# A Shoddy Tale: perspectives on the wool alien flora of West Yorkshire in the twenty-first century

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ABSTRACT

The terminology traditionally associated with the study of the wool alien flora of Britain is discussed from a historical perspective and clarification provided on the diverse nature of wool wastes. Changes in the production of wool wastes and their uses in agriculture over the past fifty years are presented as a background to an understanding of the increasing rarity and decreasing geographical distribution of wool aliens in the twenty-first century. Results are presented from a five years study of selected species in the rhubarb fields and livestock waste dumps in West Yorkshire (v.c. 63). Recommendations are put forward for research into the conservation of the wool alien flora.

KEYWORDS: wool waste, shoddy, decline of textile manufacture and agriculture, rhubarb fields, livestock waste dumps.

## INTRODUCTION: ALIEN AND/OR CASUAL

An awareness of the various industrial activities that contributed to the diversity of the flora of West Yorkshire was probably initiated by Lees (1888) who incorporated the records of several amateur botanists of aliens from wool and grain waste tips into his benchmark volume *The Flora of West Yorkshire*. Lees (1941) emphasized the continuity of wool alien recording in West Yorkshire in the early twentieth century, summarizing additional records in a supplement to his original flora. Meanwhile, it was probably the seminal work of Hayward and Druce (1919), more than any other, which alerted botanists to the increasing importance of an adventive flora in contributing to the national floristic diversity. In many ways, the lineage of adventive and alien study witnessed a sublimation in the publication of the *Flora of Bedfordshire* (Dony 1953). This work stimulated a nationwide interest amongst botanists in those species which were allegedly introduced through the agency of the wool manufacturing industry and the use of wool waste as manure in market gardening. A primary crop was brussels sprouts for which Bedfordshire with its 17,467 acres in 1938 in the area around Biggleswade was the major UK producer (Fitchett 1943). The source of these plants was traced to the woollen manufacturing districts of West Yorkshire by Lousley & Dony (1952) and the study of this peculiar flora taken up by Lousley (1958, 1960, 1961). A lifetime of dedication is to be seen in the work of John Dony, first in his county flora, the result of eighteen years of field study, followed by additional records and notes on changes (Dony 1969), then his *Bedfordshire plant atlas* (Dony 1976) and finally, some further notes (Dony and Dony 1986), records that tell the story of the establishment and gradual decline of 'wool shoddy aliens' in his native county. Dony (1976) recognised the shortcomings of such a term: 'The interpretation of the wool alien flora presents some difficulties as some native species occur as wool aliens, usually Mediterranean strains, and the use of wool waste is not of necessity the sole means of their introduction'. He also acknowledged that the wool alien species were not permanent and contended that their distribution was a matter of only passing interest, one however, that extended to the mapping of tetrads in which over 250 such species had been recorded. By the mid-1980s, Dony & Dony (1986) noted that few of the remaining market gardeners used wool waste but were able to record that its diminishing use had shown 'that wool aliens may continue to occur in fields for as long as eight years after the application of shoddy'. The term wool alien had been popularised by Lousley (1961) in his census list of all such species found in Britain in the period 1946–1960, and although it is implied in *Alien Plants of the British Isles*

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(Clement & Foster 1994), the term wool casual is generally used. The authors define casual as 'not persisting in a locality for more than two years without re-introduction'. Finally, in this context, the extremely detailed and dedicated catalogue of the *Alien Plants of Yorkshire* (Wilmore 2000) is consistent in its use of the term wool alien. It is a discussion on the alien and casual status of certain species originating as seed in wool waste that forms the core of this paper, based on five years of recording and observation in the so-called Rhubarb Triangle of West Yorkshire. Additionally, the results of five years recording on five waste dumps in which wool waste is a component are presented. These are set in the context of research into the current availability of wool waste as an agricultural manure, and a review of the several technological, industrial economic, agricultural and environmental factors that have governed the sporadic occurrence of wool aliens.

## THE NATURE OF WOOL WASTE AND SHODDY

Until the last two decades of the twentieth century, the textile waste that was the source of many of the seeds was of several different types and the different types had varying sized seed banks. There were *brokes* and *daggings* or *clarts* which comprised the dirty waste wool trimmed from imported fleeces; and there were *noils* and *carding waste*, fine, almost granular accumulations of short fibres, rich in seeds, the residue of the scouring, combing and carding processes in which the raw wool was prepared and cleansed, prior to spinning. Collectively, these waste products became known simply as 'wool waste' or 'shoddy manure' and together they provided the main seed bank for wool casuals. There was also *shoddy waste*, the residue of shoddy, a cheap, rough, fibre recovered from ground rags either collected throughout Britain or imported from Europe and the Middle East and itself the most fibrous of the wastes. Then finally, there was *mungo waste*, left after the extraction of mungo or the short fibres recovered from heavily felted woollen waste. Shoddy provided coarse fibre for the manufacture of heavy woollen clothing, such as army uniforms and blankets and industrial textiles. It was this aspect of the manufacturing industry that led to the adoption of the word 'shoddy' to refer to anything coarse or of lower quality in a general, everyday context. In a similar manner, the descriptive term 'shoddy field' as used by botanists and ecologists (e.g. Wilmore 2000) is used to describe arable fields that have been fertilized with wool waste and shoddy manure. The market gardeners of Bedfordshire and the rhubarb growers of West Yorkshire often used more than one type of waste according to availability and because of the variety of types used and their diverse provenances, the alien flora varied from year to year. Until the last decade of the twentieth century, daggings and carding waste were acquired from Halifax and shoddy waste from Mirfield for the 150 acres of rhubarb grown each year in the so-called 'Rhubarb Triangle' north of Wakefield, West Yorkshire. This area is essentially the country around the intersections of M1 and M62 motorways between Wakefield, East Ardsley, and Rothwell and within 10 km grid squares SE22 and SE32. Nowadays, the only sources of wool waste are two commission wool scouring companies in the United Kingdom, at Dewsbury and Bradford.

## CHANGES IN THE PRODUCTION OF THE SOURCE MATERIAL

Scouring is the process of washing wool in hot water and detergent to remove contaminants such as dirt, seeds and grease and to prevent entanglement or felting. The greatest technological development in the process came from the Wool Research Organisation of New Zealand (WRONZ), which through the invention of scouring machinery, made the country the most popular source for scoured and cleaned wool worldwide. The WRONZ Comprehensive Scouring System was first patented and installed in its country of origin in August 1972. By 1981, over fifty plants in New Zealand and other parts of the world had been converted to operate the WRONZ comprehensive system. It is estimated that, in the twenty-first century, plant supplied by a New Zealand manufacturer scours an estimated 70% of the world's wool. Because of the efficiency of the new technology, scouring costs rose less than other wool processing related production costs and New Zealand wool scourers costs became the lowest in the world (WRONZ 2005). Thus, by the 1980s, many UK woollen manufacturers were changing to the importation of scoured wool from New Zealand and Australia rather than import raw, unscoured wool to clean as a stage in their own production

processes. Although there are between fifty and sixty woollen manufacturers in West Yorkshire, most rely upon imported wool that has been scoured and cleaned in the country of its origin. Even the primary processing wool blending companies use New Zealand wool and the only waste product is dust which accumulates in the extractor fans and is then combusted at municipal incineration plants. There are, however, still some manufacturers who import raw wool and commission its scouring at either of two remaining wool scouring companies in the United Kingdom, Thomas Chadwick & Sons, Eastfield Mills, Dewsbury and Haworth Scouring Co., Cashmere Works, Bradford, both in West Yorkshire. A third is established at Buckfast in Devon, scouring wool exclusively for the Axminster Carpet Company. There has thus been a drastic reduction in the diversity of woollen wastes used in agriculture.

There has also been a great reduction in the quantity of imported raw wool and an inevitable reliance on the home clip. Whereas a large proportion (c. 75%) of the Dewsbury scouring company's wool was imported before 1980, 75–80% now comes from the UK clip, the remaining 20–25% wool originating in Scandinavia (mainly Norway), the Middle East (Syria and Egypt), Argentina, Australia and New Zealand. A record is not kept of the countries of origin and the quantities originating therefrom, and the previous data is based simply on observations of the notation on the bales. Similarly, the greater proportion (>70%) of the wool that the Bradford company scours comes from UK or Irish clips, the remainder from Norway and EC countries such as France, Germany and Holland. Thus, there has been a trend towards importing clean wool, a greater reliance on UK and Irish raw wool and a concomitant decline in the importation of raw wool for scouring by a few specialised companies. As a result, the waste from the woollen processing and manufacturing industry of predominantly foreign origin has become a rare commodity in the past twenty years. There has thus been a considerable reduction in the potential wool alien seed bank originating from regions outside Great Britain and Ireland.

The nature of the shoddy industry has changed considerably in the past twenty years. Few of the ten textile waste processors in the Kirklees and Wakefield Municipal Boroughs of West Yorkshire import rags from abroad and if they do, European Community regulations are such that the rags must be cleaned before import. Most rely on UK sources for c.90% of their manufacturing base, acquired either via high street charities or from the textile waste reclamation banks of local authorities. The proportion of woollen to synthetic rags in such consignments is usually low and wool raw materials far less common, so that inevitably, a greater proportion of the processed shoddy fibre for spinning is synthetic. Whether wool or synthetic rags are used, there is little waste and this merely in the form of zips, studs, buttons and labels, which finds its way to a skip and thence a landfill site. The UK woollen manufacturing industry in general is in decline, in the face of economic market forces relative to European Community and Third World trade agreements. Take for example, the three mills at Kirkheaton, Huddersfield, the heirs of the Jarmaine Company, whose wool waste dump was visited by both John Dony and Ted Lousley and from where Kit Rob and David McLintock first recorded *Medicago laciniata* in 1955 (Wilmore 2000). One has changed its operation to merchandising of cloth, a second was placed in administration in late 2004 and the third changed to cotton production and closed in March 2005.

## CHANGES IN AGRICULTURAL PRACTICE AND ENVIRONMENTAL FACTORS

The distribution of wool aliens, particularly in West Yorkshire, is now largely dependent upon the agricultural practices associated with the production of a particular vegetable crop, especially rhubarb, winter cauliflowers and spring cabbage. The waste is spread on the land in May–June, ploughed into the host soil in autumn and crowns of rhubarb planted, there to remain for two years, until transfer to the forcing sheds in the third autumn. In these two growing seasons, the casuals germinate and some apparently set viable seed. Once the crowns have been transferred, the land is again treated with wool waste, ploughed and set down to winter cauliflowers followed by spring cabbage or wheat for a further two or three years. The slow release of nitrogen from the wool waste allows for the production of two or three crops from one spread. The amount of wool waste required per acre is only 25% the volume compared with farmyard manure, which has to be applied annually and is much more difficult to spread. The various types of woollen waste vary in terms of their ability to retain moisture as a mulch and in their nitrogen concentration. They all are in the top group of

organic nitrogen sources, being ranked with guano and hide meal at 10%, with only hoof and horn meal of a higher concentration at 12% (see Table 2). Precise data is lacking on the relative nitrogen contents of the various types of wool waste, but the noils produced by the scouring process seem to have a particularly high concentration. This encourages the growth of a weed flora dominated by nitrophilous species such as *Chenopodium album*, *Galium aparine* and *Urtica urens*, and rather unusually, *Impatiens glandulifera*, a prominent and persistent weed of rhubarb fields. The gregarious nature of such plants tends to restrict the growth of other less competitive, annual wool casuals, many of which are denizens of drier soils typical of, for example, Mediterranean Europe. In the Rhubarb Triangle the predominant soil type is a clayey or loamy pelo-stagnogley of the Dale Association, a type of comparatively restricted distribution overlying Carboniferous shales in scattered areas from Sheffield in South Yorkshire, north to Ilkley (Soil Survey of England and Wales 1977, 1983). Typical brown earths of the Rivington 1 association also occur over Carboniferous sandstones, but both types are so modified by fertiliser addition as to restrict natural occurrences to a few narrow strips along a network of footpaths, old railway banks and narrow field boundaries. Many casuals of the Cardueae Tribe of the Asteraceae appear to have suffered due to the progressive reduction in marginal habitats on natural soils and in their inability to withstand competition from gregarious weed species. This group includes species of *Centaurea* such as *C. calcitrapa, C. solstitialis, C. melitensis, C. diluta*, along with *Carthamus tinctorius, C. lanatus, Silybum marianum* and *Scolymus maculatus.* An increase in a highly competitive nitrophilous weed flora thus appears to have further restricted the frequency of opportunity for annual and biennial wool aliens typical of relatively xeric soil conditions.

Rhubarb was first grown in the Wakefield region of West Yorkshire in the late-nineteenth century and by 1938, the 3818 acres accounted for 52·8% of the total acreage of the crop in England and Wales (Beaver 1941). The concentration was truly remarkable and a vital mainstay of many small farms; in the parish of West Ardsley 40% of the arable land was devoted to the crop, in Morley parish 36%, and in Outwood 34%. Beaver remarks: 'The soils are not by nature rich, and intensive cultivation can only be sustained by frequent heavy applications of manure – which, incidentally, is now less easy to obtain than in the days when horse-drawn drays and not lorries were the chief means of transport in the towns.' The implication here is that the use of wool waste had not yet become the predominant method of fertilisation in the late-1930s. This is confirmed by local information that describes the acquisition in 1941–42 of a new rhubarb variety 'Timperley Early', from the eponymous Cheshire village, where it was grown with great success by the application of liberal amounts of sewage and night soil. The same treatment was tried in the West Riding for a few seasons, but gradually the almost exclusive use of readily available wool waste came to predominate in the late forties. In the same decade, the market gardeners of Bedfordshire began to import large quantities of wool waste, but other vegetable producing regions such as the peatlands of Lincolnshire, Cambridge and south Lancashire continued to rely upon sewage, night soil and farmyard manure. Since the maximal extent of the industry in the late 1930s, a variety of market forces and agricultural trends have led to the reduction of the acreage under rhubarb in West Yorkshire from almost 4000 acres to about 150 acres from which three main growers produce the bulk of British rhubarb. Wilmore (2000) has remarked on that there has the general trend towards cereal production and a consequent decline in the use of wool waste as a fertiliser. A decline in the areal extent of traditional rhubarb fields has thus reduced the extent of habitat treated with wool waste and consequently the opportunities for the growth of wool aliens.

## CHARACTERISTICS OF THE WOOL ALIEN FLORA OF THE RHUBARB FIELDS OF WEST YORKSHIRE

From the comprehensive data presented in Wilmore (2000), it is clear that most of the recording of wool aliens in West Yorkshire in the period 1950–1980 was undertaken on the waste tips of scouring mills in the region. Significantly, all the records prior to 1980 came from localities in ten kilometre grid squares other than SE32 and it was mainly through the fieldwork of John Martin that the flora of the shoddy fields of Ardsley, Rothwell and Oulton in this latter grid square became so well known. His database and herbarium and the publication of his records by Wilmore (2000) are surely one of the major contributions to botanical

recording in the British Isles in the late-twentieth century and the data allow meaningful interpretations of the nature of the presumed wool alien flora in one of its last refuges. Fieldwork by the author since 2000 has suggested that the special ecology and environment provides a refuge for several groups of uncommon and declining alien plant species, a selection of which is discussed in the following text.

Seven species of the Pigweed genus *Amaranthus* are considered by Wilmore to be especially characteristic of the shoddy fields, whilst formerly being found as grain aliens in docklands and on local authority rubbish tips in the 1950s and 1960s. It is difficult to consider several of them to be wool aliens (*A. albus*, *A. blitoides*, *A. hybridus* and *A. retroflexus*) for they originate from North America, never a traditional source of imported wool in living memory, but a source of raw cotton, oilseed and grain, commodities that may have been a past vector. Wool imports from South Africa and South America may have resulted in the presence of *A. capensis*, *A. thunbergii* and *A. quitensis*, but the quantities imported have been so small that other vectors such as oilseed or bird seed must be considered as strong contenders (Hanson & Mason 1985). One of the rhubarb growers recalls using oilseed waste from the mills of British Oil and Cake Mills Ltd., (BOCM) at Selby in the 1970s (BOCM Pauls 2005). From its early establishment in 1910, the port mill of Selby on the Aire-Calder Navigation, some 30 km to the east, crushed oilseeds to produce vegetable oils for the human food industries and the by-product of this process was oilseed cake, a rich source of protein for feeding to all types of animals. The cake comprised waste from vegetable oilseeds such as soya from the USA and South America, groundnuts from West Africa and cottonseed from East Africa and the Far East, mixed with waste from maize and hard red wheat from the USA. All these provenances could account for the presence of most *Amaranthus* species recorded as aliens in Britain. But this source for the shoddy field aliens would necessitate either regular replenishment with the waste, for which there is no evidence, or production of viable seed annually for twenty years by *A. hybridus* to account for many of the later records. This latter situation may be the case for there are fourteen records from 1982 to 1998 *passim* (Table 1), four from Woodhouse Lane Farm, East Ardsley (SE2924), in which locality I have

TABLE 1. COMMONNESS AND RARITY OF *AMARANTHUS* AND *ERODIUM* SPECIES IN V.C. 63, POST-1980, IN 10 KM GRID SQUARES SE22 AND SE32

| Species | Origin | post 1980 Records | 1 km grid squares | Other 10 km records |
|---|---|---|---|---|
| *Amaranthus hybridus* | Tropical & North America | 14 | 8 | – |
| *A. albus* | North America | 5 | 3 | SE42 |
| *A. retroflexus* | Tropical & North America | 3 | 2 | SE13/60/72 |
| *A. blitoides* | North America | 2 | 2 | – |
| *A. thunbergii* | Tropical & South Africa | 2 | 2 | – |
| *A. viridis* | Tropical America | 2 | 2 | – |
| *A. capensis* | South Africa | 1 | 1 | – |
| *A. deflexus* | South America | 1 | 1 | – |
| *A. quitensis* | South America | 1 | 1 | – |
| *Erodium cicutarium* | Native/Mediterranean | >20 | >10 | 22 SE squares |
| *E. moschatum* | Mediterranean | >20 | >10 | SE11/13 |
| *E. botrys* | Mediterranean | 15 | 8 | SE13 |
| *E. crinitum* | Australia | 8 | 6 | SE13 |
| *E. stephanianum* | China, SE Asia | 3 | 3 | – |
| *E. brachycarpum* | North Africa | 2 | 2 | – |
| *E. chium* | Mediterranean | 2 | 2 | – |
| *E. malachoides* | SW Asia | 2 | 2 | – |
| *E. ciconium* | Australia | 1 | 1 | – |
| *E. cynorum* | Australia | 1 | 1 | – |
| *E. laciniatum* | Mediterranean | 1 | 1 | – |

[Tabulated data derived from an interpretation of cartographic details presented by Lavin & Wilmore (1994) and textual records published by Wilmore (2000)]

recorded it in 2002 and 2005. If regular seed set does occur, therefore, one must simply surmise that it is the phospho-nitrophilous nature of the habitat that encourages the growth of such a diversity of species, rather than repeated introductions; that it is ecology which is the determining factor for their ontology.

Other species from a variety of families have equally dubious origins. For example, *Sisymbrium irio*, according to Rich (1991) is "often associated with grain imports and often as a wool alien", whereas Pearman (2002) considers it to be "formerly a wool alien." Of the forty-one records cited in Wilmore (2000), twenty-nine are from wool waste dumps and shoddy fields of Yorkshire, and in two localities at East Ardsley (SE2924) and Newton Hill (SE3222), there are respectively ten and nine annual records in the period 1981–94. These data and personal observations in the period 2002–05 indicate that there can be no doubt that this species of Eurasian origin reproduces annually by seed and as such cannot be considered as a wool casual requiring reintroduction from seed in waste wool originating in the Middle East. Yet one must not dismiss a similar origin to the species of *Amaranthus*, as an oilseed alien maintaining itself in a nutrient-rich, frequently disturbed habitat. The shoddy field habitat could probably not be more contrasting than some of those of the plant's original London localities, such as the Roman walls and environs of the Tower. A similar diversity of origin is implied for various alien members of the Poaceae, Yorkshire records for approximately 30% (45 species) of which come from this locality. The species are mostly Mediterranean in origin and there is a strong probability that most may be sourced to wool imports, but the rhubarb fields are also the main habitat for *Ehrharta longiflora* from South Africa, *Ceratochloa brevis* and *C. cathartica* from South America, and from tropical regions *inter alia*, *Chloris virgata*, *Setaria verticillata* and *Pennisetum clandestinum*. Again, the oilseed cake residues from Selby are perhaps more strongly implicated as vectors than wool waste.

Certain groups of species with fruiting heads, fruit or seeds that are clearly adapted to animal dispersal by their ornamentation with hooks and spines may be considered with a far greater certainty as wool aliens. Examples of gross morphological adaptations include the species of *Centaurea* mentioned earlier, the two species of thistle, *Carduus tenuiflorus* and *C. pycnocephalus*, and *Datura stramonium* for which the rhubarb fields are probably the main inland locality in Britain. In the Lamiaceae, *Marrubium vulgare* has hooked calyx teeth, in the Malvaceae, the two commonly encountered species *Malva pusilla* and *M. parviflora*, have reticulate and ridged nutlets, whilst most species of *Medicago* (Fabaceae) have curved or spiraled, spiny fruits. Wilmore (2000) lists eleven species in the genus, of which *M. arabica*, *M. laciniata*, *M. minima* and *M. polymorpha* are the most common and particularly characteristic of the shoddy fields where they will certainly set viable seed. There are, for example, relatively early records by Kit Rob for *M. laciniata* from a potato field at Berryhills in v.c. 65 for the period 1958–63, and it was also recorded during the present study in a single rhubarb/cauliflower field at Rothwell (v.c. 63) in the period 2000–05 by the author. Wilmore also records eleven species of *Erodium* (Geraniaceae) in the Rhubarb Triangle, only four of which were found to be relatively frequent during the past five years' research (Table 1). All these species are characterized by the beaked or hooked apices of their mericarps, a feature which is no doubt responsible for their dissemination in wool waste. Although the native *E. cicutarium* is regarded as native in sandy, coastal habitats, here in the vegetable fields it is certainly introduced and is probably of Mediterranean origin. The same is true of *E. moschatum*, often the most obvious species, capable of attaining a gregarious growth which makes it the dominant weed in several fields. Both species set good seed regularly but observations on whether *E. botrys*, of Mediterranean origin, and *E. crinitum* from Australia, do likewise proved to be inconclusive.

## FLORA OF THE WASTE DUMPS OF THE UPPER COLNE VALLEY

A previously unrecorded use of wool waste in agriculture came to the notice of the author in 2000, namely, its use by several milk, suckling and beef cattle farmers in the Slaithwaite district of the upper Colne Valley (SE01), where local information indicated that the practise had been in operation for the past twenty years. The origin of the shoddy is the Dewsbury scouring company of Chadwick & Sons and it is used for bedding cattle in stall

during winter. When the cattle are turned out to grass in late-April, the bedding, comprising a mixture of shoddy, straw, manure and silage is cleared to waste dumps and left to rot. After several years rotting, usually a minimum of five, the mixture is spread on pastures previously treated with herbicide and then ploughed in as an organic nitrogen-rich fertiliser to encourage growth of an Italian ryegrass silage crop. That the environments of the dumps are short-lived is exemplified by the fact that those at Booth Hey Top (locality 2) were spread and ploughed into the surrounding pastures in the winter of 2004. In 2005, only *Chenopodium murale* and *Medicago arabica* survived in nutrient rich wall bottoms and a marginal footpath strip, the bank of which yielded a surprisingly luxurious growth of *Conopodium majus* and *Ranunculus bulbosus*. The waste heaps are augmented by a new dump of used bedding each year, so that several heaps comprise a sequence of five annual deposits on which a short-term vegetation succession is sometimes apparent. The habitat is extremely nitrogen-rich and Table 2 shows both the nitrogenous nature of wool shoddy relative to other animal by-products and the contributions of the other three components of the habitat. The habitat differs from that of the rhubarb fields of East Ardsley and Rothwell in this respect that the environment is wholly waste dump, lacking adjacent, native arable soil. The other major difference between the two habitats is that the Slaithwaite waste dumps are at least 200 m higher at 245–330 m compared to an altitudinal range of 50–125 m for the rhubarb fields. These two considerations, plus the fact that the waste dumps are simply much smaller in area, accounts for the lower species diversity; no species was present on the dumps and absent in the rhubarb fields, though some such as *Chenopodium murale* had a seemingly greater frequency of occurrence.

A study of the five waste heaps over the period 2001–2005 showed that the components of their flora may be divided into six ecosociological groups:

a. a group of common annual weeds typical of most nutrient-rich habitats that occur in abundance over the first three years of the life of the waste dumps: *Atriplex patula*, *Chenopodium album*, *Epilobium ciliatum*, *Matricaria discoidea*, *Polygonum aviculare*, *Poa annua*, *Persicaria lapathifolia*, *Sonchus oleraceus* and *Stellaria media*;

TABLE 2. PERCENTAGE NITROGEN CONTENT OF COMPOST MATERIALS

| | Source 1 | Source 2 |
|---|---|---|
| Animal Manures | | |
| pigeon | 4·2 | --- |
| fowl | 1·6 | 1·0 |
| dog | 1·9 | --- |
| duck | 1·1 | 1·0 |
| pig | 0·6 | 0·4 |
| horse | 0·4 | 0·6 |
| cow | 0·3 | 0·4 |
| Animal By-products | | |
| feather | 15 | 8 |
| blood meal | 15 | 12 |
| hoof & horn meal | 12 | 12 |
| silk waste | 8·4 | -- |
| wool shoddy | 8 | 10 |
| fish meal | 6·5 | 9 |
| bone meal | 4 | 4 |
| Vegetable Wastes | | |
| field bean haulms | 1·70 | |
| cotton waste | 1·32 | |
| timothy hay/silage | 1·25 | |
| brewing molasses/grain | 0·70 | |
| potato haulms | 0·60 | |
| wheat straw | 0·50 | |
| beet haulms | 0·40 | |

Source 1*:* Primal Seeds (2004). Percentage composition of composts. http://www.primalseeds.org/npk.htm
Source 2*:* Moor, F (2004). The world of soil: food values of different manures and fertilisers. http://web.ukonline.co.uk/fred.moor/soil/fertilis/f01.htm

b. a group of gregarious perennials that gradually come to dominate after approximately five years: *Cirsium arvense*, *Dactylis glomerata*, *Elymus repens*, *Galium aparine*, *Lolium perenne*, *Phleum pratense*, *Rumex obtusifolius*, *Trifolium repens* and *Urtica dioica*;
c. species with helophyte tendencies, both annual and perennial, growing in the moist environment provided by the water-absorbent shoddy: *Agrostis stolonifera*, *Alopecurus geniculatus*, *Impatiens glandulifera*, *Puccinellia distans* and *Ranunculus repens*;
d. cereal species from seed in the straw and cattle feed: *Avena fatua*, *Hordeum vulgare* and *Triticum vulgare*;
e. pioneer species characteristic of high nitrogen environments such as *Chenopodium murale*, *Datura stramonium* and *Arctium minus*;

TABLE 3. FREQUENCY OF SELECTED ANNUAL AND BIENNIAL SPECIES OF ECOSOCIOLOGICAL GROUPS E & F ON SLAITHWAITE WASTE DUMPS, 2001–05

| Species | 2001 | 2002 | 2003 | 2004 | 2005 | Records | %F | C/I |
|---|---|---|---|---|---|---|---|---|
| *Chenopodium murale* | 1–3,5 | 1–5 | 1,2,4,5 | 1–5 | 1,2,4,5 | 21 | 80 | -1·63 |
| *Erodium cicutarium* | 1–5 | 1,3–5 | 1,3–5 | 1,3–5 | 1,3–5 | 21 | 77 | -0·11 |
| *Medicago arabica* | 1–3,5 | 1–3 | 1–3,5 | 1–3,5 | 1–5 | 20 | 77 | +0·69 |
| *Erodium moschatum* | 1,2,5 | 1,2,5 | 1,2 | 1,2,5 | 1,5 | 13 | 53 | +0·47 |
| *Melilotus indicus* | 1–3 | 1,2 | 1,2 | 1,3–5 | 1 | 12 | 50 | -1·59 |
| *Melilotus albus* | 1,2 | 1,2 | 2,5 | 1,2,5 | 1 | 10 | 33 | -0·20 |
| *Geranium molle* | 1,3 | 3 | 1 | 1,3 | 1,5 | 8 | 33 | -0·46 |
| *Melilotus officinalis* | 1,4 | 1,4 | 1,5 | 4 | 1 | 8 | 33 | +0·02 |
| *Arcticum minus* | 4,5 | 4,5 | - | 4,5 | 4 | 7 | 28 | -0·41 |
| *Malva parviflora* | 1,4,5 | - | 3,4 | 3,5 | - | 7 | 28 | nd |
| *Malva pusilla* | - | 1,2,4 | 1,2 | 1,2 | - | 7 | 28 | nd |
| *Geranium pusillum* | 1 | 1 | 1,3 | 1 | 1 | 6 | 24 | +0·16 |
| *Geranium lucidum* | 1 | 1 | 1 | 1 | 1 | 5 | 20 | +1·42 |
| *Marrubium vulgare* | 2 | 2 | 2 | 1,2 | - | 5 | 20 | -2·02 |
| *Medicago polymorpha* | 1,2 | 1 | - | - | 4 | 4 | 16 | -1·34 |
| *Datura stramonium* | - | - | 1,2 | 2 | - | 3 | 12 | -0·71 |
| *Geranium dissectum* | 1 | 1 | 1 | - | - | 3 | 12 | -0·09 |
| *Trifolium arvense* | 1 | 1 | 1 | - | - | 2 | 12 | -0·01 |
| *Carduus tenuiflorus* | 1 | 1 | - | - | - | 2 | 8 | -0·14 |
| *Erodium botrys* | - | - | 2 | 2 | - | 2 | 8 | nd |
| *Sisymbrium irio* | - | - | 3 | - | 3 | 2 | 8 | +0·13 |

| Localities | Grid Ref | Alt (m) | Area ($m^2$) |
|---|---|---|---|
| 1. Coalgate, Slaithwaite | SE052140 | 330 | 3500 |
| 2. Booth Hey Top, Slaithwaite | SE057137 | 315 | 1500 |
| 3. Row Farm, Slaithwaite | SE063138 | 285 | 900 |
| 4. Delves Lane, Dowry Farm, Lingards | SE077128 | 265 | 1500 |
| 5. Shroggs Top, Dowry Farm, Lingards | SE076129 | 245 | 1000 |

Records = number of records in 2001–2005; %F = % frequency of occurrence; C/I = Change Index as derived from Preston, Pearman & Dines (2002)

f. annual and biennial species typical of open habitats, probably introduced as seed from the cleaning of imported wool; divisible into four sub-groups:

(i) members of the Fabaceae with nitrogen-fixing root nodules – *Medicago arabica*, *M. polymorpha*, *Melilotus albus*, *M. indicus*, *M. officinalis*, *Trifolium arvense*;

(ii) members of the Geraniaceae, including *Erodium cicutarium*, *E. moschatum*, *E. botrys*, *Geranium dissectum*, *G. lucidum*, *G. molle* and *G. pusillum*;

(iii) members of the genus *Malva* – *M. parviflora* and *M. pusilla*.

(iv) members of other families – for example, *Marrubium vulgare* (Lamiaceae) and *Carduus tenuiflorus* (Asteraceae).

In terms of the sociological affinities of the six components, Group (a) constitutes a variant of OV33 *Polygonum lapathifolium-Poa annua* community, the Group (b) assemblage fits into OV25 *Urtica dioica-Cirsium arvense* community, and Group (c) finds a place in OV28 *Agrostis stolonifera-Ranunculus repens* community (Rodwell 2000). Groups (e) and (f ) show the closest affinity to OV25 which is seen to contain four of the species in Table 3 (*Arctium minus*, *Geranium dissectum*, *G. molle* and *Malva neglecta*), plus *Amaranthus albus.* There are other less significant associations with three species. Specifically, these are OV5 *Digitaria ischaemum-Erodium cicutarium* community (with *Amaranthus retroflexus*, *Erodium cicutarium* and *Geranium molle*) and OV6 *Cerastium glomeratum-Fumaria muralis* ssp. *boraei* community (with *Erodium*

*moschatum*, *Medicago arabica* and *Medicago polymorpha*). However, the apparent restriction of these two communities to the Bagshot Beds in Surrey and the Scilly Isles and southwest Cornwall respectively, precludes any meaningful insight into sociological affinities. *Chenopodium murale* is recorded only once in OV30 *Bidens tripartita-Polygonum amphibium* community typical of the eutrophic margins of lowland ponds and clearly not closely akin to the waste dump habitat in its physiognomy. From the frequency records in Table 3, the waste dumps are clearly a major habitat for this archaeophyte which has a change index of -1·63 (Akeroyd 2002). It is one of a group of species with a relatively high negative change index that includes *Marrubium vulgare* (-2·02), *Melilotus indicus* (-1·59) and *Medicago polymorpha* (-1·34). Finally, it is interesting to note that of the seventeen species listed in Group f above, only the three *Melilotus* species, *Erodium botrys*, *Malva parviflora* and *M. pusilla* are given full records by Wilmore (2000). Nine of the remaining species are relegated to an appendix on account of their native status in parts of Britain other than Yorkshire, whilst three – *Geranium dissectum, G. molle* and *G. pusillum* – are not considered as aliens. These three species of Crane's-bill are clearly to be considered as wool aliens and probably symbolise the changing face of the woollen manufacturing industry in that most of the home scoured wool, and hence the waste, comes from UK sources.

## DISCUSSION AND CONCLUSIONS

From the foregoing information, it is quite clear that the nature of the UK woollen manufacturing industry has undergone major changes in the past thirty years, particularly, in a context relative to the changing flora of Britain, with respect to the change to the predominant use of imported, clean wool and the concomitant decline of British scouring companies. As a direct consequence, the quantities and sources of wool waste available to the agricultural industry have declined dramatically. Further, there is now a predominance of the use of the home clip from Britain and Ireland over imported wool in the few remaining scouring mills, and the shoddy manufacturers are legally bound under EC regulations to use only clean imported rags. All these features have contributed to a major decrease in the size and diversity of the wool alien seed bank entering the country. In addition, the relatively small quantity of wool waste available for use as fertiliser in agriculture has declined drastically and hence, so has its geographical use. Thus, at the start of the twenty-first century, the potential replenishment and continued existence of a wool alien flora is apparently restricted to two localised areas of West Yorkshire. The future prospects for this specialised section of the British flora would thus appear to depend on the continued operation of the two scouring mills and the use of wool waste in the rhubarb growing industry and as in-stall bedding for livestock. In an era of multiple subsidies for many aspects of the processing and production industries there may be a case to be made for the conservation of this traditional industrial and agricultural linkage as a strategy for halting future loss of biodiversity.

Perhaps a more practical and immediate contribution to an understanding of the future prospects of this section of the British flora would be the inception of a programme of research into the reproductive capacities of selected species as a contribution to the conservation of biodiversity in the face of changing climate. Four main groups/types would seem worthy of investigation. First, a comparative study of the various species of well represented genera, such as *Amaranthus, Erodium* and *Medicago*, should yield valuable data on their relative ability for establishment as stable neophytes. Second, the investigation of plants with high negative change index values, >1·0 (Preston, Pearman & Dines 2002), such as the native *Marrubium vulgare* (-2·02) and *Medicago polymorpha* (-1·34), the archaeophyte *Chenopodium murale* (-1·63) and the neophyte *Melilotus indicus* (-1·59) should provide insights into their conservation. Third, there would seem to be some merit in acquiring information on certain neophytes for which there is a lack of change index data, including *Malva parviflora* and *M. pusilla, Trifolium angustifolium* and *T. hirtum*. Finally, an investigation of the reproductive capacities of native species in this habitat, in comparison with their capacities in other more typical habitats, such as *Geranium lucidum, G. molle* and *G. pusillum* and *Trifolium arvense*, might form a fourth avenue of research. Apart from generating an important botanical and ecological data base, such research would also aid the definition of which species might be termed established 'wool aliens' and which considered as mere 'wool casuals'.

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