Part 6 Juvenile salmon and trout populations

6.1 Introduction

The productivity of Little Gruinard and Fionn Loch salmon and trout populations and fisheries depend upon both freshwater production of juvenile fish and, for salmon and sea trout, marine survival. Some of the pressures that determine marine survival are largely outwith the influence of local fisheries managers. However, some of the factors which affect juvenile fish production from freshwater can be influenced by management.

This part of the Fisheries Management Plan presents a synthesis of the main findings from electro-fishing surveys carried out to investigate juvenile fish populations within the Little Gruinard catchment. Surveys were designed primarily to assess the distribution and abundance of juvenile salmon within the part of the catchment area accessible to spawners, and to highlight any issues of concern for management. Electro-fishing survey results provide an indication of the status of juvenile salmon populations, and together with information describing fish habitat (see Part 7), the potential 'production capacity', in terms of salmon smolts, of different parts of the accessible area.

Most of the information reported here is based on field data gathered by WRFT electro-fishing teams trained to Scottish Fisheries Co-ordination Centre (SFCC) electro-fishing protocols. Dr Jason Godfrey of SFCC analysed data from the 2004 survey, as part of an assessment of juvenile salmon populations in candidate [now designated] Special Areas of Conservation [SACs] for the Atlantic salmon (*Salmo salar*) in Scotland.

Looking upstream towards the Garden Pool on 23rd August 2006. The shallow 'cobbly' channels around the islands below this pool provide excellent habitat for juvenile salmon. Salmon fry and parr were consistently found at electro-fishing site LGD8 just off the picture to the right during e-fishing surveys indicating nearby spawning.

6.2 Methods

Electro-fishing has become a standard method for surveying populations of juvenile fish in stream habitats. Electro-fishing relies on the creation of an electric field in water to which fish will respond by some form of forced swimming and / or immobilisation, thus rendering them easy to capture. Using specialised equipment and trained staff, surveys can be carried out effectively in water up to about 30cm deep. Fish are temporarily immobilised and transferred to a bucket of water where they quickly recover. They are then anaesthetised, measured and counted, and after a period of recovery, returned to the river. Studies have shown that, used correctly, the method causes insignificant damage to small fish (e.g. Sigourney *et al.*, 2005)[26].

Two survey methods were used. In **fully-quantitative electro-fishing**, a section of river is closed off with nets. Fish within that section are systematically removed. Having measured the area of water fished, an estimate of the density of fish can be made. By fishing through the closed-off section two or more times, estimates of fish densities can be made on the basis of a depletion curve. Estimates of fish densities are then standardised to the numbers of fish per $100m^2$ to allow comparisons between sites and rivers. **Timed (semi-quantitative) electro-fishing** involves fishing for a recorded time at a steady rate through a section of likely juvenile habitat. This gives an index of abundance of juvenile fish caught per minute, or ***Catch Per Unit Effort*** (CPUE). This technique is faster to use than fully-quantitative fishing and allows an insight into the relative abundance of juvenile fish over a larger area in a relatively shorter period of time than fully-quantitative fishing. For nearly all purposes, the data obtained from timed electro-fishing is as useful as fully-quantitative fishing; and as each site is fished only once, information describing juvenile fish occurrence can be gathered for more sites in a day than from fully-quantitative fishing. Different approaches are discussed further in Bacon and Youngson (2007)[27].

WRFT electro-fishing surveys were carried out by Dr James Butler, Peter Cunningham, Dr Lorna Brown, Norman Thomas, David Mullaney, Karen Starr, Ken Williamson, Roger McLachlan and Garry Bulmer, with support from Letterewe Estate and keepers Mark Melville and Graeme Wilson.

Measuring a 'fully-quantitative' stop-netted electro-fishing site just above the 1st flats in 2004.

[26] http://afsjournals.org/doi/abs/10.1577/M04-075.1
[27] http://www.scotland.gov.uk/Uploads/Documents/SFRR_67.pdf

6.3 Chronology

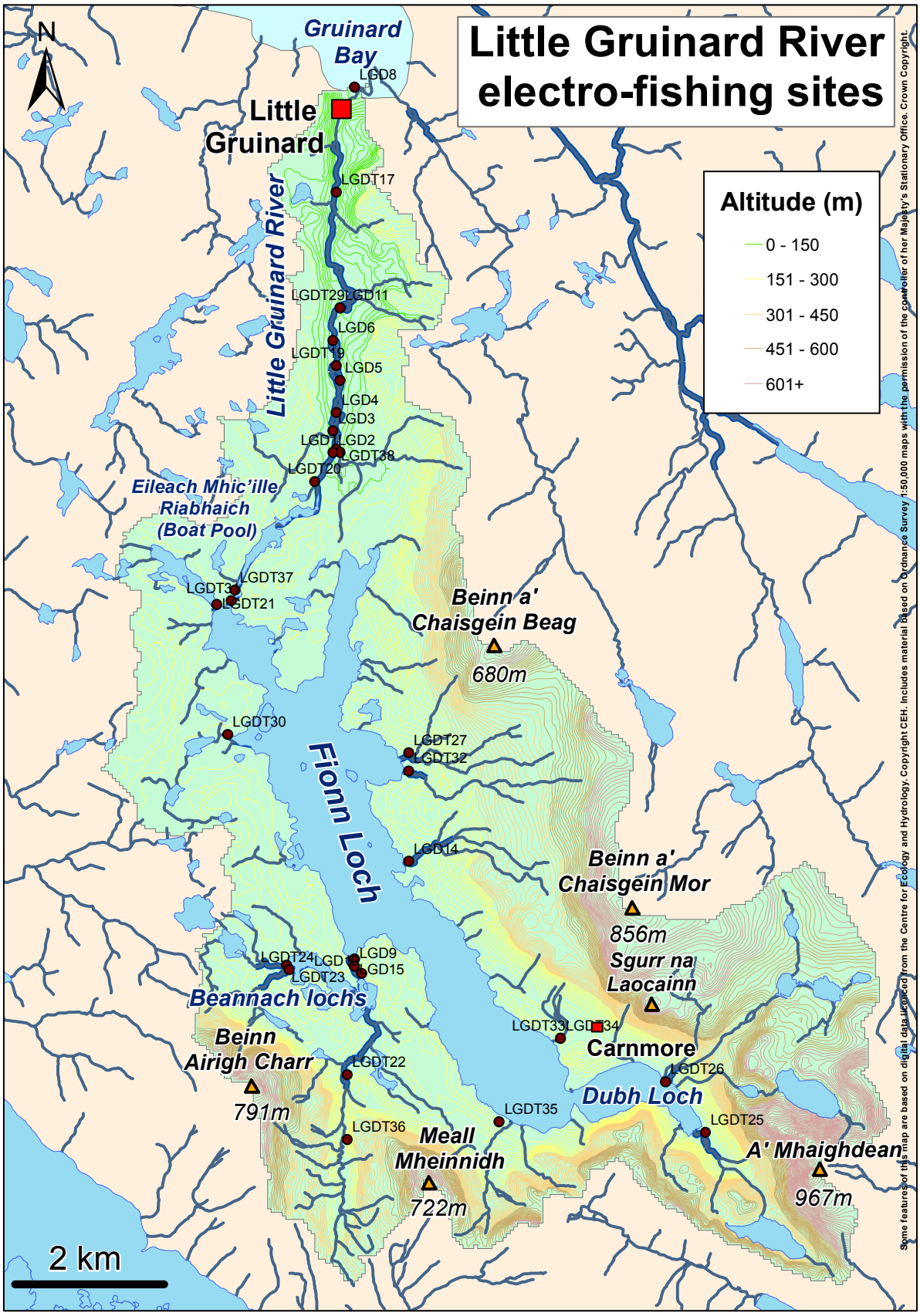
Surveys were carried out by WRFT in 1997, 1999, 2001, 2003, 2004, 2006, 2008 and 2009. From 1997-2003, the survey comprised a series of 'fully-quantitative' sites in the main river between the Fionn Loch and the estuary and two sites in the Beannach Burn above the Fionn Loch. These surveys provided an indication of variation in fish densities, and enabled comparison of juvenile fish occurrence between years and between the Little Gruinard and other salmon rivers in the area. They demonstrated that the mainstem Little Gruinard River consistently supported the highest densities of juvenile salmon.

In 2004, following designation of the Little Gruinard River system as a SAC [Special Area of Conservation] for Atlantic salmon, a more extensive survey of the catchment was undertaken, including new sites on other tributary streams above the Fionn Loch. This more detailed survey was funded by SNH as part of a programme of Atlantic salmon 'candidate' SAC [cSAC] site assessments for Scotland, and included both 'full-quantitative' sites where estimates of absolute fish density were obtained, and 'semi-quantitative' or 'timed' sites, to explore variation in the relative abundance of juvenile salmon over a larger area and contrast between different habitats. Because this survey was part of a much larger assessment of salmon populations in all the SAC salmon rivers in Scotland, it was possible to compare the distribution, density and growth of juvenile salmon in the Little Gruinard with that of other cSAC Atlantic salmon rivers in Scotland.

Dr Lorna Brown and Norman Thomas heading for an electro-fishing site above Lochan Beannach Beag, August 2004.

Following on from the 2004 survey, a scaled-down survey was carried out in 2006. Rather than focussing only on sites in 'core' habitat areas in the mainstem river (the easiest places for salmon to live), the aim was to gain an indication of juvenile salmon occurrence throughout the accessible area, revisiting 'marginal' habitat areas of the upper catchment (the hardest places for salmon to live). Elsewhere in Wester Ross, juvenile salmon populations were lost during the 1990s from the upper reaches of several rivers, including the Gruinard, Ewe, Balgy, Glenbeag and Glenmore. Populations in these areas are more sensitive to changes in rates of survival than those in core areas. So in 2006, 24 timed sites were surveyed throughout the Little Gruinard catchment over four days. In 2008, six sites were surveyed in the Little Gruinard mainstem, and in 2009, 5 sites were surveyed in tributary streams above the Fionn Loch providing an indication of the health and status of the juvenile salmon populations within the least accessible parts of the system.

Figure 6.1 Locations (labelled dots) of principal WRFT electro-fishing sites within the Little Gruinard river system (for locations of cSAC SNH sites surveyed in 2004, please see Figure 6.3).

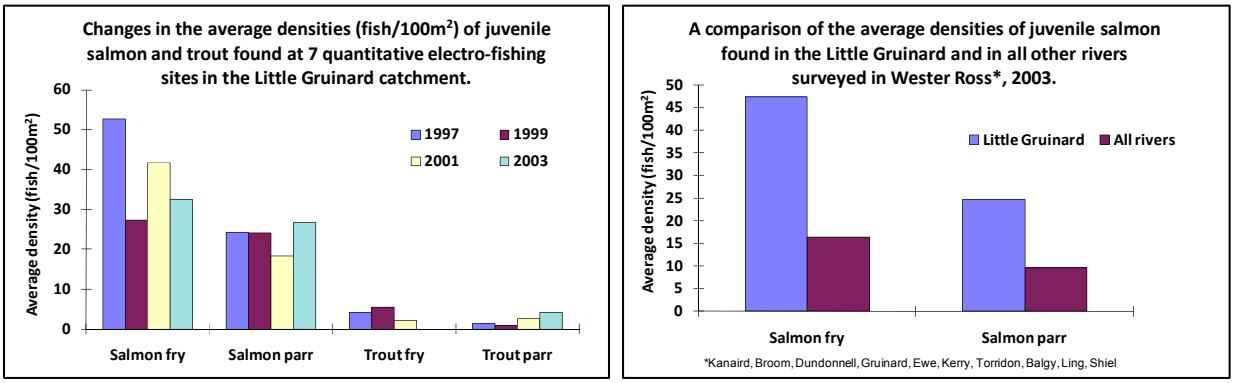


6.4 Results

6.4.1 Juvenile salmon densities in 1997 – 2003

The fully-quantitative electro-fishing surveys in 1997, 1999, 2001 and 2003 demonstrated consistently high densities of both salmon fry and salmon parr within the system. Average densities for the seven sites which were fished in each of these years are shown in Figure 6.2a. Five of these sites were in 'core' habitat areas in the main Little Gruinard River, the other two in the Beannach burn with stable streambed (note that densities of juvenile trout were consistently much lower than those of salmon; see Part 6.4.5 for discussion of trout). In 2003, densities of salmon parr and salmon fry were over twice the average of respective densities recorded for other rivers in the WRFT area that year (Figure 6.2b).

Figure 6.2 (a, left) Changes in the average densities of salmon and trout found at 7 quantitative WRFT electro-fishing sites in the Little Gruinard river catchment. Figure 6.2 (b, right) Average densities of juvenile salmon found at WRFT sites surveyed in the Little Gruinard compared to average densities of sites in other rivers in the WRFT area in 2003.

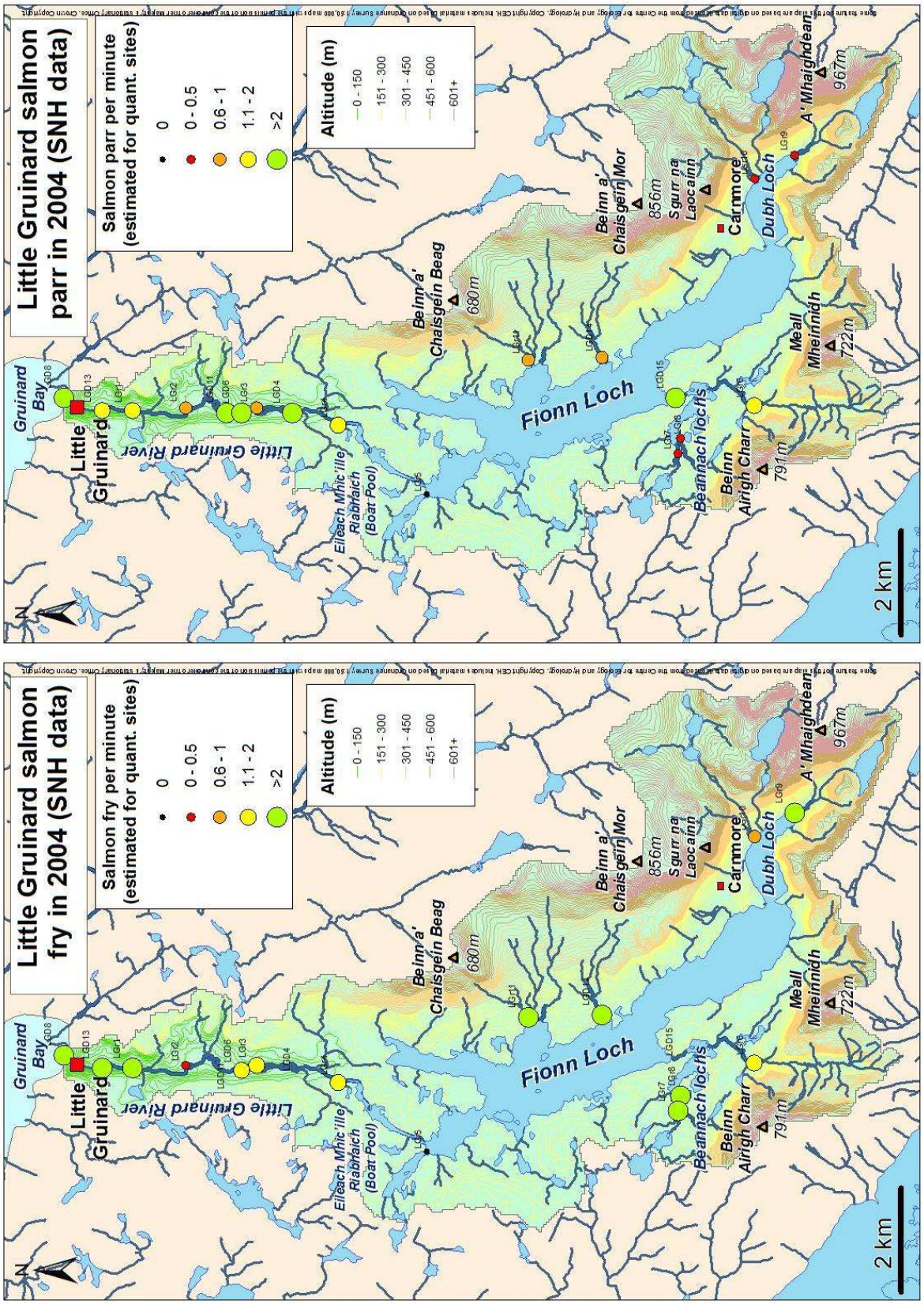


6.4.2 The 2004 cSAC juvenile salmon population assessment

As part of an initial assessment of the status of Scottish cSACs for the Atlantic salmon (*Salmo salar*) in 2004, the Scottish Fisheries Co-ordination Centre (SFCC) was awarded a contract by Scottish Natural Heritage to provide data describing juvenile fish populations. In fulfilment of the requirements of this task, the WRFT was asked by SFCC to provide electro-fishing data from a series of both fully-quantitative and timed electro-fishing sites within the Little Gruinard catchment, including new sites in previously un-surveyed streams flowing into the Fionn Loch. This survey, carried out in August and September 2004, provided the most detailed information to date about juvenile fish distribution and abundance within the system.

Juvenile salmon were recorded at all sites within the main Little Gruinard River and at 8 out of nine sites in tributaries flowing into the Fionn Loch. Figure 6.3 shows the distribution and relative abundance of both salmon fry and salmon parr within the catchment in 2004.

Figure 6.3 Distribution and relative abundance of juvenile salmon in the Little Gruinard in 2004. For timed sites, average CPUE for three habitats (glide, run and riffle) is indicated. Quantitative sites have been included using the equation number of fish per seconds = 0.1 x [3 run minimum density estimate for numbers of fish per 100m^2] (see Godfrey, 2005 for discussion of relationships). Based on SNH data.



At the seven fully-quantitative electro-fishing sites surveyed in 2004, juvenile salmon densities were again high, with averages of around 50 salmon fry per 100m^2 and 30 salmon parr per 100m^2 (Table 6.1 and Figure 6.4). These values compare favourably with densities recorded in earlier years (Figure 6.5).

Table 6.1 Estimates of juvenile salmon densities at the 7 fully-quantitative electro-fishing sites surveyed in 2004 (SNH data). Note: 1++ refers to salmon parr aged one year and older.

Site Code	Date	Area (m^2)	Mean wet width (m)	Zippin density 0+ (no $100m^{-2}$) +95% c.l.	3-run min 0+ (no $100m^{-2}$)	Zippin density 1++ (no $100m^{-2}$) +95% c.l.	3-run min S1++ (no $100m^{-2}$)
LGD8	08/09/04	112.1	7.8	51.9+4.9	49.1	46.0+3.1	44.6
LGD13	08/09/04	81.2	7.3	33.7+4.3	32.0	14.0+10.6	11.1
LGD11	06/09/04	61.4	6.7	113.6+13.7	104.2	43.7+10.6	39.1
LGD6	06/09/04	93.6	5.2	15.8+2.8	15.0	45.7+7.5	41.7
LGD4	13/08/04	115.4	4.8	116.0+63.1	71.1	38.8+34.4	24.3
LGD15	24/08/04	65.5	6.6	62.3+8.5	58.0	47.0+6.5	44.3
LGD14	18/08/04	70.2	3.6	38.5+30.1	27.1	7.2+0.5	7.1
Mean				**61.7**	**50.9**	**34.6**	**30.3**
s.d.				36.2	28.1	15.5	14.9

Figure 6.4 Comparison of juvenile salmon densities at the seven fully-quantitative electro-fishing sites surveyed in the Little Gruinard in 2004 (SNH data).

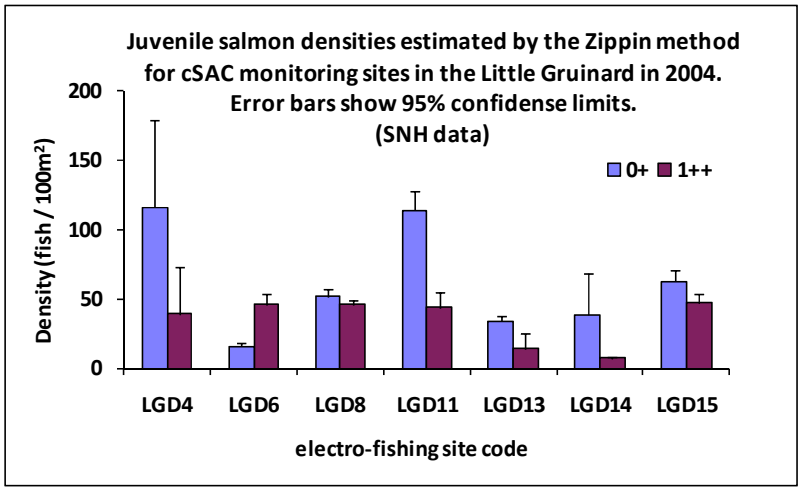
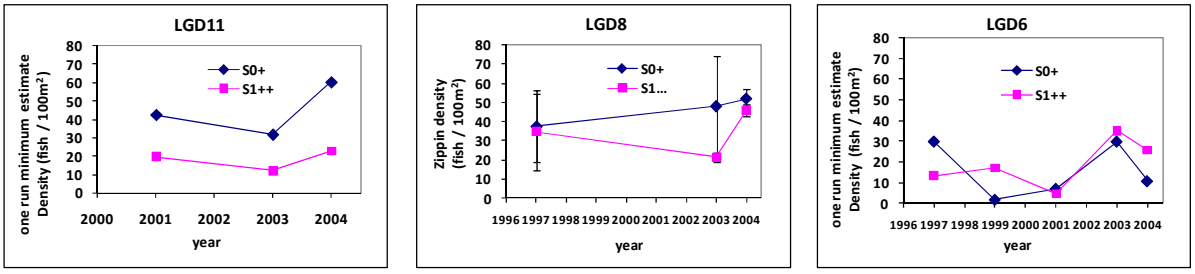


Figure 6.5 Recorded changes in densities of juvenile salmon at three fully quantitative sites fished in the Little Gruinard in 2001, 2003 and 2004 (includes SNH data).



From scale reading, salmon parr of over one (1+) and over two years old (2+) were present at all sites, and older (3+) parr were found at four of the seven sites (Table 6.2).

Table 6.2 Presence/absence of salmon year classes, and of trout 0+ and 1++ at depletion sites, Little Gruinard cSAC in 2004 (SNH data). Note: 1++ refers to trout aged one year and older.

Site Code	Salmon age class present?				Trout	
	0+	1+	2+	3++	0+	1++
LGD8	YES	YES	YES	YES	YES	no
LGD13	YES	YES	YES	no	no	no
LGD11	YES	YES	YES	no	no	YES
LGD6	YES	YES	YES	YES	no	YES
LGD4	YES	YES	YES	no	no	YES
LGD15	YES	YES	YES	YES	no	no
LGD14	YES	no	YES	YES	YES	no

The sizes and relative numbers of juvenile salmon of different age classes are shown in Table 6.3. By the end of their first summer, salmon fry (0+) were typically less than 50mm in length; parr were still less than 80mm long at the end of their second summer (1+), and exceeded 100mm at only two of the seven sites by the end of their third summer (2+). Note that a high proportion of parr at sites LGD8, LGD6, LGD14 and LGD15 were 2 or more years old, reflecting slow growth. This observation agrees with that of Walker who read the scales of adult fish in the 1990s; and is considered further in Part 7 of this report.

Table 6.3 Fork lengths of salmon of different age classes, Little Gruinard cSAC in 2004 (SNH data).

Site Code	0+ mean±s.d. fork length (mm)	no 0+	1+ mean±s.d. fork length (mm)	no 1+	2+ mean±s.d. fork length (mm)	no 2+	3+ mean±s.d. fork length (mm)	no 3+
LGD8	46.0±5.2	55	73.0±7.4	36	98.9±4.8	11	116.7±1.2	3
LGD13	45.2±4.4	26	77.6±6.4	8	116.0	1		0
LGD11	43.6±3.3	64	63.9±5.6	15	77.8±5.2	9		0
LGD6	50.6±5.6	14	65.8±1.5	4	80.4±8.3	31	101.0±3.6	4
LGD4	37.5±4.4	82	65.5±3.4	20	86.5±11.7	8		0
LGD15	49.3±4.4	38	68.7±4.9	7	84.4±8.1	19	107.0±2.0	3
LGD14	50.5±4.0	19		0	94.0	1	98.3±3.2	4

In addition to the seven fully quantitative electro-fishing sites, 11 sites were selected for timed electro-fishing survey in 2004, four on the mainstem, and seven on a range of smaller channels in tributaries around the Fionn Loch. At each of these sites, sections of 'glide', 'run' and 'riffle' habitat were each fished for 5 minutes to compare relative abundance (catch per unit effort) in different habitat types.

Table 6.4 Details of timed electro-fishing sites, Little Gruinard cSAC.

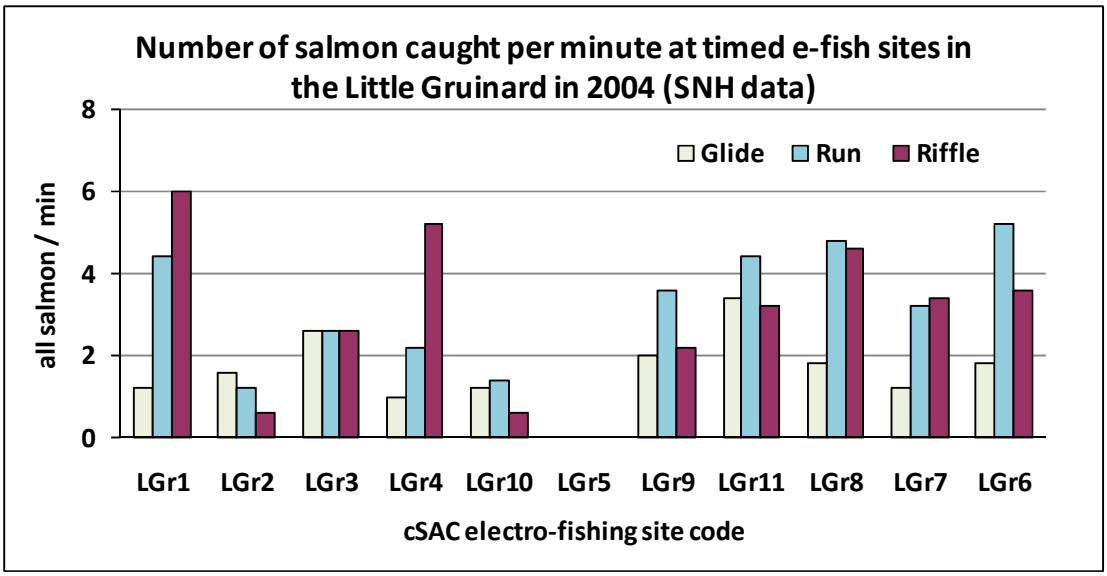
Site Code	Easting	Northing	River	Altitude (m)	Principal Local Landuse
LGr1	194250	888550	Little Gruinard	60	Heath/Moorland
LGr2	194300	887500	Little Gruinard	80	Heath/Moorland
LGr3	194300	886100	Little Gruinard	115	Heath/Moorland
LGr4	193960	884500	Little Gruinard	149	Heath/Moorland
LGr10	198830	876290	Allt Bruthach an Easain	173	Rough pasture
LGr5	192600	882750	Loch na Moine Buige Burn	174	Heath/Moorland
LGr9	199300	875500	Allt a' Chiadhain	174	Rough pasture
LGr11	195250	880750	Allt Glac Chaol	174	Rough pasture
LGr8	193700	877750	Loch an Doire crionaich Burn	175	Heath/Moorland
LGr7	193400	877800	Loch nan Clach Dubha Burn	185	Heath/Moorland
LGr6	194350	876300	Strathan Buidhe Burn	195	Heath/Moorland

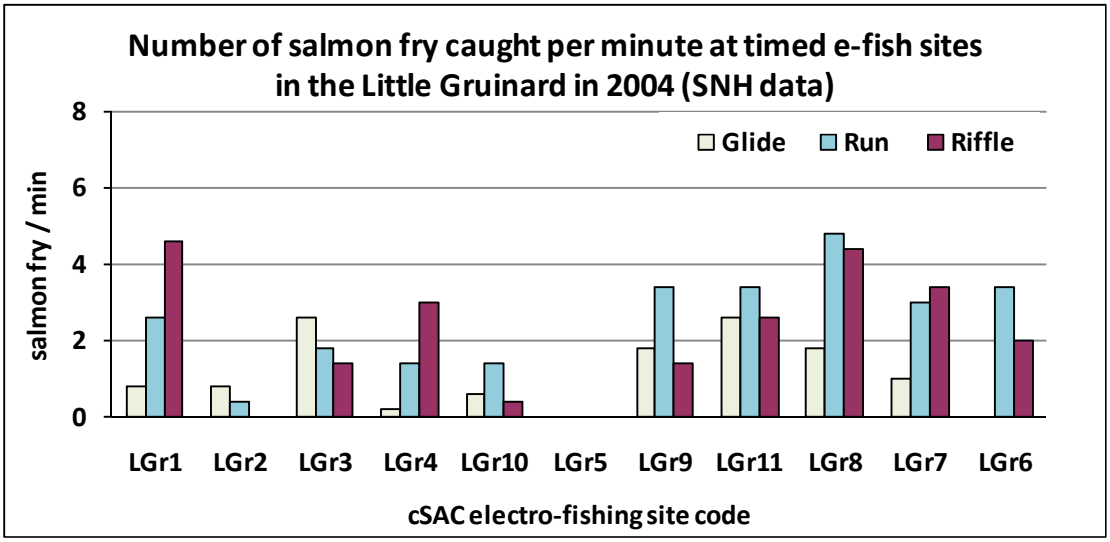
No salmon were caught at one site (LGr5, outwith the cSAC boundaries) (Table 6.5). At all the other sites both salmon fry and parr were present, with 2+ throughout, 1+ absent from two further sites, and 3+ fish present at the lowest mainstem site (LGr1). Catch rates for salmon averaged at about three per minute for run and riffle habitats, but only at about half that rate in the glides (Figure 6.6). Trout were present throughout except at the lowest mainstem site (LGR1) – see Part 6.5.

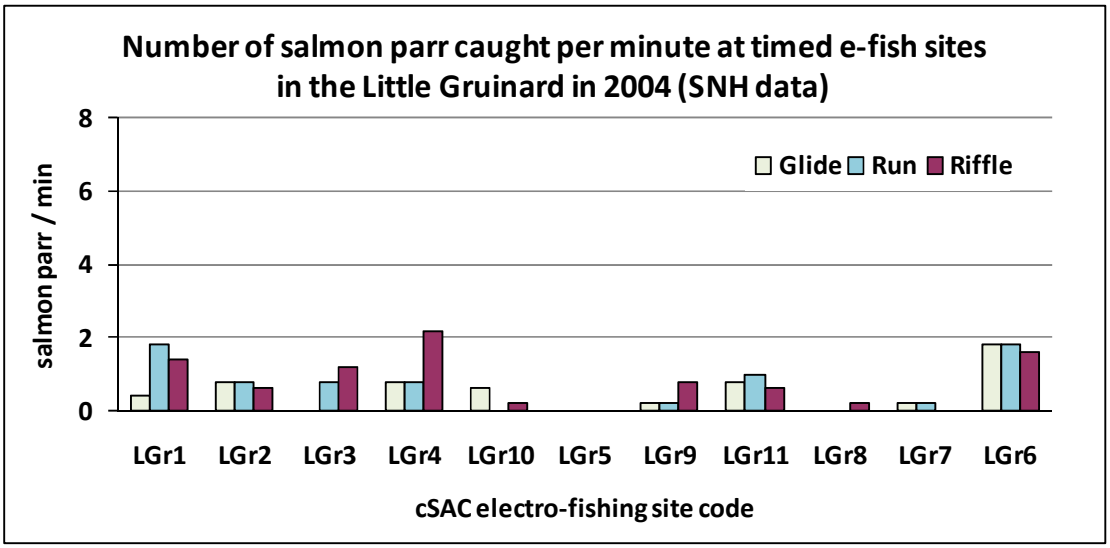
Table 6.5 Salmon CPUE in 'glide', 'run' and 'riffle' habitats at timed electro-fishing sites on the Little Gruinard cSAC. Each habitat type was fished for five minutes.

Site code	Survey date	Salmon 0+ min^{-1}			Salmon 1++ min^{-1}		
		Glide	Run	Riffle	Glide	Run	Riffle
LGr1	08.09.04	0.8	2.6	4.6	0.4	1.8	1.4
LGr2	06.09.04	0.8	0.4	0	0.8	0.8	0.6
LGr3	13.08.04	2.6	1.8	1.4	0	0.8	1.2
LGr4	13.08.04	0.2	1.4	3	0.8	0.8	2.2
LGr10	18.08.04	0.6	1.4	0.4	0.6	0	0.2
LGr5	18.08.04	0	0	0	0	0	0
LGr9	18.08.04	1.8	3.4	1.4	0.2	0.2	0.8
LGr11	18.08.04	2.6	3.4	2.6	0.8	1	0.6
LGr8	24.08.04	1.8	4.8	4.4	0	0	0.2
LGr7	24.08.04	1	3	3.4	0.2	0.2	0
LGr6	24.08.04	0	3.4	2	1.8	1.8	1.6
Mean		**1.11**	**2.33**	**2.11**	**0.51**	**0.67**	**0.80**
s.d.		0.91	1.39	1.57	0.51	0.64	0.69

Figure 6.6 Numbers of juvenile salmon caught per minute at the timed electro-fishing sites in the Little Gruinard River in 2004. Top: total fish; middle: salmon fry; bottom: salmon parr. See Figure 6.3 for locations of electro-fishing sites in 2004.







The average salmon parr density for fully-quantitative sites (all in core habitat area)in the Little Gruinard was the highest recorded for any cSAC river in Scotland in 2004 (Table 6.4, Figure 6.7). However, the mean CPUE for timed sites, which included more sites in small streams above the Fionn Loch was nearer the Scottish average (Figure 6.8)

Table 6.4 A comparison of juvenile salmon densities recorded at depletion and timed fishings at 14 cSACs in 2004 (SNH data)

	Depletion sites				Timed sites	
cSAC	Fry Zippin density mean±sd	Parr Zippin density mean±sd	Fry 3-run density mean±sd	Parr 3-run density mean±sd	Fry min^{-1} mean±sd	Parr min^{-1} mean±sd
B&L	29.1±18.2	23.2±7.9	28.4±17.9	18.6±10.0	4.3±3.1	3.0±1.9
Bladnoch	122.3±94.5	27.5±16.8	80.1±94.5	18.1±18.6	11.7±10.7	2.3±1.7
Dee	61.3±59.2	24.6±10.6	43.1±54.8	22.4±10.2	6.3±3.5	2.3±2.1
Endrick	90.5±90.7	5.0±3.8	39.4±70.0	3.7±3.0	4.8±2.7	1.9±1.8
Grimersta	25.8±21.4	21.0±7.8	19.1±17.3	16.4±4.0	1.7±1.5	1.8±0.9
L.Gruinard	**61.7±36.2**	**34.6±15.5**	**50.9±28.1**	**30.3±14.9**	**5.6±3.2**	**2.0±1.6**
Naver	67.2±46.4	29.6±10.3	38.0±41.3	26.0±9.0	3.1±2.2	1.4±0.8
N.Harris	13.5±8.4	18.9±9.7	10.5±7.3	15.8±9.5	1.2±0.5	3.7±2.2
S.Esk	40.6±25,7	8.3±7.1	37.0±25.1	5.6±6.2	3.9±3.9	0.4±0.4
Spey	54.3±57.9	28.7±18.4	35.2±49.5	21.0±16.6	3.5±3.2	1.3±1.2
Tay	83.6±38.2	23.1±12.6	72.0±26.4	16.8±12.3	15.7±10.0	2.9±1.4
Teith	163.3±122.8	25.3±18.8	79.8±106.5	13.9±17.9	13.1±9.2	2.2±2.2
Thurso	71.7±10.1	13.5±7.8	69.4±10.3	12.8±7.9	9.7±4.3	2.3±2.2
Tweed	127.8±66.6	33.9±36.0	89.7±57.0	18.9±10.3	17.8±15.0	1.2±1.1

Figure 6.7 A comparison of juvenile salmon densities for cSAC Atlantic salmon rivers, including the Little Gruinard, recorded in 2004 (SNH data).

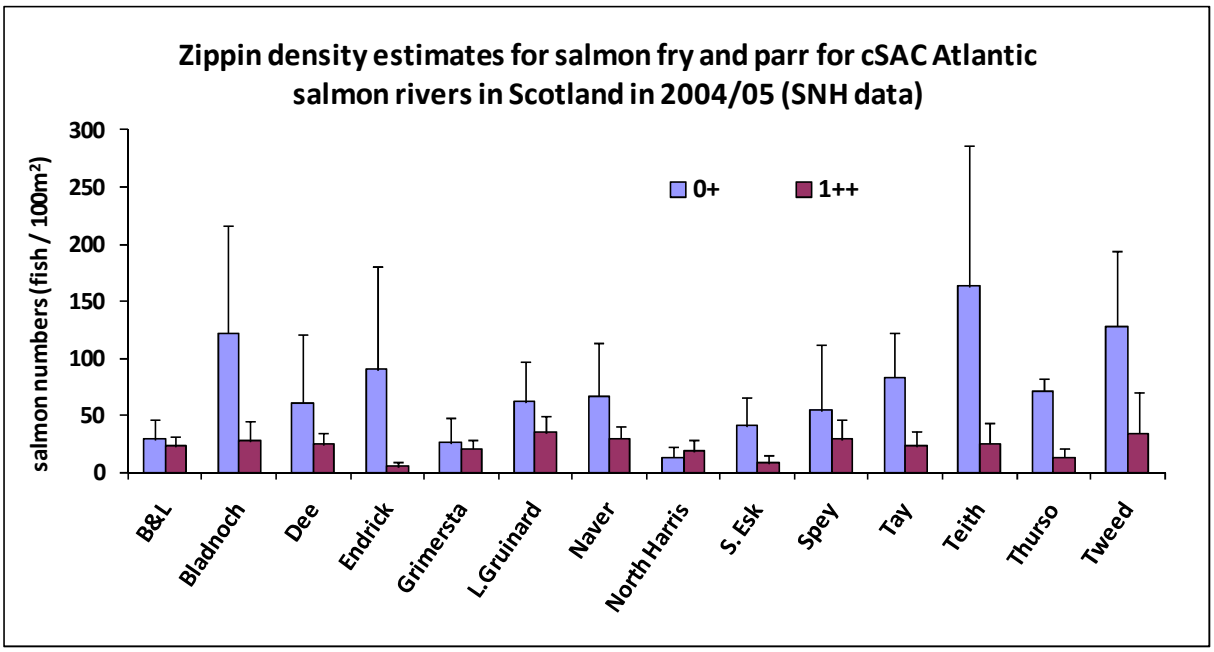
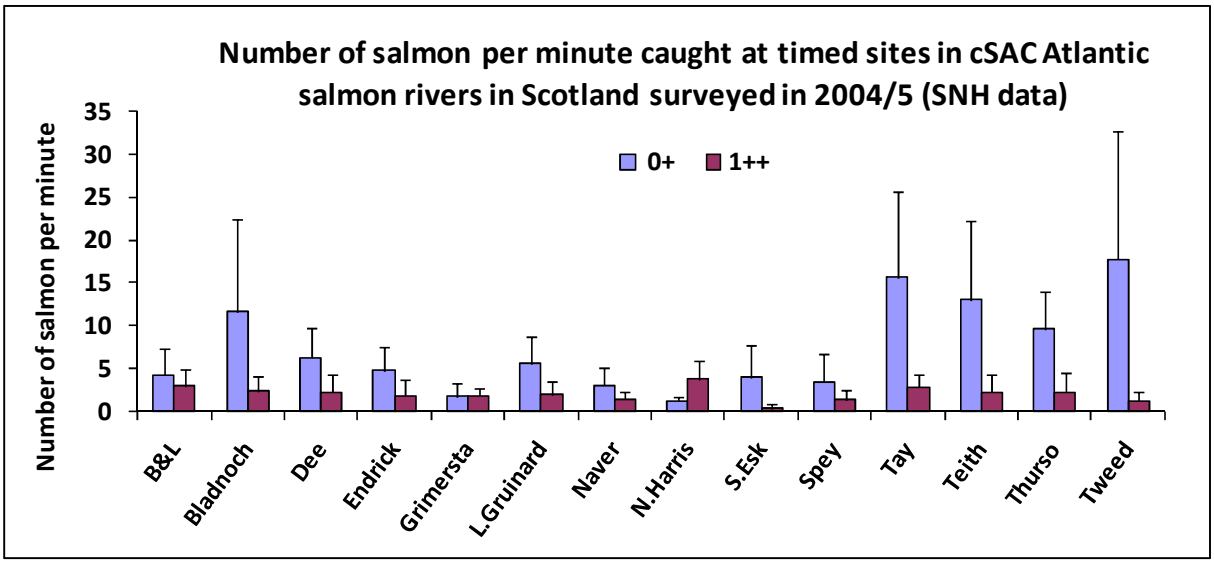
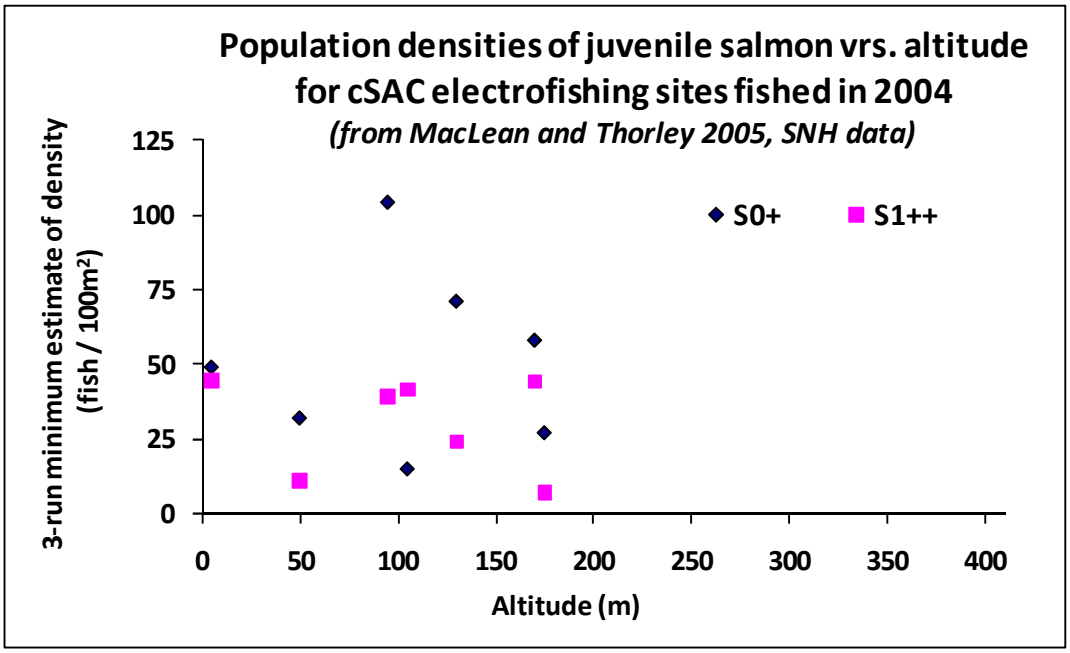


Figure 6.8 A comparison of juvenile salmon CPUE for cSAC Atlantic salmon rivers in Scotland including the Little Gruinard River, recorded in 2004 (SNH data)



There was no relationship between juvenile salmon density and altitude (Figure 6.9) for the Little Gruinard: densities were often as high at the highest altitude sites [175m above sea level] as lower down the system. This led the author of the SAC assessment report to question some of the data! This observation was considered further in 2006.

Figure 6.9 Density estimates for salmon fry and salmon parr recorded at fully-quantitative electro-fishing sites in 2004, plotted against altitude for the Little Gruinard (SNH data).



In conclusion, the electro-fishing survey of the Little Gruinard cSAC in 2004 demonstrated that juvenile salmon were present throughout the catchment area, often at high densities in comparison to other SAC salmon rivers in Scotland. As in earlier years, densities of salmon fry and salmon parr were particularly high in core areas compared to other river systems. In terms of densities and numbers of juvenile fish, the Little Gruinard juvenile salmon population within the system was clearly in a healthy state. However, important questions remained:

- Why do the juvenile salmon of the Little Gruinard system grow so slowly?
- What is the relationship between juvenile salmon populations and smolt production from the Little Gruinard system?

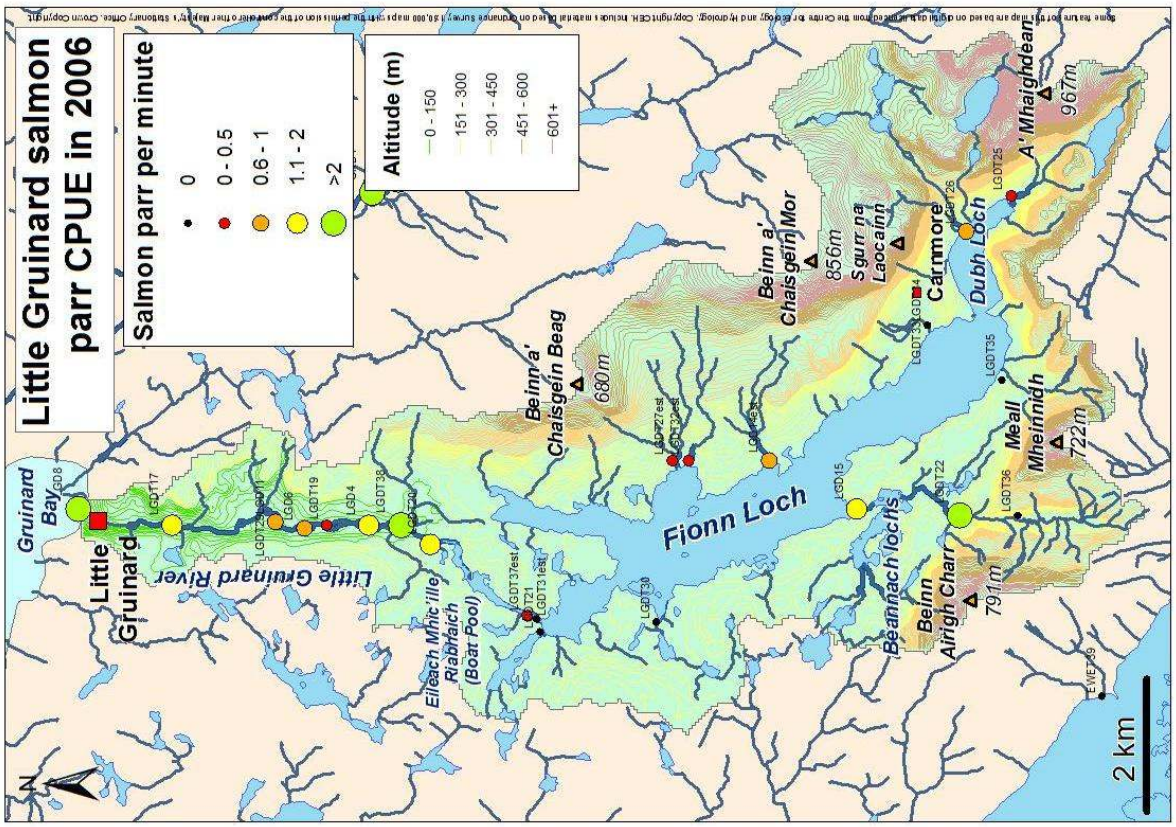
6.4.3 The 2006 WRFT Electro-fishing survey

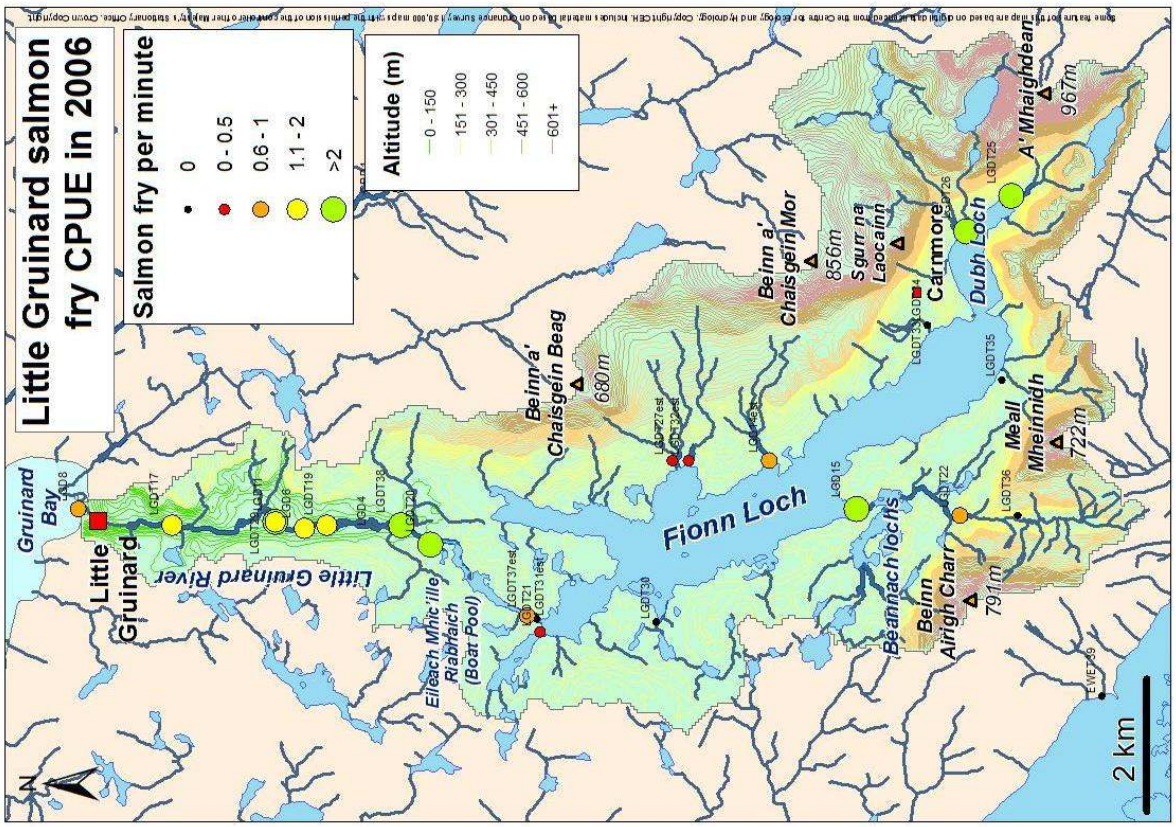
Following the SNH contract in 2004, the WRFT electro-fishing team returned to the catchment in late August and early September 2006. This time the objectives were to revisit some of the sites surveyed in 2004 including those in marginal areas around the Fionn Loch, and to investigate variation in the size and growth of juvenile salmon within the river system. Several new sites were added, comprising two sites between the outflow of the Fionn Loch and the Boat Pool; three sites on minor tributary streams entering the Fionn Loch, and a site above the waterfalls in Strathan Buidhe. The 'timed electro-fishing' method was used throughout to enable more rapid progress around the catchment area.

Juvenile salmon were recorded at all the sites where they had been found in 2004 (Figure 6.10). Salmon were also recorded in the outflow of Loch na Moine Buige (LGDT21), a satisfactory outcome following partial removal of the fish barrier at this site. However, juvenile salmon were not present at new sites in the Carnmore jetty burn (LGDT33 & 34), the Allt Poll Fraochain below Bealach Mheinnidh (LGDT21), the Loch an Eilean Burn (LGDT30) and the Abhainn an t-Srathain Mhoir [Beannach burn] above the bridge (LGDT36); only juvenile trout were recorded at these sites (see Part 6.5).

Salmon parr from the Feachaisgean burn, by Sandy Bay, Fionn Loch, August 2006

Figure 6.10 Distribution and relative abundance of juvenile salmon in the Little Gruinard from the 'timed' WRFT electro-fishing survey in 2006.





Sizes of juvenile salmon

The size of salmon fry varied considerably from site to site. Within the main river, salmon fry were typically 10 - 15+ mm longer at the top sites below the lochs than at sites near the flats. Parr were also bigger at the top of the main river (Figures 6.11). At the Stepping Stones above the Boat Pool (LGDT37), 0+ salmon fry ranged from 63 – 81mm in length, with large 1+ parr of 134 mm and 135 mm. Further downstream at LGDT20 (250m downstream from the Garbh Eilean cascade), fry ranged in size from 50mm to 62 mm; 1+ parr from 76 mm – 116 mm, and at least one 2+ parr of 103 mm. In contrast, in the side channel by the Upper Flats (LGD4), although 0+ fry were relatively more abundant, they were small, ranging in size from 33 to 55mm. At the same site, 1+ parr ranged in size from 68 - 75 mm (smaller than 0+ fry at the stepping stones!), and 2+ parr were 82mm – 102mm. By the Lower Flats (LGD11 and LGDT29) juvenile salmon were of a similar range in size.

Figure 6.11a Lengths of juvenile salmon caught at sites in the upper part of the Little Gruinard in August 2006. (The fishing time for LGDT37 was estimated at 12 minutes; water levels were high at the time of survey so the recorded relative abundance is less useful than for other sites. See 'Discussion' section).

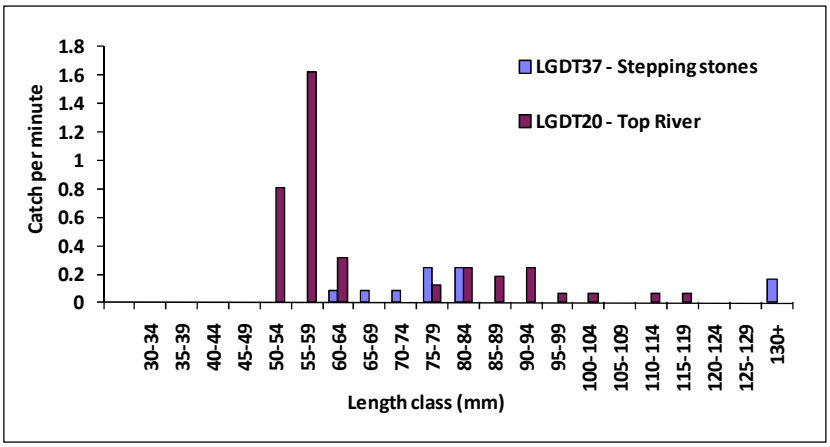
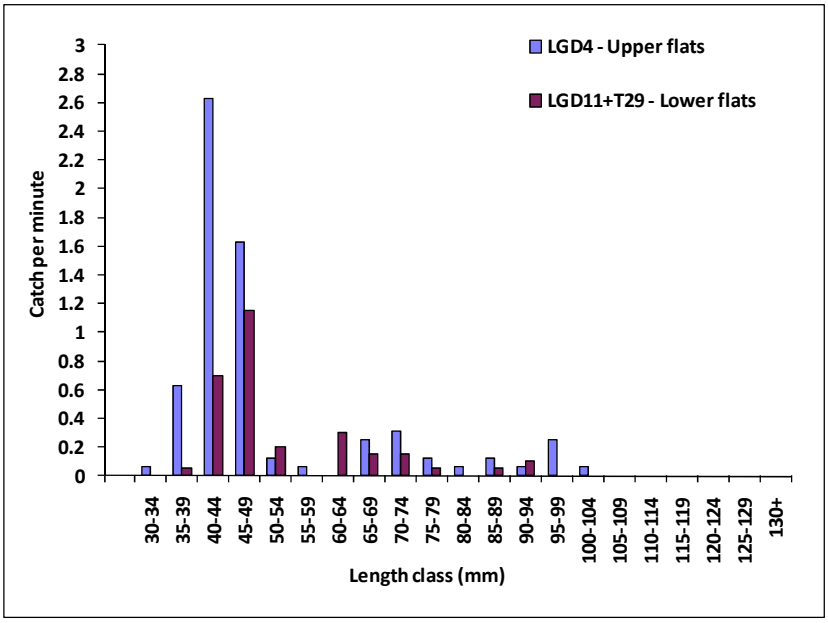


Figure 6.11b Lengths of juvenile salmon caught at sites in the middle part of the Little Gruinard near areas of ancestral salmon spawning areas at the Upper and Lower flats in August 2006.



There was also variation in the size of juvenile salmon at sites above the Fionn Loch (Figure 6.12a and 6.12b). The smallest juvenile salmon in the whole system were in the Allt a' Chiadhain at the head of the Dubh Loch (LGDT25) where the median size class was 38mm, and 1+ parr ranged in size from 50mm to 63mm. No larger juvenile salmon were caught here. Juvenile salmon were slightly larger in the Allt Bruthach an Easain ranging from 41 to 53 mm in length, and 1+ parr of 70mm to 89mm. Juvenile salmon in the Beannach burn (LGDT22) were also small for their age (Figure 6b); three year classes of parr were present, with 3+ year old parr ranging in size from 103 – 127mm.

Figure 6.12a Sizes of juvenile salmon caught in the two principal spawning burns around the Dubh Loch at the head of the Little Gruinard system.

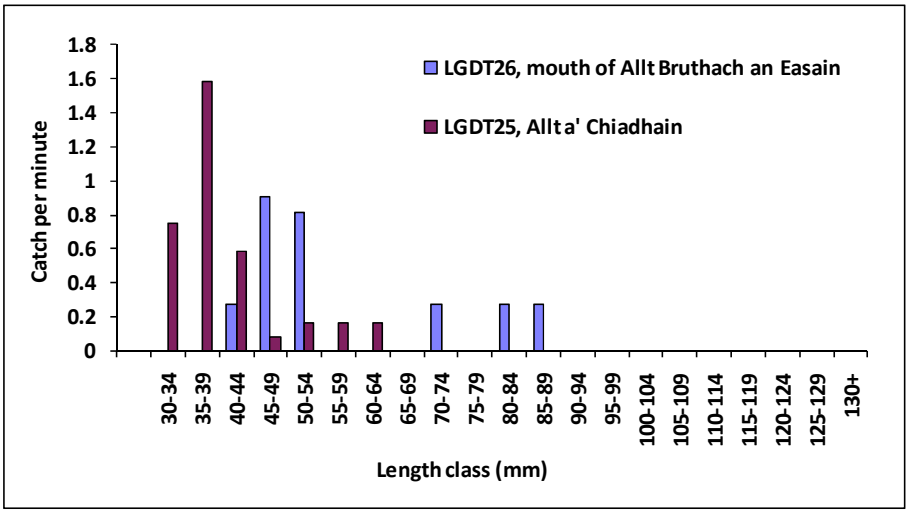
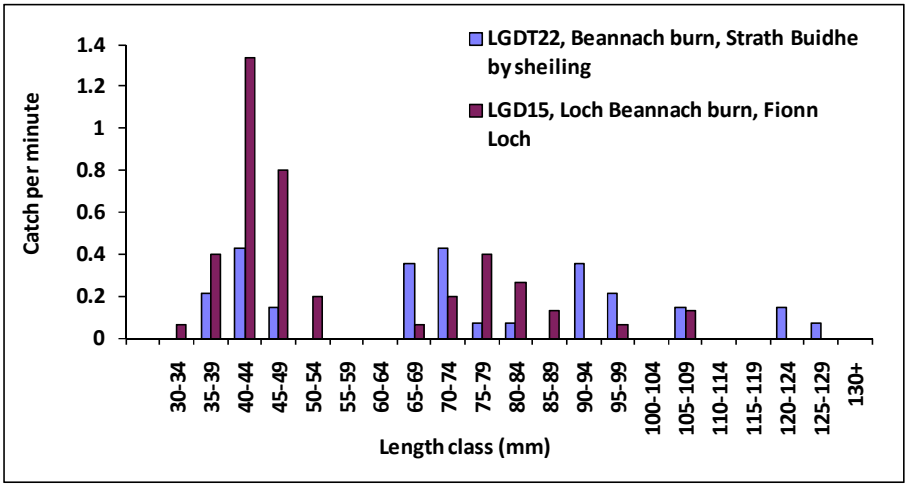


Figure 6.12b Sizes of juvenile salmon caught above (LGDT22) and below (LGD15) Loch Beannach Mor.



In conclusion, the 2006 survey demonstrated that juvenile salmon do not all grow slowly within the Little Gruinard catchment. At the two new sites below the outflow of the Fionn loch salmon fry and salmon parr were much larger for their age than at sites lower down the main river. Although river conditions were imperfect on the day of survey, this suggests that the faster growth was related to lower densities of juvenile fish and to increased food availability (less competition for food), rather than temperature.

These issues are considered more fully in Part 7.

6.4.4 The 2008-9 survey of the Little Gruinard catchment

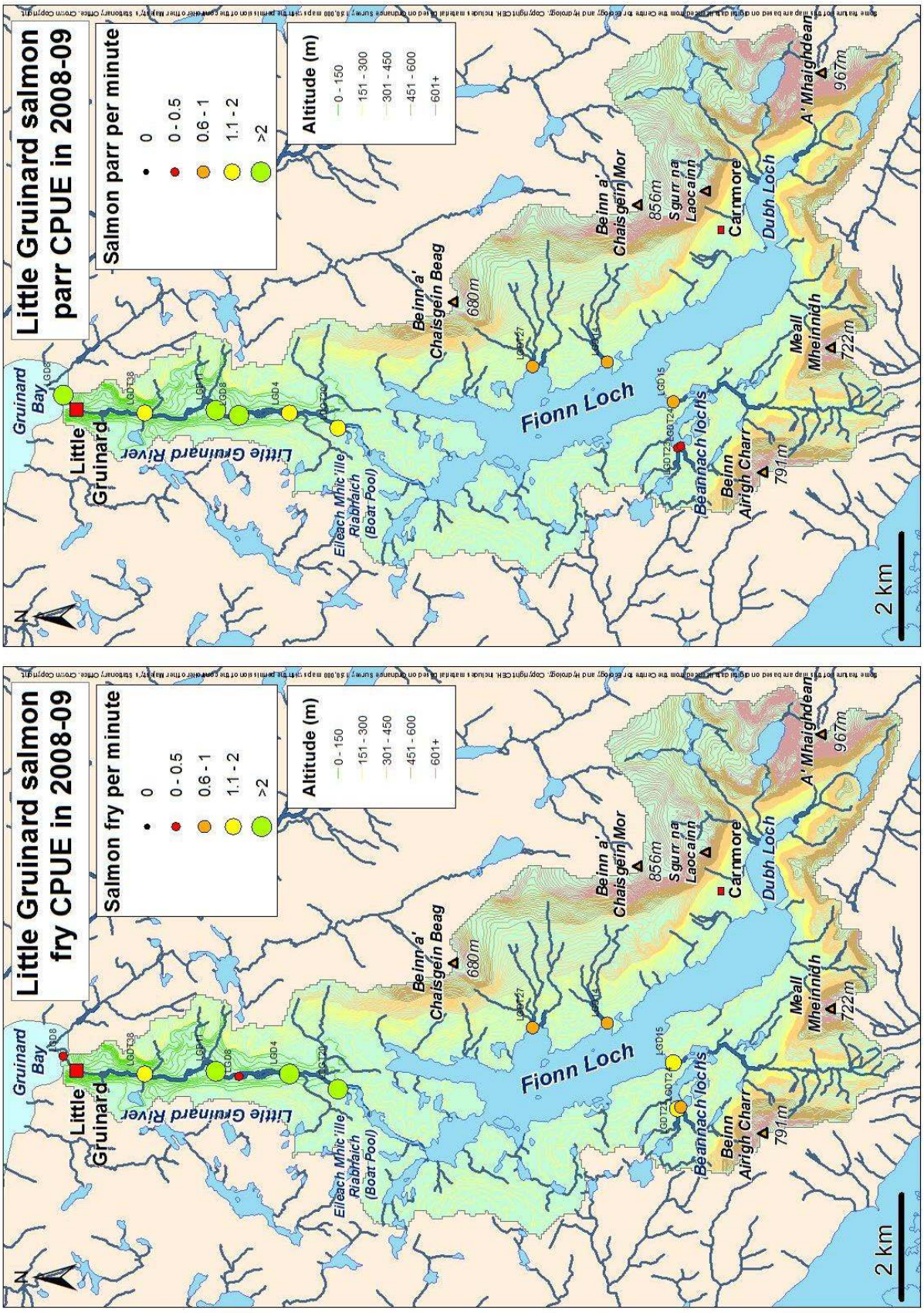
Six sites were fished in the main stem Little Gruinard River CPUE in August 2008, using the timed method. Salmon fry catch per unit effort (CPUE) was high at three of the six sites, though low at two others (Figure 6.13). Salmon parr were present at moderate to high at all sites. The survey followed an extended period of drought in May 2008; this did not appear to have caused serious damage to juvenile salmon populations in the river.

In 2009, five electro-fishing sites were surveyed in tributary streams above the Fionn Loch. Both salmon fry and parr were found at all sites (Figure 6.3). River levels were higher than during previous surveys, making fishing less effective, with a reduced catch per unit effort compared to previous years.

This survey confirmed that in terms of distributions and catch per unit effort, juvenile salmon populations remained healthy in areas surveyed.

The back channel by the 'First Flats', 23rd August 2006. Each of the gravel ridges is the top of a 'redd' formed by female salmon during the spawning season, 9 months earlier. The entire streambed in this channel has been formed by redd cutting salmon. High densities of very small salmon fry were found nearby (see also page 79).

Figure 6.13 Distribution and relative abundance of juvenile salmon in the Little Gruinard from the 'timed' WRFT electro-fishing survey in 2008-9. Sites below the Fionn Loch were surveyed in 2008; those above the Fionn Loch in 2009. Note that water levels in 2009 were higher than usual, reducing CPUE; circles underestimate abundance relative to previous years (see text for further discussion).



6.4.5 Juvenile trout populations

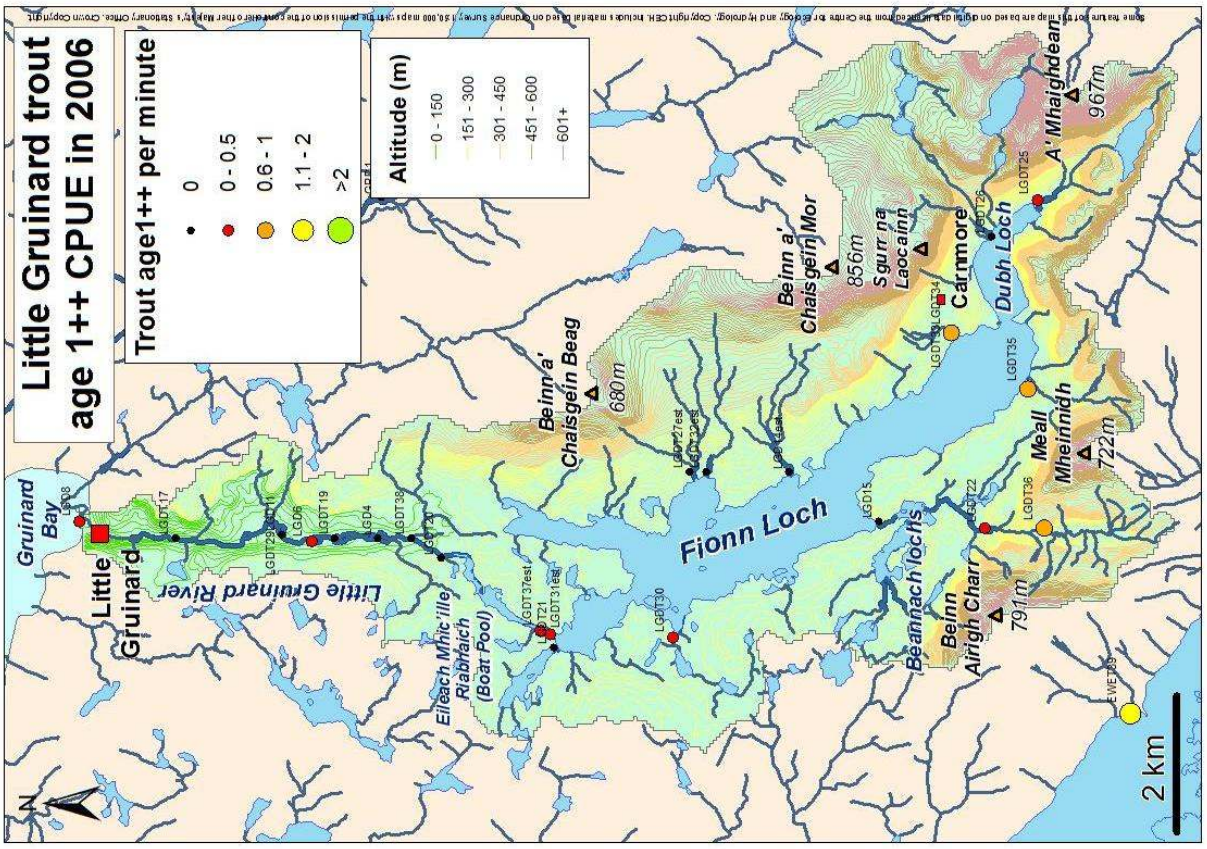
Juvenile Brown Trout (*Salmo trutta*) were found throughout the Little Gruinard system (Table 6.5; Figure 6.14). However, in the main river juvenile trout were greatly out-numbered by juvenile salmon at the sites which were surveyed. In contrast, in some of the small burns around the Fionn Loch, densities of trout fry were high, including the site at the outflow of Loch na Moine Buige (in 2004 and 2006), and the Carnmore Jetty burn and Allt Poll Fraochain (in 2006). Most of these trout were thought to be progeny of Fionn Loch brown trout rather than sea trout (see Part 5).

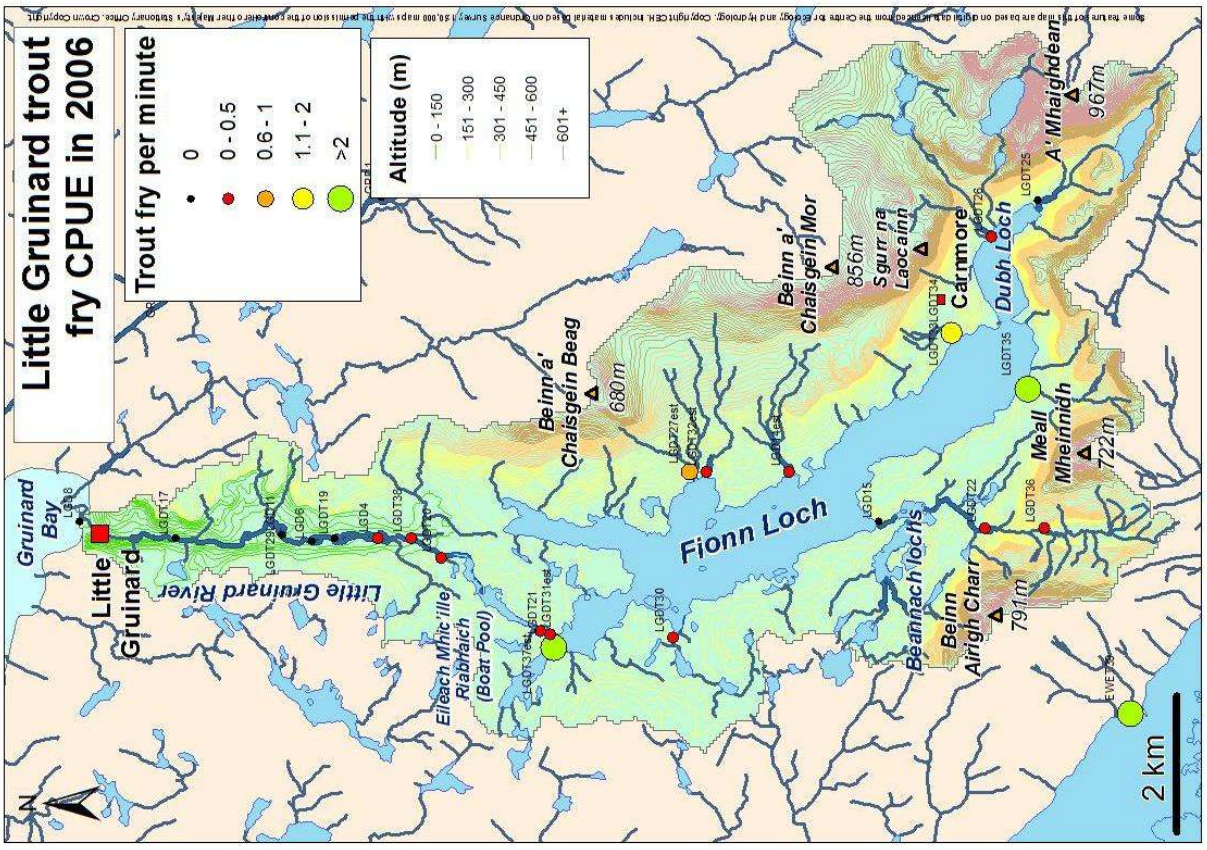
Table 6.5 Occurrence of juvenile trout at 'timed' electro-fishing sites in the Little Gruinard system in 2004. For locations of SNH electro-fishing site in 2004, please see Figure 6.3 (SNH data).

Site code	Survey date	Trout 0+ min^{-1}			Trout 1++ min^{-1}		
		Glide	Run	Riffle	Glide	Run	Riffle
LGr1	08.09.04	0	0	0	0	0	0
LGr2	06.09.04	0.2	0	0	0	0	0
LGr3	13.08.04	0	0.2	0	0	0	0
LGr4	13.08.04	0.2	0	0	0	0	0
LGr5	18.08.04	1	2	3	0.2	0.2	0
LGr6	24.08.04	0.8	0.8	0.4	0.4	0	0
LGr7	24.08.04	1.2	1.2	1	0.2	0	0.4
LGr8	24.08.04	2.8	0.8	1	1.2	0	0.2
LGr9	18.08.04	0.6	0.4	0	0	0	0
LGr10	18.08.04	0	0	0.2	0	0	0
LGr11	18.08.04	0.4	0.8	0.4	0	0	0
Mean		**0.65**	**0.56**	**0.55**	**0.18**	**0.02**	**0.05**
s.d.		0.79	0.61	0.86	0.36	0.06	0.13

The occurrence of trout and salmon within the Little Gruinard catchment area relates largely to the habitat requirements of both species: juvenile salmon tend to competitively displace juvenile trout where the current is higher. This is also further discussed in Part 7.

Figure 6.14 Distribution and relative abundance of juvenile trout within the Little Gruinard system, from the electro-fishing survey in 2006.





6.5 Summary

1. Electro-fishing surveys were carried out in the Little Gruinard System by WRFT in 1997, 1999, 2001, 2003, 2004, 2006, 2008 and 2009 to investigate the occurrence of juvenile trout and salmon.

2. Juvenile salmon were recorded almost throughout the area considered to be accessible to adult salmon on each occasion.

3. Densities and CPUE of juvenile salmon were consistently high at the majority of electro-fishing sites within the mainstem Little Gruinard and at many of the sites above the Fionn Loch, compared to other rivers in the adjacent area (1997-2003) and compared to other cSAC salmon rivers in Scotland.

4. Juvenile salmon were typically very small for their age where densities were highest. However at sites surveyed between the Fionn Loch outlet and the 'Boat Pool' in 2006 salmon fry and salmon parr were much larger for their age. This is considered further in Part 7.

5. Juvenile trout were also found throughout the area. However, densities and CPUE were very low at all main river sites and other sites where juvenile salmon were present.

6. In addition to juvenile salmon and trout, eels were recorded; and in 2009, minnow and arctic charr.

7. Many questions arise: why does the Little Gruinard consistently support some of the highest densities of juvenile salmon of any river in the WRFT area, and indeed, in Scotland? Why are juvenile salmon in the Little Gruinard so small? What does this mean in terms of the potential for production of adult salmon?

These questions are addressed in Part 7 of this report in relation to the extent and nature of the habitats which support fish populations in the Little Gruinard River system.