SURREY wildlife TRUST

Research & Monitoring Framework

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Cover image: Ockham Common, Mike Waite

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Trapping for Harvest mice on Papercourt, Mike Waite

Executive Summary

SURREY WILDLIFE TRUST'S 2018 RESEARCH STRATEGY 'NATURALLY INFORMED' IDENTIFIED A CLEAR ASPIRATION FOR MORE CONSISTENCY IN THE MEASUREMENT AND RECORDING OF OUR ACHIEVEMENTS, IN ORDER TO CONTRIBUTE TO A CUMULATIVE EVIDENCE-BASE FROM WHICH WE CAN CONFIDENTLY REPORT, REVIEW AND ADJUST THE TRUST'S MISSION, ESPECIALLY IN LIGHT OF THE PRIORITIES OF THE CURRENT STRATEGIC PLAN 2018-2023.

This focuses the Trust proactively within a pilot set of selected 'sub-regions' (Biodiversity Opportunity Areas), whilst maintaining a reactive role throughout but in reduced capacity.

The Strategic Plan serves to implement the Trust's *Living Landscapes Strategy* of 2014, which interprets the local relevance of national biodiversity policy derived from *Making Space for Nature: A review of England's Wildlife Sites and Ecological Network* (Defra 2010) as well as the current England *Biodiversity Strategy Biodiversity 2020: A strategy for England's wildlife and ecosystem services* (Defra 2011). Justification for the landscape scale approach advocated therein is not repeated here, but findings of the national *State of Nature* reports as well as our own 2017 *State of Surrey's Nature* are further reminders of the ongoing declines in biodiversity, and the imperative for enabling its recovery via reversals in wider environmental degradation.

The Research Strategy invited a deeper exploration of our research and monitoring requirements to develop a more detailed plan, which is the central purpose of this 'Framework' document. It begins with a review of the Trust's overall mission and various departmental business areas, and describes the importance of monitoring and research to each of these. The difficulties with research in the natural sciences and the resulting limitation on our current knowledge of biodiversity are clearly observed, especially with regard to the constrained funding models of the charitable eNGO sector. Despite this, a rich legacy of biological recording has developed within Surrey, largely under the encouraging banner of the Trust and predecessors, which has resulted in a considerable body of data relating to both the extent and quality of Surrey's habitats, as well as the distribution and abundance of vast numbers of species; including plants and fungi, invertebrates and vertebrates.

The differences between simple 'recording', monitoring and research approaches relate primarily to their original purpose, and also therefore to their methodology. Most national monitoring schemes are designed as continuous surveillance to observe changes in the natural environment over time. They are based on sampling of the situation of interest within a statistically-guided number of 1km grid squares randomly distributed across the country. National recording schemes accumulate records of species over time, sometimes alongside other attributes such as behavioural circumstances, from which to analyse changes in distribution and related conservation status. Research normally investigates a particular phenomenon as a formally-posed hypothesis, requiring original data collection to resolve this. Scientific research is largely an iterative process and often requires sequential adjustments to the original thesis before arriving at a satisfactory conclusion. Research is usually financially sponsored via the academic sector, whereas much of the data behind monitoring and recording schemes are generated by volunteers either casually or as targeted 'Citizen Science' projects.

The historic sourcing and quality of habitat data available in Surrey is reviewed, and we conclude the urgency for a rationalised alignment of the various data sets and an overall improvement in the accessibility of data. A relatively new application of this data relates to their use in 'connectivity modelling', to help optimise strategic land-use interventions involved in landscape scale conservation. The monitoring of success of these relies on a combination of habitat and species distributional data, and the quality of inputs here is essential for confidence in modelling as a true reflection of the real-world situation.

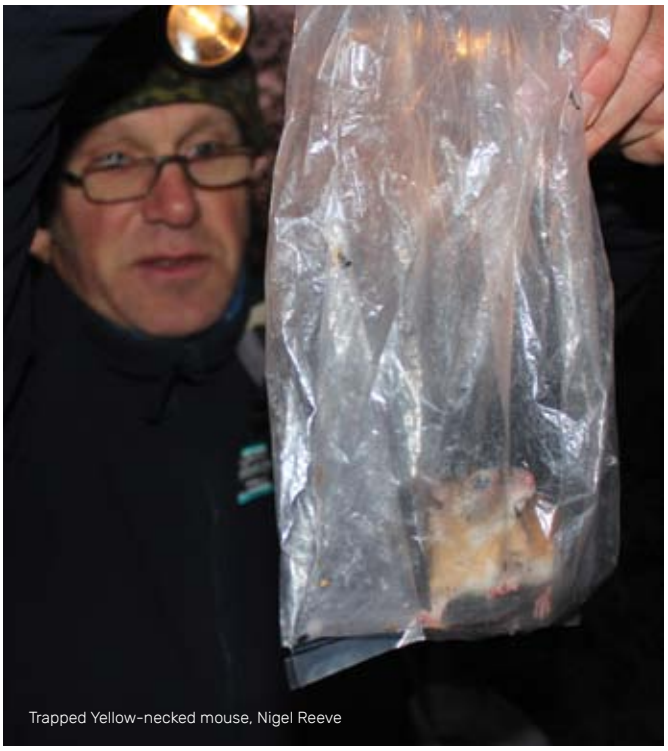
The observation and measurement of the impact of our work in facilitating people's engagement with nature, including their learning at all ages, any health and well-being benefits from contact with the natural world, as well as economic benefits arising from business associations with habitats and wildlife; must all be treated as branches of social science and therefore investigated as such. Existing means for this are reviewed here, including the national Monitor of Engagement with the Natural Environment (MENE) survey programme, as well as various local and regional schemes.

The capture, management and accessibility of biological data are reviewed, especially with regard to the role and capacities of our local records repository, the Surrey Biological Information Centre (SBIC). Existing and emergent national initiatives are discussed and an idealised system of data exchange between management agencies is compared with the current, somewhat less-than-perfect situation.

A set of basic principles is clearly laid-out to guide the efficient planning and coordination of our monitoring and research approach going forwards, whilst also recommending the minimum acceptable standard that we must aspire to meet. Next we present an overview of the available methods for base-lining and monitoring habitat extent and condition, species populations and ecological community attributes, as well as habitat connectedness across the landscape. Methods of tracking progress in people and nature engagement outcomes are also discussed, finishing with a brief foresight of new and emerging techniques gaining attention for improving both the accuracy of data collection and effectiveness of monitoring.

Our **implementation plan** for monitoring the achievement of the objectives and targets identified for the Strategic Plan period 2018-2023 then follows. Each of the five Biodiversity and four of the People Engagement Key Performance Indicators is discussed in detail; the means, methods and arbitration available for measuring the indicators' achievement, with a bulleted summary of the key actions required to enable this. Case-studies are described in boxes as illustrative examples of the process in practice.

A list of possible future research themes concludes the document. These cover both biodiversity and people engagement related research areas. The list is by no means exhaustive but instead represents the themes of a far fuller Trust research 'prospectus', to be developed in consultation with potential research partners (most likely Surrey's tertiary academic sector) in the near future.



Trapped Yellow-necked mouse, Nigel Reeve

Sheepleas in autumn, Mike Waite

1. Introduction

IN 2018 THE SURREY WILDLIFE TRUST PUBLISHED ITS RESEARCH STRATEGY '**NATURALLY INFORMED**', A HIGH LEVEL SUMMARY OF THE TRUST'S AMBITION TO EXTEND ITS SCIENTIFIC EVIDENCE-BASE THROUGH A SYSTEMATIC PROGRAMME WITHIN THE CURRENT STRATEGIC PLAN PERIOD 2018-2023 AND BEYOND.

This leant on earlier consultation across key Trust staff to gauge opinion as to where there is significant lack in such information, and how best to improve the situation with regard to the new priorities of the Strategic Plan. In summary these priorities are to focus the Trust proactively within a pilot set of selected 'sub-regions' of the county, whilst maintaining a reactive role throughout but in reduced capacity.

In essence this strategy may be seen as the natural continuation of the Trust's ***Living Landscapes Strategy*** of 2014, which prescribed concentrated effort within carefully selected, experimental Biodiversity Opportunity Areas[1] to observe and compare the success of a Lawton-inspired[2] 'landscape scale approach' to wildlife conservation over a set period. The justification for this approach need not be repeated here but in the interim, findings of the national State of Nature reports as well as our own ***State of Surrey's Nature*** published in 2017, are yet further reminders of the ongoing and steepening decline in biodiversity, and the dire need to initiate its recovery via reversals in wildlife habitat degradation wherever the opportunity can be advocated.

The Research Strategy opened the door to a deeper investigation into our current and future research and monitoring requirements, pledging to develop "*..a comprehensive Research & Monitoring Plan which will detail how we will assess the impact of our interventions*". This succinctly presents the purpose of this document.

1.1 Why monitoring and research matters

We are regularly required to account for our management priorities and decisions, from many different directions. Firstly, as a charitable body our membership deserves an articulate explanation of how and for what reasons we are spending its generous donations. The various funding bodies from whom we receive grants and awards quite rightly require similar reports of how their money has made a difference through our conservation programmes. Much of the land we manage, especially that on behalf of others under contract, is legally designated as Sites of Special Scientific Interest, Special Protection Areas and Special Areas of Conservation by Natural England, which again needs to know that we are adhering to formally agreed management plans and funding agreements. Here, accountability is achieved principally by assessing conservation outcomes - how far previously-set targets have been reached, which also indirectly demonstrates the wise and responsible use of resources within restricted budgets. But beyond this need for accountability, as a professional conservation organisation it is important we are confident in ourselves that our actions are the most effective toward achieving success in our overarching mission - to champion the recovery of all of Surrey's wildlife, with us as the exemplar operational agency. This may only be informed by carefully trialled, monitored and recorded evidence.

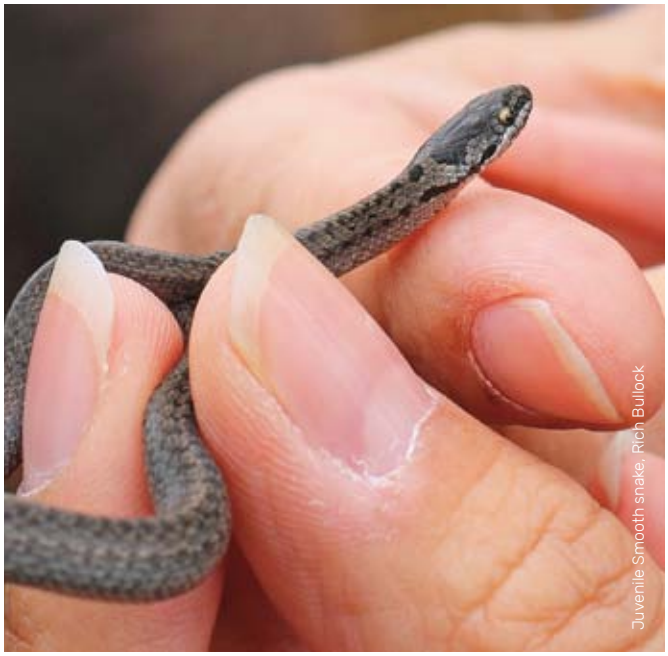
The importance of adequate monitoring of conservation interventions has been argued in some depth, with specific reference to The Wildlife Trusts' *Living Landscapes* programme by Rob Fuller et al.[3]. Their review makes some telling observations, noting

1. See; Biodiversity Opportunity Areas: the basis for realising Surrey's ecological network (Surrey Nature Partnership 2019 (*revised*))
2. See; *Making Space for Nature*: A review of England's Wildlife Sites and Ecological Network (Defra 2010)

that despite widespread appreciation of the essential role of management plans and the necessity for their regular monitoring and review; "*…the vast majority of* [country-wide] *conservation interventions are not systematically monitored*". The authors blame this primarily on resource constraints. They also worry that far too few long and faithfully-exacted interventions have been assessed adequately in terms of effectiveness, and that their focus on a limited set of simplified 'condition' assessment outcomes may not actually be benefiting the most deserving ecological interest of the site. To what extent this interest will shift and require flexibility to adjust our focus in the future, influenced for example by climate change or incoming plant pathogens, is a further consideration to take on board.

We often find that the public overestimates the depth and precision of our understanding of biological diversity and the intricacies of the natural environment. And yet, as the biosphere has taken aeons to evolve and is vastly more complex than even the most elaborate of man-made constructs, the inability to provide unequivocal explanation for many natural phenomena is hardly surprising. Nevertheless this can still be a source of bemusement or worse, frustration for sectors beyond ours in partnership situations. Accurate attribution of causal relationships requires astute and rigorous experimentation, and the answers that emerge typically invite further questions. The Natural England Information Note *Summary of Evidence: Biodiversity*[4] provides an honest statement of the current evidence base relating to UK biodiversity, including information on Natural England's as well as other key external research programmes. Whilst the document exposes the limitations of present knowledge there of course remains an extensive scientific literature dedicated to the exploration of this glorious complexity, with at least a proportion aimed directly at informing practitioners in conservation management. This is generated principally by the academic sector as well as under the auspices of publically-funded research bodies such as the Natural Environment Research Council and its Centre for Ecology & Hydrology (CEH), the Joint Nature Conservation Committee and Forest Research.

This body-of-work could in all likelihood fill a fair number of perceived evidence gaps, and in many cases inform a perfectly workable rationale to help solve various environmental management conundrums. However, a less excusable fact is the relative inaccessibility and consequent under-use of a significant volumn of this information. Early awareness of this failure as well as an abiding prevalence of 'hearsay-based' (rather than empirically-led) approaches to management, led directly to the foundation of the University of Cambridge's *Conservation Evidence* initiative[5]. This is now in its second decade of development and serves to collate globally-published, applied scientific research to provide an accessible data library dedicated to cataloguing the consequences of biodiversity conservation-motivated management interventions. Even more useful is *What Works in Conservation*; a further product providing freely-available, expert assessment of the effectiveness of interventions based on the summarised evidence as a series of topic-related synopses.


Juvenile Smooth snake, Rich Bullock

3. Fuller R J. et al. (February 2016): *The increasing importance of monitoring wildlife responses to habitat management*, in British Wildlife Vol. 27 (pp. 175-186)
4. Summary of Evidence: Biodiversity (Natural England Access to Evidence Information Note EIN004 Ed.1, March 2015)
5. See; conservationevidence.com

Surveying Ash Ranges, Jon Hawkins

2. Monitoring & research in Surrey

HERE WE REVIEW THE CURRENT AND RECENT PAST APPROACHES TO HABITAT AND SPECIES MONITORING, AS WELL AS TO RESEARCH, UNDERTAKEN DIRECTLY BY THE TRUST AND BY THIRD PARTIES ON LAND WITHIN THE TRUST ESTATE.

It is important firstly to clarify the distinctions between various monitoring rationales, as they can differ quite fundamentally in purpose, scale or requirement in terms of their accountability drivers.

2.1 What is monitoring?

Monitoring in its widest sense refers to the repeated observation of a particular set of circumstances from which an impression may be gained of changes over time from an established or notional base-line state.

In our case this might include those related to the overall state of a site, the condition of a habitat, an estimated size of a species population or the diversity within a species assemblage or community. Monitoring is often conducted to gauge the response to a particular management action intended to deliver an improvement to, or at least halt any further undesirable decline from, an initial state. Surveillance monitoring is usually less directly purposeful, but is designed to be conducted continuously and with no defined end-point to a statistically robust sampling protocol, to detect changing trends (as for example in species populations).

Species 'recording' per se. collects very useful information but not necessarily with a monitoring or research goal in mind. However, a comparison of accumulated records over time, especially if accompanied by population counts and associated habitat observations, can form the basis of estimates of the changing status of a species when more structured surveillance is not possible or does not exist. The existence of a recording 'scheme' for a specific or defined group of species can initiate a more structured approach to recording by coordinating the collective focus on targeted, perhaps under-recorded species for which their status remains largely unclear.

Research in *its* widest sense could include any of the above types of information gathering, but more strictly implies the collection and review of new or existing data to investigate a particular phenomenon as a formally-posed hypothesis. This uses experimental interventions that require systematic measurement, good control of confounding variables (often difficult in field studies) and sufficient replication to provide statistically robust conclusions. Here, research differs in approach to monitoring or surveillance which is solely focussed on tracking changes, although these can be correlated with other measured variables to explore trends and potential causal relationships. While such experimental research projects normally generate an original set of habitat and/or species data for a singular use, if appropriate these can provide a base-line for later monitoring applications. Scientific research is by definition an iterative process, and as alluded already often requires sequential adjustments to the original thesis before finally arriving at a satisfactory conclusion.

2.2 Habitat distribution baselining

The distribution and extent of wildlife habitats across Surrey has been researched under various separate directives in past decades. These include studies aimed either at quantifying all habitats within one typology, or of single priority habitats of interest such as lowland heathland, calcareous grassland, hedgerows and ancient woodland. An example of the

first approach was the *Surrey Habitat Survey Review*[6], which was initiated in 1975 but then repeated in 1985 to observe changes in the extent of habitats over the intervening decade.

The **Surrey SNCI Project** took place over an extended period of time with the specific objective of identifying our Local Wildlife Sites (termed Sites of Nature Conservation Importance/SNCI in Surrey) through a combination of desk-based research and sampled habitat survey. This exercise was based on a selective 'Phase 1' habitat survey extending across the whole of Surrey. Following their adoption by local planning authorities, Local Wildlife Sites are advisedly re-surveyed for continuity of their qualifying biodiversity interest at least every ten years. This is also an opportunity for any potential new sites to be identified. In practice however, and due to a combined lack of both resource and comprehension, this decadal cycling target has more often than not been missed.

The **Surrey Habitat Framework** originated from the UK and consequent Surrey Habitat Action Plans, but was locally initiated for use as a definitive baseline and capture-tool for all future research into changes in the spatial distribution of priority habitats across the county. Natural England has meanwhile produced its national Priority Habitat Inventory (PHI), combining a partial, sampled survey typology with extensive desk-based extrapolation, but in apparent disregard of the auditing that emerged from the UK BAP. Hence the quality of the PHI in Surrey varies greatly in its completeness and degree of resolution. Progress with completing the Surrey Habitat Framework has stalled due to resource constraints, however.

A complete national land-use survey is available from the Centre for Ecology & Hydrology as the **Countryside Survey**, designed to be a repeatable audit of the UK's natural resources (most recently updated in 2007). Among various applications it has been used nationally to monitor changes in the extent of arable field margins, hedgerows and some upland habitats. The Countryside Survey has two main components, its **Field Survey** and the **Land Cover Map** project. The Field Survey is a ground-validated study of sampled 1 kms^2 representing all major habitat types in the UK. The Land Cover Map is derived from satellite images and digital cartography, with its latest version (LCM2015, released in 2017) finally providing information for the entire UK. The LCM classifies land cover as UK BAP Broad Habitats. It is used extensively by national and local government, as well as environmental management bodies, consultants and researchers. It has wide application in many sectors and is available in various formats.

2.3 Habitat condition assessment

On Surrey's statutory protected sites, their regulatory authority Natural England has undertaken condition monitoring of all notified interest features (including habitats and species, as well as geological), within the **Common Standards Monitoring** (CSM) programme[7] since its introduction in 2004. CSM includes survey protocols for a range of broad habitat types as well as for species groups. Condition monitoring is required every six years or less depending on the interest feature, and evaluates the condition status of each of the management units of the composite site. This is aggregated and used as the basis for reporting nationally on the state of the statutory protected sites system.

Many of these sites have attracted management funding from current and discontinued agri-environment schemes, including Higher Level Stewardship and Countryside Stewardship. These schemes require separate habitat survey and assessment to monitor their attainment of maintained or enhanced habitat condition outcomes, as agreed for the relevant options chosen and funded. For HLS the protocol for this is presented within the Farm Environment Plan (FEP) Manual[8].

So far, an independent (beyond the obligatory directives described above) and wholly comprehensive policy approach towards habitat condition monitoring across the entire Trust estate is lacking. Nevertheless, for a good many sites this has at least at one time been scoped, if not actually implemented. Certain sites have benefitted from what would be described as a 'research-based' monitoring approach to certain important aspects of their habitat characters. An example is the long-term monitoring of the valley mire vegetation in relation to water-levels at Folly Bog (part of the Pirbright Ranges/Brentmoor Heath reserve). An additional aspect to this monitored the response of vegetation to the introduction of conservation grazing from 2003-2012[9]. A more wide-ranging strategy to guide grazing management and habitat monitoring of several key heathland sites was externally commissioned in 2014[10]. Furthermore, in a novel approach to correlating grazing pressure with heathland habitat structure and condition, spatial tracking of grazing stock was achieved using remotely monitored GPS-collars worn by cattle and Red deer

6. See; Lindley Dr A. (1986): *Surrey's Vanishing Wildlife: A Habitat Survey Review 1975-85*
7. See; Natural England (2016): SSSI Monitoring and Reporting Operational Standard (v.3 April 2016)
8. See; Natural England (2010): Higher Level Stewardship Farm Environment Plan (FEP) Manual. Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features (3rd Ed. March 2010)
9. See; Groome G M & Shaw P (2015): *Vegetation response to the reintroduction of cattle grazing on an English lowland valley mire and wet heath.* Conservation Evidence 12 (pp. 33-39)
10. Surrey Wildlife Trust Heathland Grazing Strategy (Jonathan Cox Associates, January 2014)

Cervus elaphus on both Ash and Pirbright Ranges. A habitat condition (and species) monitoring programme for Chobham Common was designed recently by the Trust's ecology consultancy. Further, earlier projects that either involved or intended habitat monitoring include those at Thundry Meadows in 1998-2002; Bagmoor Common 1999-2002; at Ockham & Wisley Commons in 2005; and at Park Ham (Quarry Hangers) in 2000. Fixed point photography (see 3.2.1 below) was also initiated at several reserves early in the new millennium, but has not always been continued. At Dawcombe in the North Downs monitoring of the chalk grassland flora was initiated by the voluntary warden and is ongoing.

Further habitat attribute monitoring programmes active across Surrey include statutory tracking of water quality and water levels on river catchments routinely undertaken by the Environment Agency and our respective water utilities. Physical and hydrological profiling through 'River Corridor' surveys, was also undertaken by the EA up until 2000. Some aspects of these workstreams are now supplemented by the Trust-initiated River*Search* (a 'Citizen Science'; see 2.5) project. A further priority habitat to benefit from a renewed focus on its survey, and be monitored for improvements in condition via a Citizen Science approach are hedgerows by the Trust's new *Hedgerow Heroes* project.

2.4 Habitat connectivity in Surrey

The Trust's *Living Landscapes* strategy aims to repair physical habitat fragmentation to restore ecological connectedness across and beyond Surrey, as now fully reflected in all national policy promoting a landscape scale approach to the recovery of former biodiversity. The mapping of Biodiversity Opportunity Areas[1] (BOAs) identifies those areas where the habitat management interventions necessary to further this objective should be prioritised.

There are several emerging methodologies available to both gauge present and monitor improvement of habitat connectivity. This has not been attempted before for Surrey, although such concepts and landscape qualities were considered within the protocol for identifying Biodiversity Opportunity Areas. Natural England has developed the National Biodiversity Climate Change Vulnerability Model[11], which uses a relatively coarse-grained metric to incorporate a value for habitat fragmentation, derived from the PHI and the Land Cover Map (see 2.2). In turn this is now being used by Natural England in planning the National Recovery Network, as commited through *A Green Future: Our 25 Year Plan to Improve the Environment* (Defra 2018).

Following research into the options available, the Trust is presently developing a habitat connectivity model that will establish a baseline from which to measure progress in repairing fragmentation through habitat management, restoration and re-creation interventions. This uses the methodology of the 'Circuitscape' model[12] and will first be piloted in the selected sub-regions (as prioritised 'meta-BOAs') of the Strategic Plan 2018-2023. The model relies on the availability of accurate mapping of the habitat classification utilised (in our case this must be based initially at least on Land Cover Map 2015). Also required is the careful choice of 'focal species' to provide an attribute for dispersal capability, each representing a guild of similar species associated with the most important habitat types present within the prioritised BOAs. The model will calculate an index for landscape 'resistance' to those species' natural movements, to act as a proxy for habitat fragmentation. The focal species chosen include Common dormouse *Muscardinus avellanarius* for broadleaved woodland, dense scrub and hedgerow habitats; Adder *Vipera berus* for heathland and acid grassland mosaics; the Adonis blue butterfly *Polyommatus bellargus* for calcareous grassland; Water vole *Arvicola amphibius* for fen, marsh and swamp; and Great crested newt *Triturus cristatus* for open standing water-bodies.

Providing a useful, sufficiently accurate model of habitat fragmentation requires careful design involving stepwise, logical and lateral thinking, in order to represent an acceptable simplification of a highly complex reality. If used consistently as a monitoring index however, meaningful outputs can be achieved.

2.5 Species monitoring & research in Surrey

Much of the activity mentioned above under 2.4 intrinsically involves the collection of species data. For example re-surveys of SNCI must also validate their continued qualifying interest for notable species populations or assemblages, while as already noted CSM also includes protocols for monitoring notified species features.

But it is a more 'stand-alone' approach to species recording, typically on a targeted site-by-site basis, or aggregated for presentation purposes to the equivalent Ordnance Survey recording tetrad (4km^2), which accounts for the majority of records in the accumulated species data-base for Surrey. These records are generated by voluntary naturalists for the most part and through various incentives, not least the **Surrey Atlas Project** coordinated by the local environmental records centre - the Surrey Biodiversity Information Centre (SBIC). To date SBIC has overseen the publication of a checklist for Coleoptera (beetles) and local distribution atlases for some 12 invertebrate

11. National biodiversity climate change vulnerability model (Natural England Research Report NERR054, February 2014)
12. See; circuitscape.org

groups as well as herpetofauna (reptiles and amphibians). Site recording has been driven by the various specialist groups' field meetings programmes, on occasion congregating to record a single site *en masse*. These are sometimes extended to include an additional public outreach interpretative element and are then often branded as 'Bioblitz' events. By one definition, data-sets generated primarily by volunteers (ie. not funded from dedicated resources) can be referred to as 'Citizen Science' projects (see Box across). A further large generator of records is of course, the professional ecological sector, engaged in impact assessment consultancy or with in-house project work.

Surrey's collective participation in every one of the current national species surveillance monitoring projects is evidence of another motivation for volunteer-led recording, that yields a further significant source of records collected to contribute directly to schemes designed to track the abundance trends of UK species populations. These are coordinated by the Joint Nature Conservancy Council and include Butterfly Conservation's UK Butterfly Monitoring Scheme (UKBMS), Wider Countryside Butterfly Survey (with the British Trust for Ornithology) and *Moths Count* project also incorporating the long-running Rothamsted light-trap network; various schemes run by the British Trust for Ornithology (BTO) to monitor breeding and wintering birds; the National Amphibian & Reptile Recording Scheme run by Amphibian & Reptile Conservation; several schemes to monitor bats run by the Bat Conservation Trust; and the National Dormouse Monitoring Project run by the People's Trust for Endangered Species. More recently these have been joined by the National Plant Monitoring Scheme for vascular plants run by the Botanical Society of the British Isles (BSBI) and Plantlife, as well as the British Dragonfly Society's *DragonflyWatch* project. Most of these are based on straightforward repetitive counts of individuals (or an indicative abundance attribute) both from fixed registers of sites or from plotted transects traversing randomly-sampled Ordnance Survey 1 km^2 monads (see below 2.5.1-3).

These projects are also normally nested within grouped species national recording schemes, which exist for many other species not previously mentioned. The schemes seek to coordinate the collective species recording effort for their respective groups, thereby serving to promote better knowledge of species' UK ranges and status. By stratifying both early and modern records by date classes some indication of changes in species populations becomes available. The national coordinators preside over networks of county recorders (based on the traditional vice-county system), ensuring the effective capture, consolidation and availability of records to those with cause to use them. Surrey has county recorders who collaborate in many of these schemes. The primary Surrey vice-county is VC17, although this includes some significant former territory that is now within Greater London, West Sussex or Berkshire. Moreover, the modern Surrey administrative boundary includes a small section of VC21 (Middlesex). It is always worth checking therefore, in which sense 'Surrey' is being referred in terms of species' local status. For a list of recording schemes currently active across the country, visit brc.ac.uk/recording-schemes.

Citizen Science

The so-called 'Citizen Science' approach to collecting scientific data for monitoring purposes refers in its widest sense to any of those recording schemes that are achieved 'on the cheap', ie. by amateur voluntary effort as opposed to being wholly professionally funded. There are a great many benefits from taking such an approach however, beyond simply to make it more affordable. Directing the schemes are typically one or more, often small and centralised professional bodies, themselves perhaps charitably-funded and these immediately benefit from a widened geographic distribution of potential data collection points. These can also harness the highest levels of local expertise and knowledge. Through their participation the volunteers are motivated to contribute their skills to worthwhile applications of their data. They may be introduced to similarly-interested fellows previously unmet, and act as spokespersons for related environmental issues within their communities. They can kindle the interests of and transfer skills to the next generation of scientists, or may already be them, and through all this the activity is also quite likely to have significant health and well-being benefits.

The success of a Citizen Science project will depend on its application to the projects where it can be most effective. This may depend on what research is needed, what motivates the volunteers and what they are most competent at delivering. The obvious risks include the schemes' reliance on continuity of participation. This will be influenced by the practicalities of the task, the perception of its credibility and purpose, and the regular refreshing of its approach; be it in technique, observation goals, switching of localities or training opportunities (which could threaten statistical integrity however). Streamlining the coordination of Citizen Science projects is improving all the time with the development of on-line data capture, species identification and training, and data management systems, for example the Cartographer platform.

2.5.1 Plants, lichens and fungi

The authority in Surrey for vascular plant recording is the **Surrey Botanical Society**, affiliated with the BSBI. This manages a live records data-base, and anticipates publication of a contemporary vice-county flora in the future. A more imminent project for publication through the Surrey Atlas Project is the *Surrey Rare Plant Register* (RPR). Recording extends to annual counts for a number of rare and threatened plants, in some cases having originated from the Plantlife/Species Recovery Trust 'Back from the Brink' project. Examples include Starved wood-sedge *Carex depauperata*, Narrow-leaved helleborine *Cephalanthera longifolia* and Broad-leaved cudweed *Filago pyramidata*. Continuity of effort here is largely governed by the enthusiasm of volunteers local to the (frequently final county-wide) surviving sites. SBS also covers charophyte (stonewort) recording for the vice-county. The relatively new National Plant Monitoring Scheme has had take-up in Surrey, represented by some 30 sampling monads.

The **British Bryological Society** has membership from Surrey, including our county recorder managing the vice-county data-base reporting into the BBS recording scheme. Since the vice-county Bryophyte Site Register prepared to complement SSSI site selection in 1986, recording of Bryophytes (mosses, hornworts and liverworts) in Surrey has been undertaken largely on an opportunistic, ad hoc site/locality basis, although protected and nature reserve sites have been prioritised. It is unclear if and how frequently any known rare and threatened species populations are monitored, however.

Clearly much of the habitat monitoring and research effort to date has generated valuable plant records, for both vascular and lower plants, which find their way into the respective species data-bases. A further example of research into management issues impacting specific species, includes the 2002 study into the autecological response of Bulbous buttercup *Ranunculus bulbosus* to trampling (related to calcareous grassland condition), on the well-visited site of Newlands Corner.

Recording of Lichens has less of a county focus in Surrey, and has been largely conducted from a more regional perspective. Our **British Lichen Society** county recorder is shared with several other vice-counties. The BLS has an added sub-focus on recording from churchyards. None of the "top three" most important sites for their lichen assemblages in Surrey are managed by the Trust. Recording of Fungi (non-lichenised) has a long tradition in Surrey and the national recording scheme is run by the **British Mycological Society**. Again, contemporary recording within Surrey is conducted as part of a sub-regional programme, and is primarily led by the **West Weald Fungus Recording Group**. Also again, recording of protected and nature reserve sites is prioritised.

2.5.2 Invertebrates

Aside from the macro-Lepidoptera, invertebrates have long been viewed as monitoring's 'poor cousin' in not having received their fair share of recording effort, but this perception is now gaining awareness and some degree of corrective attention at least. The situation in Surrey is probably far better than in many counties, thanks to the relative wealth of enthusiastic invertebrate specialists that have been at one time or remain based here. This effort is also highly deserved as Surrey is very important for invertebrates in a national and even international context. For example 62% of the UK's spider diversity is represented in Surrey, and 75% of its beetles.

Species recording of invertebrates has been greatly stimulated by the Surrey Atlas Project. There are vice-county recorders for all of the better-known groups, some shared with neighbouring counties. The invertebrate assemblages associated with heathland habitats are diverse and unsurprisingly well-represented in Surrey, accounting for many of the notified features of our Sites of Special Scientific Interest. Original selection of these was informed by the nationally-compiled Invertebrate Site Registers (ISR), and monitoring of this invertebrate interest has continued, albeit fitfully and sometimes funded by Natural England and its predecessors, on a site-by-site basis.

One of the best-participated national surveillance monitoring schemes is **Butterfly Conservation**'s UKBMS, and this success is also reflected in Surrey with 48 recorded transects, many being on Trust sites. Moths Count is the motif for the National Moths Recording Scheme (NMRS), with increasing numbers of contributing participants. The incorporated Rothamsted Insect Survey operates a constant-effort, national light-trap network of long-standing that chiefly monitors abundance indices for moths and other invertebrates. There have been around six such trapping stations active at any one time in Surrey. A new surveillance monitoring scheme for Odonata (dragonflies and damselflies) called DragonflyWatch has recently been launched by the **British Dragonfly Society**, and participation is presently growing.

Since the selection of UK Biodiversity Action Plan priority invertebrates, targeted surveys and bespoke management action plans to address the urgent conservation needs of several such species have had a specific focus within Surrey, including the Heath tiger-beetle *Cicindela sylvatica*, Red-barbed ant *Formica rufibarbis*, Window-winged caddis fly *Hagenella clathrata* and Field cricket *Gryllus campestris*. All but the last of these have taken place predominantly on Trust-managed sites. Important autecological findings have arisen from these projects, while further examples of specific invertebrate studies include the work on metapopulation theory in relation to the Silver-spotted skipper *Hesperia comma* on the North

Downs[13]; historic distribution reviews, autecological studies and management recommendations involving both the Hazel and Shining pot-beetles *Cryptocephalus coryli* and *C. nitidulus*[14,15]; and an investigation into the ability of invertebrates to recolonise burned heathland at Whitmoor Common. These highlight the value of academic sector-partnered research on the Trust estate, which may in this sense be viewed as an 'outdoor laboratory' serving the purposes of both researchers and managers.

Concern for the alarming reduction in abundance of several invertebrate groups representing key pollinators within the wider ecosystem has inspired a further CEH-coordinated voluntary scheme; the **Pollinator Monitoring Scheme**. This asks contributors to conduct Flower-Insect Timed (FIT) Counts as often as they can in optimum weather conditions between March and October. The Surrey participation in the scheme is presently unknown.

2.5.3 Vertebrates

Birds: Birds are probably the most thoroughly observed wildlife group in the UK. Records of bird sightings are used in a great many applications; from government-subsidised national surveillance monitoring schemes to compiling site checklists to assist, for example, in visitor interpretation. The **British Trust for Ornithology** is the lead partner responsible for organisation of all the national monitoring schemes, which include amongst their eight 'core surveys' the Breeding Bird Survey (BBS and the Waterways BBS); the Wetland Birds Survey (WeBS); BirdTrack; the Ringing Scheme; and *Garden BirdWatch*. There are many more BTO surveys that have operated either as a one-off or a continuous repository for records of single species or certain habitat-associated groups of birds. All surveys rely heavily on volunteer participation and most have a strong participatory presence within Surrey. For example the BBS/WBBS has 106 1 km^2 sampling transects in Surrey, while WeBS counts are conducted on 145 sites. The enthusiasts' group for the county is the **Surrey Bird Club**, which has published two distribution atlases and compiles an annual report of all sightings across the vice-county as the 'Surrey Bird Report'. The Special Protection Areas (SPA) in Surrey notified for their international ornithological interest are monitored under the direction of Natural England. Those sites comprising the Thames Basin Heaths and Wealden Heaths SPAs are censused annually for their qualifying specialists Dartford warbler *Sylvia undata*, Nightjar *Caprimulgus europaeus* and Woodlark *Lullula arborea*; while the sites that form part of the South-West London Waterbodies SPA are continually monitored through the BTO Wetland Bird Survey.

Herpetofauna: The **Surrey Amphibian & Reptile Group** (SARG, affiliated to **Amphibian & Reptile Conservation**) records and conducts some monitoring of this group. Its 'Common Species' survey incorporates elements of the National Amphibian & Reptile Recording Scheme (NARRS), which was designed as a survey of randomly sampled 1 km^2 to locate and estimate population sizes of widespread species. SARG's 'Rare Species' survey aims to monitor Natterjack toad *Epidalea calamita*, Sand lizard *Lacerta agilis* and Smooth snake *Coronella austriaca*, including for success of self-sustaining re-introduced populations. The group is clearly able to advance knowledge regarding best practice with herpetofauna re-introduction projects.

Mammals: A number of mammal species are monitored through national surveillance schemes. These include many of the bats, conducted through the National Bat Monitoring Programme (NBMP) organised by the **Bat Conservation Trust** (BCT). The NBMP includes survey protocols to annually count certain bat species at fixed roost sites during the active summer period as well as during hibernation. Other annual surveys record for indices of activity of single or multiple bat species from 1 km^2 sampling transects (the 'Field' and 'Waterway' surveys). Again, Surrey is well represented in many of these surveys with 25 transects contributing to the Field Survey for example. There are arrays of artificial bat roosting boxes distributed across the county, which are monitored for occupation annually. As many of these have been in place for a considerable period they too can offer a useful index for suggesting population trends. Site-based surveying to improve our knowledge of the distribution status of especially rarer bat species is undertaken on a rolling basis, with special efforts made to locate their roost sites where possible. This knowledge then helps to guide management approaches on relevant sites. Continuity of summer and hibernation roost counts is particularly necessary in Surrey as we are an important county for bats. Intrusive species counts conducted on sites occupied by bats is a legally licensable activity, which requires acquired skills. Most enthusiasts are volunteers and belong to the **Surrey Bat Group** (SBG - formally affiliated to BCT), although not all members are licensed to disturb bats. The Common dormouse is monitored through the National Dormouse Monitoring Programme (NDMP), coordinated currently by the **People's Trust for Endangered Species** (PTES). The survey protocol for this scheme relies on biannual counts of individuals occupying bespoke nest-boxes at fixed sites. Surrey supports a nationally important population of dormice and some 40 nest-box array locations are represented

13. Hill, J K et al. (1996): *Effects of Habitat Patch Size and Isolation on Dispersal by* Hesperia comma *Butterflies: Implications for Metapopulation Structure*, in Journal of Animal Ecology Vol. 65 (pp. 725-735)
14. Piper, Dr. R S (2002): *Conservation Biology of* Cryptocephalus *species and Other Threatened UK Beetles.* Doctoral thesis, University of Leeds
15. Piper Dr R S & Compton S G (2010): *Population size and dispersal ability of* Cryptocephalus nitidulus *(Linnaeus, 1758) (Col.: Chrysomelidae).* The Entomologist's Record and Journal of Variation 122:257-264 (pp. 257-263)

within the NDMP. The programme also depends on volunteers but as any potential disturbance of dormice may only be risked under licence, this participation is a restricted resource.

At a county level, surveys have been targeted at further priority mammals where distribution knowledge is viewed as deficient. This has involved the Harvest mouse *Micromys minutus* under the Trust's Harvest Mouse Project 2010-15. The Water vole has been similarly targeted, originally to compile an initial register of historically occupied sites up to around the start of the new millennium. This register was used as the basis for a structured re-survey between 2015 and 2017, which has unfortunately yielded only unoccupied sites implying a widespread local extinction event. A further association of mammal enthusiasts forms the **Surrey Mammal Group**, largely composed of members of the SBG and the Surrey Dormouse Group, as well as the two Surrey Badger Protection Societies (East & West). The PTES' *Living with Mammals* project is a long-term surveillance scheme for mammals in the built environment, which launched in 2003 and has helped to evidence the growing habituation of several species to urban habitats. It has also provided useful population indices for declining priority species such as the Hedgehog *Erinaceus europaeus*.

Fish: Environment Agency fisheries teams have a responsibility for monitoring fish populations, organised on a catchment basis. These teams, often in open consultation with local angling clubs, are able to maintain an overview of fish communities present in catchments, including non-native species introductions. Fish assemblage surveys are achieved using a multi-method approach that includes netting, angler-catch data, hydro-acoustic survey and sometimes electrofishing. Examples of Trust-managed sites where surveys have taken place include Boldermere and Brittens Pond.

2.6 People engagement monitoring & research

Studying public interaction with the natural environment is best viewed as a social science. Natural England researches this at a national level through its **Monitor of Engagement with the Natural Environment** survey programme (MENE; see 3.2.4). The Trust conducts regular surveys within its membership to gauge members' attitudes and their general understanding of the Trust's mission, which can also serve to inform our marketing campaigns. We also regularly solicit opinion on the content and satisfaction with our educational programmes and volunteering opportunities, and we record actual attendance statistics (beyond booking numbers) at public engagement events in the field. As part of our site management contract for the Surrey County Council countryside estate the Trust is obliged to conduct visitor satisfaction surveys. To date this has involved three sites per annum, selected and agreed between the two parties and most recently has served to understand visitor attitudes to the introduction of car-parking charging at several sites.

The Thames Basin Heaths SPA Strategic Access Management and Monitoring (SAMM) Project is another Natural England initiative, funded by contributions from the builders of new residential developments within proximity of the SPA. The project aims to manage the impact of public visitors at open access heathland sites, through the work of a wardening service as well as close monitoring of both visitor footfall on the sites and their qualifying ornithological interest (see 2.5.3). SAMM wardens conduct regular on-site visitor surveys combined with awareness-raising and interpretative events. Since the introduction of car-park charging we can monitor and compare numbers of visits at these (and some further, non-charged sites), albeit only in terms of daily vehicle arrivals at the parking facilities.

Research into the health & well-being benefits of regular recreation within the natural environment has been conducted widely at a national level. In Surrey we hope to be able to include a valuation of these benefits as a cultural 'ecosystem service' within the county's Natural Capital Investment Plan, and work on this has been started. Related to such well-being benefits was an original research study undertaken on Trust-managed sites that attempted to quantify the psychosomatic calming effect of exposure to birdsong in a natural setting[16].

2.7 Management & capture of data

The Surrey Biological Information Centre is the intended default repository for all natural history recording in the administrative county of Surrey, including monitoring data for habitats and species. However our primary Watsonian vice-county (VC17) extends significantly into Greater London, where the local records centre is Greenspace Information for Greater London (GiGL). Members of the London Natural History Society have traditionally recorded within a radial area of 20 miles from St Paul's Cathedral and thus well into Surrey, so their data is held by both records centres. Data provision and management services provided by SBIC and GiGL observe the modern administrative county boundaries.

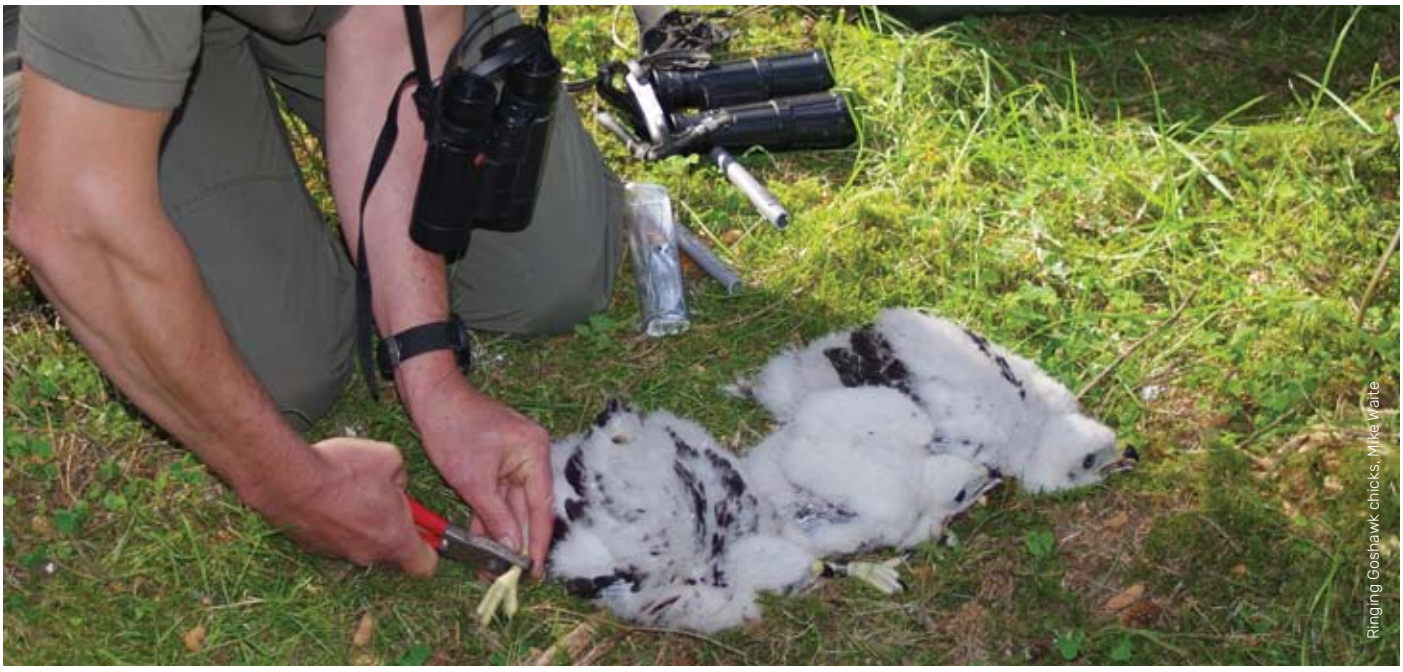
Despite this aim and position, it is acknowledged that the data held by SBIC is not fully comprehensive. Although its data-base is substantial, compared with some equivalent county record centres this remains relatively restricted. So why might this be? A perennial problem for any records centre is ensuring

16. Ratcliffe Dr E. (2015); *Restorative perceptions and outcomes associated with listening to birds.* Doctoral thesis, University of Surrey

universal success in soliciting records from their original sources. At group level, and certainly on the part of some individual recorders, there is an oft-cited mistrust over the expected level of comprehension and interpretation of the significance of their records, and/or the intended application of their data, and indeed the data management capacities (and hence efficiency) of the records centre. Some recorders take their (or their clients') intellectual property rights very seriously and see these as likely to be compromised by the admission of their data to a records centre, not least in lost revenue. Still others misguidedly foresee the wider recognition of a newly-discovered feature of interest as leading inevitably to its eventual loss, and thus apply maximum suppression to the information. Whilst there is quite probably limited scope to address the last of these, at least at the group or company level various conditions imposed on uses of data can be negotiated as a way around such limitations.

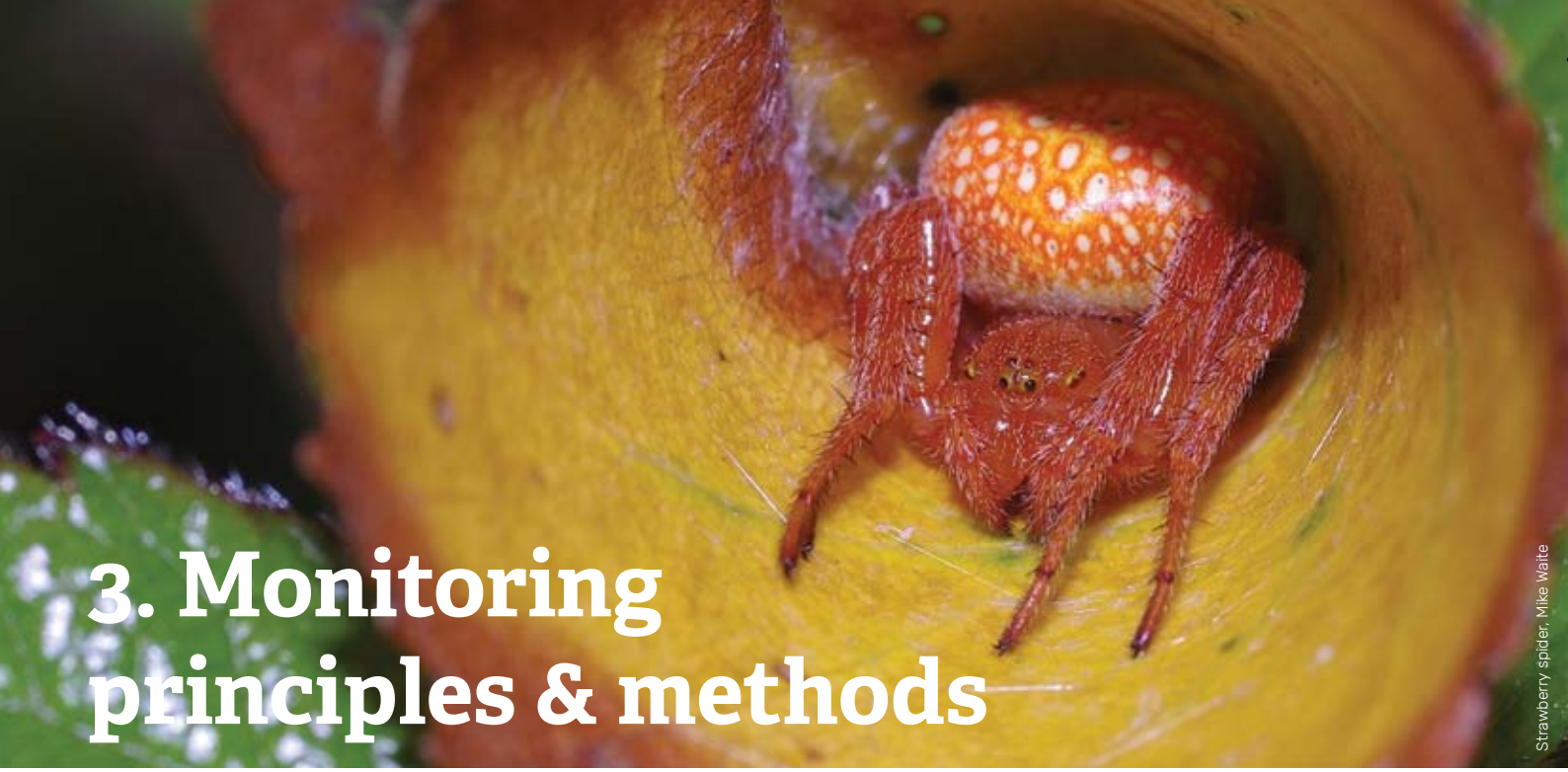
The **National Biodiversity Network** (NBN) is the national, part-publically funded charitable trust governed by a partnership of biological survey and recording organisations, whose purpose it is to improve "*...the recording, collection, verification, curation, aggregation, analysis and use of biological data in the UK*". It was set-up largely by the Biological Records Centre[17] (part of NERC) with a vision for the biological data collected and shared by the NBN to become central to knowledge of our biodiversity and critical in all decision-making about the environment. The NBN 'Atlas' project[18] aspires to operate as a national meta-records centre receiving and managing contributors' data-sets under bespoke sharing agreements, including many of the specialist national recording groups and schemes. At an agreed level of access, the information is then freely available through an online portal. There appears to be a complex and somewhat vexed reciprocation of data flow between their originators, the local records centres and the NBN however, which is perhaps explained partly by the local centres' desire to retain their *raison d'etre*. Again though, better conditional-use agreements to engender enhancement of the data cascading system might at least provide users of data-search facilities with improved reliability as to the completeness of any one records data-set.

The process of capture and validating data in the field and then submitting it to a repository such as a local records centre is quickly evolving. The possibilities for a 'paperless' approach have developed considerably, with online (electronic) identification and evaluation guidance as well as data submission software (as 'apps' - for example the British Records Centre's *iRecord*[19]) now widely available. Some monitoring systems can be left to run entirely automatically using remote data loggers, significantly reducing the person-hours involved. With so much inherent temporal and spatial data encryption now available in digital photography, this too presents an ever-more versatile tool for data capture. However, the need for notebooks and hard-copy survey templates will no doubt prevail, if only as a tried & tested back-up system. The status quo in management of data is also being challenged, with several new platforms emerging to provide this service. An example is 'Cartographer'; essentially a subscription online repository service currently under investigation by the Trust.



Ringing Goshawk chicks, Mike Waite

17. See; Roy D B et al. (eds.)(2014): *Celebrating 50 years of the Biological Records Centre.* (CEH)
18. See; nbnatlas.org
19. See; Garland S. (2019): *A guide to using iRecord* (BRC)



Strawberry spider, Mike Waite

3. Monitoring principles & methods

3.1 Some basic principles

- The first principle when designing any monitoring project is to plan realistically for it to be easily repeated. Beyond actual survey practicalities, this extends to foreseeing the likely resources available to maintain the necessary effort going forwards. Simplicity without compromising cogency is therefore by far the best approach.
- A further important principle is that it is imperative to *at least do something,* in order to sufficiently record the present characteristics of a situation if it is intended to cause changes to that situation. Too many management actions have overlooked this basic baselining task, especially in the past. As an absolute minimum this may be achieved through a series of carefully captured photographs; a timed or total tally-count of individuals with the date and weather conditions recorded for example; or the areas of habitat cover estimated by pacing-out.
- A related principle is to observe the concept of maintaining a 'control' to remind oneself of the do-nothing option, from which to compare the results of a predetermined management intervention. This may require sacrificing an ill-afforded area of the project, but the benefit in terms of the learning outcome is obvious. It is important that your control areas are representative and subject to the same conditions (other than the intervention of course) as the rest of the site. This is best achieved by randomising their locations. Replication of the intervention and control areas across a number of separate sites, perhaps involving similarly-interested partners, allows more robust statistical analysis and improves confidence that similar outcomes may be achieved by the same intervention elsewhere.
- To maintain comparability, the exact same monitoring methodology must be applied at every repetition cycle. More of the technique can be added to the data-set, but the original protocol must be strictly observed.
- Sampling is a normal feature of monitoring projects, and there will be a statistically-driven minimum number of samples necessary to secure confidence. Guidance should be sought on this, referring to appropriate literature and/or a trained statistician, as the method of analysis and sample size required should be decided before the project starts. Nevertheless, resource constraints must never be allowed to become off-putting in this regard. Remember the second principle above; provided that a robust approach to the research is adopted, monitoring of at least some samples will still be useful and more can always be added in time as further resources allow.
- It may become necessary to think laterally when required to monitor for something that is buried in a complex of multiple variables. For example is it possible to measure a reliable index that acts as a genuine indicator, or some other proxy value to represent the specific parameter you are interested in?
- Finally, there is no need to unnecessarily reinvent-the-wheel. Established monitoring projects and methodologies are likely to be the best ones to incorporate, or continue and add to by simple replication. This approach will also serve to assist their original purpose at a national level, and may even permit direct comparability with their reporting on national trends.

3.2 Overview of available monitoring methods

3.2.1 Habitats & vegetation communities

Habitats are monitored to record changes in their extent and diversity (both biological and structural), which are the typical parameters of habitat 'quality' observed as the predictable ecological responses to a management regime, or indeed a non-intervention strategy. Monitoring of habitats and their component vegetation communities most simply involves continued repetition of the initial survey technique conducted to establish their baseline state. Common survey techniques can include timed 'walk-overs' with constituent species estimated usually to a DAFOR[20] cover-abundance scale, or the more structured approach to describing a habitat via randomised samples as 'quadrats'. As the latter is the technique used to survey vegetation for the National Vegetation Classification (NVC) it makes sense to use or customise this to provide for multiple possible outputs. The NVC prescribes a clear survey protocol including the recommended number of replicates, sizes of quadrat and the method of estimating species' abundance (DOMIN in this case) suitable for various habitats. Phase 1 Habitat Survey, and the CSM and HLS Farm Environment Plan condition assessment are all examples of whole or site-sampled walk-over surveys, with varying protocols and reporting systems.

The repeat sampling cycle would depend on the purpose of the monitoring, including consideration of how rapidly any habitat changes may occur; the duration of a specific management project and hence its funding; or the demands of any parallel monitoring, for example an associated species recovery or reintroduction scheme. Sampling options include 'fixing' the quadrats or walk-over route for the duration of the project or randomising the sampling on each visit. If the project is of fixed duration it is particularly important to envision its objectives as a set of desirable outcomes. These will then decide the achievement of its success, whether this be its formal condition status or the recovery of a simpler perception of an optimum state. A fairly high degree of botanical skill is required for these survey techniques, which can also (especially the NVC-style quadrat approach) be very labour-intensive.

There is a further, relatively novel approach to monitoring habitat quality known as 'grid mapping' being developed by the Gloucestershire Wildlife Trust, with direct consideration of the typical resource constraints and evidence needs of bodies such as Wildlife Trusts. Grid mapping uses carefully chosen indicator attributes to monitor management outcomes, through a deliberately simplified auditing and evaluation protocol so those with limited identification skills can be swiftly trained to participate. Using GIS tools (eg. QGIS) a site or habitat unit is divided into a grid system, aligned with that of the Ordnance Survey for ease of onward recording applications. Individual grid squares could typically be between 625-2500m^2 on a calcareous grassland or heathland site depending on its size. Sample-points are then randomly selected from each grid square and located using a GPS device, and recorded as quadrats for the occurrence of just the chosen indicator attribute(s). Quadrats are thus distributed across the grid evenly, ideally in multiples of 1m^2 or 4m^2 from each grid square. The attribute species should be relatively recognisable (ie. not micro-cryptic) and could also double as popularly valued 'flagships', but must indicate improving condition in terms of enhanced diversity as a response to management. Attributes can then be quantitatively expressed as 'heat maps' across the grid, to graphically interpret positive changes with ease. There is much going for this approach; it is adaptable, low-cost and seamlessly links to existing recording schemes. Grid mapping could very easily be adapted to structure the sampling for species monitoring purposes as well (see below). Both Kent and London Wildlife Trusts are intending to adopt grid mapping as routine.

As alluded above at 3.1 habitats may be monitored relatively simplistically using photography, both from aerial photographic interpretation as well as fixed point photography at ground level. Areal extent can usefully be estimated from aerial photographs, especially if this is combined with limited ground surveys to 'truth' the imagery to the habitat-types being monitored. A series of fixed point photographs can visually record impressions of change, but offer less easily interpreted area values unless distance markers feature within the images.

Defining the area, type and condition of habitats will become increasingly important to enable their evaluation as 'Biodiversity Units' for use in the Biodiversity (Net Gain) Metric. This would be a prerequisite to any application for management funding available as a potential "offset" project to compensate for unmitigatable biodiversity impacts elsewhere.

3.2.2 Species and species assemblages

Species population monitoring methods can be divided into two types by their related yet fundamentally varying approaches. These are chosen as appropriate to the practical constraints of the spatial limits of the study, but both are aiming to gauge the stability of a target species within a site or larger areal unit such as a Biodiversity Opportunity Area or county, or even at national, continental or global scales. The first aims to *census a complete* population but is only possible at relatively small scales and for less mobile species, although multiple populations

20. Dominant/Abundant/Frequent/Occasional/Rare. DOMIN uses a finer 10-point scale for more detailed interpretation.

may of course be aggregated. The second essentially *samples* the population to obtain a representative index of abundance. This is sometimes then used to extrapolate a total population estimate by multiplying an average abundance value by the extent of available habitat, but a more robust use is to monitor these for abundance *trends* over time from the cumulative data-set. The most efficient methods of observation, detection and/or capture will vary across species groups and with the monitoring approach to be taken.

Annual population counts must be conducted at an optimum time of year; plants linked to their flowering or fruiting stages, vertebrates *before* young appear in the population (in order to count potential breeding adults only) and so perhaps from late winter to early summer. Surveys during the breeding season are also likely to be necessary however, if evidence for success of this on the site(s) of interest is a related objective of the exercise. Invertebrate counts will inevitably be tied closely to their often limited adult life-stage emergence periods (although other stages can sometimes be more appropriate, for example eggs in the Brown hairstreak butterfly *Thecla betulae*). It is essential that repeat counts are conducted at broadly similar dates, times and weather conditions.

Population samples are commonly achieved by walking transects with incorporated stops or stages, plotted to cover any pre-observed variations within the habitats or across the site. One or more 'point-counts' can achieve similar ends, where sampling relies on a fixed duration which must be strictly observed. When terrain is obstructive to a walked transect (worse at night) or habitat/species disturbance is a particular issue, more easily accessed point-counts can be the preferred solution. Either individuals seen or heard, or an indication of activity is then counted, as for example the 'passes' of bats heard on a bat detector. These are the protocols used in many of the national surveillance monitoring schemes described in 2.5 and each has an idealised repetition cycle. An alternative, labour intensive and ultimately long-term approach to monitoring mobile species populations is by capture and tagging (ringing in the case of birds and bats), with the intention of subsequent recapture. Such 'mark-recapture' projects can deploy large numbers of traps over lengthy periods, with populations being estimated by the rates of recapture applied to statistical formulae.

3.2.3 Habitat connectivity

The alternative approaches available here have already been discussed (see 2.4), but to expand further on the concept of 'focal species'; these may also be viewed as 'indicators' to evidence positive changes in the ecological connectedness of a geographic area. Achieving confidence in this as a robust correlation is especially difficult, however. At least, the method by which it might be concluded unequivocally at the landscape scale is likely to be unrealistically demanding in terms of the resources required in both time and effort.

Consider the challenge of establishing certainty that a focal species is initially absent from an 'isolated' site prior to the re-connection interventions being put into effect. Although undoubtedly easier for some species over others, this would always take time and the ultimate problem is deciding when total absence can be safely concluded. The efficiency of field techniques to then monitor for successful colonisation attempts using the new connections must also be considered, and proving their use alone by target species could actually be considered as an adequate objective of the intervention. Beyond intensive observation (including the use of camera-traps) these techniques could also encompass indirect detection methods such as feeding debris, hair-collection tubes and footprint pads, as well as eDNA sampling.

An approach involving derivation of indices for habitat connectivity is emerging from work on butterflies using the UKBMS data-set and undertaken by the University of Reading, in partnership with Natural England[21]. In summary, this is based on a comparison of clusters of monitored populations for their demographic *synchronicity* across a landscape supporting a meta-population of a selected indicator species. The thesis is that synchronicity will be observed to break down at the point of functional habitat fragmentation in the landscape for that species (which may also provide a 'focal' function for other species of similar ecology in this respect). The work is in development, but notably acknowledges that a significant leap of faith is required to conclude that habitat and its relative connectedness can be assumed as the only relevant factor in this attempted correlation.

Perhaps capturing the enhancement of physical (theoretical) connectivity of the landscape (as opposed to proving functional connectivity) will have to suffice to monitor progress here in the immediate term of our Strategic Plan 2018-2023. This is however, an area where academic-partnered research could play an important role in our future strategy.

3.2.4 People engagement metrics

The monitoring of public engagement with wildlife and the natural environment deals with the social sciences and therefore requires social scientific methodology. The benefits of engaging with nature in terms of its positive impacts on human health are of course, related medical outcomes. If such outcomes lead indirectly to cost savings to the medical services sector, there is also a clear economic aspect. Educational benefits from learning about the natural environment can further promote responsible citizenship, again with positive outcomes for the economy.

21. Oliver T H. et al. (2017): *Synchrony in population counts predicts butterfly movement frequencies.* Ecological Entomology, 42 (3). 375-378

Quantifying the impacts of 'people & wildlife' programmes is addressed by Natural England's Monitor of Engagement with the Natural Environment to a national standard which reports annually[22]. MENE's purpose is to: "*Understand how people use, enjoy and are motivated to protect the natural environment; monitor changes in use of the natural environment over time, at a range of different spatial scales and for key groups within the population; inform on-the-ground initiatives to help them link more closely to people's needs; evaluate the impact and effectiveness of related policy and initiatives; and measure the impact of and inform policy relating to the natural environment.*" It reports into the UK Statistics Agency, and is contracted out to a market research consultancy.

MENE's methods consist of face-to-face home hosted interviews using a standard set of questions undertaken with a representative, randomised sample of the English adult population aged over 16. The majority of survey questions are fielded on a weekly basis while others are asked monthly or quarterly. MENE mainly focuses on time spent in the natural environment for leisure purposes, but also includes questions regarding other forms of engagement with the natural environment, such as viewing nature programmes on television and engagement in pro-environmental activities such as recycling.

Personal, real-time interviews and surveys conducted through correspondence are both techniques available to gauge public attitudes and opinions. Simple foot-fall or car counts may provide an indication of popularity, but the design of research-oriented questions to delve deeper into this area requires careful deliberation and experience in order to genuinely yield the information that is being sought. This principle can even apply to drafting simple post-event feedback forms. It is important to observe General Data Protection Regulation (GDPR) considerations when conducting public data based research projects.

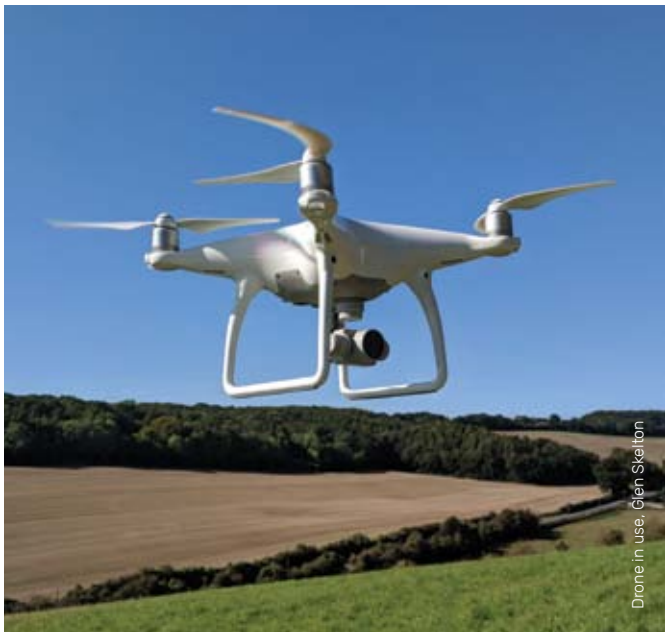
Finally, quantifying people's relative ability to access the natural environment can be achieved by applying Natural England's Access to Natural Greenspace Standard (ANGSt) to geographic areas of study. The results of this might then be usefully correlated with other standards of social deprivation.

3.2.5 New & emerging monitoring techniques

There are various recently-developed monitoring techniques that are gaining increasing attention. One involves innovations in the field of bio-acoustic recording, with prolonged capacity to operate devices in the field and to store and transmit their data remotely; enhanced microphone sensitivity, sound filtration and focusing qualities; and in-built recognition processing to enable instant species identification, albeit subject to further validation in some cases.

Another involves advances in aerial photography and remote sensing by satellite; especially using improved laser scanning technology enabling 3D interpretation of landscape relief attributes (LiDAR). At a local level, UAVs ('drones') offer the ability to aerially photograph habitats and sites more-or-less to order, and as frequently as required. The resolution of this imagery can be surprisingly precise, enabling various advanced habitat monitoring applications. On the ground, 360° photography is proving useful in habitat baselining and also in novel interpretative applications. Camera-trap technology is also advancing, with innovation in the ability to instantly transmit digital imagery. Remote-sensing using infra-red night vision and thermal imaging equipment can be used in behavioural autecological studies of nocturnal mammals.

A third area is in the increasing use of eDNA in species surveying, detection and identification. DNA sampling of individuals for genetic analysis can also be used to better understand the comparative relatedness of neighbouring species populations, which can further inform the theorised extent of former habitat connectivity.



Drone in use. Glen Skelton

22. See; Natural England (2018); Monitor of Engagement with the Natural Environment - Technical Report to the 2009-2018 surveys

Thundry Meadows, Jon Hawkins

4. Implementation plan

WHAT FOLLOWS IS AN ACTION PLAN TO MONITOR THE ACHIEVEMENT OF OUR IMMEDIATE OBJECTIVES AND TARGETS AS IDENTIFIED WITHIN THE STRATEGIC PLAN PERIOD 2018-2023. THIS MAY THEN ACT AS A TEMPLATE FOR FUTURE 5-YEAR PLAN PERIODS, PENDING FUTURE REVIEW.

The monitoring approaches recommended are in some cases quite prescriptive, while in others are presented more as a palate from which staff and partners can make decisions based on the review above and the applicability of the methodology to their situation. Where there are future research opportunities for both ourselves and partner organisations (particularly the academic sector) clearly emerging from this framework, these are explored in more depth in the next and final section.

The Lead Key Performance Indicators (KPI) for the Strategic Plan are presented below:

Biodiversity Lead KPI Strategic Plan 2018-2023	
Bio.01	SSSI units in favourable condition in prioritised Biodiversity Opportunity Areas: an additional 25% by area (over April 2018 position) by FYE 2022-23
Bio.02	In prioritised Biodiversity Opportunity Areas, 50% of SNCI protected by local planning policy; an additional 50% (over April 2018 position) in positive management by FYE 2022-23
Bio.03	Priority habitat creation &/or restoration targets met for prioritised Biodiversity Opportunity Areas by FYE 2022-23
Bio.04	Selected priority species stability/recovery achieved in prioritised Biodiversity Opportunity Areas by FYE 2022-23
Bio.05	Habitat connectivity significantly enhanced (at least 5% over current) in prioritised Biodiversity Opportunity Areas by FYE 2022-23
People Engagement Lead KPI Strategic Plan 2018-2023	
PE.01	**Formal and Informal Education:** 25% increase in the number of people who experience & engage with wildlife through formal and informal outdoor learning by FYE 2022-23
PE.02	**Communication:** 75% increase in awareness of SWT amongst the general public by FYE 2022-23
PE.03	**Membership:** Increase membership volume by 10% by FYE 2022-23
PE.04	**Volunteering:** Increase by at least 5% of volunteers who take effective action for SWT & Surrey's wildlife by FYE 2022-23
PE.05	**Fundraising:** Achieves funding of BOA project targets devised in year 1.

KPI Bio.01: SSSI favourable condition status

The formal, final arbiter for the achievement of favourable condition on Sites of Special Scientific Interest (SSSI) is Natural England, using the Common Standards Monitoring system (see 2.3). Keeping to their recommended six-year repeat cycle has become increasingly challenging for NE, and it is likely that parts of this programme could be out-sourced in the future. This may become an opportunity to influence the evaluation procedure; however the prescribed monitoring methodology is unlikely to be changed in the short to medium term to preserve consistency within the reporting programme. The baseline position on SSSI condition within the prioritised BOAs (at April 2018) is accessible on-line[23] and as summarised in **Table 1** in the Appendix. The condition of SSSI units is assessed as; Favourable ('maintained' or 'recovered'); Unfavourable recovering/unchanged/declining; Partially or (entirely) Destroyed. Since the launch of the current Strategic Plan an additional 5.5% area of SSSI within the collective Thames Basin Heaths BOAs is now in favourable condition.

CSM for open grassland and heathland habitats is typically conducted using a structured walk-over approach, which incorporates frequent stops along a W-shaped transect (recorded on-the-ground using a GPS device); traversing the whole SSSI unit or several divided sub-units. At each stop the vegetation comprising the habitat is assessed as c.4m^2 sampling plots for both its *composition* (using an adapted DAFOR scale) and *structure*. Overall habitat *extent* is better assessed using aerial photography and/or maps combined with the transect data as ground verification. Results are aggregated and compared against a set of standardised targets specific to that habitat for the site, summarised in the published guidance for undertaking CSM[24]; with the bench-mark aim of at least maintaining the site's character as it was when originally selected and described at statutory notification under the *Wildlife & Countryside Act* 1981. If generic habitat enhancement targets were set as management objectives at some earlier stage, achievement of these would also influence the condition assessment. Some comparison of results with respective NVC communities is required, as these often formed the basis of SSSI selection.

When assessing woodland habitats[25] there is more attention on their structural attributes, as well as evidence of potential regeneration and other natural processes. Assessment can take longer as visual appreciation of homogeneity is more restricted, but then again composition will be less complex overall, thus requiring fewer stops and larger plots. CSM for wetland habitats[26] (including valley mires/fens) must consider their level of hydrological complexity and the typical presence of intimately-related transitional mosaics. Constraints on access will often be an issue here and may necessitate a more pragmatic, reductive approach. Botanical skill levels must also accommodate the possibility of substantial lower plant (bryo/charophyte) interest.

There is of course also guidance for assessing the condition of the notified species interest on SSSI. In many cases this is achieved by simply establishing maintained presence on the site, as evidence of the habitat's continued ability to support the species. In others, the size of the population and its regenerative capability requires estimation in order to gauge the long-term viability of the species. Often, the condition of preferred habitat is also assessed and used in combination with the direct species population attributes. A three-year repeat cycle is typical for species condition monitoring.

As all the SSSI within our prioritised BOAs were previously assessed between 2008 and 2019, the walk-over routes and methodology then deployed by NE will have been previously fixed. In most if not all cases, the condition assessment for SSSI is designed and undertaken coincidentally with that for monitoring 'favourable conservation status' of the qualifying habitat and species interest of those sites also selected as Special Areas of Conservation (SAC) and Special Protection Areas (SPA).

ACTION SUMMARY

- Co-ordinate future CSM programme with Natural England and partner site managers, on all SSSI within prioritised BOAs.
- Consult on opportunities to influence future review of CSM.

KPI Bio.02: Sites of Nature Conservation Importance

Sites of Nature Conservation Importance (SNCI - Surrey's Local Wildlife Sites) are selected for their habitat and/or species interest features using a standard set of criteria[27]. Following their formal

23. See; magic.defra.gov.uk/MagicMap.aspx
24. See; JNCC (2004): Common Standards Monitoring Introduction to the Guidance Manual (Issued February 2004)
25. See; JNCC (2004): Common Standards Monitoring Guidance for Woodland Habitats (Version February 2004)
26. See; JNCC (2004): Common Standards Monitoring Guidance for Lowland Wetlands Habitats (Version August 2004)
27. See; Guidance for Selection of Sites of Nature Conservation Importance (SNCIs) in Surrey (Surrey Wildlife Trust 2008)
28. See; Policies and Procedures for the Identification & Selection of Sites of Nature Conservation Importance in Surrey & Surrey Local Sites Partnership - Terms of Reference (Surrey Nature Partnership 2019)

selection SNCI are recommended for adoption by their relevant Local Planning Authorities to receive the protection afforded them through planning policy[28]. Completion of this process would then define their 'protection' for the purposes of this KPI.

If a system of management is in place to conserve the qualifying interest, the site is declared to be 'in positive management' and reported as such to Defra annually by Surrey County Council (SCC) for the national compilation of Single Data List Indicator 160-00. The baseline position here at April 2018 is summarised in Table 2 in the Appendix. Surrey's data is compiled and analysed for SCC by the Surrey Biodiversity Information Centre, and this partnership would be the ultimate arbiter of the KPI.

The Trust's involvement in the management of a SNCI is by default usually interpreted as sufficient evidence for its positive management status. Positive management of SNCI beyond the Trust's estate can be variously encouraged through a proactive advocacy programme. This approach has recently been in process within the prioritised North Downs BOAs (ND02-03). Positive management guidance may be offered directly by the Trust, as well as the facilitation of connections to further sources of guidance or resources for habitat and species survey, alongside potential funding mechanisms for management. Whilst the current agri-environment scheme is one possible example of this, emerging future mechanisms could include both the proposed Basic Farm Payment replacement programme (to a 'payment by results' scheme - provisionally the Environmental Land Management (ELM) Scheme), as well as opportunities presented as Biodiversity Net Gain projects.

Monitoring the condition of SNCI (when undertaken by the Trust's Ecology Services at least) has traditionally followed a standardised survey procedure, involving a site walk-over and assessment for evidence of the maintenance of the qualifying interest feature(s). Other specialist recorders within Surrey's biological recording community can supply expertise for assessment of their respective interest groups when called upon to do so. This system is sufficiently reliable for the purpose of monitoring KPI Bio.02 although improvements in standardisation to ensure the method's repeatability, and the comparability of effort in successive surveys, might be considered in the future. On Trust-managed SNCI, a grid mapping approach to monitoring as recommended in 3.2.1 above, could also be considered (see 'case-example' in Box below).

Monitoring Lowland Meadow Restoration at Wallis Wood

Wallis Wood is a small Trust-owned SNCI nature reserve in the far south of Surrey. Funding has recently been awarded to restore and monitor both the ancient woodland and traditional meadow habitats present on the site as a Biodiversity Offset project. The offset commitment is for the meadows to attain the botanical character of the priority S.41 habitat Lowland meadow, to a 'medium' condition standard over a 5-year period. The required species diversity, sward cover and relative frequency of key indicator species are as described in the Farm Environment Plan Manual Third Edition 2010[8] (Key 2b, Table 4 G06). Only if considered as a single unit would the three meadows (Long Field, Six Acre Field and Green Wood Field) barely qualify as priority Lowland meadows in poor condition. Therefore, the restoration objective should be for **each individual meadow to safely attain moderate condition status**. The monitoring methodology proposed is as follows:

The meadows will together be sub-divided into a grid comprised of 625m^2 (25x25m) units (n = $\pm$40). One randomly selected unit from each field will be fenced as an exclosure to provide a control function (to be removed pending success of the project). A single 4m^2 quadrat will be randomly selected from every unit and monitored annually, prior to any proposed hay-cut (ie. in early-mid June).

Botanical monitoring will then track success in the attainment of the 'frequent' presence (ie. to become constant in all non-exclosed quadrats) of the following key indicator species; Greater bird's-foot-trefoil *Lotus pedunculatus*, Black knapweed *Centaurea nigra* and Glaucous sedge *Carex flacca*. To occur at least occasionally (in $\geq$50% of non-exclosed quadrats) will be Water mint *Mentha aquatica*, Marsh bedstraw *Galium palustre* and Bugle *Ajuga reptans*. Lastly, Yellow-rattle *Rhinanthus minor*, Meadow vetchling *Lathyrus pratensis*, Lady's bedstraw *Galium verum* and Betony *Stachys officinalis* will all have been successfully re-introduced using a local seeding source (these species to show an increasing occurrence across non-exclosed quadrats by the end of year 5). Certain adjustments could be made to this to analyse comparability in progress between fields.

Here, a relatively simple approach recording presence/absence of a minimal number of easily recognised indicator plant species will allow for efficient monitoring, potentially by non-specialist volunteers.

ACTION SUMMARY

- SWT Planning Services to maintain engagement with LPA strategic planning process, in coordination with Surrey Local Sites Partnership (SLSP).
- North Downs BOA SNCI (advocacy) Project to continue, with model to be extended to Thames Basin Heaths BOA in time.
- SNCI re-survey programme reviewed in partnership with SLSP.
- SWT Planning Services to lobby its client LPAs to fund recommended 10-yr SNCI re-survey programme.

KPI Bio.03: Priority habitat creation & restoration

Our Priority habitat creation and/or restoration targets for the prioritised BOAs are summarised in the Table on page 24.

Although defining habitat creation versus restoration depends strictly on the original state of the project site, this subtlety is less important to our KPI than the essential principle of a project comprising a genuine addition to the total baseline area for that Priority habitat within Surrey. Fixing such a baseline is a surprisingly difficult exercise, due to the legacy of multiple habitat classification systems in use at various times (see 2.2). However, this need not be of immediate concern if restoration and creation projects completed post-April 2018 are accounted separably until such time as the protocol for an eventual consolidation of the data-base becomes clearer.

The Surrey Habitat Framework (SHF) is close to completion and for better or worse, ought to offer a definitive quantification of the extent of Priority habitats across Surrey. Not only this, but the project was actually designed to be a central capture hub for all future changes to this GIS data-base. As soon as the SHF becomes available it should then be put into effect; the consolidation exercise undertaken as described above, and our progress monitored (under any necessary licence agreement) with this KPI going forward.

Through which mechanisms of land management reform will this KPI's targets eventually be met?
It is likely there will be minimal opportunity for habitat creation projects, in their truest sense, on Trust-managed land now and into the future. Most gains towards this KPI will come from us realising opportunities for restoration of *degraded* habitats. These might for example include reversion of exotic plantations back to entirely deciduous native woodlands, as well as the restorative management of neglected or mismanaged semi-improved grasslands and heathland inherited from partner agencies. Habitat creation, including from arable or sown ley-pastures to species-rich grassland or fen meadow, or even native woodland (for example as Beech & Yew stands, mixed deciduous or wet woodland), will most likely be envisioned by private land-owners or their tenants seeking an opportune, substantive change-of-use in response to specialised incentives. As above, these would include the incoming ELM Scheme, or as suppliers of Biodiversity Net Gain compensation projects. On-farm hedgerow planting, field margins and pond creation will remain as important opportunities, and will continue to be encouraged through existing and future agri-environment schemes. In certain situations, such as in the Holmesdale BOA (WG11), restoration of post-minerals extraction sites will continue to provide opportunities for wetland, woodland or even heathland creation. These mechanisms and others are discussed together with case-studies in the document *BOAs: the basis for realising Surrey's local ecological network*[1]. If the Trust is to be the preferred go-to adviser, and possibly also the delivery agency for such opportunities as they arise within the prioritised BOAs, we will need to take full and careful consideration of our current capacities and position ourselves accordingly. Operational capacity and resource issues become all the more relevant as typically unforeseen opportunities arise and accumulate, demanding a rapid response else they are then lost.

Methods for monitoring the progression and success of these creation or restoration projects in terms of their contribution to the recovery of Surrey's biodiversity could be similar to many of those previously reviewed. The principles in 3.1 dictate a simple (but not simplistic), meaningful and target-led approach to monitoring that could be undertaken by keen yet relatively unskilled volunteers under minimal direction. Grid mapping may then become the preferred method; with the preparatory GIS/GPS work undertaken by the Trust, who would also provide the necessary training to enable a subsequent do-it-yourself programme operated by the actual land-owner or manager, or by Citizen Science volunteers under the Trust's direction.

Priority habitat restoration &/or creation targets 2018-2023			
	TBH01-04, 06	**ND02-03**	**WG11**
Heathland & Acid grassland	**60.1** ha	**5** ha (SWT land: 33%)	**4.62** ha
Wet woodland	**4.1** ha		**0.12** ha
Fen	**7.15** ha		
Calcareous grassland		**23.75** ha	
Beech & Yew woodland		**4** ha	
Mixed deciduous woodland (restoration)		**35**% by area (SWT land: 33%)	
Hedgerows		**4.75** km	**1** km
Standing open water			**0.9** ha
Floodplain grazing-marsh			**6.75** ha
Reedbeds			**1.4** ha

ACTION SUMMARY

- Address SBIC resource-gap and complete Surrey Habitat Framework project.
- Review and devise an idealised system for capture, management and universal access to all future monitoring data.
- Continue to develop stand-alone data management platforms for Citizen Science applications (eg. Cartographer); inaugurate local 'Ecology Groups' to deliver Citizen Science biological monitoring projects nested within various geographic contexts.
- Review all opportunity across SWT estate for priority habitat restoration/creation.
- Develop Natural Capital asset map across prioritised BOAs, to capture all priority habitat potential restoration/creation projects.
- Review capacity and market SWT as preferred adviser/deliverer of potential projects (including as 'honest broker' for realising Biodiversity Net Gain projects).

KPI Bio.04: Priority species recovery

Each of the prioritised Biodiversity Opportunity Areas has a selection of priority (S.41) species that can be monitored using the existing schemes and methods described above in 2.5 and 3.2.2. For several of these, further survey work remains outstanding to obtain a more robust estimation of the local population and thus the baseline from which to gauge stability or recovery. The species are summarised in the Table across and a 'case-example' for monitoring Chamomile is provided in the Box on page 26.

Further species can and should be monitored as desirable indicators of the success of KPI Bio.03's priority habitat creation and restoration projects, especially if grid mapping emerges as the preferred approach to monitoring them. Grid mapping may eventually be considered appropriate for monitoring condition of the habitat interest on SNCI, while their species interest features would be monitored using the reviewed schemes and methods for these.

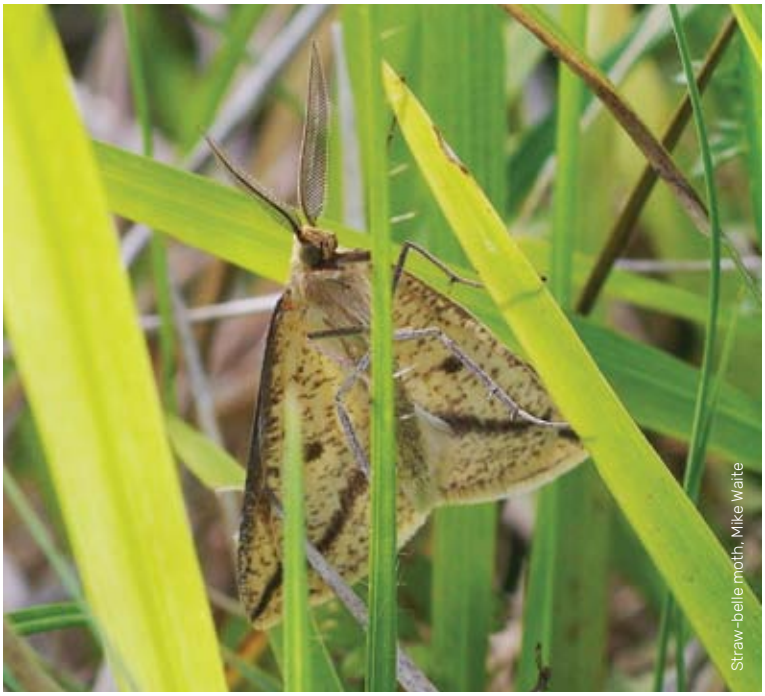
Appearing in the Appendix as **Table 3** is a short-list of species present within the prioritised BOAs (including the selected S.41 priorities where relevant) that should now be considered as *critically endangered* within Surrey, for which the county has a national responsibility and as such, urgent conservation measures are required in the shortest term if we are to avert their local extinction. The majority of these populations are the last remaining in the county (as presently known) and in many cases are now reduced to less than a hundred individuals.

Priority species for monitoring recovery in Strategic Plan 2018-2023			
	plants	**invertebrates**	**vertebrates**
TBH01-02	Deptford pink* Marsh clubmoss	Window-winged caddis Shoulder-striped clover moth	Nightjar, Woodlark Smooth snake, Sand lizard
TBH03	Chamomile Marsh clubmoss	Heath tiger-beetle	Nightjar, Woodlark Smooth snake
TBH04	Chamomile, Marsh clubmoss Pillwort*, Veilwort†	Heath tiger-beetle Window-winged caddis	Nightjar, Woodlark Smooth snake, Sand lizard
TBH06	Annual knawel† Pillwort*	Heath tiger-beetle*	Nightjar, Woodlark Sand lizard
ND02	Broad-leaved cudweed, Juniper Narrow-leaved helleborine Frog orchid, Man orchid	Small blue butterfly Straw-belle moth†	Common dormouse
ND03	Basil-thyme*, Ground-pine Man orchid, Musk orchid Starfruit*, Slender bedstraw	Small blue butterfly Straw-belle moth	
WG11			Grey partridge*, Lapwing Great crested newt, Brown hare* Water vole*

†possibly extinct (*reintroduction to be considered)

ACTION SUMMARY

- Maintain any existing monitoring programmes for selected extant priority species; devise programmes for those lacking.
- Consider and develop appropriate[29] re-introduction projects for locally extinct species.
- Develop concept of habitat condition 'indicator species' in parallel with grid mapping monitoring.
- Develop 'Pan-species list'[30] for Surrey Wildlife Trust estate.
- Urgently review conservation strategy for Surrey's critically endangered species listed in Appendix Table 3.



Straw-belle moth, Mike Waite

29. See; UCN/SSC (2013): Guidelines for Reintroductions and Other Conservation Translocations, v.1 (IUCN Species Survival Commission)
30. See; brc.ac.uk/psl/about

Monitoring Chamomile on the Thames Basin Heaths


Chamomile, Mike Waite

Although it has declined substantially, Chamomile *Chamaemelum nobile* remains widespread though highly localised in Surrey. It was a familiar, culturally-valued medicinal herb occurring on heathy commons and village greens, requiring a winter-wet acid grassland sward kept short by mowing, close grazing or trampling. Today it survives best on poorly-drained community sports fields, but has become increasingly rare on heathland. The rapid national decline driving its priority S.41 status bestows responsibility for conservation in remaining strongholds such as Surrey. There are c.8 extant populations of varying sizes across TBH03-04 (none remaining in TBH01-02 or 06). One of the largest is on Pirbright Green, for which it is an important SNCI selection feature. A monitoring approach across our prioritised BOAs is proposed as follows:

(i). **Monitoring of range:** All extant populations would be checked annually by volunteer botanists for any interim accidental destructive events (such as fire). (ii). **Monitoring of abundance:** As Chamomile typically occurs in dense, near-monospecific colonies, in year one a baseline population index could be obtained by measuring the area occupied by the plant in square metres at its peak flowering/fruiting stage, across all populations; which would then be aggregated to provide a total. A fixed photographic record could also be made. This areal index calculation would be repeated every 3 years. It may be feasible to more rapidly achieve this using an UAV-borne camera, as the limits of Chamomile colonies would be clearly delineable from a relatively low height. (iii) **Recovery strategy:** If feasible to do so, populations appearing to have been lost within approximately two decades could be managed and monitored specifically to re-establish the plant. Any re-established populations would then be absorbed into the above monitoring programme.

KPI Bio.5: Priority habitat connectivity

The Trust's habitat connectivity model under development will output a series of 'relative ecological connectedness' maps for the prioritised Biodiversity Opportunity Areas. Management interventions undertaken to improve priority habitat condition (KPI Bio.01) as well as restoration and creation projects as pursued under KPI Bio.03, will be captured and used in future iterations of the model to demonstrate enhancement of connectivity (essentially as reparation of fragmentation). The model's fundamental approach will remain consistent, but further outputs and applications may become possible with the introduction of higher resolution habitat data in time.

ACTION SUMMARY

- Complete and continue to refine connectivity model; communicate its findings and application possibilities widely.
- Use model to prioritise opportunity realisation for KPI Bio.3.

People Engagement KPI (PE.01-05)

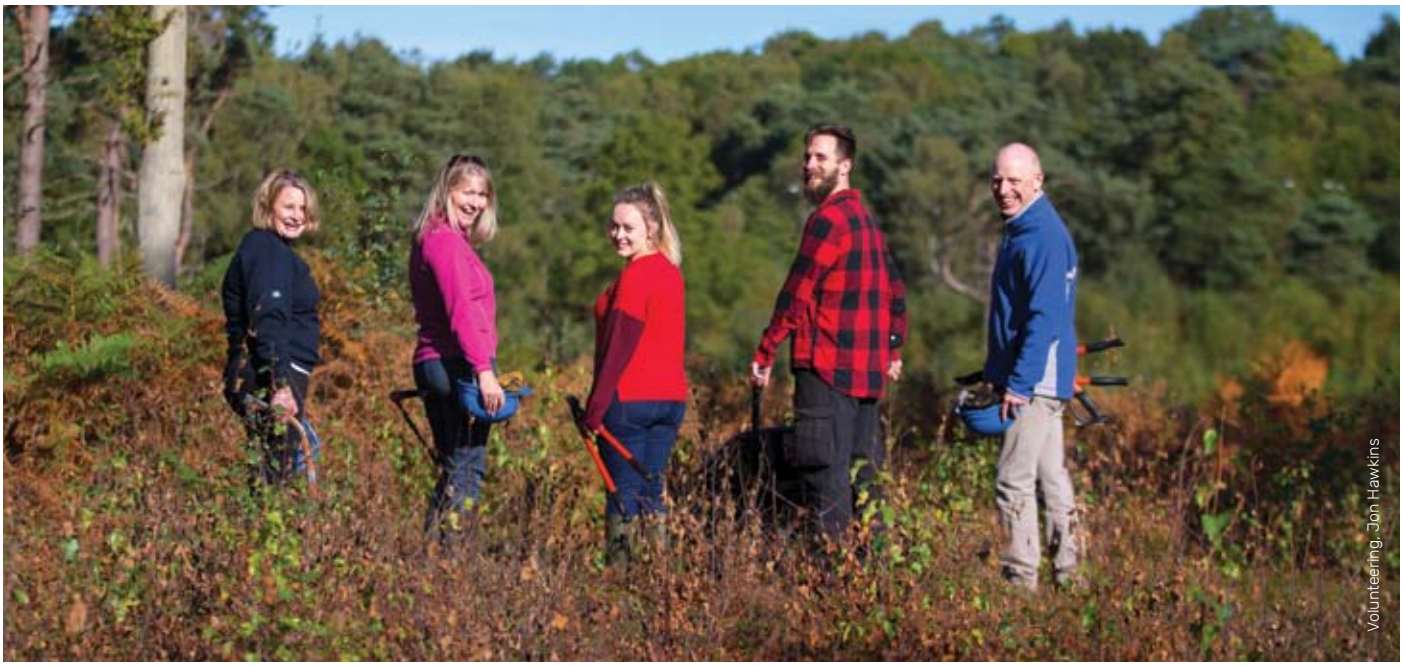
Formal and Informal Education PE.01: This KPI target (a 25% increase in engagement footfall via our formal and informal outdoor learning programme) is relatively easily monitored from bookings processed and attendance records; but it will only be achieved through improved marketing and expansion of our capacity to supply these educational services.

Communication PE.02: This KPI target (a 75% uplift in public awareness of the Trust's existence and mission) would be monitored through a public survey or poll approach, and will probably need to be out-sourced to a specialist supplier. The most straightforward method might be a simple 'before & after' survey or poll, at both ends of an intervening and well-researched marketing campaign. A key message to be communicated through this is the Trust's fundamental status as a charity and environmental NGO, embedded historically within the Voluntary Sector and not a public open spaces management service provided indirectly through Council Tax. This should be assisted considerably by using the communications opportunity presented through our 60th Anniversary celebrations in 2019-20. The national MENE programme could be used to inform the methodology used for this KPI, but a direct 'cut' of its data pertinent to Surrey would not be appropriate as a direct interpolation, however.

Membership PE.03: Membership statistics are in continuous flux, as annual renewal dates vary across the year. However, our membership staff is able to monitor the achievement of the target for this KPI via the membership data-base. Its achievement will clearly be linked to PE.02 as well as PE.04, and will demand some fresh and innovative thinking on methods of member recruitment. Our offer in terms of membership benefits, for example through providing significant financial discounts on other of our services and products, may need to be reviewed and developed further.

Volunteering PE.04: The achievement of this KPI target is again relatively straightforward to monitor via the registration and attendance of volunteers at relevant events (as required for the application of health and safety liability cover). Achievement will be closely linked to the success of PE.02 and PE.03, and indirectly PE.01 also. The opportunities for involvement in volunteer-directed activities will be significantly boosted by the expansion of our Citizen Science biodiversity monitoring programme, as implied through the strategy recommended for achieving Biodiversity Lead KPI Bio.03 and Bio.04 (see above).

Fundraising PE.05: This KPI will be monitored in terms of income raised through our external fund-raising efforts, accountable through our Finance department. Its achievement is clearly a specialised area, requiring astute awareness of a continually-changing field of opportunity and will not be covered further for the purpose of this document.



Volunteering, Jon Hawkins

5. Future research opportunities

THE MONITORING FRAMEWORK AND IMPLEMENTATION PROGRAMME OUTLINED ABOVE PROVIDES PLENTY OF OPPORTUNITY FOR WOULD-BE RESEARCHERS LOOKING FOR USEFUL, APPLIED PROJECTS THAT WOULD ULTIMATELY HELP INFORM THE TRUST'S STRATEGY AND ACTIVITIES GOING FORWARDS.

Our partners here are likely to strongly feature Surrey's academic sector, including the University of Surrey and Royal Holloway (University of London) and Imperial Colleges, partly driven by their Research Excellence Framework[31] obligations. Some of these research possibilities are discussed below. These will form the basis of a separate SWT **Research Prospectus**, to be developed and solicited to co-research partners in the future.

5.1 Biodiversity-related research

(i). Many assumptions have to be made concerning the basic habitat type and its quality (condition) when base-lining wildlife habitat data-sets. This is primarily due to a lack of resources available for ground survey, and hence the reliance on aerial photography for example. A study, or several related studies, could research the strength of reliability of this approach; perhaps by sampling from several sections of the prioritised BOAs to test accuracy in the first instance, but also for any variance in this between habitat types, or in different parts of the county.

(ii). Related to (i), the Trust wants to develop the potential for using UAV 'Drone' technology for flexible, accurate aerial photography to enable more precise interpretation of digital habitat cartography. This will have obvious monitoring applications. A research approach could investigate these possibilities.

(iii). A further area reliant on intuitive yet still largely subjective assumptions is the use of focal species to gauge effectiveness of management interventions aimed at enhancing habitat connectivity. Although much research already exists, further work on the autecology and behavioural responses of these species will therefore always be welcome, especially if this is conducted within direct context of the management activity under scrutiny. As a possible proxy value for how isolated populations of these species actually are within a fragmented landscape, their degree of interrelatedness may be researched by genetic profiling (see 3.2.5). Radio-telemetry of tagged individuals is also possible to research their dispersal movements.

(iv). It will be highly desirable to monitor, as a structured research project, the short and long-term ecological changes in our woodland reserves as a result of Ash Dieback. Comparisons of the responses in both vegetation communities and of potential replacement keystone species, within and beyond the affected areas, and within/beyond our public access safety management zones; will all be worthwhile. Such research will also need to be vigilant of any evidence of disease-resistance in individual Ash trees.

(v). The monitoring of habitat mitigation and compensation projects required of several major development and infrastructure schemes currently planned for Surrey is primarily the responsibility of their various promoting agencies. However, where these relate to impacts on sites within the Trust estate we will at least have an advisory role in dictating their scope and possibly also their execution. Relatedly, there is a strong possibility that at least one green 'wildlife' bridge will be designed and constructed to re-connect Ockham to Wisley Commons over the

31. See; ref.ac.uk

widened A3 trunk road. There will be various research opportunities in consequence of this, as there are very few such bridges presently within the UK and it will be important to robustly observe and report widely on its effectiveness.

(vi). The interdependence of healthy ecosystem function and maximised biodiversity is often assumed as a given but remains relatively poorly evidenced. In this assumption biodiversity serves largely as a proxy for bio-abundance, this being the more likely critical factor. A useful research question could therefore attempt to explore and provide evidence for this suggested correlation of bio-diversity and bio-abundance.

(vii). Research into the effectiveness and multiple benefits of species re-introductions (and see [xi], below).

5.2 Engagement-related research

(viii). A specific piece of research may involve an attitudinal survey of owners of Sites of Nature Conservation Importance. This would seek to ascertain their knowledge of the designation and its conservation role, the ecological interest of their particular sites, as well as their emotive feelings towards stewardship as owners. This could lead on to identification of local ambassadors or champions for the designation.

(ix). Very useful research could be conducted into local consumers' 'propensity-to-pay' for certain cultural ecosystem services associated with their relative access to nature. Related to this, further bespoke ('Surrey-centric') research into the health and well-being benefits of nature engagement would also be desirable. This work would logically be partnered with the Surrey Nature Partnership and the professional health sector.

(x). Related to the previous, there is always scope for more research into wider 'Green economics' and our ongoing valuation of Natural Capital. The contribution to the wider economy of expanding markets for sustainability-related goods and services, including within education, needs continual review and ever-greater societal appreciation.

(xi). Further research could be conducted to compare both public and private land-owners' attitudes towards the notion of 'rewilding' schemes and associated flagship species re-introductions within the Surrey context.

(xii). It may be considered useful research to tease-apart the conflated yet often confused drivers underlying wildlife conservation motives: sentimentalised anthropomorphism versus a more highbrow, ethical environmental issue? This might be partnered with, for example, the animal welfare hospital Wildlife Aid. Learning applications from this might seek to standardise and thus improve use of data arising from rescue centres, and influence the reduction of some potentially problematic practices. These would include rehabilitated releases into inappropriate sites and translocations over large distances, with their potential for disease transmission. Better understanding of public motives may in turn help the Trust in its marketing strategy.


Shining pot-beetle, Mike Waite

6. References & further reading

[Additional to footnotes.]

Living Landscapes Strategy (Surrey Wildlife Trust 2014)

Naturally Informed: Surrey Wildlife Trust Research Strategy 2018-2023

Recovering Surrey's Nature: Surrey Wildlife Trust Strategic Plan 2018-2023

States of Nature 2016, 2019 (State of Nature Partnership)

A Green Future: Our 25 Year Plan to Improve the Environment (Defra 2018)

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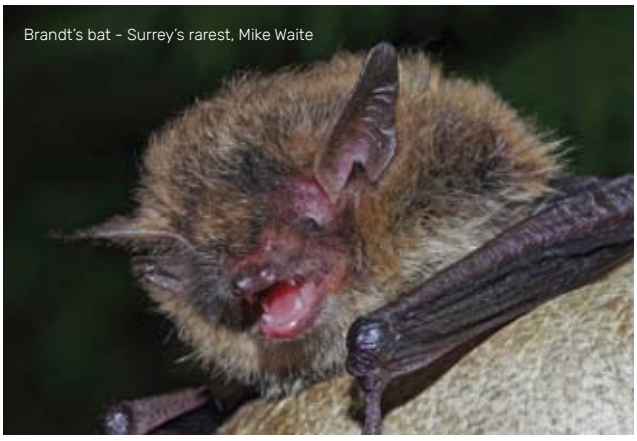
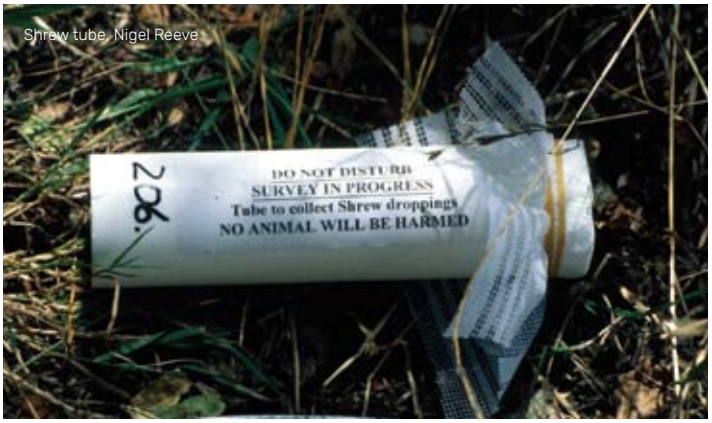


Brandt's bat - Surrey's rarest, Mike Waite



Shrew tube, Nigel Reeve

Appendix.

Table 1: SSSI Condition Status at April 2018

BOA	SSSI (& SWT) site name		unit #	unit ID	SSSI unit name	area (ha)	owner	manager	condition	last assessed
ND02	**Hackhurst & White Downs**		001	1014340	Colekitchen Farm	4.1737	SCC	tenant	UR	2013
		Hackhurst Downs	002	1014350	Hackhurst Down (LNR)	26.6395	SCC	SWT	UR	2013
		Wootton Estate	003	1014351	Blatchford Down & Old Simms (NT)	29.4062	Wootton/NT	SWT/NT	F	2014
		Wootton Estate	004	1014342	Old Simm's Copse	16.1872	Wootton E.	SWT	F	2013
		Wootton Estate	005	1014343	Pickett's Hole	40.8396	Wootton E.	SWT	F	2014
			006	1014344	Forestry Authority	2.6948	FC	?	F	2013
			007	1014341	National Trust	27.6322	NT	NT	F	2013
			008	1014345	National Trust	13.1165	NT	NT	F	2013
		Wootton Estate	009	1022937	White Downs (W)	12.2125	Wootton E.	SWT	F	2015
		Wootton Estate	010	1022938	White Downs (E)	12.2334	Wootton E.	SWT	UR	2013
	Ranmore Common		001	1008382	001	15.1855	Denbies Vineyard		UR	2017
			002	1008383	002	26.4218	NT/private		F	2011
			003	1008384	003	182.6639	NT	NT	F	2011
	Sheepleas		001	1019517	Mountain Wood (GCR)	0.3112	FC	FC	F	2008
		Sheepleas	008	1028741	Sheepleas Grassland	9.5432	SCC	SWT	F	2010
		Sheepleas	009	1028740	Sheepleas Woodland	90.0399	SCC	SWT	UR	2010
	Combe Bottom	Shere Woodlands	001	1008400	Netley Plantation	10.3465	SCC	SWT	F	2010
		Shere Woodlands	005	1028795	Combe Bottom	9.7622	SCC	SWT	F	2010
		Shere Woodlands	006	1028796	West Hanger	21.7201	SCC	SWT	F	2010
		Shere Woodlands	007	1028755	Juniper Hill	0.2329	SCC	SWT	UR	2010
	Colyer's Hanger	Colyer's Hanger	001	1008391	Colyers Hanger	10.0046	Albury E.	SWT	F	2011
			002	1022690	Lidwell Copse	4.2626	Albury E.		F	2011
			003	1022691	Alder Wood	3.6169	Albury E.		F	2011
		St Martha's	004	1022693	St Martha's Hill	4.3501	Albury E.	SWT	UR	2011
		St Martha's	005	1022692	St Martha's Hill	4.4129	Albury E.	SWT	UR	2011
	Mole Gap to Reigate Escarpment		001	1008852	Chapel Wood	7.5513	NT	NT	F	2014
		Norbury Park	002	1008879	Norbury Park (S)	77.4188	SCC	SWT	F	2009
		Norbury Park	003	1017064	Updown Wood	38.96	SCC	SWT	UR	2008
		Norbury Park	004	1017063	Fetcham Downs	43.2492	SCC	SWT	F	2009
R05		Norbury Park	029	1017065	Mole Gap	1.9467	SCC	SWT	F	2015
		Norbury Park	031	1019324	Mole Gap & The Whites	0.1138	SCC	SWT	F	2015
ND03	**Mole Gap to Reigate Escarpment**		005	1008881	Juniperhill Wood	19.5525	NT	NT	F	2014
			006	1008883	Mickleham Downs	14.6437	NT	NT	UR	2008
			007	1008882	Mickleham Downs/White Hill	43.4386	NT	NT	UR	2008

		008	1008885	Headley Warren	23.5841	private		UR	2008
		009	1025547	South of Burford Lodge	1.413			F	2008
		012	1019323	The Thorns (NT)	68.3345	NT	NT	F	2009
		013	1008922	Ashurst Rough	80.9181			F	2009
		014	1008923	Box Hill - South	32.6712	NT	NT	UR	2009
		015	1008927	Bellasis Estate	37.3133	private		F	2008
		016	1008949	Headley Heath	190.8028	NT	NT	UR	2009
	Betchworth Quarry	017	1008963	Brockham Hills	21.246	SWT	SWT	UR	2008
		018	1009004	Betchworth Hills & Chump	5.7887			F	2008
		022	1025323	Juniper Hill (NT)	7.3495	NT	NT	F	2007
		023	1008886	Colley Hill	39.9631	NT	NT	UR	2008
		024	1008928	Margery Wood	1.3867	NT	NT	F	2008
		025	1008870	Reigate Hill - NT	20.0165	NT	NT	UR	2008
		026	1008873	Reigate Hill R&BBC	8.4307	R&BBC	R&BBC	UR	2008
		027	1008874	Gatton Park/Nut Woods - NT	41.1037	NT	NT	F	2009
		028	1025299	Charley Mount	3.5315			F	2009
		030	1025536	Juniper Hill	5.7978	NT	NT	F	2009
	Fraser Down	032	1021011	White's Wood	13.9209	part-SWT	part-SWT	F	2009
	Fraser Down	033	1021012	Frazer Heath	8.502	SWT	SWT	UR	2009
		034	1023368	Betchworth Hills	2.7504			F	2008
	Dawcombe	035	1025519	Dawcombe Wood	10.5264	SWT	SWT	F	2008
	Dawcombe	036	1023381	Dawcombe	8.0461	SWT	SWT	UR	2008
	Dawcombe	037	1025300	Buckland Hills	5.1339	private/SWT		U (NC)	2009
	Brockham Limeworks	038	1025549	Brockham Quarry	14.4374	SCC	SWT	F	2009
	Brockham Limeworks	039	1025548	Dukes Plantation	24.4319	SCC	SWT	UR	2008
	Dawcombe	040	1025999	Buckland Hills	28.4436	part-SWT	part-SWT	F	2009
TBH01	**Chobham Common** (N) **& Wentworth Heaths**	001	1023787	Broomhall Heath	13.304	private		F	2013
	Chobham Common	002	1023688	North End	6.954	SCC	SWT	UR	2019*
	Chobham Common	003	1023695	Little Arm	29.1939	SCC	SWT	UR	2012
	Chobham Common	004	1023696	Ship Hill E	11.2726	SCC	SWT	F	2016
	Chobham Common	005	1023697	[2] Burma Road	8.1863	SCC	SWT	UR	2013
	Chobham Common	006	1023699	Long Arm	4.0826	SCC	SWT	F	2012
	Chobham Common	007	1023672	Ship Hill	25.8128	SCC	SWT	UR	2012
	Chobham Common	008	1023679	Roundabout Car-Park Area	17.3668	SCC	SWT	UR	2012
	Chobham Common	009	1023681	Oystershell Hill	52.1095	SCC	SWT	UR	2012
		010	1023689	[1] Burma Road	1.5524	private		UR	2019
		011	1023690	Sunningdale Golf Course	97.1792	private		F	2013
	Chobham Common	012	1023691	Brick Hill	12.9289	SCC	SWT	UR	2013
	Chobham Common	013	1023680	Rushy Pond (WO)	14.7864	SCC	SWT	UR	2019*
	Chobham Common	014	1023682	Rushy Pond E	9.9818	SCC	SWT	UR	2013

TBH02	**Chobham South Heaths**	Chobham Common	015	1023683	Chickabiddy Hill	35.5645	SCC	SWT	**UR**	2012
			016	1016958	Round Pond	5.8663	private		**F**	2019
		Chobham Common	017	1023684	Nr. Windsor Road	11.4419	SCC	SWT	**UR**	2013
		Chobham Common	018	1023685	[1] Albury Bottom	28.1725	SCC	SWT	**UR**	2013
		Chobham Common	019	1023686	[2] Albury Bottom	79.2511	SCC	SWT	**UR**	2012
		Chobham Common	020	1023701	Glover's Pond	3.8813	SCC	SWT	**F**	2013
		Chobham Common	021	1023698	Langshot Bog	54.6963	SCC	SWT	**UR**	2019*
		Chobham Common	022	1023687	[3] Albury Bottom	23.8428	SCC	SWT	**UR**	2012
		Chobham Common	023	1023692	Butts Hill	39.6	SCC	SWT	**UR**	2012
		Chobham Common	024	1023700	Gracious Pond	14.2045	SCC	SWT	**F**	2013
TBH03	**Colony Bog & Bagshot Heaths**		001	1023702	Lightwater Country Park	37.4665	SHBC		**F**	2017
			002	1023703	High Curly	5.3308	SHBC		**UR**	2014
			003	1023709	Lightwater Bog	2.9252	SHBC		**UD**	2014
		Pirbright Ranges	004	1023710	Folly Bog	25.952	MoD	SWT	**F**	2014
			005	1023711	Turf Hill	23.4696	SHBC		**UR**	2017
			006	1023712	Brentmoor Heath	61.7416	NRA		**F**	2017
		Pirbright Ranges	007	1023715	7	5.2793	MoD	SWT	**F**	2010
		Pirbright Ranges	008	1023716	8	4.1469	MoD	SWT	**F**	2010
		Pirbright Ranges	009	1023713	Chobham Ridges	51.9128	MoD	SWT	**F**	2016
		Pirbright Ranges	010	1023717	Colony Bog	634.7309	MoD	SWT	**F**	2016
		Pirbright Ranges	011	1023714	West End & Bisley Commons	32.7734	MoD	SWT	**F**	2017
		Pirbright Ranges	012	1023707	Bisley Common	20.865	MoD	SWT	**UR**	2009
		Pirbright Ranges	013	1023718	Pirbright Common	93.2375	MoD	SWT	**F**	2016
		Pirbright Ranges	014	1023708	Pirbright Ranges	81.7005	MoD	SWT-part	**UR**	2012
			015	1023704	Sheets Heath	25.2621	WoBC	SHP	**F**	2018
			018	1030336	Bisley NRA	4.6001	NRA		**UD**	2017
			019	1030337	MoD Cowshot Common	19.1159	WoBC	SHP	**F**	2017
TBH04	**Ash to Brookwood Heaths**		001	1017868	Brookwood Heath	9.3731	WoBC	SHP	**UR**	2012
			002	1017867	Woking Borugh Council Land	16.476	WoBC	SHP	**F**	2018
			003	1017140	Pirbright Common	26.0898	LA	SHP	**UR**	2012
		Ash Ranges	004	1023395	Bullswater Common	25.6799	LA	SHP	**UR**	2008
		Ash Ranges	005	1023388	Cobbetthill Common	72.991	?		**UR**	2012
		Ash Ranges	008	1008145	Peatmoor	0.2457	MoD	SWT	**UR**	2012
		Ash Ranges	011	1023393	[7] Ash Ranges	247.7873	MoD	SWT	**F**	2018
		Ash Ranges	012	1023397	12	15.309	MoD		**U** (NC)	2017
		Ash Ranges	014	1008129	[1] Ash Ranges	195.8802	MoD	SWT	**F**	2012
		Ash Ranges	019	1031371	former units 9, 10 &13	352.2538	MoD	SWT	**F**	2015
		Ash Ranges	020	1031372	former units 16 & 17	459.1894	MoD	SWT	**UR**	2015
		Ash Ranges	021	1031373	former units 6 & 15	155.0722	MoD	SWT	**F**	2015
	Whitmoor Common	Worplesdon Group	001	1023719	Jordan Hill	30.5209	SCC	SWT	**UR**	2006

	Worplesdon Group	002	1023727	Whitmoor	31.5655	SCC	SWT	UR	2019*
	Worplesdon Group	006	1023722	[1] Whitmoor Common	27.8719	SCC	SWT	F	2019
	Worplesdon Group	007	1023723	[2] Whitmoor Common	17.7559	SCC	SWT	F	2019
	Worplesdon Group	008	1023724	[3] Whitmoor Common	12.7481	SCC	SWT	UR	2019*
	Worplesdon Group	009	1023725	[4] Whitmoor Common	6.4084	SCC	SWT	UR	2008
	Worplesdon Group	010	1023726	Adjacent to Britten Pond	3.1765	SCC	SWT	F	2015
	Worplesdon Group	011	1023729	Brittens Pond	2.2005	SCC	SWT	U (NC)	2006
	Worplesdon Group	012	1029642	Heather Court, Woodcorner Farm & Whitmoor Common	33.781	SCC	SWT	UR	2019*
TBH06	**Ockham & Wisley Commons**	003	1008847	Wisley Common [E]	48.3094	SCC	SWT	UR	2019*
	Wisley & Ockham Commons	004	1008842	Pond Farm Pond	0.6099	SCC	SWT	F	2019
	Wisley & Ockham Commons	005	1008848	Wisley Common [W]	62.3627	SCC	SWT	F	2019
	Wisley & Ockham Commons	006	1008843	Wisley Common Bog	2.4597	SCC	SWT	UR	2019*
	Wisley & Ockham Commons	007	1008849	Bolder Mere	23.2016	SCC	SWT	UR	2011
	Wisley & Ockham Commons	008	1008844	Bolder Mere Lake	6.3755	SCC	SWT	F	2016
	Wisley & Ockham Commons	009	1008850	Ockham Common	55.3034	SCC	SWT	UR	2019
	Wisley & Ockham Commons	010	1017134	Chatley Heath	23.484	SCC	SWT	F	2019
	Wisley & Ockham Commons	012	1029641	Land North of M25	44.4655	SCC	SWT	UR	2019
WG11	**Godstone Ponds** Bay Pond	001	1023934	Bay Pond	3.6341	SWT	SWT	U (NC)	2019
		002	1008526	South of Bay Pond	2.5562	private		U (NC)	2010
		003	1008529	SW of the Old Pack House	2.8056	private		F	2008
		004	1008530	West of Leigh Place Pond	1.8011	private		UR	2008
		005	1008541	Leigh Place Pond	1.6741	private		UD	2008
		006	1008533	SW of Leigh Mill House	0.1639	private		F	2008
		007	1008542	Leigh Mill Pond	0.9695	private		UD	2008

NC = no change; 2019* = now **Favourable**

Table 2: SNCI Positive Management Condition Status at April 2018

BOA:	SNCI:	ref:	borough:		+/-?:	notes:
TBH01	Wentworth Golf Courses - West Wood	RU002	Runnymede	private	✓	**SWT***
	Wentworth Golf Courses - Knowle Hill	RU010	Runnymede	private	?	
	Wentworth Golf Courses - Valley Wood (inc. Great Wood)	RU012	Runnymede	private	✓	**SWT***
	Wentworth Golf Courses - Fish Ponds Wood	RU033	Runnymede	private	?	
	Wentworth Golf Courses - Duke's Copse & Wentworth Pond	RU034	Runnymede	private	?	
	Wentworth Golf Course South & land east of Heather Drive	SH004	Surrey Heath	private	✗	SWT?
	Sunningdale Golf Course	SH016	Surrey Heath	private	✗	
	Sunningdale Ladies Golf Course	SH043	Surrey Heath	private	✗	
TBH02	Monk's Walk North & West (incl. M3 Exchange Land)	RU005	Runnymede	**SWT***	✓	
	Longcross Churchyard	RU011	Runnymede	ecclesiatic	?	
	Queenwood Golf Course	RU017	Runnymede	private	✓	**SWT** advice
	Chobham Place Woods	SH019	Surrey Heath	LA	✓	
	Chobham Common (non-SSSI)	SH020	Surrey Heath	SCC	✓	**SWT***
	Stanners Hill & Fern Hill (Chobham)	SH021	Surrey Heath		✓	
TBH03	Bisley Common	SH005	Surrey Heath	SCC	✓	**SWT***
	Polledoak Slade & Short Siberia Range	SH006	Surrey Heath	NRA	✗	
	White Hill	SH010	Surrey Heath	MoD	✓	**SWT***
	Lightwater Country Park	SH011	Surrey Heath	LA	✓	
	High View Road	SH012	Surrey Heath	private	✗	
	The Folly	SH013	Surrey Heath	**SWT**/private	✗	
	Matchett's Meadow	SH025	Surrey Heath	private	✓	
	Century Range	SH039	Surrey Heath	NRA	✗	
	Dunross Farm	SH041	Surrey Heath		✗	
	Frimley Fuel Allotments	SH042	Surrey Heath	charity	✓	BVCP*
	Frith Hill	SH048	Surrey Heath	MoD	✗	
	Richmond Hill	SH049	Surrey Heath		✗	
	Land north of Matchett's Meadow	SH051	Surrey Heath	LA	✓	**SWT***
	Ralph's Meadow	SH052	Surrey Heath	LA	✓	**SWT***
	Deepcut Barracks North	SH053	Surrey Heath	MoD	✓	**SWT***
	Century Range	GU079	Guildford	NRA	✗	
	Old Windmill Hill	GU119	Guildford		✓	**SWT***
	Land north of Sheets Heath	WO013	Woking		?	
	Bisley Common	WO017	Woking	private	✓	LA*

	Brookwood Lye	WO019	Woking	**SWT**	✓	
	St John's Lye & Ponds	WO020	Woking	LA	✓	
	Brookwood Farm Stream	WO043	Woking	private	?	
TBH04	Field at Rye Farm (Ellis's Field)	GU001	Guildford		✓	
	Marne's Field	GU002	Guildford		✓	
	Pirbright Green East	GU019	Guildford	LA	✓	
	Pirbright Common & Dawney's Hill	GU020	Guildford	LA	✓	
	Pirbright Green	GU021	Guildford	PC	?	
	Wyke School Wood	GU029	Guildford		?	
	Stanford Brook Wood	GU039	Guildford		✗	
	Merrist Wood House Meadow	GU044	Guildford		✓	
	Bakersgate Meadows	GU045	Guildford		✓	
	Stoney Castle & Furze Hill Camping Ground	GU062	Guildford		✓	**SWT***
	Land to south of Hodge Brook	GU063	Guildford		✓	**SWT***
	Merrist Wood	GU064	Guildford		✓	
	Rickford Common	GU066	Guildford	SCC	✓	**SWT***
	Stringers Common	GU097	Guildford	SCC	✓	**SWT***
	Henley Park Fields	GU120	Guildford		✓	
	Withybed Copse	GU121	Guildford		✗	
	Ash Common (outside Danger Zone - Steel Hill)	GU130	Guildford		?	
	Clasford Bridge Road	GU138	Guildford		?	
	Normandy Common	GU164	Guildford	LA?	✓	
	Woods & Heath east of Basingstoke Canal	SH050	Surrey Heath		✗	
	Bridley Copse	WO002	Woking		✗	
	Crastock Woods, Hoe Valley	WO008	Woking		?	
	West of Kemishford Bridge, Hoe Valley	WO009	Woking		✗	
	Kemishford Bridge to Railway, Hoe Valley	WO010	Woking		✗	
	Brookwood Cemetery (South)	WO011	Woking	LA	✓	**SWT** advice
	Brookwood Cemetery (North)	WO012	Woking	LA/WGC	✓	**SWT** advice
	Whitmoor Pond	WO021	Woking		✗	
	Blackhorse Road Woods & Meadows	WO022	Woking		?	
	Blanket Mill Farm	WO025	Woking		?	
	Poor Jack's Wood	WO026	Woking		✓	
	Hook Heath Golf Course Pond	WO027	Woking	private	?	
	West Hill Golf Course	WO029	Woking	private	✗	

	Hoe Stream	WO039	Woking	part-LA	✓	
	Crastock Manor Pond	WO040	Woking		?	
TBH06	St George's Hill Golf Course	EL007	Elmbridge	private	?	
	Whiteley Village	EL013	Elmbridge	private	?	
	Elm Corner Woods	GU150	Guildford	SCC	✓	**SWT***
	Hunts Copse	GU151	Guildford	SCC	✓	**SWT***
	Wisley Airfield	GU127	Guildford	private	✗	
ND02	Netley Park	GU068	Guildford	NT	✓	
	Mountain Wood	GU069	Guildford	FC	✓	
	Hollisters Wood & Gravel Hill Wood	GU070	Guildford		✓	
	Pump Pond Wood	GU071	Guildford		✗	
	Dick Focks Common	GU072	Guildford	FC	✓	
	Hangers Wood	GU073	Guildford	FC	✓	
	Little Kings Wood	GU074	Guildford	NT	✓	
	Part of The Glaziers to Robinsgrove Wood	GU075	Guildford		?	
	Colekitchen	GU076	Guildford	private	✗	
	Pewley Down	GU080	Guildford	LA	✓	
	Merrow Downs 1	GU081	Guildford	LA	✓	
	Guildford Golf Club (Merrow Downs 2)	GU082	Guildford	LA	✓	
	Albury Downs	GU083	Guildford	Albury Est.	✓	**SWT***
	The Boxwood	GU084	Guildford		✓	**SWT***
	Newlands Corner East	GU085	Guildford	Albury Est.	✓	
	Newlands Corner West to White Lane	GU086	Guildford	Albury Est.	✓	**SWT***
	Harrow Hill Copse	GU087	Guildford		✗	
	Clandon Wood	GU088	Guildford	private	✓	
	Netherlands	GU089	Guildford	Albury Est.	✓	
	Merrow Down Woodland	GU090	Guildford	LA	✓	
	Tickners Copse & Chantry Wood	GU091	Guildford		✓	
	Woodland east of Netherlands	GU092	Guildford		✓	
	Effingham Golf Course	GU094	Guildford	private	✓	**SWT** advice
	West Clandon Chalk Pit (Duke of Onslow Pit)	GU115	Guildford	private	✓	**SWT** advice
	Effingham Common Crossroads	GU123	Guildford	SCC	?	
	Clandon Downs	GU126	Guildford		✗	
	Grassy Shaw & Primrose Rew	GU128	Guildford		?	
	St. Martha's Hill	GU131	Guildford	Albury Est.	✓	**SWT***

	Warren Farm, Guildford (Fields on North Side of Pewley Down)	GU161	Guildford		✗	
	Hawks Hill, Cherry Orchard Farm & Bocketts Lane	MV060	Mole Valley		?	
	Old Simm's Copse, Abinger pSNCI	MV-	Mole Valley	private	na	
ND03	Nower Wood (West)	MV017	Mole Valley	NT	✗	
	Nower Wood (East)	MV052	Mole Valley	**SWT**	✓	
	Cherkley Court (formerly Cherkley Wood)	MV069	Mole Valley	private/NT	✓	
	Royal Alexander & Albert School	RB034	Reigate & Banstead	private	✓	
	Gatton Park	RB037	Reigate & Banstead	private	✓	
	Margery Wood	RB025	Reigate & Banstead	NT	✓	
	Jubilee Plantations (west) pSNCI	TA-	Reigate & Banstead		na	
WG11	Holmethorpe Sandpits Complex	RB038	Reigate & Banstead	part-LA, SITA	✗	**SWT***
	Holmethorpe Sandpits Complex	TA086	Tandridge	various	✗	
	Graham Hendry Wood	TA010	Tandridge	**SWT**	✓	
	Hilly Field, Godstone Green	TA011	Tandridge		?	
	Kitchen Copse	TA012	Tandridge	**SWT**	✓	
	Place Pond	TA056	Tandridge		?	
	Glebe Water & Moore's Shaw	TA078	Tandridge		✓	
	Elm Platt pSNCI	695	Tandridge		na	
	Bletchingley Golf Course pSNCI	3501	Tandridge		na	
	Godstone Sewage Works 2 pSNCI	70068	Tandridge		na	
	Orchard Cottages Field pSNCI	70072	Tandridge		na	
	Garstons Wood pSNCI	70075	Tandridge		na	

Key:
BVCP=Blackwater Valley Countryside Partnership; FC=Forestry Commission; LA=Local Authority; MoD=Ministry of Defence; NRA=National Rifle Assoc.; NT=National Trust; SCC=Surrey County Council; SWT=Surrey Wildlife Trust (*managed by); PC=Parish Council; WGC=War Graves Commission

Table 3: Critically Endangered Species of Conservation Concern, Strategic Plan 2018-23

		SPI (S.41 NERC Act)	England[1]/GB Red List	Nationally (GB) Rare/Scarce	BOA Recovery Target?	SSSI citation indicator	Culturally valued	Relevant Priority Habitat(s)	Site responsibility	Notes (inc. on Surrey status)
North Downs 02-03: critically endangered species of conservation concern										
Plants[1]										
Ground-pine	*Ajuga chamaepitys*	•	EN		•	•		Calcareous grassland, AFM	**SWT** (confidential)	very rare, declining
Lesser hairy-brome	*Bromopsis benekenii*			NS		•		BYW	**SWT** (Sheepleas)	very rare, declining
Narrow-leaved helleborine	*Cephalanthera longifolia*	•	EN		•		•	BYW	private (confidential)	very rare, declining (only Sy site)
Basil thyme	*Clinopodium acinos*	•	VU		•		•	Calcareous grassland, AFM	private (Clandon Pit SNCI); **NT**	very rare, declining
Frog orchid	*Coeloglossum viride*	•	VU		•		•	Calcareous grassland	**GBC** (confidential)	very rare, declining (only Sy site)
Starfruit	*Damasonium alisma*	•	CR		•	•		Ponds, Heathland	**NT** (Headley Heath)	formerly extinct, *re-introduced
Narrow-lipped helleborine	*Epipactis leptochila ssp. leptochila*		DD			•	•	BYW	**SWT** ((confidential))	very rare, declining (only Sy site)
Marsh helleborine	*Epipactis palustris*		NT			•	•	Calcareous grassland	**SWT** (confidential)	very rare (recent re-discovery; only Sy site)
Broad-leaved cudweed	*Filago pyramidata*	•	EN		•			Calcareous grassland, AFM	private (Clandon Pit SNCI)	very rare, declining
Slender bedstraw	*Galium pumilum*	•	EN		•			Calcareous grassland	**NT** (Colley Hill, Westcott Downs)	very rare, declining (only Sy sites)
Musk orchid	*Herminium monorchis*	•	EN		•	•	•	Calcareous grassland	**NT** (confidential)	very rare, declining (only Sy sites)
Lizard orchid	*Himantoglossum hircinum*	•					•	Calcareous grassland	**GBC** (confidential)	very rare (only Sy site)
Wood barley	*Hordelymus europaeus*			NS		•		BYW	**SCC** (Effingham x-roads SNCI)	very rare, declining
Wild candytuft	*Iberis amara*	•	VU					BYW	**NT** (Juniperhill)	very rare, has declined (only Sy site)
Lesser butterfly-orchid	*Platanthera bifolia*	•	EN				•	Calcareous grassland, MDW	**SWT** (confidential)	very rare (recent re-discovery; only Sy site)
Meadow clary	*Salvia pratensis*		NT			•	•	Calcareous grassland	**NT** (Colley Hill)	very rare, declining (only Sy site)
Cut-leaved germander	*Teucrium botrys*		[-]			•		Calcareous grassland, AFM	**NT** (Juniperhill)	very rare, declining
Spreading hedge-parsley	*Torilis arvensis*	•	EN					AFM	private	very rare, declining (only Sy site)
Sterile beardless-moss	*Weissia sterilis*	•	NT	NS				Calcareous grassland	**SWT** (Dawcombe)	very rare; near-UK endemic (only Sy site)
Lichens & Fungi										
a lichen	*Placidium (=Catapyrenium) michelii*	•	VU					Calcareous grassland	**NT** (Box Hill CP)	extinct? (≤1971; only UK site)

a lichen	*Bacidia incompta*	•	VU					Wood-pasture & parkland, BYW	**NT** (Box Hill CP)	very rare, has declined (only recent Sy site)
a lichen	*Toninia sedifolia*	•				•		Calcareous grassland	**NT** (Box Hill CP)	very rare (≤1999; only Sy site)
Gilded domecap (fungus)	*Calocybe (=Lyophyllum) favrei*	•	CR					BYW	**SWT** (Norbury Park)	very rare (only recent UK site)
Sweet greyling (fungus)	*Tephrocybe osmophora*	•	CR					BYW	**SWT** (Norbury Park)	very rare (only recent UK site)
Invertebrates										
a comb-footed spider	*Dipoena melanogaster*		EN	NR				Calcareous grassland, Heathland	**NT** (Box Hill)	very rare, has declined (only recent UK site)
Barred tooth-striped (moth)	*Trichopteryx polycommata*	•		Na				Calcareous grassland	**NT** (Juniper Bottom)	very rare (recent re-discovery; only Sy site)
Straw-belle (moth)	*Aspitates gilvaria*	•	RDB3		•	•		Calcareous grassland	**NT** (Box Hill CP)	very rare, declining (only Sy site)
Plumed prominent (moth)	*Ptilophora plumigera*			Na				MDW	**SWT** (Sheepleas)	very rare; has declined (? Sy sites)
Dew moth	*Setina irrorella*			Na				Calcareous grassland	**NT** (Denbies, Box Hill)	possibly extinct? (≤1999)
Fuscous flat-body (micro-moth)	*Agonopterix capreolella*	•	pRDB1					Calcareous grassland	**GBC** (Pewley SNCI); **SWT** (Rosamund Trust)	very rare (recent re-discovery; only Sy sites)
Phantom hoverfly	*Doros profuges (=conopseus)*	•	NT					Calcareous grassland	Headley Warren; **NT** (Juniper Top)	very rare, has declined (only Sy sites)
Mellet's downy-back (beetle)	*Ophonus melletii*	•	NT	NR				Calcareous/Acid grassland	**NT** (Box Hill)	extinct? (≤1986)
Hazel pot-beetle	*Cryptocephalus coryli*	•	EN	NR				Calcareous grassland, MDW	Headley Warren; **NT** (Box Hill)	very rare, has declined (very few UK sites)
Shining pot-beetle	*Cryptocephalus nitidulus*	•	EN	NR				Calcareous grassland, MDW	**SWT, NT** (Hackhurst-White Downs)	very rare, has declined (only UK sites)
Vertebrates										
Goshawk	*Accipiter gentilis*		NT				•	MDW (conifer PAWS)	[confidential]	very rare breeder; vulnerable WCA1
Thames Basin Heaths 01-04 & 06: critically endangered species of conservation concern										
Plants & Lichens										
Tawny sedge	*Carex hostiana*							Heathland (wet), Fen	**SWT** (Folly Bog)	very rare, declining (only Sy site)
Flea sedge	*Carex pulicaris*		NT			•		Heathland (wet)	**SWT** (Folly Bog, Gracious Pond)	very rare, declining (only Sy sites)
Cornflower	*Centaurea cyanus*	•		NS			•	AFM	private (Wisley Airfield SNCI)	very rare, has declined (only Sy site)
Bog hair-grass	*Deschampsia setacea*		VU			•		Heathland (wet)	**SWT** (Wisley Common)	very rare, declining (only Sy site)
Deptford pink	*Dianthus armeria*	•	EN		•	•	•	Calcareous & Acid grassland	**SWT** (Chobham Common N)	very rare/extinct?
Slender cottongrass	*Eriophorum gracile*		VU			•		Heathland (wet), Fen	**SWT** (Ash Ranges)	very rare (only Sy site)
Marsh gentian	*Gentiana pneumonanthe*		NT			•	•	Heathland (wet)	**SWT** (confidential)	very rare, has declined (only Sy site)
Coral-necklace	*Illecebrum verticillatum*	•	EN					Heathland	**SWT** (Ash Ranges)	very rare (recent discovery; only Sy site)
Shoreweed	*Littorella uniflora*					•		Heathland, Ponds	**SWT** (Boldermere)	very rare, has declined (only Sy site)
Mousetail	*Myosurus minimus*		VU					AFM	private (Henley Fields SNCI)	very rare, has declined (only Sy site)
Pillwort	*Pilularia globulifera*	•	VU		•	•		Heathland (wet), Ponds	**SWT** (Boldermere)	very rare/extinct?
Allseed	*Radiola linoides*		VU			•		Heathland	**SWT** (Ash Ranges)	very rare, declining (only Sy site)

Large-celled flapwort	*Lophozia capitata*	•	VU					Heathland (sand-pits)	**SWT** (Ash, Whitmoor, Wisley)	rare, increasing? (only Sy sites)
Veilwort	*Pallavicinia lyellii*	•		NS	•	•		Heathland (wet)	**SWT** (Ash Ranges)	very rare/extinct?
a lichen	*Cladonia cryptochlorophaea*			NS				Heathland	**SWT** (Chobham N&S)	rare (only x2 Sy sites)
a lichen	*Cladonia uncialis ssp. uncialis*		NT	NS			•	Heathland	**WoBC** (Brookwood Cmy. SNCl)	very rare (only Sy site; few Eng. sites)
a lichen	*Micarea leprosula*							Heathland	**SWT** (Chobham Common S)	very rare (only Sy site; few Eng. sites)
a lichen	*Micarea viridileprosa*			NS				Heathland	**SWT** (Chobham N&S)	very rare (only Sy site; few Eng. sites)
Invertebrates										
Penny's long-legged sac-spider	*Cheiracanthium pennyi*		EN	NR		•		Heathland	**SWT** (Chobham & Whitmoor)	rare, has declined (only recent UK sites)
a comb-footed spider	*Enoplognatha oelandica*		CR	NR				Heathland	**SWT** (Folly Bog)	very rare, declining (only recent UK site)
Swamp look-out spider	*Notioscopus sarcinatus*	•		NS				Heathland (wet)	**SWT** (Chobham N&S)	very rare, declining (only recent Sy site)
Large marsh grasshopper	*Stethophyma grossum*	•	NT	NR				Heathland (wet)	**SHBC** (Lightwater CP)	possibly extinct?
a shore bug	*Micracanthia marginalis*		VU	NR		•		Heathland (wet)	**SWT** (Folly Bog & Chobham)	very rare, has declined (only UK sites)
Window-winged sedge (caddis)	*Hagenella clathrata*	•	EN	NR		•		Heathland (wet)	**SWT** (Chobham & Whitmoor)	rare, has declined (only Sy sites)
Shoulder-striped clover (moth)	*Heliothis maritima*	•	RDB3		•			Heathland (wet)	**SWT** (Chobham Common S)	very rare, declining (only Sy site)
Red-barbed ant	*Formica rufibarbis*	•	RDB1		•			Heathland, Acid grassland	**SWT** (Chobham Common N)	possibly extinct?
Black bog ant	*Formica picea*		RDB1					Heathland (wet), Fen	**SWT** (Folly, Colony Bogs)	very rare (only Sy site)
a digger wasp	*Mimumesa spooneri*		RDB3		•			Heathland (wet), Acid grassland	**SWT** (Brentmoor, Pirbright)	very rare, has declined (only Sy sites)
Heather moonshiner (beetle)	*Amara infima*		NT	NR		•		Heathland	**SWT** (Chobham Common N)	very rare (only x2 Sy & few UK sites)
Heath shortspur (beetle)	*Anisodactylus nemorivagus*	•	NT	NR				Heathland, Acid grassland	**SWT** (Brentmoor)	very rare, declining (only recent Sy site)
a jewel beetle	*Melanophila acuminata*		EN	NR				Heathland (burnt, with conifers)	**SWT** (Brentmoor & Chobham)	very rare, has declined (only UK sites)
a pot-beetle	*Cryptocephalus biguttatus*		VU	NR				Heathland (wet)	**SWT** (Chobham & Wisley)	very rare, declining (only Sy sites)
Sallow guest weevil	*Melanapion minimum*	•	RDB3					various (on *Salix* spp. assoc. with *Pontania* spp.)	**RHS** (Wisley Gardens)	very rare, has declined (only Sy site)
Holmesdale (WG11): critically endangered species of conservation concern										
Necklace ground beetle	*Carabus monilis*	•	EN	NS				various	**SWT** (Bay Pond)	very rare/extinct? (≤1996)
Golden dock	*Rumex maritimus*					•		Standing water, Rivers	**SWT** (Nutfield Marshes)	very rare, declining (only Sy site)

Key:
SPI = Species of Principal Importance for the conservation of biological diversity in England (S.41 NERC Act 2006)
IUCN Red Listed: **CR**=Critically Endangered, **EN**=Endangered, **VU**=Vulnerable (all Threatened); **NT**=Near Threatened; **DD**=Data Deficient
GB Red Data Book: RDB1=Endangered, RDB3=Rare, pRDB=provisional RDB
NR = Nationally Rare (≤ 15 recording hectads); **NS/a** = Nationally Scarce (16-100 recording hectads); **Sy** = Surrey; CP = Country Park
AFM = Arable Field Margins; **BYW** = Beech & Yew Woodland; **MDW** = Mixed Deciduous Woodland

Notes:

This **Research & Monitoring Framework** aspires to achieve better consistency in measuring and recording the Trust's achievements, in order to contribute to a cumulative, robust evidence-base from which we can confidently report on, review and adjust the Trust's mission over the period of our current Strategic Plan and beyond. Justification for the Trust's *Living Landscapes* approach to wildlife conservation remains as relevant as ever.

The findings of the national States of Nature reports, as well as our own 2017 State of Surrey's Nature are yet further reminders of ongoing declines in biodiversity and the imperative for enabling its recovery via reversals in wider environmental degradation.

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Heath tiger-beetle, Mike Waite

SURREY wildlife TRUST

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