Recovery of sections of river bank using willow *Salix* barriers along the River Cam at Kingfishers Bridge, Cambridgeshire, England

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SUMMARY

Barriers made from willow *Salix* spp. bundles were installed along sections of the River Cam to protect the river banks from erosion. Subsequently, a more gently sloping river bank was created which was colonised by a range of riparian plants. These vegetated margins developed into an attractive wildlife habitat and are effectively protecting these river bank sections from further erosion.

BACKGROUND

Since 1995, the Kingfishers Bridge Project has transformed 61 ha of arable farmland into a mosaic of wetland wildlife habitats. The River Cam flows along the west side of the Kingfishers Bridge wetland and Cam Washes SSSI. The river banks were almost vertical having been eroded by waves created by boats and wind. These resultant steep banks prevent establishment of vegetation, and thus have little wildlife interest. The lack of cover made this stretch unattractive to species, such as the otter *Lutra lutra* and water vole *Arvicola terrestris*. Additionally, access in and out of the water was difficult for these mammals, and also waterbirds e.g. coot *Fulica atra*. To provide additional riparian wildlife habitat, improve passages in and out of the water, and to prevent erosion, at several locations more gentle riparian bank gradients were created and willow *Salix* spp. barriers were installed.

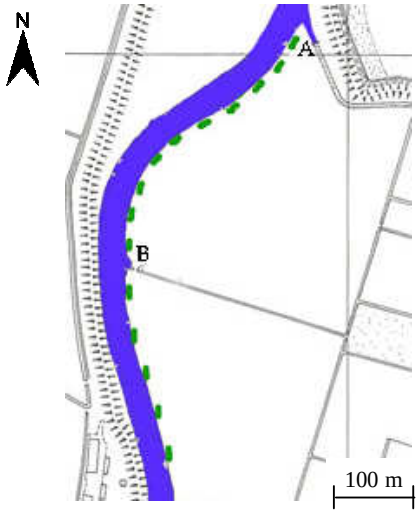

Figure 1. The River Cam (blue) runs from south to north along the western edge of Kingfishers Bridge wetland. The green dashes indicate river bank sections where *Salix* barriers were installed. The colonisation of plant species was monitored between points A and B at 10 unprotected and 10 re-profiled and protected river bank sections.

ACTION

Study site: In March 2006, approximately 18 river bank sections (from 10 to 30 m in length and around 3 m in width) along the River Cam in the vicinity of Kingfishers Bridge, Cambridgeshire, eastern England, were

protected with willow barriers and re-profiled (Fig. 1). The sections were located at places where the water depth at the bank side was fairly shallow (between 0-70 cm).

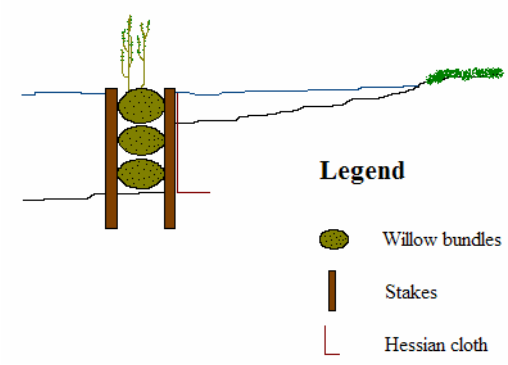

Figure 2. Schematic diagram of a willow barrier.

Installing willow barriers: Live willow branches of approximately 4-5 m in length and 1-4 cm in diameter were cut from trees at Kingfishers Bridge. Four willow species were used, osier *Salix viminalis*, purple osier *S. purpurea*, crack willow *S. fragilis* and white willow *S. alba*. The branches were bound together into tight bundles (approximately 30 cm in diameter) with binder twine. The bundles were transported on a trailer to the river bank. At 1 m intervals, two wooden stakes were driven vertically into the river substrate, roughly 2-3 m from the shoreline. Between the stakes, willow bundles were installed, placing them horizontally in the water (up to three on top of one another) and securing them to the stakes. Between the willow barrier and the shallow landward side, a Hessian cloth was positioned to support the bank. Soil taken from the bank during re-profiling was placed behind the Hessian to create a gradual transition from the river up to the bank top. (A schematic diagram of a willow barrier is shown in Fig. 2).

Monitoring: The occurrence and colonisation of plant species along 10 re-profiled and protected river bank sections, and 10 steep unprotected river bank sections, was surveyed (Fig. 1). The plant species growing in the water at the river's edge were recorded.

CONSEQUENCES

Edge protection: The river edge is now much better protected against waves as the willow barriers effectively absorb the wave energy before reaching the river bank. Willow has also started to sprout from the bundles, which will further increase the protection of the bank and add to the wildlife value.

Vegetation: To date, 19 plant species have settled within the willow barriers (Table 1), of which 17 were recorded in the wet margins, but not on the hard river banks. Two species, namely stinging nettle *Urtica dioica* and clustered dock *Rumex conglomeratus* dominated this upper bank zone. However, no species grew in the water in the absence of bank protection.

At several locations a bay had been created, where waves have less impact on the river bank. However, even though the impact of the waves is less, at these bays few riparian plants were able to establish (Fig. 3).

Fauna: The protected and revegetated river bank sections are now used by several species of waterfowl for nesting, such as moorhen *Gallinula chloropus.* Occasionally otter spraints and water vole faeces have been found on these protected banks, indicating that they use the re-profiled banks to get in and out of the water.

Upstream of the protected banks, fish have been observed using the roots of willows growing out into the water for spawning. It is hoped that the roots of the willows growing from the barrier will, in time, also provide suitable spawning sites.

Figure 3. A bay on the River Cam. The river bank is dominated by stinging nettle *Urtica dioica* with a marginal fringe of reed sweet-grass *Glyceria maxima* and dock *Rumex spp.*

Table 1. Plant species occurring within 10 protected river bank sections and along the river bank with no protection in the vicinity of Kingfishers Bridge, River Cam, 2007.

Riparian and aquatic plant species	**Unprotected river banks**										**Protected re-profiled banks**									
	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
False fox-sedge *Carex otrubae*												x								
Greater pond-sedge *Carex riparia*									x					x	x	x			x	x
Rigid hornwort *Ceratophyllum demersum*																x				
Hairy willow-herb *Epilobium hirsutum*																x		x		
Reed sweet-grass *Glyceria maxima*									x		x		x				x			
Yellow flag *Iris pseudacorus*													x							
Hard rush *Juncus inflexus*																			x	
Small duckweed *Lemna minuta*											x					x				
Gypsywort *Lycopus europaeus*											x		x	x		x		x	x	
Purple loosestrife *Lythrum salicaria*																		x		
Yellow water-lily *Nuphar lutea*													x							
Reed canary-grass *Phalaris arundinacea*																x				
Rough meadow-grass *Poa trivialis*																x				
Clustered dock *Rumex conglomeratus*	x												x		x	x				
Water figwort *Scrophularia aquatica*																x	x	x		
Woody nightshade *Solanum dulcamara*														x						
Branched bur-reed *Sparganium erectum*											x		x			x				
Reedmace *Typha latifolia*																		x		
Stinging nettle *Urtica dioica*														x						
Willow species																				
Common osier *Salix viminalis*											x		x		x	x	x	x	x	x
Purple osier *Salix purpurea*															x	x	x	x		
Crack willow *Salix fragilis*												x		x						
White willow *Salix alba*												x								

Conclusions: The willow barriers have effectively protected the river bank against erosion. Once water and marginal plants have established and spread to fully cover the protected bank sites, the protection afforded is expected to become even more effective. Seventeen riparian plant species have colonised the protected river bank sections, none of which are present along unprotected river bank edges. The protected bank sections, as they develop, are becoming wildlife habitats including nesting and foraging sites for birds, and entry/exit points for otters and water voles.

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