Risk Trees and Cavity-Nesting Birds

By Brian Kane, P. Warren, and Susannah Lerman

Trees growing in towns and cities provide many benefits, such as reducing air and water pollution, shading and cooling buildings (which reduces the need for air conditioning), and screening unsightly views. Trees also provide habitat for wildlife, including herptiles, mammals, and birds. *Habitat* includes places to forage, nest, and roost, all of which trees can provide.

A surprising number of bird species live in towns and cities, including a dozen or more species that nest in cavities in tree trunks and branches. Depending on the tree species and growing conditions—including which species of fungi are prevalent—cavities may form when trunks or branches are damaged by storms or human action, such as pruning (especially when poor cuts are made to remove branches) or accidental contact (as when a vehicle collides with a tree). Many species of birds and mammals use such "naturally formed" cavities for nests or roosts, but not all of these animals are common in towns and cities.

Other bird species only rarely use naturally formed cavities for nesting or roosting, preferring instead to excavate cavities in dead or decayed tissue. These species are known as primary excavators, and include many species of woodpeckers, as well as other species like nuthatches. Nests excavated by primary excavators typically appear as a small circular hole in dead or decayed branches and trunks; the diameter of the hole is proportional to the size of the primary excavator. Inside the branch or trunk, the cavity is much larger than one might imagine from the size of the entrance hole.

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Yellow-bellied sapsuckers are primary excavators.

Although some bird species that are cavity nesters can successfully breed in more urbanized areas, the abundance of many species declines as urbanization increases. Providing greater habitat for cavity-nesting birds could involve retaining entire or parts of dead and decaying branches. This presents a challenge, however, because it is precisely these branches that may have a greater likelihood of failure, which increases risk when targets are present.

Likelihood of failure is governed by the applied load and the capacity of the tree (branch, trunk or roots) to endure loads. When the applied load exceeds the tree's capacity, it will fail. Dead and decayed wood has less capacity than sound wood, but if the load is reduced (for example, if there are no leaves on a dead branch or tree), the likelihood of failure may not be dramatically greater.

Identifying and Calculating Tree Risk

To investigate how often cavity-nesting birds use dead and decayed branches and trunks in towns and cities, we searched street and park trees in several neighborhoods in the Connecticut River Valley region of western Massachusetts, U.S. We found 188 trees with a cavity excavated on a dead or decayed branch or trunk. For each tree with a cavity, we randomly picked a nearby tree of the same size and species. We then assessed the risk associated with each tree using the Municipal Evaluation Sheet from the USDA Forest Service Northeast Area's Risk Tree Evaluation Inspection Form (Albers et al. 2003). [We used this form rather than following the current BMPs for tree risk assessment (Smiley et al. 2011) because we assessed tree risk before the BMPs were published.]

For each tree, we assessed the likelihood of failure, size of defective part, and likelihood of target impact. We assigned numerical scores for each category. Scores were 1–3 for size of defective part and likelihood of target impact. For likelihood of failure, the Municipal Evaluation Sheet includes scores of 1–4, but we added a score of 0 for trees without a visible defect, since we randomly selected half of the trees and not all of them had visible defects.

Excluding trees with no visible defect, we considered trees with a total score between 3 and 5 to be "low" risk, trees with a score between 6 and 8 were a "moderate" risk, and trees with a score between 9 and 10 were "high" risk.


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Juvenile saw-whet owl peeking out of a cavity. Some owls use cavities for breeding.

We also recorded what the defect was (decay, dead branch, weakly attached branch, etc.), what corrective actions could be taken to reduce risk (prune, remove, cable, move target, etc.), and the approximate percentage of the tree's crown that was dead.

Of 376 trees that we measured, we observed a cavity excavated by a bird on 246 trees (65%). As expected, a much greater proportion of trees without a cavity had no visible defect (25% compared to 4%). By contrast, trees with a cavity were more often assessed as having high risk (63% compared to 28%). We also observed a greater percentage of dead crown (52%) on trees with a cavity than those without a cavity (25%). Consistent with all of these results, the most common corrective action identified for trees without a cavity was pruning (65%); but for trees with a cavity, removal was the most common corrective action (54%)—pruning was recommended for 37% of the cavity trees. Of cavities on branches, one-quarter were located within the basal 40% of the length of the branch (i.e., closer to the trunk).

The Challenge of Corrective Action

Assessing risk is complicated, and both Part 9 of the ANSI A300 Standard and ISA's BMPs for tree risk assessment are critical to understanding the process. As these references (and others) emphasize, assessors should take care to preserve trees if at all possible, to allow them to continue to provide benefits. In some cases, removal will be the only option, but it is important to consider alternatives where possible.

Our results highlight this challenge, since trees with cavities (presumably used by cavity-nesting birds—but we did not confirm this) had overall a greater likelihood of failure, a greater percentage of dead crown, and were more often recommended for removal. However, nearly half of the cavities we observed were on branches (which is in part why removal was recommended for only 52% of cavity trees), and pruning was the recommended corrective action more than one-third of the time. Conventional pruning, which uses branch-collar cuts (or natural target pruning), however, would still eliminate possible


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Pileated woodpecker—a primary excavator—outside of a large cavity.

sites for cavity nests, so an alternative would be necessary to promote bird habitat.

More research is needed to determine whether pruning only part of a branch would affect 1) the likelihood of failure (in both the short- and long-term), and 2) the likelihood of primary excavators making cavities in the remaining, partially pruned branch. In areas of infrequent or occasional use, where the likelihood of impact is low or very low, a modified type of pruning might be a viable alternative to removal, even for trees with a large percentage of dead crown.

Regarding cavity excavations on branches, we still do not know enough about exactly the types of branches that primary excavators prefer. For example, is there a minimum (or maximum) branch length or diameter and does it vary among species—both tree and bird? Is there a certain branch height that is more promising for primary excavators? Primary excavators vary quite widely in size (pileated woodpeckers are crow-sized, but downy woodpeckers are only a little bigger than chickadees), and while larger birds obviously need larger branches or trunks to excavate a nest cavity, it is not clear that smaller birds only use smaller diameter branches or trunks.

Another important question is whether there's an optimal point—lengthwise—at which primary excavators prefer to make cavities. Is it an absolute value [say, three feet (0.9 m) away from the trunk] or a percentage of the total branch length (25% or 50% of the length)? If branch length could be reduced by one-half or two-thirds, then its weight, the weight of accumulated precipitation, and drag would all be noticeably reduced. The reduced load might be enough to compensate for the reduced load-bearing capacity because of decay. For some tree species—especially those prone to dropping branches shortly after they die—partial pruning would not be advisable, despite the reduced loads. But for other species that tend to retain dead branches for a longer time, partial pruning might reduce the likelihood of failure enough, while preserving viable sites for primary excavators to make cavities. These and many other unanswered questions increase the uncertainty associated with deciding whether a partial pruning program might be a worthwhile alternative to tree removal.

Of course, undertaking a partial pruning program to reduce risk, and presumably, to retain habitat, would also

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require regular inspection to assess the ongoing reduction in load-bearing capacity of a dead, dying, or decayed tree or branch. In the long-term, leaving stubs increases the odds that decay will spread into the trunk. The rate at which this occurs for different species and growing conditions is important to understand, too. Furthermore, undertaking such a program indicates that the risk assessor is confident that the partial pruning has adequately reduced risk to the tree owner's risk tolerance. These issues also must be considered and clearly communicated to tree owners so that informed decisions about risk and wildlife habitat can be made.

Overall, our work demonstrates an association between cavity-nesting birds and risk trees. Despite the remaining uncertainties, it highlights the potential for coexistence in cities between human residents and cavity-nesting birds, like woodpeckers.

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Spotlight on: El Mirador de la Palmera

By Dina Mysko

In 2012, the Valencian government declared a six-stemmed landmark palm in Daya Vieja, Spain, a monument. Following the collapse of another multi-stemmed palm in the town, architect Joaquín Alvado Bañón conceived "Variation Guggenheim 3: El Mirador de la Palmera" or "Viewpoint from the Palm Grove."

El Mirador de la Palmera is a dual-purpose structure aimed at supporting the palm tree from wind load and enabling local residents and visitors to view the surrounding, Daya Vieja area, via its three-story spiral walkway.


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The 210+ year-old palm is a variety of *Phoenix dactylifera* (date palm) with a spread almost matching its height of 20.5 meters (67.26 ft). Alvado Bañón's original concept was to connect the town with the surrounding landscape and its orchards by creating a lookout, allowing people to observe the transition of the seasons, without obscuring the tree. Part of the design process involved implementing ground-penetrating radar to locate and map the palm bulb and root system, and determine a suitable foundation, ensuring the roots and bulb were protected and the main structure supported.

The engineering solution incorporates a series of concrete, steel-reinforced micropiles topped with a large, elevated, ring-shaped concrete pile cap, designed to minimize root damage. This supports the main structure, a complex network of white tubular steel bars and green steel plates. Altogether, these materials form a double spiral, which wraps around the palm tree and leads pedestrians to an 11-meter (36.1 ft) high viewing platform that oversees the town square and offers a clear view across the southern Costa Blanca.

The main structure of El Mirador de la Palmera acts as a wind break, and also balances momentum and pedestrian loads from the walkway, which is supported by sturdy beams that geometrically mimic trees. The palm receives additional