

West Sutherland Fisheries Trust

Project to devise an annual Elver Recruitment Protocol.



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Introduction

This report is a brief description of methods and results for the project undertaken in spring 2011, all data have been passed to Marine Science Scotland.

Recruitment of the European eel (*Anguilla anguilla*) has fallen dramatically in recent decades. Data collected across Europe and analysed by the ICES/EIFAC Working Group on Eel indicates that current recruitment of glass eels to European waters is between 1 and 5% of its level at the end of the 1970s, and that it continues to fall (WGEEL 2009). There is spatial variation around Europe in the level of decline, with Eastern Europe generally faring less well than the Atlantic seaboard. However, despite the importance in recruitment in determining the status of eel populations, the number of data series across Europe on which estimates of glass eel recruitment are based is itself falling, because many of these were derived from glass eel fisheries which are now being closed. This means that future estimates will be somewhat compromised, and there is a European level requirement for new recruitment series to be initiated. Furthermore, there have never been, and are presently no, recruitment data for the eel in Scotland, and this is recognised as a major failing in the Scotland RBD Eel Management Plan. Without information on the number of eels arriving at Scottish coasts it is not possible to model national eel populations adequately, or to predict future trends in silver eel escapement. Accordingly there is a need to a) develop a reliable method measuring recruitment in the absence of fishery data, and b) collect annual recruitment data for the eel in Scotland.

The aim of this project is to develop a standard method for calculating an elver recruitment index by using a series of pipe traps at small river mouths. The method also aims to provide a quantitative estimate of the total elver run for each catchment so that spatial variation in recruitment can be assessed. It is hoped that the use of this protocol could be extended to other catchments throughout Scotland, to provide a nationwide recruitment index.

Methodology



Pipe trap in situ

Pipe traps have been used historically by a number of local elver fishermen and have proved to be effective when set correctly. They are also currently being used by WSFT as part of an existing project looking at an eel population in a Sutherland catchment. They consist of a length of pipe 380 mm in length with a diameter of 110 mm. Within the pipe there is a funnel of gauze reducing the entrance to around 10 mm. Access to elvers/catch is via a screw off cap also fitted with fine gauze.



Traps are usually set where there is some form of small obstacle or where small channels appear between rocks/substrate. Moss is placed on the bed and packed around the entrance. Substrate is placed on and around the trap, creating a further obstacle and holding the trap in position. Flow can be diverted through the trap. As elvers move upstream they encounter the obstacle, move into the trap and are unable to escape.

For this project a series of rivers were selected to represent the range of habitat in West Sutherland. At each of these a series of traps were arranged in lines with the same number of traps in each line. These were arranged across the stream channel at 2 m intervals where possible (such that smaller channels will have fewer traps in each line). Each stream had 5 lines of traps set at a distance of 5 m apart. This gave ample coverage across the stream width to assess spatial variation in elver transport rates upstream and also the use of marginal low flow or main channel. The first line of traps in each stream started 10 m from mean high water spring tide within each stream.

Elvers which were not trapped in the first line of traps will pass up to the next line and so on, so that the total number of elvers passing above each line of traps must be smaller than the number caught in the previous traps. Accordingly it is expected that fewer eels should be caught in each line of traps, and that these data can be used to estimate the size of the total elver run for each catchment, using standard statistical depletion trapping methods. Since this work is proposed to continue on an annual basis, this protocol should generate data which will allow the characterisation of both spatial and temporal variation in eel recruitment across West Sutherland.

Initial studies in West Sutherland indicate that the main elver run generally starts in May and can last for up to a month. These run times may vary from river to river and so in order to ensure the entire run is sampled, traps were fished continuously from the end of April for 6 weeks.

A total of 6 catchments were trapped, chosen to be representative of the catchments in the area and included catchments on the North coast as well as west draining catchments. They offer a variety of catchment/stream sizes, gradients and habitats, in addition some flow into coastal lochs while others flow directly into the sea.

The traps at each site were visited on a daily basis and all captures processed and recorded. Eels were anaesthetised using MS 222 for ease of handling and processing.

Where 50 or fewer eels are trapped, the following data was recorded:

- Individual length
- Stage – glass, pigmented or yellow
- Combined mass of sample

Where more than 50 eels are trapped, a sub-sample of 50 eels was taken, and recorded as above. An estimate the total number of elvers was then obtained using the following equation:

$$N = ((\text{mass of remainder} / \text{mass of subsample}) \times \text{count of subsample}) + \text{count of subsample}$$

The following environmental factors were also recorded:

- Date and time of trapping
- Tide – times and heights
- Water temperature – via data loggers
- Lunar phase
- Flow rates across the stream width and at trap sites
- Length of fishing period.

Locations

A total of 6 catchments were chosen in order to give a geographical spread across a variety of water courses.

Stream	Grid Reference	Width (m)	Number of traps	Notes
Badhaich Daraich	215800 944800	2	8	Flows from large loch and enters the sea <i>via</i> a small lochan.
Badna Bay	222000 946800	3	10	Enters Laxford Bay inlet
Loch Innis	222900 955995	2	10	Flows from loch; traps above large waterfall.
Oldshoremore	220300 958500	4	12	Wide flat stream by car park
Kyle of Durness	238350 966075	3	10	Above road culvert. Flows into Kyle of Durness
Caladeil	240900 967750	2	8	From Limestone loch

All streams have historically contained good runs of elvers although numbers have decreased according to local sources. Tiny tag aquatic temperature loggers were deployed at each site and set to record temperatures at hourly intervals. Flow rates through each trap were measured daily using a Geopacks flow meter (MFP51). Photographs of each site can be seen below.



Badhaich Daraich



Badna Bay



Loch Innis



Oldshoremore.



Kyle of Durness



Caladeil

Results

Low flows were experienced in each catchment from 28/04/11 to 09/05/11 before unusually high rainfall meant that all streams were in full spate with most breaking free of their channel. During this time flows rose from 0.05 m/s to over 1 m/s within the space of a few hours and remained at this upper limit for approximately 2 weeks. A number of traps were lost during this period and no traps fished effectively as all were totally submerged. This occurred during the estimated peak of the elver run.

Elvers were encountered in Badhaich Daraich and Badna Bay prior to the increase in flow, and following the drop in water. No other elvers were recorded.



Badna Bay Spate



Oldshoremore Spate

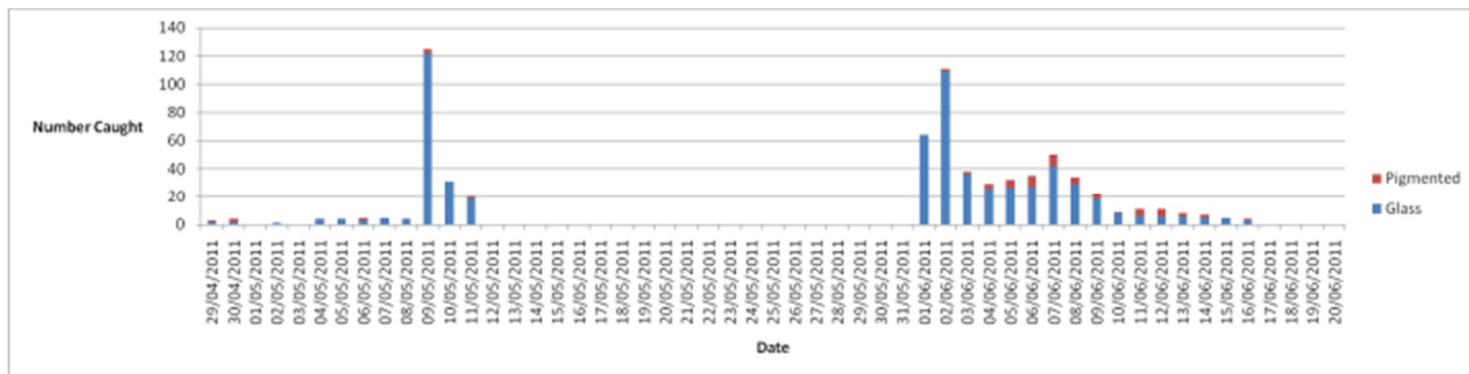
1. Badna Bay

A total of ten traps were placed in the stream and numbered as follows – L = Left, R = Right, M = Middle

1L 1R 2L 2M 3L 3R 4L 4M 5M 5R

This gave a good coverage of the stream stretch. Catch data are summarised in Figure 1.1. The gap in data between 12.5.11 and 31.5.11 represents the period when the traps were not fishing. From this, it would appear that the main elver run was missed during 2011, with an increase in catches to 9.5.11 and a decline in numbers from 2.6.11.

Figure 1.1 Showing the number of elvers caught on each date



From Fig. 1.2 it would appear that elvers migrate up the banks of the rivers, avoiding the areas of main flow, midstream. This is supported by the findings in Fig. 1.3, which shows a rapid depletion in numbers caught with flow rate. From this it would appear that glass eels favour flow rates below 0.1 ms^{-1} , the majority also migrating in extremely low water heights, below the level that flow can be measured.

Figure 1.2 Number of elvers caught in relation to instream position (L = left, R =right, M=middle)

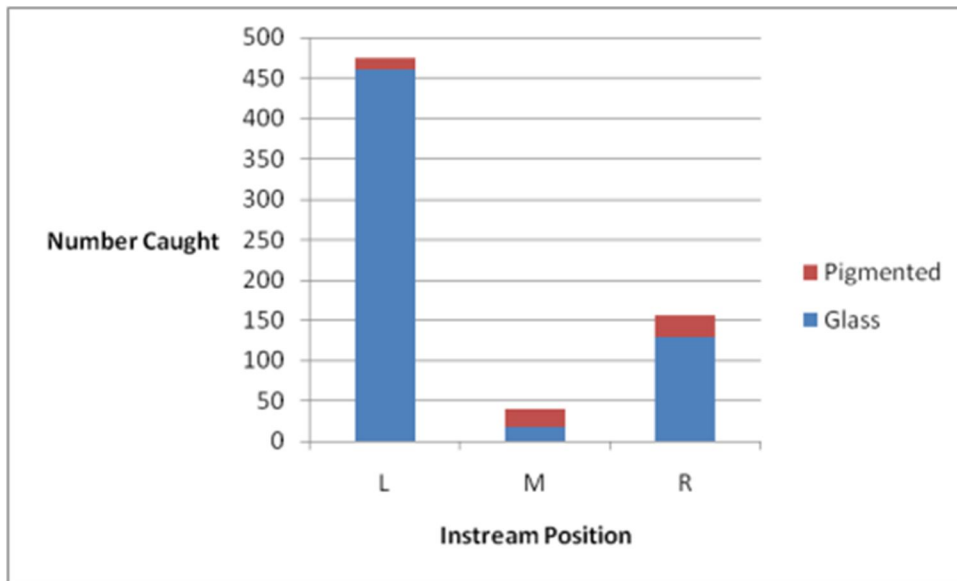
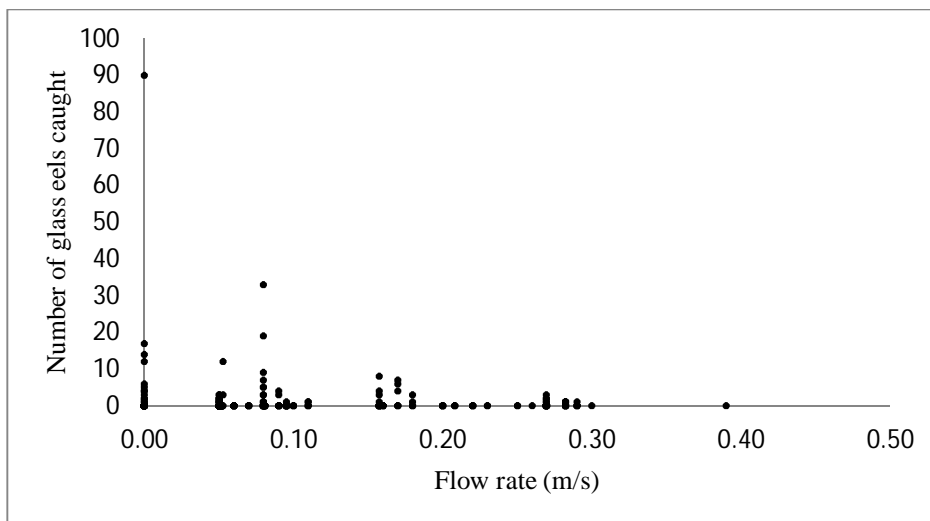
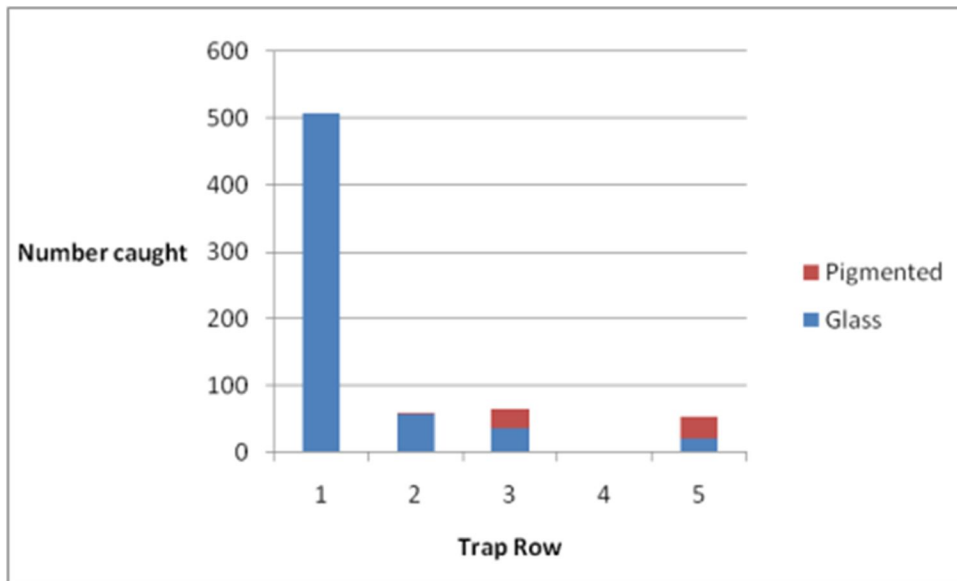


Figure 1.3 Total number of glass elvers caught in relation to flow (a flow of 0.00 indicates the water was too shallow to measure)



Within the Badna Bay catchment, elvers favour the left bank, with over 3 times the number caught in these traps compared to the right (Fig. 1.2). A depletion in numbers with distance upstream can also be seen (Fig. 1.4) with the majority of elvers captured within the first row, or downstream, traps.

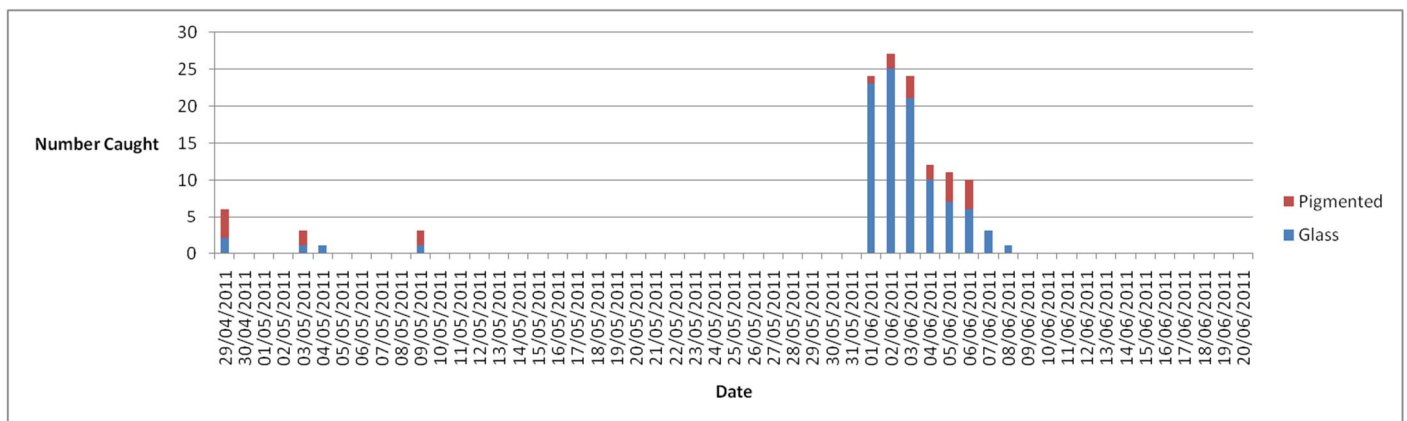
Figure 1.4 Total number of elvers caught in relation to trap row, where 1 is downstream



2. Badhaich Daraich

Trap numbers as for Badna Bay. A total of 8 traps were deployed in the stream. This gave a good coverage of the stream stretch. Catch data are summarised in Figure 2.1. The gap in data between 12.5.11 and 31.5.11 represents the period when the traps were not fishing. From this, it would appear that the main elver run was missed during 2011, with a steady decline in numbers from 2.6.11.

Figure 2.1 Showing the number of elvers caught on each date



From Fig. 2.2 it would appear that elvers migrate up the banks of the rivers, avoiding the areas of main flow, midstream. This is supported by the findings in Fig. 2.3, which shows a depletion in numbers caught with flow rate. From this it would appear that, within Bhadaidh Daraich, glass eels favour flow rates below 0.175 ms^{-1} .

Figure 2.2 Number of elvers caught in relation to instream position (L = left, R =right, M=middle)

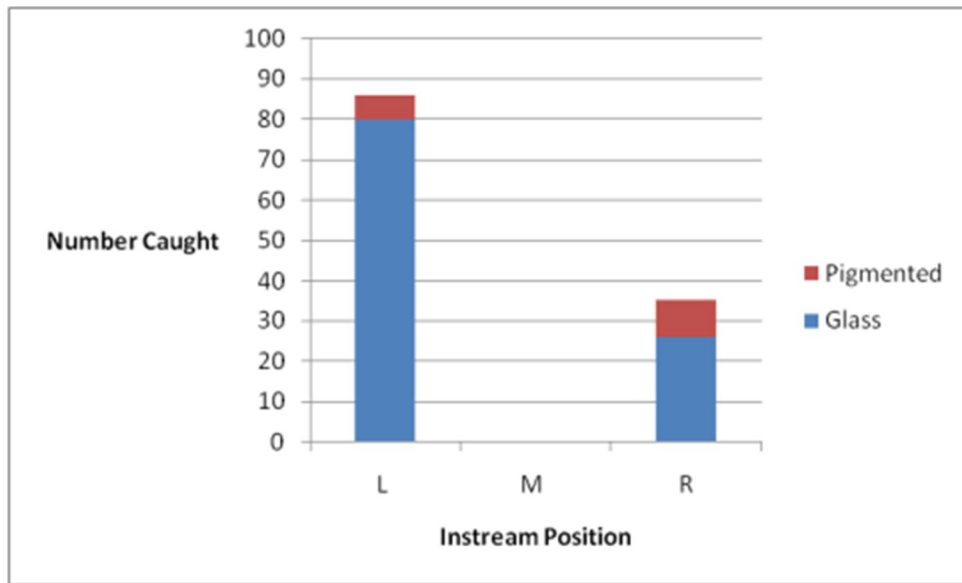
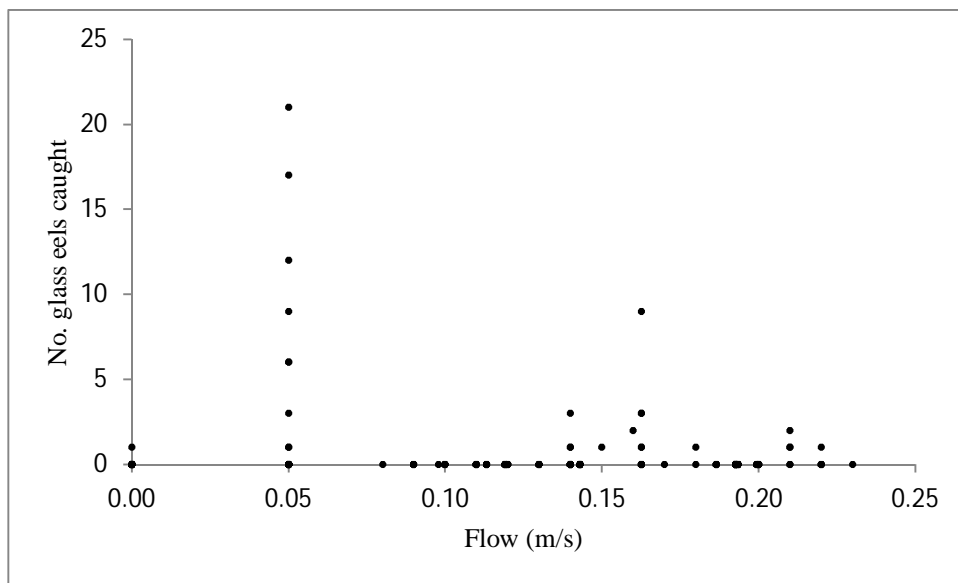
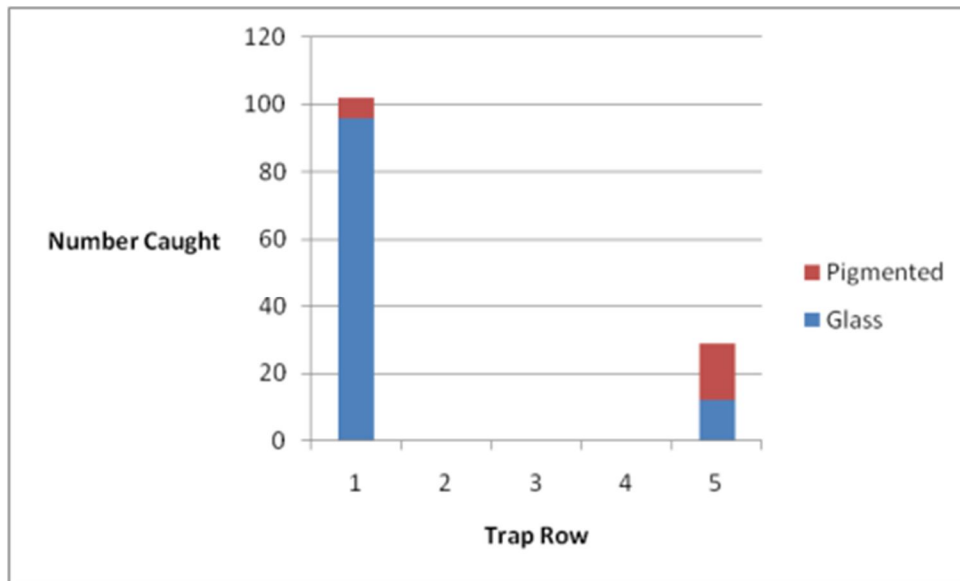


Figure 2.3 Total number of glass elvers caught in relation to flow (a flow of 0.00 indicates the water was too shallow to measure)



Within the Bhadaidh Daraich catchment, elvers favour the left bank, with over 3 times the number caught in these traps compared to the right (Fig 2.2). A depletion in numbers with distance upstream can also be seen (Fig. 2.4) with the majority of elvers captured within the first row, or downstream, traps. The middle rows of traps did not appear to be as effective within this catchment, with no further glass elvers caught until row 5.

Figure 2.4 Total number of elvers caught in relation to trap row, where 1 is downstream



Discussion

It can be seen that the peak of the elver run was missed due to the high flows despite attempts to cover this period. This can be seen in both catchments where elvers were caught. In both catchments there was a depletion in the number of glass eels caught as you move upstream. Pigmented eels, in contrast, showed an increase in numbers as you move upstream. While this may represent the transformation and movement of elvers through the system, it is more likely that at least some of these were last year's elvers and were in residence before traps were deployed.

In both catchments elvers migrate up the stream edges with very few caught in midstream. The left bank is favoured in both cases, which may represent the direction in which the eels are travelling before moving into freshwater, or may be the result of flow patterns. An assessment of flow rates and numbers of glass eels caught would indicate that flow rate is very important to elver migration, with elvers following the lowest flows, although differences between the two catchments were observed with elvers in Bhadaidh Daraich moving in higher flows than those in Badna Bay. However this is likely to be a reflection of the stream morphology rather than an actual difference.

This method has the potential to be useful in the monitoring of elver runs within a range of catchments throughout Scotland. It is known that it is used in commercial fisheries and has been successful in a range of river sizes, despite the lack of successful in 2011 as a result of environmental conditions. Positioning of traps is an important factor and it is suggested that traps be deployed in areas where flow is between 0 - 0.20 ms⁻¹ as glass eels are relatively weak swimmers. Traps should be concentrated at stream edges where flows rates are lower. It has also been suggested that elvers navigate by following the stream edges and this is supported by this study.



Elvers from Badna Bay