

Aerobiological studies based in Derby

III. A comparison of simultaneous pollen and spore counts from the east coast, Midlands and west coast of England and Wales

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Summary

The air spora of two sites on the east coast of Britain and one on the west coast were compared with each other and with the regular sampling site in Derby by the simultaneous operation of volumetric spore traps. Concentrations of airborne spores and pollen were found to be usually less at the coastal sites than in Derby. The effect of wind direction was shown to be important at coastal sites because daily counts often showed rises and falls corresponding to off- and on-shore winds respectively. Counts at the west coast site were nearly always lower than those on the east. These findings, together with the prevalence of westerly winds over Britain and the different land use in the east and west, suggest that fewer airborne allergens may be encountered on the west coast.

Introduction

In 1969 we investigated the air spora around Derby up to 60 km away (Brown & Jackson, 1978b), the area where most of the patients attending the Derby Chest and Allergy Clinic live. In 1970 it was decided to operate spore traps at sites on the east and west coasts of England and Wales respectively, in areas frequently visited by our patients on holiday, in order to compare the air spora of these areas with Derby. This project was suggested by the observation that many of our patients find their symptoms worse when near the east coast of England, particularly in Lincolnshire and Norfolk. Previous aerobiological surveys of the coast of Great Britain (Hyde, 1950, 1952, 1959; Gregory & Sreeramulu, 1958; Harvey & Mullins, 1975) have not included the east coast of England, so this survey seemed desirable in view of the clinical observations.

Skegness is a popular seaside resort, and this area seemed a suitable one in which to run a spore trap, as did the Norfolk coast and north Wales, where many patients also take their holidays. It was considered that lighthouses would make suitable sites as

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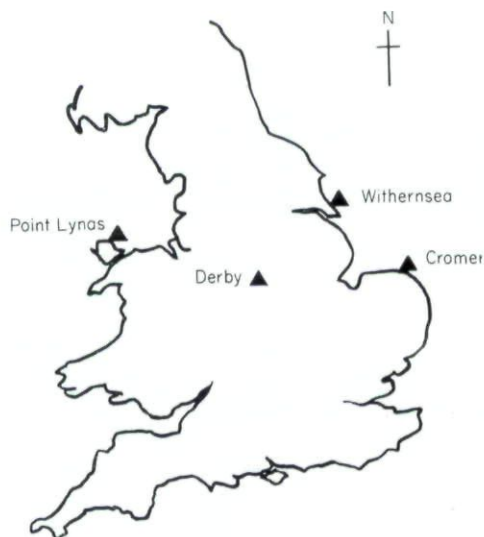


Fig. 1. Map of England and Wales showing location of spore traps in 1970. (▲) Spore sampling sites.

they are manned continuously and, being generally in exposed positions, away from other buildings, should receive relatively undisturbed airstreams, with representative spore content. The sites chosen were at lighthouses at Withernsea just north of the Humber estuary, Cromer on the Norfolk coast, and Point Lynas, near Amlwch on the coast of Anglesey, an island just off north Wales (Fig. 1).

Materials and methods

The four spore traps used in this investigation were identical, being our own modification of the Hirst automatic volumetric spore trap (Hirst, 1952), operated with a daily slide. The techniques have already been described by Brown & Jackson (1978a). Weather information, including wind direction, was recorded daily by the lighthouse keepers.

Sampling sites

Cromer ($52^{\circ} 55' N$, $1^{\circ} 18' E$). A lighthouse a few m from the sea, on a low cliff about 20 m high, surrounded by golf course and scrub. The trap was on the lighthouse balcony, a total of 40 m above sea level. The surrounding area was farmland, mostly arable.

Withernsea ($53^{\circ} 44' N$, $00^{\circ} 02' E$). A lighthouse about 40 m from the shore, in the main street of the town. The trap on the lighthouse balcony was 40 m above sea level. The surrounding area was mostly arable farmland.

Point Lynas ($53^{\circ} 25' N$, $4^{\circ} 17' W$). A lighthouse on a cliff edge 40 m above sea level, the trap being a further 10 m above the ground. Rough grassland immediately surrounded the lighthouse, with fairly poor grassland close by. Further south was an area of arable farmland.

Derby ($52^{\circ} 54' N$, $1^{\circ} 29' W$). The trap was on the roof of the Derby Chest and Allergy Clinic on a slight hill in the centre of Derby 10 m above the ground and 60 m above sea level. Arable farmland and grassland surrounds the town at a distance of

approximately 5.0 km. An area of waste grassland and farmland extends from about 2.0 km from the trapping site.

Results

Daily average concentrations per m^3 over the sampling period (June to early October) for each station are shown in Figs 3 to 5. Wind direction at the coastal sites has been expressed on the histograms in terms of on- or off-shore wind.

There were marked differences in the air spora between stations, as expected, the lowest counts being generally found at Point Lynas. In Derby, counts of most spores were usually higher than at the coastal sites, although on the coast concentrations often rose sharply but temporarily to figures well above those in Derby. These rises and falls correlated fairly well with wind direction, wind from the land being associated with high counts during the peak period of a particular spore, while a wind from the sea generally brought low numbers. The effect of wind direction at the coastal sites on grass pollen and *Ustilago* counts is illustrated in Fig. 2.

The average daily counts at the coastal stations over the sampling period, for the pollen and spore types making up the bulk of the air spora, are expressed in Table 1 as

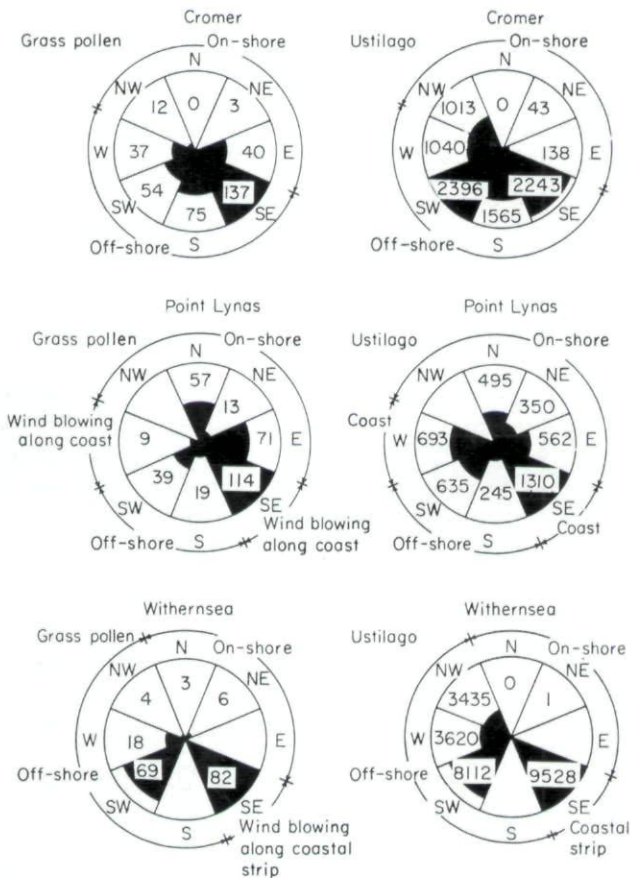


Fig. 2. Daily counts of grass pollen and *Ustilago* at the coastal stations over the peak season (June 10 to July 14) averaged for each wind direction.

Table 1. Average daily figures over the sampling period for the major pollen and spore types expressed as a percentage of the Derby figure (taking this as 100%)

Aeroallergen	Station (percentage of Derby figure)		
	Cromer	Withernsea	Point Lynas
Pollen type			
Grass	44	54	36
Nettle	77	13	23
Spore type			
Alternaria	136	144	29
Aspergillaceae	236	98	126
Epicoccum	85	64	47
Cladosporium	102	86	26
Sporobolomyces	111	86	32
Tilletiopsis	43	91	17
Erysiphe	62	74	13
Leptosphaeria	100	114	74
Puccinia sp. uredospore	150	89	29
Ustilago	93	343	33
Coloured basidiospores	65	30	65
'Hyaline indeterminate'	31	27	89
All spores counted	107	89	36

a percentage of the equivalent Derby figure. Further histograms showing daily counts are obtainable from the authors.

Pollen

Grass pollen amounts (Fig. 3) were lower at all three coastal stations. The peak season for grass was similar at all stations but a gap in the record for Cromer obscures this slightly. The late onset of the pollen season at Cromer and Withernsea is explained by on-shore winds up to June 20. Amounts of nettle pollen were also lower at the coastal sites, particularly at Withernsea and Point Lynas. Numbers were generally highest in August, but little correlation between stations is evident.

Fungal spores

At all stations, *Cladosporium* and *Sporobolomyces* made up the bulk of the air spora, the proportions of the total spores counted over the season averaging 35% and 27% respectively. Average numbers of all spores were almost invariably lower at Point Lynas than at the other sites.

Cladosporium

Two of the three periods of high counts of this spore in Derby were reflected at all three coastal stations (Fig. 4). Numbers were fairly high at Cromer and low at Point Lynas.

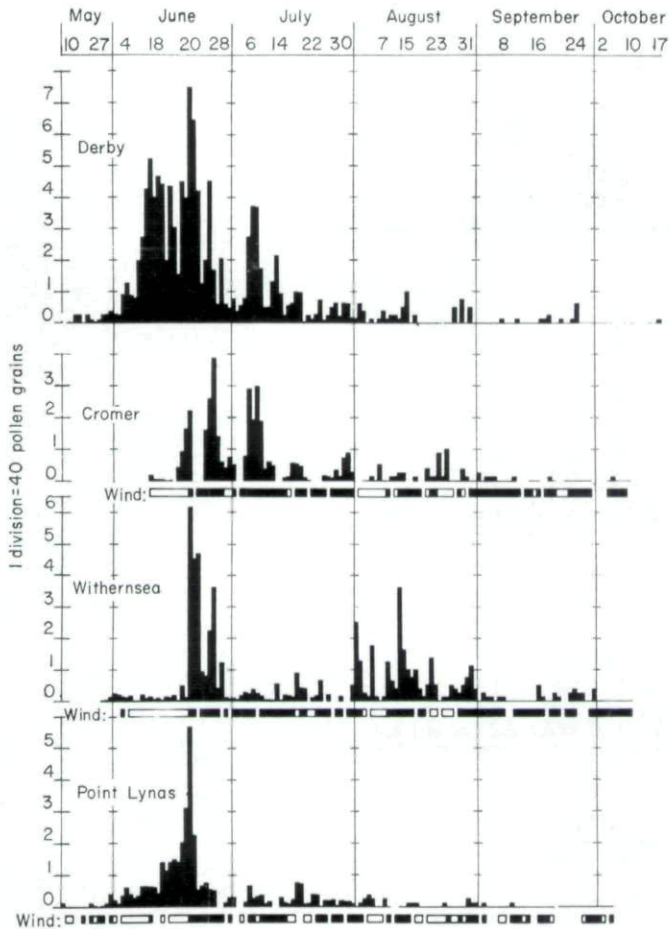


Fig. 3. Daily grass pollen counts (average concentration per m^3) from the four sampling sites. (■) Wind from land; (□) wind from sea.

Sporobolomyces

The peak season generally occurred earlier at the east coast sites, a period of low counts in early August, when *Sporobolomyces* numbers in Derby were high, probably being due to onshore winds (Fig. 5). At Cromer a maximum 24 hr mean concentration of 64,000 per m^3 was reached on July 25 compared with the Derby peak on August 7 of 34,000 per m^3 .

Tilletiopsis

High counts occurred in Derby and Withernsea during the first half of August. Numbers were mostly low at Cromer and Point Lynas but moderately high figures were recorded at all stations during July and September. Increased numbers at the coastal stations tended to coincide with off-shore winds. Very high concentrations were recorded in Derby on August 14 and at Withernsea on August 1 and 11.

Alternaria

Numbers of this spore were higher at the east coast sites and much lower at Point

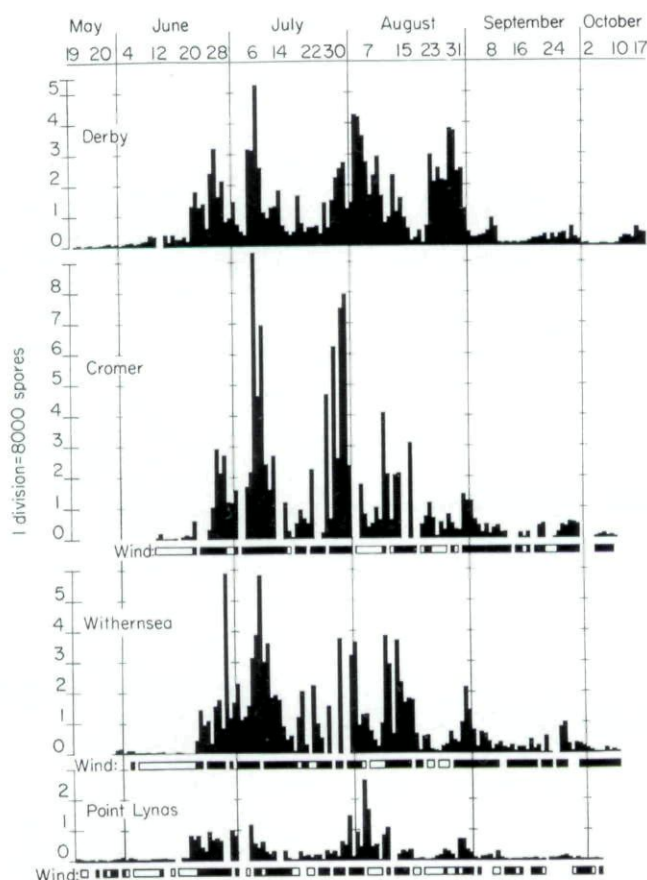


Fig. 4. Daily counts per m^3 of *Cladosporium* from the four sampling sites. (■) Wind from land; (□) wind from sea.

Lynas. Highest counts generally occurred in August, peaks in mid- and late August occurring at all stations with an additional peak at the end of July (Cromer) or beginning of August (Derby, Withernsea and Point Lynas). Low counts again tended to correlate with onshore winds.

Leptosphaeria

Total counts over the season were similar at all sites. Highest counts occurred in August and September, peak concentrations being recorded on the same day (August 14) at Derby and Withernsea (there was no record from Cromer for this day). High counts also occurred at all stations at the beginning of September and on September 8.

Ustilago

The start of the peak season at the coastal sites in mid-June corresponded with a change in wind direction from onshore to off-shore; this was particularly noticeable on the east coast (Fig. 2) and was a few days later than the Derby season. At all sites the season had ended by mid-July, although small increases in counts occurred during August. Figures for *Ustilago* were very high at Withernsea, reaching a maximum 24 hr

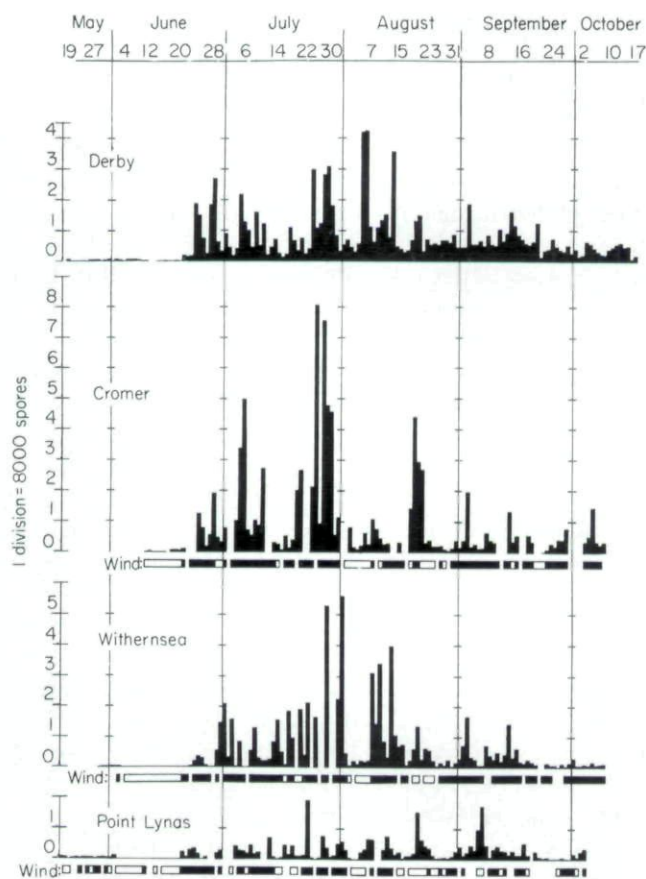


Fig. 5. Daily counts per m^3 of *Sporobolomyces* from the four sampling sites. (■) Wind from land; (□) wind from sea.

mean concentration of 31,790 per m^3 on June 23 as compared with 6600 per m^3 for Derby.

Coloured basidiospores

Numbers of coloured basidiospores (hyaline basidiospores were not counted as such in this survey) were lower at all coastal sites, but a similarity in general seasonal pattern is evident at all stations. Three peak periods occurred: late July to early August, late August to early September and late September.

Discussion

Since the prevailing wind in this country is from the western quarter, it follows that the east coast will experience more periods of wind coming over land than will the west. Different land use in the east of England, which is intensively agricultural, with an emphasis on cereal-growing, in contrast with north Wales, which is chiefly moorland and rough grassland, should result in a more pollen- and spore-rich atmosphere on the east side of Britain.

Counts in Derby are relatively high in most cases; sources lie on all sides of the

town for considerable distances, and pollen and spores will be carried by wind coming from any direction.

Pollen

The lower numbers of grass pollen found in this survey at the coastal sites, and the effect of wind direction, are generally in accordance with the findings of Hyde (1950, 1952) who, in his investigations of pollen incidence in Great Britain using the 'gravity' slide technique, observed very low concentrations of pollens at Skomer, an island off the Welsh coast, and at Bishop Rock, Isles of Scilly. He noted that on-shore winds greatly reduced the pollen catch, at least at Aberystwyth. The decrease in amount of pollen as a result of on-shore winds, and consequent greater relief for hay fever sufferers on the coast, was noted over 100 years ago by Blackley (1873). In this pioneering work he recommended the west coast on account of the prevailing wind direction.

Fungal spores

Wind direction in our survey is obviously an important factor determining the numbers of *Ustilago* obtained at the coastal stations. In Derby, sources of this spore surround the town, and wind direction does not appear to be of importance, whereas Davies (1969) recorded highest concentrations of *Ustilago* in central London when the wind was blowing from East Anglia, an important cereal growing region.

Cladosporium and *Sporobolomyces* numbers were similar at Derby and the east coast sites. Numbers of *Sporobolomyces* occasionally rose to much higher levels, possibly an effect of the coastal position with consequent high humidity (Gregory & Sreeramulu, 1958). Harvey & Mullins (1975) found *Sporobolomyces* concentrations at an estuarine site near Cardiff to be barely more than those in the city centre. In contrast to the findings of Gregory & Sreeramulu (1958), we found numbers of those spores characteristic of agricultural areas, such as *Ustilago*, *Erysiphe* and *Alternaria*, were not always much lower on the coast, but the sites were very different from the estuary studied by them. *Alternaria* numbers were higher on the east coast than in Derby, probably due to the closeness of arable land; *Ustilago* occurred in much higher numbers at Withernsea than at any other site, possibly due to a local infection. In contrast, *Puccinia* sp. uredospores were present in larger numbers at Cromer. Numbers of *Erysiphe* conidia, however, were low at all coastal sites. In each case, at Point Lynas numbers were low. The only spore types to occur in higher or equal numbers at the west coast site than the east were coloured basidiospores and the 'hyaline indeterminate' category, subsequently found (U. Allitt, personal communication) to consist mostly of basidiospores and ascospores, thus bearing out the conclusion of Hyde (1972) that basidiospores and ascospores are more prevalent in the air of the more humid west than in the east of Britain.

In many cases the seasonal pattern was similar at all stations. This applied to *Cladosporium*, *Sporobolomyces*, *Alternaria*, *Leptosphaeria* and coloured basidiospores; therefore counts of these spores taken at Derby over a season would broadly represent the picture across the country.

Since nearly all the spore types discussed here have been shown to be allergenic to some degree, it would seem that fewer airborne allergens may be encountered on the west coast of Britain, or at least in north Wales and the adjacent coastal areas of England, so that seasonal allergic patients might be more symptom-free in these areas.

This point has been discussed by Davies (1969) and is borne out to some extent by figures quoted by him showing a lower percentage of prescriptions for allergic complaints in Wales and the north and west than from the south and east and Midlands of England.

The results obtained by us do not explain entirely the severe symptoms often experienced by asthmatic patients on reaching the east coast area. It is possible that their symptoms were triggered by passing through considerable areas of arable farmland with high concentrations of spores on the journey to the coast. Alternatively, symptoms may be triggered by very high concentrations on certain days, particularly of *Cladosporium*, *Alternaria* and *Sporobolomyces*; also perhaps *Ustilago* in the Withernsea area. By contrast, Point Lynas rarely experienced higher counts of any spore, apart from the 'hyaline indeterminate' category, than are found in Derby.

Our findings accord with those of other investigators in that lower pollen and spore counts are found on the coast, concentrations being drastically reduced by on-shore winds; but the marked increase in symptoms experienced in the vicinity of the east coast and general absence of exacerbations on the west coast is only partially explained. A certain degree of correlation between counts of some spores has been shown across the country.

Acknowledgments

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