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# BEES UNDER SIEGE FROM HABITAT LOSS, CLIMATE CHANGE AND PESTICIDES

A report on the status of bees in the east of England with recommendations for conservation action.

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# FOREWORD

Our planet is under threat like never before. Global wildlife population sizes have plummeted by 60% in less than 50 years, and one in six species is at risk of extinction if we fail to act on climate change. In the UK alone, over 1,000 species are at risk of extinction.

It's a similar picture for nature's unsung heroes: a global review published this year concluded 40% of insect species are at risk of extinction in the next few decades, and a 2019 UN report has warned that biodiversity 'indispensable to food security, sustainable development and the supply of many vital ecosystem services' is in decline, risking 'severe production losses or livelihood disruption'.

Our timely report on the current status of bees in the east of England reminds us the threats to our world aren't abstract or distant. It puts a global problem into a local context, where we're seeing the impacts on wildlife in our own back gardens and our everyday lives – right here, right now.

Make no mistake – bees are essential. They maintain the reproductive success of wild flowers and the yields of crops we eat. Sadly, as this report shows, many pollinator species are struggling. The main pressures faced by bees in the east of England mirror those faced by nature the world over – devastating changes to our climate, the loss and fragmentation of vital habitats, and threats from pesticides and pollution.

Collapses in populations of wild pollinators have big economic impacts. We are already seeing the effects here – for instance, if wild pollinator populations were healthier there would be more apples on British trees (£5.7 million worth of Gala apples alone).

This report does far more than reveal that bees are under siege. Crucially, it shows we can begin to turn the problem around. But there is no easy answer – restoring our bee populations to good health will require many changes, such as reversing fragmentation of wild flower meadows, reducing the effects of chemical pollution, protecting bees from imported diseases, and taking targeted action to bring endangered species back from the brink.

The public understands the threat posed by bee declines: a 2014 poll showed people are concerned about insects disappearing. What we need urgently is for Westminster to act on these concerns. The UK government must make the most of the crucial opportunity to create an ambitious Environment Act that will protect and restore nature.

Initiatives like the B-Lines network, which has already been mapped in the east of England with funding and support from Natural England and Anglian Water, are setting out a vision for a bee-friendly future. The time is right for the UK government to step up its restoration efforts.

It's really encouraging that momentum is building, as witnessed by recent declarations – at Westminster, and in Scotland and Wales – of an environmental and climate emergency. We also need a strong and independent watchdog to hold the government to account, as well as urgent action to tackle the climate crisis.

Together we can win the fight for our world. We can clean up the air that we breathe, revive the health of our seas, and restore our fertile soils and habitats. It's essential that we gain global commitment to act urgently to restore nature. By taking bold action to restore nature at home, the UK can show the global leadership needed to steer the world towards a New Deal for Nature and People in 2020.



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At WWF, we're fighting to restore thriving habitats and species. To do that, we're tackling the root causes behind nature's decline – notably the food system and climate change. And we're inspiring a global movement of people who'll help make sure restoring nature is put at the heart of all the decisions we make in our everyday lives – so it becomes politically, socially and economically unacceptable to degrade our planet's precious natural resources.

April 2019



Buglife is the only organisation in Europe devoted to the conservation of all invertebrates. Our aim is to halt the extinction of invertebrate species and to achieve sustainable populations of invertebrates. We're actively working to save Britain's rarest little animals, everything from bees to beetles, worms to woodlice and jumping spiders to jellyfish.

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## Summary

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The East of England is one of the richest regions for bees in Britain due to the diversity of habitats present. This report aims to consolidate our knowledge of bees in the East of England, highlight the species that are most threatened and recommend conservation actions to rebuild declining populations.

Invertebrates are essential to maintaining functioning ecosystems and the decline of our wild pollinators is of widespread concern.

Almost 90% of wild plants and 75% of leading global crops depend on animal pollination, with the annual contribution of animal pollination to global crop production estimated at 235 - 577 billion US dollars.

Bees face a range of complex and interacting threats, including habitat loss, fragmentation and degradation; climate change and changes to weather patterns; and pesticides and environmental pollution.

### Bee species under threat in the East of England

- 25 species (11%) threatened
- 17 species (7%) regionally extinct
- 31 species (14%) of conservation concern

The East of England Bee Report identifies 25 species that are considered as threatened in the region. This includes species known from only a small number of sites, and species whose current status in the region is unclear.

The report uses data on the distribution of 228 bee species recorded in the region. The East of England has **nationally important populations** of a number of bees including **Moss carder bee (*Bombus muscorum*)**, **Red-shanked carder bee (*B. ruderarius*)**, **Shrill carder bee (*B. sylvarum*)**, **Sea aster colletes (*Colletes halophilus*)** and **Margined colletes (*C. marginatus*)**.

An additional 31 species are identified as being of conservation concern in the East of England. Although not as highly threatened, their future is far from secure.

### Important habitats for bees in the East of England

The coastline provides a variety of habitats, including the **extensive marshes, shingle, sand dunes and soft cliffs** of the coast that support some nationally important bee populations.

The **heathlands** (found in Breckland, Bedfordshire, Norfolk and the Sandlings, Suffolk) support some rare and specialist bees including the Small sandpit mining bee (*Andrena argentata*) and the Bilberry mining bee (*A. lapponica*).

**Wetlands** including the Norfolk Broads and areas of The Fens are important for wetland bees, while chalk grasslands in areas including Bedfordshire and Hertfordshire also support specialist species.

The East of England is notable for its **brownfield habitats**, and throughout the region **quarries, gravel pits, sea walls and post-industrial land** such as the Thames Gateway can have exceptionally important assemblages of bees.

The Bilberry mining bee, Tormentil mining bee (*Andrena tarsata*) and Armed nomad bee (*Nomada armata*) have recent records from only single sites.

Bees in the region are under pressure from many factors including habitat loss, degradation and fragmentation including development: in six years more than half of important brownfield sites in the Thames Gateway were lost, damaged or under immediate threat. Changes in land management including grassland improvement, conversion to arable, timing of cropping and grazing, and increased use of chemicals have led to declines in plant diversity, and the loss of nesting opportunities in the landscape. Trees and scrub threaten open heathland and many mineral extraction sites have been unsympathetically restored.

### **Conservation action is urgently required to ensure no more of the region's threatened bees are lost**

A number of conservation actions could be used to stabilise the threatened bee populations in the East of England, and reverse declines. These would also benefit the wider bee and pollinator community.

- Ensure that coastal management plans protect coastal habitats and promote the management of sea walls for the wildlife they can support.
- Safeguard wildlife-rich brownfield sites, and promote beneficial management
- Identify opportunities to connect disjointed habitat fragments and promote coordinated management between landowners and landholdings that provides a mosaic of habitat, for example via B-Lines.
- Local Authorities can work with and support local communities in urban areas for pollinators to restore and create new habitat and implement changes in management building on the model of projects such as Urban Buzz.
- Ongoing survey and monitoring of bee populations to improve the evidence base relating to our wild pollinators.
- Maintain and increase awareness, advice, support and funding for practical delivery projects through farmer clusters.

### **We need an ambitious Westminster Environment Act that connects habitats along B-lines, to develop a nature recovery network for pollinators**

The B-Lines network has already been mapped in the east of England, with funding and support from Natural England and Anglian Water, and sets out a vision of connected habitats for a bee-friendly future. Now these networks need to be developed and embedded in law. The first Westminster Environment Act in more than 20 years is a crucial opportunity to achieve the changes we need and to deliver on the ambition of the 25 Year Environment Plan:

- An overarching duty on all public bodies to maintain, recover and restore the environment so that it is healthy, resilient and sustainable for the benefit of people and wildlife.
- A full set of thematic and time-bound objectives that the Secretary of State must achieve to comply with the overarching duty.
- A mechanism through which the Secretary of State will set, within a specified timescale, legally binding SMART targets for restoring the environment including for pollination and pollinators. This should be done on the basis of expert advice, and with five-yearly milestones and metrics, for each of the broad objectives listed above.

- A requirement on the Secretary of State to publish and implement adequately resourced plans for achieving the objectives and SMART targets, along with the financing needs for achieving these SMART targets – and to link these needs to corresponding funding streams.
- Duties on national and local government to produce formal nature recovery maps, setting out where a network of restored pollinator habitats will be created.
- A strong and independent watchdog: an Office for Environmental Protection to hold the government to account for delivering improvements.



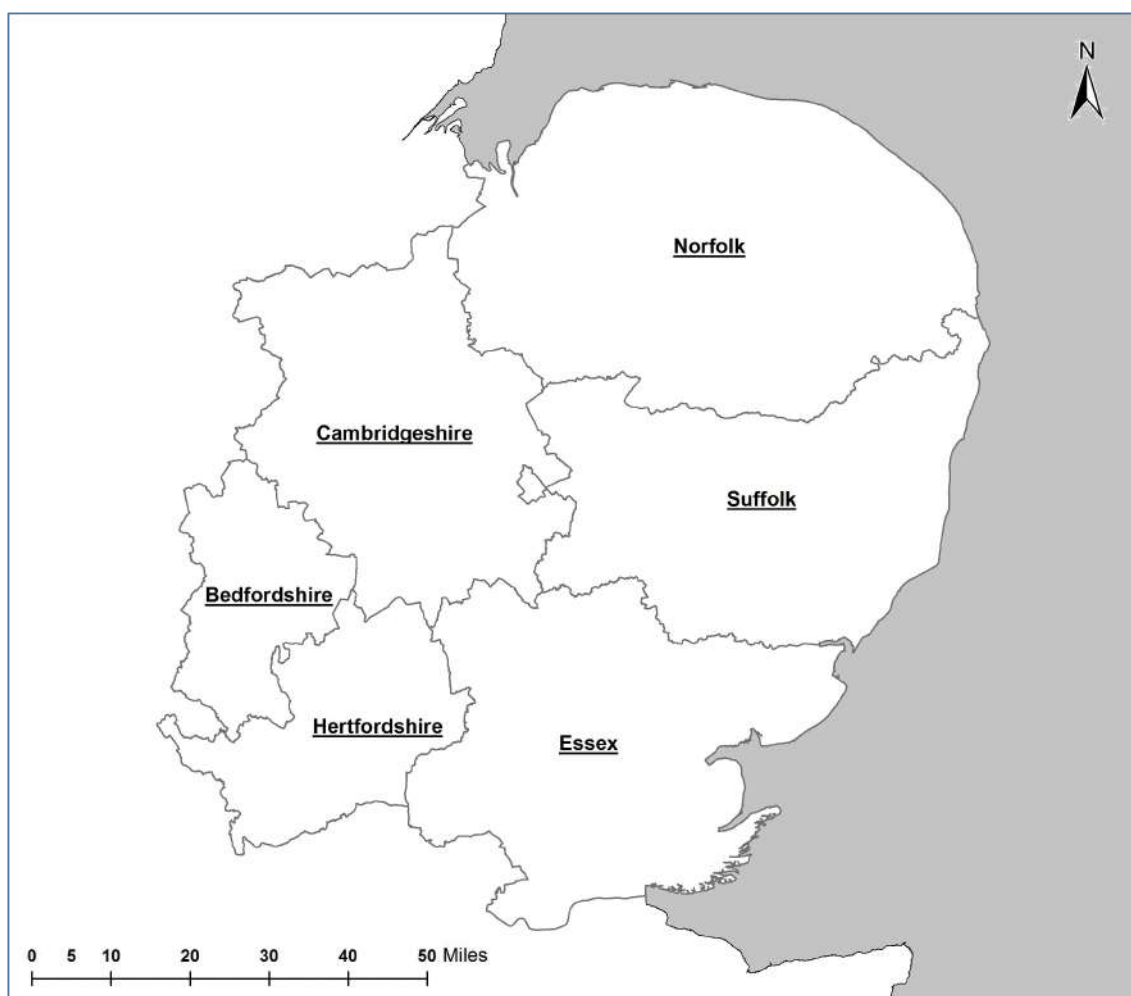
# 1. Introduction

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## Bees in the East of England

This report deals specifically with bees in the East of England, comprising the administrative counties of Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk (figure 1).

Figure 1 - map of the area covered by this report



The East of England is one of the richest regions for bees in Britain and supports many scarce and restricted species, along with some unusual bee assemblages. This is due in part to the distribution of many bee species in Britain, which favour the warmer and drier conditions of southern and eastern England, but it is also a reflection of the diversity of habitats present within the region.

The coastlines of Essex, Norfolk and Suffolk have extensive areas of saltmarsh, brackish marsh and coastal grazing marsh, coastal sand dunes, vegetated shingle, soft rock cliffs, sea walls, and coastal grassland, heathland and woodland. Valuable and complex habitat mosaics are often present that combine several of these habitat types. Many areas of the coast have international significance and there are few other places in Europe where the coastline is so varied. It is in these areas you can find some of the region's special bees, such as the Moss carder bee (*Bombus muscorum*), Shrill carder bee (*Bombus sylvarum*), Sea aster colletes (*Colletes halophilus*) and Margined colletes (*Colletes marginatus*).

Away from the coast, the landscapes of the East of England can often be dominated by intensive agriculture with more limited potential for bees. These areas are not necessarily impoverished, and there are many important areas for bees inland. Breckland, with its sandy-chalk soils that support an intricate mixture of grassy heath and chalk grassland, along with large areas of conifer plantations, flower-rich arable margins and road verges, supports some of the country's finest modern bee assemblages, and some of the best single day lists ever recorded in Britain come from Center Parcs Elveden Forest (Falk 2007). Breckland is the site of an extensive inland sand dune system, and was once characterised by rotational temporary cultivation, which alongside a long history of rabbit and livestock grazing would have helped to maintain open sandy ground, making it highly favourable for many bees. Many of the Breckland heaths have now been lost under conifer plantations, and the decline in livestock, and more recently the loss of rabbits to myxomatosis and rabbit haemorrhagic disease, threatens the open nature of this landscape, which is so important to its bees and many other species.

Further areas of heathland are scattered through the region, including some rare East Anglian examples of wet heathland and mire including Dersingham Bog and Roydon Common in Norfolk, with associated specialist bees such as the Bilberry mining bee (*Andrena lapponica*). In Suffolk, the Sandlings have another important expanse of heathland with a rather different character to Breckland. The proximity to the coast provides a maritime influence and cooler climate, and there are often strong interactions between the heaths and coastal marshes. The Sandlings have important populations of bees, including the Small sandpit mining bee (*Andrena argentata*).

The Norfolk Broads support one of the most extensive wetland systems in Britain and are important for wetland bees such as Reed yellow-face bee (*Hylaeus pectoralis*) and Yellow loosestrife bee (*Macropis europaea*) along with many other aerial-nesting bees. To the west, dominating the area south of The Wash is the huge expanse of The Fens, falling predominantly within Cambridgeshire (and Lincolnshire), but also extending into neighbouring Norfolk and Suffolk. This low-lying, flat landscape is dominated by intensive arable farmland, which often requires extensive regimes of water management using drainage pumps and sluices. The area does still retain some large and important wetland sites such as Woodwalton Fen and the Ouse Washes, along with networks of flowery ditches that favour bumblebees such as the Large Garden Bumblebee (*Bombus ruderatus*).

Chalk grassland and heathland can be found within Bedfordshire and Hertfordshire. Both support sections of the Chilterns, an area of chalk escarpment, Beech woodlands and chalk quarries where bees such as the Red-tailed mason bee (*Osmia bicolor*) and Chalk yellow-face bee (*Hylaeus dilatatus*) can be found. There are few surviving patches of heathland in Hertfordshire, but some good examples still remain in Bedfordshire along the Greensand Ridge, which travels north-east to south-west through the centre of the county. Recent survey work at sites such as the RSPB-managed heathlands in Sandy have found important populations of bees such as the Scarce black mining bee (*Andrena nigrospina*) and its cuckoo, the rare Kirby's nomad bee (*Nomada subcornuta*).

The East of England is particularly notable for its brownfield habitats, and throughout the region, quarries, gravel pits and other post-industrial sites play an important role in supporting interesting assemblages of bees that can often be richer than those in the surrounding countryside. These brownfield sites can be threatened by development and unsympathetic restoration schemes, and recognition of their importance to bees, as well as other invertebrates and wildlife is critical. The brownfields of the Thames Gateway, such as Canvey Wick in Essex, have exceptionally important assemblages of bees with strong populations of many species including the Brown-banded carder bee (*Bombus humilis*), Red-shanked carder bee (*Bombus ruderarius*) and Large garden bumblebee.

Much of the region's farmland is in intensive arable cultivation and bee diversity can be very low in places, however agri-environment funding is helping to improve bee and wild pollinator diversity in many areas, and some surprisingly rich bumblebee and furrow bee assemblages can be found (CEH unpublished data). The coastal farmland of Essex, Norfolk and Suffolk is often protected by engineered sea walls, and those in Essex in particular, support exceptional bumblebee and solitary bee assemblages.

Bees in the East of England are under pressure from a range of factors. Habitat loss, degradation and fragmentation has resulted from pressure for development in the Thames Gateway and around urban areas such as Bedford, Cambridge, Hatfield, Ipswich and Norwich, as well as changes in land management. The changing agricultural system has seen declines in key forage plants including legumes (Fabaceae) and crucifers (Brassicaceae) within the landscape. Coniferisation in Breckland has led to losses of open heathland habitats,

and changing forestry practices such as increased stump removal may be contributing to losses of important nesting and over-wintering sites for some bee species.

This part of Britain has had a significant role in bee recording and taxonomy. Britain's first great bee expert (and undoubtedly one of the world's greatest bee experts at the time) Reverend William Kirby (1759-1850) was based near Ipswich and described many bees new to science. This included over 60 of the bees on the British list, and the type localities for many bees are within Suffolk. Sadly this also includes several bees that have since gone extinct in Britain, including Cullum's bumblebee (*Bombus cullumanus*) and the Shiny-gastered furrow bee (*Lasioglossum laeve*). Other important contributions to our understanding of bees in the East of England have come from J.B. Bridgman of Norwich, the Harwood family of Colchester and V.H. Chambers of Bedfordshire. Their data provides fascinating information on the landscapes and bee assemblages of the 19<sup>th</sup> and early 20<sup>th</sup> Centuries. Whilst many of the species they were familiar with have declined or disappeared, they might be surprised to see the many bees that have arrived, including Tree bumblebee (*Bombus hypnorum*), Large-headed resin bee (*Heriades truncorum*), Spring colletes (*Colletes cunicularius*) and Variable nomad (*Nomada zonata*).

## Key areas for bees in the East of England

Current data suggests that some of the most important areas for bees in the region include:

- Bedfordshire heathlands
- Breckland (Norfolk and Suffolk)
- Essex Marshes
- North Norfolk Coast
- Sandlings coast and heath (Suffolk)
- Thames Gateway (Essex)
- The Broads (Norfolk and Suffolk)
- The Chilterns (Bedfordshire and Hertfordshire)
- The Fens (Cambridgeshire, Norfolk and Suffolk)

Protecting and enhancing bees in these areas will make a substantial contribution to the conservation of bees in the region and the UK.

## Decline in pollinators

Invertebrates are essential to maintaining functioning ecosystems and the decline of our wild pollinators is understandably of widespread concern. An astounding array of species are involved in pollination of plants globally, including bees, flies, beetles, moths, butterflies and wasps, as well as vertebrates such as birds and bats. Bees are widely recognised as one of the most significant groups of pollinators, however the population trends of many bee species are still unknown, including 1,535 (79%) of species across Europe (Nieto *et al.* 2014).

There is extensive compelling evidence of declines in the abundance and diversity of many pollinator groups. A study in Germany found a 76% decline in flying insect biomass on nature protected areas over 27 years (Hallmann *et al.* 2017), whilst an analysis of butterfly data in the Netherlands estimated a decline of 84% over the course of a century (van Strien *et al.* 2019). An analysis of nearly one million records of bee (excluding the Western honeybee (*Apis mellifera*)) and hoverfly observations in Britain and the Netherlands found a 52% decline in bee species richness since 1980 for the 10-km squares analysed in Britain (Biesmeijer *et al.* 2006) with an estimate of trends for 353 hoverfly and bee species revealing that a third have decreased between 1980 and 2014 in Britain, with the data equating to a loss of four bee and seven hoverfly species per 1-km grid square over this period (Powney *et al.* 2019).

In order to effectively prevent further extinctions and begin to restore healthy pollinator communities, we need detailed and accessible data on population trends. The aim of this report is to consolidate our knowledge of bees in the East of England by analysing the available data in order to highlight the species that are most threatened in the region and suggesting opportunities for conservation action to stabilise and rebuild populations of declining species. Although this report focuses on bees, it should be remembered that they are part of a broad and diverse community of wild pollinators, with other pollinating taxa facing the same threats as bees.

## The importance of bees and other pollinators

Bees form part of a functionally important community of animals providing the vital service of pollination, which underpins global ecosystems. Almost 90% of wild plants (308,006 species of angiosperms) depend on animal pollination (Ollerton *et al.* 2011), and it is these plants that are the basis of the habitats that form the ecosystems supporting wider biodiversity and the wide range of essential ecosystem services and functions upon which we rely.

Pollination is also critical to crop production. A review of 115 leading global crops evaluated that 75% are dependent upon animal pollination (Klein *et al.* 2006). The annual contribution of animal pollination to global crop production has been estimated at 235 billion - 577 billion US dollars worldwide (IPBES 2016). Research has demonstrated the improvements to quantity and quality, and as a result marketability of crops. Inadequate pollination is often as a result of too little, or inconsistent access to pollinators, and under-pollination resulting from the unavailability of pollinating insects is partly responsible for yield gaps (Garibaldi *et al.* 2016) with under-pollination already reaching 70% for some commercial species. As well as their financial importance, these crops allow for nutritionally diverse and healthy diets (Chaplin-Kramer *et al.* 2014), as well as providing the raw materials for many processed foods, medicines, fibre, fuels and construction materials. It has been calculated that our current consumption of fruits, vegetables and other crops (such as coffee) could not be sustained if pollinator communities were lost (Gallai *et al.* 2009). The importance of the natural environment to our mental health and well-being is now widely acknowledged, and pollinators form part of this as well as having cultural significance to many societies (IPBES 2016).

Bees are believed to be the most efficient pollinators, as they rely upon pollen and nectar for feeding their offspring. This means they may visit more flowers and spend longer foraging than some other groups of flower visitors. They also display a behaviour known as floral constancy, repeatedly visiting flowers of the same species, and so increasing the likelihood of a successful pollen transfer that leads to pollination.

Populations of managed pollinators such as honeybees can be disproportionately valued and the contribution of wild bees to pollination services is now recognised, having previously been much under-estimated. Positive associations of wild pollinator visits and fruit set were found in a study of 41 global cropping systems, which also clearly showed that managed honeybee populations supplemented but could not substitute wild pollinators (Garibaldi *et al.* 2013). Wild bees are recognised as the most effective pollinators for a range of crops including blackcurrants, raspberries, cherries and tomatoes. A study on Oilseed rape (*Brassica napus*) showed that solitary bees spend longer at flowers, and this behaviour, as well as their gathering of dry pollen gave an increased chance (71.3%) they would transfer pollen from their bodies to the plant than bumblebees (35.1%) or honeybees (34.0%) (Woodcock *et al.* 2013). In places such as the Cotswolds the Ashy mining bee (*Andrena cineraria*), can be the most abundant pollinator of Oilseed rape (S. Falk pers. obs.). Within our bee community there are a range of flight seasons, activity periods, behaviour and physical characteristics such as body size and tongue length, which dictate the flower species visited, and can result in highly specialised plant-pollinator relationships. Species-rich communities, which display functional diversity in terms of their foraging preferences and niche can be linked to enhanced crop yields, irrespective of managed honeybee populations (Hoehn *et al.* 2008).

Even for plants that attract a wide range of pollinators, diversity is important to ensure their propagation in times of climatic and environmental variation. Higher bee diversity has been linked with higher seed set and flower visits, and is believed to be critical to overall ecosystem stability (Hoehn *et al.* 2008; Rogers *et al.* 2014; Papanikolaou *et al.* 2017). Loss of bee diversity can result in loss of plant diversity, and plant species richness in Britain declined significantly when comparing 1950-1969 with 1970-1989 (Carvalho *et al.* 2013). Maintaining healthy communities of wild pollinators is imperative for maintaining pollination and other ecosystem services, as species decline beyond a critical threshold could trigger plant population decline or extinction. This in turn affects the structure and composition of natural plant communities, and the productivity of many agroecosystems that rely on insect pollination.

## Threats to bees

Bees face a range of complex and interacting threats, which have the potential to affect the abundance and diversity of species, and the health of populations.

### 1. Habitat loss, fragmentation and degradation

Habitat loss, fragmentation and degradation is generally thought to be the most important factor driving bee declines through the reduction of food and nesting resources available to pollinators. Greater landscape-scale habitat diversity often results in more diverse pollinator communities (IPBES 2016). In the UK an estimated 97% of unimproved grassland was lost in England and Wales between 1932 and 1984 (Fuller 1987). These losses are as a result of agricultural improvement such as re-seeding, intensive tillage, drainage, and use of fertilisers and herbicides, but also abandonment and loss for development. Species-rich grassland in the UK is now fragmented, often degraded and vulnerable.

The decline in many bumblebee species is largely attributable to the loss of unimproved flower-rich grassland, particularly those species that specialise heavily in gathering pollen from legumes. Bumblebees can have large foraging ranges and require large areas with varied habitats providing long flowering periods to support viable populations. The declines of other species can be linked to loss and deterioration of other semi-natural habitats such as sand dunes, heathlands and soft-rock cliff, along with a decline in flower-rich road verges and arable margins. More recently the loss of large and flowery brownfield sites and infilling of quarries has further contributed to habitat loss. In some counties, such as Bedfordshire, Hertfordshire, Northamptonshire and Warwickshire, these sites often support the best bee assemblages with high numbers of scarce species.

Habitat fragmentation can isolate species, ultimately reducing gene flow and genetic diversity, which can increase vulnerability to other stressors such as disease and internal parasites. Species with specialist requirements or limited dispersal abilities can be particularly vulnerable to habitat loss and degradation, and have experienced greater relative declines (Biesmeijer *et al.* 2006) leading to increasing dominance by a smaller number of generalist species. The disconnection of foraging areas and nesting habitats, and the loss of continuous reliable forage also puts pressure on pollinator communities. Species residing in small, disjointed populations can become increasingly vulnerable to adverse events or fragmentation barriers. The reduction of host populations has reduced capacity to support specialist cleptoparasite species such as the Six-banded nomad bee (*Nomada sexfasciata*), which is now only found in one small area of Devon, and the Square-spotted mourning-bee (*Melecta luctuosa*), now extinct in Britain.

## 2. Pesticides and pollution

Environmental pollution and the increased use of pesticides are important factors influencing bee populations. In recent years there has been considerable debate regarding the effects of one class of pesticides in particular (neonicotinoids) on pollinating insects. Used widely in the developed world, these systemic pesticides spread throughout plant tissues, and can be found in plant pollen and nectar. Neonicotinoids have been demonstrated to have a range of lethal and sublethal effects on bees under controlled conditions, with evidence of negative impacts at field level exposure (IPBES 2016).

Whilst most studies have focused on the effects of neonicotinoid exposure on honeybees, those that have examined wild bees have noted reduced reproductive success in bumblebees and solitary bees, following neonicotinoid exposure. A recent large-scale experiment spanning three European countries including the United Kingdom found that exposure of wild bees (and honeybees) to neonicotinoid pesticides reduces their ability to establish new populations in the year following exposure. In addition to reducing the amount of floral resources for pollinators, pesticide use can also have lethal and sub-lethal effects on pollinators, and may interact with other stressors to contribute to reduced population performance. Neonicotinoids have also been shown to persist in soil (Bonmatin *et al.* 2015), leach into watercourses (Shardlow 2017), and pass up the food chain, with effects seen in birds (Eng *et al.* 2017).

Plant communities can be adversely affected by nitrogen deposition, which increases nutrients in soils and can lead to shifting community composition and loss of floristic diversity, which has been shown to impact butterflies (Wallisdeveries & van Swaay 2013), and may also affect other flower visiting species.

## 3. Climate change

Alterations in insect distributions are already being seen in response to recent anthropogenic climate change (IPBES 2016). Some pollinators that are currently at the edge of their range in Britain may spread north and west, where suitable habitat is available. This could include bees such as Yellow-legged mining-bee (*Andrena flavipes*), Hairy-footed flower-bee (*Anthophora plumipes*), Buff-tailed bumblebee (*Bombus terrestris*), Vestal cuckoo bee

(*Bombus vestalis*), Sharp-collared furrow-bee (*Lasioglossum malachurum*), Painted nomad bee (*Nomada fucata*) and Dark blood bee (*Sphecodes niger*).

Climate change may also facilitate the natural colonisation of new species, as has already been seen in Britain with bees such as Grey-backed mining bee (*Andrena vaga*), Early colletes, Ivy colletes (*Colletes hederæ*) and Variable nomad. Additionally it may enable species to establish that have had assisted introductions, such as aerial nesting bees that are transported into the country in cargo. The Tree bumblebee that was first recorded in Britain in 2001 may well be a demonstration of this. The location of the East of England, both in terms of its warmer climate, and its proximity to mainland Europe make this a prime location for studying invasion ecology. It has been suggested that coastlines can act as leading lines for bee migration (Connop 2007) and those found in Essex, Norfolk and Suffolk may provide ideal opportunities for work to enhance, restore and create habitat to enable species such as the important rare bumblebee colonies of the region to expand.

Whilst climate change has the potential to benefit some species, it also has the potential to decrease abundance, shift ranges and ultimately increase extinction risk, with these effects exacerbated for specialist or range restricted species, and small, isolated populations. As well as the gradual changes to weather patterns, climate change is widely predicted to increase extreme events such as summer droughts, flooding and storms, all of which could directly impact bees in the East of England. European bee richness is generally predicted to decline with the effects of climate change, whilst insect pollination is predicted to become more important for agriculture with increasing frequency and magnitude of heat waves (Bishop *et al.* 2016).

Phenological mismatch is believed to be a key impact of climate change, and there is evidence that pollinators may lose synchronicity with their forage plants. Such phenological shifts would reduce the floral resources available to pollinators, the effect of which would be exacerbated in species with narrow dietary preferences. The curtailment of foraging season is also a major threat from climate change and is likely to be a significant problem for bumblebee species whose queens forage on early and late season plants. Climate change is widely expected to drive species extinct by reducing the amount and accessibility of suitable habitat, affecting inter-species relationships, survival and reproduction. The impact of climate change upon the range, abundance and seasonal activity of some wild pollinator species has already been observed, but much evidence is based upon modelling.

#### **4. Invasive non-native species, disease and pathogens**

There is considerable evidence that the main source of pathogens and parasitic organisms (such as parasitoids and microsporidian fungi) threatening wild pollinators is managed bees (McMahon *et al.* 2015). The number of managed honeybee hives has increased globally over the last five decades (IPBES 2016) and there is much concern regarding the use, and particularly the importation of, managed bees (including honeybees, bumblebees and mason bees), as this may introduce exotic parasites (or parasite strains) that subsequently spill over to wild populations (Fürst *et al.* 2014; McMahon). Pathogens and parasitoids are known to be important mortality factors for wild bees and have been implicated in contributing to losses (Goulson *et al.* 2015). By allowing managed and/or imported bees to mix with wild pollinators, there is the potential for damaging disease emergencies. High-density beekeeping can also result in foraging competition, potentially threatening both wild bees and certain plants (Norfolk *et al.* 2018).

There is growing evidence from around the world that pathogens (and parasitic organisms) can be shared between managed bees and the wider pollinator community (IPBES 2016). A recent review of available data noted a striking association between the use of managed bees and local declines and extinctions of wild bees, suggesting that multiple instances of disease transmission have already occurred between managed and wild bees, including within the UK (Graystock *et al.* 2016).

#### **5. Poor taxonomic knowledge**

New bees are being added to the British list at a rate that has not been seen for over 100 years. Some of this is as a result of natural or human-assisted colonisations, but others result from detailed taxonomic work including the use of DNA-sequencing. This has revealed some apparently rare and vulnerable species that are likely to

require immediate conservation action, such as Scarce black mining bee and its cuckoo Kirby's nomad bee, both of which are found in the East of England.

## Legislation and Policy

### Natural Environment and Rural Communities Act 2006 (as amended)

The Natural Environment and Rural Communities (NERC) Act 2006 (as amended) places a duty on all public authorities in England to have regard to the purpose of conserving biodiversity (Section 40). This 'biodiversity duty' applies across all functions and opportunities for implementing measures to conserve and enhance biodiversity can be found in many areas including development control and forward planning, development and management of infrastructure (including roads, buildings, flood defences), management of the public estate (including nature reserves, public open spaces, road verges, allotments, church yards), and procurement.

Under Section 41 of the NERC Act a list was published that identifies the habitats and species considered of principal importance for the purpose of conserving biodiversity in England. This list of 943 species includes 17 species of bee, 11 of which are covered by this report.

### The National Pollinator Strategy

The National Pollinator Strategy for bees and other pollinators in England was developed between June 2013 and November 2014 (Dicks *et al.* 2015). The purpose of the strategy is to take action to improve the status of wild pollinators, and to improve our understanding of current populations and the causes of their declines (Defra 2014). The strategy aims to deliver across five areas:

- Supporting pollinators on farmland, using agri-environment schemes and voluntary initiatives, as well as minimising the risks associated with pesticide use.
- Supporting pollinators across towns, cities and the countryside, working in partnership with a range of businesses, organisations, landowners, and the public.
- Enhancing the response to pest and disease risks, by improving Honeybee husbandry and management practices, and reviewing evidence of pest and disease risks.
- Raising awareness of what pollinators need to survive and thrive, by improving knowledge flow between scientists and conservation practitioners, to inform evidence-based conservation.
- Improving evidence on the status of pollinators and the service they provide, by developing a long-term monitoring programme.

The National Pollinator Strategy is supported by an implementation plan, which sets out how the actions will be delivered and how the outcomes will be monitored. This is guided by a Pollinator Advisory Steering Group, which is coordinated by Defra.

## Pollinator Initiatives and Schemes

### B-Lines

Buglife's B-Lines initiative uses a UK-wide collaborative approach to tackle the conservation of wild pollinators at a landscape-scale and is an integral component of a strategy to conserve both common and rarer species. B-Lines aims to link and buffer existing wildlife-rich areas, primarily via the restoration of permanent flower-rich habitat, either as 'stepping stones' or continuous strips of habitat. This will improve connectivity between existing habitat, facilitating species movement and dispersal, a process that is essential for maintaining metapopulations and genetic diversity. For some species, more detailed and targeted actions will also be required. In October 2018 the Environment Secretary Michael Gove launched a £60,000 fund for pollinator habitat mapping, which should enable the completion of B-Lines mapping across England.

### Shrill Carder Bee Recovery Project

The Shrill Carder Bee Recovery Project aims to help safeguard the remaining populations of Shrill carder bee in England as part of the Back from the Brink Project funded by the Heritage Lottery Fund (Earwaker 2019). In the East of England, work is focused in the Thames Gateway and aims to:

- Establish the current distribution of the Shril carder bee;
- Engage landowners with habitat restoration and creation to enable Shril carder bee populations to expand;
- Train volunteers to assist with survey and monitoring of Shril carder bee; and
- Produce a Species Recovery Plan for future conservation of Shril carder bee.

### **Urban Buzz Ipswich**

Over just three years Buglife's Urban Buzz project worked with communities to provide a range of pollinator-friendly spaces in 12 urban environments across Britain (Birmingham, Bristol, Cardiff, Falmouth, Ipswich, Leeds, Leicester, Plymouth, St Austell, Truro, Wadebridge and York). Across the project 325 hectares of land was enhanced for pollinators with over 1,300 people receiving training and over 11,500 volunteers getting involved. This included 104 sites in Ipswich, including Christchurch Park, Holywells Park and Landseer Park. The project has made an important contribution to creating corridors for bees and other pollinators and could be replicated more widely in the region's urban areas.

## **Pollinator recording and monitoring**

### **BeeWalk**

BeeWalk is a standardised bumblebee monitoring scheme, managed by the Bumblebee Conservation Trust, which has been active across Britain since 2008. The scheme protocol involves volunteer BeeWalkers walking the same fixed-route transect at least once a month between March and October, inclusive. This covers the flight period of the UK bumblebee species. BeeWalk volunteers record the abundance of each bumblebee species seen in a 4m x 4m x 2m recording area, in order to standardise the survey.

### **Centre for Ecology and Hydrology agri-environment scheme monitoring**

Since 2017, the Centre for Ecology and Hydrology has been undertaking annual monitoring across England as part of its landscape-scale species monitoring of agri-environment schemes. This involves a number of survey methods including bumblebee transects and pan traps for pollinating invertebrates, which together with other data, aim to understand the impact of agri-environment funding. The monitoring programme involves nine 1-km squares within the South Suffolk and North Essex Natural Character Area.

### **County-based recording schemes**

Bedfordshire and Luton Biodiversity Recording and Monitoring Centre  
 Cambridgeshire and Peterborough Environmental Records Centre  
 Essex Field Club  
 Essex Wildlife Trust Biological Records Centre  
 Hertfordshire Environmental Records Centre  
 Norfolk Biodiversity Information Service  
 Suffolk Biodiversity Information Service

### **UK Pollinator Monitoring Scheme (PoMS)**

A UK-wide pollinator monitoring scheme was set up in 2017, administered by the Centre for Ecology and Hydrology. It aims to gather evidence about pollinator communities to support conservation research. The scheme consists of two surveys:

- Flower-insect timed (FIT) counts are designed to engage a wider range of volunteers in collecting data about the abundance and variety of flower-visitors to a range of target plant species.
- Monitoring sites have been set up in 75 randomly allocated 1-km squares across Britain, for more detailed survey work using water-filled pan traps.



## 2. Methods

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### Aim

The aim of this report is to consolidate our knowledge of bees in this region and, in particular, to analyse the available data on their population trends in order to highlight the species that are most threatened.

### Species data

Data on bees in the region were gathered from a range of sources, including Bedfordshire and Luton Biodiversity and Monitoring Centre, Bees, Wasps and Ants Recording Society (BWARS), Cambridgeshire and Peterborough Environmental Records Centre, Essex Field Club, Hertfordshire Environmental Records Centre, Norfolk Biodiversity Information Service and Suffolk Biodiversity Information Service. It is possible that some data gathered from local biodiversity record centres could contain unverified and erroneous data. Records were also provided directly by individual recorders.

An analysis was undertaken of the number of tetrads for each of the 228 bee species recorded in the region. This identified the number of tetrads in which each species had been recorded, as well as the change in distribution between the pre- and post-1990 period. The results of the analysis were used to identify:

- Threatened bees - recorded in one to ten tetrads post-1990
- Bees of conservation concern - recorded in 11-20 tetrads post-1990
- Lost species - species not recorded in the region since 1970 or before<sup>1</sup>

Other factors, including the degree of specialisation (such as habitat or foraging restrictions), national changes in abundance and distribution, and national significance of the region's colonies were considered with advice from national and local experts to formulate the lists presented in this report.

A full list of the bee species recorded in the region is presented in Appendix 1, with the rationale behind the species identified in this report provided in Appendix 2.

### Notes on the text

The analysis and species accounts have drawn on expert knowledge and a number of published sources including BWARS species accounts and the Field Guide to the Bees of Great Britain and Ireland (Falk 2015).

Population status is dynamic and this report attempts to provide a picture of our current understanding of species' status based on available data and expert opinion. It should be noted that a national status review of Hymenoptera is currently underway, which may change some of the status information provided in this report, however this was not available at the time of writing.

When considering species extinction, it should be noted that the year a species was last recorded does not inherently equate to the point it became extinct, and species identified as regionally extinct are done so on the basis of records and opinion of national and local recorders.

### Status assessments

The report makes reference to a number of status assessments, including the European Red List of bees, the national Red Data Book (Falk 1991) and the Section 41 list. An explanation of these assessments is provided below.

#### European Red List of Bees

The European Red List of Bees is a review of the status of all bee species native or naturalised to Europe, using the IUCN Red List Criteria (Nieto *et al.* 2014). A number of the bees found within the East of England are assigned

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<sup>1</sup> The Great yellow bumblebee (*Bombus distinguendus*) and Small flecked mining bee (*Andrena coitana*) have post-1970 records however they are considered to be extinct in the region.

a threat level as part of this assessment. It should be noted that there was insufficient scientific information for 1,101 (56.7%) of bees to evaluate their extinction risk and these are classed as Data Deficient.

Table 1 - summary of the European Red List of Bees status for the bees recorded in the East of England (Niето et al. 2014).

Status	Species
Critically endangered	Pale-tailed mining bee ( <i>Andrena tridentata</i> ) Cullum's bumblebee ( <i>Bombus cullumanus</i> )
Endangered	Shiny-gastered furrow bee ( <i>Lasioglossum laeve</i> )
Vulnerable	Great yellow bumblebee ( <i>Bombus distinguendus</i> ) Moss carder bee ( <i>Bombus muscorum</i> ) Hairy-saddled colletes ( <i>Colletes fodiens</i> )
Near threatened	Large scabious mining bee ( <i>Andrena hattorfiana</i> ) Small gorse mining bee ( <i>Andrena ovatula</i> ) Sea-aster colletes ( <i>Colletes halophilus</i> ) Heather colletes ( <i>Colletes succinctus</i> ) Shiny dufourea ( <i>Dufourea minuta</i> ) Red-thighed epeolus ( <i>Epeolus cruciger</i> ) Short-horned furrow bee ( <i>Lasioglossum brevicorne</i> ) Red-backed furrow bee ( <i>Lasioglossum laevigatum</i> ) Grey-tailed furrow bee ( <i>Lasioglossum prasinum</i> ) Four-spotted furrow bee ( <i>Lasioglossum quadrinotatum</i> ) Ashy furrow bee ( <i>Lasioglossum sexnotatum</i> ) Orange-footed furrow bee ( <i>Lasioglossum xanthopus</i> ) Red bartsia bee ( <i>Melitta tricincta</i> ) Armed nomad bee ( <i>Nomada armata</i> ) Bear-clawed nomad bee ( <i>Nomada baccata</i> ) Flat-ridged nomad bee ( <i>Nomada obtusifrons</i> ) Tormentil nomad bee ( <i>Nomada roberjeotiana</i> ) Furry-bellied blood bee ( <i>Sphecodes hyalinatus</i> ) Red-tailed blood bee ( <i>Sphecodes rubicundus</i> ) Spined blood bee ( <i>Sphecodes spinulosus</i> )
Least concern	153 species
Data deficient	49 species

## Red Data Book (RDB) National Status Definitions

The Red Data Books constitute national status reviews of species in the UK and assigns them a conservation status according to internationally-approved IUCN Red Data Book criteria and categories. These categories are explained below. The rarity categories for our more threatened invertebrates and other wildlife are being replaced by new IUCN assessments. However, status reviews for aculeates are not yet available and the review of the scarce and threatened bees, wasps and ants of Great Britain (Falk 1991) is the most current assessment for bees in Britain.

### RDB 1 - Endangered

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Criteria:

- Species which are known, or believed to occur, as only a single population within one post-1970 10km square of the National Grid.
- Species which occur in habitats known to be especially vulnerable.
- Species that have shown a rapid and continuous decline over the last twenty years and are now estimated to exist in five or fewer post-1970 10km squares.
- Species which are believed extinct but which if rediscovered would need protection. Such species are denoted RDB1+.

### RDB2 - Vulnerable

Taxa which are believed to move into the Endangered category in the near future if the causal factors continue operating. Criteria:

- Species declining throughout their range.
- Species in vulnerable habitats.
- Species whose populations are low.

### RDB3 - Rare

Taxa with small populations that are not at present Endangered or Vulnerable, but are at risk. Criteria:

- Species which are estimated to exist in only fifteen or fewer post-1970 10km squares.

### Nationally Scarce

Nationally Scarce (also known as Nationally Notable) species are estimated to occur within the range of sixteen to one hundred post-1970 10km squares. This category has been subdivided into two categories:

- Na - those species estimated to occur within the range of sixteen to thirty modern 10km squares.
- Nb - those species estimated to occur within the range of thirty one to one hundred modern 10km squares.

### RDB Appendix - Extinct

Species which were formerly native but haven't been recorded since 1900.

### Species of Principal Importance for the Purpose of Conserving Biodiversity

Section 41 of the NERC Act 2006 (as amended) required the Secretary of State to publish a list of the habitats and species of principal importance for the conservation of biodiversity in England, often referred to as Section 41 species. The list was drawn up in consultation with Natural England and includes 56 habitats and 943 species. There are a number of bees on the list, detailed below.

Table 2 - bees on the NERC Act Section 41 and their status in the East of England

Species	Status in the East of England	Included in this report
Oak Mining Bee ( <i>Andrena ferox</i> )	Not recorded	No
Tormentil mining bee ( <i>Andrena tarsata</i> )	Present	Yes - threatened list
Potter flower bee ( <i>Anthophora retusa</i> )	Considered lost	Yes - lost list
Brown-banded carder bee ( <i>Bombus humilis</i> )	Present	Yes - threatened list
Moss carder bee ( <i>Bombus muscorum</i> )	Present	Yes - threatened list
Red-shanked carder bee ( <i>Bombus ruderarius</i> )	Present	Yes - threatened list
Large garden bumblebee ( <i>Bombus ruderatus</i> )	Present	No
Short-haired bumblebee ( <i>Bombus subterraneus</i> )	Considered lost	Yes - lost list
Shrill carder bee ( <i>Bombus sylvarum</i> )	Present	Yes - threatened list
Northern colletes ( <i>Colletes floralis</i> )	Not recorded	No
Sea-aster colletes ( <i>Colletes halophilus</i> )	Present	Yes - threatened list
Long-horned bee ( <i>Eucera longicornis</i> )	Present	Yes - threatened list
Cliff furrow-bee ( <i>Lasioglossum angusticeps</i> )	Not recorded	No
Armed nomad bee ( <i>Nomada armata</i> )	Present	Yes - threatened list
Purbeck nomad ( <i>Nomada errans</i> )	Not recorded	No
Cliff mason bee ( <i>Osmia xanthomelana</i> )	Considered lost	Yes - lost list

### 3. Threatened bees in the East of England

This report identifies 25 species that are considered as threatened in the East of England, 17 species thought to be regionally extinct (Section 4), and 31 additional species that are believed to be of conservation concern (Section 5).

A summary of the threatened bees is provided below, followed by a detailed account for each species that includes information on:

- **Distribution** - a current distribution map and a review of the apparent distribution trend;
- **Status** - the current national status and an assessment of status in the East of England;
- **Ecology** - information on the habitat associations, nesting and foraging requirements, and flight season as currently understood;
- **Threats** - historic and contemporary factors attributed to any decline seen and threats it faces;
- **Habitat management** - recommended land management;
- **Future prospects** - an assessment of likely changes in distribution and status under current and predicted future conditions;
- **Further information** - links to further sources of information are provided where these are available; and
- **Conservation action** - suggested opportunities to implement positive conservation actions.

Table 3 - summary of the threatened bee species covered by this report, detailing the counties of the East of England in which they occur, the counties from which they have been lost (not recorded post 1990), and their current conservation status (Falk 1991).

Species	Occurrence in East of England	Losses in East of England	National Status
Groove-faced mining bee ( <i>Andrena angustior</i> )	Essex; Hertfordshire, Norfolk; Suffolk		None
Small sandpit mining bee ( <i>Andrena argentata</i> )	Bedfordshire, Norfolk, Suffolk		Na
Bilberry mining bee ( <i>Andrena lapponica</i> )	Norfolk	Bedfordshire	None
Scarce black mining bee ( <i>Andrena nigrospina</i> )	Bedfordshire, Essex, Norfolk, Suffolk		None
Long-fringed mini-miner ( <i>Andrena niveata</i> )	Essex	Bedfordshire, Suffolk	RDB2
Red-backed mining bee ( <i>Andrena similis</i> )	Suffolk	Bedfordshire, Essex	Nb
Tormentil mining bee ( <i>Andrena tarsata</i> )	Norfolk	Bedfordshire, Suffolk	Section 41 <sup>1</sup>
Brown-banded carder bee ( <i>Bombus humilis</i> )	Essex, Suffolk	Bedfordshire, Cambridgeshire, Norfolk	Section 41 <sup>1</sup>
Moss carder bee ( <i>Bombus muscorum</i> )	Essex, Norfolk, Suffolk	Cambridgeshire	Vulnerable <sup>2</sup> ; Section 41 <sup>1</sup>
Red-shanked carder bee ( <i>Bombus ruderarius</i> )	Cambridgeshire, Essex, Norfolk, Suffolk	Bedfordshire, Hertfordshire	Section 41 <sup>1</sup>
Shrill carder bee ( <i>Bombus sylvarum</i> )	Essex, Norfolk	Bedfordshire, Cambridgeshire, Suffolk	Nb; Section 41 <sup>1</sup>
Grooved sharp-tail bee ( <i>Coelioxys quadridentata</i> )	Cambridgeshire	Bedfordshire, Essex, Suffolk	RDB3
Sea aster colletes ( <i>Colletes halophilus</i> )	Essex, Norfolk, Suffolk		NT <sup>2</sup> , Na; Section 41 <sup>1</sup>
Margined colletes ( <i>Colletes marginatus</i> )	Essex, Norfolk, Suffolk		Na
Long-horned bee ( <i>Eucera longicornis</i> )	Essex, Norfolk	Suffolk	Na; Section 41 <sup>1</sup>
Southern bronze furrow bee ( <i>Halictus confusus</i> )	Cambridgeshire, Norfolk, Suffolk	Essex	RDB3

<sup>1</sup> Natural Environment and Rural Communities Act 2006 (as amended) - species of principal importance for the conservation of biodiversity in England

<sup>2</sup> Nieto *et al.* (2014) European Red List of Bees

Shingle yellow-face bee ( <i>Hylaeus annularis</i> )	Suffolk		
Tufted furrow bee ( <i>Lasioglossum nitidiusculum</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		None
Black-headed leafcutter bee ( <i>Megachile circumcincta</i> )	Essex, Norfolk, Suffolk	Bedfordshire,	None
Gold-tailed melitta ( <i>Melitta haemorrhoidalis</i> )	Bedfordshire, Essex, Hertfordshire, Norfolk, Suffolk		None
Silver-sided nomad bee ( <i>Nomada argentata</i> )	Norfolk, Suffolk	Bedfordshire, Cambridgeshire, Essex	RDB3
Armed nomad bee ( <i>Nomada armata</i> )	Cambridgeshire	Essex, Norfolk	NT <sup>2</sup> ; RDB1; Section 41 <sup>1</sup>
Bear-clawed nomad bee ( <i>Nomada baccata</i> )	Norfolk, Suffolk	Essex	NT <sup>2</sup> , Na
Kirby's nomad bee ( <i>Nomada subcornuta</i> )	Bedfordshire, Essex		None
Dull-headed blood bee ( <i>Sphecodes ferruginatus</i> )	Cambridgeshire, Essex	Bedfordshire, Norfolk, Suffolk	Nb

## Groove-faced mining bee (*Andrena angustior*)



Groove-faced mining bee female © Steven Falk

**Habitat** - open woodland, heathland, coastal

**Nesting** - bare ground

**Flight period** - late April to early-July

**Pollen source** - polylectic

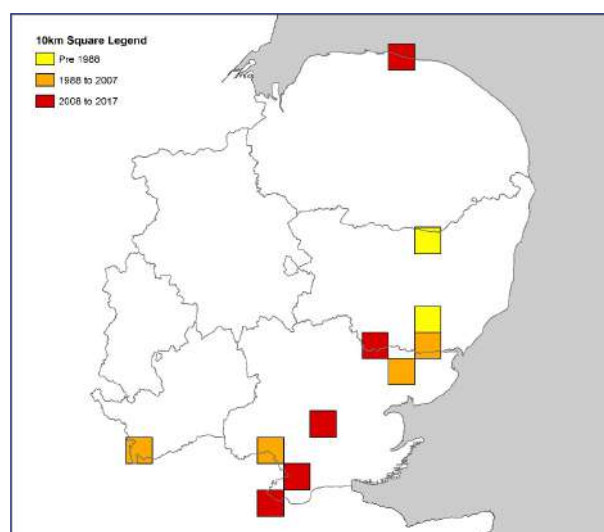
A medium-sized mining bee recorded widely throughout Britain, although with a patchy distribution, and considered rare in East Anglia (Falk 2015).

### Distribution and status

A medium-sized mining bee recorded widely, but with a scarcity of records from East Anglia (Knowles 2017), and noticeably absent from Breckland. The distribution of the Groove-faced mining bee encompasses England, Wales and southern Scotland (Falk 2015). This species is widespread in mainland Europe and not regarded as scarce or threatened in Britain.

In the East of England, the Groove-faced mining bee is surprisingly scarce, with records from Essex, Hertfordshire, Norfolk and Suffolk. The reasons for its rarity aren't fully understood, although they may relate to the drier and warmer climate of the region, and this species seems to avoid the wind-blown sands found in The Brecks.

In Essex this bee is known from several sites across the county, and most recently recorded at



Distribution in the East of England - most recent dates overlay any earlier dates

Danbury Common in 2011. There is only one site known in Hertfordshire (Chorleywood Common) where it was recorded in 2002, and two recent sites in Norfolk (Kelling Heath), where it was last recorded in 2012 and Cotessey in 2015 (Owens 2017). In Suffolk there are two modern records, with the most recent from Tiger Hill in 2016.

## Ecology

The Groove-faced mining bee is most often associated with woodland clearings, but may also be found in coastal habitats, including grasslands and cliffs, heathland, moorland edge and brownfield sites (Falk 2015). It flies during spring and early summer, where it forages on a range of shrubs and plants including Hawthorn (*Crataegus monogyna*), Wood spurge (*Euphorbia amygdaloides*), Bramble (*Rubus fruticosus* agg.), speedwells (*Veronica* spp.), and various umbellifers (Apiaceae), and crucifers (Brassicaceae). In the East of England the records for this species have come from typical open woodland habitat and mosaics of woodland and heathland, as well as a disused sand and gravel pit in Essex.

This is a ground-nesting bee, which appears to favour sunny, south-facing slopes, as well as other areas of bare or sparsely-vegetated ground such as paths (Falk 2015). It is usually solitary nesting, but small aggregations have been recorded. The Groove-faced mining bee is one of the hosts of the cleptoparasitic Fabricius' nomad bee (*Nomada fabriciana*), although it does not appear to be the main target (Falk 2015).

## Threats

Nationally this species is considered of least concern, but it is rare in the East of England. This may be as a result of a lack of open wooded heath on compacted soils, or changes in woodland management that have reduced the availability of woodland clearings. It may be that this species is also moving northwards and westwards in response to climate change.

## Habitat management

This species requires warm, sunny and sheltered areas within woodland, access to a range of shrubs and herbs, and areas of bare or sparsely-vegetated ground. Woodland sites should be managed rotationally to promote structural diversity and maintain sunny and sheltered clearings to encourage development of ground flora. Rides with scalloped or uneven edges, and that transition from short vegetation, through tall herbs and scrub, to trees, will offer more opportunities. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub.



Potentially suitable habitat at East Winch Common, Norfolk © Steven Falk

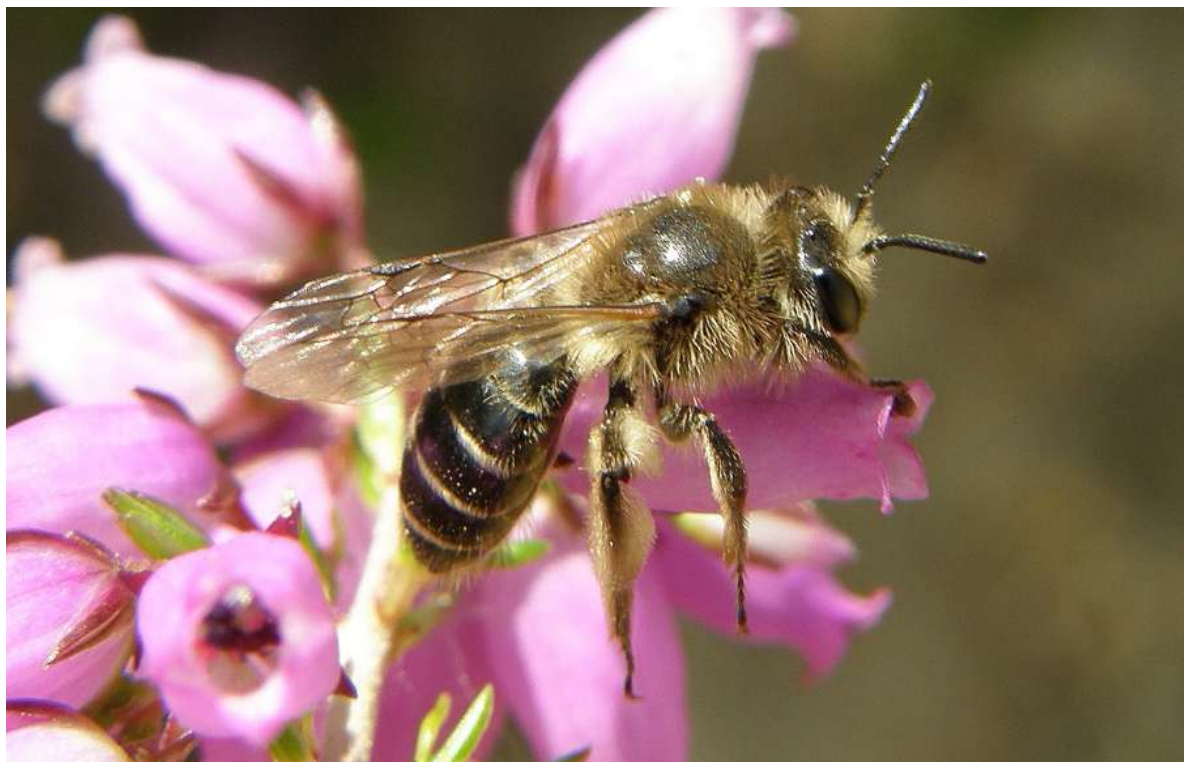
## Further information

Buglife (2017) Managing woodland for pollinators

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Manage known sites to provide structural diversity of woodlands and sunny and sheltered clearings.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Address gaps in autoecological knowledge.

## Small sandpit mining bee (*Andrena argentata*)



Small sandpit mining bee female © Steven Falk

**Habitat** - heathland  
**Nesting** - bare ground

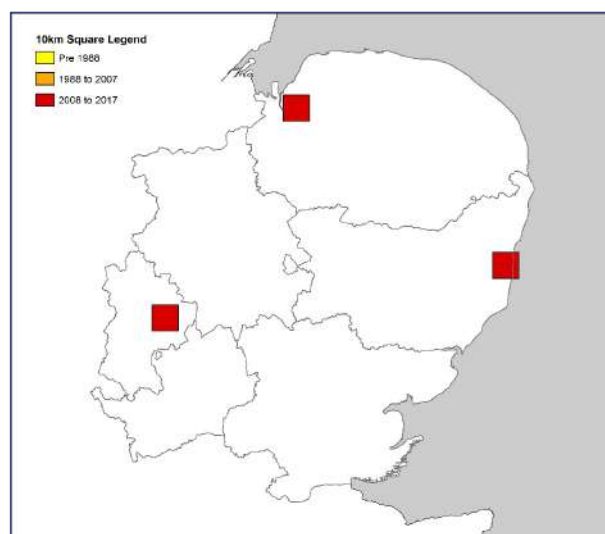
**Flight period** - late-June to September  
**Pollen source** - polylectic

The Small sandpit mining bee shows a strong association with heathland, especially where sandpits or areas of turf cutting are present. Its core populations are on the heathlands of Surrey and Dorset, but outlier populations exist in the East of England and Worcestershire (Falk 2015).

### Distribution and status

The Small sandpit mining bee is a specialist of heathland. As such it has a restricted distribution in Britain and has been assessed as Nationally Scarce (Notable A) (Falk 1991).

In the East of England this bee is seemingly restricted to three areas. In Bedfordshire, it was discovered near Sandy in 2016. It is also known from two adjacent sites in Norfolk (Roydon Common and Grimston Warren), its most northerly extant site (Owens 2017) where it was last recorded in 2018 (M. Welch pers. comm. 2019). In Suffolk there are records from several sites covering a small part of the Suffolk coast (Knowles 2017), with the most recent from Westleton Heath in 2017. The Small sandpit mining bee is notably absent from The Brecks.



Distribution in the East of England - most recent dates overlay any earlier dates



## Ecology

The Small sandpit mining bee shows a strong association with heathland, including associated sandpits and open woodland. It flies during the summer and early autumn, and has been recorded foraging on plants in several families including umbellifers, daisy (Asteraceae) and rose (Rosaceae), however heathers (Ericaceae) are thought to be an obligate requirement (Falk 2015).

This is a ground-nesting bee, which appears to favour moderately disturbed areas with loose sand (Falk 1991) exposed to full sun, especially where pits and cuttings are present. There is a suggestion that these areas may be selected by nesting females to help conceal their burrows, which are dug in aggregations. The Small sandpit mining bee is the only known host for the Bear-clawed nomad, another threatened species in the East of England. It is possible that the Reticulate blood bee (*Sphecodes reticulatus*) also cleptoparasitises it (Falk 2015).

## Threats

The loss of heathland including destruction for agriculture, forestry and development, as well as changes in heathland management that lead to a loss of bare ground or succession, are likely to have contributed to the decline of the Small sandpit mining bee.

## Habitat management

This species requires moderately disturbed sandy areas for nesting and access to foraging resources during the summer and early autumn. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub, and protected from excessive disturbance. Scrapes of vegetation in sunny locations could provide the hot, sheltered nesting spaces favoured by this species. Bracken and scrub should be maintained in discrete areas, whilst preventing over-colonisation of the heathland.



Suitable habitat at Minsmere, Suffolk © Steven Falk

## Future prospects

This is a northern and central European species and it is possible that it could expand its range in response to climate change, where suitable habitat exists, and that any successful immigrations are more likely to establish.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Manage known sites to provide structural diversity of heathland including hot, sheltered areas of loose sand for nesting.
3. Identify opportunities to facilitate expansion of existing populations such as clearance of afforested areas to restore open heathland vegetation and creation of bare, sandy ground.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.

## Bilberry mining bee (*Andrena lapponica*)



Bilberry mining bee female © Steven Falk

**Habitat** - woodland, heathland, moorland

**Nesting** - bare ground

**Flight period** - early-April to June

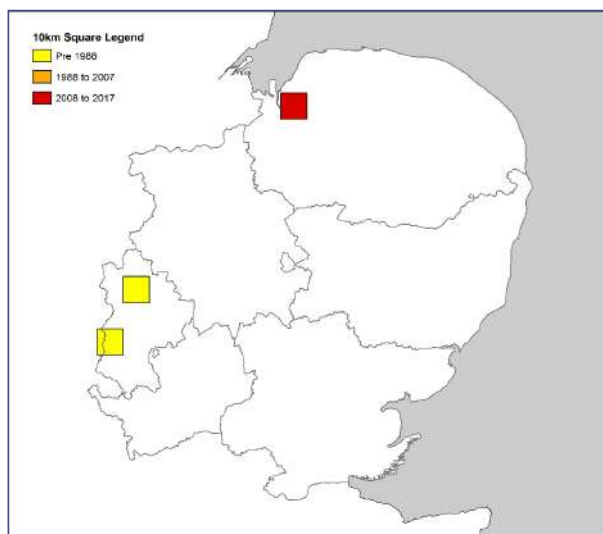
**Pollen source** - oligolectic on *Vaccinium* species

A spring and early-summer flying bee that has a widespread but patchy distribution across Britain, where it is confined to habitats with plentiful Bilberry (*Vaccinium myrtillus*) or other *Vaccinium* species. It was considered lost from the region until a population was discovered in Norfolk in 2016, however with a scarcity of suitable habitat, this species is very vulnerable.

### Distribution and status

The Bilberry mining bee has a widespread but patchy distribution across Britain; being scarce in the south-east, more widespread further north and west, and reasonably common in parts of Scotland (Falk 2015). In mainland Europe this species is more typical of boreo-alpine regions, and it is not regarded as scarce or threatened in Britain.

In the East of England the Bilberry mining bee is very rare, with a handful of old records for Bedfordshire, and Dersingham Bog in Norfolk at which it was discovered nesting in 2016. The Norfolk site is a complex of acid valley mire, heathland and woodland, and it is possible that this is a relict population that has been



Distribution in the East of England - most recent dates overlay any earlier dates

overlooked until now. The forage source at Dersingham Bog is unclear but may be Cranberry (*Vaccinium oxycoccos*).

## Ecology

The Bilberry mining bee is associated with acid habitats, including heathland, wetland and woodland, with plentiful Bilberry. Although it principally forages on Bilberry, it has been recorded using other *Vaccinium* species, as well as Rhododendron (*Rhododendron ponticum*) and various shrubs and herbs including speedwells and dandelions (*Taraxacum* agg.), but this may be for nectar only (Falk 2015).

This is a ground-nesting bee, which appears to nest in scattered aggregations or alone in areas of bare ground (Norbakk 2017). The Bilberry mining bee is one of several *Andrena* bees that are cleptoparasitised by Panzer's nomad (*Nomada panzeri*) (Falk 2015), a large and widespread nomad bee.

## Threats

This Bilberry mining bee is a specialised species whose abundance appears most limited by the availability and abundance of Bilberry (Norbakk 2017). Bilberry, a small shrub of open acid habitats, including heathland, woodland and moorland is absent from much of the East of England, with declines reflecting the loss of lowland heathland (BRC 2019) to development, cessation of management and commercial forestry.

## Habitat management

This species requires extensive areas of Bilberry and bare ground in direct sunlight for nesting (Norbakk 2017). Woodland sites should be managed rotationally to promote structural diversity and maintain sunny and sheltered clearings to encourage development of ground flora, and specifically Bilberry and other *Vaccinium* species. Research in Norway suggests removal of cut stumps had most benefit in promoting Bilberry growth, following tree felling (Norbakk 2017), although this needs to be balanced with the needs of dead and decaying wood species, including aerial-nesting bees. Conservation of bog habitat by preventing scrub encroachment and maintenance of a high water table will safeguard habitat for Cranberry, which may also be used for foraging.



Bilberry © Steven Falk

## Future prospects

As a boreo-alpine species with restricted habitat in the East of England the Bilberry mining bee is vulnerable in the East of England, and its long-term future seems far from secure.

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Address gaps in autoecological knowledge, specifically its foraging ecology at Dersingham Bog.
3. Identify opportunities to facilitate expansion of existing population through promotion of growth of *Vaccinium* species.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Establish annual monitoring at its known site.

## Scarce black mining bee (*Andrena nigrospina*)



Scarce black mining bee male © Steven Falk

**Habitat** - heathland, brownfield, sandy arable ground  
**Nesting** - bare ground

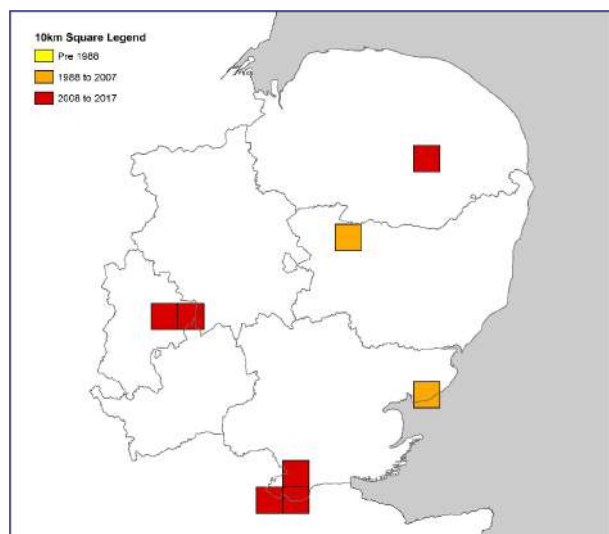
**Flight period** - late April to mid-July  
**Pollen source** - polylectic with preference for Brassicaceae

A much declined species with national strongholds including the Thames Gateway.

### Distribution and status

This species was only recently described as separate in the UK from the similar Black mining bee, making analysis of data difficult for both species, although it has clearly undergone a major decline (Falk 2015). Records are concentrated around the Worcestershire-Staffordshire border and the Thames Gateway with other scattered locations in southern and eastern England.

The majority of the records in the region are from the Essex Thames Gateway, with two sites reported as destroyed or probably destroyed (Essex Field Club 2019). There are also single records for Norfolk (Bowthorpe in 2011) and Suffolk (Kings Forest in 2003), and a strong population has recently been discovered at Sandy in Bedfordshire.



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Scarce black mining bee is mostly an inland species associated with sandy habitat, particularly heathland but also brownfield sites with crucifer-rich habitat or fully dependent on very sandy arable land. It gathers pollen from several crucifer species, in particular Wild radish (*Raphanus raphanistrum*) (Jukes 2009) but also Hoary mustard (*Hirschfeldia incana*), Turnip (*Brassica rapa*) and Oilseed rape, as well as poppies (*Papaver* spp.) and umbellifers (Jukes 2009; Falk 2015). This is a ground-nesting bee, which nests in loose aggregations both on flat and sloping ground, in arable margins and along footpaths that are bare but not churned up. It has a strong association with sandy ground and requires good access to crucifer-rich habitats. The Scarce black mining bee is host for the cleptoparasitic Kirby's nomad bee, which is also considered threatened in the region.



Scarce black mining bee female © Steven Falk

## Threats

Declines are most likely attributed to loss, fragmentation and degradation of heathland, including destruction for agriculture, forestry and development, and changes in management leading to loss of bare ground and structural diversity, changes in farmland management and loss and insensitive restoration of brownfield sites, which have led to a decrease in brassica-rich habitats. Scrub encroachment at nesting sites and loss of foraging in road verges as a result of poorly-timed management may also be contributing to the decline of this bee.

## Habitat management

This species requires sandy areas for nesting and access to crucifer-rich foraging areas. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Less intensive farmland management that incorporates fallow areas, uncultivated margins and headlands, and reduces herbicide use will allow flowering plant communities including crucifers to develop. Incorporating these features throughout farmland, and rotational small-scale clearance on brownfield sites to maintain flower-rich areas and a range of successional habitats, particularly close to known nest sites will provide the connectivity needed by this and other species. Nesting areas should be kept free from encroaching vegetation and protected from excessive disturbance.

## Future prospects

The species appears to be much declined and establishing its current status in the region should be a priority.

## Further information

Buglife (2013) Heathland mosaic habitat management

Buglife (2017) Managing farmland for pollinators

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Identify opportunities to connect fragmented or isolated patches of heathland including through management that promotes growth of crucifers on brownfield sites and farmland on sandy soils within the landscape local to its known sites.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, cultivated areas for arable plants and buffer strips. Where farmer clusters are present, provision can be coordinated across holdings to provide a complementary habitat network.
4. Establish annual monitoring at its known sites.

## Long-fringed mini-miner (*Andrena niveata*)



Long-fringed mini miner female © Steven Falk

**Habitat** - coastal habitat, farmland  
**Nesting** - bare ground

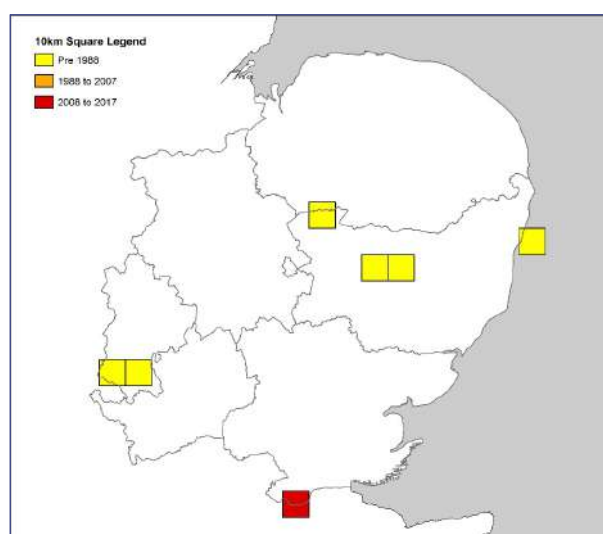
**Flight period** - early May to late June  
**Pollen source** - oligolectic on Brassicaceae

A small mining bee, which is rare in Britain. Recently rediscovered in the East of England following a long absence, there is the possibility this species is expanding its range in response to climate change.

### Distribution and status

A small mining bee, which has been assessed as Vulnerable (RDB2) in Britain (Falk 1991); distributed predominantly in the south-east of England. There are a handful of old records from Bedfordshire and Suffolk, and the Long-fringed mini-miner was recently rediscovered in the East of England, following an apparent absence of over 70 years.

The only known modern site in the region is in Essex, where the bee was discovered in 2018 (P. Harvey pers. comm. 2018). It is possible that this species is expanding its range in response to climate change, or the record may confirm the edge of the species' distribution, as this bee is small and easily overlooked.



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Long-fringed mini-miner is a warmth-loving species associated with a range of habitats where there is good availability of crucifers. This includes coastal habitats and sandy heaths as well as farmland and arable margins, and the species is known to use cultivated brassicas such as Oilseed rape, as well as wild species including Charlock (*Sinapis arvensis*) and Hedge mustard (*Sisymbrium officinale*) (Falk 2011). This is a ground-nesting bee, predicted to nest singly or in loose aggregations, however its nesting biology is rarely observed (Falk 2015).

## Threats

Declines in this species are most likely attributed to habitat loss as a result of coastal defence and development, as well as changes in land management, including use of pesticides in farmland. Outside of cultivation on farmland, crucifers are common ruderal species but their occurrence can be sporadic, and dependent on short-term land-use and the surrounding land management. The Long-fringed mini-miner has been recorded using cultivated brassicas and these may represent a valuable but unreliable food source when used in rotation, with access for nesting colonies varying from year to year.

## Habitat management

This species requires warm areas with sufficient availability of crucifers. Less intensive farmland management that incorporates fallow areas, uncultivated margins and headlands, and reduced herbicide use will allow flowering plant communities including crucifers to develop. Incorporating these features throughout farmland will provide the connectivity needed by this and other species.

Sympathetic management of areas such as sea walls, road verges and amenity greenspace, which involves less frequent cutting regimes and removal of arisings, will help to benefit crucifers and other flowering plants, providing foraging resources for a wide range of species.



Suitable habitat in Cambridgeshire © Steven Falk

## Future prospects

It is possible the Long-fringed mini-miner could expand its range in response to climate change, where suitable habitat exists.

## Further information

Buglife (2017) Managing farmland for pollinators

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Identify opportunities to facilitate expansion of existing population through promoting the growth of crucifers within the landscape local to its known Essex site.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, cultivated areas for arable plants and buffer strips. Where farmer clusters are present, provision can be coordinated across holdings to provide a complementary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Address gaps in autoecological knowledge, specifically its nesting ecology.
6. Establish annual monitoring at its known site.

## Red-backed mining bee (*Andrena similis*)



Red-backed mining bee female © Steven Falk

**Habitat** - grassland, coastal, heathland, brownfield

**Nesting** - bare ground

**Flight period** - late April to late June

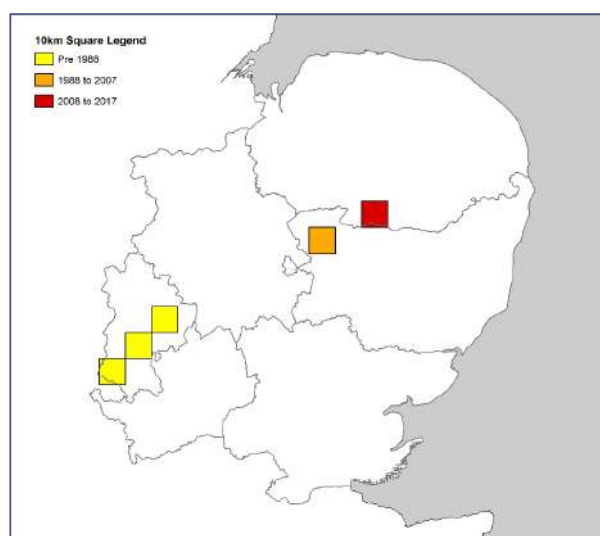
**Pollen source** - oligolectic on Fabaceae

A scarce mining bee associated with legumes that has a widespread but patchy distribution across the UK, with only two modern sites in the East of England.

### Distribution and status

The Red-backed mining bee has a patchy distribution in Britain, appearing to be localised in much of central and southern Britain, and Wales, with a cluster of records in northern Scotland, where it appears to be more common. It seems to be declining in the south-east of England (Falk 2015) and has been assessed as Nationally Scarce (Notable B) in Britain (Falk 1991). It is possible that this species is expanding its range northwards in response to climate change. The Red-backed mining bee is widely distributed in Europe, northern Africa and the Middle East.

In the East of England, the Red-backed mining bee is certainly rare, but possibly under-recorded. There are old records (pre-1949) from Bedfordshire, as well as Essex (pre-1851), although the latter are from unknown locations. The only modern records of the species are two records from



Distribution in the East of England - most recent dates overlay any earlier dates

The only modern records of the species are two records from



Suffolk, the most recent of which is from Knettishall Heath in Breckland in 2015, an area made up of a mosaic of grass heath and woodland.

## Ecology

The Red-backed mining bee can be found in a range of habitats that are rich in legumes, including chalk grassland, heathland, coastal habitats and brownfield sites. In Scotland it is also recorded in woodland clearings. This bee is oligolectic on legumes, with Gorse (*Ulex europaeus*) identified as a pollen source, as well as clovers (*Trifolium* spp.) and bird's-foot-trefoils (*Lotus* spp.). Additional plants are visited for nectar, including various shrubs and trees, as well as herbs including dandelions, speedwells, fumitories (*Fumaria* spp.) and Ground-ivy (*Glechoma hederacea*) (Falk 2015). This is a ground-nesting bee, thought to nest singly or in large aggregations, however its nesting biology is not well known in Britain (Falk 2015).



Red-backed mining bee female © Steven Falk

## Threats

The decline of the Red-backed mining bee is most likely as a result of changes in agricultural practice that have led to legume-rich habitats becoming a less common component of the farming system. These include improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), and a decline in mixed farms. The loss and deterioration of heathland, and loss of flower-rich brownfield sites has probably also had an impact.

## Habitat management

This species requires habitats rich in legumes. Existing legume-rich grasslands should be cut (after mid-July) with arisings removed and/or rotationally grazed, to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. This management can also be used to restore existing species-poor sites, increasing the abundance of legumes and other wild flowers over time. Management of adjacent woody habitats such as hedgerows should be carried out on rotation, avoiding annual cutting, which can restrict flower production. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Less intensive farmland management that incorporates fallow areas, uncultivated margins, and reduces herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. New legume-rich habitat can readily be created along margins. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats.

## Future prospects

It is possible the Red-backed mining bee could expand its range in response to climate change, where suitable habitat exists.

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Identify opportunities to facilitate expansion of existing Breckland populations by implementing habitat management that promotes habitats rich in wild flowers, and particularly legumes.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Address gaps in autoecological knowledge, specifically its nesting ecology.
5. Establish annual monitoring at its known sites.

## Tormentil mining bee (*Andrena tarsata*)



Tormentil mining bee female © Liam Olds

**Habitat** - heathland, moorland, open heathy woodland

**Flight period** - mid-June to late August

**Nesting** - bare ground

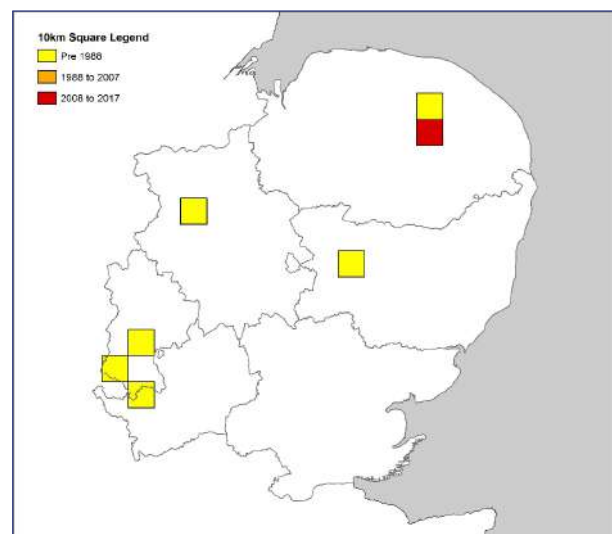
**Pollen source** - oligolectic on Tormentil

A small mining bee recorded widely throughout Britain, although generally scarce, and more common in the north and west, reflecting the greater abundance of Tormentil-rich habitats. Often considered a bee of northern Europe; this species could be vulnerable to climate change. There is only one modern record from the region, and establishing whether the Tormentil mining bee is still found in the East of England should be a priority.

### Distribution and status

The Tormentil mining bee is widespread across Britain, but estimated to have been lost from around 50% of known sites since 1970 (JNCC 2010), and is now found mainly in northern and western areas. In mainland Europe this species is more typical of boreo-alpine regions, and in Britain it has been recognised as a Species of Principal Importance in England (NERC Act 2006).

The only recent records for the East of England are from Swannington Uigate Common in Norfolk in 2010. There are historic records from Bedfordshire (pre-1949) and Suffolk (1897), but it is now considered likely to be extinct in the latter (Knowles 2017). Records originate from Tormentil (*Potentilla erecta*)-rich habitats such



Distribution in the East of England - most recent dates overlay any earlier dates

as lowland fen, ancient semi-natural woodland, wooded and open heathland.

## Ecology

The Tormentil mining bee is restricted to habitats where Tormentil is abundant, in fairly sheltered locations; typically, those forming on base-poor soils such as heathland, moorland and acid grassland, as well as open mosaic habitats and open areas within woodland. This species is almost entirely reliant on Tormentil for pollen,



Tormentil mining bee female © Steven Falk

but will visit other closely related plants such as Marsh cinquefoil (*Potentilla palustris*) and Shrubby cinquefoil (*Potentilla fruticosa*) (Horsley *et al.* 2013). Additional plants are visited for nectar, with Bramble, Bridewort (*Spiraea salicifolia*), Heather (*Calluna vulgaris*), Harebell (*Campanula rotundifolia*), Wild angelica (*Angelica sylvestris*) and Yarrow (*Achillea millefolium*) all reported. Although this bee is associated with an abundance of flowering Tormentil, it is apparently absent from suitable areas, which may indicate additional, undetermined requirements. This is a ground-nesting bee, which uses light, sparsely-vegetated soils, with a preference for south-facing slopes and banks, where it appears to nest in aggregations (BWARS 2019). The Tormentil mining bee is the host for the rare cleptoparasite Tormentil nomad bee, which is now considered extinct in the region.

## Threats

Loss, degradation and fragmentation of Tormentil-rich habitats, as a result of agricultural intensification, commercial forestry, development and inappropriate habitat management such as lack of woodland management, and succession on heathland. It may be that this species is also sensitive to climate change, as suggested by its more northern and western distribution.

## Habitat management

This species requires areas of open habitats that provide warmth and shelter, nesting opportunities and promote the development of large stands of Tormentil. In heathland this can be achieved through grazing and/or cutting to promote structural diversity. Woodland sites managed rotationally to promote structural diversity and maintain sunny and sheltered clearings will encourage growth of Tormentil. Light grazing of acid grassland, and rotational small-scale clearance on brownfields can also help to increase abundance of Tormentil.

## Future prospects

It is possible the Tormentil mining bee is still present in Norfolk, however, without action it is likely it will become regionally extinct.

## Further information

Buglife Tormentil mining bee species management sheet  
Buglife (2013) Heathland mosaic habitat management

### **Conservation action**

1. Resurvey historic sites, with priority for its last known Norfolk site, and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. If presence is confirmed, targeted management should immediately be implemented to increase the abundance of Tormentil. If necessary Tormentil abundance could be increased through planting of plugs.
3. If presence is confirmed a plan should be produced that identifies opportunities to safeguard the population of this species in the region and where possible enable it to expand its range.
4. If presence is confirmed annual monitoring should be established at known sites.

## Brown-banded carder bee (*Bombus humilis*)



Brown-banded carder bee male © Steven Falk

**Habitat** - chalk grassland, coastal, brownfield

**Nesting** - at ground level among tall grasses

**Flight period** - May to September

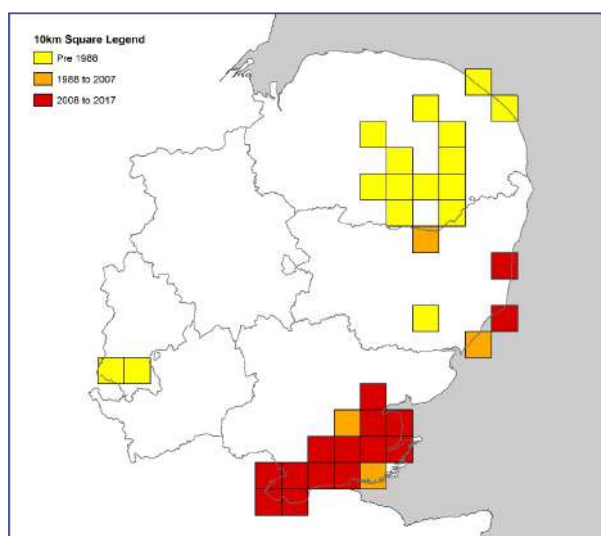
**Pollen source** - preference for Asteraceae, Boraginaceae, Fabaceae, Lamiaceae, Scrophulariaceae

A social bumblebee reliant upon extensive areas of flower-rich and structurally diverse habitats, the Brown-banded carder bee has declined substantially in Britain during the 20<sup>th</sup> Century, although it is increasing locally in some areas. The Thames Gateway is one of its strongholds, making the populations found in Essex of national importance.

### Distribution and status

The Brown-banded carder bee was once widespread in lowland Britain, but declined substantially during the 20<sup>th</sup> Century. It is locally distributed in many parts of Britain, with a bias towards coastal areas, and it has been recognised as a Species of Principal Importance in England (NERC Act 2006). It is showing signs of recovery in some parts of Britain. In mainland Europe this species is considered to be widespread but declining.

The Brown-banded carder bee has a surprising lack of records from much of East Anglia, however the Thames Gateway is now one of its national strongholds, and perhaps one of the most important remaining metapopulations in Britain. It has been recorded historically from



Distribution in the East of England - most recent dates overlay any earlier dates

Bedfordshire and Cambridgeshire, although not for at least 70 years in either. In Norfolk, the Brown-banded carder bee is presumed extinct with no records since the 1960s, although it may survive un-noticed (Owens 2017). In Suffolk it had also been presumed extinct until 2005 when it was rediscovered (at Orford Ness and Minsmere) or had perhaps re-established as part of a range expansion (Knowles 2012). South Essex is clearly the regional stronghold for this species, and it appears to be well established across a number of brownfield sites and sea walls along the Thames Estuary, and has spread in recent years to several sites along the Essex coast.

## Ecology

The Brown-banded carder bee is associated with extensive, tall but open grassland, and well-connected mosaics of flower-rich habitats including chalk grassland, heathland, coastal habitats and brownfield sites, as well as road verges and farmland. Large areas are required to support colonies, with an estimated 1km<sup>2</sup> of foraging habitat per nest (Saunders 2008) and between 10-20km<sup>2</sup> of good matrix habitat that incorporates large flower-rich patches, to support a viable population (Edwards 1998). This is a late-emerging species, often peaking later than other bumblebees. Queens leave hibernation in May and early June, with workers flying between June and September, and males during August and September.



Brown-banded carder bee habitat at Canvey Wick, Essex © Steven Falk

To support a strong population, a continuity of flowering plants is required that encompass this period from May to September (Saunders 2008). These bumblebees are long-tongued, generalist foragers, however they show strong preferences for legumes including Kidney vetch (*Anthyllis vulneraria*), bird's-foot-trefoils, clovers and vetches (*Vicia* spp.), as well as labiates (Lamiaceae), including dead-nettles (*Lamium* spp.), Betony (*Stachys officinalis*), and Black horehound (*Ballota nigra*), and Scrophulariaceae (Connop 2007). Other forage plants include Bell heather (*Erica cinerea*), Red bartsia (*Odontites vernus*), Viper's-bugloss (*Echium vulgare*), Teasel (*Dipsacus fullonum*) and various daisies.

The Brown-banded carder bee is a social bumblebee, and queens found nests on the ground's surface in long, tussocky grass, where grasses and moss are combed together to cover the surface of the nest, although they may also nest on features such as cliffs and hedgebanks (Saunders 2008). It is a pocket-making species; eggs are laid directly onto the pollen amassed within the nest allowing larvae to feed themselves (Gammans and Allen 2014). The Field cuckoo bee (*Bombus campestris*) is a cuckoo bumblebee that will take over the nests of several carder bee species, including the Brown-banded carder bee.

## Threats

The decline of the Brown-banded carder bee is probably largely as a result of loss and fragmentation of the extensive flower-rich habitats it requires, and loss of structural variety within habitats. It has been suggested that if the Thames Gateway population was lost, the dispersal distance required for natural recolonisation from other existing populations would be an impossible barrier (Connop 2007). Changes in agricultural practice are one of the main drivers of this habitat change, resulting from improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), and loss of flower-rich arable field margins, and conversion to arable. In addition, suitable sites have been lost to development, as well as insensitive restoration of mineral extraction sites, which have much potential for this and other bee and invertebrate species.



Brown-banded carder bee worker © Steven Falk

## Habitat management

This species requires extensive areas of open habitats that provide a continuity of flowering resources, and particularly legumes, from May to September, as well as structural diversity. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. Discrete patches of scrub and associated tussocky, coarse grassland and ditches should be maintained to provide nesting and hibernation opportunities as part of the habitat mosaic. Woody habitats should be managed on rotation, avoiding annual cutting, which can restrict flower production. Less intensive farmland management that incorporates fallow areas, uncultivated

margins, and reduces herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. New legume-rich habitat can readily be created along margins, and linear strips of habitat, provided they are of great enough extent can provide sufficient high-quality forage (Saunders 2008) alongside other land-use such as farming. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats.

## Future prospects

The population of Brown-banded carder bee in the Thames Gateway is nationally significant however it is considered to be vulnerable. There are opportunities for this species to extend its range in response to climate change, as has already been seen in Essex and neighbouring Kent (Edwards 2008), where there is connected habitat to facilitate its spread.

## Further information

Buglife Brown-banded carder bee species management sheet

Buglife Managing brownfields for scarce bumblebees

Buglife (2013) Coastal grazing marsh mosaic habitat management

Buglife (2013) Heathland mosaic habitat management

## Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, low intensity grassland management and management of field corners. Where farmer clusters are present, provision can be coordinated across holdings to provide a complementary habitat network.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
5. Address gaps in autoecological knowledge, specifically its foraging distances, dispersal, nesting ecology, hibernation requirements, viable population sizes, population dynamics and impact of landscape design on population success (JNCC 2010).
6. Establish monitoring at its known sites and encourage the establishment of BeeWalks, with training and mentoring available to support volunteer surveyors. A watching brief should be maintained of any advance in the range of this species in Essex, Suffolk and Norfolk to inform the delivery of a network of flower-rich habitat.

## Moss carder bee (*Bombus muscorum*)



Moss carder bee male © Steven Falk

**Habitat** - coastal habitat, moorland

**Nesting** - among tall grasses

**Flight period** - May to September

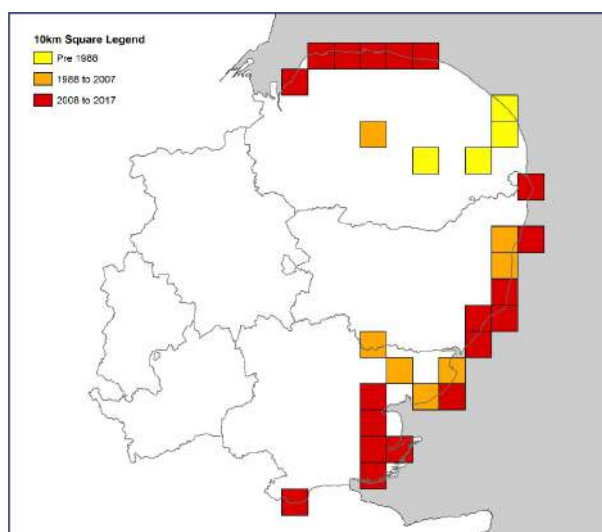
**Pollen source** - preference for Asteraceae, Fabaceae, Lamiaceae, Scrophulariaceae

A social bumblebee reliant upon extensive areas of flower-rich and structurally diverse habitats, the Moss carder bee has declined substantially in Britain since the early 20<sup>th</sup> Century. Populations in the East of England are now almost all confined to the coast.

### Distribution and status

The Moss carder bee was once widespread in Britain, but has declined substantially since the early 20<sup>th</sup> Century, and in southern Britain in particular, has shown a marked retreat towards the coast. It remains more frequent in the north and west, where it appears more able to tolerate cooler and damper conditions than many other bumblebees (Plowright *et al.* 1997). The Moss carder bee has been recognised as a Species of Principal Importance in England (NERC Act 2006) and is assessed as Vulnerable on the European Red List of Bees (Nieto *et al.* 2014).

In the East of England, the Moss carder bee is largely confined to the coast. In Essex the modern records are all coastal, with a thin but widespread distribution. In Norfolk it is scarce, and may be on the verge of extinction. In the



Distribution in the East of England - most recent dates overlay any earlier dates



1980s it was present more widely on the north Norfolk coast and inland along the River Wensum near Fakenham (S. Falk pers. comm. 2019), but modern records focus around the grazing marshes of the north coast (Owens & Richmond 2014). This picture is repeated in Suffolk, where it is now considered a species of coastal marshes, sea walls, coastal shingle and dunes, having been lost from Breckland (Knowles 2012).

## Ecology

The Moss carder bee is associated with extensive open grassland, especially where flowers such as clovers are abundant, and well-connected mosaics of flower-rich habitats. It seems to show a preference for damp and exposed habitats (Diekötter *et al.* 2006) and will use ditches in coastal grazing marsh for nesting and for additional forage. Following declines of recent decades, this species is now often confined to coastal habitats such as marshes, sand dunes and vegetated shingle, although it can be found on moorland and upland hay meadows in the north of Britain (Falk 2015). Sea walls have also been demonstrated as important habitat for the Moss carder bee (Gardiner & Benton 2011), especially where there is a wide folding with flower-rich grassland and possibly scattered scrub. Large areas of habitat are required, with an estimated 10-20km<sup>2</sup> of good matrix habitat to support a viable population (Edwards 1998). This is a late-emerging bumblebee, and the colonies seem to decline more rapidly than those of Common carder bee (*Bombus pascuorum*) and Brown-banded carder bee (Falk 2015). Queens leave hibernation in May, with workers flying by June, and males by July.



Moss carder bee queen © Steven Falk

It has been suggested that Moss carder bees have a small foraging range (Diekötter *et al.* 2006) or a tendency to use nearby foraging resources more frequently than some other bumblebee species (Walther-Hellwig & Frankl 2000). To support a strong population, a continuity of flowering plants is required that encompass the active period of the colony from May until September. These bumblebees are relatively long-tongued, generalist foragers, however they show strong preferences for legumes including Meadow vetchling (*Lathyrus pratensis*), bird's-foot-trefoils, clovers and vetches, as well as heathers (*Erica* spp.), Red bartsia, Viper's-bugloss, willowherbs (*Epilobium* spp.), Teasel and various Asteraceae. Males forage on Common Ragwort (*Senecio jacobaea*), willowherbs, thistles (*Cirsium* spp.) and scabiouses.

The Moss carder bee is a social bumblebee, and queens found nests of around 40-120 workers (Falk 2015), predominantly on the ground in long, tussocky grass, where grasses and moss are combed together to create a ball. It is a pocket-making species; eggs are laid directly onto the pollen amassed within the nest allowing larvae to feed themselves (Gammans and Allen 2014). The Field cuckoo bee (*Bombus campestris*) is a cuckoo bumblebee that will take over the nests of several carder bee species, including the Moss carder bee.

## Threats

The decline of the Moss carder bee is probably largely as a result of changes in agricultural practice that have led to the loss and fragmentation of the extensive flower-rich habitats it requires, and loss of structural variety within habitats. These include improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), and loss of flower-rich arable field margins. In addition, suitable sites have been lost to development, as well as insensitive restoration of mineral extraction sites, which have much potential for this and other bee and invertebrate species. The Moss carder bee may also be threatened by drying out of wetland habitats, and its tolerance of damp and cold weather conditions may lead to a northward range contraction as a result of climate change, with work in Essex suggesting it avoids warm and dry microclimates (Gardiner & Benton 2011), perhaps indicating it will be adversely affected by climate change.

## Habitat management

This species requires extensive areas of open habitats that provide a continuity of flowering resources, particularly legumes, thistles, knapweeds and 'yellow composites' from May to September, as well as structural diversity. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. Discrete patches of scrub and associated tussocky, coarse grassland and ditches should be maintained to provide nesting and hibernation opportunities as part of the habitat mosaic. Woody habitats should be managed on rotation, avoiding annual cutting, which can restrict flower production. Less intensive farmland management that incorporates fallow areas, uncultivated margins, and reduces herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. New legume-rich habitat can readily be created along margins, and linear strips of habitat, provided they are of great enough extent can provide sufficient high-quality forage (Saunders 2008) alongside other land-use such as farming. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats. Sea walls can be managed to provide unmown grassland with an abundance of forage plants that is cut every two to three years on rotation, in association with scattered scrub (Gardiner *et al.* 2015). In coastal dunes, the Moss carder bee can favour dune slacks and scrub encroachment or overgrazing of these areas should be avoided.

## Future prospects

There is an important but possibly declining population of Moss carder bee in the East of England. With a seeming tolerance for cooler microclimates, it may be that climate change causes this species to decline in the southern parts of its range. Ensuring there are connections of habitat encompassing the sea walls of Essex and further north may help to facilitate its spread, as well as conservation of North Norfolk populations.

## Further information

Buglife Managing brownfields for scarce bumblebees

Buglife (2013) Coastal grazing marsh mosaic habitat management

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, low intensity grassland management and management of field corners. Where farmer clusters are present, provision can be coordinated across holdings to provide a complementary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
6. Work proactively with managers of sea walls to promote their management as a network of flower-rich habitat.
7. Address gaps in autoecological knowledge, specifically its foraging distances, dispersal, nesting ecology, hibernation requirements, viable population sizes, population dynamics and habitat creation and restoration techniques (Olds *et al.* 2018).
8. Establish monitoring at its known sites and encourage the establishment of BeeWalks, with training and mentoring available to support volunteer surveyors. A watching brief should be maintained of any advance in the range of this species in Essex, Suffolk and Norfolk to inform the delivery of a network of flower-rich habitat.

## Red-shanked carder bee (*Bombus ruderarius*)



Red-shanked carder bee queen © Steven Falk

**Habitat** - chalk grassland, coastal, brownfield

**Nesting** - tussocky/scrubby grassland

**Flight period** - mid-April to September

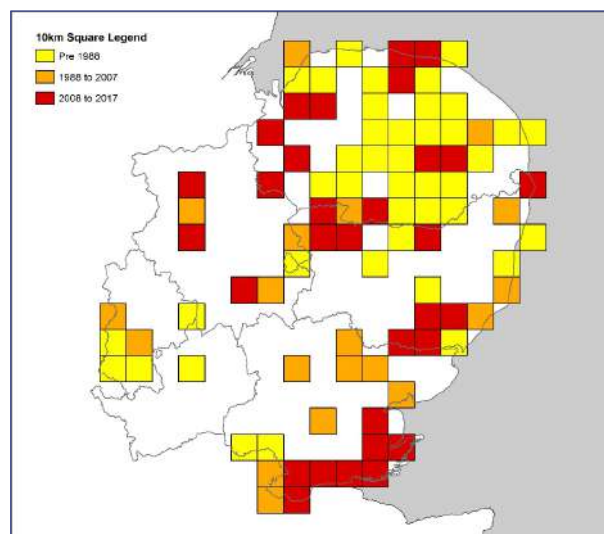
**Pollen source** - preference for Fabaceae, Lamiaceae and Scrophulariaceae

A social bumblebee reliant upon extensive areas of flower-rich habitat with scattered scrub, the Red-shanked carder bee has declined drastically in Britain during the 20<sup>th</sup> Century. Breckland appears to have one of the most stable populations in the UK, making the populations found here significant.

### Distribution and status

The Red-shanked carder bee was once widespread in England and Wales, and often common in the south and south-east of England (Benton 2008). It seems to have undergone a drastic decline in both its abundance and distribution during the 20<sup>th</sup> Century that seems to be continuing (Falk 2015), and it now seems to be one of the scarcest species wherever it occurs (Benton 2008). It has been recognised as a Species of Principal Importance in England (NERC Act 2006), and in mainland Europe where it has a wide geographical distribution, it also seems to be declining (BWARS 2019).

In the East of England, the Red-shanked carder bee has traditionally been reasonably common but with a patchy distribution. In common with



Distribution in the East of England - most recent dates overlay any earlier dates

much of Britain, its range in the region has contracted, although the Breckland population appears to be one of the most stable in the UK (Benton 2008). In Bedfordshire the most recent record is from Luton in 1978, whilst the last record from Cambridgeshire was from Portholme Meadow, a floodplain meadow in the west of the county in 2013. The evidence from Essex suggests a drastic decline, with Red-shanked carder bee now apparently absent from many former sites, found now principally in the Thames Estuary area. Norfolk has also seen a marked decline although the species is believed to persist at scattered sites including Breckland and the north Norfolk coast (Owens & Richmond 2014). This is mirrored in Suffolk, where southern Breckland is believed to be its county stronghold, although there is a chance it remains under-recorded (Knowles 2012), likely due to difficulties in identification. It has not been recorded in Hertfordshire since 1977.

## Ecology

The Red-shanked carder bee is associated with extensive, tall but open grassland, and it may have a preference for the interface with woody habitats (M. Edwards pers. comm. 2018). It requires flower-rich habitats including calcareous grassland, farmland, heathland and brownfield sites or old quarries, as well as coastal habitats such as sea walls, wide road verges and is occasionally recorded in gardens (Falk 2015). In Breckland it is found in open grassland and wide rides within plantation woodland (S. Falk pers. comm. 2019). It can also be found in farmland that has a good network of flowery margins around arable fields. Although it can coexist with other scarce carder bees (Brown-banded carder bee, Moss carder bee and Shrill carder bee), it is rarely abundant in grasslands favoured by these species (Olds *et al.* 2018). The Red-shanked carder bee queens leave hibernation from around mid-April, with workers flying between April and August, and males from June.

To support a strong population, a continuity of flowering plants is required that encompass this period from April to September. These bumblebees have a medium-length tongue, and are generalist foragers, however they show strong preferences for legumes, labiates, Bramble and stork's-bills (*Erodium* spp.). Spring queens show a preference for White Dead Nettle (*Lamium album*) and Ground-ivy, and will also visit willows (*Salix* spp.), while new summer queens visit Kidney vetch, bird's-foot-trefoils, clovers, Black horehound and scabiouses. Males visit knapweeds (*Centaurea* spp.), Viper's-bugloss and Teasel.

The Red-shanked carder bee is a social bumblebee, and queens found nests of around 50-100 workers, on the ground's surface, in scrubby or tussocky grassland. It is a pocket-making species; eggs are laid directly onto the pollen amassed within the nest allowing larvae to feed themselves (Gammans and Allen 2014). The Field cuckoo bee is a cuckoo bumblebee that will take over the nests of several carder bee species, including the Red-shanked carder bee.



Red-shanked carder bee nest © Steven Falk

## Threats

The decline of the Red-shanked carder bee is probably largely as a result of changes in agricultural practice including improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), and loss of flower-rich arable field margins. These changing practices have led to the loss and fragmentation of the extensive flower-rich habitats it requires, and loss of structural variety within habitats, and it has perhaps fallen victim more than most other bumblebee species to these changes (Knowles 2012). In addition, other suitable sites such as brownfield land and old quarries have been lost to development and unsympathetic restoration, and it has been suggested that the Red-shanked carder bee may be less able than other bumblebee species to cope with the fragmented landscapes resulting from this along with intensification of greenspaces (Benton 2008). The continued decline of Red-shanked carder bee, when other scarce bumblebees seem to be showing a recovery suggests that climatic factors, such as cold and wet springs might also be having an impact (Olds *et al.* 2018).

## Habitat management

This species requires extensive areas of open habitats that provide a continuity of flowering resources, particularly legumes and labiates from April to September, as well as structural diversity. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. Discrete patches of scrub and associated tussocky, coarse grassland and ditches should be maintained to provide nesting and hibernation opportunities as part of the habitat mosaic. Woody habitats should be managed on rotation, avoiding annual cutting, which can restrict flower production. Less intensive farmland management that incorporates fallow areas, uncultivated margins, and reduced herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats. Sea walls can be managed to provide unmown grassland with an abundance of forage plants that is cut every two to three years on rotation, in association with scattered scrub (Gardiner *et al.* 2015), and road verges and amenity greenspaces can be sensitively managed with less frequent cutting regimes and removal of arisings.



Red-shanked carder bee sea wall habitat at Wallasea Island, Essex © Steven Falk

## Further information

Buglife Managing brownfields for scarce bumblebees

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, low intensity grassland management and management of field corners. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
6. Work proactively with managers of sea walls to promote their management as a network of flower-rich habitat.
7. Address gaps in autoecological knowledge, specifically why the ecologically similar Common carder bee is common whereas the Red-shanked carder bee is declining, by examining the foraging range and queen dispersal distance of the latter, the potential for competition for nesting sites, the effect of fragmentation on breeding success, and the foraging and nesting habitat requirements.
8. Establish monitoring at its known sites and encourage the establishment of BeeWalks, with training and mentoring available to support volunteer surveyors, although targeted monitoring of colonies may be more effective for this species (Olds *et al.* 2018).

## Shrill carder bee (*Bombus sylvarum*)



Shrill carder bee queen © Steven Falk

**Habitat** - chalk grassland, coastal, brownfield

**Nesting** - tussocky/scrubby grassland

**Flight period** - late April to September

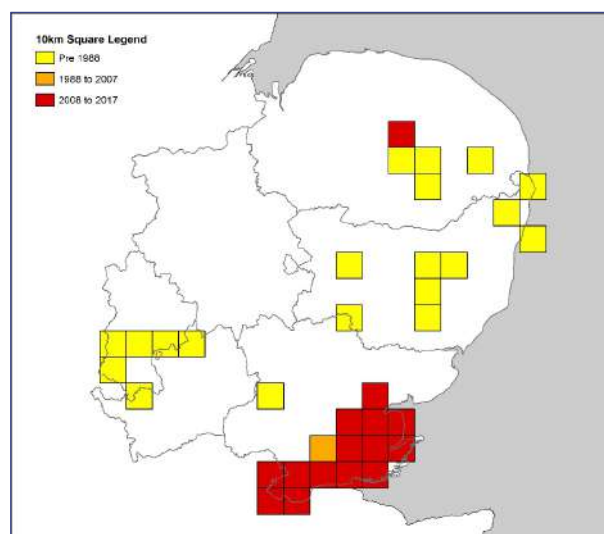
**Pollen source** - preference for Fabaceae, Lamiaceae and Scophulariaceae

A social bumblebee reliant upon extensive areas of flower-rich and structurally diverse habitats, the Shrill carder bee has declined significantly in Britain since the early 20<sup>th</sup> Century and it is now perhaps our most threatened bumblebee. The Thames Gateway is one of a handful of sites where populations remain fairly strong in Britain, and as such is of national importance for this species.

### Distribution and status

The Shrill carder bee was once locally frequent with a scattered distribution across lowland England and Wales, but has undergone a significant decline and reduction in range since the early 20<sup>th</sup> Century. It is now perhaps our rarest and most threatened bumblebee and may be in danger of becoming extinct in Britain. The Shrill carder bee has been assessed as Nationally Scarce (Notable B) in Britain (Falk 1991) and is recognised as a Species of Principal Importance in England (NERC Act 2006).

The Shrill carder bee is now restricted to a handful of areas in Britain, including the Thames Gateway, which is now one of the most



Distribution in the East of England - most recent dates overlay any earlier dates

important remaining metapopulations, and from which it appears to be expanding northwards up the Essex coast (Knowles 2012). It has been recorded historically from Bedfordshire and Suffolk, although not for at least 70 years. In Norfolk the last records were from Reymerston and Wymondham, to the west of Norwich during the 1960s, until a record was confirmed near Norwich during 2018 (A. Knowles pers. comm. 2019).

## Ecology

The Shrill carder bee is associated with extensive tall but open grassland, and well-connected mosaics of flower-rich habitats including chalk grassland, heathland and brownfield sites, as well as coastal habitats, especially sea walls (Falk 2015). Large areas are required to support colonies, with between 10-20km<sup>2</sup> of good matrix habitat to support a viable population, that incorporates large flower-rich patches (Saunders 2008). This is a rather late-emerging species, with queens leaving hibernation from late April to early June, with workers flying between June and September, and males during August and September. Like the Brown-banded carder bee, it prefers sites that remain flowery until late summer.

To support a strong population, a continuity of flowering plants is required that encompass this period from late April to September, in close proximity to undisturbed nesting habitat (Connop 2007). These bumblebees are long-tongued, generalist foragers, however they show strong preferences for legumes including Meadow Vetchling, bird's-foot-trefoils, clovers and vetches, and Red Bartsia (Connop 2007). Other forage plants include labiates, including dead-nettles, woundworts (*Stachys* spp.) and Black horehound, and various Asteraceae. It is possible the Shrill carder bee has a narrower diet than other bumblebee species (Connop 2002), with legumes and Red bartsia particularly important as pollen sources for larval development, and other species more important for nectar.

The Shrill carder bee is a social bumblebee, and queens found small colonies of around 50-70 workers, predominantly on the ground's surface or slightly underground, in scrubby or tussocky grassland, where they may incorporate thatch into the nest (Earwaker 2018). It is a pocket-making species; eggs are laid directly onto the pollen amassed within the nest allowing larvae to feed themselves (Gammans and Allen 2014). The Field cuckoo bee is a cuckoo bumblebee that will take over the nests of several carder bee species, including the Shrill carder bee.



Shrill carder bee habitat at Canvey Wick, Essex © Steven Falk

## Threats

The decline of the Shrill carder bee is probably largely as a result of changes in agricultural practice that have led to loss and fragmentation of the extensive flower-rich habitats it requires, and loss of structural variety within habitats. These include improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type) and loss of flower-rich arable field margins. In addition, suitable sites have been lost to development, as well as insensitive restoration of mineral extraction sites, which have much potential for this and other bee and invertebrate species. The Shrill carder bee is likely operating at the edge of its range in Britain (Connop 2007). The hot weather of 2018 resulted in early emergence and early dieback of forage plants (Earwaker 2019) and this type of weather pattern may become more typical with the impact on this species as yet unknown.

## Habitat management

This species requires extensive areas of open habitats that provide a continuity of flowering resources, and particularly legumes and labiates from May to September, as well as structural diversity. Red bartisa, knapweeds and scabiouses can be particularly important towards the end of its foraging season. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and

ensure that flowering patches are maintained within the local landscape throughout the foraging season. Discrete patches of scrub and associated tussocky, coarse grassland and ditches should be maintained to provide nesting and hibernation opportunities as part of the habitat mosaic. Woody habitats should be managed on rotation, avoiding annual cutting, which can restrict flower production. Less intensive farmland management that incorporates fallow areas, uncultivated margins, and reduced herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. New legume-rich habitat can readily be created along margins. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats.

## Future prospects

The population of Shrill carder bee in the East of England is nationally significant, and the Shrill Carder Bee Recovery Project aims to safeguard this population by establishing the current distribution, engaging landowners with habitat restoration and creation, training volunteers to assist with survey and monitoring, and producing a Species Recovery Plan (Earwaker 2019). It is noted that there is the potential for a recolonisation of both Suffolk (Knowles 2012) and Norfolk (as suggested by a record of this species in 2018). With conservation effort the spread of Shrill carder bee could be facilitated along coastal habitats including marshes, as well as sea walls managed to provide flower-rich habitats. The core population in Essex must also be safeguarded, as if this population were lost, the dispersal distance required for natural recolonisation from another population is likely to be an impossible barrier (Connop 2007).



Shrill carder bee male © Steven Falk

## Further information

Buglife Shrill carder bee species management sheet  
Bumblebee Conservation Trust Shrill carder bee factsheet  
Buglife Managing brownfields for scarce bumblebees  
Buglife (2013) Coastal grazing marsh mosaic habitat management

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, low intensity grassland management and management of field corners. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines. It is suggested that sites within 10km of the Thames corridor are most suitable for conservation effort due to the predominantly coastal distribution of this species (Connop 2007).
5. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
6. Work proactively with managers of sea walls to promote their management as a network of flower-rich habitat.
7. Establish monitoring at its known sites and encourage the establishment of BeeWalks, with training and mentoring available to support volunteer surveyors.



## Grooved sharp-tail bee (*Coelioxys quadridentata*)



Grooved sharp-tail bee pinned female © Steven Falk

**Habitat** - heathland, woodland, sand dunes

**Nesting** - bare ground, woody stems (cleptoparasitic)

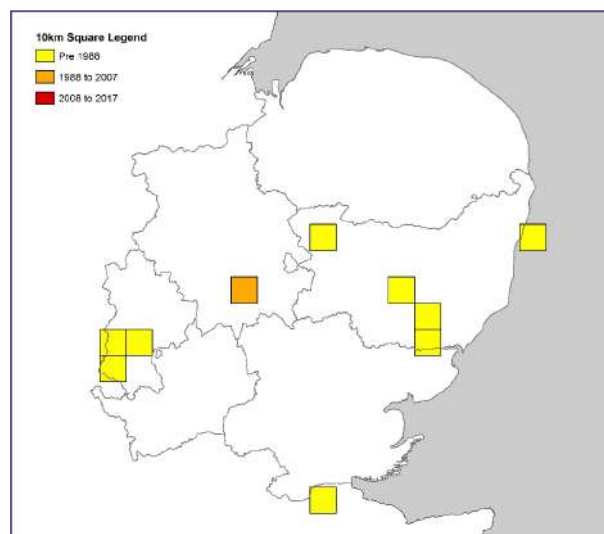
**Flight period** - mid-June to early August

**Pollen source** - cleptoparasitic, hosts show a preference for Fabaceae and Lamiaceae

A rare cleptoparasitic bee restricted to southern Britain, the Grooved sharp-tail bee is now found in just a handful of sites nationally, which includes a modern record in Cambridgeshire, and establishing its status at this site should be a priority.

### Distribution and status

The Grooved sharp-tail bee appears always to have been restricted to the southern half of Britain, and has been assessed as Rare (RDB3) (Falk 1991), following declines. In mainland Europe this species is mostly northern, central and western, perhaps indicating it is more boreo-alpine in nature. In the East of England, the Grooved sharp-tail bee had a scattered distribution taking in four counties. It has not been recorded in Bedfordshire, Essex or Suffolk for 80 years or longer. In Cambridgeshire, this species was discovered in 1997 at Cambridge Botanic Garden on White horehound (*Marrubium vulgare*), although its current status at the site is unknown. This species may be under-recorded due to the typically low density at which it occurs.



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Grooved sharp-tail bee is associated with a range of habitats including heathland and sand dunes, as well as woodland clearings, chalk grassland, and sometimes gardens; wherever its host species can be found. It is a cleptoparasite associated with several bees including the Fork-tailed flower-bee (*Anthophora furcata*), the Four-banded flower bee, and the Black-headed leafcutter bee, along with several other leafcutter bees (*Megachile* spp.) abroad. The Grooved sharp-tail bee has been recorded foraging on bird's-foot-trefoil's and White bryony (*Bryonia alba*) in Britain, but is known to use a wider range of species abroad (Falk 2015) including clovers, vetches, heathers and knapweeds (Falk 1991). Its flower bee (*Anthophora* spp.) hosts are associated with labiates, particularly woundworts and Black horehound, as well as cultivated varieties in urban areas. The Black-headed leafcutter bee feeds on legumes including bird's-foot-trefoils and restharrow (*Ononis* spp.), as well as thistles and Bramble, so the presence of these plants is also an important component. The Grooved sharp-tail targets the nests of its hosts. The Black-headed leafcutter bee typically forms loose nesting aggregations in sandy soils, favouring warm banks and slopes, and has also been reported nesting in wood or under stones. Small Four-banded flower bee nesting aggregations have been observed in sandy ground, especially south-facing slopes, but they will also use walls, whilst the Fork-tailed flower bee excavates a nest in decaying wood, typically using rotting stumps (Falk 2015). The presence of either warm, bare ground, or dead and decaying wood is therefore an important habitat component for the Grooved sharp-tail bee.

## Threats

The decline seen in the Grooved sharp-tail bee is probably largely as a result of habitat loss, fragmentation and degradation as a result of changes in agricultural practice, lack of woodland management, as well as perhaps changing forestry practices that have seen an increase in removal of stumps that may offer suitable nesting opportunities, afforestation of heathland, recreational pressure, scrub encroachment and succession of sand dunes, and insensitive restoration of brownfield sites, which have affected it and its host species. This species is noted as having several hosts, but the pattern of its decline mirrors that of the Black-headed leafcutter bee suggesting a strong dependence on this species (Olds *et al.* 2018). The Black-headed leafcutter bee has undergone a marked decline and retreat towards coastal sites and may also be vulnerable to the effects of climate change such as sea level change, drought and increased storminess, which threaten coastal habitats.

## Habitat management

This species is dependent on flower-rich habitats that provide the legumes and labiates favoured by its hosts, as well as species such as White bryony for its own foraging needs. Warm, bare ground and dead or decaying wood are used as nesting sites by its hosts, predominantly in heathland, woodland and coastal sites. The immediate priority is to establish whether it is still present in the region, if so, habitat management should be put in place to safeguard its host species. This may include promoting structural diversity in heathland, coastal habitats and woodland. New decaying wood habitat can be created using techniques such as ring-barking. Known nesting areas should be kept free from encroaching vegetation, with access managed to prevent erosion and damage.

## Future prospects

It is possible the Grooved sharp-tail bee is still present in Cambridgeshire. Establishing its status and, if confirmed, taking action to safeguard it and its hosts will be important in preventing its extinction in the region.

## Further information

Buglife (2013) Heathland mosaic habitat management

Buglife (2017) Managing woodland for pollinators

### Conservation action

1. Resurvey historic sites, prioritising its last known Cambridgeshire site, and any other suitable sites known to hold populations of its host species to establish extent of current distribution.
2. If presence is confirmed, targeted management should immediately be implemented to safeguard the populations its host species and where possible enable it them to expand their ranges.
3. If presence is confirmed annual monitoring should be established at known sites.

## Sea aster colletes (*Colletes halophilus*)



Sea aster colletes female © Steven Falk

**Habitat** - coastal habitats

**Nesting** - bare ground

**Flight period** - mid-August to October

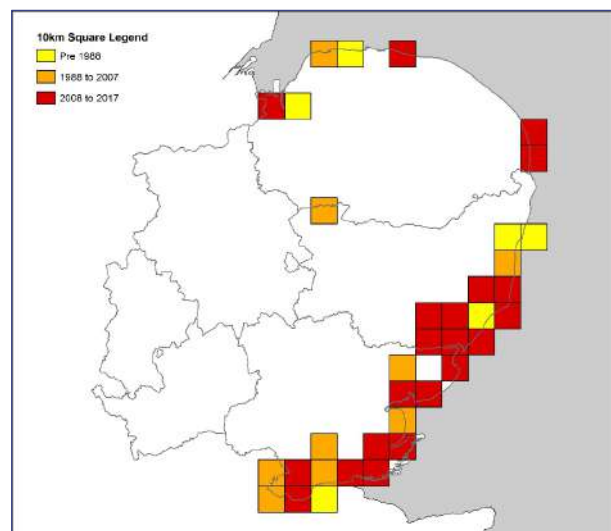
**Pollen source** - strong preference for Sea Aster

A species restricted to coastal areas, where it has a strong association with Sea aster, the Sea aster colletes population in Britain is internationally important, with a high proportion of its colonies found along the East Anglian coast in the East of England.

### Distribution and status

The Sea aster colletes is confined to the coast with records scattered along the eastern and southern coastlines of England between Christchurch Harbour and Spurn Point. It was described as new to science in 1945, following its separation from the similar Heather colletes (*Colletes succinctus*), and it has been recognised as a Species of Principal Importance in England (NERC Act 2006) and is assessed as Nationally Scarce (Notable A) (Falk 1991). Britain holds an important part of the world population of Sea aster colletes. In mainland Europe it is extremely localised and known only from France, Germany, Belgium and the Netherlands. It is assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014).

East Anglia is one of the strongholds for the Sea aster colletes, with recent records scattered



Distribution in the East of England - most recent dates overlay any earlier dates

along the Essex and Suffolk coastline. Its distribution becomes patchier in Norfolk, with the main populations found around Blakeney and Stiffkey in North Norfolk, and Great Yarmouth and Breydon Water on the east Norfolk coast (Owens 2017). The most recent record is from Terrington St Clement in 2016 (Owens 2017). The Thames Estuary is also a stronghold, and here it sometimes nests in brownfield sites with artificially produced substrates such as silt and pulverised fuel ash that are near to suitable saltmarsh vegetation. There is also a record of two females feeding on Common ragwort on Maudscross Hill in Breckland in 2006 (A. Knowles pers. comm. 2019), but this is most likely due to vagrant individuals.

## Ecology

The Sea aster colletes is a late summer and autumn-flying species associated with saltmarsh and other brackish habitats that are close to suitable nesting areas. Its flight period coincides with the peak flowering of its principal pollen source Sea aster (*Aster tripolium*) in August and September, although males can emerge earlier. It will visit a variety of other flowers to a lesser extent, including Bristly oxtongue (*Helminthotheca echioides*), ragworts (*Senecio* spp.), Weld (*Reseda luteola*), Fennel (*Foeniculum vulgare*), Common mallow (*Malva sylvestris*) and Perennial wall-rocket (*Diplotaxis tenuifolia*) (Falk 1991; Hardy 2013; Falk 2015).



Sea aster colletes habitat at Rainham Marshes, Essex © Steven Falk

This is a ground-nesting bee, which appears to favour sunny areas of bare, loose, sandy soil, in flat ground and also within slopes or compacted vertical cliff faces (Falk 2015; A. Knowles pers. obs.). Nest sites are often at the transition between saltmarsh vegetation and drier land (Hardy 2013), but they will also use well-drained land. It can tolerate its nest entrances being inundated by saltwater at the top of the highest tides. Females are noted as foraging widely over saltmarshes (Falk 1991), although it appears to have a tendency for nesting close to areas with abundant Sea aster (Sommeijer *et al.* 2012). The Sea aster colletes is one of the hosts of the cleptoparasitic Black-thighed epeolus (*Epeolus variegatus*).

## Threats

There is no evidence of a decline in the Sea aster colletes however it is vulnerable to the loss, fragmentation and degradation of coastal habitats and brownfield sites. Habitat loss has resulted from intense development pressure, particularly in the Thames Corridor, and some sites remain threatened (Essex Field Club 2019). Agricultural changes such as increased grazing pressure can result in changing plant community composition with an increase in grasses and a decrease in flower-rich areas for foraging. Grazing of saltmarsh is known to affect Sea aster, which is vulnerable to trampling and is very palatable to sheep, cattle and horses (de Vlas *et al.* 2013) but saltmarsh grazing is not commonly practised in the East of England (S. Falk pers. comm. 2019). Sea aster colletes colonies may also be vulnerable to the effects of climate change including sea level change, drought and increased storminess, which threaten their coastal habitats. Whilst this bee has been observed using waterlogged burrows it is at risk from increased inundation and tidal surges such as the loss of a large aggregation at Cley in North Norfolk that was washed away by storms (Owens 2017). There is some suggestion that the squeeze in saltmarsh communities between earth sea wall defences and rising tides is causing a shift in the distribution of the two different forms of Sea aster. The rayed form, with long, blue ray-florets, typically found in upper saltmarsh vegetation, may be becoming scarcer. In contrast, the rayless flower form (with only yellow disc florets), and more typical of lower parts of the saltmarsh community, is becoming more widespread. It is not known how this might affect foraging opportunities and pollen/nectar abundance. There are some physiological differences between the two forms, namely age at time of first flowering, time of flowering and seed germination conditions (Gray 1971).



Sea aster colletes female © Steven Falk

## Habitat management

This species requires suitable sunny nesting sites in close proximity to foraging areas rich in Sea aster. Saltmarsh should be managed rotationally to ensure that flowering patches are maintained along with bare ground within the local landscape. If grazing is an existing management practice this should be at low-intensity and on rotation, where other plants species are becoming dominant and suppressing the Sea aster (de Vlas *et al.* 2013). Cutting and scraping vegetation may also help to control dominant vegetation. Strimming areas of grassland adjacent to Sea aster stands at the end of July or in early August can create nesting opportunities, as well as creating south-facing banks with a high sand content (Buglife 2013).

## Future prospects

The Sea aster colletes population in Britain is internationally important, and many of its colonies are found within the East of England. It is a vulnerable species as a result of its habitat requirements, but there are opportunities to create new foraging and nesting areas as part of managed realignment schemes, which could help this species to colonise previously unoccupied areas.

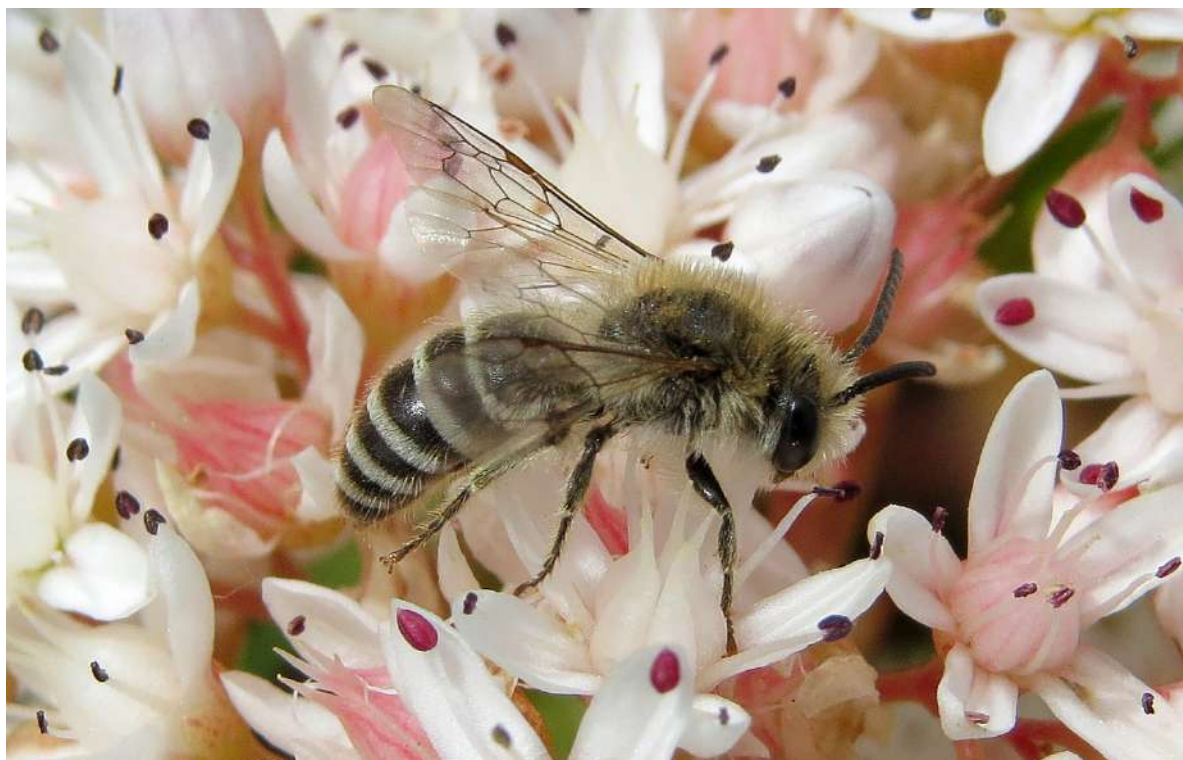
## Further information

Buglife Sea aster mining bee species management sheet

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Make effective use of agri-environment schemes to implement options such as management of coastal saltmarsh.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines and as part of managed realignment schemes. The creation of new nesting mounds may help to encourage the spread of this species and reconnect patches of foraging habitat with core populations.
5. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
6. Work proactively with managers of sea walls to promote their management as a network of flower-rich habitat. Future sea wall managed realignment scheme should allow a full saltmarsh transition vegetation to flourish where the upper saltmarsh, rayed form of Sea aster can survive. A full tidal transition zone will allow for maximum development of Sea aster in the various saltmarsh zones.

## Margined colletes (*Colletes marginatus*)



Margined colletes male © Steven Falk

**Habitat** - sand dunes, vegetated shingle, heathland

**Nesting** - bare ground

**Flight period** - late June to late August

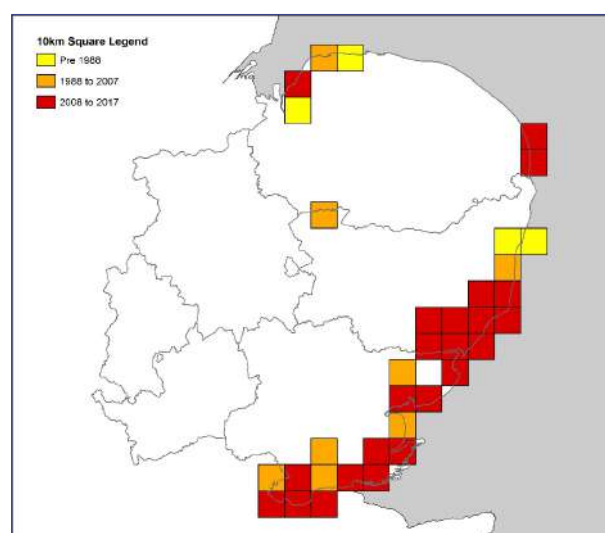
**Pollen source** - polylectic

Britain's smallest colletes bee strongly associated with sandy habitats, the Margined colletes can be found in scattered localities along the coast of the East of England as well as a cluster of inland sites in Breckland.

### Distribution and status

The Margined colletes is generally a coastal species with a patchy distribution in England and Wales (mostly in sand dunes), along with inland populations in Breckland, an area of former inland sand dunes. It is restricted by its habitat requirements, but can be numerous where found and has been assessed as Nationally Scarce (Notable A) (Falk 1991).

In the East of England, the Margined colletes has a patchy distribution along the Essex, Suffolk and Norfolk coastlines, along with a population in the Thames Gateway and the Breckland population. It seems to be most prolific in Suffolk, and Norfolk, but is considered rare in Essex (Essex Field Club 2019).



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Margined colletes is strongly associated with sandy habitats, primarily coastal sand dunes but also heathland on disturbed and wind-blown sand in the Brecks and the sandy parts of vegetated shingle. It flies between late June and late August, where it forages on a range of plants with legumes, Bramble and mignonettes (*Reseda* spp.) appearing to be important pollen sources.

This is a ground nesting bee that forms small nesting aggregations in relatively firm wind-blown soils such as partially vegetated slopes and along footpaths. The Margined colletes is one of the hosts of the cleptoparasitic Red-thighed epeolus (*Epeolus cruciger*).



Margined colletes habitat at Cranwich Heath, Norfolk © Steven Falk

## Threats

This species is restricted by its habitat requirements, which make it vulnerable. It will almost certainly have been affected by habitat loss, fragmentation and degradation, as a result of scrub encroachment and succession on sand dunes, coastal development, recreational pressure resulting in erosion of sand dunes, and afforestation and lack of management of heathland. Margined colletes colonies may also be vulnerable to the effects of climate change including sea level change, drought and increased storminess, which threaten their coastal habitats.

## Habitat management

This species requires sunny nesting sites on sandy soils in close proximity to flower-rich foraging areas. Coastal sand dunes should be managed using grazing and/or cutting to prevent succession of fixed dune grassland with woody plants such as willows (*Salix* spp.) and Bramble, or coarse grasses, and maintain open areas for nesting. Grassy heathland should be managed using grazing and/or cutting to promote structural diversity, development of flower-rich areas and maintenance of open sandy nesting sites.

## Future prospects

The Margined colletes is vulnerable as a result of its habitat requirements, but there are opportunities to create new foraging and nesting habitat, particularly in Breckland.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Identify opportunities to facilitate expansion of existing Breckland populations by implementing habitat management that promotes habitats rich in wild flowers, and suitable open areas for nesting.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Address gaps in autoecological knowledge, specifically its nesting ecology.

## Long-horned bee (*Eucera longicornis*)



Long-horned bee male © Steven Falk

**Habitat** - grassland, coastal habitats

**Nesting** - bare ground

**Flight period** - mid-May to August

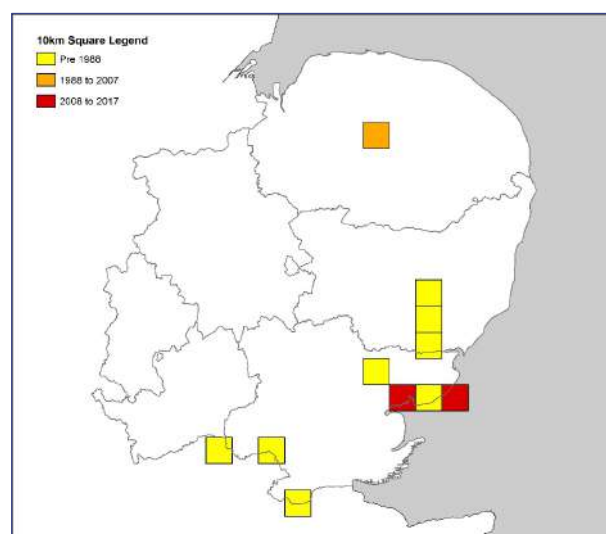
**Pollen source** - oligolectic on Fabaceae

A large and distinctive bee that relies on habitats rich in large-flowered legumes, the Long-horned bee is on the edge of its range and scarce in the East of England. Establishing its current status in the region should be a priority with conservation action to protect any extant colonies.

### Distribution and status

A large mining bee with the male instantly recognisable by his long antennae, the Long-horned bee has a patchy distribution in southern Britain but can sometimes be locally common. It has declined significantly, retreating towards the coast in many areas, and has been recognised as a Species of Principal Importance in England (NERC Act 2006) and is assessed as Nationally Scarce (Notable A) (Falk 1991). It is widespread in mainland Europe and Asia.

The Long-horned bee is on the northern edge of its range and, as such, is scarce in the region, with few modern records. The most recent records in Essex are from Fingringhoe Marshes in 2018 and Holland Haven in 2013. The last record in Norfolk is from Hoe Rough in 2006, although it is now



Distribution in the East of England - most recent dates overlay any earlier dates



presumed extinct in the county (Owens 2017). It has not been recorded in Suffolk for over 80 years.

## Ecology

The Long-horned bee can occur in a range of habitats that are rich in legumes, including lowland meadows, heathlands, woodland clearings and rides, coastal habitats including soft rock cliffs, and coastal grazing marsh, as well as road verges. There have been some recent expansions into inland sites such as sand pits and mineral extraction sites in parts of the Midlands (Olds *et al.* 2018; S. Falk pers. comm. 2019). It flies from May to mid-August, with females appearing after males and persisting much longer. The Long-horned bee is oligolectic on legumes including Meadow vetchling, Kidney vetch, bird's-foot-trefoils, clovers, everlasting-peas (*Lathyrus* spp.) and vetches. Other forage plants include Labiates such as Bugle (*Ajuga reptans*) and Ground-ivy, as well as geraniums (*Geranium* spp.), comfrets (*Symphytum* spp.) and Bramble.



Long-horned bee male at nest site © Steven Falk

The Long-horned bee is a ground-nesting bee, forming aggregations in bare or sparsely-vegetated light soils on warm, sunny slopes and banks or cliff faces. It is the host for the rare cleptoparasitic Six-banded nomad bee, which is regionally extinct in the East of England, and now confined to a small area of South Devon.

## Threats

The decline of the Long-horned bee is probably largely as a result of changes in agricultural practice that have led to legume-rich habitat becoming a less common component of the farming system. These include improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), loss of flower-rich arable margins and a decline in mixed farms. Coastal development, cliff stabilisation and changes in woodland management that have reduced the availability of woodland clearings have probably also contributed to losses.

## Habitat management

This species requires habitats rich in legumes, especially large-flowered species, which the female requires for pollen, as well as access to bare or sparsely-vegetated slopes or banks for nesting. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. Less intensive farmland management that incorporates fallow areas, uncultivated margins, and reduces herbicide use will allow flowering plant communities to develop and provide connectivity needed by this and other species. New legume-rich habitat can readily be created. Woodland sites should be managed rotationally to promote structural diversity and maintain sunny and sheltered clearings to encourage development of ground flora. Rides with scalloped or uneven edges, and that transition from short vegetation, through tall herbs and scrub, to trees, will



Long-horned bee female © Steven Falk

offer more opportunities. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub, as part of the habitat mosaic.

## Future prospects

The Long-horned bee is on the edge of its range and scarce in the East of England, and establishing its current status in the region should be a priority.

## Further information

Buglife (2013) Coastal grazing marsh mosaic habitat management

Buglife (2013) Heathland mosaic habitat management

Buglife (2017) Long-horned bee species management sheet

### Conservation action

1. Survey historic sites, with priority for its last known Essex sites, and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, low intensity grassland management and management of field corners. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
6. Work proactively with managers of coastal habitats including cliffs to promote their management as a network of flower-rich habitat and avoid activities that may significantly reduce or accelerate the natural rate of coastal erosion.
7. Ensure the requirements of this species are understood by those preparing coastal zone management plans.
8. Work proactively with managers of sea walls to promote their management as a network of flower-rich habitat.
9. Engage with the general public to encourage planting of large-flowered *Lathyrus* species in gardens close to areas with known populations
10. Establish monitoring at its known sites.
11. Address gaps in autoecological knowledge, including whether the decline in this species is partly due to a lack of open woodland glades (Olds *et al.* 2018).

## Southern bronze furrow bee (*Halictus confusus*)



Southern bronze furrow bee female © Steven Falk

**Habitat** - heathland, sandpits

**Nesting** - bare ground

**Flight period** - April to September

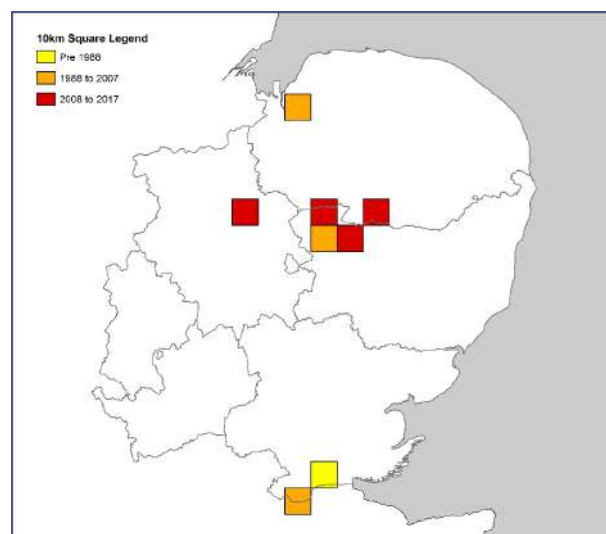
**Pollen source** - polylectic

Breckland appears to be significant as one of the British strongholds of this scarce and restricted species.

### Distribution and status

A small furrow bee of sandy habitats, the Southern bronze furrow bee has a patchy distribution in the south and east of England, with most records from the heathlands of Dorset, the New Forest, West Sussex and Surrey, as well as Breckland (Falk 2015). It is possibly overlooked at some suitable sites, as it can be difficult to separate from the similar Bronze furrow-bee (*Halictus tumulorum*) (Knowles 2017).

In the East of England this species has mostly been found in Breckland (most recently Lackford Lakes in 2017), although there are a couple of old records from Essex. In 2018 some specimens were found in pan trap samples in the Cambridgeshire Fens (S. Falk pers. comm. 2019).



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Southern bronze furrow bee shows a strong association with sandy habitats including heathland and sandpits. It has a long flight season, and has been recorded visiting a range of plants including Bramble, Asteraceae, cinquefoils (*Potentilla* spp.), heathers and speedwells (Falk 2015). This is a ground-nesting bee, which appears to nest in light soils, often at the base of plants (Falk 2015).

## Threats

The loss of heathland including destruction for agriculture, forestry and development, as well as changes in heathland management that lead to a loss of bare ground or succession, are likely to have contributed to the decline of the Southern bronze furrow bee.



Southern bronze furrow bee habitat at East Wretham Heath, Norfolk © Steven Falk

## Habitat management

This species requires open areas for nesting and access to foraging resources from late-spring into early autumn. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub, and protected from excessive disturbance. Bracken and scrub should be maintained in discrete areas, whilst preventing over-colonisation of the heathland.

## Future prospects

This species is tied to sandy habitats and work to improve management of and, where possible, reconnect fragmented habitats could help it to safeguard it in the region at one of its national strongholds.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Manage known sites to provide structural diversity of heathland including hot, sheltered areas of loose sand for nesting.
3. Identify opportunities to facilitate expansion of existing populations such as clearance of afforested areas to restore open heathland vegetation and creation of bare, sandy ground.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.

## Shingle yellow-face bee (*Hylaeus annularis*)



Shingle yellow-face bee female © Steven Falk

**Habitat** - coastal vegetated shingle, sand dunes

**Nesting** - bare ground, plant stems

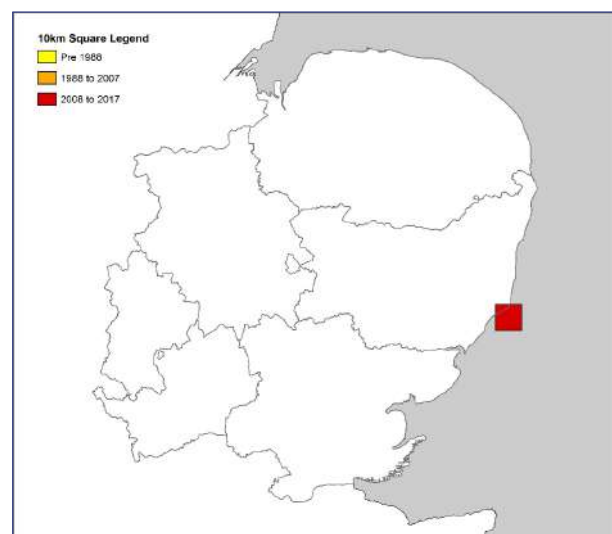
**Flight period** - mid-June to late August

**Pollen source** - polylectic

A small bee of coastal habitats, primarily associated with coastal vegetated shingle, the Shingle yellow-face bee has a restricted distribution along the south coast of England, with an outlier site in Suffolk. Establishing its current status in the East of England should be a priority.

### Distribution and status

The Shingle yellow-face bee has a restricted distribution in the UK, found only at scattered sites along the south coast of England (Falk 2015). This species has been subject to recent nomenclature changes, which make interpretation of the data difficult, however it is believed that in the East of England, only the records from Orford Ness in Suffolk refer to this species. It was last recorded here in 2012. In mainland Europe the Shingle yellow-face bee is found predominantly in the south-west, as well as north-eastern Africa, suggesting it is at the edge of its range in Britain, and increasing its vulnerability.



Distribution in the East of England - most recent dates overlay any earlier dates

### Ecology

The Shingle yellow-face bee is primarily associated with coastal vegetated shingle and to a lesser extent sand dunes (Falk 2015). It is a summer-flying species, that forages on a range of plants including Sea kale (*Crambe maritima*), along with Apiaceae such as Wild parsnip (*Pastinaca sativa*), Wild carrot (*Daucus carota*) and Fennel, as well as Sea spurge (*Euphorbia paralias*), Bramble, mallows (*Malva* spp.), Biting stonecrop (*Sedum acre*) and various Asteraceae. Nesting has been recorded in hollow plant stems and loose sandy ground (Falk 2015).

This species has been known as *Hylaeus euryscapus* or *H. spilotus* previously with the more common *H. dilatatus* being called *H. annularis* until recently (Falk 2015).

## Threats

This species is restricted by its habitat requirements, which make it vulnerable to factors that threaten coastal vegetated shingle and sand dune habitats. These include coastal development (including coastal defences, which can affect sediment supply), aggregate extraction, recreational pressure, and habitat loss, fragmentation and degradation, as a result of invasive non-native plant species and scrub encroachment. The Shingle yellow-face bee may also be vulnerable to the effects of climate change including sea level change, drought and increased storminess, which threaten their coastal habitats.



Shingle yellow-face bee habitat at Orford Ness, Suffolk © Steven Falk

## Habitat management

This species requires sandy soils in close or hollow plant stems for nesting, in proximity to flower-rich foraging areas. Minimising disturbance is one of the best management practices for coastal vegetated shingle, the primary habitat of the Shingle yellow-face bee. Management of adjacent coastal grassland or fixed dune grassland using grazing and/or cutting to prevent succession with woody plants such as willows (*Salix* spp.) and Bramble, or coarse grasses, will help promote structural diversity, development of flower-rich areas and maintenance of open areas for nesting. Some scrub can be valuable, and hollow woody stems of plants such as Bramble could also be utilised by this species for nesting

## Future prospects

The population of Shingle yellow-face bee is nationally significant and as an outlier site the Orford Ness population is almost certainly vulnerable.

### Conservation action

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, with a priority of understanding its current status at Orford Ness.
2. Identify opportunities to facilitate expansion of existing Suffolk population by implementing habitat management that promotes habitats rich in wild flowers and suitable areas for nesting.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Address gaps in autoecological knowledge, which include its nesting ecology.
5. Raise awareness of this species as a key specialist species of coastal vegetated shingle.

## Tufted furrow bee (*Lasioglossum nitidiusculum*)



Tufted furrow bee female © Steven Falk

**Habitat** - coastal, heathland, brownfield, grassland  
**Nesting** - bare ground

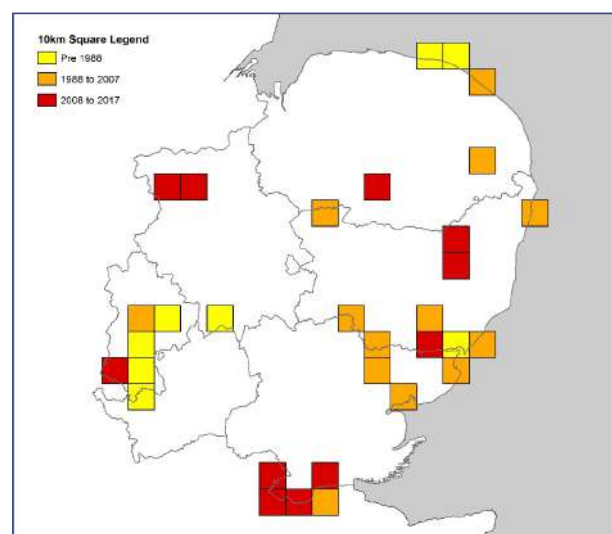
**Flight period** - March to September  
**Pollen source** - polylectic, preference for Asteraceae

A small bee of heathland and coastal habitat, the Tufted furrow bee is localised in Britain and has a scattered distribution in the East of England.

### Distribution and status

The Tufted furrow bee is widely distributed in Britain, but localised and has declined significantly in recent decades, now rarely found frequently (Falk 2015). It has some strong populations in eastern Scotland and does seem to be declining more in the south of its range, which could be linked to climate change.

In the East of England, it has a scattered distribution, with a handful of modern records in most counties. In Bedfordshire it was last recorded in 2000 at a disused landfill site in Cople. In Cambridgeshire it has been recorded at three former clay pits (Kings Dyke Pit, Orton Pit and Whittlesey Brick Pit) in the last ten years, with the most recent record from Kings Dyke Pit in 2011. The Essex locations are brownfield sites, and it was most recently recorded in Tilbury in 2018, although it appears to be declining in



Distribution in the East of England - most recent dates overlay any earlier dates

abundance (Essex Field Club 2019). There are few modern records in Suffolk (Knowles 2015), with records in the last ten years from three sites; one coastal (Holbrook 2015) and two inland (Worlingworth 2016, Stradbroke 2017).

## Ecology

The Tufted furrow bee is associated with a range of habitats, principally on sandy soils, including coastal habitats such as cliffs and grasslands, heathlands, brownfield sites and grassland. It has a long flight season, particularly the females, which can be found from March to October, foraging on a range of plants, but seemingly with a preference for 'yellow composite' Asteraceae (Falk 2015). This is a ground-nesting bee, which typically nests in south-facing slopes and cliff faces, where it appears to be solitary, but may form aggregations (Falk 2015). The Tufted furrow bee is reported among the hosts of several cleptoparasites, including the blood bees Swollen-thighed blood bee (*Sphecodes crassus*), Geoffroy's blood bee (*S. geoffrellus*) and False margined blood bee (*S. miniatus*), as well as Sheppard's nomad bee (Falk 2015), a species which is also considered to be of conservation concern in the East of England.

## Threats

The reasons for the rarity of the Tufted furrow bee are not fully understood however it does seem to be declining more in the south of its range, which could be linked to climate change, although it is still abundant in the Channel Islands, which indicates habitat loss and fragmentation is probably an important factor. Declines are likely to reflect the loss of flower-rich habitats as a result of improvement of grassland, inappropriate grazing (under-grazing, over-grazing, timing and livestock type), cessation of management and development. It may also have been affected by the insensitive restoration of brownfield and mineral extraction sites, which have much potential for this and other bee and invertebrate species, as well as coastal development, cliff stabilisation and the acceleration of cliff erosion.

## Habitat management

This species requires flower-rich habitats, particularly those with 'yellow composite' Asteraceae and access to bare or sparsely-vegetated slopes or banks for nesting. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub as part of the habitat mosaic.

## Future prospects

The declines in the Tufted furrow bee are not fully understood. If it is sensitive to climate change, it may decline in the southern parts of its range.

## Further information



### **Conservation action**

1. Survey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution, identify new or relict populations, and understand current status at existing sites.
2. Make effective use of agri-environment schemes to implement options such as low intensity grassland management. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Promote the appropriate management of brownfield and mineral extraction sites to conserve populations in these habitats, and raise their profile as important sites for invertebrates.
5. Address gaps in autoecological knowledge, in particular nesting ecology, specific habitat requirements and cleptoparasites.
6. Establish monitoring at its known sites.

## Black-headed leafcutter bee (*Megachile circumcincta*)



Black-headed leafcutter bee male © Steven Falk

**Habitat** - sand dunes, heathland, brownfield

**Nesting** - bare ground, plant stems

**Flight period** - late May to early August

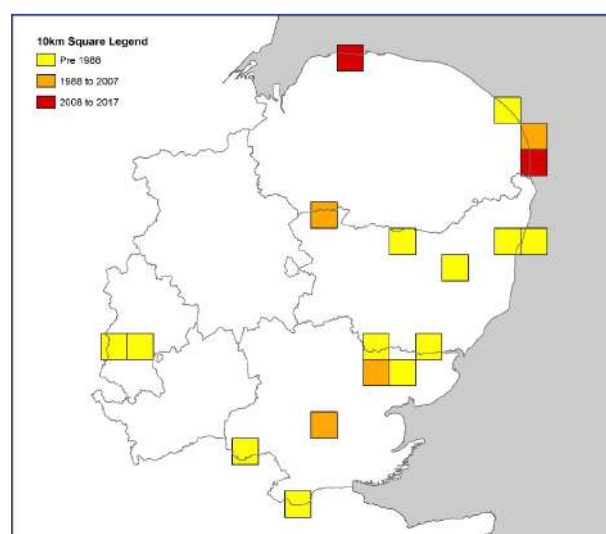
**Pollen source** - polylectic

A species of habitats on sandy soils, the Black-headed leafcutter bee has undergone a marked decline and retreat towards coastal sites. There are few records in the East of England, and its current status should be established as a priority.

### Distribution and status

The Black-headed leafcutter bee has a widespread distribution in Britain but declines have seen many of the inland colonies vanishing, particularly in the south leaving this species almost entirely confined to coastal areas. This species occurs throughout much of mainland Europe and into Asia.

The Black-headed leafcutter bee has a scattered distribution across the East of England, however there are few recent records, with this species last recorded at West Bergholt Heath in Essex in 1997 and more recently in Norfolk at Great Yarmouth in 2015 and Holkham in 2016 (Owens 2017). The declines in this region seem to mirror the coastal retreat seen by this bee in other areas of Britain.



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

The Black-headed leafcutter bee is associated with habitats on sandy soils including heathland, sand dunes and coastal brownfield sites. It is a summer-flying species, and forages on a range of plants including legumes such as bird's-foot-trefoils, Broom (*Cytisus scoparius*) and restharrow, as well as Bramble and thistles (Falk 2015). On the west coast of Britain, it seems to forage primarily on bird's-foot-trefoils (S. Falk pers. comm. 2019).

The Black-headed leafcutter bee typically forms loose nesting aggregations in sandy soils, favouring warm banks and slopes. It has also been reported nesting in wood or under stones, and it uses sections of rose (*Rosa* spp.) and birch (*Betula* spp.) leaves to create nest cells (Falk 2015). The Black-headed leafcutter bee is reported among the hosts of several cleptoparasites, including Dull-vented sharp-tail bee (*Coelioxys elongata*), Square-jawed sharp-tail bee (*C. mandibularis*), Grooved sharp-tail bee and Rufescent sharp-tail bee (*C. rufesens*). It does not appear to be the main target for any except the severely declined Grooved sharp-tail bee, which is also considered to be a threatened species in the East of England.

## Threats

The decline seen in the Black-headed leafcutter bee is most likely linked to habitat loss, fragmentation and degradation as a result of afforestation and management cessation on heathland, changes in agricultural practice, and recreational pressure, scrub encroachment and succession on sand dunes. It may also have been affected by the insensitive restoration of brownfield and mineral extraction sites, which have much potential for this and other bee and invertebrate species. This species appears to be declining in the south of its range, suggesting it may also be affected by climate change and nesting colonies may also be vulnerable to sea level change, drought and increased storminess, which threaten their coastal habitats.

## Habitat management

This species requires areas of sand dunes, heathland or brownfield rich in flowers, particularly legumes in close proximity to warm banks and slopes on sandy soils for nesting. Coastal sand dunes should be managed using grazing and/or cutting to prevent succession of fixed dune grassland with woody plants such as willows and Bramble, or coarse grasses, and maintain nesting areas. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers, bare ground and open sunny areas. Rotational small-scale clearance on brownfield sites can help to maintain flower-rich areas and a range of successional habitats. New legume-rich habitat can readily be created. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub as part of the habitat mosaic, with access in sand dunes managed to prevent erosion and damage.

## Future prospects

It is possible that this species is retreating northwards in response to climate change. Establishing its current status in the region should be a priority.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Survey historic sites, with priority for its last known Norfolk sites, and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Provide guidance to site managers to secure appropriate management at confirmed sites, raise awareness of this species' ecology, and promote its spread.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines. In particular the provision of legume-rich habitats should be prioritised in association with any extant sites.
4. Establish monitoring at its known sites.
5. Address gaps in autoecological knowledge, in particular nesting ecology and cleptoparasites.

## Gold-tailed melitta (*Melitta haemorrhoidalis*)



Gold-tailed melitta female © Steven Falk

**Habitat** - grassland, heathland, open woodland

**Nesting** - bare ground

**Flight period** - mid-July to early September

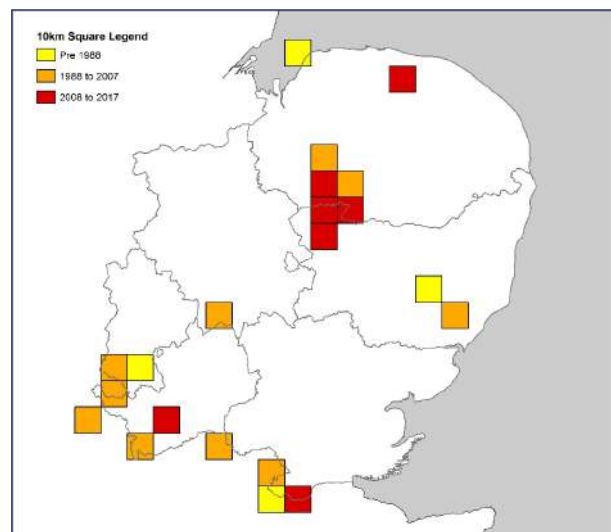
**Pollen source** - oligolectic on Campanulaceae

A species of unimproved grassland, heathland and woodland clearings where its forage plants grow, the Gold-tailed melitta has a scattered distribution in the East of England, with apparent strongholds in Breckland and the Thames Gateway.

### Distribution and status

The Gold-tailed melitta has a widespread but local distribution in southern Britain, and is much more scattered further north. In mainland Europe it has a wide distribution.

In the East of England, the Gold-tailed melitta is localised with scattered records from across the region, and an apparent hotspot in Breckland and Thetford Forest. In Bedfordshire, it was recorded in the south of the county at Whipsnade in 2005, following an absence of 70 years. The most recent records from Norfolk are from Swanton Novers Great Wood in 2015 and Fritcham in 2016, (Owens 2017). The most recent record from Suffolk is from Cavenham Heath in 2015. Records from Essex are in the Thames Gateway, most recently from a garden in Grays



Distribution in the East of England - most recent dates overlay any earlier dates

in 2017, and in Hertfordshire, this species was also recorded in a garden in 2016.

## Ecology

The Gold-tailed melitta is associated with a chalk grassland, heathland and acid grassland, as well as woodland clearings, and sometimes gardens and other urban areas (Falk 2015). It is a summer-flying species and is oligolectic on bellflowers (*Campanula* spp.), with records of foraging on Harebell (*C. rotundifolia*), Clustered bellflower (*C. glomerata*) and Nettle-leaved bellflower (*C. trachelium*). Other forage plants include crane's-bills (*Geranium* spp.), Musk-mallow (*Malva moschata*) and Hemp-agrimony (*Eupatorium cannabinum*). This is a ground-nesting bee, with nesting observed in small aggregations in light soils, including on banks. The Blunthorn nomad bee (*Nomada flavopicta*) is a cleptoparasite of several blunthorn bees (*Melitta* spp.), which includes the Gold-tailed melitta in mainland Europe, and almost certainly in Britain (S. Falk pers. comm. 2019).



Gold-tailed melitta male © Steven Falk

## Threats

The Gold-tailed melitta is reliant upon the presence of bellflowers from which it gathers pollen. Harebell and Clustered bellflower are vulnerable to grassland improvement and inappropriate grazing (under-grazing, over-grazing, timing and livestock type), whilst Nettle-leaved bellflower, which tends to grow in more shady, woody habitats can be affected by lack of woodland management that reduces the availability of clearings and rides.

## Habitat management

This species requires habitats rich in bellflowers, particularly grasslands and heathland, as well as access to nesting areas in light soils. Existing species-rich grasslands should be cut with arisings removed and/or grazed on rotation, and heathland should be managed using grazing and/or cutting to provide structural diversity and help to ensure a good abundance of flowering bellflowers. Woodland sites should be managed rotationally to promote structural diversity and maintain sunny and sheltered clearings to encourage development of ground flora. Rides with scalloped or uneven edges, and that transition from short vegetation, through tall herbs and scrub, to trees, will offer more opportunities. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub as part of the habitat mosaic.

## Future prospects

Management of grasslands, heathland and woodland to promote the growth of bellflowers should benefit this species as well as a range of other bees and invertebrates.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Resurvey historic sites and any other suitable linked/proximal habitat to establish extent of current distribution and identify new or relict populations.
2. Identify opportunities to facilitate expansion of existing population through promoting the growth of bellflowers at and surrounding its known sites.
3. Make effective use of agri-environment schemes to implement options such as low intensity grassland management. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.

## Silver-sided nomad bee (*Nomada argentata*)



Silver-sided nomad bee male © Steven Falk

**Habitat** - chalk grassland, heathland, coastal habitats  
**Nesting** - bare ground (cleptoparasitic)

**Flight period** - mid-July to mid-September  
**Pollen source** - cleptoparasitic, host has a preference for scabiouses

A rare and declining species, which is now nationally restricted to a few sites including Breckland. The colonies found in Norfolk and Suffolk are believed to be of national significance, and establishing their current status should be a priority.

## Distribution and status

The Silver-sided nomad bee is a rare and much declined species of southern Britain. It is now restricted to a handful of areas including Breckland and has been assessed as Rare (RDB3) (Falk 1991). In mainland Europe the Silver-sided nomad bee has a wide distribution.

Records of the Silver-sided nomad bee are patchy and localised. Breckland is one of its remaining strongholds, making the colonies found in Norfolk and Suffolk of national significance, however even here there are few Suffolk records (Knowles 2015). The most recent records for the region are from Cranwich Heath and Middle Harling Heath in 2016 (Owens 2017). It is believed to be long extinct in Bedfordshire, Cambridgeshire and Essex.

## Ecology

The Silver-sided nomad bee is primarily associated with scabious-rich chalk grassland, heathland and acid grassland where its host species can be found, and it can also occur in woodland clearings and coastal habitats such as sand dunes (Falk 2015). It flies in late summer and forages mainly on scabiouises but will also visit thistles (Falk 2015). The Silver-sided nomad bee is a cleptoparasite on the Small scabious mining bee, which is restricted by its reliance upon scabious-rich habitats. It forages on Field scabious (*Knautia arvensis*) and Small scabious (*Scabiosa columbaria*) in calcareous habitats and Devil's-bit scabious (*Succisa pratensis*) on heathland and acid grassland. Most if not all of the modern East of England sites seem to fall into the calcareous category (S. Falk pers. comm. 2019). The Silver-sided nomad bee targets the nests of its host, which favours short or sparsely-vegetated ground on light soils, in sunny situations including south-facing slopes and along tracks.

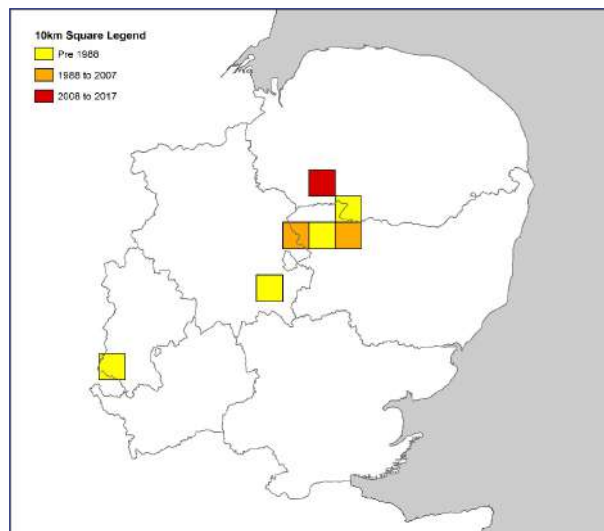
## Threats

The decline seen in the Silver-sided nomad bee is probably largely as a result of habitat loss, fragmentation and degradation resulting from changes in agricultural practice, including improvement of grassland and inappropriate grazing (under-grazing, over-grazing, timing and livestock type), as well as afforestation of heathland and lack of woodland management that have affected its host. Its decline mirrors that of its host however it is considered much scarcer, which suggests there could be other factors involved such as the loss of strong host metapopulations (Olds *et al.* 2018) or climate change.

## Habitat management

This species is dependent on scabious-rich habitats along with access to warm, bare nesting sites favoured by its host. Grasslands should be cut with arisings removed and/or grazed on rotation to maintain open areas with plenty of scabious. Known nesting areas should be kept free from encroaching vegetation.

## Future prospects



Distribution in the East of England - most recent dates overlay any earlier dates



Silver-sided nomad bee habitat at Red Lodge, Suffolk © Steven Falk

Breckland appears to be one of the strongholds of the Silver-sided nomad bee. Its host the Small scabious mining has a wider distribution in the region and safeguarding its populations and enabling them to expand their range could help conserve the Silver-sided nomad bee.

### Further information

Buglife (2013) Chalk downland mosaic habitat management

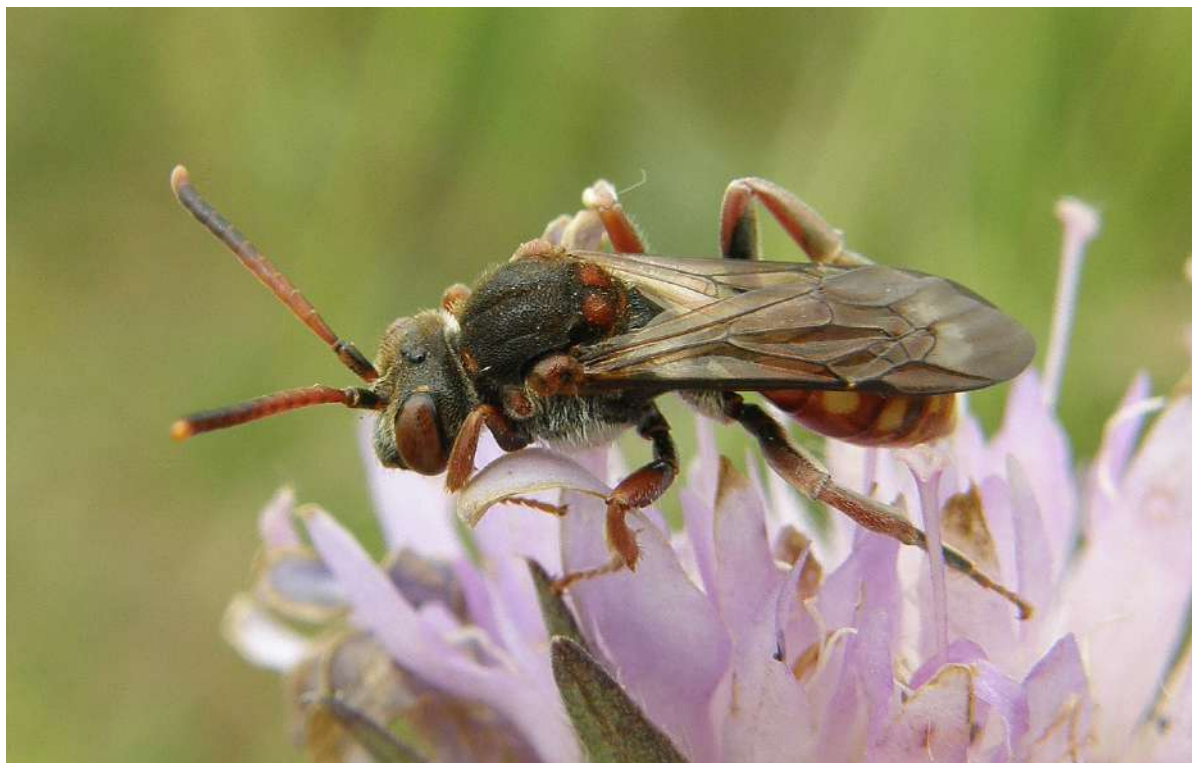
Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Resurvey historic sites and any other suitable sites known to hold populations of its host species to establish extent of current distribution.
2. Identify opportunities to facilitate expansion of existing population through promoting the growth of scabioues at and surrounding its known sites.
3. Make effective use of agri-environment schemes to implement options such as low intensity grassland management. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Establish monitoring at its known sites.

## Armed nomad bee (*Nomada armata*)

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Armed nomad bee female © Steven Falk

**Habitat** - chalk grassland, soft rock cliffs

**Nesting** - bare ground (cleptoparasitic)

**Flight period** - late June to early August

**Pollen source** - cleptoparasitic, host is oligolectic on scabioues



A rare and declining species, which has previously been recorded in the region, establishing its current status should be a priority.

## Distribution and status

The Armed nomad bee is a rare and much declined species of southern and central England and South Wales. It is much more restricted than its host, with modern records concentrated on Salisbury Plain, with outlying sites in Dorset and Oxfordshire (Falk 2015). It has been assessed as Endangered (RDB1) in Britain (Falk 1991) and recognised as a Species of Principal Importance in England (NERC Act 2006), and is also assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014).

In the East of England, it has been recorded from Essex and Norfolk, and most recently from Kings Dyke in Cambridgeshire in 2011. Its host the Large scabious mining bee has been recorded more widely in the region, with Breckland being one of its strongholds, and it is possible the Armed nomad bee still survives here (Owens 2017). During 2018 there were records from Buckinghamshire and Oxfordshire, which could indicate it remains in previous outlier sites or is expanding its range.

## Ecology

A species of open calcareous grassland, and previously in coastal areas, with plentiful scabious, where it is a cleptoparasite of the Large scabious mining bee, which is itself considered rare (Falk 1991). It flies during the summer, coinciding with the peak activity of its host, which is dependent upon habitats that support sufficient scabious. The Armed nomad bee has been recorded foraging mainly on Field scabious and Small scabious (Falk 2015).

It targets the nests of its host, which has dispersed nests in bare ground or short swards (Falk 2015).

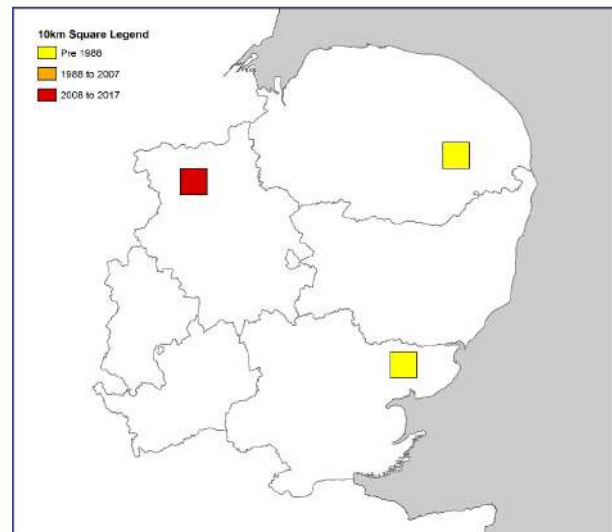
## Threats

The decline seen in the Armed nomad bee is probably largely as a result of habitat loss, fragmentation and degradation resulting from changes in agricultural practice, including improvement of grassland and inappropriate grazing (under-grazing, over-grazing, timing and livestock type) that have affected its host. Scabiousses are particularly vulnerable to over-grazing (Buglife 2013).

## Habitat management

This species is dependent on scabious-rich habitats along with access to warm, bare nesting sites favoured by its host. Grasslands should be cut with arisings removed and/or grazed on rotation to maintain open areas with plenty of scabious. Known nesting areas should be kept free from encroaching vegetation.

## Future prospects



Distribution in the East of England - most recent dates overlay any earlier dates



Armed nomad bee host (Large scabious mining bee) habitat at Red Lodge, Suffolk © Steven Falk

It is possible that the Armed nomad bee is still present in Breckland and priority should be given to establishing its current status, and if present, safeguarding the scabious-rich habitats required by it and its host.

### **Further information**

Buglife (2013) Armed nomad bee species management sheet

Buglife (2013) Chalk downland mosaic habitat management

#### **Conservation action**

1. Resurvey historic sites and any other suitable sites known to hold populations of its host species to establish extent of current distribution.
2. Identify opportunities to facilitate expansion of existing population through promoting the growth of scabioues at and surrounding its known sites.
3. Make effective use of agri-environment schemes to implement options such as low intensity grassland management. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
5. Establish monitoring at any extant sites found.

## Bear-clawed nomad bee (*Nomada baccata*)



Bear-clawed nomad bee female © Steven Falk

**Habitat** – heathland

**Nesting** - bare ground (cleptoparasitic)

**Flight period** - July to early September

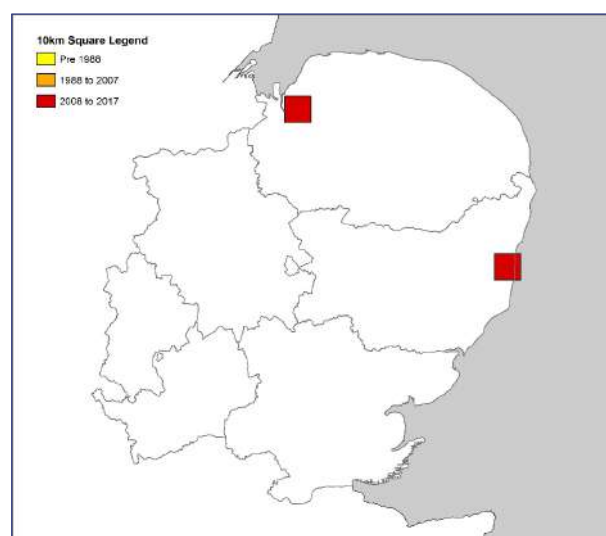
**Pollen source** - cleptoparasitic, host is polylectic

The Bear-clawed nomad bee has a strong association with heathland and in the East of England is currently only known from small areas of Norfolk and Suffolk.

### Distribution and status

A small and distinctive nomad bee with a localised distribution on the heathlands of southern England, which can be abundant where found (Falk 2015), the Bear-clawed nomad bee has been assessed as Nationally Scarce (Notable A) (Falk 1991). This species is widely distributed in northern and central areas of mainland Europe; however, it is assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014).

There are modern records from heathland around Dunwich, Minsmere and Westleton in coastal Suffolk with the most recent from Westleton Heath in 2017. The first county record for Norfolk was from Roydon Heath in 2016 (Owens 2017) and it has most recently been recorded here and at the adjacent Grimston Warren in 2018 (M. Welch pers. comm. 2019).



Distribution in the East of England - most recent dates overlay any earlier dates

These are outlier sites from its core distribution which comprises the heathlands of Surrey, Hampshire and Dorset.

## Ecology

The Bear-clawed nomad bee is cleptoparasitic and as such shows a strong association with heathland, where its host species the Small sandpit mining bee can be found. It flies during the summer where it forages on a range of plants including heathers, Bramble, Common ragwort and thistles, while its host has been recorded foraging on a range of plants, with heathers thought to be an obligate requirement (Falk 2015).

The Bear-clawed nomad bee targets the nests of its host, actively digging into their burrows. Small sandpit mining bees nest in aggregations in areas with loose sand exposed to full sun, especially where pits and cuttings are present.



Bear-clawed nomad bee habitat at Minsmere, Suffolk © Steven Falk

## Threats

The decline seen in the Bear-clawed nomad bee is probably largely as a result of loss of heathland including destruction for agriculture, forestry and development, as well as changes in heathland management that lead to a loss of bare ground and structural diversity, which have affected its host.

## Habitat management

This species is reliant upon strong populations of its host, which requires disturbed sandy areas for nesting and access to foraging resources including heathers, during summer and early autumn. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub, and protected from excessive disturbance. Scrapes of vegetation in sunny locations could provide the hot, sheltered nesting spaces favoured by this species. Bracken and scrub should be maintained in discrete areas, whilst preventing over-colonisation of the heathland.

## Future prospects

The Bear-clawed nomad bee is dependent upon the fate of its host, which in turn relies upon appropriate heathland management. The populations in the East of England appear to be outliers from its core populations on the heathlands of southern England, which could increase its vulnerability.

## Further information

Buglife (2013) Heathland mosaic habitat management

### Conservation action

1. Resurvey historic sites and any other suitable sites known to hold populations of its host species to establish extent of current distribution.
2. Manage known sites to provide structural diversity of heathland including open heathland and hot, sheltered areas of loose sand for nesting.
3. Identify opportunities to connect fragmented or isolated patches of heathland to facilitate expansion of populations of the host species, through clearance of afforested or scrubby areas to restore open heathland.
4. Establish monitoring at its known sites.

## Kirby's nomad bee (*Nomada subcornuta*)



Kirby's nomad bee female © Steven Falk

**Habitat** - heathland, brownfield, sandy arable margins

**Nesting** - bare ground (cleptoparasitic)

**Flight period** - early May to mid-July

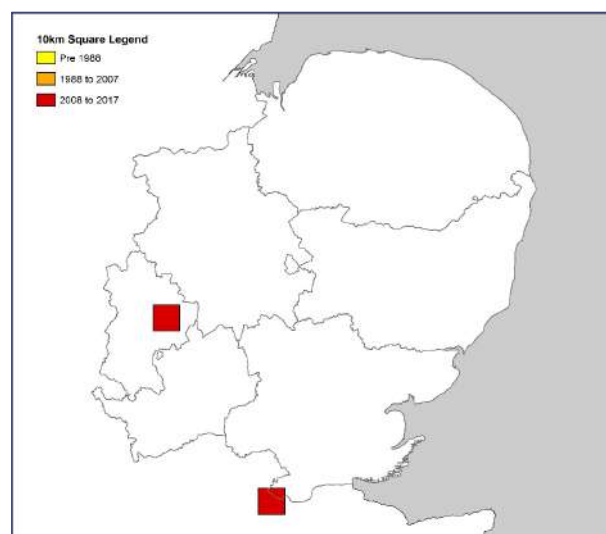
**Pollen source** - cleptoparasitic, host has a preference for Brassicaceae

Only recently split from a similar species, Kirby's nomad bee has a scattered distribution in southern England, which includes Bedfordshire and Essex.

### Distribution and status

Kirby's nomad bee was previously regarded as a subspecies of the Orange-horned nomad bee (*Nomada fulvicornis*), however DNA analysis confirmed its species status (Falk 2015). This recent split makes analysis of historic datasets difficult, but Kirby's nomad bee is considered to have had a scattered distribution in southern England but is much declined (Falk *et al.* 2017).

In the East of England this species has been recorded on RSPB-managed heathland at Sandy in Bedfordshire. It has also been found at several brownfield sites in the Thames Gateway in Essex, (A. Knowles pers. comm. 2019), where it is highly threatened through development pressure.



Distribution in the East of England - most recent dates overlay any earlier dates

## Ecology

Kirby's nomad bee is associated with sandy habitat, particularly heathland, but also brownfield sites and sandy arable land. It is a spring- and summer-flying species, which has currently only been reported foraging on Bramble. Its host the Scarce black mining bee gathers pollen from several crucifer species, in particular Wild radish (*Raphanus raphanistrum*), but also Hoary mustard (*Hirschfeldia incana*), Turnip (*Brassica rapa*) and Oilseed rape, as well as poppies (*Papaver* spp.) and umbellifers (Jukes 2009; Falk 2015). It has a strong association with sandy ground. Kirby's nomad bee targets the nests of its host, which forms loose aggregations in sandy ground in arable margins and along footpaths that are bare but not churned up, with good access to crucifer-rich habitats.



Scarce black mining bee habitat at Sandy Warren, Bedfordshire © Steven Falk

## Threats

Declines in this species are most likely attributed to loss, fragmentation and degradation of heathland, including destruction for agriculture, forestry and development, and changes in management that lead to a loss of bare ground and structural diversity, as well as changes in farmland management, and the loss and insensitive restoration of brownfield sites. These have led to a decrease in the habitats required by its host, which is also considered threatened in the region.

## Habitat management

This species is reliant upon strong populations of its host, which requires sandy areas for nesting and access to crucifer-rich foraging areas. Heathland should be managed using grazing and/or cutting to promote structural diversity, including age structure among the heathers. Less intensive farmland management that incorporates fallow areas, uncultivated margins and headlands, and reduces herbicide use will allow flowering plant communities including crucifers to develop. Incorporating these features throughout farmland, and rotational small-scale clearance on brownfield sites to maintain flower-rich areas and a range of successional habitats, particularly close to known nest sites will provide the connectivity needed by this and other species. Nesting areas should be kept free from encroaching vegetation and protected from excessive disturbance.

## Future prospects

Kirby's nomad bee is a rare species known from a couple of areas of the East of England, however its host has been recorded in Norfolk and Suffolk, so there is a small possibility that it can also be found here.

## Further information

Buglife (2013) Heathland mosaic habitat management

Buglife (2017) Managing farmland for pollinators

### Conservation action

1. Survey suitable sites known to hold populations of its hosts species and that are linked to its known sites to establish extent of current distribution.
2. Identify opportunities to connect fragmented or isolated patches of heathland including through management that promotes growth of crucifers on brownfield sites and farmland on sandy soils within the landscape local to its known sites.
3. Make effective use of agri-environment schemes to implement options such as flower-rich margins and plots, cultivated areas for arable plants and buffer strips. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
4. Establish annual monitoring at its known sites.

## Dull-headed blood bee (*Sphecodes ferruginatus*)



Dull-headed blood bee pinned female © Steven Falk

**Habitat** - chalk grassland, open woodland, quarries  
**Nesting** - bare ground (cleptoparasitic)

**Flight period** - mid-May to September  
**Pollen source** - cleptoparasitic, host is polylectic

A small blood bee, which has a scattered distribution in Britain and appears to be vulnerable and declining.

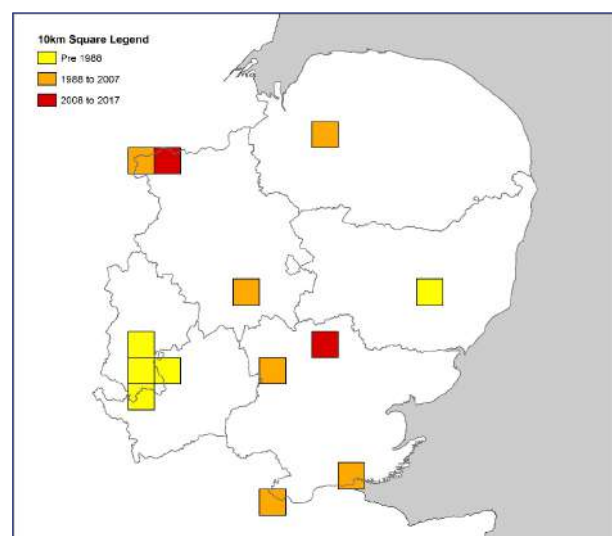
### Distribution and status

The Dull-headed blood bee is widespread but scarce in Britain, and is rarely numerous where recorded (Falk 1991). It appears to be declining nationally, and has been assessed as Nationally Scarce (Notable B) (Falk 1991). It is found across mainland Europe and into Asia (BWARS 2019).

It has a scattered distribution in the East of England, but has not been recorded in Bedfordshire since at least 1948 or Suffolk since 1923. The most recent records are from Castor in Cambridgeshire in 2017, and Wethersfield Airfield in Essex in 2011.

### Ecology

The Dull-headed blood bee is a cleptoparasite of calcareous habitats, including chalk grassland and associated woodland clearings and quarries where its main host the Chalk furrow bee (*Lasioglossum fulvicorne*) is found (Falk 2015). It is a summer-flying



Distribution in the East of England - most recent dates overlay any earlier dates

species and forages on a range of plants, in particularly 'yellow composites', umbellifers and cinquefoils, and its main host visits a range of plants including shrubs such as willows, as well as Ground-ivy, umbellifers and Asteraceae (Falk 2015).

The Dull-headed blood bee targets the nests of its host. The Chalk furrow bee, believed to be its main target species, is thought to nest in bare or sparsely vegetated ground, although other furrow bees (*Lasioglossum* spp.) may also be used.



Chalk furrow bee female © Steven Falk

### Reasons for decline

The decline seen in the Dull-headed blood bee is probably largely as a result of habitat loss, fragmentation and degradation that have affected its host species, resulting from changes in agricultural practice, including improvement of grassland and inappropriate grazing (under-grazing, over-grazing, timing and livestock type), as well as lack of woodland management, and unsympathetic restoration of quarry sites. Its main host is considerably more widespread and abundant, which suggest there could be other factors involved in its apparent rarity.

### Habitat management

This species is inevitably reliant upon strong populations of its host, which requires spring flowering shrubs and herbs as well as bare or sparsely-vegetated areas for nesting. Grasslands should be cut (after mid-July) with arisings removed and/or rotationally grazed, to provide structural diversity and ensure that flowering patches are maintained within the local landscape throughout the foraging season. This management can also be used to restore existing species-poor sites, increasing the abundance of wild flowers over time. Management of adjacent woody habitats such as hedgerows should be carried out on rotation, avoiding annual cutting, which can restrict flower production. Woodland sites should be managed rotationally to promote structural diversity and maintain sunny and sheltered clearings to encourage development of ground flora. Rides with scalloped or uneven edges, and that transition from short vegetation, through tall herbs and scrub, to trees, will offer more opportunities. Known nesting areas should be kept free from encroaching vegetation including coarse grasses and scrub as part of the habitat mosaic.

### Future prospects

The Dull-headed blood bee is a rare species with a scattered distribution in the East of England. Its host species is more widespread, and there is a possibility that it is under-recorded, which should be investigated.

### Further information

Buglife (2013) Chalk downland mosaic habitat management

Buglife (2017) Managing woodland for pollinators

### Conservation action

1. Resurvey historic sites and any other suitable sites known to hold populations of its host species to establish extent of current distribution.
2. Make effective use of agri-environment schemes to implement options such as low intensity grassland management. Where farmer clusters are present, provision can be coordinated across holdings to provide a complimentary habitat network.
3. Identify opportunities to connect fragmented or isolated populations through habitat creation, restoration and enhancement, for example via B-Lines.
4. Establish monitoring at its known sites.



## 4. Bee species lost from the East of England

Of the 17 species believed to be lost from the East of England, four were last recorded during the 19<sup>th</sup> Century, ten in the period 1900-1950, and two between 1950 and 1970. The final species, the Great yellow bumblebee (*Bombus distinguendus*), was last recorded in the region in 1980, however is recognised as extinct in England following a rapid northward decline (Natural England 2010).

This tallies with a national analysis that identifies the mid-20<sup>th</sup> Century as the period with the most rapid phase of aculeate pollinator extinction (Ollerton *et al.* 2014). A list of the bee species believed to be regionally extinct is provided, followed by a summary for each species below.



Great yellow bumblebee queen © Nick Owens

Table 4 - summary of the bee species believed to have been lost from the East of England, detailing the counties in which they have been recorded, the year in which they were last recorded in the region, and their current conservation status (Falk 1991)

Species	Losses in East of England	Year last recorded	National Status
Small flecked mining bee ( <i>Andrena coitana</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk	1983 (Norfolk)	None
White-bellied mining bee ( <i>Andrena gravida</i> )	Essex	1850 (Essex)	RDB1
Barham mini-miner ( <i>Andrena nana</i> )	Essex, Suffolk. <b>Extinct in Britain</b>	1932 (Essex, Suffolk)	RDB1+
Perkin's mining bee ( <i>Andrena rosae</i> )	Essex, Norfolk, Suffolk	1936 (Norfolk)	RDB2
Pale-tailed mining bee ( <i>Andrena tridentata</i> )	Essex, Suffolk. <b>Extinct in Britain</b>	1936 (Suffolk)	CR <sup>1</sup> ; RDB1+
Potter flower bee ( <i>Anthophora retusa</i> )	Bedfordshire, Essex, Norfolk, Suffolk	1970 (Essex, Norfolk)	RDB1; Section 41 <sup>2</sup>
Cullum's bumblebee ( <i>Bombus cullumanus</i> )	Bedfordshire, Suffolk. <b>Extinct in Britain</b>	1923 (Bedfordshire)	CR <sup>1</sup> ; RDB1+
Great yellow bumblebee ( <i>Bombus distinguendus</i> )	Bedfordshire, Cambridgeshire, Norfolk. <b>Extinct in England</b>	1980 (Cambridgeshire)	VU <sup>1</sup> ; Nb
Short-haired bumblebee ( <i>Bombus subterraneus</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk	1960 (Essex)	Na
Downland furrow bee ( <i>Halictus eurygnathus</i> )	Suffolk	1800 (Suffolk)	RDB1+
Shiny-gastered furrow bee ( <i>Lasioglossum laeve</i> )	Suffolk. <b>Extinct in Britain</b>	Pre-1802 (Suffolk)	EN <sup>1</sup> ; Appendix
Square-spotted mourning bee ( <i>Melecta luctuosa</i> )	Essex, Suffolk. <b>Extinct in Britain</b>	1922 (Suffolk)	RDB1+
Flat-ridged nomad bee ( <i>Nomada obtusifrons</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk	1945 (Bedfordshire)	NT <sup>2</sup> ; None
Tormentil nomad bee ( <i>Nomada roberjeotiana</i> )	Norfolk	1909 (Norfolk)	NT <sup>2</sup> ; RDB3
Six-banded nomad bee ( <i>Nomada sexfasciata</i> )	Essex, Norfolk, Suffolk	1900 (Suffolk)	RDB1
Fringe-horned mason bee ( <i>Osmia pilicornis</i> )	Bedfordshire, Essex, Suffolk	Pre-1948 (Bedfordshire)	Notable A
Cliff mason bee ( <i>Osmia xanthomelana</i> )	Essex, Suffolk. <b>Extinct in England</b>	1936 (Suffolk)	RDB1

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

<sup>2</sup> Natural Environment and Rural Communities Act 2006 (as amended) - species of principal importance for the conservation of biodiversity in England

### Small flecked mining bee (*Andrena coitana*)

A bee of heathland, open woodland, moorland, fens and coastal grassland, the Small flecked mining bee is distributed widely but very locally across Britain and appears to have undergone significant declines in central and southern England (Falk 2015). Recorded from the region in Bedfordshire, Cambridgeshire, Essex, Norfolk and Suffolk, the last record was from Norfolk in 1983. This species is the host for the cleptoparasite the Flat-ridged nomad bee, which is also considered lost from the East of England.

### White-bellied mining bee (*Andrena gravida*)

A bee of open, flower-rich habitats and an important pollinator of fruit trees (Falk 2015), the White-bellied mining bee is widespread in mainland Europe, but is only known from the south-east of England and considered endangered (Falk 1991). Recorded in the region only from Essex in 1850, however it seems to be increasing in the south-east and there is a chance that it will expand its range in response to climate change, helping it to reach the east of England.



White-bellied mining bee female © Steven Falk

### Barham mini-miner (*Andrena nana*)

There are only five confirmed records for this bee in Britain, from Kent, Suffolk and Surrey (Falk 1991), and it is now considered extinct in Britain, with the last English record from 1930 (Natural England 2010) and the last East of England record from Sudbury in Suffolk in 1932 (Knowles 2017).

### Perkin's mining bee (*Andrena rosae*)

Primarily a bee of coastal habitats such as coastal grassland, cliffs and scrub, as well as moorland (Falk 2015) this species has been subject to taxonomy and nomenclature issues, which make analysis difficult. Current British records are restricted to Cornwall, Devon and Kent, with records in the East of England from Essex, Norfolk and Suffolk, although it is possible that at least some of these are erroneous. The last record appears to be from 1936 in Norfolk.

### Pale-tailed mining bee (*Andrena tridentata*)

A heathland species that is rare in mainland Europe, the Pale-tailed mining bee only has confirmed records from Dorset and Suffolk, although there are further unconfirmed records that include Essex and Norfolk (BWARS 2019). The last record in the region was from Suffolk in 1936, and the species is now considered extinct in Britain, with the last record from 1944 (Natural England 2010). It is assessed as Critically Endangered on the European Red List of Bees (Nieto *et al.* 2014).

### Potter flower bee (*Anthophora retusa*)

A species of coastal habitats and heathlands, this bee is now considered nationally endangered, having declined greatly across its British range (Edwards and Jenner 2008) as a result of habitat loss and inappropriate management (JNCC 2010). In this region, the Potter flower bee has been recorded from Bedfordshire, Essex, Norfolk and Suffolk, but the most recent records are from Essex and Norfolk in 1970, which suggests it is probably now extinct in the East of England. The Potter flower bee is the host for the cleptoparasitic Square-spotted mourning bee, which is also considered lost from the East of England. The Potter flower bee is recognised as a Species of Principal Importance in England (NERC Act 2006).



Potter flower bee male © Steven Falk

### **Cullum's bumblebee (*Bombus cullumanus*)**

A bumblebee that appears to have been associated with the extensive 'sheepwalks' comprising unhedged chalk grassland, which existed in parts of southern England prior to the Enclosure Acts and agricultural intensification. The bee was last recorded in Britain in 1941 (Berkshire), with the last record in the East of England from Barton Hills, near Luton in Bedfordshire in 1923. This species was described as new to science by William Kirby in 1802 from a male collected in Suffolk (Falk 2015). It is assessed as Critically Endangered on the European Red List of Bees (Nieto *et al.* 2014).

### **Great yellow bumblebee (*Bombus distinguendus*)**

This bumblebee has suffered a huge contraction in its range over the last 100 years or so. The Great yellow bumblebee requires extensive flower-rich habitats. It is now found only in Caithness and Sutherland in mainland Scotland, along with parts of Orkney and the Hebrides, and parts of western Ireland, where it is largely confined to machair grassland and sand dunes. The last English record is from 1981, with the last record in the East of England from 1980 in Cambridgeshire. The Great yellow bumblebee is assessed as Vulnerable on the European Red List of Bees (Nieto *et al.* 2014).

### **Short-haired bumblebee (*Bombus subterraneus*)**

A bumblebee of flower-rich grassland, especially where legumes are plentiful. Historically the Short-haired bumblebee was widespread but local over much of England and South Wales, but was declared extinct in Britain in 2000, with the last confirmed record from Dungeness in 1988. A reintroduction project commenced at Dungeness in 2011 using queens from Sweden (Bumblebee Conservation Trust 2019). It was recorded from a number of locations in Bedfordshire and Suffolk, with few records from Cambridgeshire, Essex and Norfolk. The last record in the region was from 1960 in Essex.



Short-haired bumblebee release, Kent © Steven Falk

### **Downland furrow bee (*Halictus eurygnathus*)**

A bee of chalk grassland, considered extinct in Britain until it was rediscovered in 2004 (Falk 2011). The Downland furrow bee now appears confined to the South Downs of East Sussex (Falk 2015). There is only one record from the East of England, from Suffolk in 1800. It requires extensive chalk grassland with plentiful knapweed, a habitat that would have been more widespread in the region prior to the Enclosure Acts and agricultural intensification.

### **Shiny-gastered furrow bee (*Lasioglossum laeve*)**

This species is only known in Britain from two specimens collected in Suffolk over 200 years ago, which includes the type specimen, described by William Kirby in 1802. It is presumed long extinct in Britain and is assessed as Endangered on the European Red List of Bees (Nieto *et al.* 2014).



Downland furrow bee female © Steven Falk

### **Square-spotted mourning bee (*Melecta luctuosa*)**

A cleptoparasite of the Potter flower bee, this large bee was historically known from several counties of southern England, however is now considered extinct in Britain, with the last confirmed record from Hampshire in 1912.

In the East of England, it was recorded in Essex, and there is also a record from Suffolk in 1922, however no specimen is present to verify this (Knowles 2017).

### **Flat-ridged nomad bee (*Nomada obtusifrons*)**

A small nomad bee cleptoparasitic of the Small flecked mining bee, which is also considered lost from the region. The Flat-ridged nomad bee has been recorded widely across Britain, but appears to have undergone a serious decline and is now found predominantly in the north and west (Falk 2015). It has been recorded from Bedfordshire, Cambridgeshire, Essex and Norfolk, with the last records from Bedfordshire in 1945. It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014).



Tormentil nomad bee male © Steven Falk

### **Tormentil nomad bee (*Nomada roberjeotiana*)**

This is a small species of heathland and moorland rich in Tormentil and a cleptoparasite of the Tormentil mining bee. Considered rare, most modern records of the Tormentil nomad bee are from Cornwall (Falk 2015). This species was recorded in north Norfolk in the early 20<sup>th</sup> Century. It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014).

### **Six-banded nomad bee (*Nomada sexfasciata*)**

A large nomad bee, cleptoparasitic on the Long-horned bee. The Six-banded nomad bee has always been rare and is now considered endangered (Falk 1991), being confined to a small area of South Devon. In the East of England, it has been recorded from Essex, Norfolk and Suffolk in the late 19<sup>th</sup> and early 20<sup>th</sup> Centuries.



Six-banded nomad bee female © Steven Falk

### **Fringe-horned mason bee (*Osmia pilicornis*)**

A bee of open woodland with plentiful Bugle, the Fringe-horned mason bee has declined dramatically due to changes in management that have led to a reduction in flower-rich clearings and deadwood in many woodlands (Earwaker 2013). Formerly widespread in southern England, this species is now found at just a few sites in Kent and Sussex. In the East of England, it has been recorded in Bedfordshire, Essex and Suffolk with the most recent records from Bedfordshire and Suffolk during the period 1935 to 1948.

### **Cliff mason bee (*Osmia xanthomelana*)**

This large mason bee is one of our most declined bee species and now appears to be confined to the Llyn Peninsula in North Wales (Falk 2015). The Cliff mason bee is a specialist of south- and east-facing soft cliffs with slumps and seepages, where it has good access to its main forage plants, bird's-foot-trefoils and vetches. This species was previously also found in scattered locations on the south coast of England but is now considered extinct here, with the last English record from 1998 (Natural England 2010). In the East of England there is one record from Essex in the late 19<sup>th</sup> Century, along with several records from Suffolk. The latest of these is from 1936, although it is noted that these records may be misidentifications of the Fringe-horned mason bee being recorded from habitat outside that typical for Cliff mason bee (Knowles 2017). The accelerating rate of erosion along the coast of East Anglia may have rendered the cliffs here unsuitable for the Cliff mason bee.

## 5. Other bees of conservation concern in the East of England

This report identifies 31 species considered to be of conservation concern in the East of England. These are listed, followed by summary information on their habitats and distribution in the region.

Table 5 - summary of the bee species of conservation concern covered by this report, detailing the counties of the East of England in which they occur, the counties from which they have been lost (not recorded post 1990), and their current conservation status (Falk 1991)

Species	Occurrence in East of England	Losses in East of England	National Status
Painted mining bee ( <i>Andrena fucata</i> )	Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk, Suffolk		None
Hawk's-beard mining bee ( <i>Andrena fulvago</i> )	Bedfordshire, Essex, Hertfordshire, Suffolk		Na
Large scabious mining bee ( <i>Andrena hattorfiana</i> )	Bedfordshire, Essex, Norfolk, Suffolk		NT <sup>1</sup> , RDB3
Large meadow mining bee ( <i>Andrena labialis</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		None
Small scabious mining bee ( <i>Andrena marginata</i> )	Norfolk, Suffolk	Bedfordshire, Essex	Na
Black-headed mining bee ( <i>Andrena nigriceps</i> )	Essex, Norfolk, Suffolk	Bedfordshire	Nb
Black mining bee ( <i>Andrena pilipes</i> )	Bedfordshire, Essex, Suffolk		Nb
Broad-faced mining bee ( <i>Andrena proxima</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		RDB3
Grey-backed mining bee ( <i>Andrena vaga</i> )	Essex		RDB1
Blackthorn mining bee ( <i>Andrena varians</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		Nb
Green-eyed flower bee ( <i>Anthophora bimaculata</i> )	Bedfordshire, Essex, Norfolk, Suffolk		None
Four-banded flower bee ( <i>Anthophora quadrimaculata</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		Nb
Heath bumblebee ( <i>Bombus jonellus</i> )	Essex, Norfolk	Cambridgeshire, Hertfordshire	None
Short-horned furrow bee ( <i>Lasioglossum brevicorne</i> )	Bedfordshire, Essex, Norfolk, Suffolk		NT <sup>1</sup> , RDB3
Smooth-faced furrow bee ( <i>Lasioglossum fratellum</i> )	Essex, Norfolk, Suffolk		None
Squat furrow bee ( <i>Lasioglossum pauperatum</i> )	Essex, Norfolk, Suffolk	Bedfordshire	RDB3
Grey-tailed furrow bee ( <i>Lasioglossum prasinum</i> )	Norfolk	Suffolk	NT; None
Ashy furrow bee ( <i>Lasioglossum sexnotatum</i> )	Norfolk, Suffolk	Essex	NT <sup>1</sup> , RDB1
Orange-footed furrow bee ( <i>Lasioglossum xanthopus</i> )	Cambridgeshire, Essex, Hertfordshire, Suffolk	Bedfordshire	NT <sup>1</sup> , Nb
Fringeless nomad bee ( <i>Nomada conjungens</i> )	Suffolk		RDB2
Yellow-shouldered nomad bee ( <i>Nomada ferruginata</i> )	Bedfordshire, Cambridgeshire, Essex, Norfolk, Suffolk		RDB1
Blunthorn nomad bee ( <i>Nomada flavopicta</i> )	Bedfordshire, Essex, Norfolk, Suffolk		Nb
Cat's-ear nomad bee ( <i>Nomada integra</i> )	Essex, Suffolk	Bedfordshire	Na
Sheppard's nomad bee ( <i>Nomada sheppardana</i> )	Cambridgeshire, Essex, Norfolk, Suffolk	Bedfordshire	None
Broad-banded nomad bee ( <i>Nomada signata</i> )	Norfolk, Suffolk	Bedfordshire	RDB2

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

Red-tailed blood bee ( <i>Sphecodes rubicundus</i> )	Cambridgeshire, Essex, Suffolk	Bedfordshire, Norfolk	NT <sup>1</sup> , Na
Rough-backed blood bee ( <i>Sphecodes scabricollis</i> )	Essex		RDB3
Spined blood bee ( <i>Sphecodes spinulosus</i> )	Essex, Norfolk, Suffolk		NT <sup>1</sup> , RDB2
Spotted dark bee ( <i>Stelis ornatula</i> )	Cambridgeshire, Essex, Norfolk, Suffolk	Bedfordshire	RDB3
Plain dark bee ( <i>Stelis phaeoptera</i> )	Cambridgeshire, Essex, Norfolk, Suffolk	Bedfordshire	RDB2
Banded dark bee ( <i>Stelis punctulatisima</i> )	Bedfordshire, Cambridgeshire, Essex, Suffolk	Norfolk	Nb



Hawk's-beard mining bee female © Steven Falk



Large meadow mining bee male © Steven Falk



Four-banded flower bee female © Steven Falk



Ashy furrow bee female © Steven Falk

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

### Painted mining bee (*Andrena fucata*)

The Painted mining bee has a wide range throughout Britain but is usually only locally recorded, and records are patchy within the East of England. It can be found in a range of habitats, but especially in woodland with open flower-rich clearings, as well as coastal scrub and heathland. It has been recorded in all six of the counties of the region, with the majority of records from Bedfordshire and Essex. About half of the records from the region are post 1990 with the most recent records from Burnham Deepdale in West Norfolk in 2017 (M. Welch pers. comm. 2019), and Old Warden and Wixams in Bedfordshire in 2016.



Painted mining bee female © Steven Falk

### Hawk's-beard mining bee (*Andrena fulvago*)

A medium-sized mining bee, the Hawk's-beard mining bee has a distinctly central and southern distribution in Britain. It is largely restricted to acid grassland and heathland (S. Falk pers. comm. 2019) but has also been recorded in calcareous and coastal grasslands (Falk 2015). The Hawk's beard mining bee is considered a scarce species. It was readmitted to the Suffolk list in 2012, following an absence of over 200 years, which may represent a recent northwards expansion of its national distribution (Knowles 2017), however it is declining in the Midlands and South East England (S. Falk pers. comm. 2019). Essex is its main stronghold in the region, particularly along the East Thames Corridor but there are also records from Bedfordshire (most recently Sandy in 2017), Hertfordshire (most recently Wormley in 2016) and Suffolk (most recently Felixstow in 2017). This species forages exclusively on 'yellow composites' such as hawk's-beards, hawkbits and cat's-ears and is the host for the Cat's-ear nomad bee, which is considered to be of conservation concern in the region.

### Large scabious mining bee (*Andrena hattorfiana*)

A large and attractive mining bee typically found in calcareous grasslands, where it has a strong association with scabious flowers; principally Field scabious, but occasionally also Small scabious, which it uses as its pollen source. Large scabious mining bee is widespread across southern England where it is dependent upon habitats that support sufficient scabious; with an estimated 72 inflorescences or 11 plants required per nest (Larsson & Franzén 2007). It has declined where scabious has reduced, often due to inappropriate management such as poorly-timed grass cutting, abandonment or over-grazing. In the East of England this species has been recorded from Bedfordshire, Essex, Norfolk and Suffolk, with Breckland being one of its strongholds (Knowles 2017). It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014). The Large scabious mining bee is host for the cleptoparasite Armed nomad bee, which is considered threatened in the East of England.



Large scabious mining bee female © Steven Falk

### Large meadow mining bee (*Andrena labialis*)

A large mining bee found in open legume-rich habitats, including grasslands, brownfields and woodland clearings. The Large meadow mining bee is widespread but local, and rare in East Anglia (Falk 2015). There are records from Bedfordshire (most recently Wilsden in 2017) and Cambridgeshire (most recently Brampton Wood in 2013), and it was discovered in 2018 at only its third Suffolk locality, as a large colony within a grassy headland strip on an organic farm (A. Knowles pers. comm. 2019). It was rediscovered in Norfolk at Halvergate in 2017

after a long absence (since 1800s), and both males and females were recorded at the site in 2018 (N. Owens pers. comm. 2019; M. Welch pers. comm. 2019). A record of its cleptoparasite the Red-tailed blood bee from Hickling in 1988, which was thought to represent a vagrant, may in fact indicate this species was previously present there (N. Owens pers. Comm. 2019). The vast majority of records in the region come from the Thames Estuary and coastal Essex. Oligolectic on legumes such as bird's-foot-trefoils, clovers and vetches, this bee could be helped by increasing the availability of such plants, for example in arable margins. In some parts of southern Britain, it appears to survive almost entirely on improved clover leys and may be under-recorded in such locations (S. Falk pers. comm. 2019).

### Small scabious mining bee (*Andrena marginata*)

The Small scabious mining bee is restricted by its reliance upon scabious-rich habitats including chalk grassland, heathland and acid grassland, and often occurs alongside the Large scabious mining bee. It is widely distributed but local, uncommon and declining (Falk 2015). Breckland appears to be one of the strongholds for this species, with the majority of records in the region from Norfolk and Suffolk. There are records from outside this core area that indicate there were further populations in Suffolk (Knowles 2017) and suggests patches of scabious should be investigated both for this and the Large scabious mining bee. There are also records from Bedfordshire and Essex, however has not been seen in either since at least 1935. The Small scabious mining bee is host for the cleptoparasite Silver-sided nomad bee, which is considered threatened in the East of England.



Small scabious mining bee female © Steven Falk

### Black-headed mining bee (*Andrena nigriceps*)

The Black-headed mining bee is recorded widely throughout Britain but is very local. It is a summer-flying species, associated with grasslands, heathlands, coastal habitats and brownfields (Falk 2015), and collects pollen from a range of plants, particularly Asteraceae including knapweeds, thistles and ragworts. In the East of England, it has been recorded from Bedfordshire, Essex, Norfolk and Suffolk, with records thinly scattered in Breckland (Knowles 2017; Owens 2017), and most recent records from the east coast of Suffolk. Management of coastal grasslands to promote features such as short or sparsely vegetated areas for nesting alongside flower-rich areas for foraging, could be beneficial for sustaining Black-headed mining bee populations.

### Black mining bee (*Andrena pilipes*)

This species was only recently described as separate in the UK from the similar Scarce black mining bee, making analysis of data difficult for both species, although the distribution of the Black mining bee appears to be more strongly associated with coastal habitats than the Scarce black mining bee, with an overlap in the Thames Gateway. This bee appears to be found only locally in the south of Britain (Falk 2015), and the Essex Thames Gateway appears to be a hotspot, where it can be numerous (P. Harvey pers. comm. 2018). With its close association to coastal habitats, including cliffs, the Black mining bee may be threatened by sea level rise and coastal development.



Black mining bee male © Steven Falk



### Broad-faced mining bee (*Andrena proxima*)

The Broad-faced mining bee has recently been split into two species in the UK, with the Water-parsnip mining bee (*Andrena ampla*) thought to account for the more westerly and northerly distributed records, including those in Wales (Falk in prep.). It is a species of a range of habitats, including calcareous grasslands, brownfield sites and grazing marsh, which are rich in umbellifers, where it collects pollen from several species (Falk 2015). This bee appears to be expanding its range, and the East of England includes a significant proportion of its British distribution; making the populations found here important for its conservation. In Suffolk it tends to be found in the centre of the county (Knowles 2017), often occurring in churchyards on heavier soils, while in Essex it is considered rare with a site where it was previously found in good numbers now destroyed (Essex Field Club 2019). The Broad-faced mining bee was recently discovered near Norwich and the species may be spreading north in areas such as the Midlands. It is the host of the rare Fringeless nomad bee, which has recently been discovered in Suffolk (A. Knowles pers. comm. 2019).

### Grey-backed mining bee (*Andrena vaga*)

This spring-flying species can be found in a range of habitats associated with willows. The Grey-backed mining bee was declared extinct in the UK in 1946 (Natural England 2010), however it was rediscovered in a number of sites in Kent and Sussex, and is now known to have been present since at least 2009 (BWARS 2019). This bee was recorded near Alresford in Essex in 2016, and it is probably that this is part of a national expansion, although it was not seen at the site in 2018 (A. Knowles pers. comm. 2019).



Grey-backed mining bee female © Steven Falk

### Blackthorn mining bee (*Andrena varians*)

An attractive, spring-flying bee, which is associated with flowering shrubs such as Blackthorn (*Prunus spinosa*), Plum (*P. domestica*) and herbs such as Dandelion. The Blackthorn mining bee appears to be reasonably widespread but scarce in central and southern Britain, but scarce. Although there is no evidence of an overall decline it does appear to be showing some signs of decline in Kent and northern England. It has perhaps never been common in the East of England, with only two modern sites in Norfolk (Owens 2017), one in Suffolk (Knowles 2017) and a couple in Bedfordshire and Cambridgeshire, but with a number of records scattered throughout Essex, where it is not considered scarce.

### Green-eyed flower bee (*Anthophora bimaculata*)

The smallest of our five British *Anthophora* species, the Green-eyed flower bee has a strong association with sandy soils and is typically found on heathland, sand dunes, brownfield sites and quarries (Falk 2015). It appears to be on the edge of its range in Britain, reflected in its southerly distribution, although this could expand northwards in response to climate change. This species is considered scarce in the East of England (Falk 2015) but has been recorded in recent years from suitable habitat in Bedfordshire (most recently Dunstable and Sandy Warren in 2017) and Breckland, and widely recorded along the coastal Sandlings of Suffolk. The Green-eyed flower bee is one of the listed hosts for the cleptoparasite Grooved sharp-tail bee, which is considered threatened in the East of England.



Green-eyed flower bee male © Steven Falk

### Four-banded flower bee (*Anthophora quadrimaculata*)

A summer-flying species, found in a range of flower-rich habitats including coastal grassland, heathland, and also frequently found in gardens, it favours labiates. The Four-banded flower bee has a scattered southerly distribution within Britain, with particular hotspots centred on urban areas such as London and Oxford, including one in the Thames Gateway (Falk 2015). There are signs this species could be expanding its range, with an increase in Norfolk, especially in gardens around Norwich and records from Bedfordshire in 2016 (Leighton Buzzard) and 2017 (Sandy Warren and Heath and Reach), following a gap since 1935. There appears to be a good population of Four-banded flower bees at Cambridge Botanic Garden, and this presents opportunities to use this charismatic species in promoting public engagement with pollinator conservation.

### Heath bumblebee (*Bombus jonellus*)

The Heath bumblebee is a social species, most abundant in heathland and moorland, but can be found in other areas including chalk grassland and coastal habitats. Spring queens visit shrubs, particularly willows, and workers forage mainly on heathers or thymes (*Thymus* spp.) but will use other flowers (Falk 2015). This species is locally common in northern and western Britain, but in the East of England is restricted and much declined. In Suffolk it was most recently recorded during 2017 in the Minsmere, Westleton and Hollesley areas of the coast, with two records from Essex (most recently 2010). In Norfolk most recent records are from Winterton (most recently in 2017) and Weybourne (most recently in 2018).



Heath bumblebee male © Steven Falk

### Short-horned furrow bee (*Lasioglossum brevicorne*)

A small furrow bee found mainly in the south and east of England, where it appears to be becoming more common (Falk 2015). It is usually observed foraging on 'yellow composites' such as cat's-ears and hawk's-beards and may be oligolectic on Asteraceae. The Short-horned furrow bee is principally found on heathland, as well as sand dunes and other habitats on light, sandy soils, and is vulnerable to the loss and inappropriate management of these habitats. This species is typical of Breckland and there is a widespread population here (Knowles 2017). It has also been recorded from Bedfordshire (most recently Harrold-Odell in 2015) and Essex. It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014).

### Smooth-faced furrow bee (*Lasioglossum fratellum*)

This small bee appears more typical of cooler boreo-alpine regions and in Britain is more widespread in the north and west, where it has an association with moorland, heathlands and acid woodland (Falk 2015) but also recorded from chalk grassland in Norfolk (Owens 2017). It forages on a range of plants including heathers, Tormentil, cat's-ears, dandelions, thistles and Bramble (Falk 2015). The Smooth-faced furrow bee is localised in the East of England, and has been recorded from Essex, Norfolk and Suffolk, with the most recent record from Foulton Common in Norfolk in 2009. It is possible that this species will retreat towards its northern and western strongholds in response to climate change.



Smooth-faced furrow bee male © Steven Falk

### Squat furrow bee (*Lasioglossum pauperatum*)

The Squat furrow bee is predominantly a species of heathland, quarries and coastal habitats, including cliffs, where its foraging preferences are unclear but seem to include 'yellow composites'. It is currently restricted to the south and east of England. It is assessed as nationally threatened (Falk 1991), however it is now known to be more widespread and seems to be gradually expanding its range north. This species can be numerous in the Thames Gateway (P. Harvey pers. comm. 2018) and several were found in a pan trap located in arable land near Witham (S. Falk pers. comm. 2019), with a significant proportion of British colonies in Essex. It has also been recorded from Norfolk where it was found at Caistor Quarry in 2010 at what is presumed to be a breeding site (Owens 2017). It was rediscovered in Suffolk in 2017 at Flatford Mill, following an absence of over a century from the county (Knowles 2017).

### Grey-tailed furrow bee (*Lasioglossum prasinum*)

A summer-flying species characteristic of habitats on sandy soils, particularly heathland in England, but also sand dunes in South Wales. The Grey-tailed furrow bee has a restricted range focused principally on southern England with scattered records from South Wales to the East of England, and a stronghold in the New Forest, Dorset and Surrey heathlands. It forages on heathers, 'yellow composites' and Early forget-me-not (*Myosotis ramosissima*). In this region it has been recorded from typical sandy habitats in Norfolk and Suffolk, with a new site found in Norfolk during 2017 but no records from Suffolk since 1971 (Knowles 2017). It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014).



Grey-tailed furrow bee female © Steven Falk

### Ashy furrow bee (*Lasioglossum sexnotatum*)

The Ashy furrow bee is a species of heathland and marshes (usually where the two occur together), as well as parks and gardens, where it forages on ragworts, Bramble, White bryony, figworts (*Scrophularia* spp.) and dandelions (Falk 2015). This species has a highly restricted distribution in Britain, with all the known extant colonies now found in Norfolk and Suffolk, making the East of England significant in its conservation. It was presumed extinct during the 20<sup>th</sup> Century until it was rediscovered in at Buckenham Tofts in Norfolk in 1985 (Owens 2017). Suffolk appears to be its current national stronghold where it has been found around Ipswich, Orford, Minsmere and Elveden in Thetford Forest (Knowles 2017). Several new sites were found in Norfolk during 2018, including Lynford Arboretum (N. Owens pers. comm. 2018; M. Welch pers. comm. 2019) and the local spread of this species should be monitored. It is assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014).

### Orange-footed furrow bee (*Lasioglossum xanthopus*)

The Orange-footed furrow bee can be found widely but locally across southern Britain, where it is typically found in calcareous grassland, coastal habitats and brownfield sites and forages on a wide range of plants (Falk 2015). In the East of England there are recent records from Cambridgeshire (Burwell in 2016) and Essex (Tilbury in 2018). It is assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014). Populations used to occur in the brick pits and quarries found around Peterborough in the 1980s (S. Falk pers. comm. 2019), and these areas should be resurveyed to establish its current status. The Orange-



Grey-tailed furrow bee female © Steven Falk

footed furrow bee is the host for the Spined blood bee, which is also considered to be of conservation concern in the region.

### **Fringeless nomad (*Nomada conjungens*)**

A rare species with few records scattered across southern and central England, and found on chalk downland, heathland and coastal habitats (Falk 2015). Its host is the Broad-faced mining bee, which appears to be oligolectic on umbellifers and is also considered to be of conservation concern in the region. A significant proportion of the British distribution of Broad-faced mining bee is found in the East of England, with the Fringeless nomad recorded new to the region from Suffolk in 2018 (S. Falk pers. comm. 2019)

### **Yellow-shouldered nomad bee (*Nomada ferruginata*)**

A rare species scattered across southern Britain in a variety of willow-rich habitats, it seems to be gradually increasing (S. Falk pers. comm. 2019). There are two recent records from Bedfordshire (Studham in 2016 and Flitwick in 2017). It has also been recorded from Cambridgeshire (most recently Fowlmere in 2014) and Norfolk (most recently Strumpshaw in 2012), with the only recent Suffolk record is from Puris Farm in 2014. In Essex it is known from Glemsford pits, recorded there most recently in 2003. It is cleptoparasitic on the Small sallow mining bee (*Andrena praecox*), a ground-nesting bee found in a range of habitat that is rich in willows.



Yellow-shouldered nomad bee female © Steven Falk

### **Blunthorn nomad bee (*Nomada flavopicta*)**

A species of flower-rich grasslands and heathland, where it is cleptoparasitic on several species of Blunthorn bees. The Blunthorn nomad bee is widespread but local in southern Britain. In the East of England, it has been recorded from Breckland and the Norfolk Broads, as well as heathland at Sandy Warren in Bedfordshire and the Thames Gateway in recent years. There is no indication of a national decline in this species, however its host species is localised, which may increase its vulnerability.

### **Cat's-ear nomad bee (*Nomada integra*)**

A reddish-brown nomad bee found in heathland, acid grassland and coastal habitats. Widespread but local, the Cat's-ear nomad bee has been subject to nomenclature changes, which make interpretation of data difficult. A female was recorded near Colchester in May 2018 (Knowles pers. comm. 2019). Its host is the Buff-tailed mining bee (*Andrena humilis*), a widespread but scarce species, which is oligolectic on 'yellow composites'.



Cat's-ear nomad bee female © Steven Falk

### **Sheppard's nomad bee (*Nomada sheppardana*)**

Sheppard's nomad bee is the smallest nomad bee in the UK and unusual for a nomad bee as a cleptoparasite of *Lasioglossum* bees. It is predominantly a species of southern Britain, where it appears to have declined (Falk 2015) and is rare in East Anglia, recorded from Bedfordshire, Cambridgeshire, Essex, Norfolk and Suffolk. This bee is typically found in woodland edge and other woody habitats in proximity to the nesting aggregations of its hosts.

### **Broad-banded nomad bee (*Nomada signata*)**

A large and striking bee, which is cleptoparasitic on the Tawny mining bee (*Andrena fulva*) but scarce despite the relative abundance of its host (Knowles 2017). The Broad-banded nomad bee is found in the habitats favoured by its host; predominantly grasslands including parks and gardens, and open woodlands. This species has declined but there are signs of a recovery and range expansion in some areas (Falk 2015) and in Norfolk and Suffolk the population appears to be stable. The reasons for its decline are unclear, but competition with Panzer's Nomad, which is also a cleptoparasite of Tawny mining bee could be a factor (Falk 2019).

### Red-tailed blood bee (*Sphecodes rubicundus*)

A large blood bee, which is a species of southern Britain, where it is fairly widespread but locally recorded. The Red-tailed blood bee is a cleptoparasite of the Large meadow mining bee, which is oligolectic on legumes, locally distributed and apparently rare in East Anglia (Falk 2015). This species is also thought to use the more widespread and more common Yellow-legged mining bee (*Andrena flavipes*) as an occasional host. In the East of England, it has a scattered distribution taking in Cambridgeshire, Essex and Suffolk, where it appears to be becoming increasingly coastal. There are older records from Bedfordshire, and Norfolk where its main host was rediscovered in 2017. Management of grasslands and other open habitats to promote the spread of its host provides the best opportunity to conserve this species. It is assessed as near threatened on the European Red List of Bees (Nieto *et al.* 2014).



Red-tailed blood bee female © Steven Falk

### Rough-backed blood bee (*Sphecodes scabricollis*)

A rare southern species with few British records, this species has been found on heathland, coastal dunes, brownfields and woodland clearings. It is cleptoparasitic on the Bull-headed furrow bee (*Lasioglossum zonulum*), a species that forages widely but shows some preferences for Common fleabane (*Pulicaria dysenterica*) and Devil's-bit scabious. The Rough-backed blood bee appears to forage generally on Asteraceae and umbellifers (Falk 2015). It was recorded as new to the region in 2014, when it was added to the Essex list (S. Falk pers. comm. 2019).

### Spined blood bee (*Sphecodes spinulosus*)

The largest blood bee in Britain, the Spined blood bee is a rare southern species that is cleptoparasitic on Orange-footed furrow bee, a species also considered to be of conservation concern in the East of England. This species is found in the calcareous grasslands, quarries and coastal habitats favoured by its host, and appears to be at risk of extinction in the region, with a handful of recent records from Essex, one record from Norfolk and no records from Suffolk since 1992 (Knowles 2017). It is assessed as Near Threatened on the European Red List of Bees (Nieto *et al.* 2014).

### Spotted dark bee (*Stelis ornatula*)

A rare and predominantly southern species, which is cleptoparasitic on the Welsted lesser mason bee (*Hoplitis claviventris*) a species of open habitats such as chalk grassland and coastal dunes where there are lots of the bird's-foot-trefoils favoured by its host (Falk 2015). The Spotted dark bee has a scattered distribution, which includes recent records from chalk grassland at Whitmoor Marshalling in Cambridgeshire (most recently in 2013), brownfield habitat in Essex (most recently Pitsea in 2012) and Breckland (most recently Cranwich in 2011). It has not been recorded in either Bedfordshire or Suffolk for at least 70 years.



Spotted dark bee female © Steven Falk

### Plain dark bee (*Stelis phaeoptera*)

The Plain dark bee is a rare species found scattered across southern Britain. The available information suggests it has undergone a serious decline, although the reasons why are unclear. There are signs of a recent increase in records from gardens with bee hotels that are designed to encourage nesting mason bees (Jones & Cheeseborough 2010). It is cleptoparasitic on the Orange-vented mason bee (*Osmia leaiana*) but possibly also on other mason bees (*Osmia* spp.) as is seen in other parts of Europe (Falk 2015). There are scattered records from the region, with the most recent from a Suffolk garden in 2018. The increase of records from gardens could offer an opportunity to run a coordinated citizen science survey to update distribution data for this species.



Plain dark bee female © Steven Falk

### Banded dark bee (*Stelis punctulatissima*)

A widespread but scarce bee, which is cleptoparasitic on the Wool carder bee (*Anthidium manicatum*), a large bee found in a range of habitats including, frequently, gardens. The Banded dark bee is much scarcer than its host for reasons that are not clear. In the East of England there are records scattered across the region, with the most recent from a Suffolk garden in 2018. The Wool carder bee is becoming locally common in parts of southern England, and will use artificial sites such as wood and brick cavities for nesting. As such, there is an opportunity to enhance habitats including gardens by providing artificial refugia targeted to this species and planting flowers with long corollas such as labiates, with a view to benefiting this and several other species.



Banded dark bee female © Steven Falk

## 6. Habitat and species associations

There are a range of important habitats used by pollinators in the East of England. This is summarised below, with an overview of management principles. A list of the species identified as threatened or of conservation concern that have a particular association with a habitat type is also provided.

### Arable field margins and conservation headlands

Areas around arable fields managed specifically to provide benefits to wildlife, these may be permanent grass strips, naturally regenerating vegetation, or sown with selected plant species to provide foraging resources for pollinators and other species groups such as farmland birds.

Large scabious mining bee (*Andrena hattorfiana*)  
Small scabious mining bee (*Andrena marginata*)  
Scarce black mining bee (*Andrena nigrospina*)  
Long-fringed mini-miner (*Andrena niveata*)  
Brown-banded carder bee (*Bombus humilis*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Squat furrow bee (*Lasioglossum pauperatum*)  
Kirby's nomad bee (*Nomada subcornuta*)



Arable field margin at Arkesden, Essex © Steven Falk

Arable field margins of at least 5m are recommended, and these should be left uncut until late summer or autumn. It is important to provide a range of flowers (different families and different flower structure) to ensure the margins are beneficial to a range of foraging bees and other pollinators. Margins should be cut on rotation (with cuttings removed) to provide a range of vegetation heights and maintain early succession habitat. In order to provide benefit to wildlife, margins must be protected from contamination from chemicals such as herbicides and pesticides, as these can readily accumulate here if allowed to drift into such habitats. Margins adjacent to other semi-natural habitats such as ditches or hedgerows frequently support richer invertebrate communities.

**Further information** Buglife managing farmland for pollinators

### Coastal and floodplain grazing marsh

Grasslands with ditches that contain standing brackish or freshwater or that are periodically inundated with water (JNCC 2019). There are important areas of grazing marsh in the East of England, including the Essex Marshes, The Fens and The Norfolk Broads.

Large meadow mining bee (*Andrena labialis*)  
Broad-faced mining bee (*Andrena proxima*)  
Brown-banded carder bee (*Bombus humilis*)  
Moss carder bee (*Bombus muscorum*)  
Shrill carder bee (*Bombus sylvarum*)  
Long-horned bee (*Eucera longicornis*)  
Blunthorn nomad bee (*Nomada flavopicta*)  
Red-tailed blood bee (*Sphex rubicundus*)  
Low-intensity grazing will help maintain



Coastal grazing marsh at Rockland Broad, Norfolk © Steven Falk

structural diversity, including bare ground, and allow plants to flower. Ditches should be managed on rotation

with ditches present in differing stages of vegetation succession and siltation, to ensure the availability of flowering resources in the local landscape. Varying the profile of ditch banks can also provide benefits, including areas with muddy margins, and banks with shallow angles.

**Further information** Buglife (2013) Coastal grazing marsh mosaic habitat management

## Coastal saltmarsh

The vegetated area of mudflats, located at the top of the intertidal zone on fine sediments, containing plants that are tolerant of regular tidal immersion, and found in estuaries, lagoons and other sheltered coastal areas (JNCC 2019). This habitat can be found around the region's coastline, including the Essex Marshes, the North Norfolk coast, the Suffolk coast the Thames Gateway, The Wash and river estuaries.

Sea aster colletes (*Colletes halophilus*)

Disturbance of saltmarsh should be minimised as much as possible, with low-intensity grazing used only where this has been practised historically. It may be necessary to remove some areas of scrub to maintain a patchwork of successional stages with flower-rich areas, including patches of Sea aster (an important forage plant in this habitat), and a gradual transition to terrestrial conditions. Biodegradable tidal debris should be retained.



Coastal saltmarsh at Holme Dunes, Norfolk © Steven Falk

**Further information** Buglife coastal saltmarsh management

## Coastal sand dunes

A habitat forming above the high tide mark on large beaches with specialised vegetation communities that stabilise and fix sand into dunes. There are important areas of sand dunes along the North Norfolk coast in areas such as Holkham, Snettisham, Home and Hunstanton, and the eastern coast of Norfolk, in areas such as Winterton and Minsmere.

Small scabious mining bee (*Andrena marginata*)  
Green-eyed flower bee (*Anthophora bimaculata*)  
Brown-banded carder bee (*Bombus humilis*)  
Moss carder bee (*Bombus muscorum*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Margined colletes (*Colletes marginatus*)  
Long-horned bee (*Eucera longicornis*)  
Black-headed leafcutter bee (*Megachile circumcincta*)



Sand dunes at Holme Dunes, Norfolk © Steven Falk

Disturbance of sand dunes should be minimised, although low-intensity grazing may be beneficial on some sites. It may be necessary to remove some areas of scrub to maintain a patchwork of successional stages, including mobile foredunes, established dunes with varied vegetation, and dune grassland and heathland.

**Further information** Buglife coastal sand dune management



## Coastal vegetated shingle

An accumulation of pebbles with a diameter between two and 200mm (JNCC 2019) with specialised vegetation communities tolerant of high salinity. There are important areas of vegetated shingle at Orford Ness, and North Norfolk, in areas such as Blakeney and Kelling.

Margined colletes (*Colletes marginatus*)  
Shingle yellow-face bee (*Hylaeus annularis*)

Disturbance of vegetated shingle should be minimised as much as possible, although it may be necessary to remove some areas of scrub in order to maintain a patchwork of successional stages from bare shingle to grassland. Biodegradable tidal debris should be retained, and coastal planning needs to be sensitive to the threat to vegetated shingle habitat from coastal defences.



Coastal vegetated shingle at Orford Ness, Suffolk © Steven Falk

**Further information** Buglife coastal vegetated shingle management

## Hedgerows

Hedgerows are an important source of early and late forage for pollinators, providing both spring-blossoming shrubs and autumn-flowering species such as Ivy (*Hedera helix*). They also give refuge from heat, cold and wind, offer nesting opportunities, and provide a linkage between other habitat types.

Blackthorn mining bee (*Andrena varians*)

Cutting hedgerows on a rotation (ideally every three years in late-winter) will help to develop their structure and increase availability of vital early-spring forage. The protection (or creation of) associated features such as deadwood, ditches, flower-rich bottoms, and hedgebanks will provide a range of nesting and sheltering opportunities. A diversity of plants in the hedgerow, including shrubs such as willows, Cherry plum (*Prunus cerasifera*), Hawthorn and Dogwood (*Cornus sanguinea*), along with trees and climbers, and herbs in the hedge bottom, will help provide a blossoming sequence that ensures there is a supply of food from spring until autumn. Standard trees, along with dead and decaying wood should be retained.



Flowering Blackthorn in a hedgerow in March © Laurie Jackson

**Further information** Buglife ancient and species rich hedgerows; Buglife managing farmland for pollinators

## Lowland calcareous grassland

Grassland developing on shallow lime-rich soils, in the East of England this is exclusively on chalk, with small areas in Cambridgeshire, north-west Norfolk, and Suffolk, along with the eastern section of the Chilterns and parts of Essex.

Large scabious mining bee (*Andrena hattorfiana*)  
Small scabious mining bee (*Andrena marginata*)  
Broad-faced mining bee (*Andrena proxima*)  
Brown-banded carder bee (*Bombus humilis*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Shrill carder bee (*Bombus sylvarum*)  
Orange-footed furrow bee (*Lasioglossum xanthopus*)  
Gold-tailed melitta (*Melitta haemorrhoidalis*)  
Silver-sided nomad bee (*Nomada argentata*)  
Armed nomad bee (*Nomada armata*)  
Dull-headed blood bee (*Sphecodes ferruginatus*)  
Spotted dark bee (*Stelis ornatula*)



Chalk grassland at Dunstable Downs, Bedfordshire © Steven Falk

Low-intensity or strip-grazing regimes that allow periods of rest and create structural diversity with areas of disturbed, bare ground, longer flower-rich turf and islands of scrub, will provide a range of habitat features and encourage growth of a variety of wild flowers for foraging invertebrates.

**Further information** Buglife (2013) Chalk downland mosaic habitat management

## Lowland heathland

Found on acidic, nutrient-poor soils and characterised by dwarf-shrubs; the East of England has several areas of lowland heathland including Breckland, the Sandlings, North Norfolk, the London Basin and the Greensand Ridge (Eglington & Horlock 2004), and areas of uncommon chalk heath. Lowland heathland is often in mosaic or association with lowland dry acid grassland and gorse scrub, which forms on the same soils.

Small sandpit mining bee (*Andrena argentata*)  
Large scabious mining bee (*Andrena hattorfiana*)  
Bilberry mining bee (*Andrena lapponica*)  
Small scabious mining bee (*Andrena marginata*)  
Red-backed mining bee (*Andrena similis*)  
Tormentil mining bee (*Andrena tarsata*)  
Green-eyed flower bee (*Anthophora bimaculata*)  
Brown-banded carder bee (*Bombus humilis*)  
Margined colletes (*Colletes marginatus*)  
Long-horned bee (*Eucera longicornis*)  
Southern bronze furrow bee (*Halictus confusus*)  
Short-horned furrow bee (*Lasioglossum brevicorne*)  
Squat furrow bee (*Lasioglossum pauperatum*)  
Grey-tailed furrow bee (*Lasioglossum prasinum*)  
Gold-tailed melitta (*Melitta haemorrhoidalis*)  
Bear-clawed nomad bee (*Nomada baccata*)  
Kirby's nomad bee (*Nomada subcornuta*)



Lowland heathland at North Warren, Suffolk © Steven Falk

Low-intensity or strip-grazing regimes that create a mosaic of habitat including areas of disturbed, bare ground, heathers of a range of ages, grassy areas, and scattered shrubs and trees, will provide a range of habitat features for invertebrates. Wet areas should be retained, and pressure from public activity managed to avoid negative impacts. Encroachment of scrub can be a particular issue on heathland and acid grassland particularly with the decline in rabbits, and this is a major threat to bees in areas such as Breckland.

**Further information** Buglife (2013) Heathland mosaic habitat management

## Lowland meadows

Species-rich grasslands found on soils with a neutral pH in the lowlands, and traditionally managed by hay cutting and/or grazing.

Hawk's-beard mining bee (*Andrena fulvago*)  
 Large meadow mining bee (*Andrena labialis*)  
 Broad-faced mining bee (*Andrena proxima*)  
 Brown-banded carder bee (*Bombus humilis*)  
 Moss carder bee (*Bombus muscorum*)  
 Red-shanked carder bee (*Bombus ruderarius*)  
 Shrill carder bee (*Bombus sylvarum*)  
 Long-horned bee (*Eucera longicornis*)  
 Red-tailed blood bee (*Sphecodes rubicundus*)



Lowland meadow at Ferry Meadows, Cambridgeshire © Steven Falk

Low-intensity or strip-grazing regimes that allow periods of rest and create structural diversity with areas of disturbed, bare ground and islands of scrub, will provide a range of habitat features and encourage growth of a variety of wild flowers for foraging invertebrates. Alternatively, meadows can be managed by cutting for hay in late summer, with the arisings removed. Leaving areas uncut on rotation, or varying the cutting height can help to promote the structural diversity that can be beneficial for invertebrates. Continuity of management regimes (cutting and/or grazing) is important, and chemical inputs such as herbicides should be avoided.

**Further information** Buglife lowland meadows

## Maritime cliffs

Sloping to vertical faces along the coastline where a break is formed by slippage or erosion. Cliff-top grasslands receive a maritime influence from salt spray, which may continue many hundreds of metres inland (JNCC 2019). There are stretches of 'soft' (easily-eroded such as clay, chalk and sand) cliffs along the region's coastline, including Hunstanton and Sheringham in Norfolk, and Dunwich and Lowestoft in Suffolk.

Black mining bee (*Andrena pilipes*)  
 Broad-faced mining bee (*Andrena proxima*)  
 Brown-banded carder bee (*Bombus humilis*)  
 Moss carder bee (*Bombus muscorum*)  
 Shrill carder bee (*Bombus sylvarum*)  
 Sea aster colletes (*Colletes halophilus*)  
 Long-horned bee (*Eucera longicornis*)  
 Squat furrow bee (*Lasioglossum pauperatum*)



Soft cliffs, Hampshire © Steven Falk

Disturbance of maritime cliffs should be minimised as much as possible, particularly activities that disrupts or alters the rate of their natural process of erosion, such as coastal engineering. Cliff top grasslands should be managed using low-intensity grazing and/or cutting that maintains opportunities for a range of flowering plants, as well as allowing islands of spring-blossoming scrub to develop. Cliff-top buffer strips can be used to accommodate natural retreat of the cliff top and promote the development of semi-natural vegetation (Buglife 2007). Freshwater seepages should be maintained where present, along with biodegradable tidal debris.

**Further information** Buglife maritime cliffs and slopes

### Open mosaic on brownfield land

Brownfield sites are land that has previously been developed or altered by human activity, but is not currently in use. These sites often develop mosaics of habitat and can be exceedingly valuable for invertebrates.

- Broad-faced mining bee (*Andrena proxima*)
- Green-eyed flower bee (*Anthophora bimaculata*)
- Brown-banded carder bee (*Bombus humilis*)
- Moss carder bee (*Bombus muscorum*)
- Red-shanked carder bee (*Bombus ruderarius*)
- Shrill carder bee (*Bombus sylvarum*)
- Sea aster colletes (*Colletes halophilus*)
- Long-horned bee (*Eucera longicornis*)
- Southern bronze furrow bee (*Halictus confusus*)
- Squat furrow bee (*Lasioglossum pauperatum*)
- Black-headed leafcutter bee (*Megachile circumcincta*)
- Kirby's nomad bee (*Nomada subcornuta*)
- Rough-backed blood bee (*Sphecodes scabricollis*)



Brownfield at West Thurrock Marsh, Essex © Steven Falk

Brownfield sites can support exceptional assemblages of bees. Their value depends upon the range of habitats present, which include a combination of early successional habitats, along with more established grassland and woody habitats, over what can be extensive areas. The sites are often effectively abandoned without management, which is an important feature, however to sustain their value some rotational disturbance and management of woody habitats, along with cutting and/or grazing of established grassland swards, is required. Disturbance is best undertaken during the winter months, and this can include addition of substrates, diversification of topography and soil stripping. Informal public disturbance can be beneficial in maintaining open areas suitable for use by ground-nesting bees.

**Further information** Buglife Managing brownfields for scarce bumblebees

## Road verges

Flowery road verges and other transport corridors can provide important habitats for pollinators including areas of grassland, tall herbs and scrub. Even mown verges can provide a useful source of plants such as legumes, although verges are more valuable when there are areas of tall herbs such as thistles and umbellifers, along with fringing Bramble and shrubs.

Large scabious mining bee (*Andrena hattorfiana*)  
Large meadow mining bee (*Andrena labialis*)  
Small scabious mining bee (*Andrena marginata*)  
Broad-faced mining bee (*Andrena proxima*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Silver-sided nomad bee (*Nomada argentata*)  
Armed nomad bee (*Nomada armata*)



Flower-rich verge, Surrey © Laurie Jackson

Road verges can be managed using a regime that promotes both safety and provision of habitat. Cutting the strip closest to the road most frequently provides for the safety functions, whilst other areas can be cut less frequently, allowing them to flower, as well as allowing patches of scattered scrub to develop. When verges are cut, the arisings should be removed to prevent changes to the vegetation community towards more coarse grasses and less fine herbs.

**Further information** Buglife managing transport corridors for pollinators; Roberts and Phillips (2019) Road verges and their potential for pollinators.

## Sea walls

Engineered structures used extensively in coastal defence, sea walls incorporate or interact with a range of habitats, including saltmarsh, grassland, and bare ground, and their linear nature allows them to function as a corridor linking other areas of habitat. There are significant areas of sea wall along the northern and eastern coastlines of the East of England.

Large meadow mining bee (*Andrena labialis*)  
Broad-faced mining bee (*Andrena proxima*)  
Brown-banded carder bee (*Bombus humilis*)  
Moss carder bee (*Bombus muscorum*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Shrill carder bee (*Bombus sylvarum*)  
Sea aster colletes (*Colletes halophilus*)  
Long-horned bee (*Eucera longicornis*)  
Squat furrow bee (*Lasioglossum pauperatum*)  
Red-tailed blood bee (*Sphecodes rubicundus*)



Sea wall at Coryton, Essex © Steven Falk

Sea walls should be managed to provide a mosaic of open habitat and flower-rich areas, including tall herbs such as thistles and umbellifers. The sea walls in the East of England can be particularly important for scarce bumblebees and so the presence of legumes within the flowering community is important. This can be achieved using mowing (ideally with the arisings removed) and/or light grazing.

**Further information** Gardiner *et al.* (2015) Sea Wall Biodiversity Handbook

## Woodland and wood-pasture

Woodland with a high cover of native broad-leaved trees combined with open areas, good structural variety, and dead and decaying wood, offers the most opportunities for wildlife. Wood-pasture and parklands were created by historic land management, and combine woodland plants with grassland or heathland. In Breckland the rides and clearings within conifer plantations can also hold important assemblages of bees (Falk 2007).

Groove-faced mining bee (*Andrena angustior*)  
Large scabious mining bee (*Andrena hattorfiana*)  
Bilberry mining bee (*Andrena lapponica*)  
Small scabious mining bee (*Andrena marginata*)  
Red-shanked carder bee (*Bombus ruderarius*)  
Grooved sharp-tail bee (*Coelioxys quadridentata*)  
Gold-tailed melitta (*Melitta haemorrhoidalis*)



Kings Forest, Breckland © Steven Falk

Structural diversity in woodlands is important, both in terms of having a canopy, well-developed understory and ground flora component, but also in terms of age-structure and regeneration of the woody plants. Dead and decaying wood should be retained, both standing and fallen, and in a range of shade situations. The continuity of dead wood supply often needs to be considered. Open areas such as glades, rides and clearings provide warmth and shelter, and maintaining these with structural diversity from bare ground to tall herbs and scrub, with bays to provide a range of aspects will provide many opportunities for wildlife. If open areas are not present, these can be created with selective felling, and combined with the creation of new deadwood habitats, using techniques such as ring-barking and forming totems. In wet woodlands it is important to ensure that water levels are retained as part of the natural flood regime, this may involve rotational clearing of waterbodies such as ponds and ditches. In wood-pasture and parkland the open areas should be maintained using low-intensity grazing and/or rotational cutting. Blocks of permanent open habitat should be provided within plantation woodland.

**Further information** Buglife managing woodland for pollinators; Buglife lowland wood pastures and parklands; Buglife wet woodland; Blakesley & Buckley (2010) Managing your woodland for wildlife

## 7. County summaries

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A summary is provided for each county showing the threatened bees recorded, along with the species believed to be lost. This analysis is based upon the best available data at the time of writing, but it should be noted that additional records may exist that were not available and there is potential for erroneous or unverified records to be present in the datasets used. It is possible that some of the species presumed to be lost are still present, and increased recording of bees in the East of England is certainly to be encouraged.

### Bedfordshire

Five of the 25 species considered as threatened in the East of England are recorded in Bedfordshire:

- Small sandpit mining bee (*Andrena argentata*) - discovered near Sandy in 2016
- Scarce black mining bee (*Andrena nigrospina*) - discovered near Sandy in 2015
- Tufted furrow bee (*Lasioglossum nitidiusculum*) - last recorded near Cople in 2000
- Gold-tailed melitta (*Melitta haemorrhoidalis*) - recorded at Whipsnade in 2005 after an absence of 70 years
- Kirby's nomad bee (*Nomada subcornuta*) - recorded on RSPB-managed heathland near Sandy

Twenty eight bee species are believed to have been lost from Bedfordshire:

- Small flecked mining bee (*Andrena coitana*) - **regionally extinct**, last recorded in Bedfordshire pre-1949
- Bilberry mining bee (*Andrena lapponica*) - threatened, last recorded in Bedfordshire in 1949
- Small scabious mining bee (*Andrena marginata*) - conservation concern, last recorded in Bedfordshire in 1949
- Black-headed mining bee (*Andrena nigriceps*) - conservation concern, last Bedfordshire record pre-1985
- Long-fringed mini-miner (*Andrena niveata*) - threatened, last recorded in Bedfordshire pre-1949
- Red-backed mining bee (*Andrena similis*) - threatened, last recorded in Bedfordshire pre-1949
- Tormentil mining bee (*Andrena tarsata*) - threatened, last recorded in Bedfordshire pre-1949
- Potter flower bee (*Anthophora retusa*) - **regionally extinct**, last recorded in Bedfordshire in 1946
- Cullum's bumblebee (*Bombus cullumanus*) - **extinct in Britain** last recorded in Bedfordshire in 1923
- Great yellow bumblebee (*Bombus distinguendus*) - **extinct in England**, last Bedfordshire record pre-1949
- Brown-banded carder bee (*Bombus humilis*) - threatened, last recorded in Bedfordshire pre-1949
- Red-shanked carder bee (*Bombus ruderarius*) - threatened, last recorded in Bedfordshire in 1978
- Short-haired bumblebee (*Bombus subterraneus*) - **regionally extinct**, last Bedfordshire record pre-1949
- Shrill carder bee (*Bombus sylvarum*) - threatened, last recorded in Bedfordshire in 1948
- Grooved sharp-tail bee (*Coelioxys quadridentata*) - threatened, last recorded in Bedfordshire pre-1949
- Squat furrow bee (*Lasioglossum pauperatum*) - conservation concern, last Bedfordshire record pre-1949
- Orange-footed furrow bee (*Lasioglossum xanthopus*) - conservation concern, last Bedfordshire record pre-1949
- Black-headed leafcutter bee (*Megachile circumcincta*) - threatened, last recorded in Bedfordshire in 1944
- Silver-sided nomad bee (*Nomada argentata*) - threatened, last recorded in Bedfordshire in 1944
- Cat's-ear nomad bee (*Nomada integra*) - conservation concern, last recorded in Bedfordshire in 1945
- Flat-ridged nomad bee (*Nomada obtusifrons*) - **regionally extinct**, last recorded in Bedfordshire in 1945
- Sheppard's nomad bee (*Nomada sheppardana*) - conservation concern, last Bedfordshire record pre-1949
- Broad-banded nomad bee (*Nomada signata*) - conservation concern, last recorded in Bedfordshire in 1949
- Fringe-horned mason bee (*Osmia pilicornis*) - **regionally extinct**, last recorded in Bedfordshire pre-1949
- Dull-headed blood bee (*Sphecodes ferruginatus*) - threatened, last recorded in Bedfordshire pre-1949
- Red-tailed blood bee (*Sphecodes rubicundus*) - conservation concern, last Bedfordshire record pre-1949
- Spotted dark bee (*Stelis ornatula*) - conservation concern, last recorded in Bedfordshire pre-1949
- Plain dark bee (*Stelis phaeoptera*) - conservation concern, last recorded in Bedfordshire pre-1949

## Cambridgeshire

Six of the 25 species considered as threatened in the East of England are recorded in Cambridgeshire:

- Red-shanked carder bee (*Bombus ruderarius*) - last recorded in Portholme Meadow in 2013
- Grooved sharp-tail bee (*Coelioxys quadridentata*) - last recorded at Cambridge Botanic Garden in 1997
- Southern bronze furrow bee (*Halictus confusus*) - found in pan trap samples in 2018
- Tufted furrow bee (*Lasioglossum nitidiusculum*) - last recorded at Kings Dyke Pit in 2011
- Armed nomad bee (*Nomada armata*) - recorded at Kings Dyke Nature Reserve in 2011
- Dull-headed blood bee (*Sphecodes ferruginatus*) - last recorded in Castor in 2017

Nine bee species are believed to have been lost from Cambridgeshire:

- Small flecked mining bee (*Andrena coitana*) - **regionally extinct**, last recorded in Cambridgeshire pre-1917
- Great yellow bumblebee (*Bombus distinguendus*) - **extinct in England**, last recorded in Cambridgeshire in 1980
- Brown-banded carder bee (*Bombus humilis*) - threatened, last recorded in Cambridgeshire pre-1917
- Heath bumblebee (*Bombus jonellus*) - conservation concern, last recorded in Cambridgeshire in 1927
- Moss carder bee (*Bombus muscorum*) - threatened, last recorded in Cambridgeshire pre-1917
- Short-haired bumblebee (*Bombus subterraneus*) - **regionally extinct**, last recorded in Cambridgeshire in 1902
- Shril carder bee (*Bombus sylvarum*) - threatened, last recorded in Cambridgeshire in 1930
- Silver-sided nomad bee (*Nomada argentata*) - threatened, last recorded in Cambridgeshire pre-1988
- Flat-ridged nomad bee (*Nomada obtusifrons*) - **regionally extinct**, last recorded in Cambridgeshire pre-1917



Heath bumblebee queen © Steven Falk



## Essex

Fifteen of the 25 species considered as threatened in the East of England are recorded in Essex:

- Groove-faced mining bee (*Andrena angustior*) - last recorded at Danbury Common in 2011
- Scarce black mining bee (*Andrena nigrospina*) - last recorded near Tilbury in 2018
- Long-fringed mini-miner (*Andrena niveata*) - discovered near Tilbury in 2018
- Brown-banded carder bee (*Bombus humilis*) - South Essex is the regional stronghold for this species
- Moss carder bee (*Bombus muscorum*) - last recorded near Wallasea and Mersea Islands in 2017, modern records are all coastal
- Red-shanked carder bee (*Bombus ruderarius*) - principally in the Thames Gateway
- Shriill carder bee (*Bombus sylvarum*) - Thames Gateway is one of the most important remaining metapopulations
- Sea aster colletes (*Colletes halophilus*) - East Anglia is one of the strongholds for this species with recent records scattered along the Essex coastline
- Margined colletes (*Colletes marginatus*) - last recorded at Canvey Wick in 2015
- Long-horned bee (*Eucera longicornis*) - last recorded at Fingringhoe Marshes in 2018
- Tufted furrow bee (*Lasioglossum nitidiusculum*) - last recorded in Tilbury in 2018,
- Black-headed leafcutter bee (*Megachile circumcincta*) - last recorded at West Bergholt Heath in 1997
- Gold-tailed melitta (*Melitta haemorrhoidalis*) - last recorded in Grays in 2017
- Kirby's nomad bee (*Nomada subcornuta*) - recorded in the Thames Gateway
- Dull-headed blood bee (*Sphcodes ferruginatus*) - last recorded at Wethersfield Airfield in 2011.

Nineteen bee species are believed to have been lost from Essex:

- Small flecked mining bee (*Andrena coitana*) - **regionally extinct**, recorded in Essex pre-1851
- White-bellied mining bee (*Andrena gravida*) - **regionally extinct**, recorded in Essex pre-1851
- Small scabious mining bee (*Andrena marginata*) - conservation concern, last recorded in Essex pre-1851
- Barham mini-miner (*Andrena nana*) - **extinct in Britain** last recorded in Essex in 1932
- Perkin's mining bee (*Andrena rosae*) - **regionally extinct**, recorded in Essex pre-1885
- Red-backed mining bee (*Andrena similis*) - threatened, last recorded in Essex pre-1851
- Pale-tailed mining bee (*Andrena tridentata*) - **extinct in Britain** last recorded in Essex pre-1851
- Potter flower bee (*Anthophora retusa*) - **regionally extinct**, last recorded in Essex in 1970
- Short-haired bumblebee (*Bombus subterraneus*) - **regionally extinct**, last recorded in Essex in 1960
- Grooved sharp-tail bee (*Coelioxys quadridentata*) - threatened, last recorded in Essex pre-1851
- Southern bronze furrow bee (*Halictus confusus*) - threatened, last recorded in Essex in 1995
- Ashy furrow bee (*Lasioglossum sexnotatum*) - conservation concern, last recorded in Essex pre-1851
- Square-spotted mourning bee (*Melecta luctuosa*) - **extinct in Britain** last recorded in Essex in 1884
- Armed nomad bee (*Nomada armata*) - threatened, last recorded in Essex in 1902
- Bear-clawed nomad bee (*Nomada baccata*) - threatened, last recorded in Essex pre-1851
- Flat-ridged nomad bee (*Nomada obtusifrons*) - **regionally extinct**, last recorded in Essex in 1902
- Six-banded nomad bee (*Nomada sexfasciata*) - **regionally extinct**, last recorded in Essex pre-1851
- Fringe-horned mason bee (*Osmia pilicornis*) - **regionally extinct**, last recorded in Essex in 1883
- Cliff mason bee (*Osmia xanthomelana*) - **extinct in England** last recorded in Essex pre-1851

## Hertfordshire

Two of the 25 species considered as threatened in the East of England are recorded in Hertfordshire:

- Groove-faced mining bee (*Andrena angustior*) - recorded at Chorleywood Common in 2002
- Gold-tailed melitta (*Melitta haemorrhoidalis*) - last recorded near St Albans in 2016

Two bee species are believed to have been lost from Hertfordshire:

- Heath bumblebee (*Bombus jonellus*) - conservation concern, recorded in Hertfordshire in 1923
- Red-shanked carder bee (*Bombus ruderarius*) - threatened, last recorded in Hertfordshire in 1977



Gold-tailed melitta female © Steven Falk

## Norfolk

Seventeen of the 25 species considered as threatened in the East of England are recorded in Essex:

- Groove-faced mining bee (*Andrena angustior*) - last recorded at Cotessey in 2015
- Small sandpit mining bee (*Andrena argentata*) - last recorded Roydon Common and Grimston Warren in 2018
- Bilberry mining bee (*Andrena lapponica*) - discovered at Dersingham Bog in 2016
- Scarce black mining bee (*Andrena nigrospina*) - recorded at Bowthorpe in 2011
- Tormentil mining bee (*Andrena tarsata*) - last recorded at Swannington Upgate Common in 2010
- Moss carder bee (*Bombus muscorum*) - last recorded at Burnham Overy in 2016
- Red-shanked carder bee (*Bombus ruderarius*) - last recorded in 2016 from three locations near the North Norfolk coast and one inland at Stow Bardolph
- Shrill carder bee (*Bombus sylvarum*) - a photographic record was confirmed in central Norfolk in 2018
- Sea aster colletes (*Colletes halophilus*) - East Anglia is one of the strongholds for this species, the most recent record in Norfolk is from Terrington St Clement in 2016.
- Margined colletes (*Colletes marginatus*) - last recorded at Barnham Cross Common and Middle Harling Heath in 2012.
- Long-horned bee (*Eucera longicornis*) - last recorded at Hoe Rough in 2006
- Southern bronze furrow bee (*Halictus confusus*) - last recorded at Thetford Warren Lodge in 2012
- Tufted furrow bee (*Lasioglossum nitidiusculum*) - last recorded at Hockham Wood in 2008
- Black-headed leafcutter bee (*Megachile circumcincta*) - last recorded at Holkham in 2016
- Gold-tailed melitta (*Melitta haemorrhoidalis*) - last recorded in Fritcham in 2016
- Silver-sided nomad bee (*Nomada argentata*) - last recorded at Cranwich Heath and Middle Harling Heath in 2016, colonies in the region are of national significance
- Bear-clawed nomad bee (*Nomada baccata*) - discovered at Roydon Heath in 2016 and recorded at the adjacent Grimston Warren in 2018

Twelve bee species are believed to have been lost from Norfolk:

- Small flecked mining bee (*Andrena coitana*) - **regionally extinct**, last recorded in Norfolk in 1983
- Perkin's mining bee (*Andrena rosae*) - **regionally extinct**, recorded in Norfolk in 1936
- Potter flower bee (*Anthophora retusa*) - **regionally extinct**, last recorded in Norfolk in 1970
- Great yellow bumblebee (*Bombus distinguendus*) - **extinct in England**, last recorded in Norfolk in 1937
- Short-haired bumblebee (*Bombus subterraneus*) - **regionally extinct**, last recorded in Norfolk in 1894
- Armed nomad bee (*Nomada armata*) - threatened, last recorded in Norfolk in 1876
- Flat-ridged nomad bee (*Nomada obtusifrons*) - **regionally extinct**, last recorded in Norfolk in 1900
- Tormentil mining bee (*Nomada roberjeotiana*) - **regionally extinct**, last recorded in Norfolk in 1900
- Six-banded nomad bee (*Nomada sexfasciata*) - **regionally extinct**, last recorded in Norfolk pre-1880
- Dull-headed blood bee (*Sphecodes ferruginatus*) - threatened, recorded in Norfolk in the 1909
- Red-tailed blood bee (*Sphecodes rubicundus*) - conservation concern, last recorded in 1988
- Banded dark bee (*Stelis punctulatissima*) - recorded in Norfolk in 1976

## Suffolk

Sixteen of the 25 species considered as threatened in the East of England are recorded in Suffolk:

- Groove-faced mining bee (*Andrena angustior*) - last recorded at Tiger Hill in 2016.
- Small sandpit mining bee (*Andrena argentata*) - last recorded at Westleton Heath in 2017
- Scarce black mining bee (*Andrena nigrospina*) - recorded at Kings Forest in 2003
- Red-backed mining bee (*Andrena similis*) - last recorded at Knettishall Heath in 2015
- Brown-banded carder bee (*Bombus humilis*) - last recorded at Minsmere in 2017
- Moss carder bee (*Bombus muscorum*) - last recorded at Carlton Marshes in 2017
- Red-shanked carder bee (*Bombus ruderarius*) - last recorded at Ipswich Golf Club in 2016
- Sea aster colletes (*Colletes halophilus*) - East Anglia is one of the strongholds for this species with recent records from Orford Ness and Snape Marshes in 2016
- Margined colletes (*Colletes marginatus*) - last recorded at Centreparcs in Elveden Forest in 2013
- Southern bronze furrow bee (*Halictus confusus*) - last recorded at Lackford Lakes in 2017
- Shingle yellow-face bee (*Hylaeus annularis*) - last recorded at Orford Ness in 2012
- Tufted furrow bee (*Lasioglossum nitidiusculum*) - last recorded in at Stradbroke in 2017
- Black-headed leafcutter bee (*Megachile circumcincta*) - last recorded at Pashford Poors Fen in 1998
- Gold-tailed melitta (*Melitta haemorrhoidalis*) - last recorded at Cavenham Heath in 2015.
- Silver-sided nomad bee (*Nomada argentata*) - last recorded in King's Forest in 2003, colonies in the region are of national significance
- Bear-clawed nomad bee (*Nomada baccata*) - last recorded at Westleton Heath in 2017

Nineteen bee species are believed to have been lost from Suffolk:

- Small flecked mining bee (*Andrena coitana*) - **regionally extinct**, last recorded in Suffolk in 1923
- Barham mini-miner (*Andrena nana*) - **extinct in Britain**, last recorded in Suffolk in 1932
- Long-fringed mini-miner (*Andrena niveata*) - threatened, last recorded in Suffolk in 1936
- Perkin's mining bee (*Andrena rosae*) - **regionally extinct**, recorded in Suffolk in 1920
- Tormentil mining bee (*Andrena tarsata*) - threatened, last recorded in Suffolk in 1897
- Pale-tailed mining bee (*Andrena tridentata*) - **extinct in Britain**, last recorded in Suffolk in 1936
- Potter flower bee (*Anthophora retusa*) - **regionally extinct**, last recorded in Suffolk in 1899
- Cullum's bumblebee (*Bombus cullumanus*) - **extinct in Britain** last recorded in Suffolk in 1911
- Short-haired bumblebee (*Bombus subterraneus*) - **regionally extinct**, last recorded in Suffolk in 1937
- Shrill carder bee (*Bombus sylvarum*) - threatened, last recorded in Suffolk in 1928
- Grooved sharp-tail bee (*Coelioxys quadridentata*) - threatened, last recorded in Suffolk in 1936
- Long-horned bee (*Eucera longicornis*) - threatened, last recorded in Suffolk in 1936
- Downland furrow bee (*Halictus eurygnathus*) - **regionally extinct**, last recorded in Suffolk in 1800
- Shiny-gastered furrow bee (*Lasioglossum laeve*) - **extinct in Britain** last recorded in Suffolk pre-1802
- Grey-tailed furrow bee (*Lasioglossum prasinum*) - conservation concern, last recorded in Suffolk in 1971
- Six-banded nomad bee (*Nomada sexfasciata*) - **regionally extinct**, last recorded in Suffolk in 1900
- Dull-headed blood bee (*Sphecodes ferruginatus*) - threatened, last recorded in Suffolk in 1923
- Fringe-horned mason bee (*Osmia pilicornis*) - **regionally extinct**, recorded in Suffolk in 1975
- Cliff mason bee (*Osmia xanthomelana*) - **extinct in England** last recorded in Suffolk in 1924

## 8. Conservation action

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In preparing this report, a number of conservation actions were identified that could be applied to one or more of the threatened bees of the East of England, in an effort to stabilise their populations, and reverse declines. These collective actions are identified and expanded upon below, and could form the basis of positive conservation actions that benefit the wider bee and pollinator community.

### Establish extent of current distribution

In the absence of current data on species distribution and abundance it is challenging to establish clear status and identify which species are under greatest threat, and which should be priorities for the limited conservation resources available. Although recording of bees has been increasing in recent years, there are a number of species within this report whose current status is unclear. For these species the immediate priority should be the resurvey of historic sites along with any other suitable linked or proximal habitat, in order to establish current distribution, and identify any potential new or relict populations. Long-term monitoring is also vital in safeguarding pollinator communities, and can provide essential data on population declines as well as the effectiveness of targeted land management interventions (IPBES 2016).

**Action - ongoing survey and monitoring of bee populations.**

### Address gaps in autoecological knowledge

Without detailed understanding of a species' ecology, such as its habitat niche, foraging preferences, nesting requirements, and interactions with other species, the correct conservation management may not be implemented. Whilst some bees have been subject to extensive research, there are many whose autecology is still poorly understood, which can limit our ability to conserve them. At the community level we still have limited understanding of the densities of pollinator species we need to supply pollination services, along with pollinator nutritional requirements, and the amount of nectar and pollen available in real agricultural landscapes (Dicks *et al.* 2015).

**Action - improve the evidence base relating to our wild pollinators.**

### Farmer clusters

Farmer cluster groups have been set up across England with farmers working together on delivery projects across their holdings, with support and guidance from a conservation advisor. The collaboration between groups of farmers has the potential to increase the benefit of conservation action by moving delivery towards a landscape-scale. Many of the species identified in this report have a requirement for extensive areas of flower-rich habitats, and mosaics of features that can be delivered within and between farm holdings. Conservation projects by farmer cluster groups that target wild pollinators could have significant positive conservation impacts. The Countryside Stewardship wild pollinator package estimates that 2% flower-rich habitat and 1km flowering hedgerow within 100 hectares is sufficient to supply six common pollinator species with their food requirements (Dicks *et al.* 2015), and farmer cluster groups could challenge themselves to deliver this as a minimum.

**Action - maintain and increase awareness, advice, support and funding for practical delivery projects for pollinator conservation through farmer clusters.**

### Management of brownfield sites

Brownfield sites are land that has previously been developed or altered by human activity, but is not currently in use. The East of England is rich in brownfield land including sandpits and quarries, along with the extensive brownfields of the Thames Gateway. The abandonment and periodic disturbance that characterises brownfield sites can create mosaics of habitat with a range of micro-topography and plant species perfect for invertebrates with complex life-cycles, requiring different habitats at different stages of development. These sites should be protected and the mosaic of early-successional habitat with more established areas of scrub and grassland communities, maintained. Where there is a natural tendency for a site to become waterlogged, scrapes can be

created to encourage ephemeral or permanent waterbodies. The East of England has several nationally (and in the case of Sea aster colletes, internationally) important populations of bees. Many of these species have an association with brownfield sites. In just six years over half (51%) of important brownfield sites within the Thames Gateway were lost, damaged or under immediate threat, which included 39% of sites within the Essex area of the Thames Gateway (Robins *et al.* 2013). There are still significant pressures on these sites, and their value to bees and other wildlife must be safeguarded, with steps taken to designate areas with important species assemblages, and mitigation, compensation and enhancements assured where habitat damage or loss is unavoidable.

**Action - safeguard wildlife-rich brownfield sites, raise their profile and promote beneficial management.**

## Coastal habitats

The East of England contains a long coastline with a varied set of habitats including vegetated shingle, sand dune systems, saltmarsh and soft cliffs. Varied vegetation structure and bare ground are important components of all of these coastal habitats, and many of the threatened bees in this report have shown a marked retreat towards coastal areas, which may also be key areas in facilitating range expansions. Minimising the disturbance of these habitats is usually preferential, although where there is a history of low-intensity grazing on saltmarshes or dunes that is maintaining suitable habitats, this should be continued. In addition to semi-natural habitats, the region's sea walls offer much existing and potential habitat for pollinators. These manmade structures often support plants typical of saltmarsh alongside grassland vegetation. Periodic rotational cutting should help to maintain the structural diversity and invertebrate interest, ensuring there are foraging areas and undisturbed areas for shelter.

**Action - ensure that coastal management plans enable the protection of coastal habitats and raise awareness and promote the management of sea walls for the wildlife they can support.**

## Grassland

There are a wide range of vegetation communities within the region's grasslands. In addition to a diversity of flowering plants that provide foraging opportunities from spring until autumn, those offering a range of topography, along with stages of succession from bare ground to patches of dense scrub, and coexistence with other semi-natural habitats such as heathland or woody habitats, are more likely to attract invertebrate interest. Grazing is a well-used management tool that can be useful in maintaining and enhancing the botanical diversity of grassland. The intensity and timing of grazing will dictate the outcome for pollinators, with overgrazing resulting in less efficient pollination of wild plants (IPBES 2016). Mowing can result in direct mortality, as well sudden restriction of flowering resource, and a loss of structural diversity and undisturbed areas that are beneficial to insects including wild pollinators. Rotational management that promotes structural diversity and leaves uncut areas for shelter and flowering can help to mitigate the impacts on pollinators (IPBES 2016). Structural diversity should be promoted including scattered scrub, ideally using light cattle grazing. Areas of bare ground should be retained and if necessary created. Flower-rich arable margins can be created in the areas surrounding grasslands through natural regeneration or seeding with wild flowers to buffer and link semi-improved and unimproved grassland sites.

**Action - promote coordinated management between landowners and landholdings that provides a mosaic of habitat and relinks disjointed fragments of grassland in the landscape.**

## Heathland

The best heathland for invertebrates comprises extensive areas of mixed and structurally diverse habitat including flowering heather stands of varied ages, bare ground, pits and cuttings, scrub, trees, deadwood, bracken, acid grassland and wetter areas such as mires, pools and ditches. Grazing and cutting can be used to promote structural diversity within heather and help to maintain other habitat such as bare ground. Controlled burning can be used as a management tool on heathland, but should not be introduced to sites with no history of this type of management, and only carried out in small patches on a long rotation, during the winter months. Areas of vegetation can be scraped to create open, sandy ground, with south-facing slopes can often provide good sites.

**Action - promote coordinated management between landowners and landholdings that provides a mosaic of habitat and relinks disjointed fragments of heathland in the landscape.**

## **Urban areas**

Urban areas should not be overlooked as valuable habitat for pollinators and have been shown to support species-rich communities, which in some cases are more diverse than those in nearby rural landscapes (Hall *et al.* 2017). Increasing urbanisation will increase the importance of urban greenspaces, including road verges, private gardens, allotments and churchyards, as wildlife habitat. The foraging resources in urban areas are often provided through a combination of native and introduced plant species, and many non-native plants can provide large quantities of foraging resource (Baldock *et al.* 2015). Nesting opportunities including deadwood, and cavities in walls and buildings, as well as woody plant stems can also be readily available. Urban areas have the potential to support pollinators and contribute to corridors of habitat that enable them to spread in response to climate change. Advocating management and enhancement of urban habitats for pollinators could form an important part of pollinator conservation (Baldock *et al.* 2015) such as ensuring there is a long season of foraging resource available, managing greenspaces less intensively and removing cuttings, and creating corridors of habitat (green and blue infrastructure through urban areas).

**Action - Local Authorities can work with and support local communities in assessing urban areas for pollinators and implementing changes in management as well as proactive projects to restore and create new habitat, building on the model of projects such as Urban Buzz.**

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## Appendix 1 - species list for the East of England

Species	Hectad pre-1990	Hectad post-1990	Hectad change	Status (Falk 1991)
Alfken's Mini-miner ( <i>Andrena alfkenella</i> )	3	15	12	RDB3
Groove-faced mining bee ( <i>Andrena angustior</i> )	3	9	6	None
Large sallow mining bee ( <i>Andrena apicata</i> )	2	2	0	Nb
Small sandpit mining bee ( <i>Andrena argentata</i> )	1	3	2	Na
Sandpit mining bee ( <i>Andrena barbilabris</i> )	11	56	45	None
Gwynne's mining bee ( <i>Andrena bicolor</i> )	38	145	107	None
Large gorse mining bee ( <i>Andrena bimaculata</i> )	8	47	39	Nb
Big-headed mining bee ( <i>Andrena bucephala</i> )	2	5	3	Na
Hawthorn mining bee ( <i>Andrena chrysoceles</i> )	17	110	93	None
Ashy mining bee ( <i>Andrena cineraria</i> )	5	43	38	None
Clarke's mining bee ( <i>Andrena clarkella</i> )	18	53	35	None
Small flecked mining bee ( <i>Andrena coitana</i> )	15	3	-12	None
Long-fringed mining bee ( <i>Andrena congruens</i> )	0	1	1	Na
Grey-banded mining bee ( <i>Andrena denticulata</i> )	19	36	17	None
Short-fringed mining bee ( <i>Andrena dorsata</i> )	15	135	120	None
Thick-margined Mini-miner ( <i>Andrena falsifica</i> )	1	2	1	Na
Yellow-legged mining bee ( <i>Andrena flavipes</i> )	20	131	111	None
Bryony mining bee ( <i>Andrena florea</i> )	0	16	16	RDB3
Painted mining bee ( <i>Andrena fucata</i> )	6	25	19	None
Tawny mining bee ( <i>Andrena fulva</i> )	21	119	98	None
Hawk's-beard mining bee ( <i>Andrena fulvago</i> )	4	21	17	Na
Heather mining bee ( <i>Andrena fuscipes</i> )	7	32	25	Na
White-bellied mining bee ( <i>Andrena gravida</i> )	2	0	-2	RDB1
Orange-tailed mining bee ( <i>Andrena haemorrhoea</i> )	27	161	134	None
Large scabious mining bee ( <i>Andrena hattorfiana</i> )	6	15	9	NT <sup>1</sup> ; RDB3
Coppice mining bee ( <i>Andrena helvola</i> )	5	47	42	None
Buff-tailed mining bee ( <i>Andrena humilis</i> )	4	23	19	Nb
Large meadow mining bee ( <i>Andrena labialis</i> )	7	31	24	None
Red-girdled mining bee ( <i>Andrena labiata</i> )	4	47	43	Na
Bilberry mining bee ( <i>Andrena lapponica</i> )	1	0	-1	None
Small scabious mining bee ( <i>Andrena marginata</i> )	13	11	-2	Na
Common mini-miner ( <i>Andrena minutula</i> )	26	148	122	None
Plain mini-miner ( <i>Andrena minutuloides</i> )	2	10	8	Na
Barham mini-miner ( <i>Andrena nana</i> )	1	0	-1	RDB1+
Black-headed mining bee ( <i>Andrena nigriceps</i> )	8	11	3	Nb
Buffish mining bee ( <i>Andrena nigroaenea</i> )	27	134	107	None
Scarce black mining bee ( <i>Andrena nigrospina</i> )	0	8	8	None
Grey-patched mining bee ( <i>Andrena nitida</i> )	16	137	121	None
Long-fringed mini-miner ( <i>Andrena niveata</i> )	4	0	-4	RDB2
Small gorse mining bee ( <i>Andrena ovatula</i> )	7	34	27	NT <sup>1</sup> ; None
Black mining bee ( <i>Andrena pilipes</i> )	5	13	8	Nb
Small sallow mining bee ( <i>Andrena praecox</i> )	10	61	51	None
Broad-faced mining bee ( <i>Andrena proxima</i> )	6	30	24	RDB3
Perkin's mining bee ( <i>Andrena rosae</i> )	2	0	-2	RDB2
Chocolate mining bee ( <i>Andrena scotica</i> )	26	141	115	None
Shiny-margined mini-miner ( <i>Andrena semilaevis</i> )	15	91	76	None
Red-backed mining bee ( <i>Andrena similis</i> )	0	3	3	Nb
Impunctate mini-miner ( <i>Andrena subopaca</i> )	11	97	86	None
Broad-margined mining bee ( <i>Andrena synadelpha</i> )	12	45	33	None
Tormentil mining bee ( <i>Andrena tarsata</i> )	5	1	-4	Section 41 <sup>2</sup>
Cliff mining bee ( <i>Andrena thoracica</i> )	10	28	18	None
Grey-gastered mining bee ( <i>Andrena tibialis</i> )	7	36	29	Na
Pale-tailed mining bee ( <i>Andrena tridentata</i> )	3	0	-3	CR <sup>1</sup> ; RDB1+
Trimmer's mining bee ( <i>Andrena trimmerana</i> )	6	31	25	Nb
Grey-backed mining bee ( <i>Andrena vaga</i> )	0	1	1	RDB1+
Blackthorn mining bee ( <i>Andrena varians</i> )	8	18	10	Nb
Wilke's mining bee ( <i>Andrena wilkella</i> )	13	46	33	None

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

<sup>2</sup> Natural Environment and Rural Communities Act 2006 (as amended) - species of principal importance for the conservation of biodiversity in England

Wool carder bee ( <i>Anthidium manicatum</i> )	11	61	50	None
Green-eyed flower bee ( <i>Anthophora bimaculata</i> )	5	20	15	None
Fork-tailed flower bee ( <i>Anthophora furcata</i> )	12	45	33	None
Hairy-footed flower bee ( <i>Anthophora plumipes</i> )	14	118	104	None
Four-banded flower bee ( <i>Anthophora quadrimaculata</i> )	8	8	0	Nb
Potter flower bee ( <i>Anthophora retusa</i> )	9	1	-8	RDB1
Eastern honeybee ( <i>Apis mellifera</i> )	16	143	127	None
Barbut's cuckoo bee ( <i>Bombus barbutellus</i> )	27	64	37	None
Gypsy cuckoo bee ( <i>Bombus bohemicus</i> )	13	41	28	None
Field cuckoo bee ( <i>Bombus campestris</i> )	43	75	32	None
Cullum's bumblebee ( <i>Bombus cullumanus</i> )		0		CR <sup>1</sup> ;RDB1+
Great yellow bumblebee ( <i>Bombus distinguendus</i> )	1	0	-1	VU <sup>1</sup> ; Nb
Garden bumblebee ( <i>Bombus hortorum</i> )	66	192	126	None
Brown-banded carder bee ( <i>Bombus humilis</i> )	14	20	6	Section 41 <sup>2</sup>
Tree bumblebee ( <i>Bombus hypnorum</i> )	1	190	189	None
Heath bumblebee ( <i>Bombus jonellus</i> )	8	20	12	None
Red-tailed bumblebee ( <i>Bombus lapidarius</i> )	89	212	123	None
White-tailed bumblebee ( <i>Bombus lucorum</i> )	74	204	130	None
Northern white-tailed bumblebee ( <i>Bombus magnus</i> )	0	1	1	None
Bilberry bumblebee ( <i>Bombus monticola</i> )	0	4	4	None
Moss carder bee ( <i>Bombus muscorum</i> )	8	19	11	VU <sup>1</sup> ; Section 41 <sup>2</sup>
Common carder bee ( <i>Bombus pascuorum</i> )	48	180	132	
Early bumblebee ( <i>Bombus pratorum</i> )	50	190	140	
Red-shanked carder bee ( <i>Bombus ruderarius</i> )	39	38	-1	Section 41 <sup>2</sup>
Large garden bumblebee ( <i>Bombus ruderatus</i> )	11	47	36	Nb
Red-tailed cuckoo bee ( <i>Bombus rupestris</i> )	15	80	65	
Short-haired bumblebee ( <i>Bombus subterraneus</i> )	2	0	-2	Na
Shrill carder bee ( <i>Bombus sylvarum</i> )	4	15	11	Nb; Section 41 <sup>2</sup>
Forest cuckoo bee ( <i>Bombus sylvestris</i> )	24	126	102	
Buff-tailed bumblebee ( <i>Bombus sylvestris</i> )	75	215	140	
Vestal cuckoo bee ( <i>Bombus vestalis</i> )	54	177	123	
Little blue carpenter bee ( <i>Ceratina cyanea</i> )	1	11	10	RDB3
Small scissor bee ( <i>Chelostoma campanularum</i> )	13	57	44	
Large scissor bee ( <i>Chelostoma florisomne</i> )	15	47	32	
Large sharp-tail bee ( <i>Coelioxys conoidea</i> )	4	32	28	
Dull-vented sharp-tail bee ( <i>Coelioxys elongata</i> )	9	16	7	
Shiny-vented sharp-tail bee ( <i>Coelioxys inermis</i> )	15	28	13	
Grooved sharp-tail bee ( <i>Coelioxys quadridentata</i> )	6	1	-5	RDB3
Rufescent sharp-tail bee ( <i>Coelioxys rufescens</i> )	6	17	11	
Early colletes ( <i>Colletes cunicularius</i> )	0	3	3	RDB3
Davies' colletes ( <i>Colletes daviesanus</i> )	15	62	47	
Hairy-saddled colletes ( <i>Colletes fodiens</i> )	11	50	39	VU <sup>1</sup>
Sea aster colletes ( <i>Colletes halophilus</i> )	15	31	16	NT; <sup>1</sup> Na; Section 41 <sup>2</sup>
Ivy colletes ( <i>Colletes hederæ</i> )	0	59	59	
Margined colletes ( <i>Colletes marginatus</i> )	6	13	7	Na
Bare-saddled colletes ( <i>Colletes similis</i> )	10	40	30	
Heather colletes ( <i>Colletes succinctus</i> )	17	38	21	NT <sup>1</sup>
Pantaloone bee ( <i>Dasygaster hirtipes</i> )	13	53	40	
Shiny dufourea ( <i>Dufourea minuta</i> )	0	1	1	NT <sup>1</sup> ; RDB1
Red-thighed epeolus ( <i>Epeolus cruciger</i> )	10	25	15	NT <sup>1</sup>
Black-thighed epeolus ( <i>Epeolus variegatus</i> )	29	33	24	
Long-horned bee ( <i>Eucera longicornis</i> )	5	3	-2	Na; Section 41 <sup>2</sup>
Southern bronze furrow bee ( <i>Halictus confusus</i> )	4	7	3	RDB3
Downland furrow bee ( <i>Halictus eurygnathus</i> )	1	0	-1	RDB1+
Orange-legged furrow bee ( <i>Halictus rubicundus</i> )	30	84	54	
Bronze furrow bee ( <i>Halictus tumulorum</i> )	21	119	98	
Large-headed resin bee ( <i>Heriades truncorum</i> )	0	32	32	RDBK
Welsh mason bee ( <i>Hoplitis claviventris</i> )	7	25	18	
Shingle yellow-face bee ( <i>Hylaeus annularis</i> )	2	27	25	

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

<sup>2</sup> Natural Environment and Rural Communities Act 2006 (as amended) - species of principal importance for the conservation of biodiversity in England

Short-horned yellow-face bee ( <i>Hylaeus brevicornis</i> )	13	67	54	
Common yellow-face bee ( <i>Hylaeus communis</i> )	29	125	96	
White-jawed yellow-face bee ( <i>Hylaeus confusus</i> )	16	53	37	
Spined hylaeus ( <i>Hylaeus cornutus</i> )	12	38	26	Na
Chalk yellow-face bee ( <i>Hylaeus dilatatus</i> )	10	58	48	
Hairy yellow-face bee ( <i>Hylaeus hyalinatus</i> )	7	71	64	NT <sup>1</sup>
Reed yellow-face bee ( <i>Hylaeus pectoralis</i> )	11	40	29	
Little yellow-face bee ( <i>Hylaeus pictipes</i> )	5	15	10	Na
Large yellow-face bee ( <i>Hylaeus signatus</i> )	9	64	55	Nb
Bloomed furrow bee ( <i>Lasioglossum albipes</i> )	25	84	59	
Short-horned furrow bee ( <i>Lasioglossum brevicorne</i> )	3	14	11	NT <sup>1</sup> ; RDB3
Common furrow bee ( <i>Lasioglossum calceatum</i> )	28	147	119	
Turquoise furrow bee ( <i>Lasioglossum cupromicans</i> )	3	17	14	
Smooth-faced furrow bee ( <i>Lasioglossum fratellum</i> )	5	5	0	
Chalk furrow bee ( <i>Lasioglossum fulvicorne</i> )	28	54	26	
Shiny-gastered furrow bee ( <i>Lasioglossum laeve</i> )	1	0	-1	EN <sup>1</sup> ; Appendix
Red-backed furrow bee ( <i>Lasioglossum laevigatum</i> )	15	23	8	NT <sup>1</sup>
Furry-clasped furrow bee ( <i>Lasioglossum lativentre</i> )	5	45	40	
White-footed furrow bee ( <i>Lasioglossum leucopus</i> )	23	84	61	
White-zoned furrow bee ( <i>Lasioglossum leucozonium</i> )	27	112	85	
Sharp-collared furrow bee ( <i>Lasioglossum malachurum</i> )	8	100	92	
Least furrow bee ( <i>Lasioglossum minutissimum</i> )	12	86	74	
Green furrow bee ( <i>Lasioglossum morio</i> )	21	139	118	
Tufted furrow bee ( <i>Lasioglossum nitidiusculum</i> )	8	24	16	None
Smooth-gastered furrow bee ( <i>Lasioglossum parvulum</i> )	16	76	60	
Squat furrow bee ( <i>Lasioglossum pauperatum</i> )	3	21	18	RDB3
Lobe-spurred furrow bee ( <i>Lasioglossum pauxillum</i> )	5	88	83	Na
Grey-tailed furrow bee ( <i>Lasioglossum prasinum</i> )	4	2	-2	NT <sup>1</sup>
Long-faced furrow bee ( <i>Lasioglossum punctatissimum</i> )	13	59	46	
Ridge-cheeked furrow bee ( <i>Lasioglossum puncticolle</i> )	5	38	33	Nb
Four-spotted furrow bee ( <i>Lasioglossum quadrinotatum</i> )	5	24	19	NT <sup>1</sup> ; Na
Rufous-footed furrow bee ( <i>Lasioglossum rufitarse</i> )	1	6	5	
Ashy furrow bee ( <i>Lasioglossum sexnotatum</i> )	6	9	3	NT <sup>1</sup> ; RDB1
Fringed furrow bee ( <i>Lasioglossum sexstrigatum</i> )	0	1	1	
Smeathman's furrow bee ( <i>Lasioglossum smeathmanellum</i> )	16	69	53	
Shaggy furrow bee ( <i>Lasioglossum villosulum</i> )	23	115	92	
Orange-footed furrow bee ( <i>Lasioglossum xanthopus</i> )	16	18	2	NT <sup>1</sup> ; Nb
Bull-headed furrow bee ( <i>Lasioglossum zonulum</i> )	3	8	5	
Yellow loosestrife bee ( <i>Macropis europaea</i> )	7	22	15	Na
Patchwork leafcutter bee ( <i>Megachile centuncularis</i> )	12	74	62	
Black-headed leafcutter bee ( <i>Megachile circumcincta</i> )	10	4	-6	None
Silvery leafcutter bee ( <i>Megachile leachella</i> )	8	37	29	Nb
Wood-carving leafcutter bee ( <i>Megachile ligniseca</i> )	13	78	65	
Coast leafcutter bee ( <i>Megachile maritima</i> )	24	32	8	
Brown-footed leafcutter bee ( <i>Megachile versicolor</i> )	10	51	41	
Willughby's leafcutter bee ( <i>Megachile willughbiella</i> )	20	76	56	
Common mourning bee ( <i>Melecta albifrons</i> )	9	50	41	
Square-spotted mourning bee ( <i>Melecta luctuosa</i> )	1	0	-1	RDB1+
Gold-tailed melitta ( <i>Melitta haemorrhoidalis</i> )	7	16	9	None
Clover melitta ( <i>Melitta leporina</i> )	14	31	17	
Red bartisia bee ( <i>Melitta tricincta</i> )	6	28	22	NT <sup>1</sup>
Silver-sided nomad bee ( <i>Nomada argentata</i> )	5	2	-3	
Armed nomad bee ( <i>Nomada armata</i> )	1	1	0	NT <sup>1</sup> ; RDB3
Bear-clawed nomad bee ( <i>Nomada baccata</i> )	1	1	0	NT <sup>1</sup> ; Na
Fringeless nomad bee ( <i>Nomada conjungens</i> )				RDB2
Fabricius' nomad bee ( <i>Nomada fabriciana</i> )	14	111	97	
Yellow-shouldered nomad bee ( <i>Nomada ferruginata</i> )	8	16	8	RDB1
Flavous nomad bee ( <i>Nomada flava</i> )	24	124	100	
Little nomad bee ( <i>Nomada flavoguttata</i> )	10	96	86	
Blunthorn nomad bee ( <i>Nomada flavopicta</i> )	7	17	10	
Painted nomad bee ( <i>Nomada fucata</i> )	10	54	44	
Orange-horned nomad bee ( <i>Nomada fulvicornis</i> )	8	35	27	
Gooden's nomad bee ( <i>Nomada goodeniana</i> )	14	123	109	
Short-spined nomad bee ( <i>Nomada guttulata</i> )	0	2	2	RDB1

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees

Long-horned nomad bee ( <i>Nomada hirtipes</i> )	0	1	1	RDB3
Cat's-ear nomad bee ( <i>Nomada integra</i> )	0	1	1	
Lathbury's nomad bee ( <i>Nomada lathburiana</i> )	5	16	11	RDB3
Early nomad bee ( <i>Nomada leucophthalma</i> )	10	30	20	
Marsham's nomad bee ( <i>Nomada marshamella</i> )	15	85	70	
Flat-ridged nomad bee ( <i>Nomada obtusifrons</i> )	3	0	-3	NT <sup>1</sup>
Panzer's nomad bee ( <i>Nomada panzeri</i> )	20	65	45	
Tormentil nomad bee ( <i>Nomada roberjeotiana</i> )	2	0	-2	RDB3
Fork-jawed nomad bee ( <i>Nomada ruficornis</i> )	10	82	72	
Black-horned nomad bee ( <i>Nomada rufipes</i> )	13	37	24	
Six-banded nomad bee ( <i>Nomada sexfasciata</i> )	1	0	-1	RDB1
Sheppard's nomad bee ( <i>Nomada sheppardana</i> )	4	12	8	
Broad-banded nomad bee ( <i>Nomada signata</i> )	9	5	-4	RDB2
Blunt-jawed nomad bee ( <i>Nomada striata</i> )	5	21	16	
Kirby's nomad bee ( <i>Nomada subcornuta</i> )				NT <sup>1</sup> ; None
Variable nomad ( <i>Nomada zonata</i> )				
Gold-fringed mason bee ( <i>Osmia aurlenta</i> )	1	2	1	
Red-tailed mason bee ( <i>Osmia bicolor</i> )	2	33	31	Na
Red mason bee ( <i>Osmia bicornis</i> )	21	153	132	
Blue mason bee ( <i>Osmia caerulea</i> )	12	76	64	
Orange-vented mason bee ( <i>Osmia leaiana</i> )	11	70	59	
Wall mason bee ( <i>Osmia parietina</i> )	1	0	-1	RDB3
Fringe-horned mason bee ( <i>Osmia pilicornis</i> )	4	0	-4	Na
Spined mason bee ( <i>Osmia spinulosa</i> )	5	76	71	
Cliff mason bee ( <i>Osmia xanthomelana</i> )	2	0	-2	RDB1
Large shaggy bee ( <i>Panurgus banksianus</i> )	8	26	18	
Small shaggy bee ( <i>Panurgus calcaratus</i> )	6	16	10	
Swollen-thighed blood bee ( <i>Sphecodes crassus</i> )	8	62	54	Nb
Bare-saddled blood bee ( <i>Sphecodes ephippius</i> )	18	128	110	
Dull-headed blood bee ( <i>Sphecodes ferruginatus</i> )	2	7	5	Nb
Geoffroy's blood bee ( <i>Sphecodes geoffrellus</i> )	18	96	78	
Dark-winged blood bee ( <i>Sphecodes gibbus</i> )	12	41	29	
Furry-bellied blood bee ( <i>Sphecodes hyalinatus</i> )	5	15	10	NT <sup>1</sup>
Little sickle-jawed blood bee ( <i>Sphecodes longulus</i> )	6	28	22	Na
False margined blood bee ( <i>Sphecodes miniatus</i> )	9	33	24	Nb
Box-headed blood bee ( <i>Sphecodes monilicornis</i> )	14	92	78	
Dark blood bee ( <i>Sphecodes niger</i> )	5	47	42	RDB3
Sandpit blood bee ( <i>Sphecodes pellucidus</i> )	21	83	62	
Sickle-jawed blood bee ( <i>Sphecodes punticeps</i> )	14	68	54	
Reticulate blood bee ( <i>Sphecodes reticulatus</i> )	3	47	44	Na
Red-tailed blood bee ( <i>Sphecodes rubicundus</i> )	10	17	7	NT <sup>1</sup> ; Na
Rough-backed blood bee ( <i>Sphecodes scabricollis</i> )	0	1	1	RDB3
Spined blood bee ( <i>Sphecodes spinulosus</i> )	2	6	4	NT <sup>1</sup> ; RDB2
Little dark bee ( <i>Stelis breviscula</i> )	0	4	4	RDBK
Spotted dark bee ( <i>Stelis ornatula</i> )	5	6	1	RDB3
Plain dark bee ( <i>Stelis phaeoptera</i> )	4	7	3	RDB2
Banded dark bee ( <i>Stelis punctulatissima</i> )	4	13	9	Nb
Violet carpenter bee ( <i>Xylocopa violacea</i> )	2	5	3	

<sup>1</sup> Nieto *et al.* (2014) European Red List of Bees



## Appendix 2 - rationale for species inclusion

Species	Included in report	Justification
Alfken's Mini-miner ( <i>Andrena alfkenella</i> )	Not included	Restricted distribution, locally abundant in parts of region
Groove-faced mining bee ( <i>Andrena angustior</i> )	Threatened species	Restricted distribution
Large sallow mining bee ( <i>Andrena apicata</i> )	Not included	Records considered erroneous
Small sandpit mining bee ( <i>Andrena argentata</i> )	Threatened species	Restricted distribution
Big-headed mining bee ( <i>Andrena bucephala</i> )	Not included	Habitat limited in region
Small flecked mining bee ( <i>Andrena coitana</i> )	Lost species	Not recorded since 1983
Long-fringed mining bee ( <i>Andrena congruens</i> )	Not included	Outlier to core range
Thick-margined Mini-miner ( <i>Andrena falsifica</i> )	Not included	Outlier to core range
Bryony mining bee ( <i>Andrena florea</i> )	Not included	Appears to be expanding range in the region
Painted mining bee ( <i>Andrena fucata</i> )	Conservation concern	Restricted distribution
Hawk's-beard mining bee ( <i>Andrena fulvago</i> )	Conservation concern	Restricted distribution, declining in other parts of Britain
White-bellied mining bee ( <i>Andrena gravida</i> )	Lost species	Not recorded since 1850
Large scabious mining bee ( <i>Andrena hattorfiana</i> )	Conservation concern	Restricted distribution, habitat dependency
Large meadow mining bee ( <i>Andrena labialis</i> )	Conservation concern	Restricted distribution
Bilberry mining bee ( <i>Andrena lapponica</i> )	Threatened species	Restricted distribution
Small scabious mining bee ( <i>Andrena marginata</i> )	Conservation concern	Restricted distribution, habitat dependency
Barham mini-miner ( <i>Andrena nana</i> )	Lost species	Not recorded since 1932
Black-headed mining bee ( <i>Andrena nigriceps</i> )	Conservation concern	Restricted distribution
Scarce black mining bee ( <i>Andrena nigrospina</i> )	Threatened species	Restricted distribution
Long-fringed mini-miner ( <i>Andrena niveata</i> )	Threatened species	Decline in hectads
Black mining bee ( <i>Andrena pilipes</i> )	Conservation concern	Restricted distribution
Broad-faced mining bee ( <i>Andrena proxima</i> )	Conservation concern	Significant part of British distribution
Perkin's mining bee ( <i>Andrena rosae</i> )	Lost species	Not recorded since 1936
Red-backed mining bee ( <i>Andrena similis</i> )	Threatened species	Restricted distribution
Tormentil mining bee ( <i>Andrena tarsata</i> )	Threatened species	Restricted distribution
Pale-tailed mining bee ( <i>Andrena tridentata</i> )	Lost species	Not recorded since 1936
Grey-backed mining bee ( <i>Andrena vaga</i> )	Conservation concern	Restricted distribution, likely to expand range in the region
Blackthorn mining bee ( <i>Andrena varians</i> )	Conservation concern	Restricted distribution
Green-eyed flower bee ( <i>Anthophora bimaculata</i> )	Conservation concern	Restricted distribution
Four-banded flower bee ( <i>Anthophora quadrimaculata</i> )	Conservation concern	Restricted distribution, edge of range in the region
Potter flower bee ( <i>Anthophora retusa</i> )	Lost species	Not recorded since 1970
Cullum's bumblebee ( <i>Bombus cullumanus</i> )	Lost species	Not recorded since 1923
Great yellow bumblebee ( <i>Bombus distinguendus</i> )	Lost species	Not recorded since 1980
Brown-banded carder bee ( <i>Bombus humilis</i> )	Threatened species	Restricted distribution, nationally important population
Heath bumblebee ( <i>Bombus jonellus</i> )	Conservation concern	Restricted distribution
Bilberry bumblebee ( <i>Bombus monticola</i> )	Not included	Records in the region are considered likely to be vagrants
Moss carder bee ( <i>Bombus muscorum</i> )	Threatened species	Restricted distribution
Red-shanked carder bee ( <i>Bombus ruderarius</i> )	Threatened species	Restricted distribution, nationally important population
Short-haired bumblebee ( <i>Bombus subterraneus</i> )	Lost species	Not recorded since 1960
Shrill carder bee ( <i>Bombus sylvarum</i> )	Threatened species	Restricted distribution, nationally important population
Little blue carpenter bee ( <i>Ceratina cyanea</i> )	Not included	Restricted distribution, likely to expand range in the region
Dull-vented sharp-tail bee ( <i>Coelioxys elongata</i> )	Not included	Considered likely to be under-recorded
Grooved sharp-tail bee ( <i>Coelioxys quadridentata</i> )	Threatened species	Decline in hectads
Rufescent sharp-tail bee ( <i>Coelioxys rufescens</i> )	Not included	Increasing distribution into the region
Early colletes ( <i>Colletes cunicularius</i> )	Not included	Recent colonist increasing distribution
Sea aster colletes ( <i>Colletes halophilus</i> )	Threatened species	Internationally important population
Margined colletes ( <i>Colletes marginatus</i> )	Threatened species	Nationally important population
Shiny dufourea ( <i>Dufourea minuta</i> )	Not included	Record considered erroneous
Long-horned bee ( <i>Eucera longicornis</i> )	Threatened species	Restricted distribution
Southern bronze furrow bee ( <i>Halictus confusus</i> )	Threatened species	Restricted distribution
Downland furrow bee ( <i>Halictus eurygnathus</i> )	Lost species	Not recorded since 1800
Shingle yellow-face bee ( <i>Hylaeus annularis</i> )	Threatened species	Restricted distribution
Little yellow-face bee ( <i>Hylaeus pictipes</i> )	Not included	Restricted distribution - no evidence of decline

Short-horned furrow bee ( <i>Lasioglossum brevicorne</i> )	Conservation concern	Restricted distribution
Turquoise furrow bee ( <i>Lasioglossum cupromicans</i> )	Not included	National distribution scarce away from the Midlands
Smooth-faced furrow bee ( <i>Lasioglossum fratellum</i> )	Not included	Habitat limited in region
Shiny-gastered furrow bee ( <i>Lasioglossum laeve</i> )	Lost species	Not recorded since pre-1802
Tufted furrow bee ( <i>Lasioglossum nitidiusculum</i> )	Threatened species	Restricted distribution, evidence of national decline
Squat furrow bee ( <i>Lasioglossum pauperatum</i> )	Conservation concern	Restricted distribution, significant proportion of British colonies
Grey-tailed furrow bee ( <i>Lasioglossum prasinum</i> )	Conservation concern	Restricted distribution, outlier to core range
Rufous-footed furrow bee ( <i>Lasioglossum rufitarse</i> )	Not included	A northern species, some records may be erroneous
Ashy furrow bee ( <i>Lasioglossum sexnotatum</i> )	Conservation concern	Restricted distribution, likely to expand range in the region
Fringed furrow bee ( <i>Lasioglossum sexstrigatum</i> )	Not included	Presumed to be a recent colonist
Orange-footed furrow bee ( <i>Lasioglossum xanthopus</i> )	Conservation concern	Restricted distribution
Black-headed leafcutter bee ( <i>Megachile circumcincta</i> )	Threatened species	Restricted distribution
Square-spotted mourning bee ( <i>Melecta luctuosa</i> )	Lost species	Not recorded since 1922
Gold-tailed melitta ( <i>Melitta haemorrhoidalis</i> )	Threatened species	Restricted distribution, habitat dependency
Silver-sided nomad bee ( <i>Nomada argentata</i> )	Threatened species	Restricted distribution
Armed nomad bee ( <i>Nomada armata</i> )	Threatened species	Restricted distribution
Bear-clawed nomad bee ( <i>Nomada baccata</i> )	Threatened species	Restricted distribution
Fringeless nomad bee ( <i>Nomada conjungens</i> )	Conservation concern	Restricted distribution
Yellow-shouldered nomad bee ( <i>Nomada ferruginata</i> )	Conservation concern	Restricted distribution
Blunthorn nomad bee ( <i>Nomada flavopicta</i> )	Conservation concern	Restricted distribution
Short-spined nomad bee ( <i>Nomada guttulata</i> )	Not included	Host species is widespread
Long-horned nomad bee ( <i>Nomada hirtipes</i> )	Not included	Habitat limited in region for host
Cat's-ear nomad bee ( <i>Nomada integra</i> )	Conservation concern	Host widespread but scarce
Flat-ridged nomad bee ( <i>Nomada obtusifrons</i> )	Lost species	Not recorded since 1945
Tormentil nomad bee ( <i>Nomada roberjeotiana</i> )	Lost species	Not recorded since 1909
Six-banded nomad bee ( <i>Nomada sexfasciata</i> )	Lost species	Not recorded since 1900
Sheppard's nomad bee ( <i>Nomada sheppardana</i> )	Conservation concern	Restricted distribution
Broad-banded nomad bee ( <i>Nomada signata</i> )	Conservation concern	Restricted distribution, appears to be increasing distribution
Kirby's nomad bee ( <i>Nomada subcornuta</i> )	Threatened species	Restricted distribution
Variable nomad ( <i>Nomada zonata</i> )	Not included	Recent colonist increasing distribution
Gold-fringed mason bee ( <i>Osmia aurulenta</i> )	Not included	No recent records
Wall mason bee ( <i>Osmia parietina</i> )	Not included	Records considered erroneous
Fringe-horned mason bee ( <i>Osmia pilicornis</i> )	Lost species	Not recorded since pre-1948
Cliff mason bee ( <i>Osmia xanthomelana</i> )	Lost species	Not recorded since 1936
Small shaggy bee ( <i>Panurgus calcaratus</i> )	Not included	At edge of range
Dull-headed blood bee ( <i>Sphecodes ferruginatus</i> )	Threatened species	Restricted distribution
Furry-bellied blood bee ( <i>Sphecodes hyalinatus</i> )	Not included	Identification difficulties may have led to lack of data
Red-tailed blood bee ( <i>Sphecodes rubicundus</i> )	Conservation concern	Restricted distribution
Rough-backed blood bee ( <i>Sphecodes scabricollis</i> )	Conservation concern	Cleptoparasite, host at edge of range in the region
Spined blood bee ( <i>Sphecodes spinulosus</i> )	Conservation concern	Identification difficulties may have led to lack of data
Little dark bee ( <i>Stelis breviscula</i> )	Not included	Restricted by host
Spotted dark bee ( <i>Stelis ornatula</i> )	Conservation concern	Restricted by host
Plain dark bee ( <i>Stelis phaeoptera</i> )	Conservation concern	Restricted distribution - signs of recent increase
Banded dark bee ( <i>Stelis punctulatisima</i> )	Conservation concern	Restricted distribution
Violet carpenter bee ( <i>Xylocopa violacea</i> )	Not included	Non-established vagrant

## Abbreviations, acronyms and glossary

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This report includes abbreviations and terms that may be unfamiliar to some readers, as such brief explanations are provided below.

- Aculeate** - a subdivision of the insect order Hymenoptera, which includes the ants, bees and many wasps.
- Aerial-nesting** - bees that nest in holes in wood, other vegetation or walls, as opposed to the ground.
- Autecological** - the relationship between a species and its environment.
- Boreo-alpine** - relating to northern cold temperate and/or mountainous regions.
- Brackish** - water that is slightly saline (salty), often where freshwater meets the sea in estuaries and marshes.
- Breckland** - an area of southwest Norfolk and northwest Suffolk characterised by grass heaths, wetlands such as fen and grazing marsh, and shallow lakes or meres; much has been affected by changes in agricultural.
- BWARS** - Bees, Wasps and Ants Recording Society.
- Calcareous** - relating to calcium carbonate geology (chalk or limestone).
- CEH** - Centre for Ecology and Hydrology.
- Cleptoparasite** - a species whose young take the food collected or stored by another species.
- Coniferisation** - the planting of conifer trees (usually for commercial timber production).
- Corolla** - the petals of the plant, which often form a tube where they are fused at the base of the flower.
- Cuckoo bumblebee** - bumblebee species that lay their eggs in the nest of a social bumblebee, whose workers then rear the young.
- Defra** - Department for Environment, Food and Rural Affairs.
- Dry pollen** - most solitary bees carry dry pollen on hairs on their legs and abdomen, rather than mixing it with nectar or saliva to make wet pollen, as seen in bumblebees and honeybees.
- Ecosystem service** - benefits obtained from the natural environment, which includes provisioning services such as food, regulating services such as pollination, and cultural and supporting services.
- Folding** - the relatively level area of a sea wall between the toe of the landward face and the landward boundary (Gardiner *et al.* 2015).
- Habitat matrix** - the land cover surrounding a habitat of interest.
- Hectad** - a 10km by 10km square.
- Improved grassland** - land 'improved' by management practices including use of fertiliser, herbicide and drainage, which contains low plant species diversity, typically dominated by sown grasses such as Perennial ryegrass (*Lolium perenne*), Cock's-foot (*Dactylis glomerata*), Timothy (*Phleum pratense*) and Yorkshire fog (*Holcus lanatus*), along with White clover (*Trifolium repens*) and Creeping buttercup (*Ranunculus repens*).
- Inflorescence** - the complete flower head of a plant, which may contain a cluster of individual flowers.
- Local distribution** - species that may be abundant but only at a low number of sites.
- Machair** - lowland coastal grassland habitat that is unique to north-west Scotland and Ireland.
- Metapopulation** - a group of individual populations of the same species that are connected by the periodic movement of individuals between them.
- Mire** - wetland habitats typically found on deep peat with water at or just below the surface, these may be further distinguished as marshes, swamps, fens, moors or bogs depending on soil type and water source.
- NERC Act** - Natural Environment and Rural Communities Act 2006 (as amended).
- Oligolectic** - pollen gathered from only a few closely related plant species.
- Polylectic** - pollen gathered from a variety of unrelated plant species.
- RDB** - Red Data Book, a list of species believed to be threatened along with assessment of the level of threat.
- RSPB** - Royal Society for the Protection of Birds.
- Species richness** - the number of species.
- Succession** - a change in ecological community over time, for example in botanical communities, the gradual transition from bare ground to grassland, then woody scrub, and finally woodland.



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