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Hybrid Orchids · Lockdown: Good News for Wildlife?
A Natural History of British Trilobites

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Editor's note

I start this issue with the sad news that, after 27 years of sterling service, Gordon Woodroffe will be stepping down from writing for *British Wildlife*. Since 1993, Gordon has charmed and enlightened with his regular mammals column in the wildlife reports – Gordon, we offer our heartfelt thanks for your outstanding contribution to the magazine.

Mammal fans can be assured, however, that these reports will remain in safe hands: I am delighted to welcome Fiona Mathews, Chair of the Mammal Society, who will pick up the baton and ensure that we are kept up to date with all things mammalian.

Finally, we are extremely grateful to all subscribers who answered our recent reader survey. The response so far has been fantastic and all feedback – positive and negative – will be invaluable in helping us to improve the magazine in future. We will be in touch with the winner of the £100 NHBS voucher before the October issue arrives and in time we hope to give you a rundown of the trends within your answers, but for now I say, simply, thank you for sharing your thoughts!

Editorial: Neonics in salmon-farming – alarm bells are ringing

Salmon farm off the Isle of Harris, Outer Hebrides. Jan Holm/Alamy Stock Photo

Most people have heard of neonicotinoids, even if they cannot pronounce the name. These neurotoxic insecticides were widely used in farming across Europe from the mid-1990s onwards, but became notorious as evidence grew that they were killing bees. Eventually this evidence became so strong that neonicotinoids were banned from agricultural use by the European Union in 2018. Now, it seems that the pesticide industry may be looking for a new outlet for these chemicals. The salmon-farming industry is seeking to introduce a new pesticide, Ectosan (known also as BMK08), to control fish lice. The active ingredients have been shrouded in secrecy, but an application to use Ectosan in Norway reveals one to be imidacloprid, one of the banned neonicotinoids. The fact that this proposal was not rejected immediately suggests that we have not learned our lesson.

As the name suggests, neonicotinoids are synthetic variants of nicotine. They are phenomenally toxic to almost all insects, and in minute amounts; four billionths of a gram of imidacloprid is enough to give a lethal dose to a honeybee. Since billionths of a gram are impossible to visualise, this means that one teaspoon of imidacloprid (5g) could kill one and a quarter billion bees, roughly enough to fill four large lorries. Imidacloprid is about 7,000 times more toxic to insects than DDT, an insecticide long banned for the environmental harm it caused. Neonicotinoids act on neuroreceptors in the insect brain, causing paralysis and death, while at truly minuscule 'sublethal' doses they cause confusion, impair learning, damage the immune system, and reduce fertility.

The high toxicity of neonicotinoids to beneficial insects such as bees would not matter if they could be used in such a way that only pest species encountered them. In farming, neonicotinoids were used mostly as seed dressings, coatings applied to seeds of arable crops such as cereals and oilseed rape before the farmer bought them. The idea was that the pesticide dissolves in the damp soil once the seeds are sown, and is then absorbed by the roots of the crop, spreading systemically through its tissues. It seems like a neat system, and a very convenient one for farmers as they do not have to spray the chemical, but it had unexpected problems. Since the chemicals spread throughout the crop plant, they get into the pollen and nectar of crops that flower, such as oilseed rape, poisoning pollinators. Worse still, it turned out that most of the seed dressing was not taken up by the crop at all, but stayed in the soil and ground water, contaminating wildflowers and hedgerow plants growing around and near arable fields. Once in the soil, neonicotinoids can last for many years, and so they accumulate when used every year.

Being water-soluble, neonicotinoids also seep into streams. Some aquatic life, such as mayflies, are phenomenally sensitive to neonicotinoids, and studies in the Netherlands found that streams polluted with imidacloprid had much lower abundance of insect life. Neonicotinoid pollution has also been linked to faster declines of insect-eating birds and, in Japan, to declines of dragonflies and damselflies. Japan also provides perhaps the most dramatic example of the potential of neonicotinoids to have profound impacts on aquatic systems. Lake Shinji, one of the largest lakes in the country, had for centuries supported a thriving fishery based mainly on smelt and eels. In 1993, imidacloprid was used for the first time on the surrounding farmland. Zooplankton populations in the lake immediately crashed, removing the food supply for the fish. In just one year the weight of fish harvested fell from 282 tonnes to 32 tonnes, and it has remained low ever since.

It is thus deeply troubling to hear that permission is being sought to use imidacloprid in salmon-farming in Scotland. Norwegian-owned company Benchmark proposes to use the insecticide to treat salmon for fish lice, and has submitted a regulatory dossier to the Veterinary Medicines Directorate and the Scottish Environmental Protection Agency. The proposal is that salmon will be removed from their pens in the sea into a tank on a 'wellboat' containing imidacloprid solution. Once their treatment is over, the fish will be rinsed and returned to their pen. The literature available from Benchmark states that the contaminated water will then be purified onboard by means of their patent 'CleanTreat' system, and be tested for purity before being returned to the sea, so that the operation is 'environmentally safe'. No details are given, however, about how the water will be purified or what level of sensitivity can be achieved while carrying out purity tests on board a boat, and so major questions remain unanswered.

Bear in mind that imidacloprid is toxic to aquatic life at exceedingly low concentrations, less than one part per billion. To detect such low concentrations in an analytical chemistry laboratory on land one would normally need to use liquid chromatography coupled to a tandem mass spectrometer – highly delicate and sensitive equipment costing hundreds of thousands of pounds. Are they really able to do this on a boat at sea? Can we be sure that none of the well-water will wash overboard in stormy conditions? What about the salmon themselves, which will be impregnated with neurotoxin? They will be likely to excrete imidacloprid once back in the sea pens, and they may still be contaminated when they go to market, with unknown consequences for human health. Are we really expected to take it on trust that Benchmark has all of these issues covered, given the very long track record of industry in polluting our environment?

Benchmark claims that the system has been successfully trialled for two years in Norway, but there seems to be no publicly accessible, independent evaluation of this claim. Agriculture has seen a succession of pesticides arrive on the market, be used by farmers for many years, and eventually be banned when evidence accumulates that they are harmful to the environment or pose health risks to humans. DDT and other organochlorines, organophosphates, neonicotinoids, herbicides such as paraquat, and fungicides such as chlorothalonil – all were deemed to be safe, until we found that they were not. It took over 30 years to ban DDT, 24 years to ban neonicotinoids and nearly 50 years to ban chlorothalonil, and in the meantime these chemicals were all harming the environment.

There is no doubt that many chemicals currently in use will eventually be banned, once enough evidence accumulates. Our regulatory system for agricultural pesticides has repeatedly failed to prevent harmful products from entering the market.

Fish-farming wellboat off the Isle of Skye. Gerry Neely/Alamy Stock Photo

Parasite treatments of farmed salmon have followed a similar pattern: dichlorvos was banned in the 1990s owing to its potential carcinogenic risks, and teflubenzuron in 2015 following research showing that it harmed shellfish. Emamectin and azamethiphos are both currently used but are controversial, since the former kills crabs and lobsters while the latter harms shellfish. When it comes to Ectosan/imidacloprid, surely we should invoke the precautionary principle, or we risk discovering in twenty or thirty years' time that the marine environment near salmon farms is chronically contaminated with a potent and indiscriminate neurotoxin, with who-knows-what consequences for marine life and fisheries.

We humans are very poor at learning from experience, and so we repeat the same mistakes over and over again. It seems to me that it is time we learned; industrial-scale use of poisons to manage pests cannot be done without harming the environment, and risking our own health. Is it not time we stopped?

Dave Goulson is a Professor of Biology at the University of Sussex.

Just Scilly…
The puzzles of island wildlife

Anthony Flemming

The view north-west from Porthloo, St Mary's, towards Samson, Bryher and Tresco. Anthony Flemming

Some say that the fabled land of Lyonesse – home to Tristan, lover of Iseult in Arthurian legend – once lay to the west of Cornwall before it sank below the waves, leaving just the Isles of Scilly to pass from myth to modernity. But what were the ecological consequences of this?

Islands have always interested biologists: the Galapagos were as important to Darwin as the Malay Archipelago was to Wallace. They often have a puzzling assemblage of wildlife compared with their neighbours or the mainland. What are the ecological and evolutionary forces which account for this and are they unique to islands? The Isles of Scilly (or Scilly for short) are a small archipelago about 30 miles south-west of Land's End. There are five larger, inhabited islands (St Mary's, St Agnes, St Martin's, Tresco and Bryher) and a great many smaller islands and rocks. They are granite, an extension of that which underlies Devon and Cornwall; indeed, the many outcrops on the islands are like Dartmoor tors. During the last ice age, the ice sheet that extended down over what is now the Irish Sea seems to have just reached the northern limits of the islands – glacial erratic rocks turn up on the north coast of St Martin's. About 12,000 years ago, as the ice retreated, sea levels rose and the islands split from the mainland into a large northern island, Ennor, which included present-day St Mary's, St Martin's, Tresco and Bryher, with St Agnes separate to the south. Ennor was then itself inundated by the sea, forming the islands we see today; exactly when this happened is unclear, but it was possibly as late as the Middle Ages. Visiting the islands over the last few years, I have become fascinated by which species are and are not there.

Strange distributions

J. E. Lousley, in his 1971 *Flora of the Isles of Scilly*, points out that among several abundant plant species on the clifftops at Land's End, in Cornwall, some, such as Thrift *Armeria maritima*, are found in Scilly while others, such as Kidney Vetch *Anthyllis vulneraria*, are not. Why is this? In 1922, the botanist J. C. Willis thought that he had the answer with his 'age and area' hypothesis. This theory is beguilingly simple: the most widely

The Isles of Scilly. John Plumer

distributed species are those that have existed longest. Willis thought that seeds did not disperse far, but, instead, that plants colonised their immediately adjacent habitat and crept over an area which steadily increased over time. He saw islands as an important test of the idea and suggested that the flora of offshore islands is made up of ancient species that got there prior to separation from the mainland. If so, it would follow that these ancient, island species would also show the widest distributions on the mainland. Supporting this, he observed that species from several plant families present on Scilly were found in 71 UK vice-counties, while those not in Scilly – and therefore younger species by his reckoning – were in just 47 (Willis 1922).

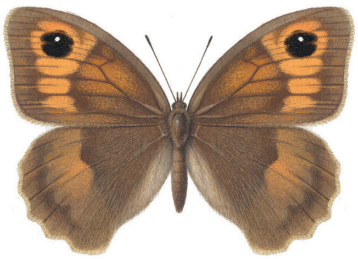
The problem is that other factors are obviously going to be much more important. H. B. Guppy pointed out in 1925 that Scilly shares 49% of its flora with the Azores, showing that, far from colonising only adjacent habitats, some species can disperse their seeds over huge distances by one means or another (Guppy 1925). Dispersal ability is more likely to explain the Scilly flora than the 'age' of the species themselves, and so, too, all those Darwinian processes of selection, competition and adaptation, which Willis's theory also ignored. Lousley, for his part, was not a fan of elaborate theories of distribution. He thought that the flora of Scilly was simply a subset of the flora of its nearest neighbours, reduced because of the islands' small size and consequently less diverse habitats. This accords with a well-known ecological rule that, as area increases, the number of species in that area also increases (roughly logarithmically). If applied to islands, this species–area relationship obviously predicts that Scilly would have fewer species than mainland Britain. So, perhaps this means that there is simply insufficient ecological capacity on Scilly for common Cornish plants such as Betony *Betonica officinalis*, Meadow Buttercup *Ranunculus acris* or Kidney Vetch, which are either absent or rare vagrants.

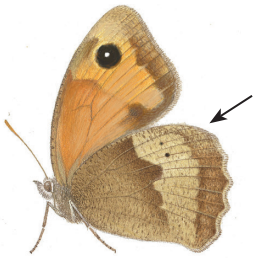
Island biogeography

In 1963, Edward O. Wilson and Robert MacArthur published their theory of island biogeography to account for species numbers on islands. They collected evidence from islands all around the world

Opposite: The remarkable Scilly fauna includes the Lesser White-toothed Shrew at its only location in Britain, the extremely rare Red-barbed Ant, otherwise known only from one other UK colony, and naturalised stick insects, of which some species may have been here for over 100 years, along with several other distinctive forms and variants. The subspecies names are either the Latin for 'island' or latinised versions of Scilly, or allude to the Cassiterides – mysterious islands referred to in classical sources which may be the Scilly Isles but probably are not. The arrow indicates the variable dots (two for this specimen) on the Meadow Brown underside which were studied by Ford and Dowdeswell. Illustrations not to scale. Richard Lewington

Mainland form ♀





ssp. *cassiteridium* ♀

Meadow Brown

Mainland form

ssp. *insula*

Speckled Wood

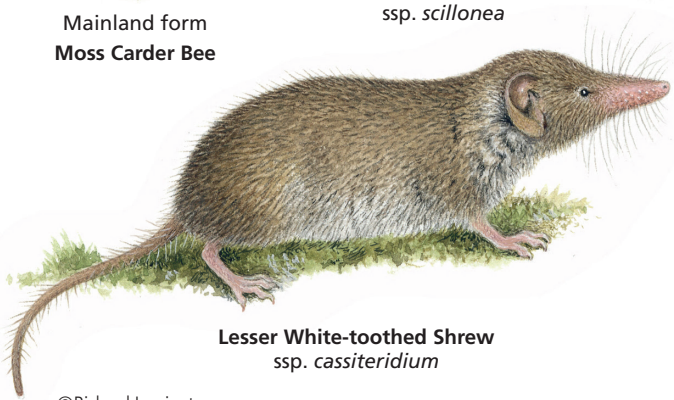
Smooth Stick-insect

ssp. *scyllonius*

Shuttle-shaped Dart
ssp. *insula*

Mainland form
Moss Carder Bee

Feathered Ranunculus
ssp. *scillonea*



Lesser White-toothed Shrew
ssp. *cassiteridium*

Red-barbed Ant

and confirmed that the species–area relationship does indeed apply: big islands have more species than small ones. But they also saw that the isolation of an island affected its species count. Taken together, the number of species present on an island was, they argued, the result of an equilibrium between immigration and extinction (MacArthur & Wilson 1963). The rate of immigration is determined by the distance of the island from a mainland source of species and by the island's size: emigrating species are more likely to encounter large, nearby islands than small, distant ones. Extinction stems from the species–area relationship: smaller islands will tend to have lower habitat diversity and therefore be capable of supporting only a subset of arriving immigrants, the remainder going extinct. Further, they will have smaller habitats, supporting only small populations of colonisers, which are inherently more susceptible to extinction over time.

Any birdwatcher will tell you that new bird species arrive all the time in Scilly: 449 (this number varies slightly between sources) species have been recorded there, the highest count of any comparable site in Europe. Many are singletons, vagrants passing through on the edges of their home range or well beyond it; those blown across the Atlantic from the Americas are of particular interest. For the most part, these are in insufficient numbers to colonise. For a species such as the Roseate Tern *Sterna dougallii* though, the islands are an occasional home; once a common resident of the islands in the 19th century, this tern is now only a visitor which sometimes breeds before disappearing again, thereby cycling through the immigration and extinction events that MacArthur and Wilson describe. Insects also visit from as far as the Americas, notably the quite regularly seen Monarch butterfly *Danaus plexippus* or the Green Darner dragonfly *Anax junius*, which came in small numbers in 1998; these long-haul travellers never last for long. Some insect arrivals from closer by, however, have stayed longer. Speckled Wood *Pararge aegeria* appeared in 1967, Holly Blue *Celastrina argiolus* in 1977 and Ringlet *Aphantopus hyperantus* in 1995 – all are now resident and common across the islands (Parslow 2010). *The New Flora of the Isles of Scilly* records several recent arrivals and departures of plants: Trifid Bur-marigold *Bidens tripartita* was first observed on the islands in 1994 and has remained, while Celery-leaved Buttercup *Ranunculus sceleratus* arrived in 1987 and again in 1998 but soon went extinct in both instances (Parslow & Bennallick 2017). Lousley reports that Sea Cottonweed *Otanthus maritimus* was present on the islands for some 60 years before going extinct in 1938. More recently, Shore Dock *Rumex rupestris*, which Lousley described as common in 1971, has since drastically declined and is extinct through most of its range in Scilly.

The ways by which species arrive are uncertain. Volant ones presumably fly, although boats and, conceivably, aircraft may assist; for plants, seed dispersal by wind or as flotsam or via animal vectors are all possible. Whether these arrivals and extinctions represent an equilibrium is hard to say, but they show the species content of the islands to be highly dynamic, consistent with the ideas of MacArthur and Wilson.

From the examples above (and there are more besides), it is clear that visits and colonisations occur quite often. Cornwall is not far away, so for more mobile species, such as flying insects and birds, just how much of a barrier is the 30 miles of sea isolating the islands? To put it another way, are the colonisations described the result of species at last making it over the sea, or because, while the species visit often, they have only now avoided extinction. Studies of butterflies on offshore islands throughout the UK have found that isolation is a not a major predictor of species number, which is much more dependent on the species richness of the mainland source of colonisers (Dennis & Shreeve 1996). This suggests that butterflies at least can get to offshore islands easily, though this may not be true for less mobile species. Certainly, the barrier does seem to be enough to keep some species out. Stands of mature elm trees *Ulmus* are a strikingly beautiful sight to those of us who grew up after the mainland population had been extirpated by Dutch Elm Disease, which has been unable so far to reach across from the mainland. The islands are also home to what is sometimes said to be Britain's rarest animal, the Red-barbed Ant *Formica rufibarbis*. This is well established, mostly on St Martin's, but elsewhere in the UK it has catastrophically declined to just a single colony in Surrey, having once been more widespread. The reasons for this decline are not well understood, but the species is threatened by raids from the slave-making ant *Formica sanguinea*, which has conspicuously not

Above: **The home of the Red-barbed Ant on the northern coast of St Martin's. Some consider it the rarest animal in Britain.**

Left: **Roadside elms on St Mary's: 'wherever an elm arches, Shivelights and shadowtackle in long lashes lace, lance, and pair' – Gerard Manley Hopkins.** Anthony Flemming

found its way to Scilly. It is tempting to think that the St Martin's Ant, as it is known locally, thrives in part through isolation from such mainland competitors in its own, biogeographical haven.

Mild winters

An important determinant of the ecological hospitality of Scilly is the weather. Comparing Meteorological Office data for St Mary's with averages for southern England shows that winter, in particular, is very different in Scilly. From December to February, the average minimum temperature is almost 5°C higher than that in southern England (maximum temperatures also are more than 2°C higher in the same period). This may well account for the success of species such as Italian Lords-and-Ladies *Arum italicum* and Balm-leaved Figwort *Scrophularia scorodonia*, which, while common in Scilly, are very rare on the UK mainland and have a southerly, warmer distribution in Europe. Furthermore, it probably allows survival by some species not present on the UK mainland and which presumably colonised from continental Europe. Orange Bird's-foot *Ornithopus pinnatus*, Dwarf Pansy *Viola kitaibeliana* and Least Adder's-tongue *Ophioglossum lusitanicum* have been continuously known from Scilly since 1838, 1873 and 1950 respectively, but not from the UK mainland (Parslow & Bennallick 2017). Winter and early-spring growth are important for these species: Least Adder's-tongue flowers as early as February, Dwarf Pansy from April and Orange Bird's-foot as late as December. For such plants, the Scilly Isles provide an ecological niche that is unique in Britain.

Climate has also driven one of the major industries of Scilly: cut flowers. Following the arrival of the West Cornwall Railway at Penzance in 1852, winter-grown daffodils, for example, could be supplied to London markets ahead of the mainland competition. To this day, there are flower farms on the isles. Aside from the crop species themselves, many others have hitchhiked with them to the islands and now live semi-wild in the margins of bulb fields and along farm tracks. For instance, at Churchtown Farm, on St Martins, the staff can help you to find the St Martin's Buttercup *Ranunculus marginatus* var. *trachycarpus*, whose natural home is in the Eastern Mediterranean. Many trees and shrubs currently on the islands were brought there for use as windbreaks on bulb farms, these ranging from UK native trees such as elm through to the New Zealand shrub *Pittosporum crassifolium*.

Italian Lords-and-Ladies has a characteristic all-yellow, short spadix. While very rare on the UK mainland, it is common in Scilly, perhaps because of the milder climate. Anthony Flemming

Orange Bird's-foot is not found on the mainland. It is tiny, so easily missed, but widely distributed across the islands. Anthony Flemming

Most famous of all the horticulture on the islands are the Tresco gardens, laid out by Augustus Smith and his heirs from 1835. Here, magnificent growths of subtropical species from across the world can be seen, all surviving largely because of the mild winters. The gardens have exported alien species all over the islands – you are never far from a South African Hottentot Fig *Carpobrotus edulis*, for example. With these plants came some very exotic invaders. In 1943, the Prickly Stick-insect *Acanthoxyla geisovii* was found in the gardens by A. A. Dorien Smith, and then the Smooth Stick-insect *Clitarchus hookeri* a few years later (Uvarov 1944, 1950). Originally from New Zealand, these may have arrived with a large consignment of plants shipped from the Antipodes to the gardens in 1907. Both can still be seen in the gardens and have spread elsewhere on the islands; just like the plants, these insects can tolerate only the mildest winters. These Scilly aliens, as with those elsewhere, highlight the importance of geography in constraining the distribution of species beyond ecological fit alone. They would never have reached the Isles of Scilly by natural means but, having bypassed this obstacle, they are avoiding the constraints of the species–area relationship for now.

Evolution

What fascinated Darwin about islands was not just which species had colonised them and from where, but also that they are home to unique species that have evolved on them. Evolution on islands is, in a sense, driven by the principles of island biogeography theory. If immigration is rare, any species that does arrive will probably be isolated and, if it escapes extinction, will diverge from its source population and may become a separate species. Conversely, regular immigration will tend to prevent divergence by genetically reunifying the source and island populations.

While Scilly has evolved no species of its own, there are a number of subspecies and variants unique to the islands. Scilly has its own minor variant of the Sea Rush *Juncus maritimus* var.

atlanticus, with larger and more diffuse panicles; it is easy to find among the reedbeds on St Mary's. Birdwatchers have noticed that Scilly Blackbirds *Turdus merula* often have redder bills and eyerings than the typical orange and that the islands' Wrens *Troglodytes troglodytes* are paler and have a slightly different song; neither is formally recognised as a distinct subspecies, although this has been proposed for the Wren (Parslow 2010). In 1924, Martin Hinton, at the Natural History Museum in London, thought that he had found a new species of shrew on the islands, which he named *Crocidura cassiteridium* (Hinton 1924). A few years previously, he was involved in another 'new' species which turned out to be the Piltdown Man hoax (he may even have been the perpetrator). Thankfully, there really are special shrews in Scilly, but they are now considered a Scilly-specific subspecies of the Lesser White-toothed Shrew *Crocidura suaveolens* ssp. *cassiteridium*. These are not found anywhere else in Britain, which is pretty odd; some suggest that these animals may have been transported to Scilly by seafarers, even the ancient Phoenicians! But not all rodents behave like rats and happily stowaway on ships, so perhaps this is a relict population from a time before the separation of Britain from the European mainland.

Some speculation also surrounds the origins of the islands' Speckled Wood butterflies. In Scilly, the typical sandy-coloured markings on the wings are darker shades of cream and orange; specimens are quite obviously different when seen in the field and have been named *Pararge aegeria* ssp. *insula*. The species was first recorded in the islands, however, in the 1960s, which would seem not to leave enough time for divergence to a new subspecies. Moreover, specimens in the Channel Islands apparently look similar – so, rather than being a divergent form of the mainland species, perhaps those in Scilly came from there. On the other hand, local adaptations can occur surprisingly quickly, as described for the Large Blue *Phengaris arion* (Thomas *et al.* 2019), and similarity to the Channel Islands form may simply represent convergent evolution – the most adaptive coloration in Scilly may be the same as that for the Channel Islands. It is hard to know just by looking, but perhaps comparison of DNA sequences will resolve the origins of Scilly Speckled Woods. Another distinct Scilly satyrid butterfly is the unique subspecies of Meadow Brown *Maniola jurtina* ssp. *cassiteridum*, which is the most beautifully marked form of this species and, like the Speckled Wood, can be found throughout the islands. A possibly unique form of the Common Blue *Polyommatus icarus* which had very blue females was once found on Tean Island (Ford 1945), although similar forms are also present on the Channel Islands, as well as in the Hebrides and parts of Ireland. The Feathered Ranunculus *Polymixis lichenea* and Shuttle-shaped Dart *Agrotis puta* moths both exist as distinctive, unique subspecies (ssp. *scillonea* and ssp. *insula*, respectively) in the islands, as does the leafbug *Piesma quadratum* ssp. *spergulariae*. Most endearingly of all, the Scilly Bee *Bombus muscorum* ssp. *scyllonius* is a distinctive version of the more widespread Moss Carder Bee and has been known from the islands since the 19th century; it seems not to have been seen since 2012, but have a look as it just might still be there. Interestingly, at least one Scilly alien has diverged during its brief time on the islands, not in its appearance but, rather, in the way it breeds. Back home in New Zealand, Smooth Stick-insects *Clitarchus hookeri* can reproduce

St Martin's Buttercup at Churchtown Farm, on St Martin's, is a species typically found in the Eastern Mediterranean. Anthony Flemming

both asexually (by parthenogenesis) and sexually, but those on Tresco now reproduce only asexually and have lost the capacity for sexual reproduction altogether (Morgan-Richards *et al*. 2019). 'No sex please, we're British' was the inevitable conclusion in the press.

Perilously rare, subtle and sometimes questionable though this handful of Scilly oddities may be, they are glimpses of evolution in action: nudges towards the endemism of more isolated islands around the world. But what about among the Scilly Isles themselves? On other archipelagos, species have adapted to individual islands; could such things happen off the coast of Cornwall?

Britain's Galapagos?

'Shrimping?' asked former prime minister Harold Wilson when he met the eminent entomologist E. B. Ford in Scilly (Rothschild 2000). Ford's net was more likely intended for the Scilly Meadow Brown, which he studied for 40-odd years, along with his co-worker W. H. Dowdeswell and others. Among other things, they were interested in the varying numbers of little black dots found on the underside of the hindwings of this species. In Scilly, they saw that, while most males have two dots, females are more variable, having anything between zero and five. Among the large islands of Scilly (St Mary's, Tresco, St Martin's) female dot number is quite variable, with zero, one and two dots equally common. On the smaller islands, however, different patterns were found: on St Helen's two dots was much the commonest, on White Island it was zero dots, and on Tean and Great Ganilly zero and two dots were both abundant while other numbers were rare. Dowdeswell was reminded of the finches of the Galapagos Islands that so fascinated Darwin, with each adapted to its particular island, suggesting that the Meadow Browns of Scilly are similarly adapted to theirs, and even more interesting because the adaptation is sex-specific (Dowdeswell 1981).

These observations do recall, albeit with a little less romance, the island adaptations that Darwin saw on his travels. This is all the more so, since subsequent work indicates that this is evolution by natural selection. These dots, though small, direct predator attacks towards the wing margin and away from the body, especially when the butterfly is in flight, thereby reducing mortality at the expense of non-lethal wing damage. Conversely, the absence

Southern Marsh Orchid *Dactylorhiza praetermissa* arrived in 1971 and can still be found, sparingly, on St Mary's, as shown here. Not so the Common Spotted *D. fuchsii*, which arrived on Tresco in 1969 but soon disappeared. Fragrant Orchid *Gymnadenia conopsea* was on St Martin's from 1974 to 1977 and is also now gone; Pyramidal *Anacamptis pyramidalis* appeared on Samson in 1997 and is still there. These are all thought to have arrived as windborne seed. Anthony Flemming

of dots aids camouflage when the insect is at rest. In patchy or suboptimal habitats where females must fly farther to find nectar or suitable sites for egg-laying, high dot numbers are favoured, whereas, in less patchy habitats where females fly less, camouflage offers better security and fewer or no dots are favoured. Observations in the field confirm that high-dot-number females fly farther in an average flight than those with lower dot numbers (Brakefield 1984). In Scilly, this implies that larger islands have a range of habitats favouring no single dot number overall, while the smaller islands' habitats are less diverse and favour particular dot numbers only. It seems surprising that populations on the different islands are sufficiently isolated to allow differences like this to stabilise: you may expect all Scilly Meadow Browns to be interbreeding enough to prevent such divergence. Yet Ford and Dowdeswell showed in mark-release-recapture experiments that there was actually very little migration of the species among islands. Another concern is that the populations on the smaller islands were possibly founded by very small numbers of individuals,

resulting in a loss of dot diversity: if a small number of founders happened all to have one spot pattern, this would be preserved to the exclusion of others in the population formed by their descendants. Ford countered that, when populations dropped to small sizes through natural events (as followed a drought on Tresco in 1957), he saw no change in dot frequency in the subsequent population. This work has since been revisited with more advanced molecular tools, allowing comparison of the DNA sequence of Meadow Browns among the islands. These studies have also concluded that there is little interbreeding between island populations and that the differences among the islands are unlikely to be a consequence of 'founder' effects (Baxter *et al.* 2016). So, this really does appear to be evolution by natural selection, messaged in Morse code on butterflies' wings.

Islands everywhere

Size, habitat diversity, climate, migration, transportation, extinction, isolation, evolution, selection and more besides have all shaped the species living on Scilly, and these factors are not limited to islands. Indeed, soon after publication of the theory of island biogeography, people started to wonder whether it could be applied to places that were not strictly islands. Mountaintops are isolated by a sea of different, lower-altitude habitats: can these be considered 'sky islands'? The different subspecies of Mountain Ringlet *Erebia epiphron* found in the Scottish and Lakeland mountains (ssp. *scotica* and ssp. *mnemon*, respectively) demonstrate the biological isolation of such habitats. In the 1970s, conservation biologists started to consider nature reserves as islands amid hostile environments (Diamond 1976). They began to think about the size of and distance between nature reserves and consequent effects on the migration and extinction of species living in them, just as MacArthur & Wilson had for islands. This was always controversial and in the 1980s was superseded by related but more sophisticated metapopulation theory, for conservation purposes (Hanski 1989). But I think it is fair to say that when conservationists talk about habitat fragmentation and strive to reconnect isolated nature reserves, these ideas owe something to the natural history of islands. It also means that we probably all have an island of some sort near us; keep an eye out for the comings and goings on yours… wherever you are.

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Natural reflections

Brett Westwood

Buzzard with worm. Steve Young/Alamy Stock Photo

During the lockdown period, few sights have been more liberating than the spectacle of a bird of prey wheeling above my garden. The clear blue skies of April and May delivered daily appearances, including the first Red Kites in 20 years, sailing past lines of pegged-out washing. Peregrines occasionally passed over en route to raid the town-centre pigeon roosts. In the mid-1970s, when I first raised a pair of binoculars, the idea that these raptors would one day be visible from my house was a fantasy barely worth considering. Marginally more realistic back then and keenly anticipated by me was the reappearance of the Common Buzzard, which began to recolonise this part of the West Midlands in earnest a decade later. The history of the national decline of buzzards in the UK over the last 150 years is well documented: they fell foul of persecutors in the 19th century, recovered partly in the first half of the 20th century, but stalled in the 1950s when myxomatosis reduced their rabbit prey. In Worcestershire, a pair or two lingered tantalisingly on the western fringes, but I had to rely on family holidays in Wales and the West Country for my annual fix.

Forty years on, the sight of one or more buzzards rising on tip-tilted wings above the frieze of lime trees in the nearby park is a daily delight. In spring, piercing calls drifting down from high above my house can herald as many as six buzzards disputing invisible territories. They've been back in the neighbourhood for several years but I'm still excited by the incongruity of seeing them in town, where their presence over tower blocks and trading estates brings the essence of wild western hills to the urban scene.

While Common Buzzards would register as highly as gulls and magpies on an index of avian conspicuousness, they can be mysterious birds, especially where their diet is concerned. During years of watching them waiting on posts or patrolling the local countryside, I have rarely seen a 'take' of vertebrate prey. Invertebrates are a different matter, though. Buzzards often follow the plough in search of earthworms, and on one October day I counted 22 running like bedraggled chickens across a newly turned field not far from home. For a raptor this looks like slumming, and a worm-hunting buzzard is described by Sean Walls and Robert Kenward in their excellent new monograph, *The Common Buzzard*, as 'an inelegant cross between a thrush and a waddling duck'. Inelegant it may be, but the authors point out that earthworms are regular ingredients in the buzzard's diet and rich in essential amino acids. Other sources of fat and protein include beetles, cranefly larvae, earwigs, spiders and woodlice, although none of these would sustain growing nestlings, which need supplements of vertebrates such as rodents and rabbits.

But what are urban buzzards eating? As I watch my local birds circling high over the garden I often wonder how and where they find food. There are few opportunities for worming here and they rarely descend to treetop level, let alone the ground, where disturbance from human activity would discourage any serious feeding. Once I saw one hunched on a lamp-post around the busy ring-road, presumably hoping for carrion, but for the most part they stay aloft.

Recently though, as I've spent more time in the garden, I've noticed clues. People in the next street reported seeing an 'eagle' in their gardens. In March, the fence-top above my tiny pond was spattered with black dots. Early one morning I flushed a buzzard from the same fence, where it had been eating frogspawn (and presumably the frogs that laid it). My neighbour said that she'd seen magpies silently chasing a large brown bird: soon after I watched the same pair of magpies hustling a buzzard through the garden and forcing it to fly so low that I felt the rush of air over my head as it passed. These brief insights into the techniques of hunting buzzards reminded me of a description by Jim Flegg in *Birdwatcher's Year* (1973) of a bird at Northward Hill, in Kent, which descended through thick woodland canopy to take a Blue Tit from a ringer's mist-net. My own parallel to this story came recently when I disturbed a buzzard from *inside* a neighbour's Lawson Cypress, where it had been rummaging in a Woodpigeon's nest. Although I didn't see it take any of the squabs, it was good evidence that this individual had for some time been recceing the area for signs of prey. For all their aerial flamboyance, there's a secretive side to the urban buzzard and I shall be curtain-twitching from now on in the cause of investigating the resourcefulness of my new neighbours.

Beavers: the original engineers of Britain's fresh waters

Kelsey Wilson, Alan Law, Martin Gaywood, Paul Ramsay and Nigel Willby

Beavers have had a profound effect on the wetlands of Knapdale Forest, Argyll, since their release 11 years ago. Roy Waller/Alamy Stock Photo

Beavers are agents of change. In modern-day Britain, it feels somewhat surreal to encounter a landscape profoundly altered by something other than humans, yet this would once have been the norm across much of the Northern Hemisphere. The loss of megafauna, and the biota and ecological processes that depend on their activities, is something that we now recognise as a hallmark of the Anthropocene. While Britain has had a slower start than some mainland European countries, beaver reintroduction is now gathering traction, motivated by prospects of habitat enhancement, natural flood management and wider biodiversity benefits. Beaver numbers in some regions of the country have reached levels which 20 years ago would have seemed unimaginable. Responding to the recent rise in licences for beaver reintroduction issued by Natural England, Patrick Barkham even joked in *The Guardian* that beavers have replaced croquet lawns as the must-have accessory for English country estates.

So, what will the expansion of beavers mean for freshwater habitats in Britain? To what extent are the benefits of beavers observed elsewhere likely to be replicated in our heavily modified landscapes after a 400-year absence, and what do we still need to know? First, we provide a brief update on the status of beavers in Britain and some background on their biology and behaviour.

A potted recent history

The Eurasian Beaver *Castor fiber* is a charismatic native mammal that was once widespread throughout Britain, but was most likely hunted to extinction by the 1600s. Beavers were officially returned in 2009, following a long debate that resulted in a five-year trial-reintroduction project at Knapdale Forest, in the west of Scotland – the Scottish Beaver Trial (SBT). The complex tale of how beavers became reacquainted with British waters has featured in previous issues of *British Wildlife* (Gaywood *et al.* 2008; Jones *et al.* 2013), but a brief update is overdue. Tayside is now the stronghold of beavers in Britain following escapes from private collections, coupled with unauthorised releases of animals on the rivers Tay and Earn, suspected to date back

Beaver-engineered stream channel on private land in Tayside. This was formerly a straightened channel 1m wide. Nigel Willby

Beaver-generated fine-scale habitat complexity, Tayside. Anyone can make a pond, but there is only one way to make a beaver pond. Nigel Willby

to the early 2000s. A 2017/18 survey estimated 114 active territories (approximating to 319–547 animals) dispersed across Tayside's fresh waters (Campbell-Palmer *et al.* 2018). This population has trebled since 2012 and appears to be spreading westwards, with satellite territories now appearing in the Forth catchment and Trossachs. In England, small, licensed populations are now established or imminent in at least ten counties, mostly as part of enclosed trial projects. Some of these date back to the early 2000s, the largest (and only officially sanctioned) free-living population in England comprising around 13 territories on the River Otter, Devon (Brazier *et al.* 2020). In Wales, the feasibility of officially bringing beavers back is being investigated, and several small enclosed populations already exist on private estates.

Since May 2019, beavers in Scotland have been listed as a European Protected Species, a status celebrated by conservationists but not welcomed by all. In parts of rural Tayside, beaver activity can conflict with lowland farming and therefore translocation or lethal control is permitted under licence. Tayside beavers have been translocated to Knapdale to reinforce that population and to boost its genetic diversity, but they are also in demand for ongoing or proposed trials in various parts of England. The River Otter Beaver Trial runs until the end of August 2020, after which the government will decide on the future status of beavers in England.

Beaver biology and engineering

The two species of beaver, North American *Castor canadensis* and our native Eurasian Beaver, are large, semi-aquatic, crepuscular rodents, in which order they are beaten for size only by the South American Capybara *Hydrochoerus hydrochaeris*. They live in family groups usually comprising two breeding monogamous adults, their offspring from the previous year(s), known as yearlings and subadults, and their kits. Unlike other rodents, beavers breed only once a year, in late spring, typically producing two to four kits, which emerge from their lodge or burrow in the summer. The offspring usually stay in their family group for up to two years, before dispersing around the period April–June. Beavers are very social animals and have a dominance hierarchy based on age. They mostly communicate through scent-marking and deposit a pungent glandular substance called castoreum (historically used in perfumes and food flavourings) at the edge of their territories to warn off rivals. Territory sizes vary widely (0.5–20km) with habitat quality, but typically average 3–4km of riverbank or lakeshore.

Although beavers themselves are often elusive, the signs of their activity are unmistakable and are usually concentrated in, or adjacent to, riparian woodlands. Beavers are strictly herbivorous and, when on land, forage mostly within 30m of the riverbank or lakeshore. They form well-worn trails inland from the water's edge, where they gnaw and fell broadleaf trees, often then stripping the bark and leaves. For shelter they build impressive lodges, using sticks, vegetation and mud, or burrow into soft banks, as well as digging networks of canals to provide access to wooded areas for feeding. Beavers also graze on aquatic and riparian vegetation, especially in the summer, leaving middens of discarded material. Unstripped branches are cached

underwater to be used in winter when food is sparse or inaccessible. The beavers will sometimes feed on cereal or vegetable crops if a territory borders arable farmland.

While beavers are best known for their dam-building abilities, this behaviour is far from ubiquitous. Dams are built in order to raise and stabilise water levels, providing a submerged lodge or burrow entrance, ready access to resources and safety from land-based predators. Dam densities, composition and heights, and the area inundated, vary hugely with topography: in smaller streams there may be in excess of 10 dams/km, with structures often 1–1.5m tall, while on lakes and lowland rivers dams are scarcer and lower in height, but may potentially be longer and can impound valley wetlands (Gurnell 1998). In some locations, dams may simply not be required.

The ponds formed upstream of beaver dams are colonised by plants, aided by propagules carried downstream, imported by beavers and other biota, or from a pre-existing wetland seedbank (beavers may rework systems that they occupied decades or even centuries earlier). The key to the ecological interest of a beaver pond is ongoing maintenance of dam and lodge, fluctuating water levels, canal-digging, grazing of plants and collapse or windblow of drowned trees, which adds to the jumble of felled or fallen dead wood. Ultimately, after anything from three to 30 years, neglect of a dam, loss of water and successional processes combine to create a beaver meadow. Beaver ponds are gloriously complex places with sometimes bizarre juxtapositions of species and microhabitats quite unlike anything else, but they would be far less interesting, and much like any other pond, if beavers simply constructed their dam and then swam away.

The end result is that beaver activities collectively promote habitat heterogeneity, which is a cornerstone of biodiversity. In ecological restoration, a common priority and criterion for success is enhanced heterogeneity. Some might call this patchiness, others complexity, but, whatever the definition, the intrinsic 'messiness' of large grazing animals is a great source of heterogeneity. Our wetlands have long since lost the large animals that used to create such heterogeneity (e.g. moose, beaver). Horses and cattle are passable substitutes in the right places and in the right amounts, but are now mostly fenced out to safeguard them or to reduce diffuse pollution and bank erosion.

An increasing obsession with order and control has undoubtedly been to the detriment of the great diversity of organisms that rely on disturbance and weak competition, many of which have declined in recent decades following eutrophication and the cessation of traditional management. As beavers excel when it comes to creating 'untidy' landscapes (perhaps one thing that all parties in the beaver debate would agree on), their activities can have important cascading effects on freshwater biota.

Ecological impacts

Aquatic vegetation

Beavers affect aquatic vegetation in two ways: first, through inundation and creation of less shaded habitat by damming; and, secondly, by eating it. The first is what beavers are renowned for, but the second is arguably of equal or greater ecological importance.

Unshaded, shallow water with periodic disturbance tends to suit aquatic plants, but the added benefits of beaver dams are still striking. In southern Sweden, the difference in plant composition between adjacent patches, an indicator of fine-scale heterogeneity, was 17% higher in beaver ponds than in other adjacent non-beaver wetlands, while plant species richness was 33% higher in beaver ponds (Willby *et al.* 2018). Fifty percent more species were restricted to beaver ponds in this region than were restricted to other wetlands, with ruderal species the main beneficiaries (Law *et al.* 2019). Beavers are clearly able to create novel freshwater habitats which are not easily replicated: anyone can make a pond, but there is only one way to make a beaver pond.

A major element in the enduring interest of beaver habitats is that the animals feed heavily on aquatic vegetation during the growing season. Beavers are usually referred to as choosy generalists: they will eat most plants but not quite everything. Being large and territorial, they have the potential to exert a strong impact on the composition of surrounding vegetation communities within a few seasons. By selecting large, fleshy or rhizomatous plants they benefit smaller, less competitive ruderal species, commonly leading to an increase in plant diversity. Repeated monitoring in Knapdale during the SBT, for example, revealed declines in Great Fen-sedge

Cladium mariscus and Common Club-rush *Schoenoplectus lacustris* of 81% and 39%, respectively (Willby *et al.* 2014). Elsewhere, marked reductions were documented in Bogbean *Menyanthes trifoliata* and Yellow Flag *Iris pseudacorus* over an eight-year period as a result of grazing, accompanied by a trebling of plant species richness (Law *et al.* 2014a). At Knapdale, beavers also fed readily on the leaves of White Water-lily *Nymphaea alba*, displaying a clear preference for larger leaves, as well as uprooting rhizomes (Law *et al.* 2014b).

Invertebrates

When a stream is dammed, the invertebrates that are more reliant on highly oxygenated running water (such as *Baetis* mayflies and Elmidae riffle beetles) are quickly replaced by those associated with slow-moving, warm shallow water with high volumes of organic debris and extensive vegetation. These include dragonflies and damselflies, diving beetles, water boatmen and backswimmers. The fauna varies spatially within a beaver pond, depending on proximity to the dam, areas of disturbance, and successional stage, although colonisation is rapid. An often overlooked outcome of habitat-engineering by beavers is the increase in invertebrate abundance, especially of generalist diptera (e.g. Dixidae, chironomids), which is likely to benefit terrestrial consumers (carabid beetles, spiders, and species at higher trophic levels). Law *et al.* (2016) found that average invertebrate abundance was three times higher in beaver ponds compared with unmodified streams. Following damming, other beaver activities continue to influence the suitability of the aquatic habitat for invertebrates. Beaver-dug channels (which may be up to 300m long), for example, have been shown to increase wetland perimeter by 575%, providing key edge habitat for some species (Hood & Larson 2015). Dams and lodges add further to habitat heterogeneity through provision of greater amounts of coarse woody debris and entrapped sediment (France 1997).

Many studies reveal lower invertebrate-species richness in beaver-created habitats compared with pre-existing or nearby streams: the fauna of running-water habitats tends locally to be richer, and damming may have a negative impact on some specialist riverine taxa, including those of conservation importance. Further scrutiny, however, shows that, as with plants, the novel habitats generated by beavers hold species not shared with other habitats. This means that landscapes containing a mosaic of unmodified and beaver-created habitats support increased biodiversity. For instance, Law *et al.* (2016) found that, overall, aquatic invertebrate richness was 28% higher in a Tayside landscape containing beaver-engineered features than in the same landscape without these features. The scale at which effects are measured is therefore important.

Vertebrates

Beavers have the ability to create havens for other animal species. Beaver ponds are ideal habitats for endangered amphibians, their shallow and well-vegetated waters providing excellent conditions for

Great Fen-sedge (top) and White Water-lily (bottom) were among the aquatic plants favoured by the Knapdale beavers during the Scottish Beaver Trial.
Nigel Willby

View of a lochan in Tayside, with fringing emergent vegetation in August 2003 (left) and August 2012 (right). The arrows indicate the same group of trees in each photograph. The decrease in conifers in the background is due to commercial forestry, not beaver activity (Law *et al.* 2014). Nigel Willby

spawning, as well as an abundance of invertebrates on which to feed (Osipov *et al.* 2018; Dalbeck *et al.* 2020). Damming, digging and the felling of trees create microhabitats that fish can utilise to avoid predators (Wathen *et al.* 2019), while various age classes of fish will also benefit from the proliferation of invertebrate prey and habitat diversification.

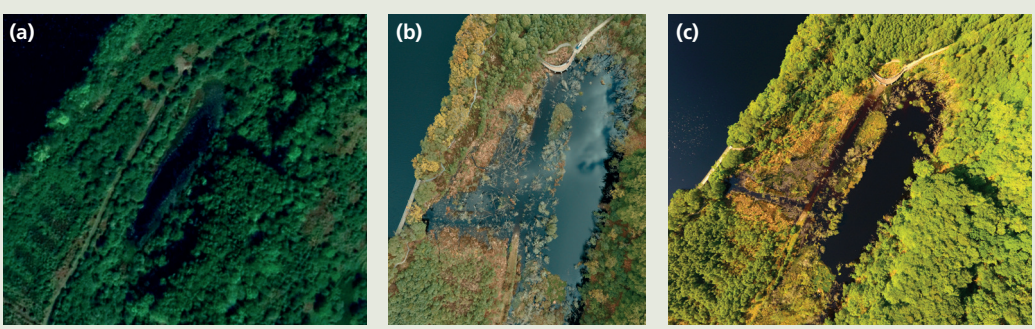
There are frequently concerns that fish of high economic importance to Britain, such as Atlantic Salmon *Salmo salar* and Sea Trout *Salmo trutta*, may, under certain circumstances, be unable to ascend beaver dams to access spawning grounds (see Kemp *et al.* 2012 for a review on this topic). Yet recent research in Norway has demonstrated that both of these species can successfully traverse beaver dams on their journey upstream (Malison & Halley 2020). Further research on the full range of fish species and age classes that utilise beaver ponds is required in order to understand this dynamic relationship.

The gently sloping banks, shallow water, exposed wet mud, diverse vegetation and abundance of invertebrates make beaver ponds ideal habitat

Dubh Loch: an untidy case study

Dubh Loch (pronounced 'doo loch' and translating as black lake), in Knapdale Forest, is one of the longest and most intensively monitored beaver sites in Britain and an excellent example of the engineering prowess of this species. Within months of being reintroduced to Loch Coille-Bharr (33ha) in 2009, the beaver family had moved to the connected and much smaller Dubh Loch (0.4ha). The animals dammed the small outflow, raising the water level by >1m, which flooded a substantial area and increased the size of the loch four-fold.

There were profound alterations to the distribution and biomass of aquatic plants following the arrival of beavers, with some plants quick to colonise the shallow areas, suggesting the pre-existence of a long-lasting seedbank. The overall plant-species richness has increased (last surveyed in 2018), and the relatively homogenous stands of vegetation that previously existed have been replaced by a kaleidoscope of alternating soggy, inundated and dry patches. The site continues to evolve. There has been a reduction in tree canopy associated with the death and subsequent windblow of drowned trees but, with ongoing declines in dam integrity and water levels falling from their peak in 2011, birch *Betula* and willow *Salix* which had seemed dead have been returning to leaf in recent years, and emergent vegetation is expanding. In April 2020, there were also reports that beavers had begun to repair the Dubh Loch dam; ongoing disturbances at different scales, and cycles of occupation, abandonment and reoccupation are what make beaver-created wetlands unique.



Aerial view of the Dubh Loch, Knapdale, in (a) 2008 pre-beaver, (b) 2015 with extensive inundated areas, and (c) 2018 showing the development of the beaver meadow. The pontoon at the top of pictures (b) and (c) was built in 2013 by Forestry and Land Scotland to cater for increasing visitor numbers. Google Earth (a); Alan Law (b and c)

Left: Dubh Loch dam in May 2014, 4.5 years after construction: dams age quickly and become leaky without maintenance and new material. Top right: patchiness in emergent plant stands (Soft Rush *Juncus effusus*, Bottle Sedge *Carex rostrata* and Branched Bur-reed *Sparganium erectum*) amid fallen and windblown trees (May 2013). Bottom right: dense beds of Broad-leaved Pondweed *Potamogeton natans* and White Water-lily established in the fourth season after damming in former birch woodland (May 2013). Nigel Willby

for some waders and waterbirds. In Finland, Teal *Anas crecca* produce larger broods on beaver ponds (Nummi *et al.* 2018), while Green Sandpipers *Tringa ochropus* were almost six times more abundant after sites were flooded by beavers (Nummi & Holopainen 2014). Bats, too, utilise beaver ponds widely, attracted by the abundance of emerging invertebrates (Ciechanowski *et al.* 2011). A combination of snow tracking and camera trapping in Finland allowed Nummi *et al.* (2019) to show that mammal richness was 83% higher in beaver-created wetlands than in non-beaver wetlands, with Moose *Alces alces*, Otter *Lutra lutra* and Pine Marten *Martes martes* all benefiting strongly. Although little research has been conducted to date, the expectation from reviewing the evidence (Stringer & Gaywood 2016) is that beaver ponds in Britain will provide new and important habitat for vertebrates of conservation importance such as Otter, Water Vole *Arvicola amphibius*, Daubenton's Bat *Myotis daubentonii* and Great Crested Newt *Triturus cristatus*. Work is now required to validate these expectations.

Beyond the water's edge: riparian woodland

Over millions of years of co-evolution, trees have adapted to the pressure of grazing herbivores. In response to felling by beavers, trees such as willow and Hazel *Corylus avellana* readily sprout new shoots from cut stumps in a coppice-like response, which allows the tree to regenerate naturally. Beavers share riparian woodlands with other large, herbivorous mammals known also to alter forests – deer. Deer often browse small saplings before they can reach maturity or strip the bark on those that do. In Scotland, recent evidence suggests that deer are threatening forest regeneration, with a third of woodlands now deemed in 'poor condition' owing to deer impacts (Burton *et al.* 2018). Initial findings from the SBT documented heavy deer browsing on resprouted beaver-cut stems at Knapdale (Iason *et*

al. 2014). Twenty riparian-woodland beaver sites are being monitored by the University of Stirling in Tayside and Knapdale as part of a research project on interactions between beavers and deer. This work will reveal the short-term and long-term outcomes of these interactions and their potential cascading, ecosystem-level consequences for Britain's woodlands. Final results are expected in 2022.

As well as influencing forest regeneration, beaver activity also alters the composition of riparian vegetation. Beavers are selective, often preferring willows and Aspen *Populus tremula* while avoiding Black Alder *Alnus glutinosa*, and generally choosing stems of 2–8cm in diameter (Haarberg & Rosell 2006). Their diet, however, reflects the availability and diversity of species in the local habitat, which can be highly site-specific. Results from the SBT showed that beavers fed on a total of six tree species, including large quantities of Downy Birch *Betula pubescens*, but that willows and Rowan *Sorbus aucuparia* were strongly favoured (Iason *et al.* 2014). Foraging intensity also varies within the riparian zone, depending on how stems of the preferred size and species are distributed. Beavers tend to take more numerous, smaller stems closer to the water and fewer, larger stems as distance from the water increases (Haarberg & Rosell 2006).

The active selection of trees of specific species and sizes, and at particular distances from water, can drive change over larger scales. Short-term studies in Norway suggested that beaver activity can result in diversification of woodland into mixed species, ages, heights and diameters at various distances from the water's edge (Haarberg & Rosell 2006). On the other hand, a longer-term investigation in Russia that monitored beaver foraging and woodland composition over 50 years revealed a complete shift in forest composition towards a more homogenous woodland, with an increase in the abundance of trees at the low end of beaver preference (Goryainova *et al.* 2014). Ultimately, the foraging preferences of beavers, possibly reinforced by other herbivores, could potentially transform some riparian woodlands.

Beavers also raise some challenges for woodland conservation that should not be overlooked. Knapdale beavers, for example, have developed a taste for Hazel, the key component of Atlantic hazelwood which also supports an internationally important oceanic-lichen community. Furthermore, the beavers' well-known penchant for Aspen may not help some rarer flies, including the Aspen Hoverfly *Hammerschmidtia ferruginea*, that specialise on dead mature Aspen. Such challenges are not, however, insurmountable and, ironically, beavers have served to raise the profile of these habitats and their biota, along with the need to protect and restore them (Stringer & Gaywood 2016).

The future

Beavers are the only native mammal reintroduced to Britain in modern times. This represents a brave step which provokes contrasting emotions, but one that clearly has much to offer for freshwater and riparian ecosystems. We conclude by considering some future perspectives and needs.

Expanding the evidence base

Beavers are part of a toolbox of measures for managing or restoring wetlands. Like any tool, they are better for some jobs than for others and are most suitable when outcomes can be flexible and focused on processes, rather than being

When foraging farther from water, beavers will typically harvest fewer, larger tree stems. Nature Picture Library/Alamy Stock Photo

A beaver-cut willow stem with newly sprouted regenerative leafy shoots in Tayside. Kelsey Wilson

highly prescribed. We now have a good general understanding of beavers' effects on some biota through case studies, but the transferability of these to a wider range of contexts is only now starting to become clear as beaver trials around Britain report their findings. Adopting some basic monitoring standards and applying these over the large number of new or recent small-scale trials would help to build a coherent evidence base across a wide range of land uses and types. Similarly, there is scope to widen the range of taxa studied, especially vertebrates. Ongoing PhD projects at Southampton and Exeter Universities will help to fill the gap in relation to the responses of fish to beaver dams in Britain, and work has recently begun at University College London to measure bird responses to habitat-engineering by beavers.

Demonstrating multiple benefits

We have intentionally focused here on freshwater biodiversity, but research at Stirling and Exeter Universities, in addition to reviews commissioned and run by Scottish Natural Heritage (SNH) (Gaywood 2015; Stringer & Gaywood 2016), increasingly demonstrate the multiple environmental benefits from habitat-engineering by beavers. These extend to flow attenuation and improved downstream water quality due to fine-sediment and nutrient storage (Law *et al.* 2016; Puttock *et al.* 2017), indicating clear potential for beavers to contribute to natural flood management and reduction of diffuse pollution. Mitigation by beavers of drought impacts is attracting increasing attention in the USA and may well prove to be a benefit of increased relevance in the UK. The potential positive socio-economic role of beavers in contributing to cultural and other ecosystem services has also been highlighted (Gaywood 2015). Demonstrating the wider environmental benefits of beavers beyond simply biodiversity gain, important though that is, will make the case for their reintroduction more persuasive.

Long-term studies

Our current understanding of beavers in Britain is inevitably limited, and based largely on short-term projects or extrapolated from mainland European and North American studies. Where they are established, however, beavers are well known to have cycles of occupation, abandonment and reoccupation that may span a period ranging from a few years to many decades. Time will tell how these cycles apply when British beaver populations are expanding and where animals face strong gradients in habitat quality and territory connectivity, which may regulate their dispersal within and beyond their present distribution. As beaver populations expand, modelling studies that link population dynamics and habitat characteristics over large scales will be increasingly valuable as a means of predicting the effects of beavers and identifying where management may be needed (Gaywood 2015).

Resolving conflicts

In sensitive locations, such as drainage or transport infrastructure, beavers can have disruptive effects and will require management, as they do elsewhere in Europe and North America. Under the present circumstances, conflicts with agriculture are also likely to need managing, especially where there is damming, burrowing and risk of embankment failure in lowland areas. There are several decades or more of experience with such matters in other European countries from which we can continue to learn. In Scotland, SNH, in consultation with a range of stakeholder organisations, has developed a management framework for beavers centred on the use of approved practical mitigations. The status quo, however, is changing. In England, for instance, the Environmental Land Management Scheme will soon replace current agri-environment schemes as

the basis for payments to farmers for delivering public goods. This may increase willingness to accommodate the consequences of beavers in some areas, given suitable rewards. Justifying these rewards will require evidence of ecological and other benefits, but beavers should not disappoint.

Acknowledgements

The presence of beavers in Britain today is testament to the immense efforts and vision of individuals and organisations, too numerous to name, without whom this work would not have been possible. Most of the research described here was made possible by funding from the Carnegie Trust for the Universities of Scotland, Natural Environment Research Council, SNH, the James Hutton Institute and the University of Stirling, and has benefited from ongoing collaboration with SNH, Bamff Estate and the work of the Scottish Wildlife Trust, Royal Zoological Society of Scotland, and Forestry and Land Scotland at Knapdale.

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Habitat management news

Compiled by Conservation Management Advice, RSPB

Response of grassland fungi to an agricultural change

The island of Fair Isle is splashed with colour throughout the summer, and as autumn sets in the flowers give way to waxcaps and other grassland fungi, which adorn grassy places from late August to October. Even wet areas have their specialists, and the only grassland generally lacking them is the improved fields and leys of the in-bye (crofting areas). The most intensively grazed fields and silage/hay parks of the in-bye receive a light dusting of agricultural fertilisers every May, a practice that began in the early 1970s with the aim of enhancing the nutrient value and growth rate of the grass.

One author (NJR), along with his wife, took over tenancy of a croft, Schoolton, in 1990. Since c. 1980, the fields at Schoolton had received 25kg of agricultural fertiliser per hectare every spring. After the new tenant arrived the only change in management initially was a small reduction in livestock numbers. In 1996, however, a decision was made to cease the application of artificial fertilisers in an attempt to return the field to flower-rich meadow. Since then, no fertiliser of any type, other than natural droppings from the sheep, has been applied to any part of Schoolton croft.

The initial change in the vegetation community was slow, the first Yellow Rattle *Rhinanthus minor* colonising the southern part of the park, cut over in late August for silage, in 2004. In that same year, waxcap fruiting bodies were discovered in the northern part of the field, given over to permanent grazing. Waxcaps and other grassland fungi have suffered a serious decline in Europe, this due particularly to the impacts of agricultural improvement, and they are recognised as a priority group for conservation. Their appearance in the croft was therefore cause for excitement, and the occurrence of a few more in 2005 prompted the two authors to set up a sampling regime in 2006, two years from the first waxcap fruiting body and 11 years after the last application of fertiliser.

The sampling regime

The sampling was conducted over the six-year period 2006–2011, and comprised five collections per annum of grassland-fungi fruiting bodies at approximately 10-day intervals between 21st August and 10th October in sheep-grazed permanent grassland immediately north of Schoolton crofthouse, Fair Isle. The target group was 'grassland fungi', defined for our purposes as members of the Hygrophoraceae (waxcaps) and *Entoloma* (pink-gill) groups. We also included praticolous Clavariaceae (fairy clubs). To make the study manageable, a 40 × 30m (1200m^2) representative parcel of permanent pasture, centred on HZ 2047 7055, was selected in the north-east portion of the field.

Each field collection involved two persons, one collecting and one processing. Processing involved labelling and maintaining each sample, all in separate containers. Thirty minutes were allocated to each collection, after which no samples were taken irrespective of numbers left in the study plot. Attempts were made to sample from all parts of the study plot in the allotted time. Immediately following collection, the samples were labelled, dated, individually photographed and placed in an airing cupboard to dry. Once dry, the fungi were sent to the second author for identification. As an adjunct to the sampling activity, an inventory of plants was made along with details of the structural complexity of the vegetation, topography and soil conditions (depth, pH) in the study plot.

The study plot

The study plot was part of a larger field area of 2.05ha, lightly grazed by up to 17 sheep (headage 8.3/ha). Grazing pressure increased from the end of May to mid-August (headage 26/ha), while the southern part of the field was fenced off to fulfil its purpose as a silage park. The density of livestock was sufficient to suppress grass growth and to

Above Since 1996, when fertiliser stopped being added to Schoolton Croft, Fair Isle, grassland fungi such as these *Hygrocybe coccinea* have staged an impressive recovery. Nick Riddiford

maintain vegetation cover in the study area as a low, tightly grazed sward.

The study site comprised a somewhat diverse plot in terms of topography, soil depth, acidity and plant species (35 vascular plants, ten mosses, five liverworts). The overall characteristics of the site are best described as reverting from improved to semi-improved low-nutrient to moderate-nutrient grassland (pH 4.5–5.5 in deeper soils).

Results

During the six-year study, a total of 24 waxcap taxa, 17 from the pink-gill group and three fairy club fungi was recorded within the study plot. The results indicate a year-on-year increase in number of waxcap taxa. The trend was not so smooth for the *Entoloma* group, suggesting a slower recovery. Nevertheless, the accumulative number of taxa more than tripled over the six years.

This study sampled the fruiting bodies. Fruiting depends on a number of factors, including weather conditions during and prior to the production of the above-ground structure. This may explain the 'no-show' of *Entoloma* fruiting bodies in 2007 and 2010. At Schoolton, only *Hygrocybe pratensis* and *H. psittacina* were recorded in all six years – both are widespread on the isle away from improved areas.

Implications of the findings

Because of the conservation interest in waxcaps, diversity among the group has been used as an indicator of habitat quality. This was quantified for Denmark by Rald (1985), who used the number of species to evaluate levels of grassland conservation value (Table 1). Vesterholt *et al*. (1999) added the category of 'international importance' once a threshold of 22 species was achieved, while Nitrare (1988) incorporated Clavariaceae, Geoglossaceae, *Entoloma* and *Dermoloma* as further indicators of grassland conservation value.

On the basis of these categories, the Schoolton study area attained national-importance status, at least for Hygrophoraceae, in 2008 and reached the cusp of international importance by the end of the study.

It is not known whether the fungi were formerly present but dormant or were the result of spores drifting from elsewhere on the Isle or from farther afield. The majority of the taxa in the study site are commoner species. The list does, however, include two rarely recorded *Hygrocybe* and a further two which appear on European Red Lists, namely *H. quieta* and *H. insipida* (although the former is rather common and widespread in Scotland). Nine (53%) of the *Entoloma* taxa are classified as rarely recorded, and one, if determined correctly, is very rare, with only two records, both in Scotland.

Conservation research

Waxcap grasslands are especially vulnerable to agricultural improvement. The speed at which and extent to which grassland fungi populations become established or, in the case of loss, recover remain largely unknown. At Schoolton, the on-site presence and local knowledge of a field observer constantly observing over a long period have provided a rare opportunity to provide novel information on fungal recovery after the cessation of chemical-fertiliser application. It should be stressed that the Schoolton study does not have the full rigour of a planned scientific experiment, but, nevertheless, the findings suggest that, with the right management, conditions and perseverance, restoration can occur, and more quickly than expected by some.

Despite the recognition of the importance and threatened nature of grassland fungi, these are often poorly catered for by agri-environment schemes, which tend to focus on options that benefit more 'popular' groups such as birds and wild flowers. For the Schoolton study field, this meant denial of entry into the Scottish Rural Stewardship Scheme because the management (specifically summer grazing) was deemed incompatible with recommended approaches. A wider lack of familiarity and appreciation may be at the root of failures in conservation management for grassland fungi and the habitats they require: it must be hoped that future agri-environment schemes address this and take account of the needs of all priority groups.

Further details of this study can be found at www.fairislebirdobs.co.uk/grassland_fungi.html.

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Table 1. Levels of conservation value, after Rald (1985).

Conservation value	Total number of *Hygrocybe* species
of national importance	17–32
of regional importance	9–16
of local importance	4–9
of no importance	1–3

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Anyone with information on the success or failure of any management technique is invited to contact John Day, Land Management Adviser, RSPB Conservation Management Advice, The Lodge, Sandy, Beds SG19 2DL; tel: 01767 680551; fax: 01767 683640; e-mail: conservation-advice@rspb.org.uk.

Britain's hybrid orchids – it's a family affair

Jon Dunn

***Orchis* × *meilsheimeri* (left), the offspring of Lady (centre) and Man Orchid (right), is known from a single site in Kent.** Jon Dunn

Compared with continental Europe, Britain has an impoverished orchid flora, with a mere 51 native species – a small proportion of the upwards of several hundred boasted across Europe as a whole. That said, orchid taxonomy, turbulent waters at the best of times, is currently in a state of particular flux: recent genetic analysis suggests that there may, in fact, be merely dozens rather than hundreds of species found in Europe. As some of the currently separate but potentially lumped 'species' are morphologically extremely distinct from one another, this suggestion is proving somewhat contentious. As the authors of the comprehensive *Hybrid Flora of the British Isles* conclude with masterful understatement: 'There have been many attempts to define a species, none totally successful' (Stace *et al.* 2015). Happily, this article will largely avoid that taxonomic minefield, charting a different, divergent course.

Britain's native orchid species have for centuries attracted the attention of naturalists. While some botanists may decry the undue focus that these plants have received compared with that afforded to the greater balance of our flora, we are nonetheless left with a particularly rich legacy of study and stories, exemplified by a disproportionate output of orchid-related papers, journals, county monographs, field guides and related literature. In the latter regard, I, too, must shoulder some blame, for it was the orchids' spell that led me to write *Orchid Summer*.

In the course of field research for that book I travelled the length and breadth of Britain, searching for all of our native orchid species. Inevitably, I encountered them in a variety of their subspecies and forms and, among those, began to notice the first of many interspecific hybrids.

Historical hybrids

Hybrids began to appear in the orchid literature only in the late 19th century, perhaps as much a reflection of profound, Darwinian changes in how we had previously viewed the immutability of God's creations as a growing awareness of the presence of

the plants themselves. Charles Darwin himself had chosen to employ orchids as a case study for the principles of evolution in his seminal 1862 work *On the Various Contrivances by which British and Foreign Orchids are Fertilised by Insects*.

During the decades after Darwin had demonstrated that orchids, as a rule, evolved close relationships with their pollinating insects as intimate and precise as that of lock and key, the burgeoning craze of orchidelirium continued to rage unabated. At its height, orchids were plundered in their countless thousands from the tropics and the first, human-made, hybrids were lovingly exhibited by their creators. If the hand of humans could be involved in the genesis of a new plant that combined the characteristics of two parent plants, it was no longer inconceivable that such a plant might occur naturally.

The founder of the Royal Horticultural Society journal *The Orchid Review*, Robert Allen Rolfe, was in no doubt that such plants arose in the wild. A frequent contributor to the journal which he founded, Rolfe gave accounts of several such plants discovered in the closing years of the 19th century. One of these, × *Dactylanthera chevallieriana*, the hybrid between Lesser Butterfly Orchid *Platanthera bifolia* and Heath Spotted Orchid *Dactylorhiza maculata*, featured in a paper of 1897. Rolfe described a single plant, found by Mr Arthur Reid on a large moor north of Trinity College, Perthshire, 'which every year about the beginning of July is carpeted with a profuse growth of *Habenaria bifolia* [Lesser Butterfly Orchid] and *Orchis maculata* [Heath Spotted Orchid]. … For the last thirteen years Mr. Reid has, early in July, collected hampers of the flowers to send to sick children in London, and it was when thus engaged with his wife and some friends on July 2nd that he was much struck by one specimen among a great company of *O. maculata* and *H. bifolia*. It had all the pose of a butterfly orchid, and the inflorescence at a distance looked most like [that of] that species, being rather lax and not at all pyramidal in form, yet its leaves were spotted, and the lip and spur of the *O. maculata* type. "I have seen *O. maculata*," he adds, "in all its Protean forms, but have never seen it assume this particular pose … it looks like a hybrid between the two".'

One of the earliest accounts of a hybrid wild orchid in Britain, this is interesting not only for the novelty of the plant itself – only a very few further examples believed to be of this particular hybrid coupling have subsequently been found in Scotland – but also for highlighting the manner in which orchid hybrids tend to blend the phenotypes, or physical characteristics, of the parent plants. In some cases, these jumbled phenotypes are sufficiently diagnostic to provide, if not certainty, then at least grounds for an educated guess at identification by the observer fortunate enough to have noticed the plant in the first place.

In 1897, Mr Reid was doubly blessed, for not only had he found a hybrid orchid, in itself a relatively unusual occurrence, but his plant was an intergeneric hybrid – that is, one born of parents from two diverged genera, *Platanthera* and *Dactylorhiza*. Hybrids within genera, as we shall see, are encountered somewhat more frequently.

As the 20th century progressed, a succession of monographs and field guides on native orchids was published, testament to the family's enduring magnetism for naturalists. It is telling that one of the earliest in the long-running New Naturalist series was *Wild Orchids of Britain*, written by Victor

***Dactylorhiza* orchids readily form hybrids with other members of the same genus. In some areas this may lead to hybrids, such as the one between Heath-spotted and Northern Marsh Orchids, dominating at the expense of the parent species.** Jon Dunn

Samuel Summerhayes and published in 1951. On the subject of identifying hybrids, Summerhayes cautioned his readers thus: 'The interpretation [of putative hybrids] becomes a task which can only be attempted successfully by a person with considerable experience … [but] even with knowledge there are many single plants which defy accurate placing.' To this day, those words ring true.

Mystery and mechanics

If some hybrids lend themselves to ready field identification, others can be trickier, more slippery customers. At this juncture it is worth examining the basic mechanics of orchid hybridisation. Orchid flowers are famously well developed for the obvious purpose of facilitating their pollination. Darwin, after all, devoted an entire book to the subject. Within each orchid genus, there are broad similarities in flower structure – in general terms, for example, the flowers of all the anthropomorphic *Orchis* genus conform to a recognisable type, as do those of the *Dactylorhiza* marsh orchids or the *Ophrys* bee orchids.

It follows, then, that the probability of a hybrid event is higher within members of a given genus than between different genera: pollinating insects that prefer to visit a particular species within one genus are more likely to make a visit to another closely related species, either collecting or delivering pollen from one to the other. Therefore, while some insect species show 'solidarity' towards a particular orchid species, some mixing is very much a possibility.

On the face of it, the hybrid between Bee Orchid *Ophrys apifera* and Fly Orchid *O. insectifera* ought never to happen. Fly Orchids are pollinated mainly by male Field Digger Wasps *Argogorytes mystaceus* (and also the later-emerging *A. fargeii*), while Bee Orchids are preferentially autogamous, or self-pollinating. Pollen from one species ought never to find its way to the other, yet three known small colonies of their hybrid, *Ophrys* × *pietzschii*, persist in the southwest of England. Genetic examination of plants found in Somerset has confirmed that the mother of this colony was a Bee Orchid, fertilised with pollen from a Fly Orchid – suggesting that a wayward wasp was not following the conventional biological script.

Similarly, the autogamous nature of White Helleborine *Cephalanthera damasonium* acts as a constraint upon hybridisation where it occurs alongside Sword-leaved Helleborine *C. longifolia*. The latter species is, however, insect-pollinated and, very occasionally, accidents happen. The resulting offspring, *Cephalanthera* × *schulzei*, display typical characters of both parents.

Further constraints on the proliferation of hybrid orchids exist beyond the vagaries of pollinator choices. The British orchid flowering season extends from late March to August, meaning that some species that could, conceivably, hybridise with one another only rarely get the opportunity, when their flowering periods briefly overlap. Species distribution provides a further constraint: some species that would readily hybridise, for instance Southern Marsh Orchid *Dactylorhiza praetermissa* and Northern Marsh Orchid *Dactylorhiza purpurella*, have only a narrow geographical buffer zone where they meet.

Habitat choices can also suppress the likelihood of pollen transfer between closely related species that flower simultaneously. As an example, Early Marsh Orchid *Dactylorhiza incarnata* ssp. *incarnata* is found only sparingly throughout Shetland in a handful of machair-type habitats and base-rich flushes, while Northern Marsh Orchid is ubiquitous, even growing on the grass verges of the Tesco supermarket in the islands' principal town, Lerwick. Their hybrid, *Dactylorhiza* × *latirella*, is vanishingly rare, found only on a handful of occasions.

Rarity of one parent can, conversely, increase the likelihood of its begetting hybrid young. One Lady Orchid *Orchis purpurea*, on the edge of a colony of Monkey Orchids *O. simia* at Hartslock NR, in Oxfordshire, is the female parent of a burgeoning swarm of hybrids between the two species, *Orchis* × *angusticruris*; with no other Lady Orchids found anywhere nearby, the likelihood was always high that this lone plant would receive pollen from an adjacent Monkey Orchid, and so it came to pass.

As we have seen, though, orchids are not shackled by probability or taxonomy. The relative frequency with which hybrids are found in Britain between Frog Orchid *Coeloglossum viride* and Common Spotted Orchid *Dactylorhiza fuchsii* or, in the Outer Hebrides, between Frog Orchid and Northern Marsh Orchid has for decades implied a closer relationship between Frog Orchid and the *Dactylorhiza* genus than taxonomists had accepted.

Parent 1	Hybrid	Parent 2
		
White Helleborine	*Cephalanthera* × *schulzei*	Sword-leaved Helleborine
		
Frog Orchid	× *Dactyloglossum viridellum*	Northern Marsh Orchid
		
Fly Orchid	*Ophrys* × *pietzschii*	Bee Orchid

Examples of hybrid orchids and their parent species. Hybridisation has been recorded in (and between) a number of British orchid genera. Jon Dunn

Table 1. Generally accepted orchid hybrids known to have occurred in Britain, per *Hybrid Flora of the British Isles* (Stace *et al*. 2015).

Hybrid name (where ascribed)	Parents	One-off historical status
Cephalanthera × *schulzei*	White Helleborine *C. damasonium* × Sword-leaved Helleborine *C. longifolia*	
Epipactis × *schmalhausenii*	Dark-red Helleborine *E. atrorubens* × Broad-leaved Helleborine *E. helleborine*	
Epipactis × *schulzei*	Violet Helleborine *E. purpurata* × Broad-leaved Helleborine	
Platanthera × *hybrida*	Greater Butterfly Orchid *P. chlorantha* × Lesser Butterfly Orchid *P. bifolia*	
× *Gymnaplatanthera chodatii*	Lesser Butterfly Orchid × Heath Fragrant Orchid *Gymnadenia borealis*	1998, West Sutherland
× *Dactylanthera chevallieriana*	Lesser Butterfly Orchid × Heath Spotted Orchid *Dactylorhiza maculata*	
× *Pseudadenia schweinfurthii*	Small White Orchid *Pseudorchis albida* × Heath Fragrant Orchid	
× *Pseudorhiza bruniana*	Small White Orchid × Heath Spotted Orchid	
× *Gymnaglossum jacksonii*	Chalk Fragrant Orchid *Gymnadenia conopsea* × Frog Orchid *Coeloglossum viride*	
	Marsh Fragrant Orchid *Gymnadenia densiflora* × Common Spotted Orchid *Dactylorhiza fuchsii*	
× *Dactylodenia st-quintinii*	Heath Fragrant Orchid × Common Spotted Orchid	
× *Dactylodenia evansii*	Heath Fragrant Orchid × Heath Spotted Orchid	
× *Dactylodenia vollmannii*	Heath Fragrant Orchid × Early Marsh Orchid *Dactylorhiza incarnata*	
× *Dactylodenia wintonii*	Chalk Fragrant Orchid × Southern Marsh Orchid *Dactylorhiza praetermissa*	
× *Dactylodenia ettlingeriana*	Marsh Fragrant Orchid × Southern Marsh Orchid	
	Marsh Fragrant Orchid × Northern Marsh Orchid *Dactylorhiza purpurella*	2003, Westmorland
× *Dactylodenia varia*	Heath Fragrant Orchid × Northern Marsh Orchid	
	Heath Fragrant Orchid × Pugsley's Marsh Orchid *Dactylorhiza traunsteinerioides*	2013, Westmorland
× *Gymnanacamptis anacamptis*	Chalk Fragrant Orchid *Gymnadenia conopsea sensu lato* × Pyramidal Orchid *Anacamptis pyramidalis*	
× *Dactyloglossum mixtum*	Frog Orchid × Common Spotted Orchid	
× *Dactyloglossum conigerum*	Frog Orchid × Heath Spotted Orchid	
× *Dactyloglossum viridellum*	Frog Orchid × Northern Marsh Orchid	
Dactylorhiza × *transiens*	Common Spotted Orchid × Heath Spotted Orchid	
Dactylorhiza × *kernerorum*	Common Spotted Orchid × Early Marsh Orchid	
Dactylorhiza × *grandis*	Common Spotted Orchid × Southern Marsh Orchid	
Dactylorhiza × *venusta*	Common Spotted Orchid × Northern Marsh Orchid	
	Common Spotted Orchid × Pugsley's Marsh Orchid	
Dactylorhiza × *carnea*	Heath Spotted Orchid × Early Marsh Orchid	
Dactylorhiza × *hallii*	Heath Spotted Orchid × Southern Marsh Orchid	
Dactylorhiza × *formosa*	Heath Spotted Orchid × Northern Marsh Orchid	
Dactylorhiza × *jenensis*	Heath Spotted Orchid × Pugsley's Marsh Orchid	
Dactylorhiza × *wintonii*	Early Marsh Orchid × Southern Marsh Orchid	
Dactylorhiza × *latirella*	Early Marsh Orchid × Northern Marsh Orchid	

Dactylorhiza × *dufftii*	Early Marsh Orchid × Pugsley's Marsh Orchid	
Dactylorhiza × *insignis*	Southern Marsh Orchid × Northern Marsh Orchid	
	Northern Marsh Orchid × Pugsley's Marsh Orchid	
Orchis × *angusticruris*	Lady Orchid *Orchis purpurea* × Monkey Orchid *Orchis simia*	Oxfordshire, 2006–present
Orchis × *meilsheimeri*	Lady Orchid × Man Orchid *O. anthropophora*	Kent, 1998–present
Orchis × *beyrichii*	Military Orchid *O. militaris* × Monkey Orchid	
Orchis × *bergonii*	Monkey Orchid × Man Orchid	
× *Anacamptorchis morioides*	Early Purple Orchid *Orchis mascula* × Green-winged Orchid *Anacamptis morio*	
Ophrys × *hybrida*	Fly Orchid *O. insectifera* × Early Spider Orchid *O. sphegodes*	
Ophrys × *pietzschii*	Fly Orchid × Bee Orchid *O. apifera*	
Ophrys × *obscura*	Early Spider Orchid × Late Spider Orchid *O. fuciflora*	1984, Kent
Ophrys × *albertiana*	Bee Orchid × Late Spider Orchid	
Ophrys × *nelsonii*	Fly Orchid × Woodcock Orchid *O. scolopax*	Dorset, 2016–present

Indeed, genetic research suggests that Frog Orchid should, in fact, be reclassified as a member of the *Dactylorhiza* genus, thus *D. viridis*, with its former genus *Coeloglossum* rendered obsolete (Bateman & Rudall 2018). It will come as no surprise for anyone familiar with the world of orchid taxonomy to learn that this change is far from universally accepted, let alone adopted.

Orchid hybrids, then, can pose questions that challenge our taxonomic assumptions and have appeared in Britain in a bewildering smorgasbord of flavours (Table 1). What they rarely provide, however, is absolute certainty. Derek Turner Ettlinger, author of the incomparable twin volumes *Notes on…* and *Illustrations of British and Irish Orchids*, in private correspondence wearily concluded: 'Remember that *Dactylorhiza* hybrids can take innumerable forms and identification by anyone is often a matter of guesswork! I am not even sure that DNA analysis could be infallible.'

Why are hybrids important?

At the most basic level, hybridisation among vascular plants is a critical component of their evolutionary journey. The authors of *Hybrid Flora of the British Isles* note that 'it seems likely that up to half of all vascular plant species are hybrid in origin'. Polyploidy – the presence in one species of multiple copies of chromosome sets instead of the standard diploid, or two sets of chromosomes – is generally accepted as a driving force in evolution, allowing new genes and gene functions to come into being. Historical hybrid events have given rise to species which we now regard as stable and recognisable in their own right, a good example being the tetraploid (four sets of chromosomes) *Dactylorhiza* complex, containing in their number Northern and Southern Marsh Orchids, and the enigmatic Pugsley's Marsh Orchid *D. traunsteinerioides*. All of these derive, originally, from diploid ancestors that would have resembled what we now recognise as Common Spotted and Early Marsh Orchids. Hybridisation may be accidental, but it can be a happy accident if it allows new evolutionary branches to flourish.

At a more selfish level, many of us succumb to the glamour cast upon a species by its rarity. For the birder, a Chiffchaff *Phylloscopus collybita* is an omnipresent summer visitor, barely warranting a second glance, while an Iberian Chiffchaff *P. ibericus*, virtually identical to its commoner congener but for a different song, is deemed considerably more interesting – the latter being a relatively newly recognised, cryptic species, and one that is seen only rarely in Britain.

Hybrid orchids, particularly the most striking, unusual and potentially unique examples, elicit a reaction familiar to the birding community (though one rather less regularly encountered in the perhaps more genteel world of botany): a journey made especially to see an exceptionally rare specimen, or 'twitching'. A case in point is the story of the so-called missing-link orchid, *Orchis* × *bergonii*, the hybrid between Monkey Orchid and Man Orchid *Orchis anthropophora* found at the site of the original Kentish Monkey Orchid colony that was first discovered in 1955. An example of this hybrid flowered there between 1985 and 1992 but

not thereafter. By the 2010s the Monkey Orchids were in decline, a pale shadow of their former, numerous glories in decades gone by. The location is officially kept secret, but when a local amateur botanist found the striking hybrid in 2016, on a different part of the site from that of the original plants, word soon spread and orchid twitchers made trips, in some cases of hundreds of miles, specifically to see the plant in question.

Kent currently harbours another extraordinarily rare hybrid, one that seems set to remain resolutely unavailable to the admiring masses. *Orchis* × *meilsheimeri*, the offspring of Lady Orchid and Man Orchid, was found in 1998 in the wooded grounds of a private house: two flowering plants among a colony of the former species, with a burgeoning population of the latter growing on the lawns of the house in question just a few metres downhill. The location has remained a closely guarded secret and, the property having changed ownership in the meantime, it looks likely to continue to remain strictly off limits. Such privacy may well have benefited the site for, with no pressure from visitors, the number of hybrids has increased, with ten flowering plants present in 2019.

It is curious to note that, while there were unsubstantiated suggestions that the earlier *Orchis* × *bergonii* hybrid was deliberately created by mischievous persons unknown during the process of hand-pollinating the fragile Monkey Orchid colony, there was no such suggestion made for the latter *Orchis* × *meilsheimeri* hybrids. Both hybrids are not irregularly encountered in mainland Europe and, indeed, the former is one of the commonest of the various permutations of *Orchis* hybrid to be found there. Perhaps the sheer novelty of the 1985 record, in a British context, coloured the judgment of the time and, now, we can be more accepting of the likelihood of such hybrids occurring naturally and spontaneously.

We cannot, however, move out of the shadowier reaches of our hybrid orchid flora without a brief historical excursion to Hampshire. At Alton Down, in 2013, another example of *Orchis* × *bergonii* was discovered. Genetic analysis revealed that it had Man Orchid as the maternal parent. Compounding the mystery, the nearest known Monkey Orchids are many miles away in Oxfordshire. Even the finder himself concluded, in his account of the plant published by BSBI, that 'after much consideration, the occurrence of this hybrid being natural is doubtful' (Chalk 2013).

The 'missing link' orchid, the hybrid between Man and Monkey Orchids, inspired that rare event: a plant twitch. Jon Dunn

Why anyone would either bring Monkey Orchid pollen from farther afield to pollinate a local Man Orchid or transplant a hybrid orchid from mainland Europe to Hampshire defies a ready answer. Transplantation does, however, appear to have taken place in the strange world of British orchids – and with significant effect…

The hybrid swarm

In 1998, the first vegetative, non-flowering rosette of Lady Orchid was discovered at Hartslock NR; four years later, it bloomed. A further four years elapsed before the first hybrid offspring between it and the site's population of Monkey Orchids flowered in 2006; seven individuals flowered in that year, with a further 16 non-flowering rosettes identified. This was the beginning of a hybrid swarm with an intriguing genesis and a questionable legacy.

From the outset, the genetics of both the parents and their offspring were subjected to an unusual level of scrutiny, this revealing not only the Lady Orchid's role as maternal parent, but also that the

individual in question contrasted genetically with the other known populations of the species in the Chilterns, being instead related to comparatively uncommon Continental populations. The implication of this was that Lady Orchid either had been deliberately introduced to the site or had, by serendipitous chance, arrived from the Continent as airborne seed. Further genetic revelations were to follow: the ostensibly pure Monkey Orchid population at Hartslock carried traces of Military Orchid *Orchis militaris* DNA, a historical hangover from the 19th century when the latter species still grew nearby. More curious still, there were also traces of Monkey Orchid DNA from Continental populations, adding some credence to a persistent rumour that persons unknown had hand-pollinated the Monkey Orchids with pollen from a Continental plant, presumably with the intention of introducing more genetic diversity into the isolated Oxfordshire population.

The Hartslock hybrids displayed every sign of hybrid vigour, growing to a population of 300 plants by 2010, and continuing to proliferate at the time of writing. For now, they remain largely isolated in one discrete station high on the hillside near their Lady Orchid mother, but inevitably the fear has been expressed that they may subsume the 'pure' Monkey Orchids downhill. To date, there seems to be little or no evidence of this happening and, besides, we know that those supposedly pure Monkey Orchids are, in fact, anything but.

Elsewhere in Britain, where one or both parents are not considered to be exceptionally rare in a local context, the debate engendered by hybrid swarms is practically non-existent and certainly not couched in emotive terms regarding what is or is not considered genetically pure. In Shetland, for example, Heath Spotted Orchid is the most widespread orchid species. Numbers of flowering plants on my small 7-acre croft on the island of Whalsay are in excess of 12,500; the population across the archipelago as a whole must run into the high millions. Northern Marsh Orchid, on the other hand, although still numerous, is rather less common – and it is my impression, having paid both species close attention over the past 15 years, that it is becoming scarcer while hybrids between the two, *Dactylorhiza* × *formosa*, are proliferating. Their pollinators, *Dilophus* flies, visit both parents indiscriminately, so that, where their local populations overlap, a hybrid swarm readily ensues. As the hybrids seem fertile, backcrosses with either parent appear possible – perhaps the origin of otherwise typical but unusually dark Heath Spotted Orchids or Northern Marsh Orchids with atypically heavily spotted leaves.

The conservation question

The discovery of chance, one-off orchid hybrids in Britain seems to elicit only delight among their observers; and the presence of a hybrid swarm, depending on our perception of the conservation value of adjacent parents, generates either guarded concern or ambivalence. This raises the question of how hybridisation colours the decision-making process for conservation.

It is perhaps instructive to go back to the two hybrid swarms above, in Oxfordshire and Shetland, respectively. Our instinctive reaction is to wish to preserve what we perceive as rare but, returning to where we began in this article, what actually constitutes a species is, particularly with orchids, not as obvious as it might initially appear. Genetically, if not in outward appearances, the Monkey Orchids at Hartslock are nth-generation examples of *Orchis* × *beyrichii*, containing Military Orchid DNA that has been diluted by successive backcrosses with Monkey Orchids. In a further twist, genetic analysis of the Lady Orchids in their Kent heartland reveals traces of Military Orchid DNA – another legacy from a time, long ago, when Military Orchids presumably were extant in the county and *Orchis* × *hybrida*, their hybrid offspring, would have been readily encountered as it is, to this day, in the likes of southern France.

Should the recently formed *Orchis* × *angusticruris* hybrids or their Lady Orchid parent be removed entirely from Hartslock NR? To date, that decision has not been taken and, for now, all seems to be well with the greater, adjacent, population of Monkey Orchids. Viewed through the lens of time, this seems a pragmatic and sensible approach. Such pragmatism is more readily applied to the locally abundant *Dactylorhiza* × *formosa* in Shetland, for neither parent is threatened with local extirpation – although, as Northern Marsh Orchid is a British endemic species, we might be forgiven for being a little more concerned. Yet with orchids as a whole, and their hybrids in particular, clarity is an elusive chimaera.

It seems timely to end with one of the more curious latter-day hybrid events, the putative *Ophrys* × *nelsonii* colony discovered on a roadside embankment in West Dorset in 2016. Its suggested identity, arrived at following correspondence with the BSBI's orchid referees, was initially ascribed to Fly Orchid and Woodcock Orchid *Ophrys scolopax* parents. The former species is at best a scarce native in Dorset; the latter is not native to Britain and, hitherto, known here only from a small naturalised colony that persisted for many years in the gardens of the Lyme Regis house belonging to the late John Fowles – better known for writing *The French Lieutenant's Woman* than for his penchant for removing wild orchids from France and transplanting them in west Dorset. Somehow, following the initial suggestion that these orchids resembled *Ophrys* × *nelsonii*, they came to be widely regarded as just that, despite the lack of any genetic research to determine their ancestry or any official determination by the BSBI's orchid referees. They may yet prove to be *Ophrys* × *pietzschii*, with Bee and Fly Orchid parentage. As Professor Richard Bateman, one of the referees, ruefully concluded: 'All the words expended on this mystery over the past several years could be negated via a £10 ITS sequence'. Internal transcribed spacer (ITS) sequencing is a DNA analytical tool widely used in plant taxonomy and phylogeny to determine the identity and relationship of even closely related species.

A mysterious *Ophrys* in Dorset is suggested to be a hybrid between Fly and Woodcock Orchid (the latter not currently known from Britain), but genetic analysis may reveal a different identity. Jon Dunn

These intriguing hybrids on a Dorset roadside are, perhaps, the perfect symbol for the hybrid orchids of Britain as a whole. Their location remains (more or less) secret; they arouse ardour among their admirers, and a determination to pin a definite identity upon them; and yet that identity remains tantalisingly out of reach. Given their benign presence in the wider countryside, perhaps a little mystery is no bad thing.

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Wild story

Amy-Jane Beer

Making marks

There's a tree we like to visit. We call it the Octopus Tree and it's a beech, with an extraordinary sprawling form. Presumably it was toppled many years ago but retained enough root connection that it continued to grow, propped on elbows and knees. Now it is a landmark, a climbing frame, a den, a temple, a place of assignation and a personage of some considerable local distinction. Its bark is densely marked with hundreds of dendroglyphs (or arborglyphs). Mostly these are names and initials, some are longer inscriptions, but made carefully with blades or more roughly with keys and coins.

People have been making marks on trees for thousands of years – the practice of carving a lover's name is recorded by both Shakespeare and Virgil. The smooth bark of beeches offers a particularly tempting surface – a living *tabula rasa* – that takes a mark so well that the Old English for beech – *boc* – is thought to be the origin of 'book'. Likewise, the word 'library' comes from the Latin *liber*, meaning bark.

We live very close to the Yorkshire arboretum, and on a recent visit I encouraged my son to remove a small strip of papery birch bark (there was a sign inviting visitors to do just that). He stowed it in a pocket, noting the way it naturally rolled tight enough to be carried by a messenger pigeon or a Hogwarts post-owl. Birch scrolls were used before paper for the early texts of Slavic, Indic and Celtic cultures among others, and the first letter of the Irish Ogham alphabet is *beith*, meaning 'birch'.

Like so many relatively innocuous infringements, tree-carving is obviously not something we can do willy-nilly – most people I've asked claim to have never deliberately marked a tree. Many express indignation or even outrage at the very idea. I have to admit that I recognise the appeal in making a mark as something akin to a promise. Perhaps this is because my childhood literary heroes were always cutting blazes in trees. They were also always nicking their thumbs or palms to swear blood oaths, and all this sap-and-blood-letting is somewhat muddled in my imagination. Trees have often pierced and scraped my skin and I've cut and stabbed them back, in pruning and felling, and indirectly by buying wooden products, consuming maple syrup, using resins and latex. When I finally finish the novel I'm writing about trees, I am tempted to have a tree tattooed on my skin and to make a reciprocal dendroglyph that will outlive me. I've normally resisted the urge to carve, but did so once, on a young Devon oak. It was the tree I was standing next to when I got a text about someone dying and I carved her initial there and then and left it, with a tiny posy of spring flowers wedged into a crevice in the bark. I don't suppose anyone ever saw it, or, knowing the way oak bark quickly overgrows a scar, that they ever will.

That overgrowing does not happen with beech. Beech glyphs grow with the tree. It's the same with aspen. In California and Nevada, between the late 1800s and the 1960s, generations of sheepherders inscribed words and images into the trunks of aspen. Most of these lonely men were Basque or Irish immigrants, and their carvings illustrate the privations they felt most keenly – many of the pictures were of women, some luridly explicit. If such etchings appeared on a tree in a public place now the assault would be roundly condemned, but these aspen groves were remote and the art was never to be seen by another human. While time has emphasised the scars, darkening and expanding them, it has also matured their meaning. Now historians are seeking to record the last of them before they decay – aspens rarely live for a whole century.

In Wittenham Clumps in Oxfordshire, in the 1840s, Joseph Tubb carved an entire poem on to a large beech. The tree finally disintegrated a few years ago, fulfilling the prescience of the last two inscribed lines: 'Such is the course of time, the wreck which fate / And awful doom award the earthly great.' If you go there now, you'll find a stone with a plaque bearing a transcript traced from a rubbing of the tree.

The glyphs on our octopus tree are more recent and more prosaic. But there's a rash of new ones, the gouged wood angry red. Many are dated 2020, and I wonder, in years to come, who will return to see them and remember this time. It gives me an odd feeling – as though we Twentytwentians have already been packaged into history, our page of the book written and turned over, to be read who knows when, by who knows who.

The Octopus Tree. Amy-Jane Beer

Comment: Lockdown: the best of times or the worst of times?

Mark Avery

Disposable barbecues appear to be the cause of a huge fire in Wareham Forest, Dorset, which spread over 220ha of heath and plantation in the two weeks over which it was burning. Paul Morton

Lockdown in spring 2020 was certainly the strangest of times and we all imagined, as we sat in our gardens in the sunshine, or perhaps simply wished that we had gardens or access to parks or nature reserves, that everything out there, in nature, where we could not get, was going swimmingly. But was that so? How will we look back on lockdown 2020 once we are in the new normal?

Those who remembered 2001's foot-and-mouth outbreak, which was also a spring event, could remember many stories of nature filling up the space that was normally occupied by people, e.g. birds nesting close to deserted footpaths. The 2020 lockdown started a bit later, loosened a bit earlier and was imposed from on high. And the economic shock was far greater, so that many staff of many conservation organisations were furloughed very quickly. This time, there were not only fewer eyes in the field and boots on the ground but also fewer tractors in the nature reserves.

One of the most publicised apparent impacts of lockdown was a rise in wildlife crime. It says much about the UK that, when there are not so many people in the countryside, some take the opportunity to kill protected species, whether it be Badgers *Meles meles* or Buzzards *Buteo buteo*. The anecdotal evidence seems quite strong that there was more wildlife crime, but this probably represents just a blip in the grand scheme of things.

There were also more pollution incidents, including examples where the loss of market for milk (all those lost commuting lattes?) led to discharges into watercourses, and Environment Agency staff were not out there doing the checks at the normal frequency.

There were more easily spotted impacts, too, such as vandalism of hides on nature reserves and more littering and fly-tipping in rural areas. Some of this increase was real, but some, particularly the littering, was simply more noticeable because the people normally employed to litter-pick were

furloughed for weeks. In contrast, in urban areas with parks and gardens closed to the public, local authorities seemed even more assiduous than usual in cutting every area of wild flowers and grasses to within an inch of their life to fill the available time.

The furloughing of most wardens and rangers across large NGOs such as RSPB, the many Wildlife Trusts, National Trust and National Trust for Scotland meant that much routine and urgent management simply did not take place. A strange apparent consequence of this was that the Arctic Tern *Sterna paradisaea* colony on The Skerries RSPB nature reserve failed to exist this year and this was put down to the lack of wardening, meaning that Peregrines *Falco peregrinus* were emboldened to nest on the island, which may have deterred the terns, although I wonder what role increased visits to the island by boats may have played in disturbing the terns. The point is that we shall probably never know, and that will be true of many things in lockdown 2020.

It is also arguable whether the exceptional nature of spring 2020 for many species will be due more to the long dry period of sunny and warm weather than to lockdown impacts. Everything seemed early; butterfly emergence, bird nesting and the flowering of many plants.

When lockdown eased in England in May, and further in June, we flooded back on to Bournemouth beach and into a parched countryside with our portable barbecues.

The National Trust said: 'We know that people have missed the outdoors and open spaces these past few months – and we're really pleased to be welcoming them back. But we're urging people not to bring barbecues to the countryside or the coast. They can lead to real problems, particularly after such little rain in April and May. Many areas of land are still very dry and all it takes is a single spark from a barbecue or a dropped cigarette to cause a serious fire.'

And fires there were, but do we put that down to dry weather or to over-enthusiastic visitors after lockdown, and how much was this offset by fewer fires in the preceding lockdown months?

I am told by my local BTO organiser that I was unusual in carrying out both visits to my two Breeding Bird Survey (BBS) squares more or less as usual. Few early visits were carried out up to mid-May in England, and many volunteers stayed at home rather than venture out to do late visits up to the end of June. In Scotland, Wales and Northern Ireland it was virtually impossible to do BBS fieldwork and stick to the rules. It remains to

A Red Kite *Milvus milvus* shot in Wales was one of a number of incidents of wildlife crime reported during lockdown. Iolo Williams

be seen whether BTO boffins can construct a BBS index for 2020 for England alone, using a smaller number of late visits.

Buglife said: 'The repercussions of this pandemic on the environment are broad and widespread, affecting everything from the management of your local roadside verges to the global spread of invasive species. Unfortunately our ability to learn about its negative and positive environmental effects has been stymied by reductions in the monitoring of several key factors. As far as we can make out the UK governments did not have cross-agency environmental management plans for this situation, it is essential that they are now developed so that in the future the key environmental risks are properly monitored and managed.'

There have been big impacts on the nature-conservation sector itself. With car parks and nature reserves closed and staff furloughed, there was little chance to charm the public into membership or donation, or to sell them coffee or scones. Incomes will have been hard hit and major redundancies are already planned in several organisations. The size of the conservation sector will probably be reduced by lockdown, and it is uncertain whether membership and income levels will bounce back or whether this will represent a new normal. This could and should be an opportunity to restructure our NGOs into better shape for the future, with fewer and more focused entities, but I wager that will not happen. And I am also sceptical that those who heard birdsong more clearly than ever before will remember to become eco-warriors come the autumn, when furloughs end.

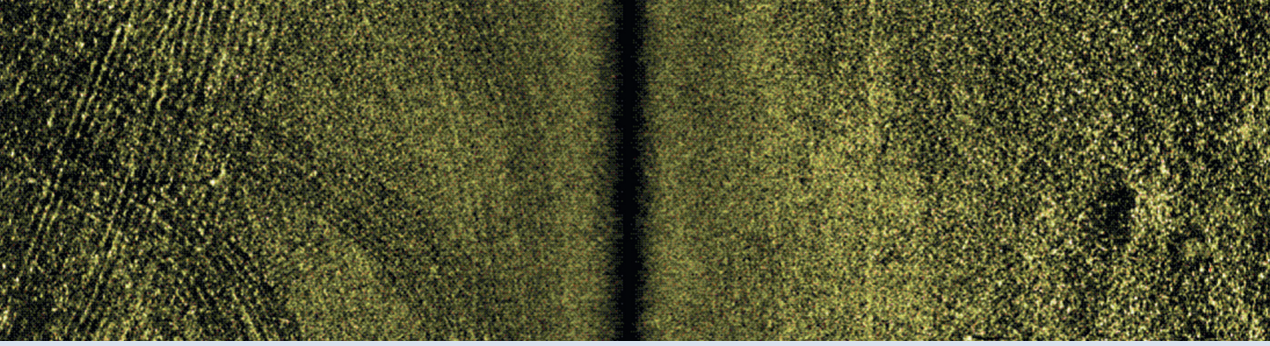
Scrutiny of development plans and of legislation will have suffered during this period, and coming out of lockdown the economy is likely to trump the ecology. What chance that there will be a green new deal of any consequence, and if there is it may well be climate-focused rather than biodiversity- and climate-focused.

The Wildlife Trusts said: 'With the Environment, Agriculture and Fisheries Bills all now delayed, we have profound concerns about whether these critical pieces of legislation will become law – and enforcement bodies will be in place – before the Brexit transition period comes to an end on December 31st. The challenges faced by the natural environment have never been greater and we need both government and public support.'

As I sat in my garden in the spring sun and watched birds, butterflies and plants I felt, guiltily at times, that for me this was really rather nice, but as we emerge into late summer and autumn I fear that the new normal may represent a ratcheting-back in nature conservation's effectiveness. But that is nature conservationists for you: glass half empty!

Mark Avery is an author and environmental campaigner who writes regularly for *British Wildlife*.

Lack of wardening may have played a role in the abandonment of the Arctic Tern colony at The Skerries, Anglesey. Mike Goldwater/Alamy Stock Photo



Letter from Caledonia

Hugh Raven

Drive or sail south along the coast of Ayrshire – you're in Burns country – and look to your right across the sea. At two o'clock is the conical island of Ailsa Craig, an outcrop of granite so fine that as Blue Hone or Common Green it yields the sliding stones used in our national sport of curling. At three o'clock, perpendicular on your right or starboard side, is Arran – Scotland in miniature, the isle is often called, combining high hills, fast rocky rivers and arable fields renowned for their early potatoes.

The fourteen-mile-wide strip of sea between is the lower Firth of Clyde. Known the world over for building fine ships, for centuries the Clyde was famous also for the quality of its fish. Herring were caught and kippered here, a twenty-thousand-ton fishery supporting hundreds of boats. Cod and haddock thrived. Whiting abounded. Large volumes of turbot and flounder were landed, hake and halibut too. Dover sole and lemon sole, skates and rays, ling, saithe, pollack and plaice were caught. Spurdog, dogfish, conger eel and even sturgeon were here. Not forgetting mackerel. This abundance and variety of finfish was perhaps the most valuable in Europe.

Lamlash Bay, on the south-east coast of Arran, became famous among sea anglers. Over two seven-hour days in May its annual fishing tourney brought entrants from far and wide, drawn by the quality of the sport and size of the quarry. At its peak in the 1960s around two hundred competed. In 1968, when the klaxon sounded for the finish, catches on rod and line topped seven tons.

Meanwhile thousands of tons were landed annually by commercial fishers. The boats got bigger and better at catching, so the fish became fewer, smaller and less fertile. As catches fell, fishing regulations were changed to allow more invasive techniques. Catches fell further, then collapsed. The folk of Lamlash Bay abandoned their fishing competition in the 1990s. The annual haul had fallen to under two hundred pounds, less than one eightieth of the peak some thirty years before.

Bemused and disappointed at the destruction of their sport, some donned diving gear and got down among the few remaining fish. They found a seabed ravaged by industrial fishing. On the muddy seafloor, a rich ecology had been razed by prawn trawls. On the shingles, the seabed was ploughed bare by dredging for scallops.

Those self-same islanders have led the recovery. In the mid-1990s they formed the Community of Arran Seabed Trust (COAST), advocating that small areas of the Clyde be spared from industrial damage. After 13 dispiriting years, they triumphed with the creation of a small protected area: at less than three square kilometres, part of Lamlash Bay became the first no-take zone in Scotland.

Then they studied the results. At the start, changes were slow. Certain habitats expanded, including sponges and large seaweeds. Gradually juvenile scallop numbers increased. The juveniles grew, and by 2019 mature scallops were almost four times as numerous as in neighbouring areas still open to fishing. Lobsters showed a similar effect – a remarkable increase in both numbers and size, with over four times as many inside the no-take zone as outside. With larger numbers and average sizes of both species, their breeding capacity increased dramatically – seeding neighbouring areas with the young of the species, benefiting the very fishing businesses that had so vigorously opposed the efforts of COAST.

The benefits to fisheries of closed areas are well proven elsewhere. On the Isle of Man, in areas off limits to dredging, after 17 years of recovery scallop densities were thirty times greater than when protection was first implemented. This is no surprise: it is a commonplace of fisheries science that closed spawning and nursery areas can yield huge dividends. That fishers, in the main, still oppose them is significant of the psychology of the hunter-gatherer, not the authority of the science.

The capacity of the sea to regenerate underlay a 2014 report to the Scottish government. Considering the potential benefits of restricting industrial or mobile fishing – the trawling and dredging with gear dragging over or excavating the seabed – 'the results suggest,' it concludes, 'that Scotland as a whole would be better off with a more diverse and productive marine environment.'

Reducing inshore industrial fishing 'is expected to deliver more economic benefits to broader sections of the population. The expansion of the marine recreational sector could thus create large numbers of jobs. All areas apart from the North West and Outer Hebrides generate an excess of benefits over costs. For the South West and East Coast areas restricting mobile gear use would create many more jobs than it loses.'

That's clear enough. But the report made no headway. Arran's no-take zone, despite its inspirational effects, remains unique. Official policy favours highly destructive fishing. In its management of fisheries, Scotland remains one of the shamefaced and outlying laggards in Europe.

With thanks to Bryce Stewart *et al.* in Frontiers of Marine Science, February 2020; Howard Wood and all at COAST; and Geoff Riddington *et al.* (Grid Economics).

Sonar image of dredging score-marks on the seabed. Millport Marine Biological Station

British Trilobites: glimpses of life from ancient seas

Richard Fortey

***Dalmanites myops* (bottom centre) and *Calymene* trilobites from the Wenlock Limestone.** Sabena Jane Blackbird/Alamy Stock Photo

While the trilobites became extinct long before the first dinosaur had evolved, their beautiful and exotic fossils continue to excite and intrigue. The trilobites discovered in Britain have played an important role in unravelling the diversity and evolution of these remarkable animals. Here we explore the long and rich history of British trilobites.

The limestone bluffs of the Wren's Nest rise up abruptly in the middle of Dudley, an industrial town close to the geographical centre of England. An undistinguished grid of ordinary streets surrounds a wild area of former quarries that happens to provide one of the most important windows into our deep prehistory. The rocks around the local nature reserve have yielded thousands of fossils of animals that together offer the clearest picture of marine life in our islands during the Silurian period, around 425 million years ago. This was 'One crowded hour of glorious life', as the New Naturalist *Fossils* volume described it (Swinnerton 1960, quoting a line from a poem by Thomas Mordaunt), when warm, coralline seas swarmed with multifarious creatures and we basked under a tropical sun. At the time when Swinnerton was writing, fossils could still be picked up around the outcrops at the Wren's Nest if your eyes were sharp and your hands were quick. These may be scarcer now, but the scattered blocks of limestone still show numerous fossil fragments, picked out as darker lines on the weathered rock.

The special prize for a fossil-hunter was a 'Dudley Locust' *Calymene blumenbachii*, a trilobite just a few inches long and burnished almost as if it were still alive. It was even more thrilling to find an example of the same species that had rolled up into a ball as perfect as a piece of precision engineering. The 'locust' was the most abundant of dozens of trilobite species found by quarrymen in the 18th and 19th centuries. They guessed correctly that the

living relatives of these fossils would be arthropods, although trilobites certainly do not resemble anything still crawling about in the Midlands. *C. blumenbachii* even found its way on to the town's coat-of-arms.

Fossils found around Dudley tell of a particularly glorious chapter in the history of British trilobites, but the complete story encompasses several hundred millions years of evolution and a spread of sites from the Scottish Highlands to Torquay. Here I briefly précis a little of the history of trilobites in Britain.

Trilobites in life and death

Trilobites became valuable objects of wonder at about the same time as they became scientifically important: British geologists studying the strata of our islands in the 1800s unscrambled the time periods still used around the globe to divide the earlier Palaeozoic Era, from the Cambrian to the Devonian. A period of more than 100 million years of Earth's history was originally calibrated from fossils, trilobites prominent among them. Around Dudley, trilobites provided a worthwhile supplementary income for the miners, who received a bounty for handing over a particularly fine example to a gentleman naturalist.

For the pioneer palaeontologists, trilobites were the *only* fossil arthropods that could be found in Britain in the oldest fossil-bearing strata of the Cambrian period (beginning 542 million years ago). They soon came to stand in for the most primitive arthropods. Yet trilobites were surprisingly sophisticated: indeed, they constitute a whole class among the phylum Arthropoda. They had prominent eyes, upon which myriad lenses can be observed on well-preserved examples. The three lobes that give trilobites their name divide their bodies lengthways, but they are also divided transversely into a head (*cephalon*) carrying the paired eyes, a thorax with a variable number of segments that could be flexed but could not wiggle sideways, and a tail (*pygidium*) at the back comprising a group of segments fused together. The middle part of the cephalon (the *glabella*) often carried lateral furrows, and housed the brain beneath. Trilobites fossilised readily because the exoskeleton on their dorsal side was made of durable, hard calcite – they are no different from clams and ammonites in this regard. Even the lenticular surface of the eyes was made of calcite. Like all arthropods, they had an exoskeleton; as they grew, they had to moult periodically to acquire a new one. The old exoskeleton came into pieces along special sutures, so that most of the fossils found in the rocks are only bits of an entire animal. Thus, the majority of fossils were not of once-living animals but cast-off moults of their 'shells'. In this way, during its lifetime a trilobite generated many potential fossils simply by growing, and a palaeontologist can spend a lot of time putting moulted fragments back together – like having a jigsaw puzzle without a convenient reconstruction picture on the box. A whole trilobite exoskeleton is a treat for the collector, but requires that the animal had not been broken up by scavengers or water currents after its death.

All arthropods have jointed limbs, but the legs of trilobites have proved hard to find. Unlike the dorsal carapace, they were not calcified and hence are very rarely preserved. These appendages had a flexible covering of chitin, as do nearly all extant arthropods. By the end of the 19th century, limbs were finally discovered on exceptionally preserved trilobites from the eastern United States. With

Wren's Nest NNR (left), in Dudley, is famed for its Silurian fossils. The 'Dudley Locust', a *Calymene* trilobite, appears on the town's coat of arms (right). Graham Worton

anterior antennae, a pair of walking legs and gill branches to every segment, these fossils are indubitably typical arthropods. Sadly, we have yet to discover any trilobite locality in Britain with well-preserved appendages. Trilobites were evidently vulnerable on their undersides, this perhaps accounting for the evolution of protective enrolment in genera such as that of the Dudley Locust, *Calymene*. The thoracic segments could glide past one another thanks to facets on their flanks, while the middle lobe of the trilobite could simultaneously expand and remain safely covered by a little concealed ring of extra cuticle which appeared as enrolment proceeded. Head and tail were often provided with 'locks' to secure an extra tightness of fit as they docked together. Some trilobites added an array of spines that turned them into prickly balls when they rolled up.

This armour served them well. Trilobites lasted for more than 250 million years, but failed to survive beyond the end of the Permian period – the greatest mass extinction in the history of our planet. They never left the marine environment. If they had followed the scorpions and centipedes on to land, trilobites might well have survived to astonish us today.

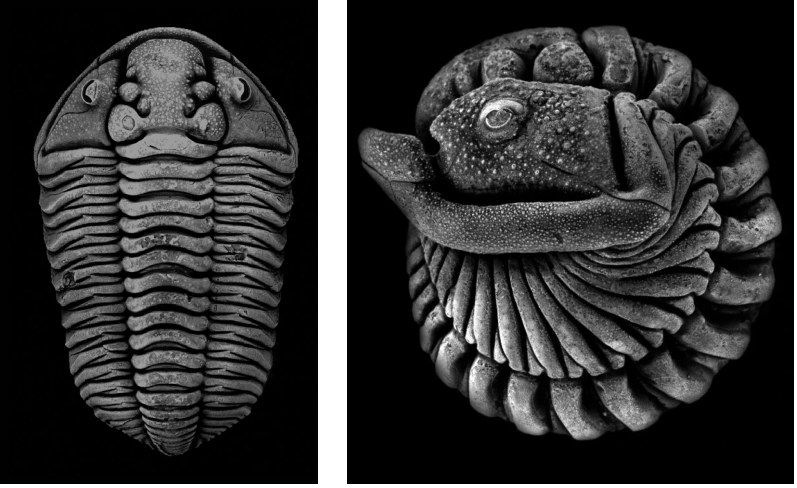
During their long sojourn in the Palaeozoic seas, trilobites occupied a full range of marine ecological niches, and their hard exoskeletons evolved an appropriately wonderful range of forms (Whittington 1997; Kennedy & Stammers 2018). Their mature size ranged from just a couple of millimetres to nearly three-quarters of a metre. While most species lived on the sea floor, several small Ordovician examples took to life in the open seas and developed huge eyes that could see through 360 degrees. Their benthic contemporaries found livelihoods as deposit feeders, predators and filter feeders – similar to many of the niches occupied by crustaceans in modern seas (Fortey 2014). Their feeding activities left tracks and burrows in sediments that became another kind of fossil: a few moments in the life of a trilobite could be immortalised until rocks crumble.

The earliest British trilobites

Britain is fortunate in its varied geology. Trilobites of every age except for the last Permian survivors can be collected from strata exposed in quarries, sea cliffs and road cuts. In the 19th century geologists recognised that successive rock formations could be identified by the kinds of trilobites that they contained. Adam Sedgwick, Woodwardian Professor at Cambridge, researched the geology of the Welsh mountains and named the Cambrian System for their ancient rocks and fossils. Charles Darwin had accompanied him into the field in 1831. Sir Roderick Murchison worked particularly in the Welsh Borders and named the Silurian for the rocks thereabouts, gathering his research in one of the great works on British geology, *The Silurian System* (Murchison 1839). Many drawings of fossils adorn its pages, trilobites to the fore. A famous tussle between Murchison and Sedgwick to claim the early trilobite-bearing strata for their respective systems was resolved only when an intermediate Ordovician System dividing Cambrian from Silurian was 'carved out' in 1879 (Secord 1986).

As a schoolboy, I found my first trilobites in black Cambrian mudstones on the coast near St Davids, Pembrokeshire. The rock was hard but brittle, and shards flew about dangerously under blows from my hammer. Unlike the perfectly preserved trilobites from Dudley, the specimens I eventually discovered there had suffered over geological time. Cracks ran through the rock and the fossils were twisted slightly. Somehow, this only added to their allure: they looked truly ancient, messengers from the past just for me. Britain's largest trilobite, *Paradoxides davidis*, was discovered here; it was as long as a lobster. I found only some fragments of this creature's thorax, but to me it was as exciting as turning up a Roman coin: here was a tangible relic from the first great explosion of marine life. Nowadays, many of the Pembrokeshire sites are protected as SSSIs and fossil-collecting is therefore no longer permitted.

Paradoxides was described in the first, monumental work devoted wholly to the trilobites of our islands, *British Trilobites* by John Salter, which was published in several parts between 1864 and 1867. This, the largest British trilobite with its well-developed eyes, was found close to one of the smallest, *Eodiscus*, a species no bigger than your little fingernail. As was the case with several other Cambrian trilobites from south-west Wales, *Eodiscus* had lost its eyes and become blind. *Paradoxides* had numerous thoracic segments and a tiny pygidium, but *Eodiscus* had only three thoracic segments and a pygidium as large as its head. So, by



***Calymene* unrolled (left) and rolled up (right): these trilobites were able to curl into a tight ball in defence, just like modern-day pill woodlice.**
Derek Siveter

the middle of the Cambrian period, trilobites had already evolved into startlingly different forms. When he published *On the Origin of Species* in 1859, Darwin accepted trilobites as the arthropod 'ancestors' but was still mystified by the fact that they appeared to be so advanced without apparent relatives in the underlying strata of the Precambrian. We now know that there *were* many other kinds of Cambrian arthropods besides trilobites, thanks to spectacular preservation of 'soft-bodied' faunas in Canada and China – but the evidence of their common origin remains elusive. Trilobites were almost alone among the oldest arthropods in hav-ing a partly mineralised exoskeleton, thereby mightily increasing the chances of finding them as fossils.

Cambrian trilobite localities are scattered around Britain. You have to travel to the north-west tip of Scotland to find the attractive early Cambrian *Olenellus lapworthi*, a species named for the 'inventor' of the Ordovician, Charles Lapworth. Its closest relatives are on other side of the Atlantic Ocean, in the Appalachians. The Cambrian rocks around Durness and to its south-west look very different from those in England. Cambrian trilobites can be found also in the Welsh Borders, but are difficult to collect without digging trenches into the appropriate rocks. A geological inlier near Nuneaton brings up Cambrian rocks into the middle of England, but the most extensive tracts are in north Wales, in the country around Harlech, Ffestiniog and Porthmadog – a tribute to Professor Sedgwick's sound judgment in naming the system after the Welsh mountains. Over much of this outcrop, however, trilobites are rare. A few precious finds of trilobite fragments prove that the great slate quarries of Bethesda were opened in strata of Cambrian age. Much of Victorian Britain was roofed with durable slates that were once soft, sea-floor sediments over which trilobites scuttled.

The Ordovician

Strata from the Ordovician (beginning 485 million years ago) drape around those of Cambrian age in north Wales, and run across south Wales from Llandeilo to St Davids, while Shropshire is home to many more classic Ordovician trilobite localities. Near Girvan, the Southern Uplands of Scotland are just as productive. Most palaeontologists would agree that the trilobites were at their most prolific and diverse during the Ordovician: they can cover whole surfaces of rock slabs. I have spent weeks of my life breaking rocks in fern-covered streams in Wales when seeking unknown trilobites from dark shale. I got accustomed to Welsh farmers asking me if I was after gold, and in a sense I was: the precious discovery of a species never seen before. Ordovician trilobites seem to have occupied all available environments in the seas of the time. Specialised, blind, deep-water species lived at the margins of former continents, and many others revelled in the shallows. There were reef-dwellers and mud-grovellers. Trilobites that lived around different ancient continents went their own way and developed genera – even whole families – that were confined to the fringes of one ancient landmass or another. Hence, the mapping of trilobite distributions played a seminal part in the discovery that, during the Cambrian and Ordovician, Britain was divided between two ancient continents, Laurentia in the north and Avalonia to the south, each with its different sets of trilobites, separated approximately along the Solway Firth. The geology of North-west Scotland is fundamentally different from that of Wales, because, 470 million years ago, these two regions were split by an ocean – the Iapetus – as wide as the present-day Atlantic.

Beautiful Ordovician trilobites abound around Llandeilo. The grounds of Dinefwr Castle lie on limestone and shale that commonly yield a large and elegant trilobite with a tail bigger than its

***Ogygiocarella debuchii* was the first trilobite to be given mention in the scientific literature, in 1679.** Richard Becker/FLPA

head: *Ogygiocarella debuchii*. This trilobite also has the distinction of being the first ever mentioned in the scientific literature, by Edward Llwyd in 1679 in the *Philosophical Transactions of the Royal Society*, where he described it as a 'flatfish', but provided a passable illustration that leaves no room for doubt about its identity. Murchison named a related giant from the area *Asaphus* (now *Basilicus*) *tyrannus*, a well-armoured 'tyrant' that was probably a predator of its fellow invertebrates. The family Asaphidae proved to be typical of Ordovician strata the world over; again, trilobites helped to establish the logic and chronology of geological time long before the metric of radioactive decay.

By the early Ordovician, most Cambrian trilobite families had declined, but a wealth of new ones appeared. The first known relatives of the Dudley Locust were accompanied by some very spiny species (odontopleurids) that would give rise to bizarre-looking, prickly trilobites later in the Palaeozoic. Small trinucleid trilobites are jewels that repay close inspection: they all have a colander-like 'fringe' surrounding the headshield, the function of which has elicited many explanations, none of them entirely satisfactory (perhaps a filter? or strengthening rods? an exit valve?). The type species of *Trinucleus* was another Murchison discovery from the Llandrindod area, where it can still be collected relatively easily. These particular trilobites evolved very swiftly, and their various genera and species, typified by wonderfully diverse 'fringes', have proved of service in subdividing the British Ordovician geological column. They are often found with *Cyclopyge* and its relatives – the reference to the mythical one-eyed Cyclops acknowledges the enormous eyes of this trilobite. In some species, the eyes fused into a single gigantic optical organ at the front of the cephalon. Such planktonic trilobites often swarmed together, while on the sea floor the sluggish trinucleids were almost blind and probably lived by stirring up soft sediment into suspension.

Most trilobite eyes were composed of numerous tiny hexagonal lenses that worked together in a similar way to that of the compound eyes of living arthropods, although the corneal surfaces were made of clear calcite. By Ordovician times, another type of eye (termed schizochroal) had evolved, with fewer, more sophisticated, biconvex calcite lenses arranged in rows. These unique eyes served to characterise a whole order of possibly predatory trilobites (Phacopida), with several families and dozens of genera, and a history extending over more than 100 million years. In Britain, they are often prominent in late Ordovician rocks around Girvan, Ayrshire, or in the Lake District. A few specialist trilobites managed to colonise deep-sea environments with reduced oxygen levels, a challenging habitat even in today's oceans.

Far from being the 'primitive' creatures that had been assumed, trilobites were almost as varied in their morphology, and as ecologically diverse, as any group of living marine arthropods. That there are about 5,000 different trilobite genera is scarcely surprising, given a history that spans hundreds of millions of years.

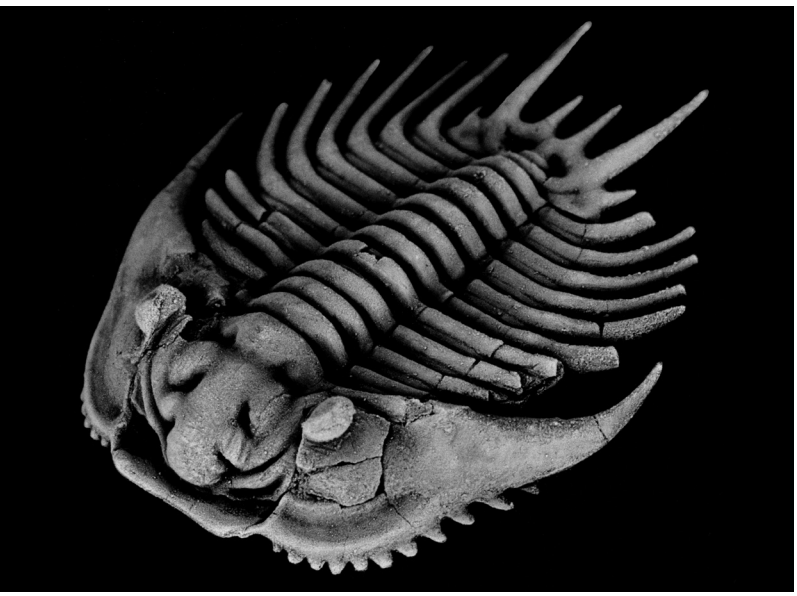
A golden age

A major glaciation at the end of the Ordovician 443 million years ago produced an oceanic crisis that culled many of the most typical Ordovician trilobite families, including trinucleids as well as *Basilicus* and its relatives. Pelagic trilobite species disappeared forever. After a brief setback, however, the group as a whole prospered again in the Silurian. By now, relatives of the vertebrates had appeared, predatory nautiloid molluscs abounded and sea scorpions had evolved into giants, so trilobites needed their armour more than ever. In Britain, probably the commonest Silurian trilobite is *Dalmanites*, one of those with schizochroal eyes and a spine-tipped

pygidium. It appears frequently in Silurian shaley outcrops near Ludlow, the charming Shropshire town known to every student of the Palaeozoic.

The prime showcase for Silurian trilobites remains the Wenlock Limestone, which underlies the precipitous Edge to the south-east of another attractive Shropshire town, Much Wenlock. The best locality for trilobites, however, is still Dudley, where the Wenlock habitat was particularly favourable (Thomas 1978–1980). The largest companion of the 'locust' is *Trimerus delphinocephalus*, a widespread, elongated trilobite in which the three lobes appear smoothed out over the thorax, while the cephalon has an almost spatula-like front, with small, elevated eyes. This sleek shape may well have assisted its ready passage while burrowing through soft sediment. *Bumastus* is almost as large and quite as smooth, but with a short thorax and a ball-like, almost featureless pygidium. Among several trilobites with spiny pygidia, *Sphaerexochus* is the neatest and most compact. It has an almost perfectly spherical glabella and 11 segments in the thorax that articulate perfectly when the animal rolls up: then it is about the size of a boiled sweet and quite as delicious. The strawberry-headed trilobite *Encrinurus* has a cephalon covered with warty lumps, and its eyes are raised on stalks. And to round off the parade comes a small, wide trilobite with a halo of spines all around its margin, *Kettneraspis deflexa*. These trilobites have been known since the quarrymen first found them, to delight 19th-century aficionados, but they have lost none of their charisma through becoming familiar. They remain the crown jewels among British species.

The spectacular *Kettneraspis*, one of the spiny odontopleurids, was part of the diverse assemblage of Silurian trilobites. Derek Siveter



The younger trilobites

Even though the eponymous county is the type area for Devonian (the period beginning 419 million years ago) strata, it has to be said that our own Devonian trilobites are disappointing in comparison with the extraordinary spiny creatures that have emerged from Eifel in Germany, from the Czech Republic and, in recent years, from Morocco. Most of Britain was not covered by sea during the Devonian. Fresh- and brackish-water deposits are widespread across Wales and Scotland, where they are familiarly known as the Old Red Sandstone. These sedimentary rocks are famed for yielding fossils of early land plants and a variety of fishes – but no trilobites. Marine Devonian rocks are confined to South-west England, which lay towards the edge of the Variscan ocean. Around Newton Abbot, some characteristic Devonian species have been recovered from limestone, but they are mostly fragmentary and difficult to collect. Nonetheless, typical Devonian forms – such as the fan-tailed *Scutellum* or the large-eyed, warty *Phacops* – are familiar across Europe and beyond. (A Moroccan relative of the latter is *Barrandeops forteyi* – I trust that the fact that this species has very odd eyes does not reflect on the present writer.) One *Calymene*-sized trilobite that is often encountered more or less complete is usually collected from dark, slaty Devonian rocks that accumulated originally at a considerable water depth. The name of this animal is a tongue-twister: *Trimerocephalus mastophthalmus*. It is another relative of *Phacops*, but one that has become completely blind. In the dark depths where this trilobite lived, eyes were obsolete. Many specimens are recovered in a curious arrangement: the thorax and pygidium are to-

The trinucleid trilobites had a characteristic fringe around the head, although the function of this feature remains unknown. The Natural History Museum/Alamy Stock Photo

gether and the 'right way up', while the cephalon is detached nearby but inverted. A plausible explanation is that this arrangement resulted from a moulting technique. When it needed to grow a new exoskeleton, the trilobite 'broke' its carapace at the junction between head and thorax, and exited forwards; then it rid itself of the encumbrance of its old cephalon by inverting its head – and walking away. So the apparently whole trilobites are actually fossilised exuviae: a day in the life of *Trimerocephalus* preserved almost 200 million years before the first dinosaur.

Towards the end of the Devonian, another mass extinction profoundly affected the marine environment. Many of the trilobites that had flourished through the Silurian and the earlier part of the Devonian disappeared, particularly those associated with reef habitats. A few families survived into the Carboniferous (beginning 358 million years ago), but trilobites are no longer common fossils in rocks of that age. There are a few localities, such as Treak Cliff, in Derbyshire, where the Carboniferous Limestone crags contain 'pockets' with rather beautiful, small, compact trilobites like *Cummingella* and *Griffithides*. It would be wrong, however, to portray the trilobites as already sliding towards their end, for the remaining groups continued to evolve rapidly (Owens 1986). Several species migrated into the deep seas and lost their eyes, much like *Trimerocephalus*. Others probably adopted the same ecological niches as had been occupied by unrelated trilobites in the earlier Palaeozoic – filter feeders, or even predators on small, soft-bodied marine worms. Nevertheless, our British trilobite narrative draws to a close when the environment became non-marine once again as the Coal Measure swamps spread across northern Europe.

I have studied some of the youngest trilobites known, from Permian strata cropping out in the Sultanate of Oman. They were perfectly enrolled specimens of several species that still looked in the best of health. I have always hoped that some deep-sea trawl might bring up a living trilobite that had somehow dodged the great cull at the end of the Palaeozoic, but that outcome seems less and less likely. I shall have to be content with fossils, and grateful for living in a country where trilobites are both common and historically important. And where new ones can still be discovered. One of my most recent papers reported the extraordinary find of a giant trilobite in North Devon that served to date the Devonian rocks along a slab of the coast at Lynton (Rushton & Fortey 2018). When I wrote my book about trilobites, *Trilobite! Eyewitness to Evolution* (Fortey 2000), I put in the exclamation mark to try to claim a little of the drama that has always belonged to dinosaurs (*Tyrannosaurus rex*!). The reader of *British Wildlife* is much more likely to come across trilobites than dinosaurs. I believe that the former are just as exciting.

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Flying kites – a view from Wales

James Robertson

I am standing at the edge of a wasteland. A pyre of brash emits a haze of smoke; a digger tears at root and branch, then slows as the farmer dismounts. I engage him in conversation, and after the usual pleasantries I question whether this wildlife-rich site should be razed to the ground. 'This was grazing land when I was a kid', he replies. 'Food production is the name of the game.' Producing food is what motivates farmers, in the same way that producing timber motivates foresters.

Wales has been a nursery for a generation of farmers wanting to do things differently. Far away from my Welsh acres, Patrick Holden's Ayrshire cows are producing the high-butterfat milk for his superlative Hafod cheese. His journey in farming began in the early 1970s, when he moved to mid-Wales, intent on producing food while working in harmony with nature. His inspiration came from a wave of green thinkers such as authors John and Sally Seymour, who had moved in 1964 to a farm in Pembrokeshire, from where they wrote and illustrated a number of classic books about practical self-sufficiency. Later, as Director of the Soil Association, Patrick became one of the most persuasive voices for organic farming, seeking to bring food production and nature into closer alignment. Now, as founder and chief executive of the Sustainable Food Trust (SFT), he is stressing the importance of food security. In a blog on the SFT website, following a long interview with Isabella Tree of the Knepp Wildland project, he puts the case for a wholesale shift of farming on to a sustainable path. This contrasts with the view that food production should be further intensified on the best land, allowing poorer land, as at Knepp estate, to be returned to nature.

Looking into a crystal ball, change is the only certainty I can see, swirling in the mists of future land use. For once, though, the options seem multiple and achievable. The coronavirus pandemic has caused a collective intake of breath, a questioning of how we do things and what really matters. Nature is being recognised as our friend and solace. Neighbours have converted lawns to vegetable plots. Seeds and plants are in demand. A passionate young Welsh horticulturalist, Huw Richards, has added 100,000 global subscribers in a few months to his YouTube channel and wrote last year's best-selling gardening book, riding on the wave of his generation's enthusiasm for growing. His message is that vegetables can be grown cheaply and simply, with emphasis on local and seasonal. As he puts it, 'diversity is important because that's what makes nature thrive'. A future filled with local food networks is starting to take shape. In the uplands, where many heaths and moors have yielded to sheep-nibbled acid grassland, change could bring greater diversity, more nature and more trees, while keeping rural communities alive.

It is never hard to find support for extending tree cover, but it is less easy to reach a consensus on how to do this. How do you achieve the best results in terms of benefits to the public, nature and climate? It will be interesting to see what role Natural Resources Wales (NRW) plays in making this happen. By bringing forestry and nature conservation together, the organisation has a unique opportunity to forge the best of both traditions into a progressive approach to managing the nature and forest estate, some 7% of Wales. How it will seek to extend tree cover remains to be seen. Will NRW advocate the right tree in the right place? Will it prohibit plantations in upland areas where, given benign management, the land could more effectively sequester carbon as peat? Will it encourage the use of natural regeneration, even though this weakens its regulatory control? Will it give equal weighting to the nature and climate emergencies, or will it favour the latter to provide green clothes for an old forestry agenda? Will it avert its eyes from England's Tree Strategy and look longingly at Scotland's commercial forestry ambition? Companies such as Shell would like to plant large upland estates with conifers to offset carbon, although in much of our uplands this would be counterproductive, and any use of public funds in this way would be unacceptable to many.

The scribbles of wet pastures, woods and hedgerows captured by early maps provide one frame of a continually shifting animation. The smoking wasteland which I witnessed was rough pasture half a century ago; now, woodland and scrub are being converted back to pasture. Changes like this are inevitable. It would be better, though, if they were not separated in time, but elided into that most productive and biodiverse of places, wood-pasture. This may depend on a new generation of people who work the land learning the arts of agro-forestry and how to harness ecological processes. Demarcation lines between farming and forestry need to soften. The time has come to put nature back in the frame.

Vegetable plot. Gary K Smith/FLPA

Wildlife reports

Compiled by Guy Freeman

Weather for May and June 2020

After a cool and showery start to May, high pressure built from 2nd, and between 5th and 9th most areas experienced warm and sunny weather. A cold snap from 10th to 15th brought wintry showers and some overnight frost to parts of Scotland and conditions remained changeable from 16th to 23rd, although there was plenty of warm sunshine in southern areas. High pressure returned for the remainder of the month, and warm sunny weather prevailed. For England and Wales, this was by far the sunniest May on record, although sunshine was close to average in Scotland and Northern Ireland. The mean temperature was 1.0°C above the long-term average for May, while rainfall was only 47% of the average.

Warmth and sun continued into June, but from 3rd to 7th temperatures dropped and showers were widespread. The weather turned wet across the country by 10th, and many areas experienced humid, showery conditions and thunderstorms through the middle of the month. A hot sunny spell from 23rd to 25th ended with further thunder in some places, while the end of the month was cloudy and windy, with some longer spells of rain. The temperature for the month overall was 1.0°C above average, and rainfall was 144% of average.

Guy Freeman

Mammals

The Mammal Society's new *Atlas of Mammals of Great Britain and Northern Ireland*, the first revision since 1993, was published just five days after the COVID-19 lockdown began. A real milestone for the Society, and the culmination of years of work by a small army of volunteer recorders and verifiers, the *Atlas* provides a comprehensive assessment of current and historical (1960–1992) mammal distributions. Cetaceans are included for the first time, thanks to the partnership between the Mammal Society and the SeaWatch Foundation.

Our mammals are undoubtedly charismatic – many are the poster children of wildlife fundraising campaigns – yet remarkably little is known of their distributions. Who stops to think that it might be important to record a sighting of a **Grey Squirrel** *Sciurus carolinensis* or a **Brown Rat** *Rattus norvegicus*? Yet these rodents, as non-native invasive species, have enormous ecological impacts. Who bothers to record a **Field Vole** *Microtus agrestis*, despite its role as a tiny ecosystem engineer and key dietary component of many raptors and carnivores? Furthermore, many species are just too shy, or perhaps too strictly nocturnal, for most people to encounter them.

Despite the known problems associated with varying levels of survey effort, atlases are tremendously useful in identifying broad-scale trends in distribution. The underlying data are also vital for analyses with new techniques that allow us to account for these biases in survey effort. The new *Mammal Atlas* clearly shows the catastrophic decline of species such as **Red Squirrel** *Sciurus vulgaris*, **Water Vole** *Arvicola amphibius* and **Harvest Mouse** *Micromys minutus*, for example, and charts the range expansion of others, such as **Roe Deer** *Capreolus capreolus*, **Polecat** *Mustela putorius* and **Nathusius's Pipistrelle** *Pipistrellus nathusii*, which is now known to breed in Britain. There are also good records of rare species such as **Fin Whale** *Balaenoptera physalus*, and of vagrants such as the **Beluga** *Delphinapterus leucas* and **Bearded Seal** *Erignathus barbatus* (a photograph of this latter rarity, taken in Lerwick Harbour by Austin Taylor, was one of the Society's Mammal

Above: Bearded Vulture in the Peak District, see p. 438.
Dylan Parry-Davies

Photographer of the Year winners in 2019). The text entry for each species in the *Atlas* also summarises the ecology and characteristic features of the species, describes changes over time, and highlights areas of potential uncertainty. In the case of the cryptic species such as **Whiskered** *Myotis mystacinus*, **Brandt's** *M. brandtii* and **Alcathoe Bats** *M. alcathoe*, for example, only a combined distribution map is possible.

We are now looking for new mammal verifiers to join the network of specialists working across the country. For many species, including the bats, along with most cetaceans and small mammals, identification requires a degree of specialist knowledge, and it is here that verifiers – the heroes of biological recording – are vital in weeding out erroneous records. If you are interested in becoming a mammal-recorder (good knowledge of one, but not necessarily all, taxonomic groups is needed), please get in touch with the Society (info@themammalsociety.org). Without verifiers, the process of recording would, for many species, simply grind to a halt.

Following on from the findings of the *Atlas*, the Society is launching a new campaign to conserve the Harvest Mouse. This tiny rodent weaves an intricate nest in the stalk-zone of grasses, and has suffered from the loss of habitat over a prolonged period. Changes in cereal production, away from long-stemmed varieties harvested in late August and September to earlier, shorter-stemmed varieties, mean that cereal fields are now hazardous places for Harvest Mouse nests. Intensification of production and the drainage of much agricultural land also mean that the tall, structured vegetation which Harvest Mice require has dwindled in extent and suitable habitat has become fragmented. There remains hope, however. Surveys by some of our local groups have identified Purple Moor-grass *Molinia caerulea* grasslands and reedbeds as places still frequented by Harvest Mice. Tall vegetation adjacent to field boundaries and hedgerows can also be suitable. In contrast to the needs of wildflower meadows, good habitat for Harvest Mice will often have layers of vegetation resulting from several years' growth; annual cutting means that the vegetation lacks sufficient structure for the mice to build their elevated summer nests, or to survive at ground level over winter. We are looking for volunteers to help with survey work beginning this summer, and also for partner organisations to work with us on habitat restoration, so do, please, keep an eye on our website (www.mammal.org.uk) for updates over the coming months.

Fiona Mathews,
The Mammal Society

The new *Mammal Atlas* shows expanding populations of some species, such as the Polecat. Robin Chittenden

Birds

Rare seabirds have dominated the last couple of months. First was an extraordinary record of a **White-chinned Petrel** *Procellaria aequinoctialis* photographed at Scapa Bay, Orkney, on 25th May; this will be the first record of this species for the Western Palearctic if accepted. This is a bird of the Southern Ocean, normally ranging as far north only as southern Australia, Namibia and Peru. A shearwater that was picked up exhausted on the beach at Tramore, Co Waterford, on 22nd June, and later perished in care, proved to be a **Short-tailed Shearwater** *Ardenna tenuirostris*, another potential first for the Western Palearctic. This species breeds in Australia and spends the winter at sea in the North Pacific between Alaska and Hawaii. An adult female **Cayenne Tern** *Thalasseus acuflavidus eurygnathus* was discovered in the **Sandwich Tern** *T. sandvicensis* colony at Lady's Island Lake, Co Wexford, on 12th June and was seen regularly until 25th June. Cayenne Tern is currently treated as a subspecies of **Cabot's Tern** *T. acuflavidus* and ranges from the Caribbean down to eastern southern Argentina. Although there is no previous record of Cayenne Tern in the Western Palearctic, there are two historic records of Cabot's

Tern – in Herefordshire and the Netherlands. An adult **Sooty Tern** *Onychoprion fuscatus* was seen briefly at Cemlyn Bay, Anglesey, on 14th June, and another was at Sizewell, Suffolk, on 8th July. An adult **Black-browed Albatross** *Thalassarche melanophris* was seen off Bempton Cliffs, Hunmanby Gap and Filey, in East Yorkshire, on 2nd July, and again off Bempton Cliffs on the next day. There have been some interesting records of **Yelkouan Shearwater** *Puffinus* yelkouan, including probables past Dawlish Warren, Devon, on 4th July and Berry Head, Devon, on 6th July, and a well-photographed individual was off Portland Bill, Dorset, on 7th–10th July at least.

A **Eurasian Scops Owl** *Otus scops* found in a mist net in Nanjizal Valley, Cornwall, on 28th May was a bit of a surprise for the ringer. Following a probable sighting in Northamptonshire at Braunston, on 25th June, a **Bearded Vulture** *Gypaetus barbatus* was photographed over a garden on Balsall Common, West Midlands, on 26th, and then seen over Scropton, Derbyshire, later that day. There were sightings in Derbyshire from 26th June to 10th July, ranging from Hassop to Edale in the north and Goyt Valley in the west. The bird had lost several tail feathers, which gave it a distinctive appearance, and it was shown to be the same individual as one seen on Alderney, in the Channel Islands, on 20th–21st May, in the Netherlands between 30th May and 13th June, and in Belgium on 18th–20th June. It is unringed and could be a wild-hatched bird from the Alps or the Pyrenees, although there is uncertainty over whether it is from a self-sustaining breeding population.

The spring will be remembered for the large numbers of two scarce warblers: **Blyth's Reed Warbler** *Acrocephalus dumetorum* and **Marsh Warbler** *A. palustris*. More than 35 Blyth's Reed Warblers were recorded between 23rd May and 6th July, spread widely across Britain. Although there were several long-staying individuals, including notably at Far Ings NR, Lincolnshire, from 7th to 21st June and Longlands Lake, Cumbria, from 27th June to 6th July; most were short-staying singing males. More than 70 Marsh Warblers, mostly singing males, along with a few that were trapped and ringed, were recorded between 27th May and 4th July. Although many were short-staying, it is likely that some breeding attempts will have been made. It has been an excellent spring also for **Rose-coloured Starlings** *Pastor roseus*, with the first record on Skomer Island, Pembrokeshire, on 28th May and new individuals still being discovered in early July. A minimum of 150 individuals has been involved in the influx.

Other notable records include a **Black-and-white Warbler** *Mniotilta varia* at Aithsetter, Shetland, on 28th May, **Calandra Larks** *Melanocorypha calandra* at Greatham Creek, Cleveland, on 31st May and on Fair Isle, Shetland, on 22nd June, a **River Warbler** *Locustella fluviatilis* on Fair Isle, Shetland, on 9th–10th June, a very popular **Asian Desert Warbler** *Sylvia nana* on Holy Island, Northumberland, from 15th to 19th June, **Green Warblers** *Phylloscopus nitidus* on North Ronaldsay, Orkney, on 1st–7th June and on Fair Isle, Shetland, on 16th June, a female **Moltoni's Warbler** *Sylvia subalpina* in Lerwick, Shetland, on 17th June, and a **White-throated Sparrow** *Zonotrichia albicollis* at Cwrtnewydd, Ceredigion, on 24th June. A **Greater Sand Plover** *Charadrius leschenaultii* was at Tyningham Bay, Lothian, from 27th June to 6th July.

There has been a spectacular movement of **Common Swift** *Apus apus***,** with some impressive counts documented down the east coast on 28th May, including 12,000 passing south by 17:15 at Spurn, East Yorkshire, 17,000 south by 14:30 at Hunmanby Gap, North Yorkshire, and 16,600 south by 13:00 at Gibraltar Point, Lincolnshire. This movement continued on the following day, when 17,500+ flew south over Southwold Harbour, Suffolk, between 07:00 and 08:35, and 46,026 flew south by 17:00 at

A Black-browed Albatross graced the seabird colony at Bempton Cliffs in early July. Martyn Sidwell

Gibraltar Point, Lincolnshire. Over the same few days, movements of **Crossbill** *Loxia curvirostra* and **Siskin** *Spinus spinus* were also impressive. Peak counts of Crossbill from South Cliff, Scarborough, in North Yorkshire, were of 675 south between 04:30 and 09:10 on 24th June, 1,223 south in the morning of 25th June, and 862 south in the morning of 26th June. For Siskin, peak counts were of 6,500+ south between 04:00 and 06:30 at Tynemouth, Northumberland, on 24th June, 1,486 south at Scarborough, North Yorkshire, on 25th June, and 1,069 south at Scarborough and 1,525 south at Ravenscar, in North Yorkshire, on 26th June.

Neonicotinoid insecticides were commonly used as seed dressings until they were banned in the EU in 2018 owing to concerns over risks to the health of bees. They are still used outside the EU, but there are now growing concerns about their sub-lethal effects on wild birds. Gamebirds may be particularly vulnerable as their diet comprises a large proportion of agricultural seed. A new study has assessed exposure to the neonicotinoid clothianidin in free-living gamebirds by collecting samples from treated winter cereals, as well as blood and liver samples from gamebird carcasses pre- and post-sowing of the crops. Clothianidin was detected in only 6% of individuals sampled pre-sowing, but in 89% of individuals sampled post-sowing, which confirms that treated cereal seed is a significant source of pesticide exposure for these birds. Furthermore, in partridge species, faecal parasite load grew with increasing concentrations of clothianidin in the liver. Although the fat score and body weight were not affected by clothianidin concentrations, these results suggest that the pesticides may have a negative impact on the health of birds. (*Science of the Total Environment* 2020; https://doi.org/10.1016/j.scitotenv.2020.140493)

Dawn Balmer (BTO) and Juliet Vickery (RSPB)

A wet start to the year followed by a warm sunny spring appears to have produced a strong emergence of Natterjack toadlets in some places. Gillian Pullinger/Alamy Stock Photo

Reptiles and amphibians

The warm and sunny spring has favoured the **Natterjack Toad** *Epidalea calamita* at its southern heathland site at Woolmer Forest, in Hampshire. This year, John Buckley reports an unprecedented observation of Natterjack toadlets emerging from their breeding scrapes before the end of May, which is at least two weeks earlier than normal. This was made possible by a lucky combination of weather events: plenty of rain in February and early March, which brought the water table up in the numerous scrapes in which the toads breed, followed by the good weather of the following two months. It is likely that spawning took place in early April, but, owing to necessary restrictions on monitoring by volunteers, it is impossible to confirm the exact timing, or how many spawn springs were deposited. On 24th May, John saw scores of young, fully metamorphosed toadlets at one pool and estimates that he saw 500 in total during his visit.

Unlike the **Common Toad** *Bufo bufo*, the Natterjack has a prolonged breeding period and will come back and spawn right through the spring until early July. Some two weeks after the emergence reported by John, I visited the site at night. By that time the only males calling were from the deeper waters of Woolmer Pond, to the south of the shallower breeding scrapes. Despite the frustrations of not being able to maintain a complete record of spawn-string counts because of the restrictions of lockdown, it looks likely that the Woolmer Natterjacks will have a good year.

Within the boundaries of Woolmer Forest it is possible to find all of our native species of reptile and amphibian with the exception of the reintroduced **Pool Frog** *Pelophylax lessonae*. The area is a mix of wet heath, dry heath and woodland and is managed as a military firing range. The rare reptiles inhabit the higher dry heath

in the centre of the site, while the Natterjack Toads are found in the flat, damp areas in the west. In the same area, close to the perimeter track, are ponds and ditches that support populations of other amphibians, including the **Great Crested Newt** *Triturus cristatus*.

Woolmer Forest must be regarded as an iconic site for British reptiles and amphibians. The lockdown has prompted thoughts of the other sites that I would consider to be iconic, mainly because of their high diversity of species or a long history of recording. First on the list would be Frensham Common, not too far from Woolmer Forest and well known for its **Sand Lizard** *Lacerta agilis* populations, which not much more than 50 years ago still attracted the attention of London pet-shop workers, who regularly came to Frensham to collect the lizards and other reptiles for subsequent sale. Today, the various parts of Frensham Common still support reasonable numbers of all six native reptile species and the Little Pond supports a thriving population of Common Toads, as well as other amphibians. Until around the 1960s Natterjack Toads still bred at Frensham Little Pond, and over the past 30 years a number of reintroductions have been attempted at the site. The most recent, on the edge of Frensham Great Pond, have met with limited success, but new ponds constructed this year are the next step in trying to establish a permanently viable population of this species.

My personal list of iconic sites would also include the Ainsdale and Birkdale Hills, on the Sefton Coast in Merseyside, where Natterjack Toad and Sand Lizard are the key species. This area again has a long history of observations and changing fortunes, but still supports strong and important populations of these two species alongside several others, including the Great Crested Newt.

Finally, the iconic jewel for me must be Studland, in Dorset. Set in the beautiful countryside of the Isle of Purbeck, Studland's mix of dune and heathland again supports all of our native reptiles and, like Frensham Common, is contiguous with other extensive heathland sites, all of which have an outstanding range of other wildlife. Perhaps next year we can hope for fewer restrictions and resolve to visit some of these iconic sites.

Howard Inns,
Amphibian and Reptile Conservation Trust

Dragonflies

Despite the stringencies of lockdown, there has been an unprecedented number of dragonfly reports so far this year. Here, unfortunately, I can report only some of the recent highlights from this mass of information.

Numerous reports of **Broad-bodied Chaser** *Libellula depressa* from across England and Wales continued through the late spring and early summer period, mainly from garden ponds (including, to the delight of the householders, some that had been newly created). This has certainly turned out to be a good year for this dispersive species, which has now reached southern Scotland, too. There were also a number of records of **Scarce Chasers** *L. fulva* from garden ponds in May, including in Exminster, Devon, on 17th, in Somerset and Cambridgeshire, on 25th, and in Wiltshire, on 30th, with many other similar reports subsequently.

At Ham Wall RSPB, in Somerset, a well-known evening roost of **Four-spotted Chasers** *L. quadrimaculata* was reported to contain thousands of the insects, gathered together on trackside vegetation, on 26th May. A fortnight earlier, at nearby Shapwick Heath NNR, Four-spotted Chasers emerging en masse were being snapped up by over 20 hunting Hobbies *Falco subbuteo* – an amazing spectacle.

This summer, **Norfolk Hawker** *Anaciaeschna isosceles* has been discovered farther from its known haunts in Broadland, Cambridgeshire and Kent. The first sightings, however, came from Norfolk, on 15th May, followed by individuals on 22nd at North Cove reserve, in Suffolk, and at Bowthorpe Marsh, Norwich. A week later, on 29th May, a Norfolk Hawker was seen in the unlikely setting of the weedy margin of a potato field at Little Plumstead, Norfolk. Even more unusually, on that same day, a lone Norfolk Hawker was seen and photographed in Weymouth, Dorset; a fortnight later, with many more people coming out to look for this new arrival to the county, a count of seven or eight, including two pairs in copula, had been logged. It is interesting to speculate how and exactly when these insects arrived in Dorset, and whether the witnessed breeding behaviour will result in progeny emerging next year. As well as expected sightings in the Norfolk and Suffolk Broadland area during June, five Norfolk Hawkers were recorded at Fen Drayton RSPB reserve, in Cambridgeshire, on 14th June, and a singleton was at Wicken Fen, in the same county, on 15th June, when one was seen also at Boreham, on the River Chelmer, in Essex. Several were at Amwell pits, Hertfordshire, on 25th June. I am not aware of how the established colony of Norfolk Hawkers at Grove Ferry, in Kent, has fared this season.

Scarce Emerald Damselfly *Lestes dryas* has an important stronghold in south-east Essex, especially on Canvey Island. True to form, four females were first observed there this year along a dyke and adjacent field, on 18th May. The number had increased to more than 25 damselflies, most of which were female, by 21st May, and then to over 100 by 2nd June. Similar numbers were again recorded here on 13th June, in the company of eight **Southern Migrant Hawkers** *Aeshna affinis* and numerous **Ruddy Darters**

Sightings of multiple Norfolk Hawkers at a site in Dorset suggest that this species may have established a new population well away from its East Anglian heartland. Martin Wood

Sympetrum sanguineum, all making their first flights. The other main locations for Scarce Emerald Damselfly are in the valley fens of Norfolk and Suffolk. Four males and three females were seen at Redgrave and Lopham Fens, Suffolk, on 1st June – this is believed to be the earliest ever Suffolk sighting. The same observer returned there on 9th June, by which time the Scarce Emeralds had increased to 25, around three-quarters of which, interestingly, were male, in contrast to the Essex sightings. Several Scarce Emerald Damselflies were also flying at the Thompson Common pingos, in Norfolk, on 17th June.

An even scarcer emerald damselfly species is the **Southern Emerald** *Lestes barbarus*. For the last few years a very small colony has been established at Bouldnor, near Yarmouth, on the Isle of Wight, and a teneral individual of this species was first seen on 18th May. Four were recorded on 30th May, but only one could be found on 13th June. Five males were observed also at Canvey Island, Essex, on 28th June, but there is no news on the colony in Buckinghamshire this year.

At the recently designated dragonfly 'hotspot' of Stover Country Park, in Devon, my colleague Dave Smallshire had a bumper number of dragonflies during a visit on 18th May. The total included three **Beautiful Demoiselles** *Calopteryx virgo*, 584 **Azure Damselflies** *Coenagrion puella*, 106 **Large Red Damselflies** *Pyrrhosoma nymphula*, 119 **Red-eyed Damselflies** *Erythromma najas*, 385 **Common Blue Damselflies** *Enallagma cyathigerum*, 21 **Blue-tailed Damselflies** *Ischnura elegans*, two **Emperors** *Anax imperator*, five **Hairy Dragonflies** *Brachytron pratense*, 18 Four-spotted Chasers, 12 Broad-bodied Chasers and one **Black-tailed Skimmer** *Orthetrum cancellatum*. This really illustrates the richness and diversity of the Odonata at this site, amply justifying its designation as a special place for these insects.

The ecology of the **White-legged Damselfly** *Platycnemis pennipes* is comparatively poorly understood and has received little research, but this species is the subject of a special British Dragonfly Survey which aims to gain a better idea of its distribution and populations. This summer, records have come from Apperley, Gloucestershire, on 18th May, the Aylesbury Arm of the Grand Union Canal at Wilstone, Hertfordshire, and West Sedge Moor, Somerset, both on 25th May, Sundon Pit, Bedfordshire, on 26th May, Longham Lakes, Dorset, on 28th May, and Tardebigge Locks, Worcestershire, on 31st May. In addition, there were other records from the River Frome and Duchess Lake, Bristol, and on the Warwickshire Avon near Long Lawford, all around the same time. These and some subsequent records comprised small numbers, including a tally of just eight at Fen Drayton RSPB, Cambridgeshire, on 14th June. More encouragingly, however, reports of larger numbers came from near Ross-on-Wye, Herefordshire, where up to 100 White-legged Damselflies were seen on bankside vegetation of the River Wye on 26th May, in the company of both Beautiful and **Banded Demoiselles** *Calopteryx splendens*. High numbers were recorded also from the River Stour at Stratford St Mary, Suffolk, on 29th May, flying with many other species. The above-mentioned colony on the canal at Wilstone, Hertfordshire, had increased to about 40 individuals, including about a dozen pairs in copula, by 29th May. This damselfly is patchily distributed in southern Britain and, although some colonies have disappeared over the years, others have emerged, sometimes away from riverine habitats. These current observations therefore flag the need for repeated and careful observations of a colony of this damselfly over time, to try to establish what factors might be governing its fortunes.

Other highlights of the early May to early July reporting period included a number of Southern Migrant Hawkers: singletons were at Hadleigh Marshes, Essex, on 8th June and at Otmoor RSPB, Oxfordshire, on 15th, 20th (both males) and 22nd June (a female), seven were at Langdon Hills, Essex, on 17th June, and two were at

Bowers Marsh RSPB, Essex, on 19th June. Further, up to 30 immature specimens were recorded flying in Friday Wood, Colchester, Essex, on 2nd July. A **Vagrant Emperor** *Anax ephippiger* was at Lower Farm, Thatcham, Berkshire, on 13th June, and male **Lesser Emperors** *A. parthenope* were reported from Hornchurch Country Park, Greater London, on 30th May and at Ormesby Little Broad, Norfolk, on 23rd June. In addition, a pair was seen (and photographed) ovipositing at Astral Lake, Leighton Buzzard, in Bedfordshire, on 26th June, on which date a female Lesser Emperor was found flying inside a house at Marston Moretaine, in the same county. Another report came from Longham Lakes, Dorset, on 7th July. **Small Red-eyed Damselflies** *Erythromma viridulum* had started emerging at Duchess Pond, Bristol, on 1st June and at Longham Lakes, Dorset, on 22nd June. A large gathering of these damselflies was seen at Hadleigh Marshes and Benfleet Downs, Essex, on 5th July. Finally, I have learned of the first seasonal emergence this year of **Willow Emerald Damselfly** *Chalcolestes viridis*, with three seen at Kirkby gravel pits, Lincolnshire, on 3rd July.

Val Perrin,
British Dragonfly Society

Butterflies

With the early emergence and high abundance of many species during May, it seemed more like midsummer. **Meadow Brown** *Maniola jurtina*, for instance, which we expect to emerge in late May and which is synonymous with high summer, was already flying in several English counties by mid-May. Populations that normally peak in late May were present in good numbers early in the month. **Small Heath** *Coenonympha pamphilus* was frequently reported in better numbers than have been usual in recent years, including more than 200 at a Derbyshire site on 19th May. This tendency towards larger numbers was not limited to Small Heath, and by the end of May several species that are not normally especially numerous were reported in large accumulations, e.g. 123 **Small Pearl-bordered Fritillaries** *Boloria selene* at a Devon site on 27th May. This was almost certainly due to the persistent, favourable weather conditions that allowed populations to build, and this is probably also why many species were observed away from their known sites. This seemed to be especially true of **Green Hairstreak** *Callophrys rubi* in the south-east of England and **Small Blue** *Cupido minimus* more widely across southern England. During May, there were also reports of various rarer native species seen at considerable distances from known colonies. It is impossible to know if some were released, especially as details of most of the sightings were suppressed in order to avoid attracting visitors at a time when the advice was to 'stay at home'.

May began with emergences of new species widely spread, but by the month's end first sightings were reported on most days. Small Pearl-bordered Fritillary on 2nd, in Glamorgan, was the first, followed by **Glanville Fritillary** *Melitaea cinxia* on 4th, on the Isle of Wight, **Chequered Skipper** *Carterocephalus palaemon* in Highland and **Lulworth Skipper** *Thymelicus acteon* in Dorset, both on 6th, **Swallowtail** *Papilio machaon* on 8th, in Norfolk, the earliest ever **Large Blue** *Maculinia arion* on 14th, in Somerset, and **Heath Fritillary** *Melitaea athalia* on 15th, in Essex, around the usual time for this species. From now on, emergences became increasingly early compared with the recent average. **Marbled White** *Melanargia galathea* on 19th, in Dorset, **Silver-studded Blue** *Plebejus argus* in Cornwall and **Northern Brown Argus** *Aricia artaxerxes* in Yorkshire, both on 20th, **Dark Green Fritillary** *Argynnis aglaja* on 21st, in Devon, **Black Hairstreak** *Satyrum pruni* on 22nd, in Cambridgeshire, and **Small Skipper** *Thymelicus sylvestris* on 24th, in Wiltshire, were all about a week earlier than normal. The **Ringlet** *Aphantopus hyperantus* (first report on 24th, in Somerset) flew about two weeks early, yet the **Grayling** *Hipparchia semele* (reported on 25th, in Conwy) was seen at about its normal time. **Mountain Ringlet** *Erebia epiphron* appeared around a week early on 27th, in Cumbria, and **High Brown Fritillary** *Argynnis adippe* on 28th, in Glamorgan, was more than a week early. **White-letter Hairstreak** *Satyrium w-album* on 29th, in Derbyshire, and **Silver-washed Fritillary** *Argynnis paphia* in Devon and **White Admiral** *Limenitis camilla* in Surrey, both on 30th, were all two weeks early. **Essex Skipper** *Thymelicus lineola* in Kent and **Large Heath** *Coenonympha tullia* in Co Armagh, both on 30th, and **Gatekeeper** *Pyronia tithonus* on 31st, in Surrey, were also earlier than normal by about a week.

Migrant activity was infrequent, despite May's excellent weather. Most notable were sightings of **Large Tortoiseshell** *Nymphalis polychloros* on 1st, in Kent, on 6th, in Buckinghamshire, and on 18th, in Norfolk, **Long-tailed Blue** *Lampides boeticus* on 25th, in Yorkshire, **Scarce Swallowtail** *Iphiclides podalirius* on 28th, in Powys, **Camberwell Beauty** *Nymphalis antiopa* on 30th, in Hertfordshire, and Swallowtail on 15th in Essex, 20th in Northamptonshire, 25th in Bedfordshire, 28th in Sussex and 30th in both Essex and Kent. All were potentially migrants, but many were seen away from obvious hotspots. Throughout May there were reports of **Painted Lady** *Vanessa cardui* along with small numbers of **Clouded Yellow** *Colias croceus* but, while the numbers of both climbed from mid-month, neither was numerous.

With so many months in 2020 being sunnier and warmer than normal, only six species were still to emerge by the end of May and, of these, four emerged in June. These four were **Purple Hairstreak** *Favonius quercus* on 2nd, in Essex, **Purple Emperor** *Apatura iris* on 13th, in Sussex, **Chalk Hill Blue** *Polyommatus coridon* on 22nd, in Cambridgeshire, Hertfordshire and Wiltshire, and **Silver-spotted Skipper** *Hesperia comma* on 29th, in Kent. All four emerged earlier than usual, and the Silver-spotted Skipper record might be the first instance of this species appearing in June – the average first emergence date since 2010 (i.e. during the more recent advanced emergence timings compared with historical data) is 13th July. Despite their early first sightings, the length of the flight periods of **Orange Tip** *Anthocharis cardamines*, **Dingy Skipper** *Ergynnis tages*, **Duke of Burgundy** *Hamearis lucina*, Green Hairstreak and **Grizzled Skipper** *Pyrgus malvae* were approximately as normal and all flew in June.

A Ringlet in Caithness (on 30th) is evidence that the species has now expanded its range to the most northerly part of the UK's mainland. Ringlet, Marbled White and Meadow Brown are regularly reported in hundreds from larger sites, but in June 2020 we learned of similarly large populations of other species. On 2nd, an excellent total of 65 Black Hairstreaks was recorded on a Cambridgeshire transect walk (which counts only butterflies within a 5m-wide strip along the route). Good counts of Dark Green Fritillaries included 468 seen on a walk in Devon on 8th, and single-site counts of c. 100 in Bedfordshire, Devon, Dorset, Northamptonshire and Oxfordshire. **Small Tortoiseshell** *Aglais urticae* was also reported in good numbers, including a remarkable 360 along a 4km walk in Cambridgeshire on 17th and, even better, 495 at a Derbyshire site on 23rd. Yet by June's end, a well-watched hibernation site in Hertfordshire already had three Small Tortoiseshells tucked away until 2021. Perhaps most pleasing given its recent poor showing was a record of 170 Lulworth Skippers on 17th, in Dorset. There were also gratifying reports of species in new areas and reappearing at sites where they were first seen last year. Small Heath was described from parts of Lincolnshire and Cambridgeshire where it had not been recorded for 15 years, and Small Blue has become established in Cambridgeshire again after a long absence from the county.

Despite the resident species largely benefitting from favourable conditions in 2019 and this year, migrant activity was decidedly unremarkable. Painted Lady and Clouded Yellow continued to be reported (including a Painted Lady from Highland, 1st June), but in reducing numbers. Unusual sightings included that of a **Monarch** *Danaus plexippus* on 3rd, in Northamptonshire, and Large Tortoiseshell on 13th in Warwickshire and on 14th at two separate sites in Sussex, but these records were overshadowed by evidence of the breeding of Large Tortoiseshell at two different sites in Dorset. In one case, a larva was discovered in Weymouth in early June, and an adult was subsequently reported from the same location towards the end of that month. On the Isle of Portland, where adults had been seen in March, the remains of larval skins and empty egg cases were discovered on elm *Ulmus*, showing that breeding had been successful. An adult was seen fairly close by on 26th, and we await news of the sightings of more adults from this brood.

The Big Butterfly Count is now underway (17th July to 9th August). Please ensure that you submit the results of your counts by the end of August via the website: www.bigbutterflycount.org. As always, if you have any observations concerning butterflies, please contact Butterfly Conservation on 01929 400209 or via www.butterfly-conservation.org, Facebook or Twitter (@DrBulman), or e-mail nick.bowles@ntlworld.com.

Corrigendum: In the previous issue we incorrectly reported a sighting of Camberwell Beauty on 4th March, in Dorset.

Nick Bowles and Caroline Bulman, Butterfly Conservation

Small Heath was one of a number of species reported in higher numbers than in other years. Richard Revels

Moths

After the warmth and sun of spring and early summer, it was not surprising that the flight season for many species of moth was early. This was very evident in the case of the **Cinnabar Moth** *Tyria jacobaeae* on our land. We have built up the population here by not cutting the grass in our meadow and by encouraging ragwort *Senecio*, the larval foodplant. The total catches of Cinnabar moths in our Robinson light-trap have risen from six in 2017, the year in which we moved in, to 67 in 2018 and 72 in 2019. The first ones trapped in 2018 and 2019 were on 21st and 19th May, respectively, while in 2020 the first in the trap was a month earlier, on 18th April, and we had seen earlier ones flying by day on 15th April.

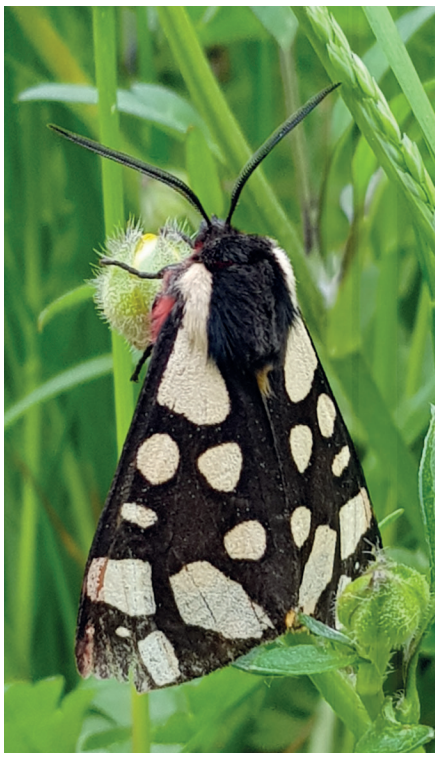
On the night of 21st May, we were surprised to find a **Cream-spot Tiger** *Arctia villica* in our garden Robinson trap here at West Walton, in west Norfolk. The accompanying photograph of this individual shows substantial wear of the forewing tips, but this may have been sustained in the trap. The new macro-moth atlas (Randle *et al*. 2019) shows that the nearest records are a collection from the Brecks, more than 20km away. There is, however, one pre-1960 record shown 30km to the west of us. Les Evans-Hill (Butterfly Conservation) advises me that this was a single adult Cream-spot Tiger found at rest in July 1891, in Peterborough, by a Mr Scott and accepted by Eustace Wallis, the recorder at the time, who states that this is the only record for the Peterborough area. The Cream-spot Tiger is a strong flier; I once observed one making headway against a very strong sea wind on the coast of the Isle of Grain, Kent, soon after dark on 16th May 1990.

It was an early season for the endangered **Marsh Moth** *Athetis pallustris*, too. Matt Blissett light-trapped at its main site, at Rimac, Saltfleetby-Theddlethorpe Dunes, in Lincolnshire, on 20th May, three days earlier than in 2019. From two traps he caught 23 males, the highest nightly total since 2013. Only two of the individuals were pristine, the rest showing some signs of wear. It was a clear night with a minimum temperature of 10°C and very little wind. The traps were checked on an hourly basis, most Marsh Moths arriving around 2am. On a second trapping session, on 29th May, when five traps were deployed across a wider area, no Marsh Moths were trapped at all. On that night there was a strong easterly wind and an air temperature of 6°C, but a ground temperature of only 1.7°C.

The *Gloucestershire Moths Newsletter*, produced by Roger Gaunt, reports that Ali Bourne again recorded the **Toadflax Brocade** *Calophasia lunula* in her garden at Bradley Stoke this year. This is the fourth year running, but so far as Roger is aware this species has been found nowhere else in the vice-counties of Gloucestershire. Roger's previous newsletter reports that 2020 seems to have been a good year for the local **Silver Cloud** *Egira conspicillaris*.

A wide range of immigrant moth species was recorded during May and June 2020, but none was in large numbers. Particularly noteworthy immigrant records, mostly gathered from the Atropos Flight Arrivals website, include a **Golden Twin-spot** *Chrysodeixis chalcites* at Densole, Kent, on 21st May (Tony Rouse) and **Lunar Double-stripes** *Minucia lunaris* at Ningwood Common, Isle of Wight, on 20th May and one at Howdales, three miles from the coast of Lincolnshire, on 4th June (John Janes). Individual **Pale Shoulders** *Acontia lucida* were recorded near Tonbridge, Kent, on 20th May, at Portland Bill, Dorset, on 7th June, and at Lade, Kent, on 17th June: the first two were seen by day, while the last was caught by light-trapping. There was a scatter of single **Beautiful Marbled** *Eublemma purpurina*, including in Essex and at Folkestone Warren, east Kent, on 21st May, in Suffolk on 26th May, in Exeter, Devon, on 1st June, and in north Hertfordshire on 21st June. **Silver Barred** *Deltote bankiana* was recorded at Southend, Essex, on 21st May, at Densole, Kent, on 25th June, and at Portland Bill, Dorset, on 26th June (a first for this intensively trapped site). Migrant hawk-moths included **Spurge Hawk-moths** *Hyles euphorbiae* at Dungeness, Kent, on 27th May and at Kingsdown, Kent, on 24th June (David Brown), **Convolvulus Hawk-moths** *Agrius convolvuli* in Kent on 26th May and Somerset on 27th May, **Death's-head Hawk-moths** *Acherontia atropos* on St Mary's, Isles of Scilly, on 26th May (Michael Scott) and found by day at Brinkworth, Wiltshire, on 23rd June, and **Bedstraw Hawk-moth** *Hyles gallii* seen and photographed by day at Blackwater Bog, Co Offaly, Ireland,

Cream-spot Tiger in West Walton, Norfolk. Paul Waring



on 29th May. Quite a number of **Hummingbird Hawk-moths** *Macroglossum stellatarum* were reported in June, widely scattered over central and southern England. On 24th May, in Kent, there was a **Dusky Hook-tip** *Drepana curvatula* near Folkestone (Julian Clarke) and an **Alchymist** *Catephia alchymista* at Ruckinge (Bernard Boothroyd). The latter species was recorded also at Dungeness, Kent, on 13th June (Alec Kolaj) and at sugar near Lowestoft, Suffolk, on 30th June. A **Dewick's Plusia** *Macdunnoughia confusa* was seen at Sutton Gault, Cambridgeshire, on 28th May (Rob Partridge), a **Bordered Straw** *Heliothis peltigera* was in south Cork on 7th June, and a **Bordered Gothic** *Sideridis reticulata* was at Dymchurch, Kent, on 10th June. The last-mentioned is presumed to be an immigrant specimen of this recently extinct former UK resident. John Owen, who caught it, reports that this is the first recorded in many years of operating his garden trap. A **Pretty Marbled** *Deltote deceptoria* on Westleton Heath on 13th June (Anthony Wren and Peter Follett) was confirmed as new to Suffolk by the county recorder, Neil Sherman. Other rarities included a **Rannoch Looper** *Macaria brunneata* at Mendlesham Green, Suffolk, on 12th June, an **Orache** *Trachea atriplicis* at Askham Bryan, Yorkshire (the first for VC64), on 15th June, **Druids** *Aedia funesta* at Ovingdean, East Sussex, on 24th June and Hythe, Kent, on 30th June, a **Radford's Flame Shoulder** *Ochropleura leucogaster* at Portland Bill, Dorset, on 23rd June, a **Splendid Brocade** *Lacanobia splendens* at Maenporth, Cornwall, on 25th June (George Davis), several **Bright Wave** *Idaea ochrata*, including individuals at Portland Bill, Dorset, on 25th June and in Norfolk (the second record for the county) and Ramsgate, in Kent, on 26th June (the last accompanied by a **Speckled Footman** *Coscinia cribraria* of the immigrant *arenaria* form). Finally, there were **Light Crimson Underwings** *Catocala promissa* in Kent at Sandwich on 25th June and Densole on 26th (Tony Rouse), and a **Marsh Dagger** *Acronicta strigosa* was reported on 25th June at Pagham, West Sussex, only the seventh recent record of this former resident.

The **Cryptic Fern** *Horisme radicaria* is virtually indistinguishable from the **Fern** *H. tersata* without dissection of the genitalia. It was added to the British list in 2019 (Smith & Clancy 2019) on the basis of dissection of specimens found in various collections of moths from east Kent and East Sussex, the earliest so far being from New Romney, east Kent, on 6th August 2004 (Clancy & Smith 2020). A number of suspected Cryptic Ferns captured in May 2020 in the above counties have now been confirmed by dissection of genitalia.

As always, I thank all the above-named individuals, organisations and websites, and others involved in the above-mentioned projects, and all other correspondents.

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Dr Paul Waring

Micro-moths

The second publication of this column (*BW* 31: 211–213) was packed with information about rare and enigmatic micro-moths that in Britain are found only in Scotland. This instalment will have a Welsh focus, but with a number of other topical updates included for good measure.

It is difficult to establish exactly how many moth species have been recorded from a given country, but over the winter of 2018–19 I attempted to put together a provisional list for Wales with the help of the Welsh county moth-recorders, who are responsible for maintaining the datasets for each of the 13 Welsh vice-counties. The new list, complete to the end of 2018, comprises 1,832 moth species (excluding adventives – imported species that have not established breeding populations in Britain). This is 74% of the total for Britain and Ireland as a whole. The micro-moths account for 1,155 species, 63% of the total for all moths in Wales. This is almost identical to the proportion in Scotland, but slightly lower than that for Britain and Ireland as a whole (where 66.5% of moths are micro-moths). Glamorgan has the highest county total with 927 micro-moth species, reflecting the size of the county and the richness of its habitats, as well as a long history of moth-recording compared with some other Welsh counties. Anglesey is at the other end of the scale, with 621 species recorded, although new species are being added annually. The Wales list is available to download as a pdf from the Butterfly Conservation website (https://bit.ly/3e7sGB5) and was summarised in a recent article (Tordoff 2020).

It may seem surprising that there are (so far as we know) no micro-moth species that are confined to Wales. Nevertheless, there are some rare species found here that have relatively few sites elsewhere in Britain. Three of these, *Coleophora serpylletorum*, *Caryocolum blandulella* and **White-spotted Sable** *Anania funebris*, are included in the highest conservation priority category in Butterfly Conservation's 2016–2025 Wales Conservation Strategy.

Breeding populations of *Coleophora serpylletorum* are known only from the Lizard peninsula, in Cornwall, and the Great Orme, on the Caernarvonshire coast of north Wales. The caterpillar feeds

on Wild Thyme *Thymus polytrichus* from within a portable case that is constructed from hollowed-out thyme leaves on which it has fed and which it has stitched together with silk. On the Great Orme, the moth occurs in a small area of suitable habitat close to the sea; the site is checked regularly by volunteers from Butterfly Conservation's North Wales Branch. The vulnerability of this population was highlighted by a rock fall from cliffs above the site in 2014; thankfully, the branch helped to ensure that mitigation measures were put in place while the cliffs were stabilised.

Caryocolum blandulella is a gelechiid moth that feeds as a caterpillar on Little Mouse-ear *Cerastium semidecandrum* growing on coastal sandhills. In Wales it was last recorded at Pembrey, on the Carmarthenshire coast, in 2006. A search of the site in 2017 for larval feeding signs proved negative, although further surveys are needed as the moth is easy to overlook. Until recently this was the last known British record, but a single adult was recorded in Suffolk in 2019.

The White-spotted Sable is a charismatic crambid moth that flies by day, but can be easily overlooked as a result of its rapid twirling flight and its habit of coming to rest on the underside of leaves. It has a scattered distribution across Britain and Ireland and is thought to be declining in many areas. The larval foodplant is Goldenrod *Solidago virgaurea* and the moth occurs in a range of habitats, including open woodland, Bracken *Pteridium aquilinum* slopes and coastal sand dunes. South Wales remains a stronghold for it, and a call for sightings in 2014 resulted in several new populations being revealed, taking the total number of sites in the area to 19. In North Wales the moth is struggling and is now believed to be restricted to a single site in Merionethshire.

New micro-moth species are being recorded in Wales every year. Many of these are species that are spreading from southern England, likely a result of climate change. Typically, these turn up first in Monmouthshire before spreading

White-spotted Sable is scarce in Britain, but is known from a number of sites in South Wales. George Tordoff

***Trifurcula headleyella* was recorded new for Wales in 2017.** George Tordoff

west into Glamorgan and then farther afield. The Microlepidoptera Review for 2018 (Davis & Tordoff 2019) includes four species that were new for Wales, three of which, *Bryotropha basaltinella*, *Teleiodes wagae* and *Cydia illutana*, were recorded in Monmouthshire. The last mentioned is a proposed Red Data Book species and the other two are Nationally Scarce, but it is possible that all are increasing in range. The fourth new species, **Potato Tuber Moth** *Phthorimaea operculella*, was recorded in a light-trap set in coastal dunes at Harlech, Merionethshire. This species is generally regarded as an adventive that is sometimes imported in potatoes, but it is believed to be also an occasional immigrant. The origin of the Harlech specimen is not known.

Some other species new to Wales may represent overlooked resident populations. The nepticulid moth *Trifurcula headleyella* was one of four new species recorded in 2017 (Davis & Tordoff 2018). It was found in a dune slack near the end of the Pembrey peninsula, in Carmarthenshire, during surveys by Butterfly Conservation staff. The foodplant, Selfheal *Prunella vulgaris*, was present nearby and the moth is likely to be breeding at the site, although larval leaf mines have yet to be searched for. Elsewhere, this proposed Red Data Book species is known from a scatter of calcareous-grassland sites in southern England, so its occurrence in west Wales represents a significant range extension.

The Microlepidoptera Review of 2018 also highlights three species new to Britain, all from England, as well as eight species new to Scotland and four new to the island of Ireland. The oecophorid moth *Trachypepla contritella* was in fact first captured in 2012, but its identity remained a mystery until further specimens were found in 2018. It is native to New Zealand and was presumably imported with plant material, but it is now established in at least two areas of Bedfordshire and Huntingdonshire (Banthorpe 2019). The larvae of

this species have yet to be found in Britain. The tortricid moth *Pammene juniperana* was recorded in a garden in Berkshire (Cole *et al*. 2019). Its larvae feed on the berries of various junipers *Juniperus* and it probably originated from imported plant material, although it does occur on the near Continent and could have arrived here unassisted. The third new species, the pyralid *Lamoria anella*, is found across much of western Europe, including the countries closest to Britain, but its arrival in the inland county of Huntingdonshire (Anderson & Dickerson 2019) suggests that the record could be due to accidental importation rather than natural immigration.

There is some good news from Scotland. The proposed Coul Links development on the Sutherland coast, which would have seen large areas of internationally important sand-dune habitat converted into a golf course, has been refused planning permission by the Scottish Government. In the previous micro-moth column, Tom Prescott highlighted the importance of this site for a suite of rare species, including *Caryocolum blandelloides*, *Aproaerema sangiella* and *Stigmella spinosissimae*. The result is a notable success for the coalition of conservation organisations that campaigned to save the site, which included expert witness evidence given at the public inquiry by Dr Mark Young and supported by Butterfly Conservation Scotland.

Finally, to continue the theme of encouraging readers to look out for and record easy-to-find micro-moth species, it is worth investigating Common Nettle *Urtica dioica* patches in August and September. There is a good chance that, by gently tapping the nettles with a stick, you will disturb the **Nettle-tap** *Anthophila fabriciana*, a small species with distinctively square-ended wings. You may also encounter the much larger **Mother of Pearl** *Pleuroptya ruralis* and, if you are lucky, late individuals of **Small Magpie** *Anania hortulata*. Sheltered nettle stands close to trees and hedges are likely to be the most productive.

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Butterfly Conservation

Flies

Once again, it was a very poor spring for flies in my Peterborough garden. This was to be expected as a legacy from the drought in 2019, but further drought this spring compounded the problem. My district missed most of the forecasted rain in the spring period, but from reports received from others the fly doldrums appear to have been widespread from the central Midlands down to south-east England. The rains in June rejuvenated the drought-stressed vegetation, but there was little response from the flies. If there was a very early emergence of hoverflies at the start of spring it did not register with me, but my monitoring year has been remarkable for a ridiculously early peak for the **Marmalade Hoverfly** *Episyrphus balteatus*, on 27th June; a cold front had passed through the night before. At that same time, singles of *Scaeva pyrastri* and *Eupeodes corollae* were present – obvious migrants of which I had received reports from elsewhere at earlier dates. I suspect that the westerly wind that brought the influx into my garden had displaced these flies from elsewhere in Britain. Numbers fluctuated greatly over the following days, especially when strong gusty winds prevailed, but by 6th July very few hoverflies were seen. This is three or four weeks ahead of the normal time for mass migration, for which even mid-July would be exceptional. Better news, however, is that the large volume of winter rain was able to recharge the aquifers that make groundwater-seepage habitats more resistant to drought, and reports from some less drought-stricken western and northerly districts, in particular, spoke of plenty of flies to be seen even during lockdown.

Dipterists Digest 27(1) is the source of records cited here. There are five further additions to the British list of agromyzid leaf-miners. *Liriomyza virgula*, a suspected miner of horsetails *Equisetum*, was found at the RSPB's Old Moor complex, in Yorkshire, and *Phytoliriomyza nigrifrons* was discovered at the Humber Estuary. *Cerodontha rozkosnyi* has been found in Cambridgeshire, Norfolk, the New Forest and Cornwall, and collected at pools with spike-rushes *Eleocharis*, its probable host. The first records of *Metopomyza junci*, restricted to Saltmarsh Rush *Juncus gerardii*, came from saltmarsh on the Essex and Norfolk coasts. Finally, *Ophiomyia ungarensis* was swept from chalk grassland at Sheepleas, Surrey; this species, whose hostplant is unknown, was described as new to science in 2015 and was hitherto known only from eastern Europe and Turkey.

The dolichopodid *Syntormon pallipes* is widespread and common in both freshwater and brackish marshes and water margins. In 1998, a very similar species, *S. pseudospicatum*, was added to the British list, although it was considered by some to be

simply a variant of *S. pallipes*. It is now confirmed, however, that *S. pseudospicatum* deserves full species rank and it has been shown to be largely confined to brackish coastal marshes. Also of note, the calliphorid shadow fly *Metopia tshernovae* has been found on coastal land managed by the Findhorn Hinterland Trust, in Scotland; there is a 2015 record from Nottinghamshire, but it had not been formally added to the British list.

The **Anthracite Bee-fly** *Anthrax anthrax* was first detected in Britain in Cambridge, in 2016. An established breeding population is now reported from a garden in Canterbury, following a sighting there in 2018. In 2019, this species was seen in the garden on a number of dates between 26th May and 15th June. Fortunately, this species of bee-fly does occasionally sit still, which allowed photos to be taken; through comparison of these, it was possible to recognise at least four and possibly up to seven individual females (on the basis of differences in wing pattern and venation), as well as at least one male. Oviposition behaviour was observed on very hot sunny days at a 'bee hotel' and at holes in brick mortar, which the flies sometimes entered. The Anthracite Bee-fly is a 'parasite' of the Red Mason Bee *Osmia bicornis*, although it is not entirely restricted to this one host. Other species of *Anthrax* are said to be capable of producing 800 to 1,000+ eggs per day (indicative of a very high failure rate); a study in Germany estimated that the flies cause only a 2% loss in the host bee. If you are worried about the impact of the bee-flies at bee hotels, however, the solution is to convert from cylindrical to rectangular nesting holes on laminar plate, which increases the death rate of the bee-fly due to parasitism from 5% to 95% according to studies of *Osmia* bees in some Mediterranean countries. Personally, though, I shall be very happy to have this attractive bee-fly in my garden if it cares to spread to Peterborough.

There have been two further additions to the series of papers on the status of flies in north Scotland. A review of the thick-headed flies (Conopidae), charismatic parasitoids of bees and social wasps, is based on 362 records. Only four of the 24 or so British species are recorded as far north as Scotland, the maps showing a bias to the east of the country. Although it is not confined to Scotland, the main locus of *Physocephala nigra* is the Highlands, so it is good to see the wide scatter of 58 records; here it must be using different bumblebee hosts from those recorded in the published literature. *Conops quadrifasciatus* has a disjunct distribution, with a gap between the English and Scottish populations. The paper reports that Common Ragwort *Jacobaea vulgaris* was the flower visited by far the most frequently by this species (and the other two summer-active conopids). The other review covers the horseflies (Tabanidae), on the basis of 407 records of nine species (c. 30 species in Britain as a whole). The maps show an eastern distribution for two species: *Hybomitra lurida*, a species of the Scottish Highlands, and *H. distinguenda*, which has a wide but patchy range across Britain. The rare *Atylotus fulvus* has 14 records, but from only three 10km squares. Most surprising, however, is that *Tabanus cordiger*, a mostly southern species, has been found in two places on the west Sutherland coast.

The British distribution of the horsefly *Hybomitra lurida* is centred on the Scottish Highlands. Steven Falk

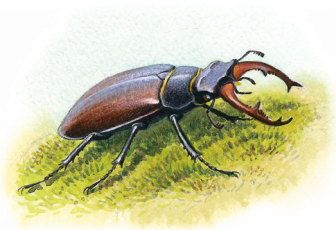
A study of flies associated with large compost heaps at Anglesey Abbey, near Cambridge, involved an impressive 44 visits in 2018–2019, curtailed in 2019 only because drought-induced dryness made the compost unproductive. A total of 140 species within 20 families was recorded, including some rarities. The Sphaeroceridae alone contributed 54 species, including *Sphaerocera pseudomonilis* ssp. *hallux*, which is new to Britain.

An analysis of the phenology of 61 univoltine (single-brooded) hoverfly species revealed that all tend to fly earlier than they did 39 years ago, and that for 49 species the change was statistically significant; the greatest shift was in flies whose peak flight period had previously fallen in May. Outlier dates, such as two records of *Epistrophe eligans* in February 2019, are interesting, but more important are shifts in the core flight period, which for this species is now 15 to 20 days earlier compared with the early 1980s. Various statistical analyses are presented.

These trends may have important implications for our hoverflies. Species that emerge

early in spring are often affected subsequently by periods of cool inclement weather, which limits adult activity and reproduction, and this may be a major factor in the decreased populations observed for many species in recent years. While no British hoverfly species is limited to foraging on a single flower species, the decoupling of plant and hoverfly phenologies could have implications for pollination assemblages more broadly and, as about a third of British hoverflies have larvae that feed on aphids, any decoupling of plant and aphid phenologies could also be significant. The analysis was based on data provided by almost 8,000 contributors to the Hoverfly Recording Scheme. The scheme has a dataset of more than one million records, the majority from the period 1980–2018, but even this is not sufficient to tease out finer detail about the effects of weather and other factors on hoverfly populations. Clearly, the contributions of citizen scientists to the recording and monitoring of invertebrates is becoming ever more important in light of the rapid environmental changes we are facing.

Alan Stubbs



Beetles

A beetle currently considered to be a non-established introduction could potentially become an established resident, if it has not already done so. *Valgus hemipterus* (Scarabaeidae) is a small chafer which was recorded twice in London in 2019 (Telfer 2020). This species breeds in decaying logs, and the records were perhaps most likely the result of accidental introduction. Telfer (2020) discusses earlier records of the species in Britain and whether it has been resident in recent history.

The chafer *Valgus hemipterus* may soon become established in south-east England, if it has not already done so. Mark Telfer

It is known from Middle Neolithic archaeological deposits and could certainly become established here again. *V. hemipterus* should be looked out for in the London area in particular and can easily be identified from photographs.

While new species are constantly being added to the British list, so others are removed. *Selatosomus cruciatus* (Elateridae) is a very distinctive click beetle. Mendel (2020) reviews the alleged historical records of this beetle and concludes that the evidence for its ever being a British species is weak, and so it should not be retained on the list. Morris & Mendel (2020) come to the same conclusion concerning *Rhynchaenus xylostei* (Curculionidae), a weevil whose food plant is Fly Honeysuckle *Lonicera xylosteum*. The authors note, however, that the beetle may well become established here in future as the plant, most likely from Continental sources, is increasingly being grown in this country.

There has recently been some online discussion concerning the **Glow-worm** *Lampyris noctiluca*, originating from a reference to a fundraiser to reintroduce this species, along with others, to a meadow on the Devon–Cornwall border. This was met with some derision by group members, and the county recorder, Martin Luff, produced a map showing that the Glow-worm is by no means scarce in Devon. While the Glow-worm has probably declined over a long period, it still thrives over much of the country yet, like many 'iconic' species, it seems to receive a great deal more attention than perhaps it deserves. In my experience, post-industrial sites are particularly productive for this species, with disused railway lines especially suitable. In 2018, I surveyed an area of mitigation land around an industrial site in central England. Once I had discovered Glow-worms, the county ecologist insisted on a special survey which involved a number of consultants going out at night, in pairs for health and safety reasons, and searching extensive areas for the beetle. How much this cost I do not know, but I am sure that it was considerably more than my broad invertebrate survey which recorded several hundred species, including a number which are truly nationally scarce. In another county, the ecologist told me that all sites with Glow-worm automatically qualify as county wildlife sites.

Since 2012, I have been monitoring a brownfield site on the Isle of Grain, in Kent. While it has largely been developed, a substantial area of the best habitats has been set aside in mitigation. The site is surveyed every two years and has produced an abundance of scarce species, not only beetles but also true bugs, bees and wasps. In many ways it is a classic Thames–Medway estuary brownfield site, such sites being renowned for their scarce invertebrates yet also seen as prime sites for development. One beetle which I have mentioned before in these reports is a tiny dung beetle, *Rhyssemus germanus*, which is regarded as probably introduced, but is still of interest. It has been recorded from only a handful of sites

and generally in very small numbers, but at this location it is abundant, with over 70 specimens found this year. It is largely confined to a fairly small core area, however, with only very occasional examples found farther afield. This has emphasised to me the importance of surveying any site as widely as possible since beetles may be very localised, as illustrated by another example from the same site. *Tachyporus formosus* is a scarce, somewhat enigmatic species of small rove beetle whose precise requirements are far from clear. In 2016 I recorded several specimens from pitfall traps at the edge of one of the pools on the site, but in 2018 that area was inaccessible. This year, with access cleared, pitfall traps in exactly the same area again produced several of the beetles. In the five survey years between 2012 and 2020, many pitfall traps, suction samples and manual searches around the margins of the numerous ponds on the site have failed to produce the species elsewhere, leaving a mystery as to why it appears restricted to this one small area. I have found the beetle at only one other location in another county – a former football field which had been abandoned because of waterlogging and so hardly a pristine site.

There are a number of other species of significance that I have recorded from the Isle of Grain site. The ground beetle *Acupalpus maculatus* was first recorded in Britain in 1993 and most records are from Dungeness and nearby, but at this site it is now the most abundant small ground beetle around pond margins. The weevil *Otiorhynchus indefinitus* is abundant and, again, probably a non-native species, as is another very rarely recorded weevil, *Gronops inaequalis*, which I have found on a small area of saltmarsh. This same saltmarsh also supports the rare Thames–Medway specialist weevil *Cosmobaris scolopacea*, both species feeding on oraches *Atriplex*. A wide range of water beetles is present, including several scarce species, and there are strong populations of the **Great Silver Water Beetle** *Hydrophilus piceus*, which breeds in at least three of the ponds (the larvae are much easier to find than the adults). In total, more than 40 scarce beetles have been recorded. As the land is being maintained in mitigation there is no danger of its being lost to development, but the habitat does require maintenance. The ponds are subject to eutrophication and drying-out in the increasingly hot summers. The very important open habitats are presently under attack from the invasive plant Goat's-rue *Galega officinalis*, which has already taken over much of the developed part of the site and is now advancing into the mitigation zone, where it swamps all other plants. A single sweep of the net through this plant can produce literally hundreds of the seed beetle *Bruchidius imbricornis*, which was first recorded in Britain as recently as 2012. This site clearly illustrates that simply setting land aside for wildlife is not enough – ongoing maintenance is almost always required.

In the previous report (*BW* 31: 216) I mentioned that the **Dried Bean Beetle** *Acanthoscelides obtectus* had infested bean seeds stored in my house, and that black-seeded varieties seemed to be unaffected. Subsequent experiments have shown that white seeds appear to be preferred, followed by brown seeds, with the black ones much less affected but by no means immune from damage. However, while broad beans will be used if no others are available, when they are mixed with French and runner bean seeds the broad beans are largely untouched, the beetles instead showing a very strong preference for the others. Later in the summer, I shall be trying to find out if these beetles are present in the wild on our allotment site, where the affected beans were grown.

By the time this report is published, volume three of *Beetles of Britain and Ireland* by Andrew Duff should be available, leaving only volume two, dealing with the Staphylinidae, remaining. It is quite remarkable how the resources for beetle identification have developed since I first started writing this column; not only Duff's books but also important volumes in the Royal Entomological Society Handbooks series and digital photography now enable non-specialists to have their findings checked and confirmed or corrected. Personally, I am more than happy to say goodbye to the venerable volumes of *A Practical Handbook of British Beetles* by Joy, files full of offprints and copies of papers, and 15 volumes in German on which I relied for many years.

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Richard Wright

Arachnids

The dramatic decline in insect population densities over past decades has been brought to public prominence in recent years through various high-profile studies. Despite concerns about the quality of the data in at least some of these, the overall trend seems to be clear, as recently reviewed by Wagner (2020). A significant decline in insects would be expected to result in a similar decrease in invertebrates that prey on them, such as spiders.

A recent paper by Outhwaite *et al.* (2020) used the rich collections of observations available for many UK species to model changes in average occupancy across taxa over a 45-year period (1970–2015). Included in their 'invertebrate' list were some 400 species of spider – about 60% of the current British and Irish checklist (Lavery 2019) –

with information drawn from the more than 1.1 million records in the British Arachnological Society's Spider Recording Scheme (SRS) database. Species for inclusion were chosen according to set criteria, although there seem to be some curious anomalies. The rare crab spider *Thomisus onustus*, for example, which is found only on a few southern heaths, is present in the dataset, but the extremely widespread and common theridiid *Paidiscura pallens* is not.

Overall, the mean occupancy appears to have declined in the mid-1970s and thereafter remained at a relatively constant, but fluctuating, level. Over the entire period, compared with the 1970 value, the trend in mean occupancy was –6.7%. While there are insufficient data to examine individual families, one division that is instructive is between the Linyphiidae (n = 179) and the rest (n = 221). Within the species showing a negative trend nearly 63% are linyphiids, whereas in those showing a positive trend linyphiids represent only 19%. If only species with 'significant' trends are considered, the contrast is even more extreme: almost 70% of the negative-trend group (n = 103) are linyphiids, whereas that family makes up less than 2% of the positive group (n = 56). Linyphiids as a whole, therefore, appear to show a disproportionately declining occupancy with time compared with other spider families.

One does wonder, however, how non-random and inconsistent temporal sampling may affect these broad-brush results. Take one example, the linyphiid *Bathyphantes nigrinus*, which showed a 'significant' decline in occupancy in the Outhwaite *et al.* (2020) analysis. SRS data show that the vast majority of Yorkshire records came from the late 1970s and early 1980s and were collected by Clifford Smith or his correspondents in preparation for the pioneering *Atlas of Yorkshire Spiders* (Smith 1982). According to the SRS, the species was verified in some 117 hectads in the county during this period but between 1992 and 2020 it has been recorded or re-recorded in only 17. This apparent drop in occupancy may, at least in part, be attributed to a lower sampling effort rather than a real decline in this very widespread species' distribution. No-one since Clifford Smith has so diligently mapped spiders across Yorkshire, and more recent recording tends to have concentrated on non-linyphiid species. Unlike the situation with Lepidoptera, where butterfly transects or moth-trapping ensure that almost all species are recorded (although there are some biases here, too), for spiders a thorough inventory of linyphiids requires a selection of aerial water traps, grubbing at grass-roots level, sieving litter and moss and, more recently, suction sampling. Many recorders (myself included) do not apply these techniques. Attempts to extract information on dynamic processes from static data, as in this paper, have to use algorithms and assumptions to infer a species' absence, and when sampling is uneven across families this could well introduce serious errors. A more finessed exploration of the Outhwaite *et al.* (2020) approach would be fascinating.

A direct way to assess the effect of a decline in potential prey on spider populations is to compare the densities of species over time. Nyffeler & Bonte (2020) used transects to quantify the orb-web densities of the **Garden Spider** *Araneus diadematus* in the Swiss midlands in autumn 2019 and compared them with data collected in a similar manner in the same locations, and across a number of European countries (including Britain), in the latter part of the 20th century. Their results were startling. Whereas densities in the 20th century were, on average, nearly 0.16/m^2, in 2019 they had dropped to 0.001/m^2, less than 1% of the former level. There are the usual caveats about single-year sampling but, as the authors point out, these differences are much greater than might be expected from the vagaries of natural population fluctuations. Unfortunately, we were made aware of the 2019 survey too late to obtain comparable density estimates from Britain (but in my York garden it was 0.016/m^2). Surveying the large orb-webs of Garden Spiders along transects is a simple means of obtaining density estimates for this species, and it would be useful to roll this out more widely, and annually, in order to track population changes over time.

One of the larger (body length 4.5–5mm) linyphiids is far from contracting its range in Britain. *Megalepthyphantes* sp. near *collinus*, which, as its scientific name suggests, has not formally been described, was first recorded

***Megalepthyphantes* sp. near *collinus* – a species apparently spreading in southern Britain.** Tylan Berry

in south-east England in 1999. Peter Harvey and Eric Philp found two females and a male on the Isle of Sheppey in November that year and initially identified them as *M. collinus occidentalis* (Harvey 2001). Peter Merrett, however, considered it likely that they represent a new, closely related species, hence the tentative nomenclature. Tony Russell-Smith subsequently located the species in Kent: at Seasalter, near Favisham, in September 2002, at two locations near Whitstable, in October 2002 and 2004 respectively, and at Blean Woods NNR, near Canterbury, in October 2004. At the time of writing, SRS records plus others yet to be submitted reveal the spider's presence in a total of 32 hectads, 28 of them from the Thames corridor and south-east England. The remaining four records, recently reported, were from much farther away: at Burnham-on-Sea (Francis Farr-Cox) and Bridgwater (James McGill), in Somerset, and at St Austell and near Helston, in Cornwall (Tylan Berry). The species clearly seems to be spreading (or, at least, being more frequently reported) in southern England. The distance between the West Country locations and the main cluster in the south-east raises the question of whether this large money spider is actually much more widespread than we currently realise or that, perhaps less likely, two distinct foci have been established in southern Britain. Mature individuals of both sexes have been found in almost all months, but with an apparent peak in September through to December, and in habitats ranging from tall grassy vegetation on stable shingles to coppiced woodland, gardens, allotments and, occasionally, indoors. They are often found lurking under debris such as bricks and plastic sheeting or in compost bins and other dark cavities. The further mapping of this species will be followed with great interest.

Finally, mention was made above of vacuum sampling as a collecting technique for ground-living spiders. Arachnologists have experimented with a variety of devices over time as new technology has made leaf-blowers/suckers lighter and less polluting. Richard Gallon has reviewed his own extensive experience, and that of others, in an article in the *BAS Newsletter* (Gallon 2019) and considers the pros and cons of different models. Naturalists interested in other groups of surface-dwelling invertebrates, such as ground beetles and Collembola species, may also find this article of value (for a copy, e-mail secretary@britishspider.org.uk).

I thank Stephen Baillie, Francis Farr-Cox, Martin Nyffeler, Charlie Outhwaite and Helen Smith for helpful correspondence.

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Geoff Oxford,
British Arachnological Society

Marine life

I doubt whether there is any wildlife or conservation organisation in the UK whose normal activities have not been significantly curtailed by the current pandemic restrictions. The Porcupine Marine Natural History Society (PMNHS) is no exception and our major recording trip to Lundy Island as part of the Lundy Marine Festival has, inevitably, been cancelled. So, records from there will have to wait until next year at least, but 'Porcupines' and other marine naturalists are an intrepid bunch and those lucky enough to live near the edge of the ocean have been out on the shore and in the water as and where allowed.

I always admire people who can take good underwater photographs of often near-invisible jellyfish. Paul Naylor is one of those people, and a recent Facebook post from him shows the beautiful **Many-ribbed Jellyfish** *Aequorea forskali* – a strange common name, perhaps, for a decidedly non-bony invertebrate. He noticed this hydromedusan jellyfish on June dives in the south-west. **Moon Jellyfish** *Aurelia aurita* also made an appearance in early June, as recorded by The Big Jellyfish Hunt (@ecogel), with reports of large numbers stranded on many beaches around Ireland, especially in Galway.

Continuing on the theme of plankton, some of the smallest can make a big impact when massed together. *Emiliania huxleyi* is a tiny coccolithophore (or prymnesiophyte) whose protective plates are good at reflecting light. As a result, blooms of this species show up as whitish patches on the ocean surface. Satellite-generated images from the NASA Earth Observatory, taken on 23rd June, showed a massive and persistent plankton bloom (see https://go.nasa.gov/2Za3WEk) in the English Channel off south-west Britain. Milky-white areas are usually coccolithophores and this part of the bloom was probably *Emiliania*. There is a normal plankton peak at this time of the year, but the unusual calm and warmth of this spring and early summer appear to have generated a particularly massive bloom.

There are many who, during lockdown, may have found that living together in a confined space for a long period is sometimes difficult. In the marine world a

Tompot Blenny off Norfolk; this species is relatively scarce in East Anglia. Dawn Watson

variety of unrelated species live together permanently in various close, symbiotic relationships. The ragworm *Neanthes fucata* lives coiled up in the innermost recesses of shells inhabited by hermit crabs, particularly the large **Common Hermit Crab** *Pagurus bernhardus*. On May 18th, Paul Naylor posted some interesting photographs on Facebook of a *Neanthes* extending its front end out of the shell and cheekily sharing its host hermit crab's meal. The worm does no harm to the crab, but probably does not provide anything much in return for its board and lodgings. Paul is adept at recording interesting pieces of marine animal behaviour and also posted a photograph of a **Velvet Swimming Crab** *Necora puber* carrying a beautiful live **Flame Shell** *Limaria hians* in its claws. He suggests that this may be to allow time for the unpleasantly acidic secretions produced by the victim to dissipate before the crab eats it. Flame shells are known to produce defensive chemicals from their tentacles, and the latter will also break off if the animal is picked up.

From my 'home patch', the coast of East Anglia, Dawn Watson (local Seasearch coordinator for East Anglia) provides news of one of my favourite fish, plus a serpulid tubeworm which I have never seen. The charismatic **Tompot Blenny** *Parablennius gattorugine* likes to live on shallow rocky reefs, where it can hide away in holes and crevices. This sort of habitat is in short supply in East Anglia, and records from this area are not that common. The one that Dawn observed, however, had found a suitable home in the extensive sublittoral chalk reef along the Norfolk coast. This large individual, seen earlier in the year, had obviously survived through the winter, something that, according to Dawn, rarely happens in this area. This winter was particularly mild. In June, Rob Spray, diving with Dawn, photographed a large boulder with some beautifully constructed **Corkwing Wrasse** *Symphodus melops* nests. These are difficult to spot because, unless you know otherwise, the nests can be mistaken for a mass of seaweed growing on the rock. The boulder is interesting, too, because it was a 'paramoudra' or 'pot stone' – a large flint nodule with a hollow centre, shaped a bit like a doughnut.

The tubeworm *Pileolaria berkeleyana* forms dense patches of white, partially coiled tubes and has contrasting red head tentacles. It was recorded for the first time in East Anglia late last year, off Norfolk, and Dawn reports that, as of early July, it is still there. Although Hayward & Ryland (2017) state that it is found on all coasts of Britain (extending north from the Mediterranean), there are no records of it on the NBN Atlas. They also say that this species is cryptogenic, which means that we do not know where it came from and it could be either a native or an introduced species. Records of small species such as this need dedicated 'Seasearchers', like Dawn, to find and report them.

Another group of small animals the finding of which requires a close look is the sea slugs. These are, however, popular with divers because many are very colourful and they come in an interesting variety of shapes and sizes. Some species can also be found on the shore with careful searching. Keith Hiscock, out exploring in Whitsand Bay, Cornwall, in early July, photographed **Celtic Sea Slugs** *Onchidella celtica*, a nationally scarce species (though relatively common in Devon and Cornwall). In contrast to all other British sea slugs, this species breathes air, and is more closely related to terrestrial slugs and snails. Dark greeny-black and covered in small papillae, Celtic Sea Slugs blend in well with the mussels, barnacles and seaweeds over which they crawl and so are not easy to spot. As the tide rises, they crawl back up the shore from where they have been feeding to a place where they can remain moist but not submerged for long periods.

Charlotte Bolton (National coordinator for Seasearch) tells me that over the last year, in her patch down in the south-west, she has had records of several uncommon species of nudibranch – one of the groups of true sea slugs. *Favorinus blianus*, for example, was found on the east side of Portland, Dorset, and *Discodoris rosi* (11 records on the NBN atlas) was reported from Porthkerris, Cornwall. The rare (and protected) **Couch's Goby** *Gobius couchi* has been recorded in the UK only from a few locations along the south-west coast, and it is nice to know (from

Charlotte) that it is still in Portland Harbour, one of the first places it was found. One of the problems with nondescript species like this is that they are not easy to spot and can be difficult to identify with certainty.

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Frances Dipper, PMNHS

Plants – England

Like everyone else, the botanical community has endured a spring, and now a summer, of scuppered plans and cancelled field meetings as a result of the COVID-19 pandemic and associated lockdown. While these have been extraordinary and troubling times, the curtailing of these activities has produced unexpected consolations, too, as many of us have found ourselves paying closer attention to the flora within walking distance of home – and making discoveries that would probably have passed us by had we not been forced to stop rushing about.

In Taunton, for instance, it is normally impossible to investigate the verges and central reservations of the busiest roads, but the lockdown gave SL a chance, for once, to engage safely in a spot of botanical kerb-crawling. This produced new inland road-verge records for inconspicuous, mainly coastal species such as **Sea Pearlwort** *Sagina maritima*, **Sea Fern-grass** *Catapodium marinum* and **Bird's-foot Clover** *Trifolium ornithopodioides*, as well as under-recorded local scarcities such as **Subterranean Clover** *T. subterraneum*, **Common Cudweed** *Filago vulgaris*, **Fiddle Dock** *Rumex pulcher*, **Compact Brome** *Anisantha madritensis* and **Early Forget-me-not** *Myosotis ramosissima*. In the small village of Aldwincle, in north Northamptonshire, where PS lives, there were new populations of the locally uncommon **Greater Tussock-sedge** *Carex paniculata* and **Marsh Valerian** *Valeriana dioica* near several small tufa springs within previously unexplored wet woodland, plus several new sites for **Wild Liquorice** *Astragalus glycyphyllos* on woodland rides and road verges.

Across the land, many botanists have likewise been busy exploring places near their homes. We have received literally hundreds of notable records but, sadly, owing to lack of space we can include only a small sample here. In Cambridgeshire, for instance, new locations were reported for **Purple Milk-vetch** *Astragalus danicus*, **Sulphur Clover** *Trifolium ochroleucon* and **Lizard Orchid** *Himantoglossum hircinum*, the last of these turning up also at a new site in the north of Wiltshire where there has been one other record in the past 80 years, as well as in Hertfordshire and Leicestershire after an absence of almost 100 years. There have also been county 'firsts' of this species for Huntingdonshire and south Essex.

Meanwhile, a large population of the Endangered and nationally scarce **Spreading Hedge-parsley** *Torilis arvensis* was found by Oli Pescott in a fallow field in Crowmarsh Gifford, Oxfordshire. This species was thought to be extinct in the county, although unfortunately its newly discovered site is earmarked for development. Mary Breeds discovered a new site for the nationally scarce **Greater Broomrape** *Orobanche rapum-genistae*, growing with its usual host plant, **Gorse** *Ulex europaeus*. In Jersey, a National Trust Ranger turned up **Marsh Helleborine** *Epipactis palustris*, which had not been recorded on the island since the 1960s. Back in south Somerset, Steve Parker spotted **Bermuda-grass** *Cynodon dactylon* and **Woolly Clover** *Trifolium tomentosum* while exploring road verges and waste ground in

Yarrow Broomrape is potentially threatened by verge-mowing at what may be its sole remaining Hampshire locality. Fred Rumsey

Bridgwater, both at only their second localities in the vice-county. On the Isle of Wight, thousands of plants of the Endangered **Annual Knawel** *Scleranthus annuus* were found by Colin Pope growing on an arable headland in the south of the island. This site was first discovered by Geoff Toone in 2002, when there was just a handful of plants, and it may well have profited this year from the wet winter and very dry spring.

Tony Mundell and Fred Rumsey have told us about June Chatfield's discovery in summer 2019 of the Vulnerable **Yarrow Broomrape** *Phelipanche purpurea* in north Hampshire, on the A31 Alton bypass. It is an extremely rare plant in the county, with just two known historical locations, and may now be present only at June's site. A follow-up visit by Fred led to the detection of two more patches in the near vicinity, and a total of 27 flowering shoots. All plants are very close to the road edge, and Tony has contacted the county council to ask for some protection from mowing activities in June and July, although it is perhaps the broomrape's bad luck that it decided to settle close to numerous road signs and a roundabout where vegetation is

cut so frequently. It is hoped that a small area can be spared so that this beautiful species, threatened throughout much of its northern European range, can flower, set seed and persist.

Holly-leaved Naiad *Najas marina* is a nationally rare species restricted to the Norfolk Broads, where it was first discovered by Arthur Bennett in 1883, rather late in the day for a native species. It is widespread globally, with a distribution encompassing Europe, Asia, Africa, Australia, the Americas and many oceanic islands, but its preference for brackish, highly alkaline waters means that it is rare or endangered in many of these regions. Following hot on the heels of its discovery in West Sussex, at the Arundel Wetland Centre, in 2015 (its first record outside the Broads), Holly-leaved Naiad has now been found at Darwell Reservoir, East Sussex, during an Environment Agency survey for the non-native freshwater shrimp *Dikerogammarus villosus*. At both these sites the species is present in considerable quantity, but how it arrived there is a mystery. Did fragments get tangled in the propeller of a boat that was previously used on the Broads? Or did it move via migratory birds? The plant is known to be eaten by waterfowl, and Agami & Waisel (1986) found that its seeds readily germinate after digestion, leading to the suggestion that ducks could be a major factor in long-range dispersal of *N. marina*, at least in North America.

Moving north, in north-east Yorkshire Dave Barlow has found a new location for **Bird's-nest Orchid** *Neottia nidus-avis*, and this rather lovely species has appeared in large numbers in south Northumberland at known localities and at a new site at Shepherd's Dene, above Riding Mill, where it was discovered by Tom Charman. There have also been new sites in south Northumberland for **Mossy Saxifrage** *Saxifraga hypnoides* and **Pale Forget-me-not** *Myosotis stolonifera*, the latter accompanied by its hybrid with **Creeping Forget-me-not** *M. secunda*, namely *M.* × *bollandica*.

In Lancashire, Joshua Styles spotted several thousand plants of **Mossy Stonecrop** *Crassula tillaea*, new to the county, in unimproved, decalcified dune grassland. The distribution of this species has expanded dramatically over the past two decades, not only across its 'core range' in East Anglia and southern and south-western England, but also along the Welsh coast, in north-eastern Scotland and in Ireland.

We raise a glass, too, to the 'More Than Weeds' campaign (https://morethanweeds.co.uk), which suggests using chalk 'graffiti' to raise awareness of the flora of urban streets and pavements (see https://bit.ly/3h5n8Jg). In Taunton, at the height of lockdown, SL came across **Herb Robert** *Geranium robertianum* and **Ivy-leaved Toadflax** *Cymbalaria muralis* with their names scrawled beside them in blackboard chalk. What a strange delight it was to discover that, despite (or maybe because of) the grimness of COVID-19, these downtrodden plants mattered enough to somebody that they felt inspired to name them in this way. They had not labelled the nearby **Water Bent** *Polypogon viridis*, probably now one of the commonest 'street aliens' in the town, but that was easily rectified. Where in the beginning there was one rebel botanist, now, it turns out, there are two!

Plant-spotting, with or without a stick of chalk, can be profitably done on one's own, of course, but not being able to meet up with botanical friends and colleagues during lockdown has highlighted for us what a sociable bunch we really are. In innumerable ways, we gain hugely from each other's company, and we look forward to a time, we hope in the near future, when we can once again crowd around plants in the field, share our thoughts on identification, and even perhaps continue our conversations afterwards at a local hostelry.

Reference

Agami, M., & Waisel, Y. 1986. The role of mallard ducks (*Anas platyrhynchos*) in distribution and germination of the submerged hydrophyte *Najas marina* L. *Oecologia* 68: 473–475.

Pete Stroh and Simon Leach

Lichens

Since my last lichen report (*BW* 31: 301–302), lockdown has dominated life and lichenology. The editorial in the June 2020 issue (*BW* 31: 313–319) carried reports on British wildlife in lockdown, including some fascinating snippets on lichens. But, of course, there are many more anecdotes of what lichenologists did during lockdown. Life in lockdown is certainly different: we all grieved that the British Lichen Society (BLS) Spring Meeting on the Outer Hebrides had to be cancelled, and fieldwork (apart from pottering close to home) was out of the question. So, having dealt with all those niggling jobs around the household and garden, Paul Cannon suggested that here was a prime opportunity for catching up and sorting through long-neglected 'problem' specimens, which we have all accumulated over the years. Vince Giavarini complied, and further suggested that people might try to: 'examine each collection very closely and pick out anything that appears to have lichenicolous fungi on them… you will be very, very surprised. For example I've had *Pyrenidium actinellum* from *Collema glebulentum* collected from Ben Hope in 1984; *Muellerella lichenicola* on *Solenopsora liparina* from Kynance Cove in April 1986, an *Arthonia* sp. on *Cliostomum flavidulum* from Holne Chase, Dartmoor, in Sept 2000 and *Endococcus fusiger* on *Rhizocarpon lavatum* from the Langdale Pikes, in June 1989.'

Brian Coppins also applied himself by curating specimens that had languished in dusty shoe boxes over the years. You would not believe how beautiful they looked, these scrotty little crumbs, once they had been mounted on pieces of card,

laid out on the spare bed, then popped into neatly labelled packets. There were hundreds of them in total (800 to be precise), all of which are destined for the cryptogam herbarium at the Royal Botanic Garden Edinburgh (RBGE). Heleen Plaisier (the herbarium curator at RBGE) enters all new acquisitions on to a database; as she was working from home (Kirkcaldy), Brian took all boxes of beautifully curated specimens to Heleen, who was grateful to be able to get on with processing the data. The question is: will extra shelf-space be needed in the lichen herbarium by the time lockdown is lifted?

There are many other discoveries and anecdotes to relate, and I plan to pull them all together for entry into the British Lichen Society Winter Bulletin. Meanwhile, the Summer Bulletin is a really good read, packed full of a range of features, from lichens in Nova Scotia and southern Spain to odd occurrences of *Imshaugia aleurites* on gravestones of a particular design in some Kent churchyards. There is a superb write-up by Maddie Geddes-Barton of the successful search on Ben Loyal, in Sutherland, for *Bryoria tenuis*, as part of the Lost and Found Fungi initiatives. Also featured is the stunning **Golden-eye** *Teloschistes chrysophthalmus* in a fascinating 'beginner's luck' write-up by Sylvia Davidson, relating her early exploration of twigs of hawthorn *Crataegus* and Blackthorn *Prunus spinosa* as she walked the Sussex South Downs. There is a twist, however: in addition to the normal spectacular orange-coloured tufts of Golden-eye, Sylvia noticed a puzzling spiky greyish lichen, and then, on a wet day, there was a spiky green 'lettuce-like' lichen. Both these entities defied identification. Simon Davey suggested that her photos of the mystery lichens be sent to Brian Coppins, who pronounced them to be *T. chrysophthalmus* var. *dickianus* in grey (dry) and green (wet) forms, with less parietin and hence lacking the usual deep orange coloration. Brian commented: 'These pics are a nice surprise… These specimens with very pale thalli equate to what Lauder Lindsay originally described as *Physcia villosa* var. *dickeana* in 1859 from material collected at Cave Hill, Belfast, by Prof. Dickie.' So, Sylvia has seen and photographed *T. chrysophthalmus* in its several guises.

***Teloschistes chrysophthalmus* var. *dickianus* lacks the bright orange coloration normally associated with this species.** Sylvia Davidson

A forthcoming paper in *The Lichenologist* reports on lichens in amber: 'Amber is fossilized tree resin, millions to hundreds of millions of years old. The two most fossiliferous European Cenozoic ambers are Baltic and Bitterfeld amber (Central Germany)' (Kaasalainen *et al*. 2020). Fossilised lichens in amber have been observed before, although it has been difficult to assign them accurately to genus. The recent discovery of a lichen preserved such that critical features could be recognised, enabling identification to the genus *Usnea*, was therefore exciting. *Usnea* is one of the 'hair' or 'beard' lichens; it is comprised of filamentous strands (an outer cortex) with a tough central strand. The outer cortex can crack, but the internal cord holds together, giving flexibility to the strand even when, as the authors describe, 'its cortex is split into vertebrae-like segments'. This feature of *Usnea* has therefore remained unchanged over the ages: 'The fossil sets the minimum age for *Usnea* to 34 million years (late Eocene).' Apart from the intrinsic fascination of finding fossilised lichens in amber, these discoveries also give an insight into the ecological conditions that existed all those millions of years ago in the Palaeogene forests – a fossilised snapshot of the trees (from which sap leaked to form the amber) and their associated lichens, which were trapped in the amber and preserved. There is also the added value that identifying a lichen to genus will provide a valuable basis for dating and calibrating molecular phylogenies.

To return briefly to lichens in lockdown, perhaps the most unusual new record was made from the sofa while the observer was watching television. On 20th May, we watched the blind climber Jesse Dufton lead an ascent of the Old Man of Hoy, a 449ft sea stack off the south-west coast of Orkney. It was stunning, and inspirational, but at one point we noticed that on the rocks beside Jesse were lichens! The Old Red Sandstone of this stack, its maritime location, and the way the lichens were forming a grey-green 'furry' coat on the rocks suggested that it could be nothing other than **Sea Ivory** *Ramalina siliquosa*. A check on the BLS database confirmed not only that was this a new site for this lichen, but also that there are no records at all from the Old Man of Hoy. Not surprising perhaps, given the locality… But maybe a new challenge for someone?

Reference

Kaasalainen, U., Rikkinen, L., & Schmidt, A. 2020. Fossil *Usnea* and similar fruticose lichens from Palaeogene amber. *The Lichenologist* (in press).

Sandy Coppins,
British Lichen Society

The Three Oak. Justina Bryan

Naturally opinionated

Mark Avery

I am resolute, you are stubborn and they are bloody-minded – is that how you see the world?

Sometimes any campaigner should do a mental check on where on that spectrum he or she is, and also where others might see them as being. The British aren't that keen on the bloody-minded, but we sometimes take that too far and just crave a compromise for a compromise's sake. I think this is especially true in nature conservation, where there are so many nice people. Quite why we love a compromise so much I don't know. Is it more that we take pleasure in the other side's discomfort at not getting all they want than feeling displeasure ourselves at not getting what we wanted? That's a bit odd, if so.

Where would you compromise between slavery and emancipation? Or votes for women and nothing of the sort? Or fighting them on the beaches and letting them in unopposed? Or to simplify further, right and wrong? Many who are now seen as historical heroes were seen by many in their time as being in the bloody-minded camp, and they probably were – but they were also right.

I've taken a vow of bloody-mindedness over just one subject – banning driven grouse-shooting. That's a topical subject at this time of year around the Inglorious 12th, when grouse-shooting traditionally opens in the UK. I want it gone; those who enjoy it or make money from it want it to stay. I don't think they are going to compromise with me, and I see absolutely no reason to compromise with them. I think I'm right, and I am resolute, and stubborn and bloody-minded. And I honestly think that, in my lifetime, driven grouse-shooting will become a thing of the past. More and more people, and more and more interest groups, from flood-stricken communities to the Climate Change Committee, and from nature conservationists to rewilders, see the management regime of intensive grouse-shooting as inimicable to their interests and the public good. This is not the time for compromise, it's the time to keep going. So I shall.

But I am wondering whether bloody-mindedness might be quite handy in other areas of nature conservation, too. It's not as though nature is doing well at the moment. Everyone tells you that there is a biodiversity emergency and then rushes to compromise with those responsible for it.

It's difficult to see why the government that brought you promises of a 'world-leading Environment Bill' (Michael Gove, 23rd July 2019) should be trusted when it has failed to bring you a 'world-beating track and trace system' by the promised date of 1st June (Boris Johnson, 20th May 2020), or should be expected to deliver 'raised standards in agriculture and the environment' (Conservative Manifesto, November 2020) when it couldn't deliver a promise of 100,000 coronavirus tests/day (Matt Hancock, 2nd April 2020) by the end of April. Let us hold government's feet to the fire, resolutely, stubbornly and bloody-mindedly!

But let me dive down to a much more local example. Near where I live there is a planned redesign of a roundabout taking place at a cost of £21m (yes, really). One of the casualties of this development is a 400-year-old tree, called the Three Oak. I've passed that tree scores of times and not really noticed it, but others regard it as a part of their local heritage and were very fond of it and they got up a petition to save the tree, which received a lot of support, but, it was argued, the tree had to go and so the tree went. I admire the local campaigners who tried to save that tree and they appeared resolute to me, and no doubt bloody-minded to the developers. Stand up for trees, and hedges, and birds' nests on buildings and all those other aspects of the natural world that are threatened within a few miles of where you live. They all need more bloody-mindedness to save some of them.

When you get involved in such cases, you will discover that there is no rush to compromise from the other side. You will be traduced, belittled, laughed at and fought. You will find that compromise is very rare in the world and will become less keen to offer it up yourself. After all, Gandhi said (although he probably didn't) 'First they ignore you, then they laugh at you, then they fight you, and then you win' – it doesn't sound quite the same with 'compromise' as the last word, does it?

Conservation news

Compiled by Sue Everett

ALL CHANGE FOR NATURE

Nature recovery – Scotland

The Scottish Wildlife Trust and Scottish Environment Protection Agency have published a new route map towards unlocking £1 billion of new investment for nature conservation in Scotland – see https://bit.ly/3eOv4NB. The publication highlights nine opportunities for investments that could contribute to a green recovery and yield significant benefits for nature, people's health and wellbeing, and Scotland's economy. The route map also includes models that aim to stimulate investment in Scotland's natural capital by delivering a financial return to investors. Proposals include a Natural Capital Pioneer Fund, a Marine Fund and a Nature-Climate Bond.

Nature Recovery Networks (England)

Nature Networks – a summary for practitioners (NERR082) and *Nature Networks Evidence Handbook by Natural England* (NERR081) were published by Natural England in March. This work stems from the Lawton Report (2010), *Making space for nature*, which suggested that action for nature should be bigger, better and more joined up. This recommendation was included in the government's 25-year environment plan, published in 2018, which outlines steps to identify and scope a Nature Recovery Network (NRN) that would eventually provide 500,000ha of additional, mostly priority habitats beyond the statutory site systems. The Environment Bill, as presented in 2019 (reintroduction expected in the autumn), also sets out a requirement for the preparation and publication of Local Nature Recovery Strategies and, in March, the Chancellor announced that £25 million is being allocated for a Nature Recovery Network Fund in England. The 2019 Landscapes Review is also relevant as this proposes bold ambitions for revitalised National Parks and AONBs, one of these being that they should 'form the backbone of the NRNs'. Finally, also included in the March budget was £10 million for a Natural Environmental Impact Fund designed to stimulate private investment and market-based mechanisms to improve and safeguard the environment – the Government is intent on ensuring that funding for nature will not come solely from the public purse.

Trust and nature recovery

Should readers wish to compare these more recent proposals for nature recovery networks with some of the previous visions, the Wildlife Trusts set out theirs in 2018 in the document *Towards a wilder Britain* (https://bit.ly/2Csvv3e).

Planning changes for nature

As Britain sits in the 'transition period', a flavour of what might be to come for the environment post-Brexit was outlined in July by Environment Secretary George Eustice (see video, including Q&A, at https://bit.ly/32D6exS and official speech at https://bit.ly/32J6lYR). For environmental assessment and mitigation for planning in England, he proposes that ecological considerations might be 'front-loaded' by applying natural-capital assessment data ahead of planning applications, while the raft of existing regulations stemming from EU directives will mostly disappear. To aid this approach, £5 million is to be spent on a new natural capital and ecosystem assessment (it is not clear how this will differ from the new county natural capital atlases published by Natural England). Time will tell whether this approach is successful, but there are many sceptics – Miles King and Craig Bennett, CEO of the Wildlife Trusts, comment at https://bit.ly/32D2mgn and https://bit.ly/2ZPPlyh, respectively, while Natural England Chair, Tony Juniper, is more upbeat (https://bit.ly/30wZaQC). Some

Above Great Crested Newts came under fire in the Prime Minister's 'green recovery' speech. Hugh Clark/FLPA

three weeks earlier, Prime Minister Boris Johnson's 'green recovery' speech sent shivers down conservationists' spines. Promising investment in a green future, Mr Johnson then belittled the importance of nature by attributing housebuilding delays to 'newt counting'. See https://bit.ly/2WE4II0 for CIEEM's response.

From September, full planning applications to create homes by demolishing and rebuilding unused buildings or repurposing commercial and retail properties in England will not be required. The ability to create sustainable housing from former offices and shops left empty owing to the COVID-19 pandemic could offer great opportunities to take pressure off greenfield development in areas around major towns and cities.

Jobs for nature?

Defra Board member and rewilding enthusiast Ben Goldsmith is backing the establishment of a new National Nature Service, an idea put forward by Wildlife and Countryside Link (see https://bit.ly/2BwYe6f) and supported by more than 60 organisations representing nature conservation, young people, BME communities and creative arts. Writing for the REACTION website (https://bit.ly/3fLNeAW), Goldsmith says that this would be similar to the Civilian Conservation Corps established in the USA during the 1930s. The service would aim to give young people and those in disadvantaged areas jobs with '21st century' skills; this new workforce would be tasked with improving public health, recovering and expanding access to nature, and doing work that would help to reduce the effects of climate change. The plan would be backed by an education and training programme, funded by grants, and implemented by private organisations, nature NGOs, local authorities and other local public bodies. You can pledge your support for a National Nature Service at https://bit.ly/3eOdw46.

PESTICIDES AND INSECTS

Initiatives for insects

Following on from *Insect declines and why they matter*, published in 2019, the Wildlife Trusts have released another report, *Reversing the decline of insects* (https://bit.ly/3eUVIV4), calling for pesticide use to be reduced by at least half by 2020, the creation of nature-rich landscapes, and other actions such as changing management of road verges and burial grounds in order to encourage native wild flowers, sowing and planting wild flowers in community spaces, and practising integrated pest management on farmland. On the practical front, Buglife's B-Lines campaign offers further encouragement for land-managers to create joined-up areas of flower-rich habitat (see https://bit.ly/39jwn5X). Target zones for B-Lines have been mapped across England, Wales, Northern Ireland, and large areas of Scotland.

Neonicotinoids

The summer of 2020 is the first when insects and other invertebrates are benefitting from the recent EU ban on the use of neonicotinoid seed dressings and sprays on all crops grown outdoors. Research has proven beyond doubt that 'neonics' are bad news for invertebrates, but more recently it has been found also that other wildlife is adversely affected by the use of these chemicals. The RSPB and other partners have recently published research which shows that, through the ingestion of treated seed, neonics end up in the blood plasma of farmland and game birds, resulting in adverse impacts on aspects of their behaviour, including feeding (see also p. 439).

The EU ban has, however, created an uneven playing field for farmers, as these pesticides remain in widespread use in many other countries which export crops and food products to those where the substances are banned. This means that the problem has been conveniently 'offshored', and the countries with strong environmental regulation are penalised economically. Stephanie Morren, RSPB's Senior Policy Officer, describes the research on the effects of neonics on gamebirds in her blog (https://bit.ly/3hu3Tt1) and also calls for the UK's Agriculture Bill to ensure that imported products are produced to at least equivalent environmental standards to those required of producers in the UK.

While the threat from the terrestrial use of neonics begins to fade, a new one has appeared in the form of a proposal to trial the use of a neonicotinoid-based insecticide (Ectosan) in Scottish salmon farms (see https://bit.ly/32IoGoB). Dave Goulson considers this folly in greater depths on pp. 391–392 of this issue. Neonics are still permitted as spot-on treatments for the control of parasites living on domestic pets, which means that aquatic life continues to be exposed to the pesticides when dogs go swimming.

BY THE WATER

No justice?

A Freedom of Information (FOI) request made by the Liberal Democrats has confirmed that the perpetrators of waste and pollution crimes largely go both undetected and unpenalised. The request reveals that only 3.6% of complaints made via the Environment Agency's pollution hotline resulted in any form of sanction, as reported by Sandra Laville in *The Guardian* (https://bit.ly/32EUKd6). In the few cases in which action was taken, this came mostly in the form of advice or warning letters.

In my experience of cases related to the misuse of urban drainage, the complaints are passed to the water company Streamclean to investigate and act upon. That team finds the problem, contacts the perpetrator, and the latter is on notice to resolve it. These incidents include misconnections, as well as businesses dumping waste down the surface-water drains. A recent

incident involved an internationally known fast-food company whose staff had dumped waste fat into the drainage system, after which it ended up in a local stream that runs through a public greenspace. If slurry is going too near a river, or there are other breaches of farming rules for water, an Environment Agency advisor may visit, but inspections are rare and staff thin on the ground. One farm has had repeated visits as rules are often breached: the advice is often to increase slurry storage or make it secure and to have in place a nutrient-management plan. Unfortunately though, the current inadequate enforcement and lack of feet on the ground is allowing numerous offenders – individuals and businesses – to escape justice and continue 'business as usual'.

Taking a prosecution is certainly necessary in some cases, but it is an expensive exercise. One river campaigner has suggested that different sanctions are needed in the form of community sentencing, involving perpetrators working on a river-restoration project along with attendance at a training course, at their expense, similar to those used for vehicle speeding offences.

Ground zero

An investigation by Greenpeace's Unearthed unit has revealed that last year there were 5,000 fewer (one third fewer) Environment Agency (EA) inspections on rivers, industrial sites and watercourses than in 2014. Since 2013, the EA has lost 20% of its staff. In a message to staff in January, seen by Unearthed, the EA also acknowledged that it expects to face an increase in pollution incidents as a result of climate change, population growth, and a reduction in the number of environment officers that it employs.

Southern Water in the dock

Southern Water appeared in court on 27th July charged with breaching anti-pollution laws 51 times between 2010 and 2015 through unlawful discharges of raw sewage from 17 of its sewage works. Affected sites included coastal waters at Sittingbourne, Herne Bay and Whitstable, in Kent, and at the New Forest's Beaulieu River (the last being an SSSI, National Nature Reserve, Ramsar Site, SAC and SPA). Gill Plimmer, writing in the *Financial Times*, reports at https://on.ft.com/2CN9MCK.

Chickened out?

The Angling Trust's sister organisation, Fish Legal, has put Natural Resources Wales (NRW) on notice that phosphate inputs linked to waste from free-range poultry-farming have caused massive environmental damage on the River Wye. Under the Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009, NRW must investigate and ensure that the farms in question put in place proposals to prevent further damage from occurring. The Wye and Usk Foundation describes the river as resembling 'pea soup'. In recent years, anglers have witnessed a gradual increase in the frequency and duration of algal blooms at Ross-on-Wye, in parallel with the expansion of the free-range poultry industry in the upper Wye catchment. Each year sees more planning applications approved for chicken farms, while cumulative impact assessments are not carried out. Waste from the chicken farms is washed off the land in heavy rain and also removed from buildings and spread on to land to add nutrients. Robin McKie covers this story in *The Guardian* – see https://bit.ly/2CVq509.

The National Farmers Union and NRW say that the problems in the Wye this year were not caused by farming practices, but by low flows and hot weather. The Wye and Usk Foundation (WUF), however, says that the problem has worsened since 2016 owing to the growth of poultry enterprises and bad agricultural practices; see https://bit.ly/3f80aQh for its overview on this issue. On a positive note, phosphate inputs from sewage have, in recent years, been reduced. In 2020, WUF has begun a three-year project, funded by the Welsh Government, Tesco and Co-op, which aims to reduce the amount of phosphate getting into the river by working with farmers, businesses, the agricultural supply chain and Welsh Water.

Meanwhile, planning permission was granted for four separate chicken farms in Powys in June. These will bring more than 130,000 birds into this part of the upper Wye catchment.

Running dry

England faces 'a serious risk of running out of water within 20 years' while 'some areas are facing shortages during the COVID-19 pandemic' according to the House of Commons Public Accounts Committee (PAC) in its report on water supply and demand management (https://bit.ly/2ZJCBZT). The PAC piles blame on 'the responsible bodies', i.e. Defra, the Environment Agency and Ofwat, which, it says, 'have collectively taken their eye off the ball'. Citing that three billion litres of water are lost to leakage every day and that no progress has been made in reducing leakage over the last 20 years, the PAC is calling on Government to do much more to reduce demand, including through product-labelling and improved building regulations. It also emphasises that the pressure from Government on water companies to reduce customer bills has conflicted with the need for the latter to invest more in infrastructure improvements, and asks for water companies to publish water-leakage tables.

The plight of chalk streams is highlighted in the PAC report, with a question posed over the adequacy of funding to restore them. In the meantime, plenty of Twitter users are sharing photographs of non-existent or low-flow streams, of which some have much of their flow originating from sewage works or sewer overflows. Sandra Laville covers this story in *The Guardian* (https://bit.ly/32zrEM7).

Play dirty

Together for Rivers (https://bit.ly/3hmGrhz) is a new Rivers Trust campaign that aims to see bathing-water standards introduced for well-used rivers across Britain as a proxy for getting rivers cleaned up. This would have many similarities to the Surfers Against Sewage campaign to clean up coastal waters – see its petition at https://bit.ly/3hhUEfq. Swimming in rivers used to be a popular pastime and is becoming so again, but it is a risky business owing to the widespread contamination of water by human sewage and livestock waste. River campaigners are increasingly active as data from monitoring have become available, revealing the scale and frequency with which raw sewage enters rivers and streams. Data for Sewer Storm Overflow Spill Duration for 2019 are now online (see https://bit.ly/30IgP8f), hosted by the Rivers Trust, thanks to a Freedom of Information request made by *The Guardian*. Limited details of the permitted discharges are also now available on the Environment Agency website (https://bit.ly/2OlZHt8) and further details can be requested, including the authorised frequency and duration of discharges. Our local river group is requesting these data in order to see how permitted discharges matched actual performance in 2019, while our local rivers trust is working with other agencies to develop effective monitoring that can be carried out by using citizen science.

Across Britain, it is recognised that many combined sewer overflows are greatly exceeding their permitted frequency. One on the River Stour, in Suffolk, for instance, spilled 366 times for almost 9,000 hours. *The Guardian* (see https://bit.ly/3hfKKuU) has done some great investigative journalism to reveal the scale of dirty discharges into rivers during 2019. An issue similarly deserving of attention is that of livestock waste (whether from chickens, pigs, or cows), which is causing major problems across pastoral Britain, where human sewage is less of an issue.

NATURE GOES LARGE

Wilder Blean

Wilder Blean (https://bit.ly/39FSELE) is a Kent Wildlife Trust and Wildwood Trust initiative that aims to bring 'transformational' change in the Blean Woods nature reserve through a controlled trial using European Bison *Bison bonasus*. The Trust says that this is a missing keystone species able to change woodlands in a way that no other animal can. The bison will be introduced in 2022.

WildEast

Three East Anglian farmers and landowners have launched an ambitious scheme to create a 'great river of nature' across every type of land in eastern England (see www.wildeast.co.uk) and create an exemplar 'regional nature economy'. Their target is for 20% of land in the area, totalling 250,000ha, to become nature-rich. All types of landowners and land-managers are invited to pledge a commitment to the initiative. WildEast is also developing an accreditation system to demonstrate the environmental sustainability of food produced in the region.

Rewilding statement

CIEEM has issued a position statement on rewilding: see https://bit.ly/3fNPKGX.

SPECIES NEWS

Mountain Hares and wild animals better protected

Members of the Scottish Parliament have voted to give Mountain Hare *Lepus timidus* strict protection under the Wildlife and Countryside Act. This will make it an offence intentionally or recklessly to kill the animals without a licence. Scotland has approximately 135,000 Mountain Hares and up to 26,000 are killed every year, most of these on grouse moors and other sporting estates. A new law, the Animals and Wildlife (Penalties, Protections and Powers) (Scotland) Bill, was also agreed. This will introduce stiffer sentences for wildlife crime, ban the practice of shooting seals around fish farms, and introduce greater restrictions on the use of acoustic devices to scare them off. Offences of the worst kind will be punishable by up to five years in prison, an unlimited fine or both.

Why cull birds?

Considerable controversy exists concerning the issuing of licences to cull birds in England. Dave Slater, Natural England's Director for Wildlife Licensing and Enforcement Cases, has explained in detail how Natural England approaches this issue – see https://bit.ly/3fNDYMu. This is one of a number of blogs aiming to give context or correct inaccurate claims about licensing decisions.

Another bird down

In July, another Goshawk *Accipiter gentilis* was killed in the North York Moors National Park, this time on a grouse moor owned by the Queen. A video shows a man entering a cage trap containing a Goshawk and appearing to kill the bird, before removing the body in a bag. North Yorkshire holds the top spot for persecution of birds of prey, contributing 10% of all known incidents in the UK since 2007.

Flying kites

One of the UK's most successful species-recovery projects has just celebrated its 30th anniversary. Thirty years ago, the Red Kite *Milvus milvus* population was down to just a handful of wild birds confined to central Wales. Today there are an estimated 1,800 breeding pairs across Britain, thanks largely to a reintroduction programme that began with 13 kites brought from Spain in 1990.

TRADE AND NATURE

Trade footprints do not stop abroad

Risky Business (https://bit.ly/3eCcNTv), a report issued by the RSPB and WWF-UK, reveals the scale and environmental and social impact of Britain's import and consumption of seven major commodities: beef and leather, oil and soy, timber, cocoa and rubber. To supply the annual UK demand for these seven commodities alone requires a land area more than half the size of the UK: a total of 13.6 million hectares. More than 40% of the UK's overseas land footprint (nearly 6 million hectares) is in countries at high or very high risk of deforestation, weak governance and poor labour standards. Timber and beef and leather each contribute around one third of the UK's overseas footprint. The footprint does not stop there either, of course: any imported fruit or vegetables grown in Spain or Morocco, for example, will require the consumption of water, potentially at the expense of nature in those countries.

The organisations are calling for businesses, governments and consumers to act both to reduce consumption of damaging commodities and to improve the environmental and social sustainability of supply chains. On the flip side, of course, a portion of the food grown through intensive farming in the UK, on land and in fish farms, is exported elsewhere; this matter seems to receive little attention, but it would be interesting to know the extent to which exports are helping to fuel nature loss and maintain nature-poor expanses of countryside across Britain.

Freeports: a new nature threat?

The UK Government is proposing, as part of its post-Brexit trade strategy, to establish a number of 'Freeports' that have different customs and planning rules from those in the rest of the country – see the consultation document at https://bit.ly/2OH9XlW. There could be significant environmental implications, including for nature in and around the Freeports themselves, as well as for endangered species that might find an easy route into the UK through these locations. Wildlife and Countryside Link says that in other countries 'serious environmental degradation' has been a consequence of Freeports – see its response at https://bit.ly/3hitUeZ.

OUT AND ABOUT

Going wild risks nature sites

Concern is growing at the increasing pressure on wildlife and protected areas from groups of people heading into the countryside with camping equipment that, along with litter and human excrement, is left in situ after the parties have ended. Closer to towns, there have been numerous reports of larger night-time gatherings involving disposable barbecues and fires, excessive consumption of alcohol, and other drug-taking. A feature in *The Guardian* by Tom Wall (see https://bit.ly/3eO4pQW) quotes the National Trust's nature-conservation chief, Ben McCarthy, who describes the situation as a 'disposable festival mentality which we've not experienced at our places before'. Local authorities and the Forestry Commission (FC) are also having to deal with the growing 'throwaway party' mentality. Wild camping has now been banned in Kielder Forest. Our local community fields, being on the edge of town, have similarly suffered from party litter and petty vandalism, with recently planted trees and tree shelters having been damaged.

Fire time

A petition to ban disposable barbecues now has over 39,000 signatures, with a target of 50,000. You can sign at https://bit.ly/2OHEGir.

WARMER WORLD

Hotter

CO_2 in the earth's atmosphere now measures 414 parts per million. It is thought that the last time this level was reached was during the mid-Pliocene warm era, 3.3 million years ago, when sea levels were 20 metres higher and global temperatures were around 3 and 4 degrees centigrade above those of today. Within five years, however, CO_2 levels are likely to reach those not seen since the Middle Miocene Climatic Optimum, 15 million years ago. For further details, see the article by Jonathan Watts in *The Guardian* at https://bit.ly/2WzF1s2.

Ponds mean carbon sinks

A new study (https://bit.ly/30lPW9G) has found that small ponds can act as significant carbon sinks, which suggests that pond-creation could be an additional tool for mitigating carbon emissions.

SOIL MATTERS

Peat

RSPB Scotland is calling on the Scottish Government to phase out peat extraction – see its video at https://bit.ly/3fJg2Ks. The Soils Alliance has also compiled a useful library of information and research about peat at https://bit.ly/2BlfmvI.

Sludge and soil

Unearthed has revealed serious weaknesses in the Environment Agency's (EA) controls on an industry that spreads millions of tonnes of sewage sludge on farmland each year. Investigators commissioned by the EA found sewage waste destined for English crops to be contaminated with dangerous 'persistent organic pollutants' such as dioxins, furans and polycyclic

aromatic hydrocarbons at 'levels that may present a risk to human health'. They reported evidence (see https://bit.ly/32Jtquo) that the sludges, which are routinely spread as fertiliser on hundreds of farms, were widely contaminated with microplastics that could ultimately leave soil 'unsuitable for agriculture'. Almost all treated sludge samples tested also contained glyphosate and the antimicrobial chemical triclosan. These contaminants are not tested for prior to spreading. The commissioned report, issued in 2017, proposed a suite of reforms to landspreading regulations which have yet to be acted upon.

A theory of soil

Decades of research are beginning to shed new light on how intensive, fertiliser-based farming damages soil structure, affects soil biota and causes soil-carbon loss. See https://bit.ly/3hkOATu for details of the new findings from Rothamsted Research.

ODDS AND SODS

County capital, England

Natural Capital Atlases showing the state of natural capital for 44 counties or city regions across England are now online: see https://bit.ly/32w8Rl1.

Where is the garden?

Garden Villages were meant to be a new way to build stand-alone, sustainable communities, with plentiful green spaces full of wildlife and happy people. Unsurprisingly, this idyll is likely to be far from reality. *Garden Villages and Garden Towns: Visions and Reality*, issued by Transport for New Homes and the Foundation for Integrated Transport, scrutinises 20 newly built 'garden' communities and compares their performance against the garden-village vision.

In my area, a bunch of farmer/landowners and a local estate agent have produced a proposal for a 2,500-house development called 'Selwood Garden Village' (see https://bit.ly/2OZ1BGj) that would be tacked on to the town of Frome, on spring-clad slopes above the river and in a poor location in terms of sustainable travel. While described as a garden village, this appears to be merely another large housing estate on the edge of town.

Jobs in nature crisis

While it is still too early to know exactly what the impact of the COVID-19 pandemic on countryside jobs will be, initial indications are that many employees could be shed. For example, National Trust Scotland (NTS), Scotland's largest countryside charity, is one of that country's biggest employers of countryside rangers, ecologists and other countryside-based staff. In May, NTS declared emergency measures and placed 429 of its permanent staff at risk of redundancy. The trust's total charitable income from all sources is forecast to collapse to the tune of £28 million this year, and to fall again in 2021 even if current restrictions are relaxed. This does not include estimated investment losses of £46 million due to stock-market conditions.

People and nature

Interim experimental indicators from the People and Nature Survey, covering the period 1st–31st May 2020, have been published (https://bit.ly/2WwP4xU). The aim is to understand the impact of COVID-19 on the way in which people use the natural environment in England. The survey reveals that in May, during lockdown, eight out of ten adults agreed that 'being in nature makes me very happy'. In addition, 41% reported that visiting green and natural spaces had been even more important than normal to their wellbeing.

Connection between mental health and wellbeing and greater access to high-quality natural areas is beginning to be recognised in Government policy. In England, a further £4 million is to be invested in a two-year pilot which will bring 'green-prescriptions' – recommendation from doctors to spend more time out in nature – to four urban and rural areas that have been hit the hardest by the coronavirus pandemic.

England tree strategy

A new England Tree Strategy outlines how tree numbers can be increased and the management of existing trees improved. See https://bit.ly/3ePDKU6 to read the consultation (closing 12th September).

Roads to oceans

Wind-borne microplastics originating from the wear of car tyres have been found to be a major source of ocean pollution. Each car tyre loses around 4kg of material in its life, with particles washed off or blown away from roads. Damian Carrington reports in *The Guardian* – https://bit.ly/3eRlCbg.

Green economy matters

Blueprint for a resilient economy (https://bit.ly/3eQTAxN) was published in June by Green Alliance as a proposal for a post-COVID world. It has five themes: 1, invest in net zero infrastructure; 2, restore nature; 3, stop wasting valuable resources; 4, ensure clean air and healthy places; and 5, make the recovery fair.

Agriculture Bill

Richard Young of the Sustainable Food Trust has published a detailed critique of the Agriculture Bill: see https://bit.ly/2OLhX59.

Sue Everett is an independent ecologist and sustainability consultant and can be contacted on conservation.news@gmail.com. She occasionally blogs and increasingly tweets at http://warmerandwilder.blogspot.com and @suesustainable.

Simon Webster/Alamy Stock Photo

Twitcher in the swamp

Twitcher's Ongoing Covid Diary

22nd June Faced with *British Wildlife*'s readers' survey, Twitcher is asked to tick whether he is male, female or 'other'. Well, this column has always maintained a discrete silence over its gender, but I can reveal that Twitcher has for long envied certain lowly creatures in their sex lives. Among the assorted squirmy things at the bottom of the food chain are a few that could tick *all* the boxes. They can change sex on an impulse, or even decide that they are both male *and* female, and probably 'other' as well. And without surgery! But, sadly, Twitcher concludes that he cannot plausibly pretend to be a flatworm, and so ticks 'prefer not to say', like everyone else.

24th June The Wildlife Trust has issued another of these 'calls' it likes to make from time to time. This time it is calling for a new, improved tier of Marine Protected Areas (MPAs), to be known as *Highly* Protected Marine Protected Areas (HPMPAs?). But, you have to wonder, will even that be enough to save the poor little fishes? Do we not need a really thoroughgoing designation that omits neither jot nor tittle, in other words a *Very* Highly, Highly Protected, Marine Protected Area (VHHPMPA!). And if even that won't do, I'm sure that we could dream up another one: Very, *very* highly protected etc.

25th June Phew, wot a scorcher! A nature reserve in Northamptonshire reports receiving hordes of 'visitors' today, all presumably intent on reconnecting with nature. With music blaring, the visitors lit barbecues, peed in the river, left rubbish all over the place, and generally 'flouted the countryside code'. Oh, and they decided to burn down the bird hide, too.

It is all perfectly understandable. The reason why people like to relax among piles of plastic bottles, pizza boxes, crisp packets and other debris is that it makes them feel more at ease in an otherwise alien environment. It reminds them of home. The solution, surely, is to allow nature reserves to turn into rubbish dumps. Some of them, like this one, are clearly already well on the way. Many landfill sites now make attractive wild places, with newts, marsh orchids, and reed warblers warbling their agreeable song, agreeable because it will remind the visitors of the sound of motor bikes. Everyone is happy.

30th June. Boris announces a New Deal for Britain, terrifyingly titled Build, build! build!!! Among the things he intends to build are lots of new 'woods' (70,000 acres worth!), £40 million worth of 'conservation projects', and 3,000 'jobs', including some 'countryside rangers'. All this, he believes, will go a long way to restore our wildlife habitats, protect biodiversity, and remove carbon from the atmosphere.

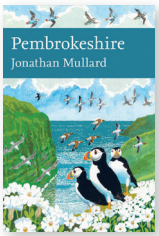
Well, it won't, but, quite honestly, how do you start explaining to him why it won't? This government and its advisors plainly know nothing about wildlife – money is what they know – and so Twitcher will try to keep this very simple. Listen, Boris. Your new woods are a waste of space. Young trees don't store much carbon, and they aren't going to turn into old trees are they? Nor can you create worthwhile jobs without worthwhile education. You can't restore natural habitats and protect biodiversity by planting and sowing. And you won't reconnect people with nature because you don't know how. Other than that, Prime Minister, carry on!

1st July Twitcher learns that a vegan footballer called Hector Bellerin has pledged to plant 3,000 trees every time his club, Arsenal, wins a game! He has teamed up with one of the many tree-planting 'charities' to achieve this. If Arsenal wins every game for the next couple of years, Boris's dream of covering Britain with diseased Christmas trees will be well on the way to fulfilment. Surely every football-loving naturalist will wish to do his/her best to ensure that this ghastly vision will not succeed. Every time Arsenal looks likely to score, we should hurl stink bombs at the striker or strip off and run on to the pitch naked. But perhaps a quicker way to sort it out would be to plant up Arsenal's football pitch with all of Mr Bellerin's favourite trees.

3rd July Twitcher, along with two other chaps, has finished writing a book about this sunny, locked-down spring. All that is left to decide is the title. I suggested *Covid Spring: See nature before you snuff it!* But the other two demurred, suspecting that the title might offend somebody. So, it will be called instead *The Consolation of Nature*. But on Twitcher's presentation copies the correct title will be clearly marked.

4th July With pollution levels so much lower, thanks to the lockdown, wildlife is returning to Ramsbury ('Nature is healing. We are the virus!'). Today, I swear I spotted a dolphin heading up the river. On the other hand, it may just have had something to do with the pub re-opening. Cheers! (hic!).

Book reviews



Pembrokeshire

Jonathan Mullard
Collins New Naturalist (No. 141)
William Collins 2020
510pp, colour-illustrated
ISBN 9780008112806 £65 (hbk)
ISBN 9780008112820 £35 (pbk)

This is Jonathan Mullard's third Welsh regional volume in the New Naturalist series, after *Gower* in 2006 and *Brecon Beacons* in 2014. Pembrokeshire has an exceptionally diverse coastline with internationally important and very well-studied seabird islands. To describe these islands along with the mainland coast and to do justice to the inland parts of Pembrokeshire has been a Herculean task. The result is a volume crammed full of fascinating highlights of what can be found, presented in the 'grasshopper' style of the two earlier books. The many photographs are again superb.

Mullard has written a most enjoyable historical romp through the nature of Pembrokeshire. The many entertaining anecdotes capture the enquiring spirit of the old naturalists. I was particularly pleased with the mention of the Elizabethan polymath, George Owen of Henllys, whose description of the landscape, natural history, and the customs and people of the county is astonishing. Owen even produced a map of the county which is regarded as one of the gems of the maps collection at the National Library of Wales. On one side it has an alphabetical index of place names which is keyed into the map by a marginal grid. A copy of this map ought to have been included. Indeed, there are only two maps in the book, whereas there were 11 in the Gower volume.

Two chapters, 'Cathedral, Churches and Chapels' and 'Castles and Palaces', stand out for the way they seamlessly merge history and natural history. The start of the aptly titled 'Farmland Survivals' chapter gently chides agriculture for creating a 'green desert' and goes on to include a telling comment that it is notable that 'most of the meadows now designated as Sites of Special Scientific Interest form part of smallholdings owned and managed by former employees of conservation organisations'.

There is a geological map, and the story of the underlying rocks is another good read with much on the early discoveries. More could have been said about the superb *Geological Conservation Review* series initiated in 1977 by the Nature Conservancy Council (NCC).

The description of the sublittoral world relies very much on the huge numbers of surveys of the waters within the Skomer Marine Nature Reserve. Some of the scarce species are well described, but their communities less so. The diving staff who helped to set up and ran this pioneering marine reserve for a quarter of a century receive praise but, like many of us, Mullard wonders whether the replacement Marine Conservation Zone will be as effective. There is comment about numerous intertidal and inshore survey and monitoring reports away from Skomer, but an admission that it was beyond the scope of the book to summarise their findings.

The vast amount of information about the two internationally important seabird islands, Skomer and Skokholm NNRs, seems to have caused difficulties for the author. For example, Mike Harris has written at least 25 papers reporting his work on Skokholm and 12 on Skomer, yet only two are in the references. The discussion of Tim Birkhead's long-running Skomer Guillemot studies should have included mention of the pre-eminent role of the Oxford University Edward Grey Institute of Field Ornithology. Shortage of space perhaps also accounts for the fact that there is nothing about the long-running work on the Grey Seals of Skomer. Although recent seal work on Ramsey is covered, early pioneering studies are missing.

Nonetheless, despite the omissions there is a huge amount of fascinating information in the well-written chapters on the islands. As for the mainland coast, the author admits that it is 'impossible to cover all of the rocky coastline in detail'. This follows a most important section summarising the success story of reintroducing coastal grazing, largely to help the Chough population. There are excellent summaries of invertebrates at Stackpole NNR, a very clear explanation of the complexities of the various rock sea-lavenders and a delightful piece on the Scaly Cricket. These are just some of the examples of stories that deserve to be, and are, well told.

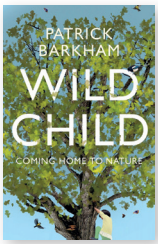
Unfortunately, the great growth of knowledge about the habitats of Pembrokeshire that occurred between 1970 and 2010, led by the NCC in partnership with the Field Studies Council, the local Wildlife Trust and other organisations, is hardly referred to. Many of the findings from this recent golden age of exploration of the nature of Pembrokeshire were used to refine the SSSI selection and improve the site descriptions which underpin much of the author's text.

The final chapter is a thought-provoking piece on conserving Pembrokeshire. This is needed, as much of the earlier chapters tend to favour good news over bad. It covers the climate crisis, pollution and conservation and carbon. The wording is diplomatically crafted, and I would suggest that the scale of the current expansion of huge dairy units, some now practising zero grazing, could perhaps have received more brutal treatment.

Tucked away in this last part of the book is a profound explanatory statement by Mullard: 'People do not realise what we have already lost, which is why I have included so many examples from the past in this book.' This book is a brave attempt and should be read and, it is hoped,

enjoyed despite the errors and omissions that may be obvious only to those long embedded in the nature of this most westerly county of Wales. An error that may not amuse any foodies fond of Goji berries is the suggestion, on page 263, that the red berries are probably poisonous to humans! More seriously, though, some might agree with me that it would have been better as two volumes, one on the islands and the seas beyond, and the other on the mainland coast and inland Pembrokeshire.

Stephen Evans



Wild Child: Coming Home to Nature

Patrick Barkham
Faber Independent Alliance 2020
342pp
ISBN 9781783781911 £17 (hbk)

Patrick Barkham is as likeable and accessible as an author as he is in person, and this is a book that almost reads itself. It could be summarised in one sentence, but doing so would deprive the reader of a delightful journey, full of tender humour and truths which most will recognise, if not as a parent, then as someone who was once a child.

I was always going to approve, because Patrick and I agree on the principle that access to nature is a human right. And having a nine-year-old child myself, I believe wholeheartedly that this right matters most especially to children. Hence I was immediately hooked by one of the book's opening statements, that 'The idea that a child, of say, nine would roam without adult company through copses and spinneys close to home is anathema' and the quantification of the curtailment of an average child's freedom within one generation – from a radius of kilometres in the 1960s and 70s to little more than the confines of a garden, if they are lucky.

Patrick's family is growing up in a large village – not as wild as he would like, but it sounds good. Counterintuitively, while truly rural children benefit from cleaner air and more 'green' space, they are often even more confined than urban ones, having smaller social circles and fewer shared spaces in which they are allowed to explore because the green around them is often closed to them – farmland, golfcourses, other people's gardens.

Over 18 months of volunteering in forest school settings and watching his own youngsters engage with nature, Patrick records experiences and insights with convincing honesty. We meet a lot of children, including his twin girls and their younger brother but also many more with widely varying backgrounds. There are city kids, village kids, white kids, ethnic-minority kids, comfortable middle-class kids, working-class kids, refugee kids, kids with special educational needs and disabilities. They are bright, curious, covetous, sulky, squabbly, shy, confident, fragile, exasperating and hilarious – I lost a bit of my heart to them all in ways as different as they are. Virtually all are pre-school or primary age. Is 11 when childhood begins to wane? The thought that fills me with a sort of panic – like watching a window close.

If the stars of the book are kids, the heroes are unconventional teachers, and in particular the indefatigable Emma and Hayley, who run Dandelion outdoor nursery – a setting devoid of branded items and plastic toys, and resembling not so much a pre-school as a Neolithic settlement with a central hearth, causeways and strawbale fortifications, populated by small busy humans who clamber and dabble, collect and invent, and participate in regular philosophy lessons. It could be the most middle-class setting ever were it not for the free nursery hours that make it available to any local family.

Dandelion wisdom drifts throughout the pages of the book. 'The outdoors is a place for learning because there is sensory input without sensory bombardment,' says Hayley. 'In a classroom you've got sensory overload – the noise, the visuals, the colours, the proximity of people to you and the proximity of the walls; it's just too much for a lot of children.' Patrick makes clear that the stimulation found in nature is different, 'a ceaseless giver of serendipity' – try even saying that without smiling – and this book navigates its gentle undulations and surprises beautifully.

Another sentence that will linger long with me describes Patrick being outpaced by the children of Dandelion in a chasing game. 'I'm so big and sluggish, I don't have to pretend very hard to fail to catch them… I can no longer enter childhood as a child, nor can I quite catch my own childhood. But I just about feel it in the cold air, warm cheeks, tingling hands.' It made me sigh because, oh, I almost remember, too.

The icons of the book are those you would expect: conkers, frogspawn, caterpillars, bird nests, and trees – the kind you can climb into or den beneath. There is also a recurrent dose of death – the kind that is not an end but a part of life. But, ultimately, *Wild Child* is a dandelion book. Cheery, familiar, not very big (I read it in a few hours), sometimes bold, sometimes delicate, but with roots that grow fast and deep and little idea-seeds that might travel and flourish almost anywhere. It is a manifesto for change in education and, by extension, in our wider treatment of nature. Not just for childhood's sake, but because humans in nature tend to be better humans. I hope that its seeds spread far and wide.

Amy-Jane Beer

Britain's Ferns – A field guide to the clubmosses, quillworts, horsetails and ferns of Great Britain and Ireland

James Merryweather
Princeton University Press 2020
280pp, colour-illustrated
ISBN 978-0-691-18039-7 £20 (pbk)

In the Victorian period and at the height of 'pteridomania' the world was awash with relatively

inexpensive illustrated guides to the ferns and their allies. Fast forward a hundred years and the would-be fern-identifier would struggle to find a dedicated up-to-date guide. The most comprehensive account of these plants, Chris Page's *The Ferns of Britain and Ireland*, was last revised in 1997, is expensive, lacks established non-natives and is not for the field. For much of the late 20th century the misleadingly modestly named *Welsh Ferns* was the work of choice until the arrival of James Merryweather's *Fern Guide*, now in its 3rd edition. That admirable work, though, is effectively just an illustrated key, and there has clearly been demand for a meatier but still accessible and affordable modern treatment of this popular group of plants. It is this vacuum which Merryweather's new guide aims to fill. Those familiar with the *Fern Guide* will see the same approach adopted here, with brief introductions to the pteridophytes, a glossary and then nicely illustrated keys to groups, families and genera. Almost every one of the 77 taxa treated is given a two-page spread, with observation tips, a very brief description of aspects of the plant and its habitat useful for its identification, and its distribution. These are nicely laid out and well illustrated. Of smaller format than the *Fern Guide*, I guess with field use in consideration, this can on the text-rich pages give a daunting density and crowded feel, for there is much packed into this book beyond the very nicely illustrated accounts of the species and the few commoner hybrids treated. The book concludes with various short illustrated pieces on all-year-round pteridology, juvenile ferns, urban ferns, variation in pteridophytes and non-native and nuisance pteridophytes. These are for me the less successful elements. I am not sure that, given the space available, much could be meaningfully said here and they feel a bit tacked on and random, lacking a flow although admittedly containing much of interest. They might be better placed in the introduction, although I can see why Merryweather did not want to bombard users with too much information at this point.

The nomenclature generally follows the most recent Pteridophyte Phylogeny Group treatment and subsequent papers; users of Stace will have to come to terms with the change to *Struthiopteris* from *Blechnum* and to *Vandenboschia* from *Trichomanes*, and the adoption of *Pseudathyrium* for the ex-indusiate montane lady ferns. The novel clubmoss genus *Spinulum* has, however, not found favour here. A few extinct taxa are not included, neither is the very rare *Equisetum ramosissimum* (which gets the briefest of mentions, on page 56) perhaps because of its questioned status – it is, however, listed on the Wildlife and Countryside Act, Schedule 8 and hence its identification is important. I think it a great shame that no non-native taxa are treated beyond the brief concluding discussion – one is after all much more likely to find a *Cyrtomium* than a *Woodsia*! Even the very widespread water-fern *Azolla* gets only the briefest of mentions. Two common hybrids are fully described: both are admittedly frequent, but they are not the commonest British and Irish hybrids. Why they were chosen above others is unclear. I wish that more hybrids could have been included, but I know that focusing on these can detract from the simple messages needed by beginners.

There are a few small errors, On page 94, *D. oreades* has been mislabelled *D. dilatata* and there is an inconsistency in the naming of *Asplenium obovatum* subsp. *Billotii*, which more regularly is called, incorrectly, subsp. *lanceolatum*. Our *Diphasiastrum* '*complanatum*', briefly mentioned on page 106, should be called *Diphasiastrum* × *issleri*, or *D. issleri* if one prefers. This partially fertile hybrid was treated as a subspecies of *complanatum* by Jermy in *Flora Europaea* and subsequently has too often been rather lazily called *complanatum*. Its distinguishing features are not adequately given. I have a few small additional quibbles: *Gymnocarpium robertianum* is not found exclusively on limestone, *Ophioglossum azoricum* is not exclusively a seaside plant, and surely no one in lowland England would regard Beech Fern as widespread and common. It is a shame that photos of Irish examples of *Asplenium onopteris* were not used; our plants are of a rather extreme and distinct form, but, even so, spore size is really the only satisfactory discriminant from *A. adiantum-nigrum*. Such criticisms should not detract from what is an excellent book. It goes a long way to filling the massive void and will, I think, be very popular with many naturalists and botanists. The conversational approach taken will engage with many readers getting to grips with these plants for the first time. It is, as it claims to be, user-friendly. The many photographs are good and well selected, the keys, hints and tips fine-honed, and the book looks handsome but robust enough to survive field use. It is strongly recommended.
Fred Rumsey

Gentians of Britain and Ireland

Tim Rich and Andy McVeigh
Botanical Society of Britain and Ireland 2019
174pp, colour-illustrated
ISBN 978-0-90115-855-0 £16 (pbk)

Most of BSBI's excellent handbooks on the British and Irish flora are about plants that are similar to one another, and in some cases hard to identify. At first sight gentians seem different. As a family, gentians are pretty, often of conservation interest (they indicate good-quality habitats) and not a critical group at all. Yet the two largest genera of the Gentianaceae, *Gentianella* (the felworts) and *Centaurium* (the centauries), have concentrated and confused botanical minds for decades, and indeed this handbook introduces some new changes which, one hopes, will be the last word on the matter.

By this computation the family contains 18 species in Britain and Ireland. Of these, two (Willow *Gentiana asclepiadea* and Trumpet Gentians *G. acaulis*) are neophytes, one, the Fringed Gentian *Gentianopsis ciliata*, is possibly extinct, and a fourth, Guernsey Centaury

Exaculum pusillum, is confined to Guernsey. Two former species, Early Gentian and Dune Gentian, are now believed to be subspecies of the widespread and variable Autumn Felwort *Gentianella amarella*. On the other hand, the authors raise the endemic Intermediate Centaury *G. intermedia* to a full species (a 'true breeding allohexaploid' no less). The family contains quite a few endemic British forms, although mostly now at subspecies or varietal level.

BSBI handbooks have to focus on identification rather than ecology and conservation, and within a fairly rigid format, but all the same this handbook manages to cover a lot of ground, including distribution (with updated dot-maps), variation and hybrids, discovery dates and what those Latin names mean, reproductive biology, and population trends, which in all too many cases are firmly downhill. The colour photographs of the plants are generally good. The habitat shots are too small and, in some cases, rather dark.

May I add a personal note about 'conservation status'. The survival of any species has little to do with conservation bureaucracy and everything to do with ecology. For example, the survival of the Spring Gentian in Britain has nothing to do with legal protection, nor with its 'threat status' of 'Vulnerable'. It survives in the overgrazed fells of northern England because it can exist indefinitely as vegetative clones, even when the sheep graze all the flowers. I should know. I once spent a year of my life helping to prove it.

Peter Marren

Letters

Stop before you chop

Habitat management news in the April issue (*BW* 31: 252–253) promoted actions to increase volumes of wood/woody debris in rivers and riparian zones. It is a very compelling article, well written, well argued and with sound reasons for increasing wood within water courses. There is good practical advice to achieve this: winching, 'chop and drop', ring-barking and chain-saw felling. I have no arguments with the reasoning for this practice, which, as the authors explain, will benefit a whole swathe of wildlife and contribute to flood management.

The alarming part, however, is that there is no mention of carrying out prior survey to check the possible importance of individual trees as wildlife habitats – as they stand, alive. There was no indication on how trees to be felled were to be selected. Trees flanking rivers and streams are often key locations for supporting particularly rich lichen and bryophyte assemblages, which benefit from the light, shelter and humidity provided by these linear habitats. There is also the consideration that trees along rivers may be providing potential roosts for bats and nest holes for birds, etc.

As a lichenologist, my concern is also for aquatic lichens on rocks within and associated with the splash zone of riverside rocks – some of these communities are very restricted and vulnerable to drastic alterations to the habitat outwith the 'normal' dynamics of the riverine system. Yet, of course, trees die, and branches fall and lie across stream beds – this is part of the normal dynamics.

It is good to remember that 'no size fits all' and that each site and indeed each tree is individual. The desired results for one conservation action need to be seen in context of the overall situation and wider wildlife interest. It would be distressing to find that your actions may have achieved your particular desired goal, but in the process have destroyed other habitats and/or priority species.

A useful article by Harriet Downey (2020) on evidence-based decision-making in conservation urges scoping, evaluating and assessing evidence before embarking on any habitat management. I would also strongly recommend the Plantlife publication *Rapid Woodland Assessment*, as a guide to help in selecting potential trees for felling.

My fear – perhaps ungrounded, but I have seen similar things happen before – is that the piece in Habitat management news could entice site-managers into trying the same approach as a simple way of achieving something positive. But before you chop down trees, please consider the lichens!

Reference

Downey, H. 2020. Evidence-based decision making in conservation and land management: why it is important and how it can be done. *Conservation Land Management* 18(2): 14–19.

Sandy Coppins (British Lichen Society)

SuDS ponds

I was interested to read the 'Freshwater life' report in the June Issue (*BW* 31: 372–373), as it reminded me of surveying for water bugs (Hemiptera: Heteroptera) for a provisional atlas published in 2003 by the Biological Records Centre. There were parts of Scotland where what we called SuDS (short for Sustainable Drainage System) ponds occurred. These were generally useful aquatic habitats in an otherwise 'tidied-up' countryside, but, as the Freshwater life report states: '"multipurpose" interception ponds… had only modest biodiversity benefits. In particular, these "dirty water" ponds could not sustain rarer species'. The point of this letter is simply to recall that the 'dirty water' was occasionally not so much in the water but, rather, floating on top, and this could prevent some water bugs from respiration when coming to the surface for fresh air. I particularly recall a SuDS pond near the eastern outskirts (at the time) of Dunfermline, where I was mightily puzzled as to why so many dead specimens of the large corixid *Corixa punctata* were floating on the surface. Then the reason dawned: someone had allowed oil or petrol to be washed into the pond, where it rose to the surface in a fine film, thereby preventing the water bugs from replenishing fresh air.

Thomas Huxley

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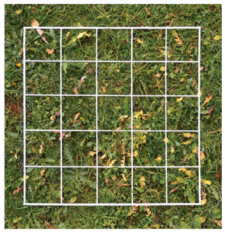

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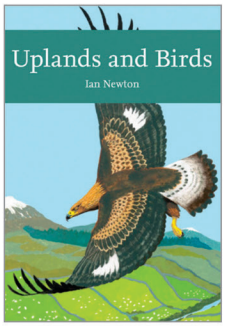

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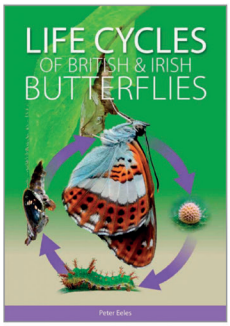

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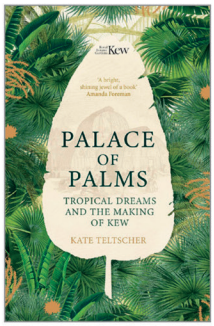

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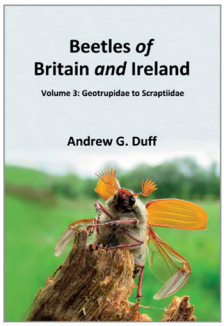

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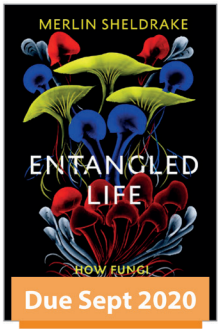

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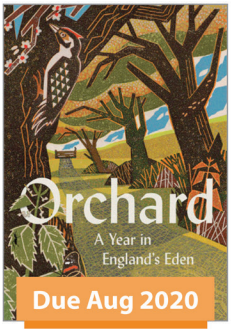

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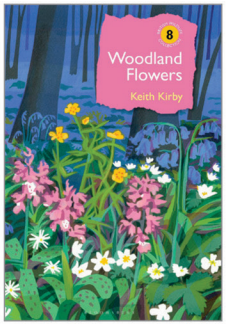

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