ZERO CARBON BRITAIN and wetlands

By Jane Fisher and Tom Barker

Wetlands have multiple benefits such as maintaining biodiversity, providing fodder and commercial products, stabilising micro-climates, moderating floods, groundwater recharge and water quality improvements (CEC 1995; Dugan 1990; Maltby 1990; Hogan et al. 1992; Maltby and Barker 2009). An increase in the area of arable land due to ZCB may lead to an increase in the export of nitrogen (N), and phosphorus (P) and loss of soil and soil carbon from agricultural soils. Wetland ecosystems situated in lowlands, particularly in floodplains, are important for intercepting these potential pollutants prior to their deposition in lakes and rivers. Wetlands are known to reduce P in runoff water via sedimentation (Johnston et al., 1984, Khalid et al., 1977), and N via denitrification (Lowrance et al., 1984). They also reduce nutrient concentrations by assimilating them in plant biomass (Lee et al., 1975).

The ability of wetlands to reduce nutrient loading in runoff waters is known to be impaired at very high nutrient inflow concentrations or during high runoff, e.g. after heavy rain (Hill, 1997; Mander et al. 1991), and can also be lower in longstanding wetlands (Nichols, 1983). This occurs because of the chemical saturation of binding sites (e.g. in sediment, organic matter and plant roots), and is particularly significant for P removal (Omernik et al. 1981; Richardson, 1985). A lack of contact time with denitrifying bacteria, or their unavailability also leads to reduced N removal. In a high-arable landscape, these are potential problems that will require careful management (Cook et al. 2009).

Haycock et al. (1997) concluded that N reduction is greater in wetter environments while P reduction is greater in drier conditions. An increase in arable land as proposed by ZCB therefore will necessitate a greater acreage of 'wet' wetlands to intercept the increased N-rich runoff characteristic of arable farming. A review of 57 wetland studies showed that wetlands characteristically reduce nutrient runoff during the spring and summer, but can release soluble forms of nutrients during the winter, when the vegetation dies back or when sediment erosion occurs (Fisher and Acreman, 2004). Phosphorus is also released if the wetland soil becomes anaerobic, which can happen during warm and wet periods. It is thus in the interests of eutrophication management to preserve floodplain wetlands, but also maintain 'buffer zones' (broad strips of wild vegetation at low field borders) to intercept P in runoff.

Preserving and encouraging diversity of plant and animal species is important for ecosystem services, and is largely dependent on structural heterogeneity of plants and litter. The vegetation composition of a wetland has been linked to its capacity to reduce nutrient loads. A comparison of three wetland areas of different vegetation type found that a wetland comprising mainly *Iris pseudacorus* and mixed other vegetation, and one containing mixed *Iris pseudacorus*, reed (*Phragmites*) and reedmace (*Typha* spp.) vegetation removed more N than a wetland comprising a monoculture of *Phragmites* (Fisher et al. 2009). There is a growing body of evidence that more biodiverse ecosystems in general are more efficient in providing ecosystem services than less diverse ecosystems (see for example Tilman 2001; Englehardt and Ritchie 2002, Elmqvist et al. 2010). A more diverse wetland functions at least as well as a less diverse wetland, and supports a greater diversity of microbes, fungi, invertebrates, birds and mammals by virtue of the more diverse habitat and niches provided (Morrealle and Sullivan 2010).

Wetlands are an easy target for conversion to agriculture or grazing because they are marginal pieces of land with no obvious value to farmers. The great value of wetlands ecologically and in provision of ecosystem services should be made explicit when making plans for agricultural expansion, which will be at the expense of biodiversity, which we can ill afford to reduce further (see e.g. Lewis 2012).

Recommendations

- Conserve and establish new wetlands in lowland areas between agricultural areas, particularly between arable land, and receiving waters;
- Make the case for allocating large areas of land for wetlands to increase nutrient removal capacity and biodiversity value;
- Maintain connections between wetland areas and between wetlands and semi-natural areas in order to create habitat corridors. These are important for maintaining ecosystem resilience and gene flow;
- Plant with a mixture of plant species to encourage a diversity of other biota. This mix should include emergent perennial vegetation, emergent annual and biannual species, and submerged and floating-leaved species if water levels allow. This increases the length of the season over which the wetland will function and provides a diverse habitat and enhanced functioning characteristics (van der Valk 2009; Ramseier et al. 2009);
- Topography of newly constructed wetlands should be varied to allow frequently flooded areas to promote denitrification, and shallower areas to promote P removal.

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