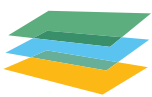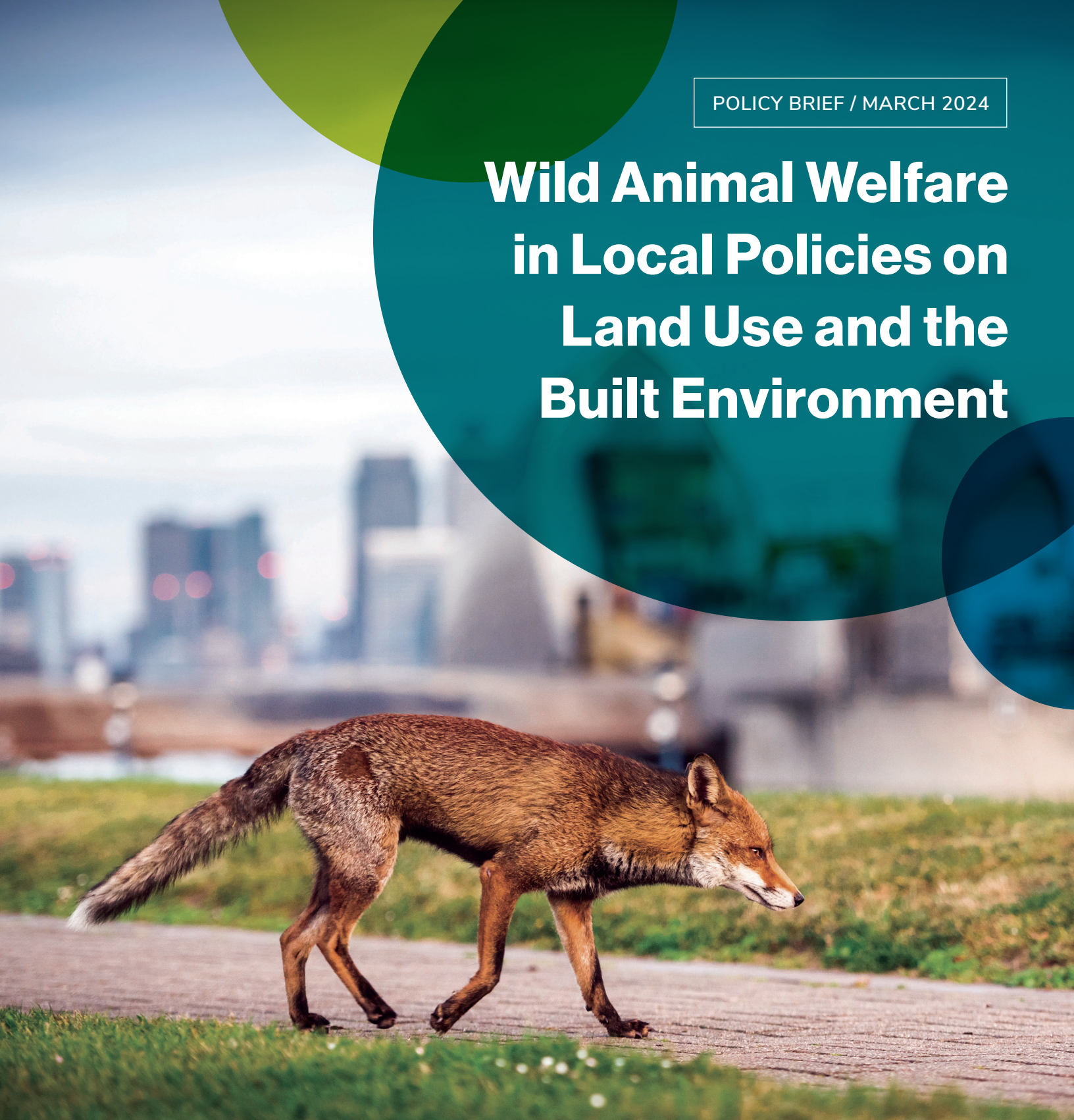# Wild Animal Welfare in Local Policies on Land Use and the Built Environment

Guarini Center
on Environmental, Energy & Land Use Law
NEW YORK UNIVERSITY SCHOOL OF LAW

NYU
WILD ANIMAL WELFARE

The Law, Ethics & Animals Program
AT YALE LAW SCHOOL

Wild Animal Welfare in Local Policies on Land Use and the Built Environment

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Table of Contents

Introduction

This policy brief describes local policies on land use and the built environment that have the potential to improve wild animal welfare. The policy examples highlighted in this brief have known benefits for humans and the climate but also have promising potential benefits for wild animals. The brief focuses on local policies in the United States but draws on policies from outside the United States.

This brief seeks to address the "missing issue" of wild animal welfare in local policies on land use and the built environment. The health of humans, animals, and the environment are interlinked.[1] For example, policies that negatively impact the welfare of wild animals may increase the risk of human-wildlife conflict, disease, and reduction in the well-being of humans as they witness animal suffering.[2] When we consider human, animal, and planetary health holistically, we can improve health outcomes for all beings more effectively and sustainably.

Policymakers have recognized that animal welfare is currently a "missing issue" in environmental, climate change, and sustainable development policy that merits further research and consideration.[3] Policymakers at all levels of government have limited understanding of how their policies may impact wild animal welfare or how they could better take wild animal welfare into account. This brief begins to address this gap in knowledge and policy action for wild animal welfare at the local government level.

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[1] One Health Basics, Center for Disease Control.
[2] NYU Wild Animal Welfare Program and Guarini Center on Environmental, Energy & Land Use Law at New York University School of Law, Public Comments to Office of Information and Regulatory Affairs (2023).
[3] United Nations, Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development 117 (2019); Jeff Sebo et al., Sustainable Development Matters for Animals Too: Governments Have A Responsibility to Recognize That, CABI One Health (2022); UNEP/EA.5/Res.1 (March 7, 2022).

Key Concepts and Definitions

Animal welfare: the biological, behavioral, and mental functioning of individual animals that can range from generally negative to generally positive.[4]

Wild animals: animals living autonomously from humans and animals that are not domesticated, farmed, or companion animals (e.g. dogs and cats).

Climate change adaptation: "adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects."[5]

Climate change mitigation: "human intervention to reduce the sources or enhance the sinks of greenhouse gasses."[6]

Climate change resilience: "The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation."[7]

In particular, local government policies on land use and the built environment affect animal welfare, as well as humans and the climate. For example, cities[8] are enhancing green space and tree cover to combat heatwaves and the urban heat island effect intensified by climate change.[9] Extreme heat not only has negative human health impacts but also has negative nonhuman health impacts that worsen animal welfare.[10] Recent studies have highlighted how heat stress contributes to animal mortality and affects the movement of wild animals such as deer, rabbits, and cougars in urban areas.[11] Local policies that cities are already implementing to address extreme heat may also benefit wild animals.

Cities are well-positioned to implement local land use and built environment policies that may benefit wild animals. Some cities are leaders on climate change mitigation, adaptation, and resilience policies.[12] Some cities are already assessing biodiversity and implementing local policies that protect and enhance

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[4] D. M. Broom, Animal Welfare: Concepts and Measurement, 69 Journal of Animal Science 4167 (1991); David Fraser et al., A Scientific Conception of Animal Welfare that Reflects Ethical Concerns, 6 Animal Welfare 187 (1997); David Mellor & Ngaio J. Beausoleil, Extending the 'Five Domains' Model for Animal Welfare Assessment to Incorporate Positive Welfare States, 24 Animal Welfare 241 (2015); Heather Browning, Assessing Measures of Animal Welfare, 37 Biology & Philosophy 1 (2022).

[5] IPCC, Synthesis Report of the Fifth Assessment Report, Annex II: Glossary 118 (2019).

[6] Id. at 125.

[7] Id. at 127.

[8] This brief will refer to cities, but many policies and processes described herein can be implemented by any local government unit (e.g., municipality, county, or town).

[9] How Cities are Using Nature to Keep Heatwaves at Bay, UN Environment Programme (July 22, 2020).

[10] Heat Island Impacts, U.S. Environmental Protection Agency.

[11] Jeffrey D. Haight et al., Urbanization, Climate and Species Traits Shape Mammal Communities from Local to Continental Scales, 7 Nature Ecology & Evolution 1654 (2023); Himali U. Ratnayake et al., Forecasting Wildlife Die-Offs from Extreme Heat Events, 22 Animal Conservation 386 (2019).

[12] See, e.g., C40 Cities.

biodiversity,[13] but few are explicitly considering animal welfare in local policy.[14] This brief identifies how cities can identify and implement priority policies on land use and the built environment that are promising for wild animal welfare. Some policies described in the brief are already being implemented by cities but could be modified to better account for wild animal welfare.

Wild Animal Welfare Compared to Biodiversity Conservation

Wild animal welfare is a distinct concept from biodiversity. As a general matter, improving wild animal welfare is a matter of ensuring that individual wild animals experience more positive states like pleasure and fewer negative states like pain where possible.[15] Biodiversity focuses on genetic diversity within a species, a diversity of species in an ecosystem, and a diversity of ecosystems.[16] Biodiversity conservation seeks to maintain and enhance this diversity.[17]

Biodiversity and wild animal welfare may be aligned in practice. For example, anthropogenic noise may negatively impact both biodiversity and the welfare of individual animals.[18] However, biodiversity and wild animal welfare changes are not always in lock step. For example, there may be policies in some cities that improve wild animal welfare but have no measurable effect on biodiversity, or vice versa. For example, a bird-friendly building policy in a particular city may not have any measurable effect on the health of a bird species as a whole, the diversity of bird species in the ecosystem, or the health of the ecosystem. However, the policy still improves wild animal welfare because the individual birds that would have collided with the glass windows without bird-friendly materials are spared death, injury, and suffering. There may also be examples of policies that increase biodiversity but decrease wild animal welfare or vice versa.

The scope of this brief focuses on the impacts of local policies on wild animals and wild animal welfare. Cities host a wide variety of wild animals, including members of endangered and threatened species.[19] Examples of wild animals found in cities may include birds, squirrels, deer, foxes, turtles, bats, butterflies, and frogs. This brief focuses on the welfare of wild animals in cities because it is an important and understudied area raising a distinct set of challenges.[20] The majority of animals on Earth are wild and do not live in captivity, but most animal welfare policies at every level of government focus on captive

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[13] Timothy Beatley & J. D. Brown, Cities4Biodiversity Deep-Dive Learning Program Summary Report: Greening Cities (2022); Jennifer Rae Pierce et al., Actions, Indicators, and Outputs in Urban Biodiversity Plans: A Multinational Analysis of City Practice, 15 PLOS ONE 1 (2020).
[14] The City of Amsterdam is a leading example of planning for wild animal welfare in local policy on land use and the built environment. See Policy: Animal Welfare, City of Amsterdam.
[15] Jeff Sebo, The Moral Problem of Other Minds, 25 Harvard Review of Philosophy 51 (2018).
[16] UN Sustainable Development Goals Knowledge Platform, United Nations.
[17] See Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79.
[18] Shannon Graeme et al., A Synthesis of Two Decades of Research Documenting the Effects of Noise on Wildlife, 91 Biological Reviews 982 (2016).
[19] Christopher D. Ives et al., Cities are Hotspots for Threatened Species, 25 Global Ecology and Biogeography 117 (2016).
[20] See David W. Macdonald, Mitigating Human Impacts on Wild Animal Welfare, 13 Animals 1, 3 (2023).

animals.[21] It is also important for cities to take action to enhance the welfare of domestic, farmed, and captive animals, but this brief focuses on policies that may benefit wild animals in particular.[22]

This brief covers examples of local policies on land use and the built environment that have the potential to benefit wild animals, with a focus on local policy applications in the United States. This brief does not describe in detail local policies on human-wildlife conflict, non-lethal pest and predator management, zoonotic disease management, waste management, food systems, or disaster risk planning but identifies them as areas for further policy research.[23] Some of these policy areas are important to wild animal welfare and some are at least related to policies on land use or the built environment. However, this brief is not an exhaustive or comprehensive review, but a selection of local policies that are promising for supporting wild animal welfare. Furthermore, this brief highlights policies that may have triple benefits: to humans, the climate, and animals. The authors recommend that cities and local actors consider the policies listed in this brief alongside others that can be identified outside of this brief.

While this brief focuses on local government policies, large institutions and landowners such as universities and companies can also implement analogous policies to those listed in the brief. Institutions and landowners often make decisions about their private land use, building operation and construction, and land maintenance. As such, they could play a role in implementing their own policies on land use and the built environment that may improve wild animal welfare. It is also important to note that the policies in this brief include local government action on government-owned or government-controlled property as well as government regulations and incentives for private entities.

The brief proceeds as follows. Part I of this brief introduces wild animal welfare concepts and highlights some overarching challenges and opportunities for cities to include wild animal welfare in local policy. Part II provides overarching approaches for local policy makers seeking to introduce wild animal welfare into local planning and policy. Part III provides a range of examples of local policies on land use and the built environment that have the potential to improve wild animal welfare while also benefiting humans and the climate. Part IV briefly identifies some future directions for research on local policies that contribute to wild animal welfare.

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[21] While there is growing interest in wild animal welfare at the international level, there is no treaty or instrument protecting the welfare of individual wild animals; although there are treaties protecting animals at the species level. See Elien Verniers, Bringing Animal Welfare Under the Umbrella of Sustainable Development: A Legal Analysis, 30 Review of European, Comparative, and International Environmental Law 349, 351 (2021); Steven White, Shifting Norms in Wild Animal Protection and Effective Regulatory Design, in Animal Welfare and International Environmental Law (Werner Scholtz ed. 2019); CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora (2019).

[22] For example, climate change also impacts domestic, farmed, and captive animals, and many policies in this brief may also benefit these animals. See Alexandra Protopopova et al., Climate Change and Companion Animals: Identifying Links and Opportunities for Mitigation and Adaptation Strategies, 61 Integrative and Comparative Biology 166 (2021).

[23] See Section IV for a description of future possible research in these areas.

I. Background

A. Introduction to Wild Animal Welfare

Experts in science, ethics, and policy increasingly agree that all sentient beings—all beings with the capacity to consciously experience positive and negative states like pleasure and pain—merit consideration for their own sakes.[24] Experts also agree that a wide range of animals, including all vertebrates (mammals, birds, reptiles, amphibians, and fishes) and many invertebrates (cephalopod mollusks, decapod crustaceans, and insects) are either sentient or, at the very least, sufficiently likely to be sentient.[25] While many questions remain about the details, when decision-makers have the chance to improve outcomes for humans and nonhumans at the same time—or, at least, to improve outcomes for nonhumans without worsening them for humans—they should take it.

Wild animals live in cities and may adapt to urban conditions, with varying degrees of success.[26] The conditions in cities pose risks and benefits to wild animals, both at the population level (since conditions can cause a species' local population to expand or contract) and at the individual level (since conditions can cause individual animals to be better or worse off). Since the risks and benefits that arise for species are different from, though related to, the ones that arise for individuals, cities should consider impacts on wild animals at both levels. Figure 1 conceptualizes some of the positive and negative conditions that cities may provide for wild animals.

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[24] Heather Browning & Walter Veit, The Sentience Shift in Animal Research, 28 New Bioethics 299 (2022); Charlotte E. Blattner, The Recognition of Animal Sentience by the Law, 9 Journal of Animal Ethics 121 (2019).

[25] Heather Browning & Walter Veit, The Sentience Shift in Animal Research, 28 New Bioethics 299 (2022); Andrew Crump et al., Sentience in Decapod Crustaceans: A General Framework and Review of the Evidence, 32 Animal Sentience 1 (2022); David Baracchi & Luigi Baciadonna, Insect Sentience and the Rise of a New Inclusive Ethics, 29 Animal Sentience 1 (2020); Jonathan Birch et al., LSE Consulting, Review of the Evidence of Sentience in Cephalopod Molluscs and Decapod Crustaceans (2021); Jonathan Birch, Animal Sentience and the Precautionary Principle, 16 Animal Sentience 1 (2017). But see Benjamin K. Diggles et al., Reasons to be Skeptical About Sentience and Pain in Fishes and Aquatic Invertebrates, 32 Reviews in Fisheries Science & Aquaculture 127 (2024).

[26] See, e.g., Hélène Lowry et al., Behavioural Responses of Wildlife to Urban Environments, 88 Biological Reviews 537 (2012).

Figure 1: Examples of Positive and Negative Conditions in Cities for Wild Animals[27]

POSITIVE CONDITIONS	NEGATIVE CONDITIONS
Access to supplemental food sources	Low quality food sources
Access to shelter, including in buildings and human constructions	Noise from traffic and other sources
Milder winter temperatures	Air and water pollution
Lower levels of predation	Extreme heat/urban heat island effect
	Conflict with humans and other animals, including vehicle collisions and unintended poisonings

Scientists have developed several models to measure and assess animal welfare. The Five Domains Model for Animal Welfare Assessment (see Figure 2), Welfare Quality®, and Decision Support Systems are some of the most commonly used combination measures to assess animal welfare.[28] Combination measures bring together "multiple partial indicators, each of which represent a contributor to subjective welfare experience—such as nutrition, health, or behavior" and generate an overall score.[29] These frameworks were developed primarily for farmed animals or captive animals used for research or testing, and there may be challenges to applying them to accurately measure the welfare of wild animals.[30] While further research is needed, these measures are a starting point to understand wild animal welfare.[31]

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[27] See Animal Ethics, Investigating the Welfare of Wild Animals in Urban Environments (2021).
[28] See Heather Browning, Assessing Measures of Animal Welfare, 37 Biology & Philosophy 1, 16 (2022).
[29] *Id.* at 15.
[30] Wild Animal Welfare Research Priorities, Wild Animal Initiative.
[31] See, *e.g.,* Romain Espinosa, Animals and Social Welfare, Social Choice and Welfare 1 (2023).

Figure 2: Summary of The Five Domains Model for Animal Welfare Assessment (adapted from Beausoleil et al. 2023)

PHYSICAL/FUNCTIONAL DOMAINS

Domain 1
NUTRITION & HYDRATION

Restrictions on:
Food/water intake, food quality

Opportunities for:
Appropriate amount and quality of food and water

Domain 2
PHYSICAL ENVIRONMENT

Inescapable/imposed conditions:
Thermal extremes, close confinement, frequent intense noise, poor atmosphere quality

Available conditions:
Space for freer movement, thermally tolerable, appropriate environmental variability and predictability

Domain 3
HEALTH/FUNCTIONAL STATUS

Presence of:
Disease, injury, functional impairment, obesity

Presence of:
Normal function, appropriate body condition, physical fitness

Domain 4
BEHAVIOURAL INTERACTION

Animal's 'agency' restricted by:
Invariant/barren environment, limited choices, inappropriate social environment, inability to avoid threats

Animal's 'agency' facilitated by:
Varied, novel, engaging environmental and social challenges, ability to choose, avoid threat, explore, move and rest freely

AFFECTIVE DOMAIN

Domain 5
MENTAL EXPERIENCES

Negative experiences:
Hunger, thirst

Positive experiences:
Satiety, pleasure of drinking and food taste/smells

Negative experiences:
Thermal discomfort, stiffness, auditory discomfort, breathlessness, or respiratory discomfort

Positive experiences:
Physical and thermal comfort, enjoyment related to variety

Negative experiences:
Pain, breathlessness, sickness, nausea, weakness, exhaustion

Positive experiences:
Physical comfort and feelings of vitality

Negative experiences:
Fear, anxiety, boredom, loneliness, frustration, anger

Positive experiences:
Feelings of calm, safety, control, engagement/interest, companionship, reward

ANIMAL WELFARE STATUS

For example, consider an illustrative application of the Five Domains Model for a house sparrow, a common bird. The Five Domains are, from one to five: nutrition, environment, health, behavioral interactions, and mental state/experiences (Figure 2).[32] The positive and negative conditions and physical states in domains one to four have associated affective experiences for animals (domain five) that positively or negatively impact their welfare status.[33] For example, a house sparrow is likely to benefit from having access to high quality diets of forage, especially seeds (Domain 1).[34] This high quality diet may lead to positive mental experiences like satiety or enjoyment of food in Domain 5, resulting in improved animal welfare status. However, house sparrows in urban environments may have negative experiences in Domain 5 and reduced animal welfare status due to exposure to nitrous oxide from traffic pollution (Domain 2), which contributes to lower body mass in sparrow chicks, tissue damage, and impacts on fitness of birds in breeding season.[35] This is one example of how to begin to analyze how city conditions may impact the welfare of a wild animal living in the city.

B.   Opportunities and Challenges for Cities Considering Wild Animal Welfare

Cities and other local actors have emerging opportunities to be leaders on wild animal welfare. Cities are implementing policies and receiving federal and state funding for climate change mitigation and adaptation, including for nature-based solutions.[36] As cities develop and implement new policies and infrastructure, there are opportunities to consider wild animal welfare. Cities are also well-positioned to be policy incubators that can experiment with policy interventions that, when successful, can then be adopted in other cities and even at higher levels of government.[37] Meanwhile, many wild animals live in cities, and more wild animals may migrate to cities in the future as human-caused climate and environmental changes place pressure on them in their current habitats.[38] For these reasons, cities have both the opportunity and the responsibility to take the lead in considering how to shape their institutions and infrastructure to benefit both humans and animals.

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[32]   David J. Mellor et al., The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare, 10 Animals 1 (2020).

[33]   Ngaio Jessica Beausoleil et al., Application of the Five Domains Model to Food Chain Management of Animal Welfare: Opportunities and Constraints, 4 Frontiers in Animal Science 1 (2023).

[34]   House Sparrow, Audubon.

[35]   W. J. Peach et al., Reproductive Success of House Sparrows Along an Urban Gradient, 11 Animal Conservation 493 (2008); Amparo Herrera-Dueñas et al., Oxidative Stress of House Sparrow as Bioindicator of Urban Pollution, 42 Ecological Indicators 6 (2014); see also Animal Ethics, Investigating the Welfare of Wild Animals in Urban Environments (2021).

[36]   The White House, Opportunities to Accelerate Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, & Prosperity (2022); Cities Call for Increased Investment to Halt and Reverse Nature Loss, UN Environment Program (Dec. 10, 2022).

[37]   City Climate Policy, Center for Climate and Energy Solutions; Brian D. Galle & Joseph K. Leahy, Laboratories of Democracy? Policy Innovation in Decentralized Governments, 58 Emory Law Journal 1333 (2009).

[38]   See Erica N. Spotswood et al., The Biological Deserts Fallacy: Cities in their Landscapes Contribute More than We Think to Regional Biodiversity, 71 Bioscience 148 (2021); Jeffrey D. Haight et al., Urbanization, Climate and Species Traits Shape Mammal Communities from Local to Continental Scales, 7 Nature Ecology & Evolution 1654 (2023).

Nature-Based Solutions

Nature-based solutions are wide-ranging, but are generally defined as an "ecological approach to climate change action, whilst also enhancing the resilience of natural and managed ecosystems and the human settlements that adjoin them."[39] The International Union for Conservation of Nature (IUCN) describes nature-based solutions as "actions to protect, sustainably manage, and restore natural and modified ecosystems, benefiting people and nature at the same time."[40] Examples of nature-based solutions include green corridors connecting natural areas in cities or mangrove protection and restoration.[41]

However, cities and other local actors also face many challenges that stand in the way of improving wild animal welfare. First, the ability to predict and control the net impacts of policies on wild animal welfare remains limited.[42] The field of wild animal welfare is in its early stages, and researchers need to make further progress before they can estimate the net effects of policies on wild animal welfare.[43] For instance, researchers need to learn more about which animals are sentient, how particular interventions will directly and indirectly affect particular animals, and to what extent particular effects count as beneficial or harmful for particular animals.[44] Absent progress in this and other research, attempts to predict and control the net impacts on wild animal welfare may be ineffective or counterproductive.[45]

Second, cities may face tradeoffs as they seek to implement policies that may benefit wild animal welfare. For example, they may face tradeoffs between policies that benefit some wild animals and not others. Wild animals inhabit complex ecologies, and policies that benefit some wild animals (say, members of

[39] David Simpson, United Nations Environment Program, Thematic Brief: Nature-Based Solutions (2020).
[40] Nature-Based Solutions, IUCN.
[41] World Wildlife Fund, Urban Nature Based Solutions: Cities Leading the Way (2021).
[42] See, e.g., Bob Fisher, The Welfare Range Table, Rethink Priorities (Nov. 7, 2022).
[43] Abraham Rowe, Wild Animal Welfare and Uncertainty, Wild Animal Initiative.
[44] Mark Budolfson et al., Animal Welfare: Methods to Improve Policy and Practice, 381 Science 32 (2023); Wild Animal Welfare Research Priorities, Wild Animal Initiative; Matthew Allcock & Luke Hecht, Potential Effects of Habitat Fragmentation on Wild Animal Welfare (2020); Andrea M. Harvey et al., A Ten-Stage Protocol for Assessing the Welfare of Individual Non-Captive Wild Animals: Free-Roaming Horses (Equus Ferus Caballus) as an Example, 10 Animals 1 (2020); Luke Hecht, The Importance of Considering Age When Quantifying Wild Animals' Welfare, 96 Biological Reviews 2602 (2021).
[45] See Wild Animal Welfare Research Priorities, Wild Animal Initiative; Abraham Rowe, Wild Animal Welfare and Uncertainty, Wild Animal Initiative.

predator species) might harm others (say, members of prey species).[46] Cities may also face tradeoffs between pursuing policies with wild animal benefits versus policies that benefit human residents. Cities have limited funding, capacity, and political will for implementing new policies, and understandably, are likely to prioritize human health and welfare to the extent it conflicts with the goal of promoting wild animal welfare.

These two key challenges may limit the extent to which cities can improve wild animal welfare in the short term. However, they should not prevent cities from taking modest first steps. First, with respect to measurement of animal welfare outcomes from policies, we might not be able to estimate the impacts of all policies for all animals with full confidence, we can still estimate the impacts of some policies for some animals with some confidence, based on existing scientific research. As cities implement policies, researchers can further study the effect of these policies on wild animal welfare and recommend how to improve the policies over time.[47] Moreover, both action and inaction carry risk in this context. While attempting to help wild animals risks causing new harms, not attempting to do so risks amplifying ongoing harms from existing policies or lack thereof. This brief recommends that cities attempt to consider and improve wild animal welfare in targeted ways now, and should then build on this work over time.[48]

Second, with respect to policy tradeoffs, policy decisions affecting humans and animals are not always a zero sum game. In many cases, human, animal, and climate impacts are interconnected, and policies that benefit humans can improve animal welfare and vice versa.[49] In particular, this brief focuses on local land use and built environment policies that have potential to be beneficial to humans, animals, and the climate with relatively few tradeoffs, given the limited scientific evidence available. If cities have limited capacity to focus on animal welfare at this time, land use and built environment policies are an excellent place to start. Cities are already in the process of upgrading their infrastructure to promote climate change mitigation, adaptation, and resilience and improve human health. Some of the policies listed may also be cost saving to local governments, including by increasing building energy efficiency and reducing nighttime light.

Overall, if cities at least consider wild animal welfare when making decisions, they might be able to identify policies that benefit humans and wild animals at the same time—or, at least, policies that benefit wild animals without harming humans.[50] As cities implement these policies, we further recommend that they consider partnering with researchers to study and improve the effects of their policies on wild animal welfare over time.

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46 See Heather Browning & Walter Veit, Positive Wild Animal Welfare, 38 Biology & Philosophy 1 (2023).
47 See William McAuliffe, Risk Aversion in Wild Animal Welfare, Rethink Priorities (2023).
48 Jeff Sebo, Saving Animals, Saving Ourselves (2022); William McAuliffe, Risk Aversion in Wild Animal Welfare, Rethink Priorities (2023).
49 See One Health Basics, Center for Disease Control.
50 Jeff Sebo, Saving Animals, Saving Ourselves (2022).

II. Overarching Approaches for Introducing Wild Animal Welfare into Local Policy

This section identifies overarching approaches that cities can use to incorporate wild animal welfare into local policy processes. Through these cross-cutting approaches, cities can begin to consider animals as stakeholders in policy making, as local policies impact the lives and welfare of animals. The institutional and policy mechanisms described in this section can serve as a foundation for ongoing and future work by cities to support wild animal welfare.

A.   Address wild animal welfare in ongoing city planning processes

Cities already incorporate environmental and climate change concerns into many city planning processes, including climate action plans, stormwater and green infrastructure plans, open space plans, urban forest plans, biodiversity plans, capital investment plans, and more.[51] Cities could also begin to incorporate wild animal welfare concerns into these planning processes, as they have the potential to affect wild animal welfare.

For example, cities could readily incorporate wild animal welfare considerations into existing biodiversity planning and policy efforts. Some cities are already leading in global efforts to address the drastic decline in global biodiversity. Cities are addressing impacts of urbanization on biodiversity through biodiversity planning, assessment, and policy action.[52] For example, Los Angeles, California recently adopted Biodiversity Guidelines and Chicago, Illinois has a Nature and Wildlife Plan.[53] As of 2018, 108 cities

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[51]   See, e.g., City of Chicago, Green Stormwater Infrastructure Strategy (2014); Asian Cities: Climate Focus Needed in Capital Investment Planning, The World Bank (May 15, 2014).

[52]   How to Enhance, Restore and Protect Biodiversity in Your City, C40 Cities Climate Leadership Group; World Bank, Urban Nature and Biodiversity for Cities: Policy Brief (2021); see also Timothy Beatley & Peter Newman, Biophilic Cities are Sustainable, Resilient Cities, 5 Sustainability 3328 (2013).

[53]   Chicago Nature and Wildlife Plan & Update, City of Chicago; City of Los Angeles & County of Los Angeles, LA Biodiversity Guidelines (2023).

globally have adopted biodiversity action plans (or an equivalent) or otherwise integrated biodiversity into their sustainability, green space, or green infrastructure plans.[54] Cities have led international efforts to promote nature and biodiversity in cities, including the Biophilic Cities Network and CitieswithNature, among others.[55] Yet, most major cities' biodiversity planning documents do not mention wild animal welfare.[56] While wild animal welfare is distinct from biodiversity, there may be overlap in measurement of and indicators for biodiversity and wild animal welfare.

Cities should also assess opportunities to incorporate wild animal welfare into city planning beyond biodiversity plans. For example, for their parks and green infrastructure planning, cities could use existing urban forest assessment tools to model how parks and tree management choices affect bird habitat potential.[57] In addition, many cities already include policies that could promote wild animal welfare in their climate action plans. For example, San Diego, California has a goal in their climate action plan to "[r]estore 350 acres of salt marsh land and other associated tidal wetland and riparian habitats."[58] Although San Diego's plan does not describe wild animal welfare or biodiversity concerns, there is nothing barring a climate action plan from identifying the welfare of wild animals as a potential benefit or consideration. Similarly, a climate action plan could indicate that wild animal welfare should factor into the implementation of its goals, especially those related to nature-based solutions or green infrastructure.

B.   Incorporate monitoring of animal welfare into existing wildlife monitoring

Cities can begin to gather data about wild animal welfare in tandem with existing wildlife monitoring processes. This would leverage existing scientific expertise in city departments, align with other city planning processes, and save time and costs associated with beginning to monitor wild animal welfare. Cities should also seek to gather data on wild animal welfare beyond animals that are part of threatened or endangered species. Monitoring for wild animal welfare could include assessing rates of disease among animals, starvation of animals, and animals' exposure to extreme anthropogenic noise and high temperatures. This monitoring would ideally measure more than just the presence or absence of animals in an area but measure their body condition, which could indicate their welfare.[59]

For example, cities that are assessing biodiversity can choose to measure indicators that overlap with assessing wild animal welfare. For example, the City Biodiversity Index (CBI) and IUCN Urban Nature Index—two prominent city self-assessment tools for biodiversity—include indicators that likely correlate with wild animal welfare.[60] For example, for the Urban Nature Index, cities could choose biodiversity indicators that overlap with wild animal welfare considerations. Measures 2.3 and 2.4 of that index assess the levels of light and noise pollution in the city, both of which may affect wild animal welfare alongside

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54   The Nature Conservancy, Nature in the Urban Century 54 (2018).
55   See World Bank, Urban Nature and Biodiversity for Cities: Policy Brief 12 (2021).
56   For example, biodiversity planning documents in Toronto, Canada; San Francisco, California; Los Angeles, California; and Singapore do not mention animal welfare.
57   See Susannah B. Lerman et al., Using Urban Forest Assessment Tools to Model Bird Habitat Potential, 122 Landscape and Urban Planning 29 (2014).
58   City of San Diego, San Diego Climate Action Plan 76 (2022).
59   David J. Mellor et al., The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare, 10 Animals 1 (2020).
60   Timothy Beatley & J. D. Brown, Cities4Biodiversity Deep-Dive Learning Program Summary Report: Greening Cities 8-10 (2022).

biodiversity.[61] In addition to choosing metrics, as cities assess conditions in their parks and green spaces, including monitoring for biodiversity, they may consider incorporating wild animal welfare monitoring. This could at least include tracking changes in habitat availability, habitat connectivity measures, noise pollution, and light pollution, among other environmental factors that may impact wild animal welfare.[62]

C.   Establish a city animal welfare office or official

Cities should consider appointing an official to coordinate animal welfare efforts or creating an animal welfare office. Over time, cities should further consider a subdivision within an animal welfare office or an official dedicated to wild animal welfare in particular. For two prominent examples, New York City recently created a Mayor's Office of Animal Welfare after several years of having an animal welfare liaison, and Amsterdam, Netherlands has a Councilor for Animal Welfare coordinating city policies to promote wild animal welfare.[63] In New York City, animal welfare accomplishments include the "first and only municipal non-lethal deer impact management plan in the country," bird-friendly building materials, and a city-wide ban on wild and exotic animals from circuses, among other accomplishments.[64] In Amsterdam, the Councilor for Animal Welfare coordinates the city-wide Animal Agenda to ensure the welfare of wild and captive animals is considered in city policies. Under the Animal Agenda, Amsterdam has succeeded in removing ecological bottlenecks to wild animal movement in the city, creating wildlife-friendly river and canal banks, and supporting the creation of wild animal rescues and shelters, among other accomplishments.[65]

Overall, an animal welfare office or official could serve a coordinating role—helping agencies across the city consider animal welfare in their planning and policies. Amsterdam, Netherlands has one of the leading examples of interagency coordination on local land use and built environment policies that consider wild animal welfare.[66] Among other activities, an animal welfare office or official could create checklists for city agencies to include animal welfare in their planning and actions, develop best practices on including animal welfare in city policies, review technical guidance to enhance animal welfare, and more. The office or official could also lead efforts to draft wildlife ordinances that support wild animal welfare, in coordination with other departments and experts.

In addition, as scientific research on wild animal welfare advances, the office or official may consider implementing or coordinating monitoring efforts to measure the welfare of wild animals. For these efforts, the animal welfare office or official could coordinate with city scientists or external researchers to assess the life cycles and needs of wild animals in the city to design policies to better support the welfare of

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[61]   IUCN, The IUCN Urban Nature Indexes 15-16 (2023).
[62]   See David J. Mellor et al., The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare, 10 Animals 1 (2020).
[63]   See About, NYC Mayor's Office of Animal Welfare; Policy: Animal Welfare, City of Amsterdam.
[64]   About, NYC Mayor's Office of Animal Welfare.
[65]   City of Amsterdam, Agenda Dieren (Animal Agenda) 2015-2018 (2016); City of Amsterdam, Agenda Dieren (Animal Agenda) 2024-2026 at 21, 27, 29-30 (2023).
[66]   Id.

these animals.[67] The office or official could coordinate gathering wild animal data with camera traps, observations, and other methods depending on the target animal species.[68] Cities could partner with nonprofit organizations and universities on wild animal monitoring, for example, building on community-led efforts to track bird-window collisions.[69]

D. Develop an animal welfare planning process for the city

As cities develop greater capacity to consider animal welfare, they may create a specific planning document focused on animal welfare. Local policies to benefit wild animals are likely to be more successful when they consider wild animals throughout policy planning, design, implementation, and monitoring.[70] For example, Amsterdam, Netherlands has an Animal Agenda to coordinate city planning and policymaking to support the welfare of wild and captive animals.[71] This Agenda was in effect from 2015-2022 and a 2024-2026 agenda was recently released.[72] For wild animals, the Agenda identifies key policies and planning processes to support wild animals, identifies departments and officials in the city government responsible for implementing these policies (including interagency collaborations), establishes monitoring and accountability for implementing the agenda, and identifies financial allocations for different policies in the agenda.[73] This Agenda is reflected in other Amsterdam policies that impact wild animals. For example, Amsterdam's Green Infrastructure Vision emphasizes that the City aims to "care for the well-being of animals in the city."[74]

The Amsterdam Animal Agenda lists many policies and city planning actions to better support wild animals. Among other policies, the Animal Agenda prioritizes nature-inclusive construction policies, increasing habitat connectivity in the city, minimizing light pollution impacts on wild animals, and creating city meadows that are optimal for meadow birds.[75] For each policy listed, the Animal Agenda identifies departments, councilors, or aldermen to coordinate with to develop and implement the policy. The Animal Agenda also references coordination with Amsterdam's biodiversity planning, green agenda, green infrastructure plan, and water-related planning.[76] Other cities could draw on this model for their own planning to better incorporate wild animal welfare concerns. For example, Washington, DC already has a wildlife action plan that could incorporate wild animal welfare considerations, although it does not do so at this time.[77]

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[67] See Chris Reed, Wild Ways: A Fifth Ecology for Metropolitan Los Angeles, Harvard University Graduate School of Design (2022); Harford County, Green Infrastructure Plan 13 (2019).
[68] See Andrea M. Harvey et al., A Ten-Stage Protocol for Assessing the Welfare of Individual Non-Captive Wild Animals: Free-Roaming Horses (Equus Ferus Caballus) as an Example, 10 Animals 1 (2020).
[69] Collision Map, The Yale Bird-Friendly Building Initiative; Collision Monitoring, NYC Audubon.
[70] Beate Apfelbeck et al., Designing Wildlife-Inclusive Cities that Support Human-Animal Co-Existence, 200 Landscape and Urban Planning 103817 (2020).
[71] Policy: Animal Welfare, City of Amsterdam.
[72] Id.; City of Amsterdam, Agenda Dieren (Animal Agenda) 2015-2018 (2016).
[73] See City of Amsterdam, Agenda Dieren (Animal Agenda) 2015-2018 (2016); City of Amsterdam, Agenda Dieren (Animal Agenda) 2024-2026 (2023).
[74] See City of Amsterdam, Amsterdam Green Infrastructure Vision 2050 at 28 (2020).
[75] City of Amsterdam, Agenda Dieren (Animal Agenda) 2015-2018 at 38 (2016).
[76] Id. at 37.
[77] 2015 District of Columbia Wildlife Action Plan, District of Columbia Department of Energy & Environment.

E. Pass flexible wildlife ordinances that incorporate wild animal welfare

In addition to city planning, cities can pass comprehensive and flexible wild animal welfare ordinances in the city that apply to the development and use of private lands. A wildlife ordinance for wild animal welfare should explicitly identify its goals to promote wild animal welfare, alongside climate and human health benefits of the policy. It should also seek to build flexibility into the ordinance for emerging scientific understanding of wild animal welfare. For example, an ordinance could define bird-friendly building materials required for new buildings based on the American Bird Conservancy Material Threat Factor Reference Standard, as New York City's Local Law 15 does.[78]

Some cities, including Los Angeles, California and Brunswick, Maine have begun implementing wildlife ordinances or wildlife overlay zones to better protect wildlife and enhance their habitat in the city.[79] These ordinances can be applied city-wide or as a zoning overlay in specific areas of the city that would be most beneficial to wild animals. Cities should analyze wildlife movement and use of city land to identify land areas for an ordinance that does not cover the entire city.

Wildlife ordinances can combine multiple policies that have the potential to benefit wild animal welfare, including those listed in Section III of this brief. For example, the draft wildlife ordinance for Los Angeles, California applies to landowners living in the Wildlife District created in the Santa Monica Mountains.[80] The wildlife ordinance requires landowners constructing on private land to implement wildlife-friendly fencing, "maintain habitat and biodiversity," "manage stormwater and sequester carbon by retaining Native and Significant Trees," "incorporat[e] native vegetation that supports wildlife," implement wildlife-friendly landscaping, limit outdoor lighting that harms wildlife, install bird-friendly materials to prevent bird-window collisions, and other requirements to benefit wildlife.[81] This type of ordinance could also include turf grass replacement requirements, restrictions on the use of gas lawn equipment, green roof or wall requirements, cluster development, animal nesting and shelter boxes, among other policies listed in Section III of this policy brief.

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[78] New York, N.Y., Local Law No. 15 (Dec. 10, 2019).
[79] Los Angeles City Planning Commission, Exhibit A: Proposed Wildlife District Ordinance Components As Approved by the City Planning Commission 12/08/22 (2022); Brunswick, Maine, Zoning Ordinance ch. 2, § 2.3.5 (2017).
[80] Los Angeles City Planning Commission, Exhibit A: Proposed Wildlife District Ordinance Components As Approved by the City Planning Commission 12/08/22 (2022). Cities may choose to only apply a wildlife ordinance in parts of the city or otherwise tailor the ordinance to avoid any negative impacts on housing affordability.
[81] *Id.* at 11, 15-17.

III. Policies to Support Wild Animal Welfare

Cities can also implement specific local policies on land use and the built environment that may benefit wild animals. This section presents examples of policies affecting land use and the built environment that have the potential to benefit wild animals. Some of the policies listed have already been implemented by cities for their climate and human health benefits and can be tailored to benefit wild animals. Other policies are novel suggestions. Where available, **examples** are provided of the policy in practice.[82]

Policies are further grouped into the following six categories:

	Policy Category	Brief Description
A	Green Infrastructure (GI)	Incorporate wild animal habitat, shelter, and food sources for animals into GI deployed to reduce flooding and stormwater runoff
B	Tree Canopy	Consider wild animal habitat, shelter, and food sources in tree planting and focus on mature tree protection due to greatest animal benefits
C	Ecosystems	Protect existing wild animal habitat and manage forests, meadows, wetlands, rivers, and coastal areas to promote habitat quality, connectivity, and freedom of movement for wild animals
D	Buildings and Developments	Design buildings and promote land developments that include wild animal habitat, shelter, and food sources, support habitat connectivity, and reduce noise, light, and building collision impacts on wild animals
E	Lawns and Open Spaces	Maintain lawns, landscaped parks, and yards to promote wild animal habitat, shelter, and food sources, support habitat connectivity, and reduce noise and air pollution impacts on wild animals
F	Roads	Plan roads to support habitat connectivity and reduce the impacts of noise, light, and vehicle collisions on wild animals

Recommended policies are identified for all six categories. Recommended policies appear to have the lowest likelihood of complicated welfare trade-offs between different species of wild animals and between humans and wild animals. In addition, **policies to consider** are identified for four categories. These policies may have benefits for wild animals but may include some more complex or uncertain tradeoffs between the welfare of different populations of animals.

For each category of policy, the likely benefits for wild animals and animal welfare considerations are identified. The "Buildings and Developments" and "Lawns and Open Spaces" categories also include boxes briefly addressing **legal considerations** for some policy examples in that category.

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[82] The format of the tables in this Section was inspired by a forthcoming draft Toolkit from the Environmental Law Institute, "Toolkit for Leveraging the Benefits of Plant-Based Proteins for Municipal Climate Action."

A.   Green Infrastructure (GI)

Many cities have GI policies to address stormwater runoff and flooding.[83] GI also mitigates the urban heat island effect, air pollution, and reduces energy demand.[84] GI includes rain gardens, green roofs, bioswales, urban tree canopies, retention basins, green parking, and more.[85] Careful planning and siting can also promote equitable distribution of GI, and mitigate urban heat island effect and air pollution that disproportionately affect low income communities and people of color.[86] To promote wild animal welfare in GI policies, cities can incorporate wild animal habitat, shelter locations, and food sources for animals into GI planning, design, and implementation.

Green Infrastructure - Recommended Policies		
Policy Option Incorporating Wild Animals		**Examples in Practice and Details**
A.1	Include consideration of wild animals in local GI plan	• Amsterdam, Netherlands Green Infrastructure Vision 2050 supports wild animals as the "design and management strategy [of GI] depend on the location and the needs of local people, plants, and animals" (p. 27). • Harford County, MD Green Infrastructure Plan lists protecting wildlife habitat and corridors as a goal and habitat assessments and wildlife surveys guide strategies to improve habitat through the GI network.
A.2	Update GI design manuals and technical guidance to promote plant selections that provide habitat, shelter, and food to wild animals	• Lancaster, PA Green Infrastructure Design Manual requires that plants in GI are selected taking into account "wildlife value" which includes food and shelter provision to wild animals (p. 67; 148-190). • Hillsborough County, FL Green Infrastructure Manual requires the use of native plants in rain gardens and to select plant varieties from the approved plant list that will encourage wildlife habitation (p. 43).

[83]   Lauren Sommer, Green Infrastructure Helps Cities With Climate Change. So Why Isn't There More of It? NPR (Apr. 14, 2022); see Nathaniel R. Mattison & Kyle McKenney, Lincoln Institute of Land Policy, Equity in Green Infrastructure, WP24NM1 (2024).

[84]   Reduce Urban Heat Island Effect, U.S. EPA.

[85]   What is Green Infrastructure?, EPA.

[86]   Viniece Jennings et al., Emerging Issues in Urban Ecology: Implications for Research, Social Justice, Human Health, and Well-Being, 39 Population & Environment 69 (2017); Christopher J. Schell et al., The Ecological and Evolutionary Consequences of Systemic Racism in Urban Environments, 369 Science 1 (2020).

Green Infrastructure - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
A.3 Pass ordinances that require GI on private lands and developments to select plants similarly to A.2	• Los Angeles, CA has a Low Impact Development ordinance requiring stormwater management on site for some developments, but this ordinance and its accompanying manual do not yet require plant selection for wild animal habitat, shelter, and food.
Other Resources: Landscaping for Wildlife.	

Potential wild animal benefits and welfare considerations. GI can support wild animals by providing a more suitable habitat for animals relative to conventional, "gray" infrastructure for stormwater. Depending on the type, the size, the location, and the plant species included, GI can provide habitat for different mammals, birds, reptiles, amphibians, and insects.[87] Other services include shelter from predators and weather, food sources, and refuges for nesting.[88] For example, there are studies that show migratory birds frequently utilize green roofs for forage, resting, and nesting.[89] GI can mitigate the urban heat island effect, reducing the negative impacts of heat on animals such as reduced hours per day that are a suitable temperature for some animals' movement and foraging.[90] However, it is important to recognize that selection of plant type and plant location should be done carefully and on a location-specific basis. Cities could develop additional guidance or pursue further research (including in partnership with a university) on how to choose plants that could promote wild animal welfare at a given location and avoid incidentally promoting aggressive or competitive interactions among animals in newly-created habitat.

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[87] See Alessandro Filazzola et al., The Contribution of Constructed Green Infrastructure to Urban Biodiversity: A Synthesis and Meta-Analysis, 56 Journal of Applied Ecology 2131 (2019); Frédéric Madre et al., A Comparison of 3 Types of Green Roof as Habitats for Arthropods, 57 Ecological Engineering 109 (2013).
[88] Other Benefits of Urban Forests, National Park Service.
[89] See Dustin R. Partridge & J. Alan Clark, Urban Green Roofs Provide Habitat for Migrating and Breeding Birds and their Arthropod Prey, 13 PLOS ONE 1 (2018).
[90] Walter Leal Filho et al., Addressing the Urban Heat Islands Effect: A Cross-Country Assessment of the Role of Green Infrastructure, 13 Sustainability 753 (2021); Jeffrey D. Haight et al., Urbanization, Climate and Species Traits Shape Mammal Communities from Local to Continental Scales, 7 Nature Ecology & Evolution 1654 (2023);

B. Tree Canopy

Many cities have already been investing in increasing urban
tree canopy by planting trees and protecting existing trees
along streets, in parks, and in other public spaces.[91] Urban tree
canopy can support climate change adaptation and resilience by
reducing the urban heat island effect and flooding.[92] It can also
mitigate climate change by absorbing carbon dioxide and providing
shade that can improve energy efficiency of buildings, further reducing
greenhouse gas (GHG) emissions.[93] Trees have other human health
benefits, including reducing the air pollution humans breathe and improving
mental health.[94] Alongside these climate and human health benefits, cities can
tailor their urban tree canopy policies to support wild animal welfare. In particular, cities
can prioritize planting trees that provide food, shelter, and habitat for wild animals and implement policies
to protect mature trees that provide the greatest wildlife benefits.[95]

Tree Canopy - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
B.1 Require or incentivize planting trees for their food, shelter, and habitat value to wild animals on public and private property	• Balancing other constraints on planting, cities could include or require consideration of animal food provision, shelter, and habitat values on lists of approved trees for planting street trees or park trees. For example, New York, NY has a list of street tree species approved by the Parks department, but it does not list food, shelter, and habitat value or require these values to be a part of tree selection.

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91   See Alec LeSher, Jonathan Rosenbloom & Christopher Duerksen, Tree Canopy Cover, Sustainable Development Code;
      Associated Press, US Launches $1bn Tree-Planting Scheme to Mitigate Effects of Climate Crisis, Guardian (Sept. 14, 2023).
92   Sarah White, 6 Ways Urban Trees Benefit Our Climate and Health, Conservation Law Foundation (Aug. 4, 2023); USDA,
      Climate Adaptation Actions for Urban Forests and Human Health (2021).
93   USDA, Climate Adaptation Actions for Urban Forests and Human Health (2021).
94   Id.; Kathleen L. Wolf et al., Urban Trees and Human Health: A Scoping Review, 17 International Journal of Environmental
      Research and Public Health 4371 (2020).
95   See How Trees Make a Difference, National Wildlife Federation; Karen Stagoll et al., Large Trees are Keystone Structures in
      Urban Parks, 5 Conservation Letters 115 (2012).

Tree Canopy - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
B.2 Pass ordinances and use incentives to protect mature trees from being cut down and protect trees with 15.7 inches (40 cm) or greater in diameter for the most animal benefits[96]	• Washington D.C. passed an ordinance to prevent removals of trees on public or private property with a diameter greater than 14 inches, including expanded city authority to issue stop work orders if a tree may be unlawfully removed and higher penalties that reflect inflation. • Redwood City, CA ordinances protect all street trees on public property and all trees on private property greater than 12 inches in diameter. • Charlotte, NC gives setback reductions and density bonuses to save existing trees in a tree save area.
Other Resources: Large Trees are Keystone Structures in Urban Parks.	

Potential wild animal benefits and welfare considerations. Planting trees that provide food sources, shelter, and/or habitat for wild animals may improve their welfare.[97] For example, animals use trees as sites for nesting, rest, and reproduction.[98] Similarly, increased tree canopy can reduce heat and noise stress on wild animals, alleviating conditions that could harm their welfare.[99] Studies show that large, mature trees support a greater variety and abundance of wild animals and provide "disproportionate quantities of flowers, pollen, nectar, seed set, mistletoe, and hanging bark" that provide food to a range of wild animals.[100] Large trees may also provide more optimal shelter and protection from noise pollution, as large, mature trees tend to have large horizontal limbs, hollows, and cavities for animal shelter.[101] As such, cities should ensure mature tree protection to increase the likelihood of wild animal welfare benefits. As with plant selection, it is important to recognize that tree species selection should be done carefully and on a location-specific basis to promote wild animal welfare and avoid incidentally promoting competitive and aggressive interactions between wild animals.

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[96]   Karen Stagoll et al., Large Trees are Keystone Structures in Urban Parks, 5 Conservation Letters 115 (2012).

[97]   *Id.*; Benefits for Wildlife, National Wildlife Federation.

[98]   Benefits for Wildlife, National Wildlife Federation.

[99]   See João Carlos de Castro Pena et al., Street Trees Reduce the Negative Effects of Urbanization on Birds, 12 PLOS ONE 1 (2017); Shannon Graeme et al., A Synthesis of Two Decades of Research Documenting the Effects of Noise on Wildlife, 91 Biological Reviews 982 (2016); Stephen A. Oswald & Jennifer M. Arnold, Direct Impacts of Climatic Warming on Heat Stress in Endothermic Species: Seabirds as Bioindicators of Changing Thermoregulatory Constraints, 7 Integrative Zoology 121 (2012).

[100] See Karen Stagoll et al., Large Trees are Keystone Structures in Urban Parks, 5 Conservation Letters 115 (2012); Darren S. Le Roux et al., Single Large or Several Small? Applying Biogeographic Principles to Tree-Level Conservation and Biodiversity Offsets, 191 Biological Conservation 558 (2015).

[101] Karen Stagoll et al., Large Trees are Keystone Structures in Urban Parks, 5 Conservation Letters 115 (2012).

C. Ecosystems

Cities are implementing policies to protect ecosystems within their borders, including forests, meadows, wetlands, rivers, and coastal ecosystems (including dunes, beaches, and mangroves).[102] Policies include protecting larger, intact ecosystems and creating or restoring corridors connecting larger ecosystems and habitat areas. In part, cities are promoting ecosystem protection to sequester carbon and mitigate climate change.[103] Ecosystem protection can also reduce inland and coastal flooding, water pollution, and urban heat island effect.[104] In addition to climate and health benefits, ecosystem protection can support food, shelter, and habitat for wild animals and enable wild animal freedom of movement and agency in larger areas of intact ecosystems and via wildlife corridors.

Ecosystems - Recommended Policies		
Policy Option Incorporating Wild Animals		**Examples in Practice and Details**
C.1	Develop green corridors prioritizing connectivity for wildlife movement between intact habitat	• Medellín, Colombia implemented a three-year initiative to develop 30 green corridors including planting 8,800 trees and the explicit goal to promote ecological connectivity. • Amsterdam, Netherlands identified ecological bottlenecks for animal movement in the green corridors in the city and is working to remove bottlenecks (p. 305).
C.2	Pass ordinances creating overlay zones for habitat connectivity and wildlife movement	• Ventura, CA has Habitat Connectivity and Wildlife Corridors to allow wildlife movement. • Los Angeles, CA has a draft Wildlife Ordinance that requires wildlife-friendly fencing and hedges, restrictions on hillside grading, and minimal alteration of existing landforms and vegetation.

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102 World Wildlife Fund, A Playbook for Nature-Positive Infrastructure Development (2023).
103 *Id.*
104 *See id.* at 41, 86; Adapting to Flooding and Sea Level Rise Through Wetland Conservation, American Flood Coalition (Feb. 1, 2022); Coastal Resiliency, EPA.

Ecosystems - Policies to Consider	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
C.3 Create urban meadows for wildlife on city-owned lots and provide incentives or rebates for urban meadow development on vacant, private lots	• Dessau, Germany planted urban meadows on city lots, spreading wildflower seeds and mowing periodically to maintain a permanent meadow. • Amsterdam, Netherlands is assessing its lease agreements for meadow areas to provide optimal meadow habitat for birds (p. 38). • Seattle, WA has allowed passive-use turf lawns to grow into meadows for wildlife benefits.
C.4 Enhance wetlands, riparian corridors, and coastal areas for animal habitat and habitat connectivity	• New York, NY has a Wetlands Management Framework that identifies and monitors habitat supportive of wildlife and promotes connectivity of streams to reduce barriers to animal movement. • Seattle, WA has built an ecologically engineered seawall to integrate habitat for species into sea walls built for climate change adaptation. • Hearbin, China has protected and expanded a wetland in the city for habitat and green space.

Potential wild animal benefits and welfare considerations. Ecosystem protection may reduce habitat fragmentation and allow animals to better meet their species-specific needs for movement, exploration of their environment, and a variety of food sources and foraging options.[105] Intact ecosystems also provide food sources and shelter for wild animals. Intact ecosystems and natural areas in cities reduce heat and noise stress on wild animals.[106] Higher decibel noise in cities can impact predator or prey detection, interrupt mating signals, alter animal movement patterns, decrease foraging, and increase psychological stress in animals.[107] Many of these impacts may have a negative welfare impacts on animals by inhibiting

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[105] David J. Mellor et al., The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare, 10 Animals 1 (2020); Paul C. Paquet and Chris T. Darimont, Wildlife Conservation and Animal Welfare: Two Sides of the Same Coin?, 19 Animal Welfare 177 (2010). Habitat fragmentation may also be particularly dangerous for juvenile animals who move away from where they are born and may have to cross roads between patches of habitat. See Hugo Cayuela et al., Multiple Density-Dependent Processes Shape the Dynamics of a Spatially Structured Amphibian Population, 88 Journal of Animal Ecology 164 (2019); Filipe Serrano et al., Landscape Connectivity Affects Individual Survival in Unstable Patch Networks: The Case of a Freshwater Turtle Inhabiting Temporary Ponds, 65 Freshwater Biology 540 (2020).

[106] See Crystal A. Crown, et al., Natural Areas Conservancy, NY, Cooling Cities: Harnessing Natural Areas to Combat Urban Heat (2023); see note 100 in Section III.B.

[107] See note 100 in Section III.B.

their mating and movement and increasing psychological stress.[108] In addition, ecosystem protection can reduce air pollution that may negatively impact wild animal welfare.[109]

While this brief recommends policies C.1 and C.2, it is important for scientists to continue to study the effects of promoting habitat connectivity on wild animal welfare to determine when it is most welfare-positive for wild animals.[110] For policies C.3 and C.4 that focus on creating or restoring ecosystems within cities, the welfare effects on wild animals are not well understood. We do not have systematic scientific evidence at this time of whether animals living in "natural" habitats being restored have higher welfare than animals living in human-modified habitats. However, these policies may have some welfare benefits as they provide animals access to food and water sources, shelter, and reduce air and noise pollution.

D. Buildings and Developments

Cities can implement building and land development policies to increase the resilience of buildings and housing to climate change and reduce GHG emissions from buildings. Building policies that promote wild animal welfare may already align with city priorities. Policies to reduce light from buildings at night and implement some types of bird-friendly building materials can improve the energy efficiency of buildings, reducing GHG emissions.[111] Green roofs and walls that are designed to mitigate flooding and heat impacts from climate change can also provide food and shelter for many wild animals.[112] For housing development, pairing wildlife-friendly design with density bonuses could promote greater housing density in urban areas, reducing GHG emissions associated with sprawl.[113] Overall, there are opportunities for cities to incorporate wild animal welfare into their existing efforts to update building and housing development policies to address climate change and support human health.

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[108] *Id.*

[109] See Animal Ethics, Investigating the Welfare of Wild Animals in Urban Environments 25, 33 (2021); Air Pollution: Effects on Wild Animals, Government of Canada.

[110] Matthew Allcock & Luke Hecht, Potential Effects of Habitat Fragmentation on Wild Animal Welfare (2020).

[111] See, e.g., Meredith Barges & Viveca Morris, Building Safer Cities for Birds: How Cities Are Leading the Way on Bird-Friendly Building Policy, 5-7, 16 (2023); Light Pollution Wastes Energy and Money and Damages the Climate, Dark Sky.

[112] See Green Roofs for Healthy Cities, Green Roof and Wall Policy in North America: Regulations, Incentives and Approaches (2023); Dustin R. Partridge & J. Alan Clark, Urban Green Roofs Provide Habitat for Migrating and Breeding Birds and their Arthropod Prey, 13 PLOS ONE 1 (2018); Using Green Roofs to Reduce Heat Islands, EPA.

[113] Christopher Jones & Daniel M. Kammen, Spatial Distribution of US Household Carbon Footprints Reveals Suburbanization Undermines Greenhouse Gas Benefits of Urban Population Density, 48 Environmental Science & Technology 895 (2014).

Buildings and Development - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
D.1 Pass ordinances mandating bird-friendly materials in all new buildings and major alterations to exterior facade of buildings and mandating or incentivizing retrofits on existing buildings	• Local Law 15 in New York, NY requires bird-friendly materials for new construction or significant alteration of exterior glazing, on 90 percent of facades up to 75 feet above grade; up to 12 feet above green roofs; and on structures that are hazardous to birds. • San Francisco, CA offers rebates for energy efficiency upgrades on some properties, including for ceramic fritting of glass that also reduces bird collisions. • Arlington, VA requires any lot seeking bonus density to meet bird-friendly building standards under the city's Green Building Incentive Program. • Ordinances should avoid including: exceptions for residential areas or storefronts, low height regulations (recommended that ordinances apply to at least 100 feet above grade), and/or application only in so-called "bird sensitive areas."
D.2 Require or incentivize green roofs providing animal habitat, shelter, and food sources, including through mandatory construction standards or technical guidelines	• Toronto, Canada has Design Guidelines for Biodiverse Green Roofs including three key design factors to promote biodiversity: variation of media, vegetation diversity, and structures creating organism niches (such as branches or stones). • San Francisco, CA has a Living Roof Manual that includes recommended habitat and plant species. • Presently, green roof design guidelines that support animal habitat, shelter, and food are usually not mandatory and supplemental. Plant compostion and vegetation diversity affect the suitability of green roofs for animals and requirements or enhanced incentives[114] could promote green roofs with more wild animal benefits.

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[114] For examples of city incentives to promote green roofs that do not yet incorporate suitability of green roofs for animals, see Green Roof Tax Abatement, New York City (offering building owners a tax abatement equal to $5.23 per square foot of green roof, with enhanced tax abatement available for growth medium of at least four inches on the roof or location in priority areas); Green Roofing, Sustainable Development Code (describing cities offering bonus floor area ratio for a green roof, allowing more units constructed on the same lot, or granting a $10 sewer bill rebate per square foot of green roof). See Danielle Spiegel-Feld & Lauren Sherman, Expanding Green Roofs in New York City: Towards a Location-Specific Tax Incentive, 26 NYU Environment Law Journal 297 (2018).

Buildings and Development - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
D.3	Require new developments to follow "green standards," including green space and include plant and tree species that provide habitat, food, and shelter for animals	• Toronto, Canada has a green standard for sustainable design requirements for new private and city-owned development that includes measures to increase habitat and reduce bird colli-sions—and could include additional measures to promote wild animal welfare. • Washington, DC has a green area ratio requirement (GAR) to protect green space in development which includes credits for including listed native plant species. The city could allow developers to gain points toward their GAR score by planting trees with food, shelter and habitat value, and the city could include these tree species on the GAR plant list.
D.4	Require new housing developments and/or existing homes to integrate animal shelter boxes, cluster development to protect existing habitat in the urban periphery, and install wildlife-friendly fences	• Cambridge, England requires that new developments integrate bat, bird, or insect shelter boxes on at least 50% of dwellings or units (p. 42-43). • Cambridge, England requires hedgehog-friendly fencing in new development and Los Angeles, CA is piloting wildlife-friendly fencing in parts of the city. • Concord, MA implements cluster development by reducing minimum lot sizes for each home, clustering homes in one part of the project area, and requiring fifty percent of the development's land to be perpetually maintained as open space.
D.5	Ensure lighting and bird-friendly materials used reflect evolving scientific understanding	• New York City's Local Law 15 defines "bird-friendly" materials based on the American Bird Conservancy Material Threat Factor. • Cupertino, CA lighting ordinance is based on Dark Sky International principles for outdoor lighting.

Legal Consideration: Bird-Friendly Building Materials

Bird-friendly ordinances may face legal challenges where the state has a building code and cities are not permitted to add building code restrictions. However, based on recent case law, courts may find that bird-friendly building materials ordinances are zoning ordinances that cities retain the authority to create.[115] Recently, a bird-friendly ordinance in Madison, Wisconsin was challenged on the grounds that the city did not have the authority to pass the ordinance.[116] Opponents argued that the bird-friendly ordinance was a "building code" and Wisconsin state law prohibits cities from imposing building code requirements that deviate from Wisconsin's statewide uniform commercial building code.[117] However, at trial and on appeal in 2023, the courts upheld the Madison, WI bird-friendly ordinance, finding the ordinance is a zoning ordinance affecting design or aesthetic considerations, not a building code that would be prohibited under state building code law.[118] Legislators and advocates should assess the possibility for legal challenge in their jurisdiction and consider framing and drafting bird-friendly ordinances as relating to design and aesthetics to distinguish them from building codes.

Buildings and Development - Policies to Consider		
Policy Option Incorporating Wild Animals		**Examples in Practice and Details**
D.6	"Dark sky" ordinances restricting outdoor light use; require non-residential buildings to turn off non-essential lights at night	• Cupertino, CA ordinance requires non-residential indoor lighting to turn off or be motion activated within two hours of close of business and outdoor lighting to turn off or be motion activated by 11pm, among other provisions.
Other Resources: Building Safer Cities for Birds; Bird-Safe City; DarkSky Model Lighting Ordinance; LEED Projects Save Energy by Saving Birds; Green Roof and Wall Policy in North America; Green Roofs Policies, Incentives and Guidelines.		

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115 Nick Viviani, Judges Back Madison Ordinance - Because it is for the Birds, WMTV (Oct. 5, 2023); Associated Builders & Contractors of Wisconsin v. City of Madison, Case No. 21 CF 1729 (Wis. Cir. Ct. Aug. 16, 2022); Associated Builders & Contractors of Wisconsin v. City of Madison, Case No. 2022AP1468 (Wis. Ct. App. Oct. 5, 2023).

116 Associated Builders & Contractors of Wisconsin v. City of Madison, Case No. 21 CF 1729 (Wis. Cir. Ct. Aug. 16, 2022).

117 *Id.* at 5-6.

118 *Id*; Associated Builders & Contractors of Wisconsin v. City of Madison, Case No. 2022AP1468 (Wis. Ct. App. Oct. 5, 2023).

Potential wild animal benefits and welfare considerations. These policies would reduce bird-window collisions that kill up to one billion birds annually in the United States and harm the welfare of birds.[119] For green roofs, varied and appropriate plants and media provide food and nesting places for insects, birds, and bats.[120] Green roofs and walls support urban habitat connectivity, including for insects.[121] Green roofs may also reduce air pollution and noise impacts on wild animals.[122] Furthermore, the suggested housing development policies may benefit wild animals by providing shelter, maintaining animal habitat, promoting habitat connectivity to permit animal movement (especially with cluster development and wildlife-friendly fencing), and providing food sources for animals.[123] Policies that reduce urban sprawl further reduce wildlife habitat fragmentation on the urban periphery.[124]

As described in Section III.A, policies that promote animal habitat creation should take into account location-specific plant selection and avoid habitats that create competitive or aggressive interactions among animals. This consideration should also be applied to green roofs and walls and green standards recommended in policies D.2 and D.3 in this section. At this time, Policy D.6 is included as a policy to consider. Light reduction policies may reduce bird mortality, insect and bird disorientation, altered feeding, or disruptions to breeding and migration.[125] However, artificial light at night may have welfare tradeoffs by, for example, improving hunting success of some birds and bats (improving their welfare) but increasing predation of insects (reducing their welfare).[126]

[119] Scott R. Loss et al., Bird–Building Collisions in the United States: Estimates of Annual Mortality and Species Vulnerability, 116 The Condor 8 (2014); David Klem. Bird–Window Collisions: A Critical Animal Welfare and Conservation Issue, 18 Journal of Applied Animal Welfare Science S11 (2015).

[120] See Frédéric Madre et al., A Comparison of 3 Types of Green Roof as Habitats for Arthropods, 57 Ecological Engineering 109 (2013); Dustin R. Partridge & J. Alan Clark, Urban Green Roofs Provide Habitat for Migrating and Breeding Birds and their Arthropod Prey, 13 PLOS ONE 1 (2018); K. L. Parkins & J. Alan Clark, Green Roofs Provide Habitat for Urban Bats, 4 Global Ecology and Conservation 349 (2015).

[121] Flavie Mayrand & Philippe Clergeau, Green Roofs and Green Walls for Biodiversity Conservation: A Contribution to Urban Connectivity?, 10 Sustainability 985 (2018); Sonja Braaker et al., Habitat Connectivity Shapes Urban Arthropod Communities: The Key Role of Green Roofs, 95 Ecology 1010 (2014).

[122] Margareth Viecco et al., Green Roofs and Green Walls Layouts for Improved Urban Air Quality by Mitigating Particulate Matter, 204 Building and Environment 1 (2021); Ahmet B. Besir & Erdem Cuce, Green Roofs and Facades: A Comprehensive Review, 82 Renewable and Sustainable Energy Reviews 915 (2018).

[123] See Charlotte E. Gonzalez-Abraham et al., Patterns of Houses and Habitat Loss from 1937 to 1999 in Northern Wisconsin, USA, 17 Ecological Applications 2011 (2007).

[124] See, e.g., Dimitrios Gounaridis, Joshua P. Newell & Robert Goodspeed, The Impact of Urban Sprawl on Forest Landscapes in Southeast Michigan, 1985–2015, 35 Landscape Ecology 1975 (2020); John E. Hasse & Richard G. Lathrop, Land Resource Impact Indicators of Urban Sprawl, 23 Applied Geography 159 (2003).

[125] Benjamin M. Van Doren et al., Drivers of Fatal Bird Collisions in an Urban Center, 118 Proceedings of the National Academy of Sciences 1 (2021); Benjamin M. Van Doren et al., High-Intensity Urban Light Installation Dramatically Alters Nocturnal Bird Migration, 114 Proceedings of the National Academy of Sciences 11175 (2017); James D. McLaren et al., Artificial Light at Night Confounds Broad-Scale Habitat Use by Migrating Birds, 21 Ecology Letters 356 (2018); How Light Pollution Impacts Wildlife & How You Can Help, National Wildlife Federation; Animal Ethics, Investigating the Welfare of Wild Animals in Urban Environments 15, 21 (2021).

[126] See Airam Rodríguez et al., Artificial Light at Night as a Driver of Urban Colonization by an Avian Predator, 36 Landscape Ecology 17, 24 (2021).

E.   Lawns and Open Spaces

Cities are implementing new policies to address how turf lawns and lawn care impact the climate and environment. Over 100 U.S. cities have already prohibited the use of gas leaf blowers for lawn care due to noise and air pollution concerns.[127] Lawn care workers, 35 percent of whom are Latino, and children are exposed to carcinogenic chemicals and pollutants from gas lawn equipment.[128] Other cities have passed policies to support naturalized lawns that mitigate the impacts of drought[129] and reduce greenhouse gas emissions from fertilizer use.[130] Naturalized lawns are lawns that include native plants and mimic what grows naturally in the area, which may be a range of shrubs, ferns, flowers, and grasses rather than a turf or monoculture lawn.[131] Naturalized lawns further reduce the need for gas lawn equipment that contributes to significant noise and air pollution.

[127] Oliver Milman, Tree-mendous News: Noisy Gas-Powered Leaf Blowers Banned in Washington DC, Guardian (Jan. 5, 2022).
[128] Gas Leaf Blowers are Health Hazards, Mount Sinai Institute for Climate Change, Environmental Health, and Exposomics; Inter-University Program for Latino Research; University of Notre Dame, The Economic Impact of the Landscape and Lawn Care Services Industry on U.S. Latinos (2022); U.S. PIRG, Lawn Care Goes Electric (2023).
[129] Stephanie Pincetl et al., Evaluating the Effects of Turf-Replacement Programs in Los Angeles, 185 Landscape and Urban Planning 210 (2019).
[130] See, e.g., Pernilla Tidåker, Therese Wesström, and Thomas Kätterer, Energy Use and Greenhouse Gas Emissions from Turf Management of Two Swedish Golf Courses, 21 Urban Forestry & Urban Greening 80 (2017).
[131] See Washington State University Spokane County Extension, Naturalizing a Landscape: Preparing a Grassy Area for Planting (2017); Alexander Adams et al., Ecological Design Lab, Urban Biodiversity: Cultivating Support Through Municipal Codes (2021).

Lawns and Open Spaces - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
E.1 Prohibit gas lawn equipment (including leaf blower) operation and sale and include rebates for electric equipment	• Washington D.C., Maplewood, NJ, and Montgomery County, MD banned sale and use of gas leaf blowers. • Burlington, VT only permits leaf blowers operating at 65 decibels or less (effective ban on gas equipment). • South Pasadena, CA has all electric municipal lawn care equipment and Walnut Creek, CA is phasing out gas leaf blowers in their operations. • Montgomery County, MD has a three-year rebate program. Yonkers, NY has a rebate program. • Cities may seek prohibitions with few exceptions (i.e. not for turbo blowers) that apply beyond residential zones, have increasing fines for repeat violations, and include an online form to report violations. • Ordinances may seasonally or temporally limit (e.g., one day a month) or fully phase out all motorized lawn equipment (some cities already have time and day restrictions on use).
E.2 Remove plant height limits in local ordinances or exempt from height limits "naturalized" lawns that implement wildflowers, shrubs, and other plants for animal food and habitat	• Fredericton, New Brunswick, Canada does not include a plant height limit. • Guelph, Ontario, Canada does not apply a height limit to naturalized areas. • This could also include local ordinances to prevent homeowners associations (HOAs) from requiring turf grass or otherwise preventing wildlife-friendly lawns.

Lawns and Open Spaces - Policies to Consider	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
E.3 Promote naturalized lawns that include animal food and habitat on private property, including requiring or incentivizing replacement of turf grass lawns with naturalized lawns	• Scottsdale, AZ ordinance prohibits turf grass in the front yard of all new single family homes to reduce water-intensive landscaping in drought conditions. • Chino Hills, CA and many other cities offer rebates per square foot of turf grass removed. • Fort Lauderdale, FL requires a landscaping permit that must follow Florida-Friendly Landscaping principles (Sec. 47-21.9), which includes principles on wildlife (guidance to provide a water source, wildlife shelters, plants that provide food or shelter) and to reduce chemical use that could harm wildlife.
E.4 Replace non-functional lawns on public land (e.g., roadway strips, medians), using state funding where available	• Denver, CO is replacing turf grass in medians and non-functional city lots with low-water landscaping. The city used state Turf Replacement Program funds. • Fairfax County, VA has exempted right of ways and park lands from any plant height limitations. • New York, NY has a policy to minimize the presence of exotic monocultures on all city-owned property
E.5 As part of promoting solar energy development, require wildlife-friendly solar siting policies to promote food, shelter, and nesting habitat for animals	• Allegheny County, VA ordinance requires utility-scale solar facilities to use "pollinator-friendly and wildlife-friendly native plants, shrubs, trees, grasses, forbs, and wildflowers in the project area and in the setbacks and vegetative buffering." (Article XXV, Sec. 66-754) Many localities in Virginia have similar ordinances. • Linn County, IA has a pollinator-friendly solar ordinance requiring planting of a mix of grasses and wildflowers in and around solar projects. • Ordinances should require or incentivize using plant species that provide food and shelter for animals but avoid being burdensome on solar development.
Other Resources: Enhancing Biodiversity in Private Property: A Toolkit for Local Governments; By-Laws for Biodiversity Project; Protection of Pollinators from Habitat Loss and Chemical Exposure; Toolkit for Pollinator-Friendly Solar; Urban Biodiversity: Cultivating Support through Municipal Codes	

Legal Consideration: City Prohibitions of Gas Leaf Blowers

Cities likely have the legal authority to prohibit non-functional turf grass lawns and the use of gas lawn equipment under their zoning or police power to regulate for public health, safety, and welfare.[132] However, a group of landscapers recently challenged the Montclair, NJ gas leaf blower prohibition, claiming it is preempted by the Clean Air Act, a taking of private property, and violates equal protection.[133] These claims are unlikely to succeed: localities have clear authority to regulate to address health and noise concerns associated with gas leaf blowers. However, Texas passed and Georgia introduced state laws prohibiting local restrictions on gas fuel use (or based on any fuel type).[134] These state laws are unlikely to prevent local noise-based regulation on lawn equipment, such as banning equipment operating over a certain decibel level.

Potential wild animal benefits and welfare considerations. Gas lawn equipment may harm wild animal welfare due to exposure to noise, increased air pollution, and impacts on food availability.[135] Noise pollution from gas lawn equipment may disturb animal foraging, fitness, and communication.[136] Gas and electric lawn equipment may disrupt leaf litter habitat and cover for insects and reptiles; reduce bird nesting materials; and decrease food availability.[137] Policies prohibiting gas lawn equipment reduce these harms to wild animals. Naturalized lawns may have less well-established benefits to wild animal welfare. However, they may provide animals with habitat and food, especially for bees and butterflies, and contribute to habitat connectivity across private lands in the city.[138] At the very least, this policy brief recommends that local policies prohibiting naturalized lawns should be repealed or amended to allow for naturalized lawns, especially if emerging scientific research reveals further wild animal welfare benefits. The policies to consider listed in this section would further advance naturalized lawns and open spaces. Any requirements for wildlife-friendly planting during solar energy development should be designed so the policies are not burdensome to solar development nor used by opponents to block solar development.

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[132] See Sarah B. Schindler, Banning Lawns, 82 George Washington Law Review 394 (2014).

[133] Complaint at 2-3, Gaia Gardens, LLC v. Township of Montclair, No. 2:23-cv-20733 (D.N.J. Sept. 28, 2023).

[134] Tex. Loc. Gov't Code §§ 247.001-.003 (2023); Landscape Equipment and Agricultural Fairness (LEAF) Act, S.B. 145, 158th Gen. Assemb., Reg. Sess. (Ga. 2023).

[135] Animal Ethics, Investigating the Welfare of Wild Animals in Urban Environments 25, 33 (2021).

[136] Shannon Graeme et al., A Synthesis of Two Decades of Research Documenting the Effects of Noise on Wildlife, 91 Biological Reviews 982 (2016); Cameron Albert Duquette et al., A Meta-Analysis of the Influence of Anthropogenic Noise on Terrestrial Wildlife Communication Strategies, 58 Journal of Applied Ecology 1112 (2021).

[137] Laura Baird, Wildlife Connections: Leaf Habitat, University of Kentucky; Elizabeth A. Johnson & Kefyn M. Catley, American Museum of Natural History, Life in the Leaf Litter (2002); Mark J. Mackey et al., Do Golf Courses Reduce the Ecological Value of Headwater Streams for Salamanders in the Southern Appalachian Mountains?, 125 Landscape and Urban Planning 17 (2014).

[138] Gabriella L. Pardee and Stacy M. Philpott, Native Plants are the Bee's Knees: Local and Landscape Predictors of Bee Richness and Abundance in Backyard Gardens, 17 Urban Ecosystems 641 (2014); Amy J. Lynch, Creating Effective Urban Greenways and Stepping-Stones: Four Critical Gaps in Habitat Connectivity Planning Research, 34 Journal of Planning Literature 131 (2019); Caragh G. Threlfall et al., Approaches to Urban Vegetation Management and the Impacts on Urban Bird and Bat As- semblages, 153 Landscape and Urban Planning 28 (2016).

F. Roads

Cities can plan and design roads that promote safety for
humans and for wild animals. In recent years, road deaths
and injuries have become an increasing threat to humans.[139]
Cities are already redesigning roads to reduce traffic fatalities
and air pollution and address flooding risks from sea level rise.[140]
In addition, many cities are seeking to reduce their GHG emissions
from their transport sector by redesigning streets and transit systems
to promote public transportation, micromobility, and walking instead of
private gas vehicle use.[141] As cities redesign roads and streets, they can also
promote wild animal welfare in street design.

Roads - Recommended Policies		
Policy Option Incorporating Wild Animals		Examples in Practice and Details
F.1	Construct wild animal overpasses and underpasses to reduce animal roadway fatalities and allow for animal movement	• Los Angeles, CA is constructing a wildlife crossing to restore fractured ecosystems and promote connectivity for the Santa Monica Mountains. The project will allow for mountain lions, bobcats, and other animals to safely cross the 101 freeway. • Concord, MA created four underpasses along Route 2 to mitigate habitat fragmentation and avoid wild animal collisions with the 50,000 daily vehicles. An average of 32 species use the underpasses annually.
F.2	Include wild animals in the Complete Streets Policy Framework and consider wild animals in all 10 elements of a Complete Streets Plan	• When using the Complete Streets Policy Framework to draft a policy, wild animals should be explicitly mentioned in the commitment and vision section. This commitment should shape the required policy elements like design guidance, proactive land-use planning, and criteria for choosing projects that take into account wild animals.

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[139] See David Leonhardt, The Rise in U.S. Traffic Deaths, N.Y. Times (Dec. 11, 2023).

[140] Wendy Heaps et al., Health Affairs, Public Transportation In The US: A Driver Of Health And Equity (2021); Smart Growth America & National Complete Streets Coalition, Dangerous By Design (2022); NYC Mayor's Office of Resiliency et al., Raising Shorelines City Wide: Travis Avenue Road Raising Project (2019).

[141] U.S. EPA, Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions 1990-2021 (2023); Alternative Fuels Data Center, Active Transportation and Micromobility, U.S. Department of Energy; Defining Micromobility, Institute for Transportation & Development Policy.

Wild Animal Welfare in Local Policies on Land Use and the Built Environment

Roads - Recommended Policies	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
F.3	Implement seasonal, nighttime, or temporary road closures during animal migration and movement periods	• In Southern Ontario, some roads are closed at night for a month during the spring to protect the endangered Jefferson Salamander. • Christmas Island, Australia incorporates road closures for crab migrations on peak migration days.
F.4	Prohibit motorized vehicles on at least some roads in cities in ways that mitigate noise and danger from motor vehicles to animals	• NYC's Open Streets program includes full closure of some city streets which may benefit wildlife as well as human residents. • Barcelona, Spain is prioritizing pedestrians by creating a network of green hubs and squares. This policy focuses on human residents, but may also benefit wild animals. • Pontevedra, Spain has prohibited cars in most of the city since 1999.
F.5	Include wild animal mortality and movement in local transportation planning	• New York, NY created a Deer Impact Management Plan for Staten Island which maps deer-vehicle collision concentration areas to target signage to decrease vehicle collisions.

Roads - Policies to Consider	
Policy Option Incorporating Wild Animals	**Examples in Practice and Details**
F.6	Incorporate Dark Sky Lighting into street design to reduce light pollution impacts on wild animals	• Pittsburgh, PA has a Dark Sky Lighting ordinance that applies to streetlights, requiring technologies such as "LEDs, shielding . . . in an effort to reduce light pollution" and "including on-off and dimming controls, where possible." § 424A.02-.03. • Bee Cave, TX introduced a Dark Sky Lighting ordinance to protect the environmentally-sensitive area and species, including the Mexican Honeybee and Golden-Cheeked Warbler.
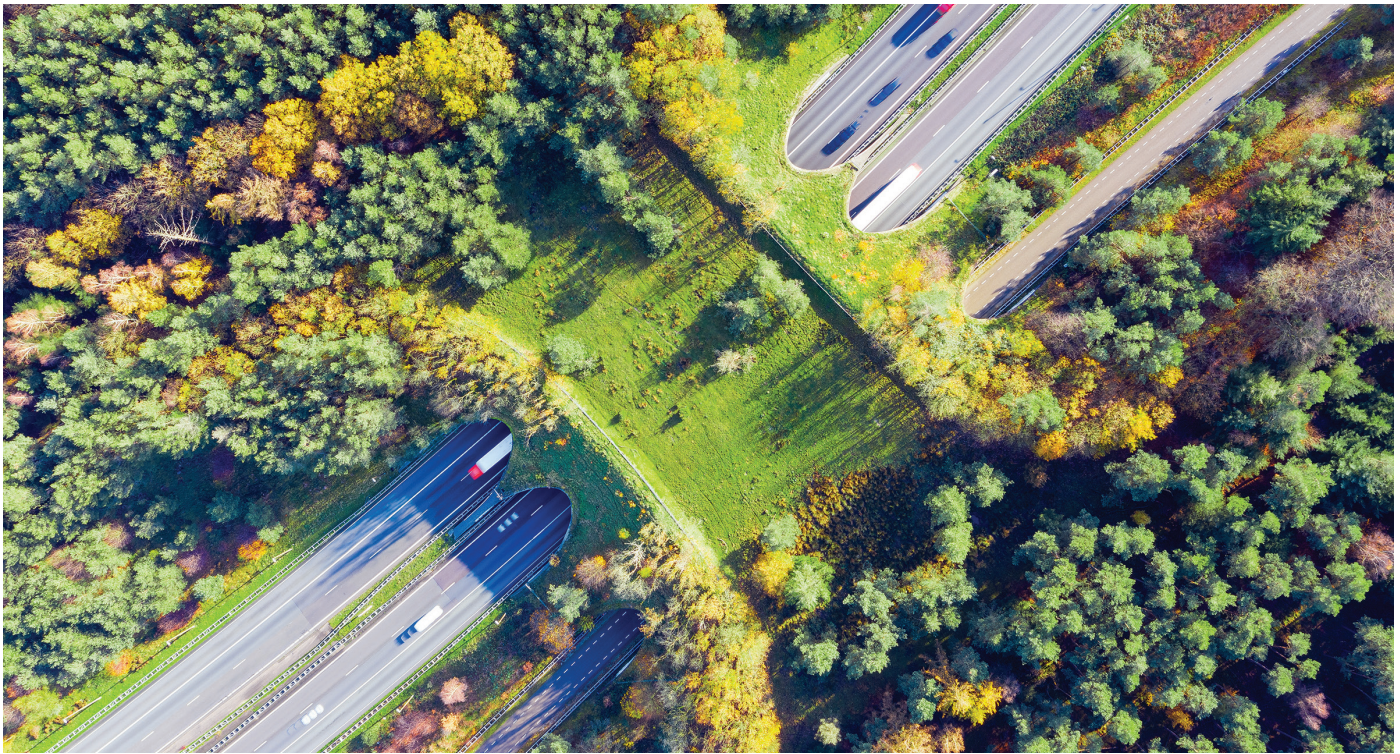
Potential wild animal benefits and welfare considerations. Redesigning streets can mitigate or eliminate persistent noise that may alter wild animal behavior including communication, distribution, fitness, foraging, and movement.[142] Redesigning streets could also mitigate the at least 1-2 million annual collisions between motorists and wild animals.[143] Even temporary street closures at night can benefit wildlife movement, habitat connectivity, and reduce animal and human fatalities from collisions.[144] For example, a Harvard Graduate School of Design report described how street redesign can benefit humans and wild animals. The report describes pedestrianization of a street in Los Angeles to improve walkability for humans and passage for the California Quail and redesigning streets to reduce the number of snakes on high-traffic highways.[145] As described in III.D, light reduction policies are listed as a policy to consider due to the potential for some welfare tradeoffs among wild animals.

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[142] See Christopher JW McClure et al., An Experimental Investigation into the Effects of Traffic Noise on Distributions of Birds: Avoiding the Phantom Road, 280 Proceedings of the Royal Society B: Biological Sciences 1 (2013); Shannon Graeme et al., Road Traffic Noise Modifies Behaviour of a Keystone Species, 94 Animal Behavior 135 (2014).

[143] Robert Ament et al., U.S Department of Agriculture, Forest Service, Highway Crossing Structures for Wildlife: Opportunities for Improving Driver and Animal Safety (2021); Fraser Shilling et al., A Reprieve from US Wildlife Mortality on Roads During the COVID-19 Pandemic, 256 Biological Conservation 1, 2 (2021).

[144] See *id.*; Jesse Whittington et al., Temporal Road Closures Improve Habitat Quality for Wildlife, 9 Scientific Reports 1 (2019).

[145] Chris Reed, Wild Ways: A Fifth Ecology for Metropolitan Los Angeles, Harvard University Graduate School of Design 115, 132 (2022).

IV. Future Directions of Local Policy Research

This policy brief focuses on how local building and land use policies may contribute to positive wild animal welfare. This brief does not assess local policies on human-wildlife conflict,[146] pest and predator management,[147] zoonotic disease management,[148] waste management, food systems, or disaster risk planning.[149] For example, cities could consider wild animals in their disaster and emergency planning, including in case of flooding, extreme heat, or wildfire.[150] In addition to lawn equipment policies described in Section III, cities may also consider other local policies that reduce noise, such as greater restrictions on fireworks and drone use.[151] All of these policy areas may be promising for future research at the intersection of local government policy and wild animal welfare.

Cities may also consider future policy research in addressing some of the harms to animals that were not covered in detail in this brief, including diseases and when high population growth of an animal species reduces the welfare of individual animals in the species or individuals in other species.[152] For example, cities could implement vaccination programs for animals that could be vectors for diseases transferred to

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146 See Carl D. Soulsbury & Piran C. L. White, Human–Wildlife Interactions in Urban Areas: a Review of Conflicts, Benefits and Opportunities, 42 Wildlife Research 541 (2015); James D. Brown, Biophilic Laws: Planning for Cities with Nature, 34 Virginia Environmental Law Journal 52, 72-74 (2016).

147 See Christian Hunold & Maz Mazuchowski, Human–Wildlife Coexistence in Urban Wildlife Management: Insights from Nonlethal Predator Management and Rodenticide Bans, 10 Animals 1 (2020); Aitor Hernandez-Morales, Pigeons on the Pill: Cities Tackle Climate-Related Pest Boom, POLITICO (Dec. 1, 2022); Julie K. Levy & P. Cynda Crawford, Humane Strategies for Controlling Feral Cat Populations, 225 Journal of the American Veterinary Medical Association 1354 (2004).

148 See Bailey Andree, The Future of Pandemics: Land Use Controls as Means of Preventing Zoonotic Disease, 35 Pace International Law Review 1 (2022).

149 See Briana Abrahms et al., Climate Change as a Global Amplifier of Human–Wildlife Conflict, 13 Nature Climate Change 224 (2023); Francesca Coccon & Shira Fano, Effects of a New Waste Collection Policy on the Population of Yellow-Legged Gulls, Larus michahellis, in the Historic Centre of Venice (Italy), 66 European Journal of Wildlife Research 1 (2020).

150 See NYC Hazard Mitigation Plan, NYC Emergency Management; Ashleigh P A Best, Planning for Animals in Disasters: A Case for Disaster Risk Reduction, 48 University of Western Australia Law Review 68 (2020).

151 Kendra Coulter, The Devastating Effects of Fireworks on Pets and Wildlife, MIT Press Reader (Jul. 3, 2020).

152 See Luke Hecht, Optimal Population Density: Trading Off the Quality and Quantity of Welfare, Wild Animal Initiative.

humans.[153] In addition, cities could implement animal contraceptive programs, among other alternatives to lethal control of animals deemed to be "pests" or "predators," such as rats, mice, feral cats, and other animals.[154] For another example, a village in Florida has implemented a peacock birth control program to address the large increase in population of peacocks.[155]

V. Additional Resources

Wild Animal Welfare Background

- Investigating the Welfare of Wild Animals in Urban Environments
- Introduction to Urban Welfare Ecology Research
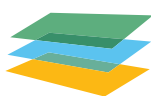- Core Concepts: Wild Animal Welfare Science

Local Laws for Wildlife and Nature Background

- Sustainable Development Code, including Chapter 1.3, Sensitive Lands and Wildlife Habitat
- Biophilic Laws: Planning for Cities with Nature
- Urban Biodiversity Hub

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[153] See, e.g., NYC to Vaccinate Racoons Against Rabies Citywide, NYC Health (Sept. 9, 2022).
[154] See Holly Elmore, The Rodent Birth Control Landscape, Rethink Priorities (Apr. 29, 2022).
[155] See Jonathan Edwards, A Florida Village's Solution to its Peacock Problem: Vasectomies, Washington Post (Aug. 10, 2023).