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The Effects Of Urbanization On Local Wildlife Populations

Dr Archana Shailesh Patel*

*Dhunn Charitable Trust, Department : Setlor and Researcher, Institutional/Personal
Email:- dhara2402@gmail.com, Orcid ID Profile: - 0009-0007-5355-2633

Abstract

Rapid urbanization is one of the most pervasive forms of land-use change worldwide, profoundly reshaping ecological processes and wildlife populations. While numerous empirical studies document biodiversity declines in urban environments, existing research remains fragmented, often focusing on isolated variables or single taxa, with limited integration of underlying mechanisms. This study develops a comprehensive conceptual framework to explain how urbanization influences local wildlife populations through interacting ecological, behavioral, and spatial pathways. Drawing on principles from landscape ecology, disturbance ecology, and socio-ecological systems theory, the framework conceptualizes urbanization as a multidimensional process encompassing physical habitat transformation, human activity intensity, sensory pollution, and resource redistribution. The study identifies key mechanistic pathways, including habitat fragmentation, altered species interactions, behavioral modification, and trophic restructuring, that collectively drive population-level responses. The framework highlights the importance of nonlinear dynamics, threshold effects, and species-specific traits such as behavioral flexibility and ecological specialization in determining urban tolerance. To advance empirical research, the study formulates a set of testable propositions linking urban intensity to changes in wildlife abundance, community composition, and functional diversity. Beyond theoretical contributions, the framework offers practical insights for conservation planning by emphasizing the role of habitat connectivity, green infrastructure, and biodiversity-sensitive urban design. By integrating diverse mechanisms into a unified, testable model, this study provides a foundation for future empirical validation and supports evidence-based strategies aimed at promoting coexistence between urban development and wildlife in rapidly urbanizing landscapes.

Keywords: Urbanization, Wildlife populations, Habitat fragmentation, Urban ecology, Conservation planning.

1. Introduction

Urbanization is accelerating at an unprecedented rate and has emerged as one of the most transformative forces shaping contemporary landscapes worldwide. According to recent broader assessments, more than half of the world's population currently resides in urban areas, with projections indicating continued expansion in both population size and spatial extent of cities over the coming decades (United Nations, 2023). This rapid urban growth is not merely a demographic phenomenon but represents a profound ecological transition, involving large-scale conversion of natural and semi-natural habitats into built environments. As urban areas expand, they increasingly intersect with ecosystems that support diverse wildlife populations, raising critical concerns about biodiversity persistence in human-dominated landscapes.

Urbanization is now widely recognized as a dominant driver of wildlife population change across spatial scales. Forecasts of urban expansion have demonstrated that cities are encroaching into biodiversity-rich regions, intensifying pressures on species through habitat loss, fragmentation, and degradation (Seto et al., 2012). These structural changes to landscapes are accompanied by a suite of associated disturbances, including increased human activity, altered resource availability, and modified environmental conditions. Collectively, these factors influence wildlife populations by reshaping species distributions, abundance patterns, and ecological interactions. Importantly, urban environments do not affect all species uniformly; while some taxa decline or disappear, others persist or even thrive, highlighting the complexity of urban ecological responses.

Empirical research has documented a wide range of wildlife responses to urbanization, including changes in behavior, physiology, and population dynamics. Studies have revealed consistent urban-driven phenotypic shifts in both animal and plant populations, suggesting that cities act as strong selective environments (Alberti et al., 2017). At the same time, urban ecosystems function as novel disturbance regimes, where traditional ecological concepts such as disturbance, resilience, and recovery require reinterpretation within coupled social–ecological technological systems (Grimm et al., 2017). These findings underscore the ecological significance of urbanization not only as a source of stress but also as a driver of ecological and evolutionary change.

Despite substantial advances, existing urban wildlife research remains limited by fragmentation in both conceptual and methodological approaches. Many studies focus on single variables such as land cover, noise, or human density or on specific taxonomic groups, resulting in piecemeal insights that are difficult to generalize. McDonnell and Hahs (2013) argue that urban biodiversity research has often targeted easily measurable patterns while neglecting deeper mechanistic understanding. Similarly, evolutionary perspectives highlight the need to move beyond descriptive studies toward integrative frameworks that link urban pressures to biological responses across organizational levels (Johnson & Munshi-South, 2017). The lack of cohesive, mechanism-based models constrains the ability to synthesize findings and limits their application to conservation and planning.

Given these limitations, there is a clear need for an integrated conceptual approach that captures urbanization as a multidimensional process and explicitly links its components to wildlife population outcomes. Urbanization encompasses not only physical habitat transformation but also human disturbance, altered ecological processes, and novel selective pressures. Understanding how these elements interact to influence wildlife populations requires a framework that bridges landscape ecology, disturbance theory, and urban evolutionary ecology. Such an approach can help identify generalizable pathways, threshold effects, and species-specific traits that mediate urban tolerance or sensitivity.

This study aims to develop a comprehensive, mechanism-based conceptual framework that explains how urbanization influences local wildlife populations. By synthesizing established ecological principles into a unified model, the study seeks to advance theoretical understanding while providing a foundation for future empirical testing and practical application in urban conservation.

Objectives of the study are to:

1. Develop an integrated conceptual framework linking multidimensional urbanization processes to mechanistic pathways affecting local wildlife populations.
2. Formulate testable propositions that can guide future empirical research and inform biodiversity-sensitive urban planning.

2. Conceptualizing Urbanization as a Multidimensional Process

2.1 Urbanization Beyond Land-Use Change

Urbanization has long been equated with land-use and land-cover change, particularly the conversion of natural or semi-natural landscapes into built environments. While this view captures the visible spatial footprint of cities, it underestimates the broader ecological complexity of urban systems. Contemporary perspectives emphasize that cities function as hybrid ecosystems in which social, ecological, and technological processes are tightly coupled, producing novel environmental conditions that differ fundamentally from non-urban systems (Alberti, 2016). From this standpoint, urbanization is not a single-dimensional driver but a composite process operating through multiple interacting mechanisms that collectively shape wildlife populations.

2.2 Physical Habitat Transformation

One of the most direct dimensions of urbanization is physical habitat transformation. Urban development replaces continuous habitats with fragmented patches embedded within a matrix of impervious surfaces. These spatial changes reduce habitat availability, disrupt connectivity, and constrain wildlife movement, thereby influencing population persistence and community composition. Although urban green spaces can partially mitigate habitat loss, their ecological function is often constrained by size, isolation, and intensive management, limiting their capacity to support sensitive species (Lepczyk et al., 2017).

To illustrate how habitat transformation interacts with other urban drivers, Figure 1 presents a conceptual model in which physical landscape change forms the structural basis upon which additional urban stressors operate. The figure highlights that habitat fragmentation alone does not determine wildlife outcomes but interacts with disturbance, sensory pollution, and resource dynamics to shape population-level responses.

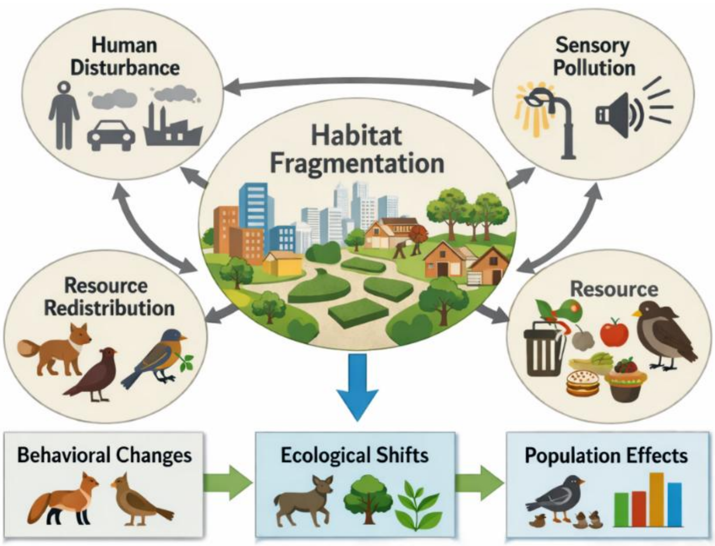

Figure 1. Conceptual framework illustrating urbanization as a multidimensional process affecting wildlife populations.

The figure depicts physical habitat transformation, human disturbance, sensory pollution, and resource redistribution as interacting dimensions that jointly influence behavioral, ecological, and population-level responses in wildlife.

2.3 Human Activity Intensity and Disturbance

Beyond structural change, urbanization is characterized by elevated levels of human activity, including traffic, recreation, and infrastructure use. These activities generate persistent disturbances that differ from natural disturbance regimes in both frequency and predictability. Urban ecosystems, therefore, challenge traditional ecological interpretations of disturbance and require explicit consideration of human behavior as a driving force (Shochat et al., 2006). Such disturbances can alter wildlife activity patterns, habitat selection, and movement behavior, often favoring species capable of tolerating close proximity to humans.

2.4 Sensory Pollution: Noise and Artificial Light

Urban environments are also defined by pervasive sensory pollution, particularly anthropogenic noise and artificial light at night. Artificial lighting disrupts natural photoperiods, affecting circadian rhythms, reproductive timing, and foraging behavior across a wide range of taxa (Gaston et al., 2015). Similarly, chronic noise pollution interferes with acoustic communication and can elevate stress levels, with potential consequences for survival and reproductive success (Shannon et al., 2016). These sensory dimensions represent subtle yet powerful mechanisms through which urbanization influences wildlife populations.

2.5 Resource Redistribution and Anthropogenic Subsidies

Urbanization fundamentally alters the distribution and availability of resources. Cities introduce novel food sources through waste, ornamental vegetation, and intentional feeding, leading to anthropogenic subsidies that can inflate population sizes of certain species while restructuring trophic interactions. Urban planning decisions

strongly influence these dynamics by shaping the spatial arrangement and management of green infrastructure and ecosystem services (Cortinovis & Geneletti, 2018).
The major dimensions of urbanization and their primary ecological implications are summarized in Table 1, which provides a structured overview linking abstract processes to population-level effects. This table clarifies how different dimensions operate simultaneously rather than independently.

Table 1. Major dimensions of urbanization and their primary ecological implications for wildlife populations

Dimension	Key characteristics	Ecological implications
Physical habitat transformation	Habitat loss, fragmentation, and impervious surfaces	Reduced connectivity, altered habitat suitability
Human activity and disturbance	High human presence, traffic, and infrastructure	Behavioral modification, stress responses
Sensory pollution	Noise, artificial light at night	Disrupted communication, altered activity patterns
Resource redistribution	Anthropogenic food subsidies, managed vegetation	Trophic restructuring, population inflation

2.6 Relevance of a Multidimensional Perspective
Adopting a multidimensional view of urbanization is essential for understanding the diverse and sometimes contradictory responses of wildlife populations to cities. Rather than acting independently, physical, sensory, and resource-based drivers interact to produce nonlinear and context-dependent outcomes. Mechanistic urban ecology emphasizes the importance of integrating these processes to move beyond pattern-based descriptions toward causal understanding (Shochat et al., 2006). Such an integrated perspective provides a robust foundation for identifying key pathways through which urbanization shapes wildlife populations and for guiding both empirical research and urban biodiversity management (Alberti, 2016).

3. Mechanistic Pathways Linking Urbanization to Wildlife Populations
3.1 Habitat Fragmentation and Loss of Connectivity
Habitat fragmentation represents one of the most fundamental mechanisms through which urbanization influences wildlife populations. Urban development divides continuous habitats into smaller, isolated patches, reducing effective habitat area and limiting connectivity between populations. Fragmentation alters movement pathways, restricts dispersal, and increases edge effects, all of which can negatively affect population viability. While fragmentation may increase habitat heterogeneity at small scales, its overall consequences are often detrimental for species requiring large or connected habitats (Fletcher Jr et al., 2018). In urban contexts, fragmentation is intensified by impermeable surfaces and linear infrastructure, further constraining wildlife movement.
The consequences of reduced connectivity are illustrated in Figure 2, which conceptually depicts how fragmented urban landscapes disrupt animal movement and gene flow. The figure emphasizes that fragmentation interacts with other urban pressures rather than acting as an isolated driver of population decline.

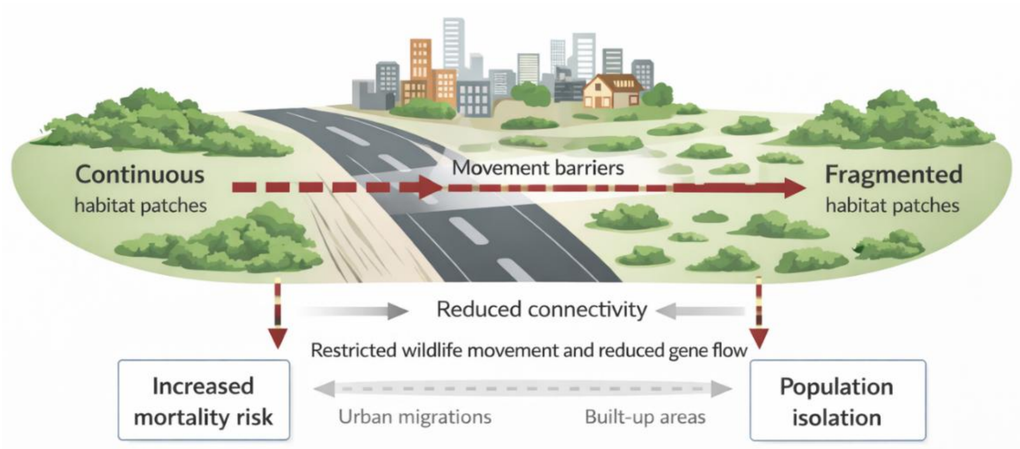

Figure 2. Conceptual representation of habitat fragmentation and reduced connectivity in urban landscapes.

The figure illustrates how urban infrastructure divides continuous habitats into isolated patches, constraining wildlife movement and increasing exposure to disturbance and mortality risks.

3.2 Behavioral Modification and Stress Responses

Urban environments impose novel behavioral challenges on wildlife, often requiring rapid behavioral modification to persist. Increased human presence, traffic, and infrastructure can alter activity patterns, vigilance, and space use. Such behavioral shifts are frequently accompanied by physiological stress responses, which may not immediately result in mortality but can reduce fitness through sublethal effects on reproduction, immune function, and growth (Birnie-Gauvin et al., 2016). These stress-related mechanisms represent an important but often overlooked pathway linking urbanization to long-term population change.

Large-scale reductions in animal movement further reflect behavioral constraints imposed by human-dominated landscapes. Global analyses have demonstrated widespread declines in terrestrial mammal movement, highlighting the pervasive influence of anthropogenic barriers on wildlife behavior and spatial ecology (Tucker et al., 2018).

3.3 Altered Species Interactions and Community Restructuring

Urbanization also reshapes species interactions, leading to changes in community composition and structure. Differential sensitivity to urban pressures results in the loss of disturbance-sensitive species and the persistence or proliferation of tolerant generalists. In particular, urban environments can alter predator–prey dynamics, competitive interactions, and disease transmission pathways. Carnivores in cities often exhibit modified spatial behavior and altered interactions with both prey and humans, contributing to novel urban food webs (Bateman & Fleming, 2012). These interaction-level changes can cascade through communities, influencing overall ecosystem function.

3.4 Trophic Dynamics and Resource Shifts

One of the most influential mechanisms in urban ecosystems is the redistribution of resources through anthropogenic subsidies. Human-derived food sources can increase resource availability and predictability, leading to inflated population sizes of certain species and altered trophic relationships. Such subsidies can decouple populations from natural resource cycles and modify selection pressures, with long-term ecological and evolutionary consequences (Oro et al., 2013). Sensory pollution further compounds these effects by altering foraging efficiency and predator detection, particularly in environments characterized by chronic noise and artificial light (Halfwerk & Slabbekoorn, 2015).

The diversity of mechanistic pathways operating in urban environments is summarized in Table 2, which links major urban drivers to their primary ecological and population-level effects. The table highlights how multiple mechanisms operate simultaneously, reinforcing the need for integrated analysis.

Table 2. Key mechanistic pathways linking urbanization to wildlife population responses

Mechanistic pathway	Urban driver	Primary population-level effects
Habitat fragmentation	Built infrastructure, impervious surfaces	Reduced connectivity, isolation, and local extinctions
Behavioral modification	Human disturbance, barriers	Altered movement, increased stress
Altered species interactions	Differential species tolerance	Community restructuring, trophic imbalance
Resource shifts	Anthropogenic food subsidies	Population inflation, altered food webs

3.5 Integration of Ecological, Behavioral, and Spatial Mechanisms

Critically, the mechanisms described above do not operate independently. Habitat fragmentation constrains movement, which in turn amplifies behavioral stress and alters species interactions. Resource subsidies may offset some negative effects while simultaneously intensifying competition or dependency on urban environments. Sensory pollution further modifies perception and performance, influencing both behavior and trophic dynamics (Halfwerk & Slabbekoorn, 2015). Understanding wildlife responses to urbanization, therefore, requires an integrated perspective that explicitly links ecological, behavioral, and spatial processes. Such integration provides a mechanistic foundation for explaining observed population patterns and sets the stage for developing testable propositions in subsequent sections.

4. Population-Level Responses and Species-Specific Traits

4.1 Changes in Abundance and Population Viability

Urbanization exerts strong population-level effects by altering demographic processes such as survival, reproduction, and dispersal. Changes in habitat structure, disturbance regimes, and resource availability can lead to declines in population abundance for many species, particularly those with narrow ecological requirements. Conversely, some species experience population increases in urban environments, often driven by access to anthropogenic resources and reduced predation pressure. These divergent responses highlight that urbanization reshapes not only species presence but also population viability across landscapes (Aronson et al., 2017).

Population viability in urban settings is further influenced by cumulative sublethal effects, including chronic stress and altered behavioral patterns, which may not immediately reduce abundance but can erode long-term persistence. Such processes emphasize the importance of evaluating population responses beyond simple presence–absence metrics.

4.2 Community Composition and Functional Diversity Shifts

At the community level, urbanization drives systematic changes in species composition, often resulting in biotic homogenization. Communities in highly urbanized areas tend to be dominated by a limited set of generalist species, while specialists decline or disappear. This selective filtering alters functional diversity by reducing the range of ecological strategies represented within communities. Broader assessments indicate that ongoing environmental change, including urban expansion, threatens the persistence of diverse ecological strategies among birds and mammals (Cooke et al., 2019).

These compositional changes have implications for ecosystem functioning, as losses of functional diversity can reduce resilience and disrupt ecological processes. Urban green spaces may partially buffer these effects, but their effectiveness depends on size, connectivity, and management intensity (Aronson et al., 2017).

4.3 Role of Behavioral Flexibility and Ecological Specialization

Species-specific traits play a critical role in mediating population responses to urbanization. Behavioral flexibility, including the ability to modify foraging strategies, activity patterns, and risk perception, is a key determinant of urban persistence. Species capable of rapid behavioral adjustment are more likely to exploit novel urban environments successfully (Sol et al., 2013). In contrast, ecological specialists with narrow habitat or dietary requirements are disproportionately vulnerable to urban pressures.

Trait-based analyses demonstrate that no single strategy guarantees urban success. Instead, combinations of traits related to behavior, life history, and ecological tolerance determine species-specific outcomes across urban gradients (Santini et al., 2019). These findings underscore the need to consider trait diversity when evaluating population-level responses.

The relationship between species traits and population outcomes is summarized in Table 3, which links key traits to generalized responses observed in urban environments. The table provides a structured overview of how behavioral and ecological characteristics influence population persistence.

Table 3. Species-specific traits influencing population-level responses to urbanization

Trait category	Trait characteristic	General population response
Behavioral traits	High behavioral flexibility	Increased persistence or population growth
Ecological traits	Broad diet and habitat use	Tolerance of urban environments
Specialization	Narrow ecological niche	Population decline or local extinction
Life-history traits	High reproductive output	Increased resilience to disturbance

4.4 Threshold Effects and Nonlinear Population Responses

Population responses to urbanization are often nonlinear, characterized by threshold effects beyond which rapid declines occur. Moderate levels of urbanization may support relatively stable populations, while further intensification can trigger abrupt losses in abundance or connectivity. Such thresholds emerge from the interaction of habitat fragmentation, disturbance, and demographic constraints, emphasizing the importance of scale and intensity in urban ecological processes (Evans et al., 2011).

These dynamics are conceptually illustrated in Figure 3, which depicts generalized nonlinear relationships between urban intensity and population responses across species with differing traits. The figure highlights that thresholds vary among species, reinforcing the need for trait-informed assessments.

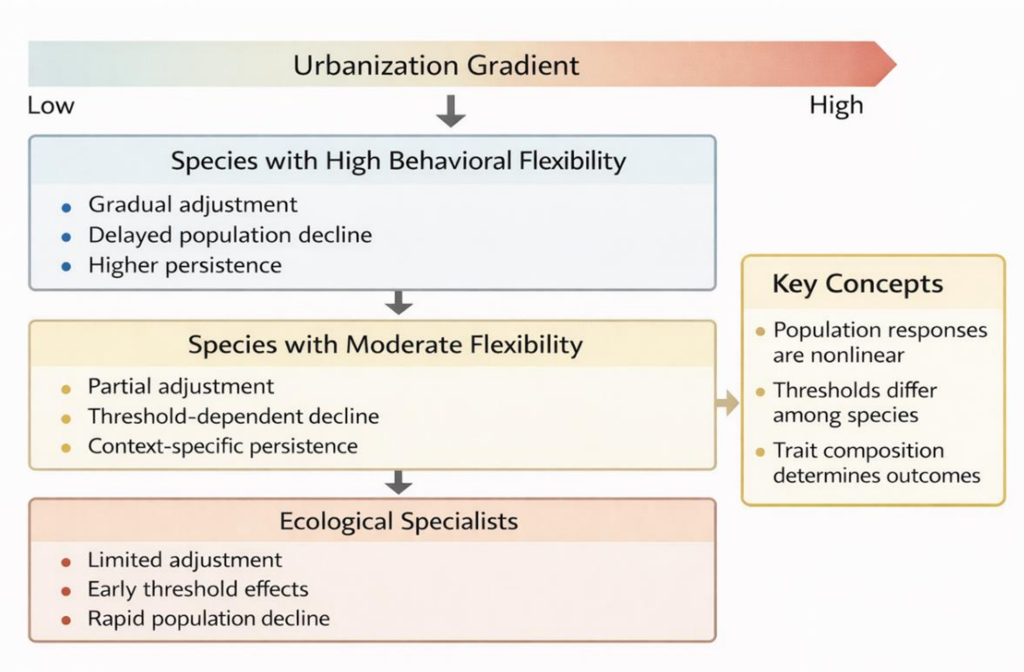

Figure 3. Conceptual illustration of nonlinear population responses to increasing urbanization intensity.

The figure depicts species-specific population trajectories along an urbanization gradient, showing threshold points beyond which population viability declines sharply. Species with high behavioral flexibility exhibit delayed or weaker thresholds compared to ecological specialists.

4.5 Integrating Population Responses and Trait-Based Perspectives

Integrating population-level patterns with species-specific traits provides a powerful framework for understanding urban wildlife dynamics. Urbanization acts as a selective filter, shaping communities through differential survival and reproduction linked to behavioral and ecological characteristics. Evolutionary perspectives further suggest that sustained urban pressures may drive adaptive responses over time, reinforcing trait-based differences among populations (Rivkin et al., 2019). Recognizing these integrated processes is essential for predicting future population trajectories and informing conservation strategies in increasingly urbanized landscapes.

5. Testable Propositions for Empirical Research

5.1 Proposition-Based Research Approach

Conceptual frameworks achieve scientific relevance when they generate propositions that can be empirically evaluated. Rather than offering descriptive generalizations, a proposition-based approach explicitly links theoretical mechanisms to testable expectations. In urban ecology, such propositions enable researchers to design comparative studies, identify appropriate indicators, and assess causal relationships across heterogeneous urban landscapes. This approach is particularly valuable in complex social–ecological systems, where multiple drivers interact to shape ecological outcomes (Meerow & Newell, 2019).

The framework developed in this study emphasizes propositions as a bridge between theory and observation, allowing future research to evaluate how urbanization processes translate into population-level responses under different environmental and social contexts.

5.2 Urban Intensity and Population Decline Relationships

A central proposition emerging from the framework is that increasing urban intensity is associated with declining wildlife population viability, but that this relationship is neither linear nor uniform across species. Urban intensity encompasses multiple stressors, including built infrastructure, disturbance, and altered resource regimes, which collectively filter species from local assemblages. Empirical studies across cities demonstrate that biodiversity patterns vary strongly along intra-urban gradients, reflecting differential sensitivity to urban pressures (Beninde et al., 2015).

This relationship is conceptualized in Figure 4, which presents a qualitative pathway linking increasing urban intensity to population outcomes through interacting ecological and spatial mechanisms. The figure emphasizes that population declines accelerate beyond species-specific thresholds rather than occurring gradually across the entire gradient.

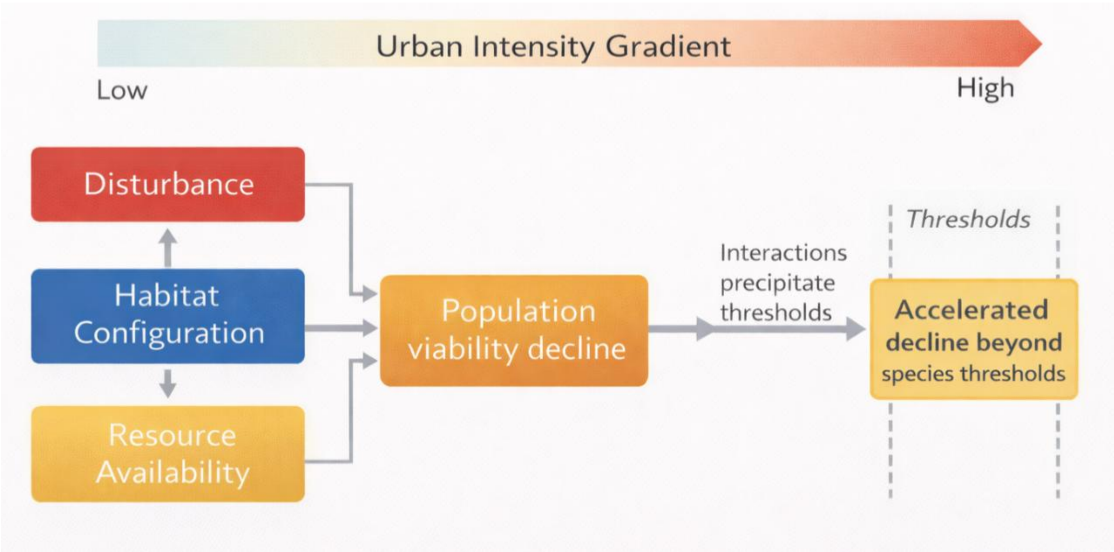

Figure 4. Conceptual pathway linking urban intensity to wildlife population responses.

The figure illustrates how increasing urban intensity influences population viability through interacting drivers such as disturbance, habitat configuration, and resource availability, leading to nonlinear and threshold-dependent population declines.

5.3 Moderating Role of Habitat Connectivity

A second key proposition is that habitat connectivity moderates the effects of urban intensity on wildlife populations. Even in highly urbanized settings, connected green spaces can facilitate movement, dispersal, and recolonization, thereby reducing extinction risk. The importance of spatial structure within cities highlights that urban biodiversity outcomes are not solely determined by urban extent, but also by the configuration and quality of habitat networks (Beninde et al., 2015).

Urban planning strategies that prioritize connectivity can therefore alter expected population trajectories, transforming otherwise hostile urban matrices into permeable landscapes for wildlife (Apfelbeck et al., 2020).

5.4 Importance of Species Traits in Urban Tolerance

Species traits represent a critical filter determining which populations persist under urban conditions. The framework proposes that behavioral flexibility, ecological generalism, and life-history traits jointly influence urban tolerance. Species capable of exploiting novel resources or adjusting behavior are more likely to persist, whereas specialists face heightened extinction risk. Community assembly in cities is thus shaped by hierarchical filtering processes that operate from regional species pools to local populations (Aronson et al., 2016).

The interaction between species traits and urban drivers is summarized in Table 4, which outlines how specific trait categories correspond to expected population responses. This table provides a clear structure for translating conceptual predictions into empirical hypotheses.

Table 4. Trait-based propositions linking species characteristics to urban population responses

Trait category	Trait expression	Expected population response
Behavioral traits	High flexibility	Increased persistence under high urban intensity
Ecological traits	Broad habitat and diet use	Reduced sensitivity to urban stressors
Specialization	Narrow ecological niche	Early population decline
Dispersal ability	High mobility	Greater resilience through recolonization

5.5 Framework Applicability Across Taxa and Spatial Scales

The final proposition is that the conceptual framework is applicable across taxa and spatial scales, while allowing for context-specific variation. Although taxonomic groups differ in life histories and ecological requirements, the underlying mechanisms urban intensity, connectivity, and trait-based filtering operate broadly

across vertebrates and invertebrates. Integrating social values and planning priorities into urban ecological research further enhances the relevance of such frameworks for real-world decision-making (Ives et al., 2017; Karvonen, 2014).
Designing wildlife-inclusive cities requires aligning ecological knowledge with urban governance and planning processes, ensuring that empirical research informed by this framework contributes to both biodiversity conservation and human well-being (Apfelbeck et al., 2020).

6. Implications for Urban Conservation and Planning

Urbanization is no longer an external pressure acting on natural ecosystems but a dominant context within which wildlife conservation must operate. The conceptual framework developed in this study highlights the necessity of integrating wildlife considerations directly into urban development processes rather than treating biodiversity as an afterthought. Conservation outcomes in cities depend not only on the extent of urban expansion but also on how urban form, land-use decisions, and infrastructure placement interact with ecological processes. Embedding ecological principles into early stages of urban planning can reduce irreversible impacts on wildlife populations and improve long-term population viability.
A central implication of the framework is the critical role of green infrastructure in mediating urban impacts on wildlife. Green spaces, when strategically designed and interconnected, can function as habitat networks rather than isolated fragments. Ecological corridors facilitate movement, dispersal, and gene flow, reducing the risks associated with population isolation and local extinction. Importantly, the effectiveness of green infrastructure depends on spatial configuration, quality, and connectivity, emphasizing that small, poorly connected green spaces are insufficient to sustain wildlife populations in highly urbanized landscapes.
The framework also underscores the need for biodiversity-sensitive urban design strategies that accommodate species with varying ecological requirements. Designing cities that support wildlife coexistence requires moving beyond uniform solutions toward context-specific interventions. Urban environments should incorporate habitat heterogeneity, reduce unnecessary disturbance, and maintain structural features that support both generalist and sensitive species. Such design strategies align urban functionality with ecological resilience, enabling cities to support a broader range of species and ecological interactions.
Finally, the relevance of this framework extends to sustainable urban policy, where long-term planning must balance human well-being with ecological integrity. Policies informed by an understanding of threshold effects and nonlinear population responses can prevent sudden biodiversity losses associated with unchecked urban intensification. Integrating ecological thresholds into zoning regulations, infrastructure planning, and land-use governance can help ensure that urban growth proceeds in a manner that promotes wildlife persistence. By aligning conservation goals with urban development objectives, cities can play an active role in fostering resilient social–ecological systems capable of supporting both human and wildlife populations in the future.

7. Conclusion and Future Research Directions

This study develops an integrative conceptual framework to explain how urbanization influences local wildlife populations through interacting ecological, behavioral, and spatial mechanisms. By conceptualizing urbanization as a multidimensional process rather than a single land-use change, the framework clarifies how habitat configuration, disturbance, sensory stressors, and resource redistribution jointly shape population-level outcomes. A key insight is that wildlife responses to urbanization are highly variable and nonlinear, with species-specific traits such as behavioral flexibility and ecological specialization determining the timing and severity of population declines. The framework advances urban ecology by shifting emphasis from descriptive patterns to mechanistic understanding and by explicitly linking urban drivers to population viability through testable pathways. In doing so, it provides a unifying structure that bridges landscape ecology, behavioral ecology, and conservation science. The propositions outlined in this study offer clear directions for empirical validation, encouraging future research to quantify thresholds, evaluate the moderating role of habitat connectivity, and assess trait-based responses across taxa and spatial scales. Longitudinal and comparative studies across urban gradients will be particularly valuable for testing the framework's predictions and refining its applicability under diverse socio-ecological contexts. Interdisciplinary research integrating ecological data with urban planning, governance, and social dimensions is also essential to translate conceptual insights into effective conservation action. Ultimately, promoting wildlife–urban coexistence requires recognizing cities as dynamic ecosystems capable of supporting biodiversity when ecological principles are embedded within urban development. By providing a theory-driven foundation for future empirical work and applied planning, this study contributes to a more nuanced understanding of urban biodiversity dynamics and supports the development of resilient cities in which human activities and wildlife populations can persist together over the long term.

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