Ballyquirke Bog

Ballyquirke West townland is south-east of Moycullen village and c. 2 km west of Lough Corrib. The bog itself is located in a shallow basin in undulating terrain, east of the village and north-west of Ballyquirke Lake, and is bounded on the east side by the Ballyquirke Canal, which was probably built as part of the Corrib Navigation Scheme in the later 1800s. The bog has been extensively cut over (i.e. by small-scale peat-harvesting for fuel) to the east and west. The intact, undisturbed section of the bog currently measures c. 0.5 ha. This appears to have been unaffected by peat-cutting in the past, although it is likely to have been subject to shrinkage as a result of cutting elsewhere in the bog. On the second-edition Ordnance Survey six-inch map of 1893 it is evident that the surviving bog was once part of a larger bog system (52 ha in extent) that extended north-east beyond Ballyquirke Canal towards Lough Corrib. Much of this area is now under agricultural grassland on a peaty soil. In addition, there has been development of dry birch woodland on old cut-over bog areas.

The study site is within the remaining area of intact bog. Here the surface of the bog retains a cover of vegetation typical of a western raised bog (Illus. 3.2), dominated by varying amounts of cross-leaved heath (*Erica tetralix*), white-beaked sedge (*Rhynchospora alba*) and deer grass (*Trichophorum germanicum*). Other frequent vascular plant species in the vegetation include ling heather (*Calluna vulgaris*), purple moor-grass (*Molinia caerulea*), common bog cotton (*Eriophorum angustifolium*), carnation sedge (*Carex panacea*), bog asphodel (*Narthecium ossifragum*) and bog myrtle (*Myrica gale*) (Table 3.1). The occurrence of blanket bog species such as black bog rush (*Schoenus nigricans*) and purple moor-grass differentiates western raised bogs from midland raised bogs, which occur in the eastern half of the country. The cover of mosses is locally well developed, with three sphagnum mosses (*Sphagnum cuspidatum*, *Sphagnum papillosum* and *Sphagnum capillifolium*) the main species encountered. The lichen *Cladonia portentosa* is also frequent, growing on the drier hummocks.

Investigation methods

In order to carry out palaeoenvironmental investigations it is first necessary to recover a continuous sediment sequence (core). Individual samples are then taken from the core at regular intervals with a modified syringe, and undergo chemical treatment to remove as much debris (e.g. plant remains, silt) as possible, leaving only the fossil pollen (see Moore et al. 1991 and Molloy & O'Connell 2004 for details of the methodology). The pollen is then identified and counted under a microscope (magnification x400) and the results plotted as percentage data on a pollen diagram. Changes in the pollen percentages from one sample to the next reflect changes in the composition of the vegetation growing around the coring site over time as the sediment accumulated.

The bog in Ballyquirke West was cored in November 2016 (Illus. 3.3). Probing with a gouge corer was first carried out to locate the deepest part of the bog. The main core BQW2 (NGR 122180, 232749), which measures 821 cm in length (Illus. 3.4), was then taken with an Usinger

Table 3.1—Species list for the intact bog surface at Ballyquirke West. Apart from sphagnum, other mosses cannot be differentiated on the basis of their spores.

Botanical name	Common name/type
Aulocomium palustris	Moss
Calluna vulgaris	Ling heather
Carex panicea	Carnation sedge
Cladonia portentosa	Lichen
Cladonia uncialis	Lichen
Dicranum scoparium	Moss
Drosera rotundifolia	Round-leaved sundew
Drosera intermedia	Oblong-leaved sundew
Erica tetralix	Cross-leaved heath
Eriophorum angustifolium	Common bog cotton
Eriophorum vaginatum	Hare's-tail bog cotton
Hylocomium splendens	Moss
Hypnum jutlandicum	Moss
Molinia caerulea	Purple moor-grass
Myrica gale	Bog myrtle
Narthecium ossifragum	Bog asphodel
Pleurozia purpurea	Liverwort
Pleurozium schreberi	Moss
Potentilla erecta	Tormentil
Racomitrium lanuginosum	Moss
Rhynchospora alba	White-beaked sedge
Schoenus nigricans	Black bog rush
Sphagnum capillifolium	Sphagnum moss
Sphagnum cuspidatum	Sphagnum moss
Sphagnum denticulatum	Sphagnum moss
Sphagnum papillosum	Sphagnum moss
Sphagnum tenellum	Sphagnum moss
Succisa pratensis	Devil's bit scabious
Trichophorum germanicum	Deer grass

piston corer. (Another attempted core, BQW1, was abandoned because a fossil timber, most likely a pine stump, was hit at a depth of 220 cm from the bog surface.) Fifty samples, each 2 cm^3, were taken for pollen analysis between the intervals 122–530 cm from core BQW2. It was thought that this interval was most likely to relate to the Neolithic/Bronze Age periods. The sampling interval ranged from 6 cm in the upper part to 24 cm at the base of the sequence investigated. In addition to pollen and spores, 'extra fossils' or non-pollen palynomorphs (NPPs), including fungal spores, testate amoebas (microscopic animal remains) and micro-charcoal (≥37 μm), were also routinely counted. In most samples a total terrestrial pollen (TTP) sum in excess of 500 pollen grains (excluding bog taxa) was counted. In order to establish a chronology that can be applied to events in the pollen record, six samples were taken for radiocarbon dating at the ^{14}CHRONO Centre, Queen's University, Belfast. These samples were sieved to recover macrofossils—heather flower heads, birch and hazel twigs and wood fragments—suitable for dating (Appendices, Table A.1).

Results

The stratigraphy of the core indicates that the study site was originally a shallow lake, which gradually infilled to become a fen and eventually a western raised bog. The lowermost 70 cm of core BQW2 (820–750 cm) consists of a sediment sequence typical of the end phase of the last glaciation—the Late-glacial (c. 15,000–

Illus. 3.3—(Left) Coring team members Daisy Spencer, Carlos Chique, Pat O'Rafferty, Aaron Potito and Ailbhe Conaghan, using an Usinger piston corer. (Right) White lake sediment from beneath the bog being measured by Karen Molloy. (*NUI Galway*)

11,700 years ago). This is represented by a tripartite sequence, with 1.5 cm of glacial clay overlain by white lake marl, which in turn is overlain by 32 cm of dark minerogenic clay representing the Younger Dryas. This relates to a severe cold snap at the very end of the last Ice Age, preceding the beginning of the current post-glacial period (c. 9500 BC) (Illus. 3.4). Immediately above this the sediment consists of white-brown marl with organic-rich layers (750–685 cm). These marl layers were laid down under shallow lake conditions as climatic conditions warmed up and calcium carbonate precipitated out of the water. Above the marl a fine brown lake mud (gytjja) (685–675 cm) occurs, and then a well-decomposed fen peat, with reed (*Phragmites*) and wood remains scattered throughout, is recorded (675–252 cm). Saw sedge (*Cladium mariscus*) remains are present at c. 620 cm. This fen peat was formed by plants of fen, reed swamp and woody carr (i.e. low-growing, wet woodland, dominated by willows, alder, reeds and meadowsweet) rather than true bog plants. Above this (252–83 cm) the sediment consists of red-brown fibrous peat with alternating layers of peat rich in bog cotton (*Eriophorum*) or in bog moss (*Sphagnum*), indicating

Illus. 3.4—Core BQW2 from Ballyquirke Bog, halved longitudinally and cut into c. 1 m segments. The grey silt layer represents the Younger Dryas. The white sediment (marl) was laid down under warm lake conditions. (*NUI Galway*)

that the transition from fen to raised bog had occurred. Fibrous peat with ling heather (*Calluna*) remains and modern roots makes up the upper 80 cm of sediment.

The results of pollen analysis are presented on a percentage pollen diagram (Illus. 3.5), which is divided into seven local pollen assemblage zones (Zones 1–7) based on major changes in the pollen curves. On the basis of radiocarbon dating an estimated age can be assigned to each zone. Based on the size of the basin, it is assumed that the pollen is quite local and derives from a 1 km radius of the bog. While the core taken measures 821 cm and potentially spans the period from the end of the last Ice Age to recent times, in view of the discovery and subsequent excavation of the Early Neolithic site at Ballyquirke East 1 the focus of the research reported on here was predominantly the Neolithic and Bronze Age periods. With that in mind, neither the bottom nor the top of the core were investigated for pollen analysis and what follows is an account of landscape change from approximately 6300 to 910 BC.

Mid-post-glacial woodlands: c. 6300–5750 BC (Zone 1: 530–506 cm)

The lowermost part of the pollen profile indicates a landscape dominated by woodland. Trees and shrubs account for almost 80% of the TTP, which excludes bog plants that were growing locally on the bog surface. The dominant tall canopy tree was pine (*Pinus*), with lesser amounts of oak (*Quercus*), elm (*Ulmus*) and birch (*Betula*). Hazel (*Corylus*) was present in abundance but probably as an understorey shrub. Ferns, including bracken (*Pteridium*) and polypody (*Polypodium*), were a feature of these woodlands. The stratigraphy indicates that the shallow lake once present at this site had become a fen before 6300 BC. The pollen of grasses probably arises from plants such as reed (*Phragmites*) and purple moor-grass (*Molinia*) growing on and around the edges of the fen.

Pre-Elm Decline Atlantic woodlands: c. 5750–3800 BC (Zone 2: 482–380 cm)

In Zone 2 there is a substantial change in the pollen record, with the pollen of pine and hazel decreasing initially as oak, elm and alder (*Alnus*) increase. The abundance of alder pollen (maximum value of 39% at 410 cm) in this zone marks the transition from Boreal to Atlantic woodlands c. 7,700 years ago (Molloy & O'Connell 2014) and the expansion of alder in the landscape. Tall canopy woodland (pine, oak and elm) dominated the landscape to the detriment of hazel. Ivy was also present, probably as a component of the woodland edge community. Alder probably grew on wet soils around the bog basin. At times this was a closed canopy woodland, with tree pollen accounting for up to 93% of the TTP. A high number of fern spores were recorded in the upper half of this zone, most of which could not be identified to a particular fern as the spores had lost the outer diagnostic coat. These are plotted as monolete fern spores in the pollen diagram. Spores of marsh fern (*Thelypteris palustris*), a plant of fens, wet woodlands and lake shores (Parnell & Curtis 2012), are also present in this zone, however, and it is possible that marsh fern spores

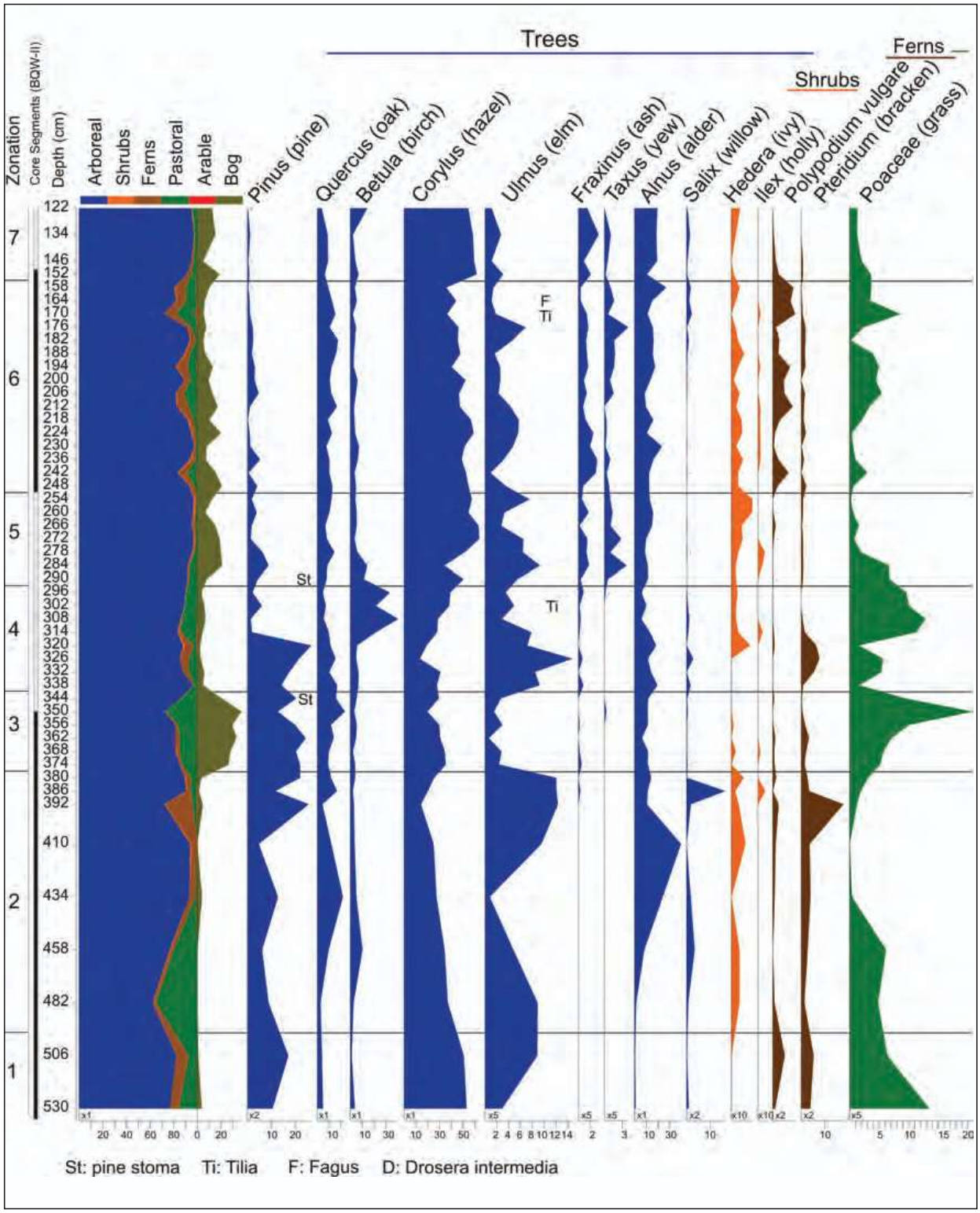
account for a large proportion of the monolete curve. Locally, a wet alder–willow woodland/carr, which probably included marsh fern, dominated the site, while pine, oak and elm woodlands occurred on drier mineral soils close by.

Microscopic charcoal suggestive of fire is common in this zone. We hesitate to attribute this to Mesolithic activity, given that there is neither pollen nor archaeological evidence for a human presence at this time. Microscopic charcoal is also recorded, in a pre-Neolithic context, from other pollen records from around the country, e.g. the Céide Fields, Co. Mayo (O'Connell & Molloy 2001), and Lough Muckno, Co. Monaghan (Chique et al. 2017). It is possible that the fires resulted from natural causes, such as spontaneous combustion during dry periods, for example.

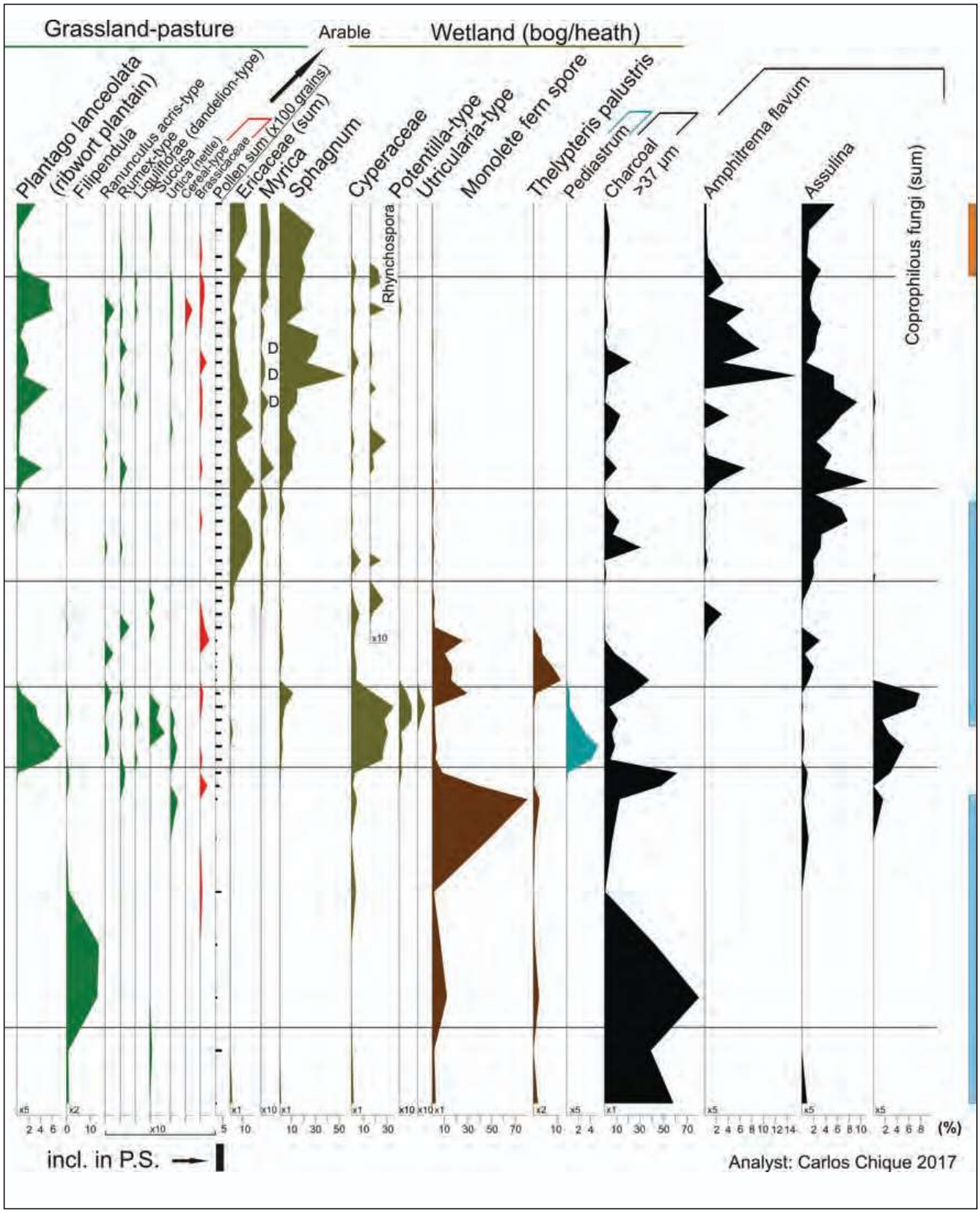
The Elm Decline and Neolithic *landnam*: c. 3800–3400 BC (Zone 3: 374–344 cm)

A sharp decline in elm pollen defines the lower boundary of this zone. This is interpreted as representing the Elm Decline, a feature of many north-west European and most Irish pollen diagrams, which has been widely dated to 3800 BC (Molloy et al. 2014; Molloy & O'Connell 2016; Chique et al. 2017). The Elm Decline is very well expressed at Ballyquirke West, with elm pollen decreasing from 10% to 2% within c. 100 years while at the same time an increase in hazel pollen is recorded. This suggests a reduction in the elm population and an opening up of the canopy, which facilitated the increased flowering of hazel. The decline in elm was presumably caused by a disease that adversely affected elm alone, similar to the modern Dutch Elm disease (Molloy & O'Connell 1987; Peglar & Birks 1993; Parker et al. 2002), but human activity associated with Neolithic farming may also have played a role. Bear in mind here the Early Neolithic remains discovered at Ballyquirke East 1 near the shores of the lake (Chapter 2). Immediately following the initial decline in elm there is a dramatic expansion of herb pollen, in particular grasses (Poaceae) and ribwort plantain. Pollen of buttercups (Ranunculaceae), dandelions (*Taraxacum*), clovers (*Trifolium*) and nettles (*Urtica*) also register and are strongly suggestive of pastoral farming locally. Overall, elm was the main tree affected. Pine was growing on or near the bog surface (there is one record of a stoma—one of the specialised cells found on the surface of pine needles—at the top of the zone) and appears to have been unaffected by farming. Coprophilous fungal spores (CFS), which derive from fungi that grow mainly on herbivore dung, also have increased representation. This is surprising, as dispersal of fungal spores is generally poor in comparison to pollen, as they grow close to the ground surface and records for them are rare in bog systems (Feeser & O'Connell 2009; van Geel et al. 2003). They are regarded as an indicator of local grazing, which in this instance was in close proximity to the coring location.

Locally, surface conditions were very wet. Sedges dominated, with lesser amounts of bog moss and tormentil (*Potentilla*) present. Bladderwort (*Utricularia*), a small, aquatic, insectivorous plant that occurs in ditches, bog holes, pools, fens and lake margins, was present. *Pediastrum*, a unicellular alga that often responds to nutrient enrichment of waters, was also present.



Illus. 3.5 (above and right)—Pollen diagram representing sample core BQW2 from Ballyquirke Bog, plotted to a depth scale and showing percentage composite (left) and individual (main taxa) curves. Colour coding indicates the main ecological/land-use indicator groups. (*NUI Galway*)


Grassland-pasture
Arable
Wetland (bog/heath)
Plantago lanceolata (ribwort plantain)
Filipendula
Ranunculus acris-type
Rumex-type
Liguliflorae
Succisa
Urtica (nettle)
Cereal-type
Brassicaceae
Pollen sum (x100 grains)
Ericaceae (sum)
Myrica
Sphagnum
Cyperaceae
Rhynchospora
Potentilla-type
Utricularia-type
Monolete fern spore
Thelypteris palustris
Pediastrum
Charcoal >37 µm
Amphitrema flavum
Assulina
Coprophilous fungi (sum)
D
D
D
x10
(%)
incl. in P.S.
Analyst: Carlos Chique 2017