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A broad scale analysis of tree risk, mitigation and potential habitat for cavity-nesting birds

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ABSTRACT

Trees in towns and cities provide habitat for wildlife. In particular, cavity-nesting birds nest in the dead and decayed stems and branches of these trees. The same dead and decayed stems and branches also have a greater likelihood of failure, which, in some circumstances, increases risk. We examined 1760 trees in Baltimore, MD, USA and western MA, USA, assessing tree risk and, for a sub-sample, noting the presence of cavity nests excavated by birds. In Baltimore, most trees were in areas of frequent use and had no visible defects. In western MA, most trees were in areas of infrequent use and 70% had visible defects. The most common defect in both locations was dead branches and stubs between 10 and 51 cm in diameter. Trees with a cavity nest had a greater likelihood of failure than trees without a cavity nest. Our data provide an overview of tree risk assessment and mitigation, a baseline understanding of risk parameters for common street trees in the Northeast and Mid-Atlantic regions of the United States, and insight into whether a balance can be struck between tree risk and provision of wildlife habitat.

1. Introduction

Trees in towns and cities provide many benefits (Nowak and Dwyer, 2000; Roy et al., 2012), including habitat for wildlife (Fernandez-Juricic and Jokimäki, 2001; Donnelly and Marzluff, 2004). In particular, dead and decayed branches of trees growing in urban parks and residential areas provide nesting sites for a dozen or more species of cavity-nesting birds, depending on the region in which the city occurs (DeGraaf and Wentworth, 1986; Marzluff, 2001; Reale and Blair, 2005). However, habitat features that benefit wildlife also pose a risk for people because dead and decayed tissue has a high potential to fail.

Woodpeckers and other so-called primary excavators create holes in trees for nesting. They generally do so by using their bill to excavate a cavity with an opening that is smaller than the interior space of the cavity—only the opening is visible. Different species of woodpeckers prefer to excavate cavities in trees at different stages of decay (DeGraaf and Shigo, 1985; Runde and Capen, 1987). However, most woodpeckers will excavate nesting cavities in either branches or trunks with some sound wood on the outside and a central column of decay inside (DeGraaf and Shigo, 1985). Once a nesting cycle is complete (i.e. the young birds have left the nest), a cavity is often used by an array of other bird and mammal species for either nesting or denning (Martin and Eadie, 1999). Natural cavities, such as those formed from a wound and subsequent decay without active excavation, are rarely used by woodpeckers, but may be used by many other species such as owls, ducks, and many mammal species (DeGraaf and Shigo, 1985).

Although some cavity nesting species can be successful at breeding and persisting in urban areas (Chace and Walsh, 2006), many bird species decrease in abundance with urbanization (Marzluff, 2001; Morrison and Chapman, 2005; Blewett and Marzluff, 2005). Maintaining dead and decayed branches in urban trees may be one way to support habitat for these species. However, for the same load, dead and decayed branches have a greater likelihood of failure (see below), which increases risk.

Arborists often assess risk associated with trees on public and private land. Among many parameters included in street tree inventories, risk level was among the most important (Östberg et al., 2013). Presumably, one reason for the emphasis on tree risk assessment in arboricultural practice is the potential for human injury and fatality (Schmidlin, 2009) and the concomitant threat of litigation (Mortimer and Kane, 2004), even though the risk itself may be comparatively small (Ball and Watt, 2013).

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In the United States, the process of tree risk assessment has been recently revised (Anonymous, 2011; Smiley et al., 2011). Risk is the combination of the likelihood of an event and the severity of the consequences of that event. Prior to the publication of Part 9 of the American National Standards Institute (ANSI) A300 (Anonymous, 2011), other approaches were used to assess tree risk (Matheny and Clark, 1994; Albers et al., 2003; Ellison, 2005). Earlier approaches shared common factors to assess: potential of tree (or part) to fail, size of the defective part, and target use. In the United States, the current Best Management Practices for assessing tree risk uses a matrix approach to assess (i) likelihood of failure, (ii) likelihood of impact, and (iii) severity of consequences (Smiley et al., 2011).

The likelihood of failure of a tree or tree part depends on intrinsic wood strength, geometry of the tree (or part) and the applied load. Together, the latter two factors govern the applied stress, which, if it exceeds wood strength, induces failure. Defects (e.g., decay, crack, weakly attached branch) increase the likelihood of failure by reducing wood strength, increasing stress, or both. Not all defects are cause for concern, and arborists must consider all factors when assessing tree risk. In addition, response growth can decrease stress: diameter growth increases the moment capacity of a stem or branch, whereas increased toughness of woundwood (Kane and Ryan, 2003) increases the stress needed to induce failure.

Most previous work on tree risk assessment has examined methods (Ellison, 2005), tools to assess defects like decay (Johnstone et al., 2010), the occurrence of common defects such as decay (Luley et al., 2009; Terho, 2009) and the thresholds at which defects increase the likelihood of failure (Kane et al., 2008; Kane, 2014). Studies have explored maintenance needs (Nowak, 1990) on a broad scale, but few reports exist of tree risk assessments on a community-wide scale (Sreetheran et al., 2011; Jim and Zhang, 2013).

Our objectives were (i) to develop a baseline understanding of the species, size, and defects associated with likelihood of tree failure and (ii) to determine whether cavity-nesting birds preferentially use trees that present greater risk, and, if so, whether it is possible to mitigate risk while retaining wildlife habitat.

2. Methods

We inspected trees in July through September of 2005–2009 in two locations designed to encompass a range of conditions from highly urbanized (Baltimore, MD, USA) to suburban residential to rural wildlands (western Massachusetts, USA). In each location, a single ISA Certified Arborist inspected all trees (but the Certified Arborist was not the same in both locations). In 2006 in Baltimore, MD, USA, a Certified Arborist inspected 10 randomly selected trees per transect along 100 m long street side transects, in association with long term bird count sites as part of the Baltimore Ecosystem Study Long-Term Ecological Research project (http://beslter.org). In 2005–2009 in ten towns around the Connecticut River Valley region of western Massachusetts, a Certified Arborist inspected two sets of trees: (i) 10 randomly selected trees from 100 m long transects along roads or bike trails ("transect trees") and (ii) pairs of trees identified through searching for bird nests. In western MA, we identified areas in the region with sufficient tree cover to support cavity nesting birds, and then selected sites in a stratified design to include: large towns, small towns, and extensively forested recreational areas. We selected pairs of trees by first identifying all trees in a plot with a woodpecker-excavated cavity nest(s) ("nest tree"). Then we paired each nest tree with a randomly selected, nearby tree of the same species and DBH ("paired tree"). We analyzed data from (i) and (ii) separately because transect trees were randomly selected, but pairs of trees were not.

To assess risk, a Certified Arborist used the "Municipal Evaluation Sheet" from the USDA Forest Service Northeast Area "Risk Tree Evaluation Inspection Form" (Albers et al., 2003), a commonly used method at the time of data collection. The method assesses the following "risk parameters": likelihood of failure, size of the defective part, and likelihood of target impact. Categories for likelihood of failure are 1, 2, 3, and 4, which correspond to qualitative descriptors: "low", "moderate", "high", and "very high". Since we randomly selected transect and random trees, we included a category (0) for trees that did not have any visible defects. Categories for size of defective part are 1, 2, and 3, which correspond to the following ranges of trunk diameter measured 1.4 m above ground (DBH): less than 10 cm, between 10 and 51 cm, and greater than 51 cm When we could not measure the diameter of defective parts from the ground, we visually estimated diameter. Categories for the likelihood of target impact are 1, 2, and 3, according to the use of the area in which the tree was growing: occasional, intermediate, and frequent. Public access to one area in western MA was restricted, but it was otherwise similar to other sites in western MA. Consequently, we did not assess the likelihood of target impact at the site.

Excluding trees with no visible defects, the sum of the risk parameters is between 3 and 10. We categorized risk from the sum as follows: risk rating between 3 and 5 is "low", risk rating between 6 and 8 is "moderate", and risk rating of 9 or 10 is "high". For all trees, we identified any defects (dead branches, decay in a branch or trunk, weakly attached branch, root defects, leaning stem, poor crown architecture, crack) and analyzed the combination of risk parameters that resulted in the greatest numerical value. We distinguished between dead and decayed branches as follows: we considered branches that were dead and decayed to be dead branches, and branches that were alive but had evidence of decay (e.g., fruiting bodies and cavities) to be decayed. In some cases, different defects in the same tree resulted in the same numerical risk rating; for these, we listed multiple defects. Since a different Certified Arborist assessed risk in each site, we analyzed data from each site separately. Each Certified Arborist was familiar with the Municipal Evaluation Sheet (Albers et al., 2003).

For transect trees at each site, we conducted descriptive analyses of species, DBH, and the risk parameters. For each site, we used logistic regression to determine whether the presence of a defect was associated with DBH. The only defect with sufficient sample size to analyze was dead branches. We repeated logistic regressions including the effect of species for species with at least five observations each of dead branches and no visible defect. We used a generalized linear model (GLM) to determine whether DBH differed between levels of the likelihood of failure. We did not include the effect of species in the GLM because of insufficient sample size. We used Tukey's Honestly Significant Difference test for multiple comparisons of means within each site. We used Fisher's Exact Test to compare the frequency distributions of the likelihood of failure and size of defective part.

For pairs of trees in western MA, we visually estimated the percentage of the crown that was dead. For cavities that occurred on branches, we measured the distance of the cavity from the trunk. In all years except 2005, the Certified Arborist recommended management action(s) (prune, remove, cable, and monitor, or a combination of these activities) to mitigate risk. We used Fisher's Exact Test to compare frequency distributions of categories of (i) the likelihood of failure and (ii) the recommended mitigation actions between trees with and without cavities. After arcsine transforming the visually estimated percentage of the tree that was dead, we used a t-test to compare percentages between trees with and without cavities. We present non-transformed data in the results. We used SAS (SAS Institute, Cary, NC) for all analyses.

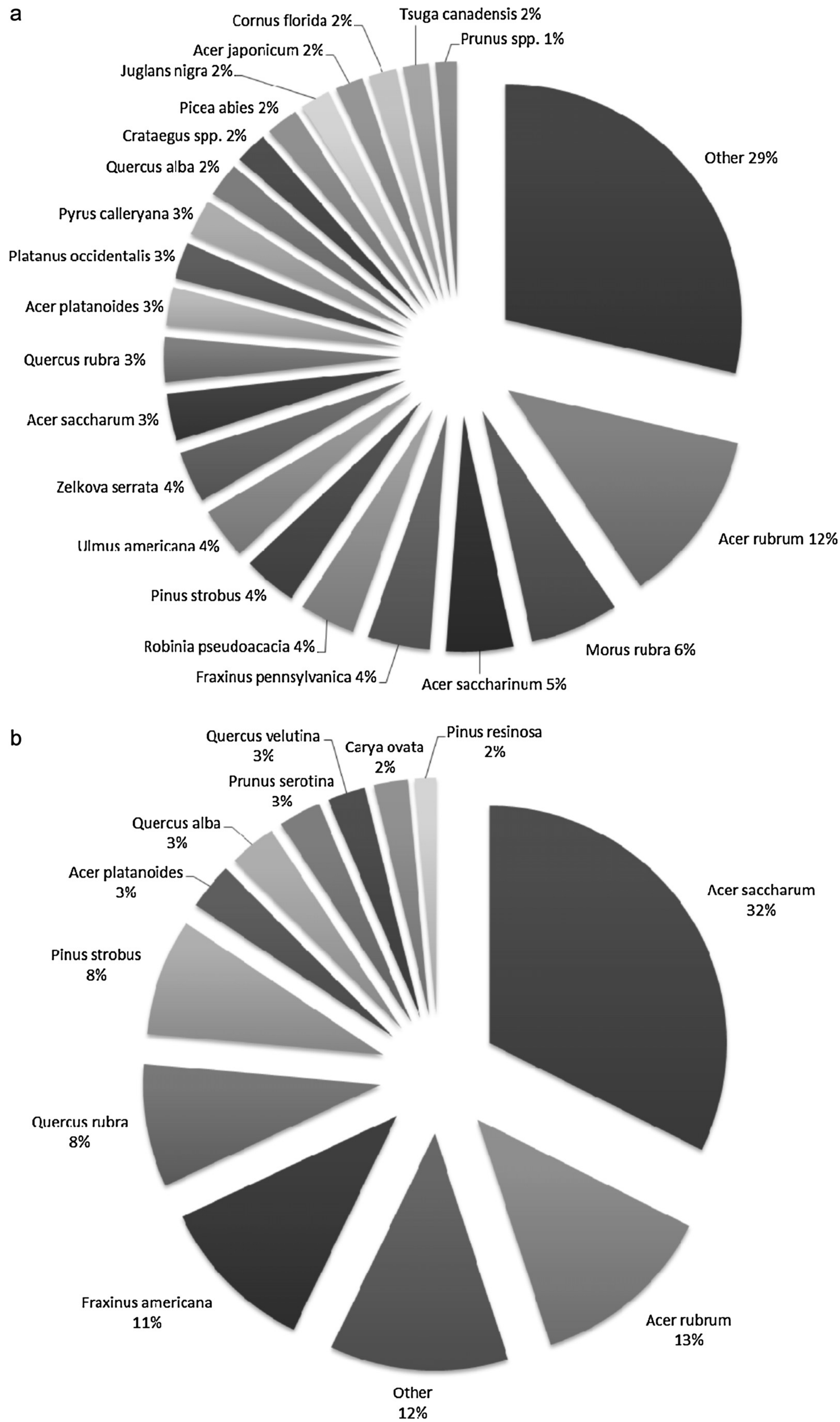

Fig. 1. Species composition of trees measured in (a) Baltimore ($n = 678$) and (b) western MA ($n = 691$). There were 59 "Other" species in Baltimore and 36 in western MA.

3. Results

3.1. Transect trees

We inspected 678 individual trees of 80 species in Baltimore and, excluding pairs of trees, 691 individual trees of 47 species in western MA (Fig. 1). We inspected at least 10 individuals of 21 species in Baltimore and 11 species in Western MA (Fig. 1). The most abundant genus in both sites was *Acer*, which composed 24% and 49% of individuals in Baltimore and western MA, respectively. The next most common genera in Baltimore were *Quercus* (8%) and *Morus* (6%); the next most common genera in western MA were *Quercus* (14%) and *Fraxinus* (12%). In Baltimore, there were more trees in smaller diameter classes (<30 cm), and, in western MA, more trees in larger diameter classes (>40 cm) (Fig. 2).

In Baltimore ($n = 678$), 90% and 10% of trees were in areas of frequent and occasional use, respectively. In contrast, in western MA ($n = 451$), 86% and 14% of trees were in areas of infrequent and occasional use, respectively. This reflects the more densely populated urban nature of the Baltimore site as well as differences in study design.

In Baltimore, 72% of individuals had no visible defects, and the likelihood of failure was moderate or low for 22% of individuals. Only 6% of individuals had a high or very high likelihood of failure (Fig. 3). In western MA, 30% of individuals had no visible defects, 53% of individuals had a low or moderate likelihood of failure, and 16% of individuals had a high or very high likelihood of failure (Fig. 3). In Baltimore, mean DBH of trees without a visible defect was less than other trees, except trees with a very high likelihood of failure (Fig. 4). In western MA, DBH of trees without a visible defect was less than other trees, and DBH of trees with a very high likelihood of failure was greater than other trees (Fig. 4).

The most common defect in Baltimore (47% of individuals) and western MA (82% of individuals) was a dead branch(es) (Fig. 5). Decay (in trunk or branches) and weakly attached branches (including co-dominant stems) made up 13% and 3% of defects in Baltimore and western MA, respectively (Fig. 5). In Baltimore, several other defects were observed, including poor crown architecture (e.g.,

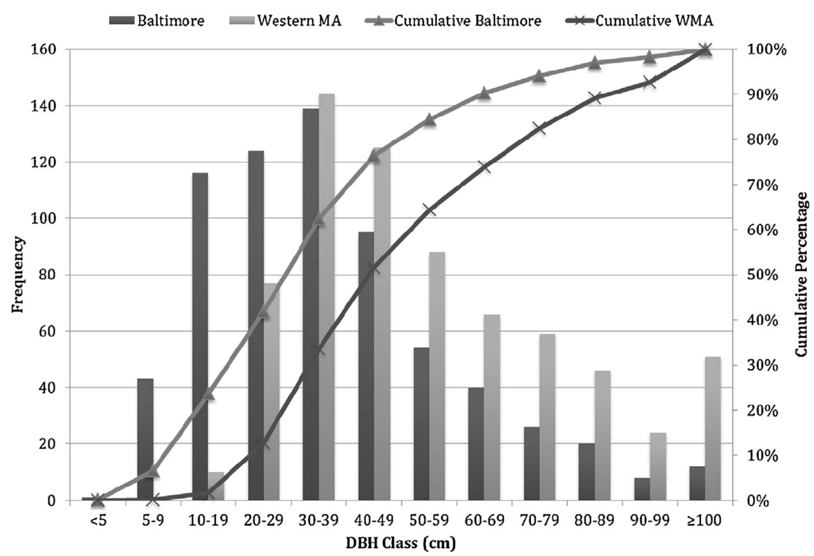

Fig. 2. Frequency distribution of DBH classes of trees in Baltimore ($n = 678$) and western MA ($n = 691$).

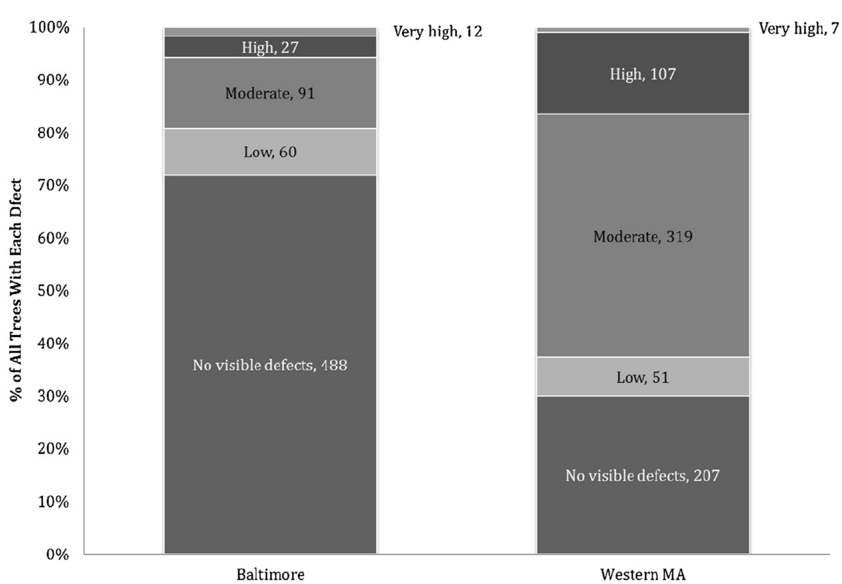

Fig. 3. Frequency distribution of the likelihood of failure of trees in Baltimore ($n = 678$) and Western MA ($n = 691$). Shaded areas in each column are labeled with the level of defect and count; the *y*-axis indicates the percentage of all trees in each defect category in each site.

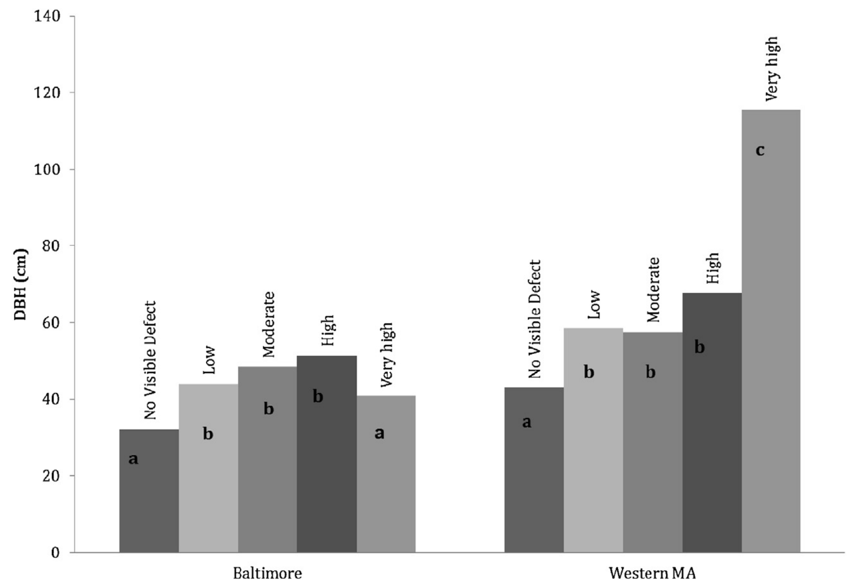

Fig. 4. Mean DBH of trees in each level of likelihood of failure. Within each site, columns marked with the same letter are not significantly different ($p > 0.05$) by Tukey's Honestly Significant Difference test.

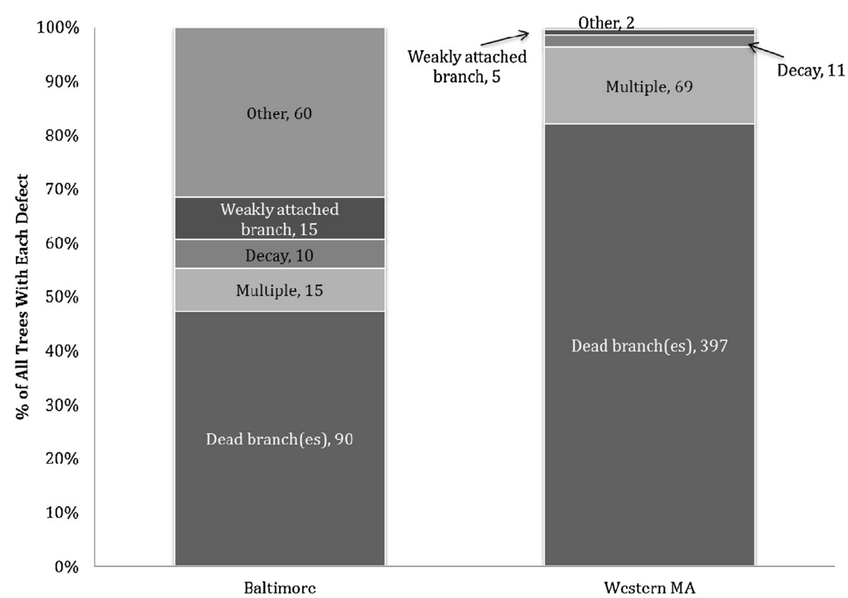

Fig. 5. Frequency distribution of defects identified on trees. Shaded areas in each column are labeled with the defect and count; the *y*-axis indicates the percentage of all trees with a defect in Baltimore ($n = 190$) and western MA ($n = 484$). Defects with too few individuals to categorize separately are described in the text and included in the category, "Other." For clarity, we did not include trees with no visible defects.

crown asymmetry, leaning tree), topped trees, and root defects (e.g., girdling or severed roots). In Baltimore and western MA, multiple defects were observed on 2% and 10%, respectively, of trees. In both sites, the most common combination of defects was the presence of decayed and dead branches. The odds of a dead branch(es) occurring increased by 2.5% for each cm increase in DBH in Baltimore [Wald $\chi^2 = 16.7$, df = 1, $p < 0.0001$)] and 3.4% in western MA [Wald $\chi^2 = 14.7$, df = 1, $p = 0.0001$)]. In Baltimore, the increased odds did not vary among species, but in western MA, with each cm increase in DBH, the odds of a dead branch(es) occurring decreased by 2.6% for *Acer platanoides* (Wald $\chi^2 = 4.83$, df = 1, $p = 0.0279$) and increased by 7.6% for *Acer saccharum* (Wald $\chi^2 = 8.09$, df = 1, $p = 0.0044$) (Fig. 6).

In both sites, most defective parts were between 10 and 51 cm in diameter (Fig. 7). The distribution of remaining individuals was different for each site: In Baltimore, there were more defective parts less than 10 cm in diameter; in western MA, there were more defective parts greater than 51 cm in diameter (Fig. 7). In both sites, the distribution of size of defective part varied among categories of likelihood of failure (Fig. 8). In Baltimore, the frequency of defective parts < 10 cm in diameter was greatest in trees with a low likelihood of failure, less in trees with a moderate likelihood of failure, and least in trees with a high or very high likelihood of failure, while the opposite trend was true for defective parts ≥10 cm in diameter ($\chi^2 = 46.7$, df = 6, Fisher's Exact $p < 0.0001$). In western MA, for trees with a low or moderate likelihood of failure, the majority of defective parts were between 10 and 51 cm in diameter, but in trees with a high or very high likelihood of failure, the proportion of defective parts between 10 and 51 cm in diameter was smaller ($\chi^2 = 45.7$, df = 6, Fisher's Exact $p < 0.0001$).

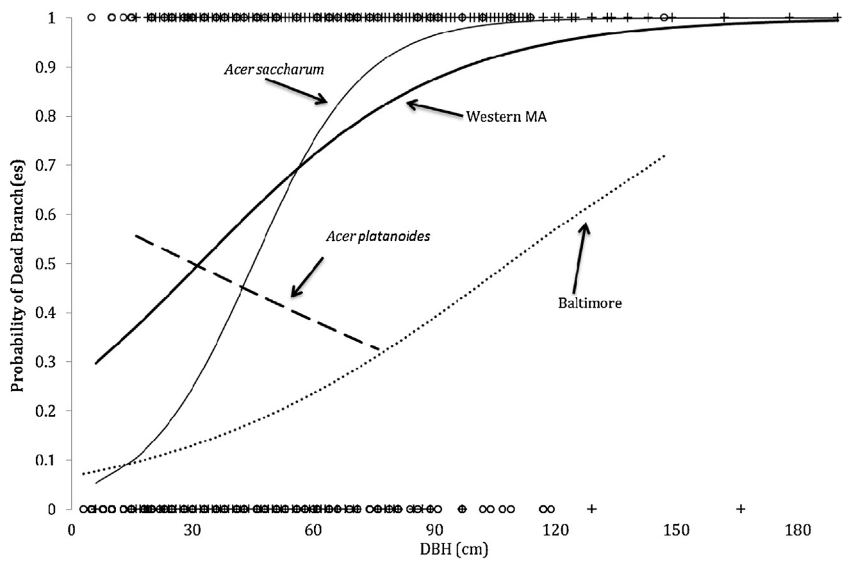

Fig. 6. Modeled probability of the occurrence of a dead branch(es) on trees (0 indicates absence, 1 indicates presence). "+" and "○" represent individual trees in Baltimore ($n = 578$) and western MA ($n = 603$), respectively. In Baltimore, the probability (dotted line) increased with DBH and did not vary among species. In western MA, the probability for all species (heavy solid line) increased with DBH; it increased at a greater rate for *Acer saccharum* (thin solid line), and decreased with DBH for *Acer platanoides* (dashed line).

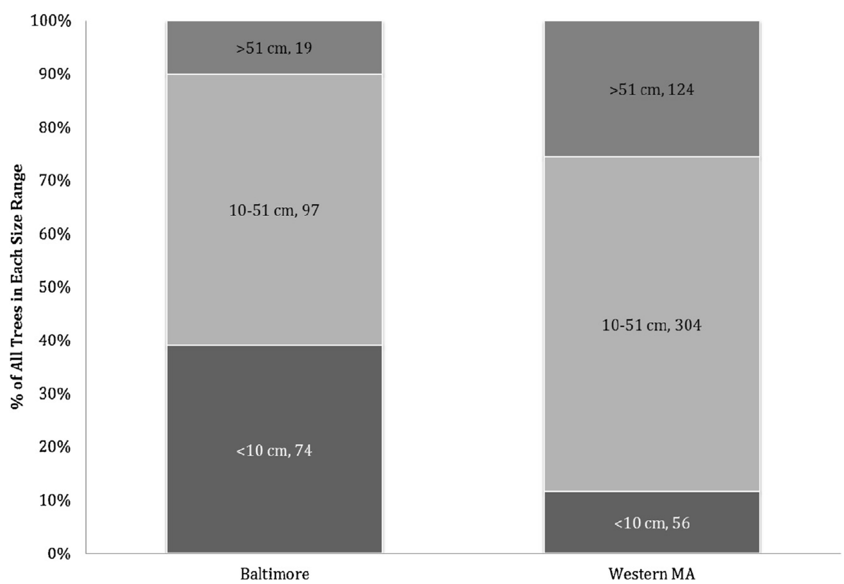

Fig. 7. Frequency distribution of the size of defective part of trees in Baltimore ($n = 190$) and Western MA ($n = 484$). Shaded areas in each column are labeled with the size range and count; the *y*-axis indicates the percentage of all trees in each size range for each site. For clarity, trees with no visible defects were not included.

Most trees in Baltimore presented insignificant risk because there were no visible defects, and less than 2% had a high degree of risk (Fig. 9). In western MA, more trees had low or moderate risk than no visible defects, and there were no trees with high risk (Fig. 9). In western MA, the most common management option to mitigate risk was pruning (72%), followed by pruning and cabling (in the case of weakly attached branches) (13%) and removal of whole trees (11%) (Fig. 10).

3.2. Pairs of trees

Of 376 nest and paired trees in Western MA, we observed at least 1 cavity excavated by a bird on 246 trees ("cavity tree"). Cavity trees had a greater likelihood of failure than trees without a cavity ($\chi^2 = 64.4$, df = 3, Fisher's Exact $p < 0.0001$) (Fig. 11).

For cavity trees, the mean percentage of an individual crown that was dead was 52%, which was significantly greater than the mean for trees without a cavity (25%; $t = 6.56$, df = 374, $p < 0.0001$). Consistent with this finding, tree removal was a more common option to reduce the likelihood of failure of cavity trees, while pruning was the most common option for trees without a cavity ($\chi^2 = 28.8$, df = 3, Fisher's Exact $p < 0.0001$) (Fig. 12). Other options to reduce the likelihood of failure included cabling co-dominant stems and monitoring decayed parts of trees. Of 111 cavities on branches, 25% of them were located within the proximal 37% of total branch length, and 50% were located within the proximal 63% of total branch length.

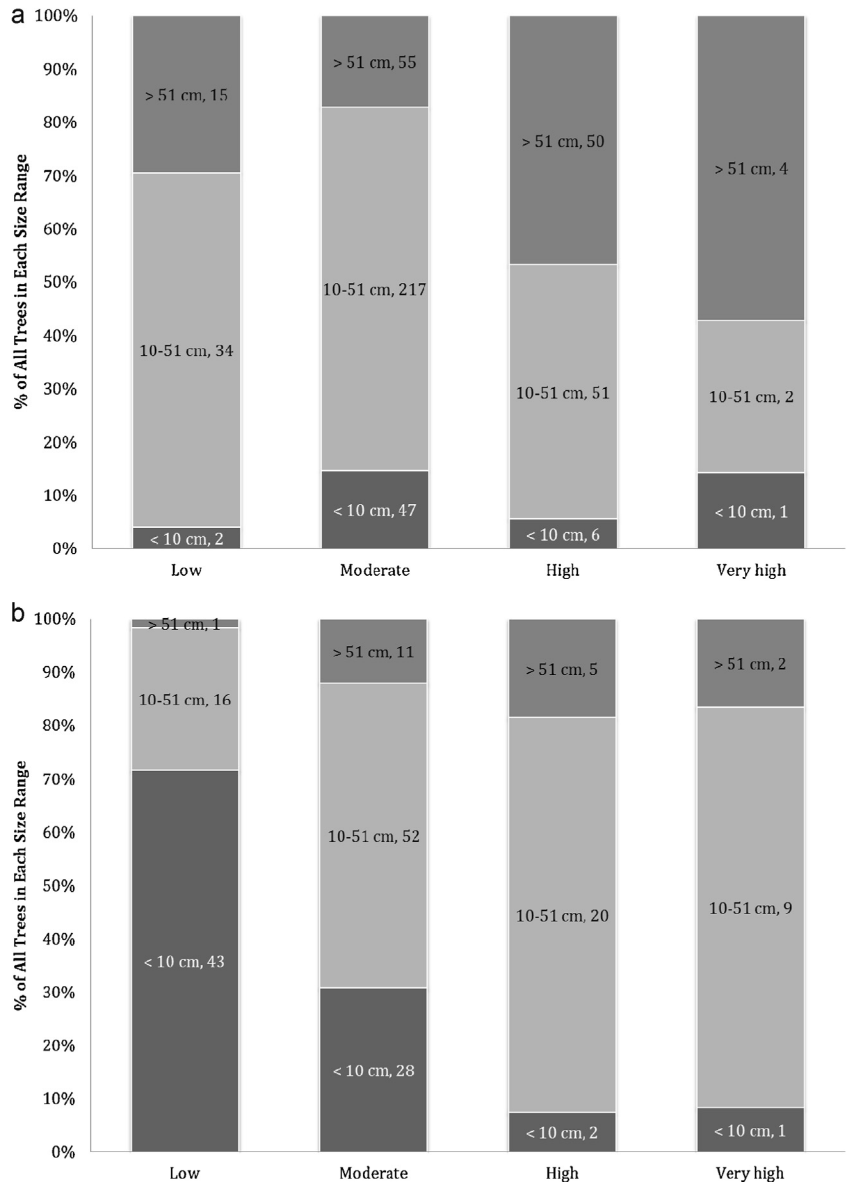

Fig. 8. Frequency distribution of the size of a defective part with respect to the likelihood of failure of trees in (a) Baltimore ($n = 190$) and (b) western MA ($n = 484$). Shaded areas in each column are labeled with the size range and count; the *y*-axis indicates the percentage of all trees in each size range for likelihood of failure category. For clarity, trees with no visible defects were not included, nor were trees in western MA that were on restricted access roads.

4. Discussion

Our data provide an overview of tree risk assessment and mitigation, and a baseline understanding of risk parameters for common street trees in the Northeast and Mid-Atlantic regions of the United States. We have also provided insight into whether a balance can be struck between the degree and mitigation of tree risk and provision of wildlife habitat, an important component of urban ecosystems (Pickett et al., 2011). Our limited sample size precluded a more thorough analysis of the effect of species. Since the probability of a dead branch(es) with respect to DBH differed among species in western MA, future work should more intensively measure particular species. Previous studies that have taken this approach are based on uncontrolled observations (Edberg et al., 1994; Edberg and Berry, 1999). While helpful, guidelines based on experience do not always align with empirical data [see, for example, Nowak's (1990) data regarding maintenance needs]. Another limitation of our work concerns different individuals assessing trees in each site. Although both individuals are Certified Arborists with experience using the Risk Tree Evaluation Inspection Form (Albers et al., 2003), we did not measure inter-rater reliability. Recognizing this limitation, we did not test for differences between sites. Acknowledging the limitation, we draw attention to interesting qualitative comparisons between Baltimore and western MA in the following discussion.

4.1. Transect trees

In both sites, the small percentage of trees with a high or very high likelihood of failure presumably reflected adequate management. Municipal arborists are well aware of the importance of managing and mitigating tree risk (Rines et al., 2010), and risk rating is a common parameter in tree inventories (Östberg et al., 2013). In Baltimore, the high percentage of trees without a visible defect was likely due to the fact that nearly all trees were in areas of frequent use. Such trees remain a higher priority to maintain, and it is possible to identify trees with a high likelihood of failure using efficient, drive-by surveys (Rooney et al., 2005). The finding that almost half of trees in western MA had a moderate likelihood of

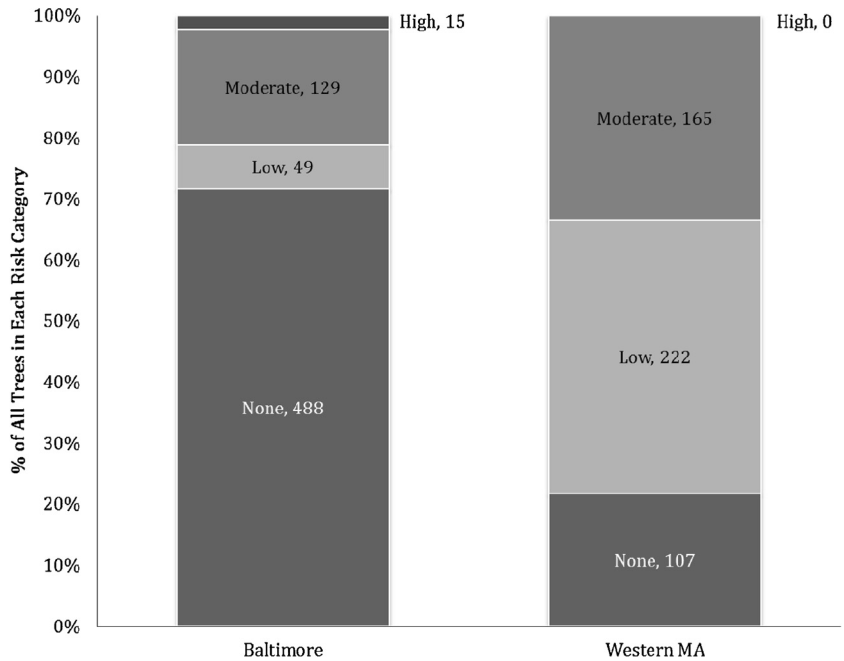

Fig. 9. Frequency distribution of risk rating of trees in Baltimore ($n = 678$) and western MA ($n = 494$). Shaded areas in each column are labeled with the risk rating and count; the *y*-axis indicates the percentage of all trees in each risk rating category in each site. Trees in western MA that were on restricted access roads were not included.

failure and 16% had a high or very high likelihood of failure squares with the observations in Baltimore because trees in western MA were all growing in areas of infrequent or occasional use. There was no need to prioritize maintenance, as reflected in the absence of any trees with a high risk rating – despite the number of trees with a high or very high likelihood of failure and the frequency of larger defective parts in such trees. These findings, as well as others – in Baltimore, the small percentage of (i) trees presenting high risk and (ii) large defective parts in trees with a high or very high likelihood of failure; and, in western MA, the small percentage of removals—indicate that municipal arborists in both sites appreciate the importance of considering all of the risk parameters and prioritizing maintenance in areas of frequent use or where risk is greatest. The small percentage of trees presenting high risk in Baltimore was consistent with studies in other large cities where targets are frequent: heritage trees in Hong Kong (Jim and Zhang, 2013) and street trees in Kuala Lumpur, Malaysia (Sreetheran et al., 2011) and Tehran, Iran (Pourhashemi et al., 2012).

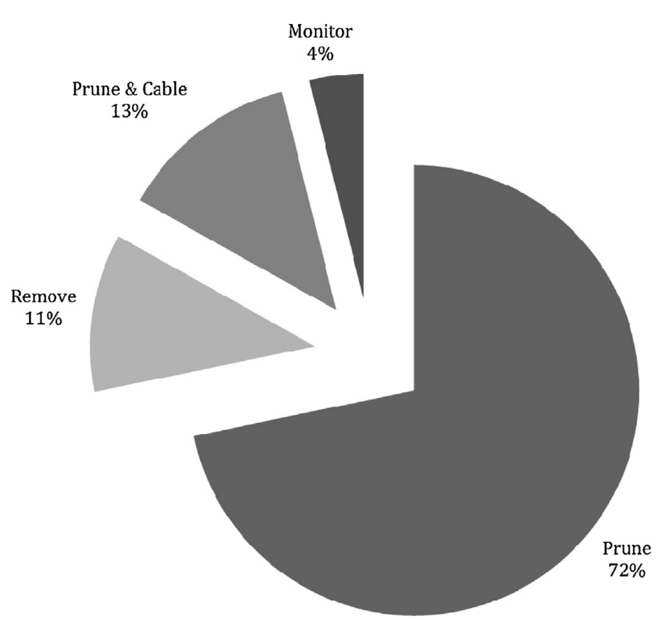

Fig. 10. Frequency distribution of mitigation options for trees in western MA ($n = 308$). Trees with no visible defect are not included.

The common occurrence of dead branches in both sites was consistent with previous studies (Sreetheran et al., 2011; Pourhashemi et al., 2012), and aligns with the frequency with which pruning was recommended to mitigate risk in western MA. The less frequent occurrence of dead branches in Baltimore may have been due to the greater proportion of smaller trees since, in both sites, dead branches occurred more frequently as DBH increased (with the exception of *A. platanoides* in western MA). This was consistent with Nowak's (1990) assessment of management needs in several cities in the United States. In contrast, dead branches were uncommon on (mostly large) heritage trees in Hong Kong (Jim and Zhang, 2013), but this may have reflected more intensive maintenance given their heritage status. In western MA, the greater odds of a dead branch(es) for the same diameter of *A. saccharum* may have been associated with de-icing road salt, which in winter is commonly applied in western MA, and of which *A. saccharum* is intolerant (Westing, 1966). It was unclear why the odds of a dead branch(es) decreased with increasing DBH for *A. platanoides*, an observation that contradicted Nowak's (1990) results, but it may have been an artifact of the small sample size for that species ($n = 24$).

The comparatively infrequent occurrence of decay in both sites was consistent with previous surveys of street trees (Sreetheran et al., 2011; Pourhashemi et al., 2012). Although Luley et al. (2009) found a greater incidence of decay in street trees, they measured decay internally. Luley et al.'s (2009) finding that less than five percent of street trees with severe decay in four cities squares with the infrequent assessment of decay as a structurally significant defect in Baltimore and western MA.

Differences between sites with respect to the frequency of use may also explain why in Baltimore (i) we observed a greater diversity of species and (ii) there were more trees in smaller diameter classes than in western MA. In Baltimore, all trees were planted

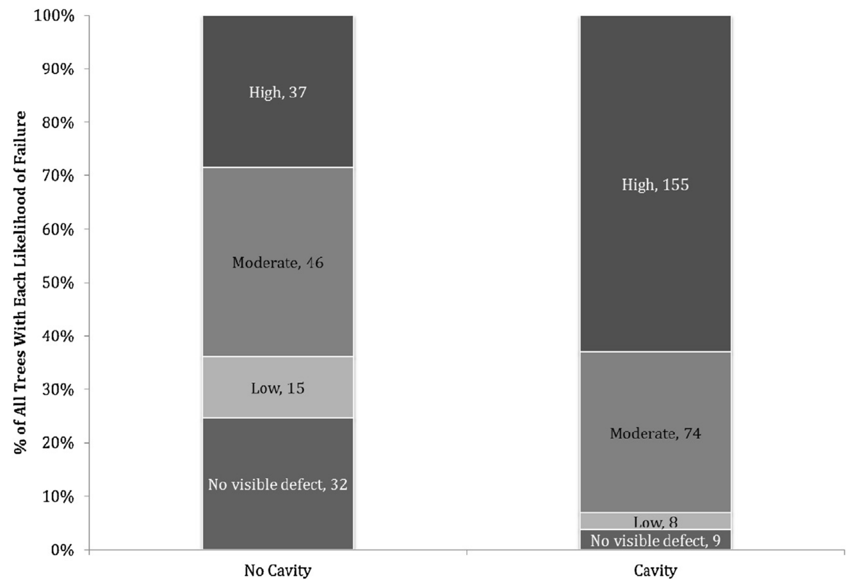

Fig. 11. Frequency distribution of the likelihood of failure for trees in Western MA with ($n = 246$) and without cavities ($n = 130$). Shaded areas in each column are labeled with the risk rating and count; the *y*-axis indicates the percentage of all trees in each risk rating category.

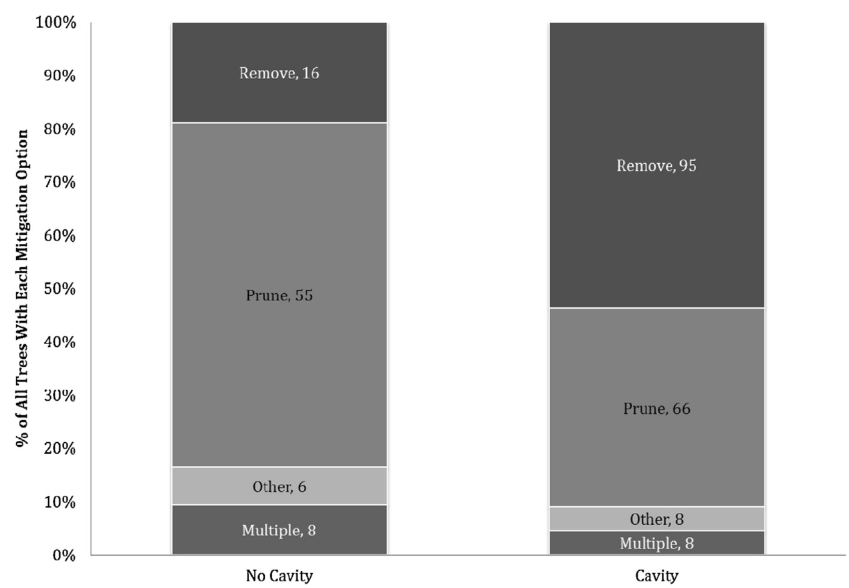

Fig. 12. Frequency distribution of options to mitigate risk for trees in Western MA with ($n = 177$) and without ($n = 85$) cavities. Shaded areas in each column are labeled with the mitigation option and count; the *y*-axis indicates the percentage of all trees in each mitigation option category.

street trees (which may explain the more frequent observation of root defects than in western MA), while in western MA, most trees were naturally growing along suburban and rural roads.

4.2. Cavity trees

We expected that more cavity trees would have a high likelihood of failure than paired trees because of the greater percentage of dead crown in cavity trees. Both of these findings were consistent with the more frequent prescriptions to mitigate risk for cavity trees (removal) and paired trees (pruning). Cavity-nesting birds commonly use dead and decayed branches (DeGraaf and Shigo, 1985), thus raising the challenge of balancing the provision of wildlife habitat with the mitigation of risk. In areas of frequent use, risk mitigation must take priority, especially in light of concerns about litigation associated with injury or property damage (Mortimer and Kane, 2004). However, since almost half of the cavities we observed occurred on branches, whole tree removal was only recommended a little more than half the time. Removing fewer trees offers the possibility of retaining habitat for cavity-nesting birds if pruning can reduce risk. Pruning may be a viable alternative in areas of infrequent or occasional use, but conventional practice would have to be modified.

Pruning dead branches ordinarily removes the entire branch – rather than leaving a stub – to facilitate the occlusion of wounds. However, removing an entire branch removes sites for cavity nests, which may adversely affect wildlife in urban and suburban areas (Blewett and Marzluff, 2005; Morrison and Chapman, 2005). Some cavity nests occurred within the proximal 40% of branch length, and if cavity-nesting birds can use short branches or stubs for nests, future studies should consider the effect of pruning only the distal portion of branches. Shortening branches reduces the wind-induced bending moment (Smiley and Kane, 2006; Pavlis et al., 2008) as well as the moment due to self-weight; it also increases oscillation frequency of a tree (Kane and James, 2011). Both of these consequences reduce the likelihood of tree failure. However, substantially shortening branches (leaving stubs) may facilitate trunk decay and reduce mass damping, which can increase the likelihood of failure of the tree. A clearer understanding of the effect of pruning on the likelihood of failure is necessary. Whether wildlife will utilize partial branches or long stubs on trees growing in urban and suburban areas, or whether they simply prefer the proximal portion of entire branches, must also be investigated.

Acknowledgments

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