The State of Surrey's Nature

Surrey Nature Partnership

Healthy Environment | Healthy People | Healthy Economy
























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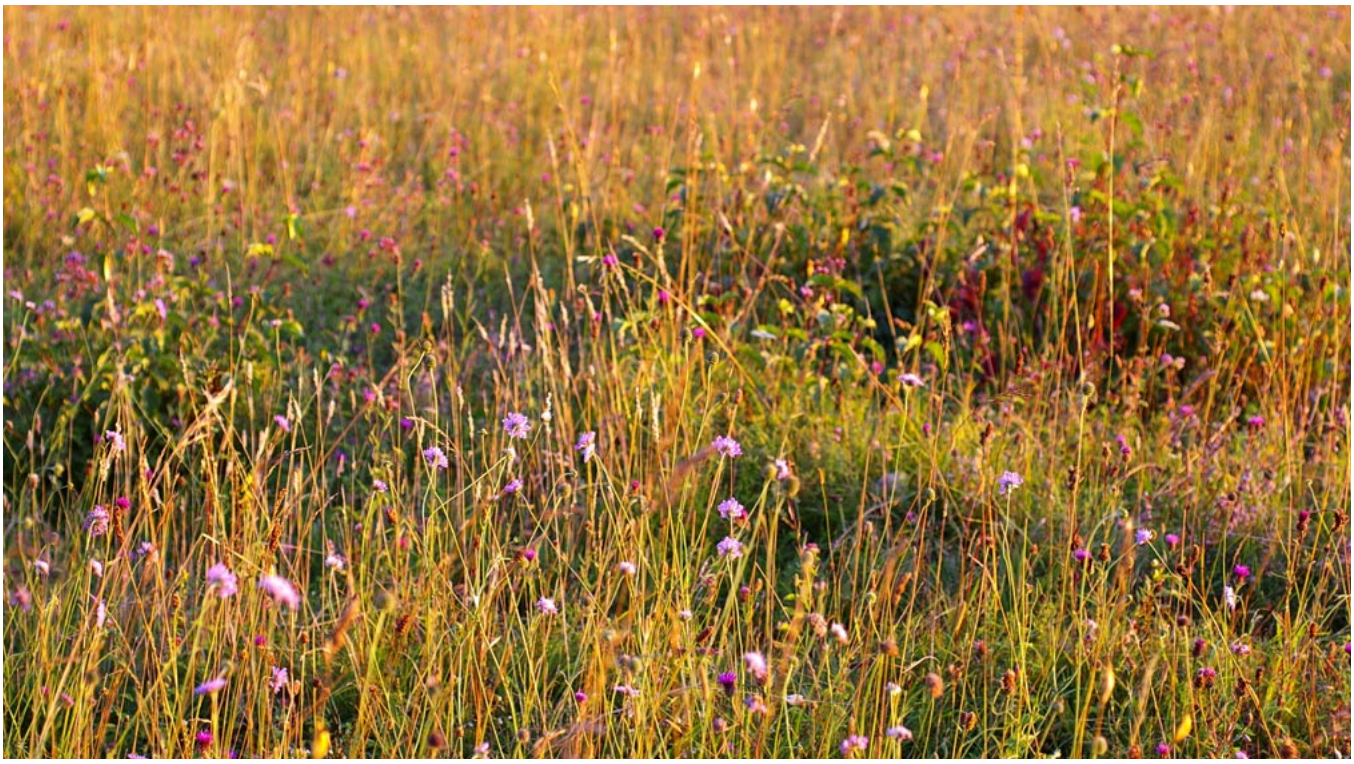
Introduction



Surrey's Coronation Meadow at Sheepleas

Surrey's Local Nature Partnership was formally approved by national Government in August 2012. LNPs are an initiative of the Natural Environment White Paper: *The Natural Choice: securing the value of nature* and are intended to strengthen local action in effecting the recovery of biodiversity, while enabling local leadership to champion the benefits of a healthy natural environment. Furthermore they are specifically encouraged to promote the green economy and work closely in this with their equivalent Local Enterprise Partnerships.

The Surrey Nature Partnership now has a strong governing Board directing several working groups, and has made progress with a number of projects and initiatives to address its mandated *raison d'etre* as summarised above.

This *State of Surrey's Nature* report is intended to provide the Partnership with a current stock-take of the county's biodiversity, to include as many of its wildlife species and their habitats as possible. The overall aim is to quantify what we have lost in recent history and that which remains most threatened. This will help to clarify where our responsibilities to national and international biodiversity conservation lie, thus serving to further prioritise our conservation efforts at the county level. The report also recognises new natural colonisers as well as species undergoing population expansions, and provides contextual explanation for all these up and downward trends, and the local extinctions.

More difficult to assess is how these findings relate to the overall 'health' of our natural environment, ie. its future sustainability. At best we can assume the simple premise that higher diversity must offer stronger, more complex ecosystems that are more resilient to human-induced impacts, for example climate change. Where there are obvious examples of critical species/ ecosystem-function relationships at stake, these are highlighted here.

In its simplest application this report can be used as a base-line from which to measure future biodiversity trends and changes. From this all the partners in the Surrey Nature Partnership will not only be able to gauge the success of future programmes, but are also better evidenced in their mission to tirelessly remind the residents of Surrey of the fundamental contribution of its outstanding natural environment to our well-being and all our livelihoods.

Surrey's Biodiversity

It is no secret that Surrey is an impressively diverse county biologically. Indeed it is possibly the most blessed of all land-locked counties in terms of sheer numbers of recorded species. This owes much to British social history and the proximity of Surrey to a ready concentration of able natural historians of every specialist persuasion. Partly inspired by their legacy, Surrey's natural history continues to be well recorded and can also boast an effective, accessible collective catalogue by way of the ongoing Surrey Atlas Project, published by the Surrey Biodiversity Information Centre through the Surrey Wildlife Trust.

Although small, the administrative county boundary delimits a portion of Great Britain that is so-positioned geologically to support a relative complexity of natural habitats. We are also in the south-eastern corner of our islands where both climate and European continental proximity are most influential in boosting biological diversity. Thus we may lack a coastline but are gifted with a significant proportion of the country's remaining lowland heathland and mires, juxtaposed by smaller but equally well-preserved examples of Chalk downland, together with several richly varied river catchments as well as a palette of historically-derived woodland management types.

Semi-natural habitats (see page 14) comprise a proportionately far more significant land-use in Surrey than many other English lowland counties. Again this has as much to do with social history as with the natural character of the landscape and its incapacity to support more intensive forms of agriculture. On the advancing fringe of south-west London, those with influence on national policy (and extensive countryside estates) led an early land protection movement born largely out of necessity, which eventually culminated in Green Belt legislation in 1938. Irrespective of this land-use changes have manifested here as elsewhere, with the more easily worked parts of Surrey witnessing their share of intensification (then latterly redundancy) in farming; quarrying of minerals; river realignment schemes; as well as creeping urbanisation in an ever upwards trajectory from the end of the Second World War.

With all this diversity of course comes responsibility. Surrey can lay claim to important populations of around 30% of the tranche of rapidly declining species afforded 'priority' conservation status initially under the UK Biodiversity Action Plan, and now the *Natural Environment & Rural Communities Act*. These reside within 19 similarly protected priority habitats (see Table 2 in the Appendix). Indeed a not insignificant number of species are now wholly reliant on efforts to conserve them in this county for their long-term future in the UK. But whilst celebrating our distinctiveness we should also be mindful of this report's sad indication that nearly 12% of our native wildlife has been lost; clearly this is neither the time nor place for resting on laurels...

The declining & now largely coastal Long-horned mining bee has important inland populations in Surrey

1. Surrey Biodiversity Partnership

Following the landmark International Convention on Biological Diversity in 1992, the UK published a national plan to halt and begin reversal of continuing biodiversity declines. The Surrey Biodiversity Partnership implemented its own county Biodiversity Action Plan from 1999 through to the restructure of the UK response to ICBD in 2010[1]. Chaired by Surrey County Council and with a single co-ordinator post providing continuity throughout the period, the partnership's members led various roles across the plan's ten Habitat and two Species Action Plans. Together these set out a framework for the action needed to recover biodiversity in Surrey. Much great work was achieved during this period[2], drawing on funding sources available at the time to make significant gains in the extent of key habitats, as well as enacting several successful threatened species recovery projects. These are duly referenced in the relevant sections that follow.

[1] See; JNCC (2010): *UK Post-2010 Biodiversity Framework*
[2] See; SBP (2010): *The Surrey Biodiversity Action Plan: achievements and future action*

Headline Conclusions

In the last five years we have seen the launch of two national *State of Nature* reports, initially in 2013 with its update in late 2016. Both these presented stark factual evidence for the continuing decline in biodiversity across the UK. The 2016 report in particular used new measures of change from national monitoring schemes to show how our wildlife varies widely in response to modern pressures on the natural environment. Some species appear stable or indeed are thriving, but a great many certainly are not.

2. Key findings from *State of Nature 2016*

- 56% of UK wildlife species have shown a declining population trend between 1970 and 2013;
- 15% of all UK wildlife is either threatened with extinction (ie. Red Listed - 13%), or is extinct already (2%).
- The UK Priority Species Indicator shows a post-1970 declining population trend index of 67% across the tranche of species with priority conservation status.
- The report has introduced a new index of global 'Biodiversity Intactness' to attempt to measure the planet's descent from its notional pristine natural state. In this the UK compares very badly in the international league table included in the study.

This *State of Surrey's Nature* report has been researched in a similar context to the two national documents, but largely without the confidence in species population trends achieved through their scale of country-wide collected data. Nevertheless, the scope of our research has for the first time brought together a catalogue illustrating the strength, variety and uniqueness of the county's biodiversity.

We have also gauged these species' vulnerabilities without appropriate conservation action. For the grand total of 4,242 species from an aggregated pool that includes plants and lichens, plus most of the major invertebrate and all vertebrate groups, we have firstly decided their qualification for a criteria-based 'long list' as Species of Conservation Concern in Surrey. Species include those believed extinct here already; species threatened or near-threatened (if so-designated on national Red Lists); those of restricted national and local distribution; as well as priority and legally protected species. This long list (2,155 species) has then been analysed further to refine recognition of local status and vulnerability to extinction. See the Appendix for further information on the data research and analysis used in this report.

So for the entire species sample of 4,242 species we can estimate that 11.5%, or slightly below 1 in 9 of species native to the county are now locally extinct (**Box 3** discusses this alarming extinction rate in more detail). Clearly we are faring much worse than the national 2% concluded by *State of Nature 2016*. 4.4% of species are threatened with extinction as decided by IUCN[3] Red List criteria, while a further 2.8% narrowly miss these and qualify as near-threatened in Surrey. A further 13.8% of species are over a perceived threshold of rarity in the county with demonstrable evidence to show their historic and/or continuing decline. Only 3.1% are of comparable rarity but in contrast appear to be increasing; 15.2% comprise those Species of Conservation Concern that for now at least appear stable.

Just under half of the sample consists of species that are not of conservation concern for us at the present time and although many will undoubtedly be in some concurrent state of flux, we have not explored this further for the purposes of this report. See **Figures 1** and **1a** (and **Table 1** in the Appendix). **Figure 1b** extracts the proportion of extinct species to better enable comparison with *State of Nature 2016*, indicating that an overall 23.7% of extant species are in some degree of trouble in Surrey.

By taxonomic meta-group…

Plants include the higher or Vascular plants, Bryophytes (mosses, hornworts and liverworts) and Charophytes (the stoneworts). **Lichens** have been aggregated here to align their treatment with *State of Nature 2016*, although of course they are not plants in the true sense. Of the total 1,922 species, 9.8% are believed to be extinct in Surrey; 5.5% are threatened; 3.4% are near-threatened in Surrey; a further 11.6% are in decline; 7.4% are assumed to be stable, while only 1% is increasing (see **Figure 2a**).

For **invertebrates**, the largest meta-group at 2,110 species, we have assumed 12.7% to be locally extinct. 2.5% are threatened and 1.8% near-threatened; 16.4% are in decline; while 22.7% are stable and 4.5% are increasing (see **Figure 2b**). Although large this group still only represents a fraction of Surrey's invertebrate fauna. The included groups are: non-marine snails, slugs and bivalves; millipedes, centipedes and woodlice; spiders; mayflies; stoneflies; dragonflies; grasshoppers, crickets and allies; shieldbugs and water bugs; butterflies; caddis-flies; hoverflies; and six sub-groups comprising 46 families of both aquatic and terrestrial beetles.

Vertebrates include breeding birds (both migratory and resident), mammals, reptiles, amphibians and freshwater fish (210 species). 14.7% are locally extinct; 13.8% are threatened and 6.2% near-threatened; 7.1% are in decline; 12.3% are stable; and 8.6% are increasing (see **Figure 2c**).

The **priority species of national conservation concern** that have occurred in Surrey form a second interesting pool for analysis. Of a total 404 species, 31.2% are already extinct locally, while 37.1% are threatened and/or remain in worrying decline. This only leaves the remaining 31.7% presently considered stable or recovering (see **Figure 3** and **Box 5**).

Attention on the prioritised Phoenix fly has shown it to be less rare than previously thought

3. Local Extinction

Extinction is difficult to be sure of, certainly for a great many wildlife species with secretive life-styles that are notoriously 'under-recorded'. Plants can exist below ground in the seed-bank for many years, while some fungi put in an appearance only once in a human generation, or even a life-time! Invertebrates can naturally cycle through great ranges in abundance, and relative to other groups generally lack the expertise required for their reliable and consistent field detection.

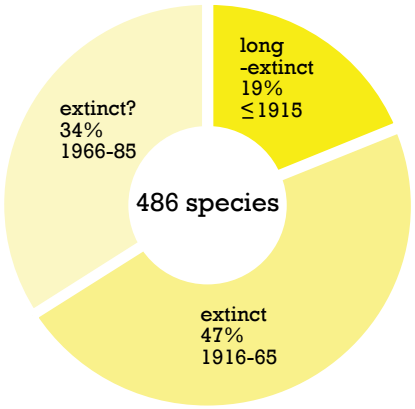


Fig. 4

The innovation of a new survey technique has often revealed species to be far less rare than originally realised. In consequence, rediscoveries of lost species are thankfully regular enough to warrant caution before labelling species as gone 'for ever'. Nevertheless, for this report we have decided to assume that species with no local records for over thirty years are indeed likely to be extinct, and if this period is over fifty years our assumption is viewed as definite (see **Figure 4**). If a species has knowingly been lost within the recent thirty year period, such knowledge clearly overrides the reciprocal 'extant' assumption.

Jonty Denton[4] has undertaken a detailed analysis of the history of extinction in Surrey, for a broader range of species than is included in this report and for the wider biological recording county which includes parts of Greater London. He has concluded that while 60% of extinctions occurred before 1950, the actual rate of extinction has remained rather constant. However, Jonty has also analysed the number of extinct species by their preferred habitats, and sure enough this correlates with the most destructive periods of change impacting these habitats in the past. This aligns too with our own analysis of the priority habitat associations of extinct and declining Species of Conservation Concern summarised in the broad habitat accounts below and in **Figure 5** (see Appendix).

[3] International Union for Conservation of Nature.
[4] Denton, Dr J. (in prep.): *Local Extinction: A Case Study of Species Loss in Surrey*

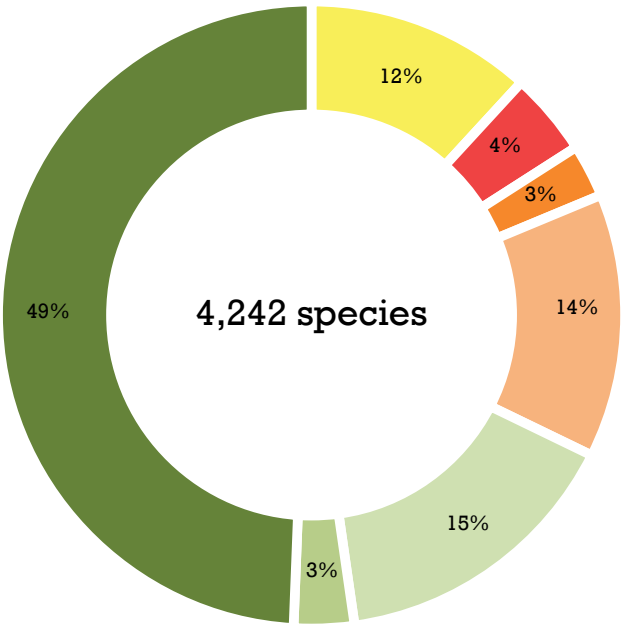


Fig. 1: Entire species sample

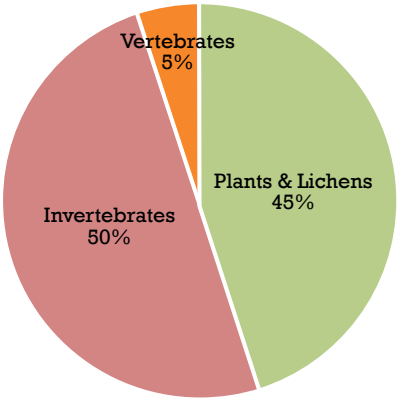


Fig. 1a: Relative size of meta-groups

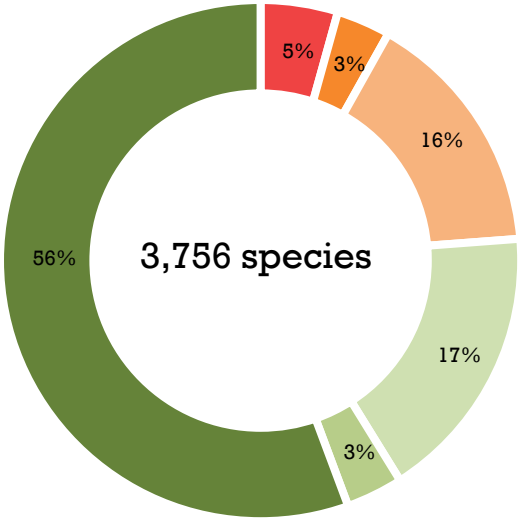
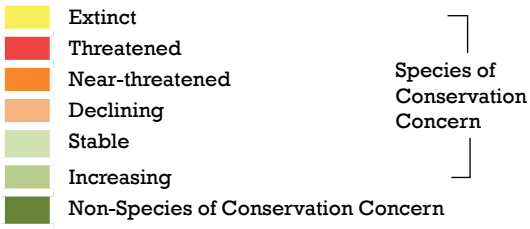


Fig. 1b: Extant species



4. Surrey's special responsibility

Surrey's biodiversity responsibilities can be viewed in both international and national contexts. The 2010 Natural England publication *Lost Life: England's lost & threatened species* summarised the special contribution of Britain's wildlife to a global biodiversity audit, highlighting Atlantic ferns, mosses & lichens; Breeding seabirds; Wintering & passage waterbirds/gulls; Grassland & woodland fungi; and Heathland invertebrates. The last three hold particular resonance with Surrey's biodiversity, especially the final group.

The South-West London Waterbodies Special Protection Area in the north of the county is internationally designated for its wintering waterfowl. Surrey has a rich fungal flora, with many hundreds of species recorded from some classic sites, including the Esher Commons, the Mole Gap woodlands at Norbury Park and Box Hill, and Windsor Great Park. Surrey's importance for lowland heathland and associated wetlands can never be over-stated, and it is no coincidence that a number of the UK's most endangered invertebrates are now believed to survive only on Surrey's heaths and commons.

From a more national perspective, Surrey is oft quoted as England's most wooded county. In consequence we find the county is special for many species requiring extensive and relatively continuous woodlands, for example several species of birds and bats, the native dormouse, woodland butterflies and others. Some of these woodlands even provide suitable conditions for disjunct populations of a few of those Atlantic bryophytes, although claims of 'responsibility' here might be somewhat tenuous. Yet we are undoubtedly very rich botanically, with an estimated 55% of the English vascular plant flora.

Unfortunately many of our rarest wild plants are now in an extremely fragile state, often clinging on in single sites in common with most English lowland counties. Unsurprisingly the flora of wetter heathland and bogs is well-represented in Surrey, as well as that of Chalk grassland and older broadleaved woodlands.

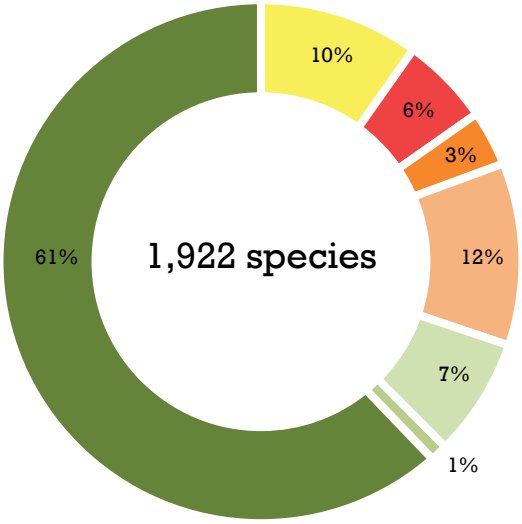


Fig. 2a: Plants & Lichens

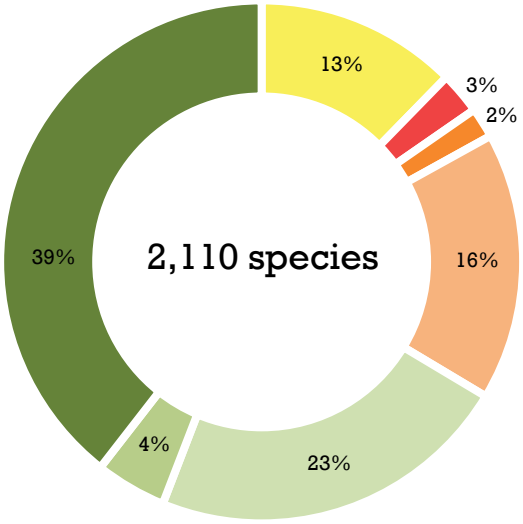


Fig. 2b: Invertebrates

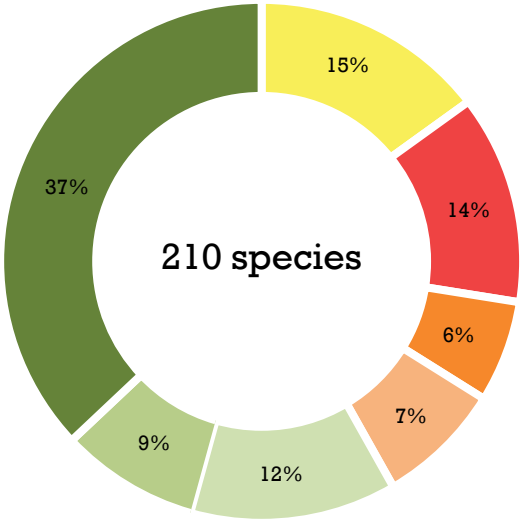


Fig. 2c: Vertebrates

5. Surrey's priority species of national conservation concern

Surrey can lay claim to having once supported at least 406 of the species nationally prioritised for urgent conservation action under the old UK Biodiversity Action Plan. Three of these have become extinct within England, accounting for the small disparity with the 404 Species of Principal Importance[5] recorded in the county (affecting a stonewort, a snail and the now Scottish-only Wildcat; contrarily Hen harrier is a SPI but was never BAP priority). These of course are all also lost from Surrey, along with 125 others. Although the national strategy[6] for meeting our commitments to the international UN Convention on Biological Diversity has undergone a major re-organisation in its current phase (2010-2020), the recovery of these selected species remains accountable to the goals of that strategy. No doubt this will prove elusive, certainly across the full range and 'regional' (ie. national) extinction for some is now believed to be inevitable.

Species recovery is ultimately dependent on the retention, expansion and appropriate management of preferred habitats, but for many their continued existence is so precarious that only a directly targeted, S-O-S response can hope to avoid imminent extinction. This can involve off-site boosting of part of the surviving population under 'safe' propagative conditions prior to reintroduction in the wild. Some examples of successful priority species recovery actions are cited under the relevant broad habitat accounts below.

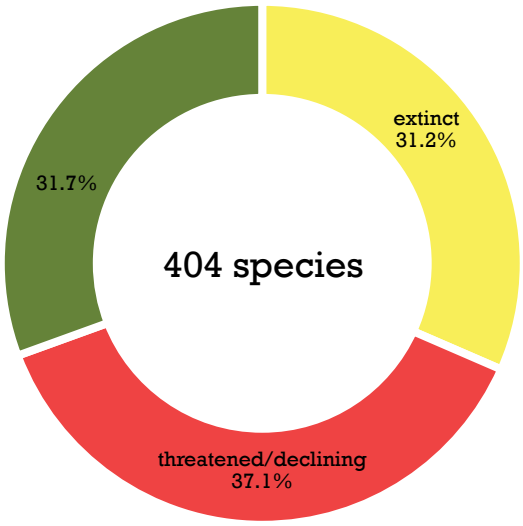
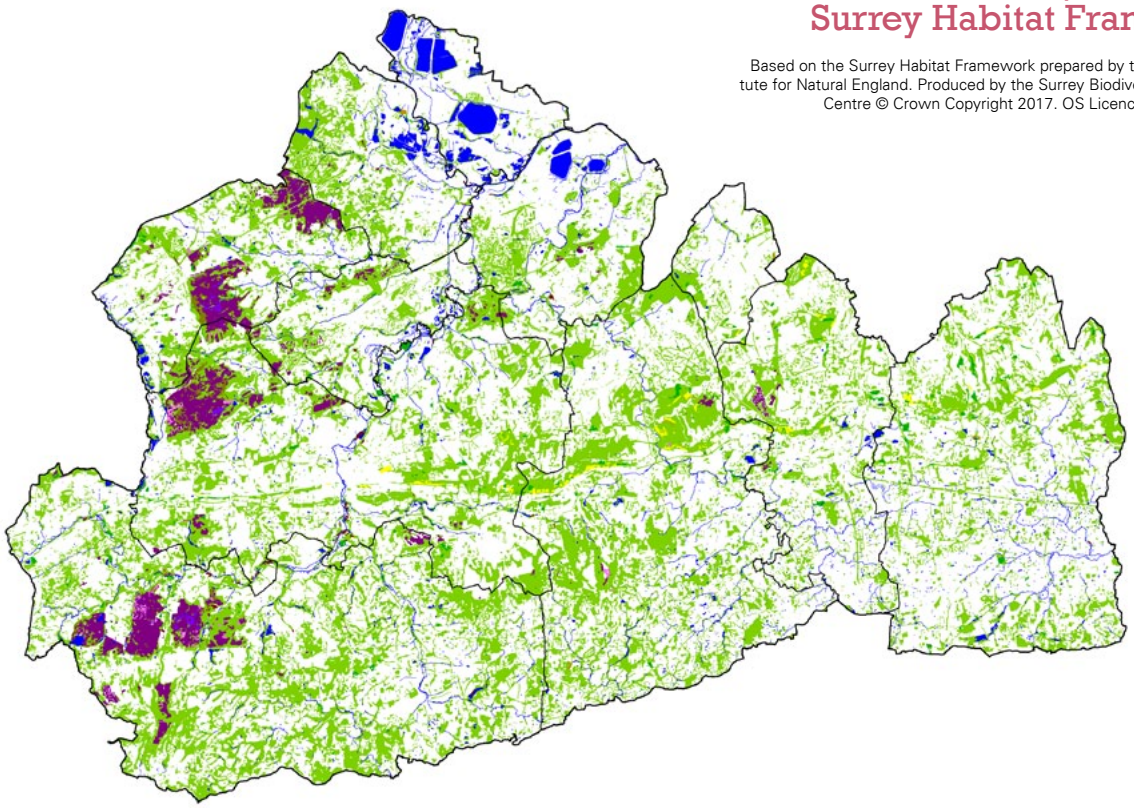


Fig. 3: Priority Species in Surrey

[5] See; JNCC website: *http://jncc.defra.gov.uk/page-5705*
[6] See; Defra (2011): *Biodiversity 2020: A strategy for England's wildlife and ecosystem services*

Broad Habitat Accounts

Priority Habitats within the
Surrey Habitat Framework



Broad Habitat Accounts

The survey, mapping and quantification of wildlife habitat have all evolved over many decades in the UK. Methodologies and classification protocols have developed also, alongside the advent of digital Geographic Information Systems (GIS), which have significantly aided the capture and evaluation of this information. However, consolidation of the successive phases of habitat survey into a single definitive dataset is yet to be satisfactorily completed, although there are several works-in-progress available nationally. As ever, resource implications inevitably govern progress here.

In Surrey there have been a series of studies and projects aimed at estimating either the extent of all habitats within a single classification system, or for key individual habitat types such as lowland heathland, calcareous grassland and ancient woodland. One earlier and somewhat unique all-habitat project (the *Surrey Habitat Survey Review*) repeated its methodology in both 1975 and 1985 to detect changes in the extent of habitats across the ten year gap[7]. At present there are two referable datasets for the priority habitats classified as Habitats of Principal Importance, accountable in the current national biodiversity strategy[6]. One is Natural England's *Priority Habitats Inventory* and the other is the *Surrey Habitat Framework* under development by our local biological records hub, the Surrey Biodiversity Information Centre. The latter has had the active encouragement of Natural England and is designed to be a distinct refinement of the former, to finally offer the elusive integrated dataset that has been such a Holy Grail until now.

We next describe the state of Surrey's nature in the context of its main, broad habitat categories in an approach similar to that in *State of Nature 2016*.

[7] See; Lindley, Dr A. (1986): *Surrey's Vanishing Wildlife: A Habitat Survey Review 1975-85*

Woodland & Parkland

Surrey's proportion of woodland cover is unrivalled by any other English county. Our North Downs Beech hangers, Yew groves and the extensive wooded Low Wealden ghylls are justly celebrated, while Box Hill's eponymous native Box stand is nationally unique.

Various estimates of this woodland cover have been attempted. The *Surrey Habitat Framework* indicates that just under 36,100 hectares or 21% of Surrey consists of the priority habitat types Mixed deciduous and Beech & Yew woodland, with coniferous woodland adding a further 5,100 hectares or 3% land cover.

The recently-recognised Alcathöe whiskered bat has a national stronghold in Surrey's woodlands

The Nightingale has declined in Surrey and is now largely confined to the far south of the county

Surrey's fragile Wood white population is nationally important but highly isolated

Woodland takes many forms, and it may be true to say that there is more woodland now than at any time since the early systematic clearances up to the late Medieval period. From the end of the 19th century woodland has been slowly regaining lost ground largely through natural succession, as the traditional extensive grazing of open habitats has declined. Conservation management has sought to revive this on the most important open sites for biodiversity, and might just be keeping pace with natural processes there at the present time. Another large addition to the woodland area has been through active coniferous afforestation in the post-war era, dealt with next under Semi-natural grasslands & Heathland.

This potential 'good news' woodland expansion story belies several issues for biodiversity conservation, however. The richest, most diverse woodland is our longest-established (ancient) broadleaved and mixed woodland, which was traditionally worked to produce an essential timber crop on a continuous, rotational basis. As the demand for home-grown timber began to decline especially after the First World War, these woodlands have increasingly fallen into neglect. The important rejuvenation phase delivered through regular management thus no longer happens and woodland biodiversity has subsequently suffered. Also, the destructive afforestation of biodiverse open habitats has an equivalent in woodland, when fast-growing non-native trees are extensively planted within former broadleaved, often ancient woodland stands. A suite of local declines and extinctions can be directly linked to woodland management change and neglect, including woodland butterflies such as the threatened Wood white and lost Pearl-bordered and Small pearl-bordered fritillaries. These will be only the tip of the iceberg, with many other invertebrates suffering equally. Birds such as Nightingales have been similarly implicated, although they also appear to have newer problems associated with the widespread explosion in deer populations impacting the habitat structure of woodlands through intensive browsing. This also poses a danger for rarer woodland flora. Woodlands, even ancient, are still threatened by human enterprise on occasion - agricultural and essential built infrastructure projects for example, and Surrey's relative abundance of trees quite possibly lends a certain complacency when implementing such decisions.

Surrey is also blessed with the valuable tree and woodland habitats associated with historic parklands, often tied to the former titled country estates laid out in the late 17th and 18th centuries. These usually feature significant numbers of veteran trees of extreme age together with ancient copses amidst permanent, often deer or stock-grazed rough grassland. Then there are the ancient grazed commons, nowadays largely wooded but also featuring high densities of aged trees, often as magnificent pollards. This is the priority habitat Wood pasture & parkland and the *Priority Habitats Inventory* indicates that this is particularly well-represented in Surrey. Some well-known examples include Farnham and Loseley Parks, Clandon and Hatchlands Parks, Albury Park, Polesden Lacey, Ashtead, Epsom and Bookham Commons, Priory and Gatton Parks at Reigate and of course Windsor Great Park. This habitat is most important for species dependent on dead and decaying wood, especially that still attached to veteran living or moribund trees, including fungi, epiphytic lichens and mosses, and a great many 'Saproxylic' invertebrates. As historic heritage features, parklands tend to be relatively secure and many today belong to the National Trust, which is well versed in the exemplary conservation of their important biodiversity features.

New threats and solutions

Huge numbers of Surrey's trees fall outside woodlands and here remain vulnerable to indiscriminate removal for their perceived risk to human safety or transport disruption. Usually this is justified but the rate of removal may only increase with many new and rapidly spreading threats to native tree health, often introduced from abroad including Ash dieback (*Chalara*) and infestation by the Oak processionary moth. Dead wood, both standing and fallen, is so important to the diversity and function of wooded habitats that its needless disposal or removal off-site can only be harmful in the long-term.

More positively, several new drivers are encouraging a renaissance in broadleaved woodland management including restoration of non-native plantations to more natural mixed stands. The Forestry Commission is behind much of this innovation, especially directed at private owners of smaller woodlands. New developing markets for home-grown timber are also responsible, including for use as fuel in sustainable energy systems. This revaluation has furthermore revived the market in neglected native woodlands to return them to active management, thus affording additional long-term security. Finally, the planting of new native woodland for purely conservation reasons has a place in Surrey, even though this is clearly of low priority for us. There will always be locations where tree planting can fill compromising breaks in the continuity of semi-natural habitats throughout the landscape; a strategic overview is essential to realising such necessities however, and important existing biodiversity interests must certainly never be jeopardised.

Our analysis of the Species of Conservation Concern by their priority habitat associations indicates a 13.6% proportion of locally extinct; 18% of threatened; 10% of near-threatened; and 19% of further declining species are those of woodland (Mixed broadleaved and Beech & Yew) and/or Wood pasture & parkland habitats (see **Figure 5**, page 30).

Semi-natural Grasslands & Heathland

These essentially open, unwooded habitats are termed semi-natural as they were created and maintained through early clearance of the original natural vegetation for agriculture. They have never existed in isolation however, and their shifting interface with successional scrub and young woodland is forever in flux. Heathlands in Surrey are often in intimate association with a separate priority habitat treated elsewhere within the wetland category, Lowland fen. These are our fascinating valley mire systems or 'bogs', but the line where wet heathland ends and these begin really exists only in the minds of habitat surveyors so we describe them here.

The Man orchid is just one of sixteen orchid species present on Surrey's open downland

The UK is globally important for its heathland invertebrates, including the specialised Raft spider

The Curlew is close to extinction in Surrey and in worrying decline throughout the UK

Having been reduced greatly for agriculture and development over recent centuries, the best of these habitats is today within protected sites and therefore relatively secure from such threats. Yet there is still a significant area of perhaps degraded yet restorable habitat that remains vulnerable in sites such as golf courses. The purposed 'improvement' of semi-natural grasslands in the past using fertilisers, herbicides and reseeding to eliminate their diversity, continues more subtly today through diffuse and cumulative atmospheric pollution. The strongest evidence of this can be seen alongside roads and is due to vehicle emissions, where water-borne pollution from surface run-off is also problematic. A slow but insidious homogenisation of formerly rich plant communities through the loss of their individual, diverse characters is a particularly worrying modern phenomenon.

Calcareous grassland

The North Downs support a significant area of this nationally restricted habitat but less than that in our neighbouring counties of Kent, Sussex and Hampshire. Although formerly more extensive due to far wider-scale shepherding in the past, the Downs in Surrey have always retained a more significant proportion of their ancient woodland. The *Surrey Habitat Framework* estimates the present areal extent to be 307 hectares or 0.2% of Surrey, occurring as multiple fragmented units averaging around one hectare in size. Protected sites include the internationally important Mole Gap to Reigate Escarpment Special Area of Conservation. In such sites 46.3% of the habitat is reckoned to be in favourable and 45% in recovering condition[8]. Succession or short-term climatic vagaries can rapidly vary the character of chalk grassland and many of its specialist species have quite precise requirements that are difficult to maintain using the effective but relatively blunt tool that is extensive conservation grazing. Invertebrates in particular often have preferred sward heights and strict dependencies on food-plants that are themselves of restricted distribution. These factors and the wholesale losses of the habitat in the past have contributed to the highly localised status of many of these specialists today. Butterflies, moths, flies, beetles and others are all implicated. For example Surrey has important populations of the Straw belle moth and the Adonis blue butterfly, present in just a few places in the Downs. Species such as the Shining pot-beetle now appear to be virtually confined to a small number of sites on Surrey's downland. Plants for which we have a similar responsibility include Ground-pine and Broad-leaved cudweed. The habitat's rich flora is also celebrated for its wild orchids; no less than 16 species have been recorded from the Chalk in Surrey.

Restorative management under recent collaborative projects such as the Mid-Surrey Downs and Surrey Downlands (Old Surrey Downs), has recovered a significant area of open grassland from encroaching scrub and coarser grasses in recent decades. Maintenance is key however, and there can be no relaxation of grazing, mowing or both if this gain is to be sustained. Over the same period the local branch of Butterfly Conservation has successfully rescued the dwindling Small blue in Surrey and a new phase for this project is set to commence in 2017. Many of the Downs' characteristic species are highly temperature-dependent, being at the edge of an otherwise continental range here and are largely confined to the south-facing escarpment. Although still not clear, climate change is predicted to favour these and is already suggested as the reason for the recent dispersal of the Silver-spotted skipper onto the relatively cooler, north-facing dip slope.

Heathland & mires

As already mentioned Surrey is privileged with a heavy responsibility for the preservation of this iconic habitat in Britain. We owe this to our distinctive geology, in particular the Bagshot Beds in the north-west and the Wealden greensands in the south. Additional outliers occur as 'Chalk heath' on the clay capping the North Downs. Lowland heathland has diminished by an estimated 80% in the UK since its likely zenith around 1800 and our county supports a substantial 13% of the remainder[9]. As the habitat is globally restricted this responsibility is moreover international. The *Surrey Habitat Framework* estimates open heathland, bracken and bog to cover 4,119 hectares or 2.4% of Surrey. The majority is protected within statutory sites, which also have European status; the Thames Basin Heaths and Wealden Heaths Special Protection Areas, and the Thursley, Ash, Pirbright & Chobham Special Area of Conservation. Despite this, much potentially restorable heathland including that beneath coniferous tree plantations and peripheral to these core sites, remains negotiable in the struggle to find enough land for housing development and its supporting infrastructure. Even if no direct threat such pressures can present disturbance issues for sensitive heathland biodiversity from cumulative, additional recreation uses. A clearly-prioritised and relatively well funded programme by the Heritage Lottery Fund enabled the *Surrey's Last Wilderness* project to restore or create c.2,000 hectares of heathland and acid grassland from 2002-2007, exceeding all its targets.

[8] See; *https://designatedsites.naturalengland.org.uk/SearchCounty.aspx*
[9] See; Surrey County Council (1980): *A Strategy for Surrey's Heathland*

These habitats have a singular importance in Surrey's impressive biodiversity. They can be amazingly rich places - the rainforests of our latitudes - comprising an intricately complex, subtly gradational yet thoroughly interdependent community of both higher and lower plants alongside myriad specialised invertebrates from every order, often displaying spectacular adaptation and behaviour. There are also a somewhat more modest number of highly characteristic birds and reptiles. The latter include the localised Nightjar, Dartford warbler, Woodlark and Hobby, the extremely rare Curlew plus all six of our native lizards and snakes. The invertebrates include long lists of spiders, beetles, bees and wasps, bugs, dragonflies and hoverflies. Examples of threatened species for which we now appear to have sole responsibility include the Red-barbed ant, the spiders *Cheiracanthium pennyi*, *Enoplognatha oelandica*, *Oxyopes heterophthalmus* and the Great fox-spider, the jewel beetle *Melanophila acuminata*, and the Early sunshiner and Blue plunderer ground beetles. We share responsibility for many others with just a few other counties, including the Bloody spider-hunting wasp, Broken-banded wasp-hoverfly and Large marsh grasshopper, the aquatic bug *Micracanthia marginalis* and the Window-winged caddis fly.

Surrey's wet heathland and bogs have an ancient kinship with the upland moorland confined to modern Britain's north and west. So a major element of their biodiversity represents relict post-glacial species populations a long way from their current heartlands and hence at the margins of climatic tolerance. These will be particularly vulnerable to a warming climate and their eventual extinction could prove unavoidable in the long-term. Many of our long lost bryophytes, as well as the White-faced darter dragonfly and the hoverfly *Anasymia lunulata* are examples of species that have already succumbed to local extinction in this way.

Meadows and acid grasslands

Species-rich grasslands of less extreme soils, managed perhaps for hay-making in mixed farming systems are the least well-audited in Surrey. They occur on our clays and alluvial soils and due to their consistent improvement for agriculture in these flatter lands, are probably relatively scarce. Yet the damper versions host some of our rarest flora, including Green-winged orchid, Narrow-leaved water-dropwort and even Wild daffodil. There is a definite need for a comprehensive survey of these grasslands in order to afford some degree of protection to the best, before they are lost out of ignorance of their very existence.

Acid grassland is usually found in close association with heathland, and where extensive is sometimes referred to as 'grass heath'. It too is often seasonally damp and can also support declining wildflowers such as Chamomile, Pennyroyal and the probably now extinct Small fleabane. Where undisturbed these swards are often important for their autumnal diversity of colourful waxcap, earthtongue and club fungi. At a few places in Surrey it is possible to see several of these grassland types intergrading as part of an intricate mosaic in a single site. Headley Heath is one such place. The *Surrey Habitat Framework* estimates that acid grassland occupies 151 hectares (0.1%); and neutral grassland to cover a mere 33 hectares of Surrey.

Our analysis of the Species of Conservation Concern by their priority habitat associations indicates a 31% proportion of locally extinct; a clear majority 40.3% of threatened and 52% of near-threatened; and 34.7% of declining species are those of open semi-natural habitats (calcareous & acid grassland, meadows or heathland). Heathland-associated wetland adds yet a further 8% (of locally extinct), 8.5% (of threatened), 12.6% (of near-threatened); and 10.6% (of declining species) to these totals.

Low-growing acid grassland can host important communities of colourful waxcap fungi

The Silver-spotted skipper may be benefitting from increasing temperatures associated with climate change

Surrey's highly threatened populations of Broad-leaved cudweed are some of the last few remaining in the country

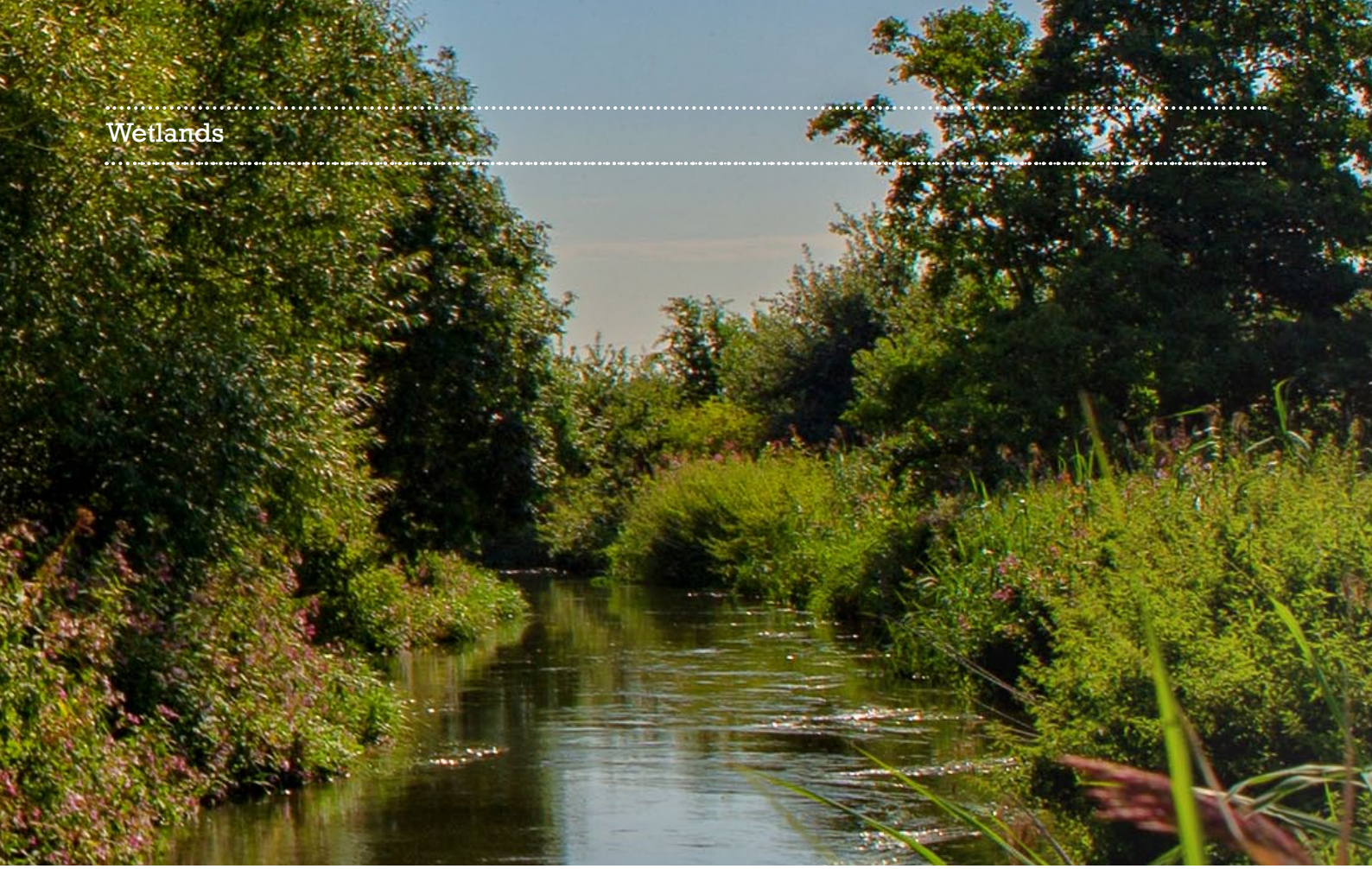
Nightjars are currently doing well and represent a heathland restoration success story

The Window-winged caddis fly is nationally confined to just two sites on Surrey's heathland mires, as well as in the Shropshire mosses

Surrey's heathlands host all six of the native snakes and lizards; Sand lizards have benefitted from a carefully targeted reintroduction programme

The Small blue has declined but is responding well to targeted conservation action

Green-winged orchid is now very rare in Surrey, confined to a few meadows in the Low Weald



Wetlands

This spans a rather broad range of habitats with their unifying feature being the essential and more-or-less permanent presence of water. They involve the surface land drainage system itself including our rivers and streams, together with the associated marshland, ditches and wet meadow habitats of their immediate floodplains; our three canals; and a whole inventory of static open water-bodies both large and small. The latter include the huge man-made reservoirs and flooded gravel-pits seen especially in the north of the county, as well as more modestly proportioned meres and ponds occurring throughout. Waterlogged woodland, or fen carr, is considered here although the mires draining heathlands have been discussed previously. The *Surrey Habitat Framework* estimates these types of wetlands to occupy 3,516 hectares or 2.1% of Surrey.

Despite intensive surveys we are still unclear if any wild populations of Water voles remain in Surrey

Many of Surrey's dragonflies have expanded their range in recent decades, including the White-legged damselfly

The rapid spread of Himalayan balsam along Surrey's waterways has contributed to the decline of native wildflowers such as Small teasel

Surrey's two main river catchments are those of the Rivers Wey and the Mole, both tributaries of the Thames with their sources in neighbouring counties. The Eden Brook drains the far east of the county and the Blackwater fills this role in the far west. The Hogsmill is a small catchment on our boundary with Greater London. The headwaters of the River Arun flow in an opposite direction to all the others from a minor catchment in the south of Surrey.

The broad scale of wetlands considered here can obviously present very different habitats for biodiversity, but their common dependency on clean freshwater presents them with similar issues. Wetland habitats have reached their current restricted distribution after centuries of land drainage and reclamation primarily for agriculture. More latterly watercourses were successively modified to move water off the land and out to sea as efficiently as possible. Field ponds and ditch networks, essential in pastoral systems, have been infilled or allowed to silt up as agriculture has declined or moved on. And although water quality standards are far higher than in previous centuries, the initial strides made in cleaning up the water environment have long achieved stasis, compromised by the limitations of sewerage systems and the growing demands of water consumers. Therefore water basically remains polluted, especially by the chemical phosphate and nitrate left after waste treatment and residues of fertilisers used in agriculture. These make eutrophication (stagnation) a constant threat to the aquatic ecosystem. Meanwhile we are in a high water consumption area and this demand is met by abstraction directly from the environment. During extended drought periods rivers can run dry because of this, especially in their upper reaches, while pollution is made worse by the constraints to dilution. The compounding influence of future climate change on this situation can well be imagined. Wetland biodiversity is of course impacted by both poor water quality and quantity. Mass fish kills are the first obvious sign of pollution events but the effects on invertebrate communities are equally dramatic, involving molluscs, the 'riverfly' groups and others.

Wetland habitats are especially exposed to invasive species introduced into the environment either intentionally or by accident from abroad. The growing list of these includes many wetland plants and also invertebrates. The plants can rapidly dominate water-bodies to the exclusion of native vegetation, which can then de-stabilise the aquatic ecology. Notorious culprits are New Zealand pygmy-weed, Parrot's-feather, Floating pennywort and Himalayan balsam. Declines in some Surrey wild plants can be directly attributed to the near-universal spread of the last of these. Small teasel, Greater dodder and Tubular water-dropwort have all been locally affected. The native White-clawed crayfish is now extremely rare in Surrey, while its widespread alien relatives the highly predatory American signal and Turkish crayfish threaten both it and a host of other native species. Lastly, the rapid demise of the Water vole in inland Britain is a particularly sad loss and we are still unclear as to whether there are any wild populations left in Surrey. The feral American mink is mainly to blame here, another introduced predator originally imported and farmed for its fur but later released into the wild.

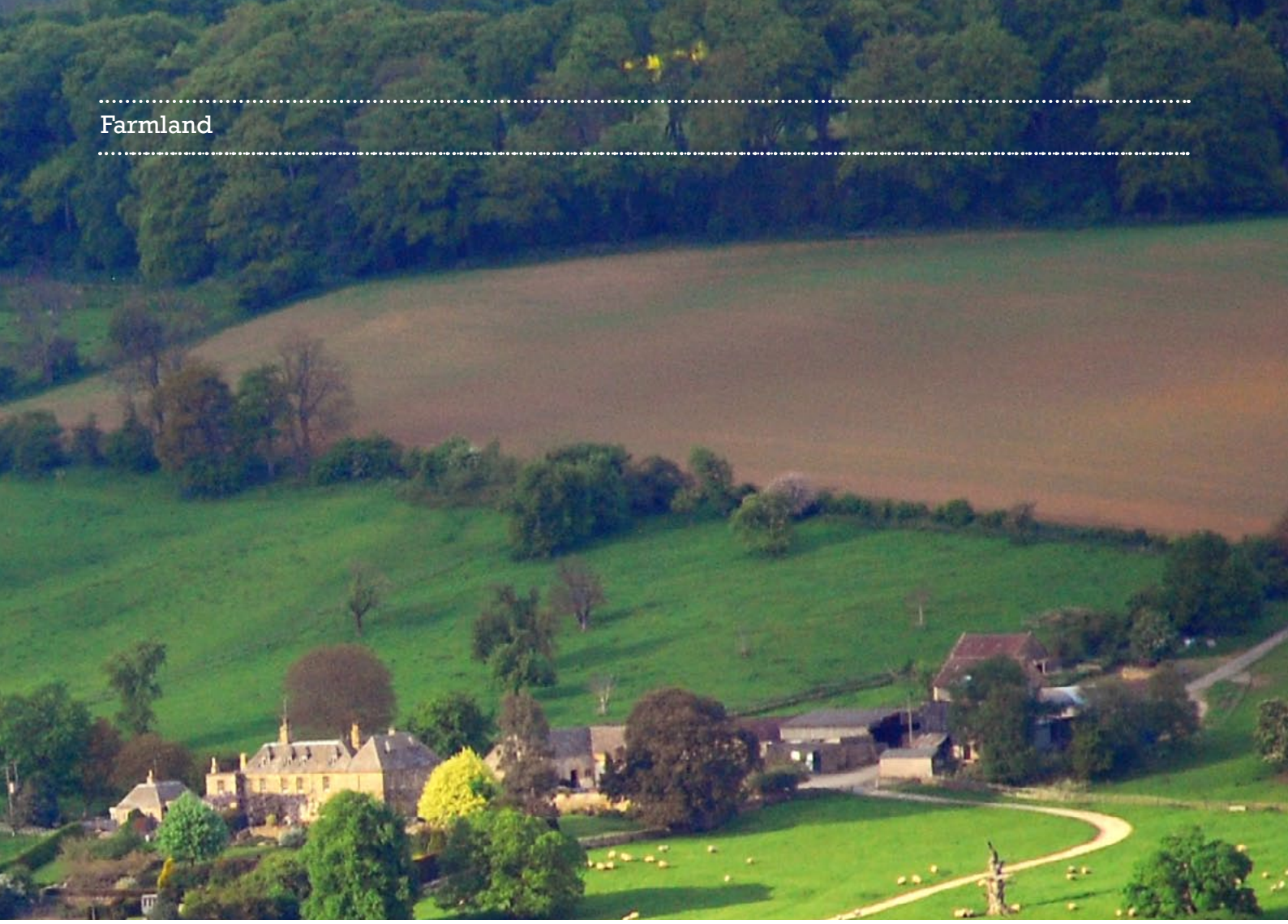
New wetland initiatives...

Fortunately wetlands are some of the easiest habitats to restore or create from scratch. The minerals extraction industry has been responsible for much of this work in Surrey, under obligation to return worked-out pits and quarries to some useful purpose combining both biodiversity conservation and recreation. Many of our wetland nature reserves have arisen in this way, including Farnham Quarry (Tice's Meadow) and the Nutfield Marsh and Laleham Lakes complexes. The latest will be the Molesey Wetlands; 60 hectares of open water, wet grassland and reedbeds replacing the redundant water storage reservoirs alongside the River Thames in Elmbridge.

As a member state of the European Union the UK must enact the Water Framework Directive, which requires a near pollutant-free water environment by 2027 via review and delivery of River Basin Management Plans. Defra's Catchment-Based Approach[10] (CaBA) to achieving this has encouraged the formation of delivery partnerships active in every river catchment. In Surrey, the Wey Landscape Partnership and River Mole Catchment Partnership have both made solid progress in returning wetland habitats within these catchments to 'good ecological status', as defined by the Directive. Projects range from watercourse restoration to increasing public awareness of society's responsibility to avoid further pollution and water wastage. Thankfully these efforts are starting to pay dividends, with the welcome return of the Otter to Surrey (residency status still to be confirmed) and increased numbers of Common snipe and other wetland birds on several key sites, including Stoke Meadows at Guildford and The Moors in Holmethorpe. Other bespoke projects have rescued highly threatened species such as the aquatic plant Starfruit, reintroduced to a created pond near Dorking where it now appears to be thriving.

Our analysis of the Species of Conservation Concern by their priority habitat associations indicates a clear majority 39.8% proportion of locally extinct; 17.4% of threatened; 19.3% of near-threatened; and 30.3% of declining species are those of wetlands, including rivers and streams, canals, carr, reedbeds and fens (other than mires), lakes and ponds.

[10] See; Defra (2013): *Catchment Based Approach: Improving the quality of the water environment*



Farmland

Farming in the sense of growing staples is in slow decline in Surrey. There are still significant parts of the county in rotational arable and silage production as well as some remaining pastoralism, but the latter especially has given increasing ground to demands for equestrian livery. The *Surrey Habitat Framework* indicates around 9,518 hectares (5.6%) of Surrey to be in arable and horticulture, compared with a vast 43,446 hectares (26%) in permanent pasture (as 'improved grassland'), grazed or otherwise. Boundary features, much of them farmland hedgerows, account for a further 5.8%.

Although still widespread, farmland birds such as the Yellowhammer have become increasingly localised

A suite of wildflowers associated with historic tillage methods are now reduced to single sites in Surrey, such as the Night-flowering catchfly

Brown hares are inexplicably rare in Surrey, although illegal coursing may have had an impact in the past

The main centres of arable production are on the clay plain north of the Hog's Back, continuing east of Guildford along the A3 corridor and up onto the dip slope of the North Downs; then also as scattered concentrations in the Low Weald south of Dorking, eastwards across the M23 corridor as far as Lingfield. Elsewhere the farmed landscape consists of tightly clustered mosaics of mostly small fields grazed by various livestock, but increasingly horses. There are still some pockets of cattle-raising however, along with novelty herds such as deer and even llamas. The mean size of Surrey farms is well below the national average. Farm diversification is a modern necessity especially for small farms and Surrey also has a growing number of 'hobby' farmers trying out new ventures. For example there has been a recent expansion in viniculture along the North Downs scarp. So in general not a huge proportion of Surrey has been exposed to the desertification of the countryside that is modern factory farming, when compared with many of our neighbours.

Nevertheless we have certainly witnessed depletion in farmland biodiversity. Intensification in arable production has seen local field enlargement and the poor treatment of hedgerows; a relentless move towards regular autumn sowing; and an increasing dependence on pesticides and fertilisers. This all adds up to a more inhospitable countryside for most widespread biodiversity, the trends for which continue to signal steady declines. In Surrey this is borne out by increasingly localised populations of once common farmland birds such as Lapwing and Yellowhammer, while Turtle dove and Grey partridge are fast following the fate of Tree sparrow and Corn bunting, both now extinct in the county. The damage done by improved seed-cleaning and herbicides to the former 'weed' flora of cornfields was set in train decades ago and the majority of these colourful arable plants have become exceedingly rare. The likes of Corn buttercup, Mousetail, Red hemp-nettle, Cat-mint and Night-flowering catchfly are now all reduced to small populations in single localities. 22% of locally extinct higher plants are of this type of habitat, along with 20% of all those Red Listed as threatened in Surrey. Some of our scarcer bryophytes are going the same way. Brown hares are now inexplicably rare in the county, as thriving populations do exist just over the border in Hampshire.

A slowly unfolding collapse in abundance of invertebrate populations, as observed from declines in nationally monitored light-trap catches of moths, in bumblebees, beetles and many other orders, is nothing short of an impending catastrophe. On these we are totally reliant for crop pollination and soil fertility, and they also dominate a critical tier in all food chains. The indiscriminate use of pesticides in agriculture is suspected to be largely responsible, especially as these can disperse widely beyond their point of application while also accumulating within the environment. The universality of horse livery has had its own impacts on nature and the landscape. Pastures can often be regularly over-stocked, field ponds poached to oblivion and hedgerow maintenance woefully overlooked, while inefficient disposal of manure is a further source of diffuse pollution to local watercourses. Illegal 'fly grazing' can often compound the problem. The growing abandonment of agriculture seen especially on approaches to Greater London furthermore invites urban expansion on 'redundant' farmland, the peripheries of which have often become important local refuges for wildlife.

Stewards of the countryside

Agri-environment schemes have evolved considerably since the end of the last millennium and are in their present guise as Countryside Stewardship, albeit the majority of agreements under predecessor schemes have yet to complete their full term. Their collective success in making the farmed landscape a better place for biodiversity is a debatable issue, although this can indeed be claimed with confidence under many such agreements. Natural England has worked hard in recent years to maximise take-up of stewardship in Surrey. Advisory officers from the government-funded Farming & Wildlife Advisory Group were also actively promoting stewardship in the county until this service was dissolved in 2010. Some continuity in farm advice work has been ensured however, using various vehicles such as the CaBA partnerships mentioned earlier. Several national initiatives have assisted awareness of farmland biodiversity declines and have probably also contributed to the uptake of agri-environment agreements, including the *Campaign for the Farmed Environment*[11] as well as the launch of the National Pollinator Strategy in 2016. A new local volunteer wardening initiative of the Surrey Wildlife Trust - 'Hedgerow Heroes' - is intended to specifically address neglect and mis-management of hedgerows throughout Surrey, but with a heavy focus on farmland in rural areas.

Our analysis of the Species of Conservation Concern by priority habitat association indicates a 7% proportion of locally extinct; 16% of threatened; 6% of near-threatened; and 5.2% of declining species are those of farmed environments. As farmland species represent those that are still relatively widespread rather than the specialists of more restricted habitats, their relative under-representation is not surprising here.

[11] See; http://www.cfeonline.org.uk/home/

Urban

Being so rich in rural biodiversity, the important contribution made by urban wildlife is perhaps understandably often overlooked in Surrey. Yet around 17% of the county is 'urbanised' and at least 25% of this is estimated to consist of community green spaces and private gardens. Indeed the urban environment can offer an improved sanctuary to some species that for any of reasons discussed earlier are in greater trouble in the countryside.

Urban gardens can offer important sanctuary for the much-loved but declining Hedgehog

Peregrine falcons have increasingly taken to breeding on high-rise buildings in towns & cities

Garden ponds can support important populations of amphibians, dragonflies and other invertebrates

One of these is the Hedgehog. Although possibly due in part to their active predation by Badgers in rural areas, there is also something in the variety of foraging opportunities in gardens, allotments and small urban woodlands to which they are particularly suited. Their ease of movement through this townscape must be ensured, however. Some wildlife is virtually dependent on buildings for breeding, including birds such as the Starling, Swift, House martin and Swallow, as well as many of the commoner bats. The welcome recovery of the Peregrine falcon owes everything to these magnificent birds' recent preference for nesting on high-rise buildings in city and town centres, most publically in recent times at Woking.

Garden wildlife is justly celebrated by many homeowners, who take pride in recording often staggering numbers of species visiting or resident on their property. In *My Side of the Fence*, naturalist Jeremy Early describes the observation of no less than 13 mammals, 53 birds and over 200 bees, wasps and hoverflies in his Reigate garden. The addition of a garden pond boosts lists considerably and can even support populations of declining species such as Common toads and Great crested newts. As the oldest built structures in some of their neighbourhoods, churchyards and cemeteries can retain surprising significance for biodiversity conservation at the local and even national level. Rare wildflowers, ferns, lichens and fungi are often found amongst their ancient swards and funerary stonework. The exceptional Brookwood Cemetery even hosts its own liverwort; the Brookwood crestwort, which to date remains globally unique.

Urban habitats are some of the most threatened by escalating development pressures, with proposals to build over allotments, playing-fields and less glamorous brownfield sites presented as a clearly preferred option over new housing in the Green Belt. Infill development or 'densification' is an ongoing reality, usually to the cost of back gardens and small private communal green spaces. But this represents something of a tension alongside recognition of the parallel importance of planning for adequate local Green Infrastructure to support our quality of life and well-being, especially in urban centres.

Lastly, the impacts of road transport on wildlife are obvious from the scores of roadkill victims piled on the hard shoulder. These of course are the visible result of habitat fragmentation, but if positively managed for wildlife, transport infrastructure corridors can ironically also offer opportunities for re-connecting habitats. Various enhancement schemes are currently planned to upgrade Surrey's roads network, thus offering the distinct possibility that some of these aspirations might well be realised.

...For Wildlife *and* People

The wildlife of their immediate neighbourhood, or if they are lucky enough to have one their garden, presents most people's first opportunity to experience the wonders of nature. As the majority of us live in towns, urban nature conservation has a crucial role in both preserving this opportunity and assisting in its interpretation, thus making the experience even more meaningful. The perception that biodiversity is inaccessible within the built environment is certainly challengeable given adequate initiative and experience. The Surrey Wildlife Trust has run various 'People & Wildlife' programmes in recent years including the acclaimed Surrey Greenspace Project in three of the county's larger towns - Guildford, Woking and Redhill - with the principal aim of enhancing these 'doorstep' nature experiences. Currently the Trust is actively promoting approaches to gardening that will maximise benefits to wildlife in partnership with Squires Garden Centres. Alongside this the Trust hopes to launch another of its highly successful Citizen Science surveys to monitor the importance of gardens to biodiversity conservation, including early indicators of climate change.

Nature conservation as investment in Surrey's 'Natural Capital'

In recognition of failures to halt the decline in biodiversity and the unsustainable way in which we continue to exploit our natural environment, the 2011 Government White Paper *The Natural Choice: securing the value of nature* proposed a new policy approach. Underlying this was support for 'greener' approaches to the consumption of natural resources that would be fairer on future generations and limited fundamentally by the regenerative capacities of the environment.

This would be achieved by reforms driving sustainable decision-making in the planning system; by taking Sir John Lawton's recommended *Bigger, Better, More & Joined* landscape-scale approach to recovering biodiversity; and through a monetised re-evaluation of the natural environment's resources as 'Natural Capital', that might be better understood and incorporated as investment-worthy stock into the wider economy. Local Nature Partnerships were a further recommendation of the White Paper, seen as key agencies for advancing this new approach and especially as translators of the natural capital concept with the local business sector.

Natural capital represents the entire stock of natural resources from which Ecosystem Services flow (the latter divided into *Provisioning, Regulating, Supporting and Cultural*), which are essential to human existence and well-being. But for the relationship to continue sustainably we must invest adequately in this natural capital.

In *State of Nature 2016*, Georgina Mace of the Natural Capital Committee muses on the relevance of the biodiversity accounting in the report to the natural capital agenda (see Box 6). She acknowledges that natural capital is a complex concept but cautions against the misconception that the approach only values nature in terms of benefitting mankind, without regard to any notion of intrinsic or ethical worth. She continues by alluding to the need for the natural capital approach to improve articulation of the fundamental connection between a healthy natural environment capable of supplying ecosystem services sustainably, and the quantum of diversity necessary to ensure this with respect to the habitats and species within that environment. Greater clarity here would then enable the conservation sector to use biodiversity as evidence in a natural capital context to its fullest envisaged effect. Whilst we are still developing this evidence, she endorses adopting the Lawtonian vision for a healthy environment via first securing "*..coherent and resilient ecological networks*" of biodiverse sites spanning the country, as the only sensible and realistic approach.

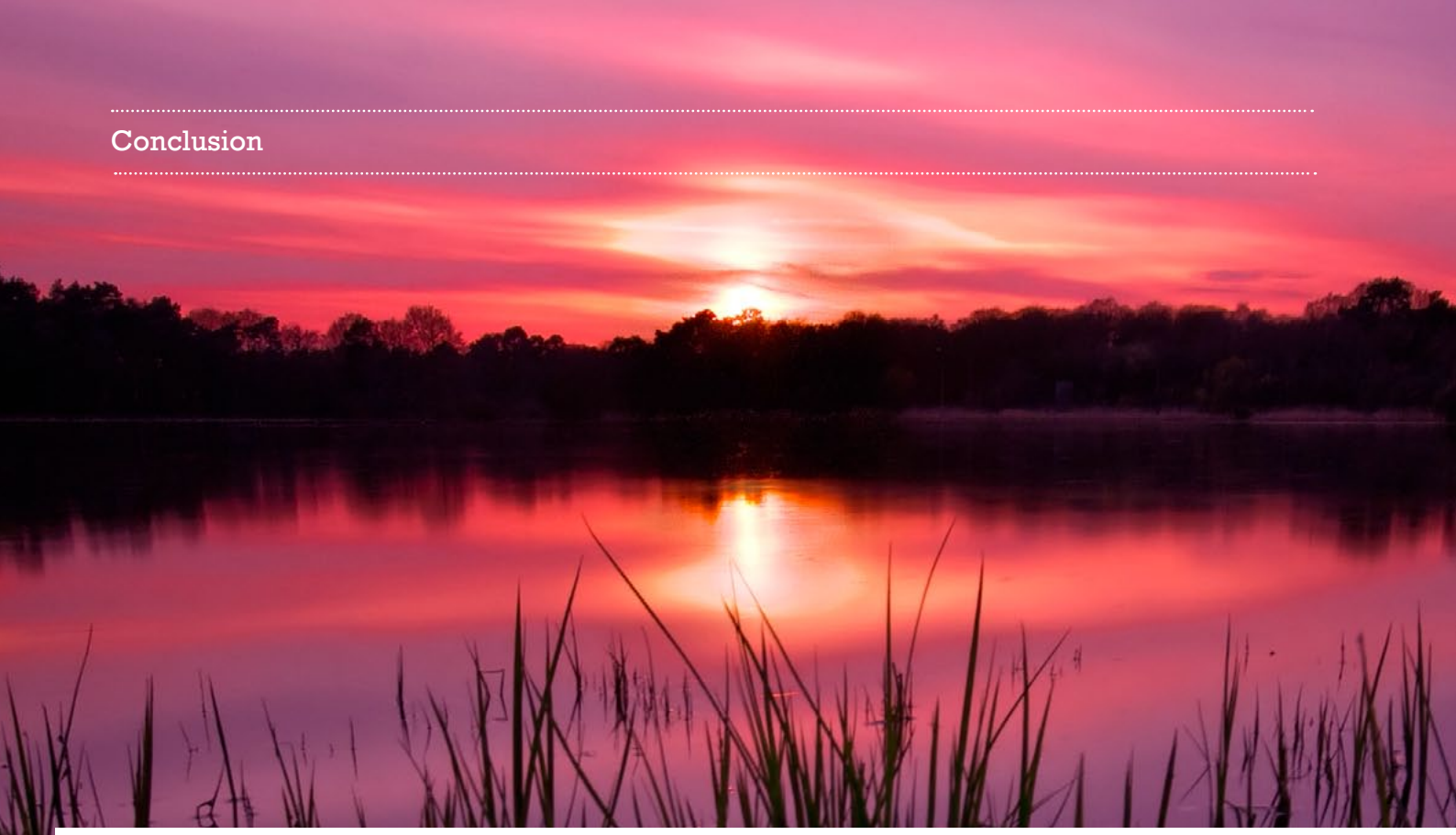
Natural Capital in Surrey

The Surrey Nature Partnership has published *Naturally Richer: a natural capital investment strategy for Surrey* and has invested in the *Valuing Surrey* project, to begin the mammoth task of realising the wide-ranging contribution of Surrey's natural environment to the local economy. To date this has focussed on a pilot valuation of our woodland assets, setting out a Natural Capital assessment methodology that can be further refined as new data becomes available. Key ecosystem services deriving from woodland in Surrey include timber production ('provisioning'), carbon sequestration, air and water purification, and water absorption (all 'regulating'), and of course also as a recreational venue ('cultural'). Given all this it is a relatively easy step to further the case for upscaling sustainable woodland management across the county. *Valuing Surrey* has also begun exploring the value of the county's wetlands in natural flood alleviation, as well as the benefits to health of urban greenspace. The partnership plans to produce a Natural Capital Investment Plan in 2017.

6. What is Natural Capital?

"*Natural capital refers to the elements of nature that produce value (directly and indirectly) to people, such as the stock of forests, rivers, land, minerals and oceans. It includes the living aspects of nature (such as fish stocks) as well as the non-living aspects (such as minerals and energy resources). Natural capital underpins all other types of capital (manufactured, human and social) and is the foundation on which our economy, society and prosperity is built. By combining different forms of capital, we are able to enjoy a huge variety of benefits; ranging from the food we eat and water we consume in our homes to outdoor experiences and improved health to name but a few. If properly measured and managed, natural capital (the living aspects at least) can continue to provide these benefits indefinitely. The problem is that whilst some of the benefits can be measured and are clear to see (for example, timber has a market price), most are difficult to quantify and are often invisible in our day to day lives despite being critical to our wellbeing.*" (source: Natural Capital Committee).

"*...How does* [natural capital] *connect to species and habitat conservation? Conservation often aims for a state of the environment that is relatively undisturbed by people, or one that closely matches a recent benchmark, such as in this report, which looks at changes over recent decades. For nature conservation to easily translate into the natural capital agenda we need to ensure that it is part of the analysis at a landscape, seascape and ecosystem scale; that it is not just an output measured as counts of species and areas of habitat, but that it is evidence of functioning and resilient species and habitat assemblages. Importantly, this needs to connect to larger-scale ambitions for nature at the local, as well as regional and national, level.*" (Professor Georgina Mace, *Natural capital: valuing our nature*, in *State of Nature 2016*).



Conclusion

We hope this brief but timely overview of the past achievements, present issues and future opportunities for biodiversity conservation in Surrey may serve as a solid platform to explore our options and capacities for action going forward. It is surely a time of great uncertainty for the environmental movement. Some of the weightiest foundations supporting our existing strategy will eventually be removed, in the least by name, through our leaving the European Union. So we must strongly defend both the principles these espouse and their legacy in a post-Brexit Britain. At the same time we are entering a new phase and scale of development to deliver housing and related infrastructure across the county. Our resources will be stretched ever tighter to ensure these proceed as sustainably as possible, by incurring no further losses to Surrey's biodiversity but instead offering opportunities that result in a genuine net gain.

Returning to the previous section, we have a county response to Sir John Lawton's *Making Space for Nature* recommendations as set out in the Surrey Wildlife Trust's *Living Landscapes Strategy*. Their earlier 2010 document *A Living Landscape for Surrey* justified the policy for taking a landscape scale approach to a wide audience throughout Surrey. In brief, we have put great faith in promoting Surrey's Biodiversity Opportunity Areas as the preferred foci for implementing biodiversity enhancements to deliver net gain. These are the places where improved habitat management, as well as the targeted restoration and creation of priority habitats will be most effective in restoring connectivity for the recovery of priority species in a fragmented landscape. They are therefore the basis for achieving a coherent and resilient ecological network within and beyond Surrey.

A recent Surrey Nature Partnership document aimed specifically at promoting adoption of Biodiversity Opportunity Areas by Surrey's planning sector is starting to prove its worth. To date, all of the county's District and Borough planning authorities have referred to this while developing their Local Plan policies for biodiversity conservation and Green Infrastructure. This is certainly welcome, but we can no longer rely on policy implementation and regulation alone. We must also influence the initiators of land use changes at their inception. Thankfully environmental responsibility is increasingly gaining its rightful place in the minds of such people and across the sectors they represent. We can soon hope to see business competitiveness extending also to companies' green portfolios, on a par with more conventional assets.

This report with its insights into Surrey's still enviable biodiversity will hopefully provide its many ambassadors with a further, valued advocacy tool whilst engaged in their enthusiastic defence of perhaps the most fundamental of our county's incalculable riches - its natural environment.

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[Further technical references are cited in the appropriate Species of Conservation Concern lists online.]

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Appendix

The State of Surrey's Nature; data research and analysis

The *State of Nature 2016* report uses a combination of changes in species abundance and distribution to provide trends indicating decline, stability or increase over two time periods; long (1970-2013) and short (2002-2013). These changes are detected through national surveillance monitoring (abundance) and/or recording schemes (distribution). Our *State of Surrey's Nature* report is not based on this kind of analysis. Our approach originally set out to achieve a number of related products from the report, the research for which pre-dated publication of *State of Nature 2016*. Even if available it would have been inappropriate to simply lift a 'cut' of the national data appropriate to Surrey. The surveillance monitoring schemes rely on their scale of data collection for statistical robustness, and would become less reliable if applied to an extracted dataset from just a single county. We have in fact used the same data that underlie many of the recording schemes informing distributional change in *State of Nature 2016*, where this is available in publications (including atlases), on the National Biodiversity Network platform or the individual schemes' dedicated websites.

Species 'decline' in our report has been defined for the most part in terms of evidence for range (ie. distribution) contraction, as indicated by the diminishing pattern of a species' records over time. Obviously caution is required with this approach as natural history recording effort can vary considerably and for some groups is in steady decline itself. An 'increase' trend has been concluded when records suggest an expanding range. Where Surrey recorders make a strong contribution to the national surveillance monitoring schemes, we have actually chosen to refer to national trends in abundance change when assigning local status to the relevant species groups, notably bats and certain other mammals, as well as breeding birds. This is also inherent where we directly infer species' threatened status from their respective national Red Lists. One invertebrate group (the butterflies) is comparatively so well recorded on an annual basis in Surrey that local trends in both abundance and distribution are in fact made possible and these have been duly referenced for this report.

The 'perceived threshold of rarity in the county' (an important criterion for species' inclusion as Species of Conservation Concern) will inevitably vary across groups, although we have tried to be as consistent here as possible. Surrey status has been summarised as 'very rare'; 'rare'; 'local'; and occasionally 'locally common', or even 'common'. As a primary criterion for inclusion as SoCC is driven by species' national rarity status (nationally scarce and rarer), a small number of nationally restricted species that are not at all rare in Surrey have become SoCC. 'Very rare' typically applies to species with a single extant known locality, or perhaps two if the second refers to an older, possibly extinct record. 'Rare' is applied to species with two to c. five extant localities, again slightly more if records are older. 'Local' is the most variable status used across groups; generally from six to c.15 extant localities for less well-recorded groups but more for some better recorded groups, and sometimes if this status has been suggested by an independent published source. 'Locally common' applies where species are obviously range-restricted but relatively frequent within that range. 'Common' means occurring frequently throughout Surrey and only involves those species that are otherwise nationally restricted. 'Surrey responsible' has been subjectively applied to species for which we hold a major/ significant proportion of the national population; or an isolated, disjunct population, perhaps at the edge of the species' current national range ('EoR').

A factor used to limit the species groups considered in the report is the availability of IUCN Red List Criteria reviews. These provide current information on the threatened status of species nationally/internationally and are an invaluable reference source offering confirmation of suggested local trends, as interpreted from datasets underlying national recording schemes. The considered groups therefore include;

- Vascular plants (using the 2014 Red List for England); Charophytes; Bryophytes; Lichens.
- Non-marine Mollusca; Millipedes & Centipedes (Myriapoda) & Woodlice (Isopoda); Mayflies (Ephemeroptera); Dragonflies (Odonata); Stoneflies (Plecoptera); Grasshoppers & allies (Orthoptera); Shieldbugs & allies (Hemiptera); Aquatic & Semi-aquatic bugs (Hemiptera); Butterflies (Lepidoptera); Caddis flies (Trichoptera); Hoverflies (Diptera); 46 families of Beetles in six sub-groups (Coleoptera).
- Breeding birds[12] ; Reptiles; Amphibians; Mammals; Fish.

It was also possible to include Spiders (Araneae) using pre-publication reference material (Harvey, P. *pers. comm*.). Species within the groups considered for the report include all those assumed as belonging to the native flora and fauna of Surrey ('administrative' county). This includes natural colonisation by native UK species, but excludes species introduced by human agency (termed 'aliens'). In the case of plants, 'archeophytes' (ancient introductions) were included. Where the original method of arrival of certain species is not clear, we have made assumptions veering towards inclusion in this regard. Extinction is also a naturally-driven process and where the only evidence for a species' native status is provided from fossil/sub-fossil records, these are also excluded from the analysis. Treatment of taxonomic revisions and origination of sub-species follows that within respective references.

Species of Conservation Concern lists have also been produced for the following groups with no IUCN Red List review; Larger moths (Lepidoptera), Aculeate hymenoptera (Bees, Ants and Wasps) and the Dipteran groups Craneflies, Soldierflies & allies, Conopidae and Picture-winged flies. These were chosen by the availability of local atlases for most, and to provide contextual reference for groups including Surrey Priority/Species of Principal Importance. The SoCC list for Birds also incorporates species of concern that winter regularly in Surrey.

To compare and understand the types of habitats most associated with extinct and 'at risk' species in Surrey, the Species of Conservation Concern were first ascribed priority habitat associations (multiple where appropriate). Then the habitat association attributes for all extinct, threatened, near-threatened and declining species were aggregated into the broad habitat categories (Woodland & parkland; Semi-natural grasslands & Heathland; Wetlands; and Farmland) for quantification and analysis. Heathland-associated wetland (ie. valley mires) has been kept as a separate category to allow for consideration with either the Semi-natural grasslands & Heathland, or the Wetlands categories. See **Table 2** and **Figure 5** in the Appendix.

The Surrey Species of Conservation Concern lists are published as appended spreadsheets separate to the *State of Surrey's Nature* report, available only as an electronic download. **Table 1** shows the compiled data table behind **Figures 1-3**.

[12] Analysis of breeding birds used the RSPB/BTO 'Red' & 'Amber' lists as equivalent to threatened and near-threatened status respectively.

Table 1: Combined data-table State of Surrey's Nature

		All species Surrey	%	SoCC Surrey	%	SoCC extinct Surrey	%	SoCC extant Surrey	%	SoCC Threatened	%	SoCC Near-threatened/ declining	%	SoCC declining	%	SoCC stable	%	SoCC increasing	%	Surrey responsible	Priority/SPI England	Priority/SPI Surrey	Priority/ SPI Surrey	Priority/SPI Threatened & in decline
Vascular Plants		975	100	436	44.7	85	8.7	351	36	94	9.6	54	5.5	136	13.9	59	6	8	0.8	45	152	66	21	43
Bryophytes		467	100	179	38.3	67	14.3	112	23.9	6	1.3	6	1.3	68	14.5	21	4.5	11	2.4	11	77	14	7	7
Charophytes		15	100	15	100	5	33.3	10	66.6	1	1.6	1	1.6	8	53.3	0	0	0	0	1	9	3	2	1
Lichens		465	100	114	24.5	31	6.7	83	17.8	4	0.8	5	1	12	2.6	62	13.3	0	0	2	97	15	8	6
	Total:	**1922**	100	**744**	38.7	**188**	9.8	**556**	28.9	**105**	5.5	**66**	3.4	**224**	11.6	**142**	7.4	**19**	1	59				
Fungi																					61	29	9	5
Invertebrates	**Mollusca**	135	100	53	39.2	13	9.6	40	29.6	1	0.7	1	0.7	31	23	7	5.2	0	0	1	17	7	4	2
	Crustacea																				5	1	0	1
	Myriapoda/Isopoda	79	100	36	45.5	8	10.1	28	35.4	0	0	0	0	0	0	28	35.4	0	0	0	3	1	1	0
Arachnida	**Araneae**	417	100	293	70.3	43	10.3	250	60	14	3.4	6	1.4	108	25.9	107	25.7	15	3.6	45	31	16	6	8
Insecta	**Ephemeroptera**	34	100	18	52.9	5	14.7	13	38.2	2	5.9	0	0	2	5.9	9	26.5	0	0	2	2	2	1	0
	Odonata	36	100	21	58.3	2	5.6	19	52.8	1	2.8	1	2.8	1	2.8	8	22.2	8	22.2	5	2	0	0	0
	Plecoptera	14	100	13	92.8	0	0	13	92.8	1	7.1	0	0	0	0	12	85.7	0	0	1	1	0	0	0
	Orthoptera & allies	29	100	19	65.5	1	3.4	18	62	1	3.4	1	3.4	2	6.9	10	34.5	4	13.8	7	4	3	1	2
Hemiptera (part)	**Shieldbugs & allies**	46	100	32	69.5	3	6.5	29	63	0	0	0	0	12	26	9	19.6	8	17.4	3	0	0	0	0
	Aquatic Bugs	57	100	29	50.8	7	12.3	22	38.6	2	3.5	0	0	2	3.5	15	26.3	3	5.3	1	10	0	0	0
	Homoptera (part)																					1	0	1
Lepidoptera (part)	**Butterflies**	50	100	29	58	9	18	20	40	8	16	3	6	2	4	4	8	3	6	3	23	16	6	7
	Moths																				142	96	12	7
	Trichoptera	123	100	81	65.8	29	23.6	52	42.2	1	0.8	0	0	22	17.9	27	21.9	2	1.6	1	4	3	2	1
Diptera (part)	**Craneflies**	*>75*																		8	6	1	0	0
	Soldierflies & allies	*99*																		13	5	3	0	2
	Conopidae	*19*																		1	0	0	0	0
	Syrphidae	205	100	93	45.4	6	3	87	42.4	2	1	6	2.9	38	18.5	34	16.6	7	3.4	7	4	2	0	2
	Picture-winged Flies	*9*																		0	1	1	0	0
Hymenoptera (part)	**Bees**	*220*																			17	11	7	1
	Ants	*34*																			7	4	0	2
	Wasps	*223*																			7	4	0	3
Coleoptera (part)	**Ground Beetles**	232	100	158	68.1	48	20.7	110	47.4	6	2.6	7	3	58	25	37	15.9	2	0.8	7	27	13	3	10
	Leaf Beetles	217	100	110	50.6	27	12.4	83	38.2	5	2.3	2	0.9	31	14.3	38	17.5	7	3.2	10	10	6	2	4
	Soldier Beetles & allies	74	100	48	64.8	9	12.2	39	52.7	1	1.4	4	5.4	6	8.1	23	31	5	6.8	4		1	0	1
	Darkling Beetles	96	100	69	71.8	13	13.5	56	58.3	6	6.2	1	1	9	9.4	34	35.4	6	6.3	0		3	3	0
	Water Beetles	197	100	127	64.5	27	13.7	100	50.7	0	0	4	2	15	7.6	60	30.4	21	10.7	2		2	2	0
	Scarabs & Chafers	69	100	50	72.4	17	24.6	33	47.8	2	2.9	3	4.3	7	10.1	17	24.6	4	5.8	4		2	1	0
	Other beetles																				38	9	7	2
	Total:	**2110**	100	**1279**	60.6	**267**	12.7	**1012**	47.9	**53**	2.5	**39**	1.8	**346**	16.4	**479**	22.7	**95**	4.5					
Birds Breeding		127	100	82	64.6	19	15	63	49.6	25	19.7	12	9.4	2	1.6	13	10.2	11	8.7	7	49	39	14	15
Amphibians		6	100	3	50	0	0	3	50	0	0	0	0	3	50	0	0	0	0	0	4	3	0	3
Reptiles		6	100	6	100	0	0	6	100	0	0	0	0	3	50	1	16.7	2	33.3	2	6	6	0	3
Mammals		44	100	29	65.9	7	15.9	22	50	2	4.5	1	2.3	6	13.6	8	18.2	5	11.4	2	19	16	5	8
Fish		27	100	12	44.4	5	18.5	7	25.9	2	7.4	0	0	1	3.7	4	14.8	0	0	0		5	2	3
	Total:	**210**	100	**132**	62.8	**31**	14.7	**101**	48	**29**	13.8	**13**	6.2	**15**	7.1	**26**	12.3	**18**	8.6	11				
																					943	**404**	**126**	**150**
Plants & Lichens	**Total:**	**1922**	100	**744**	38.7	**188**	9.8	**556**	28.9	**105**	5.5	**66**	3.4	**224**	11.6	**142**	7.4	**19**	1			%	31.2	37.1
Invertebrates	**Total:**	**2110**	100	**1279**	60.6	**267**	12.7	**1012**	47.9	**53**	2.5	**39**	1.8	**346**	16.4	**479**	22.7	**95**	4.5					
Vertebrates	**Total:**	**210**	100	**132**	62.8	**31**	14.7	**101**	48	**29**	13.8	**13**	6.2	**15**	7.1	**26**	12.3	**18**	8.6					
All Species	**Total:**	**4242**	100	**2155**	50.8	**486**	11.5	**1669**	39.3	**187**	4.4	**118**	2.8	**585**	13.8	**647**	15.2	**132**	3.1					
Extant All Species	**Total:**	**3756**	100					**1669**	44.4	**187**	5	**118**	3.1	**585**	15.6	**647**	17.2	**132**	3.5					

Appendix

Figure 5: Priority habitat associations analysis for extinct and 'at risk' species

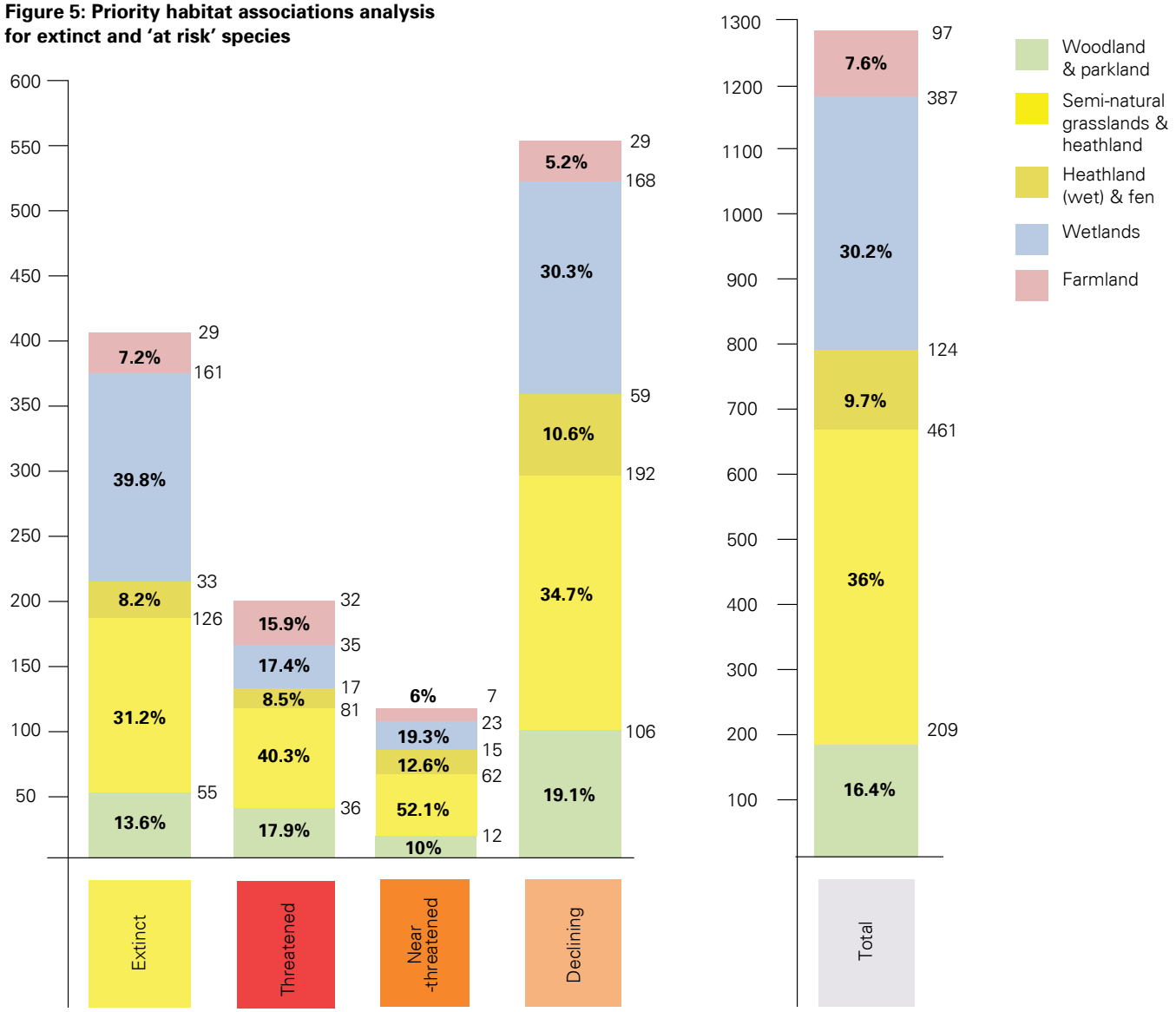

Table 2: Priority/Habitats of Principal Importance occurring in Surrey

This report's broad habitat categories	'Broad' HPI categories	Priority/Habitats of Principal Importance
Woodland & parkland	**Woodland**	Lowland Beech & Yew woodland
		Lowland mixed deciduous woodland
		Wood-pasture & parkland
Wetlands		Wet woodland
	Freshwater	Rivers
		Ponds
		Eutrophic standing waters
	Wetlands	Floodplain grazing marsh
		Reedbeds
Semi-natural grasslands & heathland		Lowland fens (incl. valley mires)
	Heathland	Lowland heathland
	Grassland	Lowland calcareous grassland
		Lowland dry acid grassland
		Lowland meadows
Farmland	**Arable & horticulture**	Arable field margins
		Traditional orchards
	Boundary	Hedgerows
Urban	**Inland rock**	Open mosaic habitats on previously developed land (incl. some 'Brownfield')
		Inland rock outcrops & scree

Surrey Nature Partnership

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Surrey Nature Partnership's Biodiversity Working Group is helping to protect biodiversity in Surrey in alignment with Defra's current England *Biodiversity 2020* strategy, in a challenging environment where over 40% of priority habitats and 30% of priority species are declining nationally. The group has replaced the steering group of the former Surrey Biodiversity Partnership, which drove implementation of the Surrey Biodiversity Action Plan from 1999-2010. Members include representatives from Natural England, the Forestry Commission and the Environment Agency, Surrey County Council and the Surrey Boroughs and Districts, Surrey Wildlife Trust, SBIC, The National Trust, RSPB, Surrey Botanical Society, Butterfly Conservation, the Surrey Bat Group and others.

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Reference: Waite, M (2017); The State of Surrey's Nature (Surrey Nature Partnership).