# West Sutherland Fisheries Trust

# 2017 Electro-fishing Surveys

A report to the West Sutherland Fisheries Trust, Report No. WSFT1/18

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## Introduction

As part of West Sutherland Fisheries Trust's work programme, established sites in each freshwater catchment are routinely monitored every two years by undertaking electro-fishing surveys, which are carried out in accordance with Scottish Fisheries Coordination Centre (SFCC) protocol. This provides valuable information on temporal changes within juvenile salmonid densities. Where possible all sites were revisited, although some could not be accessed due to time and flow constraints; summer/autumn 2017 was exceptionally wet with river levels remaining consistently high, meaning not all catchments scheduled for 2017 could be surveyed. This report summarises the data for each catchment surveyed. Maps giving the location of each site and pictorially represented densities are available on request. Similarly, graphic data for each catchment is also available.

## Methodology

Electro-fishing equipment operates by creating an electrical field in the water which affects the muscles of the fish, causing them to swim towards the positive electrode (anode) and subsequently immobilises them for a brief period; at this point they can be captured for processing before being released unharmed into the river sections from which they were caught. As the electrical field is restricted in size and the conductivity of the water generally extremely low in all WSFT catchments, the best operating conditions are within shallow water in narrow tributaries. While it is possible to sample large main river stems, the escape rate is higher than that found in the narrower tributaries. Similarly, a high escape rate is found in exceptionally shallow, stony or weedy areas, where fish can move into the substrate and are thus inaccessible to the nets.

Semi quantitative surveys are conducted in compliance with SFCC protocol. This involves one fishing run of a site in order to calculate a minimum estimate of juvenile salmonid densities. Although semi-quantitative surveys do not calculate absolute densities (as fully quantitative multiple fishing run depletion surveys do), this is a more appropriate method when considering the purpose of the surveys; to monitor temporal changes in juvenile populations within a single catchment. A greater number of sites can be fished given available resources and the physical nature of the west Sutherland catchments. This results in a broad picture of the population status of each catchment which can then be easily compared from year to year.

Fish densities were assessed using an electracatch backpack supplying smooth direct current (DC). Fish drawn to the hand-held anode were netted into a bucket, most commonly using small hand nets due to the narrow water channels and slow flows, and were retained until the end of the run for processing. The sites were fished systematically in an upstream direction, applying the same fishing pressure throughout to ensure that all fish had the same probability of capture as far as possible, thus increasing the reliability and accuracy of the minimum estimates of density.

All fish were anaesthetised using 2 Phenoxyethanol, identified to species and measured (± 1 mm). Small scale samples were taken from a proportion of each length range for age determination. The fish were then placed in a bucket before being returned to the survey site upon complete recovery. Densities of fish were calculated as minimum estimates, such that a minimum number of fish present per 100 $m^2$ could be determined. Water level was not used in the density estimates, although it must be realised that stream conditions will have an impact on the density determined and efficiency of the fishing technique. Bankside and instream characteristics, including substrate type, water flow, and riparian cover, were recorded at each site in accordance with the SFCC habitat survey associated with electrofishing surveys.

## Results

## 1. Hope catchment

Table 1.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 1.2, together with minimum estimates of density for salmon and trout fry (0+ years) and parr (>1 year) per 100 m$^2$.

| Site Code | Easting | Northing | Altitude | Situation |
|---|---|---|---|---|
| H2A | 247700 | 957800 | 30 | Breasgill burn, below road |
| H2B | 247500 | 956900 | 15 | Breasgill burn, above road and below sheep dip. |
| H4A | 246300 | 947700 | 25 | Tributary at shed by Ben Hope path. |
| H9A | 242000 | 941500 | 120 | Abhains Strath Coir an Easaidh |
| H10A | 243200 | 941500 | 100 | Allt a Choire Ghrainde |

**Table 1.1:** *Electro-fishing site details*

| | | | Minimum density (100m$^2$) | | | |
|---|---|---|---|---|---|---|
| Site Code | Length (m) | Area m$^2$ | Salmon Fry | Salmon Parr | Trout Fry | Trout Parr |
| H2A | 16.5 | 78.1 | 17.93 | 28.17 | 12.80 | 1.28 |
| H2B | 16.3 | 46.18 | 15.16 | 38.98 | 8.66 | 25.99 |
| H4A | 6 | 22.8 | 0.00 | 8.77 | 35.09 | 4.39 |
| H9A | 8.3 | 32.09 | 0 | 0 | 9.35 | 3.12 |
| H10A | 5.8 | 52.39 | 0 | 0 | 21.00 | 3.82 |

**Table 1.2:** *A summary of the density of salmon and trout fry (0+ years) and parr (greater than 1 year) at each site per 100 m$^2$*

The maximum, minimum and mean densities are given for all sites (Table 1.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 17.93 | 6.62 |
| Salmon parr | 0 | 38.98 | 15.18 |
| Trout fry | 8.66 | 35.09 | 17.38 |
| Trout parr | 1.28 | 25.99 | 7.72 |

**Table 1.3:** *A summary of the densities determined for all sites surveyed*

Trout were present in all sites and salmon were not present in H9A and H10A. Where salmon were present, fry densities were lower than parr densities. Trout fry densities were higher than parr in all sites other than H2B. Eels were present at H2A, H2B, and H4A, with the 3 eels seen within each of these sites. Minnows were not present within any of the sites surveyed.

Figures 1.1 and 1.2 show temporal changes in juvenile salmonid densities per 100m$^2$ by catchment average, separated by salmon and trout. Figure 1.1 shows a decrease in salmon fry since 2008, although the fry densities have recovered slightly since the 2015 surveys. Salmon parr densities have dropped since 2015. Figure 1.2 shows that trout fry and parr densities have generally increased since surveys began, with the highest recorded trout fry densities during the 2017 surveys.

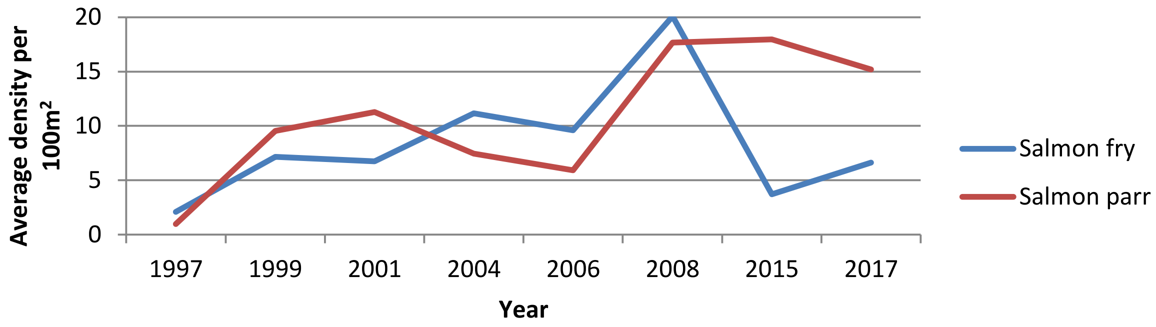


**Figure 1.1:** *Temporal changes in average salmon densities within the Hope catchment*

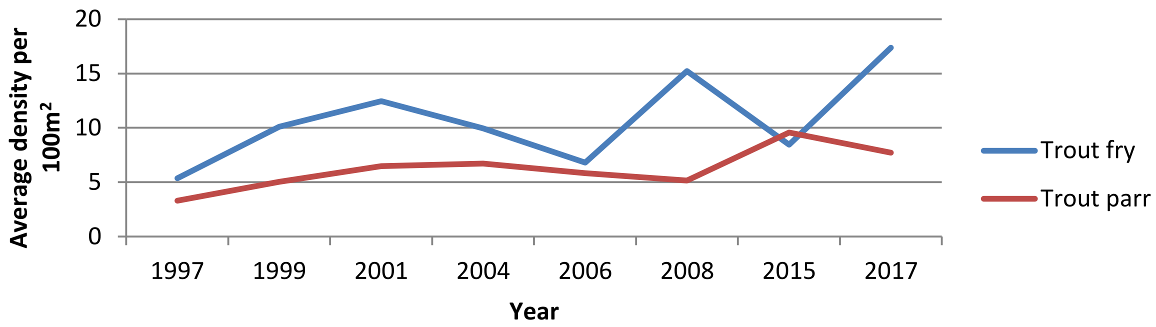


**Figure 1.2:** *Temporal changes in average trout densities within the Hope catchment*

## Discussion

It is important to note that the average densities of juvenile salmon may be low due to figures being brought down by the small number of sites surveyed during 2017, which include H10A where salmon have never been present, and H9A where salmon visit only sporadically. When considering average trout densities, these figures may have been pushed up due to less salmon dominant sites being surveyed during 2017, however, when considering the temporal changes in average trout populations calculated using historic data only from the five 2017 sites it is encouraging to note that trout populations are increasing within their niche areas. With regard to salmon, the only sites surveyed in 2017 were within burns affected by the catastrophic flood following storm Bertha in 2014; fry densities have clearly suffered here, which may be attributed to redd washout as spates subsequent to the flooding have been transporting large quantities of gravel, pebble, and cobble substrate downstream due to the unstable nature of the riverbeds. Interestingly, trout fry populations do not seem to be so affected. An explanation may be the differing homing and wandering tendencies between salmon and trout; as spawning salmon largely tend to home to their point of birth, while spawning trout have more of a tendency to stray, it is possible that the progeny of the salmon populations within these areas may take longer to recover. Parr numbers do however remain high, which provides a confusing scenario and further surveys will be carried out in order to provide more data over time. In any case, it is unfortunate that the other more stable burns frequented by salmon were unable to be surveyed due to the high flows experienced during the summer and early autumn of 2017.

## 2. Loch Innis catchment

Table 2.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 2.2, together with minimum estimates of density for salmon and trout fry (0+ years) and parr (>1 year) per 100 m$^2$.

| Site Code | Easting | Northing | Altitude | Situation |
|---|---|---|---|---|
| LI1 | 222200 | 957500 | 20 | From 2nd meander through gate |
| LI2A | 223000 | 956900 | 50 | Above bedrock falls, just before bend in river |
| LI2B | 222600 | 956900 | 15 | Near mouth of river |
| LI3 | 222600 | 957000 | 15 | By track, just above loch |

**Table 2.1:** *Electro-fishing site details*

| | | | Minimum density (100m$^2$) | | | |
|---|---|---|---|---|---|---|
| Site Code | Length (m) | Area m$^2$ | Salmon Fry | Salmon Parr | Trout Fry | Trout Parr |
| LI1 | 9 | 8.4 | 0 | 11.90 | 47.62 | 11.90 |
| LI2A | 14.8 | 40.5 | 0 | 0 | 9.89 | 7.42 |
| LI2B | 13.8 | 37.72 | 0 | 0 | 47.72 | 5.30 |
| LI3 | 14.2 | 16.09 | 0 | 0 | 62.15 | 6.22 |

**Table 2.2:** *A summary of the density of salmon and trout fry (0+ years) and parr (greater than 1 year) at each site per 100 m$^2$*

The maximum, minimum and mean densities are given for all sites (Table 2.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 0 | 0 |
| Salmon parr | 0 | 11.90 | 2.98 |
| Trout fry | 9.89 | 62.15 | 41.84 |
| Trout parr | 5.30 | 11.90 | 7.71 |

**Table 2.3:** *A summary of the densities determined for all sites surveyed*

Trout densities dominated salmon densities within all sites; only 1 salmon was caught within the catchment (at 1+ years). Trout fry dominated parr within all sites. Eels were present within LI2B and LI3 with one eel seen in each site. Minnows were present within LI1 and LI3 with one minnow seen in each site.

Figures 2.1 and 2.2 show temporal changes in juvenile salmonid densities per 100m$^2$ by catchment average, separated by salmon and trout. Figure 2.1 shows relatively low and sporadic salmon densities since surveys began in 1998. Figure 2.2 shows that average trout fry densities have remained very stable and at exceptionally high levels, while parr densities have also remained stable, albeit at slightly lower levels.

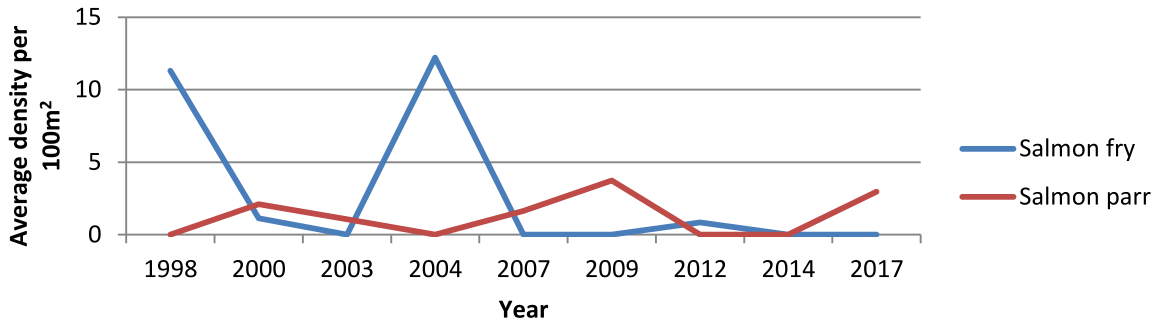


**Figure 2.1:** *Temporal changes in average salmon densities within the Loch Innis catchment*

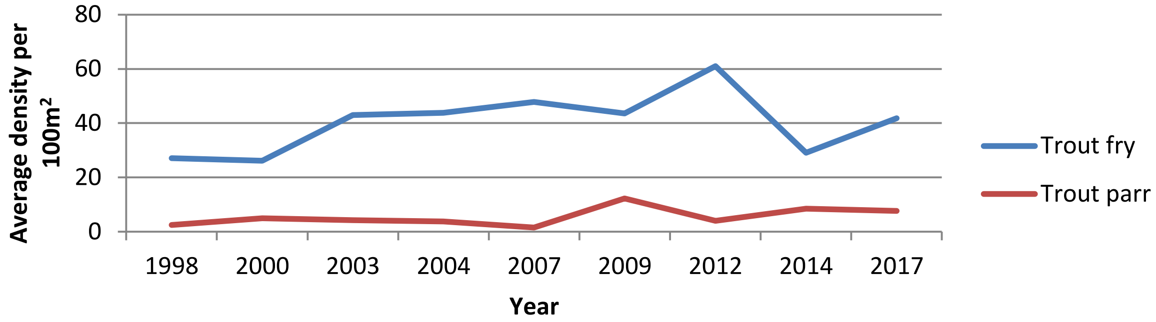


**Figure 2.2:** *Temporal changes in average trout densities within the Loch Innis catchment*

## Discussion

There appears to be a very healthy and stable population of trout within the Loch Innis catchment with consistently prolific densities of fry. The high numbers of fry may be a result of spawning sea trout due to the higher fecundity of these larger female fish. While parr densities are comparatively low it should be remembered that salmonid parr densities are naturally lower than fry due to density dependent mortality. Parr will also migrate to some extent, seeking new feeding territories as they grow; it is likely that they will move into nearby Loch Innis which offers improved cover through depth as well as expanding feeding opportunities. Salmon appear sporadically within the Loch Innis catchment; this is possibly due to spawning habitat type, however it is also likely that salmon access between Loch Inchard (saltwater) and Loch Innis (freshwater) may be flow dependent.

## 3. Laxford catchment

Table 3.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 3.2, together with minimum estimates of density for salmon and trout fry (0+ years) and parr (>1 year) per 100 $m^2$.

| Site Code | Easting | Northing | Altitude | River | Situation |
|---|---|---|---|---|---|
| L14 | 230500 | 942700 | 50 | Tributary | Beside Loch Stack |
| L18A | 230900 | 942200 | 40 | Lone Burn | Downstream of bridge at Lone |
| L18B | 231100 | 942300 | 50 | Lone Burn | Downstream of trees in gorge |
| L18C | 231200 | 942400 | 45 | Allt Horn | Middle of S bend |
| L18D | 231300 | 942600 | 55 | Allt Horn | Within conifer corridor (Scots Pine/Rowan) |
| L19 | 230700 | 941700 | 40 | Tributary | Near quarry on way to Lone, below track |
| L20 | 230700 | 941600 | 50 | Allt a' Chuilinn | 50m u/s of trees from riffle to drop off - deep scour |
| L26A | 229500 | 939700 | 50 | Allt Achfaraidh | Below Ian's house in the gorse bushes |
| L36 | 230900 | 938200 | 50 | Tributary of Loch More | Maternity Burn, below road |
| L53 | 234700 | 935900 | 40 | Tributary of Loch More | Below rough track into Allt a Reinidh |
| L59A | 234800 | 934800 | 50 | Allt Ceann Loch | Below houses |
| L59B | 234800 | 934300 | 60 | Allt Ceann Loch | 50m above bridge |

**Table 3.1:** *Electro-fishing site details*

| | | | Minimum density (100m$^2$) | | | |
|---|---|---|---|---|---|---|
| **Site Code** | **Length (m)** | **Area m$^2$** | **Salmon Fry** | **Salmon Parr** | **Trout Fry** | **Trout Parr** |
| L14 | 41 | 105.2 | 0.00 | 0.00 | 26.29 | 2.39 |
| L18A | 9.9 | 76.9 | 46.55 | 23.27 | 1.22 | 0.00 |
| L18B | 10 | 94.67 | 10.56 | 26.41 | 1.06 | 0.00 |
| L18C | 23.9 | 83.65 | 56.19 | 31.08 | 2.39 | 2.39 |
| L18D | 7.6 | 29.6 | 14.89 | 14.89 | 2.48 | 6.21 |
| L19 | 29 | 45.4 | 12.20 | 0.00 | 126.09 | 0.00 |
| L20 | 10.7 | 46.7 | 32.45 | 5.41 | 9.01 | 0.00 |
| L26A | 9.8 | 53,6 | 73.43 | 43.39 | 5.01 | 0.00 |
| L36 | 8.5 | 13 | 0.00 | 0.00 | 52.08 | 59.90 |
| L53 | 16.5 | 17.9 | 18.17 | 0.00 | 131.70 | 22.71 |
| L59A | 10 | 31.3 | 60.83 | 41.36 | 4.87 | 2.43 |
| L59B | 6.3 | 35.5 | 53.85 | 18.46 | 10.77 | 7.69 |

**Table 3.2:** *A summary of the density of salmon and trout fry (0+ years) and parr (greater than 1 year) at each site per 100 m$^2$*

The maximum, minimum and mean densities are given for all sites (Table 3.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 73.43 | 31.59 |
| Salmon parr | 0 | 43.39 | 17.02 |
| Trout fry | 1.06 | 131.70 | 31.08 |
| Trout parr | 0 | 59.90 | 8.64 |

**Table 3.3:** *A summary of the densities determined for all sites surveyed*

Table 3.2 clearly shows a dominance of salmon in all sites other than L14 and L36 (where no salmon were present). However, trout dominated salmon within L19, L36, and L53. Eels were present within all sites except L18D and L59B and were most abundant at L14 with 19 eels seen. Minnows were present within L14 with 6 seen. The species composition in the Laxford catchment is shown below in Figure 6.

Figures 3.1 and 3.2 show temporal changes in juvenile salmonid densities per 100m$^2$ by catchment average, separated by salmon and trout. Figure 3.1 shows the 2017 surveys to have the highest recorded average salmon fry and parr densities since surveys began in 1997, marked by a sharp increase since 2013, suggesting that recruitment has dramatically increased over the past several years. Figure 3.2 shows that trout fry and parr densities remain comfortably within the average range since surveys began, suggesting a relatively stable population. The pronounced changes in average trout fry densities may be attributed to fluctuating numbers of spawning sea trout.

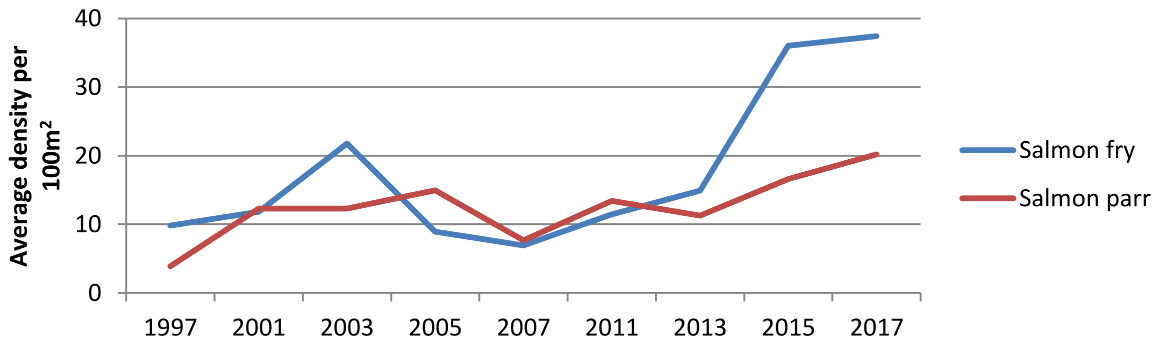


**Figure 3.1:** *Temporal changes in average salmon densities within the Laxford catchment*

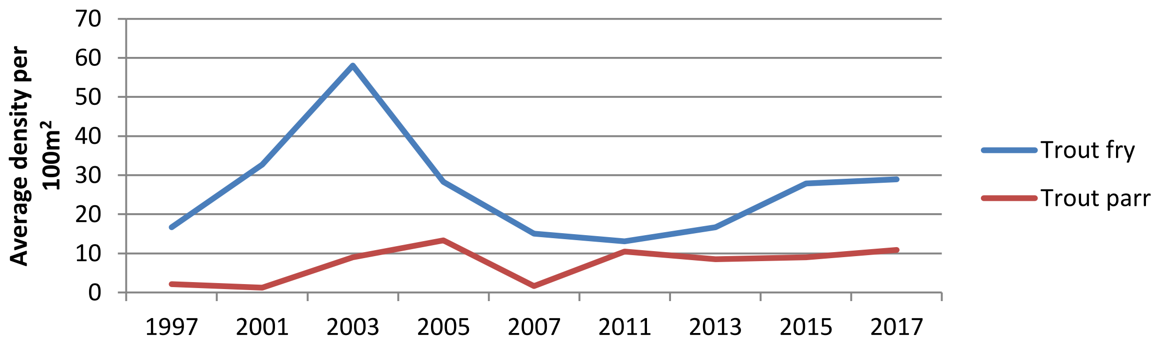


**Figure 3.2:** *Temporal changes in average salmon densities within the Laxford catchment*

## Discussion

There are certain years where salmonid fry numbers are dramatically high (suggesting prosperous spawning in the previous year), yet parr numbers remain relatively constant in comparison, due to density dependent mortality. However, it is likely that given the short length of many of the burns within the Laxford catchment, the carrying capacity for parr is exceeded, resulting in migration into the lochs; the water is deeper and provides more cover, as well as having a greater expanse in which to support feeding territories for higher parr densities. Despite the dip in the catchment average of juvenile salmon densities between 2003 and 2011, the trend shows there to be a general increase since surveys began in 1997, with a dramatic increase in densities over the past several years. The dip may have been part of a longer term natural cycle, and is likely to have been influenced by marine pressures; the dramatic increase in densities over recent years confirms that there is no major cause for concern in regard to freshwater habitat in terms of instream characteristics, although strategical planting of mixed broadleaf trees in riparian zones would be extremely beneficial, and would provide better fish cover, additional food sources, and bankside stability. The trout populations fluctuate fairly dramatically, particularly in fry densities. This is likely to be a result of natural ecosystem dynamics, and varying marine pressures on sea trout. . It is also important to consider that both adult and juvenile salmon will out-compete trout for territories in areas of species crossover. Despite the fluctuations, the salmonid populations within the Laxford catchment appear to be healthy and stable with salmon populations currently increasing.

## 4. Bhadaidh Dharaich catchment

Table 4.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 4.2, together with minimum estimates of density for trout fry (0+ years) and parr (>1 year) per 100 m$^2$. Salmon are not present within the Bhadaidh Dharaich catchment.

| Site Code | Easting | Northing | Altitude | Situation |
|---|---|---|---|---|
| BD1 | 215689 | 944820 | 10 | Below house in reeds by wall |
| BD2 | 216000 | 944700 | 20 | Below loch |
| BD3 | 216500 | 944300 | 25 | By the big boulder |
| BD4 | 216300 | 944200 | 35 | Between small rocks and higher barrier |
| BD5 | 216300 | 944100 | 45 | Just below loch |

**Table 4.1:** *Electro-fishing site details*

| | | | Minimum density (100m$^2$) | | | |
|---|---|---|---|---|---|---|
| Site Code | Length (m) | Area m$^2$ | Salmon Fry | Salmon Parr | Trout Fry | Trout Parr |
| BD1 | 12 | 28.4 | 0 | 0 | 65.47 | 27.28 |
| BD2 | 11.3 | 14.2 | 0 | 0 | 42.37 | 28.25 |
| BD3 | 14 | 28 | 0 | 0 | 17.86 | 14.29 |
| BD4 | 11.8 | 22 | 0 | 0 | 51.74 | 7.39 |
| BD5 | 21.5 | 57.3 | 0 | 0 | 37.21 | 0 |

**Table 4.2:** *A summary of the density of trout fry (0+ years) and parr (greater than 1 year) at each site per 100 m$^2$*

The maximum, minimum and mean densities are given for all sites (Table 4.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 0 | 0 |
| Salmon parr | 0 | 0 | 0 |
| Trout fry | 17.86 | 65.47 | 42.93 |
| Trout parr | 0 | 28.25 | 15.44 |

**Table 4.3:** *A summary of the densities determined for all sites surveyed*

Trout fry occurred in higher densities than parr in all sites. Eels were present within all sites other than BD4, with the highest numbers occurring at BD2 with >60 eels present. Minnows were present at BD5 in prolific numbers where approximately 40 were seen.

Figure 4.1 shows temporal changes in juvenile trout densities per 100m$^2$ by catchment average. The 2017 average trout fry density is above average (with a slight decrease since 2012). The average trout parr density has levelled since 2012, and is within the average range.

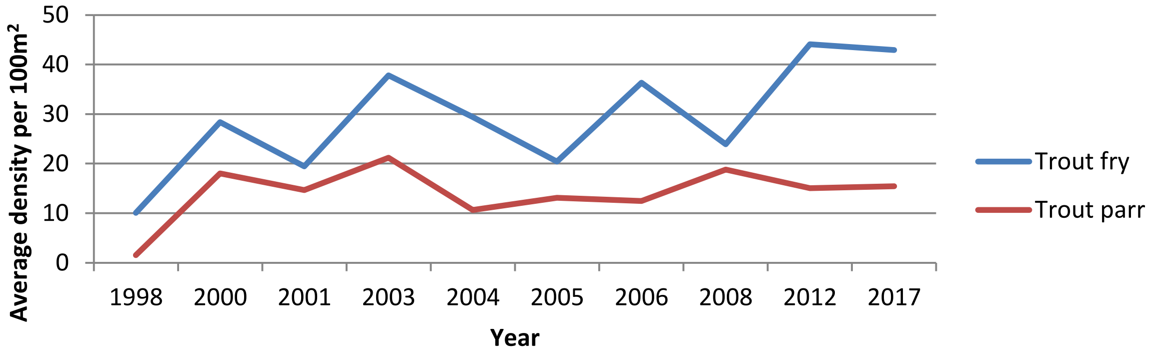


**Figure 4.1:** *Temporal changes in average salmon densities within the Bhadaidh Dharaich catchment*

## Discussion

The peaks and troughs in juvenile trout densities are most likely part of a long term natural cycle as a result of natural ecosystem dynamics. Despite these fluctuations there is a general increase in both fry and parr densities since surveys began in 1998. However, parr numbers are particularly low within BD4 and BD5. This is reflected historically, particularly in the case of BD5. Yet there appears to be a strong population of trout within the Bhadaidh Dharaich catchment, supported by good spawning grounds and fry habitat. This suggests there is no major cause for concern regarding the natural habitat in terms of instream characteristics. However, the easing of fish passage through the culvert (A894) would be beneficial to migratory salmonids.

## 5. Geisgeil catchment

Table 5.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 5.2, together with minimum estimates of density for trout fry (0+ years) and parr (>1 year) per 100 $m^2$.

| Site Code | Easting | Northing | Altitude | Situation |
|---|---|---|---|---|
| G1 | 217352 | 941790 | 20 | Just above fence line to step/falls |
| G3 | 217401 | 941613 | 20 | By loch, below fence |

**Table 5.1:** *Electro-fishing site details*

| | | | Minimum density (100$m^2$) | | | |
|---|---|---|---|---|---|---|
| Site Code | Length (m) | Area $m^2$ | Salmon Fry | Salmon Parr | Trout Fry | Trout Parr |
| G1 | 6.7 | 52.26 | 0 | 1.91 | 11.48 | 3.83 |
| G3 | 8.8 | 39.6 | 15.15 | 2.52 | 5.05 | 5.05 |

**Table 5.2:** *A summary of the density of trout fry (0+ years) and parr (greater than 1 year) at each site per 100 $m^2$*

The maximum, minimum and mean densities are given for all sites (Table 5.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 15.15 | 7.58 |
| Salmon parr | 1.91 | 2.52 | 2.22 |
| Trout fry | 5.05 | 11.48 | 8.27 |
| Trout parr | 3.83 | 5.05 | 4.44 |

**Table 5.3:** *A summary of the densities determined for all sites surveyed*

Trout densities dominated salmon densities within G3; both trout and salmon parr densities were greater than trout and salmon fry densities within this site. There were no salmon fry present within G1; trout parr densities were greater than trout fry densities within this site. Eels were present within both sites with 11 seen in each site. G1 also contained 9 minnows.

Additional consistent monitoring is needed before realistic comparisons of temporal changes in average densities can be made. However, figures 5.1 and 5.2 show temporal changes in juvenile salmonid densities by individual site data, separated by salmon and trout. Surveys of the Geisgeil catchment are in their early stages, yet G1 is already showing to be a consistently important site for juvenile trout. Salmon are using both sites, but fry and parr presence is showing to be inconsistent at this point.

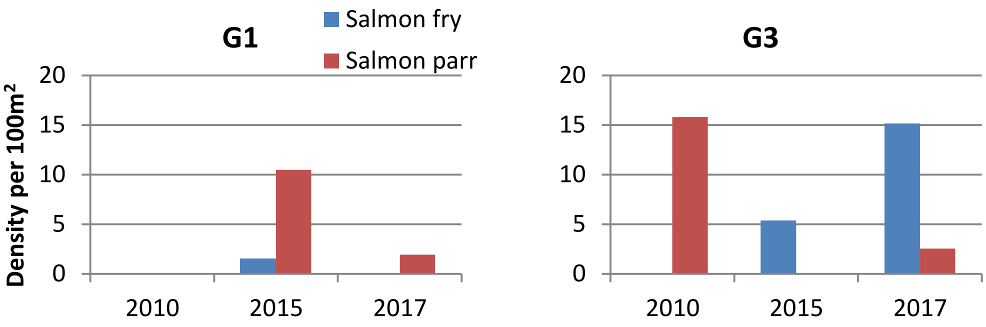


**Figure 5.1:** *Temporal changes in juvenile salmon densities by survey site within the Geisgeil catchment*

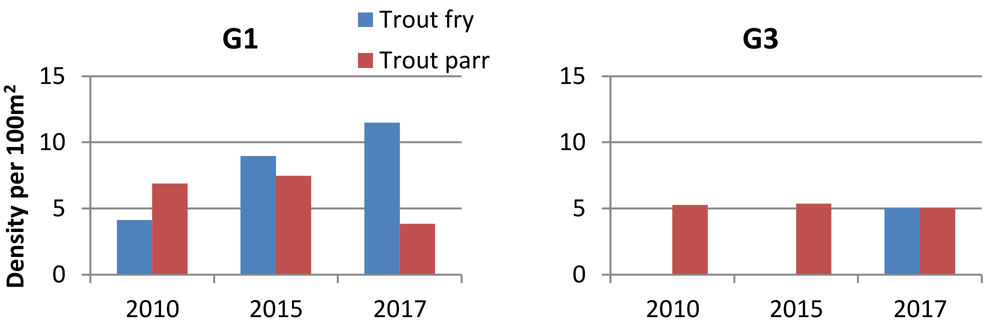


**Figure 5.1:** *Temporal changes in juvenile salmon densities by survey site within the Geisgeil catchment*

### Discussion

The burns above the loch appear to be potentially prosperous for consistent salmon populations when considering the sporadic, yet reasonable densities of juveniles that have previously been found. The fluctuating fry and parr densities would suggest that salmon access is flow dependent. The fish pass at the weir below the A894 may be insufficient to allow access under all flow conditions; continued monitoring will allow more stable temporal comparisons to be made between site and catchment average densities.

There is likely to be a stable catchment-wide population of trout when considering similar catchments in close proximity in the West Sutherland area. This is supported by the consistent occurrence of juvenile trout in G1. When considering this, in addition to the appearance of salmon populations, there is likely no cause for concern over salmonid habitat in regard to instream characteristics; it is suitable given sufficient access.

## 6. Inver catchment

Table 6.1 gives the grid reference, altitude, and location of each site fished. The length and area fished are presented in Table 6.2, together with minimum estimates of density for salmon and trout fry (0+ years) and parr (>1 year) per 100 m$^2$.

| Site Code | Easting | Northing | Altitude | Situation |
|---|---|---|---|---|
| I11B | 215200 | 924600 | 70 | River Inver, Allt an Tiaghaich, upstream |
| I11C | 215150 | 924600 | 65 | Just above deer fence to mossy rock on right |
| I23 | 220700 | 925800 | 80 | Allt na Doire: between bridge on new road and old road |
| I30A | 223500 | 924400 | 60 | Skiag: at road junction |
| I32B | 224100 | 923800 | 70 | Loch Assynt tributary: by Ardvreck Castle, left tributary at mouth of loch |
| I32C | 224200 | 924000 | 95 | Upstream of road, below tree with pool |
| I33A | 224300 | 923500 | 70 | D/S of road bridge |
| I35A | 225000 | 921700 | 70 | Downstream of road bridge. Downstream of tree on left bank for 18 m |
| I35B | 225800 | 921900 | 95 | Just below the bridge |
| I4A | 212300 | 923700 | 50 | Allt na-h-Airbhe: moorland at the mouth of the tributary near Brackloch. |
| I4B | 212700 | 923600 | 50 | Allt na-h-Airbhe: 400m U/S from river |
| LB1 | 214050 | 925300 | 65 | River out of Loch Beannach by large rock in stream |
| LB2 | 214100 | 925500 | 65 | In left hand braid, below Loch Uidh na Geadaig |
| LB3 | 213600 | 925500 | 65 | Just below Loch Bad nan Aighean |
| LB4 | 213400 | 926000 | 70 | Just below Loch Beannach |

**Table 6.1:** *Electro-fishing site details*

| | | | Minimum density (100m$^2$) | | | |
|---|---|---|---|---|---|---|
| Site Code | Length (m) | Area m$^2$ | Salmon Fry | Salmon Parr | Trout Fry | Trout Parr |
| I35A | 7.6 | 75.49 | 35.77 | 30.47 | 1.32 | 0.00 |
| I35B | 19 | 101.3 | 0.00 | 0.00 | 1.97 | 6.91 |
| I33A | 12.1 | 55.66 | 70.07 | 55.70 | 0.00 | 1.80 |
| I32C | 11.4 | 16.72 | 0.00 | 0.00 | 11.96 | 71.77 |
| I32B | 13.5 | 36.9 | 0.00 | 2.71 | 32.52 | 0.00 |
| I30A | 12.7 | 36.41 | 30.21 | 46.69 | 8.24 | 0.00 |
| I11C | 9.6 | 50.88 | 31.45 | 41.27 | 0.00 | 0.00 |
| I4A | 24.8 | 115.7 | 49.25 | 11.23 | 6.91 | 5.18 |
| I4B | 12.7 | 57.57 | 20.84 | 12.16 | 3.47 | 1.74 |
| I11B | 19.7 | 114.3 | 26.26 | 29.76 | 2.63 | 0.88 |
| I23 | 15 | 27 | 11.11 | 11.11 | 33.33 | 22.22 |
| LB1 | 12.5 | 88.33 | 4.53 | 4.53 | 3.40 | 0.00 |
| LB2 | 15 | 43 | 4.65 | 2.33 | 13.95 | 0.00 |
| LB3 | 14 | 66.27 | 28.67 | 21.13 | 7.54 | 4.53 |
| LB4 | 13 | 51.57 | 34.90 | 11.63 | 9.70 | 7.76 |

**Table 6.2:** *A summary of the density of salmon and trout fry (0+ years) and parr (greater than 1 year) at each site per 100 m$^2$*

The maximum, minimum and mean densities are given for all sites (Table 6.3). This summarises the data and allows comparisons within the system and with other systems within the west Sutherland area.

| Species/age class | Minimum | Maximum | Mean |
|---|---|---|---|
| Salmon fry | 0 | 70.07 | 23.18 |
| Salmon parr | 0 | 55.70 | 18.71 |
| Trout fry | 0 | 33.33 | 9.13 |
| Trout parr | 0 | 71.77 | 8.19 |

**Table 6.3:** *A summary of the densities determined for all sites surveyed*

While trout are present in all sites other than I11C, table 6.3 clearly shows a catchment dominance of salmon. Both salmon and trout fry occurred in higher densities than parr in the majority of sites with the exceptions of I32B, I30A, I11C, and I11B where salmon parr densities were greater than salmon fry. I23 and LB1 contained equal numbers of salmon fry and parr, while I35B, I33A, and I32C contained higher densities of trout parr than trout fry. 4 eels were present only within I4A. This is unusual within the west Sutherland area, and migration may be being impeded by the sluice systems on the lower sections of the river Inver. Minnows were present at four sites, with the highest density at LB1 with 15 minnows seen.

Figures 6.1 and 6.2 show temporal changes in juvenile salmonid densities per 100m$^2$ by catchment average, separated by salmon and trout. Figure 6.1 shows a very slight decrease in the average salmon fry density since 2015, while parr densities have steadily increased since 2013. The average juvenile salmon densities fall comfortably within the average range since surveys began. Figure 6.2 shows that trout fry densities have decreased since 2015 yet are comfortably within the average. Trout parr densities have increased slightly since 2013.

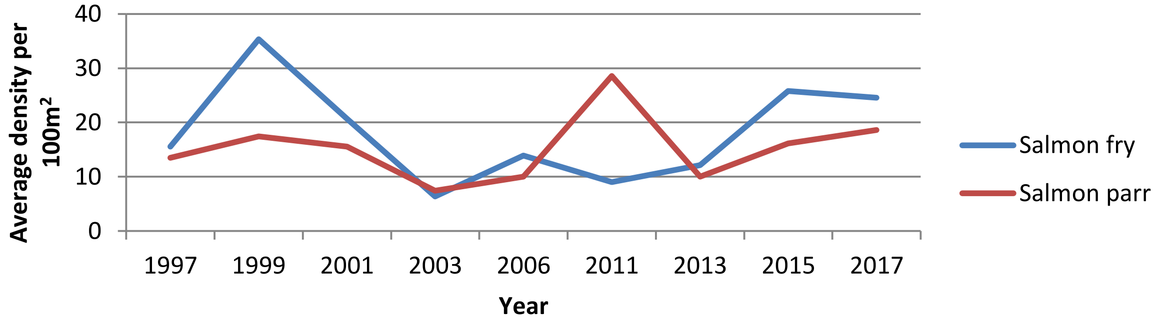


**Figure 6.1:** *Temporal changes in average salmon densities within the Inver catchment*

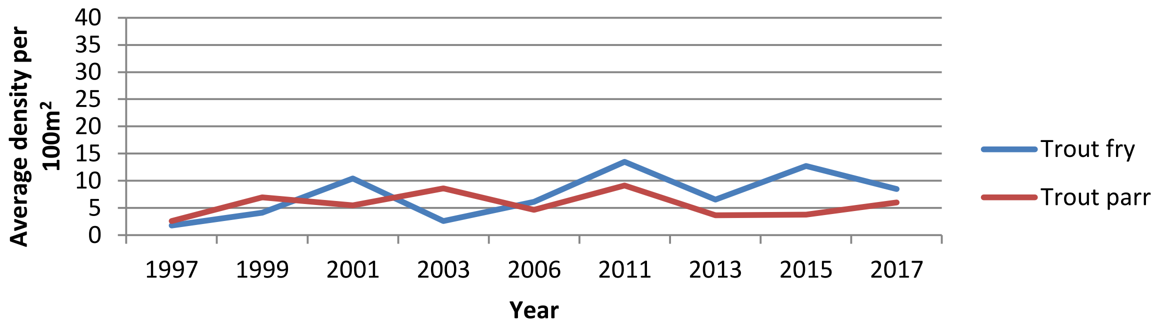


**Figure 6.2:** *Temporal changes in average trout densities within the Inver catchment*

## Discussion

There are certain sites within the Inver catchment where parr numbers are higher than fry which is likely due to site specific habitat types. WSFT surveys a range of habitat types including both optimal and suboptimal areas for trout and salmon in order to gain a realistic picture of the population status. Trout populations within the Inver catchment remain at a low but consistent level, while salmon populations are currently high and appear to be extremely healthy, particularly when considering the prolific densities found within certain sites when comparing with the SFCC regional classification scheme.

It is important to consider that the Inver is a salmon dominated system, and both adult and juvenile salmon will out-compete trout for territories. Despite apparently natural temporal fluctuations, the salmonid populations within the Inver catchment appear to be gravitating around a stable level.

## 7. Average for the West Sutherland Fisheries Trust area

The average densities of fish within each catchment are summarised (Table 7.1). This allows comparison between the catchments, although it should be noted that temporal changes in density throughout the summer months and habitat differences between catchments are not considered in this table. The timing of sampling is important, with fish moving within the tributaries as a result of water height and temperature, food availability and size. Thus sampling after a spate may give a low density as a result of washout, whilst drought may decrease density as fish move into deeper water to avoid predation or desiccation, or may increase density as a result of concentration in severe cases. Similarly, densities will be greater shortly after hatching, reducing with time as the fish grow and require a larger territory for survival.

| | **Average density (100m$^2$)** | | | |
|---|---|---|---|---|
| **Catchment** | **Salmon fry** | **Salmon parr** | **Trout fry** | **Trout parr** |
| Hope | 6.62 | 15.18 | 17.38 | 7.72 |
| Loch Innis | 0 | 2.98 | 41.84 | 7.71 |
| Laxford | 31.59 | 17.02 | 31.08 | 8.64 |
| Bhadaidh Dharaich | 0 | 0 | 42.93 | 15.44 |
| Geisgeil | 7.58 | 2.22 | 8.27 | 4.44 |
| Inver | 23.18 | 18.71 | 9.13 | 8.19 |
| **West Sutherland area average** | **11.5** | **9.35** | **25.10** | **8.69** |

**Table 7.1:** *Average densities of salmonids per catchment surveyed*

As evident from Table 7.1, figures 7.1 and 7.2, there is a good distribution of salmonid species throughout the West Sutherland area with trout present in every system surveyed. Within salmon dominated systems, juvenile salmon densities were largely excellent. The area average trout and salmon parr densities are similar, while the area average trout fry density dominates salmon fry.

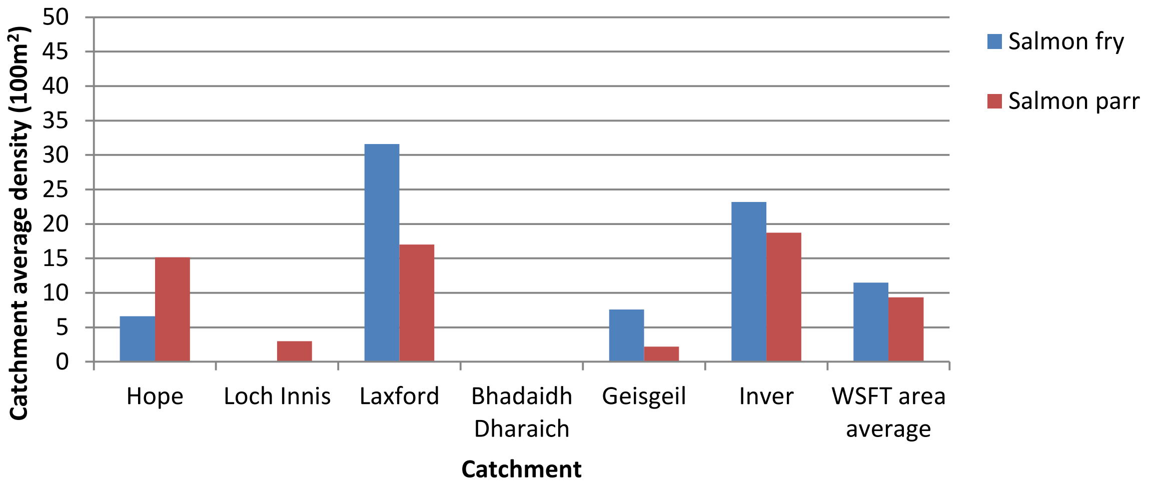


**Figure 7.1:** *Average salmon fry and parr densities within West Sutherland catchments shown alongside the average fry and parr densities for the West Sutherland area 2017*

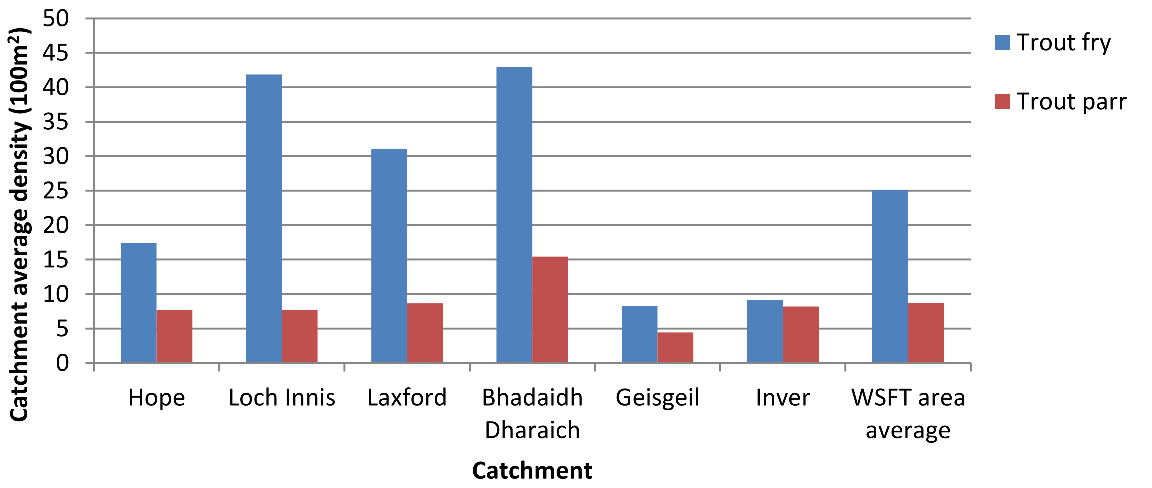


**Figure 7.2:** *Average trout fry and parr densities within West Sutherland catchments shown alongside the average fry and parr densities for the West Sutherland area 2017*

## 8. SFCC Classification

The SFCC absolute regional classification scheme, presented in Table 8.1, was developed so that fish populations could be compared across Scotland, allowing electrofishing results in Sutherland to be presented in a Scottish context. Unlike the relative regional classification scheme, this does not take into account river width which is known to affect salmonid densities with generally more fish present in narrower tributaries. When compared to the SFCC regional classification scheme for the North West area, salmonid densities range from absent (unclassified) to excellent and there is a lot of within-catchment variation, in part due to the location, habitat type, and accessibility.

| | | Minimum density per 100m$^2$ | | | |
|---|---|---|---|---|---|
| **SFCC Class** | **Descriptor** | **Salmon fry** | **Salmon parr** | **Trout fry** | **Trout parr** |
| **A** | Excellent | 26.05 | 13.09 | 15.80 | 8.58 |
| **B** | Good | 14.15 | 8.04 | 8.25 | 4.31 |
| **C** | Moderate | 8.00 | 4.67 | 4.26 | 2.72 |
| **D** | Poor | 4.42 | 2.58 | 1.99 | 1.52 |
| **E** | Very poor | 0.78 | 0.66 | 0.44 | 0.22 |
| **U** | Unclassified | 0 | 0 | 0 | 0 |

***Table 8.1:*** *SFCC salmonid density classification scheme for the North West area*

The percentages of SFCC classifications across the west Sutherland area for 2017 are displayed in Figure 8.1. 53% of all sites were classed as having moderate to excellent salmon fry densities (33% classed as excellent), with salmon parr densities classed as moderate to excellent within 51% of all sites (35% classed as excellent). Trout fry densities were classed as moderate to excellent in 74% of all sites, (40% classed as excellent), with 56% of sites containing moderate to excellent trout parr densities (21% classed as excellent).

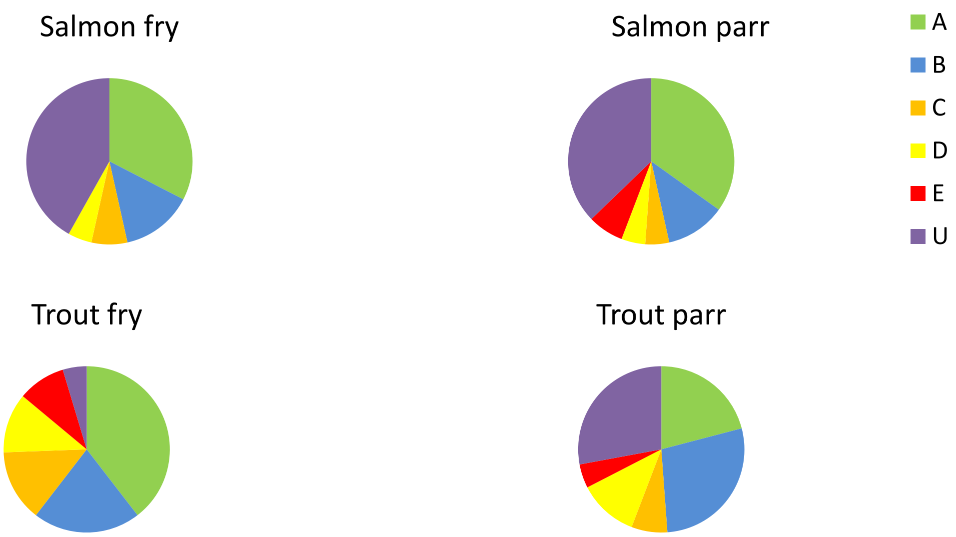


**Figure 8.1:** *West Sutherland area salmonid densities according to the SFCC classification scheme*

## 9. Discussion

The 2017 surveys covered three smaller trout dominated catchments (most of which have limited or no access to migratory salmonids), and three larger salmon systems; therefore the area average reflects a good mixture of separate trout and salmon systems. It is however interesting to note a pattern (albeit expected) within the West Sutherland; catchment wide trout populations are far more stable and prolific within catchments inaccessible to (or sporadically visited by) salmon, due to the natural tendency for salmon to outcompete trout within spawning and juvenile habitats.

Due to high water flows during the summer months of 2016 it was not possible to survey Culag, Rhiconich, Sandwood (carried over from 2016 also due to high flows), with Polla, and Duart also scheduled for 2017; this will also have an effect on the area averages. The aim will be to survey these catchments in 2018 alongside the additional catchments due to be surveyed in accordance with the routine monitoring program.

Whilst instream habitat characteristics within the West Sutherland area are generally favourable for salmonids, strategic planting of mixed broadleaf trees within riparian zones would undoubtedly improve fish cover, food availability, and bankside stability.

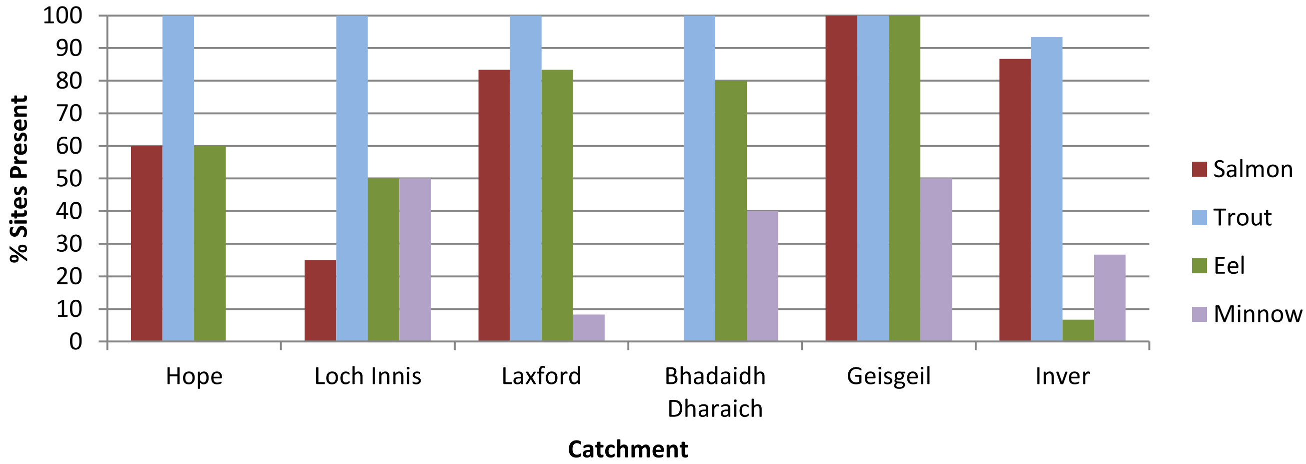


**Figure 13.1:** *Species composition and distribution per catchment*

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