

## Technical Appendix 4: Biodiversity

Agricultural and forestry operations have profound effects on habitats and wildlife, both positive and negative (Ehrlich 1995; DEFRA 2002).

The dramatic changes envisaged in the scenario are bound to alter the patterns of biodiversity, and it is important to know whether there are likely to be serious deleterious effects. The main thrust of the scenario is a substitution of most kinds of grazed grassland with perennial biomass crops that are harvested intermittently and subject to much less disturbance. There is no ecological reason to think this would reduce diversity; in fact rather the contrary (Haughton *et al.*, 2009). The main 'new' crops are 'energy silage', Miscanthus and Short-Rotation Coppice (SRC), mostly willow.

Probably 'energy-silage' would not be greatly different from grazed improved pasture in biodiversity terms. (Semere and Slater, 2005). Almost certainly it would require lower fertiliser inputs, and this itself can increase biodiversity, as is found in low-nutrient grasslands (Weigelt *et al.*, 2009; Walker *et al.*, 2004). Although in the scenario grazing is much reduced, it can be assumed that priority for grazing land will be given to areas where grazing has a positive conservation value, such as calcareous, neutral or acid grasslands. It is expected that old permanent pasture & haymeadows would continue to be managed traditionally.

Miscanthus is not native to Britain and appears to support little, if any, insect life in the crop itself, but neither does the improved rye grass it would displace. Its value lies in the combination of cover or shelter in the crop, with easy access to undisturbed grass or weeds or woodland edge plants growing in rides and on the fringes of the crop. Once established, a Miscanthus crop needs no inputs, and is remarkably efficient at recycling its own nutrients. It is deciduous; the bulk of the nutrients are drawn down into the rhizome before the leaves are shed in the autumn; the leaf litter is then recycled through the soil, and is available for the regrowth of the crop in the spring. Risk of groundwater contamination by agrochemicals is effectively eliminated. With high biomass input, soil biodiversity is good, and with a low input system botanical diversity on the fringes can develop. Increased botanical diversity will support increased insect diversity, and thus more bird life. Field margins of miscanthus have been recorded as having 60% more butterflies than arable field margins (Haughton *et al.*, 2009). Because the crop is undisturbed right through the breeding season, its value as bird nesting habitat, or for invertebrates is much improved. Its offers cover for larger wildlife, e.g. hares and game birds. Depending on the time of harvest, miscanthus could be an important as overwinter cover for birds.

Short rotation coppice willow (SRC) can also provide a very good quality wildlife habitat that can increase the biodiversity of an area compared to previous agricultural land uses, including sheep grazed pastures where a low biodiversity predominates (Cunningham *et al.*, 2006). Plants, insects and birds, have all been shown to have improved in number species (Wales Biomass Centre, 2010).

The SRC habitat is similar in many ways to young woodland, it can support a wide range of birds; over 50 species of birds have been recorded using the habitat in one way or another. In summer SRC is attractive to migrant warblers.

If the crop can be established without ploughing the whole field, to conserve soil carbon, or heavy use of herbicides, then there can be early development of floral diversity. Annual weeds in particular are important to birds, for the food they produce in their seeds and the food they support in insects. As the SRC crop matures, weeds and seeds are scarcer but the habitat is preferred by many birds for nesting and foraging for invertebrate food (Lowthe-Thomas, 2003).

Small mammals, particularly woodmice, have been recorded in the SRC Willow crop, with a greater diversity of small mammals in the edges of the crop. Willow has been found to increase the biodiversity of an area over previous land uses, including sheep grazed pastures and arable crops where a low biodiversity predominates. Ecological studies of the large areas of willow SRC planted in Yorkshire for the ARBRE project clearly demonstrated that willow plantations never displace species from an area and that the overall biodiversity, including ground vegetation, birds, butterflies and invertebrates, is improved (Rich and Sage, 2001).

In addition to perennial crops, a substantial area of land in the scenario is converted from grassland to carbon-conscious forestry. Although managed forests are probably marginally less biodiverse than unmanaged forests (Paillet *et al.*, 2010) they are unlikely to be less biodiverse than grasslands.

The scenario does not specify that land use be strictly 'organic' but the changes tend to drive practice in the direction of lower inputs of agrochemicals. There is reasonable evidence that low input farming systems support greater biodiversity than conventional farming systems. Studies have clearly shown that the abundance of species, across a wide range of wildlife, tend to be higher on organic than on conventional farms, and many of the species performing better on organic farms, are ones that have elsewhere declined as a consequence of agricultural intensification (Hole *et al.*, 2005).

Overall there are expected to be significant net increase in biodiversity throughout the agricultural landscape caused by the land-use changes in this scenario.

## References

- Cunningham, et al. (2006) The effects on Flora and fauna of converting grassland to short rotation coppice, DTI report B/W2/00738/00/00 URN 06/1094
- DEFRA (2002) Working with the grain of Nature: A Biodiversity strategy for the UK [online] available at: [www.defra.gov.uk/environment/biodiversity/.../biostrategy.pdf](http://www.defra.gov.uk/environment/biodiversity/.../biostrategy.pdf) [accessed 01/07/2010]
- Ehrlich, P.R (1995) The scale of human enterprise and biodiversity loss. In: Extinction Rates Eds. Lawton, J.h. and May, R.M. Cambridge U.P., p.214.
- Haughton et al., (2009) A novel, integrated approach to assessing social, economic and environmental implications of changing rural land use: a case study for perennial biomass crops. *Journal of Applied Ecology* (46) 315-322
- Hole, D.G. Perkins, A.J. Wilson, J.D. Alexander, I.H. Grace, P.V. Evans, A.D. (2005) Does Organic Farming Benefit Biodiversity? *Biological Conservation* (101) 113 – 130.
- Lowthe-Thomas SC. (2003) Ground cover management for short rotation willow coppice in the uplands of mid-Wales PhD Thesis, Cardiff: University of Wales (Cardiff University)

Paillet, Y., Bergès, L., Hjältén, J., Ódor, P., Avon, C. Bernhardt-Römermann, M., Bijlsma, R-J., De Bruyn, L., Fuhr, M., Grandin, U., Kanka, R., Lundin, L., Luque, S., Magura, T., Matesanz, S., Mészáros, I., Sebastià, M-T., Schmidt, W., Standovár, T., Tóthmérész, B., Uotila, A., Valladares, F., Vellak, K., Virtanen, R. (2010). Biodiversity Differences between Managed and Unmanaged Forests: Meta-Analysis of Species Richness in Europe. *Conservation Biology* 24 (1) 101–112. DOI: 10.1111/j.1523-1739.2009.01399.x

Rich, T.J. Sage, R.B. Moore, N. Robertson P, Aegerger J, Bishop J. (2001) ARBRE monitoring – ecology of short rotation coppice plantations. ETSU B/U1/00627/REP, DTI/Pub URN/ 01/768

Semere, T., Slater, F. (2005) The effects of energy grass plantations on biodiversity DTI report B/CR/00782/00/00 URN 05/1307

Wales Biomass Centre (2010) Potential Ecological and Environmental Impacts of SRWC [online] available at: <http://www.walesbiomass.org/env-willow.htm> [accessed 01/07/2010]

Walker, Kevin J., Paul A. Stevens, David P. Stevens, J. Owen Mountford, Sarah J. Manchester and Richard F. Pywell (2004) The restoration and re-creation of species-rich lowland grassland on land formerly managed for intensive agriculture in the UK. *Biological Conservation* 119 (1) 1-18.

Weigelt, A., W. W. Weisser, N. Buchmann, and M. Scherer-Lorenzen (2009) Biodiversity for multifunctional grasslands: equal productivity in high-diversity low-input and low-diversity high-input systems. *Biogeosciences* (6) 1695–1706.