Geisgeil Eel Project

Final Report 2011

C.Daphne

Scottish Natural Heritage
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All of nature for all of Scotland
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THE CROWN ESTATE

RAFTS

West Sutherland Fisheries Trust

Contents

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Acknowlegements

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Introduction

This report is the final report of three and is a summary of findings taken over a three year period looking at the eel population on the Geisgeil catchment. The initial aim of the project was to take an in depth look at the population including all life stages from elver through to the silver eel stage and to gain an understanding of the biology of the species. In addition methods of capture were investigated to see which ones would be most effective so that future monitoring in similar catchments throughout Scotland could be implemented so as to add data to eel management plans. A full description of methods deployed can be found in Geisgeil Eel project – Year 1 and 2 Interim reports 2009 and 2010.

Elvers

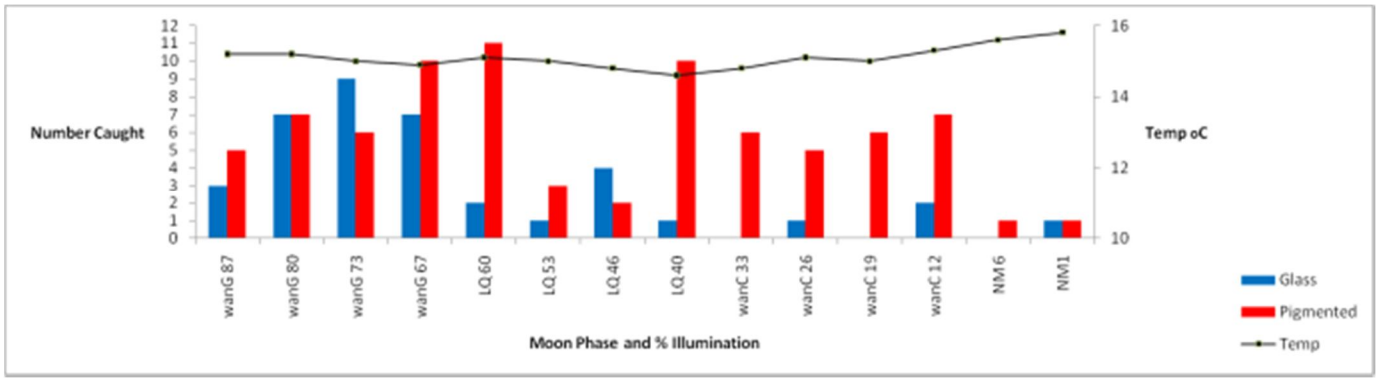
It was possible over the course of this study to ascertain an estimate of timing of the elver run within the system. As this was unknown in the first year, traps were deployed late and therefore caught the end of the run. The second year traps were in situ at an earlier date and a larger number of elvers were trapped and also observed, which gave an indication of the trap efficiency. During the final year, traps were deployed even earlier and left in situ longer. However, the area suffered heavy rainfall during the estimated peak run time and so the traps were flooded and in some cases washed out due to the heavy spates. This period was covered in the previous years so an overall estimate could be obtained. Yearly captures are as follows.

YEAR	Glass eels	Pigmented eels	Total Number	Average per g	Total Weight g	Average Length (mm)
2009	38	91	129	5.5	23.45	73
2010	2696	491	3187	5.5	579.45	72.5
2011	874	101	975	5.5	177.27	73

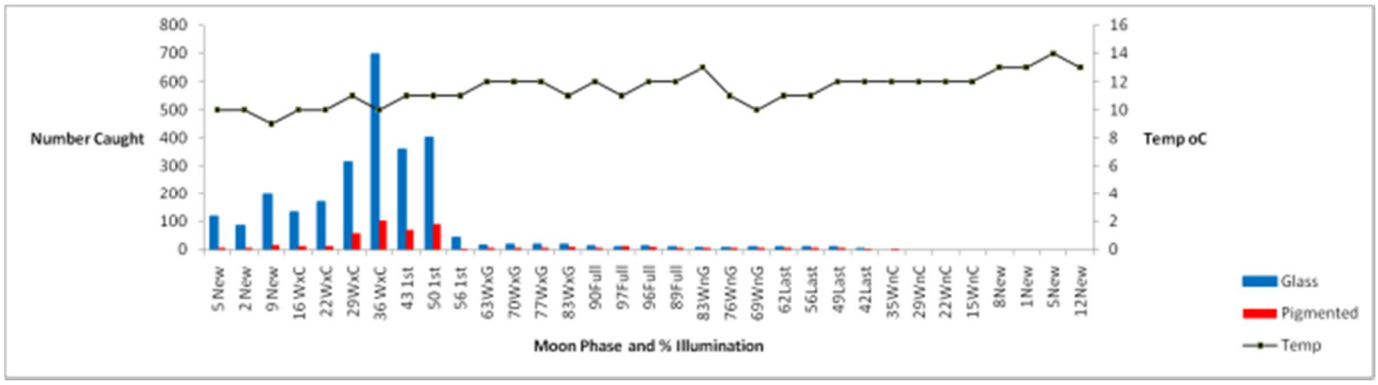
Table showing yearly glass and pigmented eel captures

Samples were measured and weighed, average length and number per gramme are shown above, this did not vary over the course of the study. In total 3608 glass eels and 683 pigmented elvers were caught, giving a total of 4291. During the run in 2010, elvers were observed migrating upstream, this only occurred for one day, from this observation it was estimated that the efficiency of the traps was between 5% and 10%, so the estimated run would be somewhere between 42910 and 85820 elvers. These figures would give a total yield for the system of between 7.80 Kg and 15.60 Kg of elvers. These figures are minimum estimates but show that elver fishing is not commercially viable on this system.

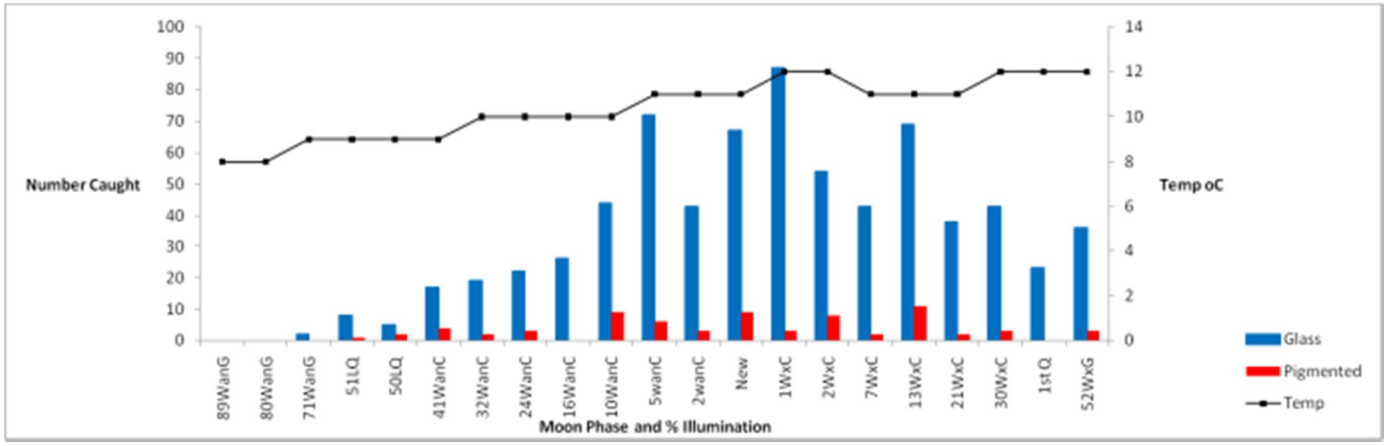
Environmental variables were also recorded to see if there were any relationships with the run timings. These were recorded daily. The following charts show the yearly catches in relation to temperature and moon phase. It can be seen that elvers do not enter the river until temperatures reach 9^{O}C. Moon phase also has an effect, with elvers tending to run on the darker nights after the New moon. Elvers were observed in the daylight hours in 2010, the reason for this is unknown but it is thought that temperatures were relatively low and once the temperatures reached an optimum level then they entered the river *en masse*. This would make them susceptible to predation however and is an unusual occurrence.



Elver Captures for period 09/06/2009 – 22/06/2009 in relation to Moon Phase and temperature

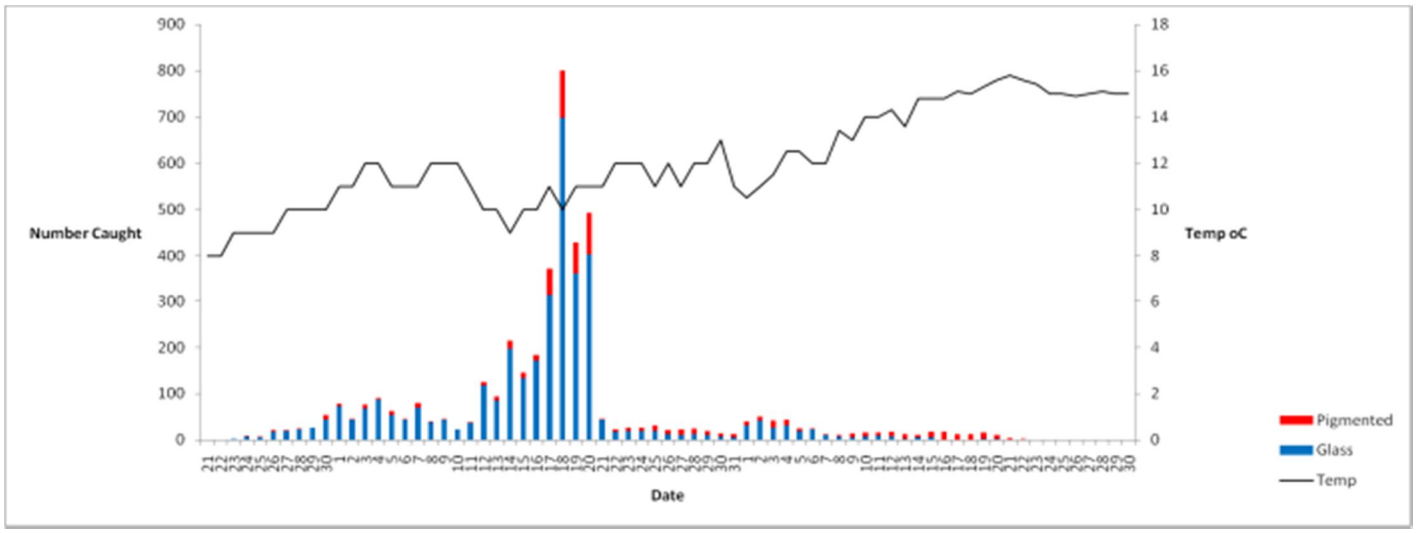


Elver Captures for period 12/5/2010 – 13/06/2010 in relation to Moon Phase and temperature

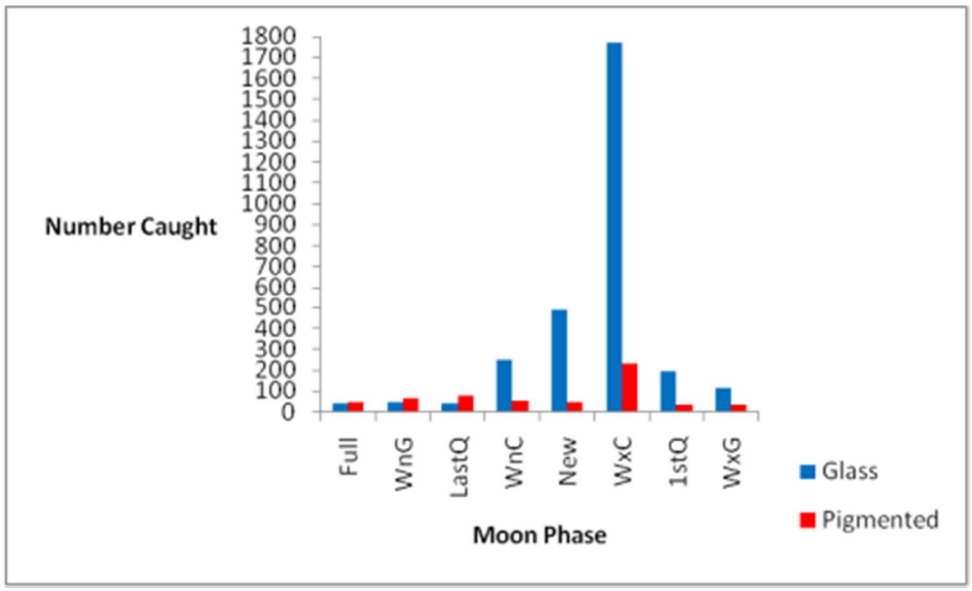


Elver Captures for period 01/05/2011 – 13/06/2011 in relation to Moon phase and temperature

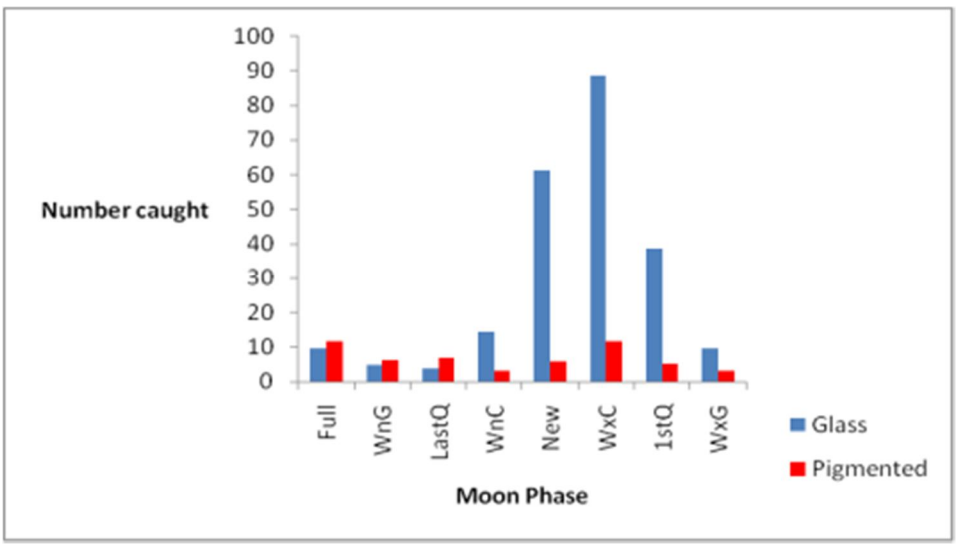
It is difficult to see any relationships from the above charts, when the data for the 3 years is amalgamated and shown on one chart, the run timing becomes clear. Elvers enter the river at the beginning of May once temperatures have reached 9^{O}C. The peak of the run is estimated mid May where numbers increase rapidly before dropping dramatically. Numbers also peak after the New moon and during the Waxing Crescent phase. These are the darkest periods. As the moon becomes brighter the number of elvers decreases. So it can be assumed that the peak of a run would occur during the new – waxing crescent phase during May with a temperature of 9^{O}C +.



Elver and pigmented Captures for the period 21 April – 30 June 2009 -2011 in relation to temperature



Total Elver captures 2009-2011 in relation to moon phase



Elver captures divided by number of nights of each individual moon phase

Pipe Trap in Situ

Elvers migrating

Yellow Eels

Fyke nets and baited traps proved to be unsuccessful throughout the project. All traps were set from April and fished through until July. The main species caught were brown trout and a solitary sea trout along with the non native Minnow. These were caught in huge numbers and were removed.

Angling proved to be a successful method for the capture; this was done in the same area as the fykes and traps. A total of 60 yellow eels were caught, all of varying sizes. Two bait types were used each session, these were worms and fish baits. All size ranges were targeted by using both large and small baits of both types. It was apparent that the majority of eels within the loch were predatory with fish baits being more favourable than worm. This was also confirmed by the actual shape of the jaw apparatus with most having a large jaw width and sharp teeth. Worm baits resulted in smaller eels overall and these had much narrower jaws; this suggests that these are predominantly invertebrate feeders. Fish baits were readily taken by the broadhead variety with a number having a jaw width which exceeded the jaw length. These fish were more powerful, aggressive with larger girth in relation to their total body length. These also had slightly different appearance having a somewhat bulbous head resembling that of a dolphin and were the largest eels caught. In addition sensory pits around the head and on the lateral line were more pronounced. From these observations it is thought that these eels may feed solely on other fish including smaller eels (as one regurgitated a small eel in 2009). The remainder of the broader headed eels probably feed on both invertebrates and fish whilst the narrow headed eels feed mainly on invertebrates. Low productivity in invertebrates and the abundance of prey fish species means as the eel grows it has to adapt to the available prey.

Comparisons were made between fish caught and worm caught eels from the collected data. All measurements were compared as a percentage of the total body length. In addition jaw widths and lengths were compared as a percentage of the total head length also. These percentages were entered into a simple t-test, the null hypothesis being that there was no difference. A two-tail p-value of 0.05 or lower indicates a significant difference and the null hypothesis can then be rejected. A one-tail p-value of 0.05 or lower indicates that the fish caught variable is larger.

%Girth of Length	*Fish*	*Worm*	*%Head of Length*	*Fish*	*Worm*
Mean	17.23	15.74	Mean	15.74	14.95
Variance	19.39	30.40	Variance	4.70	6.85
Observations	34	26	Observations	27	17
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	47		df	29	
t Stat	1.13		t Stat	1.05	
P(T<=t) one-tail	**0.13**		**P(T<=t) one-tail**	**0.15**	
t Critical one-tail	1.68		t Critical one-tail	1.70	
P(T<=t) two-tail	**0.27**		**P(T<=t) two-tail**	**0.30**	
t Critical two-tail	2.01		t Critical two-tail	2.05	

No difference in the girth and head length

%Jaw Length of Length	*Fish*	*Worm*	*%Jaw Width of Length*	*Fish*	*Worm*
Mean	4.14	3.78	Mean	4.23	2.94
Variance	2.55	3.25	Variance	1.08	3.10
Observations	37	19	Observations	37	19
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	33		df	25	
t Stat	0.74		t Stat	2.95	
P(T<=t) one-tail	**0.23**		**P(T<=t) one-tail**	**0.00**	
t Critical one-tail	1.69		t Critical one-tail	1.71	
P(T<=t) two-tail	**0.47**		**P(T<=t) two-tail**	**0.01**	
t Critical two-tail	2.03		t Critical two-tail	2.06	

No differences in Jaw length but it can be seen that significant differences occur in jaw width. Fish caught eels – wider

%Jaw Length of Head	*Fish*	*Worm*	*%Jaw Width of Head*	*Fish*	*Worm*
Mean	23.15	22.63	Mean	25.11	18.60
Variance	49.17	70.45	Variance	25.83	87.42
Observations	23	17	Observations	23	17
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	31		df	23	
t Stat	0.21		t Stat	2.60	
P(T<=t) one-tail	**0.42**		**P(T<=t) one-tail**	**0.01**	
t Critical one-tail	1.70		t Critical one-tail	1.71	
P(T<=t) two-tail	**0.84**		**P(T<=t) two-tail**	**0.02**	
t Critical two-tail	2.04		t Critical two-tail	2.07	

It can be seen that there is a significant difference in the jaw widths of fish caught eels when compared to those caught on worm.

A 3lb broadheaded specimen caught on a fish bait in 2011

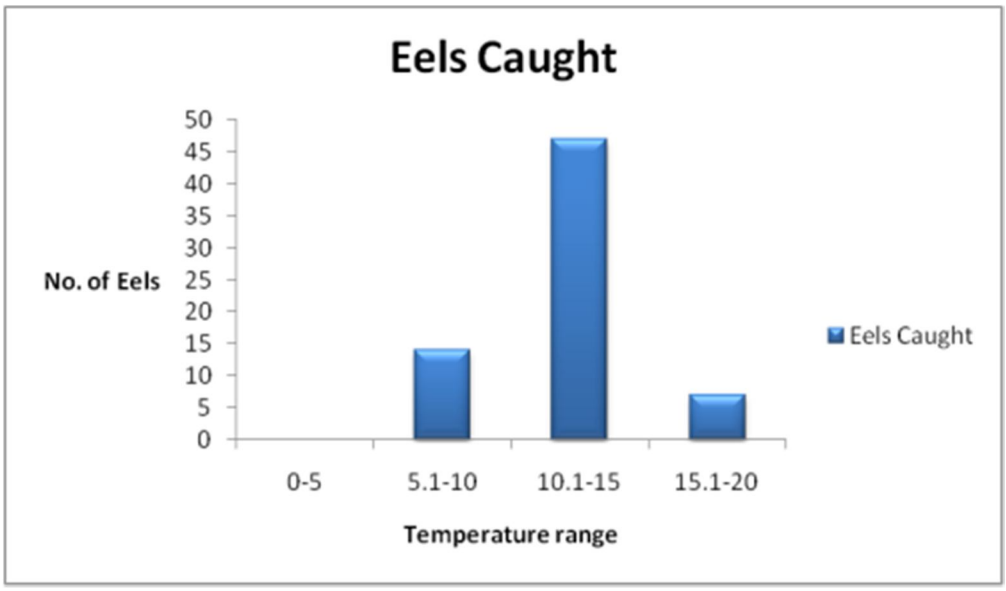
A much smaller narrowhead caught in 2009 on worm

(L.Daphne)

Eels are mainly nocturnal and were very active once darkness fell. Lots of interest was shown in baits with a large number of missed or aborted takes. The bait was often chewed once retrieved and this indicated small eels tearing chunks from the bait. Compared to most fish eels have a relatively small mouths and will often spin on their own axis in order to tear smaller morsels from the bait. Larger eels however, tend to grab the bait and bolt, often swallowing it whole. As there seemed to be a lot of eels in the area fished it can also be assumed that they were competing for the baits, not too dissimilar to a pack of wild dogs, where, if a morsel of food is offered, one will grab it and run away with it before swallowing. This has been observed by a number of members of the National Anguillla Club.

One area was fished consistently throughout the period, it provided excellent habitat, with reeds to one side and numerous weed beds and soft mud/silt for substrate. It measured 300m^2 and had an average depth of approximately 7ft and a maximum of around 12ft. All 60 eels came from this area giving a possible minimum density of 0.2/m^2 or 20 per 100m^2. It is important to note that eels do move around a lot and therefore this is not reliable although it is a useful guideline. Ten eels were marked using Visual elastomer tags. None were recaptured. An interesting finding occurred in the third year, activity on the baits saw a dramatic decrease. Takes were hard to come by with one maybe two takes per night. In previous years takes occurred non stop all night. It has often been noted that this occurs on waters where eels suffer from heavy fishing pressure. In comparison the angling pressure during this project was minimal. It is thought that eels do communicate, possibly through a release of hormones (NAC. Pers, Comm) and that the area or baits were seen as a danger. This is not uncommon in a lot of fish species; the eels caught in 2011 however were slightly larger with two being over 3lb and may have been passing through the area on the hunt. This is of course hypothetical but interesting nonetheless.

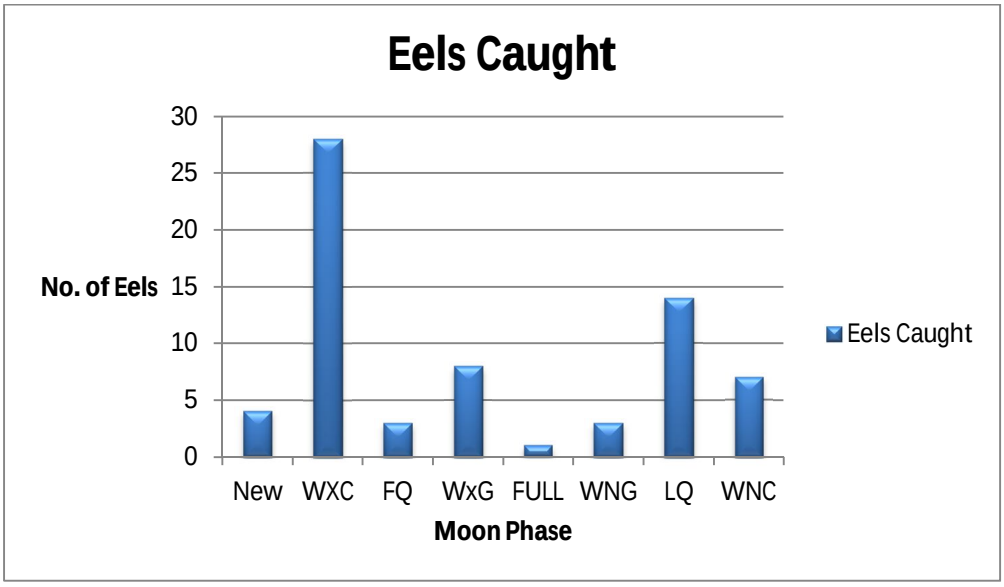
Temperature and moon phase were also recorded to identify any trends or patterns relating to feeding and activity. It was found that eels show a marked lack of activity when temperatures are below 10^oC with only 2 eels caught below this temperature (7^oC)



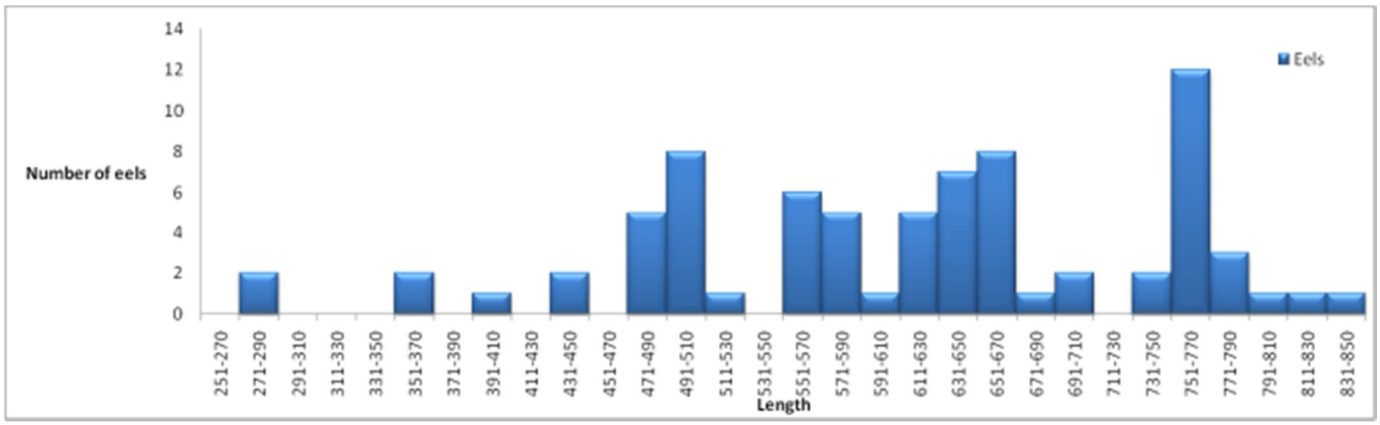
Number of eels caught in relation to temperature

It can be seen that the optimum temperature range for feeding is 10.1°C – 15°C. This chart only shows eels caught, many more were lost or missed. This only occurred once the temperatures got above 10°C. With little or no interest shown below this. Temperature does appear to be the main factor in triggering feeding activity.

Moon phase also has a slight effect on activity as can be seen in the chart below, although as with temperature activity was constant at all phases of the moon. More eels were caught during and immediately after the New moon and through the Waxing Crescent phase. As with elver migrations the darkest nights seem more favourable.

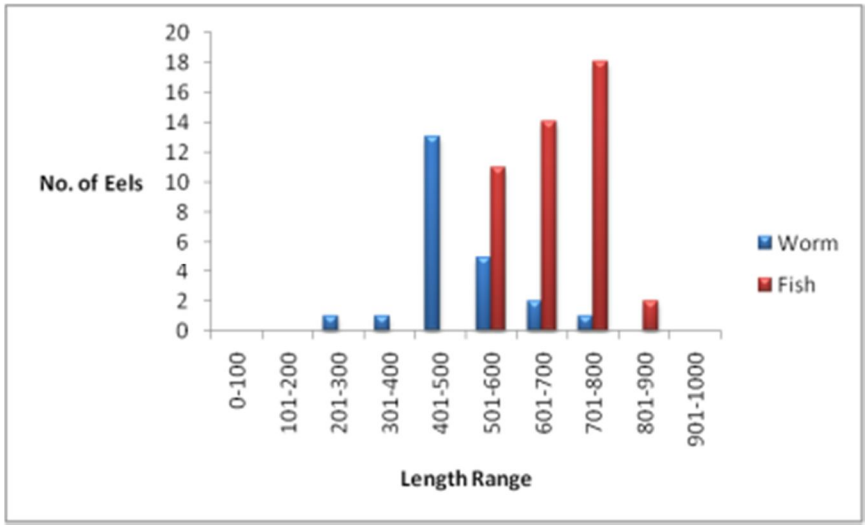


Number of eels caught in relation to moon phase

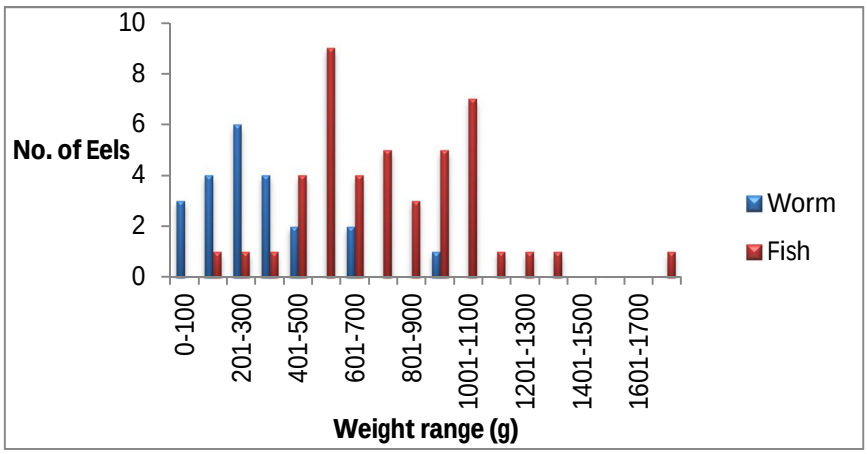


Length frequency of all eels caught

The average length of all eels caught from the loch at Geisgeil was 618.62 mm and the average weight was 606.54 g. The majority of bigger fish were taken on fish baits. These also had a larger girth overall when compared to fish taken on worm baits and so appeared much stockier and relatively short when compared to leaner worm taken fish. Again this is due to an abundance of prey fish and a smaller population of invertebrates. Eels in this loch are the top predatory fish although large trout do exist and will also prey on smaller eels. It is assumed that a great deal of cannibalism may take place, as numerous fish also appeared to have bite marks in the shape of the eels jaw.



Length and weight comparisons of worm and fish caught eels



Last year it was possible to carry out electro-fishing surveys on the streams feeding the loch at Geisgeil. These were aimed at salmonids but all eels were recorded. 2 sites were sampled on the main stream and 1 site on the smaller stream. Eel numbers seemed to be low on these sections, however, after calculating areas and density it was found that densities were actually high for Scotland. In Scotland the mean density is estimated to be 4.33 per 100 m^2. Eel densities above this have been recorded in Sutherland (May and Marshall). Main stream 1 = 21 per 100m^2, Main stream 2 = 4 per 100 m^2 and Small stream 1 =3 per 100 m^2.

The sites fished offered a variety of habitats that were indicative of the whole stream in both cases. Some areas, particularly on Main stream 2 were more suitable for eels with slower slightly deeper areas with lots of instream cover. It was expected that more eels would be found in these areas but this ceased to be the case. Although it has been listed that a small number were missed, there was no evidence of any other eels in these areas.

Eel Length	Main stream 1 – 38m^2	Main stream 2 – 72.6m^2	Small Stream 1 – 84.7m^2
100mm-104mm	0	0	1
170mm-174mm	1	0	0
210mm-214mm	1	0	0
260mm-264mm	1	0	0
282mm	0	0	1
300mm	1	0	1
MISSED	4	3	0

Table showing eel captures during electro-fishing.

By dividing the number of eels by the area, an estimate of minimum density can be ascertained. Therefore densities of:-

- Mainstream 1 = 0.21 eels/m^2 = 21/100m^2
- Mainstream 2 = 0.04 eels/m^2 = 4/100m^2
- Small Stream 1 = 0.03 eels/m^2 =3/100m^2

In 2009 SEPA conducted an electrofishing survey below the loch and weir. A total of 90 eels were caught from an area of 380.38 m^2 this gave a minimum density of 23.66 eels/m^2 and an actual density of 29.47 per 100 m^2 using the zippin method. These eels were much smaller and were obviously juveniles. This also suggests that the weir may pose problems for upstream migrations as larger eels which are obviously older are found above it. It may be that these eels entered the loch before the weir was built (around 15-20 years ago).

Silver Eels

The capture of silver eels remained difficult. Fyke nets were placed in the outflow at Geisgeil at the beginning of October each year, it was found however, that as soon as the river rose they became ineffective due to the velocity of the water. These were removed as soon as it was safe to do so. In order to try and obtain some data on silver eels, fyke nets were also deployed in the outflow from Badaich Daraich. This was met with some success with 4 eels captured before water levels rose in November and the nets again became ineffective.

Weight	Length	Girth	Head	Dorsal	Anal	Jaw L	Jaw W	Eye	Nares	Pectoral
81	348	60	48	110	150	9.24	6.24	6.23	4.97	N/R
**	**	**	**	**	**	**	**	**	**	**
36	300.5	50	40	92.6	120	10.04	10.1	8.21	4.61	16.2
66	340.5	55	50	115	152	11.7	10.7	6.87	6.52	21.1

** Eel escaped **Table showing Silver Eel captures**

An excel macro add in was obtained courtesy of Dr. J. Godfrey at Marine Scotland. This based on research carried out by fisheries scientists. By entering the Length, weight, eye diameter and pectoral fin length the add in can determine at what morphological, physiological and a simplified stage of development. This is based on gonadal and hormonal indices. (*Durif et al., 2005 and Durif et al., 2009*). The results are described as F=Female. FI, FII = Resident female. FIII =Pre migrant female. FIV and FV = Migrant Female. MD Migrant male.

The two eels that were measured for this purpose returned a result of MD, migrating males. These eels were totally silver in appearance and had large eyes as would be expected. In 2009 6 small silvering eels were caught from the loch at Geisgeil, 3 in May, 1 in August and 2 in September. All were short and fat, totally silver in colour and all had large eyes when compared to resident yellow eels. These were the only Silver eels caught. A dedicated Silver eel trap at the weir would be a useful tool but due to the high spates this would not be viable. In addition this would also act as a barrier to salmonids migrating upstream. Fykes are effective but only in streams of low velocities.

Small Silver eel from the Loch at Geisgeil (K.Daphne)

Silver eel showing film over eyes

Small silver eel from Bhadaich Daraich outflow

It was noticed that in some cases Silver eels develop a thin milky membrane over the eyes, perhaps as a protective mechanism in readiness for the shift to the marine environment or as a result of changes to the eye structure.

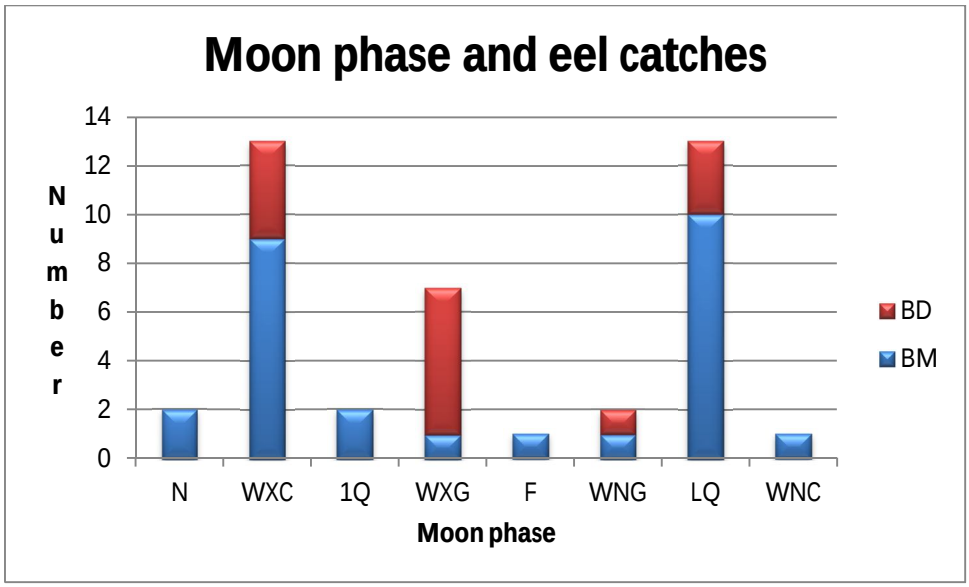
Comparisons with other lochs in the area.

Badaich Daraich is a slightly larger Loch and much deeper. It has a similar outflow to the loch as Geisgeil. This was fished with the rod during the 2009 -2010 period with the same tactics employed. A total of 42 eels were caught. All weights were recorded throughout 2009 and all measurements recorded during 2010 so some comparisons could be made.

Bait	Weight	Length	Girth	Dorsal L	Anal L	Head P	Head E	Jaw W	Nostril	Eye
W	85.05	406.4	27.5	..	..	..	..	..	..	..
W	113.4	406.4	37.5	..	..	..	..	..	..	..
W	170.1	457.2	37.5	..	..	..	..	..	..	..
F	581.175	635	55	..	..	..	..	..	..	..
W	141.75	431.8	27.5	..	..	..	..	..	..	..
W	170.1	444.5	32.5	..	..	..	..	..	..	..
F	425.25	615.95	50	..	..	..	..	..	..	..
F	425.25	571.5	47.5	..	..	..	..	..	..	..
W	83	392	27	100	180	49	7	6	4	3
F	907.2	761	110	263	324	112	30	36	12	8
F	510.3	509	82	170	230	100	30	28	10	5
F	567	602	80	180	241	102	34	30	12	6
W	453.6	678	98	230	340	98	32	28	10	5
W	907.2	764	111	261	322	114	30	37	11	7
F	963.9	772	138	254	346	112	20	32	12	6
F	538.65	621	82	240	330	102	30	26	10	5
W	793.8	653	143	221	339	109	32	24	9	5
W	652.05	615	121	207	314	100	28	22	8	4
F	963.9	770	141	251	352	118	18	32	12	5
F	907.2	765	112	258	333	112	20	34	11	6

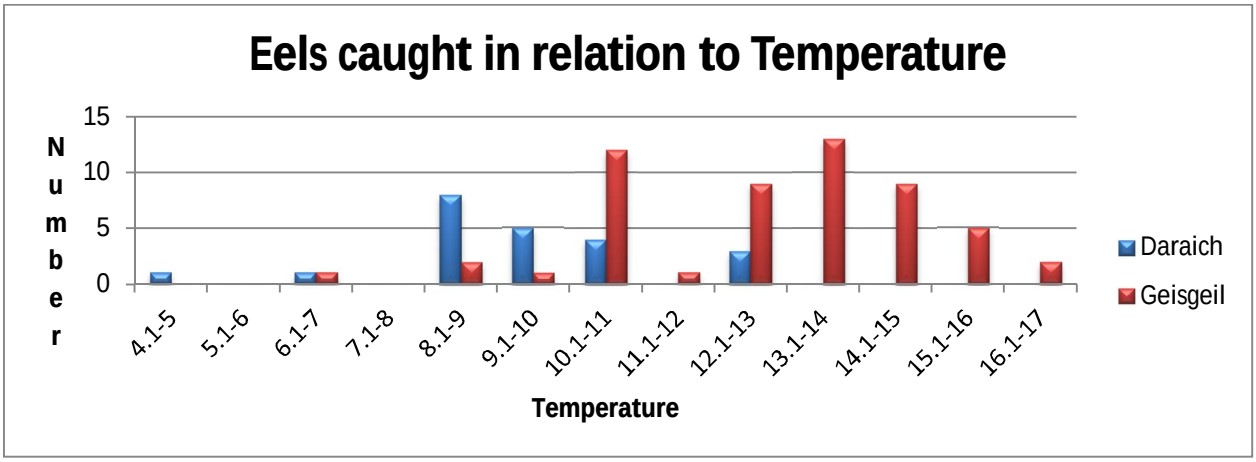
Badaich Daraich Eel captures 2010

Environmental factors and the relationship between captures were also recorded. Again eels fed during all moon phases but on some occasions eels fed but not caught, some were hooked but were not landed. In some instances the eel was not hooked but was just holding on to the bait, refusing to let go until the last minute.

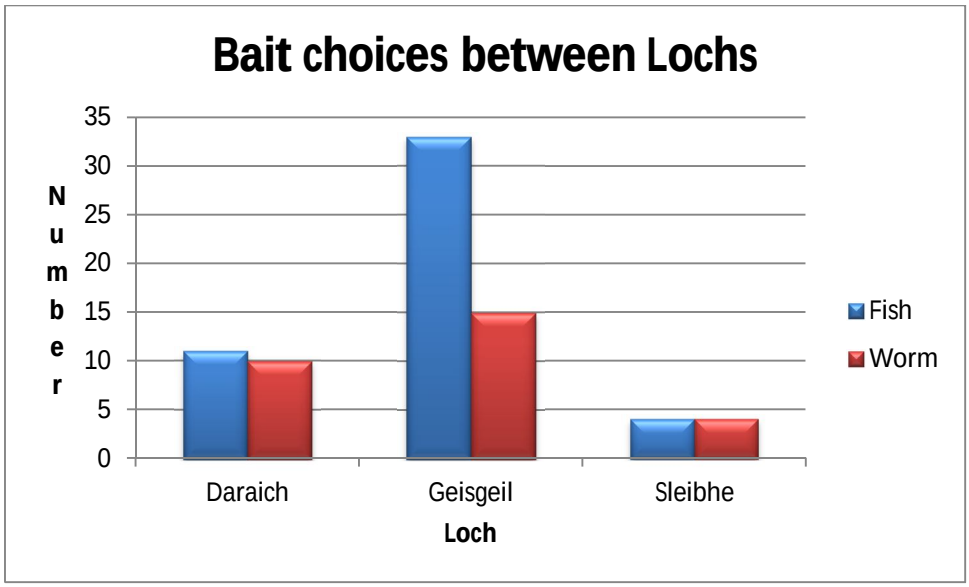


It does appear that more were caught in the darker periods – WXC=Waxing crescent, LQ = Last quarter. But this just shows captures, eels fed throughout the whole lunar phase.

Temperature was also recorded. In Geisgeil eels started feeding well once the temperature remained above 10°C. One eel was caught when the temperature was only 7°C but this was the only eel caught, no signs of feeding occurred until 10°C was reached. In Badaich Daraich eels seem to feed at lower temperatures, as mentioned before this is a very deep loch when compared to Geisgeil and temperatures at depth are unlikely to fluctuate. One very small eel was caught in December 2009 when temperatures were only 4.1°C. It is possible that eels here may feed throughout the winter period; it is likely that feeding will be minimal as metabolism will be much reduced.



Bait choices between lochs showed no significant preference, although there is a slight preference towards fish baits in Geisgeil, eels here tend to be larger than the other two lochs which may account for this, although one extremely large specimen was captured on a fish in 2009 on Badaich Daraich.



These captures along with eels caught last year can be plotted on a bar graph to show the length frequency numbers for each loch. The graph below shows that there is a variety of eels of all sizes found within each loch. Geisgeil has the higher numbers of all sizes but this could be a result of a more concentrated fishing effort on the loch. The average length of all eels caught to date is 602.92 mm with an average weight of 551.12 grammes. The average length and weight for individual lochs is as follows;

- Geisgeil – 611.875 mm and 596.78 grammes
- Badaich Daraich – 583.84mm and 497.18 grammes
- Loch na Airighe Sleibhe – 599.25 and 418.75 grammes

This does not include the large eel caught last year on Badaich Daraich (6lb 2 oz).

Eels were also caught from a loch above Geisgeil and these are listed below.

Bait	Weight	Length	Girth	Dorsal L	Anal L	Head P	Head E	Jaw W	Nostril	Eye
F	455	700	114	245	330	..	..	..	13	..
F	225	510	100	175	250	..	..	..	10	..
W	185	450	80	150	205	..	..	..	8	..
W	420	645	131	226	306	..	..	..	14	..
F	670	745	133	256	343	..	..	..	16	..
W	225	520	96	180	250	..	..	..	9	..
W	160	458	89	135	190	..	..	..	5	..
F	1010	766	166	266	366	..	..	..	14	..

Loch na Airigh Sleibhe Eel captures

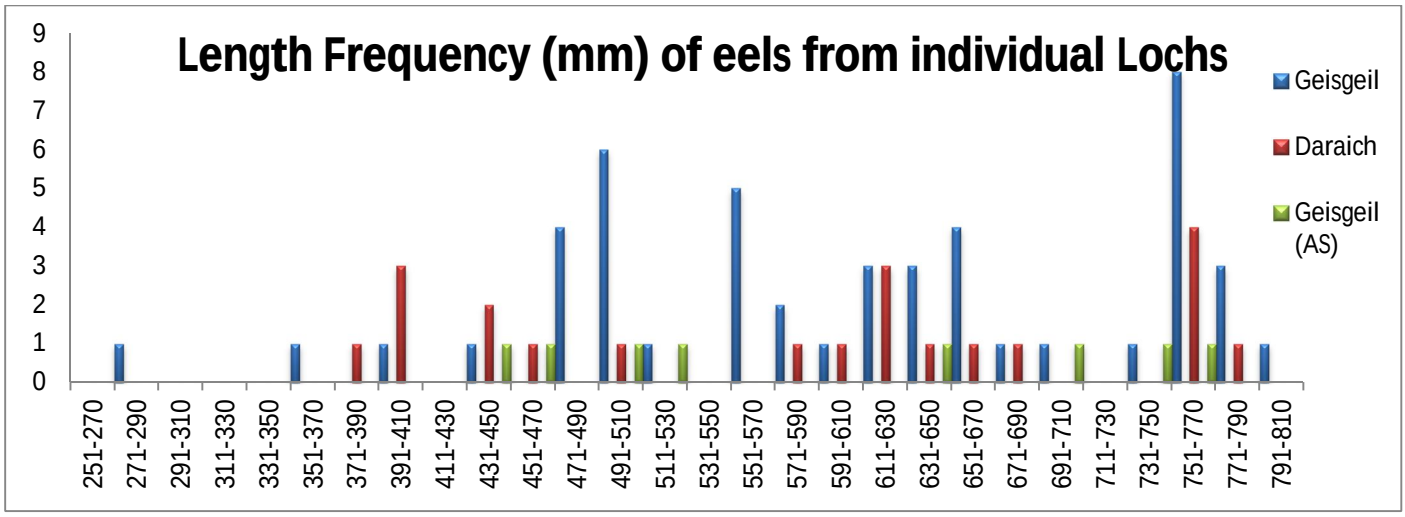


Chart showing length frequency between lochs.

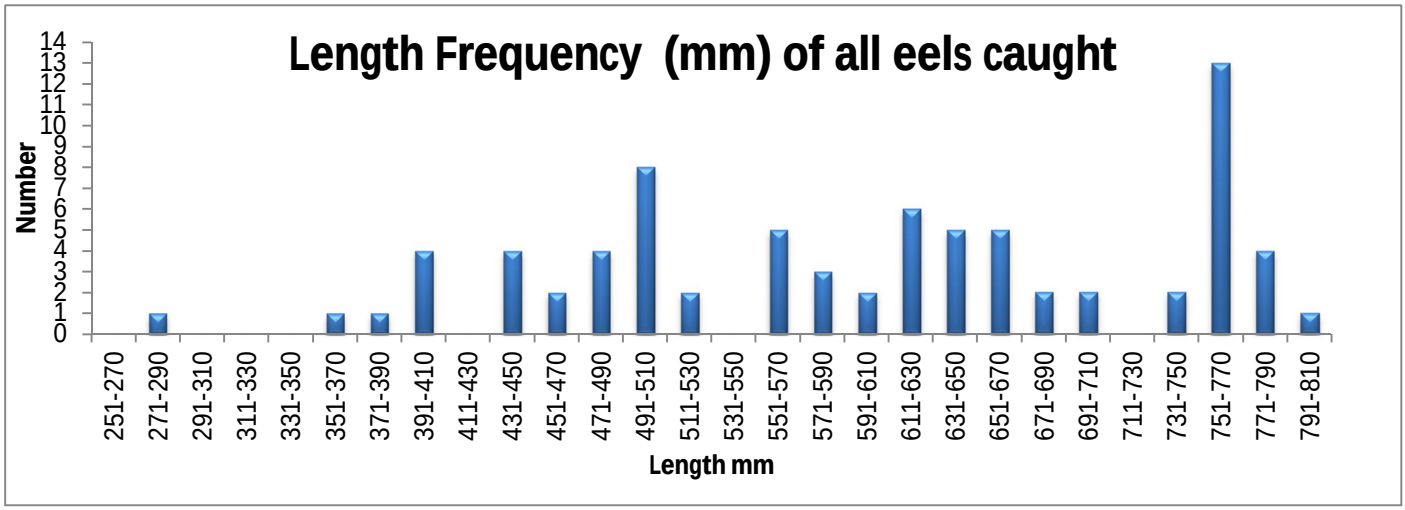
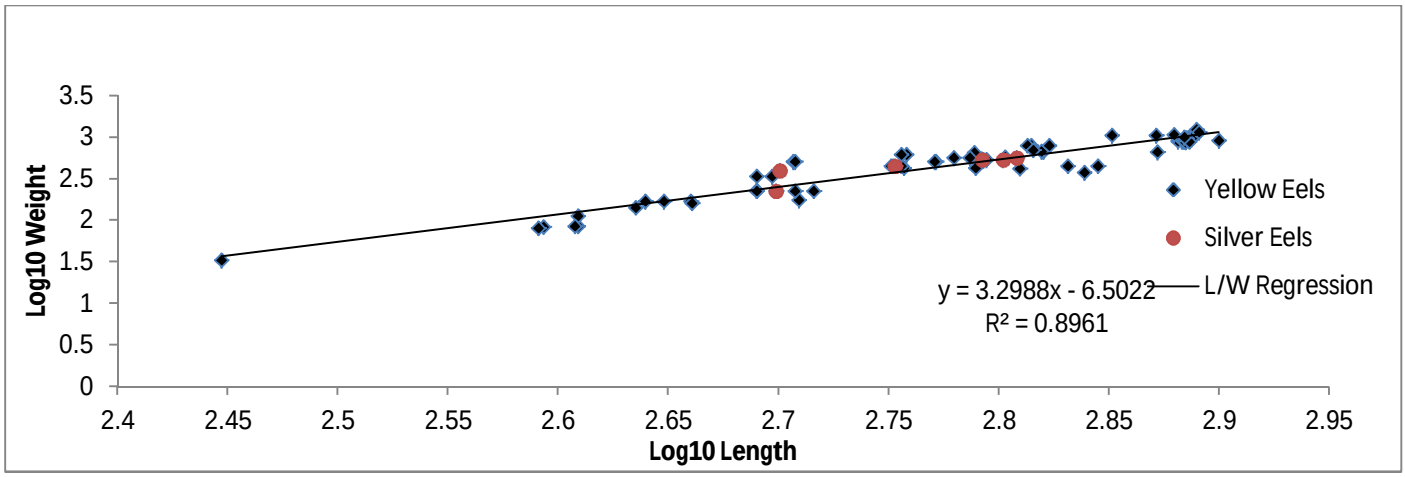
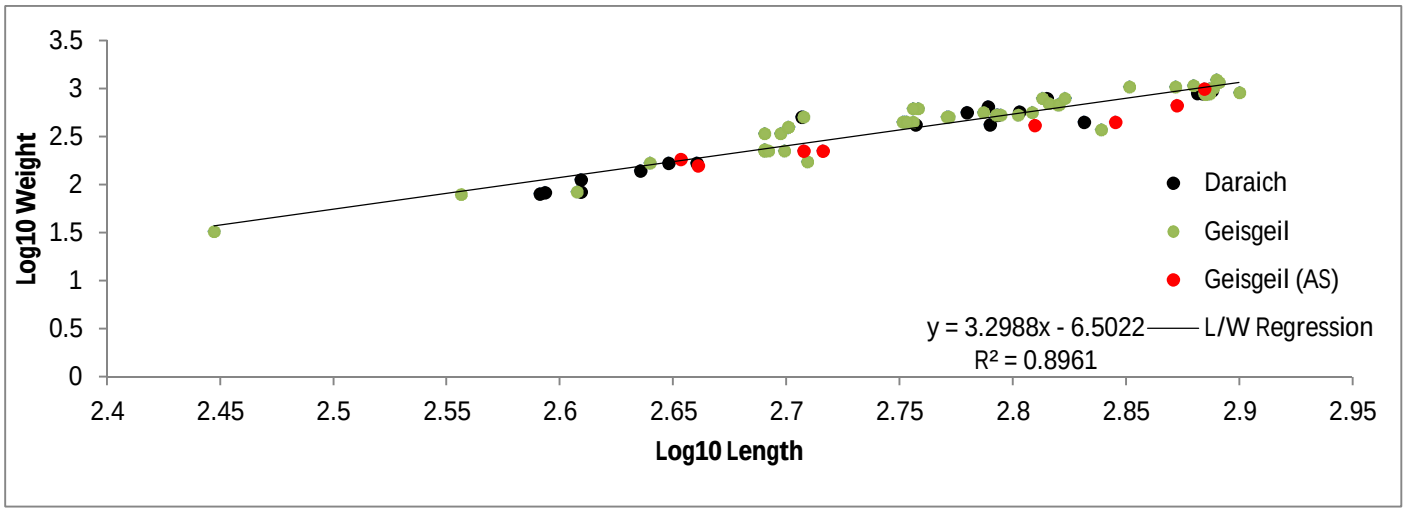


Chart showing length frequency of all eels caught

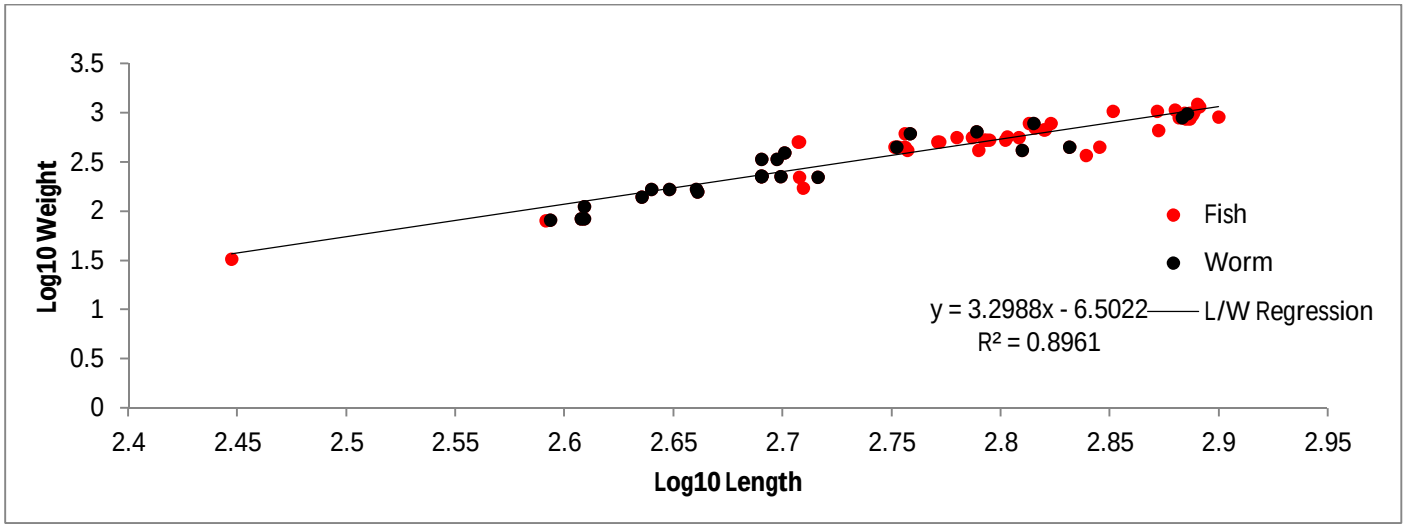
By plotting the log10 length and log10 weight on a chart and inserting a regression line the condition of all eels caught can be identified. Eels below this line are of a low condition and eels above are of a high condition. It is important to note however that any eels that are silvering or close to silvering will be found above this line due to a higher weight gain and a reduced length increase. From this, it is possible to compare condition between lochs and also between the types of bait used. It can be seen from below that all silver eels are found either on or above the regression line and the majority of eels in the area are of normal condition. Eels from Loch na Airighe Sleibhe tend to be of a lower condition, this may be due to altitude and therefore lower temperatures and so feeding and productivity is lower compared to the lochs lower down the system. The majority of eels in Geisgeil are of normal or high condition whilst eels in Badaich Daraich are evenly split. Badaich Daraich is a much deeper loch and so temperatures are likely to be lower in these deeper areas, again leading to slower growth. There is very little difference between worm and fish caught eels.



Length/Weight regression of all eels showing silver eels



Length/Weight regression between lochs



Length/Weight regression between bait types

A small sample of eels was taken from the outflow to Badaich Daraich in the hope that otoliths could be obtained for ageing. This proved to be harder than first thought and was unsuccessful. Staff at Marine Scotland have offered to provide training in this procedure to comply with European standards.

As these eels were killed it was felt that it was important to obtain as much information from them as possible. This sample was dissected to ascertain if the parasite *Anguillicola crassius.* No evidence of this parasitic worm was found. Stomach contents were investigated also and a genetic sample was also obtained. The results are listed below.

Length	Weight	Girth	Head length	Pre Dorsal	Pre Anal	Jaw Length	Jaw Width	Nares	Eye	Genetic Number	Gut contents
535	254	90	27.96	182	255	19.39	23.7	9.72	6.37	R3301	Elver
330	59	53	42.86	102.05	136.98	9.71	8.72	4.17	4.9	R3302	Empty
290	38	46	37.12	82.89	126.34	9.34	7.04	2.75	2.98	R3303	Empty
273	25	38	33.26	80.3	109.56	8.39	5.14	2.56	2.43	R3304	Mayfly/Stonefly
291	30	33	35.02	92.61	131.25	8.59	6.68	3.68	3.14	R3305	Empty
231	18	32	28.27	68.35	92.02	5.71	5.51	3.49	2.05	R3306	Empty
235	17	32	28.8	73.49	107.1	7.24	5.53	3.65	2	R3307	Empty

The majority of eels were found to have empty stomachs. Two were found to contain prey items. Eel R3301 had the remains of an elver. This eel also had a very broad head, the jaw being wider than its length. Eel R3304 contained the remains of either Stonefly or Mayfly larvae. This eel was much smaller, almost half the length of R3301 and had a much narrower head.

Other species and additional project related work

A total of 24 trout were captured in fyke nets and baited traps in 2010. In addition a further 18 were captured using rod and line. Sizes ranged from 77mm to 302mm. In addition a Sea trout kelt was also captured in a fyke net.

Brown Trout caught in fyke nets

Sea Trout Kelt

Rod caught Brown Trout

Trap and Trout

A total of 11321 minnows were also trapped from 2009 -2011 as these are an invasive species they were killed and removed. This removal had little impact on the minnow population. These proved to be useful bait and were used for rod and line sampling and for baiting traps. Dead minnows were chopped and mixed with fish meal and oil to form a paste; this also broke down in the water and was used as an attractant. In addition a number of juvenile flounder were also captured in the elver traps.

Minnows

Juvenile Flounder in pipe traps

Conclusion

This project has fulfilled the majority of the aims first set out in 2009. A great deal has been learnt about the biology of the species but it has also raised many more questions. Due to its complex and long lifecycle to fully understand the species would require a much longer study over a greater area and a variety of differing habitats. Unlike many species found in Scotland, namely salmonids, they are unpredictable in that as far as scientists are aware there is no homing mechanism therefore migrations are totally dependant on environmental conditions making them susceptible to any change be it natural or man made.

Methods of capture deemed suitable for yellow eels such as fyke nets and traps failed on this system, though further trials could be met with some success as they are known to work effectively elsewhere. The same can be said for the capture of silver eels, although this particular system is prone to very heavy spates which raise concerns over health and safety and also effectiveness. Angling can be an effective tool on stillwaters as long as all size ranges are

targeted and both bait choices are offered. By scaling down tackle and bait size, smaller size ranges can be caught. Great care must be taken however as eels are prone to deep hooking, to avoid this there a number of techniques which can be employed. The National Anguilla Club offer advice on this along with correct handling and unhooking.

Pipe traps are an effective way to trap elvers on small systems; they are however, labour intensive. They are best deployed where flows are minimal and where substrate causes a bottleneck. They are not really suitable for streams that suffer extreme flows. The river at Geisgeil does suffer from very high flows which made trapping very difficult at times. When conditions are suitable and if deployed correctly they are an efficient monitoring tool. Further modifications and investigation would be required in order to gain a more accurate estimate of capture efficiency of these traps. An attempt at devising a protocol using these traps was carried out during the Spring of 2011 as a result of this project. Although this was again hampered by unusually high flows in the experimental sites.

There is a large obstacle on the river, in the form of a weir and salmonid fish pass and it would be possible to incorporate an elver pass/trap here for future monitoring. To gain a real insight as to whether recruitment is decreasing further monitoring of the system is required. Historical evidence suggests that peak runs occurred over a longer period of time, this does not seem to be the case at present suggesting recruitment has fallen dramatically.

Fish Pass/weir

6lb 2oz (Record equalling) (S. Marshall)

It does appear that the eel populations in the two systems studied are healthy and densities are higher than the Scottish average. More work is required to ascertain escapement of silver eels and a recruitment index in order to monitor the number of elvers migrating into systems, this is an important component for any possible management plan.

This project was also used to raise awareness regarding the plight of the Eel and a number of presentations, field trips, workshops and demonstrations were given to a wide range of people. Assynt field club visited in 2009 and they were given a talk on the lifecycle along with a demonstration of various capture techniques and tagging. A presentation was delivered to the Highland biodiversity forum in 2009 also. Schools in the West Sutherland Fisheries Trust area were given a presentation about eels, this led to two workshops and field visits based on the lifecycle and decline. An interview was also given to Talksport radio regarding eel populations and the decline. In 2010 a demonstration in fyke netting and a general talk on eels was delivered to the Dundonnell Biodiversity event.

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L	W	J/L	J/W	E/D	Girth	Head (P)	Pre Dor	Pre An	Nares	Bait	Y/S	TEMP	MOON	TAG/NO.
612	567.00	40	33	5	...	...	...	...	...	F	Y	12.4	WnC	NT
643	567.00	41	34	7	...	...	...	...	...	F	S	12.4	WnC	NT
502	396.90	30	25	8	...	...	...	...	...	F	S	12.4	WnC	NT
492	226.80	30	25	3	...	...	...	...	...	W	S	12.4	WnC	NT
360	80.00	4	3	2	...	...	...	...	...	W	Y	15.8	WxC	1
280	33.00	4	3	2	...	...	...	...	...	W	Y	15.8	WxC	2
710	1048.95	16	30	6	...	...	...	...	...	F	Y	15.8	WxC	3
570	623.69	30	25	5	...	...	...	...	...	F	Y	16.2	WxC	4
660	680.39	30	35	7	...	...	...	...	...	F	Y	16.2	WxC	5
665	793.79	42	34	5	...	...	...	...	...	F	Y	15.2	New	6
744	1048.95	18	36	6	...	...	...	...	...	F	Y	15.2	New	7
758	1077.30	18	34	6	...	...	...	...	...	F	Y	14.4	WnG	8
620	538.65	39	30	6	...	...	...	...	...	F	S	14.4	WnG	NT
654	708.75	36	32	7	...	...	...	...	...	F	Y	14.4	WnG	9
566	453.60	33	26	7	...	...	...	...	...	F	S	14	LQ	NT
590	510.30	34	27	5	...	...	...	...	...	F	Y	14	LQ	10
634	538.65	33	23	7	...	...	...	...	...	F	S	14	LQ	NT
498	340.2	28	23	5	94	98	190	282	5	W	Y	7	WxG	NT
500	226.8	30	25	4	88	85	176	238	5	W	Y	9	LQ	NT
510	510.3	31	26	5	80	100	170	230	8	F	Y	9	LQ	NT
650	793.8	30	35	5	150	110	220	340	10	F	Y	10	WnC	NT
700	455	...	...	...	114	...	245	330	13	F	Y	10	...	NT
510	225	...	...	...	100	...	175	250	10	F	Y	10	...	NT
450	185	...	...	...	80	...	150	205	8	W	Y	10	...	NT
645	420	...	...	...	131	...	226	306	14	W	Y	10	...	NT
745	670	...	...	...	133	...	256	343	16	F	Y	10	...	NT
520	225	...	...	...	96	...	180	250	9	W	Y	10	...	NT
458	160	...	...	...	89	...	135	190	5	W	Y	10	...	NT
766	1010	...	...	...	166	...	266	366	14	F	Y	10	...	NT
570	453.6	26	34	5	120	115	220	280	10	F	Y	11	WxC	NT
405	85	5	4	3	28	48	102	198	4	W	Y	13	WxC	NT
770	880	...	...	5	160	116	255	343	13	F	Y	14	...	NT
512	175	...	...	4	80	62	165	216	8	F	Y	14	...	NT
690	375	...	...	4	114	88	194	280	7	F	Y	14	...	NT
794	915	...	...	5	143	114	281	365	14	F	Y	14	...	NT
490	226.8	10	6	5	90	60	170	230	7	W	Y	12	WxG	NT
490	232	10	6	3	89	61	172	234	7	W	Y	13	LQ	NT
770	1010	18	26	5	167	120	270	368	8	F	Y	13	LQ	NT
766	907.2	32	24	4	140	116	254	350	7	F	Y	14	LQ	NT
623	538.65	32	26	4	80	107	244	339	8	F	Y	14	LQ	NT
661	680.4	28	23	5	140	110	244	336	9	F	Y	14	1stQ	NT
770	963.9	18	24	5	141	112	255	335	8	F	Y	14	1stQ	NT
773	1020.6	16	32	5	166	125	267	356	10	F	Y	14	1stQ	NT
776	1247.4	18	28	5	168	131	270	350	10	F	Y	14	Full	NT
565	453.6	30	26	3	122	115	220	281	8	W	Y	13	New	NT
490	226.8	10	8	3	90	62	177	240	5	W	Y	13	New	NT
573	623.7	31	23	3	111	98	222	332	7	W	Y	14	WxC	NT
768	992.25	30	36	5	168	111	243	360	11	W	Y	14	WxC	NT
767	876.2	28	31	4	161	100	250	343	11	F	Y	14.1	WxC	NT
490	340.2	12	8	4	98	76	191	279	6	W	Y	14.1	WxC	NT
768	963.9	16	28	4	142	120	256	339	9	F	Y	14.1	WxC	NT
778	1162.35	34	26	5	163	116	264	360	7	F	Y	14.1	WxC	NT
564	453.6	28	26	3	122	101	227	292	8	F	Y	14	LQ	NT
591	510.3	31	24	4	120	100	230	309	7	F	Y	14	LQ	NT
436	170.1	6	4	3	89	52	144	220	2	W	Y	14.3	LQ	NT
502	396.9	10	4	3	98	71	212	260	2	W	Y	14.3	LQ	NT
435	170.10	6	5	3	95	70	210	262	2	W	Y	7	WnG	NT
520	226.00	11	9	3	85	63	177	238	5	W	Y	13	WxC	NT
576	502.10	29	22	4	116	100	227	300	6	F	Y	13.2	WxC	NT
838	1701.00	26	38	8	177.8	121	278	348	8	F	Y	14	WxG	NT
814	1360.80	25	35	9	165.1	115	270	340	8	F	Y	14	WxG	NT
485	340.20	12	9	4	96	75	193	280	5	W	Y	14.2	WxG	NT
770	1020.60	16	32	5	168	127	269	358	10	F	Y	14	WnC	NT
633	737.10	27	33	4	156	107	216	336	7	F	Y	14	WnC	NT
761	935.50	32	36	5	144	118	257	351	7	F	Y	15	WxC	NT
758	850.50	24	28	3	157	100	244	338	8	F	Y	13	WxG	NT
667	793.80	30	35	5	150	110	220	340	10	F	Y	13	WxG	NT
645	612.00	31	23	3	106	94	220	331	7	W	Y	13	WxG	NT

Appendix 1 Yellow Eel Captures from Geisgeil 2009-2011