8. Coleoptera

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Background

Introduction

This chapter looks at samples taken for insect analysis at various sites throughout Derryville Bog. The analysis of insect remains, particularly Coleoptera (beetles) which will be the main focus of this chapter, and their use in environmental reconstruction is relatively new in Ireland but has had a long and distinguished history in Britain and parts of Europe.

In order to recover insect remains a certain degree of waterlogging and organic build-up must be present. Obviously, a wetland setting has both in abundance and, in addition, the interference of humans creates artificial habitat niches that insects exploit and from which they are subsequently recovered.

The archaeological structures sampled range in age from the Bronze Age to the Iron Age, however, the time periods covered, in particular by column sampling, encompassed a much wider time frame. It was hoped that by varying the sampling strategy, both micro and macro-environmental changes would be highlighted.

Sampling strategy

Vertical columns of samples in one area were taken to present a picture of changes through time in the Coleoptera and whether the presence of an archaeological structure changed that faunal variety. These profiles can pick up natural occurrences such as flooding episodes, bog bursts and dry episodes.

Site-specific sampling involved a block of peat taken underneath a structure, at the same level as the structure (usually incorporating some wood from the structure) and immediately above a structure. This type of sampling is used to create a picture of the immediate environment often helping to understand why a structure was sited where it was, the community of species which exploited the site (including importations) and the changes that occurred in that environment when the structure went out of use.

Spot sampling, or subjective sampling, is also very important where something of interest is uncovered but the area is not conducive to profile sampling or site-specific sampling, and where they can be closely linked, both stratigraphically and through dating, to a particular structure or activity. This has certainly proved to be the case with samples from Derryfadda 23 which have produced some of the most significant finds of this project and have important implications for the history of the Irish forest fauna relict.

The results will be looked at in terms of the local environment, drawing on information from clusters of structures sampled on different sides of the bog. They will also be examined in terms of overall landscape changes in three areas: woodland, wetland and dryland usage—pasture and cultivation.

Methodology

The samples ranged in size from 1 litre to 6 litres (all samples over 3 litres were sub-sampled) and were processed at the Killoran House facility during the excavation season. They were processed using the paraffin flotation method outlined by Coope and Osborne (1967) and expanded by Kenward (1980). The flots were then sorted in alcohol using a low-powered binocular microscope and the extracted remains identified using the usual range of keys (see bibliography) and the Gorham and Girling Coleoptera Collections at Birmingham University (with help from Dr. David Smith). One species (*Rhyncolus ater* Linn.) was sent to Dr Nicki Whitehouse, Department of Archaeology and Prehistory, Sheffield University (now of Queen's University, Belfast) for confirmation of identification. The species lists (Tables 1–10, additional files) are given in taxonomic order according to the revised lists of British (Kloet and Hincks 1977) and Irish Coleoptera (Anderson *et al*. 1997).

Explanatory note on the habitat data and the figures

The specific habitat information given in Tables 1–10 (see additional files), is adapted from Robinson (1991) and every sample taken has been analysed according to this information. The key is as follows:

A: aquatic; B: bankside/waters edge; C: carrion; D: disturbed or bare ground; F: foul (dung); G: grassland; M: marsh (fen/bog); T: terrestrial, occurring in a variety of habitats; V: decaying plant matter and W: woodland or trees. The specific habitats are then generalised into general habitats and presented in bar charts for each site (Figs 8.1–8.4 and 8.6–8.12) throughout the text. These are (i) aquatic; (ii) dung/rotting vegetation; (iii) dead wood; (iv) marsh/bog/aquatic plants; (v) trees/carr woodland and (vi) terrestrial/pasture. Species are assigned to

the most appropriate general grouping, i.e. if a species normally occurs in a marsh environment then it is assigned to the marsh/bog/aquatic plants group. Habitat data was gleaned from BUGS Ecology database (Buckland *et al.* 1996) and various keys and written sources (see bibliography).

A number of references will be made to the status of species as they are recorded in the *British Red Data Books: 2. Insects* (Shirt 1987). This Red Data Book (RDB) is a catalogue of all the rare, vulnerable and extinct insect species in Britain. The list of Coleoptera in this catalogue has since been updated by Hyman (1992; 1994), with additional notes on current distribution and known ecology. Various categories are given including Notable B (a species found in a restricted number of locations in Britain), Rare, Local (restricted in its choice of habitat) etc. This kind of catalogue is not available for beetles in Ireland, so variations may occur in the status of certain species in Britain and Ireland (M. Morris, pers. comm.). Where Irish data is available for the status and distribution of species today, they will be referred to. However, for any species that is not on the current Irish list (Anderson *et al.* 1997), Hyman's (1992; 1994) study is the best method of gauging their current distribution and status in our nearest neighbour.

The local environment

Eastern bog margin

Column samples—Neolithic to Iron Age

A number of column samples were taken through structures in this southeastern cluster covering long periods of time. A vertical column in the drain face on the east side of Field 46 to mineral soil, incorporating Derryfadda 13a, was taken. This site has a date of 767–412 BC but the column may start in late Neolithic levels. This sample was looked at from the earliest layers to the most recent (bog surface) and the habitat data is presented in Fig. 8.1. The species list is in Appendix 1A, Table 1 of the additional files.

The transition layer between the original mineral soil layer and the development of the fen peat (124.48m OD) above had no discernible insect remains of any type, indicating a low organic content and a relatively dry layer compared to those above.

Moving up through the column, a more typical fen fauna was identified (sample 6). The aquatics, *Hydroporus angustatus* and *Graphodytes* sp., indicate peaty pools of acid water, while *Ochthebius* sp. and *Hydreana* sp. are indicative of stands of fresher water. *Paracymus scutellaris* and *Hydrobius fuscipes* are found in shallow acid waters. All these species taken together indicate the beginning of the development of the fen.

Phylopertha horticola, however, is indicative of the nearby drier land, possibly pasture land. *P. horticola* is a pest on many types of bushes and at the roots of grasses, clover and cereals. It usually infests poor quality pasture, often on slopes of hilly areas where there is high rainfall. As this species is present in most of the samples from this site it can be assumed that it was fairly common throughout the local pasture land and that there was a constant presence of such land nearby. The numbers of individuals overall is low and this is probably due to the high silt content. This layer seems to represent the interface between the original drier land, at this point, with its sparse woodland and the inundation of that land, which resulted in the inception of the fen proper in this area.

A maturing of the fen is represented from (sample 5) 124.83–124.98m OD by an increase in insect numbers and variety, probably Early to Middle Bronze Age in date. The wood remains are most likely roots and indicate a bog-edge forest that is fairly well represented in the species present. However, also well represented are

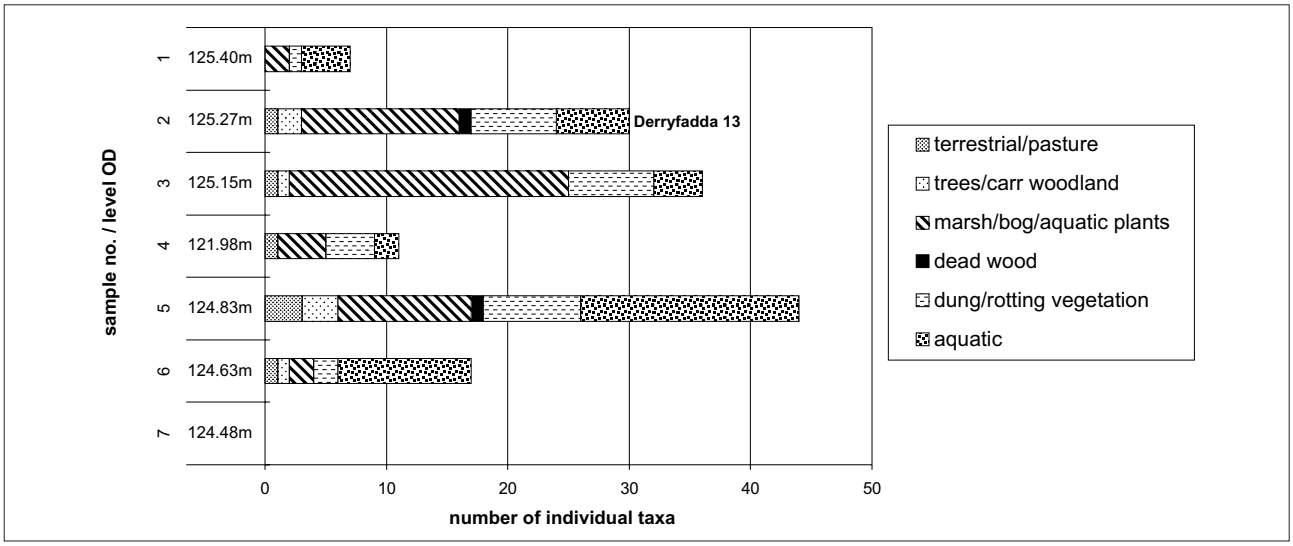

Fig. 8.1 Habitat data from column of samples taken through Derryfadda 13a, Field 46.

pool/bank-side species and drier, pasture species. A small number of species occur in rotting and decaying vegetation but may also indicate dung, carrion and other fouler habitats. These include *Cercyon melanocephalus*, *Megasternum obscurum* and *Staphilinus* sp. In particular, *C. melanocephalus* is found in the dung of large herbivores (i.e. sheep, cow and horse) and less frequently in other decaying matter.

Of the plant feeders, both wetland and drier land species are indicated. *Phylopertha horticola* occurs again, while *Agrypnus murinus* is often found under stones in fields and gardens rich in humus. It has been noted as a pest on various cultivated plants, particularly vegetables. *Gastrophysa viridula* feeds on members of the dock family, a classic waste/cultivated ground plant species. These species and the dung feeders may have been washed down into the fen from nearby grassland during a flooding episode. This level has a higher number of aquatics than any other sample in this sequence, which may be indicating the same thing or a rise in the water table. *Rhinoncus perpendicularis* is also common on various members of the dock family in both moist and dry habitats. *Plateumaris sericea* occurs on great reedmace, burreed and yellow iris, species typical of fen or marshland.

The most significant finding from this level is *Dirhagus pygmaeus* (Plate 8.1), a species listed as rare in the RDB and is absent from the current Coleoptera list for Ireland. It is an inhabitant of woodland and copses of old deciduous trees, including birch, alder, oak and hazel. The larval stage probably develops in dead wood and has been found in old oak and beech stumps (Hyman 1992). Its absence from the Irish list is indicative of two things. The general clearance of deciduous woodland throughout the country from earliest times has contributed to this and probably many other species of beetle disappearing from the Irish record. Also, detailed studies of the pockets of ancient woodland which still exist have not been carried out and could possibly produce examples of some of these species, albeit in drastically reduced numbers. Its presence at this level is the clearest indicator of stands of ancient woodland on the eastern margin.

Plate 8.1 Dirhagus pygmaeus.

A dramatic difference in species numbers and variety is noted at 124.98m OD (sample 4, Fig. 8.1). Only one true aquatic species occurred, pointing to a drier phase in this area for a period of time. From comparative peat morphology and testate amoebae data, a bog burst dated to 1250 BC (bog burst B) has been identified in this area (see Chapters 3 and 6). This would explain the dramatic drop in the water table and, consequently, a radical reduction in water species. *Phylopertha horticola*, the grassland beetle is represented by four examples, while wetland species are all secondary indicators, i.e. the ground beetle *Pterostichus diligen*s and the rove beetles *Lathrobium* sp. and *Stenus* sp. that thrive in moist biotopes. *Pterostichus gracilis* (RDB status: notable) occurs in wet vegetated soil and is therefore more eurytropic than many species of its genus. The phase would appear to last for up to four hundred years. A return to normal fen conditions in noted from 125.15m OD (sample 3) until the building of Derryfadda 13a sometime between 767 and 412 BC.

The ground beetles *Elaphrus cupreus*, *Pterostichus nigrita* and *Dromius* sp. are all species of carr and wet deciduous woodland. There are two examples of *Plateumaris discolor*, which feeds at the roots of cottongrass, a raised bog species, and among *Sphagnum* but also occurs on sedges. There are a number of dryland/pasture indicators in this sample also. As well as *Phylopertha horticola*, *Dascillus cervinus* is found which feeds on flowers and shrubs, generally on dryland. The weevil *Alophus triguttatus* is found on a number of species such as hemp agrimony, dandelion and common comfrey. These plants occur on the margins of wet areas often in damp grasslands or flooded pasture and on waste ground. The presence of these beetles in the sample could be indicative of flooding of the nearby dryland (contributed to by the removal of tree cover, for example) and its subsequent draining into the basin in which the bog was developing.

The structure occurred at 125.27m OD in this column (sample 2) and a number of roundwoods were examined as well as the peat surrounding the wood at this level. No direct woodland or dead wood feeders were recovered. Along with the usual species of ground beetle, *Agathidium rotundatum* is associated with the fungi of various trees while *Bryaxis* sp. is found in rotting wood mould, under bark and in leaf litter. Aquatic species such as *Agabus paludosus* and *Hydraena* sp. often indicate running water or fresh water, which may indicate the presence of a nearby ditch or stream bringing fresh water down from higher ground. Nearby dryland or pasture is also indicated.

Occasionally, animals may have strayed into the bog edge forest to graze but, in general, the numbers of dung indicators on the trackway is small and any found are more likely to be casualties from nearby pasture.

About 0.15m of peat above the structure was examined and proved quite unproductive. All insect remains recovered were indicative of raised bog. Species such as *Pterostichus minor* and *Hydroporus* sp. are typical of wetland from raised bog to fen. *Cyphon* sp. generally occurs in wetland areas from base-rich fens to acidic raised bogs. However, the dung beetle *Aphodius fimetarius* is found in hay refuse, deer and cow dung and, again, is an indicator of nearby dryland or pasture.

Two small column samples were taken in Field 50 from just under the platform Derryfadda 6 (dated to 380–5 BC) to mineral soil. The platform had been built in marginal forest peats in an area of root systems, directly on top of the eastern landfall of the trackway Derryfadda 215, dated to 457±9 BC. The column also incorporated Derryfadda 216, a *fulacht fiadh*, constructed on a natural layer of fen peat and dated to 1400–990 BC. One column was located at the northern end of the platform in the drain face on the west side of Field 50, the other in the middle of the platform to the south in the same drain face. The results are presented in Figs 8.2 and 8.3 but will be looked at together. The species list is presented in Table 2 of the additional files, with the results from both columns combined together. These columns represented the easternmost bog marginal environment examined and, although not as long as at Derryfadda 13a, cover a period from the Early Bronze Age to the early Iron Age.

The number of insects recovered from just above mineral soil (samples 22 and 26, approximately 125.03/125.08–125.13/125.28m OD) was very small. A small number of unidentifiable beetle remains and fly puparia were present. This layer was similar to the basal fen layer at Derryfadda 13a and appeared to be nutrient-poor or leached out, militating against the preservation of insect remains.

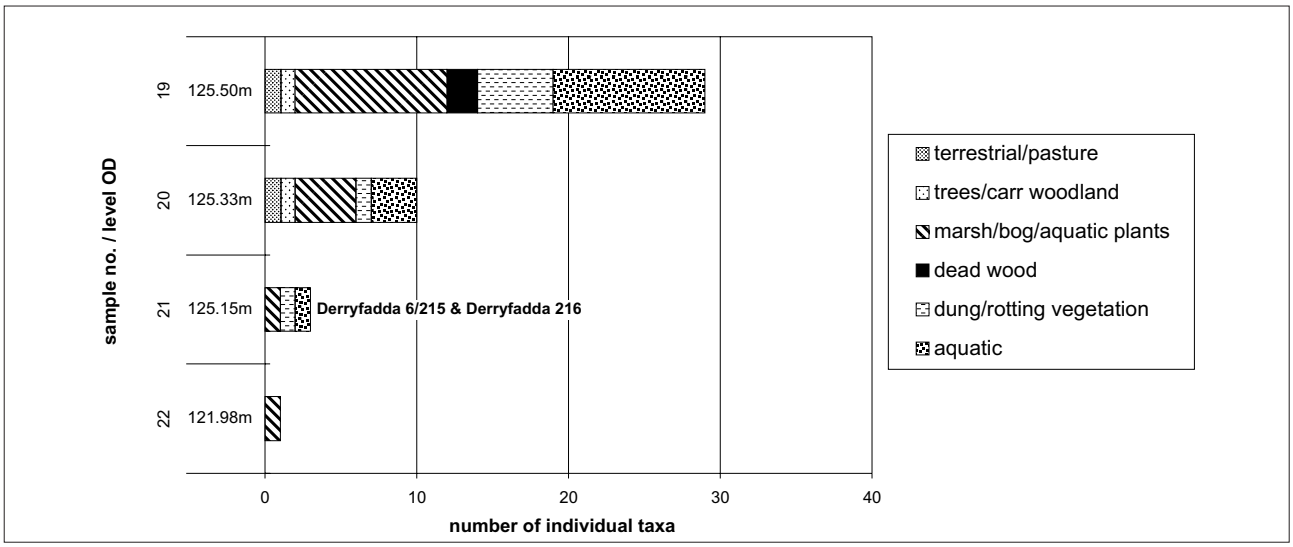

Fig. 8.2 Habitat data from Derryfada 216 and Derryfada 216, Field 50. Northern column.

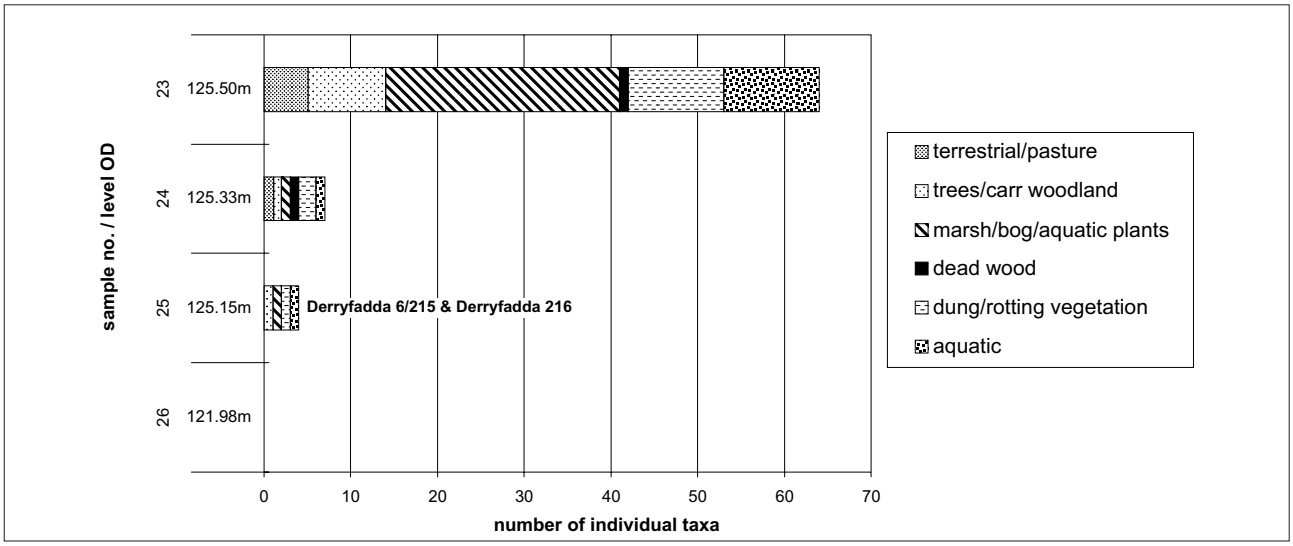

Fig. 8.3 Habitat data from Derryfadda 215 and Derryfada 216, Field 50. Southern column.

Unsurprisingly, the number of insects recovered from the *fulacht fiadh* ash and stone layer (sample 21 and 25) was also small. *Limnebius* sp., *Cyphon* sp. and a possible *Hydropous* sp. all indicate stagnant water but were in a very poor state of preservation. Their presence in this layer was most likely due to waterlogging of the *fulacht fiadh* by a rising water table or natural flooding from the upland.

A layer of dark brown silty carr woodland peat that developed across the top of Derryfadda 216 (samples 20 and 24, 125.33–125.50m OD) after it went out of use proved to be very interesting. From the northern end of the site, where the ash layer was thinner, the fauna is more indicative of fen with standing water. *Pterostichus nigrita*, *Agonum* sp., *Hydroporus* sp., C*yphon* sp. and *Hydraena* sp. are all typical of this environment. *Dascillus cervinus* and *Phylodrepa* sp. are more typical of dryland or pasture. *Leiosoma deflexum* feeds on wood anemone, marsh marigold and buttercup and so can occur in both wet and dry places. The dryland species are unsurprising as this site is extremely close to upland.

However, from the middle of the site (the second column), the fauna is more indicative of a forest floor (sample 24). The ground beetle *Abax parallelpipedus* is a pronounced forest species, preferring shaded rather moist habitats (Lindroth 1969). *Leiosoma oblongulum*, a species not on the current Irish list and classified as notable B in the RDB, is found in broad-leaved woodland in leaf litter, damp moss and is also associated with the buttercup family in grasslands (Hyman 1992).

The most significant find is the Scolytid *Tomicus minor/piniperda* (Plate 8.2). Only the head was found and on the basis of this alone it was not possible to separate the species. However, while both are found in the same habitat, they attack standing, weakened or recently fallen conifers. *T. minor* is extremely rare while *T. piniperda* is more common. *T. piniperda* was found at Thorne Moors (Buckland 1979) but *T. minor* has never been found in an archaeological context. It is confined to Scotland and the native Scots pine belt, and in one pocket of natural coniferous woodland in Dorset, in southern England. *T. piniperda* appears to have adapted to the more recent species of conifers such as Norway and Sitka spruce, introduced to Britain and Ireland by the Forestry Commissions, and is therefore more widespread. In this context, however, they could only have been attacking Scots pine, which was native to Ireland at this time. Scots pine is represented throughout the pollen profiles, albeit in small numbers. Casparie has noted that relics of the Boreal pine forests occur but usually at the base of fen peat, however, in a number of locations, small stands of usually badly grown pine existed on top of the fen peat (see Chapter 3).

This small number of species produces an interesting picture of the bog-edge at this point, as a mixed woodland is clearly established in this area but may be very localised. It could be that the ash, stone and charcoal provided an artificially dry base for this section of the forest, which can also be seen from the western bog margin at Killoran 240.

On top of this layer, a loose woody peat, red brown in colour developed in which Derryfadda 215 and, subsequently, Derryfadda 6 was constructed. From the northern column (sample 19, Fig. 8.2), some of the substructural brushwood was included for analysis. Taking both samples together, this layer proved to be the richest in terms of insect remains (sample 23, Fig. 8.3). This is unsurprising given that it represents a mature fen peat and also the organic build-up around the substructure of the platform. However, in terms of habitat diversity the picture presented is fairly predictable—fen with carr woodland. The picture is perhaps clearer than before with not only ground species indicating the presence of alder/willow carr in particular, but also a number of wood and plant feeding species indicating the same thing.

While the actual composition of the fauna is unremarkable, the contrast in terms of diversity and number between it and other layers, both here and in other parts of the eastern margin, is notable. The presence of the platform has added a range of decomposer species while fen itself has provided the standard range of wetland

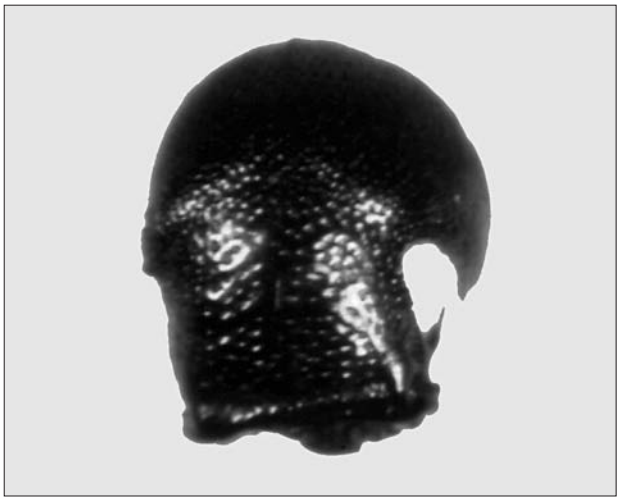

Plate 8.2 Tomicus minor/piniperda.

Plate 8.3 Hydroporus melenarius.

indicators. However, no species specifically associated with dung, animal hides or cadavers was recovered from the trackway substructure.

Of the ground species, *Leistus* sp. is a woodland genus but is also hygrophilous and can be found in swampy woodland. *Agonum fuliginosum* is found in alder carr, willow thickets and moist deciduous/mixed woodlands, as is *A. obscurum*. *Agonum gracile* is found in very wet places in sedge fens and among *Sphagnum*. A great number of species testify to water, particularly stagnant or acid water with *Sphagnum* and other detritus.

The weevil *Dorytomus taeniatus* occurs on varieties of willow, and *Phyllobius* sp. occurs in many trees species, including alder. One fragment of an anobid (wood-worm beetle) was also found.

Site-specific and spot samples—Bronze Age

Samples were taken from the trackway Deryyfadda 23 at two points and are presented in stratigraphic order in Fig. 8.4. The species list is presented in Table 3 of the additional files. Samples were taken immediately above, at and below the structure in an extension cutting in Field 40. Two spot samples were taken through a section of a thoroughly rotted (but once very substantial) timber (Timber 9) in the main cutting in Field 41. The site has two dendrochronological (felling) dates of 1606±9 BC and 1590±9 BC from Timbers 1 and 4, respectively. A pollen diagram and a study of the testate amoebae from this site are presented in Chapter 6.

Studies of the peat morphology and the palaeohydrology of the bog in this area show that raised bog growth began in the vicinity of Derryfadda 23 *c*. 1800 BC, 400 years prior to raised bog growth 400m north at Killoran 18. The majority of species from below the structure strongly indicate a very wet raised bog environment (sample 12). *Hydroporus melanarius* (Plate 8.3) occurs in peat mosses and six other examples of *Hydroporus* sp. also occur, indicating acidic water and *Sphagnum* pools. The genus *Enochrus* sp., of which one example occurs, are increasingly rare, their status these days ranging in Britain from rare to occasional or very local (Hyman 1994). They are strong indicators of acidic conditions.

The weevil *Micrelus ericae* is a true raised bog species as it occurs on heather and heath plant species and, combined with the water beetles above, shows an area of mature, wet raised bog upon which the trackway was built. A well-developed hummock and hollow system of bog growth was identified in this area by Casparie (see Chapter 3).

Samples taken through the very rotted wood of the structure (samples 8 and 9; 124.16m OD) shows the usual range of wetland indicators as well as species specifically indicating raised bog. However, the range of woodland indicators is the most significant aspect of the trackway samples.

The most important find was twenty-seven examples of *Prostomis mandibularis* (identified immediately by Dr. David Smith from photographs in Buckland 1979), an extremely rare species now extinct in Britain and Ireland and confined to a small number of areas in Europe (Plates 8.4 and 8.5). From archaeological contexts it has only been found twice before, at Thorne Moors and at the Sweet Track on the Somerset Levels. It is very much a creature of primary, undisturbed natural forest and is now restricted to the few areas in Central Europe where sub-primary forest remains (Horion 1960; Palm 1959). It was, however, predicted by Horion (1960) that this species would disappear altogether from Central Europe as, even in these sub-primary forests, tidier forestry practices were removing its habitat (it is primarily recorded from damp, rotten oak and pine on forest floors). It has a holarctic distribution, occurring in the southern part of Sweden, localities in Denmark, parts of Germany, also parts of Portugal, southern France, Sardinia and parts of Italy (Fig. 8.5).

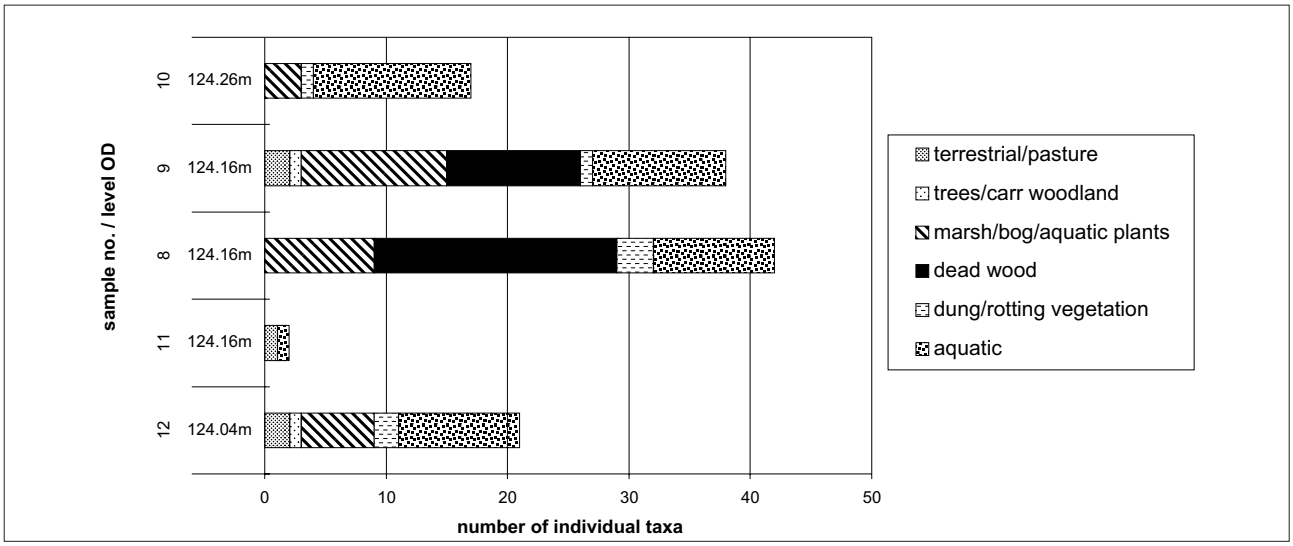

Fig. 8.4 Habitat data from site specific samples taken through Derryfadda 23, Field 41. Samples 8 and 9 are spot samples taken from Timber 9, Field 40.

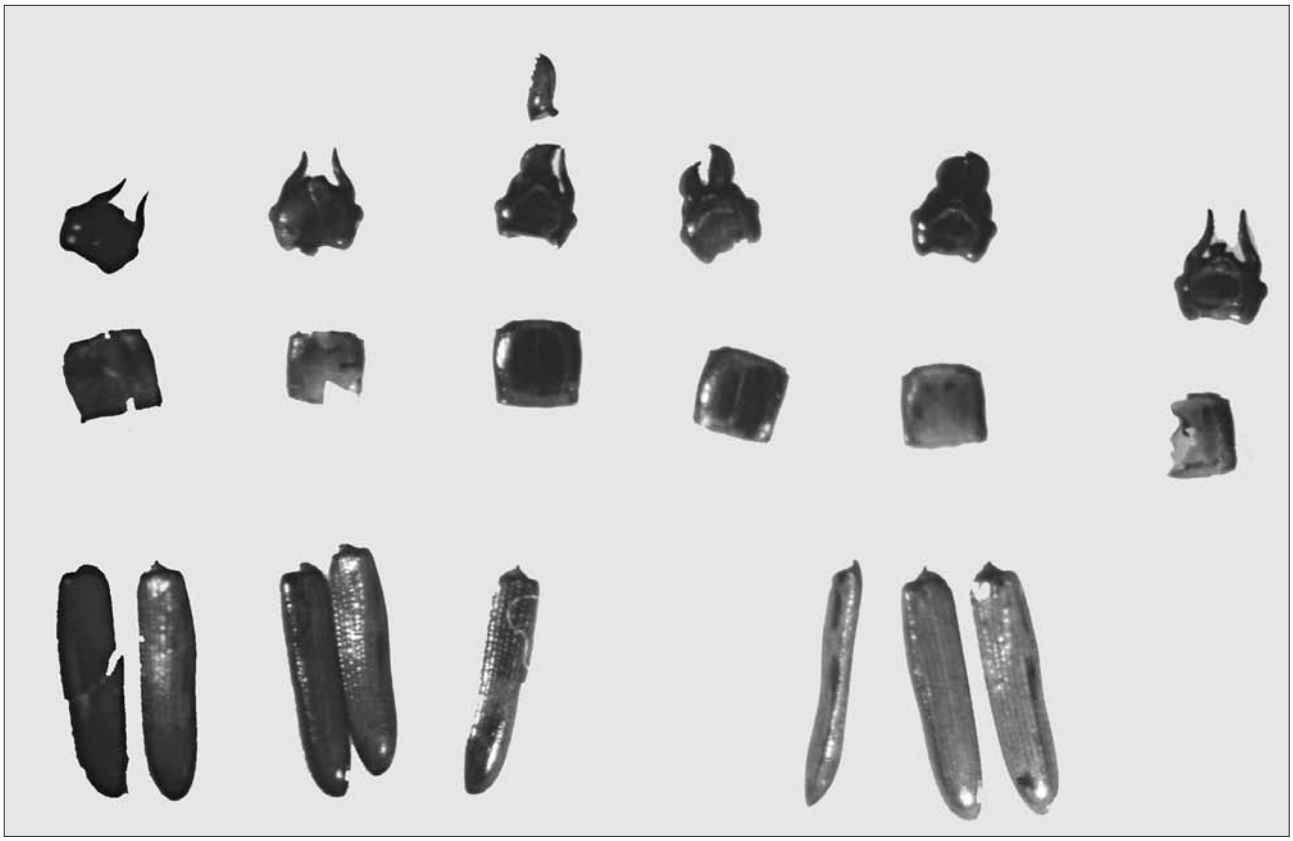

Plate 8.4 Prostomis mandibularis.

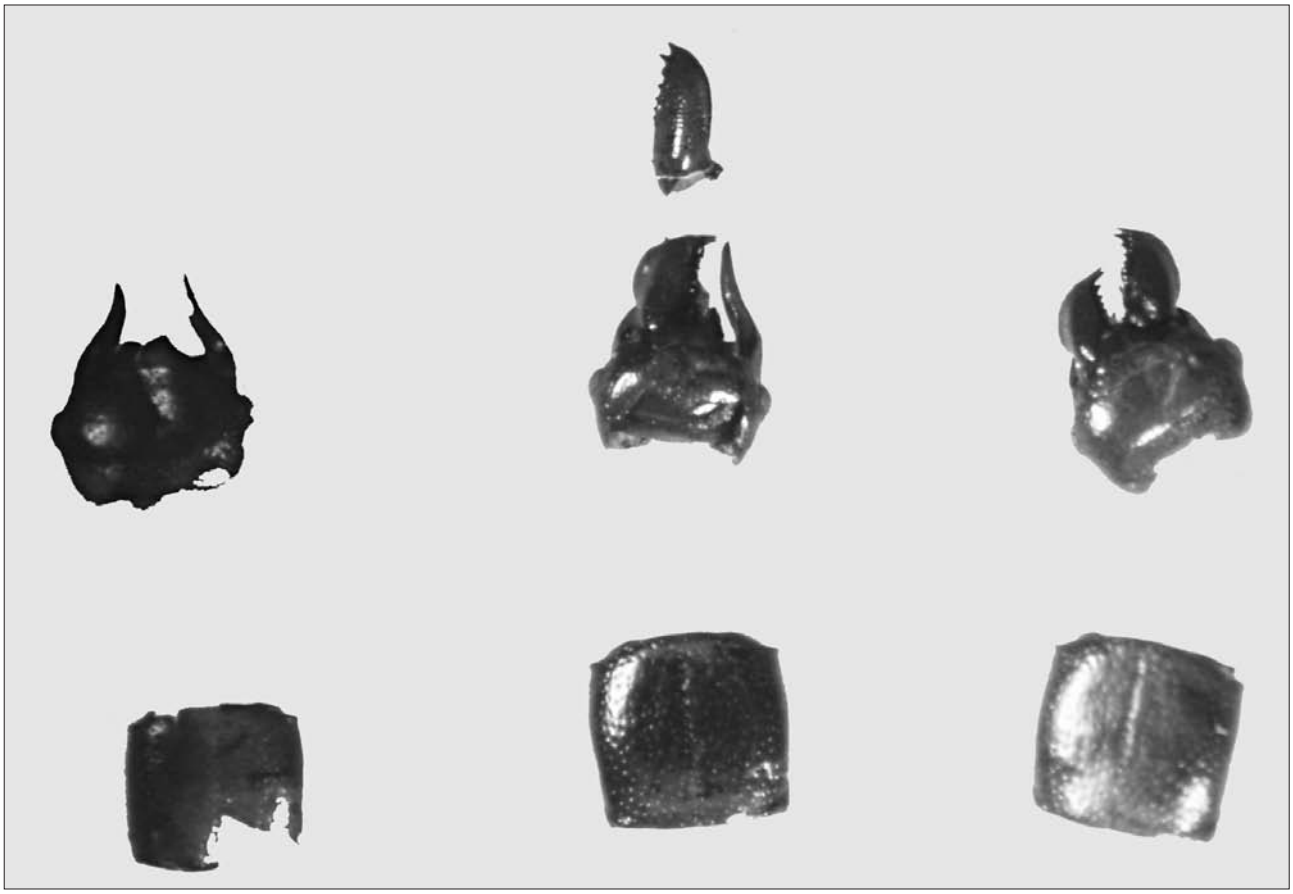

Plate 8.5 Prostomis mandibularis *(close up of head and thorax)*.

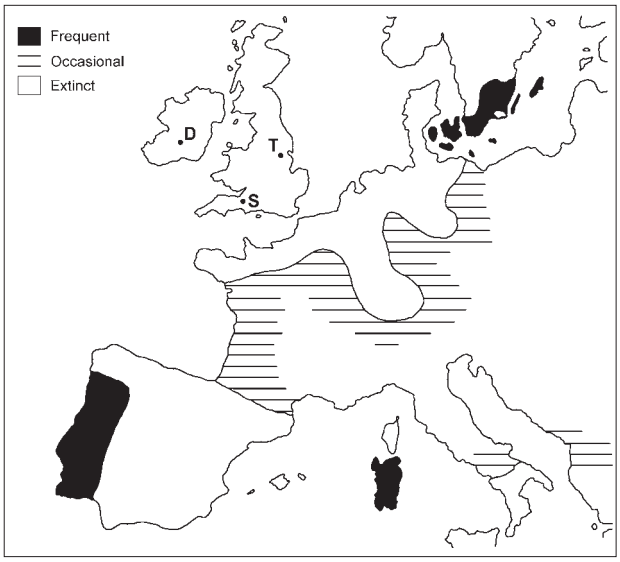

Fig. 8.5 Present distribution of Prostomis mandibularis in Western Europe (adapted from Buckland 1979). D=Derryville, S=Somerset Levels and T=Thorne Moors.

Added to that are two more species that do not occur on the Irish list of Coleoptera, one of whom is listed as endangered in the RDB. *Teredus cylindricus* has only been recorded from Sherwood Forest and Windsor Forest (Donisthorpe 1939) in Britain. On the Continent, it is distributed unevenly occurring on some Swedish islands, in southern Germany and Austria, with some old records from the Lower Rhineland, Thuringia and Bavaria (Horion 1951), and is considered a primary forest species. From archaeological contexts it has been found at Thorne Moors (Buckland 1979) and Runnymede Bridge (Robinson 1991). It is generally found in old beech and oak that has been infested with wood-boring beetles and in the nests of ants (particularly *Lasius brunneus*) in old trees. It appears to be a predator to ants and, interestingly, the most common anthropod at trackway level, apart from beetles, were ants, with twenty-nine heads recovered. One example of *Phloeophagus lignarius* was found which, although not uncommon in Britain, does not appear on the Irish list. It occurs in the sapwood of hardwood tree species and was also found at Runnymede Bridge (Robinson 1991).

Two other species found here that could not be taken beyond genus level were *Rhizophagus* sp. and *Cerylon* sp. Nevertheless, their presence amplifies the information from the previous species. *Rhizophagus* sp. is found under bark of all types of trees from pine to deciduous and also in sap and in tree fungi. *Cerylon* sp. is generally found under the bark of standing and fallen dead trees including oak, elm, beech, birch and lime. They are also found in the galleries left by other wood-borers and, in general, are native to areas of primary woodland.

Most of these species are indicators of primary or fairly unmodified secondary (sub-primary) forest cover, which must have existed on the fringes of the fen and raised bog. *Prostomis mandibularis* probably represents the last stages of the decay of wood, while the other species are found in drier wood.

The pollen diagram at this point (DV III) shows falls in tree pollen before the building of Derryfadda 23, probably corresponding to the removal of trees for construction of this and other trackways. However, plenty of primary woodland would seem to remain, which would have supported these beetle species, including birch, pine, elm and oak. The number of beetles from above the trackway (sample 10) is quite small but all indicate the continued development of the raised bog in this area after the trackway had gone out of use. Indeed, the area appears to be even wetter than before with true aquatic species making up the majority of individuals present, i.e. *Hydroporus melanarius*, *Enochrus* sp. and *Cyphon* sp. Only one anomaly appears, *Agriotes* sp., which occurs at the roots of grassland species. This was probably an accidental casualty from the nearby dryland.

Site-specific samples—Iron Age

Derryfadda 9, a platform radiocarbon dated to 395–180 BC, was also sampled for site-specific environmental information (Fig. 8.6). The species list is presented in Table 4 of the additional files. Casparie identified a bog-edge forest below the site and it appears to have been constructed within this (see Chapter 3).

Approximately 0.15m of peat below the site was examined but did not reach mineral soil (sample 614). It was very poor in terms of remains, indicating standing water and nearby grassland.

The platform itself produced slightly higher numbers but did not significantly increase or add to the species diversity (sample 613). The presence of *Dorytomus taeniatus*, common on willow, could be explained by local standing trees. Many water species were present and it has been suggested that the site was submerged in water for a time. These include three 'rarities' from an Irish perspective—*Agabus striolatus*, a species of relict fen carr, *Graphodytes* sp. and *Limnebius* sp. A number of species that occur on decaying vegetation were found, which probably reflect the accumulated vegetation on the platform. Although hazelnut shells were found at trackway level and below it, no specific indicator of hazel was found.

The layer above the platform was the most productive, although the numbers were still small compared to other sites. The majority of species were marsh/aquatic plants species, however, two species reflect the nearby upland, *Aphodius* sp. and *Phylopertha horticola*. The aquatic element appears to increase from below the site to above the site. This seems to be the case for most of the sites on the eastern margin and attests to the increased wetness overall of this area during this period. Nothing in the assemblages gave any clear indication as to the use of the platform.

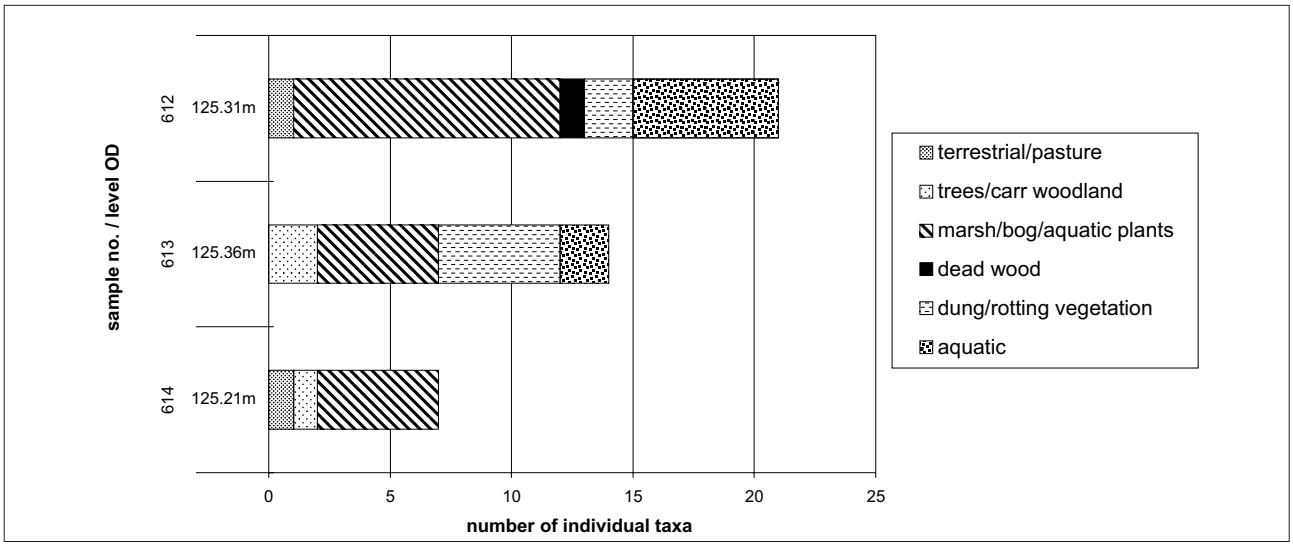

Fig. 8.6 Habitat data from site specific samples taken through Derryfadda 9. Field 51.

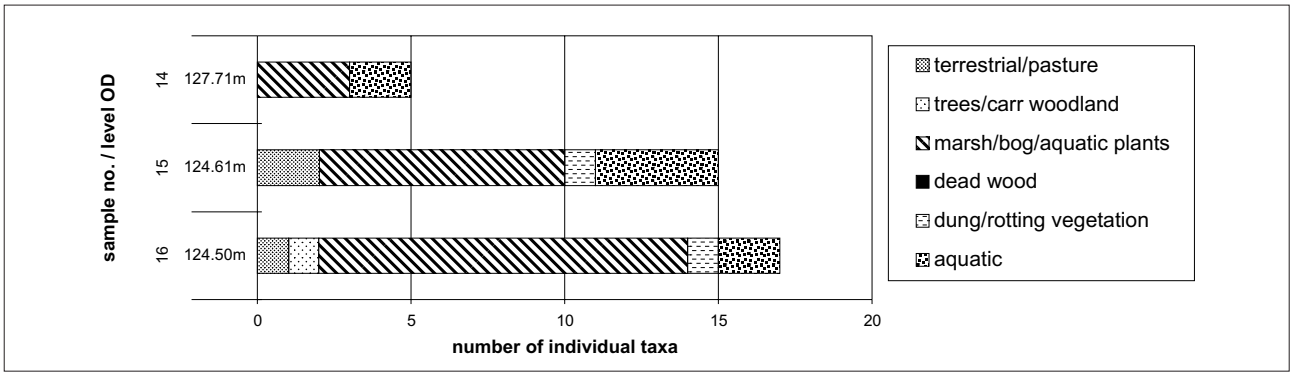

Fig. 8.7 Habitat data from site specific samples taken through Killoran 18 (east), Field 39.

Site-specific samples from the eastern end of Killoran 18—Bronze Age

These were taken from Killoran 18, the stone causeway, at Field 39 towards the eastern end of the trackway. A wood sample at this point produced a dendrochronological date of 1440±9 BC. A pollen diagram was also produced for this site (see Chapter 6). Killoran 18, although built not long after Derryfadda 23, was built in fen peat on top of a ridge which runs east–west across the whole basin. Peat morphology studies would appear to indicate that the building of the trackway itself profoundly changed the environment of the bog, precipitating the inception of raised bog over the whole length of the trackway (see Casparie, Chapter 3). The habitat data is presented in Fig. 8.7. The species list is in Table 5 of the additional files.

Below the trackway (sample 16, 124.5m OD), the majority of species show a typical fen environment. *Dyschirius globosus* is eurytropic on all types of wet ground. *Othius* sp. is a predator on small Carabidae and ants, and is found in mosses and leaves. A build-up of rotting plant remains would account for *Philonthus* sp. and *Bryaxis* sp., while *Brachygluta* sp. occurs in mosses and in decaying wood. One example of *Micrelus ericae* indicates the presence of raised bog plant species nearby. These species are reasonably well represented in the pollen zone T18ii, below the trackway construction level.

At trackway level (sample 15, 124.61m OD), a portion of a roundwood with many insect channels visible was taken as well as the surrounding peat. Although a lot of frass (white coating from larval channels) was recovered, no full individuals were found. Indeed, the channels may well have been the result of ant damage that would have provided prey for *Othius* sp. and *Quedius* sp. found in the previous sample. No clear woodland/dead wood indicators were recovered.

The fauna from the peat layer surrounding the wood yielded a typical range of raised bog species including *Plateumaris discolor,* which feeds at the roots of cotton grass and *Sphagnum*.

The layer from immediately above the trackway yielded poor numbers but all of the species indicate a raised bog environment (sample 14). *Plateumaris sericea* feeds on great reedmace and bur-reed, which are common near stands of water. Samples of almost pure cotton grass, as this one was have, unfortunately, proven to be very unproductive. The pollen diagram shows an increase of sedge pollen (undifferentiated) throughout zone T18iii, which indicates increased wetness throughout this period.

Samples from the opposite drain face were looked at as part of the preliminary survey by the IAWU in 1995 (IAWU 1996a). The two samples, one from the trackway and one from immediately above the trackway, produced remarkably similar results both in terms of assemblage size and environmental indicators. Indeed, a species tentatively identified in those samples as *Rhynchites* sp. (without the use of a comparative collection) has since been correctly identified as *Micrelus ericae*, the heather beetle. Its host plants, as noted in sample 16, are well represented in the pollen diagram. So, the lack of wood indicators holds true for these samples also.

The stark contrast between the trackway fauna of Derryfadda 23 and Killoran 18 would seem to suggest that many of the species found at Derryfadda 23 had already invaded the wood before it was brought out on to the bog. This idea will be explored more fully in the discussion below.

Western bog margin

Column samples from the western landfall of Killoran 18 and associated sites—Bronze Age to the early historic period.

Killoran 18 proved quite unproductive in terms of insect remains towards its eastern end. However, the nature of the peat in the middle of the bog, both at trackway level and above, was not conducive to good samples. The peat on the western margins proved to be more productive, particularly the fen peat. A column sample was taken in Field 17 from 124.14m OD (*c*. 0.2m below trackway level) to 126.087m OD (1.46m above the structure into raised bog). A sequence of samples for pollen and testate amoebae analysis was taken at the same location. A spot sample from a yew stump in Field 14 was placed stratigraphically in the column, as it added extra information to the site profile. Dendrochronology dates for Killoran 18 include 1542±9 BC (IAWU 1995). The species list is set out in Table 6 of the additional files and the habitat data is in Fig. 8.8.

The basal layer of light grey/brown peat had only two species present (sample 6510, 124.14–124.27m OD), *Limnobaris pilistrata*, which is found on reeds and rushes, and *Chrysomela* sp. There is only one member of this genus listed for Ireland, *C. aenea*, which is found on alder, but it is recorded only rarely in England (Maynard 1994). However, there are three other members of this genus in Britain found mainly on willow and poplar. All but the poplar species (Harde 1984) are rare or have not been recorded for a long time in Britain and are considered to be ancient broad-leaved woodland species (Hyman 1992; 1994).

The roots of the yew stump in Field 14 were used to support the substructure of Killoran 18 in this field (sample 6937, 124.2m OD). The assemblage from it is small but interesting in its composition. There were no aquatics and very few marsh/wetland indicators except *Cyphon* sp. and *Bagous* sp., an increasingly rare genus of wetland plant feeders. *Agonum fuliginosum* is found in wet carr woodland and *Rhynchaenus* sp. is a leaf miner in various deciduous and carr woodland tree species, not usually found in

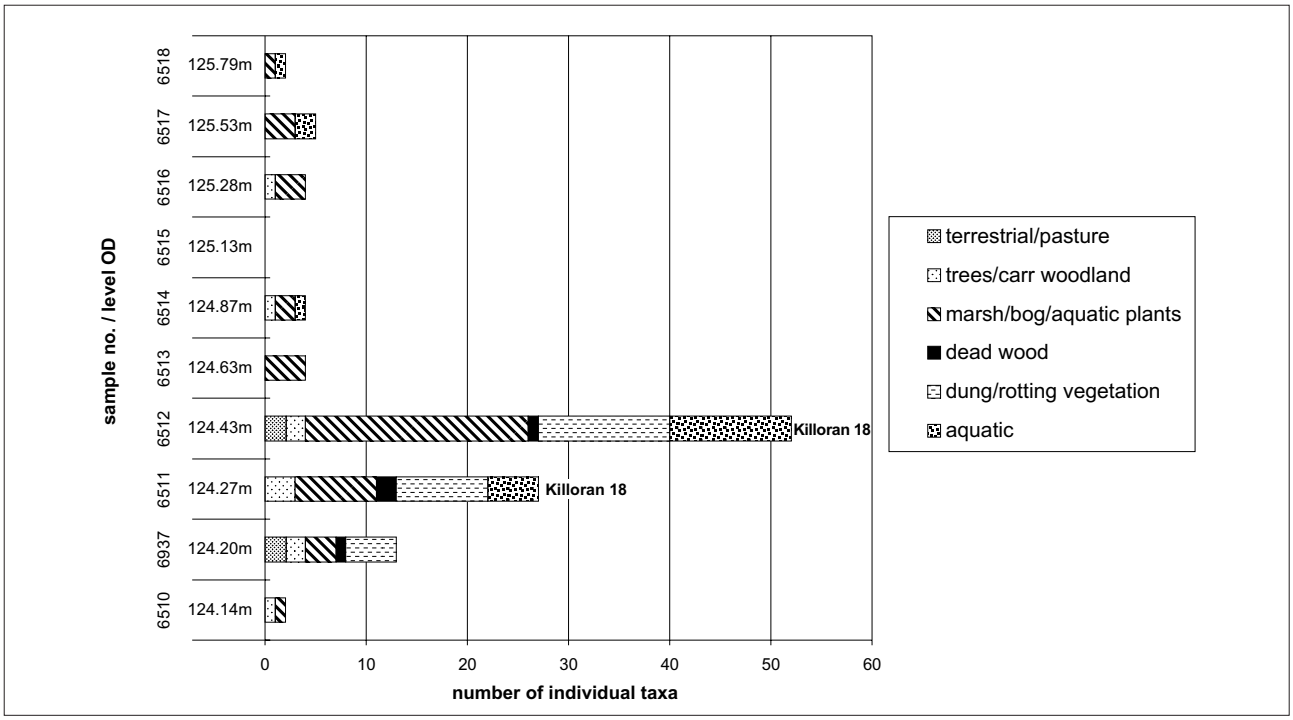

Fig. 8.8 Habitat data from column of samples taken through Killoran 18 (west), Field 17. Includes a spot sample from a yew stump from Field 14 (sample 6937).

yew. The rest of the assemblage indicates rotting organic matter and wood. *Platystethus arenarius* is found in rotten plant matter and dung and like *Carpelimus* sp., also recorded here, is very common in cesspits in later periods (Kenward and Hall 1995). Two examples of *Meligethes* sp., a pollen beetle found on various flowers and bushes, are recorded. It could be a dryland indicator and is also found on hawthorn and other small flowering trees.

The layer immediately above this (sample 6511) corresponds to Phase 2 of construction in this area, consisting of a rather scrappy deposit of brushwood. Species of note in this layer are the tiny rotting vegetation feeder *Acrotrichus* sp., found in compost heaps, dung and rotting fungi in wood. Also found at this level is the important *Rhyncolus ater*. This species is relatively localised in Britain (Hyman 1992), restricted to the Scots pine belt of Scotland and Sherwood and Windsor Forests in England, and is not known from Ireland. It is generally recorded from oak and Scots pine, and is regarded as a primary woodland species. However, unlike *Prostomis mandibularis* found at Derryfadda 23, it seems not to have been as sensitive to woodland management techniques such as clearance of fallen wood and selective tree felling, as it is known from medieval contexts at Back Lane, Dublin (Reilly 1997). It appears to have suffered most from the fragmentation of woodland during the more severe clearances of the 17th to 19th centuries.

The layer above this, which corresponds to Phase 3 of the causeway (sample 6012), was very species-rich. Killoran 18 was laid across the discharge channel of the bog at this point. The combination of wetness, aquatic plants and trackway wood contributed to the richness of this sample compared to similar track level samples further east. The ground beetles indicate both wooded and marshy ground, e.g. *Pterostichus niger* (woodland), *P. diligens* (fen and marsh) and *Dromius* sp. (woodland species especially of alder/willow carr). The leaf beetle *Chaetocnema hortensis* is found in willow carr usually under moss in these trees. It is worth noting here that a very high proportion of the wood used in the construction of Killoran 18 was willow.

There were a high number of water beetles mostly indicating stands of water and the increased wetness of this particular part of the trackway. The wetland plant indicators show a change from previous samples with rushes and reeds replaced by cotton grass, *Sphagnum* and heather (three examples of *Micrelus ericae* were present). *Alophus triguttatus*, found on clover, and *Chatocnema concinna*, found on many weed species, were both recovered at this level also, indicating either open grassland or disturbed ground. The dung beetle *Aphodius* sp. was also found and probably ties in with these findings.

A complete drop in the variety of species and habitats is seen after the trackway goes out of use (sample 6513). Studies of the peat morphology show that Killoran 18 completely changed the hydrology of the bog, effectively acting as a dam to the rising water table in this area (see Chapter 3). The effect of this was a rapid submerging of the trackway in raised bog as the rising water flooded over its length. The poor nutrient content of raised bog peat is reflected by the low numbers—only four individuals were recovered—*Stenus* sp., tolerant of most bog/marsh situations, and the heather beetle *Micrelus ericae*.

A marked drop in the water table from -0.01m to -0.1m below the surface around 1250 BC, at the time of Cooleeny bog burst C, is picked up at *c*. 124.80m OD in the testate amoebae (see Chapter 6). However, this does not manifest itself in a change in the insect fauna in sampling interval 6513. A rapid rise in the water table after this event probably masked any subtle changes.

From 124.87m to 125.28m OD (samples 6514 and 6515) almost no insect remains were recovered from the matted cotton grass layers. Above this, one or two interesting finds were noted (sample 6516). This level, like the next is dominated by *Sphagnum*. *Pterostichus minor* is generally a bog marginal/fen species and *Quedius* sp. is found in fungi and other rotting material. Both could be present due to in-wash from the bog margin.

At 125.53m to 125.79m OD, surprisingly for a sample dominated by *Sphagnum*, more insect remains were recovered than from the previous three levels (sample 6517). All species present were typical of this environment, e.g. acid water species *Hydroporus obscurus* and *Enochrus* sp.

From the testate amoebae and palaeohydrological data, these two samples roughly correspond to a period of very high water table from 380 BC onward (see Chapter 6). Above this layer, to the current bog surface, it reverts to an impoverished fauna typical of raised bog (sample 6518). The water table fluctuates between -1cm and -6cm during this period to the end of the sequence at approximately AD 720 (see Chapter 6).

Site-specific samples—Bronze Age

Two site-specific samples were taken from Killoran 18, Field 23. The trackway was less substantial at this point and the large flat stones gave way to smaller rounded stones. The runners were less substantial and rotted, with a lot of alder tree stumps present. One sample was taken from the trackway level and consisted of red-brown friable peat. The other came from immediately above the trackway and provides a dramatic contrast. There is no figure or table for this data as it is only used to illustrate the different areas of Killoran 18.

The number of insects recovered from the trackway level was very small (124.58–124.68m OD). While almost no aquatic species appear (except one example of *Hydroporus* sp.), all the other species present indicate fen with carr woodland. A number of tree stumps were found in this part of the trackway so it is possible that less stones were needed due to the ground being somewhat

drier. *Pterostichus strenuus* prefers the drier parts of alder carr woodland but also occurs in moss and *Sphagnum*, while *P. minor* occurs in bogs, swamps and near stands of water. *Drusilla canaliculata* is predatory on ants and is found under stones and in leaf litter. *Megasternum obscurum* occurs on very rotten plant matter and dung, both of which could have accumulated on the trackway surface if the area was relatively dry.

No discernible insect remains were recovered from the layer above the trackway surface (124.68–124.75m OD). Some very brittle and unidentifiable beetle parts were found as well as some mites. This was primarily due to the nature of the peat, which was extremely poorly humified cotton grass with a very high water content. The inundation of the whole length of Killoran 18, due to the nature of its construction, is consistently portrayed in the insect assemblages looked at in each area.

Site-specific samples—Late Bronze Age/Early Iron Age transition

Killoran 69, a trackway in a complex of sites to the northwest of Killoran 18, consisted of layers of closely packed roundwoods within compact, root-rich fen peat. It is dated to 838–799 BC. Samples were taken below, at and above the site. A piece of wood from the trackway from which some wood feeders were recovered was included in sample 6731. It was built at some points on laminated peat and mud, thought to be caused by a violent flooding episode, which resulted in parts of the trackway being dislodged and washed away. Where the samples were taken in Field 13 the trackway appears to have been built over a pool of *Menyanthes* and *Scheuchzeria palustris*, which eventually overwhelmed the track. The species list is set out in Table 7 of the additional files and the habitat data is in Fig. 8.9.

The layer below the trackway produced a small assemblage with the usual wetland species and associated rotting material and plant species (125.13–125.25m OD, sample 6730, Fig. 8.9). Two species were obvious imports and may be related to a flooding episode. *Chaetocnema concinna* is found on polygonum species and docks, and *Hypera plantaginis* is found on birds-foot trefoil.

The peat at trackway level was darker in colour to that beyond the trackway (amorphic), mostly due to the organic matter which builds up on the surface and the pressure exerted by use of the trackway (sample 6731, 125.25–125.48m OD). This sample showed an increase in species diversity and numbers, mostly due to the increase in water beetles, particularly pool species. Many of these species, e.g. *Limnebius* sp., *Paracymus* sp., have a terrestrial element in their life cycle so a build up of detritus and the presence of water make an ideal habitat. There is an indication of carr woodland also, e.g. *Dromius* sp. and *Agabus bipustulatus*. A piece of wood from this track was examined for wood analysis and three examples of *Grynobius planus*, two of which were immature, were recovered. This beetle attacks a wide range of tree species, boring into dry, usually dead, wood (Alexander 1994). In later times it became a common pest of structural wood (Kenward and Hall 1995), although never as significant as its better known family member, *Anobium punctatum* (the 'wood-worm' beetle). Based on the testate data for Killoran 18 (west), the building of the trackway would appear to correspond to a period with a high water table. A slight fall is noted after 850 BC but the major fall does not happen until after 700 BC (see Chapter 6).

The layer above the trackway consisted of fen peat with the beginnings of raised bog (sample 6732, 125.48–125.62m OD). It provided poor numbers of insect fragments. Species recovered were mostly water or detritus indicators as well as *Plateumaris* sp., a typical feeder on plants of this environment.

Column samples from western Killoran cluster—Bronze Age to early historic period

This cluster of sites was sampled by columns in two locations to maximise the information that could be recovered. *Fulacht fiadh* Killoran 240 and associated sites was sampled in Field 7. A number of spot samples were also included where they could be tied into the column samples either stratigraphically or by date. The juxtaposition of the trackway Killoran 75 and Killoran 234 made them a particularly favourable location for sampling. A column

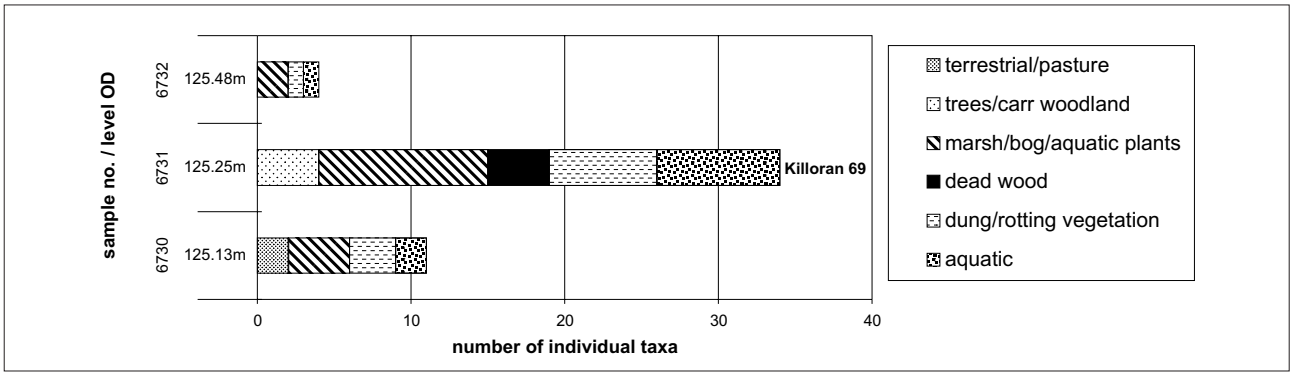

Fig. 8.9 Habitat data from site-specific samples taken through Killoran 69, Field 13.

of samples for pollen and testate amoebae analysis was also taken here. The peat morphology for this region has proved very complex and is reflected in the insect findings also. The presence of the northern discharge channel, running west and south of Killoran 240, passing Killoran 75 and on northward, has contributed to the rich and mixed nature of the fauna in this location. The local Killoran upland discharge system also influenced the hydrology of this area.

A column of samples was taken in the eastern drain face of Field 7 in an attempt to understand the relationship between trackway Killoran 243 and *fulacht fiadh* Killoran 240. Killoran 243 has been dated by dendrochronology to 979±9 BC. The date of Killoran 240 has not been established but is believed to be Middle Bronze Age, similar to other *fulachta fiadh* in the area. Parallel to Killoran 243 was Killoran 241, which was stratigraphically similar to it. However, it is dated to 1547±9 BC. It would appear that this area of the bog was affected by a very specific hydrological system emanating from the Killoran upland. It seems that any peat growth west of the *fulacht fiadh* mound between the building of Killoran 241 and the eventual building of Killoran 243 was washed away, resulting in two sites 800 years apart in age appearing at almost the same level. During excavation of the trough of Killoran 240, Field 8, two samples were taken from the fill, thought to be natural as opposed to deliberate backfill. One sample from an oak tree stump growing on the artificially dry ground provided by the *fulacht fiadh* mound in Field 8 was also looked at. It is possibly part of an oak regeneration phase dating to *c*. 1000 BC identified in DV IV in the pollen record (see Chapter 6) and can be stratigraphically linked to Killoran 240 and Killoran 243. One piece of hurdle wood from trackway Killoran 314, Field 9, was found to contain eighteen examples of a rare bark beetle (sample 5706). Stratigraphically, Killoran 314 is similar to Killoran 243, however, it is dated to 370–5 BC. Many layers of hurdle were laid down in what appears to have been a very wet area. It may have been affected by the discharge channel, which passed close to the east of Killoran 314. The full species list is found in Table 8 of the additional files and the habitat data is in Fig. 8.10.

The trough samples were looked at first, as stratigraphically they are the earliest (samples 5701 and 5702). Whether it was deliberately backfilled or naturally filled, it acted as a pitfall trap for certain species. The ground beetle *Carabus problematicus* is native to dry light woodland. The majority of water beetles recovered are found in stagnant water and a number of ground beetles, such as *Elaphrus cupreus* and *Agonum fuliginosum*, indicate wet, marshy conditions.

Geotrupes vernalis is found in sheep dung and other dung on grassland, and *Sitona* sp. is found in clover, buttercup and other grassland species. *Megasternum obscurum* is also found in dung. The grassland species *Phylopertha horticola* was present and, along with these insects, definitely point to an area of open ground or pasture nearby. Their presence in the trough may be due to discharge from the upland Killoran system across pasture close to the bog margin, perhaps relating to a period of settlement activity between 1600–1310 BC.

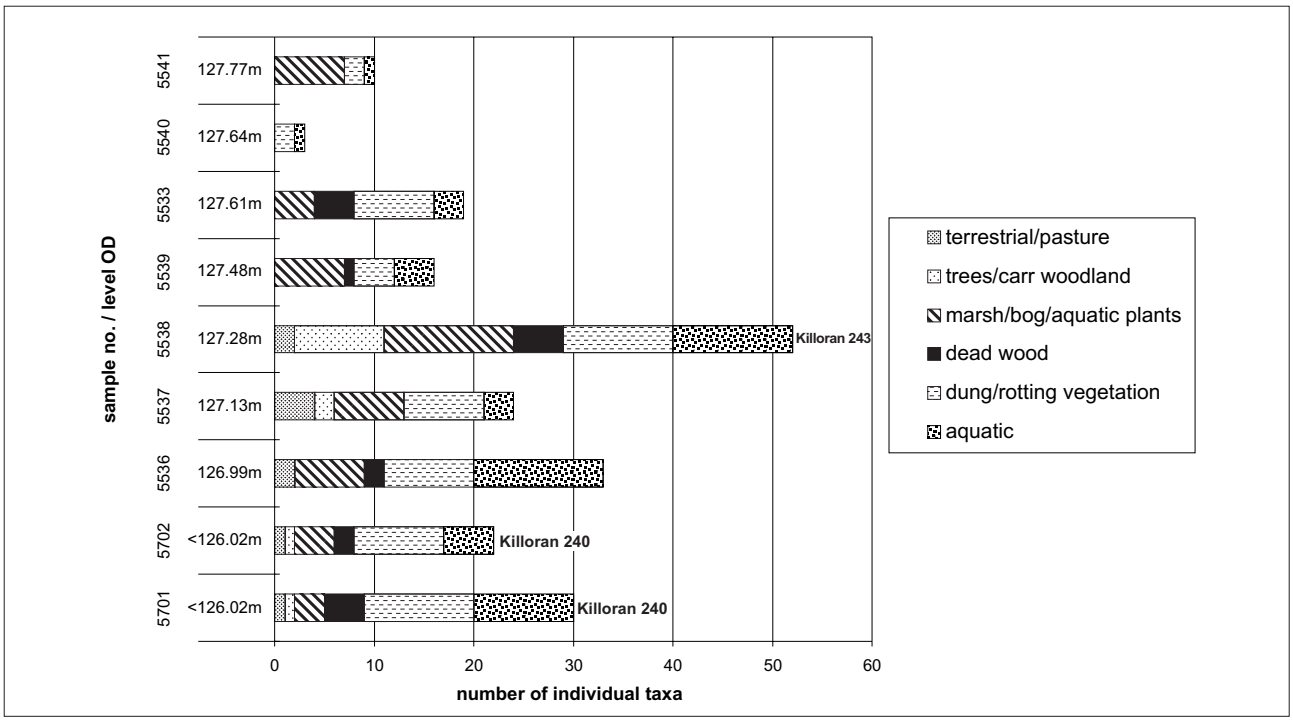

Fig. 8.10 Habitat data from column of samples taken through Killoran 243, Field 7, with two samples from the trough of Killoran 240, Field 8, and an oak bole, Field 8.

A number of species found in wood were recovered. These included the Scolytid *Xyloterus domesticus*, which attacks standing weakened trees or felled trees of lime, cherry, mountain ash, birch, hornbeam, alder and oak (Alexander 1994). Secondary indicators include the rare *Tachinus rufipennis*, a rove beetle which is found under bark and moss in wood; *Silpha atrata*, which eats snails under moss and bark, and a Ptilidae, many of which feed on the detritus of other wood feeders. All of these species could have come from the structural wood of the trough lining or surrounding natural wood that fell into the open trough.

Above mineral soil in the drain face was a light yellow brown fen peat with wood and silt inclusions, with a range of fen/marsh indicators, acid water/*Sphagnum* pools and running water species (sample 5536). Associated rotting vegetation and two possible dung indicators were also found.

Two species occur from outside this dominant habitat—*Calathus fuscipes*, a ground beetle strongly associated with dry and cultivated ground, and *Sitona* sp., which is found on clover among other grassland plants. The presence of silt throughout this layer may relate to the flooding episode described by Casparie for this area in *c*. 1600 BC (see Chapter 3), which may also explain the presence of dryland taxa. Certainly the pollen shows an expansion of grassland with some small areas of cultivation along the western bog margin in pollen zone DV III, 1640–1310 BC (see Chapter 6). Wood is present still with a couple of species that feed on wood moulds evident, including *Aspidiphorus orbiculare*.

The level above this early fen peat shows continued development of the fen and associated carr woodland but a reduction in the actual number of water beetles, indicating a possible dry period or stabilisation of the water table (sample 5537). Ground beetles such as *Pterostichus minor* and the water beetle *Agabus bipustulatus* are indicative of wet woodland and forest pools. There is a continued presence of surrounding grassland/dryland including *Phylopertha horticola* and the dung beetle *Aphodius contaminatus*, found in cow and horse dung.

The presence of trackway Killoran 243 increases the actual number of beetles by adding to the available habitat niches and overall species variation (sample 5538). *Agonum livens* is very rare in Britain, but apparently was not found in Ireland before 1976 (Speight 1976). It is found in birch/alder carr and, along with *Agonum fuliginosum*, are clear indicators of tree cover. *Cercyon convexiusculus* is found under moss, logs and fen litter usually in wooded situations. *Proteinus atomarius* is found in decaying fungi on the forest floor. *Cerylon* sp. is found in rotting wood and *Grynobius planus* is found in dry structural as well as natural wood. *Rhynchaenus* sp. are leaf miners in various deciduous tree species, so all stages of wood decay are represented. *Phylopertha horticola* is present also. *Ocypus olens* is an interesting inclusion as it is found under moss and in logs but also in cut grass and sand pits.

The layer that recorded the interface between fen and raised bog shows a big reduction in numbers of species (sample 5539). Some decaying vegetation species are present as well as dung beetles. *Plateumaris discolor*, which is found on cotton grass primarily, is present, as is *Micrelus ericae*, from heather. These are the first true raised bog species in the sequence. Although raised bog was well developed to the east of the Killoran 240, the presence of the *fulacht fiadh* mound appears to have created a drier micro-environment on its western slope. This was also noted at *fulacht fiadh* Derryfadda 216 on the eastern bog margin.

Although not part of the column, a sample taken from an oak stump, which turned up during initial machining of the area above Killoran 240, is looked at here (see Fig. 8.10) because stratigraphically it occurs at this level (sample 5533). It belongs to an oak regeneration phase during the Iron Age.

A mixture of species was recovered. The background fauna is of marshy conditions with acid pools and *Sphagnum*. The dung beetle *Aphodius* sp. is present, a constant throughout much of this sequence. The wood borer *Rhyncolus ater* is worthy of note and is described at Killoran 18 (Bronze Age levels). Secondary woodland indicators include *Cerylon histeroides*, *Atomaria* sp. and *Grynobius planus*.

A marked decrease in the number and diversity of species is seen (samples 5540 and 5541) from 127.64m OD to the top of the column. The dominant plant material is matted cotton grass. One water beetle, *Agabus* sp., is found in all types of water situations, mostly stagnant pools, fens and certain species are very acid tolerant. The other species are all found in decaying vegetation in marsh situations. This small micro-environment was eventually overwhelmed by raised bog which enveloped the mound of Killoran 240. The Killoran system discharging into the lower Derryville system eventually blocked it with extra peat growth, resulting in increased wetness in the whole northwestern area (see Chapter 3).

A sample of hazel wood from the hurdle at Killoran 314 (127.04m OD) was looked at for insect remains (sample 5706, not in Fig. 8.10). It was found to be infested with *Xyleborus dispar*, a Scolytid (bark beetle). This species has not been recorded before from Ireland and is native to ancient broad-leaved woodland occurring in the wood of oak, elm, hazel, holly, pear and plum. Adults emerge from late spring to early summer. In natural environments they are found in fallen branches, dead timber etc. However, they have adapted to woodland management and are found in felled wood and plantations, often becoming a pest in orchards (Hyman 1994).

A column of samples was taken from mineral soil to the top of the current bog surface at a point were Killoran 75 and Killoran 234 intersected. Killoran 234 is dated to 775–415 BC and Killoran 75 is dated to between

385 and 50 BC. The *Menyanthes* pool, which formed in this area as a result of discharges from the upland Killoran bog system, is dated to *c*. 600 BC. Peat formed to a depth of 0.8m between mineral soil and the building of Killoran 234. Due to the two discharge systems operating in this northwestern margin, peat formation occurred quite rapidly. It is difficult to say, therefore, how many years 0.8m of peat growth represents but a safe assumption is that it started probably somewhere in the Middle to Late Bronze Age. The species list is set out in Table 9 of the additional files and the habitat data is in Fig. 8.11.

The layer above mineral soil was dominated by beetles indicating woodland, probably carr. A lot of naturally occurring wood was found at this level (sample 6020, 125.56–125.76m OD). The ground beetle *Pterostichus niger* is a pronouncedly woodland species, while the water beetles *Suphrodytes dorsalis* and *Agabus melanarius* are common in freshwater forest pools with leaf detritus. Other species indicate a waterside environment, such as *Dryops* sp. and *Alophus triggutatus,* which is found on common comfrey. The Scolytid *Hylesinus oleiperda* is found in thin twigs and branches of ash (Alexander 1994). It has not been recorded from Ireland before, is very local in Britain (Duffy 1953) and is considered rare on the Continent (Talhouk 1969; Lekander *et al*. 1977).

The water beetles present in the layer above (sample 6021) indicates a degree of stagnation of the water present. *Paracymus scutellaris* is tolerant of shallow acid waters, and *Hydrobius fuscipes* and *Limnebius* sp. are found in vegetated pools and ditches, usually stagnant. Also, marsh and fen plants such as reeds and sedges are indicated by the presence of the leaf beetle *Donacia* sp. and the weevil *Erirhinus acridulus*. However, some wood is indicated by the presence of *Cerylon histeroides*, which is found under bark in rotting wood, and one example of *Tomicus minor/piniperda* (found at Derryfadda 6), a pine indicator (Alexander 1994).

In the level above this, a change is noted in the form of an increase in freshwater run-off (sample 6022, 125.96–126.16m OD). In particular, the water beetle *Ochthebius minimu*s is found in freshwater or indeed running water and *Agabus bipustulatus* is found in freshwater pools. A build-up of rotting vegetation and presence of dung is indicated by *Onthophilus striatus*, *Megasternum obscurum* and *Aphodius equestris* (a forest species, Landin 1961; Jessop 1986). Two interesting species present were *Melanotus* cf. *erythropus* and *Denticollis linearis*. These beetles are found in rotting wood feeding on other insects and their waste, particularly Scolytidae (Alexander 1994).

A well-developed woody fen peat is noted in the next level (sample 6023, 126.16–126.36m OD). Here there is a slight increase in freshwater or running water indicators such as *Ochthebius minimus*, however, they are certainly balanced by stagnant water indicators and species found in *Sphagnum* pools and detritus pools with increased acidity. The fen environment is clearly indicated by these and the weevil *Limnobaris pilistrata*, which is found on rushes and reeds. However, carr woodland is more clearly illustrated by the presence of woodland taxa such as *Bembidion harpaloides*, *Agonum assimile*, *A. fuliginosum* and *Pterostichus niger*. The anobidae *Grynobius planus* is found, as are the secondary wood feeders *Denticollis linearis* and *Melanotus* cf. *erythropus*. Again, a number of

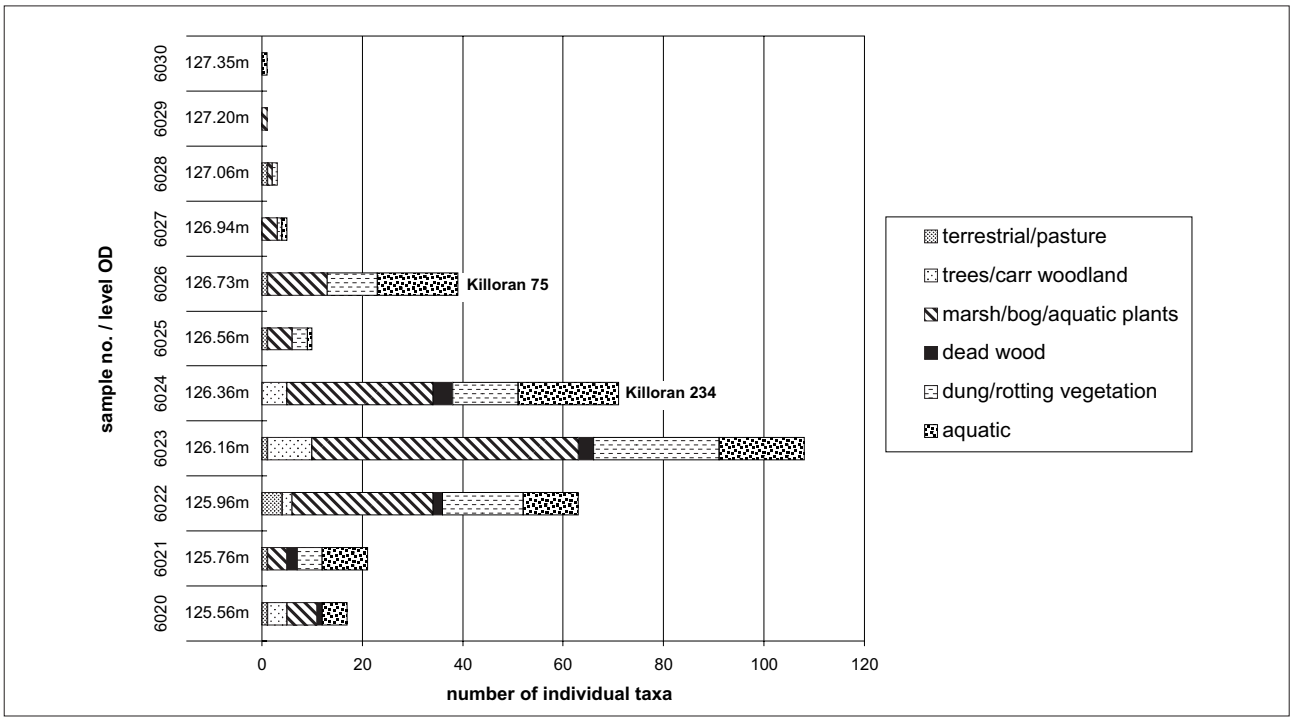

Fig. 8.11 Habitat data from site-specific samples taken through Killoran 234 and Killoran 75, Field 9.

dung beetles were found including *Aphodius lapponum*, found in sheep and deer dung in grassland and open ground, and *Geotrupes vernalis*, found in sheep and fox dung in grassland and moorland (RDB status: notable B, Hyman 1992). Other open ground species include *Phyllobius* sp., found on trees, grasses and nettles, and *Dascillus cervinus*, found on flowers and bushes. The presence of nearby open ground, possibly pasture, is a constant picture throughout these levels and mirror findings from the column at Killoran 240. It is likely that the presence of these species at this level relates to the beginnings of pollen zone DV V (1000–600 BC). This shows a marked drop in all tree species on the western margin (and throughout the bog area) and an increase in plantain (see Chapter 6).

The most numerous single genus is *Cyphon* sp., included as a fen/marsh indicator here as the larvae requires water to develop (Harde 1984). However, the adults are found in many situations, including under leaf litter, reed litter and in detritus pools, and would be common in a bog marginal forest environment.

The trackway Killoran 234 occurs at the next level but is in a very poor state and indeed the range of species present differs very little with the two levels below it (sample 6024, 126.36–126.56m OD). There are a high number of freshwater/running water indicators, in particular, a number of species which indicate freshwater or forest pools. Continuity from previous levels is evident from both wood feeders and dung/rotting vegetation species. Another dung species, *Aphodius foetens*, is present, found usually in deer and cow dung (Jessop 1986). While the leaf beetle *Prasocuris phelandrii* is found on brooklime, a waterside species (also found at Back Lane, Dublin, Reilly 1997).

The layer of *Scheuchzeria*-dominated pool peat shows a dramatic decrease in species and numbers typical of the poor faunal nature of this kind of peat (sample 6025). Interestingly, no water beetles are present except *Paracymus scutellaris*, which is highly tolerant of acid water. Other plant feeding species such as *Donacia* sp. and *Plateumaris discolor/sericea* are found on various waterside and raised bog species including *Sphagnum* and cotton grass.

The hurdle of trackway Killoran 75 is laid in this deep layer of *Scheuchzeria* peat at a height of 126.73–126.94m OD (sample 6026). Indeed, it would appear to have been laid at the deepest point of the pool and it seems evident that it could not have been used for a long time. It does not contribute significantly to the fauna itself, i.e. no wood feeders or even secondary feeders are recovered except *Atomaria* sp., a fungal feeder on wood. The main result of its presence is to increase the number of water beetles and detritus species compared to the pure layers of *Menyanthes* peat above and below. This may be because many of these beetles require some terrestrial element, whether it be at larval stage or otherwise, to survive, in particular, *Coelostoma orbiculare* and *Limnebius* sp. (Friday 1988). Detritus collecting on the surface of the track may have provided a habitat for taxa such as *Megasternum obscurum* and *Hydrobius fuscipes*. Many more aquatic plant feeders are present such as *Erirhinus* sp., *Limnobaris pilistrata* on reeds and rushes, and *Micrelus ericae*, on heather.

The hurdle was then enveloped by the *Scheuchzeria* and again a total drop in faunal numbers and diversity results (sample 6027). However, two species recorded here were found nowhere else in Derryville. *Sphaeridium scarabaeoides* is found in cow dung and *Chaetarthria seminulum* is found under moss and *Sphagnum* in bogs. *S. scarabaeoides* is a reasonably widespread species today but *C. seminulum* is considered quite rare. It is not clear why they should be found here and nowhere else.

From 127.06m OD to the top of the sequence, the peat is dominated by poorly humified cotton grass (samples 6028, 6029 and 6030). This is the start of the true raised bog in this area. However, one interesting finding is *Bembidion lampros* (6028), a ground beetle usually found in cultivated or waste ground. It is obviously a casualty from nearby dryland and from its level would seem to occur towards the end of pollen zone DV VII (200 BC–80 AD). This pollen zone records a major inwash of silt from the dryland corresponding to significant woodland removal in the specific catchment areas of the western bog margin (see Chapter 6).

Site-specific samples from southwestern Cooleeny cluster—Early Iron Age

Three samples were taken from the surface of causeway Cooleeny 31 in Field 19. Samples from within the causeway and beneath it were not possible due to the nature of the excavation and the height of the water table at this point. The primary aim of taking samples was to see if the beetles could shed any light on the use of the causeway, i.e. if dung beetles were present it might indicate animals and cart transport. Cooleeny 31 has been dated to 790–380 BC and 778–423 BC, and its massive construction and weight would appear to have contributed to the Cooleeny bog burst dated to *c*. 600 BC (bog burst D). The list of species is presented in Table 10 of the additional files and the habitat data in Fig. 8.12.

In findings not unlike Corlea 9, County Longford (Reilly 1996), the assemblage better reflects the surrounding environment in which the causeway is lying than the actual causeway itself. This is due mainly to compression of peat from above onto and between the timbers of the causeway. Although there is definite evidence for a build-up of organic matter on the causeway surface, only one true dung beetle is found—*Aphodius prodromu*s, found mainly in deer and horse dung (rarely in cow dung). This would not be enough to offer any definite conclusions as to causeway usage. Two species most likely directly related to the causeway are *Silpha atrata*, which is predatory on snails under mosses and bark, and the bark beetle *Xyloterus signatus* (not recorded from Ireland before). This beetle is classified notable B status in Britain and is

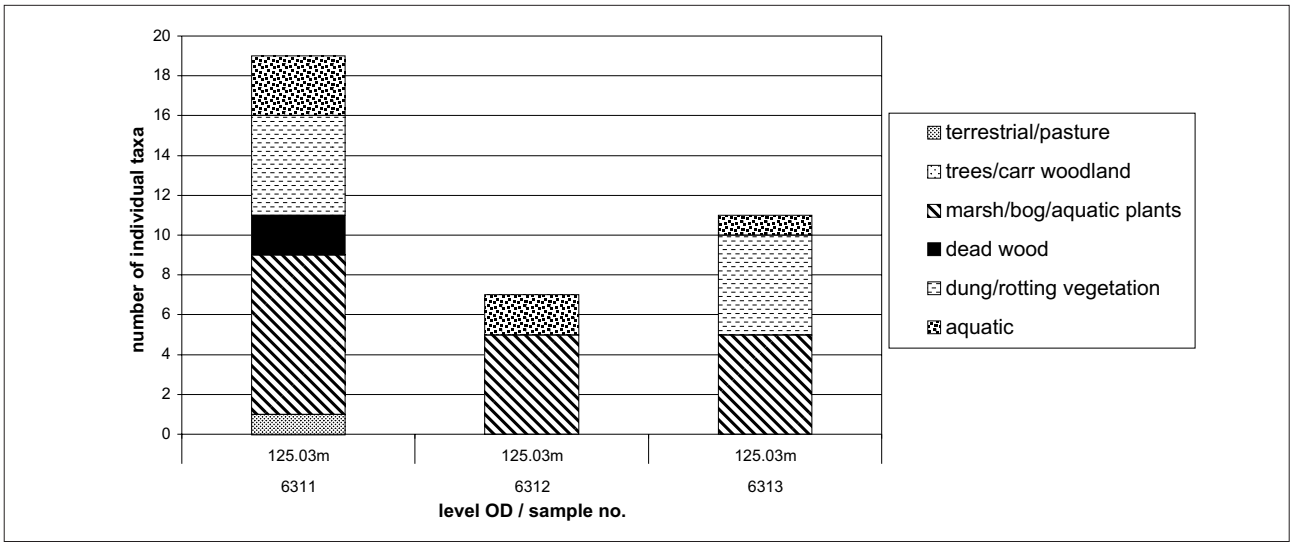

Fig. 8.12 Habitat data from samples taken across the surface of Cooleeny 31, Field 19.

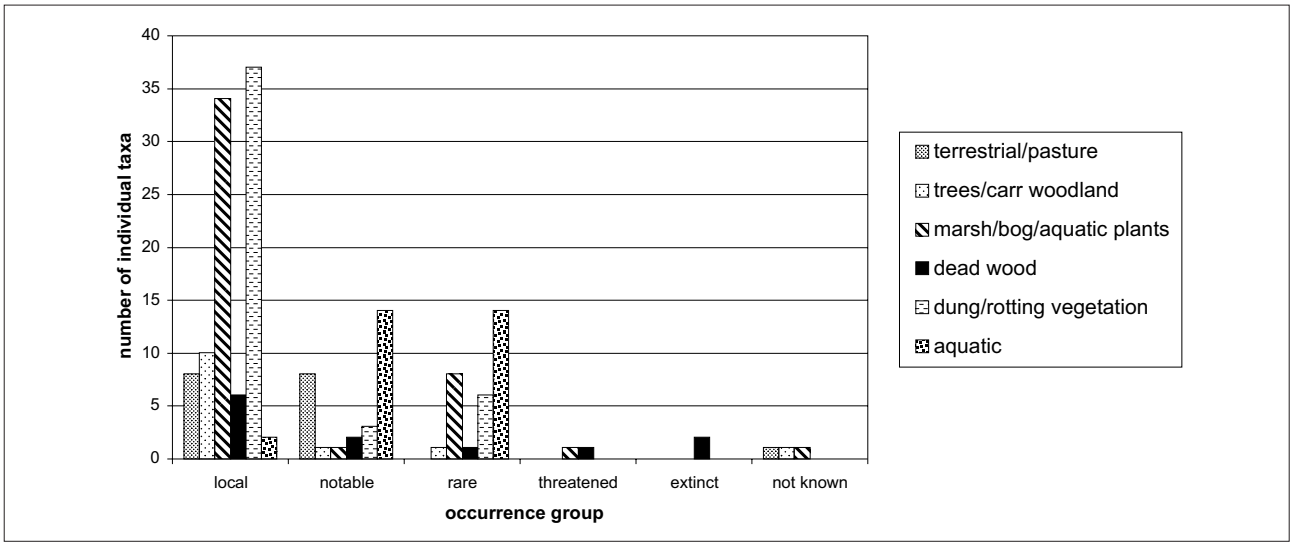

Fig. 8.13 Total number of individual taxa from selected occurrence groups from all samples, Derryville Bog.

found in ancient broad-leaved woodland in dead wood of oak and birch (it has also been found in ash, alder and beech, Hyman 1992). Like a number of other bark beetles from the western bog margin, this species has adapted to woodland management techniques and is found in newly felled trees in broad-leaved woodland plantations.

Landscape changes

Introduction

The information from the insect remains can be used to reconstruct macro-environmental changes and to identify relict landscapes. Three broad areas will be looked at with variations between the eastern and western margins highlighted, if any.

Taking all the species and genera together, and graphing their current status in Britain and Ireland (Fig. 8.13), a clear picture of these relict landscapes can be identified.

The vast majority of species from the 'notable B' to 'extinct' groups are related to woodland and wetland, particularly fen. The 'local' group adds carr woodland and dung to this picture. This is mainly due to the fact that species of dung beetle have become localised due to fragmentation of habitats and changes in agricultural practices; the same is true of carr woodland. A large number of species relating to wetland also appear here due to increased pressure from commercial peat production and agriculture on the few remaining natural wetland habitats in both Ireland and Britain.

Woodland

Some notable species found are now either rare or extinct in Ireland (Table 8.1). The finding of *Prostomis mandibularis* is particularly interesting as it gives us a very clear picture of the surrounding primary or sub-primary woodland during the Bronze Age, woodland that has all but disappeared from Ireland. It would seem that

P. mandibularis can also shed light on the construction of Derryfadda 23. The larger timbers had mortice holes and it was thought that they may have been reused. The location of Derryfadda 23, built on raised bog away from marginal forest, means that this species would not have invaded the wood after it was laid down in the bog as it is found only in forests, usually in the last stages of decay in damp wood. As Buckland noted in his study of Thorne Moors, "having evolved in a world carpeted with continuous forest and immediate proximity of suitable hosts for oviposition, many woodland insects tend to have very low dispersal potential" (1979, 144). This implies that the wood was already infested before being brought out to the construction site. It seems that it was not felled and brought to the bog immediately, but rather lay either on the forest floor or in proximity to it for long enough to be invaded by this species. The same can be said for *Teredus cylindricus* and probably for *Phloeophagus lignarius*, given the similar context in which they were found.

Dirhagus pygmaeus, however, although it does not appear on the Irish list, is found in carr woodland tree species such as alder and birch. The level from which it came at site Derryfadda 13a represented a maturing of the fen in this area prior to 1250 BC. Therefore, this species was recovered in a natural setting rather than from wood used in the construction of a site.

Similarly, *Tomicus minor/piniperda*, was found in the relatively dry layer above the *fulacht fiadh* Derryfadda 216, but before trackway Derryfadda 215 was constructed. Although the dry and well humified nature of this layer was not conducive to good preservation, the species found pointed to a covering of mixed woodland.

Apart from *P. lignarius* and *T. piniperda*, the species above are all considered primary woodland species. They are all rare, extinct or threatened in Britain (status in Ireland unknown) and have not adapted well to forest management practices or fragmentation of forest cover. These species were all recovered from the eastern margin from Middle Bronze Age contexts, and although similar periods were examined from the western margin, no species of equivalent rarity were found, except possibly *Rhyncolus ater*. Pollen diagrams show that clearance started in small amounts at first from 2300 BC onwards, with more widespread clearance from 1640 BC until about 1310 BC. The building of Derryfadda 23 falls into this time period. It would seem that enough damage had already taken place in the habitat of these species as they are not recovered from any site or layer later than this period. The earliest human activity may, therefore, have been on the eastern margin, however, the more widespread clearance and settlement on the bog margins would seem to have been concentrated on the western margin. A huge number of dryland sites of Bronze Age date have been excavated in this area compared to the relative paucity of dryland sites from the east.

This western settlement bias can also be seen from the number of beetle species found on the western margins that would not be considered particularly sensitive to woodland management. Although almost all do not appear on the Irish list and are of notable status in Britain, in general species such as *Xyloterus signatus*, *Hylesinus olieperda* and *Xyleborus dispar* are found in thin dead branches of trees such as ash, alder, hazel etc., and are well suited to coppiced woodland.

Species/Genus	Occurrence Status U.K./Irl.	General Habitat	Context in which species recovered
Dirhagus pygmaeus	rare/NL	dead wood	Derryfadda 13 natural
Prostomis mandibularis	extinct/NL	dead rotting wood	Derryfadda 23 structural
Teredus cylindricus	threatened/NL	dead wood	Derryfadda 23 structural
Rhyncolus ater	rare/NL	dead wood	Killoran 18 (west) structural, Killoran 240 oak stump, natural
Phloeophagus lignarius	local/NL	damp rotting wood	Derryfadda 23 structural
Hylesinus oleiperda	local/NL	dead wood	Killoran 234/75 natural
Xyloterus signatus	notable B/NL	dead wood	Cooleeny 31 structural?
Xyleborus dispar	notable B/NL	dead wood	Killoran 314 structural
Tomicus minor/ piniperda	rare/common/ NL/common	dead wood	Killoran 234/75 natural, Derryfadda 215/216 natural
Rhynchaenus sp.	varied status/ varied status	trees/carr woodland (leaf miner)	Killoran 243 structural, Killoran 18 (west) natural/structural
Tachinus rufipennis	rare/NL	trees/carr woodland	Killoran 240 (trough) natural

Table 8.1 Woodland species, occurrence status and context. (NL=Not Listed)

These species are found from Bronze Age through to Iron Age levels and, where found in structural wood, can provide anecdotal evidence for determining when a site was built. *X. dispar* was recovered in large numbers from a piece of hazel rod in the hurdle of Killoran 314. The area was very wet at the time it was laid down (370–5 BC) and the hurdle became waterlogged reasonably quickly after being laid, as five layers in total were used to compensate for the waterlogging.

This species, along with many of the other Scolytidae found at Derryville, emerge as adults in spring. They disperse and burrow into new wood, preferably newly fallen or cut, and lay eggs. The imagines are developed by early autumn and live inside the wood throughout their immature stage feeding on ambrosia fungus that develops inside their boreholes. This generally requires high humidity to develop. The new adults emerge the following spring. This life cycle takes one year to complete and would indicate that the wood was felled for this hurdle in spring, with the hurdle subsequently being submerged in water, killing the almost fully developed adults sometime in late winter or early spring.

All the Scolytidae species recovered, regardless of their ability to cope with woodland management, have suffered from severe fragmentation of their habitats. It may be that all of the species listed in Table 8.1 are still found in Ireland today and due to a lack of detailed studies of pockets of ancient woodland have been overlooked. It is more likely, however, that sustained clearance and manipulation of woodland from Neolithic times onward, and particularly during the seventeenth to neneteenth centuries, has meant the destruction of most of its ancient forest insect fauna also.

Wetlands

A number of aquatic genera found at Derryville are considered rare or vulnerable for much the same reason. The general use of midland raised bogs for commercial peat cutting has resulted in the destruction of many species natural habitats. Hammond noted that "undisturbed fens are rare and can only be found in a few counties in Ireland. Owing to their small size their representation on the map is not possible, even though there continued existence … is under threat from agricultural and urban pressures" (1981, 26). The study by Foster *et al.* (1992) of 289 water beetle assemblages collected since 1983 produced data on the frequency of occurrence of 165 different species of water beetle. It showed that some species of *Limnebius* and *Enochrus* are restricted to only one site each, and in a review of ten different water habitats, most of these species are restricted to base-rich fens, acid-rich fens occasionally receiving base-enriched water and acid bogs undiluted by base-rich water. Although they may be common in these relict areas, genera such as *Enochrus*, *Graphodytes* and *Limnebius* are extremely localised and could be threatened by further shrinkage of these habitats. It is worth noting that no modern example of *Agabus striolatus* (Derryfadda 9) was found in any of these assemblages.

The water beetles can be useful in reconstructing the changing hydrology of the bog in different locations (Figs 8.14 and 8.15). This is particularly useful where long sequences were sampled but this was not always possible. It must be noted, however, that the information is quite subjective as some water beetle species could be placed in multiple categories.

The purpose of these illustrations is to give a general idea of the sensitivity of the water beetle population to changes in hydrology.

Fig. 8.14, from the western margin, demonstrates the changing water regime in the vicinity of Killoran 234 and Killoran 75. The continuous run-off from the Killoran upland is well illustrated by the presence of species indicating flowing water. The freshwater element is largely illustrated by beetles occurring in freshwater forest pools, particularly *Agabus bipustulatus*, *A. melanarius* and *Suphrodytes dorsalis*. These fresher pools of water would have been short-lived as leaf fall increased stagnation and eventually lead to the formation of peaty hollows.

The increasing aquatic presence led eventually to the formation of the *Menyanthes* pool, which is represented by a complete drop in species presence. This is mainly due to the nutrient-poor nature of pure pool peats of this type. The presence of Killoran 75 brings the population up again temporarily, but this is short-lived and as the whole area is subsumed by raised bog, the numbers of water beetles (and all other categories) drops, those species present being indicative of acidic conditions. This information ties in with findings from the peat morphology (see Chapter 3) and the testate amoebae (see Chapter 6).

On the eastern bog margin, Fig. 8.15 illustrates the changing bog hydrology in the vicinity of Derryfadda 13a. The earliest layers illustrate the developing fen with the flowing water species indicating the nearby discharge system. The bog burst of 1250 BC (bog burst B) is clearly shown at sample 4, with a complete drop in all water species noted. The peat above this shows a forest floor fauna, indicating the drop in the water table and relatively dry nature of this area after the bog burst. A gradual recovery is seen as an increase in water beetle species by the construction of Derryfadda 13, however, a drop is again seen after this time. This could be caused by the influence of the Cooleeny bog burst of *c*. 600 BC (bog burst D); however, the exact date of the construction of Derryfadda 13a would be needed before this could be confirmed. The other reason for a drop in species is the development of raised bog and certainly the layers above the site show the beginnings of raised bog growth.

There is a general trend in all of the site sequences showing an increase in aquatic and raised bog beetle species in the later layers. This corresponds with well-established views on the nature of environmental change at macro-level throughout the Bronze Age and early Iron

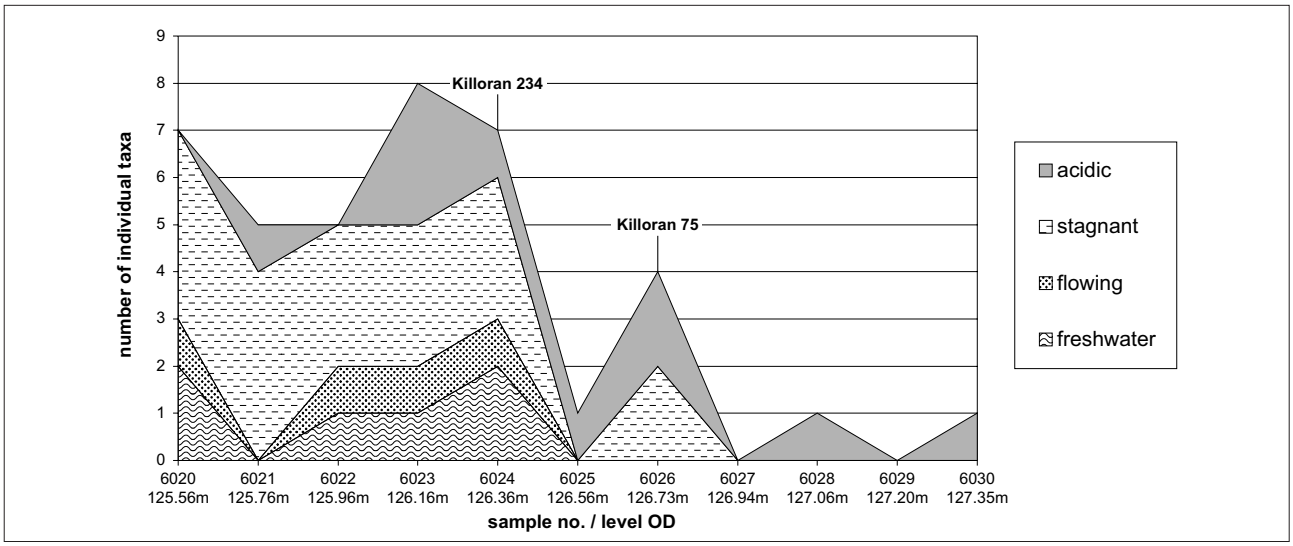

Fig. 8.14 Hydrology of Derryville Bog using water beetle species as indicators, as seen at column through Killoran 234 and Killoran 75, Field 9.

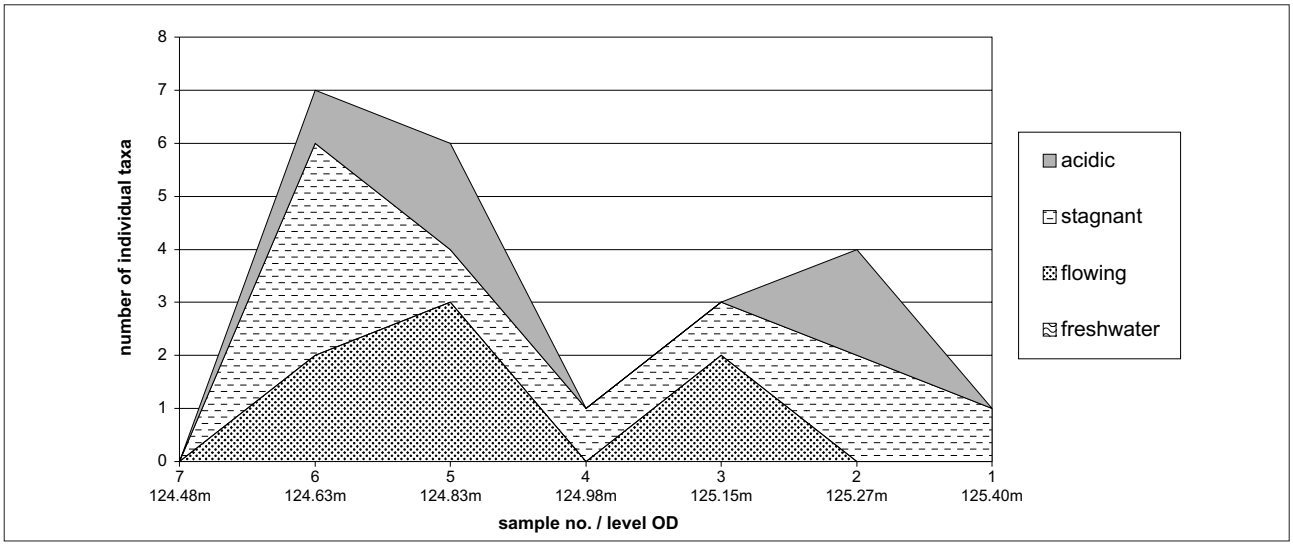

Fig. 8.15 Hydrology of Derryville Bog using water beetle species as indicators, as seen at column through Derryfadda 14, Field 46.

Age and the detailed peat morphological and testate amoebae studies of the bog. It is believed that climatic deterioration occurred during the Late Bronze Age and again at the end of the Iron Age, although it must be noted that widespread forest clearance on the nearby upland would have increased surface run-off in the immediate bog environs. This would have amplified increasingly wet conditions and encouraged raised bog development.

A small number of species found are now restricted to a more northerly range in Britain, for example, *Erirhinus acridulus*. This species was found in Windsor Forest Park by Donisthorpe (1939) but it is generally restricted to the northern Scottish islands such as the Outer Hebrides and Shetland. Lindroth (1973) noted it from between N and 69N in Norway but not above the treeline, and also from western Iceland. Its restricted occurrence may be due to the general shrinking of natural wetlands in Ireland and elsewhere, but may also be due to general climatic warming.

In general, however, unlike findings from the Somerset Levels (see Girling's various papers in the *Somerset Levels Papers* 1977–85), no beetles found at Derryville can be described as truly thermophilous (i.e. presence determined by temperature), either in terms of warmer temperatures or colder temperatures. Most of the extinct, rare and localised species found would seem to be restricted by habitat destruction or alteration.

Dryland: pasture and cultivation

The illustration of the changing nature of the surrounding upland is well demonstrated by the pollen data. However, the beetles have also shed some light on this. The woodland indicators have been discussed but many species that feed on grassland, meadow and disturbed ground plant species are found in the samples. Also, a large number of different dung beetle species, which may originate from animals grazing in bog marginal forest or as casualties

Species/Genus	Occurrence Status	General Habitat	Context in which species recovered
Bembidion lampros	common	cultivated/waste ground	above Killoran 75, raised bog sample
Calathus fuscipes	common	dry grassland/cultivated	above mineral soil Killoran 243
Pterostichus melanarius	local	grassland/disturbed ground	peat below Derryfadda 215
Chaetocnema concinna	common	various weed species	structural level Killoran 18 (west), level below Killoran 69, Cooleeny 32
Gastrophysa viridula	not known	various weed species	fen/alder carr level Derryfadda 13a column
Rhinoncus perpendicularis	widespread	various weed species	same as above
Alophus triguttatus	notable B	various grassland herbs	structural level Killoran 18 (west), mature fen levels Killoran 234/77 mature fen levels Killoran 234/77
Leiosoma oblongulum	notable B	buttercup family	peat below Derryfadda 215 & above Derryfadda 217
Agrypnus murinus	widespread	roots of grassland	fen/alder carr level Derryfadda 13a level
Geotrupes vernalis	notable B	dung in moor/grassland	trough of Killoran 240, Killoran 234 level and peat in level below
Onthophilus striatus	common	cow & deer dung etc.	fen/alder carr below Killoran 234
Cercyon sp.	varied status	various dung/rotting vegetation	structural level Killoran 243 amongst others
Megasternum obscurum	widespread		Field 17/23 trackway level Killoran 18, Killoran 243 various levels, below Killoran 69 etc.
Phylopertha horticola	widespread	roots of poor/wet grassland	almost every level Derryfadda 13a, Derryfadda 215/216 & Derryfadda 9. Different levels Killoran 240/245
Aphodius equestris/ foetens/lapponum/icterius	all very local	horse/cow/deer dung etc.	Killoran 240/243, Killoran 234/75, Cooleeny 31, Derryfadda 215/216, Derryfadda 13a

Table 8.2 Upland, pasture/cultivation indicators, occurrence status and context (selected species only).

from nearby pasture, are found. There are also a very small number of beetles associated today with cultivated ground. Although no firm conclusions can be made for the presence of cultivation, taken together with data from the pollen diagrams and dryland excavation evidence, a tentative picture can be drawn for particular parts of the bog margin. The information is summarised in Table 8.2.

The presence of pasture/open grassland is indicated by particular species from all levels within the columns. On the east, this is best represented by the beetle *Phylopertha horticola*, which occurs at almost all levels at Derryfadda 13a, Derryfadda 6 , Derryfadda 215 and Derryfadda 216, and below Derryfadda 9. It is mostly found on poor pasture, particularly that which occurs at the edge of rivers and lakes prone to flooding. This type of land must have been quite common at the edge of the developing fen, particularly in areas with steep slopes running down to the basin. Other species, such as *Agrypnus murinus* and *Gastrophysa viridula*, were found in Bronze Age levels at Derryfadda 13a. *Agrypnus murinus* feeds at the roots of grassland and *Gastrophysa viridula* feeds on disturbed ground weeds.

Equally, from the peat level below Derryfadda 215 (constructed in 457±9 BC) the ground beetle *Pterostichus melanarius* occurs, found in grassland and disturbed ground. A very small number of dung beetles were recovered from the eastern margin samples. Although open ground and poor pasture or water meadow was probably present here, the number of indicators is quite small adding to the picture that the eastern margin had a lower level and variety of settlement activity.

Ground beetles, cultivated/disturbed ground weed feeders and dung beetles are present from the earliest levels on the western margin. Some of the dung beetles present, e.g. *Aphodius equestris*, are forest species, however, it is very likely that the bog margins were frequented by grazing animals. Indeed, some trackway levels have dung beetles present, which may represent use by animals, but could also indicate rotting vegetation build-up on the trackway surface.

Weed and disturbed ground feeders are present at many levels, most notably *Chatocnema concinna*, *Alophus triguttatus* and various *Sitona* spp. They most likely arrived in fen and raised bog levels as casualties from upland through surface run-off. The ground beetle *Bembidion lampros* is a species of cultivated ground and, as mentioned above, its finding in later levels at Killoran 75 corresponds with a period of forest clearance.

Equally, *Calathus fuscipes* from the trough of Killoran 240, is predominantly found on cultivated ground. The period around and after the construction of the *fulacht fiadh*, the Middle Bronze Age, saw widespread forest clearance and undoubtedly some cultivation, as has been indicated by findings in the pollen record. The trackway level at Killoran 18 (west) also recorded a number of open ground species adding to the picture of increased dryland activity around the Middle Bronze Age.

The lull in clearance and settlement activity post-1310 BC, as indicated by the pollen record, is not as clear in the faunal record. However, there is an increase in dung and general disturbed ground species around the construction of Killoran 234. Built between 775–415 BC, this would seem to correspond to the interface of pollen zones DV V and DV VI, which shows clearance and continued, if variable, activity.