

Conservation measures for the freshwater pearl mussel in the River Dee in north east Scotland

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Pearls in Peril

The freshwater pearl mussel *Margaritifera margaritifera* was once widespread in the UK (Cosgrove *et al.*, 2000). However, these populations have undergone serious decline and in England, Northern Ireland and Wales the species is now restricted to a few sites and the majority of the UK's viable populations are found in 72 Scottish rivers. In the UK, 26 Special Areas of Conservation (SACs) have been designated for the species (jncc.defra.gov.uk).

'Pearls in Peril' (PIP) is an EU LIFE+ Nature project which aims to safeguard Great Britain's important pearl mussel populations (pearlsinperil.org.uk). Twenty two organisations are working together to deliver 48 actions across 21 SACs. PIP aims to: 1) restore the habitat of pearl mussels and salmonids, 2) secure the long term survival of existing pearl mussel populations, and 3) communicate with local, national and international audiences to raise awareness of pearl mussel conservation issues. PIP runs from September 2012 to September 2016. One of the PIP project's largest initiatives is taking place on the River Dee in north east Scotland.

The River Dee

Geography

The River Dee is one of the UK's largest rivers. From its source at 1220m on the Cairngorm plateau, the Dee flows 130km east from mountain and moorland, through farmland, to enter the North Sea in Aberdeen harbour (Figure 1). The catchment area of 2000km², drained by 17 main tributaries, is relatively unusual in the UK in that it is characterised by predominantly upland, semi-natural ecosystems. The Dee catchment is of exceptional conservation value supporting flora and fauna typical of an uncontaminated highland system. The Dee and its tributaries are designated as an SAC due to internationally important populations of Atlantic salmon, pearl mussel and European otter. The catchment consists of two geographically distinct regions: an upland western area dominated by mountain and moorland and a lowland eastern area of arable and improved grassland.

Land management – upland areas

Semi-natural land characterises the upper (western) part of the catchment. The land cover is predominantly moorland, consisting of a mosaic of blanket bog and heather moorland on the upper and middle slopes, with montane and alpine heath vegetation on the highest summits. The soils, climate and topography are not suitable for intensive agriculture, and extensive sheep farming, deer and grouse shooting predominate. Their management, which involves 'muirburn' (burning heather to promote new growth) and maintaining high deer densities, favours open moorland and suppresses tree regeneration, leading to a largely treeless landscape.

Without tree cover, watercourses are subject to high summer temperatures and in recent years water temperatures of over 26°C have been recorded in the Dee catchment. In northern climates, the freshwater pearl mussel requires temperatures below 25°C (Hastie *et al.*, 2003) and perhaps less than 20°C (unpublished information); the lethal limit for young salmon and trout is 28°C. Therefore the temperatures recorded are a serious cause for concern, and the situation is likely to become worse, as government climate change scenarios project an increase of 4°C in mean summer temperatures by 2080 (UK Climate Projections UKCP09). The lack of trees also promotes erosion, resulting in the stream channel becoming wider and shallower, and these effects are increased by deer and sheep trampling the riverbanks.

The upper catchment is not entirely devoid of trees. A high proportion of the few remaining areas of semi-natural Caledonian pine woods in Scotland are within the catchment and managed coniferous and deciduous forests have been established on many of the lower slopes.

Land management – lowland areas

The eastern lower half of the catchment is an agricultural mosaic managed for beef cattle, fodder crops and cereals. The river system in this area has been affected by widespread land drainage and changes to morphology

associated with agricultural improvements. Most streams have been realigned and many are incised. The development of light industry in this area in the 1800s (e.g. mills, small-scale hydropower) involved construction of weirs and dams and these have formed long-term barriers to fish migration.

The river enters the sea at Aberdeen harbour, a world class port handling around five million tonnes of cargo annually for a wide range of industries. The harbour, one of the busiest ports in Britain, is the centre of activity for the offshore oil and gas industry's marine support operations in north-west Europe.

Population

The majority of the catchment's population resides in the City of Aberdeen (220,000 people) surrounded by commuter settlements and light industrial estates. Beyond the city, towns are small, and are concentrated around the river and in the lowlands. The 1970s oil boom led to expansion of these settlements and the catchment is faced with continued pressures as local populations grow rapidly, bringing an increased need for domestic water supply and waste water disposal and an expansion of associated infrastructure.

Water supply and waste water disposal

The River Dee and its tributaries are an essential water resource. Two large abstractions provide domestic water to the whole of Aberdeen City and over half of Aberdeenshire, supplying 300,000 people each day. The Dee's waters also dispose of effluent discharges. Although the focus has previously been on upgrades to waste water treatment plants, recent work has shown that inputs from private septic tanks are, collectively, a significant source of nutrients (Withers *et al.* 2013).

Recreation

The Dee is one of Britain's top four salmon rivers, internationally famous, especially for its multi-sea winter spring salmon, and also provides excellent summer fishing for salmon, grilse and sea trout. Annually, over 10,000 anglers visit Deeside, which is worth £15 million to the local economy and supports 500 jobs. Past management in support of the fishery has led to widespread bank reinforcement on the river's main stem and the creation of instream structures such as current deflectors.

The catchment is an attractive centre for a wide range of outdoor pursuits e.g. canoeing, walking, cycling, camping, climbing, mountain biking and skiing. There are pressures from littering, fires and erosion in some hotspots.

Condition of the river

Overall, the lack of heavy industry or intensive agriculture means that the catchment is in relatively good condition, with 22 of the catchment's 56 Water Framework Directive waterbodies at Good and a further two at High ecological status (sepa.org.uk). The two major causes of downgrade are morphological problems and diffuse source pollution and consequently the Dee is the subject of two targeted government programmes to address these pressures. Point source pollution and abstraction are significant in some waterbodies, and invasive non native plant species are also an important issue. Since the freshwater pearl mussel requires the upper end of High status to be achieved, there is a need for considerable improvement throughout the catchment if the population is to be sustainable.

Dee Catchment Partnership

All of the organisations with an interest in water management in the Dee are members of the Dee Catchment Partnership (theriverdee.org) which has been tackling the river's complex issues for over 10 years. The 20 partner organisations have published a management plan (Cooksley, 2007) that provides an agreed strategic framework for action. The Partnership promotes widespread awareness and discussion of the main problems, coordinates activities, develops projects to tackle key issues, and provides a central source of information and advice.

Dee Pearls in Peril project

Although the Dee pearl mussel population numbers around 1.3 million, the population is sparse and reproduction is not sufficiently successful to maintain numbers. Declines have been linked to diffuse and point source pollution, degraded habitat and pearl fishing and it is likely that a combination of these factors are collectively responsible for the population's Unfavourable status. To tackle these problems, PIP is undertaking five areas of work in the Dee, taking a catchment-based, long-term approach to improving habitat conditions.

1. Riparian woodland

An ambitious tree-planting scheme aims to facilitate the establishment of native woodland over 70km of riverbank in the upper Dee. The intention is to plant 40-50% of the riparian zone in this area. The trees will provide a range of benefits – reduced water temperatures in salmon habitat, stabilised riverbanks and reduced erosion, improved retention of rainwater and reduced flooding, creation of habitat for wildlife, and generation of instream woody material and leaf litter.

Agreeing plans for planting has involved working with a wide range of bodies. A bottom-up approach has been essential with every step in the work involving close liaison with the landowners and estate staff. All of these stakeholders have different requirements e.g. to avoid certain areas for planting, a need to build appropriate infrastructure or to plant appropriately for the landscape. Different methods, tailored to meet the needs of the land managers, are being used to protect the trees – these range from small enclosures (Figure 2), to fences set back some distance from the riverbank. 40km of planting is currently underway.

2. Riparian protection

The PIP project is tackling agricultural diffuse pollution in the middle catchment. The project aims to reduce the amount of soil, fertiliser and pesticide entering watercourses, and allow natural bankside vegetation to develop by facilitating the construction of 45km of riparian fencing. Ten km of 10-12m wide buffer strips have been completed, towards a total target of 45km by 2016.

3. Habitat restoration

The PIP project is making morphological improvements at 8 sites on the main stem of the river. River engineering features have been linked to absences in the pearl mussel population (Cooksley *et al.*, 2012) and the removal of features such as current deflectors and bank protection will help to restore natural processes, benefiting pearl mussels by increasing habitat availability. To date three current deflectors (constructed from boulders arranged in a line across the river) have been broken up and re-distributed in the river (Figure 3).

4. Monitoring

The restoration work is underpinned by a long term monitoring programme to determine whether the project delivers its expected results. This covers the effects of the project on water quality and temperature, levels of shading, salmonid and pearl mussel populations and habitat, and levels of uptake and implementation of habitat restoration measures.

5. Pearls in the Classroom

PIP is providing an education programme to raise awareness of the freshwater pearl mussel amongst children and in local communities. During classroom visits primary school children are being taught about the species' unusual lifecycle, its habitat requirements, threats to its survival, and its important cultural history in Britain.

Conclusion

The PIP project is tackling the issues affecting the River Dee's pearl mussel population at a catchment-scale and is establishing measures and knowledge that will continue to have benefits for generations to come. This ambitious programme of work has been possible due to the opportunity to work within the established framework of the Dee Catchment Partnership and to use the delivery experience of the River Dee Trust and Dee DSFB. Partners are confident that monitoring will demonstrate that the project has, in time, contributed significantly to the recovery of the River Dee freshwater pearl mussel population.

Pearls in Peril is led by Scottish Natural Heritage. In the Dee catchment the project is delivered by the River and Fisheries Trusts of Scotland with support from Cairngorms National Park Authority, Dee Catchment Partnership, Dee DSFB, Forestry Commission Scotland, Scottish Environment Protection Agency, and Scottish Natural Heritage.

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Figure legends

Figure 1: The River Dee catchment and the main ecosystem services it provides. (Dee Catchment Partnership)

Figure 2: Newly planted riparian trees in small fenced enclosures. (River Dee Trust)

Figure 3: Breaking up current deflectors using a hand-winch. (River Dee Trust)