Downholland Moss

[SD 323 083]

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Introduction

In south-west Lancashire the area with the most complete record of sea-level changes from 8000 to 4000 years ago is Downholland Moss. Its lithostratigraphy, biostratigraphy and chronostratigraphy have been examined in detail (Tooley, 1978a, b, 1980, 1985; Huddart, 1992) and have provided data for the construction of sea-level curves for constraining geophysical models of isostatic uplift (Lambeck, 1991), for the vegetational history of coastal lowlands during the Flandrian and for the impact of prehistoric folk on the coastal environment. It was the key area for the application, development and testing of the concepts of transgressive and regressive overlap tendencies (Shennan *et ed.,* 1983).

The following palaeoenvironments are represented in the Downholland Moss sediments.

1. Tidal flat and lagoonal: represented by alternating organic and inorganic sediments of marine, brackish-water, freshwater and terrestrial origin, where the morphology includes old tidal creeks or roddons (as defined by Godwin (1938) and discussed by Huddart (1992); see (Figure 8.98) and sandbanks.
2. Perimarine: represented by alternating organic and inorganic sediments of freshwater and terrestrial origin.
3. Sand dune: represented along the western margin of the moss by surface sheets of sand and by sand layers interfingering the limnic and terrestrial organic deposits and along parts of the eastern margin by a morphology of low dune ridges.

Raised bog peats also exist but have been much degraded as a result of drainage schemes following extensive flooding in 1954 and 1956, but they persist under coverts and where they have been overblown by sand along the western margin of the moss.

Downholland Moss has attracted attention since burning oil slicks on the water of the dykes were reported in the late 18th century by Aikin (1795). Binney and Talbot (1843) were the first to discuss the stratigraphy of the moss, describing three marine clays intercalated with peats. Few significant records exist until 1939, when the stratigraphy of the unconsolidated sediments was described during a programme of oil prospecting (Cope, 1939; Wray and Cope, 1948) and a few pollen and diatom counts were undertaken by Blackburn (1939). Hall (1956) completed a survey of the coastal mosslands in 1955 and put down eight borings to a maximum depth of 3 m along a transect across Downholland Moss, which proved three inorganic horizons intercalated with peat (see also Hall and Folland, 1967). Further stratigraphical, pollen and diatom (Tooley, 1974, 1978a, b, 1985), plant macrofossils (A. GreatRex, pers. comm., 1985) and foraminiferal investigations (Huddart, 1992) have been completed.

Description

Beneath Downholland Moss the sub-drift surface on Triassic sandstones varies in altitude from +6.0 to -26.8 m OD. Till thicknesses vary from 2 to 30 m and the surface of this till has been eroded to form a funnel-shaped valley, opening and deepening westwards (Howell, 1973). At the eastern end of the moss the surface of the till lies at -1.7 m OD and at the western end at -14 m OD. This till is overlain by Late-glacial coversand, known as the 'Shirdley Hill Sand Formation' (Wilson *et al.,* 1981), which was reworked during the Flandrian by both wind and water (Tooley, 1978a, 1985), including nearshore marine waters (Huddart, 1992). The Shirdley Hill Sand is overlain discontinuously by a basal peat and successively by marine sands, silts and clays, with interruptions of peat. Along the western margin of the moss the peat has been covered by blown sand and ombrogenous peats have survived.

The complexity of the stratigraphy on the moss is revealed in the transects ((Figure 8.99) and (Figure 8.100)) and sections from New Cut (Figure 8.101), which divides Downholland and Altcar Mosses. At five sites on the moss, described in subsequent sections, all the palaeoenvironments are encountered.

1. Site DM-11 (Figure 8.99); [SD 3365 0819]). This site is west of the Hillhouse Coastline mapped by Gresswell (1953) and east of the limit of Grey Clay of marine origin mapped by De Rance (1869b). In 1968 the ground altitude was +2.7 m OD and there was about 4.5 m of unconsolidated sediment. The basal sediment was a coarse white sand (Shirdley Hill Sand) with granule gravel and farther to the east this sand has a morphology of low dunes. The sand gives way to a unit of organic, black sand 40 cm thick, with *Phragmites* rhizomes and *Alnus* wood, where the pollen assemblage is dominated by *Pinus* and *Betula.* This bed is overlain in turn by a *Phragmites*-rich clay 50 cm thick and a 75 cm bed of *Phragmites* peat, with rare alder wood. The frequencies of Chenopodiaceae, *Artemisia* and *Armeria* pollen bear witness to marine and brackish water conditions at the site from –0.8 to –0.3 m OD. Above this there are alternating beds of freshwater peats with *Menyanthes* seeds and the pollen of *Nymphaea, Potamogeton, Hydrocotyle, Cladium mariscus* and *Typha angustifolia* and humified, woody, detrital peat layers. Two radiocarbon assays from an adjacent site provide an age of between 6980 and 6760 years BP for the deposition of the *Phragmites*-rich, marine clay. These ages are corroborated by the pollen diagram ((Figure 8.102).

2. Site DM-15 ((Figure 8.98) and (Figure 8.99); [SD 3202 0838]). This site lies close to the centre of the moss, where the thickness of unconsolidated sediments above the till has been proved to be about 20 m (Wray and Cope, 1948). At this site a shallow core was taken to 271 cm as the silts below proved to be impenetrable with the equipment available. However, the pollen, diatom and foraminiferal diagram (Figure 8.103) and (Figure 8.104) reveals a considerable diversity of palaeoenvironments over a short time period, established by a series of radiocarbon dates from 6750 to 6050 years BP. In 1968 the ground altitude was +2.4 m OD, which is 1.7 m below the present Mean High Water Mark at Formby. The basal sediments are silts, with sandy laminations, passing up to a *limus,* with *Phragmites* rhizomes and overlain by a laminated silt and a second *limus* layer dated from 5565 to 6050 years BP. This in turn is overlain by a laminated clay and a *limus* with *Phragmites* rhizomes.

3. Site DM-16 (Figure 8.98) and (Figure 8.99); [SD 3238 0839]). The importance of this site lies in the fact that it was the last area of uncut peat on the moss and hence the ground surface was 1.1 m higher than the surrounding farmland. It also was possible to penetrate the silts and sands and reach the basal peat, which overlies in turn the Shirdley Hill Sand Formation and till some 13 m from the surface. There were six organic layers interrupting the deposition of marine sands, silts and clays laid down between 7960 and 5615 years BP The five dates from this site contribute to the transgressive and regressive overlap tendencies sequence for north-west England and have been used as sea-level index points on the sea-level age–altitude graph for northwest England (Tooley, 1978a, 1982). The detailed stratigraphy is given and discussed in Middleton *et al.* (2001).

4. New Cut and The Rib between Moss Bridge and Moss Heath. Stratigraphical and micro-palaeontological details from drainage, excavation and construction work in this area on the boundary with Altcar Moss (Figure 8.98) have added to Tooley's earlier work. This area is known from 19th century tithe award apportionments as 'Segar's Moss' and had been reclaimed in the 1750s by Edward Segar of Barton Hall (Harrop, 1985). The stratigraphy and location of foraminiferal samples are shown in (Figure 8.98), (Figure 8.101) and (Figure 8.104). The pale buff sand exposed at the eastern end of the New Cut by the pumping station overlies a red till near the junction of The Rib and New Cut. This bleached fine sand, occasionally stained with organic material, rises in elevation along The Rib, although the upper surface is irregular, towards Moss Heath where it passes under 3 m of peat. At its maximum thickness the sand is 1.3 m, it coarsens downwards and shows parallel lamination and granule gravel lines (Huddart, 1992). In the New Cut, to the east of The Rib the upper surface shows a pararendzina soil 19 cm thick. In sections 8 and 9 (Figure 8.105) this soil is succeeded by parallel-laminated, grey silt, with *Cerastoderma edule, Scrobicularia plana* and *Hydrobia ulvae* in life positions. At 8A the Foraminifera are dominated by *Protelphidium germanicum* and the *Elphidium* group, with a wide range of species (Huddart, 1992). Just below the contact with the overlying peat the Foraminifera in 8B are dominated by *Trochammina inflataiadaminna macrescens* and *Protelephidium germanicum.* Above is 75 cm of peat, which infills hollows in the top of the grey silt. Its upper surface is very irregular because 'flames' of peat rise into the overlying grey silty clay, which slightly coarsens upwards. *Scrobicularia plana* is located in growth position towards the base of this unit. The Foraminifera are dominated by *P. germanicum.* Above are grey silts with occasional fine sand laminae and convolute

lamination where these fine sands occur. The Foraminifera are dominated by *P. germanicum* in 8F but in 8G there is a significant percentage of *J. macrescens.* The silts pass to grey silty clay and are capped by 65 cm of peat. There are similar foraminiferal assemblages in section 9 but in 9F, although *P. germanicum* dominates, there are 58 species present and the faunal diversity is much higher than in the rest of this section (Huddart, 1992). Farther south-west along the New Cut (Figure 8.101)c a similar stratigraphy is seen, with grey silts and peat at the base of the cut, grey clay coarsening upwards into horizontal, iron-stained, parallel laminated fine sand and silt, with root channels and peat clasts, capped by peat. Foraminiferal numbers are not high, except in 2D and *P. germanicum* tends to dominate, except in 21 and 2K, where *J. macrescens, T. inflata* and *P. germanicum* are co-dominant. There are occasional rippled surfaces in fine sand, capped by silt laminae. Flame structures cause many of the fine sand laminae to be irregular and there is convolute lamination in places. The silts infill a pre-existing channel. The stratigraphy in the New Cut east of The Rib was described by Heptinstall (pers. comm., 1983) and also shows considerable variations in the thicknesses, altitudes and composition of the marine beds and intercalated organic beds. Monolith samples were taken from the free-face excavations on the south side of the New Cut at NC-F (Figure 8.99), close to sampling site 9, and at NC-A, 65 m south-west of site 7. Samples 2 cm thick were cut from the monoliths to radiocarbon date the transgressive and regressive overlaps. These dates and three taken from the eastern end of the New Cut and reported by Middleton *et al.* (2001) are shown in (Table 8.18).

A drainage cut, at right angles to the New Cut and parallel to Rib Lane (Figure 8.98), revealed the stratigraphy in the upper part of the succession, as shown in (Figure 8.101)d. In the field can be seen a series of low-amplitude ridges and the drain bisects four of them. This morphology can be picked out on aerial photographs where they focus on Downholland Brook and the River Alt. These ridges are further described and discussed in Huddart (1992).

5. Altcar 1 [SD 3304 0738]. This site is 500 m south of the New Cut and The Rib intersection. From the pollen diagram (Figure 8.106) three local pollen-assemblage zones were identified (Middleton *et al.* 2001).

1. ALT-a, in which the tree pollen is dominated by *Quercus* and *Pinus* is co-dominant. A feature (Figure 8.106) is the rise and fall of freshwater taxa, particularly *Typha angustifolia.*
2. ALT-b where *Quercus* remains dominant with *Alnus* as a subdominant. *Pinus* values decline and *Ulmus* values are low but persistent. *Tilia* values are low and discontinuous. The pollen of Chenopodiaceae is present throughout the zone and rises immediately before the lithological change from a well-humified monocot peat with *Phragmites* rhizomes to a silt clay with monocots, including *Phragmites* and *Cladium*(*i*)rhizomes.
3. ALT-c, in which *Quercus* and *Alnus* pollen characterize the tree pollen and the non-arboreal pollen are dominated by grasses and sedges, which dominate the assemblage from 46–56 cm.

The continuous *Ulmus* pollen record and the low discontinuous *Tilia* record, with the tree pollen characterized by *Quercus* and with *Alnus* and *Pinus* pollen values declining, indicates an early to mid-Flandrian Chronozone II age for the succession.

Interpretation

This site is important because it provides indications of the environmental changes that have affected the coastal lowlands in the time period between 8000 and 4000 years ago. There is evidence for sea-level change, associated with changes in water level and quality. These changes are indicated by variations in sediments and foraminiferal and diatom biozones. There are associated vegetation changes indicated by the pollen and macrofossil record and some evidence of human activity influencing this vegetation. The changes in landscape have been dated and the evidence from Downholland Moss is important in our overall understanding of the coastal ecosystem development in north-west England.

Downholland Moss is the classic site from which coastal palaeoenvironmental change and associated sea-level change has been documented in south-west Lancashire. From this area there has been a long history of theories advanced to explain the distribution of coastal landforms and lithostratigraphy in the tidal flat, peri-marine, dune and saltmarsh zone. These have been summarized as follows (Tooley, 1980):

1. the breaching of sand barriers and the shoaling of inlets during a period of static sea-level (Binney and Talbot, 1843);
2. land subsidence and uplift during a period of static sea-level but with relative rises and falls of sea-level (Reade, 1871);
3. an oscillating sea-level caused by the interplay of land uplift and the eustatic rise of sea-level (Gresswell, 1953, 1957).

However, the bio- and lithostratigraphy from this moss indicate three periods of positive and negative sea-level tendencies between 6980 and 5615 years BP, with age indicated absolutely by ^{14}C dating and relatively by the pollen-assemblage zones. Micropalaeontological and sedimentological analyses indicate fundamental changes in water depth and water quality during accumulation of both the minerogenic and the biogenic sediments (Tooley, 1978b; Middleton *et at,* 2001). In the New Cut section there is evidence for three units of silt and clay with quiet brackish to marine water indicators in the macrofossils and in all the sedimentary indicators. These clastic units are subdivided by terrestrial, telematic or limnic peats. This is similar to the interpretation for DM-15 (Tooley, 1974, 1978a, b, 1985; Huddart, 1992; Middleton *et al.,* 2001), where three transgressive and regressive overlaps occurred progressively higher in the stratigraphical column and with progressively younger dates. Each transgression shows facies changes that permit an interpretation of a rising sea-level followed by a falling sea-level. This is indicated by a saltmarsh regime succeeded by a higher to lower mud-flat sedimentary environment and later by a saltmarsh regime, before brackish water, limnic biogenic deposits accumulated.

In DM-11 the major environmental event is the marine transgression that occurred at the beginning of Flandrian Chronozone II, at altitudes from –0.87 to –0.36 m OD. The onset of marine conditions at 6980 years BP occurred when the regional forest was dominated by pine, in an arrested succession on the sandy soils that had developed on the Shirdley Hill Sand Formation. Nevertheless, the mixed-oak forest taxa were present and marine conditions were anticipated by the presence of wetland pollen taxa, such as *Typha angustifolia* and open freshwater taxa and then saltmarsh conditions, with Chenopodiaceae. The marine event lasted only 200 radiocarbon years and DM-11 and DM-11A are close to the eastern, landward marine limit, which is about 500 m farther inland than the marine limit mapped by De Rance (1869b), but *c.* 1.4 km seaward of the Hillhouse Coastline of Gresswell (1953, 1957). In the overlying 3 m of organic sediments there is abundant evidence of changing freshwater levels, associated with the repetitive marine transgressions and regressions documented at other sites farther west from DM-10 (Figure 8.99).

During pollen-assemblage zone DM-11c (Figure 8.102) there is an autogenic plant succession from saltmarshes to freshwater reeds-wamps and thence to dry woodland. The pollen frequency of *Quercus* increases to 50% of the tree pollen, whereas that of *Alnus* declines to 6%. This indicates an increase in the regional pollen component and a decrease in the local pollen as the groundwater table declined. Wetter conditions returned at the DM-11c–d boundary, with a rise in *Cladium* pollen frequency and a rise in *77pha angustifolia. Alnus* values exceed those of *Quercus.* This coincides with the onset of marine conditions at DM-10, which caused a rise of the groundwater table farther east. In DM-11e *Alnus* pollen values again increase, whereas those of *Quercus* decline but maintain values of around 30%. The presence of *limus* in the sediment, frequent diatoms, a continuous curve of *Nymphaea* pollen and colonies of *Pediastrum,* coincide with a period of marine clastic sedimentation at DM-9, some 600 m seaward of DM-11, and a consequent rise in the fresh groundwater table, leading to an area of open water with appropriate aquatic taxa.

The organic units between the three marine episodes display significant changes in the frequency of their components. Five pollen-assemblage zones have been recognized (Figure 8.104):

1. DM-15a, in which where the tree pollen never rises over 45%, with *Quercus* the dominant tree. The assemblage is characterized by non-tree pollen and the changing frequencies of freshwater taxa indicate fluctuating groundwater tables. The high frequencies of Chenopodiaceae and the presence of *Plantago maritima* suggest that saltmarsh conditions existed close by.
2. DM-15b, in which tree pollen never exceeds 25% and is dominated by *Quercus.* Of the herbaceous pollen, grasses are dominant and the characteristic of this zone is the rise and fall in aquatic taxa frequency
3. DM-15c shows an increase in tree pollen, dominated by *Quercus.* Gramineae values decline and those of the aquatics rise and fall once again. As the frequency of the aquatic pollen declines so that of saltmarsh taxa increases. In addition there is an increase in the number of dinoflagellate cysts as the boundary with the overlying marine strata

is approached.

4. DM-15d is still dominated by *Quercus* tree pollen, although the zone is characterized by non-tree pollen. Grasses are accompanied by saltmarsh taxa.
5. DM-15e, in which the tree pollen is characterized by *Quercus* and *Alnus,* although there are significant contributions made by *Betula* and *Ulmus.* The pollen of herbs and the spores of *Filicales* are characteristic of this zone, in which the pollen of cereals and ruderals are conspicuous.

Fluctuations of the fresh groundwater table consequential on the changes in sea level and the deposition of marine clastic sediment dominate the processes that affect the vegetational history at DM-15. Similarly at Altcar 1, changes in water level and water quality are indicated from data given in (Figure 8.106). In the lower peat an autogenic plant succession is manifest from saltmarsh with Chenopodiaceae and *Artemisia,* through freshwater reedswamp to a terrestrial woodland, dominated by oak and hazel with ferns. The highly oxidized black monocot *turfa* is indicative of dry, oxidized conditions. A retrogressive succession is characteristic of the upper 25 cm of the lower peat. Here the oxidized *turfa* gives way to a wet, silt-rich *turfa* with *Phragmites, Cladium* and rising sedge pollen values, succeeded by rising Chenopodiaceae pollen frequencies, which presage the onset of marine, clastic sedimentation. The changing ratios of *Quercus* and *Alnus* pollen are indicative of a change in regional pollen dominance (*Quercus*)compared with the local pollen (*Alnus*)and higher ground water. At DM-16, Middleton *et al.* (2001) suggest that the sequence as a whole represents a complex interaction between changes in water level and water quality driven by relative changes in sea-level.

The foraminiferal analyses from DM-15 can be referred to the three marine episodes; they have confirmed the sedimentary environments and have added detail about these marine phases (Huddart, 1992). From the DM-15 core five foraminiferal biozones can be identified. These biozones, with their approximate environmental locations, are as follows:

1. *Jadammina macrescens* biozone on the high marsh;
2. *Jadammina macrescens–Trochammina inflata* biozone on the high marsh;
3. *Jadammina macrescens–Protelphidium germanicum* biozone at the high marsh to low marsh transition;
4. *Ammonia batavus–Jadammina macrescens–Elphidium excavatum–Protelphidium germanicum* biozone on the upper to middle part of the low marsh;
5. *Protelphidium germanicum Elphidium excavatum–Elphidium articulatum* biozone from the lower low marsh.

The more detailed work from the New Cut and The Rib adds to this interpretation. The lowest silt passes from a relatively species-rich marine lagoon with an assemblage dominated by *Protelphidium germanicum* and *Elphidium* species and a large number of small, current-transported inner shelf species (8A, (Figure 8.105) to the upper and middle section of a saltmarsh indicated by the low-diversity assemblage. The lower assemblage must indicate an active sediment source linking with the open shelf. In fact there are three foraminiferal samples at different stratigraphical positions that are marked by similar characteristics: a high number of species (49–58) and a high number of Foraminifera present in the samples; *Protelphidium germanicum is* dominant (45–85%), with *Elphidium articulatum* (2–8%); other *Elphidium* inner shelf species present; a large number of smaller, inner shelf species (Huddart, 1992). Their origin must be from the main sediment and water input linking the inner marine shelf to the quiet water lagoon environment and this seems likely to have been to the south-west via the Alt estuary (Huddart, 1992). The cause of these exceptional foraminiferal inputs to Downholland Moss, although not exceptional in the Alt estuarine sediments, is probably storm-induced flood conditions, which flushed Foraminifera from the inner shelf far into the quiet water basin via channels linking the saltmarsh to the estuary Hence a sixth foraminifer-al biozone can be added: *Protelphidium germanicum-Elphidium*-small inner shelf species biozone from the lowest low marsh and estuarine channel.

The morphology of low amplitude, sinuous ridges, west of Rib Lane, and obvious elsewhere on Downholland and Altcar Mosses, was described by Tooley (1985). They were interpreted by Huddart (1992) as a series of roddons, which were described first by Skertchly (1877) from the Fenland, and defined by Fowler (1932, 1934) as banks of laminated silt meandering through the peat fens. The banked form of the roddons was, according to Godwin (1938), the result of the natural levee of a tidal creek, and MacFadyen's (1933) work on Foraminifera supported this view, as he suggested that the roddon silts appear to have been deposited from tidal estuarine water flowing up the ancient waterway. He also suggested that the roddon silts were rich in species of estuarine origin brought in up the channel from the sea. This is similar to the explanation for the high-diversity samples lower in the stratigraphical sequence and the roddon characteristics are seen in cross section and vertical succession in (Figure 8.101). The pattern of roddon channels feeds towards the present-day location of the Downholland Brook and the River Alt and this last phase of saltmarsh and tidal-channel sedimentation therefore was controlled by higher land to the west, likely to be the dune system and the influence of the palaeoestuary, which may have been in a similar location to the present-day River Alt. Other evidence to suggest this interpretation of the latest sedimentation phase comes from the change in orientation of Downholland Brook from an east–west to north–south flow and the distribution of Downholland Silt, which forms an embayment in the lower Alt valley extending almost to Homer Green (Wray and Cope, 1948). The estuary and connection to the sea must have been to the south-west of Downholland Moss and not directly to the west, which had been the conclusion of Tooley (1978a). There is likely to have been a dune barrier to the west for the whole of the evolution of the sedimentary succession on Downholland Moss. In core 2 (Figure 8.99), sand up to 1 m thick has overblown the peat and forms the landward limit of the modern dunes. A ^{14}C date on peat immediately subjacent to the sand yielded a date of 4090 years BP and blown sand is incorporated into the surface peat farther east. In core 3, 25% of the upper stratum is sand, which levens the limnic peat and indicates that sand was blowing into the lagoon at that time. Tooley (1990) and Innes and Tooley (1993) suggest that the dune formation was younger than the Elm Decline (younger than 5000 years BP) but Pye and Neal (1993a) provide a date of 5110 ± 70 years BP from dune-slack peat in a core on the eastern margin of the Ainsdale National Nature Reserve ((Figure 8.107). Blown sand also was recorded in the sieve fractions as occasional fine sand grains in DM-16, which indicates blowing sand on the coast from dunes to the west of the site prior to 6000 radiocarbon years ago (Middleton *et al.,* 2001). It appears probable, however, that there has been a sand barrier in this area back to 8400 years BP, in order to pro vide the quiet-water environment for deposition of the Downholland Silt, associated organic sediments and transgressive wind-blown sand sheets in back-barrier marine lagoons that had a connection to the sea to the south-west from time to time. The stratigraphy west of Downholland Moss (Tooley, 1978a) clearly shows a sand barrier beach with incorporated shell fragments up to +3 m OD, and it is conceivable that windblown sand also may have been incorporated within or on top of this barrier from an early date.

(Table 8.18) Radiocarbon dates from the New Cut (after Huddart, 1992; Middleton *et al.,* 2001).

Site name	Coordinates	Grid reference	Material dated (after Troels-Smith, 1955)	Palaeoenvironment represented	Stratigraphical position of sample	Laboratory code	^{14}C date (years BP ±σ)	Height of top of sample (metres OD)	Thickness of sample (metres)	Depth of top of sample from ground surface (centimetres)	Interpretation
New Cut-A	55°33'39"N 03°01'05"W	[SD 3260 0762]	Sh4, Th(Phra)^2 + Th(Cladii)^2 + Humous substance with *Cladium* and *Phragmites*	Saltmarsh to reedswamps	Silt overlaid by organic stratum	Hv.12540	6870 ± 235	+0.52	0.02	134	Regressive overlap

New Cut-A	55°33'39"N 03°01'05"W	[SD 3260 0762]	Sh4, Th(Phra)^{2} + Humous substance with *Phragmites*	Reedswamps to saltmarsh	Organic stratum overlaid by silty clay	Hv.12539	6840 ± 95	+0.99	0.02	87	Transgressive overlap
New Cut-F	53°33'47.5"N 03°00'42"W	[SD 3304 0787]	Ld^{3}3, Th(Phra)^{2}1 Laminated *limus* with *Phragmites*	Saltmarsh to reedswamps	Silt overlaid by organic stratum	Hv.12537	7015 ± 90	–0.20	0.02	180	Regressive overlap
New Cut-F	53°33'47.5"N 03°00'42"'W	[SD 3304 0787]	Ld^{3}4, Th^{3} + Laminated *limus*	Reedswamps to saltmarsh	Organic stratum overlaid by clayey silt	Hy.12538	7435 ± 300	+0.16	0.02	144	Transgressive overlap
New Cut			Th^{2}(Phra)3, Sh1, Dl^{+} Dh^{++}	*Phragmites* turfa		Gu-7229	5670 ± 70	+0.73			
New Cut			Dh^{3}, Shl, Ag^{+} Dl^{+} Th(*Phra*)1+	Woody detritus		Gu-7230	5810 ± 80	+0.60			
New Cut			Th^{2}(*Phra*)3, Sh1, Ag^{+} Dh^{++}	*Phragmites* turfa		Gu-7231	6610 ± 80	–0.19			

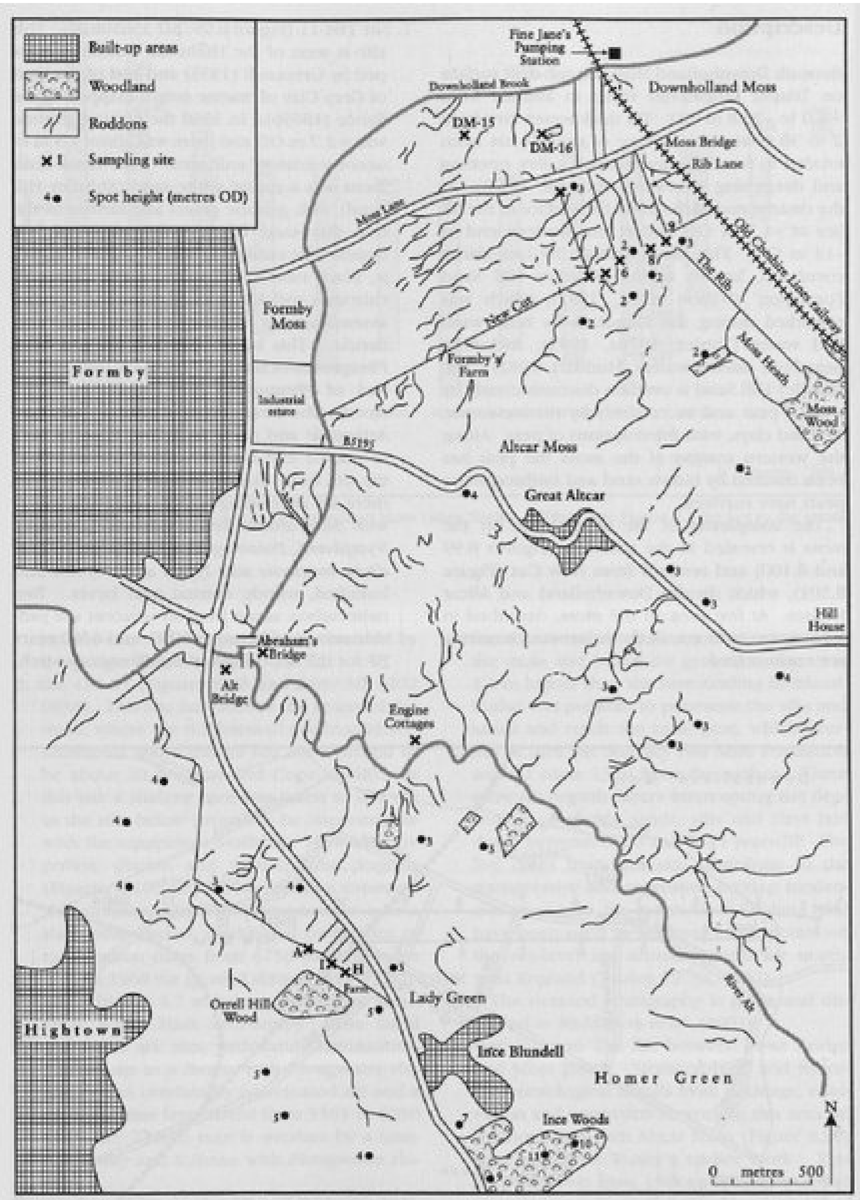
There are some indications of prehistoric human activity on the moss. At Altcar 1, however, these are minor, although the peak frequencies of Gramineae (which may be a manifestation of groundwater fluctuations), the low, discontinuous frequencies of the spores of bracken and of *Taraxacum,* all of which occur prior to the Elm Decline, may indicate human influence on the vegetation. However, the paucity of evidence for human activity both pre-dating and post-dating the Elm Decline may be because of remoteness attributable to the sedimentary environments present around this site. For example, there are two marine episodes separated by episodes in which reedswamps were characteristic, and these environments clearly are not suitable for pastoral or agricultural farming, although they would be attractive as a resource. At several levels in the upper organic stratum at DM-16, between 190 and 5 cm, there is some evidence of human activity. There are low frequencies of ruderals or single grains of *Rumex, Urtica, Plantago lanceolata* and *Taraxacum* and the spores of *Pteridium.* Charcoal was recorded at several levels pre-dating the Elm Decline. This indicates human activity on dry land nearby, either on islands of till and coversand in the wetland, or the rising subcrops of till farther east. There are some tantalizing correlations, such as the presence of low frequencies of *Pteridium aquilinum* spores associated with charcoal at several levels. As bracken is associated with forest clearance it may be that this remote wetland site clearance on the drier, sandy ground to landward is being recorded. However it is necessary to move closer to the blown sand farther west at DM-15 (Figure 8.98) before indicators of agriculture are present. Here there are unequivocal indicators of human activity, particularly in the upper peat, which accumulated largely as a freshwater deposit. Prehistoric farming must though have been taking place close by as there are records of arable weeds, such as *Polygonum persicaria, Centaurea cyanus,* cereal pollen and pastoral weeds, such as *Rumex* and *Plantago lanceolata.* The location of this farming is speculative but as the *limus* has been enriched with blown sand from 54 cm upwards it is probable that the landward margin of the better-drained, warmer sandy soils of the sand dunes to seaward had been settled. Middleton *et al.* (2001) speculate that the early farmers who must have occupied the sand dunes that overran the western margin of Downholland Moss some 4090 years ago were the ancestors of the hunters who left their footprints, along with the hoof prints of both aurochs and domesticated ox, in the silts at Formby Point, and pursued red and roe deer (Huddart *et al.* 1999b).

Conclusions

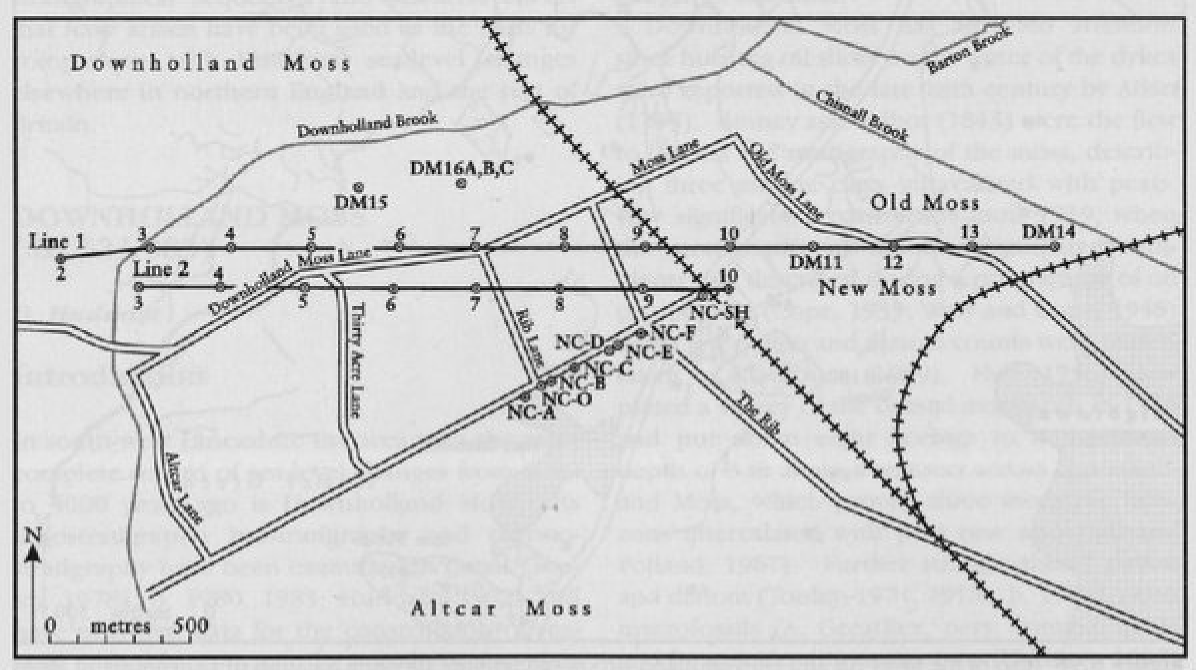
Downholland Moss has been studied for over 150 years and there has been a wealth of information obtained related to its development over the past 8400 years. It has provided important data related to sea-level change in north-west England and there is evidence for three marine phases in the deeper parts of the moss succession. The detail of the associated vegetation changes and detailed diatom and foraminiferal biostratigraphy have provided much local evidence as to the environmental changes related to transgressions and regressions of the sea. These sea-level changes have been dated across the moss and in stratigraphical succession by ^{14}C dating of the contacts. It has been difficult to correlate marine phases across the moss but major changes from the Alt estuary area to the New Cut and farther to the north at DM-15 suggest that the transgressions observed had their source from the proto-Alt estuary to the southwest rather than from the immediate west. This too suggests a barrier to the west throughout most of the Flandrian, with the connection to the sea via the Alt estuary.

The moss too has given detailed information for the first time in north-west England for the stratigraphy and morphology of roddon landforms, which drain to the Downholland Brook and the River Alt. Throughout Flandrian times Downholland Moss appears to have been a wetland habitat, with a mosaic of freshwater, saltmarsh and brackish-water lagoon environments, behind a sand barrier to the west. Occasionally islands of the Shirdley Hills Sand Formation or till provided a drier habitat for woodland. There are isolated glimpses of prehistoric human land use of the moss, or at least its immediate adjacent dune habitats or drier islands within the wetland.

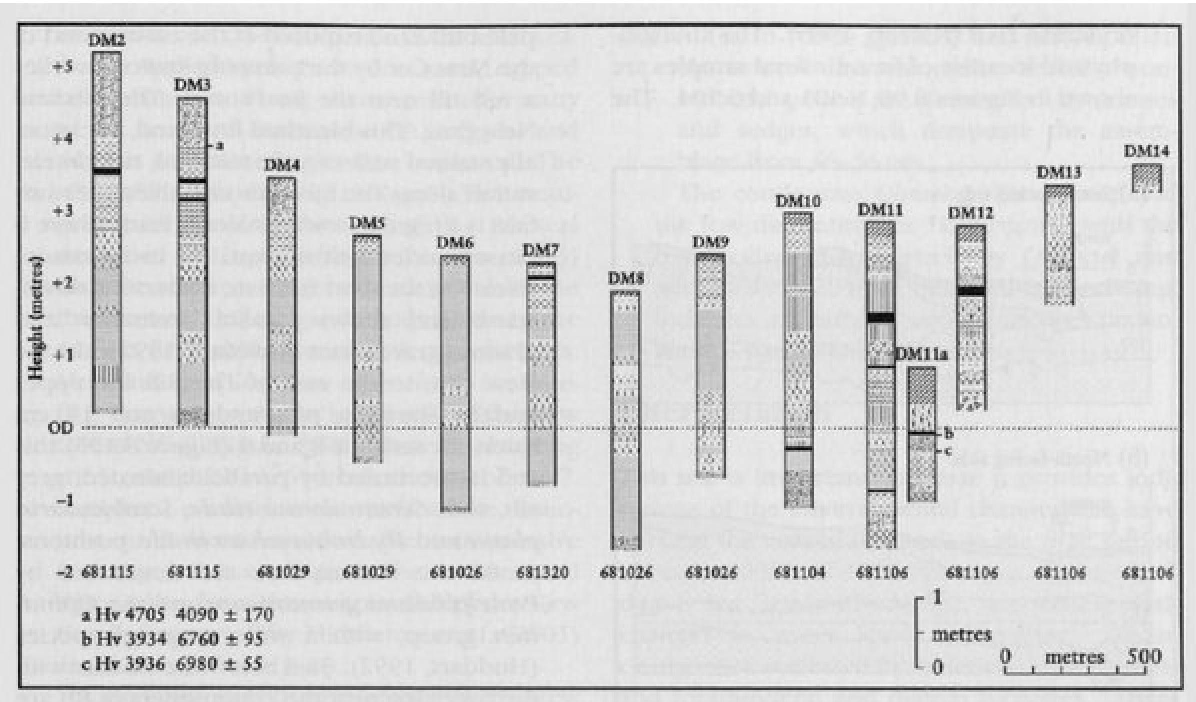
[References](#)



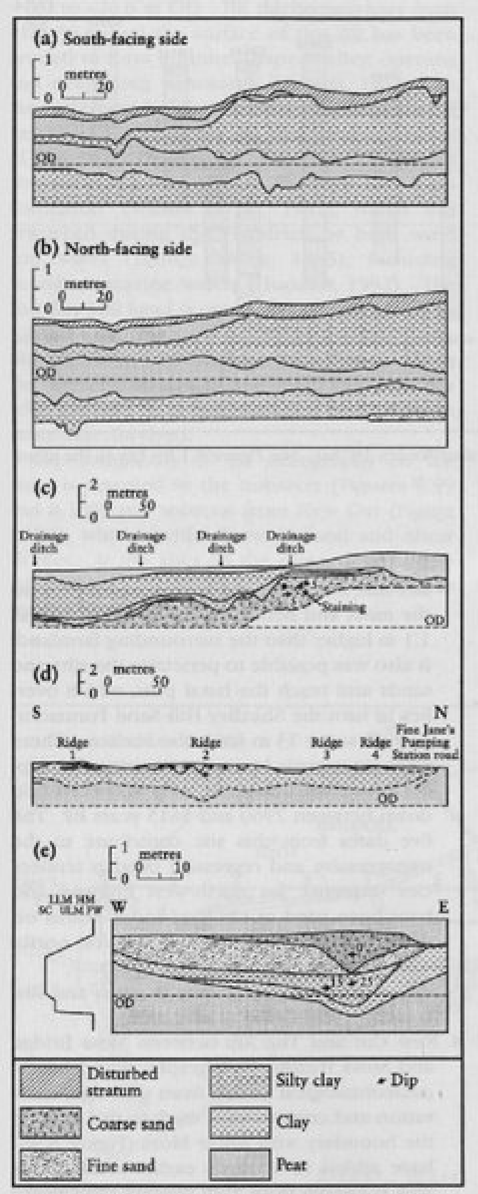
(Figure 8.98) Map of the River Alt and Downholland Brook catchments showing location of Downholland Moss and sampling sites (after Huddart, 1992).



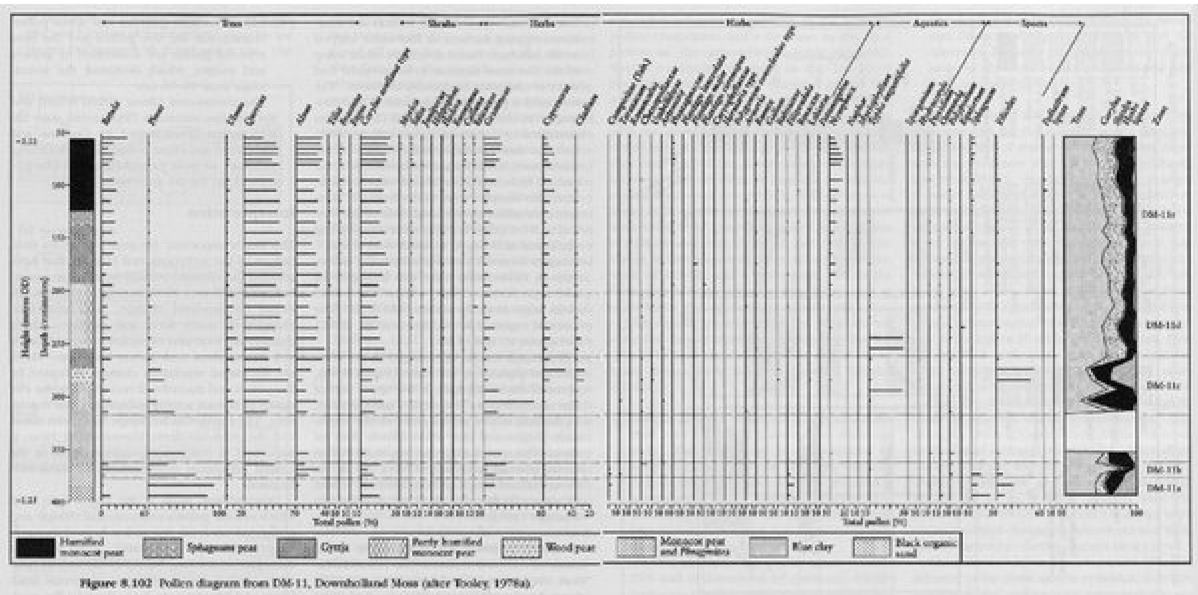
(Figure 8.99) Map of Downholland Moss showing the sampling sites (after Tooley, 1985).



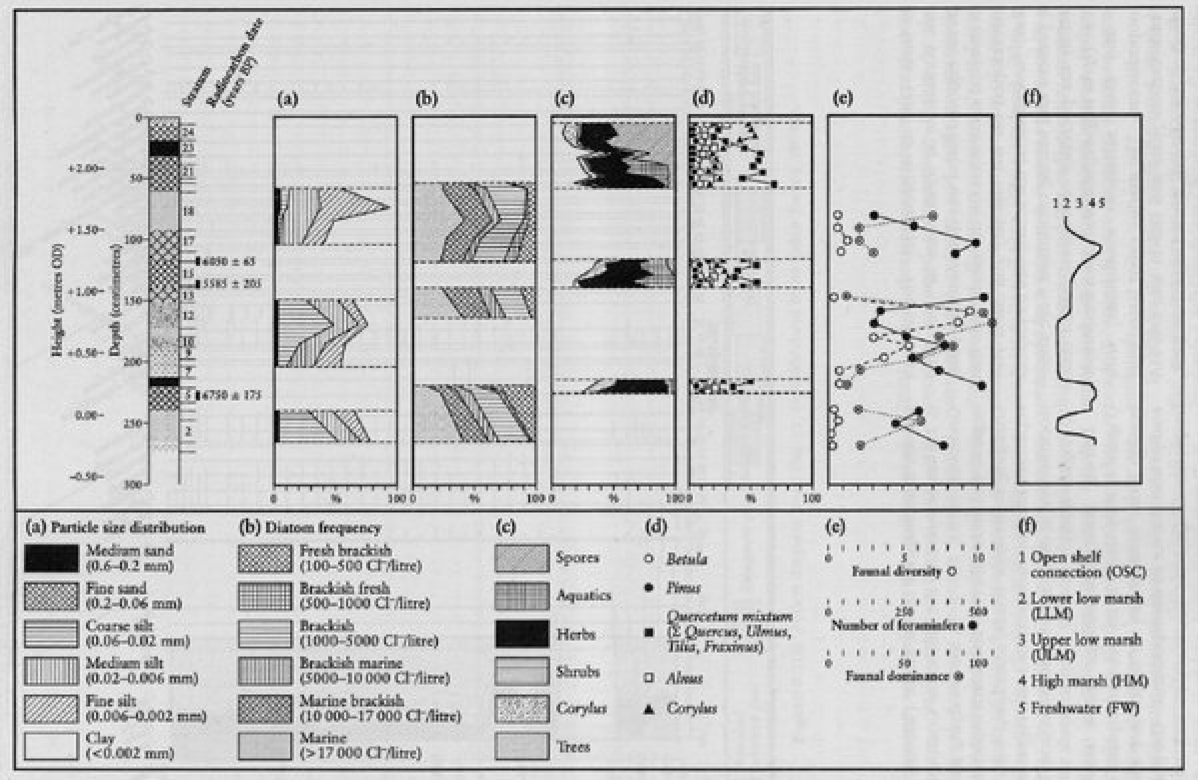
(Figure 8.100) Stratigraphy across Downholland Moss (after Tooley, 1978a). See (Figure 8.1) for key to the stratigraphical log.



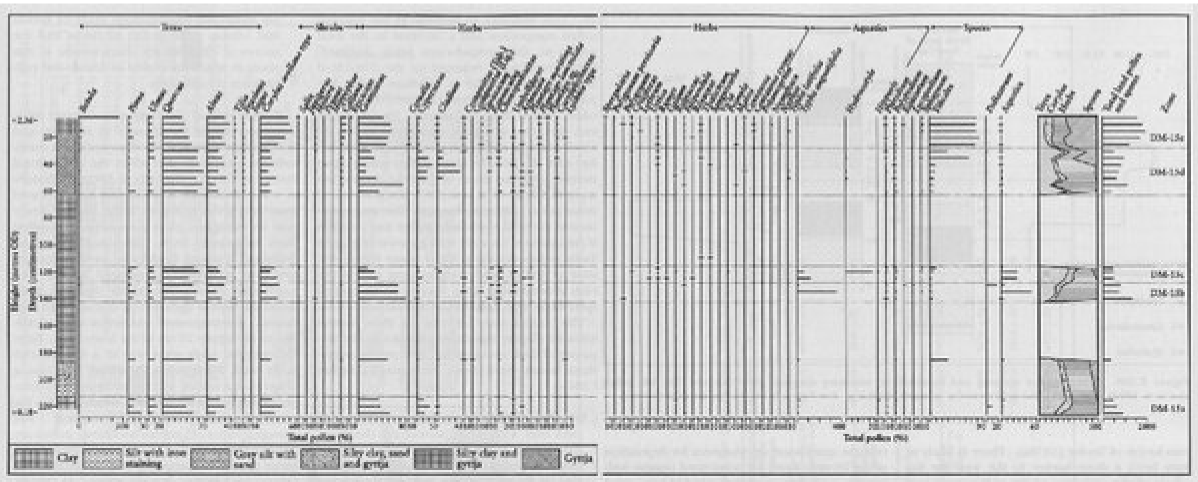
(Figure 8.101) Stratigraphical sections along the New Cut (after Huddart, 1992). See (Figure 8.10)3 for key to labels in (e).



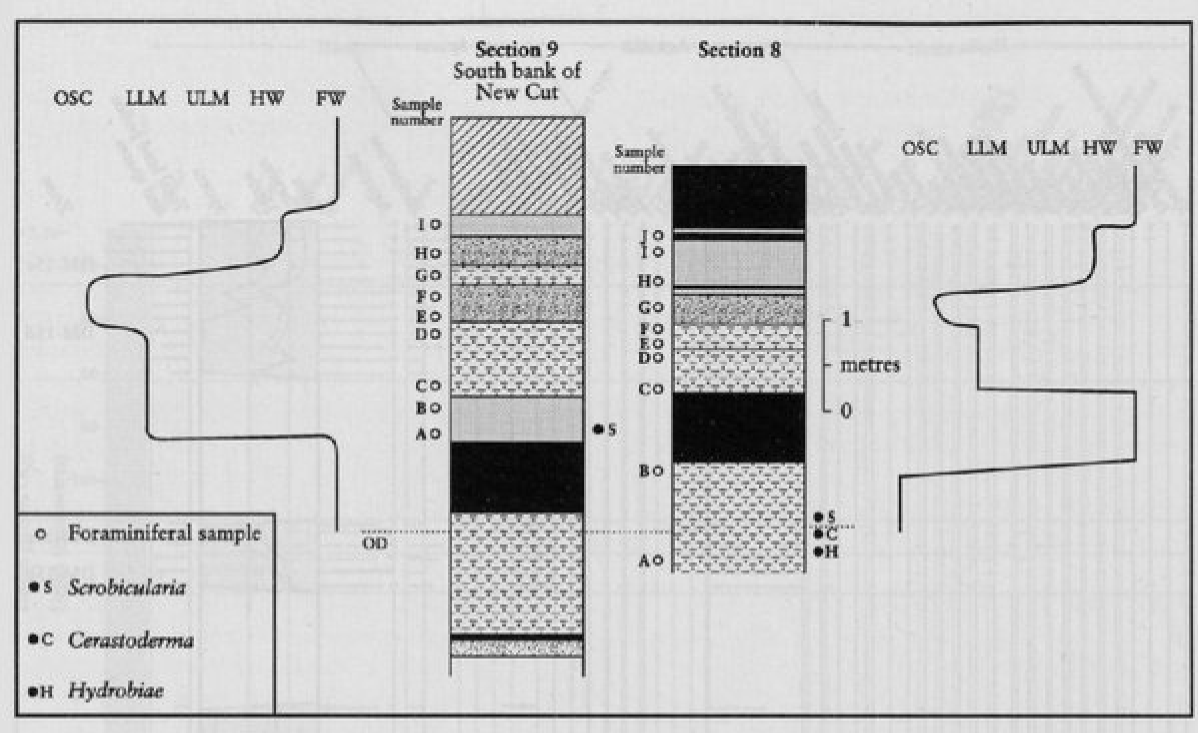
(Figure 8.102) Pollen diagram from DM-11, Downholland Moss (after Tooley, 1978a).



(Figure 8.103) Pollen, diatom and foraminiferal diagram from DM-15, Downholland Moss (after Tooley, 1978a). See (Figure 8.1) for key to stratigraphy.



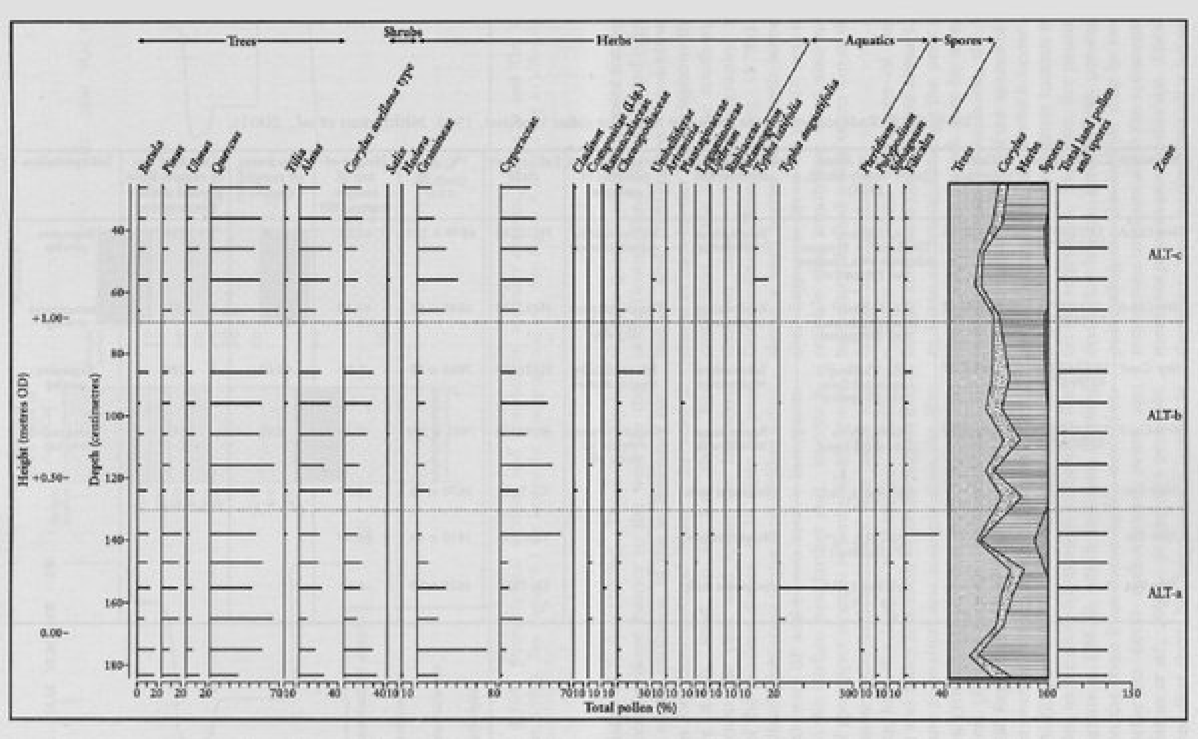
(Figure 8.104) Pollen assemblage zones from DM-15, Downholland Moss (after Tooley, 1978a).



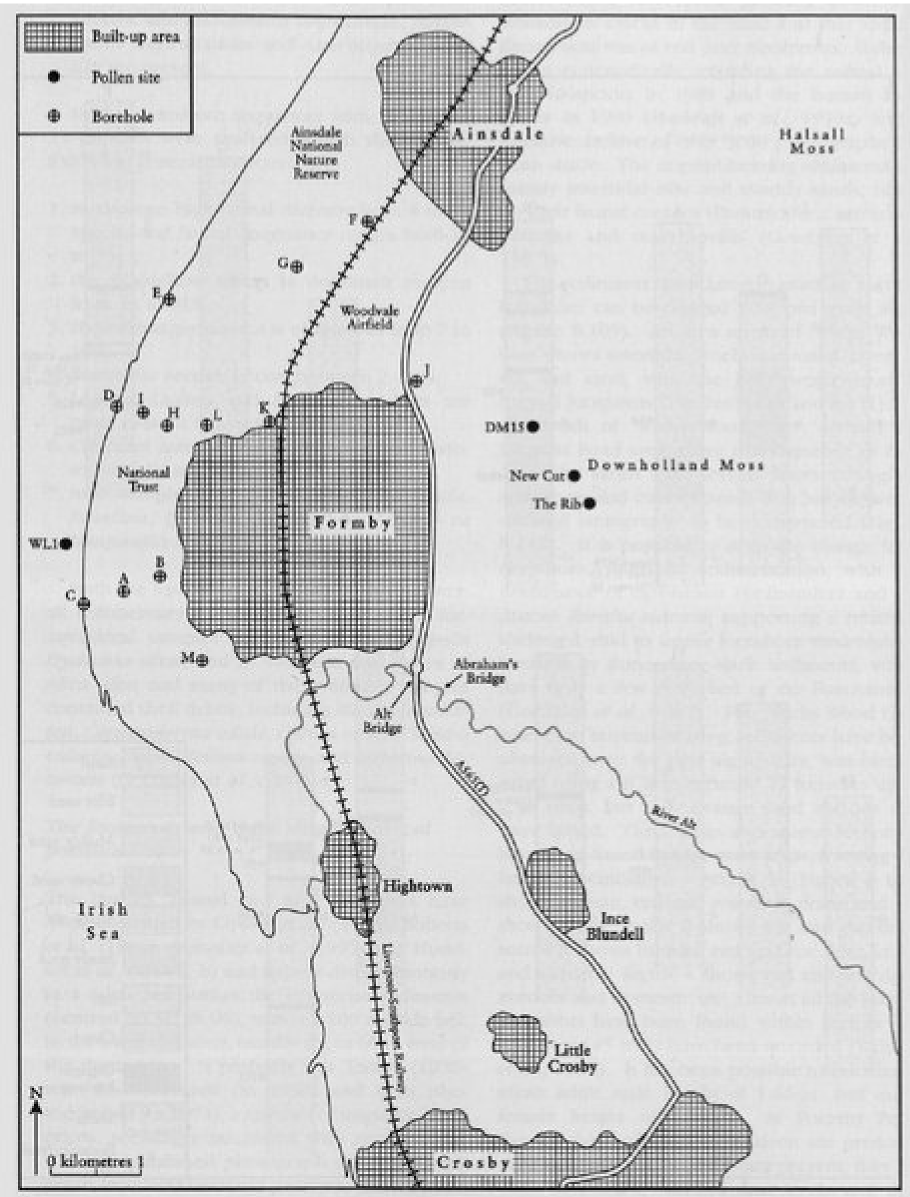
(Figure 8.105) Stratigraphical sections and foraminiferal summary diagram, New Cut and The Rib (after Huddart, 1992). See (Figure 8.1) for key to the stratigraphical log. See (Figure 8.103) for key to abbreviations.

Site name	Coordinates	Grid reference	Material dated (after Troels-Smith, 1955)	Palaeoenvironment represented	Stratigraphical position of sample	Laboratory code	^{14}C date (years BP ±1σ)	Height of top of sample (metres OD)	Thickness of sample (metres)	Depth of top of sample from ground surface (centimetres)	Interpretation
New Cut-A	55°33'39"N 03°01'05"W	SD 3260 0762	Sh4, Th(*Phra*)^2 + Th(Cladi)^2 + Humous substance with *Cladium* and *Phragmites*	Saltmarsh to reedswamps	Silt overlaid by organic stratum	Hv.12540	6870 ± 235	+0.52	0.02	134	Regressive overlap
New Cut-A	55°33'39"N 03°01'05"W	SD 3260 0762	Sh4, Th(*Phra*)^2 + Humous substance with *Phragmites*	Reedswamps to saltmarsh	Organic stratum overlaid by silty clay	Hv.12539	6840 ± 95	+0.99	0.02	87	Transgressive overlap
New Cut-F	53°33'47.5"N 03°00'42"W	SD 3304 0787	Ld^{3}3, Th(*Phra*)^{2}1 Laminated *limus* with *Phragmites*	Saltmarsh to reedswamps	Silt overlaid by organic stratum	Hv.12537	7015 ± 90	−0.20	0.02	180	Regressive overlap
New Cut-F	53°33'47.5"N 03°00'42"W	SD 3304 0787	Ld^{3}4, Th^3 + Laminated *limus*	Reedswamps to saltmarsh	Organic stratum overlaid by clayey silt	Hv.12538	7435 ± 300	+0.16	0.02	144	Transgressive overlap
New Cut			Th^2(*Phra*)3, Sh1, Dl$^+$ Dh^{++}	*Phragmites* turfa		Gu-7229	5670 ± 70	+0.73			
New Cut			Dh^3, Sh1, Ag$^+$ Dl$^+$ Th(*Phra*)1$^+$	Woody detritus		Gu-7230	5810 ± 80	+0.60			
New Cut			Th^2(*Phra*)3, Sh1, Ag$^+$ Dh^{++}	*Phragmites* turfa		Gu-7231	6610 ± 80	−0.19			

(Table 8.18) Radiocarbon dates from the New Cut (after Huddart, 1992; Middleton et al., 2001).



(Figure 8.106) Pollen diagram at Altcar 1 (after Heptinstall, unpublished data 1983).



(Figure 8.107) Location of boreholes, Formby Point.