Fauna

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Mammals

Sheep, mostly Swaledale, are the most obvious mammals in Upper Teesdale and graze over much of the open upland areas. Rearing sheep on the uplands was first developed by Cistercian monks several hundred years ago, and this involved the burning of trees and shrubs which were at that time widespread in the uplands and replaced it by 'moorland', a mixture of grassland and heather which produced better grazing. Within the last 200 years, shooting red grouse (*Lagopus lagopus*) became fashionable and many areas of uplands had their management modified to increase the amounts of heather, the main food of adult red grouse. Currently, both sheep and grouse are a source of income and employment in Upper Teesdale and much of the area is covered by upland farms and open 'moorland'.

Many of the other mammals of the Upper Dale are inconspicuous or nocturnal. Roe deer (*Capreolus capreolus*) maintain good numbers and are increasing, but fallow deer (*Dama dama*) and red deer (*Cervus elaphus*) only occasionally wander into the area. Hedgehogs (*Erinaceus europaeus*) occur widely in the lower Dale but numbers have suffered over the past 10 years from road-kills. Badgers (*Meles meles*) occur throughout the Dale, up to 600 m, but are mainly restricted to woodland and areas of scrub. Otters (*Lutra lutra*) have made a comeback along the Tees as recorded by Durham Wildlife Trust surveys over the past four years.

Roe deer
© Hilary Chambers

Recent mild winters and less snow cover have led to rabbits (*Oryctolagus cuniculus*) becoming widespread, especially where soil allows burrowing, and even on the higher fells. This is exacerbated by low numbers of predators. High rabbit density in areas with deep soils produces in-breeding, with offspring colours varying from brown to brown/white to black (these individuals are not 'pet rabbits' that have been released!) Rabbits cause considerable problems for farmers and their overgrazing can threaten the survival of rare plants — five rabbits can eat as much as one sheep.

Hares are infrequent and rare on the moors. A large increase in mole (*Talpa europaea*) numbers over the past 20 years has created problems for farmers through disruption to grass/hay meadow growth and damage to big bale silage caused by molehill soil.

Small mammal trapping surveys in the juniper woodland and other woodland/grassland sites over the last 30 years show a steady population of short-tailed field vole (*Microtus agrestis*), bank vole (*Myodes glareolus*) and long-tailed wood mouse (*Apodemus sylvaticus*). 2015 and 2016 were explosive breeding seasons for short- tailed field vole. Abundant populations attract short- eared owls (*Asio flammeus*) to breed in the area.

Bank vole
© Hilary Chambers

Most of the mammalian carnivores, such as fox (*Vulpes vulpes*), stoat (*Mustela erminea*) and weasel (*Mustela nivalis*) are kept at a low density for the benefit of grey partridge (*Perdix perdix*), red grouse and black grouse and there is evidence that this management favours numbers of lapwing (*Vanellus vanellus*), golden plover (*Pluvialis apricaria*), snipe (*Gallinago gallinago*) and curlew (*Numenius arquata*).

Common shrew (*Sorex araneus*) is restricted to grasslands, with its main food, earthworms, restricted to mineral soils. Pygmy shrew (*Sorex minutus*) is even more abundant and occurs wherever there are peat soils. It was only within the last 50 years that it was discovered that it occurred commonly on moorlands and has an unusual distribution in England, mainly occurring in conifer woodlands, on sand dunes and areas of deep peat on the uplands; all areas with no or few earthworms and where the common shrew as a competitor does not occur. Both common and pygmy shrew have been found living on the summit of Great Dun Fell and this begs the question of how they survive during the winter since they do not hibernate and need to consume invertebrates every few hours. The ground on the fell tops during the winter is often frozen solid for weeks on end and how the shrews find food is unknown. One possibility is that at this time of year they retreat into places where there are deep and unfrozen burrows made by moles. A third shrew species, the water shrew (*Neomys fodiens*) occurs along the banks of the River Tees and its tributaries, although it is rarely reported. Repeated surveys from 2001 have reported good breeding populations of water vole (*Arvicola amphibious*) on the banks of rivers, becks and sikes, but heavy rainfall in exposed areas in more recent years has washed out many breeding sites.

Middleton-in-Teesdale is home to good numbers of all nine species of bat found in County Durham; whiskered/Brandt's (*Myotis mystacinus* / Myotis brandtii), Daubenton's (*Myotis daubentonii*), noctules (*Nyctalus noctula*), common pipistrelles (Pipiestrellus pipistrellus) and soprano pipistrelles (*Pipiestrellus pygmaeus*) are relatively common. The former Field Study Centre in Middleton, monitored by Durham Bat group since 1983, was an important nursery roost for whiskered bats until recently. Bats are scarcer up the Dale, but forage to Langdon Beck where Daubenton's bats and common pipistrelles have been recorded.

Whiskered and pipistrelle bats
© Noel Jackson

There was a brown long-eared bat (Plecotus auritus) roost at Bowlees Visitor Centre in the past. Newbiggin has an important colony of whiskered/Brandt's bats that moves between the former chapel and other buildings, possibly from a local nursery roost. The highest known roost is at Dent Bank where both brown long-eared and common pipistrelles breed.

The major importance of Upper Teesdale to bats is in late summer when the blooming heather is buzzing with insects. Bats follow the becks to the high moors to fatten up ready for hibernation in caves, adits and mines. Concerted work has shown that Moking Hurth, Elf Cleugh Cave, Swinhope Cave and Swinhope Mine provide a winter home for Brandt's, whiskered, Daubenton's, brown long-eared and Natterer's bats (*Myotis nattereri*).

Birds

The Dale has a large number of bird species recorded, many breeding, but most leave the area in winter, the notable exceptions being the two grouse species. Woodlands at lower altitudes have the expected mixture of small birds breeding, including the smallest British bird, the goldcrest (*Regulus regulus*) which has a preference for conifer plantations. Garden warblers (*Sylvia borin*) and willow warblers (*Phylloscopus trochilus*) continue to increase in number, but wood warbler (*Phylloscopus sibilatrix*) and tree pipit (*Anthus trivialis*) have disappeared during the last five to eight years. Within the last 50 years the Dale has lost two breeding bird species: corncrake (*Crex crex)* and dotterel (*Charadrius morinellus*), while twite (*Linaria flavirostris*), a small finch, only just manages to hangs on as a breeding species. In recent years four new species have been recorded as breeding: oystercatcher (*Haematopus ostralegus*), goosander (*Mergus merganser*), jackdaw (*Corvus monedula*) and ringed plover (*Charadrius hiaticula*).

Black Grouse

Black Grouse is perhaps the rarest English breeding bird in the Dale. Numbers, monitored annually, plummeted after the bad winters of 1976 to 1987, but a slow population recovery since then is largely attributed to more open winters and milder conditions. These birds form leks in the Dale. These sites, used yearly, are places where males collect within a small area in the spring to display to and attract females as mates. One lek is visible from the road running from Forest-in-Teesdale to St John's Chapel in Weardale.

Black Grouse on the Lek
© David Hill

Waders

Ten species of breeding waders, and one uncommon visitor, are highly conspicuous and form a major feature of Upper Teesdale. The Dale must rate within the top six to eight sites for breeding waders in Great Britain. No cereal or root crops are grown, but moorland, hay meadows, pastures and allotments provide a good mixture of breeding habitats for these birds.

These wading birds associated with upland farms and moorland may benefit from the control and reduction of predatory foxes, stoats, weasels and carrion crows by game keepers employed to manage moors for the benefit of red grouse. In many other areas, these wading birds have declined dramatically and mainly in areas where there is no control of predators.

Weather patterns have changed over the past 20 years; winters have been more open, with less snow cover over a shorter period of time on middle and higher ground. In recent years waders have returned to the Dale two to four weeks earlier, congregating on major sites as their numbers build up. Such sites record high numbers of species; lapwing (400 – 600), curlew (20 – 60+), golden plover (100 – 200), redshank (20), common snipe (20 – 30), oystercatcher (60 – 80). If the weather is settled, the birds disperse to their primary breeding sites, sometimes by late March. But they will return temporarily to their mustering areas if snow falls again. Surprisingly, 20 to 30 skylark may join them.

Lapwing

Lapwings are the most numerous wader and many breed in the upland pastures and hay meadows, particularly those without nearby trees which would be used by crows as lookouts for finding their nests. Occasionally pairs breed on Cross Fell. Despite national declines, lapwing numbers still remain high in the Dale and continue to be the subject of long-term research.

Following a period of hard winters, 1976 to 1986, the lapwing population increased greatly in the springs of 1987 to 1990. Very high numbers, with a spill-over from primary to secondary sites, were also recorded in 2007 and 2016, possibly due to milder winters.

Lapwing
© Hilary Chambers

Lapwing in flight
© C Keith Robson

Many of the young birds reared in the Dale return to breed very close to where they had hatched and often in the same field, but a few individuals move much further, with one ringed chick being found east of Moscow during a later breeding season. Early return in late February/early March and early nesting, before the ground has warmed up, risks food shortage — only one or two chicks surviving in the first brood.

Golden Plover

Golden plovers breed on the high fells above 400 m and on bogs, and in the breeding season follow walkers for considerable distances, giving their plaintive alarm calls. Calcium levels are low in their food on the acid moors and pairs regularly fly in the evenings to limestone areas at lower altitudes to consume snails, presumably to allow the female to accumulate the calcium needed for egg-shell production. Breeding numbers have not fluctuated over the past 46 years — 66 active nest sites have been recorded annually, with a variation of only four to six around this figure each year.

Golden Plover
© Hilary Chambers

Dunlin

Dunlin (*Caldris alpina*) are the smallest and rarest wader in the Dale with between eight and 16 scattered pairs breeding on the top of the high fells.

Curlew

Curlew breed on the lower moors and in rough pasture. They are conspicuous because of their size and aerial display flights, while their bubbling calls gives them their common name and their long, down-curved beaks make them readily identifiable. Breeding numbers were never high in the past but, unlike the national decline, curlew have enjoyed very good breeding seasons over the past three years. A late snowfall in March 2008 pushed waders down from the upper Dale, but more than 120 curlews remained, their long shanks and probing bills coping well with the deep snow.

Curlew
© Hilary Chambers

Common snipe

Common snipe are widespread on wet and boggy ground and difficult to see except when making their aerial displays, males repeatedly diving and vibrating two stiff tail feathers which produce a buzzing or drumming sound and reveals the presence of this otherwise secretive species. Breeding numbers fluctuate with high or low numbers from year to year.

Common Sandpiper

Common sandpiper (*Actitis hypoleucos*) is a migratory species restricted to the streams and edges of reservoirs and are readily recognised in flight, which involves several wing beats followed by a brief glide, or by their bobbing action as they walk along the stream edge and move from rock to rock. Surveys show a constant level of breeding populations. High spring or summer rainfall will wash out nest sites.

Common sandpiper
© Hilary Chambers

Oystercatcher with chicks
© Hilary Chambers

Oystercatcher

Oystercatchers have invaded the Dale over the last 50 years, with breeding flocks of 80 to 100 in the last 20 to 30 years. Formerly only coastal nesters, they have spread inland along rivers in northern England and now nest in small numbers in streamside fields and on gravel banks. This large and conspicuous black and white wader with red legs and bill engages in noisy piping displays that often involve a small group of individuals. It is a late breeder, usually raising two chicks.

Woodcock

Woodcock (*Scolopax rusticola*) mostly breed in upland woodlands. More recently a few nests have been seen on the high fells, moorland edge and among bracken (possibly due to open winters and less snow cover). They are infrequently seen except when the males become active near sunset, flying at tree canopy height like large bats and repeatedly patrolling back and forth in search of females. It is the only wader species that does not form lasting pairs while breeding and only the female takes care of the young.

Common Redshank

Common redshank (*Tringa totanus*) breeds on wet and marsh areas on farmland and is also noisy when protecting its breeding site, eggs and young. The double or triple alarm call is characteristic, as is the white and brown pattern when in flight and red legs. Records show mixed breeding seasons, good years then bad, for no apparent reason. 2016 was a very good year throughout the Dale.

Woodcock
© John Miller

Redshank
© Hilary Chambers

Ringed Plover

Ringed plover had previously been restricted to a few coastal nesting sites in County Durham but have recently invaded Upper Teesdale and a few now breed around the edges of the reservoirs.

Dotterel

Dotterel used to breed on the main fell tops, but now visit in small numbers only on spring, and sometimes on autumn, passage to and from more northern breeding sites. They sometime occur in small flocks known as 'trips' and the birds are noted for their tameness and the ease with which they can be approached.

Ducks

Few ducks breed in Upper Teesdale. Mallard (Anas platyrhynchos) is a fairly common breeding species, with large numbers overwintering and feeding in the fields and, in recent years, in sheep troughs. There were very few wigeon (*Anas penelope*) or teal (*Anas crecca*) pairs before 1980 and small numbers now nest in most years. The building of the Cow Green reservoir has encouraged a few fish-feeding goosanders to breed in the area on the Tees and Maize becks. Merganser (*Mergus serrator*) is a rare visitor, with only one breeding record (in the 1990s). Shelduck (*Tadorna tadorna*) pass over the area each summer on migration from Morecambe Bay and across the North Sea to the Heligoland Bight, where they moult their feathers and remain flightless until new feathers have grown and they then return to England.

Birds of prey

Kestrel (*Falco tinnunculus*) and merlin (*Falco columbarius*) breed in low numbers the upper Dale. Buzzard (*Buteo buteo*), peregrine (*Falco peregrinus*) and raven (*Corvus corax*) are present every season but fail to breed. Peregrine falcons are known to have bred previously in a few places in Upper Teesdale. Golden eagle (*Aquila chrysaetos*) and osprey (*Pandion haliaetus*) have occasionally been seen in the Dale, but neither breed here, while a few red kite (*Milvus milvus*) have spread into the area from a reintroduction programme near Gateshead. Hen harrier (*Circus cyaneus*) is rarely seen. Raptor conservation, particularly illegal persecution, is a major and urgent concern, locally and nationally.

Other species

Different species of small, perching birds breed on the moorland and in the wooded areas of the Dale. Meadow pipit (*Anthus pratensis*) is the commonest small bird on the moorland, while both skylark (Alauda arvensis) and yellow wagtail (*Motacilla flava*) occur in decreasing numbers in the meadows. Wheatear (*Oenanthe oenanthe*) and small numbers of ring ouzel (*Turdus torquatus*), the 'upland blackbird' with a white crescent on the breast, breed on the edges of the moorland where there are stone walls and mineral soils, but they generally avoid the extensive peatlands.

Dipper
© Keith Robson

Dippers (*Cinclus cinclus*) feed by swimming underwater in the streams to catch aquatic insects, while grey wagtail (*Motacilla cinerea*), which despite its name has yellow under parts and should not be confused with the yellow wagtail, is restricted to capturing insects which have recently emerged from the streams. Kingfisher (*Alcedo atthis*) is absent from most of the area.

Black-headed gulls (*Chroicocephalus ridibundas*) breed in the Dale and they nest in varying numbers alongside the upland reservoirs and small ponds. Some of their eggs are legally collected each year under an annual licence issued by Natural England and based on ancient traditional rights to do so. Common gulls are increasing in the winter. Gulls are very serious predators of lapwing nests.

Some bird species are declining in the Dale. Wheatears are fewer, but still widespread as are the yellow and pied wagtails (*Motacilla alba*). Cuckoo (*Cuculus canorus*) still occurs but in reduced numbers and does not follow its main host, the meadow pipit, onto the moorland as far or as extensively as it used to do.

Reptiles

Small numbers of adders (Vipera berus) occur in the lower woods, scrub areas and on the edge of the moorland and the viviparous lizard (*Lacerta vivipara*) is widespread over the moorland areas and individuals are sometimes found sunning themselves on sunny days.

Adder © John Grundy

Amphibians

Frogs (*Rana temporaria*) are incredibly abundant, and spawn in pools on mineral soils almost to the highest parts of the dale, but they do not use pools on blanket bog. Spawning in the spring is later than at lower altitudes and growth of the tadpoles is slightly slower, with a few even overwintering as tadpoles. Smooth newts (*Triturus lissotriton vulgaris*) and common toads (*Bufo bufo*) occur only in the lower areas of the Dale.

Invertebrates

Many of the interesting vertebrates living in Upper Teesdale are dependent on numerous invertebrates for food and many of these are abundant, with over 1,400 species recorded. Many insects are numerous, but the most abundant invertebrates are small, thread-like pot worms (*Enchytraeidae*) with over 200,000 and 3 million microscopic nematodes having been recorded in a square metre of upland soil, together with 80,000 springtails, 30,000 mites and 300 spiders. These small, but abundant, animals are the starting point of important food chains for larger invertebrates, such as beetles, true flies, harvestmen and spiders which, in turn, are key food sources for many of the vertebrates.

Sexton (burying) beetle infested on its head with mites. © Lesley Hodgson

Emperor moth caterpillar. © Fal Sarker

Violet ground beetle © Lesley Hodgson

The abundance of the invertebrates cannot be exaggerated and in simple terms for each sheep seen on the uplands in summer, there are tens times their weight of invertebrates hidden in the soils. Some of these invertebrates are extremely rare elsewhere in England and several have been described as species new to science. They all play an important role, along with sheep and fungi, in decomposing all of the annual production of grass on mineral soils, but they fail to do so on the peat areas because of the low nutrient quality of Sphagnum and cotton grass and this results in about ten percent of the annual production of plant material produced on the blanket bog remaining and being accumulated as peat.

Unlike many areas of the Arctic, blood-sucking mosquitoes are absent from the moorland, but there are other blood-sucking flies in the Dale. The most irritating are the very small biting midges known scientifically as *Culicoides* or commonly as no-see-ums (and other unrepeatable names used by local people) and these make themselves known to visitors on the few warm days with little wind between April to October. Several species of the blood-sucking blackflies (also called buffalo gnats and not to be confused with the aphids of the same name which occur on plants), and their larvae, live in the fast-flowing streams. The small adults suck the blood of birds and mammals and some species take blood from humans and some fly many kilometres to obtain a blood meal. In June and July, the larger horseflies can also common and even more readily attempt to obtain a blood meal from people.

In contrast to the distribution of rare plant species in Upper Teesdale, the areas of deep peat and the fast-flowing streams which lie at the head of Teesdale hold almost all of the rare invertebrate species which occur in the Dale and very few are associated with sugar limestone. Because of this difference, many of the zoological studies in the Dale have centred on the higher ground of the Moor House National Nature Reserve, which lies to the south and west of the River Tees, starting at the river's source between Cross Fell and Little Dun Fell. This reserve is an area mainly dominated by deep, blanket bog and wet flushes which rarely dry out because it has a high rainfall and low temperatures throughout the year, producing a climate comparable to many sub-Arctic and tundra areas of northern Europe and also with Iceland at sea-level.

A major reason for the high diversity of invertebrates in the Dale is the wide range of soil types, ranging from deep organic blanket peats through shallow peaty heaths, to rich brown earth mineral soils. These soils have very different invertebrate faunas and this difference makes an appreciable contribution to the high diversity found in the Dale.

A second factor is the high rainfall which keeps the ground wet or moist for much of the time and which is appreciably higher at the higher altitudes and this is important because many of the invertebrate animals are small and run a high risk of dehydration. Annual rainfall at Moor House (550 m) is three times greater than at Durham City, while the frequent mists and drizzle results in precipitation falling for ten times longer. These differences, combined with the lower temperatures, result in the soil and peat rarely drying out and so permit the abundance of many small animal species which are unable to exist at lower altitudes.

Invertebrate fauna of grassland and peatland habitats

Upland grasslands

These consist mainly of alluvial soils alongside streams and restricted areas where limestone is at or near the surface and produces rich mineral soils. Peat does not accumulate on these areas because the whole annual production of vegetation is decomposed or is washed away by frequent floods. The invertebrate species are typical of those also found on lowland grasslands and few are nationally rare.

Upland blanket peat

Upland blanket peat has a metre or more of peat which has accumulated since the last Ice Age. This peat is nutrient-poor as the depth of peat prevents the roots of plants from reaching the underlying mineral sub-soil and so has a vegetation restricted to those plant species which can live under these nutrient-poor and waterlogged conditions and are dominated by heather, cotton grass and Sphagnum moss. These areas resemble the tundra of Arctic and sub-Arctic areas and which also naturally lack trees and often contain the same invertebrate species. Thus on the blanket bog and the stream side grasslands, two very different faunas exist side by side, one associated with temperate grasslands and the other with arctic areas.

Northern Heaths

These are areas where heather is abundant but there is little or no peat, and the soils are mainly mineral with only small pockets of shallow peat. These are usually at a lower altitude and have been called Northern Heaths and were forested until cleared for sheep grazing and are now regularly burnt to encourage short heather for red grouse or in a few places more heavily burnt to increase grass for sheep grazing.

Cessation of regular burning results in the re- establishment of trees. As a result, these areas are a man-made habitat and have not yet developed their own natural fauna and so are species- poor. Many of the insect species present require and pass part of their lifecycle in sheep dung.

The invertebrates found on these three main habitat types are very different. Earthworms are abundant on the mineral grassland soils and occur at up to 400 under a square metre of ground. In contrast, earthworms are totally absent on blanket bog and few exist on heaths. The role of major invertebrates on blanket bogs are replaced by the larvae (often called leather jackets) of crane-flies (*Tipulidae*) (daddy-long-legs) and these can occur as hundreds of larvae per square metre and 69 species have been recorded at Moor House.

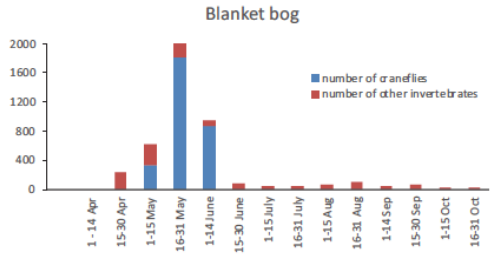

Figure 1: The numbers of invertebrates emerging from a square metre of ground on blanket bog in two-weekly periods from April to the end of October. No captures were made from November to March. No earthworms were present in the soil.

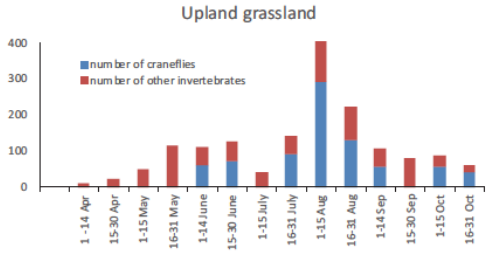

Figure 2: The captures of invertebrates from a square metre of ground at two-week intervals on upland grassland at Moor House from April to the end of October. Note the reduced scale compared to Figure 1 and the much later peak of captures which were all different species to those on blanket bog. Earthworms are not included but were present throughout.

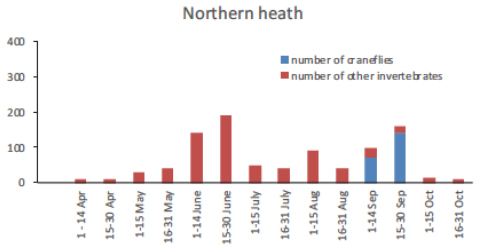

Figure 3: The numbers of active invertebrates per square metre on a Northern Heath in Upper Teesdale. Note the change of scale. Numbers of captures are much lower than on the Blanket Bog and Northern Heath sites. They involve few rare species and were spread out through the late spring, summer and early autumn. Earthworms were uncommon in the soil throughout the year.

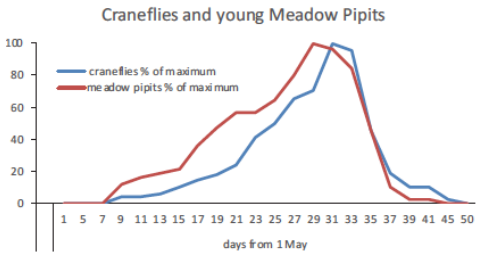

Figure 4: The co-incidence of the emergence of adult craneflies on blanket bog and the numbers of young Meadow Pipits in nests at Moor House.

As many of the insects occurring on the blanket bog are northern species and presumably evolved in cold areas of the world where the short summers are only long enough to permit a maximum of one generation each year, the insects almost all pupate and emerge as adults in response to the spring rise in temperature or the lengthening day. Using environmental cues occurring later in the year runs the risk of winter conditions returning before they reach adulthood.

As a result, there is a remarkable synchronised emergence of insects on both the arctic tundra and on the blanket bog in Upper Teesdale and most of the individuals are three species of craneflies. Only one of these has been given a common name and has been called the 'grouse fly' because it is eaten in large numbers by young red grouse. It is small, black, has reduced wings, cannot fly and its scientific name is *Molophilus ater*; it occurs at up to a thousand individuals to the square metre. The other species are *Tipula subnodicornis*, a larger species and only the males can fly and *Tricyphona immaculata*, where both sexes are able to fly only short distances.

The emergence at the end of May and in the first half of June is a period of superabundance of surface-active insects on the blanket bog, but since none of these species feed as adults they, like mayflies, live for only a few days. Yet at the peak of emergence the blanket bog shimmers as the adults crawl over the heather on a sunny day in search of mates or to lay eggs, but this is soon followed by a paucity of active invertebrates on the blanket bog until the next generation of adults a year later. The pattern of abundance of invertebrate, including craneflies, on blanket peat is shown in Figure 1.

In many cases the grasslands along upland streams, only a few metres from blanket bog, show a very different pattern of invertebrate activity during the year. This mainly involves different species, and insects use different cues as to when to pupate. The peak of craneflies is in August and is due to the emergence of the common cranefly (*Tipula paludosa*) which is also abundant on lowland grasslands and often flies into houses in the autumn. There is no major spring abundance of invertebrates on the grasslands.

As a result of the abundance of heather on Northern Heaths it might be expected to have a similar invertebrate fauna to blanket bog, but this is not so. Craneflies are scarce, apart from the emergence of *Tipula marmorata* in September — a species whose larvae feed on mosses and is also common in the lowlands. Many of the insects recorded on these heaths are species associated with dung and if there are no sheep grazing these areas, they would have an even lower diversity. There is only a minor peak of invertebrates in the spring.

The seasonal abundance of invertebrates, and particularly of insects, is important to the success of many of the bird species breeding on the blanket bogs of Upper Teesdale. They are consumed by young wading birds, such as golden plover and curlew, by red grouse and meadow pipits and it is important that these birds breed at a time when this abundant food is available for their chicks, because the periods before and after are times when food is scarce. The close link between the period that the meadow pipit have young in the nest is closely correlated with the peak of emergence of insects on the blanket peat (see Figure 4) and it is evident that the eggs in this species are mainly laid about two weeks before the major emergence takes place. Presumably the birds, like the insects, are responding to the rise in temperature rather than identifying the start of pupation by insects.

The abundance of food on the blanket bog at this time of year is remarkable and one pair of meadow pipits repeatedly walked in a small circle about 2 m radius from the nest collecting craneflies to feed to their chicks and not having to fly to suitable feeding areas. Although the meadow pipit is claimed to rear two broods each year, only a few produce a second brood in Upper Teesdale and while these young are in the nest there is very little food available on the peat areas and they are fed almost exclusively on insects emerging from or alongside the streams, with some adults nesting on the blanket peat flying up to 2 km to collect food for the nestlings.

In contrast to the meadow pipit, the recently hatched young of wading birds which all have well developed legs on hatching, are frequently led by their parents to suitable feeding grounds. Common sandpiper chicks are almost always led down-stream and the headwaters of the Tees is rapidly emptied of these birds. Adult woodcock are reputed to fly, carrying a chick between their thighs, and to take them past obstructions to reach good feeding areas, but this does not seem to have been observed in Teesdale.

Rarer invertebrates

Only one rare species has been recorded, in the Cow Green area — the round-mouthed whorl snail (*Vertigo genesii*), discovered in 1979 on Widdybank Fell. This very small snail is a glacial relict which was widespread following the last glaciation, but this is the first time it has been recorded in England in recent times. In contrast, at least five species of invertebrates new to science and four found for the first time in England (including a species of flea) have been found on the higher areas of blanket peat forming the Moor House National Nature Reserve. Some taxonomic groups are represented by many species in Upper Teesdale. A total of 157 species of rove beetles and 69 species of craneflies have been found and identified from Moor House and more must exist at lower altitudes in Upper Teesdale.

The streams contain the nymphs of several interesting insects, such as the rare stoneflies *Capnia vidua* and *Protonemoura montana* and the mayfly *Ameletus inopinatus*, all of which have a very restricted distribution to upland areas in Britain. Some upland pools have the predatory nymphs of the large common hawker dragonfly (Aeshna juncea) and large red damselfly (Pyrrhosoma nymphula) and a few have the remarkable larvae of the cranefly (*Phalacrocera replicata*), which in colour and shape closely resemble pieces of Sphagnum moss.

Apart from the flowering of thyme in July and heather in August, there are relatively few flowering plants on the blanket peat areas and this is reflected in only one common bee species, *Bombus jonellus*, being widely distributed and there are few other insect species in the area which rely on nectar and pollen as a food source.

Nightly trapping of moths over the past 44 years has recorded over 200 species of macro moth. April to September are the most prolific months with up to ten species caught each night including Hebrew character (*Orthosia gothica*), large yellow underwing (*Noctua pronuba*), silver Y (*Autographa gamma*) and July highflyer (*Hydriomena furcata*). Fewer moths fly in the winter: November moth (*Epirrita dilutata*), December moth (*Poecilocampa populi*) and winter moth (*Operophtera fagata*) are examples.

The common moths which occur on the wet, high altitude moors are restricted to those which pupate on vegetation above the ground and so avoid the wet, waterlogged soils. The beautiful emperor moth (*Saturnia pavonia*) and northern eggar (*Lasiocampa callunae*) are both large, day-flying moths whose larvae feed mainly on heather and which occur on the high moors. Strangely, the emperor moth can complete its lifecycle in a year, but the northern eggar takes two years, despite both species often occurring together and using the same larval food. Further, the latter species fluctuates dramatically in numbers from year to year, while numbers of the Emperor are much more consistent.

Large Yellow
© Keith Robson

Underwing Common Blue
© Keith Robson

July Higflyer
© Keith Robson

The most abundant moth on the moorlands is the minute rush moth (*Coleophora alticolella*). The larvae feed on the seed capsules of the Moor Rush and the distribution of the moth fluctuates and this is determined by the variable altitude at which the rush sets seed each year. Many will have seen the small silk case produced by the caterpillar protruding from the seed capsules and not recognised these as containing a moth caterpillar. Interestingly, the rush has been setting seed at higher altitudes in recent years and the moth has spread to altitudes over 600 m in some recent years, but every now and again, the rush fails to set seed above a lower altitude, and the caterpillars hatching from eggs laid at the higher levels starve and as a result the moth is again restricted to lower altitudes. In effect it is a biological game of 'snakes and ladders' and offers an insight into how climate variations can directly affect a plant and as a consequence, an insect which feeds on its seeds.

Butterflies are poorly represented and become even less common as one proceeds up the Dale, but these are occasionally increased by migratory species such as painted lady (*Vanessa cardui*) visiting from the continent. A butterfly transect at 300m, part of a national monitoring programme, has been surveyed between April and September for over 40 years. Sixteen species have been recorded in one year, green veined white (*Pieris napi*) being most abundant and with two broods per season. Good numbers of red admiral (*Vanessa atalanta*), peacock (*Aglais io*) and small white (*Pieris rapae*) have been recorded, moderate counts of small heath (*Coenonympha pamphilus*) and less of common blue (*Polyommatus icarus*). Large white (*Pieris brassicae*), comma (Polygonia c-album), small skipper (*Thymelicus sylvestris*) and small copper (*Lycaena phlaeas*) are rarely recorded. Small tortoiseshell (*Aglais urticae*) has declined in recent years, but dark green fritillary (*Argynnis algaja*) and ringlet (*Aphantopus hyperantus*) have rapidly increased over the past six years.