon

Smolt production increased, with the continued dominance of the production of S1 smolts. The number of staff directly employed on site increased, with the creation of 20 jobs. Productivity per person involved in freshwater production is over 102,000 fish.

Almost all ova for the production of Scottish salmon was derived from Scottish farmed stocks, with only 6% derived from non-Scottish stocks. The export of ova to other countries within the EU decreased by 56%, whilst exports to Chile decreased by 40%.

Projected estimates for 2001 suggest that there were fewer ova laid down to hatch, and that more smolts will be produced in 2001 and 2002.

The production tonnage in sea water increased by 1.8% in 2000, due mainly to an increased average weight. The estimated smolt placement in 2001 is 50.2 million, which would indicate an increased harvest in 2001 and 2002, given improvements in average weight. The estimated harvest forecast for 2001 is 158,479 tonnes, an increase of 23% on the 2000 total.

Overall production was dominated by 15 companies in 2000, which between them accounted for 74% of the salmon production in Scotland. Another developing characterisic of the Scottish industry is that 11.6% of the active farms produced 60.5% of the toal harvest in 2000. This demonstrates the salmon industry's continued reliance on larger farms.

4. OTHER SPECIES

There is an increased interest in the production of other species, in aquaculture. Brown trout (*Salmo trutta*) has been farmed for many years for the restocking market, but there is an increasing interest in diversification into emerging marine species. As this sector expands, the employment provided and the contribution to the total production of the Scottish aquaculture industry will increase.

Table 39: Number of Staff Employed in Farming Other Species during 1999-2000

Year	Full-time	Part-time	Total
1999	54	18	72
2000	73	25	98

Table 40: Number of Companies and Sites Producing Other Species and Production of Other Species (tonnes) during 1999-2000 and Estimated Production 2001

Species	No. of companies	No. of sites	1999 production tonnage	2000 production tonnage	2001 production tonnage*
Arctic Char	7	10	2.8	7	16
Brown Trout/ Sea Trout	19	26	92	138	191.5
Cod	6	7	0.1	15.7	41
Halibut	7	12	3.6+	4.5	189

***farmers' estimates based on stocks currently being on-grown**

Not all of this production is for the table market. There is some production of Arctic char (*Salvelinus alpinus*) and brown trout for the angling restocking market.

Table 41: Source of Other Species Ova Laid Down to Hatch in 2000

Species	Source of ova laid down to hatch (000s)		
	Own broodstock	Other GB broodstock	Foreign ova
Arctic char (*Salvelinus alpinus*)	350	82	835
Cod (*Gadus morhua*)	10,600	0	0
Brown trout/Sea trout (*Salmo trutta*)	2,451	200	47
Halibut (*Hippoglossus hippoglossus*)	37,400	1,300	0

Table 42: Trade in Other Species Small Fish in 2000

Species	Bought (000s)	Sold (000s)
Cod	25	0
Halibut	57	103
Brown Trout / Sea Trout	144	477

There were also sites stocked with carp (*Cyprinus carpio*), turbot (*Scophthalmus maximus*), lemon sole (*Microstomus kitt*), lumpsucker (*Cyclopterus lumpus*) and haddock (*Melanogrammus aeglefinus*). There was production of carp, brook trout and turbot, but due to the small number of companies in production, it is not possible to summarise these data without revealing the production of individual companies.

APPENDIX 1

Questionnaires sent to Fish Farmers

ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS
FOR THE PERIOD 1 JANUARY TO 31 DECEMBER 2000

RAINBOW TROUT - DATA

Please complete and return by 11 January 2001 to C. E. T. Allan, FRS Marine Laboratory
PO Box 101, Victoria Road, Aberdeen, AB11 9DB

Reg No SF/

Name of site	Please correct site name here (if necessary)	Please correct main method of production on each site (if necessary), ie freshwater cages or tanks

1 How many staff were employed in trout production (company total) **Full time** ☐☐☐ **Part time** ☐☐☐

		Site 1	Site 2	Site 3	Site 4
2	**How many eyed ova were laid down for hatching in 2000**				
a	from own broodstock				
b	from GB broodstock				
c	from abroad (Northern Hemisphere including N Ireland and Isle of Man)				
d	from abroad (Southern Hemisphere)				
3	**How many of the above ova were**				
a	all female diploid				
b	mixed sex diploid				
c	all triploid				
4	**How many fry/fingerlings were**				
a	bought				
b	sold				
5	**How many bought fry/fingerlings were**				
a	all female diploid				
b	mixed sex diploid				
c	all triploid				
6	**How many of these fish were vaccinated against ERM**				
a	on site				
b	bought vaccinated				
7	**What was your total production in TONNES for the TABLE TRADE**				
a	<450 g (<1 lb)				
b	450-900 g (1-2 lb)				
	>900 g (>2 lb)				
8	**What was your total production in TONNES for the RESTOCKING TRADE**				
a	<450 g (<1 lb)				
b	450-900 g (1-2 lb)				
c	>900 g (>2 lb)				

ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS
FOR THE PERIOD 1 JANUARY TO 31 DECEMBER 2000

ATLANTIC SALMON - SMOLT DATA

Please complete and return by 11 January 2001 to C. E. T. Allan, FRS Marine Laboratory
PO Box 101, Victoria Road, Aberdeen, AB11 9DB

Reg No SF/

Name of site | Please correct site name here (if necessary) | Please correct main method of production on each site (if necessary) ie freshwater cages or tanks

1 **How many staff were employed in smolt production company total)** **Full time** ☐☐☐ **Part time** ☐☐☐

2 **How many ova were produced in the winter of 1999-2000 (company total)** ☐☐☐☐☐☐☐

		Site 1	Site 2	Site 3	Site 4
3	**How many eyed ova were laid down for hatching (winter of 1999-2000)**				
a	From own farmed broodstock	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	From other GB farmed broodstock	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
c	From GB wild broodstock	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
d	From foreign sources	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
4	**How many eyed ova do you expect to hatch this winter (2000-2001)**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
5	**How many fry or parr were**				
a	Transferred into the site	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	Transferred out of the site	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
6	**How many smolts were produced as**				
a	S1/2 s (ie from 2000 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	S1s (ie from 1999 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
c	S1 1/2 s (ie from 1998 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
d	S2s (ie from 1998 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
7	**How many smolts were sold as**				
a	S1s (incl S1/2 s)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	S2s (incl S1 1/2 s)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
8	**How many smolts do you expect to produce for sea winter on-growing next spring (2001) as**				
a	S1s (incl S1/2 s)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	S2s (incl S1 1/2 s)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
9	**How many smolts do you plan to produce in the spring of 2002**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
10	**What is the fish holding capacity of each site in cubic metres**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
11	**Duration of FALLOW PERIOD in WEEKS (cage sites only)**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
12	**How many fish did you vaccinate**				
a	**against furunculosis**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	**against ERM**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
c	**agianst *Vibrio* sp.**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
d	**against IPN**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐

ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS
FOR THE PERIOD 1 JANUARY TO 31 DECEMBER 2000

ATLANTIC SALMON - PRODUCTION DATA

Please complete and return by 11 January 2001 to C. E .T. Allan, FRS Marine Laboratory
PO Box 101, Victoria Road, Aberdeen, AB11 9DB

Reg No SF/

Name of site	Please correct site name here (if necessary)	Please correct main method of production on each site (if necessary), ie seawater cages or tanks

1 How many staff were employed in salmon production (company total), excluding post-harvest processing staff) **Full time** ☐☐☐ **Part time** ☐☐☐

		Site 1	Site 2	Site 3	Site 4
2	**How many smolts were put into the site in 2000 as**:				
a	$S^1/_2$ s (ie from 2000 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	S1s (ie from 1999 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
c	$S1^1/_2$ s (ie from 1998 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
d	S2s (ie from 1998 hatch)	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
3	**How many of the above smolts came from England**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
4	**Total smolt input proposed in 2001**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
5	**HARVEST of 2000 SMOLT INPUT in 2000**				
a	Number of tonnes	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	Number of fish	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
6	**HARVEST of 2000 SMOLT INPUT from 1 JANUARY to 31 AUGUST**				
a	Number of tonnes	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	Number of fish	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
7	**HARVEST of 1999 SMOLT INPUT from 1 SEPTEMBER to 31 DECEMBER**				
a	**Number of tonnes**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	Number of fish	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
8	**HARVEST of 1998 SMOLT INPUT**				
a	Number of tonnes	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
b	Number of fish	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
9	**How many tonnes of fish do you expect to produce in 2001**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
10a	**Were brood fish produced in 2000**	**YES/NO**	**YES/NO**	**YES/NO**	**YES/NO**
b	**How many fish were stripped**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
11	**What is the current fish holding capacity of each site in cubic metres**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
12	**Duration of FALLOW PERIOD in WEEKS (cage sites; MAX=52)**	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐	☐☐☐☐☐☐
13	**Does a management agreement in respect of fish health operate with other producers in your area**	**YES/NO**	**YES/NO**	**YES/NO**	**YES/NO**

ANNUAL RETURN OF INFORMATION FROM SCOTTISH FISH FARMS
FOR THE PERIOD 1 JANUARY TO 31 DECEMBER 2000

OTHER SPECIES – DATA

Please complete and return by 11 January 2001 to C. E. T. Allan, FRS Marine Laboratory
PO Box 101, Victoria Road, Aberdeen, AB11 9DB

Business address

Business number:

FB/0

	Name of site	Site no	Species code	Main method of production
1		FS0		
2		FS0		
3		FS0		
4		FS0		

1 How many staff were employed in smolt production company total) **Full-time** **Part-time**

	Site	Site	Site	Site
SPECIES CODE				
2 How many eyed ova were laid down for hatching (winter of 1999-2000)				
a From own broodstock				
b From other GB broodstock				
c From foreign sources				
3 How many fry/small fish were				
a Bought				
b Sold				
4 What was your total production for the market in TONNES				
5 What is your predicted production for the market in 2001 in TONNES				

APPENDIX 2

Glossary and Abbreviations

Active	Fish farms in a production growing cycle which may contain stock or be fallow.
Alevin	Young salmon, at stage from hatching to end of dependence on yolk sacs as primary source of nutrition.
Approved Zone Status	EU recognition of an area clear of listed disease(s).
Biomass	Weight of organisms in an area.
Cohort	A group of fish spawned at a given period.
Diploid	Fish with the normal two sets of chromosomes.
Eyed-ova/eggs	Fish egg(s) at the stage of development when the heavily pigmented eyes of the embryo are sufficiently developed to be clearly visible.
Fallow	Fish farm having no stock, but still part of a growing cycle.
Fecundity	Fertility of an organism.
Fingerling	A term commonly applied to young stages of salmonid fish.
First feeder	Refers to the youngest feeding fish on a farm.
Fry	Young salmon at stage from independence of yolk sac as primary source of nutrition to dispersal from the redd.
GB approved	EU recognised zone clear of List ll diseases. health zone
Grilse	Salmon maturing after one winter at sea.
Grilsing period	Period during first year at sea when gonads are maturing (salmon).
Inactive	Fish farms not in a production cycle and without stock.
Milt	Sperm.
Monovalent	Vaccine to produce a protective immune response against a single pathogen.
Non-producing	A site which is active, may be stocked with fish, but has produced no fish for harvest during the specified year.
Ongrowing	Farm producing fish for the table market.
Ova	Eggs
0-year fish	Fish in their first year of life.
Parr	Young salmon at stage from dispersal from redd to migration as a smolt.
Photoperiod	Alteration of light regime.
Polyvalent	Vaccine to produce a protective immune response against several pathogens.

Pre-salmon	Non-mature salmon usually after one winter at sea.
Raceway	Concrete or brick channels used for farming fish.
Recreational Fisheries	Angling fishery.
S$^{1}/_{2}$	Salmon or sea trout smolting at approximately six months from hatch (usually by photoperiod and/or temperature manipulation)
S1	Salmon or sea trout smolting at approximately one year from hatch.
S1$^{1}/_{2}$	Salmon or sea trout smolting at approximately 18 months from hatch.
S2	Salmon or sea trout smolting at approximately two years from hatch.
Smolt	Fully silvered juvenile salmon ready to be tansferred or to migrate to sea.
Third Country	Country outside the EU.
Triploid	Genetically modified fish which have three sets of chromosomes instead of two.
Year Class	Fish hatched or put to sea in a given year.

ATC	Animal test certificate
ERM	Enteric redmouth
IHN	Infectious haemopoeitic necrosis
IPN	Infectious pancreatic necrosis
ISA	Infectious salmon anaemia
VHS	Viral haemorrhagic septicaemia
RTFS	Rainbow trout fry syndrome
SEERAD	Scottish Executive Environment and Rural Affairs Department
VMD	Veterinary Medicines Directorate