EDF Abundance data

Estimation of a single tidal population in the Severn estuary.

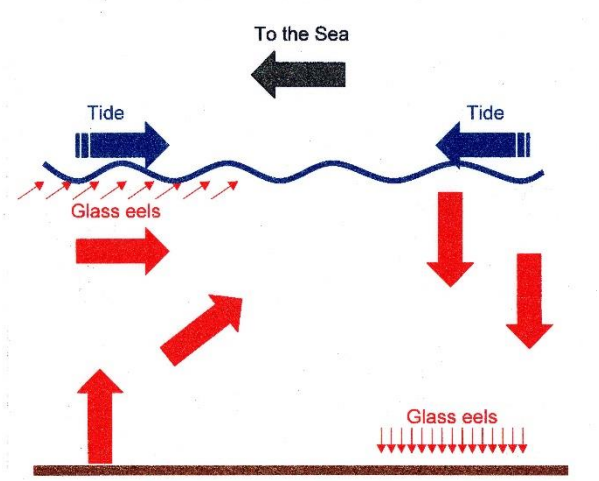
There is no doubt that estimating tidal populations in wide estuaries is challenging and requires significant resources. Though a survey for EDF may not have been conclusive in terms of making comparative population studies between year 2013 and 2014 it was a comprehensive survey. Glass eel abundance data was collected at the surface, midwater and across the whole width of the channel including the Welsh and English shores. Some assumptions have to be made about the distribution of glass eels. There is however sufficient data to give an indication of estuarine mean population densities.

Selective Tidal Stream Transport (Harrison)[3]

Glass eels are not capable of significant sustained active migration.

Experience on the River Severn, where gradients are shallow and water flow rates are slow, is that active migration might be sustained under optimal conditions for one or two hours. But on faster flowing rivers such as the Wye the period of active migration is much shorter perhaps 15 to 30 minutes.

It is now generally accepted that glass eels migration depends on a tidal ratchet mechanism. It is the principal mechanism for upstream estuarine migration.



Tidal Rachet Mechanism

On an incoming tide the glass eels become suspended in the water column and are carried forward with the tide. As soon as the tide starts to flow back to the sea the glass eels fall to the bottom and hold their position until the next tide. It has been demonstrated experimentally that glass eels are buried in the river bed in order to maintain their stationary position

Local conditions will no doubt influence timings and outcomes. However observations at our operating bases on the Severn, the Arzal and the Seudre are that at high water or just after water there are no or virtually no glass eels in the water column until the next flood tide.

Abundance

The overall mean abundance 2013 is based on the survey work commissioned by EDF Energy and a collaboration between CEFAS and the EA carried out in 2012 and 2013. (CEFAS 2014)[1] Samples were taken at multiple sites and stations and fished at 3 depths. The Severn chart shows the position of the fishing sites, the depths and tidal streams. Most of the fishing was carried out on the flood tide because the scientific literature suggests Selective Tidal Stream Transport is the most likely method of migration through the estuary. Many of the plots showed little or no apparent trend. However glass eel abundance was highest on the surface though not statistically significant.

In conclusion, the results of the survey in 2013 have confirmed that:

- Glass eels used the full width of the Severn Estuary to migrate upriver.
- The greatest abundance of eels was consistently found in shallow, inshore sites on the southern and northern sides of the Estuary.
- There is evidence that eel densities are greater at the surface than at deeper depths; particularly than at depths of 7m.

From the 2013 estuarine mean glass eel abundance data (CEFAS 2014)[1] an estimate of a single tidal population has been made based on the chart data for mean high water spring tides.

The accuracy of the immigration calculation depends on the efficacy of the Selective Tidal Stream Transport mechanism. Data from (Prouzet et al 2009)[4] indicates that the migration speed may be equal to the displacement of the tide. There is a lag phase of one series of spring tides when the glass eels are first observed on the Parrett and then on the Severn which is compatible with the migration speeds indicated by Prouzet et al. The separation distance between the two rivers is 100 kilometres.

Prouzet et al also showed in normal hydroclimatic conditions when the tides progress through the estuary, that the daily glass eel runs remain distinct. They assumed non accumulation of different runs of glass eels issued from two (or more) consecutive rising tides.

The mean estimations of abundance for 2013 is based on observations from trawls conducted on 20 days over a period seven weeks starting in February and terminating in April.

The Hypothesis

Three cross sectional areas of the estuary were chosen. Lavernock Point to Hinkley Point, Lavernock Point to Brean Down and from Newton to Sand Point. This was to test the sensitivity of the data to different cross sections and to make the Welsh parallel data more inclusive. In the final analysis the mean tidal population has been calculated on the basis of the three cross sectional areas. See Excel[5]

Survey 2013

The overall mean abundance for all tows sampled in 2013 was 0.00580 eels m-3 (95% CI = 0.00103 eels m-3).

The single tidal populations at the different cross sections was calculated as follows:

1.Newton to Sand Point – 8963 kgs

2.Lavernock Point to Brean Down - 10694 kgs
3.Lavernock Point to Hinkley Point - 13589 kgs
Mean of the three cross sections - 11082 kgs (for one single tide)

The total UK glass eel fishery catch for the whole of the 2013 fishing season was – 7807 kg

In broad terms:

- The single tide population of glass eels – 10,000 kgs
- The single tidal population of Silver eel Equivalents – 1000 tonnes (Dekker) [3]
- The single tidal population of Silver eel Equivalents – 650 tonnes (DEFRA)[2]
- Dekker 2000 1kg of glass eel was considered equivalent to 93.8 of silver eel
- Defra 2015 1kg of glass eel was considered equivalent to 59.4kg of silver eel

Based on the best spatial evidence that it currently available it was possible to estimate the quantity of glass eels present on a single tide.

The review of this data would suggest that the glass eel fishery is a very small fraction of the total estuarine recruitment.

The historical silver eel equivalents from the glass eel recruitment have been significantly under estimated.

Even if the assumptions of non-accumulation by Prouzet et al are not totally accurate the potential estuarine glass eel recruitment is still substantial. Looking at the glass eel recruitment spread over four series of spring tides during the survey period the silver eel equivalents entering the estuary would be estimated in thousands of tonnes even if a large proportion of the samples were double counted.

The survey was restricted to a notional recruitment period that coincided with the start of glass eel fishing season as opposed to the actual recruitment period that logically would have proceeded the fishing period. It is therefore likely that a number of days were excluded from the survey and consequently the seasonal biomass has been underestimated.

References

1) Sarah Walmsley, Jon Barry, James Pettigrew. Dynamics of glass eels in the Bristol Channel 2012 – 2013. CEFAS
2) Report to the European Commission in line with Article 9 of the Eel Regulation 1100/2007 Implementation of UK Eel Management Plans. DEFRA June 2015
3) Andrew J. Harrison, Alan M. Walker, Adrian C. Pinder, Cedric Briand, Miran W. Aprahamian. A review of glass eel migratory behaviour, sampling techniques and abundance estimates in estuaries: implications for assessing recruitment, local production and exploitation.
4) Noëlle Bru, Patrick Prouzet, and Michel Lejeune. Daily and seasonal estimates of the recruitment and biomass of glass eels runs (Anguilla anguilla) and exploitation rates in the Adour open estuary (Southwestern France).

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