Abstract

The work establishes the ecological importance of shale bings at both a local and global scale by presenting the mechanisms and processes of succession. The bings are post-industrial spoil heaps, the result of retorting mineral oil from deep-mined carboniferous shale beds.

The structure of vegetation on the shale bings was determined by a review of published data and a base-line survey of eight bings resulting in new floristic and environmental data from 340 quadrats and 261 plant species. The floristic data were analysed in the context of ecological indicator values (Ellenberg), functional type (competitive, stress-tolerant, ruderal), National Vegetation Classification and two-way indicator species analysis. The results indicated considerable variation in plant communities both between and within different bing sites.

The vegetation patterns were associated with the physical (altitude, aspect, slope and bare ground) and chemical (pH, calcium, phosphorous, potassium, magnesium, and nitrogen) environment of the shale substrate. Multivariate analyses (Detrended Correspondence Analysis and Canonical Correspondence Analysis) were used to ascertain the amount of species variation explained by each of the different environmental gradients. Although these abiotic environmental factors were shown to have a statistically significant influence on the plant community structure around 75% of the variation was still unaccounted for.

Nine species were selected to determine whether inherent plasticity within a species (plant height, number of flowering heads and seeds produced), the influences of seed dynamics and plant physiology could account for the variation in community structure not explained by environmental variables. This showed that almost half of the variation between and within bing sites was stochastic and probably dependent on the chance arrival of propagules in the initial stages of succession.

The results from this study were compared and contrasted with theoretical successional models and with similar studies of primary successions on both natural (glaciers, sand dunes, islands in fresh water, coral islands and volcanoes) and man-made (china clay, coal, other post-industrial sites, urban waste and arable land) sites. The similarities established the relevance of the work to other regions and sites, to successional theory and to ecological restoration and management practices.

On a local scale the bings are shown to have high ecological importance. They are refugia for locally rare fauna and flora and are a major component of the West Lothian biodiversity action plans. They are also of considerable social and historic importance.