Flood embankment vegetation management trials

Science Summary SC030228/SS1

Scientists from consultants Ecology, Land and People (ELP) worked with Environment Agency staff in a long-term project that aimed to improve our understanding of the effects of vegetation management on the performance of flood embankments.

The flood embankment vegetation management trials took place between 2003 and 2007 at three sites in the Environment Agency's Anglian Region (Ely Ouse, Reach Lode and Billingborough). Designated plots along the embankments at each site were subjected to a series of different management techniques over the five-year period including:

- different cutting frequencies (none to six cuts per year);
- removal of mown arisings;
- treatment with herbicides;
- application of aquatic dredgings.

The treatments were carried out by either Environment Agency staff or external contractors.

Important indicators of embankment performance such as soil strength and erosion resistance, soil nutrient levels, soil moisture, soil organic content and the diversity of floral and faunal communities were monitored to assess the effects of the different management techniques. A complementary study tested the erosion resistance of the vegetated floodbanks. Weather data and information about local conditions (e.g. extent of public, animal and vehicle access) were also collated.

The three trial sites had substantially different characteristics and so data from each were analysed separately. This analysis showed that vegetation management had a strong affect on a number of indicators of bank performance. The main relationships are summarised below:

- Cutting frequency strongly affected vegetation composition and was found to be the overriding factor determining the plant communities found at two of the three sites (the embankment face was found to be the overriding factor at the third site, with management secondary).
- Cutting frequency affected the dry weight of arisings collected, with the greatest weight of arisings collected in those treatments receiving three or more cuts per year.
- Cutting frequency can affect surface soil strength; the greatest soil strength was found in those areas with a short sward (i.e. cut three times a year or more). No mowing proved poorest in terms of both surface soil strength and erosion resistance.
- Cutting frequency was not found to significantly affect soil strength at depths of 300 cm. The material used in the construction of the bank appeared to be the overriding factor, with peat soils proving especially weak.
- There was some evidence that a greater frequency of cutting resulted in greater invertebrate diversity, but this was not consistent across all three sites.
- Application of weed wipes had very little effect on vegetation composition, soil strength or erosion resistance.
- Application of growth retardant resulted in reduced production of arisings at two of the three sites. At the third site, the timing of the herbicide treatment was crucial in terms of its effectiveness in counteracting invasive annual species .
- Collection of arisings after mowing was generally found to have little effect on vegetation composition, particularly where only one cut per year took place. There was some evidence at one of the sites that, where vegetation was cut more frequently (i.e. three times per year), plant diversity was greater when the arisings were removed.
- Some evidence was found that collection of arisings improved surface soil strength indirectly through soil moisture (i.e. the presence of large quantities of arisings led to increased soil moisture leading to reduced surface soil strength), but it was found to have little effect on erosion resistance.
- Invertebrate populations were larger both in the more productive areas (i.e. where a greater weight of arisings were collected) or where leaf litter cover was high (i.e. where arisings were not collected).

- Deposition of aquatic arisings and channel dredgings on the bank (during annual watercourse maintenance) resulted in vegetation communities with little variation in species. No noticeable difference was recorded even where aquatic arisings were removed after one week.
- Deposition of aquatic arisings and channel dredgings proved detrimental to surface soil strength, though no discernable effect was found at depth.

Many other factors were found to affect vegetation and invertebrate composition including:

- embankment face (river, crest or landward);
- starting condition of the sward and the availability of a diverse seed rain;
- presence of invasive species;
- soil nutrient levels and moisture content;
- exposure to fire events, trampling and other forms of disturbance.

In the majority of cases, these variables affected the vegetation composition as a secondary factor in addition to the overriding influence of management.

Tables are presented in the report outlining which management technique is most appropriate given a series of environmental scenarios. Scores are given for criteria such as bank strength, erosion resistance, cost, health and safety, floral and faunal diversity. In general, the highest scores are obtained by those treatments where the vegetation is cut more than once a year and the arisings are left on. However, individual sites are likely to require particular emphasis on certain criteria (e.g. bank strength where flooding risk is high, plant diversity where rare species are present). Background information about a site will therefore be crucial in determining the most appropriate management option.

The results of the trials will contribute to a decision support framework for determining the optimum vegetation management regime for the maintenance of flood embankments that takes into account their engineering, operational and environmental attributes. The research will also enable the Environment Agency to produce improved national guidance for its staff on maintenance practice on flood embankments and to provide general guidance on this issue to the wider land drainage community.

To supplement the report, additional data and evidence are provided on a series of three CDs.

This summary relates to information from Science Project SC030228, reported in detail in the following output:

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