Reduction and elimination of trampling and soiling of river by cattle by fencing vulnerable river bank sections

- Monitoring Report

Action C2

LIFE09 NAT/IE/000220 BLACKWATER SAMOK

April 2016

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I.R.D. Duhallow Ltd.

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Executive Summary

Cattle access to the river network was identified as a significant issue requiring urgent remediation in the Allow catchment. Cattle access to the riparian zone was degrading river water quality due to trampling and poaching of the river bank and riverbed, grazing of riparian vegetation, and defecating in the water. This increased bank erosion and siltation of the riverbed, removed riparian vegetation which exacerbated bank erosion and lowered biodiversity, and increased nutrient and faecal bacteria levels in the river.

Up to 38,534m (38.5km) of river bank was fenced along the River Allow and its tributaries (River Dalua and River Brogeen) within the SAC. This was undertaken with the full cooperation of private landowners.

By investigating the size of the riparian margins of existing fences in the catchment, the project determined that fences positioned 1.5m or less from the top of the bank, were ineffective in satisfying the objective of establishing a functional riparian zone in terms of good ecological management. In this respect, good ecological management is the reestablishment of riparian vegetation, improved river bank stability, and biodiversity enhancement. For this reason, all fences built by the project were positioned at least 2m distance from the top of the riverbank.

Vegetation surveys found that plant species richness increased between the fence line and the river (riparian margin), once livestock were excluded.

Due to frequent flooding which can damage fences, the fence design was single strand electric which is the customary practice along riparian margins in the Allow catchment. A "flood friendly fencing" innovation was developed which helps protect fences within riparian margins. This low cost and practical innovation is transferable to other SAC rivers where regular flooding makes excluding livestock from riparian zones problematic.

Background

Bank erosion is a natural process which can be exacerbated by human activity. Human activity through livestock management is one of the main causes of riverbank erosion (SEPA, 2008; Iowa Department of Natural Resources, 2006). Excessive bank erosion causes loss of land, with the deposition of eroded material within the riverbed causing environmental harm (e.g. smothering of fish spawning gravels by fine sediment) and structural damage (e.g. sedimentation under bridges) (Anon, 2010; SEPA, 2008; Pimentel, 2006). Studies have shown that riparian vegetation and its associated root systems can help protect river banks by binding the soil together, making it more resilient to erosion (Thorne, 1990; Pimentel, 2006; Hubble et al., 2009).

Fencing to exclude livestock from riverbanks protects riparian plants and allows vegetation to grow unimpeded due to the absence of grazing pressure (Collins et al., 2010). Grazed grass has shorter roots compared to grasses and plants which are allowed to grow uninhibited and develop long, dense and multi-branched roots. Deep root systems offer a range of benefits including enhanced nutrient cycling, erosion control, and increased capacity to retain water (Jones, 2000).

In addition to encouraging the growth of riverbank vegetation, fencing of riparian margins also helps protect the riverbank from trampling and poaching. Poached, compacted soil on riverbanks increases the potential for bank collapse and sediment loss. If the riparian margin is of sufficient width it will act as a buffer, preventing sediment, nutrients, faecal bacteria and other surface run-off from entering the waterway (Zeckoski et al., 2007).

Establishing a buffer zone by restricting or excluding cattle access to riverbanks and channels improves plant diversity and abundance (Zeckoski *et al.,* 2007). In 2012, baseline monitoring of plant diversity in fenced and unfenced riverbank margins along the Allow and Dalua rivers was conducted (Murphy, 2012). It concluded that plant diversity was higher within riparian margins where fences were set back at least 2m from the top of the riverbank, than in areas that lacked fencing, or had a fence set back less than 2m.

Action C2 of the Blackwater SAMOK LIFE project (DuhallowLIFE), involved the fencing of 37.96km of riverbank along the Allow, Dalua and Brogeen rivers. Following negotiations with landowners, fencing was erected no less than 2m from the top of the river bank (in many places up to 4m).

Site Description

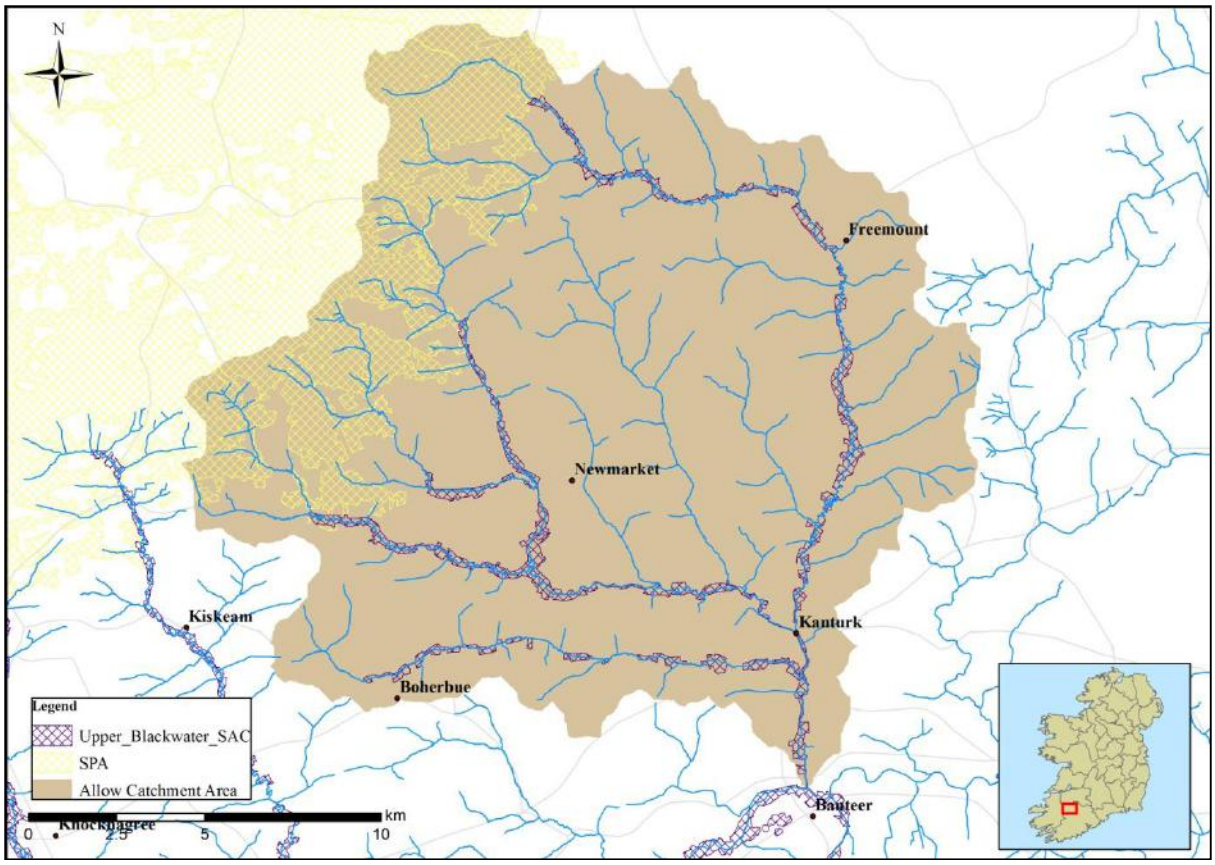

Figure 1 River Allow catchment area targeted by the DuhallowLIFE Project (LIFE09 NAT/IE/000220 Blackwater SAMOK)

The River Allow catchment is 310km^2 (Figure 1). The three major rivers that drain the catchment are the Allow, Dalua and Brogeen. The main land use in the catchment is agricultural, with pasture based dairying and beef production of most importance.

The majority (70%) of the soils in the Allow catchment are deep, poorly drained mineral soils. Blanket peat covers approximately 5% of the catchment, mostly in upland reaches. Mineral alluvium is associated with the river channels, while shallow well drained mineral soils make up the remaining soil type in the catchment (EPA/Teagasc, 2006; Tedd, 2014).

The Allow catchment rivers (Allow, Dalua, Brogeen, Glenlara and Owenkeale) form part of the Blackwater River (Cork/Waterford) Special Area of Conservation (Natura 2000 site code: 002170). These tributaries provide important habitat for FPM (*Margaritifera margaritifera*), Atlantic salmon (*Salmo salar*) and European otter (*Lutra lutra*), all of which are listed in the Annex II of EU Habitats Directive. The upper reaches of the Allow catchment contain the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protection Area, which was designated as such for Hen Harrier (*Circus cyaneus*) (listed in Annex I of the EU Bird's Directive).

Methodology

Landowner and Farmer Engagement

The Allow, Dalua and Brogeen rivers were surveyed to determine the condition of the riparian zone, degree of cattle access, and the condition of any existing fences. In areas with no riparian fencing, or where current fencing was ineffective in preventing grazing within the riparian margin, the relevant landowner was contacted. Each farmer/landowner was met on-site and a fencing regime was discussed.

Initial research by the project established that the traditional fencing option used by farmers in the Allow catchment was single strand electric fencing. Discussions with farmers highlighted that single strand fencing facilitated movement of water during floods beneath the fence wire, whereas double strand and barbed wire tended to catch debris, which can unravel or collapse entirely during large floods.

Erecting a fence 1.5m from the top of the riverbank was acceptable in previous agri-environmental schemes (e.g. Rural Environment Protection Scheme) (DAFM, n.d.). However, field investigations by the project team found that where 1.5m fencing was erected, cattle were able to reach under the fence and graze up to 1m beyond the fence line. This left a mere 50cm of ungrazed riparian vegetation. This was discussed with each of the 50 landowners that were approached, and a fence line of at least 2m was agreed upon by all but two landowners (one of whom already had a fence line of over 2m from the top of the bank, albeit with temporary electric fencing, and another who felt that their fencing scheme was adequate). Any doubts regarding the loss of farmable land were countered by the argument that much of the land would be lost to erosion if no action was taken.

Riparian Fencing

Fencing work ranged from the complete installation of posts and wires to, the recycling of intact fence posts where appropriate. With agreement of the landowner the existing fence lines were moved further back from the river. Generally, a fence line of over 2m was achieved compared to 0m to 1.5m where existing fence lines were in place. In some instances, a fence line was erected up to 4m from the top of the river bank.

A team of Rural Social Scheme participants, who themselves are farmers, erected locally sourced posts using a post-driver mounted tractor. Wiring was completed once all posts for one field were driven.

Project Innovation

During flood events, the rivers in the catchment transport high volumes of woody and vegetative debris. This flood debris accumulates along fence lines, which slows the flow of water thereby increasing the water pressure exerted of fences. This regularly leads to the loss of fences on floodplains.

Prior to the project it was not possible to fence in some locations. This project pioneered a flood friendly fencing technique that releases the excessive pressure caused by debris build up on the fence line. This was developed by the LIFE Project team in partnership with local farmers, and was tested on the River Dalua. With guidance and advice from landowners and consultant engineers, the sections of fences most vulnerable to flood damage were identified and a quick release system at each pressure point was developed (Figure 2). Under significant pressure the handle and clip would come apart. Once the flood has passed the two parts are easily reconnected.

Riparian Vegetation Surveys

The riverbank sites that were used in the first vegetation study (Murphy, 2012) were revisited to record the vegetation regeneration within the fenced off riparian margins. Plant species diversity was recorded at these sites. Plant identification was carried out using a wild flower key (Rose, 2006). Before and after photographs of fenced off riverbanks were taken. Samples of grass roots from within the fence line (grazed) and outside the fence line (un-grazed) was measured to assess the impact grazing had on rooting systems.

Results

Riparian fencing

DuhallowLIFE has provided 38.53km of fencing to landowners farming along the Allow, Dalua and Brogeen Rivers (Figure 2).

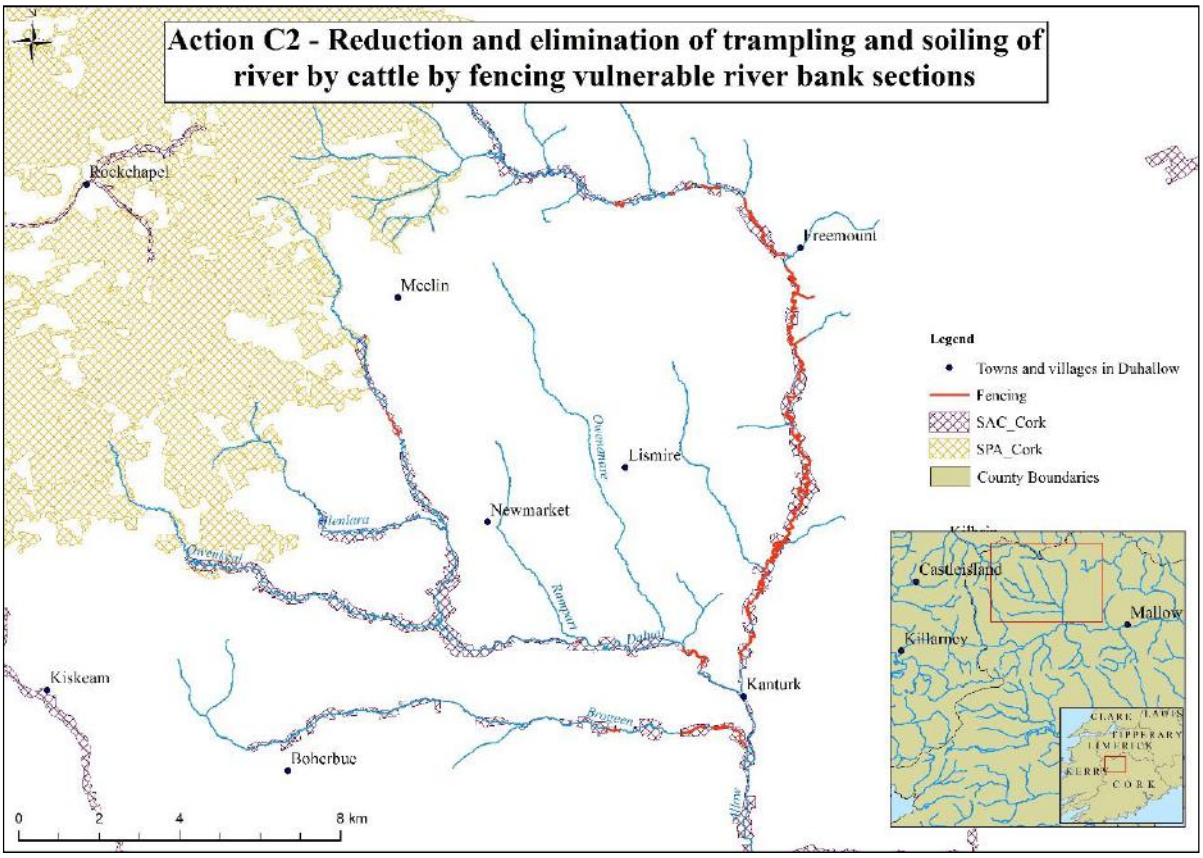

Figure 2 Extent of the fencing installed along the Allow, Dalua and Brogeen Rivers by the LIFE Project

Establishing a single strand fence line at least 2m from the top of a riverbank facilitates the regeneration of a riparian buffer. It also allows for grazing beyond the fence line without severely impeding on natural regrowth (Figure 3). Previous agri-environmental schemes (e.g. Rural Environment Protection Scheme) allowed for a fence line of at least 1.5m from the top of the bank to protect riverbanks from overgrazing and poaching. While this can prevent livestock from accessing the top of the riverbank, it can also lead to soil poaching and resultant sedimentation of the riverbed. It also prevents plants from developing sufficient root length (Tables 1 and 2, $p < 0.05$) and mass, which lessens their capacity to hold banks together and filter surface runoff (Hoorman and McCutcheon, 2005). For this reason, DuhallowLIFE convinced farmers to allow the project to erect fencing at least 2m back from the top of the riverbank.

Table 1 Grass root length from samples measured in grazed and un-grazed sites

Root length grazed (cm)	Root length un-grazed (cm)
16	38
16	22
14	23
14	14
15	17
17	24
14	17
16	22
17	25
13	18
17	23
22	19
17	18
14	21
16	13
16	20
12	19
24	16
12	18
13	25
13	19
16	17
17	15
11	17

Table 2 T-test comparing grass root lengths from grazed and un-grazed sites

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	*Variable 2*
Mean	15.5	20
Variance	8.695652	25.82609
Observations	24	24
Pooled Variance	17.26087	
Hypothesized Mean Difference	0	
df	46	
t Stat	-3.75208	
P(T<=t) one-tail	0.000245	
t Critical one-tail	1.67866	
P(T<=t) two-tail	0.00049	
t Critical two-tail	2.012896	

Figure 3 Cattle can graze beyond the fence line showing the importance of establishing a fence line at least two metre from the top of the riverbank.

A project innovation now makes it possible to fence flood prone areas, previously not possible to fence due to entrainment of large debris. Instead of fencing wires snapping under the pressure of large debris carried by high floodwaters, breaks points have been installed at strategic locations along fence lines in the Allow, Dalua and Brogeen rivers. The break points proved successful during the large floods of 2014, with no loss of project fencing (Figure 4).

Figure 4 Fencing wire after detaching from the post after coming under pressure for a large debris carried by floodwaters (left), and reattaching the fencing wire after floodwaters have dissipated (right).

Riparian vegetation surveys

The vegetation survey showed that species richness and diversity was greater when the riparian zone is fenced off from livestock (Tables 3 and 4). Revisit surveys of four riverbank sites found increases in plant diversity with each site showing an increase in the number of individual species present. This is due to the absence of grazing pressure at the top of the riverbank. Grazing is present to a certain extent under the fence wire, but decreases markedly closer to the bank (Figure 3). While the most dominant species are grasses, flowering plants are also present. The increased species diversity found beyond the reach of grazing animals is testament to the effectiveness of the fencing regime implemented by DuhallowLIFE.

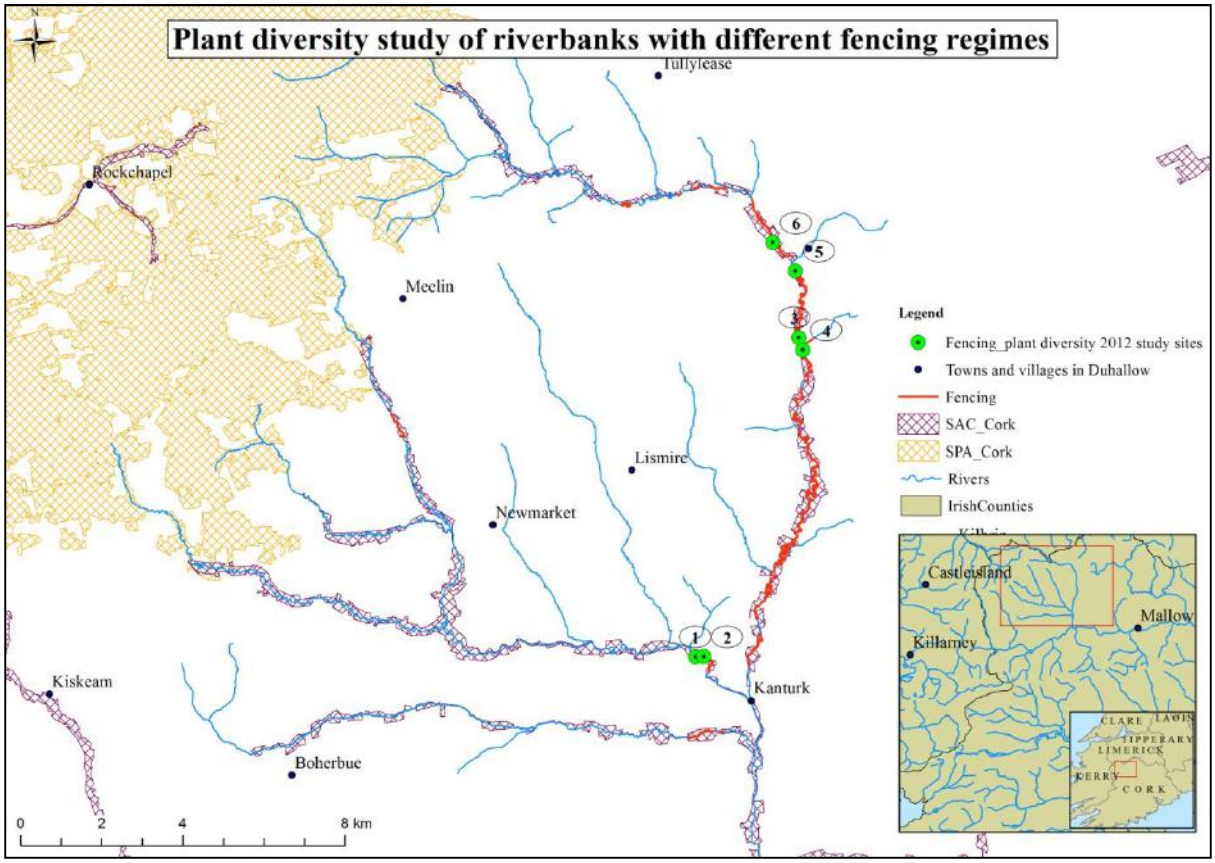

Figure 4 Locations of plant diversity study sites from 2012 that were surveyed again in 2015 (see Table 1 for results)

Equation 1 Shannon-Wiener Diversity Index

H′= Shannon-Wiener Diversity Index:

$$H' = \frac{N \ln N - \sum (n_i \ln n_i)}{N}$$

Table 3 Plant diversity study using Shannon-Wiener Diversity index between 2012 and 2015 at locations indicated in Figure 4

Plant diversity study	**2012**		**2015**	
Site	*Fencing Regime*	*Plant diversity*	*Fencing Regime*	*Plant diversity*
1	Fenced 3.9m from bank	2.082	Fenced 3.9m from bank	Not Surveyed
2	Not fenced	1.04	Fenced 2m from bank	1.729
3	Fenced 4.5m from bank	2.061	Fenced 4.5m from bank	Not Surveyed
4	Fenced 0.7m from bank	1.598	Fenced 2m from bank	2.06
5	Fenced 0.6m from bank	1.609	Fenced 2m from bank	1.758
6	Not fenced	1.224	Fenced 2m from bank	1.697

Table 4 List of species recorded (and percentage cover) at four sites along the Allow and Dalua Rivers (before and after DuhallowLIFE erecting fencing, at least 2m from the top of the river bank (see Table 3). Sites 3 and 4 were not resurveyed.

	Pre Fencing (2012)		**Post-fencing (2015)**	
	Species	*% Cover*	*Species*	*% Cover*
Site 2	Agrostis sp	100	Willow (Salix)	75
	Perennial Rye-grass (Lolium perenne)	8	Agrostis sp	50
	Creeping Thistle (Cirsium arvense)	15	False Oat (Arrhenatherum elatius)	30
	Clover sp (Trifolium)	20	Perennial Rye-grass (Lolium perenne)	25
	Ragwort (Senecio Jacobea)	5	Creeping Thistle (Cirsium arvense)	15
			Clover sp (Trifolium)	10
			Cocksfoot (Dactylis glomerata)	15
S-W diversity index		**1.04**		**1.729**

Table 4 continued

	Pre Fencing (2012)		Post-fencing (2015)	
	Species	*% Cover*	*Species*	*% Cover*
Site 4	Ragwort (Senecio Jacobea)	3	Bramble (Rubus fruticosus)	*30*
	Bramble (Rubus fruticosus)	10	Common Vetch (Vicia sativa)	*3*
	Common Vetch (Vicia sativa)	1	Birdsfoot Trefoil (Lotus corniculatus)	*1*
	Birdsfoot Trefoil (Lotus corniculatus)	1	Meadow Buttercup (Ranunculus acris)	*1*
	Meadow Buttercup (Ranunculus acris)	1	Common Knapweed (Centaurea nigra)	*5*
	Common Knapweed (Centaurea nigra)	20	Common Marsh-bedstraw (Galium palustre)	*15*
	Common Marsh-bedstraw (Galium palustre)	3	False Oat (Arrhenatherum elatius)	*10*
	False Oat (Arrhenatherum elatius)	15	Tufted Hair Grass (Deschampsia cespitosa)	*65*
	Tufted Hair Grass (Deschampsia cespitosa)	70	Timothy (Phleum pratense)	*35*
	Timothy (Phleum pratense)	30	Creeping Thistle (Cirsium arvense)	*40*
			Yorkshire Fog (Holcus lanatus)	*20*
			Ragwort (Senecio Jacobea)	*15*
S-W diversity index		***1.598***		***2.06***

Table 4 continued

	Pre Fencing (2012)		Post-fencing (2015)	
	Species	*% Cover*	*Species*	*% Cover*
Site 5	Bramble (Rubus fruticosus)	5	Red Fescue (Festuca rubra)	60
	False Oat (Arrhenatherum elatius)	40	Yorkshire Fog (Holcus lanatus)	50
	Soft Rush (Juncus effusus)	5	Creeping Bent (Agrostis stolonifera)	50
	Red Fescue (Festuca rubra)	50	Bramble (Rubus fruticosus)	10
	Lesser Stitchwort (Stellaria graminea)	5	Cleavers (Galium aparine)	10
	Cocksfoot (Dactylis glomerata)	15	Germander Speedwell (Veronica chamaedrys)	3
	Creeping Bent (Agrostis stolonifera)	35	Bindweed (Convolvulus sp)	5
			Common Vetch (Vicia sativa)	1
			Cow Parsley (Anthriscus sylvestris)	10
			Meadow Buttercup (Ranunculus acris)	5
			Perennial Rye-grass (Lolium perenne)	35
S-W diversity index		**1.609**		**1.942**

Table 3 continued

	Pre Fencing (2012)		Post-fencing (2015)	
	Species	*% Cover*	*Species*	*% Cover*
Site 6	Creeping Thistle (Cirsium arvense)	60	Creeping Thistle (Cirsium arvense)	30
	White Clover (Trifolium repens)	50	White Clover (Trifolium repens)	50
	Meadow Buttercup (Ranunculus acris)	10	Meadow Buttercup (Ranunculus acris)	10
	Creeping Bent (Agrostis stolonifera)	80	Creeping Bent (Agrostis stolonifera)	50
			Foxglove (Digitalis purpurea)	1
			Soft Rush (Juncus effusus)	70
			Dock (Rumex sp)	25
			Groundsel (Senecio vulgaris)	5
			Yorkshire Fog (Holcus lanatus)	25
			Mouse-Ear Chickweed (Cerastium vulgatum)	5
S-W diversity index		**1.224**		**1.946**

Table 4 Riverbank sections before and after fencing by LIFE Project. All fence posts were erected at least 2m from the top of the riverbank.

Before Fencing	After Fencing
River Allow - Upstream of Metal Bridge	
 June 2011	 February 2014
River Allow - Downstream of Metal Bridge	
 May 2013	 June 2015
River Allow (RHB) - Downstream of Allow Bridge	
 April 2011	 June 2015

River Allow - Upstream of Freemount

July 2012

June 2015

River Dalua - Upstream of Kanturk

July 2012

June 2015

River Dalua - Upstream of Kanturk

April 2014

June 2015

Freshly cleared drain that flows into the Allow (Silt traps were installed and the drain was fenced off to prevent cattle access) - Upstream of Metal Bridge

April 2013

June 2015

Conclusion

Cattle access to the river network was identified as a significant issue requiring urgent remediation in the Allow catchment. To tackle this problem, DuhallowLIFE fenced up to thirty-eight kilometres of river bank along the River Allow and its tributaries (River Dalua and River Brogeen) within the SAC. The project team determined that the present requirement to erect a fence at 1.5m from the top of the riverbank was not sufficient to meet the ecological objectives of the project. With the support of landowners, riparian fencing was erected at least 2m from the top of the riverbank. Vegetation surveys showed that plant species richness increased between the fence line and the river, once livestock were excluded. A "flood friendly fencing" innovation was developed which helps protect fences within riparian margins. This low cost and practical innovation is transferable to other SAC rivers where regular flooding makes excluding livestock from riparian zones problematic.

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