



Rialtas na hÉireann
Government of Ireland

VWT Vincent
Ireland Wildlife Trust

Lesser Horseshoe Bat Species Action Plan 2022-2026



Prepared by the Department of Housing, Local Government and Heritage
npws.ie

Citation: NPWS & VWT (2022) *Lesser Horseshoe Bat Species Action Plan 2022-2026*. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Cover Photograph: Lesser horseshoe bat ©Frank Greenaway

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National Parks and Wildlife Service 2022

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Executive Summary

This is the first Species Action Plan (SAP) for the lesser horseshoe bat in Ireland. The aim of the plan is to guide, inform and provide structure for the conservation management of this important species over the next five years (2022-2026).

The SAP provides some background to the ecology and status of the lesser horseshoe bat in Ireland. It also includes an overview of the conservation and research activities that has been undertaken to date.

The core of the plan is Section 4: Practical Conservation Measures. These measures have been divided into broad categories – Roosts, Habitat, Connectivity, Outreach – with a number of specific actions under each heading. The effective conservation of the lesser horseshoe bat will require cooperation across a number of Departments, agencies and NGOs. Extensive consultation has taken place with these stakeholders in the development and finalisation of this SAP. Arising from this it has been possible to identify timeframes and lead actors for each action. The plan also endeavours to identify cross-over and synergies with other local or national management plans. This SAP provides ambitious but achievable targets for the coordinated conservation of the lesser horseshoe bat during the coming five years.

Acknowledgements

We would like to acknowledge the input of colleagues who took part in the consultation process for this plan from the following organisations: NPWS, VWT, Department of Agriculture, Food and Marine, OPW, Forest Service, Coillte, Transport Infrastructure Ireland, Teagasc, Local Authorities, Heritage Council, Bat Conservation Ireland.

With thanks to Andrew Harrington for use of the Map on Page 9.

Abbreviations

BCIreland – Bat Conservation Ireland

DAFM – Department of Agriculture, Food and Marine

FS – Forest Service

HC – Heritage Council

LA – Local Authority

NPWS – National Parks & Wildlife Service

OPW – Office of Public Works

TII – Transport Infrastructure Ireland

VWT – Vincent Wildlife Trust

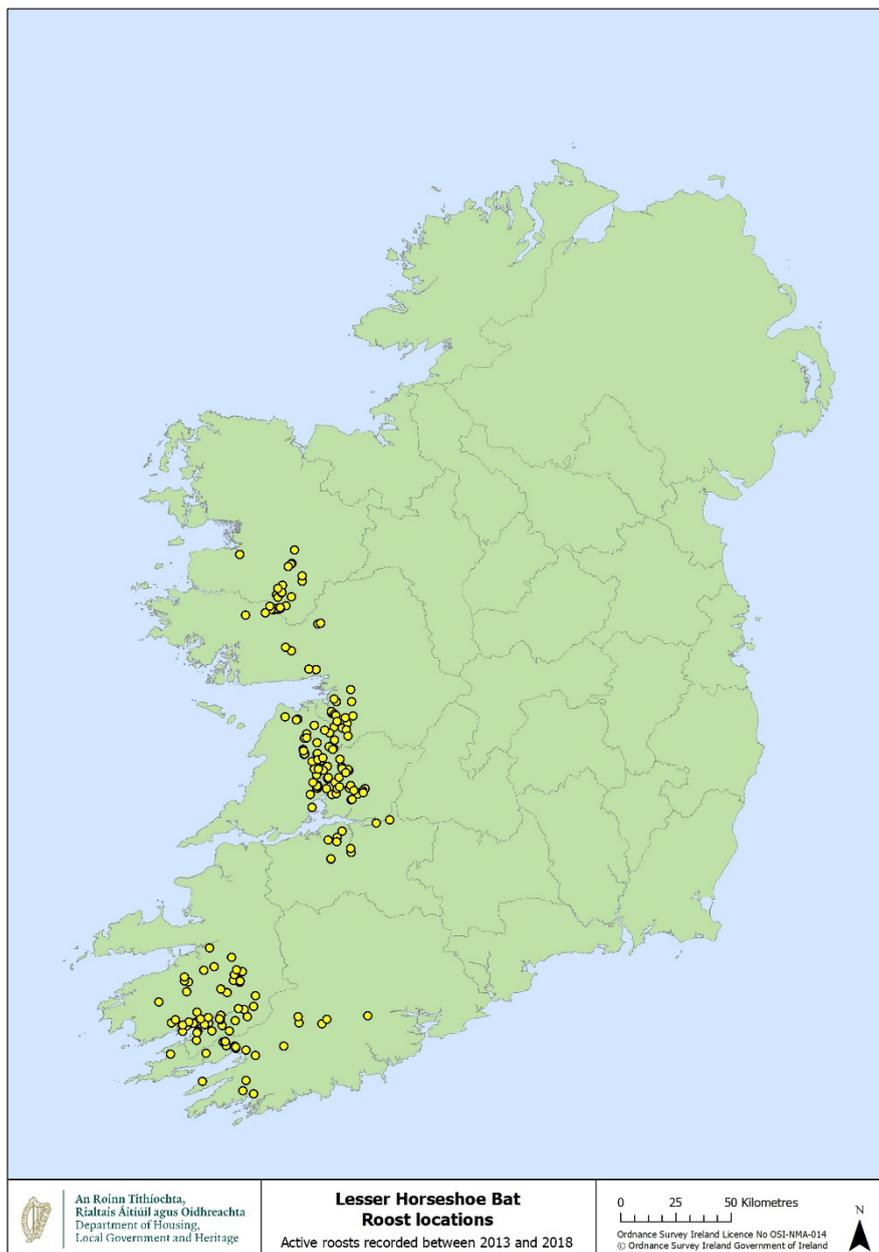
Introduction



Credit: Frank Greenaway

1. Introduction

There are many factors that set the lesser horseshoe bat apart from the other eight Irish bat species and so merit the production of an action plan focused on it alone. It has limited access to suitable summer and winter roosts due to its inability to land and crawl through small openings, needing to fly directly into a structure. Although it does not have a specialized diet, it prefers to feed in broadleaf woodland, a scarce habitat comprising less than 2% of Ireland’s tree cover. Its distinctive echolocation call enables it to fly within cluttered environments but does not travel far, so the bats need to fly close to linear features to navigate through the landscape. Lesser horseshoe bats generally fly within 5m of a feature and avoid open areas. In addition, the echolocation call is not able to detect approaching predators so at higher light levels this species flies close to vegetation to avoid being attacked. It is the most photophobic of all the Irish bats.



The most recent estimate of the lesser horseshoe bat's population is 12,790 individuals. Although population monitoring indicates that the species' numbers are increasing, the bat is confined to six western counties, occurring in clusters, with large areas that contain few or no colonies.

Two recent population genetic studies indicate that this species now consists of four distinct sub-populations that have developed due to habitat fragmentation caused by agricultural intensification and urbanisation, with the water bodies of Lough Corrib and the Shannon Estuary possibly posing additional barriers to movement. The lesser horseshoe bat is listed on Annex 2 of the EU's Habitats Directive and there are 41 Special Areas of Conservation for which this species is a Qualifying Interest. These sites are believed to contain between 5,000 and 7,000 bats.

Nonetheless, concerns about habitat loss and landscape connectivity led to an 'unfavourable inadequate' assessment of its conservation status in the most recent Article 17 report to EU Commission (NPWS, 2019). The actions described in this plan are those considered necessary to restore this species to a favourable conservation status.

Current Knowledge



Credit: Ruth Hanniffy

2. Current Knowledge

In contrast to other species whose numbers are declining and for which little is known about their ecology, the lesser horseshoe bat in Ireland has been the subject of surveys, long-term monitoring, research and conservation since the late 1970s. There is, therefore, a large body of information on which to base future actions to assist it, although certain aspects of their behaviour are still little studied, for example, mating behaviour.

2.1 Roost Surveys

O'Sullivan (pers. comm.) undertook regular visits to a number of summer and winter roosts of the lesser horseshoe bat from the 1970s onwards. He observed a decline in the number of hibernating horseshoe bats at three caves in County Clare from 1979 to 1982 coinciding with low mean minimum winter temperatures, while numbers at sites in west Cork and Kerry, where higher mean winter temperatures were recorded, remained stable or increased. His observations at these sites comprised the only research on the species until the first national bat survey was launched by the then Wildlife Service in 1985, which continued until 1988 (O'Sullivan, 1994). This survey located lesser horseshoe bats at 157 summer and winter roosts, many of which were in large, unoccupied old buildings and over half of which held 50 or more bats. VWT conducted surveys during the winters of 1994 and 1997 at 166 potential hibernation sites in six counties and recorded 757 lesser horseshoe bats, with twice as many recorded from caves and fissures compared to man-made structures, such as cellars or mines (McAney *et al.*, 2013).



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McGuire (1998) undertook a detailed survey of north Clare in 1995 and recorded 990 lesser horseshoe bats in summer and 165 in winter at 24 sites. All of the summer roosts were in unoccupied structures, ranging from former dwellings to farm outbuildings. Roche (2001) undertook a survey of potential roost sites in County Limerick in 1997, the first of nine summer horseshoe bat surveys undertaken by the VWT up to 2004. She checked 185 properties and although 142 new bat roosts were recorded, only four of these held horseshoe bats and the largest colony contained only fifty bats.

Anecdotal reports noted by Roche suggested that this species had been more common and that suitable buildings had been renovated or demolished or woodland cleared.

The other VWT summer surveys targeting horseshoe roosts took place in Mayo, Galway, Clare, west Cork and Kerry (McAney *et al.*, 2013). A total of 3,276 structures in 3,000km² were visited and of these 508 were classified as being used by the species, based on the presence of the bats or their distinctive droppings. Fifty-nine maternity roosts were recorded containing 4,322 bats, almost all of which were in old unoccupied buildings, with open doors or windows as bat access points. The majority of buildings were stone-built with natural slate roofs. Several roosts containing >150 bats were discovered. Colonies using small outbuildings were thought to have relocated to these from nearby larger, previously more suitable, structures that were no longer available to the bats, primarily due to the deteriorating conditions at the buildings.

Kelleher (2004) collated all the documented roost data collected a 30-year period on the lesser horseshoe bat in a study for NPWS, one of the aims of which was to determine the distribution of the species. This study applied a roost classification system, created by Schofield (1996), to 690 roosts and classified 126 as maternity (sites with >20 more bats between May-Aug and young present), 148 as hibernation (bats present Oct-March), 82 as satellite (sites <20 bats but situated close to maternity roosts), 121 as transitional (bats present prior to occupying maternity roosts in April or after leaving these in October) and 318 as night roosts (used between March and November by small numbers of bats). Of the 690 roosts recorded, 366 were in Kerry, 176 in Clare, 67 in Galway, 35 in Cork, 25 in Mayo and 21 in Limerick. This study highlighted the lack of information on the foraging and commuting behaviour of the species and the need to designate foraging areas and commuting routes once these were identified. The data collated by Kelleher were subsequently converted into an MSAccess database by NPWS and this remains the primary national database of lesser horseshoe bat roosts and monitoring data.

The summer roost preferences of the species was investigated by Kelleher (2006) using the dataset from his 2004 study but also data on roosts discovered since then. Of the 546 structures for which the building material was recorded, 93% were stone-built. Of the 523 structures for which the roofing material was recorded, 53% were slate, increasing to 55% for slate roofs with underlying felt or timber boarding while 20% of roosts were covered by corrugated iron, increasing to 38% where the iron was laid on other roofing materials such as thatch, felt or timber or combined with slate. Only five roosts were under tiled roofs.

2.2 Ringing Studies

As the lesser horseshoe bat is highly sensitive to disturbance and may suffer from capture myopathy when handled, it has not been the subject of a systematic ringing study in Ireland. A number of licences, however, have been issued to ring a small number of bats at specific sites, in order to locate other roosts used by them. O'Sullivan (pers. comm.) ringed horseshoe bats during hibernation in a cave in County Clare in the early 1980s and subsequently found them at two other caves and a summer roost, all within one kilometre of the first cave; one ringed bat was still being observed 16 years later.

VWT (pers. comm.) ringed 17 bats in March 1997 at caves in Clare and Galway and an underground passage associated with a ruined mansion in Mayo and subsequently traced these bats to three summer roosts, one of which had not been known previously.

A small number of individuals were also tagged during the EIA for the Galway bypass to help identify connected roosts and potential commuting routes.

2.3 Population Estimates

The first population estimate for this species was based on the number of bats recorded at the 157 roosts surveyed by NPWS between the years 1985-1988 and was assessed to be 12,000 bats (O'Sullivan, 1994). Kelleher (2004) produced a lower estimate of between 9,000–10,000 bats based on data from 690 roosts, noting that several of the large colonies discovered in the 1980s now contained fewer bats, because the buildings had deteriorated or the bats had been disturbed, causing the colonies to split into smaller groups that were roosting in less favourable breeding conditions.

A third population estimate of 12,250 bats was generated based on the number of bats recorded in one year at winter and summer roosts in a review for NPWS (Biggane, 2006). A total of 101 winter sites in six counties were visited between mid-January to 28 February and 154 sites were surveyed over a four-week period in May and June, so before the young of that year were on the wing. More bats were recorded in summer than winter (7,560 and 4,411 respectively) and the author highlighted five winter sites and 14 summer sites that were at risk from some form of disturbance and that warranted protection.

Roche *et al.*, (2012) analysed count data from summer and winter covering the years 1986 to 2012 in order to update the population estimate and to identify trends and threats. Results of the revised population estimate using a ratio of 1:3 (male:female bats) per summer site, and the addition of estimated count data for unmonitored sites produced a population estimate of 14,010 bats from the 183 maternity sites that had previously been identified by Kelleher (2004). The statistical software, Genstat, was used to conduct trend, power and simulation analyses on 2,864 records.

Results of the trend analysis suggested the number of bats at summer roosts increased for most of the study period, with significant increases from 2003-2005, following by a levelling-off or slight decline since 2008. Trend analysis for a longer time period was possible on data from winter sites and followed that observed at summer roosts. Power Analysis proved that one annual count at summer and winter sites was sufficient to detect a significant increase or decline but there was a slight difference in the number of years at which a 50% decline would be detected, within 10 years if 50 summer sites were counted but 13 years at the same number of winter sites. This study, where information was available, also looked at the effects of various activities on the sites and highlighted that urbanisation was a negative factor at 24 out of 36 sites, with other human activity negatively affecting 14 out of 19 sites. There was, however, a decrease in the level of disturbance recorded at winter sites from 2010 onwards. During 2006-2009, 1,707 bats benefited from roost or habitat enhancements at 19 sites with 1,927 bats at 18 sites benefiting during 2010-2011.

Roost monitoring surveys have been conducted annually since 2006 at c80 winter sites and c120 summer sites. The counts are added to the national database, now managed on behalf of NPWS by BCIreland (Roche *et al.*, 2015).

Population estimates are now calculated for each cycle of Article 17 reporting under the Habitats Directive. The estimate included in the 2013 report was 14,010, the figure generated by Roche *et al.*, (2012), based on counts conducted at summer roosts. The current estimate of 12,791 included in the 2019 report is based on count data for the years 2016-2017 (NPWS, 2019). This is lower than the previous estimate but reflects the significant adjustment made to the formula used in 2012-2013, rather than an actual decline. This adjustment was based on two factors: a) new genetic research (Harrington, 2018), which demonstrated that the percentage of males present at summer sites was approximately 44% rather than 25% as previously thought, and b) because additional estimates for unmonitored sites were not added to the estimate, instead data from 162 confirmed and regularly counted sites were included.

2.4 Diet Studies

The diet of the lesser horseshoe bat in Ireland (McAney & Fairley, 1989; Biggane, 2003) varies seasonally with a greater range of arthropods eaten in summer than winter and this species is considered to be an opportunistic and generalist forager that benefits from access to a range of habitats. The summer diet consists mainly of night-flying Diptera (midges, crane flies, window midges), Lepidoptera (moths and butterflies – the latter presumably caught within the roosts) and insects associated with aquatic habitats (Trichoptera – caddis flies and Neuroptera – lacewings), Psocoptera (barklice) and Hemiptera (true bugs). Several of the insect families taken, such as the jumping plant lice (Psyllidae), live primarily on vegetation, so are gleaned off this by the bats rather than caught in flight. In winter the diet was primarily Scathophagidae and Sphaeroceridae, insects associated with cow dung, but these insects are also consumed in summer.

The reduction in the abundance of these insects by the use of anthelmintic treatments in cattle requires investigation to assess its significance on the diet of horseshoe bats in Ireland.

2.5 Bat Detector and Radio Telemetry Studies

The lesser horseshoe bat has evolved a highly specialised echolocation system that differs from that of the other Irish bats and is adapted for flying in cluttered environments, for example, dense vegetation. This species is also very sensitive to movement, such as the wing beats of flying insects. It produces its calls by suppressing the fundamental note in favour of the second harmonic, so on a hand-held tuneable bat detector the call is best heard at 110kHz, rather than 55kHz, and sounds like a melodic warble. Although distinctive, this high frequency call quickly attenuates and is highly directional, making this species difficult to detect by the normal survey method of walked line transects.



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This species can, however, be successfully detected using static detectors placed along flight lines from roosts or along potential commuting routes. Abbott *et al.*, (2012) recorded lesser horseshoe bats at three adjacent motorway under-passages on the Ennis by-pass in County Clare using detectors that recorded bat activity from dusk to dawn. The passageways varied in size

but were all easily negotiated by the lesser horseshoe bat. Concurrent radio telemetry studies confirmed that the bats were using the passages to fly under the motorway but also revealed that they regularly flew over the motorway's four traffic lanes while commuting between patches of tree cover and generally only made short detours to use the passageways (Abbott, pers. comm.). An important recommendation from the 2012 study was that where sections of woodland are severed by a new road, incorporating narrow passages at these junctions may reduce lesser horseshoe bat mortality. More recently new records for this species have been recorded on static bat detectors during the Foynes to Limerick Road Environmental Impact Assessment Report (2019).

Biggane (2003) conducted the first radio telemetry study of the lesser horseshoe bat in Ireland in the summers of 2001 and 2002 as part of her research of the diet, foraging activity, habitat selection and nocturnal behaviour of the species at one summer maternity roost in County Clare from 1999-2003. Several other radio telemetry studies have been undertaken since then to establish foraging areas and commuting routes around specific roosts (eg Biggane, 2005a and 2005b; Kelleher 2007; Kelleher & Schofield, 2008) or as part of road mitigation studies (Abbott *et al.*, 2012; N6 Galway City Ring Road Environmental Impact Assessment Report, 2018).

All the studies confirm that this species is sedentary and stays within a few kilometres of the maternity roost (although longer flights are occasionally made) and highlight the importance of protecting the habitat close to the roosts, in addition to the roost structure. The tracked bats used tree lines, hedgerows, stone walls and reed beds to commute along and made frequent use of temporary roosts at night, close to their foraging areas, including unoccupied houses, farm buildings, timber shelters, and on one occasion a horse box (McAney & Schofield, pers. comm.).

2.6 Landscape Modelling Studies

Lundy *et al.*, (2011) included data on the lesser horseshoe bat during their study of the roosting and landscape associations of Irish bats. Using the existing database of records collated by BCIreland (www.batconservationireland.org) they analysed the habitat and landscape associations of all Irish bats. The results for the lesser horseshoe bat, based on 494 roosts, showed that this species had a positive association for both broadleaf woodland and mixed forests but a negative association for arable land. It selected roosts constructed of stone rather than brick and avoided occupied buildings. The core area occupied by it was the smallest of all the Irish bats at just 5,933km² and was restricted to the karst landscapes in the west of the country. This was the first study to highlight the existence of two distinct regions within this core area, one in Kerry and west Cork in the south and one comprising Galway/Clare/Mayo in the north, separated by marginally favourable habitat. The authors pointed out that the area dividing the two regions, corresponding to Limerick and north Kerry, was important if further fragmentation of the national population were to be prevented.

VWT has conducted three desktop studies, two of the landscape in the Limerick and north Kerry area and one of all six counties to determine what factors were responsible for the absence of the lesser horseshoe bat and what options there were to mitigate for these. Lyons (2014) assessed roost records supplied by BCIreland and found the species was no longer using the four most westerly roosts in Limerick. A gap of over 45km had opened between the still occupied roosts in Rathkeale (Limerick) and those at Castleisland and Tralee (north Kerry) and this increased to 70km between roosts with more than 25 bats. She highlighted that Limerick and north Kerry were traversed by uplands with four peaks over 300m, unsuitable habitat for the lesser horseshoe bat, and there were only scattered remnants of old-growth broadleaf. There was also a lack of natural caves for winter hibernation in the Namurian sandstone and shale and although this is also the case further south, there horseshoe bats are able to hibernate in man-made structures, due to the warmer mean minimum winter temperature. Despite these restrictions, the good river matrix in Limerick, a proposed greenway between the two counties and the expansion of conifer woodland in the uplands were considered possible pathways for bridging the gaps, along with the provision of new roosts.

Lenihan *et al.*, (2021) used roost records of the species and expert opinion to identify areas of potential connectivity in the Limerick and north Kerry area using the software package Universal Corridor Network Simulator (UNICOR), which is a species connectivity and corridor identification tool used to increase understanding of species connectivity in fragmenting landscapes. The study area of 4,062km² was based on Lundy *et al.*, (2011) and information on 26 Limerick roosts and 36 Kerry roosts was obtained from the national database. Two different scenarios were investigated, one based on the three roosts that contained more than 25 bats and a second using all roosts in the region. The results of this study identified a potential pathway to link the largest maternity roost in Limerick with two maternity roosts in north Kerry that ran to the west of the Stacks and Mullagharirk Mountain Ranges and then along the Shannon Estuary. When all roost locations were used multiple potential corridors were identified that followed lowland habitats through the two mountain ranges and also a single route to the east of these.

The third VWT desktop study undertaken used Circuitscape, which is predictive software that uses electrical circuit theory to represent the landscape as a resistance surface through which a species can move, based on resistance values posed by landscape features (Finch & McAney, 2020). The datasets used in this study were roost data from all six counties, GIS information for land cover, distance to roads, distance to rivers, density of linear features and density of street lighting. Four different model scenarios were created for interaction between all roosts in all regions at landscape scale, between roosts in the northern and central regions, between the central and southern regions and between roosts in south Limerick and east Kerry. The results of this study indicate there are high levels of local connectivity between roosts within each of the three regions but limited connectivity between the regions. There is good connectivity within and between the northern and central regions, less scope for connectivity between the central and southern regions and there appears to be potential pathways to connect roosts in Limerick with those in east Kerry. The high level of artificial illumination associated with the cities of Galway and Limerick may be a barrier to movement by this species; County Limerick showed the highest density of street lights per m²; County Mayo had the lowest (Finch & McAney, 2020).

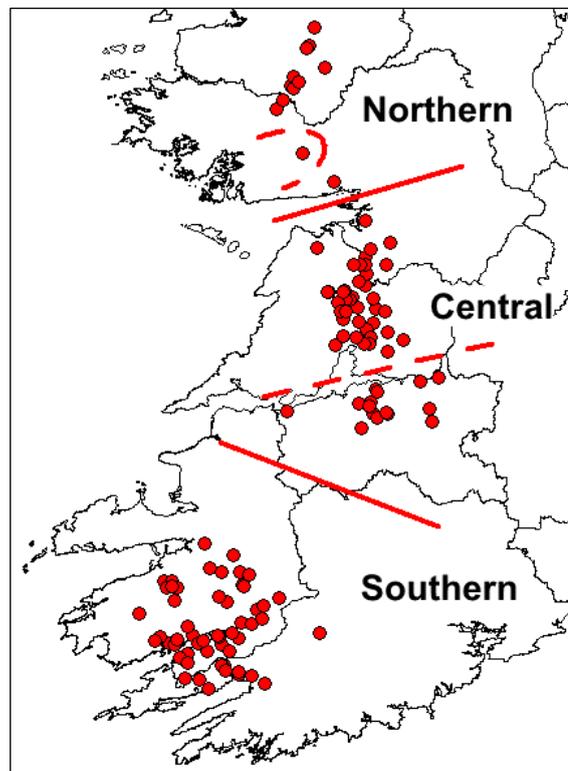
2.7 Genetics Studies

The first study of the genetics of Irish lesser horseshoe bats was undertaken by Dool *et al.*, (2016). This study was based on DNA collected from 491 bats at 37 colonies and revealed the presence of a North-Range/South-Range differentiation within Ireland. Analysis of echolocation data and microsatellites suggested further differentiation of the northern-most colonies, between bats in Mayo and north of Galway city and those in south Galway and Clare.

In addition, a landscape genetics framework to assess the impact of habitat versus geographic distance on population differentiation showed that habitat features at a five-km resolution were equally likely to be correlated with the differentiation as geographic distance alone. The authors stated that further differentiation of the two groups is likely to occur and that the viability of either group alone is uncertain given their restricted distribution, small population sizes and isolation.

Harrington (2018) examined the population genetics of the species, focusing on the northern part of its range, using DNA extracted from droppings collected at roosts. This study confirmed that there is consistent genetic structuring within the Irish lesser horseshoe bat population that has created three subpopulations described as southern (Cork/Kerry), central (Limerick, Clare and south Galway) and northern (north Galway and Mayo) (see Map below). In addition to this large-scale genetic structuring, differentiation was also detected at a smaller scale in both the central and northern subpopulations, with semi-isolated groups of colonies present in Limerick and north Galway, distinct from the other colonies in each subpopulation. The north Galway colonies were distinct from those in Mayo, while the colonies in south Galway and Clare were distinct from those sampled in Limerick, although sampling was only possible at one Limerick site. No additional genetic structuring was detected in the southern subpopulation. The three main subpopulations, however, are not completely isolated as there was evidence that interbreeding continues to occur at a low level between them or did so up to the time of this study.

Distribution gaps are leading to genetic sub-populations within the range of the lesser horseshoe bat in Ireland, from Harrington (2018).



Previous Conservation Actions



Credit: Frank Greenaway

3. Previous Conservation Actions

Conservation measures have been implemented at a wide range of lesser horseshoe bat roosts across the species range in Ireland. Initial efforts by NPWS to protect important cave sites by grilling date back to the 1980s. Minor repairs to individual summer roosts within National Parks followed. The arrival into Ireland of the VWT in the 1990s led to a significant expansion of roost protection works and the creation of dedicated and managed bat reserves for the species. The Heritage Council has also played a role through its protection of an important maternity site in Dromore, Co. Clare and through its management of the Traditional Farm Building grant scheme. Most recently, NPWS has been undertaking a programme of roost enhancement operations as well as constructing new winter and night roosts in suitable Nature Reserves and National Parks where the species occurs. NPWS farm plans with a focus on lesser horseshoe bats have also been prepared. A few examples of some of these conservation activities are provided in more detail below.

3.1 National Parks and Wildlife Service

Flahive's Lodge, Glengarriff Nature Reserve, County Cork

Glengarriff Nature Reserve, County Cork, is a 301ha woodland within the Glengarriff Harbour and Woodlands Special Area of Conservation (SAC). The Nature Reserve is owned and managed by NPWS. The lesser horseshoe bat is one of the qualifying interests of the SAC. In 2006, 'Flahive's Lodge,' a derelict building used by a lesser horseshoe maternity colony of 50-60 bats, was restored as an office for the Nature Reserve.



©Clare Heardman

As part of the renovations, the attic was adapted to provide a replacement roost for the bats, with a new access provided via a 'dormer window' opening in the roof. The number of bats using the roost increased from 101 in 2007 to 318 in 2021.

As it was not known where the bats using Flahive's Lodge hibernated, NPWS created an artificial hibernation site for this colony, to provide it with access to protected sites throughout the year. This was created close to the summer roost in 2007. The structure consists of a 2.2m (high) x 2.4m (wide) x 6m (long) underground chamber constructed with three precast concrete underpass sections set into an earthen bank.



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Block walls were built at both ends and an insulated access door, provided at the front with an opening as the access point for the bats. Suitable temperature and humidity levels, necessary during bat hibernation, were created by facilitating moisture to seep into the two chambers. The entire structure was covered by a layer of earth to a depth of 1m, which also helps to provide a suitable temperature regime.

The numbers of bats using this hibernaculum have risen from just one in the first winter (2007-2008) to 373 in 2020-2021.

Hen Harrier Project Grant (2020-2021), County Clare

NPWS and VWT used funding obtained from the Hen Harrier Project to create two hot boxes within existing privately-owned outbuildings in the Tulla area of County Clare in 2020. In both cases the owners undertook the construction work. There was no evidence of lesser horseshoe bats using either of these outbuildings prior to the provision of the hot boxes, but the species is present in this part of the county. In May 2021 a lesser horseshoe bat was recorded inside the hot box in one of the buildings and by July droppings were recorded in the other hot box.



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Two timber night roosts were also built and erected in woodlands in the area in 2021.



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Moorehall, Co. Mayo

Moorehall House is a ruined mansion in County Mayo, adjacent to Lough Carra. The mansion was first identified by NPWS as a lesser horseshoe bat roost in the mid-1980s and it has been monitored on an almost annual basis since then. Currently the basement of the mansion is a hibernation site for approximately 750 bats while an adjacent building is a maternity roost for approximately 300 bats. VWT funded minor repairs and security measures at both roosts during the 1990s to counteract a decline in the number of bats caused by storm damage at the maternity roost and disturbance at the hibernation roost. During the winter of 2009-2010 NPWS funded the complete restoration of the roof of the maternity roost and installed additional security measures at the basement. In January 2018 the ruin, its associated buildings and 32 hectares of surrounding woodland were purchased from Coillte by Mayo County Council. In June 2021 the council signed a Memorandum of Understanding with Coillte and the NPWS for the purpose of protecting, developing

and managing the natural, built and cultural heritage of Moorehall and the Lough Carra complex.

NPWS Farm Plan Scheme

The NPWS Farm Plan Scheme, which is administered by NPWS Agri-Ecology Unit, was launched in 2006. To date over 800 NPWS Farm Plans have been approved and these plans have been instrumental in pioneering conservation efforts for various habitats and species in Ireland and designing national agri-environment measures, which have been taken forward on a larger scale, for example in the Rural Development Programme.

One of the main objectives of this scheme is to trial novel approaches to farming for the environment, to safeguard particular sites, habitats and species, and to work towards meeting conservation measures required under the EU Birds and Habitats Directives.

To date, the NPWS Farm Plan Scheme has contributed to habitat enhancement works for the lesser horseshoe bats at 15 farms from South Kerry to Mayo. The measures applied have been an appropriate combination of roost works and includes the provision of new roosts, repairs and renovations to existing roosts, managing disturbance, habitat retention and enhancement, creation of new foraging corridors and resting opportunities and the avoidance of damaging activities, including anti-helminthic dosages in livestock that result in reduced prey availability.

3.2 The Heritage Council



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Dromore Stables in County Clare was first recorded as a lesser horseshoe bat maternity roost in the mid-1970s. It is one of a small number of maternity roosts of this species that has been monitored on an almost annual basis since its discovery and the colony has been the subject of two PhD studies.

The HC purchased the building in 1998 to safeguard its future as a bat roost. It undertakes repair and enhancement work on the building and surrounding grounds on an ongoing basis in partnership with Clare County Council's Heritage and Architectural Conservation Officers and BurrenBeo Volunteers.

Emergence counts are conducted annually by NPWS. The maximum number of adults recorded emerging was 376 in June 2020, while 331 were counted in June 2021

3.3 Vincent Wildlife Trust

VWT owns nine properties and leases on a long-term basis three others that are currently used by approximately 4,000 lesser horseshoe bats (or 30% of the national population) across four counties, Mayo, Galway, Clare and Kerry. These properties were acquired between the years 1998 and 2007 and all required extensive renovation following their acquisition. To-date additional post-restoration enhancement has been possible at eight of these and included the installation of hot boxes, a cool room, an artificial hibernation site and a night roost, the planting of small patches of woodland at three roosts and the conversion of 6.6 hectares of conifer woodland to native woodland at a fourth roost.

The Trust gathers evidence of the efficacy of the enhancement work it undertakes so this can be demonstrated and shared with others undertaking



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similar work for the species. It has also published a Handbook of practical measures for the species (Schofield, 2008).

During 2020-2021 VWT secured funding from the Hen Harrier Programme (<http://www.henharrierproject.ie/>) to create additional roosting areas for the lesser horseshoe bat in the Slieve Aughty Mountains area of County Clare. Potential locations for new roosts were identified by NPWS and by August 2021 two hot boxes had been installed in existing outbuildings and two night roosts erected in woodlands. Horseshoe bats are using both hot boxes and a static bat detector is being used to monitor activity at one of the night roosts, with visual checks for droppings at the second.

In May 2021 VWT, in partnership with Mulcair Catchment Ltd in County Limerick, was successful in obtaining funding from the Department of Agriculture, Food and the Marine under the EU Rural Development Programme 2014-2022 'Farm and Community Biodiversity Initiative' for a one-year project on the lesser horseshoe bat. The aims of this project are to provide new and permanent summer roosts on farms in east Limerick for this species and to raise awareness amongst the farming and rural community of the important role that farmers play in its future. The new roosts will be built within a few kilometres of waterways and woodlands that will, in time, increase the chances of this species connecting with horseshoe bat colonies in other parts of Limerick and possibly in adjacent counties (<https://www.mulkeareip.com/>)

3.4 Coillte

Several Coillte properties contain significant lesser horseshoe bat roosts, while the forests surrounding these provide important foraging and commuting habitats for the bats. Coillte has undertaken a range of measures to benefit these colonies that include providing a maternity roost in the courtyard of the ruined Curraghchase House, County Limerick, undertaking a study of the flight paths of the colony at Moorehall House, County Mayo (Kelleher, 2007) and commissioning a Biodiversity Action Plan that provides guidelines for forestry practices (Browne, Dunne & Roche, 2004). The future work of Coillte Nature in planting new native forests has the potential to enhance foraging habitats around lesser horseshoe bat roosts, both summer and winter.



Roost buildings at Curraghchase House, Limerick. ©Ruth Hanniffy

3.5 Transport Infrastructure Ireland

The Green Bridge on the M17/M18 motorway at Coole, on the outskirts of Gort, opened to traffic in September 2017. It is a dual-purpose bridge installed to allow both agricultural vehicles and lesser horseshoe bats to safely cross over the motorway. The lesser horseshoe bats in this area use foraging grounds and roosts that are located on both sides of the new motorway. Bat activity on the bridge was monitored during 2017, 2018 and 2019 by two static bat detectors (Aughney, pers. comm.). These devices were placed on the bridge and were programmed to record and store the ultrasonic calls of bats as they flew along the bridge. Static detectors were also placed north and south of the Green Bridge along the boundary of the motorway, with microphones directed towards the centre of the motorway median. Results of this monitoring revealed that the Green Bridge is being used by lesser horseshoe bats, however, a small number were also recorded flying directly over the motorway at points of established hedgerows and tree lines.



The Green Bridge on the M17/M18 motorway at Coole. ©Galway Co. Co. and Tina Aughney

Practical Measures for Lesser Horseshoe Bat Conservation



4. Practical Measures for Lesser Horseshoe Bat Conservation

As seen in the previous section, a substantial amount of work to conserve the lesser horseshoe bat has already been undertaken and is a basis for informing future activity, but this needs to operate at two levels. Actions are still needed at specific sites to provide/enhance suitable roosting opportunities, but others are now required at a broad landscape-scale across all six counties to counteract the problem of genetic isolation. This two-pronged approach is necessary to ensure that the three key areas of conservation concern, Roosts, Habitat and Connectivity, are addressed.



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4.1 Roosts

4.1.1 Roost Recording

Some roosts of the lesser horseshoe bat have been physically protected since the late 1970s, when the first hibernation sites were grilled to prevent disturbance of the bats or modified to create winter sites. Since then 92 roosts at 41 locations (summer and winter) have been included within the SAC network and conservation work has been undertaken at a number of these. Some of the SACs were designated just for this species, while in other cases the presence of the bats at roosts were added as qualifying interests in larger designations, for example, the Lough Corrib SAC. The structures designated vary in size from small natural caves and single-storey former dwellings or farm outbuildings to larger cave systems and large mansions.

Regardless of the size of the structure, in most cases the criteria used to select a site for designation was the presence of 100 or more bats in summer or the presence of 50 or more in winter.

There were more than 4,000 roost records for the lesser horseshoe bat when the national database for the species was updated and the condition of some of these was assessed in 2015 (Roche *et al.*, 2015). This report highlighted an ongoing problem of site deterioration, causing bat numbers to decline or, in some cases, roost abandonment. The problem was not restricted to a particular region, but was occurring throughout the species' distribution.

4.1a ACTION: Continue to update the national database annually with information on new roosts as they are discovered, but also to account for those that have deteriorated, been abandoned or lost and ensure this data is available to all relevant competent authorities.

WHO: NPWS/NPWS Database contractor

WHEN: Annually

4.1b ACTION: Undertake a review of the roost network across the species' range to identify those areas without adequate roosting opportunities, for example, winter hibernation sites, night roosts and maternity roosts.

WHO: NPWS/NPWS Database contractor, VWT, HC, Coillte, OPW

WHEN: 2023

4.1.2 Roost Protection

There is a system of strict protection in place for all bats in Ireland (see Mullen *et al.*, 2021; Marnell *et al.*, 2022). In addition, site-specific conservation objectives have been set for all lesser horseshoe bat SACs¹. A site-specific conservation objective aims to define the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level. Conservation objectives are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable status, namely population, range, and habitat for the species. Further detail on the rationale behind the conservation objective setting for the lesser horseshoe bat is provided in NPWS (2018).

Conservation measures have been undertaken at many roosts in recent years. At VWT sites they have been undertaken in a systematic manner. Elsewhere these measures have been implemented on an ad hoc basis when resources can be found and where land owner permission is readily available. A methodical review of lesser horseshoe roosts, including an assessment of all 41 SACs designated for the species (with reference to their site-specific conservation objectives), is now needed.

4.1c ACTION: Produce a roost resilience audit for 200 lesser horseshoe bat sites to identify the site specific measures needed to ensure the long-term conservation status of the species. This assessment (and audit form) should be based on the methodology used by the VWT and should highlight the priority measures needed at each site. The sites selected for this audit should include all those currently monitored annually plus those considered strategic for maintaining or acting as links between colonies or areas. A priority list for conservation action to be established, based on an objective scoring system.

WHO: NPWS, VWT, HC, Coillte, OPW

WHEN: 2022-2023

4.1d ACTION: Fund and oversee a multi-annual programme of roost repairs and

¹ <https://npws.ie/protected-sites/conservation-management-planning/conservation-objectives>

enhancement works to implement the site specific conservation measures identified in the resilience audit. This programme could be overseen by the creation of a Roost Liaison Officer.

WHO: NPWS, LAs, HC, Coillte, OPW and other landowners

WHEN: 2023-2026

4.1e ACTION: Maximise the potential of future Traditional Farm Buildings schemes to provide funding to support repairs to lesser horseshoe roosts by farmers.

WHO: HC, NPWS

WHEN: 2023-2026

4.1f ACTION: Continue to roll out NPWS farm plans that include repairs and enhancement works for lesser horseshoe bat roosts and foraging habitats.

WHO: NPWS

WHEN: 2022 - 2026

4.1.3 Roost Buffer Zones

In many cases it is only the structure the bats inhabit that has been included within the boundary of the SAC, due to a lack of information on how the colony utilized the surrounding habitat at the time of designation. We now know that the presence of suitable commuting and foraging habitat within a radius of at least 2.5km is important for the success of a maternity colony. Previously gathering this type of information was prohibitive, both in terms of equipment and personnel, and involved catching and handling bats. There is now, however, scope to assess habitat by using a combination of methods, including surveying commuting routes leading from a roost with hand-held detectors at dusk and by using modelling to target the placement of static devices in habitats and along linear features.

4.1g ACTION: Run a pilot study with NPWS staff and volunteers at a number of key roosts in areas at risk of habitat loss to determine key commuting and foraging areas, using both handheld and static detectors.

WHO: NPWS, BC Ireland, LAs

WHEN: 2023-2024

4.1.4 Roost Monitoring

At present all monitoring of lesser horseshoe bat roosts, both summer and winter, is undertaken by a small number of staff of NPWS and VWT and the latter's experienced volunteers.

This model yields high quality data. Ideally two counts are conducted at summer roosts before the young are able to fly, to ensure only adult bats are recorded, and the higher count is used in subsequent analysis. Roche *et al.*, (2015), however, referred to the high survey load experienced by this small team and that while this model conferred clear advantages (in-house training, availability of equipment and established relationships with roost owners) it does limit the number of counts that can be undertaken within relatively short survey periods. Where counts are conducted outside the survey period, due to a limited number of surveyors, this may impact the population trends produced, because later counts may include newly volant juveniles. It also limits the number of roosts that can be surveyed on a regular basis, so other strategies to augment survey capability, such as recruiting voluntary surveyors, was suggested.

While it is recommended, due to safety concerns at underground sites, that winter counts will always be conducted by NPWS staff, there is scope for creating a volunteer network to count emerging bats at summer roosts. This will, however, involve an initial investment in time and equipment to ensure new volunteers are trained to recognise both the variation in time of emergence and the behaviour of the bats at the roosts. Where exits are sheltered, the bats may start to emerge early but then return to the roost or fly directly outside the exit, because they have encountered higher light intensities away from the roost. This can make it difficult to distinguish emerging bats from those returning, particularly at roosts with hundreds of bats. Roosts with more than one exit require more than one surveyor or the use of infrared cameras at the exits. The resulting recorded footage then needs to be replayed at a later date, but this does confer the advantage of being able to replay at a slower speed, which enables a more accurate assessment to be made of the numbers of bats emerging or returning.

During the 2021 monitoring period in England and Wales, VWT worked with 45 newly recruited volunteers to help monitor its lesser horseshoe bat roosts. This was possible by securing a grant that enabled the purchase of 25 CCTV cameras that enabled the volunteers to count out bats on the night, thus removing the need for replaying recorded footage later, although back-up recordings were made. It is hoped, in time, that most roosts surveyed by Trust staff in the UK will be monitored in this way. In a pilot scheme in 2021 in Ireland VWT provided volunteers with recorded footage to view and record numbers of bats.

This footage had previously been viewed by its staff and it is hoped that a small number of dedicated volunteers will be recruited and retained to assist in this way on an annual basis with summer counts. If both or either of these approaches prove to be a reliable method to conduct summer counts this will allow local volunteers to assist with monitoring the existing roost network, but also to increase the number of roosts that can be monitored, should this be considered necessary.

4.1h ACTION: Continue monitoring winter and summer roosts annually and keep the national database up to date.

WHO: NPWS, VWT, NPWS database contractor

WHEN: Annually

4.1i ACTION: Run a pilot project using CCTV equipment and trained volunteers to test if this method enables emergence counts to be conducted in real time under dim lit conditions, thus removing the need to view recorded footage at reduced replay speeds at a later date.

WHO: VWT, BCireland

WHEN: 2023

4.1j ACTION: Continue to survey for new roosts, particularly in those areas that border the current known range for the species.

WHO: NPWS, HC

WHEN: 2023-2026

4.2 Habitat

Lundy *et al.*, (2011) indicated that there is little scope for this species to extend beyond its current distribution and the most recent Article 17 report (NPWS, 2019) states that the short-term trend for foraging habitat for this species is decreasing. It is essential, therefore, that existing foraging habitat supporting colonies is retained, and that steps are taken to provide new habitat.

The optimal foraging habitats for this species are deciduous woodlands, riparian vegetation and mature hedgerows within a few kilometres of a roost. In the absence of woodland, areas of scrub close to roosts are important and should be retained. Conifer plantations are used for commuting and some foraging, where there are deciduous trees associated with the plantation, but are less suitable than mixed and deciduous stands. Dietary studies have highlighted the importance of grazed pastures, particularly in winter.

There is scope to target the planting of new broadleaf woodland that would benefit the lesser horseshoe bat under the Native Woodland Scheme by promoting the scheme to landowners within 2.5km of a roost and by offering these additional payments. Similarly, measures to assist farmers to plant hedgerows under future agri-environment and climate schemes could be further incentivised by additional payments for those farmers choosing this measure if within 2.5km of a roost.

Projects involving planting along watercourses for the purpose of preventing soil erosion, increasing water retention or providing shelter for livestock could also target areas within this radius of a roost.

4.2a ACTION: Provide information on roosts of 20 or more bats to all relevant landowners, managers and agencies responsible for landscape projects (eg LAs, Coillte, FS, OPW), so measures to enhance habitats in the vicinity of these roosts are incorporated into any management plans they undertake or oversee. This information should include a map that will enable land managers to identify where land owned by them overlaps with roost locations so that appropriate management of this is targeted to benefit the colonies at those roosts.

WHO: NPWS

WHEN: 2023-2026

4.2b ACTION: Ensure adequate surveys are undertaken when woodland (native, mixed broadleaved or conifer) or scrub is being felled or cleared within 100m of a lesser horseshoe bat roost. Surveys should assess how these habitats are being used for feeding and commuting by the bats.

WHO: FS, NPWS

WHEN: 2025

4.2c ACTION: Incentivise farmers to plant suitable hedgerows under AECM and AECM Co-operative Projects especially within 2.5km of a roost. Incentives should also be available for the retention and enhancement of existing hedgerows associated with roosts.

WHO: DAFM, AECM Local Area Teams, Teagasc

WHEN: 2023-2024

4.2d ACTION: Promote appropriate planting along watercourses for the purpose of preventing soil erosion, increasing water retention or providing shelter for livestock within 2.5km radius of a roost.

WHO: DAFM, AECM Local Area Teams, Teagasc, OPW

WHEN: 2023-2024

Research needs to be undertaken to determine the significance of dung fauna in both the summer and winter diet of the bats and how this might be impacted by the use of anti-helminthic treatments of livestock. Recommendations on the application of treatments could then be based on the evidence of this research and farmers incentivised to adopt these where they cost more than existing methods of application.

4.2e ACTION: Commission research on the impacts of anti-helminthic drugs on dung fauna and the knock-on impacts on lesser horseshoe bats.

WHO: Teagasc, 3rd level Institutes, DAFM

WHEN: 2023

An additional factor that may determine the importance of a foraging area is the availability and proximity of night roosts, where bats can rest and digest meals between foraging bouts. Knight & Jones (2009) found that 75% of the lesser horseshoe bats they radio tracked over two summers roosted in buildings at night that were not their day roost. These night roosts were significantly nearer to the core foraging area of the bats than to the day roosts. The authors suggested that minimising the distance to feeding sites may be the primary function of night roosts and are an integral feature of core foraging areas and warrant protection. VWT designed a timber night roost that can be easily located in suitable habitat and several of these have been erected under a number of schemes that will provide evidence of their efficacy for future use. These are not, however, permanent structures and where night roosting is considered critical for a colony, a more robust structure should be provided (Schofield, pers. comm.)

4.2f ACTION: Provide night roosting facilities within or close to woodland in the vicinity of important bat maternity roosts. The locations of such night roosts should be notified to NPWS so their use will be monitored and evaluated and this information be accessible to all relevant parties.

WHO: NPWS, HC, Coillte, OPW, landowners

WHEN: 2024-2026

4.3 Connectivity

4.3.1 Landscape

Maintaining the genetic diversity of the lesser horseshoe bat in Ireland is crucial for its long- term survival. The retention of existing linear landscape features within at least 2.5km but preferably 5km of lesser horseshoe bat roosts with 20 bats or more is essential to counteract the documented genetic differentiation that has already occurred within the species throughout its Irish distribution. This is best achieved by implementing a landscape-scale project across all six counties by which groups of landowners are brought together to retain or create connectivity on a scale that provides a network of sites that link foraging areas and maternity, hibernation, satellite, transition and night roosts. The targeting of this connectivity needs to be based on the results of additional modelling, similar to the research undertaken by VWT in 2020 described earlier in this plan.

Local volunteers will be key players in any landscape-scale project in helping to identify key areas for actions, assisting with the provision of these and the subsequent assessment and evaluation of their effectiveness.

4.3a ACTION: Provide advice to all relevant parties (FS, Coillte, DAFM, Teagasc and LAs) on ways to improve connectivity between the horseshoe roosts located within each county.

WHO: VWT, NPWS

WHEN: 2025

4.3b ACTION: Create a steering group to identify and co-ordinate opportunities for conservation measures through land-use plans such as County Heritage and Biodiversity Plans, County Development Plans and AECM Co-operative Projects.

WHO: NPWS, LAs, DAFM, Teagasc, OPW

WHEN: 2023

4.3c ACTION: Implement a programme to enhance landscape connectivity between lesser horseshoe bat roosts and foraging grounds.

WHO: LAs, VWT, OPW, DAFM

WHEN: 2025 – 2026

4.3.2 Lighting

Lesser horseshoe bats are extremely sensitive to artificial light, even at low light intensities, and they avoid brightly lit areas. Artificial light at or near roosts may impact the bats by delaying their emergence time at dusk, reducing reproductive success or even cause roosts to be abandoned (Stone, 2014; Voigt et al., 2018; Bat Conservation Trust & Institute of Lighting Professionals, 2018). Information on the extent of artificial lighting was provided by the six local authorities with horseshoes in their areas to a modelling study undertaken by VWT in 2020 and revealed that there were high densities of lighting associated with Galway and Limerick Cities, which could be acting as a barrier to the movements of bats in these areas (Finch & McAney, 2020). It is recommended that there is no significant increase in artificial lighting adjacent to roosts of importance, or along commuting routes within 2.5km of these roosts, and a list of recommendations will be provided to each local authority on how to reduce or mitigate existing high levels of light intensity in the vicinity of roosts or foraging areas.

4.3d ACTION: Produce guidelines for use by local authorities, OPW and others on the nature of illumination to be used in the vicinity of lesser horseshoe bat roosts and their foraging areas.

WHO: HC, BCIreland

WHEN: 2023

4.3e ACTION: Evaluate current lighting regimes in the vicinity of key lesser horseshoe bat roosts and their foraging areas and implement site-specific mitigation measures where required.

WHO: LAs, HC, OPW

WHEN: 2023-2024

4.3f ACTION: Highlight the overlap between the distribution of the lesser horseshoe bat and Dark Sky Areas and explore ways to promote and enhance both.

WHO: VWT, Mayo Dark Sky Park, Lough Gur Dark Sky Initiative, Kerry Dark Sky Reserve

WHEN: 2022

4.3.3 Roads

The negative impacts of major roads on the lesser horseshoe bat were referred to earlier, but it is noted that, since 2006, all bats are considered as an integral part of the early planning phases for road projects. This practice needs to continue. Surveys should be undertaken well in advance of decisions relating to new route selection and the best practice principles for bat mitigation along linear transport infrastructure as described by Berthinussen & Altringham (2015) be adopted. The most up to date guidance on Annex IV species protection and mitigation, and the requirements regarding derogation licences, are available online at:

<https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence>.

The impact of the construction of forest roads during forestry activities also needs to be considered.

4.3g ACTION: Ensure that guidance and advice to road planners and developers is up to date and based on the results from monitoring studies of previous mitigation measures.

WHO: TII

WHEN: 2023

4.3h ACTION: Ensure that mitigation measures are in place and functioning using follow up inspections by relevant local authorities. Consideration of the presence of lesser horseshoe bats is also necessary in the case of small-scale road projects, cycleways, junction improvements.

WHO: LAs

WHEN: 2022-2026

4.4 Outreach, Awareness and Review

Extensive stakeholder consultation and input was needed to draft this Species Action Plan and the continued engagement and commitment of these stakeholders and others will be needed if the plan is to be effectively implemented. A recurring comment was the need for targeted guidelines on a range of topics, such as habitat connectivity, artificial illumination and the renovation of historic buildings containing roosts.

4.4a ACTION: Continue consultation with relevant stakeholders to produce guidelines.

WHO: NPWS, VWT, HC, BCIreland

WHEN: 2023-2026

4.4b ACTION: Run a series of information/training sessions for LA Heritage Officers/Biodiversity Officers, LA ecologists and those in government departments and agencies, relevant OPW and Coillte staff, Conservation Architects and Agricultural Advisors. Sessions to highlight the various implications of this SAP and identify potential methods of engaging with and taking forward the listed actions.

WHO: NPWS, VWT, HC

WHEN: 2024-2025

4.4c ACTION: Consider ways of providing information to and engaging with the public about the lesser horseshoe bat, particularly across the range of the species.

WHO: NPWS, VWT

WHEN: 2024-2025

4.4d ACTION: Establish a steering group to support and monitor plan implementation.

WHO: NPWS, VWT, DAFM, OPW HC, FS, Coillte, Teagasc

WHEN: 2022

4.4e ACTION: Review progress with implementation of this SAP and consider need for a further 5-year SAP for the species.

WHO: NPWS, VWT

WHEN: 2026

Summary Table of Proposed Actions

Action	Details	Who	When
4.1	Roosts		
4.1.1	Roost Recording		
4.1a	Continue to update the national database annually with information on new roosts as they are discovered, but also to account for those that have deteriorated, been abandoned or lost and ensure this data is available to all relevant competent authorities.	NPWS/ NPWS Database contractor	Annually
4.1b	Undertake a review of the roost network across the species' range to identify those areas without adequate roosting opportunities, for example, winter hibernation sites, night roosts and maternity roosts.	NPWS/ NPWS Database contractor, VWT, HC, Coillte, OPW	2023
4.1.2	Roost Protection		
4.1c	Produce a roost resilience audit for 200 lesser horseshoe bat sites to identify the site specific measures needed to ensure the long-term conservation status of the species. This assessment should be based on the methodology used by the VWT and should highlight the priority measures needed at each site. The sites selected for this audit should include all those currently monitored annually plus those considered strategic for maintaining or acting as links between colonies or areas. A priority list for conservation action to be established, based on an objective scoring system.	NPWS, VWT, HC, Coillte, OPW	2022-2023

4.1d	Fund and oversee a multi-annual programme of roost repairs and enhancement works to implement the site specific conservation measures identified in the resilience audit. This programme could be overseen by the creation of a Roost Liaison Officer.	NPWS, LAs, HC, Coillte, OPW and other landowners	2023-2026
4.1e	Maximise the potential of future Traditional Farm Buildings scheme to support repairs to lesser horseshoe roosts.	HC, NPWS	2023-2026
4.1f	Continue to roll out NPWS farm plans that include repairs and enhancement works for lesser horseshoe bat roosts and foraging habitats.	NPWS	2022-2026
4.1.3	Roost Buffer Zones		
4.1g	Run a pilot study with NPWS staff and volunteers at a number of key roosts in areas at risk of habitat loss to determine key commuting and foraging areas, using both handheld and static detectors.	NPWS, BC Ireland, LAs	2023-2024
4.1.4	Roost Monitoring		
4.1h	Continue monitoring winter and summer roosts annually and keep the national database up to date.	NPWS, VWT, NPWS database contractor	Annually
4.1i	Run a pilot project using CCTV equipment and trained volunteers to test if this method enables emergence counts to be conducted in real time under dim lit conditions, thus removing the need to view recorded footage at reduced replay speeds at a later date.	VWT, BC Ireland	2023
4.1j	Continue to survey for new roosts, particularly in those areas that border the current known range for the species.	NPWS, HC	2023-2026

4.2 Habitat			
4.2a	Provide information on roosts of 20 or more bats to all relevant landowners, managers and agencies responsible for landscape projects (eg LAs, Coillte, FS, OPW), so measures to enhance habitats in the vicinity of these roosts are incorporated into any management plans they undertake or oversee. This information should include a map that will enable land managers to identify where land owned by them overlaps with roost locations so that appropriate management of this is targeted to benefit the colonies at those roosts.	NPWS	2023-2026
4.2b	Ensure adequate surveys are undertaken when woodland (native, mixed broadleaved or conifer) or scrub is being felled or cleared within 100m of a lesser horseshoe bat roost. Surveys should assess how these habitats are being used for feeding and commuting by the bats.	FS, NPWS	2025
4.2c	Incentivise farmers to plant suitable hedgerows under AECM and AECM CPs especially within 2.5km of a roost. Incentives should also be available for the retention and enhancement of existing hedgerows associated with roosts.	DAFM, AECM Local Area Teams, Teagasc	2023-2024
4.2d	Promote appropriate planting along watercourses for the purpose of preventing soil erosion, increasing water retention or providing shelter for livestock within 2.5km radius of a roost.	DAFM, AECM Local Area Teams, Teagasc, OPW	2023-2024
4.2e	Commission research on the impacts of anti-helminthic drugs on dung fauna and the knock-on impacts on lesser horseshoe bats.	Teagasc, 3rd level Institutes, DAFM	2023
4.2f	Provide night roosting facilities within or close to woodland in the vicinity of important bat maternity roosts. The locations of such night roosts should be notified to NPWS so their use will be monitored and evaluated and this information be accessible to all relevant parties.	NPWS, HC, Coillte, OPW, landowners	2024-2026

4.3 Connectivity

4.3.1 Landscape

- | | | | |
|------|---|-------------------------------|-----------|
| 4.3a | Provide advice to all relevant parties (FS, Coillte, DAFM, Teagasc and LAs) on ways to improve connectivity between the horseshoe roosts located within each county. | VWT, NPWS | 2025 |
| 4.3b | Create a steering group to identify and co-ordinate opportunities for conservation measures through land-use plans such as County Heritage and Biodiversity Plans, County Development Plans and AECM co-operative projects. | NPWS, LAs, DAFM, Teagasc, OPW | 2023 |
| 4.3c | Implement a programme to enhance landscape connectivity between lesser horseshoe bat roosts and foraging grounds. | LAs, VWT, OPW, DAFM | 2025-2026 |

4.3.2 Lighting

- | | | | |
|------|---|--|-----------|
| 4.3d | Produce guidelines for use by local authorities, OPW and others on the nature of illumination to be used in the vicinity of lesser horseshoe bat roosts and their foraging areas. | HC, BC Ireland | 2023 |
| 4.3e | Evaluate current lighting regimes in the vicinity of key lesser horseshoe bat roosts and their foraging areas and implement site-specific mitigation measures where required. | LAs, HC, OPW | 2023-2024 |
| 4.3f | Highlight the overlap between the distribution of the lesser horseshoe bat and Dark Sky Areas and explore ways to promote and enhance both. | VWT, Mayo Dark Sky Park, Lough Gur Dark Sky Initiative, Kerry Dark Sky Reserve | 2022 |

4.3.3 Roads

4.3g	Ensure that guidance and advice to road planners and developers is up to date and based on the results from monitoring studies of previous mitigation measures.	TII	2023
4.3h	Ensure that mitigation measures are in place and functioning using follow up inspections by relevant local authorities. Consideration of the presence of lesser horseshoe bats is also necessary in the case of small-scale road projects, cycleways, junction improvements.	LAs	2022-2026

4.4 Outreach, Awareness and Review

4.4a	Continue consultation with relevant stakeholders to produce guidelines.	NPWS, VWT, HC, BC Ireland	2023-2026
4.4b	Run a series of information/training sessions for LA Heritage Officers/Biodiversity Officers, LA ecologists and those in government departments and agencies, relevant OPW and Coillte staff, Conservation Architects and Agricultural Advisors. Sessions to highlight the various implications of this SAP and identify potential methods of engaging with and taking forward the listed actions.	NPWS, VWT, HC	2024-2025
4.4c	Consider ways of providing information to and engaging with the public about the lesser horseshoe bat, particularly across the range of the species.	NPWS, VWT	2024-2025
4.4d	Establish a steering group to support and monitor plan implementation.	NPWS, VWT, DAFM, OPW, HC, FS, Coillte, Teagasc	2022
4.4e	Review progress with implementation of this SAP and consider need for a further 5-year SAP for the species.	NPWS, VWT	2026

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