LIFE IN A HEDGE

Robert Wolton

A Dunnock nest in one of the hedge's Bramble outgrowths. Robert Wolton

The author reports on the number of species found in a single Devon hedge, explains why this number is so high, and discusses what this means for hedge and landscape management.

On New Year's Day 2011, I embarked on a two-year intensive study of a single hedge to see how many species of plant, animal and fungus I could find within it. Why? I wanted to provide further insight into the importance of hedges for wildlife. Nobody appears to have attempted this before, to record everything in a hedge, at least not across all major taxonomic groups. In this article, I not only reveal how many species I found, which was a quite remarkable total, but also, through observation and reference to published research, explore what makes for a good wildlife hedge. I hope that the evidence presented will be useful for the conservation and management of this valuable, yet under-appreciated, habitat.

Recording and identification

I set myself two basic rules about which species to count. First, they had to be big enough to see with the naked eye, and, secondly, they had to be observed or caught within 2m of the tips of shrub or tree growth. Cormorants *Phalacrocorax carbo* or Swifts *Apus apus* flying high overhead were ignored!

To supplement records made by observation and hand-netting, I employed a variety of techniques. The most productive of these was a Malaise trap, very effective at catching flying insects, especially flies and wasps (mainly parasitoids such as ichneumons). Moths, along with many caddisflies and craneflies, were sampled by tucking a light-trap into the base of the hedge. Six emergence traps, home-made from fine netting stretched over a simple wire armature, were placed at intervals along the bank, ditch or margins; each covered 0.5sq m. Other techniques used included small-mammal traps,

Box 1 The chosen hedge

The hedge is on our farm in the middle of Devon, within sight of Dartmoor a few miles to the south. I chose it solely because it begins just 40m from our house, to one side of the access lane: I wanted to be able to visit the hedge at the drop of a hat. As hedges in Devon go, it is nothing exceptional – there are thousands of similar roadside hedges throughout the county. Nevertheless, it is towards the top end of hedges in the British Isles in terms of habitat quality.

Being a Devon hedge, it has at its heart an earth bank, in this case about 0.75m high and 2.5m wide. A wide range of shrubs and trees grows on this, Hawthorn *Crataegus monogyna*, Blackthorn *Prunus spinosa*, Hazel *Corylus avellana* and Grey Willow *Salix cinerea* predominating. Three young Pedunculate Oaks *Quercus robur*, some 25 years old and 7m tall, emerge above the shrub layer. Along the lane side of the bank lies a shallow ditch which flows with water following heavy rain and within which grows much Hemlock Water-dropwort *Oenanthe crocata*. Between the ditch and the tarmac there is a narrow margin with tall herbs such as Nettle *Urtica dioica*, Cow Parsley *Anthriscus sylvestris* and Hogweed *Heracleum sphondylium*. On the other side of the hedge is another herbaceous margin, kept fairly short by grazing since the field is permanent pasture. This margin has tussocks of Cock's-foot grass *Dactylis glomerata* and Soft Rush *Juncus effusus*, along with Knapweed *Centaurea nigra*, Bugle *Ajuga reptans*, Greater Bird's-foot-trefoil *Lotus pedunculatus*, mints *Mentha* and other flowers. The hedge is 85m in length, and 6.5m wide between the outside edges of the margins. I don't know its age, but it predates the 1845 parish tithe map. A more detailed description can be found in Wolton *et al.* 2014, while full information on Devon hedges can be found in a new book (Devon Hedge Group & Devon County Council 2014).

sheets of tin on the ground, sweep-netting, beating and a few pitfall traps. Holes were dug to sample worms and other soil fauna.

I was given essential help with identification by many experts (see Acknowledgements).

Species count

To date, a total of 2,070 species has been identified at the hedge. A breakdown by major taxonomic groups is given in Fig. 1 on page 308, but this is by no means the full picture, as many groups have been poorly sampled while just a few species from others have as yet been identified. On a shelf in the Natural History Museum in London there are bottles full of hundreds of species of parasitoid Hymenoptera awaiting identification when either the technology or the funding makes this possible. Many planthoppers, psyllids and aphids (Homoptera) also remain to be identified, along with numerous midges and other primitive flies (Nematocera). Even among

The hedge showing the lane side in spring and the field side in summer. The tent-like structure is a Malaise trap and the white domes are home-made emergence traps. Robert Wolton

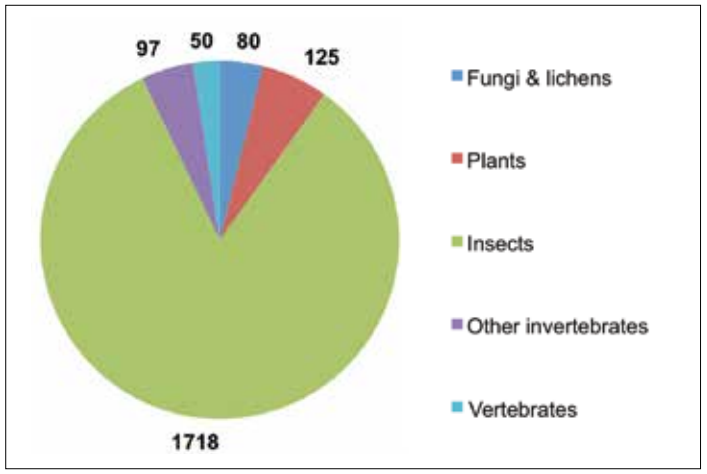


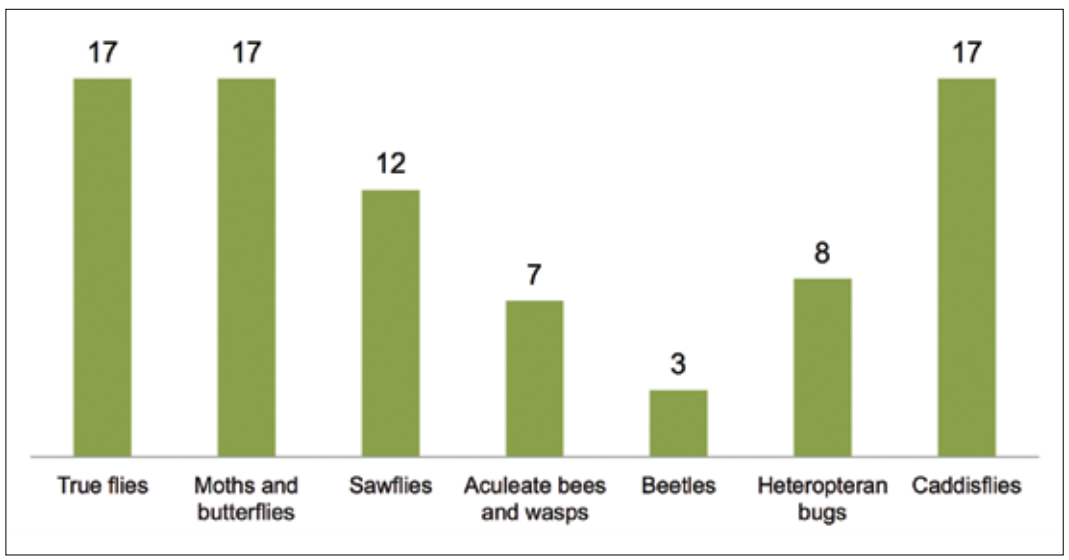
Figure 1 The number of species identified in each major taxonomic grouping.

the birds I know that the list is incomplete. For example, both Tawny Owl *Strix aluco* and Sparrowhawk *Accipiter nisus* are frequent on the farm, yet I never happened to see them at the hedge. I expect that the true total of organisms big enough to be seen with the naked eye is closer to 3,000.

To most people, this high number is a staggering revelation. Walking briskly along a hedge, one is usually aware of little more than the larger plants, a few birds and the odd rabbit. The trouble is, as Gordon Corbet (2011) observed in his *British Wildlife* article 'Life on the links – a perspective on biodiversity', we are far too big to see most wildlife easily. If we were ant-sized, we would be aware of so much more. And even then we would overlook myriads of micro-organisms.

As may be expected, the great majority (83%) of species found were insects. Other invertebrates included 50 species of spider, harvestman and pseudoscorpion (just a few gall-forming mites were identified), and 13 molluscs. Fig. 2 gives some context to the insect numbers. For those families identified to species level, no fewer than 17% of all the true flies, butterflies and moths, and caddisflies so far recorded in the British Isles were found in the hedge over the two years of sampling. The figures are lower for other groups. Nevertheless, I think it reasonable to suggest that, with further sampling and full identification, some 10–12% of the 24,000 insects on the British list may be found at the hedge. Numbers of British insect species are taken from Barnard (2011).

Figure 2 The percentage of all species of seven insect groups known from the British Isles recorded at the hedge.



At just 3% of the British list, the number of beetles found at the hedge is lower than expected. This almost certainly reflects poor sampling. Pitfall traps proved difficult to use, pan traps were not placed under the Malaise trap, abundant Bramble *Rubus fruticosus* growth made beating and sweeping difficult, and no suction sampling was carried out. Other groups that were poorly sampled include fungi, with very few fruiting bodies produced in 2012 and no rusts or smuts identified. Georg Müller (2013) found 280 species of fungus on a single hedge bank in Germany, while I found just 56.

Is the hedge good or bad?

So, a great many animal species were seen or captured at the hedge. The all-important question that follows is this: Are these species benefiting from the hedge, or do hedges, as John Dover has described it to me, act as drift nets, waylaying and obstructing animals when going about their normal day-to-day activities or dispersing?

To try to answer this, I spent much time in observing the behaviour of birds, insects and so forth at the hedge, and reviewed the relevant literature. The firm conclusion which I reached is that the great majority of species do benefit from the hedge. They may use it in a variety of ways: for breeding (nesting, larval development, etc.), as a food source, for shelter from harsh weather or predators, as a place to find mates, or as a safe flyway or navigation aid. A few records will be for incidental visitors, but even they will be benefiting from the hedge, such as the Sedge Warbler *Acrocephalus schoenobaenus* that stopped off for a few days – it must have found food there.

The emergence traps give an indication of the number of insect species breeding in soil, litter or plants at the base of the hedge, including the ditch and immediate margins. Although these traps covered just 0.05% of the area of the hedge, they caught no fewer than 162 true fly species from 38 families, together with a few moths among other flying insects. A further 19 flies were recorded as either leaf mines or galls, so that, at the very least, 22% of the flies recorded at the hedge breed within it, and the true proportion is likely to be considerably higher. For instance, larvae of 42 of the 48 hoverfly species recorded more than five times could potentially have developed in the hedge since the necessary larval microhabitat was present, whereas only five species appeared in the emergence traps (Wolton *et al.* 2014).

Published accounts show that most vertebrates, whether it be Common Toads *Bufo bufo*, Grass Snakes *Natrix natrix*, Common Lizards *Zootoca vivipara*, Weasels *Mustela nivalis* or bats, choose to stick closely to hedges and similar uncropped features within farmed landscapes. Most readers will be familiar with the way in which parties of small birds work their way along hedges while foraging. Woodland birds are three times as likely to move along hedges as across open fields (Bellamy & Hinsley 2005), and the same behaviour holds true for invertebrates. Butterflies, moths and hoverflies are well known to follow hedges, favouring the sheltered conditions and stopping off to nectar on flowers. The only occasion on which it was obvious to me that the hedge was just an obstacle was when I saw a Large White butterfly *Pieris brassicae* fly towards it from across the field, rise up over it, and continue on its way.

Are there rarities present?

An appreciable number of species recorded at the hedge are considered nationally rare, scarce or threatened. The biological recording database which I use, MapMate, gives 16 of the invertebrates recorded as Red Data Book species, and 60 as nationally scarce. Although this database does not reflect fully the recently published and ongoing reviews of species status which use stringent IUCN criteria, the numbers nevertheless demonstrate that many invertebrates present are of conservation concern. Turning to the vertebrates, six red-listed and five amber-listed birds were recorded, three of them nesting, namely Song Thrush *Turdus philomelos* (red-listed), and Dunnock *Prunella modularis* and Bullfinch *Pyrrhula pyrrhula* (both amber-listed). A Hazel Dormouse *Muscardinus avellanarius* built its nest in a Bramble outgrowth, and youngsters were seen.

Altogether, 40 Species of Principal Importance for the conservation of biodiversity under Section 41 of the Natural Environment and Rural Communities Act (2006) were recorded. These consisted of 26 species of widespread yet rapidly declining moths, along with Common Toad, Grass Snake, Common Lizard,

This young Hazel Dormouse was born in a nest in the hedge. Robert Wolton

Dunnock, Song Thrush, Spotted Flycatcher *Muscicapa striata*, Marsh Tit *Poecile palustris*, Willow Tit *P. montana*, House Sparrow *Passer domesticus*, Bullfinch, Brown Long-eared Bat *Plecotus auritus*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Hedgehog *Erinaceus europaeus* and Hazel Dormouse.

Why does the hedge support so many species?

To answer this question, I shall consider the influence of several factors, including the composition and connectedness of the surrounding landscape, hedge structure, plant diversity and the 'green-lane effect'.

The landscape context The hedge does not exist in isolation but, rather, it lies within a landscape which retains many wildlife habitats, some close by. This is perhaps the most important reason for the high species count. There is a small farm pond just 20m away on the other side of the lane, a small woodland with native broadleaf species 130m across the field, and a small stream at one end. Although a neighbouring farm is intensive dairy and there are no protected sites or nature reserves nearby, the landscape meets the standards of High Nature Value farmland (see www.high-nature-value-farming.eu).

On its own, the hedge is likely to provide only some of the resources needed by many, perhaps most, of the animals recorded at it. True, it may well still be important, even essential, for local-population survival, but only together with surrounding features that provide complementary resources. The behaviour of some dance flies (Empididae) demonstrates the benefits of small-scale habitat heterogeneity particularly well, different habitats providing different resources. Certain *Hilara* species occur as larvae in open grassland, form mating swarms around bushes (as within hedges) and hunt at the edges of ponds (Delettre *et al*. 1998). All three habitats need to be present in close proximity for these flies to thrive.

Connectivity The hedge is connected directly or indirectly to other hedges in a network which extends for tens of kilometres in all directions. Devon farmers have removed few hedges in comparison with those in most of the rest of Britain. The physical continuity of habitat created by the network of hedges is itself likely to account for some of the species richness.

Putting migration to one side, animals make two main types of movement: those involved in the everyday search for food or mates, perhaps back and forth from breeding sites, and those involved in dispersal. If we look at the influence of hedges on everyday movements, Hazel Dormice and some bats are known to turn around when they encounter even quite small gaps, just about 5m wide, in hedges (e.g. Bright 1998). The same is true for such insects as butterflies and bumblebees: they prefer to move through the landscape along continuous linear features such as hedges, rather than taking the most direct route between resources. Indeed, seed set due to bumblebee pollination increases where patches of flowers are linked by hedges (Cranmer *et al*. 2011). On the other hand, in a study of Linnets *Carduelis cannabina*, breeding success actually increased after more than half the hedges were removed from the landscape, an effect due in part, at least, to the use of hedges as movement corridors by corvids and mustelids, the main predators of eggs and nestlings (Eybert *et al*. 1995).

The picture for dispersal movement is similarly conflicting and occasionally counter-intuitive. Some studies show that hedge continuity enhances gene flow and the ability of organisms to (re) colonise new areas, whereas others show the opposite. Evidence for a positive role in dispersal is provided by research in Sweden which showed that trees with animal-dispersed seeds (Hazel, Hawthorn, Spindle *Euonymus europaeus* and oak) were more frequent in well-connected hedgerow networks than in poorly connected ones (Sarlöv Herlin & Fry 2000). Further positive evidence comes from a citizen-science project which investigated the mobility of larger moths within farmland around Wytham Woods, near Oxford (Slade *et al*. 2013). This revealed that the moths use solitary trees as stepping stones for dispersal through the landscape, an effect that is enhanced when the trees are set within hedges. Forest specialists such as the Lobster Moth *Stauropus fagi* are particularly reliant on hedgerows making a direct connection between woodland fragments.

Studies which reveal that hedges play an insignificant or even negative role in dispersal include those involving ancient-woodland plants such as Dog's Mercury *Mercurialis perennis*, found to spread only very slowly along hedges (Pollard *et al*. 1974). Hedges can be a significant barrier to the dispersal of some ground beetles, decreasing landscape permeability, and there is evidence from France that hedges restrict the genetic variability in Primrose *Primula vulgaris* populations through impeding pollen dispersal (Burel & Baudry 2012). Even Hazel Dormice, already noted to dislike crossing open ground, are willing to do so when dispersing, being able to cross several hundred metres of unfavourable space (Chanin & Gubert 2012).

A study in Brittany of aquatic non-biting midges (Chironomidae) exemplifies particularly well the complexities associated with hedgerow continuity. While densely hedged landscapes limited the dispersal of adults, the hedges kept them close to their larval habitats, and provided shelter and markers for mating swarms: on balance they were considered beneficial (Delettre & Morvan 2000). In short, hedge connectivity is inherently neither good nor bad. It all depends on species and movement type.

Hedge structure The varied structure of my hedge is another important factor in explaining its species richness. It is what may be described as a 'complete' hedge, having shrubs, emergent trees, bank, ditch and herbaceous margins. Together, these provide a wide range of microhabitats. The only major structural feature desirable in a hedge which my one lacks is one or two mature trees with veteran features such as rot holes. If these had been present, the species count would no doubt have been higher still.

Plant diversity The occurrence within the hedge of a wide range of plants – 25 mosses and liverworts, eight ferns, 74 herbs (including grasses) and 17 shrubs, trees, creepers and ramblers – not only provides a rich food source for many organisms but also increases structural diversity further. Such plant-species richness is typical of hedges in Devon: Phillip Michelmore and Michael Proctor (1994) found 293 vascular-plant species in the hedges of a small farm in the county.

The living plants provide an essential source of food for moth and butterfly caterpillars, as well as for many beetles and true bugs. Hedge flowers are

The shallow ditch which forms part of the hedge produced large numbers of non-biting midges and other flies, as well as records of molluscs and Palmate Newt *Lissotriton helveticus*. Robert Wolton

rich sources of nectar and pollen, from spring to autumn. Worthy of special mention in my hedge are the flowering umbels of Hemlock Water-dropwort, Wild Angelica *Angelica sylvestris* and Hogweed: on a sunny summer's day, they heave with insects, in particular hoverflies and calypterate flies. They are also highly favoured by longhorn beetles (Cerambycidae), Parasitica and some micro-moths. Research carried out by Bristol University (Pocock *et al*. 2012) has suggested that such tall members of the plant family Apiaceae, together with *Cirsium* thistles, are among the most important plants for the maintenance of robust ecological networks, such as food webs, on farmland. Instead of being regarded merely as weeds, these plants should generally be encouraged.

Using the Invertebrate Species-habitats Information System (ISIS) classification developed by Natural England (Webb & Lott 2006), which covers about two-thirds of the species which I recorded, an analysis of the species present reveals that the hedge is of particular conservation significance for insects (mainly beetles, flies, bees and wasps) associated with decaying wood, both heartwood decay and bark and sapwood decay. As an indication of the importance of these micro-habitats, 162 of the true-fly species and 16 beetles recorded at the hedge are known to be associated as larvae with decaying wood, including associated fungi. David Clements and Keith Alexander (2009), after sampling the invertebrates of hedges on an intensive farm in Somerset, hedges that lacked large ancient trees, concluded that old hedges are an important habitat resource for ancient-woodland and old-growth invertebrates of dead and decaying wood. They noted that networks of old hedgerows can support a range of such species similar to that of substantial areas of ancient semi-natural woodland or wood-pasture, including good numbers of scarce species.

Tall flowering umbellifers such as Wild Angelica in the hedge margins were very popular with flies, such as this hoverfly *Leucozona laternaria*, as well as with other insects. Robert Wolton

Here, I find myself speculating on the impact that the trimming of hedges with flail cutters has on their wildlife. On the one hand, the rain of chippings may provide a valuable larval resource for invertebrates, especially flies; on the other, it may act as a mulch, suppressing basal flora. Research is needed.

Green-lane effect Green lanes are defined as farmland tracks with unsealed surfaces bordered on each side by hedges. Although not technically a green lane, since the surface is sealed with tarmac, in all other respects the farm lane along which my hedge runs qualifies as such. As may be expected and research confirms, the inside faces of green-lane hedges tend to be warmer and more sheltered than the sides facing outwards, and so are particularly favourable to wildlife (e.g. Dover *et al*. 2000). In addition, because they are not grazed and are cut only occasionally, verges within green lanes typically support different herbaceous communities from those on the field side, increasing plant and structural diversity; this was true with my hedge.

Management pointers

The very high species count suggests that the hedge which I studied was in great condition for wildlife (and, I hope, still is). The hedge was last laid (or 'steeped', as we say in Devon) over the winter of 1999/2000, and the hedge shrubs have been cut by flail every three or four years since, to create a thick and bushy structure. Eventually, it will start to become gappy, and I shall then let it grow up before rejuvenating it once more by laying, an expensive and time-consuming business and not one to be done more often than it has to be, given that there are 9km of hedge on the farm. Thus, the management cycle will be completed (Bealey *et al*. 2009).

Eight species of bumblebee have been seen at the hedge, along with many other pollinators. This queen *Bombus terrestris* was searching for a nesting site. Robert Wolton

When I lay the hedge, I shall take care to leave behind as much dead and decaying wood as possible. Meanwhile, I shall endeavour to ensure that stocking levels in the adjacent field remain light so that the margin can produce flowers, while I shall continue to cut back the Bramble growth on the lane side every year or so in order to permit easy vehicle passage (and, I must admit, to give visitors the impression that the farm is cared for). The ditch is likely to need a light clean with a digger in a few years' time, but I shall keep the sides shallow and the bottom muddy.

The main way in which I can improve the hedge is by letting the young oaks mature. This will entail little more than the occasional cutting-off of lower branches where they are shading out the shrubs beneath: this is one hedge which I do not want to fence. I am keen to encourage emergent trees, partly because numbers of such trees are falling rather fast across the UK (Carey *et al*. 2008), a situation which will be made much worse by 'Chalara' Ash dieback disease (caused by the fungus *Hymenoscyphus fraxineus*), and partly because they support much wildlife. Of the 106 Species of Principal Conservation Importance which are significantly associated with hedges across Britain (excluding widespread moths), 60% are associated with trees, a higher proportion than with the shrub layer, base, bank, ditch or margin (Wolton *et al*. 2013). Further evidence of the high value of hedgerow trees comes from Thomas Merckx and colleagues (2012), who, working on 16 arable farms in Oxfordshire, showed that the presence of hedgerow trees markedly increased macro-moth species richness.

Conclusions

The 1995 UK Biodiversity Action Plan for hedges states that more than 600 plant species, 1,500 insects, 65 birds and 20 mammals have been recorded at some time as living or feeding in hedgerows. It is now obvious that this is a considerable underestimate (at least of invertebrate numbers). If a single hedge can provide resources for more than 2,000 species, and perhaps 3,000, consider the number that a network of hedges may be able to support. Set in farmed landscapes with close-set and varied patches of wildlife habitat, hedges can, evidently, help to maintain populations of a great many species. If any reader is prepared to carry out a similar study to mine in an area of intensive farmland, where habitat patches are fewer and less well connected, the results would, I suspect, be most illuminating (Wolton *et al*. 2014 gives information on sampling intensity, etc.).

Flowers in the field-side margin: Water Mint and Greater Bird's-foot-trefoil, with Soft Rush. Robert Wolton

While the sheer number of species involved may be surprising, the value of hedges for farmland wildlife should not be. A number of studies have shown just how important they can be. For example, researchers from Bristol University have found that the majority of biodiversity on a Somerset farm could be conserved by retaining and appropriately managing uncultivated habitats such as hedges (Evans *et al*. 2011, 2013). The importance of hedges and 'waste ground' for maintaining overall ecological integrity was out of all proportion to the 4.5% of the land area which they occupied. The fact that the farm was organic makes these conclusions even more striking.

To realise their potential for wildlife, hedges, like most other habitats, require management.

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This applies not just to the shrub layer, but also to emergent trees, the bank or base, margins and any associated ditch. For the farmer, such management is expensive and time-consuming. We must hope that support for hedges through agri-environment schemes such as Countryside Stewardship in England and Glastir in Wales will grow, reversing the trend over the last decade.

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