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Derelict industrial land as a habitat for rare plants in S. Lancs. (v.c. 59) and W. Lancs. (v.c. 60)

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ABSTRACT

The importance of derelict land in S. and W. Lancs. as refugia for regionally rare and local species is demonstrated with particular reference to colonies of marsh orchids (*Dactylorhiza* species and hybrids). The significance of the sites for research and nature conservation is discussed.

INTRODUCTION

During the last ten years or so a number of sites containing marsh orchids (*Dactylorhiza* species and hybrids) have been found in the Watsonian vice-counties of S. and W. Lancs. (now forming parts of the administrative counties of Cheshire, Greater Manchester, Lancashire and Merseyside) where earlier workers (Wheldon & Wilson 1907, Savidge *et al.*1963) reported them to be rare. Our studies of these sites have revealed that many of the orchid-rich habitats have been formed from derelict industrial land, being either grossly modified by man or entirely man-made.

In this study 35 sites containing large populations of marsh orchids were discovered. 22 of these are located in the more industrialized vice-county of S. Lancs, where only two sites, including one of a series of locations on the coastal sand-dunes, are in natural or semi-natural habitats.

Altogether 25 of the sites were found to be entirely man-made or grossly modified by man and it is the significance of these that is discussed.

THE HABITATS

In the semi-natural habitats the substrates were generally base-rich and damp, as in coastal dune-slacks. Inland habitats were frequently old meadows or commons where, usually through grazing, scrub and woodland development had been prevented.

The man-made habitats were always base-rich but not necessarily marshy or damp. They varied from old cultivated fields, reclaimed salt-marshes and disused railway cuttings to tipped industrial waste and abandoned clay pits. Table 1 lists 21 man-made sites and indicates the kind of site involved together with the date of abandonment. None of the sites existed 100 years ago and the earliest records for orchid colonization date from 1915 (Rainford Junction) and 1942 (Cop Lane, Penwortham), but most records are much more recent. It is probably worth noting, however, that at Rainford Junction and Cop Lane it took 57 and 60 years respectively before the sites were known to be colonized by marsh orchids, whereas in the more recently abandoned sites colonization has occurred much more quickly. At some sites, e.g. Marton railway cutting, colonies have been noticed less than ten years after the site had been abandoned.

TABLE 1. THE ORIGIN OF SOME INDUSTRIAL SITES

Site	Origin	Date of abandonment (where known)
v.c.59		
Banks Marsh, GR 34/38.23	Reclaimed salt-marsh after building of embankment	1895
Chat Moss, GR 33/69.97	Formerly raised bog, cut over for peat and dominated by *Molinia caerulea*. High lime content unexplained but possibly from agriculture	
Cop Lane, Penwortham, GR 34/52.27	Railway cutting started for sidings	1882
Darcy Lever, Bolton, GR 34/73.07	Leblanc process waste	1920s
Failsworth Golf Course, GR 34/88.01	Hollow adjacent to railway cutting	—
Hart Common, GR 34/63.05	Damp hollows between colliery spoil heaps	—
Haskayne railway cutting, GR 34/35.09	Railway cutting	1953/4
Hightown meadows, GR 34/30.03	Arable fields reclaimed from Link Sands, then used as hay-meadows	*c*1968
Ince Moss, GR 34/59.02	Colliery subsidence, colliery washery waste, boiler ash, lime waste and peat remnants	1960s
Kirkless Lane, Ince in Makerfield, GR 34/60.06	Blast-furnace slag and boiler ash	1930s
Lightshaw Hall Flood, GR 33/61.99	Colliery subsidence	—
Longton Brickworks, GR 34/48.25	Clay pit used for brickworks	1965
Nob End, Little Lever, GR 34/74.06	Leblanc process waste	*c*1900
Pollard Moor, Hapton, GR 34/79.31	Lime waste and gas-lime tip	*c*1935
Rainford Junction, GR 34/47.02	Triangle of land at railway junction	1858
Rixton clay pits, GR 33/68.90	Clay pits used for brickworks	1960s
Westwood Power Station, Wigan, GR 34/58.04	Power-station ash tipped into subsidence flash	*c*1963
v.c.60		
Broadwater, Fleetwood, GR 34/32.45	Waste land, formerly reclaimed salt-marsh	—
Heysham Flash, GR 34/40.59	Old sand-dunes enclosed by construction of Heysham Harbour and tipped boiler ash	1900s
Marton railway cutting, GR 34/33.33	Marsh orchids appeared on banks when management ceased on closure of railway	1967
Salwick Atomic Energy Works, GR 34/46.31	Alkali waste	1963/4

Of particular interest are the habitats associated with tipped waste material; Table 2 lists five principal types of waste that can be recognized. The raw, unweathered wastes from which the tip soils are derived were strongly alkaline and ranged from pH 8.5 (lime waste) to pH 12.7 (Leblanc process waste). Observations of exposed profiles of colonized Leblanc process waste (Table 3) revealed the development of rendzina soils. However, older and more weathered wastes were less base-rich due to leaching and carbonate formation from calcium hydroxide; this has allowed invasion by willow and hawthorn scrub to occur. At the same time, surface humification has encouraged the establishment of various species including legumes, particularly *Lotus corniculatus*, with a consequent enrichment of soil nitrogen leading to eventual formation of closed grassland communities. Such successional changes may, in time, destroy the floristic richness of the sites.

THE FLORA OF MAN-MADE SITES

The industrial habitats characterized by the marsh orchid populations contained a number of other species regarded as rare according to a recent systematic survey of W. Lancs. (Table 4). In this survey. rare species were defined as those occurring in 10 (2·6%) or fewer tetrads (2 × 2km squares of the National Grid). A similar list of rare species can be prepared for S. Lancs. using *Travis's Flora of South Lancashire* (Savidge *et al.*, 1963), but *Carex pseudocyperus* and *Glyceria maxima* are more common there whilst *Eleocharis uniglumis*, widespread in W. Lancs. coastal habitats, is rare. Also *Dactylorhiza incarnata* and *Blackstonia perfoliata* are widespread on the S. Lancs. coastal sand-dunes but inland they are rare. None of the species is nationally rare (Richards 1972), although a number are either only found occasionally or are at the limits of their distribution in Britain (Perring & Walters 1962).

TABLE 2. THE PRINCIPAL TYPES OF WASTE WHICH PROVIDE HABITATS FOR ORCHID POPULATIONS

Type of waste	Contribution to soil reaction	Type of flora
Leblanc process	$CaCO_3$, $Ca(OH)_2$, hydrolysis products of CaS	Open, herb-rich, calcicolous associations. *Festuca rubra* dominant. Invasion by *Crataegus* and *Salix* scrub
Lime waste and gas lime	$CaCO_3$, hydrolysis of CaS	Open, herb-rich, calcicolous associations. *Festuca rubra* dominant. Invasion by *Salix* scrub
Power station ash	Hydrolysis of calcium silicate minerals	Calcicolous vegetation under *Salix* scrub. Herb-rich in clearings
Blast furnace slag and boiler ash	$CaCO_3$, $Ca(OH)_2$ and hydrolysis of basic silicates	Very open, herb-rich, calcicolous associations. Marsh vegetation on boiler ash in damp hollows
Colliery washery waste and slurry	Carbonate minerals	Open herb-rich associations. Invasion by *Salix* scrub

TABLE 3. SOIL PROFILE OF HABITAT ON LEBLANC PROCESS WASTE AFTER 60–80 YEARS EXPOSURE AND COLONIZATION

Depth (cm)	pH	Profile description
0–5	7·7	Black, surface humus
5–15	7·7	Dark, partially humified waste
15–25	7·8	Yellowish-brown waste stained with deposited ferric salts
25–35	8·0	
35–45	9·4	Yellowish, partially weathered waste. Ferric salts present
45–55	9·7	
55–65	12·2	White, unweathered waste, calcium hydroxide present
65–75	12·1	

TABLE 4. RARE W. LANCS. SPECIES FOUND IN MAN-MADE SITES IN S. AND W. LANCS.

Apium inundatum
Blackstonia perfoliata
Carex pseudocyperus
C. riparia
Dactylorhiza incarnata subspp. *coccinea* and *incarnata*
D. praetermissa
D. purpurella
Echium vulgare
Epipactis palustris
Glyceria maxima
Gymnadenia conopsea
Ophrys apifera
Orchis morio
Orobanche minor
Osmunda regalis
Pyrola rotundifolia subsp. *maritima*
Ranunculus trichophyllus

There is evidence, therefore, that man-made sites are providing additional habitats for regionally rare or localised species, especially in urbanized areas. This is particularly true for the two species *Dactylorhiza purpurella* and *D. praetermissa,* which are near the southern and northern limits respectively of their ranges of distribution in Britain. Further, the occurrence of presumed hybrid swarms between these and other orchid species suggests that the presence of these sites may contribute

to the breakdown of isolating mechanisms between species by providing new habitats. So far the following hybrids are thought to have been found: *D. fuchsii* × *D. purpurella, D fuchsii* × *D. praetermissa, D. fuchsii* × *D. incarnata, D. incarnata* × *D. praetermissa, D. incarnata* × *D. purpurella* and *D. fuchsii* × *Gymnadenia conopsea.* Much less certain is the occurrence of *D. praetermissa* × *D. purpurella.*

TABLE 5. SPECIES CHARACTERISTIC OF ORCHID-RICH INDUSTRIAL HABITATS IN S. AND W. LANCS. (PRESENT IN > 70% OF SITES)

Angelica sylvestris	*Juncus inflexus*
Arrhenatherum elatius	*Lotus corniculatus*
Carex nigra	*Plantago lanceolata*
Centaurea nigra	*Ranunculus acris*
Cerastium fontanum	*Rumex acetosa*
Cirsium arvense	*Salix cinerea*
Dactylis glomerata	*Senecio jacobaea*
Epilobium angustifolium	*Taraxacum officinale*
Equisetum arvense	*Trifolium pratense*
Festuca rubra	*T. repens*
Heracleum sphondylium	*Vicia cracca*
Holcus lanatus	
Hypochoeris radicata	

Floristic lists, compiled for most of the sites mentioned in Table 1, have revealed several species with a high degree of constancy (Table 5). Of the grasses, *Festuca rubra* and *Dactylis glomerata* occurred in over 75% of the sites and were often the dominant or most frequent grasses, as illustrated by the three alkaline waste sites for which species lists are given in Table 6. The most constant and abundant dicotyledons were *Centaurea nigra* and *Tussilago farfara,* followed by *Angelica sylvestris, Lotus corniculatus* and *Plantago lanceolata* (Tables 5 and 6).

Most of the species found in the man-made sites are common and widespread ruderals which have colonized the sites from nearby habitats. Surprisingly, there were few aliens, although the continued presence of *Sisyrinchium bermudiana* at Little Lever is noteworthy in view of its rarity at inland locations.

In S. Lancs. there are few natural or semi-natural habitats away from the Irish Sea coast and these are mostly relict raised bogs. These acid 'mosses' covered much of the area and, although most of the man-made sites containing marsh orchids are base-rich, acid conditions were found at a few of the sites allowing calcifuge species such as *Calluna vulgaris, Carex curta, Eriophorum angustifolium* and *Molinia caerulea* to occur. Of more significance was the occurrence of *Empetrum nigrum* at Hart Common and *Osmunda regalis* and *Potamogeton polygonifolius* at Haskayne. At both sites, natural or semi-natural habitats have disappeared from the vicinity.

Surprisingly, a number of the plants found at the inland, man-made sites are more characteristic of coastal habitats in north-western England (Table 7). Of the species listed (Table 7), 12 are rare in S. and W. Lancs. and of these *Pyrola rotundifolia* subsp. *maritima* is especially noteworthy. This subspecies was formerly confined in Britain to the coasts of Lancashire and Norfolk but during this century, and particularly since about 1950, it has been extending its range along west coast sand-dune systems (Kay *et al.* 1974). The site at Haskayne is, however, only the second inland record for this subspecies. In Cheshire, Lee (1975, 1977) has similarly reported a number of coastal species from inland saline and alkali waste sites.

SIGNIFICANCE OF THE SITES

Kelcey (1975) has presented evidence that industrial development in Britain has contributed much to the continued existence of certain rare and unusual species as well as preventing some common species from becoming rare. It is difficult, however, as Davis (1976) has pointed out, to compare the overall gains and losses through industrial development, although our observations support Kelcey's

TABLE 6. DESCRIPTION OF FLORA COLONIZING LIME WASTE HEAPS AT THREE SITES IN S. AND W. LANCS.

Species	Abundance (Domin scale)		
	Nob End, Little Lever	Darcy Lever	Pollard Moor
Festuca rubra	4–6	6–7	5–6
Centaurea nigra	4–6	3	x–1
Dactylis glomerata	4–5	4	2–3
Tussilago farfara	3–5	4	4–5
Linum catharticum	3–4	3–4	3–4
Lotus corniculatus	3–4	1	1
Agrostis tenuis	2–4	1–2	1
Festuca ovina	2–4	3–4	2–3
Succisa pratensis	2–4	x–1	
Sisyrinchium bermudiana	3		
Angelica sylvestris	2–3	x–1	1
Centaurium erythraea	2–3	2–3	
Crataegus monogyna	2–3	2–3	x–1
Dactylorhiza incarnata	2–3	1	3
Deschampsia cespitosa	2–3	1	x
D. flexuosa	2–3		
Erigeron acer	2–3	1–2	
Euphrasia nemorosa	2–3	3	3
Gymnadenia conopsea	2–3	x	
Pilosella officinarum	2–3	1	3–4
Plantago lanceolata	2–3	2	1
Potentilla erecta	2–3	x–1	2
Trifolium pratense	2–3	1	x
T. medium	2–3		
Aster novi-belgii	1–3	x	x
Carlina vulgaris	2		
Dactylorhiza purpurella	2		
Hieracium vulgatum	2	2–3	2
Leontodon hispidus	2	x	2
Luzula multiflora	2	1	1
Vicia cracca	2	x–1	
Achillea millefolium	1–2	x	x
A. ptarmica	1–2		x
Agrostis stolonifera	1–2	3	2–4
Arrhenatherum elatius	1–2	1–2	1
Bellis perennis	1–2	2	x
Cirsium arvense	1–2	2–3	2–3
Dactylorhiza fuchsii	1–2	x	3
Heracleum sphondylium	1–2	x–1	2–3
Juncus inflexus	1–2		
Senecio jacobaea	1–2	1–2	1–2
Agrostis gigantea	x–2		
Arabis hirsuta	1		
Carex flacca	1		2
Epilobium angustifolium	1	1	2–3
Hieracium umbellatum	1	1–2	1
Holcus lanatus	1	x	x
Juncus effusus	1		
Orobanche minor	1		
Ranunculus acris	1		
Solidago canadensis	1		
Sonchus oleraceus	1		

TABLE 6—*continued.*

Species	Abundance (Domin scale)		
	Nob End, Little Lever	Darcy Lever	Pollard Moor
Taraxacum officinale	1	3	3–4
Tragopogon pratensis	1		1–2
Trifolium repens	1	2	1
Vicia sepium	1		
Cerastium fontanum	x–1	1–2	x
Hieracium glandulosum	x–1		
H. maculatum	x–1		
Hypochoeris radicata	x–1	x	2–3
Lathyrus pratensis	x–1		
Plantago major	x–1		
Poa pratensis	x–1		
Rumex acetosella	x–1		
Rubus fruticosus	x–1	1–2	x
Acer pseudoplatanus	x	1–2	
Carex hirta	x		
C. nigra	x	x	
C. ovalis	x		
Cirsium palustre	x		
C. vulgare	x	x–1	1–2
Equisetum arvense	x	x	1
Festuca arundinacea	x		
F. tenuifolia	x		
Hieracium vagum	x		
Juncus bufonius	x		
Lolium perenne	x		
Molinia caerulea	x		
Nardus stricta	x		
Orchis morio	x		
Potentilla anglica	x		
Rumex acetosa	x		
R. crispus	x		
R. obtusifolius	x		
Sagina procumbens	x		
Salix caprea	x		
S. repens	x	x–1	2
Solidago gigantea	x		
Betula pendula			x
Calystegia sepium		1	
Chrysanthemum leucanthemum			1
Eupatorium cannabinum		x	x
Leontodon autumnalis		x	2
L. taraxacoides			x
Potentilla reptans			2
Prunella vulgaris		1	2–3
Salix cinerea		x	x
Sambucus nigra		x	x
Solanum dulcamara		x	x
Sorbus aucuparia		x	
Triglochin palustris			x

conclusions. We consider that all the sites mentioned in Table 1 are of botanical interest because of their floristic diversity and significance as refugia for regionally rare and localized species. As such they have been included in a list of 252 sites of scientific interest prepared by the Lancashire Naturalists' Trust. Man-made sites account for only 16% of these sites in rural W. Lancs. but for 41% of the sites in the more urban S. Lancs., where the more natural sites are largely coastal or rural.

TABLE 7. SPECIES WITH A PREDOMINANTLY COASTAL DISTRIBUTION IN S. AND W. LANCS. BUT FOUND ON INLAND MAN-MADE SITES

Species	Characteristic coastal habitat
Anthyllis vulneraria	Fixed sand-dune
Apium inundatum	Wet dune-slack
Blackstonia perfoliata	Fixed sand-dune
Carex arenaria	Mobile sand-dune
Dactylorhiza incarnata subspp. *incarnata* and *coccinea*	Damp dune-slack
D. praetermissa	Damp dune-slack
Echium vulgare	Fixed sand-dune
Eleocharis uniglumis	Brackish marsh
Epipactis palustris	Damp dune-slack
Gymnadenia conopsea	Fixed sand-dune
Juncus gerardii	Salt-marsh
Oenothera spp.	Mobile sand-dune
Ophrys apifera	Damp dune-slack
Orobanche minor	Fixed sand-dune
Pyrola rotundifolia subsp. *maritima*	Damp dune-slack and fixed sand-dune
Ranunculus trichophyllus	Wet dune-slack
Salix repens subsp. *argentea*	Damp dune-slack
Schoenoplectus tabernaemontani	Brackish marsh

The sites also provide valuable opportunities for research, including studies of the origin and development of populations of *Dactylorhiza* and other species, problems of habitat management, possibilities of deliberate habitat creation and the planning of industrial activities to achieve natural resource benefits.

We conclude from our studies of industrial waste sites and disturbed areas in S. and W. Lancs. that certain types of industrial development and waste disposal provide exciting possibilities for the deliberate creation of habitats of high wildlife interest. To achieve this, new industrial sites, particularly those involving extractive and waste disposal operations, should be carefully planned with a view to habitat development and future natural history interest upon their eventual closure. How to achieve this with different industrial processes, particularly modern ones, opens up a whole new field of research into the use of landscape modelling techniques, placement of materials both during and after industrial operations, different soil fertilizer treatments and soil moisture or drainage control as methods of providing specific habitat types or a variety of conditions for colonization. Such sites provide opportunities for the documented introduction (with the prior approval of the Nature Conservancy Council) of indigenous plant taxa including ones which are isolated geographically from native populations and which do not have effective long-range dispersal mechanisms.

We believe that suggestions of this kind should be given greater attention if the conflicts between industrial development and nature conservation are to be minimized.

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