Repurposing Hazard for Habitat on the Colorado Front Range:

A Guide to Promote Bird Activity in Urban Environments through Hazardous Tree Mitigation

A joint study from the City of Littleton in conjunction with CU Boulder designed for the public implementation throughout the Front Range of Colorado

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PURPOSE

The purpose of this document is to create a systematic guide for the implementation of habitat trees that is safe, approachable, educational, and efficient for use by municipal foresters, private arborists, and homeowners. Ranging from passive methods to nuanced arboricultural pruning and climbing techniques, the methods are curated to increase native and migratory bird activity specifically within urban environments on the Colorado Front Range. The goal of the guide is to increase awareness and education around the need for habitat retention in urbanized areas.

INTRODUCTION

As urban areas continue developing, the interface between humans and wildlife become more prominent with notably negative trends towards wildlife. Colorado has added an estimated 2.5 million residents since 1982. To accommodate this population surge, the state has lost 1,038 square miles of fields, forests, and other open spaces to new developments. (NumbersUSA, 2022). Urbanization is a multifaceted circumstance that is happening so fast it is hard to holistically categorize the negative impacts. However, one overt consequence is habitat destruction due to irresponsible planning, or lack thereof, around urban sprawl.

Though it is acknowledged that prioritizing the health and preservation of existing trees is the most fruitful environmental outcome for both humans and wildlife, this paper and field guide will focus on ways that urban areas can lessen their contribution to native and migratory bird habitat loss specifically by retaining parts of dead trees slated for removal. Dead or dying trees can often be mitigated so that they pose minimal hazard to the public. Through doing so, part of the tree can be safely retained rather than a ground removal. This retention aids in providing wildlife resources so that there is a healthier basis for human-wildlife coexistence. It is becoming exceedingly important to prioritize and protect urban spaces while also maintaining wildlife populations for future generations.

There is no industry standard or “best management practice” of retaining habitat snags. Therefore, there is a lack of implementation and varying standards around dead tree retention for habitat.

Furthermore, we wholly acknowledge that the consequences of urbanization are much more involved than encouraging and protecting a safe habitat for birds or even planting and preserving trees. However, as Dr. Jane Goodall encouraged: "Cumulatively small decisions, choices, and actions make a very big difference." Therefore, we are creating a guide, made of small, easy actions that can be implemented by a wide variety of people so that, hopefully, a very big difference can be made.

DEFINING HABITAT TREE

Perhaps the most controversial portion of this study is in defining a habitat tree. We acknowledge that all trees within all phases of life are indeed important habitats. Habitat is an somewhat vague topic. However, to keep focus on this paper's goal, "habitat tree" will herein be specifically focused on the retaining of a tree that is planned for removal by mitigating hazards in a productive way for birds. The importance of preserving decayed material in urban environments is often overlooked. There are many varying terms describing this process: habitat tree, wildlife tree, wildlife special-use tree, veteran tree, old growth tree, dead wood preservation tree, etc.

For the sake of this paper, "creating" a habitat tree can be as simple as allowing the natural process of decay to occur and as involved as implementing artificial cavity boxes within a spar. The overall goal of a habitat tree is mimicking naturally occurring decay found within old growth forests.

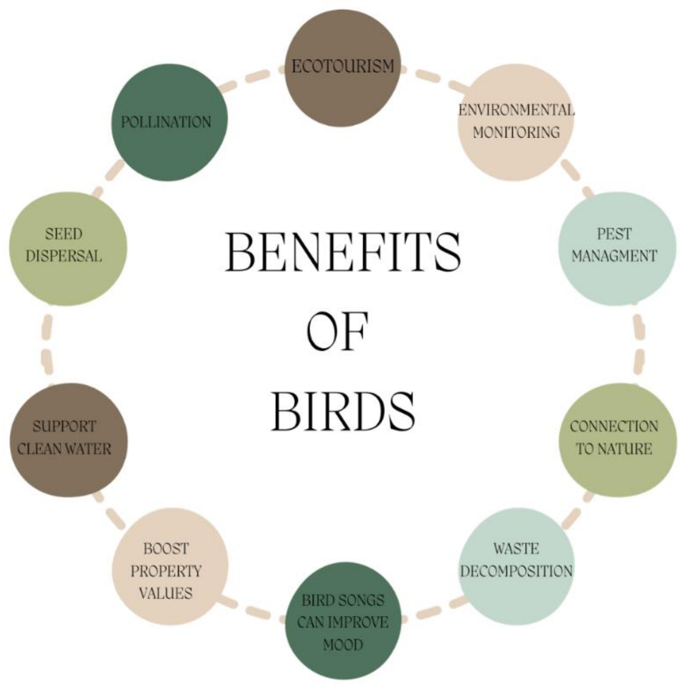
OLD GROWTH AND VETERAN TREES

Old growth trees and forests provide exponentially greater benefits than trees in a newly planted setting. However, given the shortened lifespan and hazard restrictions that come with the urban environment, there is often not an opportunity to safely retain veteran trees. A veteran tree can be defined as having features associated with advanced age (for its species) or having the connotation of a battle-scarred survivor. As such, a veteran tree has features which increase its value as habitat for wildlife (dead wood, cavities etc.) irrespective of its chronological age (Wilson, 2021).

Veteranization is defined as deliberate damage to a tree by natural fracture pruning techniques, the drilling of holes, etc., to simulate the characteristics of a veteran tree. The subject tree need not be old (Wilson, 2021). Much of creating a habitat tree is simply mimicking the decay patterns of a veteran tree.

BENEFITS OF BIRDS

Wildlife is essential to ecosystem health- encouraging nutrient cycling and waste decomposition. Insects, birds, and small mammals act as pollinators and are responsible for natural seed dispersal thus positively contributing to urban green spaces and gardens. The presence of native species, particularly in urban environments, is an educational tool offering insights into ecosystem interdependencies and nurturing environmental awareness among communities. The presence of urban wildlife fosters environmental stewardship, local habitat preservation, and sustainable practices. These animals, a link between urbanization and the natural world, are a necessity in urban environments inspiring conscientious urban planning and design.



Birds alone provide many benefits. As a natural pest management system, birds mitigate nuisance insect populations and reduce pesticide use. Bird diversity acts as a reliable indicator of urban environmental health, signaling shifts in equilibrium. Native bird's preference for indigenous plants fosters native flora growth, which is crucial for pollination and ecosystem stability, especially in a cityscape. The presence of birds fuels an economic niche as significant income is generated by birding tours, recreational equipment, and local businesses that cater to enthusiasts. According to the 2011 U.S. Fish and Wildlife Service survey, the estimated annual economic value of U.S. bird watching is $15 billion for trip-related and $26 billion for equipment-related expenditures, generating a total of $41 billion and creating a total industry output (direct, indirect and induced) across the United States of $107 billion (Carver, 2011). Birdwatching fosters a connection to biodiversity within urban areas and creates curiosity about the local environments, leading to community and educational opportunities.

BIRDS AS ECOSYSTEM INDICATORS

As mentioned, birds are indicators of ecosystem conditions because they are quickly responsive and easy to observe. Unfortunately, bird populations have detrimentally declined in North America over the past fifty years. Since 1970 it has been reported that once thriving populations have decreased by nearly 3 billion birds. Grassland birds, that inhabit much of the Front Range, have declined by 720 million birds (Rosenberg et. al., 2019). These declines are attributed to a wide variety of factors including habitat loss, pesticide usage, competition with invasive species, and collisions with urban structures ranging from windmills to skyscrapers. The decline of birds signals a larger crisis of decline in the natural world. It is important for humans to consider this as motivation for an increased effort on conservation. If healthy birds are indicators of healthy ecosystems, then protecting birds protects our overall quality of life- from clean drinking water to crop production.

PRIMARY VS. SECONDARY CAVITY DWELLERS

Cavity dwelling birds are dependent on excavated holes in trees as essential habitat. The two kinds of cavity users are primary and secondary dwellers. Primary cavity dwellers excavate their own nesting sites while secondary cavity dwellers utilize preexisting cavity holes.

PRIMARY CAVITY DWELLERS:

Within primary cavity dwellers, there are two types of excavators: hard wood and soft wood excavators. Hard wood cavity dwellers are extremely versatile and can create a cavity in wood at any circumstance, these birds often consist of Woodpeckers and other drilling birds. Woodpeckers are an adaptable and resilient species that supply the majority of cavities for our secondary nesters in the Front Range. Urban Forestry efforts should certainly prioritize promoting and protecting them.

Soft wood excavators, such as Chickadees and Nuthatches, can create cavities out of soft wood, usually utilizing rotten or decaying wood. Soft wood cavity birds are a prime example as to why it is important to retain rotten wood in urban settings.

SECONDARY CAVITY DWELLERS

Secondary cavity dwellers, such as Swallows and Wrens, are birds that rely on abandoned cavities created by primary cavity nesters. Part of habitat tree creation includes drilling cavity holes with an auger bit to allow less competitive habitat opportunities for secondary dwellers. As habitat loss continues in urban areas, competition between cavity dependent species increases. Invasive secondary dwelling species, such as the European Starling, have proven to be more aggressive in occupying cavities than native bird species. This aggressive competition limits native success. By increasing the amount of cavity holes within an urbanized area it creates more opportunities for native birds and reduces competition within invasive species.

COMMON CAVITY DWELLING BIRDS IN THE URBAN FRONT RANGE:

Like most of the natural world, birds have preferences on habit but are largely adaptable in their survival strategies. No single species is completely confined to a particular nesting height or cavity width. However, there are limitations and preferences that are worth considering when one is intentionally trying to establish a habitat tree.

In acknowledging that naturally occurring cavities are the preference of wild birds, it also is important to recognize that an urban setting is not a bird’s evolved environment. Artificial cavities are rapidly becoming more essential as nesting bird's natural habitats are becoming more limited.

Table 1, below, consists of generalized cavity dimensions that are typical of target bird species on the Colorado Front Range. The birds included here are some of the most prominent urbanized birds in The Front Range. Usage of these cavity dimensions are by no means limited to this list of species. Placing an emphasis on certain bird dimension preferences should be held loosely. This chart is to act as a broad guide that allows the user opportunity to pursue targeted species.

Table 1: Nesting Preferences for Common Cavity Dwelling Birds in the Urban Front Range

Target Bird Species (Cavity Dweller Type)	Image	Type of Cavity Dweller	Cavity Entry Hole Size (circumference)	Internal Cavity Height/ Depth Requirements	Preferred Height (From Ground)
Northern Flicker		Primary (Hard Wood)	2.5-3 in	Height: 16-18in Depth: 13-16in	6-15 feet
Mountain Bluebird		Secondary	1.5 in	Height: 5-6 in Depth: 4-6 in	5-6 feet
Tree Swallow		Secondary	1.5 in	Height: 6-7 in Depth: 4-5 in	5-15 feet
Violet-green Swallow		Secondary	1.5 in	Height: 4.5-6.5 in Depth: 3.5-5.5 in	5-30 feet
Black-capped Chickadee		Primary (Soft wood)	1.125 in	Height: 6-15 in Depth: 4-6 in	4-15 ft
House Wren		Secondary	1.125 in	Height: 4-10 in Depth: 4-6 in	4-10 ft

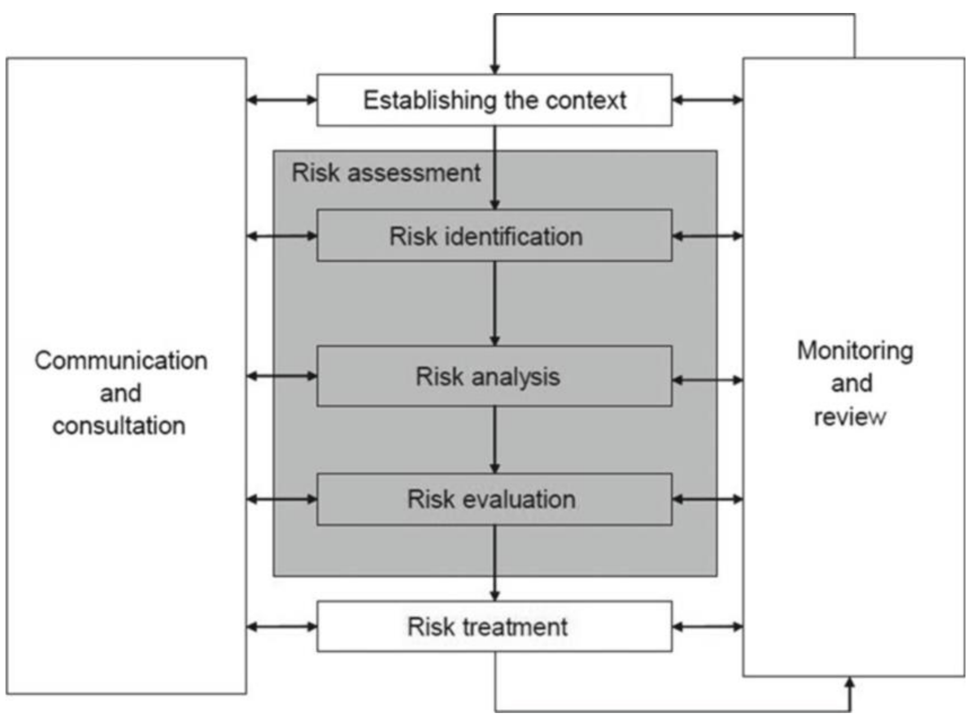
Western Bluebird		Secondary	1.5 in	Height: 5-10 in Depth: 4-6 in	4-20 ft
American Kestrel -Secondary Cavity Dweller		Secondary	3.0 in	Height: 12-20 in Depth: 10-16 in	10-30 ft
White-breasted Nuthatch		Primary (Soft Wood)	1.25 in	Height: 6-12 in Depth: 4-8 in	4-15 ft
Ash-throated Flycatcher		Secondary	1.5 in	Height: 8-30 in Depth: 6-12 in	4-20 ft
Downy Woodpecker		Primary (Hard Wood)	1.25 in	Height: 6-20 in Depth: 6-12 in	4-20 ft
Hairy Woodpecker		Primary (Hard Wood)	1.5 in	Height: 12-24 in Depth: 6-12 in	4-20 ft
photo credit: (Cornell, 2019).					

The target bird species included in Table 1 were chosen based upon active presence, recent observation, breeding season location, and site applicability. The date was reviewed via three “hot spot” locations in Littleton according to eBird. eBird is one of the largest citizen databases in the world and allows for mass monitored observation of bird species, which then can be used to study the changing behavior patterns of thousands of birds. More conclusive information on data collection is included in Appendix B- Data Collection and Attribution.

WHAT MAKES TREES HAZARDOUS

Any discussion of trees, much less dead tree retention in urban spaces, must include the conversation of public safety at the foreground. A healthy, well-maintained tree provides more environmental benefit than converting a dead to tree into a designated habitat tree. However, urban areas are often difficult places for trees to survive. So often, the expectation is a completely safe and manicured cityscape. As arborists have known for many decades, all trees come with an inherent, potential risk. However, there are ways to categorize the risk severity and strategies to mitigate risk.

Our habitat tree conversion starts by surveying risk via International Society of Arboriculture's (ISA's) tree risk assessment. Tree risk assessments are the systematic process used to identify, analyze, and evaluate tree risk. An understanding of the basic terminology and fundamental concepts of tree risk assessment provides a strong foundation on which knowledge and experience can continue developing. (Dunster, et al. 2017).



Tree risk assessments involve a wide range of considerations from site factor, tree species, target, and tree defects. Intentionally analyzing the entire site of the tree encourages a deeper level of understanding of a tree's safety. Trees are living, dynamic organisms. The goal of a tree risk assessment and action plan is not to create a risk-free tree, but rather to mitigate undue hazards. It is impossible to completely eliminate risk, in that some level of risk must be accepted in order to experience the countless benefits that trees provide in urban settings (Pokorny et al., 2003). This is not to say there is any excuse for negligence; the assessing arborist should balance the risk that a tree poses with the benefits that communities receive from trees. Arborists are held to a standard to be stewards of education that is backed in both science and experience.

Tree risk assessments are nuanced and allow opportunity for subjectivity; however, the ISA manual and testing has helped create an industry wide standard on the process of risk analysis while still allowing space for professional judgment. Despite the unpredictability of trees and risk, the industry was able to create a Best Management Practice around risk analysis that is widely used by a variety of forestry managers.

To date, there is no formalized Best Management Practice for creating and retaining habitat trees. This is a lacking spot in the industry. Professionals can lean on tree risk assessments coupled with pruning techniques to mitigate hazardous deadwood to promote habits, but this strategy is lacking in wildlife expert input and an industry standardization.

CREATING HABITAT TREES

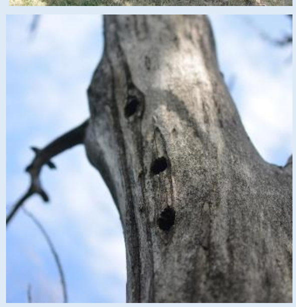
Habitat tree conversions should both begin and complete with formal tree risk assessment. Safety should always be the highest priority.

The simplest goal to follow in encouraging habitat trees is an intentionality in accelerating decay. Rot within trees establishes a vibrant saproxylic (insects dependent on dead or decaying wood) population. Saproxylic insects are at the core of biodiversity. These insects continue increasing internal tree rot, acting as food source for birds and other wildlife, and aiding in creating microhabitats within the tree.

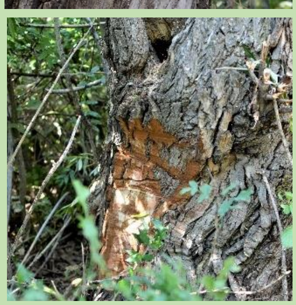
In Table 2 below, the levels of implementation have been divided into three categories: passive, intermediate, and involved. Generally, all of these techniques encompass (partially or in whole) are: encouraging natural rot, promoting insect habitat, promoting bird shelter (including nesting or perching sites), aiding in providing food sources, and decreasing bird's risk of predation.

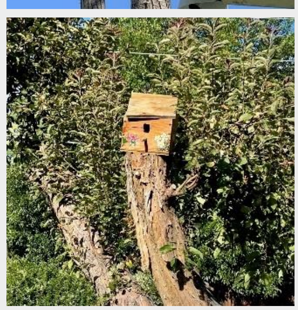
A. **Passive** - generally no extra work involved. This is simply being aware of preexisting habitat and preserving dead and decaying wood.
B. **Intermediate** - all of this work can be completed with a chainsaw and tree climbing gear.
C. **Involved** - additional tools and hardware may be required to drill artificial cavities, create/ install boxes, etc.

Table 2. PRUNING TECHNIQUES:
Methods of Urban Wildlife Habitat Promotion
See Appendix A for definitions.

Level	Techniques	Photo Examples	Equipment	Habitat Goal (how does this help?)
Passive	stump suckering preexisting cavities snag	  	None! Be aware of natural breaks and preexisting habitat sites and protect them.	Generally, these techniques: Advocate natural habitat protection by allowing space for existing rot and habitat thus decreasing the risk of predation

	natural fracture/ break			
	stump (leave 6 ft standing)			

Level	Techniques	Photo Examples	Equipment	Habitat Goal (how does this help?)
Intermediate	boring/ plunge cuts		All you need is a chainsaw! Potentially utilize climbing gear for tall portions of the tree.	Generally, these techniques: Expedite natural rot, extend decay, promote insect and bird habitat (including nesting, forging, and perching behaviors).
	scoring/ hashing cuts			
	trunk wounding			

	coronet cuts (cuts made to mimic natural breaks	 		
Level	Techniques	Photo Examples	Equipment	Habitat Goal (how does this help?)
Involved	drill cavity holes mimic spiral fractures bird house installation	  	Requires additional expertise, gear, and tools. Ex: drill with spade bit, crowbar, hardware, etc.	Generally, these techniques: Decrease competition for nesting sites and reduce possible predation risk by, promoting insect habitat, and bird habitat (including nesting and foraging sites).

	nesting box installation			
	post signage			

CREATING ARTIFICIAL NESTING CAVITIES

Artificial nesting cavities in urban environments represent a strategic solution for promoting wildlife habitats and biodiversity. By mimicking natural nesting sites, these structures offer shelter and breeding spaces for native bird species, countering threats posed by the removal of natural habitat, especially in urban environments. The implementation of artificial cavities increases habitat opportunity by reducing cavity competition with invasive species. In combating habitat destruction due to urbanization, artificial cavities offset the reduced plant diversity that is necessary for some species to thrive. Artificial cavities play a pivotal role in supporting native species in urban habitats.

Unlike externally attached nest boxes (i.e., bird houses), internal nesting boxes are cut directly into stems. This gives a more natural aesthetic that is better insulated and less obvious to predators. Internal boxes have a wide variety of applications and can be focused on specific species dependent on the preexisting site conditions.

Table 3. Steps to Creating an Artificial Nesting Box

	Note	Photo
Step 1	Choose a safe location that is high within the tree. Since the box requires deep, boring cuts that go through the majority of the trunk, it is important to not install in an area that could compromise the safety of the stem above the box.	
Step 2	Drill hole with desired drill bit spade size (we used 1 ½). Tip: Drilling the hole first helps the face stay better intact and is easier to do aloft. Drill as deep as you plan for the nest box to be.	
Step 3	Bore into the stem to make the face plate. Match the bored cut with downward angled horizontal cuts. This cutting needs to stay shallow. Only cut as deep as the face of the box needs to be to slide back into place.	

	Tip: cutting the horizontal cuts at a slight downward angle ensures the face plate will not slip out in weather.	
Step 4	Cut out the interior of the box by drilling. Note: We tried the drilling technique in effort to keep required equipment to a minimum. This is not a realistic strategy if creating deeper nesting boxes.	
Step 4 (alternate)	Cut out the interior of the box by scoring & prying chunks out with a crowbar. **Photo credit** for scoring with crowbars: Sydney Arbor Trees - Urban Habitat Creation	

Step 5	Secure the face plate by sinking it back into place. Note: decided to go "hardware free" by using a wood shim (made from a coronet cut) instead of installing screws into the tree. **Pros**: requires less equipment, keeps the nesting box fully natural **Cons**: as the tree weathers there is a greater potential for losing face plate	 
Step 5 alternate:	Secure the back plate by installing screws around the corners. **Photo credit source:** Sydney Arbor Trees - Urban Habitat Creation **Pros**: the most secure option for keeping face plate in place. **Cons**: more involved in that it requires additional tools and hardware to be brought into the tree.	

NESTING BOX, LESSONS LEARNED:

Our first nesting box came with many lessons learned. As with all things, there are many variations to achieve the same goal. It is likely that as we continue trying new alternatives, we will modify the steps above.

For example, the photos in Table 3 from Sydney Arbor Trees-Habitat Creation, shows them drilling the entry into the front of the tree and excavating out of the back. Rather than resecuring the face plate, they resecure the back end which naturally will receive less traction.

A PHOTO OF THE INITIAL, FAILED, ATTEMPT AT AN ARTIFICIAL NESTING BOX.

Our first attempting nesting box was sloppy. We had extreme difficulty drilling a hole into a loose faceplate while aloft, the faceplate was cut too thick (which meant the cavity space was too cramped in proportion to the entry hole), and the fit was not secure enough to aid in insulation. The extra gear was cumbersome, and we failed to prepare an aloft tool bag meaning that more than once a tool was dropped or slipped out of the saddle's gear loop.

In conclusion, the first box was a missed target that took too much time. Through that trial and error, it led to a better second attempt! It does not seem to be realistic that this first attempt will be utilized as bird habitat. That being said, exposing heartwood and boring into a tree still encourages decay and the presence of saproxylic insects, thus encouraging an increase in bird activity. Not all was lost and much learned.

CONCLUSION

Habitat trees are act as an important pillar in establishing a beneficial urban ecosystem. The need to protect Colorado's environmental roots is becoming increasingly urgent and evident in our communities. Urban institutions and departments have a responsibility to their communities, citizens, and wildlife.

Proactive environmental protection and management is essential to maintain healthy urban environments. This study provides a limited overview and guide to habitat trees on the Colorado Front Range. There is a need for continued research and observation-based studies around habitat trees in urban environments. Standardized best management practices need to be developed in a way that allows local research to influence regional priorities. Industry wide standards are needed to provided consistency in messaging and vernacular around the subject of habit tree retention.

Efficient standards will only happen with cross- sector collaboration. In analyzing existing research, there was a lack of field arborist's input, discrepancies in defining and understanding "habitat tree," and an absence of practical implementation in North America. Most notably, was how widely vernacular differs, (ex: habitat tree, wildlife snag, veteranization of trees, creating ancient tree patterns, leaving dead wood, standing spars, etc.). We hope for there to be work in housing information in a way that allows the user to clearly understand how they can positively contribute to retention of habitat trees.

Finally, though municipalities certainly have opportunity to retain deadwood, private properties have proven to offer a much greater breadth of potential. The private sector needs to be valued as a leader in normalizing this conversation and encourage safe implementation and that comes through industry standards, continued education, and partnerships.

REFERENCES

Artificial Nesting Structures, Natural Resources Conservation Service, July 2008, ucanr.edu/sites/csnce/files/124138.pdf.

Carver, Erin (2011). Birding in the United States. pp. 13-14.

Cornell Lab of Ornithology. 2019. All About Birds. Cornell Lab of Ornithology, Ithaca, New York. https://www.allaboutbirds.org Accessed on [9/14/2023].

Donovan, G., et al. 2013. The relationship between trees and human health: evidence from the spread of emerald ash borer. American Journal of Preventative Medicine 44(2): p. 139–145.

Dunster, J. A., Smiley, E. T., Matheny, N., & Lilly, S. (2017). *Tree Risk Assessment Manual* (Second). Martin One Source. International Society of Arboriculture

Ingold D.J. (1998) The influence of starlings on flicker reproduction when both naturally excavated cavities and artificial nest boxes are available. The Wilson Bulletin, 110, 218-225

McPherson, E.G., and J. Muchnick. 2005. Effects of street tree shade on asphalt concrete pavement performance. Journal of Arboriculture 31(6):303.310.

McPherson E.G., Q. Xiao, C. Wu and J. Bartens. 2013. Metro Denver Urban Forest Assessment. Final report, 28 March 2013, 89 pp.

Miller Robert W et al. *Urban Forestry : Planning and Managing Urban Greenspaces*. Third ed. Waveland Press 2015.

NumbersUSA. (2022, September 7). *Urban sprawl, population growth are chief concerns for Colorado voters, finds new poll*. PR Newswire: press release distribution, targeting, monitoring and marketing. https://www.prnewswire.com/news-releases/urban-sprawl-population-growth-are-chief-concerns-for-colorado-voters-finds-new-poll-301619126.html#:~:text=Colorado%20has%20added%202.5%20million,Colorado%20Springs%2C%20and%20Boulder%20combined

Pokorny, Jill & obrien, joe & Hauer, Richard & Johnson, Gary & albers, jana & bedker, peter & mielke, manfed. (2003). Urban Tree Risk Management: A Community Guide to Program Design and Implementation.

Rosenberg et. al. (PDF) Decline of the North American Avifauna - Researchgate, Sept. 2019, www.researchgate.net/publication/335939269_Decline_of_the_North_American_avifauna.

Wilson, P. (2021). *A-Z of tree terms: A companion to British arboriculture* (3rd ed.). Ethelburga House.

APPENDIX A: DEFINITIONS

- **Bore Cuts**- also called plunge cut. Using the tip of a chain saw to cut into or through the middle of a piece of wood.
- **Coronet Cuts**- A technique that mimics natural fractures by cuts parallel to the branch so there is jagged finish rather than a conventional stub. This method blends in to the environmental a bit more naturally.
- **Habitat tree**- the retention of a tree that is planned for removal by mitigating hazards in a productive way for wildlife and mimicking the naturally occurring decay process that is found within old growth forests." Also called: wildlife tree, special use tree, veteran tree, snag tree
- **Natural Fracture**- A branch break that comes from natural causes. Usually, jagged. No cutting involved.
- **Primary Cavity Nesters**- birds that excavate nesting holes.
- **Scoring/ Hashing Cuts**- Cutting groves or hashing marks on the side of a branch or on top of a flat cut
- **Secondary Cavity Nesters**- birds that rely on abandoned cavities created by primary cavity nesters.
- **Snag**- Leaving the dead tree in its natural state with the use of minimal cuts only to remove hazardous material surrounding the trunk.
- **Stump**- Leaving the hollow base of a tree to serve as protection against predators. ~6 ft. If trunk is not hollow, cut flat and score the top of the stump to encourage rot.
- **Stump Suckering**- Species dependent. Leave stump at determined height, retain any natural stump suckers during work. Do not chemically treat stump or suckers.
- **Spiral Fractures**- Long, vertical plunge cut, often spiraling, along the trunk to mimic natural cracks.
- **Trunk Wounding-** Cutting parallel to the stem to mimic bark loss and expose sap wood.
- **Urban Forest-** all trees within a municipality or community (on private and public lands). This includes trees in backyards, parks and open spaces, street trees, and commercial land areas.

- **Urban Forestry**- a specialized branch of forestry that integrates the art, science, and technology of managing trees and forest resources in and around urban and suburban areas for the psychological, sociological, aesthetic, economic, and environmental benefits trees provide society.
- **Veteran Tree**- A veteran tree can be defined as having features associated with advanced age (for its species) or having the connotation of a battle-scarred survivor'. As such a veteran tree has features which increase its value as habitat for wildlife (dead wood, cavities etc.) irrespective of its chronological age.
- **Veteranization**- deliberate damage to a tree, by natural fracture pruning techniques, the drilling holes, etc., to simulate the characteristics of a veteran tree. The subject tree need not be old.

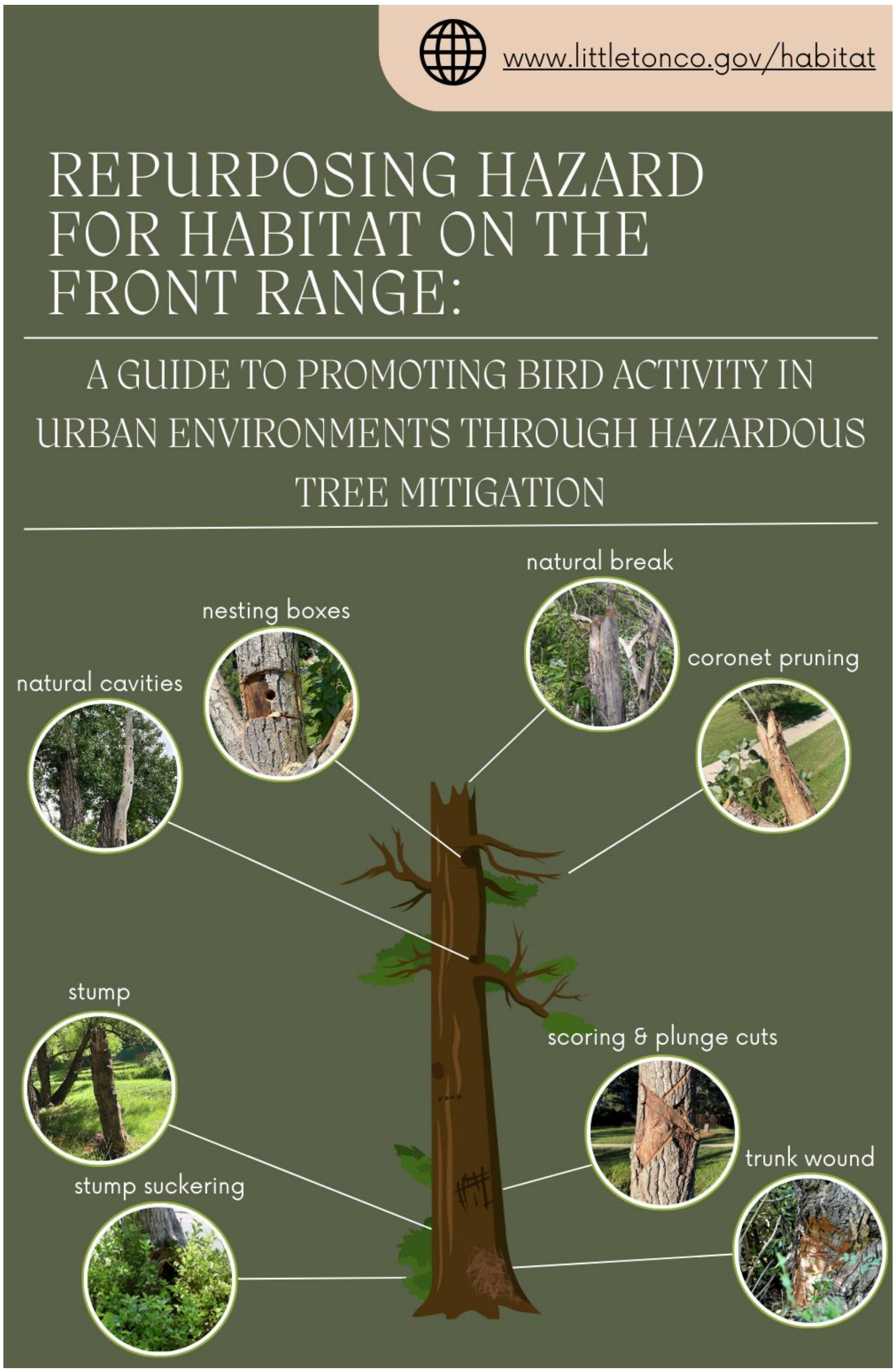
APPENDIX B: DATA COLLECTION & ATTRIBUTION

A collection of various pre-existing scientific papers provided background information on the different nesting strategies and cavity dimensions for the target species. These sources, cited in the references, were then cross referenced and used to create the dimensions attributed to the guide.

To have constant and consistent data on the status and patterns of bird species in the changing urban settings, it is imperative that citizen data is recorded. eBird is one of the largest citizen databases in the world and allows for mass monitored observation of bird species, which then can be used to study the changing behavior patterns of thousands of birds. eBird is a reviewed and monitored source and investigates pattern anomalies submitted by individuals, increasing reliability, which can be a large concern when using data produced by anyone and everyone. This study used eBird data that was recorded in and around the City of Littleton, Colorado in 3 "hotspots", places where a large amount of data has been submitted by varying individuals. These locations included: South Platte River- W. Bowles Ave. to S. Prince St., Sterne Park, and Hudson Gardens. Using these hot spots allows for the data to be relevant, current, and growing in allowing observation of cavity nesting birds, among others, to be associated with specific locations and seasons.

APPENDIX C: FIELD GUIDE- REPURPOSING HAZARD FOR HABITAT ON THE FRONT RANGE

Below is an extracted version of the single page field guide. If you want a print friendly version of the brochure, go to www.littletonco.gov/habitat.



PRUNING TECHNIQUES:
Methods of Urban Wildlife Habitat Promotion

PASSIVE

be aware of preexisting habitat. as safety allows, advocate to leave them be!

examples: stump suckering, snag, natural fracture, stump

INTERMEDIATE

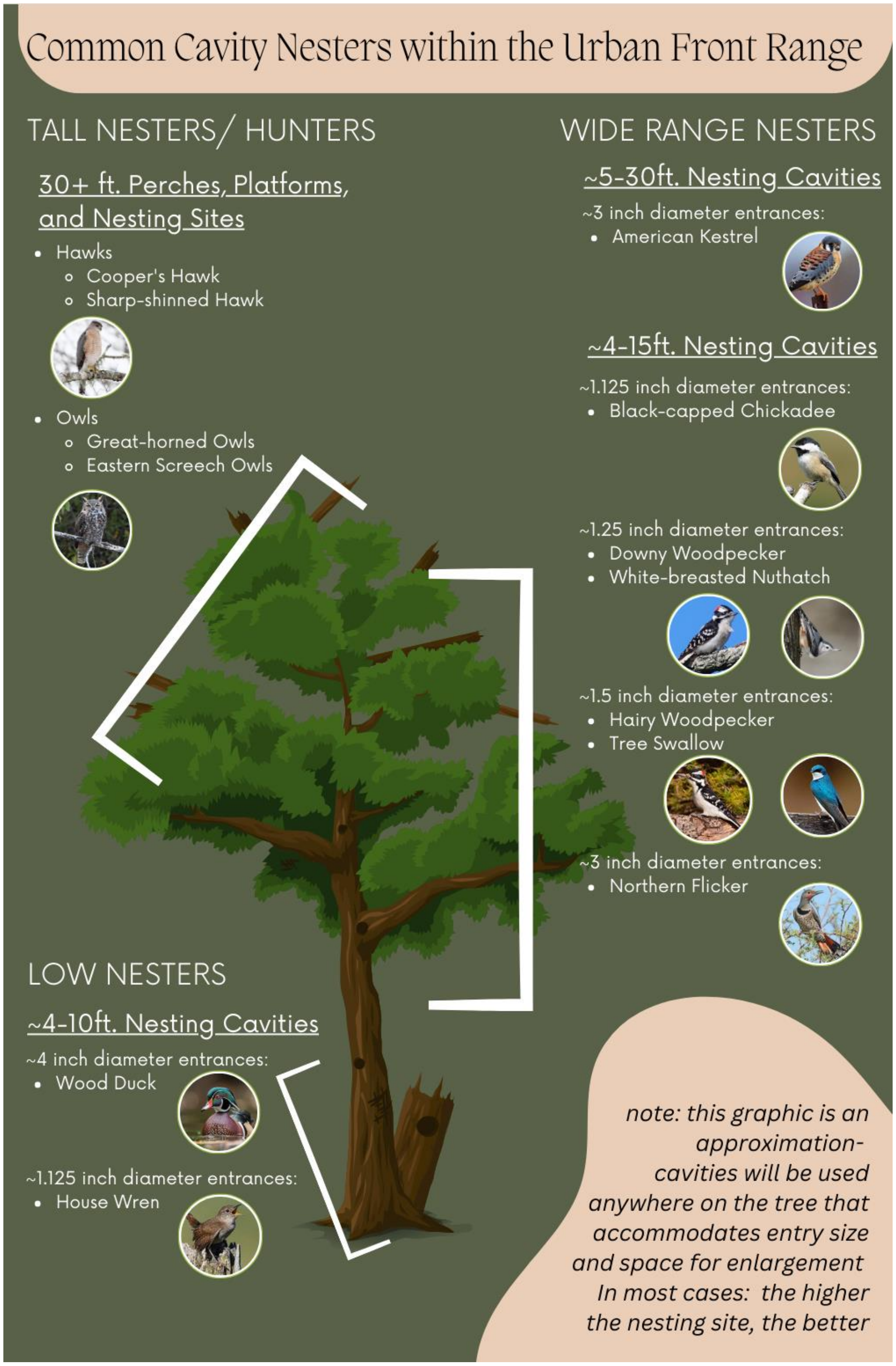
all you need is a chainsaw! potentially utilize climbing gear

examples: boring/ plunge cuts, scoring/ hashing, trunk wounding, coronet cuts (cuts made to mimic natural breaks)

INVOLVED

requires additional expertise, gear, and tools (ex: drill with spade bit attachments)

examples: drill cavity holes, mimic spiral fracture cuts, bird house, nesting box installation


Common Cavity Nesters within the Urban Front Range
TALL NESTERS/ HUNTERS
30+ ft. Perches, Platforms, and Nesting Sites
• Hawks
◦ Cooper's Hawk
◦ Sharp-shinned Hawk
• Owls
◦ Great-horned Owls
◦ Eastern Screech Owls
WIDE RANGE NESTERS
~5-30ft. Nesting Cavities
~3 inch diameter entrances:
• American Kestrel
~4-15ft. Nesting Cavities
~1.125 inch diameter entrances:
• Black-capped Chickadee
~1.25 inch diameter entrances:
• Downy Woodpecker
• White-breasted Nuthatch
~1.5 inch diameter entrances:
• Hairy Woodpecker
• Tree Swallow
~3 inch diameter entrances:
• Northern Flicker
LOW NESTERS
~4-10ft. Nesting Cavities
~4 inch diameter entrances:
• Wood Duck
~1.125 inch diameter entrances:
• House Wren
note: this graphic is an approximation- cavities will be used anywhere on the tree that accommodates entry size and space for enlargement
In most cases: the higher the nesting site, the better

& BENEFITS THREATS

Benefits of Urban Trees

- clean air
- produce oxygen
- stormwater management
- city cooling
- reduce asthma rates
- reduce stress
- increase property values
- protect biodiversity
- increase recreation rates
- beautification

Benefits of Urban Birds

- control pests
- encourage native plantings
- promote conservation practices
- promote outdoor hobbies
- support economy
- connect people to nature

Threats to Cavity Dwellers in Urban Environment:

- removal of natural habitat- dead trees
- improper use of pesticides
- urbanization/ destruction of native habitat
- reduced plant diversity
- competition for cavities with invasive species

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PRESERVATION TREE CARE "For the ♥ of Trees"