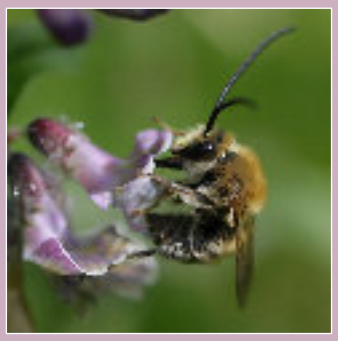
GREAT DIXTER

BIODIVERSITY AUDIT 2017-2019



Prepared by Andy Phillips for the Great Dixter Charitable Trust.

heritage lottery fund

LOTTERY FUNDED

Published by the Great Dixter Charitable Trust and funded by the Heritage Lottery Fund.

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Prepared by Andy Phillips for the Great Dixter Charitable Trust.
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Common spotted orchid (*Dactylorhiza fuchsii*) by Crystal Ray

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FRONT COVER MAIN **Grey-patched mining bee** (*Andrena nitida*) - Ian Phillips
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FRONT COVER BOTTOM **Scarce forest tubic** (*Dasycera oliviella*) - Ian Phillips

Foreword

BY FERGUS GARRETT

Christopher Lloyd gardened Great Dixter in dynamic and exuberant style with riotous colour and swashbuckling exotica. But Christo was also an observant and knowledgeable naturalist, acutely aware of the natural world that surrounded him. He appreciated his birds and butterflies, was intrigued by beetles and spiders, and had a deep relationship with the meadows and woodlands that surrounded him.

Christo passed away in 2006, and we have continued to build on the foundations left by him. We have drastically slashed our chemical use to nil, composted more and burnt less, created habitat piles, allowed mown grass verges to grow, and have let hedges billow and embrace the adjoining land. We have become more proactive with dead wood standing when not dangerous to the public, and have expanded the meadows strewing hay from our orchid rich meadows.

This made the place even more charming, and encouraged by the results we expanded our efforts. Then we got interested in biodiversity; and becoming more adventurous we varied cutting regimes in some long grass areas to give a mosaic structure thereby varying the vegetation and the biodiversity. We sunk large chestnuts poles in the ground and drilled holes in them as insect hotels, and put up turf roofs with wide seams of sand in the turf to attract ground dwelling insects. We started butterfly and bumblebee transects and carried out ad hoc moth and bat surveys.

But even so, our efforts seemed fragmented and incomplete. Dabbling in a few things here and there didn't give us a handle on the overall picture – as biodiversity isn't just about a few select species but an integrated world with all parts impacting on the other. No one was considering spiders, beetles, ants, hover-flies, flies, lichens, mosses and liverworts, let alone everything else. We needed a comprehensive study to understand everything on the estate, and then target our management in different and appropriate areas, deciding whether to encourage diversity or target the rarest, or both.

Knowledge was key to us going forward in an effective and intelligent way, along with monitoring to evaluate our management practices.

The Heritage Lottery Fund, the Hartnett Conservation Trust, Elizabeth Coombs and Ian & Megan Richardson through their generosity have made it possible for us to compile this extensive study of the biodiversity at Great Dixter and we are deeply grateful to them.

The results have proved astonishing showing how an intensive flower

garden can support a rich abundance of life as long as care is taken in its management. The process has connected us deeper with the life that surrounds us. The results of this audit will not only encourage us to do more, and to act more sensitively and intelligently as we go forward into the future, it will give us direction, but also provide impetus and inspiration for other similar organisations to be aware of the life that exists within their grounds.

There is hope that gardeners and ecologists work closer together along with politicians, planners, volunteer bodies, architects, builders and landscapers in making our urban and suburban towns, cities and villages places where wildlife can coexist with humans.

I would like to thank everyone involved in making this report possible.

Acknowledgments

We would like to thank Victoria Williams for coordinating such a successful and important project. The enthusiasm and support shown by the Great Dixter gardening team, staff and students has been crucial in the successful undertaking of the project. Their expert knowledge of the estate and it's management has been essential. Also the direction and support from Amanda Ferguson in the formulation and undertaking of the audit is greatly appreciated.

We would like to thank the audit team who carried out all the survey & research necessary to undertake the audit. Most importantly Martin Newcombe for coordinating all the survey work and collating data, and the authors of the technical reports: Lynn & Kevin Cornwell, Barbara & David Martin, Christopher Whittick, Nicola Bannister, Brad Scott, Simon Davey, Philip Sansum, Kate Ryland, Claire Williamson, Dave Rossney and Andy Phillips. Their expertise and knowledge has greatly expanded our understanding of the archaeological, historic and ecological importance of Great Dixter and has been greatly valued.

We would also like to thank all the other ecologists, botanists, arachnologists and entomologists who contributed to the audit in particular Laurie Jackson from Buglife who provided pollinator training and expert advice during the audit process, Mike Edwards who helped with the invertebrate survey and provided expert advice, Tony Russell-Smith from the British Arachnological Society who helped with the invertebrate & pitfall trap survey and has been instrumental in raising awareness of the invertebrates of Great Dixter, Edward Tuddenham who helped with fungi surveys, Norman Heal who helped with beetle identification during the pitfall trap survey, and Jim Winter who helped with moth trapping surveys during the audit. Also thank you to all members of the Sussex Botanical Recording Society, Hastings Botany Group and Hastings Moth Group who helped with surveys during the audit, and the Sussex Biodiversity Record Centre for help with data search and collation.

We would also like to give a special thank you to Ian Phillips for his outstanding photographs of the wildlife of Great Dixter, many of which are included within this report, and his essential support with the invertebrate and bird surveys and throughout the audit process. And a special thank you to Crystal Ray and Julie Weiss for providing some beautiful images for the audit report.

Summary

Great Dixter is a special and unique part of the historic High Weald landscape situated within Northiam, East Sussex, UK. The site is of considerable archaeological and historic importance and a rich biodiversity radiates out from the 15th century Great Dixter House through the famous gardens, meadows and ancient woodland which are skilfully managed by the Great Dixter staff.

The design, management and philosophy behind Great Dixter gardens, made famous by the late Christopher Lloyd, is a masterclass in how to bring biodiversity conservation into modern day horticulture and create a garden nature reserve.

The audit, funded by the Great Dixter Charitable Trust and Heritage Lottery Fund, has documented a diverse ecology present within the estate's gardens, meadows and surrounding ancient woodland and hedgerows. One of the most significant findings of the audit was the presence of an important pollinator community including a high abundance of nationally rare and scarce bees, wasps, hoverflies & moths. The very rare white-bellied mining bee (*Andrena gravida*), which requires an abundance of early spring flowering fruit trees and scrub was found in the Orchard area of the garden. In the surrounding ancient woodland the very rare oak mining bee (*Andrena ferox*) was recorded and a population of the greatly declined long-horned bee (*Eucera longicornis*) was discovered within the garden, meadows and woodland edge.

The richness of the pollinator community within the gardens is maintained by the plentiful space which is made for the nesting and breeding habitat needed by pollinators as well as the diverse late winter-late autumn pollen and nectar sources provided within the gardens and meadows. Great Dixter highlights how gardening and horticulture can play such a crucial role in reversing the loss of pollinators within the UK. Many of the techniques used at Great Dixter to create and maintain pollinator habitat can be replicated in any garden or semi-natural greenspace.

The botanical diversity of the gardens, meadows and woodland also provides habitat for an abundance of moths and butterflies. One of the highlights of the audit was the discovery of the purple emperor (*Apatura iris*) within one of the estate's ancient woodland areas, Weights Wood, as well as a large population of white admiral (*Limenitis camilla*) within the wood.

At night the gardens are just as busy with insect life as during the day with a abundance of moths and other nocturnal insects including a number of

BOTTOM **Common blue** (*Polyommatus icarus*) - Crystal Ray

nationally scarce species such as the scarce forest tubic (*Dasycera oliviella*) and festoon (*Apoda limacodes*).

Bats are also a conspicuous feature of the nocturnal garden with the historic buildings providing roosting space, and the gardens providing feeding habitat, for brown long-eared bat (*Plecotus auritus*), common pipistrelle (*Pipistrellus pipistrellus*) and soprano pipistrelle (*Pipistrellus pygmaeus*). The garden ponds also come alive at night during spring with breeding amphibians including a large population of great crested newt (*Triturus cristatus*) and common toad (*Bufo bufo*).

The great majority of Britain's flower-rich meadows have been lost over the last few decades but Great Dixter is an example of how this decline can be reversed by action to restore this threatened and biologically diverse habitat. The meadow creation expertise at Great Dixter has produced grassland dense with carpets of green-winged orchid (*Anacamptis morio*), common spotted orchid (*Dactylorhiza fuchsii*) and dyer's greenweed (*Genista tinctoria*). Some of this meadow has only recently been created and has been rapidly colonised by the site's invertebrate populations with long-horned bees (*Eucera longicornis*) now recorded foraging throughout the garden's meadows.

An exceptional assemblage of breeding birds was recorded throughout the estate including many declining species of high conservation concern associated with gardens and woodland edge such as swift (*Apus apus*), house sparrow (*Passer domesticus*), starling (*Sturnus vulgaris*), song thrush (*Turdus philomelos*), marsh tit (*Poecile palustris*), cuckoo (*Cuculus canorus*), lesser spotted woodpecker (*Dendrocopos minor*) and nightingale (*Luscinia megarhynchos*).

The experienced and skilled team of archaeologists, historians and ecologists that carried out the biodiversity audit also identified great potential for improvements and enhancements to the archaeological, historical and ecological features within the estate. These include educational and interpretation opportunities, innovative habitat management improving the connections between woodland and meadow wildlife plus a programme of survey and monitoring to continue documenting the estate's biodiversity.

Great Dixter has outstanding potential to be a model for integrating biodiversity conservation into garden design and management and to be a centre for study and research into garden biodiversity.

Introduction 1

TO THE BIODIVERSITY OF GREAT DIXTER

The Great Dixter Estate is situated within Northiam, East Sussex, United Kingdom. It sits within the High Weald Area of Outstanding Natural Beauty close to the border with neighbouring county Kent. At it's core is an internationally important Grade I listed garden which contains the Grade I listed Great Dixter House and the Grade II listed North Barn and Grade II listed Great Barn & oast house. The surrounding estate consists of a mosaic of ancient woodland, species-rich hedgerow, meadow and pasture which was at one time part of a much larger estate.

The estate, farmstead and nationally important Medieval hall house were purchased by Nathaniel Lloyd and Daisy Lloyd in 1910. The original 15th century manor house was creatively restored and extended by Sir Edwin Lutyens between 1910-12. Lutyens also designed and constructed the gardens around the house incorporating many of the original farm buildings. Nathaniel and Daisy Lloyd further developed the gardens integrating meadows, hedging, topiary and orchard fruit trees into the garden's structure. The Lloyd's youngest son Christopher Lloyd continued the horticultural vision of the garden and made the garden famous through many publications on gardening at Great Dixter and a long running Country Life column. His protege and head gardener Fergus Garrett now continues this vision of horticultural excellence within the gardens and is developing the importance of documenting the biodiversity of the gardens and estate and integrating

BOTTOM **Topiary lawn orchids** - Julie Weiss

biodiversity conservation into the heart of horticulture.

Originally a medieval farmstead situated within a medieval landscape the considerable historic interest of the estate is well known and has been further researched and interpreted through a historic landscape survey by Nicola Bannister, archive research by Christopher Whittick and archaeological interpretation of the farm buildings by David and Barbara Martin as part of this biodiversity audit.

Less well known and documented is the ecological interest of the estate. Naturalists, naturalist societies, conservation organisations, ecologists and members of staff have for a number of years been starting to study and document the biodiversity of the estate including the British Arachnological Society, Sussex Botanical Recording Society, Hastings Botany Group, the Bumblebee Conservation Trust, Buglife, Brian Banks, Nikki Gammans, Sarah Seymour, Claire Williamson, Graham Tippen, Catherine Haydock, Tony Harman, Jim Winter, Tony Russell-Smith, Evan Jones, Richard Price, and Greg Hitchcock amongst others. This outstanding work in combination with the support and enthusiasm from the Great Dixter Trustees and the Great Dixter gardeners & students led to the formulation of the current Great Dixter Biodiversity Audit project funded by the Heritage Lottery Fund and the Great Dixter Charitable Trust.

A team of professional naturalists and ecologists including Martin Newcombe, Kate Ryland, Dave Rossney, Philip Sansum, Simon Davey, Claire Williamson, Laurie Jackson and Andy Phillips have compiled data and information on 2000+ species (including 1200+ invertebrates) within Great Dixter Estate.

The most speciose groups recorded are listed below with the total number of species for each group stated.

Total number of species recorded: 2029
Lepidoptera (Moths & butterflies) - 418
Flowering plants - 328
Hymenoptera (Bees, wasps, ants, saw-flies & parasitoid wasps) - 197
Araneae (Spiders) - 189
Coleoptera (Beetles) - 175
Fungi - 128
Lichens - 124
Diptera (Two-winged flies) - 113
Birds - 86
Mosses & liverworts - 84
Hemiptera (True bugs) - 70
Mammals - 19
Odonata (Dragonflies & damselflies) - 17
Ferns & horsetails - 12
Orthoptera (Grasshoppers & bush-crickets) - 11
Molluscs - 10
Other taxa - 48

This is just a start, a snapshot of the current biodiversity present within the estate. Gaps in knowledge still exist especially within the invertebrate fauna of the site, which will require many years of survey and monitoring to fully record. This audit provides an excellent foundation, a legacy that will inspire an ongoing initiative to ensure Great Dixter becomes one of the most well documented gardens for it's biodiversity and will influence other horticulture institutes and bring the worlds of ecology and horticulture together.

The High Weald

The High Weald is a medieval landscape consisting of small settlements connected by sunken route-ways surrounded by small farmsteads with irregular fields of meadow, pasture and arable within a mosaic of enclosed ancient gill woodland and heathland. The word Weald is of Anglo-Saxon origin and means forest and at one time the entire Weald was an area of almost continuous forest. During the Neolithic period human settlement gradually converted the High Weald into a more agricultural landscape and much of the area was deforested, although the High Weald is still one of the most wooded landscapes in Britain.

During the Iron Age through to the post-Medieval the High Weald was used for ironstone mining and timber was used for making charcoal as fuel. The great majority of the Great Dixter Estate lies on the Wadhurst Clay Formation, a sedimentary bedrock of mainly mudstones and siltstones formed during the Cretaceous period. This bedrock is the source of much of the ironstone mined in this area of the High Weald and evidence for ironstone mining and charcoal burning can be found in both Four Acre Shaw and Weights Wood, the two substantial areas of ancient woodland within the estate.

The south-east edge of Weights Wood, and the Horse Pond & Prairie area of Great Dixter lie on the interbedded sandstone and siltstone of the Tunbridge Wells Sand Formation. The quarry adjacent to Horse Pond at the entrance to Great Dixter was dug to extract this sandstone deposit.

There is also an area of exposed Ashdown Sand Formation at the southern end of Four Acre Shaw which extends northwards along the gill stream bed. Evidence for medieval ironstone extraction in the form of bell pits lie just north of this exposure. The erosion by the gill stream most likely exposing this layer of ironstone within the Wadhurst Clay Formation just above the Ashdown Sand Formation allowing extraction of the ironstone.

The underlying Cretaceous sands and clays of the Hastings Beds coupled with deforestation, agriculture and human settlement shaped the medieval landscape of this part of the High Weald. Much of this character is retained around Great Dixter with its small irregular fields surrounded by enclosed ancient gill woodland and hedgerows. Despite the early 20th century restoration of Great Dixter and change of use to a managed garden, and the removal of some field boundaries, the estate still retains much of its character as a medieval farmstead (Bannister, 2018).

Biodiversity & Gardens

The combined amount of land in the UK managed as a garden is estimated to be in excess of 430,000 ha (Davies et al., 2009). Combined with the amount of land managed as urban greenspace this is a substantial area. More importantly gardens and urban greenspace provide close access to nature and biodiversity for the great majority of the UK population.

Private gardens provide a space where garden owners can have a direct positive impact on biodiversity if managed with wildlife in mind. Public gardens and urban greenspace can be important spaces to inspire and educate on the importance of managing for biodiversity.

RIGHT *Hylaeus* and *Apis* on *Eryngium* - Ian Phillips

Gardens and buildings are also important habitats for a number of declining species associated with the built-up environment such as swift (*Apus apus*), starling (*Sturnus vulgaris*), song thrush (*Turdus philomelos*) and house sparrow (*Passer domesticus*). Garden owners can play a very important role in reversing the population declines in many of these species by providing nesting space and a food resource.

Gardens themselves can also be a very speciose, botanically and structurally rich habitat if managed with biodiversity in mind. Most gardens essentially mimic a dynamic woodland edge habitat. They replicate the ecotone and plant succession between meadow through tall herbaceous vegetation to scrub and high canopy. This is a highly energised habitat with a large diversity of plants and animals competing for light, space and resources.

Pollinators such as bees, hoverflies, moths and butterflies continue to decline in the general countryside (Fox et al., 2013; Powney et al., 2019). Gardens can provide important refuges for pollinator communities if managed well.

With the changing climate new species of invertebrate are colonising the UK. Many of these species are succeeding well in gardens and spreading rapidly such as the ivy bee (*Colletes hederae*) and the tree bumblebee (*Bombus hypnorum*). Also species that were once on the edge of their range in south-east England and highly restricted in habitat and habitat resource have expanded greatly in distribution due to climatic changes. Species such as Roesel's bush-cricket (*Metrioptera roeselii*), which was once restricted and nationally scarce is now a common and abundant insect in southern Britain and one of the most widespread and abundant insects within the Great Dixter Estate. Other newly colonising or naturalised species are less desirable such as the box-tree moth (*Cydalima perspectalis*) which can have a devastating effect on box hedges within gardens.

The following report summarises the key findings from the surveys and studies carried out as part of the biodiversity audit and highlights the importance of the house, gardens and estate for it's biodiversity.

Great Dixter is clearly a model for the management of an internationally important garden with the conservation of biodiversity at it's heart.

Great Dixter 2

HOUSE & GARDENS

Great Dixter House is a Grade I listed building which originally was a 15th century timber framed farmhouse restored and extended by Sir Edwin Lutyens for Nathaniel Lloyd in 1910-12. The house sits at the centre of a complex of ancillary farm buildings many of which were originally part of a medieval farmstead. This includes the Grade II listed Great Barn and oast house and later North Barn. There are also a number of other built structures throughout the gardens, most notably the granite dry stone retaining wall below the Lower Terrace built during the construction of the garden and restoration of the house in 1910-12.

The buildings and walls throughout the estate support a surprising diversity of wildlife including a cavity nesting assemblage of breeding birds, roosting populations of bats, important lichen assemblages and large populations of tube nesting bees and wasps. The buildings themselves can be considered important 'living spaces' and an integral part of the complex of habitat resources contributing to the biodiversity of the estate.

Key Features:

Grade I listed house and Grade II listed barns & oast house. Timber framed outbuildings, drystone walls, thatched roof and log piles.

Key Species:

Birds:
Swift (*Apus apus*), **swallow** (*Hirundo rustica*), **house sparrow** (*Passer domesticus*), **starling** (*Sturnus vulgaris*).

Mammals:
Brown long-eared bat (*Plecotus auritus*), **common pipistrelle** (*Pipistrellus pipistrellus*), **soprano pipistrelle** (*Pipistrellus pygmaeus*).

Invertebrates:
Harebell carpenter bee (*Chelostoma campanularum*), **large-headed resin bee** (*Heriades truncorum*), **little dark bee** (*Stelis breviuscula*), **little yellow-face bee** (*Hylaeus pictipes*), **little mason-wasp** (*Microdynerus exilis*).

Cavity Nesting Breeding Birds & Roosting Bats

Many breeding bird species associated with man-made cavity nest sites and buildings are declining nationally. Species such as house sparrow (*Passer*

Large-headed resin bee (*Heriades truncorum*) - Ian Phillips

BOTTOM **Great Dixter House** - Crystal Ray

TOP **Great Barn** - Andy Phillips

BOTTOM **Young swallows and nest under thatch** (*Hirundo rustica*) - Ian Phillips

domesticus), starling (*Sturnus vulgaris*), swift (*Apus apus*) and house martin (*Delichon urbicum*) have all shown declines in population over the last few decades.

The buildings at Great Dixter support good populations of house sparrow, starling, jackdaw (*Corvus monedula*) and swallow (*Hirundo rustica*). The starling population mainly use natural cavity nest sites in the tree line of ash trees leading from the Great Barn to the Nursery as well as cavity nest sites in the Great Barn itself. Starling breeding numbers have declined by 66% since the 1970s and are now a red list species of high conservation concern (Eaton et al., 2015). Starlings benefit greatly from short grazed grassland as they feed primarily on soil dwelling invertebrates such as crane-fly larvae and earthworms. The starling population at Great Dixter feed mainly within the sheep paddock adjacent to the Plant Fair Field but probably also forage in adjacent land.

The jackdaw population within Great Dixter and the surrounding land is doing very well with a roosting flock numbering at least 400 birds. At least 6 pairs breed within the estate most nesting in building cavity nest sites as well as natural tree cavity nest sites around the Lower Moat. Jackdaws are opportunistic omnivores feeding on invertebrates, fallen fruit and seeds, food scraps and carrion. The species benefits greatly from human activity and can be seen foraging in and around the garden, especially within the Orchard and Nursery areas and within the sheep paddock feeding on invertebrates.

The Great Dixter swallows mainly nest under the open roof space within the Great Barn and adjacent thatched roof with at least 6 pairs breeding, which in some years produce two or even three broods during the season. Flocks of adults and fledged young numbering up to 50 birds congregate around the entrance to the Great Barn by the end of July. These numbers are bolstered by migrating swallows and house martins in August and September. Swallows also nest in a small number of the other outbuildings, such as the Hovel and Nursery sheds but the current population is centred around the Great Barn where maintaining the traditional working barn function of the building has clearly benefitted the species.

In 2018 there was some evidence that at least two pairs of swift nested in Great Dixter House above the Terrace. The swift is another species showing long term decline and is on the amber list of species of conservation concern (Eaton et al., 2015). One of the possible reasons for decline is the loss of suitable nest site resource.

Swift and swallow, being insectivorous birds, also need an abundant source of insect prey to feed and raise young. The invertebrate rich gardens, meadows and

ponds are all equally important in creating the ideal environment for these breeding species.

House sparrow is another red list species of high conservation concern that nests within the buildings at Great Dixter. The species nests in and around the front porch of Great Dixter House and within the Exotic Garden shelter shed, the potting shed and the Nursery sales shed, although the population appears to move nest site location between the shelter sheds. The house sparrow population would benefit greatly by the installation of house sparrow nest boxes within the shelter sheds in the Nursery and Exotic Garden area.

The buildings are also important refuges for a small number of species of roosting bat. Brown long-eared bats (*Plecotus auritus*), common pipistrelle (*Pipistrellus pipistrellus*) and soprano pipistrelle (*Pipistrellus pygmaeus*) have all been recorded using buildings as roost sites with Great Dixter, in particular Great Dixter House and the Great Barn. Daubenton's bats (*Myotis daubentonii*) have also been recorded at Great Dixter with most activity around Great Dixter House and Horse Pond.

TOP **Harebell carpenter bee** (*Chelostoma campanularum*) **at nest site** - Ian Phillips

BOTTOM **Harebell carpenter bee** (*Chelostoma campanularum*) - Ian Phillips

RIGHT **North Barn & thatched roof** - Andy Phillips

Tube Nesting Bees and Wasps

The stone & brick walls, roofs and timber framed buildings at Great Dixter provide an abundance of space for tube nesting bees and wasps, all forming part of the important pollinator community present within the gardens.

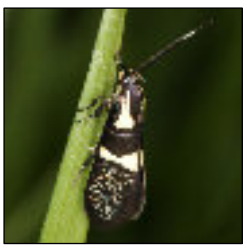
Each species of tube, stem and cavity nesting aculeate (bees, wasps & ants) present at Great Dixter requires specific components for nesting, feeding and hibernation/over-wintering. The connection between human activity, horticulture and pollination cannot be better illustrated than through the stem nesting aculeate assemblage at Great Dixter. Every available space is utilised including old beetle borings in medieval building timbers, holes and cracks in posts and stumps, thatch straws in thatched roofs, eroded mortar between bricks and stones in walls or recently created green roofs on shelters. The buildings and man-made structures at Great Dixter are very important resources for nesting pollinators.

A number of species recorded at Great Dixter are particularly associated with gardens. The harebell carpenter bee (*Chelostoma campanularum)* is found mainly in gardens in southern and central England. At Great Dixter the bee nests in large numbers using old woodworm beetle borings within the timber framed

buildings especially the 18th and 19th century shelter sheds and in thatch straws within the thatched roof adjacent to the Great Barn and North Barn. This is one of the UK's smallest bees and is a specialist on *Campanula* pollen, although at Great Dixter is also regularly seen foraging from *Geranium* species throughout the gardens.

The timber framed buildings and adjacent log piles and wooden posts provide an abundance and diversity of nesting space for a considerable number of tube/stem nesting aculeates and a breeding resource for many dead wood breeding saproxylic (wood and fungi feeding) invertebrates. The Great Barn, North Barn and adjoining thatched roof, dog house, log pile and wooden posts providing one of the best areas of this habitat resource within the estate.

To illustrate how important this habitat resource can be the list below highlights information on the species recorded nesting or breeding in this one small area during the audit surveys. Many of these species are important pollinators and/or predators of garden pests. Many other species of insect and spider were recorded feeding or hunting within this particularly speciose area.



<u>Species found breeding within the North Barn/Great Barn area (pictured above).</u>

Bees, Wasps & Ants (Aculeates):

Ancistrocerus gazella - small-notched mason-wasp - nests in hollow plant stems, thatch, walls and other similar cavities - predator of moth larvae,
Ancistrocerus trifasciatus - three-banded mason-wasp - nests in hollow plant stems, thatch, walls and other similar cavities - predator of moth and leaf beetle larvae,
Anoplius nigerrimus - a spider wasp - predator of wolf spiders and ground spiders,
Bombus lapidarius - large red-tailed bumblebee - nested behind a window in the North Barn,
Chelostoma campanularum - harebell carpenter bee - collects *Campanula* and *Geranium* pollen,
Chrysis angustula - a jewel wasp - cleptoparasite of *Ancistrocerus* & *Symmorphus* mason-wasps,
Chrysis gracillima - a jewel wasp - a nationally rare species and possible cleptoparasite of the little mason-wasp *Microdynerus exilis*,
Chrysura radians - a jewel wasp - nationally scarce parasitoid of the orange-vented mason bee *Osmia leaiana*,
Crossocerus annulipes - a solitary wasp - predator of plant feeding Hemipteran bugs,
Crossocerus distinguendus - a solitary wasp - nationally scarce predator of small flies and aphids,
Crossocerus megacephalus - a solitary wasp - predator of small flies,
Crossocerus ovalis - a solitary wasp - predator of small flies,
Coelioxys elongata - dull-vented sharp-tail bee - cleptoparasite of leaf-cutter bees,
Ectemnius cephalotes - a solitary wasp - predator of medium-sized flies,
Ectemnius cavifrons - a solitary wasp - predator of hoverflies,
Ectemnius continuus - a solitary wasp - predator of medium-sized flies,
Formica fusca - an ant - nests under stones and under bark,
Heriades truncorum - large-headed resin bee - nationally rare although has spread in recent years and is becoming common in gardens in the south-east nesting in bee hotels, thatch, fence posts and brickwork,
Hylaeus communis - common yellow-face bee, - nests in stems, dead wood, soil and walls.

Hylaeus confusus - white-jawed yellow-face bee - nests in stems and timber,
Hylaeus pictipes - little yellow-face bee - a nationally scarce species which is very common at Great Dixter where it nests in thatch and plant stems,
Leptothorax acervorum - slender ant - nests in dead wood, under bark and in fence posts,
Megachile ligniseca - tree-carving leaf-cutter bee- nests in large diameter holes in timber and forms nest cells and end plug with sycamore leaves,
Megachile willughbiella - Willughby's leaf-cutter bee - nests in timber and soil and forms nest cells and end plug with leaves from a variety of trees, scrub and herbaceous plants,
Megachile centuncularis - patchwork leaf-cutter bee - nests in timber and walls and forms nest cells and end plug with leaves and petals.
Mimumesa dahlbomi - a solitary wasp - predator of plant feeding leafhopper bugs,
Osmia leaiana - orange-vented mason bee - nests in walls, dead wood and cliffs and collects Asteraceae pollen,
Pemphredon inornata - a solitary wasp - predator of aphids,
Pemphredon lugubris - a solitary wasp - predator of aphids,
Pemphredon morio - a solitary wasp - a nationally scarce predator of aphids,
Psenulus concolor - a solitary wasp - predator of psyllids,
Psenulus pallipes - a solitary wasp - predator of aphids and the most abundant species nesting in thatch at Great Dixter,
Priocnemis pusilla - a spider wasp - predator of jumping spiders and sac spiders,
Sapyga quinquepunctata - white-spotted *Sapyga* - cleptoparasite of mason bees,
Stelis breviuscula - little dark-bee - nationally rare cleptoparasite of *Heriades truncorum* although has spread with its host and is now becoming frequent in gardens in south-east England,
Trichrysis cyanea - a jewel wasp,
Trypoxylon clavicerum - a solitary wasp - predator of small spiders,
Vespula vulgaris - common wasp - predator of many plant feeding pests and nests provide habitat for a number of inquiline invertebrates such as lesser hornet hoverfly *Volucella inanis* and bee moth *Aphomia sociella.*

Parasitoid Wasps:

Gasteruption jaculator - inquiline predator within nests of solitary bees and wasps,
Odontocolon dentipes - parasitoid of longhorn beetle larvae and pupae,
Perithous scurra - parasitoid of dead wood nesting solitary wasps such as *Pemphredon lugubris,*
Perithous septemcinctorius - parasitoid of stem nesting solitary wasps such as *Psenulus* spp.

Saproxylic Beetles:

Platyrhinus resinosus - cramp-ball fungus weevil - larvae feed within *Daldinia concentrica* growing mainly on dead or dying ash trees,
Platystomos albinus - fungus weevil - larvae feed on the dead and decaying branches of trees,
Clytus arietis - wasp beetle - larvae feed on the dead and decaying branches of trees,
Leiopus nebulosus *agg.* - black-clouded longhorn beetle - larvae feed within the timber of various tree species,
Leptura quadrifasciata - four-banded longhorn beetle - larvae feed within the timber of various tree species,
Phymatodes testaceus - tanbark borer - larvae feed under the bark of various tree species.

Saproxylic Moths:

Crassa unitella - golden-brown tubic - larvae feed on fungus under dead bark,
Dasycera oliviella - scarce forest tubic - a nationally scarce species whose larvae feed on decaying wood,
Esperia sulphurella - sulphur tubic - larvae feed under bark of dead and decaying wood,
Metalampra italica - Italian tubic - a newly colonised species whose larvae feed under bark of dead and decaying wood.

Lichen Rich Walls

The granite wall separating the Orchard and Upper Moat area from the Lower Terrace supports an important assemblage of lichens and is the most lichen rich area within Great Dixter (Davey, 2018). The lichen flora growing on the Guernsey Granite wall is similar to lichen assemblages found on magnesian limestone and may contain species imported with the stone as well as species that have naturally colonised the wall since it was built around 1912. Of particular importance is *Lecanora campestris* ssp. *dolomitica* which is a nationally scarce subspecies and may be a first record for Sussex. Also present is the coastal species *Lecanora gangaleoides* which is only occasionally found inland. The brick walls around the kitchen garden also support a good assemblage of lichens.

The walls present around Great Dixter provide habitat for a rich assemblage of invertebrates most importantly spiders, aculeates (bees, wasps & ants) and lichen feeding moths. Again the Upper Moat wall area being the most important providing records of nationally scarce species including four-banded flower bee (*Anthophora quadrimaculata*), little mason-wasp (*Microdynerus exilis*), the spider wasp *Auplopus carbonarius* and the dark blood bee (*Sphecodes niger*). An impressive assemblage of invertebrates can be found here especially during hot dry weather either on the wall or foraging from the flowers growing in the wall. The most abundant species seen being the common green furrow bee (*Lasioglossum morio*) which is preyed upon by the jumping spiders *Salticus scenicus* and *Sitticus pubescens*. The spiders themselves being preyed upon by the spider wasp *Agenioideus cinctellus* which specialises in hunting immature jumping spiders. Crevices within walls are commonly used by overwintering humming-bird hawk-moths (*Macroglossum stellatarum*) and the species is regularly seen around the Upper Moat and Lower Terrace area nectaring from red valerian (*Centranthus ruber*).

There is also an assemblage of lichen feeding moths present within Great Dixter. Some species such as marbled beauty (*Bryophila domestica*) and marbled green (*Nyctobrya muralis*) feed on lichens growing on walls and rocks whereas other species present such as orange footman (*Eilema sororcula*) and red-necked footman (*Atolmis rubricollis)* feed mainly on lichens growing on tree bark.

LEFT **Pale-footed black-wasp** (*Psenulus pallipes*) - Ian Phillips

TOP **Lower Terrace/Upper Moat wall** - Andy Phillips

BOTTOM **Marbled beauty** (*Bryophila domestica*) **larva** - Andy Phillips

The Formal Gardens

Great Dixter is Grade I listed in the Register of Parks and Gardens of Special Historic Interest in England administered by Historic England. It is an internationally important and world renowned garden. The registered part of the garden is around 2 ha, designed and constructed by Sir Edwin Lutyens in 1910-12. Further additions and alterations were made by Nathaniel Lloyd, such as the construction of the Sunk Garden and pond in 1923. Even though Lutyens was responsible for the structure of the gardens Nathaniel and Daisy Lloyd were mainly responsible for the planting design. Nathaniel Lloyd being responsible for the hedging and topiary and Daisy Lloyd designing the flower gardens and incorporating meadows into the Meadow Garden and Orchard parts of the garden.

It was Nathaniel and Daisy Lloyd's youngest son Christopher Lloyd who made the garden internationally famous through his publications on gardening at Great Dixter and his long running Country Life column. Christopher developed the design philosophy behind the mixed border planting, best exhibited within the Long Border. This planting philosophy has been creatively and skilfully developed by head gardener Fergus Garrett and his gardening team, since the early 1990s to the present day, producing the exceptionally diverse and long lasting pollen and nectar resource currently present within the gardens and garden meadows.

Key Features:

Grade I listed botanically rich garden. Long-lasting diverse pollen and nectar resource. Sunk Garden pond and Horse Pond.

Key Species:

Amphibians:
Great crested newt (*Triturus cristatus*), **smooth newt** (*Lissotriton vulgaris*), **common toad** (*Bufo bufo*), **common frog** (*Rana temporaria*).

Invertebrates:
Four-banded flower bee (*Anthophora quadrimaculata*), **wool carder bee** (*Anthidium manicatum*), **large garden bumblebee** (*Bombus ruderatus*), **humming-bird hawk-moth** (*Macroglossum stellatarum*), **small red-eyed damselfly** (*Erythromma viridulum*).

Emperor dragonfly (*Anax imperator*) - Ian Phillips

BOTTOM **Tulips & forget-me-nots** - Crystal Ray

Pollinators & Floral Resources

Initially designed to create a diversity of botanical colour and form throughout the year the current planting within the gardens provides a rich pollen and nectar resource for the important pollinator community that nests and breeds within the garden and surrounding countryside. Great Dixter has managed to nurture a rich pollinator community during a time when pollinator diversity has declined, and continues to decline, within the general countryside.

The planting philosophy also mimics natural plant succession, but at a much higher tempo, with low growing plants and bulbs being replaced by taller more structural plants later in the year as the season passes. There are a mix of displays, some of which are changed two or three times a year, while more permanent deeply layered displays change naturally through succession during the year. Native species, which are left to self seed throughout the garden, are interspersed with more exotic and ornamental species further complementing the diverse pollen and nectar resource. This is a very high maintenance, and predominately ornamental, garden yet creates an environment highly beneficial to the diverse insect community present. Great Dixter is a 'Garden Nature Reserve', very different to a low maintenance, low intervention wildlife garden or semi-natural greenspace.

The pollen and nectar resource begins in late winter/early spring. Early flowering *Crocus* bulbs within the Meadow Garden and Orchard are a particular favourite with early emerging bumblebee queens. Early flowering *Salix* followed by *Malus*, *Pyrus* and *Prunus* are extremely important foraging resources for bumblebees and mining bees and a key nectar resource for early hoverflies and bee-flies. Exotic fragrant shrubs such as *Osmanthus delavayi* are a favoured resource for bumblebees and the hairy-footed flower bee (*Anthophora plumipes*), which nests in the walls around the gardens. The nectar and pollen resource then builds throughout the year to a resplendent crescendo in mid to late summer best observed throughout the Long Border. The late season colour, for which Great Dixter is well known for, provides an abundant nectar and pollen resource for many late flying insects.

TOP **Barn Garden** - Andy Phillips

BOTTOM **Long Border** - Julie Weiss

Pollination is a complex subject and gardens are ideal places to study and research pollination, and the insect assemblages dependant on floral resources, due to the diverse range of pollination and pollinator strategies exhibited within a garden. Honey bees usually get most of the focus when talking about pollination even though wild pollinators account for the great majority of plant pollination. Wild pollinators such as bumblebees, solitary bees, wasps, hoverflies, butterflies, moths and beetles are all key components of a pollinator community. And it is this diversity of pollinators which is essential.

When the population of a key species declines the population of another competing species will increase to replace it. This is a very important ecological concept called functional redundancy and is why maintaining pollinator diversity is key to the health of botanical, invertebrate and vertebrate communities within most terrestrial ecosystems.

There is a very long and close evolutionary relationship between flowering plants and insects and the floral architecture of insect pollinated flowers is based around attracting and exploiting insects using diverse and surprising strategies. One strategy exhibited by plants within the Asteraceae (composites) and Apiaceae (umbellifers) is to produce large inflorescences made up of many small flowers with a short corolla, easily accessible nectaries and unconcealed reproductive organs. This maximises the number of insect species visiting the flowers therefore increasing the chances of pollination. This is very evident at Great Dixter due to the abundant use of umbellifers throughout the year including native species like *Anthriscus sylvestris* and *Angelica sylvestris* as well as non-native species such as *Ferula communis*, *Anethum graveolens*, *Ammi majus* and *Astrantia major*, a native of central and eastern Europe. This species is a particular favourite of the little yellow-face bee (*Hylaeus pictipes*) at Great Dixter, a nationally scarce species restricted mainly to the extreme south-east England. This is generally a rare species found in a variety of open habitats but is particularly numerous at Great Dixter especially during July foraging from *Astrantia major,* although it is widely polylectic (collects pollen from many different plant families and species).

Yellow-face bees in the genus *Hylaeus* are very different to most other bees as they do not possess pollen collecting hairs, instead they swallow a mix of nectar and pollen and transport the pollen stored in the crop back to their tube nests. *Hylaeus pictipes* nest within thatch and plant stems at Great Dixter. The *Hylaeus pictipes* pictured above shows the bee collecting pollen from the anther of an *Astrantia major* flower with its front legs and mouthparts.

The large-headed resin bee (*Heriades truncorum*), once a very rare insect, is spreading rapidly and doing particularly well in gardens in south-east England. At Great Dixter it is quite common nesting in holes in posts throughout the gardens. The species collects pollen mainly from yellow flowered Asteraceae such as ragwort (*Senecio jacobaea*) and fleabane (*Pulicaria dysenterica*) within the meadows and *Erigeron karvinskianus* growing in the walls

TOP **Little yellow-face bee** (*Hylaeus pictipes*) - Ian Phillips

BOTTOM **Large-headed resin bee** (*Heriades truncorum*) - Ian Phillips

around the garden. *Heriades* is a member of the leaf-cutter family of bees Megachilidae. This family of bees possess pollen collecting hairs under their abdomen rather than on their hind legs. *Heriades* females can be commonly seen doing their pollen collecting 'dance' on yellow composite flowers vibrating their abdomen up and down in a circular motion to collect the easily accessible pollen from flat Asteraceae flower-heads.

Other pollination strategies include plants that exhibit revolver architecture, best shown within the genera *Aquilegia* and *Geranium*. The flower is divided into sections each containing nectaries that produce only a small amount of nectar. This forces the pollinator insect to 'revolve' around the centre of the flower in a circular motion to obtain a full 'portion' of nectar maximising contact with the anthers and stigma.

Other plant families such as Fabaceae (legumes) and Lamiaceae (labiates) restrict access to their nectaries and concealed reproductive organs. This strategy reduces the chance of wasting floral resources. The close evolutionary relationship between bees and flowering plants is exhibited particularly well within these plant families and bees that specialise in exploiting pollen from within these plant families. The architecture of flowers in these plant families favour bees with long tongues enabling access to the nectar and pollen. Unfortunately the loss of legume and labiate rich meadows due to changes in agriculture has caused the decline of many bee species associated with legume and labiate floral resources such as long-horned bees (*Eucera longicornis*) and long-tongued bumblebees such as *Bombus ruderatus* and *Bombus ruderarius*. These three bees are all species of principal importance for the conservation of biodiversity in England and are all present at Great Dixter. *Bombus ruderatus* is associated with large flowered labiates within the gardens and *Bombus ruderarius* and *Eucera longicornis* are mainly found within legume rich areas of the garden meadows. *Eucera longicornis* is oligolectic (specialise on pollen from a restricted range of plants) on Fabaceae.

Some bees, including a number of short-tongued bumblebee species, have developed nectar robbing strategies to exploit concealed floral resources by biting holes in the base of flowers to access the nectaries. This is commonly seen on large flowered labiates growing within the gardens at Great Dixter.

The nationally scarce four-banded flower bee *Anthophora quadrimaculata* is also particularly associated with Lamiaceae and is another species increasing in occurrence within gardens in south-east England where it exploits cultivated labiates. At Great Dixter it is found mainly around *Salvia* flowers, especially along the Long Border. *Salvia* flowers exhibit an unusual lever pollination mechanism which can be observed watching foraging *Anthophora quadrimaculata*.

MIDDLE **Long-horned bee male** (*Eucera longicornis*) - Ian Phillips

Bare Ground, Leaf Litter & Habitat Piles

Great Dixter is a very popular garden and the footfalls of in excess of 50,000 visitors each year can create erosion damage to paths and mown lawn edges. These eroded and disturbed patches of bare ground are an important resource for many ground nesting bees and wasps and provide habitat for ruderal and self-sown species of plant not found in other parts of the garden.

An important community of ground nesting bees and wasps use this resource at Great Dixter including the very rare white-bellied mining bee (*Andrena gravida*) which nests in bare patches of ground amongst sparsely vegetated areas of level ground and within south-facing banks.

This type of micro-habitat resource is greatly ignored despite its importance and erosion and bare ground is commonly repaired. At Great Dixter there are a few nice areas of compacted eroded paths and exposed root plates which provide habitat for an assemblage of ground nesting bees and wasps including *Astata boops*, a large black and red solitary wasp which preys on shield bug nymphs. This wasp is a heat loving species restricted to southern England and is usually found in sandy coastal habitats and heathland. Interestingly, at Great Dixter, this species only nests in the sandier soil atop the Tunbridge Wells Sand Formation bedrock between Horse Pond and the Prairie.

Another type of micro-habitat greatly underestimated for its ecological significance are saprobic habitats, these are habitats containing decaying plant litter. Leaf or plant litter which accumulates under trees, around tree roots, amongst tall vegetation & grass tussocks, under log piles or at the bottom of temporary pools of water are extremely important habitats and support a rich community of detritivores and detritivore predators and parasitoids. Fungi and invertebrates dominate this habitat but the abundance and diversity of invertebrates present provides prey for amphibians such as great crested newt through most of the year, breeding and wintering birds such as song thrush and insectivorous mammals.

At Great Dixter this habitat is certainly not underestimated and the number of spectacular examples of habitat pile provision cannot be missed by any visitor to the garden. These habitat piles, some

TOP ***Astata boops* female with prey** - Andy Phillips

BOTTOM **Habitat pile construction** - Julie Weiss

containing meadow cuttings others containing cut timber and brash are not only functional and of ecological value but are creatively constructed to provide a sculptural feature to the gardens.

The habitat piles consisting of meadow cuttings are used for composting providing a source of fertiliser for the garden. These hay cut piles also retain a considerable amount of seed providing an all year food source for the linnet (*Linaria cannabina*) breeding population present within the gardens. In recent years two of these hay cut piles have provided space for hornet (*Vespa crabro*) and tree bumblebee (*Bombus hypnorum*) nests.

The Nocturnal Garden

The garden is just as busy with wildlife at night as during the day. Long-eared bats and pipistrelles emerge from their day time roosts in the Great Barn and Great Dixter House to hunt. The garden ponds in early spring are packed with breeding great crested newts, smooth newts, common frogs and common toads. But it is the activity of insects that really dominates the nocturnal garden.

Gardens can support an outstanding abundance and diversity of moths and at Great Dixter Lepidoptera (butterflies & moths) is the most speciose group with over 400 species recorded. The larvae of moths are primarily phytophagous with many species restricted to a particular species or family of plant. The higher the botanical diversity within a habitat the greater the diversity of phytophagous species, such as moths, butterflies, beetles and saw-flies and their associated predators and parasitoids. Botanically rich gardens which keep pesticide use to the absolute minimum, such as Great Dixter, can support a high diversity of moths. Adult moths are also important pollinators and this is evident at Great Dixter as plants covered in bees, wasps, flies and beetles during the day will be replaced by moths at night. Some species of plant are adapted to moth and butterfly pollination. The flowers of these species usually have a very long tube like corolla with very long projecting stamens and styles. A number of nationally scarce species of moth have been recorded from Great Dixter including the oak feeding festoon (*Apoda limacodes*) and yellow-legged clearwing (*Synanthedon vespiformis*).

TOP **Poplar hawk-moth** (*Laothoe populi*) - Ian Phillips

BOTTOM **Festoon** (*Apoda limacodes*) - Ian Phillips

Pond Life

Within the gardens there are three main bodies of standing freshwater: Horse Pond, Lower Moat and the Sunk Garden pond. There are also a number of drained or filled in ponds within the gardens including the Upper Moat. Upper Moat was drained in the early 20th century although still contains components of a pond edge or wet meadow habitat. Upper Moat and Lower Moat were once considered to both be part of a moat system protecting the original 15th century farmstead although there is evidence that casts doubt on this interpretation. Even so Lower Moat and Upper Moat are of historic importance and the long period of silt deposition within these bodies is of considerable archaeological importance (Bannister, 2018).

Horse Pond, which is possibly of 18th century origin and originally used for livestock and wildfowl, is now more ornamental in nature with a dense stand of *Gunnera* on one side of the pond and the surface of the pond is dominated by water-lilies. Adjacent to Horse Pond is a small quarry of 19th century origin which was cut for sandstone. The low lying basin of the quarry is marshy and acidic and has components of a wet meadow vegetation.

The small octagonal pond within the Sunk Garden, built by Nathaniel Lloyd in 1923, is a small shallow pond surrounded by York stone paving.

Both Horse Pond and the Sunk Garden pond have considerable interest for amphibians. In early spring 70+ breeding great crested newt (*Triturus cristatus*) use the Sunk Garden pond to breed. Good populations of smooth newt (*Lissotriton vulgaris*), common toad (*Bufo bufo*) and common frog (*Rana temporaria*) are also present as well as small numbers of palmate newt (*Lissotriton helveticus*). The lack of fish and abundance of aquatic invertebrates within the sunk garden pond create an ideal amphibian pond. This pond also supports a population of the stonewort *Chara globularis*.

Seventeen species of dragonfly and damselfly occur within Great Dixter which mainly involves a fauna associated with small bodies of well vegetated standing freshwater. The most interesting species being both red-eyed damselfly (*Erythromma najas*) and small red-eyed damselfly (*Erythromma viridulum*). Both these species require extensive floating vegetation, such as water-lilies, to maintain territory and avoid competition with other species of damselfly which maintain territory amongst emergent water side vegetation. The small red-eyed damselfly is a relatively recent

TOP **Sunk Garden pond** - Andy Phillips

BOTTOM **Common toad** (*Bufo bufo*) - Ian Phillips

colonist to the UK which is now widespread within south-east England.

Three other species of interest occur, golden-ringed dragonfly (*Cordulegaster boltonii*), white-legged damselfly (*Platycnemis pennipes*) and beautiful demoiselle (*Calopteryx virgo*). These three species breed within streams and rivers and are seen mainly within Weights Wood and around Four Acre Shaw possibly breeding within the gill streams running through these woodlands.

A Changing Climate

Over the last two decades there has been quite a significant change in the invertebrate fauna of southern Britain. Many new species are colonising, rare species undergoing rapid expansion in distribution, and common species becoming scarce. This is largely due to climate change, pesticide use and loss of habitat.

A number of these newly colonised or recently spreading species are doing well in gardens and many of these have been recorded at Great Dixter. Two of the most well known recently colonised species that have undergone an extraordinary population and distribution expansion are the ivy bee (*Colletes hederae*) and the tree bumblebee (*Bombus hypnorum*).

The ivy bee is a ground nesting species which emerges in autumn to coincide with the flowering of ivy. The species is benefitting from the increasingly warm dry autumns. Ivy growing in open sunny locations such as in the High Garden and on the ash trees adjacent to the Nursery is favoured by ivy bees foraging for pollen and many other late flying insects for nectar such as hornets.

The tree bumblebee nests in aerial cavities such as holes in trees and is doing well in gardens by exploiting nest boxes put up for cavity nesting breeding birds. At Great Dixter the species has been using holes in habitat piles to nest and is now a common part of the bumblebee assemblage within the gardens.

Two species which have either recently colonised the UK or have been imported and have become naturalised are the box-tree moth (*Cydalima perspectalis*) and the blue mint beetle (*Chrysolina coerulans*). Both these species are considered serious pests. The blue mint beetle was first found at Great Dixter in 2017 and was the first record for Sussex at the time. The box-tree moth was first recorded at Great Dixter in 2018. Currently both these species do not seem to be causing any serious harm within the gardens.

There are also a number of species that were once very rare, scarce or restricted which have undergone rapid distribution expansions in recent years and are now doing well within gardens. One of these species is the large-headed resin bee (*Heriades truncorum*). This species was at one time considered to be restricted to heathland where it required resin from pine trees. The species is also a heat loving species that specialises on collecting pollen from yellow composites. The species is now quite common in gardens in the south-east including Great Dixter where it collects resin from a number of sources, forages from yellow composites throughout the gardens and nests in holes in posts and thatch.

Other species undergoing recent distribution and habitat expansion which have been recorded at Great Dixter include Roesel's bush-cricket (*Metrioptera roeselii*), box bug (*Gonocerus acuteangulatus*), cinnamon bug (*Corizus hyoscyami*) and the false widow spider (*Steatoda nobilis*).

The Garden Meadows

THE ORCHARD, THE PRAIRIE, MEADOW GARDEN & TOPIARY LAWN

The garden meadows within the Orchard, the Prairie, Meadow Garden and Topiary Lawn, are important examples of what can be achieved in an attempt to recreate flower rich meadows in the UK, especially within an urban or suburban setting. Within the last few decades over 90% of flower-rich meadow has been lost in the UK due to changes in agriculture. Gardening and ground maintenance can play a key role in reversing this loss.

Growing flower rich hay meadow under scattered fruit trees is reminiscent of a traditional type of agriculture which is now rarely seen in the High Weald. The Orchard, and on a smaller scale the Meadow Garden, are excellent examples of this habitat and probably originated from small pockets of unimproved meadow that were incorporated into the garden design. This was initiated by Daisy Lloyd at Great Dixter and continued by Christopher Lloyd. The land around Great Dixter has a long history of use for orchards, pasture & meadow, hop growing followed by the sowing of legume rich grassland. A traditional rotation of agricultural management that has shaped the High Weald landscape around Great Dixter (Bannister, 2018).

The meadows at Great Dixter contain many of the species characteristic of flower-rich High Weald meadows such as green-winged orchid (*Anacamptis morio*), dyer's greenweed (*Genista tinctoria*), corky-fruited water drop-wort (*Oenanthe pimpinelloides*) and adder's-tongue fern (*Ophioglossum vulgatum*) (Ryland, 2018). The botanically rich meadow swards and fruit trees provide a foodplant resource for a diverse assemblage of plant eating insects especially moths, butterflies and beetles. This is especially true of dyer's greenweed which

Key Features:

Flower-rich meadow, orchard fruit trees, rich lichen assemblages.

Key Species:

Birds:
Goldfinch (*Carduelis carduelis*),
song thrush (*Turdus philomelos*),
mistle thrush (*Turdus viscivorus*).

Plants:
Green-winged orchid (*Anacamptis morio*),
dyer's greenweed (*Genista tinctoria*),
corky-fruited water-dropwort (*Oenanthe pimpinelloides*),
adder's-tongue fern (*Ophioglossum vulgatum*).

Invertebrates:
White-bellied mining bee (*Andrena gravida*),
long-horned bee (*Eucera longicornis*),
red-shanked carder bee (*Bombus ruderarius*),
small heath (*Coenonympha pamphilus*).

Small heath (*Coenonympha pamphilus*) - Ian Phillips

BOTTOM **Ox-eye daises** - Crystal Ray

supports an important community of insects. The meadows and fruit trees are also part of a very important nectar and pollen resource within the gardens supporting a pollinator community which includes five bee species of principal importance for the conservation of biodiversity in England listed in Section 41 of The Natural Environment and Rural Communities (NERC) Act 2006 .

These meadows also support a dense population of breeding goldfinch (*Carduelis carduelis*) and song thrush (*Turdus philomelos*) and provide feeding habitat for a neighbouring mistle thrush (*Turdus viscivorus*) population. The number of breeding goldfinch at Great Dixter is particularly high due to the availability of fruit tree nest space, especially within the Orchard, and the abundance of Asteraceae seeds present within the meadows from early spring dandelions through to mid and late summer hawkbits, hawkweeds, knapweed and cat's-ears. This is supplemented by seed-heads left to overwinter within the formal gardens.

The Orchard

The Orchard meadow has a number of special features that combine to form a very important part of the garden. The visual and ecological impact of connecting and interlocking the semi-natural High Weald landscape into the garden is key to the philosophy of bringing biodiversity into garden design. Smoothing the boundaries between ancient woodland, orchard, flower-rich meadow, more formal mixed border design and Great Dixter House is most obviously apparent to visitors within the Orchard, Long Border and Upper Moat area of the garden.

The Orchard meadow sward is very rich in orchids, most importantly green-winged orchid which is a declining species of orchid in the UK. This orchid is pollinated by queen bumblebees, as they emerge from hibernation, thorough deception pollination. The orchid does not produce nectar but fools queen bumblebees into visiting the flowers by producing scent to attract the bees. The provision of bumblebee hibernation and breeding habitat is therefore essential in close proximity to meadows containing green-winged orchids and other deception pollinated orchid species such as early purple orchid. A rich resource of early flowering fruit trees and scrub is also necessary nearby for the emerging queen bumblebees. This is something the Orchard meadow provides in abundance.

The Orchard is also home to an important community of ground nesting bees the most important being the white-bellied mining bee (*Andrena gravida)*. This is a very rare bee in the UK with just small populations surviving mainly in Kent and East Sussex. On the continent it is

TOP **Green-winged orchid** (*Anacamptis morio*) - Crystal Ray

BOTTOM **Early bumblebee** queen (*Bombus pratorum*) - Ian Phillips

considered to be an important pollinator of fruit trees although at Great Dixter most records have been of females foraging from dandelions. Dandelions are a very important early nectar and pollen resource for many early spring mining bees. Worn patches of ground created along paths and amongst short grass are used by these ground nesting bees to dig their nests. Many of these mining bees will also spend the winter in these underground nests either in a pupal stage or as hibernating adults.

A diverse assemblage of ground nesting bees within the genera *Andrena*, *Lasioglossum*, *Halictus*, *Melitta* and *Eucera* have been recorded within the Orchard and the other garden meadows. Many of these species are host to cleptoparasitic bee species in the genera *Nomada* and *Sphecodes*. Cleptoparasitic species do not collect pollen but lay their eggs in the nest burrows of their hosts. One of the most common ground nesting bee species at Great Dixter the bull-headed furrow bee (*Lasioglossum zonulum*) is host to the rough-backed blood bee (*Sphecodes scabricollis*). This rare bee, which was discovered at Great Dixter during the audit, has very few records for Sussex.

Another significant find during the audit was a good population of the long-horned bee (*Eucera longicornis*). First found on the edge of Weights Wood in 2016, increasing numbers of females foraging on meadow vetchling (*Lathyrus pratensis*) and bush vetch (*Vicia sepium*) within the garden meadows have been recorded during 2018 and 2019. This species has declined greatly in the UK but still holds a relative stronghold in the High Weald and is probably overlooked as females can be tricky to locate and are easily mistaken for a worn common carder bee (*Bombus pascuorum*). *Eucera* is a solitary bee which nests underground in sparsely vegetated banks or level ground.

Another greatly declined species of meadow foraging bee is the red-shanked carder bee (*Bombus ruderarius*). This species favours meadows rich in legumes and labiates and has been recorded from the Orchard. *Bombus ruderarius* nests on the surface amongst vegetation or underground in abandoned rodent burrows. These nests are small with usually up to 100 workers. Both these bees are species of principal importance for the conservation of biodiversity in England.

But it is not just the rare and scarce bees that are of interest of equal importance is the diversity of more common and widespread species present. Many of these species such as the grey-patched mining bee (*Andrena nitida*) and chocolate mining bee (*Andrena scotica)* commonly nest and forage within gardens. These are large bees that will nest

TOP **Marsham's nomad bee** (*Nomada marshamella*) - Ian Phillips

BOTTOM **Long-horned bee female** (*Eucera longicornis*) - Ian Phillips

in worn patches in lawns and forage from dandelions and early spring flowering scrub and fruit trees and are all important components of a diverse pollinator community.

Butterfly Meadows

The butterflies of Great Dixter are well known thanks to work carried out mainly by Claire Williamson and Graham Tippen. The butterfly fauna of the meadows and grassland at Great Dixter is typical of neutral or slightly acidic grassland within the High Weald. The most common species being grass feeding species such as meadow brown (*Maniola jurtina*), gatekeeper (*Pyronia tithonus*), ringlet (*Aphantopus hyperantus*), small skipper (*Thymelicus sylvestris*) and Essex skipper (*Thymelicus lineola*). Common blue (*Polyommatus icarus*), which feeds mainly on common bird's-foot trefoil (*Lotus corniculatus*), small copper (*Lycaena phlaeas*), which feeds mainly on common sorrel (*Rumex acetosa*), and orange-tip (*Anthocharis cardamines*) & green-veined white (*Pieris napi*) which feed mainly on cuckoo flower (*Cardamine pratensis*) and garlic mustard (*Alliaria petiolata*), are also common species within the garden meadows.

Scarcer members of the meadow butterfly fauna at Great Dixter include marbled white (*Melanargia galathea*), which is currently spreading in distribution, brown argus (*Aricia agestis*) which feeds on *Geranium* species within High Weald meadows, and small heath (*Coenonympha pamphilus*) which is a species of principal importance for conservation in England.

A recently recorded species is green hairstreak (*Callophrys rubi*), which has probably colonised due to the introduction and spread of dyer's greenweed within the garden meadows sward, although *Lotus corniculatus* may also be used as a foodplant. In total 29 species of butterfly have currently been recorded from within the Great Dixter Estate including 23 species within the formal gardens and garden meadows (Williamson, 2018; Phillips, 2017).

The garden meadows also support an interesting assemblage of day flying moths including grass rivulet (*Perizoma albulata*) whose larvae feed in the seeds of yellow rattle (*Rhinanthus minor*), the meadow longhorn (*Cauchas rufimitrella*) which feeds on cuckoo flower, and the nationally scarce translucent pearl (*Paratalanta hyalinalis*) which is commonly disturbed from its foodplant common knapweed (*Centaurea nigra*) during the day.

TOP **Marbled white mating pair** (*Melanargia galathea*) - Ian Phillips

BOTTOM **Green hairstreak** (*Callophrys rubi*) - Ian Phillips

Meadow & Pasture 3

NEW MEADOW, PLANT FAIR FIELD, LOWER PADDOCK & BOTTOM MEADOW

Within the estate but outside of the gardens and garden meadows there are four key areas of meadow and pasture: New Meadow, Plant Fair Field, Lower Paddock and Bottom Meadow. The meadow and pasture around Great Dixter occur predominantly on the Wadhurst Clay bedrock which produces the seasonably wet neutral to slightly acidic loamy and clayey soils which characterise much of the grassland throughout the estate.

New Meadow is the most botanically rich of these areas and the most recent area of flower-rich hay meadow to be created within the estate (Ryland, 2018). The flower rich sward here is very similar to the adjacent area of meadow within the Orchard. New Meadow is bordered by the ancient woodland of Four Acre Shaw on it's western and southern sides and a hedge containing a mature open grown oak on it's eastern side. The native speedwells and forget-me-nots within this meadow are important pollen sources for the nationally scarce girdled mining bee (*Andrena labiata*).

The fields within and around Great Dixter contain many features of archaeological interest providing evidence of past management and past field boundaries including lynchets, ditches and banks. Examples of ridge and furrow have survived in three areas including New Meadow and parts of the Orchard. These two areas were former orchards for at least 100 years creating the ridge and furrow observed. Orchard trees would have been planted along the ridges and the furrow ditches cultivated to keep clear of weeds and also aided in drainage (Bannister, 2018).

Key Features:

Flower-rich meadow, biologically rich grassland/ancient woodland edge, views over High Weald landscape.

Key Species:

Plants:
Green-winged orchid (*Anacamptis morio*), **dyer's greenweed** (*Genista tinctoria*), **corky-fruited water-dropwort** (*Oenanthe pimpinelloides*).

Invertebrates:
Clover blunt-horn bee (*Melitta leporina*), **blunt-horn nomad bee** (*Nomada flavopicta*), **sleepy carpenter bee** *(Chelostoma florisomne),* **girdled mining bee** *(Andrena labiata),* **wood-vase hoverfly** *(Myolepta dubia),* **golden-haired robberfly** *(Choerades marginatus)*.

Girdled mining bee (*Andrena labiata*) - Ian Phillips

BOTTOM **New Meadow** - Andy Phillips

At first glance the Plant Fair Field may not seem remarkable due to the majority of the field being botanically species poor and it may be assumed that the heavy disturbance caused during the spring and autumn plant fairs would negatively affect the ecological value of this field. In fact the complete opposite is true and this field turned out to be one of the most speciose areas within the estate, which is explained later.

The Lower Paddock was used in seed germination trials in association with the Weald Meadows Initiative in 2004 and still retains components from these trials such as dyer's greenweed, corky-fruited water-dropwort and green winged orchid (Ryland, 2018). This field is currently separated from the adjacent Bottom Meadow by a wire fence which could be replaced with a species rich hedge.

The Bottom Meadow is the largest of these areas of sheep pasture but is the most species poor, grass dominated and agriculturally improved. Areas of dense white clover (*Trifolium repens*) provide a pollen resource for the clover blunt-horn bee (*Melitta leporina*) and large populations of grass feeding butterflies, grasshoppers and bush-crickets such as Roesel's bush-cricket (*Metrioptera roeselii*) occur within this field but these habitat resources and the associated invertebrate assemblages are very common and widespread throughout the estate and surrounding countryside. The only significant feature of interest present is the large pile of sandy soil excavated during car park expansion and construction. This is a very important nesting resource for ground nesting solitary bees and wasps and the only nesting site at Great Dixter for a small number of sand nesting wasps including *Oxybelus uniglumis* and *Crabro peltarius*.

This large field, which was once two fields (Four Acre Field & Five Acre Field), is bordered by the ancient woodland of Four Acre Shaw, Calves Lodge Shaw and a species-rich hedgerow and has the greatest potential for improved management and habitat creation.

Biologically Rich Grassland Edge

Vegetation that develops within the transition between two or more habitats is ecologically very valuable. This edge habitat is usually transient in nature, highly dynamic with high levels of interspecific competition. Plant, fungi and animal species are all competing for light, space and resources creating a biologically rich community. The edge or ecotone between woodland, scrub and grassland is especially diverse both biologically and structurally. New Meadow, Plant Fair Field and Bottom Meadow are all adjacent to Four Acre Shaw and contain some very important areas of grassland/woodland edge.

As scrub is a relatively rare component within the estate a mosaic of woodland edge, scrub and cattle or pony grazed grassland could be created within Bottom Meadow. Allowing

TOP **Roesel's bush-cricket** (*Metrioptera roeselii*) - Andy Phillips

the woodland edge of Four Acre Shaw and Calves Lodge Shaw to extend out into the field, leaving the field ungrazed for at least a couple of years and then introducing cattle or pony grazing will produce a structurally and biologically rich edge habitat. The early 19th century boundary separating Bottom Meadow into the original Four Acre and Five Acre fields could be reestablished by planting a species rich hedge north to south as well as planting a hedge along the boundary between Bottom Meadow and the Lower Paddock.

This mosaic of woodland edge, hedgerow, scrub and tall grassland would create ideal habitat for barn owls (*Tyto alba*) and the installation of two new barn owl boxes in the north-east corner of the field should attract breeding barn owls back to the estate.

Posts & Umbels

One of the surprises of the audit surveys was the rich invertebrate assemblage recorded within the Plant Fair Field. This field is mainly used twice a year during the Great Dixter plant fairs in April and October. The majority of the field is relatively botanically poor although there are a number of unique features present within the field.

The northern boundary of the field adjacent to the gardens has a dry bank of species rich unimproved meadow including a number of yellow meadow ant (*Lasius flavus*) nests, flower-rich grassland including patches of corky-fruited water-dropwort and a border of bramble thickets. The population of girdled mining bee (*Andrena labiata*) present at Great Dixter use the lesser stitchwort (*Stellaria graminea*) growing along this bank as a primary pollen resource once speedwells and forget-me-nots have finished flowering elsewhere within New Meadow.

The southern boundary is a humid woodland edge dominated by hogweed (*Heracleum sphondylium*) which produces a dense display of hogweed umbels in mid summer supporting a rich assemblage of pollinators. A large number of solitary wasps including five species of *Ectemnius*, a genus of digger wasp, were recorded nectaring from the hogweed here. A good diversity of hoverflies was also recorded here including all five UK species of *Volucella* and the nationally scarce wood-vase hoverfly (*Myolepta dubia*). There are also a number of bees that specialise on Apiaceae pollen, including the nationally rare carrot mining bee (*Andrena nitidiuscula*), which although wasn't recorded here was found on umbellifers close by in the gardens.

The most unique feature of the field is an array of wooden posts used to support the stalls used during the plant fairs. These provide an

TOP **Plant Fair Field** - Andy Phillips

BOTTOM ***Ectemnius continuus*** - Ian Phillips

exceptional nesting resource for aculeates in combination with the log piles within the field and the natural dead wood resource present within the hedgerow trees bordering Lower Paddock. These wooden posts are used by a small population of the sleepy carpenter bee (*Chelostoma florisomne*) which is host to the nationally scarce cleptoparasite *Monosapyga clavicornis*. The nationally scarce jumping spider *Marpissa muscosa* is also commonly seen hunting on these posts.

The dense white clover patches within Plant Fair Field and the neighbouring Bottom Meadow are an important resource for the clover blunt-horn bee (*Melitta leporina*) and it's nationally scarce cleptoparasite blunt-horn nomad bee (*Nomada flavopicta*).

The bramble thickets around the edge of the field support a population of the welted lesser mason-bee (*Hoplitis claviventris*) which nests in dead pithy stems of bramble. The scrub and hedgerow on the edges of this field are also rich in species and the nationally scarce cribellate spider *Nigma puella* is common on hawthorn (*Crataegus monogyna*) here. The spring flowering scrub within this hedgerow which includes hawthorn, field maple (*Acer campestre*) and blackthorn (*Prunus spinosa*) is also an important spring pollen and nectar resource for mining bees and bumblebees.

Without a doubt one of the most useful micro-habitats to include in any garden or greenspace which will have an almost immediate positive impact on biodiversity is a log pile, especially if placed close to a pollen and nectar resource. Log piles placed in warm sunny situations will be very quickly utilised by dead wood nesting bees and wasps. The bark and dead wood retain a lot of heat during the day and will be used for thermoregulation by many insects, including many species of Diptera (two-winged flies). This in turn attracts many insect predators such as the nationally scarce golden-haired robber-fly (*Choerades marginatus*) whose larvae are predators of dead wood feeding beetles and the adults hunt other flies as well as beetles and ants.

This mosaic of micro-habitats and habitat resources has created an ideal habitat for a rich assemblage of invertebrates. A continuing programme of surveys and monitoring to study the field, including light trapping and malaise trapping, will provide further data on the invertebrate assemblage present here. Efforts are already underway to improve the botanical diversity of parts of the field and to improve the sand bank ground nesting resource in the adjacent Bottom Meadow.

TOP **Golden-haired robberfly** (*Choerades marginatus*) - Ian Phillips

BOTTOM **Plant Fair Field log pile** - Andy Phillips

Ancient Woodland 4

HEDGEROWS & WOOD BANKS

There are two areas or ancient deciduous gill woodland within the Great Dixter Estate: Four Acre Shaw and Weights Wood. Smaller areas of semi-natural woodland also occur within the estate and approximately 1.2 km of species rich hedgerow and wood bank occur around the site. Four Acre Shaw is also adjacent and connected to Calves Lodge Shaw, a small area of ancient woodland outside of the current estate boundary. Ancient woodland, wood banks and species rich hedgerow are of considerable importance both ecologically and for their archaeological and historic importance.

Roughly 25% of the High Weald Area of Outstanding Natural Beauty is wooded and much of this woodland is ancient woodland and is a key component of the High Weald landscape character.

Ancient Woodland Indicators

Four Acre Shaw (4.8 ha) and Weights Wood (12 ha) both contain a good number of ancient woodland indicator species. These are species associated with a long ecological continuity of a predominantly wooded habitat under high canopy and are species that spread and colonise new woodland habitat slowly. Reliable ancient woodland indicator lists have been made for vascular plants, bryophytes and lichens. Within Four Acre Shaw 34 ancient woodland vascular plants have been recorded and 35 recorded within Weights Wood

Key Features:

Ancient coppiced gill woodland, species-rich hedgerow, medieval wood banks, bell pits & veteran hornbeams.

Key Species:

Mammals:
Dormouse (*Muscardinus avellanarius*), **noctule bat** (*Nyctalus noctula*).

Birds:
Marsh tit (*Poecile palustris*), **lesser spotted woodpecker**, (*Dendrocopos minor*), **nightingale** (*Luscinia megarhynchos*).

Plants:
Midland hawthorn (*Crataegus laevigata*), **broad-leaved helleborine** (*Epipactis helleborine*), **violet helleborine** (*Epipactis purpurata*).

Invertebrates:
Purple emperor (*Apatura iris*), **white admiral** (*Limenitis camilla*), **oak mining bee** *(Andrena ferox),* **scarce forest tubic** *(Dasycera oliviella),* **golden-ringed dragonfly** *(Cordulegaster boltonii),* **white-legged damselfly** *(Platycnemis pennipes)*.

White-legged damselfly (*Platycnemis pennipes*) - Ian Phillips

BOTTOM **White admiral** (*Limenitis camilla*) - Ian Phillips

(Sansum, 2018; SBRS, 2018). These are relatively high species counts of ancient woodland vascular plants especially within the smaller Four Acre Shaw. Two ancient woodland indicator lichen species were recorded within Weights Wood, *Thelotrema lepadinum* and *Enterographa crassa*, and *Pyrenula chlorospila* was found within Four Acre Shaw (Davey, 2018).

A significant population of midland hawthorn (*Crataegus laevigata*) was discovered within Four Acre Shaw. This is a shade tolerant ancient woodland specialist and an important historical-ecological feature characteristic of woodland on Wadhurst Clay (Sansum, 2018). The greatest threat to this species is hybridisation with common hawthorn (*Crataegus monogyna*) and woodland management should endeavour to protect this population of midland hawthorn within Four Acre Shaw by avoidance of coppicing or removal of midland hawthorn and possible control of common hawthorn within the woodland and woodland edge.

Historic Importance

The ancient woodland within Great Dixter Estate is of considerable antiquity and contains many features of archaeological and historic importance (Bannister, 2018).

Probably of greatest significance are the groups of bell pits within both Weights Wood and Four Acre Shaw. These are possibly of Tudor origin or even older dating back to the Roman period. These pits were dug to extract ironstone from the Wadhurst Clay. The position of the bell pits within the northern part of Four Acre Shaw indicating erosion from the gill stream had exposed a layer of ironstone just above the Ashdown Sand and this exposure was followed by the ironstone extraction process. Evidence for possible Roman origin of the bell pits comes from the recent identification of a local Classis Britannica Roman iron production site in Northiam.

In addition to the bell pits both Weights Wood and Four Acre Shaw contain a number of other features of archaeological and historic importance including boundary wood banks, lynchets, quarry pits, and old trackways. All providing important evidence of how the woodland around Great Dixter was exploited and managed in the past. Weights Wood also contains a group of saw pits and a charcoal hearth possibly of 16th century origin.

Both Weights Wood and Four Acre Shaw have a significant veteran tree resource mainly consisting of laid, pollarded and coppiced hornbeam and ash along medieval boundary wood banks and as veteran marker trees.

Many of these archaeological and historic features are in good condition and woodland management within Four Acre Shaw and Weights Wood should endeavour to maintain their condition and prevent any damage.

TOP **Four Acre Shaw** -
Julie Weiss

Woodland Invertebrates

Weights Wood is especially rich in woodland invertebrates due to a number of factors. The south-eastern edge of Weights Wood, which has an elevation of 44-49 m, sits on the Tunbridge Wells Sand and is much dryer with sandier soil. The rest of the wood, which sits on Wadhurst Clay, is much wetter and drops steeply down to the gill stream which runs along the western boundary.

The flower-rich edge habitat around the entrance, along the main track and within the recently cut coppice along the south-east edge is particularly good for ground nesting aculeates many of which are associated with open woodland.

There is a great deal of dead wood habitat including a veteran tree resource, standing dead wood and stumps as well as damper saprobic habitat and log piles which have been created within coppiced areas during woodland management. A number of species associated with a long continuity of dead wood habitat occur with Weights Wood including the scarce forest tubic *(Dasycera oliviella)* which can be quite common within Weights Wood flying in the early morning sunshine during June and July. The larvae of this nationally scarce moth, which is associated with good quality mature woodland, feed mainly on dead and decaying oak and hazel. Log piles created from cut and fallen timber taken from Weights Wood has spread this distinctive micro moth to other areas of Great Dixter. All four UK species of the hoverfly genus *Criorhina* have been recorded from Great Dixter. The larvae of these hoverflies feed in the wet decaying heartwood and roots of trees and stumps, this is also true of the larvae of the cranefly *Ctenophora pectinicornis*.

The sallow and aspen scrub which occurs within the damper parts of the wood on Wadhurst Clay is a very important component supporting an interesting invertebrate assemblage most notably being the presence of purple emperor (*Apatura iris*). This impressive butterfly is confined to deciduous woodland in central southern England and even though it is relatively widespread in West Sussex the species is quite rare in this part of East Sussex. Goat sallow (*Salix caprea*) is the most important foodplant for this species while adults spend most of their time in the oak high canopy feeding on aphid honeydew. Males occasionally descending to the woodland floor to feed on salts and minerals from carrion, animal droppings or wet mud. The discovery of this majestic butterfly in Weights Wood was one of the highlights of the audit (Williamson, 2018).

Early spring sallow blossom is also a very important pollen and nectar resource for mining

TOP **Scarce forest tubic** (*Dasycera oliviella*) - Ian Phillips

BOTTOM **Golden-ringed dragonfly** (*Cordulegaster boltonii*) - Ian Phillips

bees especially species such as Clarke's mining bee (*Andrena clarkella*) which specialises in collecting sallow pollen and is restricted to woodland or woodland edge that has an abundance of sallow scrub. The dryer more open parts of Weights Wood contain a great deal of bare ground and flower-rich habitat for many species of ground nesting bees and wasps including *Andrena clarkella* and most importantly the long-horned bee (*Eucera longicornis*). Male long-horned bees are very commonly seen patrolling the edge of Weights Wood from mid May to early June.

Golden-ringed dragonfly (*Cordulegaster boltonii*), white-legged damselfly (*Platycnemis pennipes*) and beautiful demoiselle (*Calopteryx virgo*) are all common and conspicuous insects within Weights Wood and can be seen hunting along rides and around open coppice within the wood. These species are associated with flowing water habitats and possibly breed within the gill streams flowing through Weights Wood or in nearby streams.

Cavity Nesting Woodland Birds

The abundance of standing dead wood on mature trees throughout the gardens, Weights Wood and some parts of Four Acre Shaw provides an excellent nesting resource for many breeding bird species. Large cavity nesters such as jackdaw (*Corvus monedula*), stock dove (*Columba oenas*) and great spotted woodpecker (*Dendrocopos major*) are doing well. Of the small cavity nesting passerines blue tit (*Cyanistes caeruleus*) is particularly abundant and is one of the most successful breeding species within the estate. Specialist cavity nesters are also present such as treecreeper (*Certhia familiaris*), which nests behind loose bark. Of greatest importance though is marsh tit (*Poecile palustris*). This much declined species nests in cavities low down on mature living trees (especially hornbeam and lime) and unlike other cavity nesting species does not use old and abandoned woodpecker nests.

The natural diversity and abundance of standing dead wood within the gardens and woodland therefore supports an excellent assemblage of natural cavity nesters. This also intersects with the importance of dead wood for the assemblage of saproxylic, saprobic and dead wood nesting invertebrates, which provide an important food resource for many of the insectivorous cavity nesting bird species such as great spotted woodpecker, treecreeper, nuthatch (*Sitta europaea*) and marsh tit.

As well as marsh tit a number of other red list species of high conservation concern occur within Weights Wood and Four Acre Shaw including lesser spotted woodpecker (*Dendrocopos minor*), song thrush (*Turdus philomelos*), nightingale (*Luscinia megarhynchos*) and cuckoo (*Cuculus canorus*).

TOP *Ctenophora pectinicornis* - Ian Phillips

Biodiversity Vision 5

Biodiversity Vision for Great Dixter

Great Dixter has considerable potential to be a model for the integration of biodiversity conservation within the heart of horticulture, gardening and grounds maintenance. The gardens themselves already present a masterclass into how this can be done but there is still considerable scope for improvement and continued survey, monitoring and research into the gardens biodiversity and continued development in biodiversity interpretation and education. This has now become one of the Trust's key aims.

The audit identified a suite of management recommendations which are presented here as a biodiversity vision for Great Dixter. A number of estate wide biodiversity objectives are identified, a monitoring and survey plan as well as some more detailed projects.

Estate Wide Biodiversity Objectives

1. Set up a biodiversity strategy for the Trust to keep it at the heart of the Trust's aims. To improve biodiversity and target rare species, and then to educate, inspire and make a difference to gardens and landscape locally, regionally, and nationally.

2. Apply for Local Wildlife Site status to the Sussex Local Wildlife Site Initiative administered through the Sussex Wildlife Trust.

3. Continue to monitor and survey the biodiversity of Great Dixter by following the monitoring and survey plan below and send regular data updates to the Sussex Biodiversity Record Centre.

4. Keep up-to-date with the latest environmental and global biodiversity research especially where it relates to garden management.

5. Maintain a policy of minimal use of pesticides & herbicides within the garden and estate except for exceptional circumstances where invasive or injurious species require immediate chemical control.

6. Ensure invasive or injurious plant or animal species are not introduced into the estate or allowed to escape into the surrounding countryside. Ensure national guidelines on the identification, control and disposal of invasive non-native plants are undertaken via consultation with

Natural England, DEFRA or the Environment Agency.

7. Ensure protected species and breeding birds are not disturbed during any building work, renovations or grounds maintenance and Natural England, DEFRA or the Environment Agency are consulted regarding any possible protected species disturbance.

8. Continue to develop Great Dixter as a centre of education and research for the study of garden biodiversity in partnership with conservation societies, schools and universities.

9. Train and educate own staff to increase awareness and ability to monitor biodiversity on the gardens and estate.

10. Implement biodiversity education into symposium and training programmes.

11. Try and influence biodiversity in urban and suburban areas through gardening but by also using the Dixter Template to create mosaics within these areas. Influence our neighbours and adjacent land owners.

12. Continue to develop the Great Dixter website, Friends newsletter and Journal to publish information on the biodiversity of the gardens.

13. Develop other means of publishing information about the biodiversity of Great Dixter through the publication of a book on the biodiversity of Great Dixter and through the production of booklets on different aspects of Great Dixter biodiversity for visitors to the house and gardens.

Monitoring & Survey Plan

Outlined below is a categorised list of biodiversity surveys and monitoring which should be carried out over the next 5-10 years, some of which are ongoing monitoring schemes. Surveys and monitoring which increase understanding of the importance of garden biodiversity should be prioritised, these are marked with **. Great Dixter has the potential to be an important site for research into garden biodiversity and this can be fulfilled by following and developing this monitoring and survey plan.

Invertebrates

1. Conduct further field surveys building on current studies to gain further understanding of key invertebrate groups and under-recorded areas to continue documenting the rich invertebrate assemblages present at Great Dixter.*

2. Carry out co-ordinated botanical & pollinator monitoring of grassland and meadow, especially within the garden meadows in partnership with organisations such as Plantlife and Buglife to ensure Great Dixter can contribute to national studies on pollination and ensure meadow management continues to maintain a diverse pollinator assemblage.*

3. Continue butterfly and bumblebee transect monitoring to contribute to long-term national monitoring schemes.*

4. Conduct a study into the potential of gardens for supporting aculeate nesting habitat by carrying out trap nest and aculeate nest aggregation monitoring throughout the formal gardens, garden meadows, thatched roof and timber framed buildings. Aculeates are fixed

point foragers and Great Dixter would be an ideal site to study how fixed point foraging pollinators, such as bees and wasps, interact with floral resources within a garden environment.**

5. Carry out a baseline invertebrate survey of any new land acquired and after any major changes in management of land within the estate.

6. Carry out special monitoring of key species identified as national priorities for conservation (e.g. long-horned bees & white admiral) to ensure populations of these species are maintained through targeted management.**

7. Continue regular moth trapping in partnership with the Hastings Moth Group concentrating on parts of the garden that have not been sampled using this method. Conduct a moth morning event each year to educate & inform visitors on the moths of Great Dixter and how gardens can be managed for moth conservation.*

Plants, Lichens & Fungi

1. Conduct further field surveys building on current studies to gain further understanding of vascular plants, bryophytes, lichens and fungi to further document Great Dixter's important plant, lichen and fungi communities in partnership with the Sussex Botanical Recording Society, Plantlife and the British Lichen Society.*

2. Carry out co-ordinated botanical & pollinator monitoring of grassland and meadow, especially within the garden meadows in partnership with organisations such as Plantlife and Buglife to ensure Great Dixter can contribute to national studies on pollination and ensure meadow management continues to maintain a diverse pollinator assemblage.*

3. Carry out a baseline grassland and hedgerow botanical survey of any new land acquired.**

4. Carry out regular botanical surveys and fixed point photography of grassland and meadow after any new management or habitat creation project is undertaken to monitor changes in vegetation due to management.**

Birds

1. Carry out regular breeding bird surveys of the estate, especially the breeding bird assemblage associated with building cavity nest sites and red list species of high conservation concern.*

2. Consider carrying out monitoring of wintering bird and migrant bird populations within the estate.

Amphibians

1. Carry out regular monitoring of the important amphibian populations within the estate especially within Horse Pond and the Sunk Garden pond to ensure pond managamnet continues to maintain ideal amphibian habitat.*

Mammals

1. Carry out regular monitoring of bats by conducting roost surveys and field surveys within the estate.*

Summary of Management Recommendations

Outlined below is a categorised list of management recommendations highlighted within the technical reports produced for the biodiversity audit.

Archaeological features within ponds, fields and woodland.

1. All archaeological features within fields and woodland should be protected from damage or disturbance during any management activity. Features vulnerable to damage such as saw pits, charcoal hearths and boundary wood banks should be avoided during any management activity. Any essential management activity that may cause damage or disturbance should be carried out under an archaeological watching brief.

2. Ponds of historic significance should not be filled in, de-silted, disturbed or enlarged without an archaeological watching brief to record cores of the silts and recover any artefacts discovered.

Bottom Meadow

1. Create mosaic of woodland edge, scrub and tall grassland by allowing woodland edge to extend out into field and scrub patches to establish for at least two years. Monitor changes in vegetation each year.

2. Introduce cattle or pony grazing to maintain scrub/grassland mosaic either through short periods with a large amount of stock or through more extensive light grazing over a longer period.

3. Re-establish boundaries separating Four Acre field, Five Acre field and the Lower Paddock by planting species rich hedge (avoid using common hawthorn due to presence of midland hawthorn within adjacent Four Acre Shaw). Include spring blossoming scrub species such as blackthorn, wild cherry and apple. Consultation with HAARG should be undertaken before any new hedge planting is undertaken.

4. Install two barn owl boxes on pole supports in the north-east corner of Bottom Meadow.

Four Acre Shaw

1. Consider reducing the amount of common hawthorn present within Four Acre Shaw and woodland edge to protect the midland hawthorn population.

2. Avoid coppicing any midland hawthorn if coppicing management is undertaken within Four Acre Shaw and avoid coppicing areas where there is a good population of midland hawthorn as this species is shade tolerant and may lose out to competition with common hawthorn if the canopy of Four Acre Shaw is opened up.

3. Do not remove fallen dead wood or twig jams from gill streams as these are extremely valuable micro-habitats and hold up flowing water creating a diversity of stream bed habitats.

Weights Wood

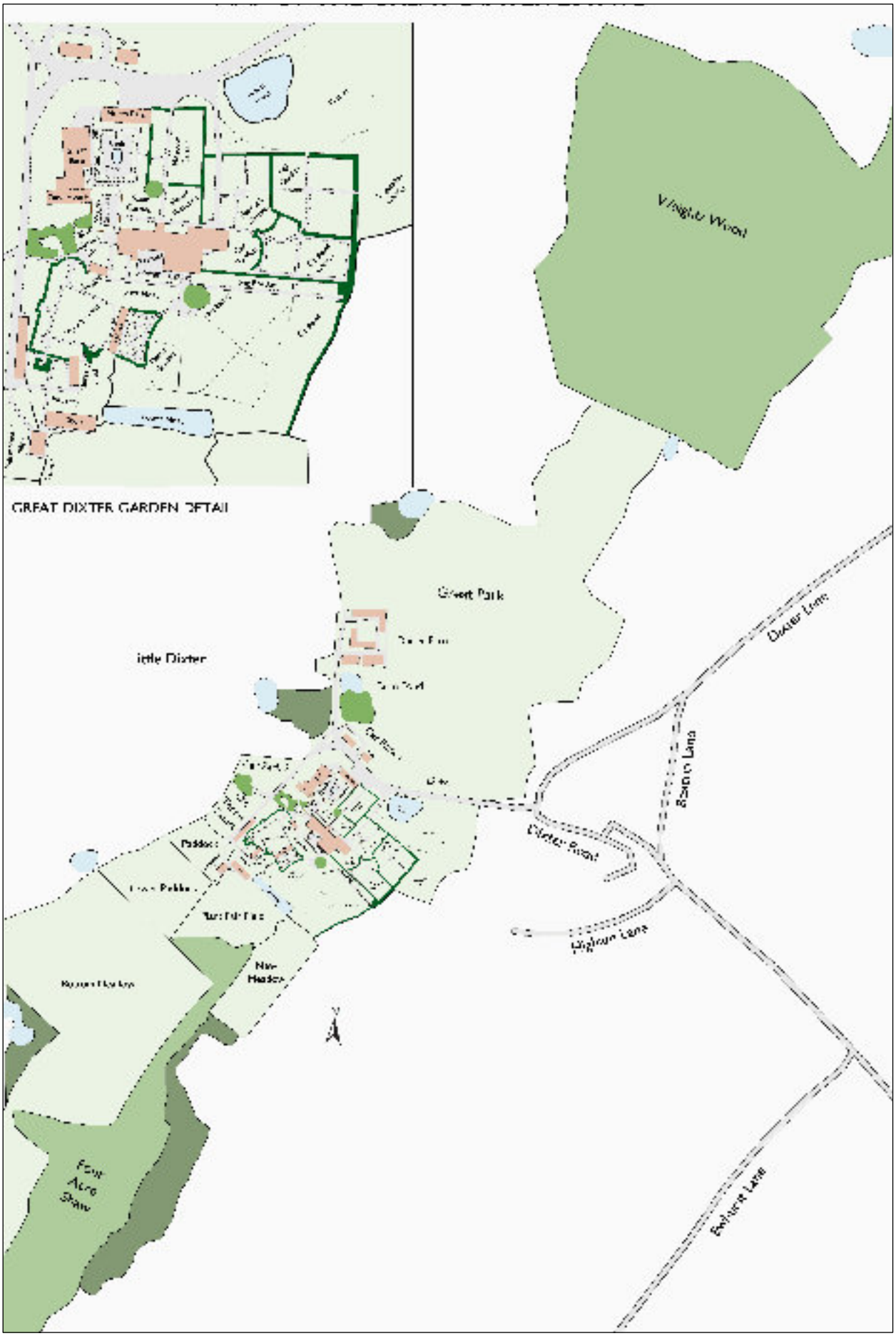
1. Create permanently open glades within the south-east strip of Weights Wood on Tunbridge Wells Sand.

2. Continue to create and maintain a wide open flower rich ride starting from the entrance gate and along the main track through Weights Wood.

3. Undertake management as specified in the woodland management plan.

4. Maintain as much sallow and aspen understorey within the wood where it will not outcompete coppice.

5. Do not remove fallen dead wood or twig jams from gill streams as these are extremely valuable micro-habitats and hold up flowing water creating a diversity of stream bed habitats.


GREAT DIXTER GARDEN DETAIL
Great Park
Little Dixter
Dixter Lane
Dixter Road
Higham Lane
New Meadow
Four Acre Shaw
Bodiam Lane

References

This summary audit report is based on the technical reports and datasets listed below and will be available as digital downloads (except for any confidential reports & data).

Bannister, N.R. (2018) *Great Dixter Estate: Historic Landscape & Archaeological Assessment.*

Cornwell, K. & Cornwell, L. (2019) *Geophysical Surveys at Great Dixter.*

Davey, S. (2018) *The Lichens of Great Dixter.*

Martin, B. & Martin, D. (2018) *A Brief Archaeological Interpretive Survey of Ancillary Farm Buildings, Great Dixter, Northiam, East Sussex.*

Newcombe, M. (2018) *Great Dixter Species Checklist.*

Newcombe, M. (2018) *Mammals at Great Dixter.*

Phillips, A. (2017) *Great Dixter Estate Invertebrate Survey 2017*.

Phillips, A. (2018) *Great Dixter Invertebrate Records Update 2018.*

Phillips, A. (2018) *Great Dixter Estate Breeding Bird Survey 2018.*

Phillips, A. (2019) *Fungi & Lichens - Great Dixter Species Lists.*

Phillips, A. (2019) *Invertebrates - Insects - Great Dixter Species Lists.*

Phillips, A. (2019) *Invertebrates - Other - Great Dixter Species Lists.*

Phillips, A. (2019) *Vertebrates - Great Dixter Species Lists.*

Phillips, A. & Russell-Smith, T. (2019) *Invertebrates - Arachnids - Great Dixter Species Lists.*

Phillips, A. & Ryland, K. (2019) *Plants - Great Dixter Species Lists.*

Ryland, K. (2018) *Vegetation Survey & Assessment of Grassland & Hedgerows at Great Dixter.*

Sansum, P. (2018) *Woodland vascular plant and vegetation data*.

Scott, B. (2018) *Bryophytes of Great Dixter.*

Sussex Biodiversity Record Centre. (2017) *Ecological data search for land at Great Dixter Estate.* [Unpublished confidential report.]

Whittick, C. (2019) *Great Dixter Estate Archive Research from Primary Material.*

Williamson, C. (2018) *Great Dixter Biodiversity Audit 2018 Butterfly Survey.*

Davies, Z.G., Fuller, R.A., Loram, A., Irvine, K.N., Sims, V. & Gaston, K.J. (2009) *A national scale inventory of resource provision for biodiversity within domestic gardens.* Biological Conservation, 142 (4). pp. 761-771. ISSN 0006-3207.

Donald Insall Associates, The Landscape Agency and Julia Holberry Associates. (2007). *Great Dixter House and Gardens, Northiam, Rye. Ecological survey and assessment.*

Eaton, M.A., Aebischer, N.J., Brown, A.F., Hearn, R.D., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A. & Gregory, R.D. (2015) *Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man.* British Birds 108: 708–746. (BoCC4)

Edwards, B. (2008) *Historic Farmsteads & Landscape Character in the High Weald AONB*. The High Weald AONB Joint Advisory Committee.

Else, G. R. & Edwards, M. (2018) *The Bees of the British Isles*. The Ray Society, c/o The Natural History Museum, Cromwell Road, South Kensington, London, SW7 5BD, U.K.

Fox, R., Parsons, M.S., Chapman, J.W., Woiwod, I.P., Warren, M.S. & Brooks, D.R. (2013) *The State of Britain's Larger Moths 2013*. Butterfly Conservation and Rothamsted Research, Wareham, Dorset, UK.

Harman, T. (2011). *Great Dixter Lepidoptera Records to 2011.* [Unpublished document.]

Hinsley, S.A., Carpenter, J.E., Broughton, R.K., Bellamy, P.E., Rothery, P., Amar, A., Hewson, C.M., Gosler, A. (2007). *Habitat selection by Marsh Tits Poecile palustris in the UK*. Ibis. 149. 224 - 233. 10.1111/j.1474-919X.2007.00691.x.

Jones, R. (2009). *Ecological survey to verify the presence of bats and bat roosts.*

Powney, G.D., Carvell, C., Edwards, M., Morris, R.K.A., Roy, H.E., Woodcock, B.A., Isaac, N.J.B. (2019) *Widespread losses of pollinating insects in Britain.* Nature Communications, 2019, Volume 10, Number 1, Page 1

Russell-Smith, T. (2012). *A survey of spiders at Great Dixter, Sussex.*

Russell-Smith, T. (2014). *Spider May 2014 List.* [Unpublished dataset.]

Stubbs, A. & Drake, M. (2001) *British Soldierflies and their allies.*

Sussex Botanical Recording Society (2018). *Weights Wood, Great Dixter Estate.* [Unpublished dataset.]

Woodward, I.D., Massimino, D., Hammond, M.J., Harris, S.J., Leech, D.I., Noble, D.G., Walker, R.H., Barimore, C., Dadam, D., Eglington, S.M., Marchant, J.H., Sullivan, M.J.P., Baillie, S.R. & Robinson, R.A. (2018) *BirdTrends 2018: trends in numbers, breeding success and survival for UK breeding birds.* Research Report 708. BTO, Thetford. www.bto.org/birdtrends

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