Bringing nature home: promoting multi-species justice through building retrofit

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Bringing nature home: promoting multi-species justice through building retrofit

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ABSTRACT

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The Committee on Climate Change (CCC) recognises that building retrofit and biodiversity recovery are essential to meeting the UK's environmental commitments. However, retrofit practices pose an overlooked risk to cavity-dependent species of birds, bats and insects through the hermetic sealing of building envelopes. This research aims to discover the current level of integration between biodiversity within retrofit systems and assess the effectiveness of artificial habitats as conservation tools. This review establishes existing literature on the alignment between retrofit and nature recovery. The results revealed that biodiversity and retrofit governance currently operate separately. Significantly, permitted development rights apply to most domestic retrofit, this means that retrofit does not involve the same Biodiversity Net Gain (BNG), environmental assessment or reporting and monitoring requirements that apply to new developments. These findings demonstrate the oversight of the cumulative impact of domestic retrofit to the environment. Additionally, there is a disconnect between empirical evidence and local plans that are integrating artificial habitats, meaning that adherence to maintenance and reporting regulation will be critical to avoid negative outcomes. With retrofit across 30 million homes imminent in the UK alone (under the Warm Homes Plan), ensuring that retrofit is accounted for in biodiversity strategies is crucial to reducing habitat pressures caused by urban expansion. If ignored we risk undermining current efforts towards decarbonisation and nature recovery and risk the displacement of legally protected cavity-dependent species. This review demonstrates the potential for existing buildings to contribute to both decarbonisation and nature recovery, supporting a climate-resilient built environment.

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INTRODUCTION

The Global Status Report for Buildings and Construction, published by the UNEP (2024), highlighted that the decarbonisation of buildings will be critical to meeting global emissions reductions targets. However, there is growing evidence to suggest that this endeavour poses a risk to nature recovery (Dulisz, Stawicka et al. 2022, Rosin, Hiron et al. 2020), an equally important measure for planetary health (Climate Change Committee 2025). This is especially important across Europe and specifically in the UK, where meeting our legally binding decarbonisation commitments depends on retrofitting on a national scale (Li, Arbabi et al. 2022, Gillich 2025, BEIS 2021). To mitigate this problem, it is critical that retrofit practices work with nature recovery strategies.

In the UK, 17.5 per cent of all greenhouse gas emissions are produced by building operations. As 50 per cent of dwellings are expected to still be inhabited by 2050, updating the existing building stock to improve energy efficiency will be imperative in contributing to emissions reductions (BRE Trust 2020, UKGBC 2021). Thus, national retrofit programmes are imminent across the UK (DESNZ 2024).

However, retrofit measures can pose specific risks to cavity-dependent species (Dulisz, Stawicka et al. 2022, Rosin, Hiron et al. 2020) that either partially or completely rely on buildings for breeding and hibernation. Many species are more vulnerable to harm, such as swifts and bats due to loss of natural nest sites, nest site fidelity and migratory nature (Dumas, Meier et al. 2025, Jahelková, Ceľuch et al. 2024). Consequently, compensatory measures are crucial as biodiversity contributes towards improved mental and physical wellbeing (Richardson, Passmore et al. 2021). Furthermore, increased exposure to urban species contributes to stewardship (Liu, Li 2024), which can aid in public-facing conservation efforts.

Retrofit and nature recovery strategies are integrated into policy, but they are most often treated separately. The potential of the built environment to facilitate nature recovery is typically overlooked and there are significant challenges in integrating biodiversity into retrofit systems as standard practice. In addition, relatively little is known about artificial habitats as conservation measures to compensate for domestic retrofitting. Therefore, more evidence is required on the effectiveness of artificial habitats to provide an environment for species to thrive within the urban environment.

Therefore, this literature review examines empirical and grey evidence to contribute to a reconciliation between decarbonisation and biodiversity. The findings were analysed to reveal the extent of integration between retrofit and nature recovery within the current system and assess artificial habitats as a solution. Avenues for further research in this area are revealed. As upgrading building stock is a key issue across Europe (Norton, Gillett et al. 2021, Barbosa, Almeida 2025), this places us at a pivotal moment to shape decision-making around retrofit practice and shift towards a nature-positive built environment.

METHODS

The search method used systematic principles to understand the extent of existing knowledge on the topic. Searches were designed to retrieve results on the impact of building retrofit on cavity-dependent birds, bats, and insects and the effectiveness of artificial habitats. Thematic coding was used to analyse the data, the results of which are synthesised in the findings.

The databases selected were Web of Science and Scopus, due to the wide range of interdisciplinary peer-reviewed literature relevant to the topic available. Key words were generated by the reviewer based on the topic and were refined during the searches. Related or synonymous key words were grouped into themes. The themes included: artificial habitats, policy, methodologies, retrofit, biodiversity and sustainable development. Search strings were formed using the OR Boolean operator for key words within the same theme. Search queries were built by searching strings against one another using the AND Boolean operator. Search queries were consistent for both databases; formatting was adjusted based on the database requirements.

Example search query to return papers on artificial habitats related to retrofit, biodiversity and sustainable development:

01. HBT-RF.BIO.SD

> (“Bat box*” OR “Bat roost*” OR “Bee brick*” OR “Bird box*” OR “Bird-nest* featur*” OR “Swift* brick*” OR “Swift* box*” OR “Insect* hotel*” OR “Integrat* nest* box*” OR “Artificial nest*” OR “Artificial Habitat*”) AND (“Bird*” OR “Bat*” OR “Insect*” OR “Species” OR “Wildlife” OR “Animal*”) AND (“Cavit* depend*” OR “Cavity using” OR “Cavit* nest*” OR “Crevice depend*” OR “Crevice using” OR “Crevice nest*” OR “Hollow depend*” OR “Hollow using” OR “Hollow nest*”) AND (“Renovat*” OR “Refurbish*” OR “Retrofit*” OR “Restor* retrofit*” OR “Façad* retrofit*” OR “Upgrad*” OR “Insulat*” OR “Insulate Britain” OR “Architects Can” OR “ACAN” OR “Low Energy Transformation Initiative” OR “LETI” OR “Energy efficien*” OR “building* perform*” OR “Thermal perform*”) AND (“Conservation” OR “Conservation of natur*” OR “Conservation of habitat*” OR “Natur* conservation” OR “Wildlife enhancement*” OR “Biodivers* enhancement*” OR “Technolog*” OR “Sustainab*” OR “Climate” OR “Transition*” OR “City” OR “Cities” OR “Built Environ*” OR “Urbanis*” OR “Develop*” OR “Construct*” OR “Climate Resilien*” OR “Resilien*” OR “Climate justice*” OR “Decentralis*” OR “Carbon*” OR “Carbon mitigation*” OR “Carbon reduction*” OR “Emissions reduc*” OR “Emissions mitig*” OR “Climate chang*” OR “climate chang* mitig*”)

The searches took place between October 2025 and February 2026. Snowballing and supplementary Google Scholar searches returned 131 empirical and grey literature sources, 1,449 results from Scopus and 1,845 results from Web of Science. A total of 3,425 records were retrieved.

300 results were excluded due to the publication date occurring before 2016, 1,331 duplicates were removed, and 3 results were excluded as they were not published in English. The remaining 1,791 sources underwent a three-stage screening process. After screening the titles of each source, the 516 remaining results were then screened for relevance based on abstracts, or executive summaries in the case of grey literature. Of these, 148 studies were identified as relevant and were retrieved for full-text review. A further 5 results were excluded where the full text was unavailable. Thematic analysis was used to synthesise findings and identify trends in the literature using a hybrid inductive-deductive coding approach. Initial themes were built during title and abstract screening and additional themes emerged whilst coding full texts.

Exclusion criteria:

- papers published before 2016
- theoretical papers, as this review’s scope is focused on applied research
- artificial habitats mounted in forests or agricultural land
- duplicate results
- papers not published in English
- unavailable full-text

Inclusion criteria:

- international retrofit or biodiversity policy and governance
- international studies and review articles on the effects of retrofits on cavity-dependent birds, bats or insects
- international studies and review articles on artificial habitats for cavity-dependent birds, bats or insects
- study methods with artificial habitats mounted within the built environment
- results related to the proximity of artificial habitats to the built environment

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FINDINGS

This review aims to discover the degree to which biodiversity and retrofit currently interact in literature, policy and practice and to assess the effectiveness of building-integrated habitats for cavity-dependent species. The evidence revealed themes including policy, governance, conservation and artificial habitat design and best practice.

GAPS IN RETROFIT AND NATURE RECOVERY GOVERNANCE

The statutory instruments protecting cavity-dependent species include laws to protect birds, bats and their nests or roosts. Whilst bat habitat is protected year-round, most bird nests, including cavity-dependent species, are only protected when in use (i.e. during breeding season) (Wildlife and Countryside Act, c. 1981, The Conservation of Habitats and Species Regulations 2017). Building associated species are accounted for in nature recovery targets (Natural Environment and Rural Communities Act 2006, Natural England 2025b) despite this, priority habitats do not include buildings. Generally, strategies do acknowledge a range of land types, from rural to urban, as opportunities for nature recovery. However, buildings are not a focus within the broader strategic landscape (DEFRA 2025a, Natural England 2025a).

The target for net zero emissions by 2050 will be significantly supported by national retrofit delivery (HM Government 2021). Yet the statutory (Climate Change Act 2008), policy (DESNZ 2026, BEIS 2021) and regulatory (MHCLG 2021, BSI 2023b, BSI 2023a) instruments governing retrofit, do not show any alignment with the nature recovery agenda. The BREEAM (Bre Group 2014) certification for domestic retrofit is a notable exception, which requires compliance with legal protections and ecological assessment. Recommendations can include installation of artificial habitat boxes for birds, bats, and insects.

Environmental, social and economic sustainability is a priority in national planning (MHCLG 2024b). Development should achieve BNG and where possible provide multiple benefits for nature and humans. Cavity-dependent species are directly referenced for consideration in decision-making and inclusion in local policy (MHCLG 2024b). This is reflected in adopted and emerging local plans (Brighton & Hove City Council 2022, Greater Cambridge Shared Planning 2022, Wiltshire Council 2023).

Although all development is legally required to achieve BNG as a part of planning conditions (*The Environment Act* 2021), metrics focus on greening actions. Consequently, building-integrated habitats are not adequately included when quantifying gains (DEFRA 2025b). Retrofit, like all development is required to meet national and local planning conditions. However, most domestic retrofit falls within permitted development, so will not require BNG (*The Town and Country Planning (General Permitted Development) (England) Order* 2015, MHCLG 2019). In some cases, permitted development may require Environmental Impact Assessment (EIA) if there is significant environmental risk identified (MHCLG 2020, *The Town and Country Planning (Environmental Impact Assessment) Regulations* 2017).

Devolution should enable faster and more streamlined delivery of targets (MHCLG 2024a). Monitoring and reporting of Local Nature Recovery Strategies (LNRS) will now be the responsibility of devolved authorities MHCLG 2024a, (*Natural Environment and Rural Communities Act* 2006, DEFRA 2025a). However, monitoring and enforcement gaps due to a lack of resources in local authorities are a risk for under-delivery of BNG in accepted planning applications (Rampling, zu Ermgassen et al. 2024).

There has been significant involvement from conservation stakeholders which has produced a range of design, monitoring, technical guidance and strategic resources that focus on buildings for nature recovery (Table 1). Natural England's Action Plan (2025a) stated that 250 species will benefit from nature recovery projects from 2025–2026. The data set (Wilkins, Baker et al. 2025) includes many cavity-dependent species. The Action Plan states that strategies with greater impact will take priority, including new housing and infrastructure schemes. A recent Department for Environment Food and Rural Affairs (DEFRA) and Natural England project (2026) retrofitted derelict buildings to recover bat roosting habitat, demonstrating the potential of adaptive reuse to benefit cavity-dependent species.

TITLE	CONTENT	SOURCE
Design for Biodiversity	RIBA published design guidance and technical specification for building-integrated habitat	(Gunnell, Williams et al. 2019)
Swift Mapper	RSPB published data set of records of swift habitats in the UK	(RSPB 2026)
EUROBATS: Guidelines for bats, insulation and lining materials | UNEP/Eurobats	Collaboration between Eurobats and the UNEP with guidance on the risks of insulation to bats and includes mitigation techniques for diverse scenarios	(Jahelková, Ceľuch et al. 2024)
Nature Recovery and Climate Resilience Playbook	Urban built environment strategy with actions to support the environment, including cavity-dependent species	(UKGBC 2022)
The Swift – A Bird You Need to Help!	Overview on swift conservation, provides best practice and guidance on swift bricks	(Jahelková, Ceľuch et al. 2024, Day, Mayer et al. 2019)
Swift Bricks: the 'universal' nest brick	Swift brick design and best practice	(Barlow, Priaulx et al. 2022)
Homes for people and wildlife	Resource for nature recovery in new developments	(The Wildlife Trusts 2018)
When Nature moves in: A guide to managing wildlife in and around buildings	Guidance on species commonly found around residences including how to manage building works in line with conservation laws, includes mitigation measures for development to existing buildings	(Bullock, Ferneyhough et al. 2013)
Biodiversity in new housing developments	Created in collaboration with the RSPB, with design and technical guidance for biodiversity friendly development, includes species-specific actions	(Day, Stephen et al. 2021)
Framework for a nature-positive built environment	Frames the built environment through potential to enhance ecosystems	(UKGBC 2026)

Table 1 Resources on cavity-dependent species within the built environment.

ARTIFICIAL HABITATS AS CONSERVATION TOOLS WITHIN URBAN ENVIRONMENTS

The effects of anthropogenic exposure are species-specific (Mulholland, Ferraro et al. 2018) and are still not fully understood (Liu, Li 2024). Urban stressors include exposure to artificial light and noise (Luo, Xu et al. 2021, Mulholland, Ferraro et al. 2018). Urban habitats may risk ecological traps (Reynolds, Ibáñez-Alamo et al. 2019, Liu, Li 2024, Russo, Ancillotto 2015). In addition, the migratory and nomadic nature of some species of birds and bats can add pressures due to the unpredictable settlements over winter and summer habitats (Jahelková, Ceľuch et al. 2024, Runge, Martin et al. 2014). Whilst urban areas present challenges for wildlife, many have stressed the opportunity of urban nature recovery (Kline, Joshi 2024, Reynolds, Ibáñez-Alamo et al. 2019, Liu, Li 2024). Moreover, re-use of existing structures can play a significant role in urban conservation (Carlier, Moran et al. 2019, Vincent Wildlife Trust 2026).

For species that live in building facades or wall and roof cavities (Table 2), upgrading buildings for thermal performance can cause habitat loss (Rosin, Hiron et al. 2020, Dulisz, Stawicka et al. 2022, Jahelková, Ceľuch et al. 2024). Mitigation measures to avoid harm to cavity-dependent species include providing a means of escape, safe materials and retention of cavities (Jahelková, Ceľuch et al. 2024). Additionally, artificial habitats have been proposed as a means of diversifying land-use to provide multiple benefits such as mitigating habitat loss as well as energy production (Boscarino-Gaetano, Vernes et al. 2024). However, artificial habitats have been implemented with mixed success (Dulisz, Stawicka et al. 2022, Schaub, Meffert et al. 2016, Watchorn, Cowan et al. 2022). Not all species are suitable for conservation with such methods (Reynolds, Ibáñez-Alamo et al. 2019). Some species will not readily use artificial habitats, whilst other species show a preference for them (Dulisz, Stawicka et al. 2022). Artificial habitats are often used in degraded ecosystems (Boscarino-Gaetano, Vernes et al. 2024) and are not a long-term solution for all species (Cowan, Callan et al. 2021, Boscarino-Gaetano, Vernes et al. 2024, Dulisz, Stawicka et al. 2022).

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SPECIES	WHERE THEY CAN BE FOUND IN BUILDINGS
Swift	High off the ground in cavities under eaves, between the soffit and the wall, gaps in cladding, gaps in roof tiles, gaps in vents and inside the roof or wall cavities
House Martin	Outside buildings and under roof eaves
House Sparrow	High off the ground, under roof eaves and in wall cavities or in ivy
Jackdaw	Large chimneys
Kestrel	Building ledges
Starling	Under roof tiles and building crevices
Honeybee	Roof voids, wall crevices and chimneys
Mason bee	Tube-like crevices in walls and mortar
Wasp	Tube-like crevices in walls, window vents, vacant chimney flues, lofts and under eaves
Bats	Above ground level in roof voids, roof eaves, barge boards, verges, gables, wall cavities, openings in structural timber or timber fittings, gaps in cladding, chimney flues, soffits, gaps in mortar, stone or brickwork, gaps in doors and gaps around pipework

Table 2 Urban cavity-dependent species.

Adapted from: When Nature moves in: A guide to manage wildlife in and around buildings (Bullock, Ferneyhough et al. 2013).

Studies show that strategic design of artificial nest boxes is essential to make them an effective conservation tool (Watchorn, Cowan et al. 2022). There is strong evidence that the design of artificial habitats should target specific species of conservation concern (Watchorn, Cowan et al. 2022, Griffiths, Bender et al. 2017, von Königslöw, Klein et al. 2019) and should integrate the qualities of natural habitats (Watchorn, Cowan et al. 2022, Griffiths, Bender et al. 2017). The risk of not doing so can lead to habitats being populated mostly by generalist species that are not a conservation concern (Griffiths, Bender et al. 2017, Henry, Berrou et al. 2023, Shaw, Christman et al. 2021). Artificial habitat outcomes are species dependent (Sudyka, Di Lecce et al. 2022). Evidence on predation of artificial nests had conflicting results (Van Riper, Greeney et al. 2024, Marcus, Hart et al. 2024, Vincze, Seress et al. 2017). Importantly, artificial nests are not always sufficient to fulfil species needs when used in isolation. Supplementary actions, such as locating habitats within connected green networks (Pinaud, Claireau et al. 2018) or with nearby nest building materials (Fortel, Henry et al. 2016) is often required.

Bee and wasp habitat design factors include natural versus synthetic nesting materials (von Königslöw, Klein et al. 2019), colour (Shaw, Christman et al. 2021) and entry hole size and smoothness (von Königslöw, Klein et al. 2019, Henry, Berrou et al. 2023). Location of nest sites is especially important for bees as they rely on biodiverse flowers and surrounding materials to build and enrich habitat (Kline, Joshi 2024). Concrete bee habitats have been proposed as a building-integrated solution (Henry, Berrou et al. 2023, Shaw, Christman et al. 2021). However, studies on 'bee bricks' (Shaw, Christman et al. 2021), which are being implemented into local policy (Brighton & Hove City Council 2022), have revealed low occupancy rates (Shaw, Christman et al. 2021). Moreover, bricks need regular maintenance to clean cavities, which may mitigate the potential for disease and predators (Shaw, Christman et al. 2021).

The design considerations of artificial habitats for bats principally focus on mitigating overheating. Some solutions include using multi-chamber designs and strategically planning the mounting location, colour and aspect of the habitat (Fontaine, Simard et al. 2021, Bakken, O'Keefe 2025). Equally, opting for artificially carved holes in trees simulate the thermal conditions of natural habitats (Griffiths, Lentini et al. 2018). In addition, there is evidence of bat preference for roost boxes mounted on buildings as well as older boxes (Arias, Gignoux-Wolfsohn et al. 2020).

Artificial habitat occupancy in birds has been linked to the mounting location, height, size and level of enclosure of nests (Dulisz, Stawicka et al. 2022, Van Riper, Greeney et al. 2024). Predation has been linked to the mounting location's degree of urbanisation and proximity to urban elements (Wang, Pirie et al. 2025, Van Riper, Greeney et al. 2024). Entry hole shape, size, mounting location and the degree of urbanisation have also been linked to breeding fitness (Dale, Reudink et al. 2021, Lee, Kim et al. 2023, Peng, Chen et al. 2025). The Common Swift is critically dependent on buildings due to the loss of natural nesting sites and is extremely at risk as a result of retrofit (D'Hoop 2023). As a result, they have been a focus of recent urban bird conservation efforts (Building Regulations (Swift Bricks) Bill 2024, D'Hoop 2023, Dulisz, Stawicka et al. 2022). Swifts are extremely faithful to their nests, so re-establishing displaced swifts is a challenge (Dulisz, Stawicka et al. 2022, D'Hoop 2023). Furthermore, studies have shown nesting boxes designed for swifts are commonly colonised by other species (Schaub, Meffert et al. 2016, Dulisz, Stawicka et al. 2022). Occupancy of nests sites has been linked to the mounting location and height of nests (Schaub, Meffert et al. 2016, D'Hoop 2023), proximity to neighbouring nests and nest age (Schaub, Meffert et al. 2016).

Retrofit mitigation projects are more likely to succeed when measures are installed directly after displacement amongst existing populations of cavity-dependent species (Arias, Gignoux-Wolfsohn et al. 2020, Schaub, Meffert et al. 2016). Additionally, the timing of measures should be considered to not coincide with breeding or hibernation (Schaub, Meffert et al. 2016, Jahelková, Ceľuch et al. 2024), awareness of the ideal monitoring conditions as well as consistent monitoring of outcomes is important to be able to draw conclusions from studies (Schaub, Wellbrock et al. 2019, Cowan, Callan et al. 2021), refine practices (Watchorn, Cowan et al. 2022) and mitigate the risk of ecological traps (Cowan, Callan et al. 2021). Pre-retrofit surveys should take place to assess quantity of the mitigation measures needed (Dulisz, Stawicka et al. 2022) and to monitor biodiversity recovery from baseline conditions (Schaub, Meffert et al. 2016). Long term maintenance of sites is essential to prevent parasites and disease spreading (Dulisz, Stawicka et al. 2022, Kline, Joshi 2024).

There is a lack of evidence on the effectiveness of artificial habitats as a conservation tool (Cowan, Callan et al. 2021). Current evidence is inconsistent and methods are hard to replicate (Lambrechts, Deeming 2024, Cowan, Callan et al. 2021). Moreover, current studies are limited by looking at relationships between single factors, as built-up environments contain multitudes of stressors. Looking at the overlaps of stressors and their effects would contribute to a better understanding (Mulholland, Ferraro et al. 2018).

DISCUSSION

Whilst existing urban habitats for bats and birds have legal protections (*Wildlife and Countryside Act, c.* 1981, *The Conservation of Habitats and Species Regulations* 2017), bird nests are only protected when active. This increases the risk of displacement for species such as swifts, who are extremely faithful to nest sites (D'Hoop 2023), yet only occupy nests for short portions of the year (Schaub, Wellbrock et al. 2019). This risks displacement when carrying out building works on buildings with nests sites outside of breeding season where nest presence is less noticeable. Furthermore, whilst cavity-dependent species are included in biodiversity action planning, buildings are overlooked (Wilkins, Baker et al. 2025). Urban approaches mostly focus on blue and green infrastructure rather than protecting existing urban habitats, such as those in buildings (IPCC 2022, DEFRA 2025a). This ignores evidence that conservation actions should be species-specific (Dale, Reudink et al. 2021, Kline, Joshi 2024).

Current biodiversity recovery measures within the built environment inadvertently omit domestic retrofit. Common upgrades like loft and cavity-wall insulation do not usually require planning permission and are classed as permitted development (*The Town and Country Planning (General Permitted Development) (England) Order* 2015). As these are the areas most associated with bats and birds (Bullock, Ferneyhough et al. 2013), it creates a governance gap where many of these habitats could be disturbed unknowingly without triggering EIA or enforcement actions. There is a requirement within EIAs to consider cumulative impact of development against other approved projects (MHCLG 2020). Considering the cumulative impact that national retrofit will have, greater consideration should be given to it within environmental assessments. Due to legal protections retrospective enforcement is possible, but without more rigorous screening and compensatory measures in place, there is a risk that habitat disturbances through retrofit will occur unchecked and species will be displaced.

Currently the regulations that govern retrofit and biodiversity recovery are fragmented. Biodiversity requirements, such as BNG, that should apply to retrofit are at risk of failing through governance gaps that disproportionately apply to new developments (*The Environment Act* 2021, *The Town and Country Planning (General Permitted Development) (England) Order* 2015). Moreover, BNG metrics do not include building-integrated habitat (DEFRA 2025a) which may disincentivise developers from including them. Additionally, Natural England has stated that high-impact projects will take funding priority (Natural England 2025a). Consequently, projects focusing on nature recovery in domestic retrofit may be less likely to be actioned as it may not be perceived by the government as high impact. Taken together, these findings highlight that important habitats within existing buildings are being overlooked for their potential for nature recovery. Regulatory frameworks need to rapidly and systematically embed measures into practice to mitigate habitat displacement caused by domestic retrofit.

Much of the evidence informing nature recovery decision-making originates from existing data sets made by stakeholders with expertise in conservation science (Wilkins, Baker et al. 2025). However, nature recovery is increasingly delivered through local authorities, as is the responsibility for monitoring and reporting on outcomes. As solutions have started to be integrated into planning policies (Brighton & Hove City Council 2022), there is a risk of creating ecological traps without more evidence to support their effectiveness for risks such as predation, breeding fitness, parasitism and proximity to required resources (Cowan, Callan et al. 2021, Morozov 2021). This means that long-term monitoring and reporting of solutions is critical in ensuring species success. Yet, reporting on BNG outcomes will not be required for domestic retrofits that fall under permitted development. This is a missed opportunity and poses a risk of missing negative outcomes without monitoring enforcement. This is especially true of solutions such as bee bricks, where there are substantial evidence gaps on parasitism and disease in unmaintained bricks. As bee bricks are now mandatory in new development within some local authorities (Brighton & Hove City Council 2022), this is an important gap to address. As pollinators have an important role in urban agriculture (Henry, Berrou et al. 2023), negative outcomes would present significant consequences for humans.

CONCLUSION

This review presented evidence on the systems governing biodiversity and retrofit and the effectiveness of artificial habitats for urban conservation strategies. Fragmented regulatory frameworks result in risks of displacement for cavity-dependent species. Nature recovery regulations such as BNG inadequately incorporate existing buildings due to permitted development legislation. Furthermore, a lack of data on the efficacy of artificial habitats risks producing ecological traps. There is a disconnect between evidence and actions which risks undermining efforts without more understanding through robust monitoring.

This paper contributes to a new understanding by foregrounding governance challenges in integrating nature recovery and retrofit. These findings are significant due to the scale of retrofit that will soon take place and the current integration of artificial habitats in local plans. Effective urban nature recovery strategies should embed species-specific action along with reporting and monitoring. This perspective informs further research directions with implications for policymakers, homeowners, and retrofit practitioners.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **PowerPoint Slides**. PowerPoint Slides relating to this article. DOI: https://doi.org/10.66506/essp.1-047-26.s1

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