NATURA 2000

KerryLIFE

Life

‘Sustainable land use management for the conservation of the freshwater pearl mussel’

Layman’s Report

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
Department of Housing, Local Government and Heritage

Forest Service

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

COILLTE

SOUTH KERRY DEVELOPMENT PARTNERSHIP CLG.

pobal
government supporting communities

teagasc
Agriculture and Food Development Authority

KerryLIFE Layman's Report.

KerryLIFE

Sustainable land use management for the conservation of the freshwater pearl mussel
LIFE13 NAT/IE/000144

Project location	Southwest Ireland
Project start date	16/06/2014
Project end date	31/08/2020
Total project duration	66 months
Total budget	€5,010,581
Total eligible budget	€4,301,698
EU contribution	€2,150,849
(%) of total costs	43%
(%) of eligible costs	50%

Coordinating Beneficiary

Name	Department of Housing, Local Government and Heritage
Contact person	Claire Cooper
Postal address	90 North King Street, Smithfield, Dublin, D07N7CV
Postal address	90 North King Street, Smithfield, Dublin, D07N7CV
Telephone	00353 18883958
E-mail	claire.cooper@housing.gov.ie
Project website	https://www.npws.ie/research-projects/kerrylife

Associated Beneficiaries

Name(s)	Department of Agriculture, Food and the Marine (Nitrates, Engineering and Biodiversity Division and Forest Service Division)
	Teagasc – Agricultural and Food Authority
	Coillte Teoranta – Irish State Forestry Board
	South Kerry Development Partnership CLG
	Pobal

The project

The KerryLIFE project was a demonstration project aimed at the long-term delivery of sustainable land use practices to restore and conserve the freshwater pearl mussel population to favourable condition by addressing the threats of siltation, nutrient enrichment and hydro-morphological change affecting the pearl mussel's habitat. The project also aimed to enhance the awareness and understanding of this very cryptic species among stakeholders.

The freshwater pearl mussel

The freshwater pearl mussel (*Margaritifera margaritifera*) is one of the most critically endangered species in Europe. It is a bivalve, which is a type of mollusc with a body that is almost completely enclosed between a pair of shells. Individuals can grow to more than 15 cm in length, slowly building up thick calcareous shells in rivers with relatively soft water and low levels of calcium. For most of its life it is a filter feeder and large quantities of water are pumped through the animal's siphons, food particles are trapped and passed to the mussel's mouth.

The freshwater pearl mussel has a complex life cycle producing free-living glochidial larvae that require an intermediary fish host, typically Atlantic salmon (S*almo salar*) and sea trout (*S. trutta*) in Ireland, to complete their life cycle. After 9 months, the larvae develop into juvenile mussels and drop off their hosts where they bury into gravel and sand substrate of the river bed, feeding, breathing and growing for the first five years. Once large enough to withstand the flows they settle part-buried in the river bed where they filter-feed and can live for over 100 years.

Freshwater pearl mussels in Ireland are restricted to oligotrophic, acid to neutral waters of rivers flowing over granite or sandstone bedrock, often downstream of oligotrophic lakes. The species has particularly stringent requirements, demanding high water clarity and low nutrient concentrations, stable cobble and gravel substrates, with very little fine material and free water exchange between the open river and the water within the gravel substrate.

Fig. 1 Freshwater pearl mussel and host salmonid fish

The project area

The KerryLIFE project operated in the Blackwater and Caragh river catchments in the Iveragh peninsula in County Kerry, Ireland.

The Blackwater catchment drains part of the Iveragh peninsula in the south-west of Ireland. The river flows from north to south, discharging to the Kenmare River estuary. Two principal tributary rivers, the Kealduff and the Derreendarragh, drain into the Blackwater River. These rivers are characterised by a high-density network of tributary streams and the river traverses ca. 10 km before it reaches the sea. Although fewer and smaller in area than those in the Caragh catchment, oligotrophic lakes (Loughs Brin, Fadda and Beg) are also found in the Blackwater catchment. The main land-uses within the catchment are agricultural, mostly cattle and sheep grazing enterprises and forestry.

The Caragh catchment is located to the north of the Caragh catchment on the Iveragh peninsula in County Kerry and ranges in altitude from ca. 1000 m above sea level (A.S.L.) in the south-east to 20 m A.S.L. in the north, where the main river channel enters Lough Caragh. The system is characterised by an extensive river network and includes a number of oligotrophic lakes, notably Cloon Lough and Lough Acoose. The main tributaries of the Caragh River include the Meelagh and Dromalonhurt, which drain from the west, the Caraghbeg from the east, and the Owenroe from the south-west of the catchment. The main land-uses within the catchment are agricultural, mostly cattle and sheep grazing enterprises and forestry.

These rivers and their catchments are designated under the Habitats Directive (92/43/EEC) as Special Areas of Conservation (SAC) for freshwater pearl mussel, *Margaritifera margaritifera* (L.) amongst other species and habitats. The Caragh and the northern part of the Blackwater (Kerry) catchments are part of the Killarney National Park, MacGillycuddy Reeks, and Caragh Catchment SAC (Site Code IE000365) and southern part of the Blackwater lies within the Blackwater (Kerry) SAC (Site Code IE002173).

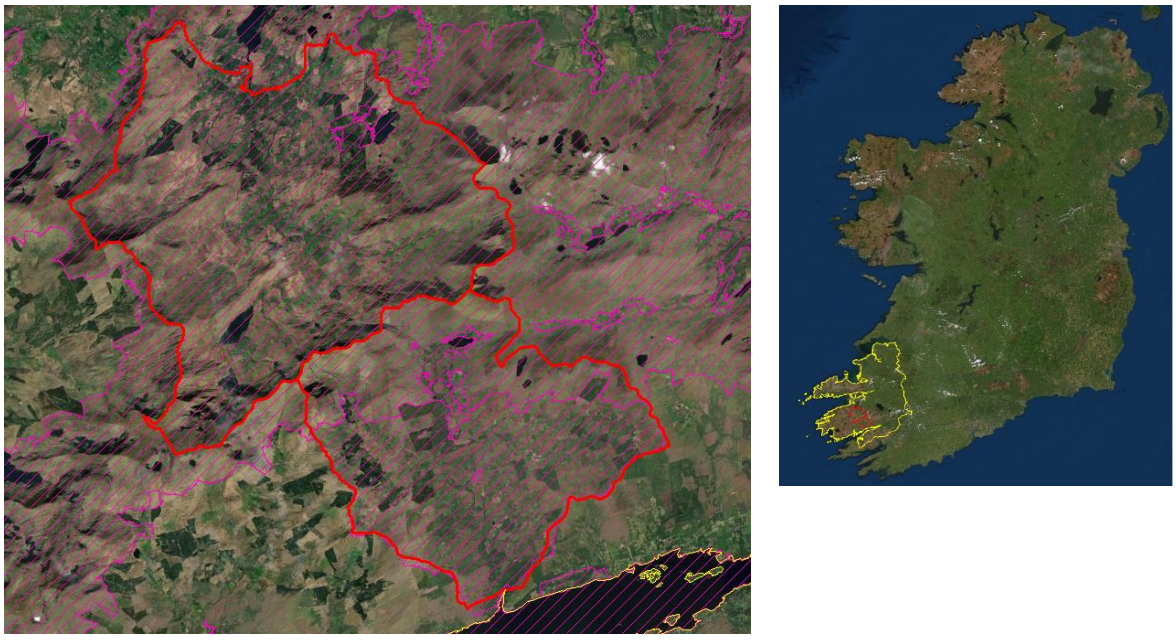


Fig. 2 Map of Ireland and KerryLIFE project area Special Area of Conservation

Freshwater pearl mussels in the project area

The Blackwater and Caragh river systems support very large freshwater pearl mussel populations with a wide distribution within their respective river networks (Ross, 1999). It was estimated that the total population within the Caragh is approximately 2.8 million individuals, across 22.6 km of river channel, while the estimated total population within the Blackwater is approximately 2.75 million individuals (Ross, 1999), across 18.95 km of river channel. The populations have a good distribution of mussel size classes, although both populations have some recruitment, the number of juveniles and younger mussels are insufficient to sustain the population. The density of the mussels varies with habitat suitability, but some stretches have very abundant mussel beds (Ross, 1999).

The conservation threats

The conservation condition of the Blackwater and Caragh freshwater pearl mussel populations and their habitat were assessed as unfavourable using the targets and objectives of the freshwater pearl mussel regulations, in 2009, 2011, 2017 and 2019. In parts of the catchments, riverbeds have become too clogged with silt, algae and rooted plants for young mussels to survive, while in others adult mussels have become stressed and are prematurely dying owing to habitat deterioration. The pressures affecting the mussels' habitat come from a wide variety of point or diffuse sources throughout the catchment. Both agricultural activities and forestry were identified as the two main sectors contributing siltation, nutrient enrichment and hydro-morphological change impacting on the freshwater pearl mussel populations (DEHLG, 2010 a) in the Blackwater and Caragh.

Siltation causes water quality and in-stream changes, affecting mussels in many ways and at all life cycle stages. Silt that infiltrates the riverbed blocks water exchange between the river and the substrate. This reduces the oxygen supply in the substrate and causes juvenile deaths. Siltation also leads to adult mortality through direct ingestion. Turbid water causes adult mussels to clam up and stop filtering, causing oxygen starvation. Deposited sediment provides a rooting medium for macrophyte growth that can further smother the juvenile habitat and trap sediment. Silt can also negatively affect the fish species that host the mussel glochidial stage (Levasseur et al., 2006). The transport of silt through the river in suspension or as 'bed load' also increases riverbank and riverbed erosion, further exacerbating the changes to the mussel's habitat.

Nutrient enrichment promotes growth in aquatic plants, particularly macroalgae (typically filamentous species) and rooted higher plants (macrophytes). Macroalgal growth is stimulated by the dissolved nutrients nitrogen and, especially, phosphorus. Increases in macrophyte cover require both rooting medium (silt) and dissolved or particulate nutrients. Both macroalgae and macrophytes block water exchange between the river and the riverbed, disrupting the oxygen supply and leading to juvenile deaths. In severe cases, dense algal growths lead to night time oxygen depletion and the death of adult mussels. Deoxygenation of the river water and riverbed is exacerbated when the plants die and decompose in situ.

Hydrological and morphological changes are a significant part of the story of the decline of the freshwater pearl mussel. The extensive drainage of land to increase its productivity for agriculture and forestry, as well as to facilitate development, has changed the water flow patterns in rivers. Flood flows have become more frequent and powerful, causing erosion of riverbeds and riverbanks and causing direct loss through wash-out of mussel habitat. Summer flows have become lower and droughts more frequent, exposing mussels to the air and increasing sedimentation and enrichment of mussel habitat. Drains and their on-going maintenance are sources of fine sediment and provide direct pathways for both silt and nutrients to the mussel's habitat.

The methods – farm plans

The project worked closely with farmers and forest-owners within these two SACs. The original target area was 2,500 ha of farmland and 515 ha of forestry (in both public and private ownership) was exceeded with 5,038 ha of farmland and 542 ha of forest involved.

Farm selection - 124 expressions of interest were received from the 212 farmers in the project area. Using criteria to select the most suitable land to meet the project objectives, 42 farmers covering 5,038 ha of farmland were selected to work with the project and complete actions to improve the conservation condition of the farms. 37 farmers implemented only agricultural measures, 3 farmers implemented both agricultural and woodland measure and a further 2 implemented only woodland measures on their farms.

Farm surveys - Each farm was visited by the project team and a detailed survey carried out. Farm plans involved; documenting current management practices, habitat mapping, source mapping for sediment and nutrients, and pathway mapping (e.g. drains, stream and rivers). The pressures identified and the pathway to the pearl mussel was assessed. Selection of conservation measures. The measures included drain management, laying of hedgerows, optimising of grazing, nutrient management planning and the provision of drinking water facilities for livestock.

Farm plans - A bespoke farm management plans which detailed the conservation actions to be implemented by the farmer. Each plan identified the measures required, the location and the costs involved. The plan included a farm map which highlighted the location where each action needed to be undertaken and details. The finalised plan consisted of maps showing the external farm boundary and farm plots overlain the Natura 2000 designation, the location of drain and sediment reduction measures and the location of nutrient management plan measures.

The methods – forest plans

Forest selection -Eight high risk publicly-owned forests covering 495 ha were selected as part of the grant application, 7 of the forest properties were in the Blackwater catchment and 1 in the Caragh. 5 privately-owned woodlands and potential woodland sites were identified through the farm surveys and through the public events.

Forest surveys and management plans - Each forest property visited by the project team and a detailed surveys of sources of sediment and nutrients and pathways were carried out. Preparation of each forest management plan involved; documenting current and past management practices, source mapping of sediment and nutrients, and mapping of pathways (e.g. drains, streams, rivers) to the freshwater pearl mussel. The resulting data were used to carry out an integrated risk assessment and to inform the selection of restructuring trials.

Forest operational plans –Once trials were selected, operational plans were prepared outlining the various aspects of each operation were prepared. 12 operational plans covered the restructuring of 178 ha of conifer plantation into long-term retention woodland, retaining unplanted areas under Action C.7, 1 involved a continuous cover forestry (CCF) trial under Action C.8 covering 2.5 ha and 9 operational plans were prepared for firebreak trials covering 2,918 m under Action C.9. The operational plans formed the basis of licence applications and each operational plan was subject to appropriate assessment screening.

The project worked closely with farmers and forest-owners within these two SACs. The original target area was 2,500 ha of farmland and 515 ha of forestry (in both public and private ownership) was exceeded with 5,038 ha of farmland and 542 ha of forest involved.

The conservation measures and trials

Drainage and restructuring of agricultural land - Drains are one of the most critical sources of sediment loss. Farms and forests in the Blackwater and Caragh catchments are characterised by a dense network of field drains that were installed to improve productivity on wet soils and in an area of high precipitation. A hydrological audit of participating farm and forests covering 5,532.9 ha, revealed 267.9 km of drains on project farms with a density of 53 m of drain per hectare and 79 km of drains in project forests with a density of 146 m per hectare. Once installed, drains require ongoing maintenance, including the removal of silt, vegetation and other obstructions, and the repair of damaged banks.

Re-wetting/re-vegetating of drains - 277 drains extending to 76 km of channel were allowed to re-wetting/re-vegetating of drains. Farmers were more willing to adopt this passive technique to trap eroding sediment from adjoining farm land. Rapid re-vegetation occurred in drains within a short period thus disrupting the transport of sediment to the river.

Protective buffers 5.9 km of buffers zones were established on farms to intercept sediment transported by overland flow to the river promote the uptake of nutrients. The buffers also excluded livestock from grazing the river bank except for short periods each year.

Peat or plastic dams - were installed in 122 drains to block water flow and to raise the water table.

Log dams - a form of leaky dam constructed from felled tree trunks were installed at 1,436 locations. Dams were installed in series along mound furrows and drains to slow the flow of water through the forest floor and to promote colonisation of aquatic plants such as *Sphagnum* moss

Hedgerows and In-field buffers 3,211 m of new hedgerow and 382 m of in-field buffers were established along contours

Livestock and grazing management - Changes to traditional farm practices driven by external market, political and socio-economic forces (e.g. off-farm employment) and facilitated by new technologies and farm infrastructure (e.g. slatted houses) has led to changes in grazing regimes, and shifting from traditional mixed farm systems (relying on native breeds of sheep and cattle) to the (continental-cross dominated) suckler cow systems. This has resulted in the development of critical source and transport areas (CSA) where sources of either sediment and /or nutrients occur and when a pathway e.g. overland flow, drain or stream is present the pollutants can reach the river. Examples include poached pastures and river banks, supplementary feeding stations; access points, and track ways.

Critical source and transport areas (CSA) – 437 ha of critical source and transport areas identified on project farms were scored annually using a five point scoring system, 1 being the lowest quality and 5 the highest. Areas that scored 3 or higher received a results based payment determined by the ecological condition. The area in the two lowest scores (88 ha) decreased by 50% between year 1 and year 3 of the farm plans, while the area with the highest score increased from 36 ha to 229 ha in the same period.

Grazing and supplementary feeding management strategies – Grazing and supplementary feeding management strategies were developed, where required, to aid with the management of CSAs or the implementation of nutrient management plans.

Infrastructure - 42,654 m of fencing was installed to exclude livestock from freshwater pearl mussel habitat or to enhance livestock management. 100 new feed sites were implemented, 20 new gates /access points have been created and 10 new cattle or sheep foot bridges have been installed as part of these livestock management actions.

Split herds and out-wintering -On some farms, as part of the livestock management action, the number of cattle were reduced or the animals were split into smaller herds. Wintering of livestock outdoors between two blocks of land and pre-positioning winter fodder in the fields before winter was found to have positive outcome in terms of CSA scores

Nutrient management planning - Increased importation of chemical fertilisers onto farms, increased slurry production and changing livestock management have resulted in increased losses of nutrients, especially phosphorus, which is generally considered to be the limiting factor for algal growth in freshwaters. Nutrient inputs on farms are concentrated in low-lying areas adjacent to and upslope of freshwater pearl mussel habitat.

Nutrient management planning tool - A bespoke nutrient management planning system tailored for the requirements of the freshwater pearl mussel in high rainfall areas and challenging physical settings was developed. This novel approach was designed to reduce nutrient inputs both at a farm-level and, crucially, at a field level.

Stock reduction or conversion –The herd across all participating farms was reduced by 52 suckler cows, 10 cattle and 20 ewes. Conversion from large continental breeds to smaller traditional breeds took place on two farms, with Charolais and Limousine cattle replaced with Hereford and shorthorn cattle.

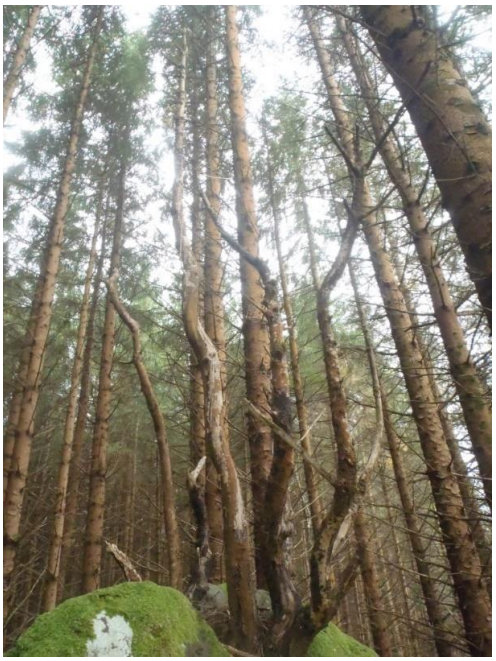
Change in fertiliser - switching to non-phosphorus containing chemical fertiliser and alteration of grazing patterns. Across the participating farms,

Provision of alternative livestock water drinking facilities - Riverbank erosion is one of the most significant pressures in the Blackwater and Caragh catchments. Livestock in the project area get nearly all of their water for drinking by accessing rivers, streams and drains. The provision of alternative drinking water facilities will discontinue this practice, thereby reducing the risk of riverbank destabilisation. It also prevents direct fouling of water from excreta and trampling of freshwater pearl mussels. Fencing allows for the recovery of riparian vegetation helping to maintain bank stability.

Water-troughs – 262 water-troughs were installed in a range of situations on project farms. 1,024 cattle were excluded from entering freshwater pearl mussel connected watercourses to access drinking water.

2015 2018

2019



Restructuring of commercial conifer plantation to long-term retention woodland - Conifer plantations in the project area are managed under a clearfell silvicultural system, with a crop cycle of approximately 40 years involving drainage, ground preparation, planting, fertiliser application, road construction, thinning, clearfell harvesting, timber extraction and replanting.

178 ha of commercial conifer plantation was restructured into long-term retention woodland or open habitat. A mix of motor-manual and mechanised techniques were demonstrated are briefly described below:

Halo-thinning - a gradual restructuring technique that removed unwanted trees in a circle (i.e. halo) around a target tree through manually felling or ring-barking conifer trees in a circle to release the broadleaf tree from competition was implemented across 84.5 ha.

Ring barking - involved cutting away a section of bark completely around a target tree in 31 ha. This initially starves the roots of food produced by the leaves, which gradually kills the tree. These trees tend to snap rather than uproot reducing the risk of sediment loss. As the needles drop, the increase light reaching the forest floor promotes ground vegetation recovery which benefits from the gradual release of nutrients from the decaying needles.

Skylining/cable – consisting of a pulley system, one end of which was attached to an anchor tree and the other to a tractor mounted winch. The felled logs were attached to a moving carriage on the cable and the logs winched to the road, reducing ground disturbance from machinery associated with timber extraction. Skylining was implemented in conjunction with conventional harvesting and forwarding method. The conditions available for skylining were limited across the surveyed forest properties due to the slopes, infrastructure and the availability of stable anchor trees.

Heli-logging – A feasibility study into the use of helicopters (heli-logging) for the management of trees at high risk locations was carried out. This approach has potential benefits to the felling and harvesting of trees in some instances as the risk is transferred from the forest site to the processing site. However, trees still need to be felled by a harvester machine prior to extraction.

Chainsaw fell-to-machine – where trees were felled with a chainsaw towards the harvester machine extend its reach allowing more trees to be processed from the harvesting rack.

Sensitive harvesting – involving a harvester only operation. Trees were felled to waste and no timber was extracted as part of the operation (see above).

Sensitive harvesting / extraction – involving harvester / forwarder combination was implemented at three sites covering 37.7 ha. This approach was similar to how conventional clearfell and extraction is undertaken, however, the project devised an extensive range of mitigation measures to minimise potential losses of sediment and nutrients.

Replanting – Five sites conifer sites covering 50.2 ha were replanted under the Native Woodland Scheme with birch pioneer woodland, with enrichment planting of Scots pine, rowan and oak using pit-planting and no fertiliser, pesticide or herbicide.

Chainsaw fell-to-waste where trees were felled with a chainsaw or harvester fell-to-waste where trees are felled with a harvester were used where trees were not planned to be extracted. The harvester was used in instances of complex wind-throw.

Continuous cover forestry - Transformation of conventional clearfell managed commercial forests to continuous cover forestry was trialled at one 2.8 ha site.

Firebreak management – Three alternative firebreak methods, prescribed burning, green firebreak and willow firebreak were trialled and demonstrated across 3 km as an alternative management to the current practice of grubbing, in which the surface vegetation is scraped off and the base soil is susceptible to weathering and erosion, increasing risk of fine silt entering the river.

Broadleaf planting to stabilise riparian sediments – Strategic and targeted tree planting at vulnerable locations along channels was proposed to reduce sediment and nutrient run-off and the undercutting and slumping of river banks. The tree planting was envisaged to be delivered through the Native Woodland Scheme.

Establishment of new native woodlands was implemented at four locations covering 27.2 ha. These new woodlands were developed with a new planting scenario of pre-dominantly of birch with some enrichment planting of oak, rowan and Scots pine. The woodland design included drain blocking both in the wet and the dry; reduced or no ground preparation; no fertiliser or pesticide applications.

Conservation of existing native woodland was implemented at three locations covering 14.9 ha of woodland. These sites were a mix of Oak- Holly woodland with some areas containing Annex I (91A0) woodland habitat. The primary measures implemented included the erection of a deer proof fence to eliminate browsing pressure; drain blocking to break pathways from which nutrients and sediment could be lost from the woodland; supplementary planting; and removal of invasive species (i.e. *Rhododendron*).

Conversion: One privately owned conifer plantation 5.5 ha in area was restructured from a commercial conifer plantation to long-term retention woodland with open spaces, watercourse setbacks and buffer zones. This was a two phased operation, involving first the sensitive harvesting of the mainly Sitka spruce crop prior to the trees reaching maturity.

Monitoring within the KerryLIFE project

Monitoring the impact of the project actions was an important aspect of KerryLIFE and a programme was developed to test effectiveness of project action and

Monitoring of pearl mussel population - Monitoring of the large, widespread and dense populations of freshwater pearl mussels in catchments the Blackwater and Caragh involved the following three elements density, demography and distribution. A baseline survey was carried out in 2014, with repeat monitoring in 2016, 2017 and 2019. Population monitoring including density (number of adult mussels), demography (population structure based on length of visible and hidden mussels) and distribution (range within the river network). An aging and genetic study were also undertaken.

Monitoring of pearl mussel habitat - The biological condition of the freshwater pearl mussel's habitat was monitored at 24 sites distributed across the catchments by assessing the percentage cover of filamentous algae and macrophytes and by assessing the macroinvertebrate (e.g. insect larvae) community at 20 sites. 6 sites were monitored biweekly throughout the growing season (April-September) resulting in between 64 and 74 samples being collected each year. Visual assessments of filamentous algal species and rooted macrophytes allowed changes in trophic state linked to nutrient enrichment and declining juvenile habitat conditions to be detected.

Monitoring of sediment and flow - The physical condition of freshwater pearl mussel habitat was monitored using turbidity, flow, redox, visual sediment assessments (cover and infiltration), and sediment fingerprinting.

- Turbidity sondes (a measure of how turbid the water is) were deployed at the outflow of three sub-catchments at intervals of 15 minutes. Water level or depth gauges were deployed at the same locations water level.
- Flow transects were completed using an electronic current meter and these data were combined with the water level data to model discharge.
- Handheld redox (reduction-oxygenation) probes were used to determine the reduction potential (Eh) between the open water and the interstitial river bed habitat at 5cm depth. Redox potential is a "proxy" for the ability of juvenile mussels present in the river bed to obtain oxygen.
- Visual assessments of fine sediment cover were undertaken at all mussel monitoring, biological monitoring and water chemistry sites. Silt infiltration into the substrate was also monitored using a kicked silt-plume NPWS methodology at all mussel and mussel habitat monitoring sites.
- Sediment fingerprinting or provenance was used to identify non-point sources of sediment using a suite of radionuclides, magnetic tracers and organic content to distinguish the sources of sediment. Source samples were taken from 300 locations on project farms, forests and other land uses e.g. roadways and river banks within the project area. River sediment was collected in time-integrated-sediment-samplers (TISS) which passively collected suspended sediments from the river. Bed sediment was collected through the deployment of 24 bed-load samplers and drum 36 re-suspension. The results were used to calculate what contribution each source made to the river.

Monitoring of water chemistry – 660 samples were collected from 18 sites on the main river channels and from 25 in streams/drains associated with project forests and farm on 15 occasions. Water samples were analysed for total phosphorus, molybdate reactive phosphorus, total nitrogen, total oxidised nitrogen, ammonia, nitrate, alkalinity, colour and dissolved organic carbon by a specialist laboratory capable of analysing low limits of detection.

Continued monitoring - Monitoring will continue after the project to tell us if the work has been successful and it will also provide us with invaluable information to track changes in mussel populations in the coming years.

Added value and outreach initiatives

A key objective of the project was to enhance the understanding, appreciation and engagement by all the key stakeholders of the conservation of the freshwater pearl mussel in the Blackwater and Caragh catchments. To achieve this the project linked into local and national initiatives that promote natural heritage and science such as the IPB Pride of Place Award Kerry Science Festival, National Science Week, BT Young Scientist Competition, Heritage Week, ESB Tree Week, Wild Derrynane Weekend, Knowing Nature and the National Ploughing Championships.

Farm produce brand – a farm produce brand initiative to add a premium price to sustainably produced beef was developed jointly between SKDP and Ring of Kerry Quality Lamb Society Ltd. A proof of concept trial was undertaken on a two pilot farms in which calves were fed a specially devised feed developed with Agri-King to supplement the diet of the weanlings and tailored to the forage available on farms. A tasting trial was subsequently carried out and a marketing plan produced.

Walking trails – three looped walks measuring 7.6 km were established at the Lickeen. These walkways provide an important local amenity for the community and link up with the existing Kerry Way, which is Ireland's longest and most popular walking trail.

Educational events - A schools education programme was delivered to 585 school children and 177 undergraduate students through 24 events. Four undergraduates completed work placement as part of their degree and one international graduate completed an internship. The placements/internship were provided an opportunity for the participants to develop their ecology, farm planning, report writing and communications skills as part of a multidisciplinary team. The educational programme linked into local and national events

such as Kerry Science Week, National Science Week, and the ESB National Tree Week.

Training and demonstration events - 4 demonstration sites were established and 32 demonstration events and training workshops were held with a strong emphasis on practical application.

Media campaign - The media campaign resulted in 31 articles published in local, regional and national publications. The project also featured on both television and radio such as '10 things to know about water', EcoEye, Agritime and Morning Ireland.

Outreach events - 18 public events to raise awareness of the project, freshwater pearl mussels and other wildlife in the project area. Annual celebrations brought together the communities comprised the KerryLIFE. The celebration centred on the 'Pearl Shield' football competition, embracing the strong sporting traditions in the area.

Conclusion

KerryLIFE was an ambitious project which was successful in achieving its objectives of demonstrating sustainable land use management practices for the conservation of the freshwater pearl mussel. The actions implemented to reduce sediment and nutrients have had an immediate direct benefit to the freshwater pearl mussel and to the wider environment. While measures to restore the hydrological conditions are expected to take longer as there is a lag between the implementation of the measure and the achievement of the desired effect for the freshwater pearl mussel population. It must also be recognised that not all measures and land use management practices demonstrated by the project were fully effective and that the partners involved in the KerryLIFE project remain committed to further developing the work completed by KerryLIFE in restoring and conserving the important populations of freshwater pearl mussels found in the Blackwater and Caragh catchments.