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Conservation Strategy for West-European Hedgehog (*Erinaceus europaeus*) in the United Kingdom (2015-2025)

Produced by the conservation partnership of:

people's trust for endangered species

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British Hedgehog Preservation Society

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Why the hedgehog?

The hedgehog is widely recognised as the UK's most popular wild animal (e.g. Hoare, 2013). The population now appears to be in dramatic decline, with at least a quarter of the population lost in the last decade (Roos et al., 2012). We know that the presence of hedgehogs indicates that the local environment is unfragmented, varied and rich in invertebrates. A lack of hedgehogs in otherwise suitable habitat indicates that all is not well in the environment. Hedgehogs are unusual in that they can cope in environments that are heavily modified by people; they are also a unique and cherished part of our cultural heritage. To lose them would be a devastating indictment of our inability to live sustainably.

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This strategy has been been produced by the PTES and BHPS hedgehog steering group, in consultation with:

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Game and Wildlife Conservation Trust (GWCT)	Natural England (NE)	Natural Resources Wales (NRW)	Royal Society for the Protection of Birds (RSPB)	Royal Society for the Protection of Cruelty to Animals (RSPCA)	Zoological Society of London (ZSL)

1. Introduction

This is a working document, designed to encourage collaboration and improve the efficiency of conservation action, as organisations increasingly appreciate the need to take action for hedgehogs, and the opportunities they present for engagement.

This document summarises the main threats facing the hedgehog in the UK, and plans actions for the next decade. This builds upon previous strategic work commissioned by the British Hedgehog Preservation Society (BHPS) and People's Trust for Endangered Species (PTES) (Warwick, 2010).

The overall aims of the strategy are:

1) (urban/suburban areas): Stabilise populations within urban/suburban areas by 2025.

We define the scope of this aim as the establishment of stable hedgehog populations in a major settlement in every county across the UK.

2) (rural areas): To understand and demonstrate the ecological parameters underpinning viable rural hedgehog populations by 2025.

2. Background information

2.1 Distribution and population

Widely distributed throughout the British Isles, in both rural and urban habitats (Mitchell-Jones et al., 1999). Absent from some Scottish islands including Barra, Jura, Colonsay, Eigg and Rum in the Hebrides and Rousay in Orkney. Introduced to Isles of Wight, Man, Orkney, Shetland, South Uist, North Ronaldsay and many others including possibly Ireland (Harris & Yalden, 2008).

The only credible estimate of population size is 1,550,000 for Great Britain (England 1,100,000, Scotland 310,000, Wales 140,000) (Harris et al., 1995), but this has a high degree of uncertainty, using density estimates for hedgehogs in different habitat types based on very limited information (Harris & Yalden, 2008). Given this figure, and more firmly established rates of decline (Roos et al., 2012), there are now perhaps fewer than a million hedgehogs in Great Britain.

2.2 Life history

Breeding

Breeding occurs between May and September and animals are promiscuous (Reeve and Morris, 1986; Moran et al., 2009). Average litter size is typically four or five, although mothers rarely manage to raise more than three young to independence (Morris, 1977). Mothers are liable to eat or desert the young if disturbed soon after giving birth, although they will relocate the nest if disturbed once the young are older (Burton, 1969). Weaning occurs after five weeks and young are independent at six weeks (Reeve, 1994). Females will sometimes attempt a second litter but few data exist on this in mainland Britain; evidence from elsewhere of animals successfully raising two litters in a year has been reported (Jackson, 2006).

Feeding

Hedgehogs are omnivorous and opportunistic, consuming a wide range of prey items, but the bulk of their diet is made up of macro-invertebrates. Earthworms and beetles (esp. carabids) are most frequently eaten, with caterpillars, slugs, millipedes and earwigs also consumed frequently (Yalden, 1976; Wroot, 1984). Other food sources includes carrion, fungi, birds' eggs, and small mammals and amphibians (Reeve, 1994). In urban/suburban areas, food provided by humans (e.g. meat-based pet food, mealworms) can be a common supplement to the hedgehog's natural diet (Morris, 1985).

Habitat requirements

The West-European hedgehog is found across a wide range of habitat types, encompassing both semi-natural vegetation types and those areas that have been heavily modified by man. The range includes woodland, grasslands such as meadows and pasture, arable land, orchards and vineyards as well as within the matrix of habitat types found in human settlements (Morris, 1986; 1988). The species prefers lowlands and hills up to 400-600m, but is also locally present on mountains (Mitchell-Jones et al., 1999). Outside cultivated land it prefers marginal zones of forests, particularly ecotonal grass and scrub vegetation (Mitchell-Jones et al., 1999).

Hedgehogs are most abundant within gardens, parks and amenity land close to or within human settlements (Young et al., 2006; Parrott et al., 2014; Trewby et al., 2014). They are generally scarce in areas of coniferous woodland, marshes and moorland, probably because of a lack of suitable sites and materials for the construction of winter nests (Morris, 2006). Our knowledge of the distribution of hedgehogs in the UK is, however, heavily biased by recorder effort and we must be wary of assuming their absence in sparsely populated areas.

2.3 Threats and limiting factors

Threat	Driver	Ecological effect
Loss of habitat	Over-management of amenity space, infill development, paving/hard surfacing, intensification of farming	• Reduces carrying capacity of landscape • Fewer nesting opportunities • Greater risk of predation • Reduced foraging area • Disrupted dispersal routes
Reduced habitat quality	Intensive farming methods, under/over management of hedges	• Less invertebrate food • Fewer nesting opportunities • Greater risk of predation • Disrupted dispersal routes
Habitat fragmentation	Fencing, infrastructure, badgers (*Meles meles*), loss of hedgerows	• Isolated populations can become unviable • Increased mortality • Genetic effects
Increased exposure to hazards	Traffic-related mortality, more badger predation, garden hazards and management	• Combine with habitat changes to cause local extinctions and population decline
Climate change	Anthropogenic CO_2 emissions	• Disrupt over-winter survivorship • Death from more extreme weather events
Disease	Infectious disease (e.g. viruses/bacteria/fungi/protozoa/endo/ecto parasites etc.) and non-infectious disease (e.g. toxins, the possible toxic effects of agricultural chemicals)	• Death • Loss of fecundity • Behavioural effects
Rehabilitation	Widespread capture, treatment, release and translocation of wild hedgehogs	• Genetic effects • Infection & immunity

Table 1. Summary of threats to hedgehog populations. Grey = limited/no research has been undertaken

Threats

a. Loss of habitat for nesting (rural and urban)

Hedgehogs use nests as a daytime retreat, for breeding and for hibernation. The structure of these varies according to conditions (Reeve, 1994), but in general in the UK they require leaves and some kind of supporting structure. Hibernacula are the most critical of these, with animals spending up to six months in the same nest. They select deciduous leaves of intermediate size to form the laminate structure needed to maintain humidity in the nest (Morris, 1973). Areas of land with suitable vegetation for hibernation nests are often undervalued, both from amenity and biodiversity perspectives, and are frequently lost in development or management (e.g. 'tidying up'). Fortunately, studies have shown that relatively small areas of suitable hibernation habitat can be used by many

hedgehogs (Morris, 1973). Individuals may travel some distance (>500m) to such areas and thus availability of this resource is thought to be important in the long term persistence of populations.

Likely importance: high

b. Reduced invertebrate abundance (rural)

Conventional farmland management has caused widespread reduction of invertebrate abundance and diversity across the UK (Burns et al., 2013). This can either be through the direct losses from chemical treatments (insecticides, molluscicides) or indirectly through reduction of plant diversity and loss of habitats (herbicides, fertilizer, land-use change) (Shah et al., 2003). Whether comparable invertebrate shortages occur in the urban environment needs further investigation. The impact of agri-environment schemes on the management of grassy field margins and hedgerows is likely to have significant impacts on rural hedgehog populations (Hof and Bright, 2010a; 2010b).

Likely importance: high

c. Reduction in hedgerow quality (rural)

Hedges can provide food, shelter from predators and can be important for nesting sites during hibernation (Haigh et al., 2012; Jensen, 2004; Riber, 2006). They are also vital corridors facilitating movement (Haigh et al., 2012; Hof et al., 2012). The majority of hedges in the British Isles are either over-managed, from annual flail cutting, or undermanaged, due to a lack of traditional management practices such as coppicing and laying (Mills and Billings, 2011). Sustained periods of over-management or neglect will lead to hedges which are of reduced value to hedgehogs and can lead to loss of entire hedgerows.

Likely importance: high

d. Fragmentation of land (urban and rural)

Hedgehogs need to roam widely for food and mates (Reeve, 1981). They are also faithful to particular home ranges (Reeve, 1982), which makes them vulnerable to land-use change and development. Minimum Viable Population (MVP) modelling has provided an indication of the requirements of isolated populations of hedgehogs in different habitat types. Population modelling suggests that the *minimum* estimate for a sustainable population in what is classified as “urban” habitat is 32 individuals in 0.9km^2 (90ha) of contiguous land (Moorhouse, 2013a). Urban habitat has the lowest MVP values as it is classified as having plentiful food and low levels of predation; in contrast, minimum rural values are estimated to be 120 individuals in 3.8km^2 (380ha). Fragmentation, as a result of roads (and other features) acting as a physical or behavioural barrier, could reduce access to food resources, prevent gene-flow between populations and increase the probability of populations becoming locally extinct (Jaeger et al., 2005). PTES/BHPS have recently funded a three year research project by University of Reading to investigate the potential effects of major roads on the genetics of hedgehog populations.

Likely importance: high

e. Loss of foraging habitat (urban)

One requirement for sustainable urban hedgehog populations is the availability of sufficient areas of gardens and grassland, rich in invertebrates. Hedgehogs are known to be associated with urban neighbourhoods that have a large percentage of grass present, as well those that have a common, woodland or a park in their vicinity (Hof & Bright, 2009). These are increasingly lost from infill

development and hard-surfacing. Use of chemical treatments and other intensive management practices by groundkeepers and garden owners reduces the value of cultivated areas for foraging.

Likely importance: high

f. Increased predation and fragmentation of habitat from badgers (rural)

Badgers and hedgehogs have an asymmetrical intra-guild predatory relationship (Doncaster, 1992). Badgers predate hedgehogs and they also compete with hedgehogs for food, primarily worms and beetles. Research has also shown that hedgehogs will avoid areas where badgers are present, and thus badgers fragment the landscape for hedgehogs (Doncaster, 1992). With badger densities on the increase in many parts of the UK (Battersby, 2005; Young et al., 2006; Parrott et al., 2014; Trewby et al., 2014), in areas where rural habitats are unfavourable it can be expected that high densities of badgers will exclude hedgehogs from patches of land (Micol et al., 1994). Hedgehogs and badgers have coexisted in farmland landscapes for thousands of years, so it is important to understand why this has changed. Some farmland landscapes appear to support both species and it is unknown how sustainable this is in the long-term.

Likely importance: high in southern England, increasing

g. Loss of hedgerows (rural)

The loss of hedges from the British landscape in the first few decades after WWII, as incentivised by the drive to become more productive under the Common Agricultural Policy, is well documented (e.g. Robinson and Sutherland, 2002). This will have greatly reduced the amount of habitat available for hedgehogs. Hedgerow loss in recent years is largely driven by threat (**c**).

Likely importance: high

h. Reduction of permanent grassland (rural)

Permanent grassland, ideally closely cut or cropped and extensively managed, is ideal foraging habitat for hedgehogs, providing abundant macro-invertebrate prey. In farm landscapes, these areas are largely represented by pasture, field margins and road verges. Permanent grasslands managed as pasture for livestock dominate the farmland landscape in certain parts of England and Wales (ADAS, 2005). The long-term trend across the UK during the 20th and 21st Century has been of a reduction in permanent grasslands and an increase in tillage (Fowell, 2010). Permanent grassland features are also present at the margins of fields, particularly as a product of Entry Level Stewardship agreements. Field margins have been shown to be a valuable source of target invertebrates for hedgehogs in arable-dominated landscapes (Hof and Bright, 2010a; 2010b).

Likely importance: moderate

2.4 Threats requiring further research

a. Mortality from roads (rural and urban)

The only published estimate of hedgehog road casualties in Great Britain is of 15,000 *per annum* (Morris, 2006) but this may be a significant underestimate (Wembridge et al., in prep.). More reliable estimates and a better understanding of the impact of road mortality on populations are necessary.

Likely importance: unknown

b. Climate change

Anthropogenic climate change is affecting the phenology of many species and may be contributing to increasingly severe fluctuations in the UK's weather (e.g. Coumou & Rahmstorf, 2012). PTES/BHPS *Hedgehog Hibernation Survey* (2012-2014) and BTO *Garden BirdWatch* (2003-) are both datasets that can be used to consider whether hedgehog emergence and activity patterns are changing in response to climate change. The effect of extreme weather events on hedgehog populations, such as droughts or flooding, needs investigation. Key questions are a) how does weather effect fat accumulation prior to hibernation, and b) are patterns of over-winter survival changing? Climate change may also affect disease by increasing the range and/or availability of the intermediate hosts that carry many of the parasitic diseases that affect hedgehogs.

Likely importance: unknown

c. Disease

The prevalence and impact of disease in wild hedgehog populations is poorly documented. Knowledge of the health of hedgehogs in rehabilitation and the conditions that affect them in captivity is better understood, since they are the mammal species which is most frequently admitted as a wildlife casualty. Some wildlife rehabilitators claim that new diseases have come to prominence in their areas and an unknown disorder(s) could be a component of the national decline. Zoological Society of London's Garden Wildlife Health (www.gardenwildlifehealth.org) project is currently collecting both systematic and opportunistic records of sick and dead hedgehogs from members of the public as a means of detecting diseases that might be involved in the current hedgehog decline. They are also examining carcasses *post mortem* to create a national dataset on wild hedgehog causes of death, including a tissue archive for retrospective research. All diseases (infectious: e.g. bacteria, viruses, fungi, ecto- and endoparasites; and non-infectious: e.g. toxicity) are being investigated.

Likely importance: unknown

d. Impact of wildlife rehabilitation

Uncertainty surrounding the minimum requirements (in terms of body condition) for hedgehogs to survive hibernation may lead to animals being taken into care unnecessarily. How animals are treated whilst in care and where and how they are released is also known to affect survival post-release. There is a lack of centralised monitoring, regulation and licencing across the sector. There is also still much to learn from studying hedgehogs post-rehabilitation with a view of improving protocols for animals in care and during release (Morris, 1998). The translocation of animals between different sites may also have a range of unintended effects.

Likely importance: unknown

2.5 Conservation status and recent conservation measures

Listed in 2007 as a Biodiversity Action Plan 'priority species'. Partially protected under Schedule 6 of the Wildlife and Countryside Act (1981) and the Wild Mammals Protection Act (1996). Listed as a 'Species of Principal Importance' under the Natural Environment and Rural Communities Act (2006). Legislation does not cover any of the primary drivers of the decline. There has been no recent national census information and no legal imperative to survey and mitigate for this animal in environmental impact assessments.

As a generalist species requiring large areas of contiguous habitat, conservation hinges on landscape-scale initiatives, both in rural and urban areas. The drivers of the decline are probably varied, reflecting the diverse range of habitats that the animal can be found in, and incompletely understood. Interventions in rural habitats have been hindered by a lack of detailed knowledge of the ecological requirements for hedgehogs in different farmed landscapes. The matrix of gardens and green spaces in towns and cities can support the highest densities of hedgehogs, and densities can be an order of magnitude higher than at rural sites (e.g. Hubert, 2011). Hedgehog requirements in these areas are better understood and conservation efforts have so far concentrated on encouraging gardeners to link up their gardens and make practical changes (Hedgehog Street*,* a PTES and BHPS campaign with over 36,000 registered volunteers), or training programmes aimed at urban land managers and consultants (*Hedgehog Ecology and Management for Practitioners*, a BHPS/PTES course).

There are also an increasing number of significant regional projects, good examples being Dorset (Bridport/Dorset Mammal Group), Suffolk (Suffolk Wildlife Trust) and Warwickshire (Warwickshire Wildlife Trust HIA).

2.6 Better legal protection for hedgehogs in the UK?

Potential advantages	**Potential disadvantages**
Better protection for hedgehog nests could be hugely beneficial. Habitat is ignored in all current legislation.	Protection of hedgehog nesting habitat would have significant impacts on land management, e.g. road verge flailing, haymaking, garden activities.
Protection could make it obligatory that surveys and mitigation are undertaken in developments. Mitigation measures that maintain habitat structure and landscape-scale connectivity during large-scale developments might prove highly beneficial.	Difficult to make legislation impact upon underlying drivers of the hedgehog decline.
Could facilitate developments that result in a net gain for hedgehogs.	A cost implication for developers.
Could prevent hedgehogs from being killed in non-specific ground traps used by gamekeepers.	
Regulation of rehabilitators could include provisions for centralised, electronic data collection.	

Table 2. Summary table of pros and cons of improved legal proection for hedgehogs.

On balance, the conservation status of the hedgehog would be improved by moving it to Schedule 5 of the Wildlife and Countryside Act (1981) and such a move should be encouraged. The wording of this must exclude those areas where hedgehogs are not naturally present.

3. Aims and objectives

Aims

Urban: By the year 2025 to have stabilised hedgehog populations in towns and cities through widespread recruitment of volunteers to Hedgehog Street, and by training land managers, local councils and practitioners to manage green space within the urban matrix in a way that provides for the needs of hedgehogs.

Rural: In rural areas it is unrealistic to expect the same to be achievable; instead, the requirements of sustainable hedgehog populations in farmed landscape must be understood. This understanding should be enforced by an example of habitat modification in the field that has successfully enhanced a wild hedgehog population, successfully coexisting with a wild badger (*Meles meles*) population. Ideally this would be tested in both arable and pasture dominated landscapes.

Objectives (numbered O1-O17)

3.1 Monitoring (O1-O4)

O1 → Develop an biennial 'State of the Nation's Hedgehogs' index of sufficient power and coverage

Current surveys that include hedgehogs need to be published in an annual review to provide a quantified and up to date reference for the status of the population. This could use a traffic light system to indicate the trend away from a determined baseline (e.g. Link's Nature Check system), with surveys corrected for coverage and number of records. Existing surveys for inclusion: PTES *Living with Mammals*, PTES *Mammals on Roads*, *Survey*, BTO *Garden BirdWatch*, BTO/JNCC/RSPB *Breeding Bird Survey/Waterway Breeding Bird Survey*. This should also involve a data stream from hedgehog rehabilitators – a currently underutilised resource.

Key partners: PTES, BHPS, BTO, hedgehog carers, local mammal groups

Priority: high

Timescale: ongoing

Status: pending

Target: Deliver first report at conference The Day of the Hedgehog 21st November 2015

***O2* → Develop improved tools and methodologies for hedgehog surveying by professionals**

PTES & BHPS previously commissioned work on surveying hedgehogs using: a) footprint tracking tunnels (Yarnell et al., 2014); and b) molecular detection of a hedgehog-specific parasite carried in slugs (Simon Allen, Bristol University). Tunnels are already available to buy and survey guidance for this technique has been published (Yarnell et al., 2014), including an 'ink-on-paper' footprint ID guide (Johnson & Thomas, 2015). The parasite detection technique requires further work to prove affordability. We currently lack a reliable method for estimating the abundance (and hence density) of hedgehogs in different habitats.

Key partners: PTES, BHPS, University of Reading, Nottingham Trent University, University of Bristol, Gower Bird Hospital, University of Brighton, The Mammal Society

Priority: high

Timescale: ongoing

Status: underway Disseminate tunnel survey protocol to ecologists by end of 2015.√ (+ CIEEM article & scientific paper)

Target: Establish the commercial viability of parasite detection technique by 2016.

O3 → Learn more from the existing datasets

There are lots of potential insights that could come from the various hedgehog datasets. For example, BTO *Garden BirdWatch* dataset as it also collects information about the garden habitats where recorders are surveying. Is there a change in emergence times for hedgehogs over the years of *Garden BirdWatch* (i.e. since 1994)? What does *Garden BirdWatch* reveal about the distribution of hedgehogs across the UK? How closely linked is presence/absence of hedgehogs in gardens to features in gardens E.g. feeding, hedges, dogs, badgers, busy roads, proximity to urban centres? Recently the RPSB's *Big Garden BirdWatch* has also started recording hedgehog data. Data from the National Gamebag Census could shed light on changing hedgehog distribution since 1961.

Key partners: PTES, BHPS, BTO, GWCT, RSPB

Priority: medium

Timescale: short

Status: pending

Target: Commission a new piece of analysis every 2 years.

O4 → Publish all available knowledge about hedgehog trends, monitoring techniques etc. so they are in the public realm

Current knowledge should be published in peer-review journals so that it is available to all. Priorities are the *Living with Mammals* 10 year trend analysis, the footprint tunnel tracking methodology and any re-analysis of roadkill. It would be beneficial to regularly update existing guidance for consultants (e.g. Cresswell et al., 2012).

Key partners: PTES, BHPS, University of Reading, Nottingham Trent University, Gower Bird Hospital, The Mammal Society, CIEEM

Priority: medium

Timescale: short

Status: underway √ Footprint tunnel methodology: Yarnell et al., 2014

Target: Deadlines for publishing for researchers and staff. Where appropriate, we should encourage publishing in the grey literature (e.g. Conservation Evidence, Farm Wildlife) by researchers to speed up knowledge-sharing.

3.2 Habitats (O5-O9)

O5 → Understand the significance of rural habitat fragmentation

Theoretically we understand how this might affect hedgehogs, but we lack empirical data. A project is underway at University of Reading (Baker/Williams) to investigate whether major roads are

affecting the genetics of hedgehog populations. Hedgehog use of underpasses installed for reptile/amphibian mitigation is also being investigated (Petrovan/Froglife) and has shown that hedgehogs successfully use a variety of such underpasses (including small ones of 0.5m diameter) but overall useage remains low. The effect of improving fragmented hedge networks on hedgehog movements has been modelled (Moorhouse, 2013a).

Key partners: PTES, BHPS, University of Reading, Froglife

Priority: medium

Timescale: short

Status: underway

Target: Produce peer-reviewed paper on this topic by 2017.

O6 → Compile and promote advice for farmers that includes specifications for hedgehogs

Although currently somewhat limited, there is a growing body of research surrounding farmland management for hedgehogs that needs to be synthesised and disseminated when it is ready. This is dependent on the conclusion of several research projects (e.g. WildCRU research and University of Nottingham/University of Reading/PTES/BHPS national footprint survey). A comprehensive review of the existing literature should also feed into this. Advice for farmers may come through RSPB's network of advisers and advisory materials, and consider requirements for future versions of agri-environment schemes if appropriate. Best practice hedgehog conservation advice should be incorporated into the wildlife packages that have been devised to help a range of taxa.

Key partners: PTES, BHPS, NE, NRW & the Welsh Government, SNH, NIEA, WildCRU, University of Reading, Nottingham Trent University, WildCRU, RSPB.

Priority: high

Timescale: medium

Status: underway √ Literature review commissioned by PTES & BHPS spring 2015.

Target: Significant progress towards understanding the fundamental requirements of viable hedgehog populations on farmland by 2020.

O7 → Understand what will permit badger and hedgehog coexistence, in both arable and pasture dominated farmland

Pending research: Carly Pettett's PhD (completes 2015 at WildCRU, University of Oxford); National Hedgehog Survey project (completes 2015/6 at University of Reading); Hibernation Study (completes 2016 at University of Reading/Nottingham Trent University). Also needs a farm-scale manipulation to practically test our understanding of the critical limiting factors underpinning viable rural hedgehog populations.

Key partners: PTES, BHPS, Nottingham Trent University, University of Reading, WildCRU, RSPB (Hope Farm), BTO, GWCT (Loddington)

Priority: high

Timescale: long

Status: underway

Target: By 2025, have a working example of a farm landscape where habitat modifications permit coexistence of badgers and hedgehogs.

O8 → Collect evidence of successful habitat mitigation for hedgehogs

There is great potential for development to benefit hedgehogs, if done sensitively. Projects such as the RSPB/Barratt/Kingsbrook development will be the first field scale trial for this, demonstrating the importance of baseline monitoring (Harper, 2015). Also Land South of Croft Road/EPR/Taylor Wimpey and David Wilson Homes. In general, evidence of benefits may be hampered by ongoing issues with estimating hedgehog abundance. It is also important to use the network of people who have attended the PTES/BHPS Hedgehog Ecology and Management for Practitioners course and CIEEM contacts. All opportunities should be taken to work with willing developers, and especially housing associations, whether or not legal protection for hedgehogs improves.

Key partners: PTES, BHPS, RSPB, Barratt, Wildlife Trusts, consultants, NE, NRW, SNH, NIEA, LPAs

Priority: medium

Timescale: ongoing

Status: underway

Target: Circulate written guidance for developers based on successful hedgehog-friendly new builds by 2017.

O9 → Deal with urban habitat fragmentation - existing properties and new builds

Hedgehog Street (and The BIG Hedgehog Map: www.bighedgehogmap.org) should be the main mechanism for delivering this in existing properties, as well as ongoing outreach. Fencing contractors need to be encouraged to provide (and promote) permeable solutions to their clients. There are huge opportunities for new build developments that improve the status of hedgehog populations right across the UK. Experiences from development projects where impacts on hedgehogs are being monitored (e.g. Barratt/RSPB Kingsbrook) will hopefully add a much needed evidence base and demonstate the art of the possible to the development sector as a whole. New technologies for off-the-shelf garden connectivity may also be needed. Better legal protection would be the most direct way of delivering hedgehog-friendly new builds.

Key partners: PTES, BHPS, RSPB, Wildlife Trusts, developers, consultants, NE, NRW, SNH, NIEA, LPAs

Priority: high

Timescale: ongoing

Status: pending

Target:

(a) Have 10,000 hedgehog holes recorded on The BIG Hedgehog Map by 2020.
(b) Hedgehog population trends from garden-based survey data (BTO *Garden BirdWatch*, PTES *Living with Mammals*) stabilised by 2025 (see O1).

3.3 Mortality (O10-O12)

O10 → Monitor disease and its impact

It is important that we collect more information about the diseases (infectious and non-infectious) affecting the wild hedgehog population, and their impact, as research has been limited. This information could also could inform the triage and management of hedgehog casualties in rehabilitation and shed light on the drivers of the national decline. New diseases may also emerge in the future which are far harder to detect and respond to without national surveillance schemes in place.

Key partners: ZSL, RSPB, BTO, Froglife, PTES, BHPS, RSPCA, BWRC.

Priority: medium

Timescale: ongoing

Status: underway

Target:

(a) Ensure national health surveillance continues until 2025 as a minimum.
(b) Update rehabilitation guidance based on growing scientific knowledge base.

Additional research #3: Ultrsonic pest deterrents - Easy to do but no information about numbers in use or evidence for any impacts (even anecdotal). Existing research: Nelson et al. (2006) shows some support of efficiency on cats. Needs evidence base.

O11 → Improve estimates of numbers of hedgehogs killed annually on roads AND Investigate road mortality and mitigation O18)

Current estimates of road mortality are possibly too low, especially in light of far larger values calculated for Holland and Germany (Huijser & Bergers, 1998). It would be beneficial to reassess the population-level impact of this driver of mortality in both urban and rural settings.

Key partners: PTES

Priority: medium

Timescale: medium

Status: pending

Target: Published a revised estimate of the number of animals killed on roads by 2016. (Wembridge, et al., 2016)

A recent paper has upgraded the importance of road mortality as a possible driver of hedgehog declines (Wembridge et al. 2016). To increase the accuracy of the estimate of the total number of hedgehogs killed on our roads, the parameters for both ‘persistence’ and ‘detection’ of hedgehog carcasses must be improved. We must also learn more about roadkill itself: are there hot spots, and if so why? How can road tunnels and fencing be used to effectively mitigate for this threat?

Priority: high

Timescale: up to 2021

Status: pending

Target: Have an accurate estimate for number killed on roads by 2019. Demostrate effective road mitigation for roadkill by 2020.

O12 → Engage with gamekeeper organisations and others to tackle bycatch

The impact of bycatch from non-specific traps is unknown. Form/join a forum with interest groups. Develop improved Fenn trap exclusion techniques (building on Short & Reynolds, 2001). Get a reliable indication of number killed per annum. RSPB estates data?

Key partners: PTES, BHPS, GWCT, BASC, RSPB, NGO, SGA, Moorland Association, DEFRA, devolved governments, VWT

Priority: medium

Timescale: long

Status: pending

Target: End bycatch of hedgehogs on estates by 2020.

NEW OBJECTIVE FOLLOWING SGM NOV 2017:

- First winter mortality rate study to work out minimum figure of survival
- Run Hibernation surveys again in Phase 5/6

3.4 Public engagement and training (O13-O17)

O13 → Maintain, develop and grow Hedgehog Street campaign to engage the public

This campaign offers a key way urban hedgehog populations could be stabilised. With the hedgehog recognised as the nation's favourite wild animal, 'Hedgehog Champions' can be recruited on an unprecedented scale. An updated and improved website would be central to this, with materials and content updated and current. Hedgehog Street resources should also be expanded to target children, schools and teachers. Part of a successful expansion will also be a research project that rigorously tests the concept, and provides evidence of the limiting requirements for success (e.g. minimum density of participating households in a neighbourhood).

Key partners: PTES, BHPS, Housing Associations, RHS, Wildlife Trusts, National Trust, RSPB

Priority: high

Timescale: ongoing

Status: underway

Target: 100,000 Hedgehog Champions recruited by 2025.

O14 → Create hedgehog-friendly management advice aimed at improving non-garden urban/suburban land

Engage new audiences by producing guidance on helping hedgehogs in urban/suburban habitats other than gardens (e.g. allotments, churchyards, schools, parks, woodlands etc.) in partnership with/to disseminate to relevant interest groups. Branded Hedgehog Street and/or through RSPB's 'Giving Nature a Home' campaign and Wildlife Trusts' 'Living Landscapes'/'Wild about Gardening'.

Key partners: PTES, BHPS, Church of England, allotment societies, RSPB, Wildlife Trusts.

Priority: high

Timescale: medium

Status: pending

Target: Establish partnership projects to deliver these materials for different greenspace habitats by 2020

O15 →Deliver training courses targeting urban green-space management

Franchise training courses across the UK to educate consultants, green-space managers and developers about the ecological needs of the species.

Key partners: PTES, BHPS, Wildlife Trusts, expert trainers

Priority: high

Timescale: medium

Status: underway

Target: Run five courses a year until 2020, then reassess. Push into five new regions in this time. Develop online hub for participants through a Google Group. Ensure over 50% of attendees rate course as 'excellent'.

O16 →Public events

Who would the audience be? Talks based on the findings of research funded by PTES and BHPS. Audience primarily 'Hedgehog Champions'. There is significant scope for future events involving the commercial sector, developers and farming organisations too.

Key partners: PTES, BHPS

Priority: medium

Timescale: short

Status: Underway The Day of the Hedgehog (public event), 21st November 2015, Telford International Conference.

Target: Hold an event before the end of 2015

O17 → Maximise the positive impact of rehabilitation centres

There are currently ~800 known wildlife rehabilitators that take in hedgehogs, ranging from those that accept a handful of animals to large centres hosting 1000+ animals per year (Morris, 1998). This is a diverse sector, with active participants ranging from professional wildlife rehabilitators, volunteer hedgehog carers and members of the public that encounter hedgehogs. The number of centres also appears to be on the increase (Fay Vass, pers. comm.). Currently there is no centralised record keeping and no regulation of practice. Develop best practice guidance (BHPS, RSPCA and carers), including centralised electronic record keeping. Existing research programmes (e.g. RSPCA and University of Brighton) should be built upon to improve our understanding of post-release survival and integration of released animals into existing hedgehog populations. Perhaps beneficial for rehabilitators to be licenced, following USA (and Wales possibly). Encourage collaboration between wildlife rehabilitators and organisations undertaking hedgehog health surveillance; e.g. reporting of unusual or novel casualty presentations; provision of non-invasive samples for study for hedgehogs recently admitted into care; contribution to sample archives.

Key partners: BHPS, RSPCA, Gower Bird Hospital, Shepreth Wildlife Park, Vale Wildlife Hospital, BWRC

Priority: high

Timescale: ongoing

Status: pending

Target: Have centralised electronic database in place by 2018.

Additional research following the introduction of a carers database:

#10 - Carer activities survey. Moderate - the meat of the problem is setting up the database. Once this is in place, 14.a, 15.a, 15.b, 15.c could all follow fairly easily.
#4 - Dispersal and fate of rehab releases. Moderate - need GPS/radiotracking equipment, a researcher, a licence
#13 - Implications of supplementary feeding on dental health. Needs evidence base
#14a – Parasite distribution and persistence
#15a – Numbers in captivity
#15b – Longterm welfare of released injured hogs (eg missing limb)
#15c – Prevalence of ear conditions
#16 – Timing of releasing rehab hedgehogs

4. Position statements

4.1 Badgers and hedgehogs

Several studies have demonstrated that badgers will kill hedgehogs, but they also eat many of the same prey items (especially worms). The same food cannot be eaten twice. Badgers are both a predator and a species competing for food.

The recent controversy regarding culling of badgers concerns the vexed question of how to control bovine TB in cattle and badgers. Since badgers represent a threat to hedgehogs, see above, British Hedgehog Preservation Society (BHPS) has been urged to support badger culls as being potentially beneficial to hedgehogs.

None of the scientific evidence supports the idea that culling badgers is an effective means of controlling bovine TB in the field. Recent pilot culls (2013, 2014) failed to kill sufficient animals for the cull to have been effective (despite extending the length of the trial) and raised doubts about the humaneness of the method. Given this, BHPS and People's Trust for Endangered Species (PTES) join leading wildlife scientists in arguing against a cull of badgers to control bovine TB. Indeed, scientific evidence suggests that culling badgers may make the TB situation worse, a further reason why PTES/BHPS would not advocate culling badgers to benefit hedgehogs.

An analysis of the original badger culling experiments, published in April 2014, shows that, at some sites, hedgehog numbers did increase following reduction in the number of badgers. This is not unexpected, considering what we know of the relationship between hedgehogs and badgers. BHPS and PTES do not consider this sufficient evidence to advocate culling badgers as a means of increasing hedgehog numbers, and believe that culling any species in an effort to conserve another is undesirable given better environmental approaches.

Hedgehogs are predated by badgers and badgers compete with hedgehogs for food. The two species have coexisted in Britain for several thousand years and, whilst it is likely that where badger numbers are high the number of hedgehogs will be low, to identify badgers as the single most important factor affecting hedgehogs today is a mistake when there are more pressing issues like habitat loss. We know that when the habitat is rich with nesting and feeding sites, the species are able to coexist.

Hedgehogs are declining severely even in parts of the country with low badger densities (e.g. East Anglia). It is clear that several interacting pressures are at work. Bolstering hedgehog populations would be better achieved by increasing and improving habitat that supports both species – for example: restoring hedgerows to improve shelter and nesting opportunities; managing field margins and grasslands in ways that encourage abundance and diversity of invertebrates.

4.2 Introducing hedgehogs onto islands

There is an extensive literature on the effects of the introduction of non-native mammals on the ecosystems of islands. Such introductions can often result in negative impacts on the native flora and fauna, ecosystem-level effects and sometimes extinctions. In light of this research, it is unequivocal that hedgehogs should not be deliberately introduced onto an island where they are not considered native. Examples of where this has happened with the West-European hedgehog (*Erinaceus europaeus*), e.g. New Zealand, North and South Uist, North Ronaldsay) demonstrate that the ecological impacts can be deleterious and significant, particularly on ground nesting birds whose

eggs and chicks they can predate. It can take some time for the presence of the mammal to be recognised, by which point intervention is difficult and expensive. In scenarios where hedgehogs are detected on such islands, it is imperative that the response is swift and robust. Any intervention must also be mindful of the fact that: 1) hedgehogs are thought to be tolerant of capture and translocation; 2) offtake targets must be based on a sound understanding of population ecology; and 3) hedgehogs are hugely popular animals and any intervention will be a significant PR exercise. Non-lethal methods of control should always be considered as the preferred course of action.

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6. Summary of Extant Objectives			Year													
Priority	Objective		14	14	15	15	16	17	18	19	20	21	22	23	24	25
high	*O1*	Develop a biennial 'State of the Nation's Hedgehogs' index of sufficient power and coverage			x	x	x	x	x	x	x	x	x	x	x	x
high	*O2*	Develop improved tools and methodologies for hedgehog surveying by professionals	x	x	x	x	x	x	x	x	x	x	x	x	x	x
medium	*O3*	Learn more from the existing datasets			x	x										
medium	*O4*	Publish all available knowledge about hedgehog trends, monitoring techniques etc.	x	x	x											
medium	*O5*	Understand the significance of rural habitat fragmentation	x	x	x	x	x	x								
high	*O6*	Compile and promote advice for farmers that includes specifications for hedgehogs	x	x	x	x	x	x	x	x	x					
high	*O7*	Understand what will permit badger and hedgehog coexistence	x	x	x	x	x	x	x	x	x	x	x	x	x	x
medium	*O8*	Collect evidence of successful habitat mitigation for hedgehogs		x	x	x	x	x	x	x	x	x	x	x	x	x
high	*O9*	Deal with urban habitat fragmentation - existing properties and new builds	x	x	x	x	x	x	x	x	x	x	x	x	x	x
medium	*O10*	Monitor disease and its impact	x	x	x	x	x	x	x	x	x	x	x	x	x	x
medium	*O12*	Engage with gamekeepers directly to tackle by-catch			x	x	x	x	x	x	x					
high	*O13*	Maintain, develop and grow Hedgehog Street campaign to engage the public	x	x	x	x	x	x	x	x	x	x	x	x	x	x
high	*O14*	Create hedgehog-friendly management advice aimed at improving non-garden urban/suburban land			x	x	x	x	x							
high	*O15*	Deliver training courses targeting urban green-space management	x	x	x	x	x	x	x	x	x					
high	*O17*	Maximise the positive impact of rehabilitation centres		x	x	x	x	x	x	x	x	x	x	x	x	x