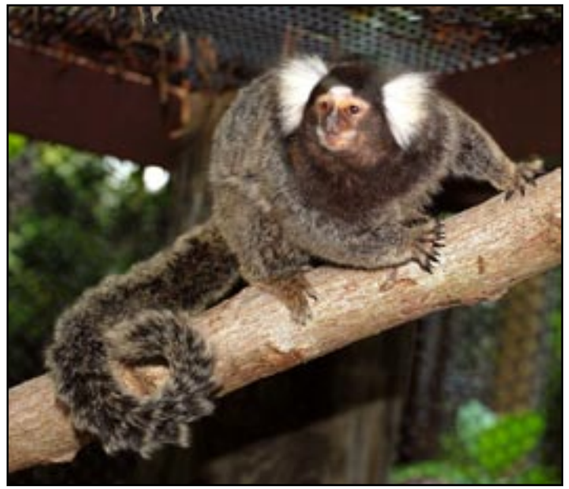
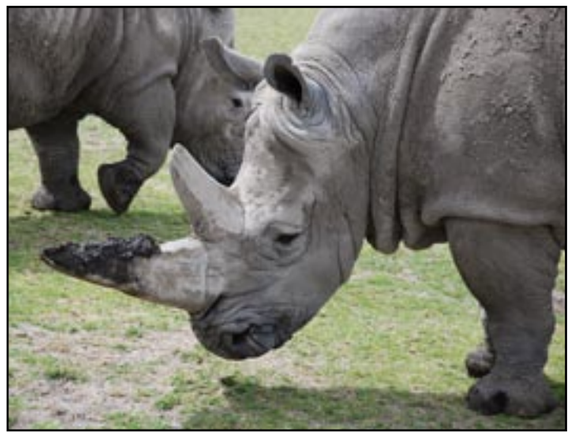
ROUNDTABLE

Special Challenges of Urban Forestry in Zoos

Zoo arborists and municipal arborists share in common the need for high-level communication skills, the pursuit of excellent tree care amid a myriad of environmental stresses, and the ability to perform work safely in sensitive areas. The contributors to this Roundtable are professional members of the Association of Zoological Horticulture (AZH) (www.azh.org).



These common marmosets enjoy destroying trees for their sap. Photo by Jeff Shimonski



A rhino completes his excavation project. Photo by Jeff Shimonski

The life of a tree in the zoo environment can be tough. Thankfully, there are many tools and techniques that can improve and maintain proper tree health. At Naples Zoo (43 acres/17 ha) at Caribbean Gardens in Naples, Florida, we have a unique combination of historical and tropical specimens that tell a story about the property as well as create a lush and beautiful backdrop for the animals and exhibits.

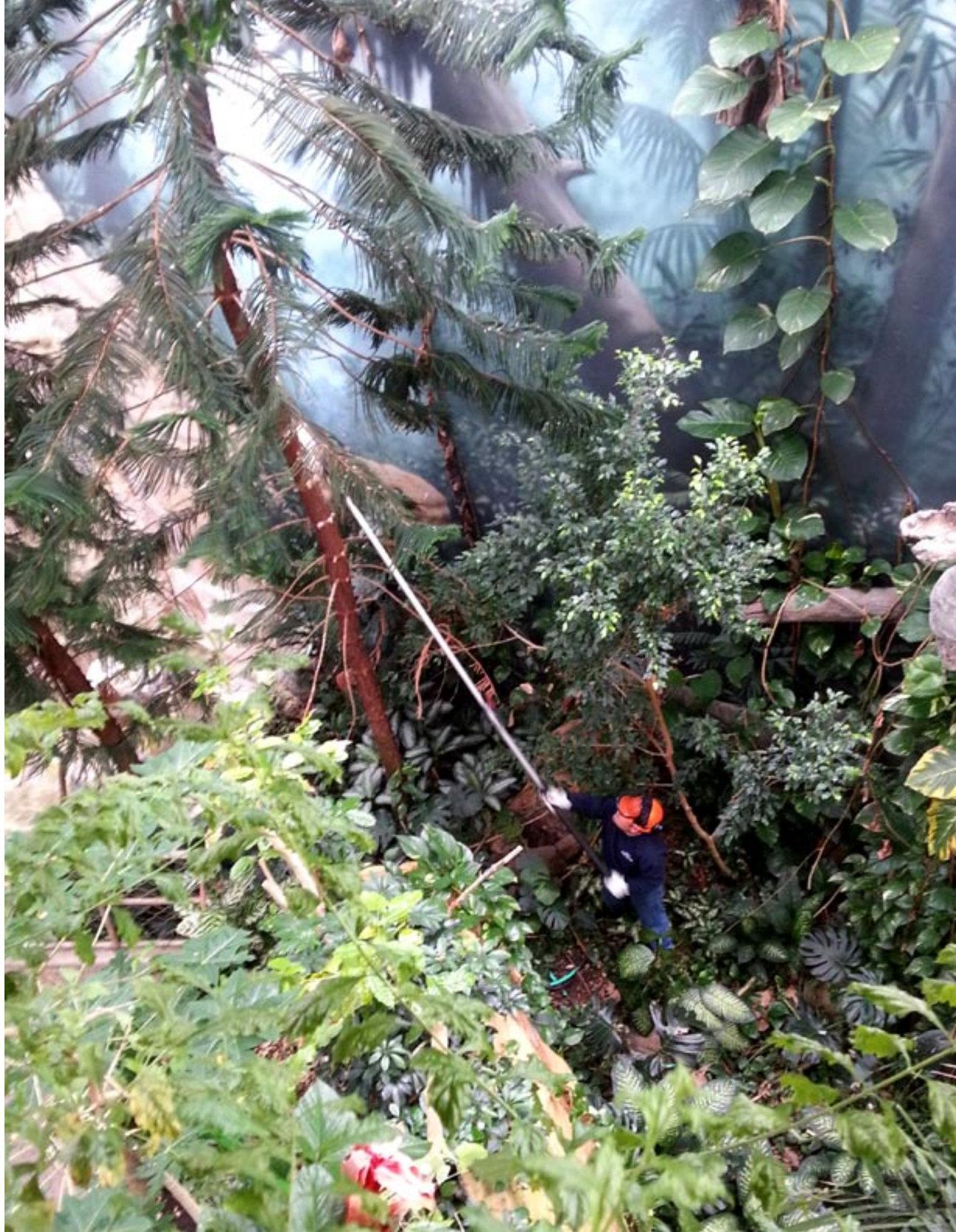
Many of our specimen trees were planted in the early 1900s by Dr. Henry Nehrling and mid-century by Julius Fleischmann. Our climate allows for many species including those in the genera *Ficus, Ceiba, Tectonia, Pterocarpus, Cedrus,* and *Auracaria.* Our trees at the zoo serve many functions: beauty, shade for animals and guests, food for the animals to browse, perching sites for birds, scratching posts for tigers, and "furniture" that encourages animals to explore and be active.

Managing the tree canopy in a zoo environment requires organization and consistent monitoring. Safety of the animal collection and the zoo guests is always a priority. Frequent inspections and documentation serve to ensure specimens are healthy and concerns can be addressed promptly.

Soil compaction is a frequent issue in the zoo environment. Many tree specimens are located between exhibits, adjacent to public pathways and facilities, and within event spaces. This means they are subject to constant foot traffic from guests, staff, and/or animals; construction also compacts the soil. We have used an air-powered excavator at the zoo to reverse soil compaction issues and get fertilization to the root system.

Access to many specimens can be difficult because of adjacent structures such as restrooms, playgrounds, food areas, or animal exhibits. Tree work such as pruning or root therapy requires planning and good communication among horticulture, animal, and operations staff. Animals may need to be off-exhibit and this can negatively impact the guests' experience as they do come to see the animals.

On the plus side, signage and interpretation of the tree work being performed can serve to educate zoo guests and even staff on proper pruning and plant health care techniques and pest and disease control. Signage also educates zoo guests about how some trees provide browse for the animals. **—Danielle L. Green, Director of Gardens & Grounds, Naples Zoo at Caribbean Gardens, Naples, Florida**



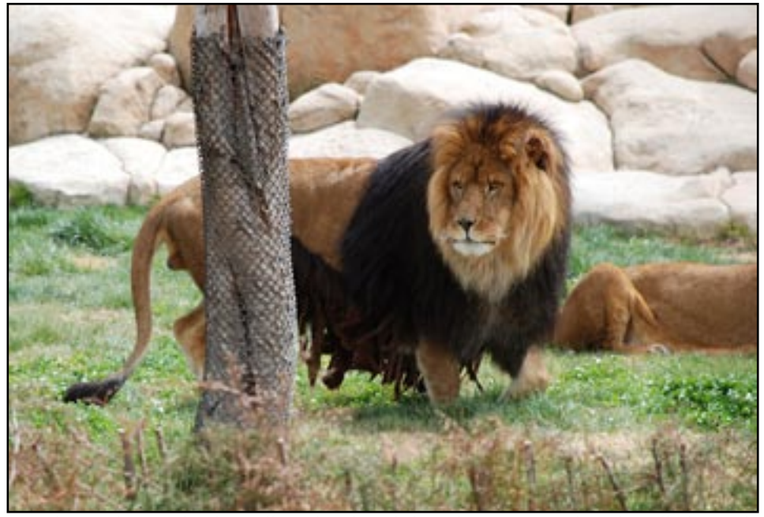
(right) An arborist prunes a tree in the Henry Vilas Zoo Aviary. Photo by Adam Alves

My experiences relating to urban forestry and animals in zoological facilities span almost 40 years and I have dealt with many species of animals, from birds to apes to large cats. Animals can certainly damage and even kill mature trees. When space is limited, as it is in the majority of situations, trees will be destroyed. Designers of zoological facilities must physically exclude the animals from the trees, often via discretely placed and camouflaged electrical wires.

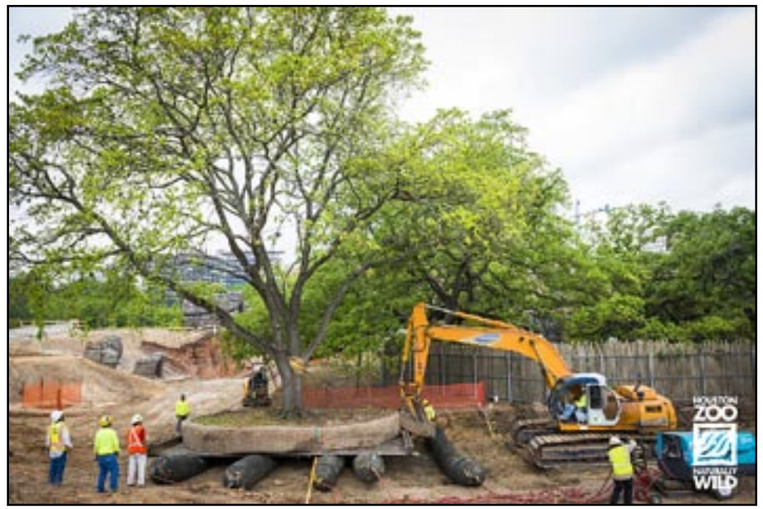
In my first zoological experience, the facility would release a dozen or so pairs of macaws and the occasional cockatoo each morning and bring them back inside to their roosting cages each evening. Pairs of parrots would fly out of the park to avail themselves of whatever neighborhood palms or trees were in fruit, and they "subdivided" the park into territories where they had their favorite perching trees. These parrots could be very destructive. If they decided one day to chew through a 6-inch (15-cm) live oak branch, the humans responsible for the property and lives below that branch had to be really aware.

There is also the fact that trees growing *outside* of an exhibit may eventually be "accessed" by the animals that are the most intelligent. One very windy morning, I saw a young female orangutan climb to the top of a structure within her space in an attempt to reach the fronds of a palm tree. She stood on the top of a 10-inch-wide (25 cm) pole about 25 feet (7.6 m) off the ground and kept trying to grab one of the palm fronds blowing in the wind. I was not only impressed with her concentration and determination but her ability to balance on top of this pole in the high wind.

[Many species of palms evolved in areas that are prone to hurricanes or typhoons, and some of these species are amazingly flexible and resilient. This group of palms that had been planted outside of the exhibit was Winin palm (*Veitchia winin*), a tough species well-suited for windy tropical locations.]



A malagasy lion in Florida scoffs at the chain link trunk protection. Photo by Jeff Shimonski



A massive live oak is transplanted in the Houston Zoo. Photo Courtesy Houston Zoo

The orangutan finally grabbed the end of a frond and pulled the palm closer. She suddenly shot out of the enclosure like a rocket while fortunately maintaining her grip on the palm. It would have been pretty funny except for the fact that a 10-year-old orangutan was now outside of her exhibit. She seemed scared to death and remained clinging to the palm while those of us below figured out what to do. We finally had to dart her and catch her on a blanket, fireman-style, when she fell from her perch. She was not injured, but I had to cut down two of the palms immediately so she would not escape that way again.

When designing and maintaining exhibits, I always had to be aware of trees growing both inside and outside of the exhibits. I have seen trees crush barrier fences and cages when they failed during hurricanes. The urban forester has a very important responsibility in ensuring not only the aesthetics of the exhibit and shelter and shade, but also being aware of the safety of the animals and public during extreme or even not-so-extreme weather events. — **Jeff Shimonski, Consulting Arborist and former Director of Horticulture, Jungle Island, Miami, Florida**

At the Toledo Zoo (51 acres/20 ha), one of the issues we face is how to adequately protect new and existing trees inside animal exhibits. One of the first considerations is what type of animals will be in the exhibit and how they will interact with the plantings. Large animals can damage trees in a number of ways, by climbing, chewing, or rubbing the foliage, bark, or limbs. We use a number of protective measures to ensure the integrity of our trees based on the animals in the exhibit and the type of damage they are likely to do.

With animals such as gorillas that may climb, break limbs, or feed on foliage, our objective is to keep them at a sufficient distance from the tree to avoid such damage. For this we use a type of electrified wire called "hot grass" which is more naturalistic in appearance than a standard two-wire electric fence. We space the hot grass around the trees so the electrified elements provide continuous protection.

Another type of tree protection we've used in an exhibit of mixed African hoof stock is chain link fencing. This was particularly useful for a stand of existing sweet gum trees we left in the exhibit to provide shade to the animals. To protect the sweet gum trunks, we wrapped them with black vinyl coated chain link to a height of about 8 feet (2.4 m) and joined the ends using heavy-duty cable ties. Each year we adjusted the chain link as the trunks grew. These worked well and over time we were able to remove or reduce the amount of chain link on the trees because

A royal poinciana (*Delonix regia*) in a Naples Zoo at Caribbean Gardens playground. Photo by Danielle Green

A council tree (Ficus altissima) with showy aerial roots is a beloved specimen at Naples Zoo at Caribbean Gardens. Photo by Danielle Green

the animals came to ignore the trunks of the trees altogether. **—Alan Donges, Assistant Curator of Horticulture, Toledo Zoo, Ohio**

At Northwest Trek Wildlife Park (*nwtrek.org*) in Eatonville, WA, we have a unique setting for many of our carnivore and herbivore animal exhibits. Our 723-acre (293 ha) park is predominantly covered in 80-plus-year-old Douglas fir (*Pseudotsuga menziesii*) and mixed conifer and deciduous forest. Our animal collection is made up exclusively of species found in the Pacific Northwest and our exhibits are fenced off forest sections that are then augmented exclusively with native flora from the same geographic area. Having established mature trees and other native plant species that are genetically adapted to both the soil and climatic conditions of our region has worked well for us.

Zoo horticulturists and arborists try to protect plant collections or install plants that the animals will not likely damage. Hot wire, hot grass, woody debris, thorny shrubs, and other exclusionary measures are commonly part of the zoo arborist's tools for protection. As a horticulturist, arborist, and general plant lover, my first instinct is to protect trees from damage, but based on known animal behavior and our specific observations, we sometimes take a different tack.

At our Park we want the animals to display natural behaviors for both their health and for the enjoyment of the public. Depending on our understanding of each animal's behavior, we sometimes consider it good for animals to damage trees. For instance, in our grizzly and black bear exhibits and 440-acres (178-ha) of free roaming area, we have Douglas fir that have been scraped and rubbed for as much as thirty years.

Our animal keepers and outside wildlife experts tell us that bears, bison, elk, deer, and many other native species select specific trees

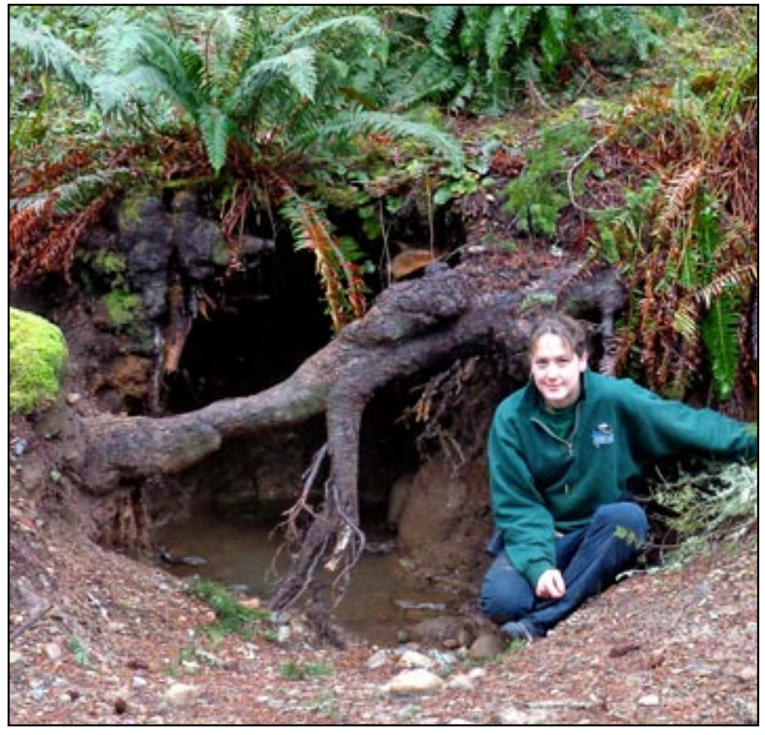
A grizzly bear rubs and scratches a Douglas fir (*Pseudotsuga menziesii*) on its way to enjoying the honey feeder enrichment. Photo by Nathan Andrews

for communication purposes. They mark their territory using scent glands and demonstrate how big they are by the size and height of the scrape they leave on the bark. If I decide to protect that tree, those animals will simply move to a new tree in the exhibit to continue this natural behavior, just as wild animals would in a city park.

Fortunately, Douglas fir is resistant to interior rot and is able to compartmentalize damage effectively for a long period of time, so it can withstand this marking. Other native species such as red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) do not resist interior rot and must be protected or sacrificed for animal enrichment. If the trees do not pose a hazard potential to the public or exterior perimeter fences, we leave those trees unprotected for animal enrichment and for the public to observe natural behavior displays. There is nothing like seeing an 800-lb (363-kg) grizzly bear dig its claws into a tree trunk or a 2000-lb (907-kg) bison bull rub his head with all his might on a favorite exhibit tree.

Grizzly bears do not just scrape and rub trees. Cool fall weather is also the start of denning season. This is harder to tolerate because denning can be lethally disruptive to the root systems of mature trees. We install hot grass as soon as these large dens are found. Some holes we fill by hand, using additional large rocks as infill material to discourage re-digging. When we have access, we use mini excavators and other equipment to fill holes in a timely manner.

Just as bears have favorite communication trees to scrape, certain denning sites are perennial favorites. We apply large woody debris and rocks over the favored locations to discourage the bears from digging; however, it's not always possible to get large enough debris to stop a determined grizzly bear. Usually our exhibits are fixed in size, so excluding entire areas permanently is not always the best option for the bears. In those situations, we use hot wire and hot grass preventively during periods of high denning potential. **—Jake Pool, Horticulturist/Arborist Specialist, Certified Arborist, Northwest Trek Wildlife Park, Eatonville, Washington**



Grizzly bears dug this den under a 30-inch- (76-cm-) DBH Douglas fir (*Pseudotsuga menziesii*) over a period of one to two days. Note the abnormal root growth from repeated denning efforts over the years. Photo by Jake Pool

Visited by 3.5 million visitors annually, the San Diego Zoo (100 acre/40 ha) is well known for its botanical collections and landscaped exhibits. Maintaining trees within exhibits and around public gathering points takes planning and coordination among a variety of staff. Our employees start work around 5:30 a.m. and visitors enter as early as 9:00 a.m., giving us only about three hours to perform regular tree work.

In our zoo many of the popular areas cannot be closed and animals cannot be secured for extended periods of time. In addition, road closures are necessary for things like crane placement to reach into exhibits for planting large boxed trees, but road closures are problematic because they affect deliveries for other department operations. We try to schedule much of this type of work for midweek during winter months that have less attendance.

When exhibits become empty for various reasons, we adjust our seasonal pruning schedules accordingly, as this may be our only chance to have full access to an area without the animals being impacted. For this reason, we make sure to have an existing plan of action that can be launched when the opportunity arises.

Nesting cycles also require there to be no disturbances within the designated area. For example, we need to complete tree work at the flamingo exhibit well before their courtship behavior and nesting cycle starts. In our larger aviaries we need to avoid disturbing nesting birds with eggs or young. Some of our rare bird species are not as predictable as natives; we rely on the aviculturists to let us know what's happening and when we can perform the type of work needed.

Trees in our gorilla exhibit are pruned every year. There are only six trees in it but it takes a week to complete the work, which includes reduction pruning to maintain tree clearance from exhibit perimeters. Each day for our three-hour work window we have all the climbers in the trees at once, and extra staff labor is supplied for faster debris haul-out.

We are tasked with melding seasonal pruning cycles with animal reproductive cycles. For instance, an impending panda or polar bear birth can require a zone of silence to minimize stress impact on animals, so the pruning schedule has to be adjusted. Some trees we prune specifically to encourage abundant new growth for animal foraging. Conversely, we occasionally find that we exceed industry pruning guidelines for canopy removal in order to provide adequate solar access for animals within an exhibit. This allows animals to produce vitamin D and can help reduce detrimental soil organisms.

In addition to pruning for tree health, safety, and size control, we prune for seasonal flower display. For instance, we are careful about the pruning schedule for our collection of coral trees (*Erythrina* spp.) from around the world. The largest and showiest members of our coral trees bloom in winter, so we try to complete our artistic reduction pruning at least three to four months before flowering time so new buds will have adequate time to form. **—Dan Simpson, Horticulture Manager and Certified Arborist, San Diego Zoo, San Diego, California**

Founded in 1911, Henry Vilas Zoo in Madison, Wisconsin is a 28-acre (11-ha), admission-free zoo operated by Dane County. When I think of our zoo, I tend to think of opportunities more than challenges. For instance, we are doing some creative urban wood utilization for enrichment of the animals with what would previously be thought of as waste wood. We provide large chunks of oak logs for the rhinos to interact with, platforms for the goats to stand on, hollow logs for the porcupines to traverse, and branches for parrots to perch on. We even save the invasive mulberry brush cut from throughout the County parks as a dietary additive for the giraffes. The animal keepers are extremely imaginative in their applications for reusing all parts of a tree.

We have American bison that love rubbing up against and trampling the honey locust trees in their enclosure. For the trees that were damaged beyond saving, we removed their crowns to limit any hazard, leaving trunks to provide an opportunity for animal enrichment. The remaining honey locusts had a natural, aesthetically pleasing boulder wall built around them to separate them from the animals.

With the large cats we need to be mindful of their climbing abilities so they don't get up and out of their enclosures. We keep trees limbed up high and away from the perimeter of the enclosure. We check in regularly with zoo staff to understand the abilities of the animals so we can make sure we are maintaining enough clearance. We also have to prune trees outside the enclosures to ensure no humans enter the exhibits by climbing trees!

Henry Vilas Zoo has a greenhouse/aviary with trees needing attention. Working with trees indoors and in 80-degree-plus temperatures can be quite nice during the long cold Wisconsin winters. Trees can only grow so tall before they run out of room, so it's extra important to have the right trees in the right place. The trees in the greenhouse/aviary also get intensive pruning at least once a year. Among them are Norfolk island pines, avocado and ficus trees, and palms—presenting a learning curve for arborists trained in the frozen tundra that is Wisconsin.

Black bear claw scrapes on red alder (*Alnus rubra*) trunks are not unlike the graffiti carved into city trees by humans. Photo by Jake Pool

In the aviary we are also mindful not to disturb any nesting that may be going on in the trees or underbrush. The aviary also presents some operational difficulties, as there are little to no drop zones and a number of the trees have limited rooting zones, making some unsafe to climb. Currently we use scaffolding and ladders where necessary; however, for greater efficiency and safety we are in the process of looking at putting a fall arrest system into the ceiling to provide extra tie-in points.

Finally, as Henry Vilas Zoo is one of the largest free zoos in the country, it is a major destination for locals and tourists alike, drawing in nearly a million visitors every year. This presents a prime opportunity to promote our industry and educate the public. For instance, we work with the Zoo every Earth Day to put on a "Kids Climb," which draws thousands of young climbers and their parents and gives us a chance to inform them about Emerald Ash Borer, planting the right tree in the right place, and what an arborist is and when to hire one. There is no other place in our community where we as arboriculture professionals get to interact with the public on this level. That in itself is both a rewarding challenge and an invaluable opportunity. **—Adam Alves, Arborist, Dane County Parks and Land & Water Resources, Henry Vilas Zoo, Madison, Wisconsin**

At the North Carolina Zoological Park (500 acres/202 ha), we have more than 250 different tree species in the collection. Each exhibit has different challenges; for example, in our chimp, gorilla, baboon, and lemur exhibits, we inspect and prune trees not only for safety but to prevent animals from using trees to escape their enclosure.

The trees in these exhibits are all protected with hot wire and hot vine systems to prevent animals from accessing the trees. In the event that an animal does manage to gain tree access, we also have to be aware of the distance these animals could jump, either out of the exhibit or into a tree adjacent to the exhibit boundaries, and we prune accordingly.

We also inspect the perimeter of all exhibits to ensure that any trees that could potentially fall or lose large branches, creating a breach in the containment structures, are removed or trimmed. By either falling into an exhibit or leaning onto boundary structures, these trees could enable animals to climb out.

Good communication among the Arbor staff and those of other sections including animal and horticulture staff allows us to better schedule and prioritize the management of trees in and around the exhibits thus eliminating the potential for animal escapes or containment failures. **—Robert McCrory, Arbor Supervisor, Certified Arborist, North Carolina Zoological Park, Asheboro, North Carolina**

This Douglas fir tree (*Pseudotsuga menziesii*) has been rubbed and scraped by grizzly bears for the last 20 years, resulting in a series of compartmentalization layers. Photo by Jake Pool

Maintaining large specimen trees in an urban forest is difficult under "normal" circumstances, but our work is even more challenging when the residents are gorillas, orangutans, tigers, and the like. When implementing a tree care program for our mature trees here at Zoo Atlanta (40 acres/16 ha), our major considerations are scheduling the work so as not to disrupt our animals or visitors and grappling with design challenges in exhibits that are not conducive to ease of maintenance.

As they are the stars of the show, we try to have our animals on exhibit as much as possible. As the Zoo's attendance slows down in winter, we schedule our larger, more disruptive tree work at that time, when the animals are going to be off-exhibit anyway.

In the late 1980s, Zoo Atlanta went through a renaissance period, transitioning from outdated, concrete-and-cage exhibits to more modern, naturalistic outdoor habitats. The new habitats incorporated existing mature trees but were constructed with little thought to the long-term maintenance of the trees. For instance, maintaining the 20 or so mixed hardwood trees in four of the gorilla and one of the orangutan habitats is a unique challenge because each habitat is surrounded by a 15-foot- (4.6-m-) wide, 15-foot-deep moat.

Zoo Atlanta's tree care regimen includes pruning, root zone therapy, and inspection of tree cabling and lightning protection systems. To get personnel, equipment, and debris into and out of the exhibits requires either building a bridge over the moats, which isn't very practical or safe, or going through a building which houses the animals in their overnight holding areas. The latter is what we usually do. Hauling equipment and debris back and forth through the tight hallways and stairs of the holding building while working around the primate keepers trying to complete their husbandry routines can be stressful on humans and animals alike, and it requires a great deal of flexibility. Zoo Atlanta is fortunate to have a first-class tree care partner in Downey Trees, which has the expertise and flexibility to work around the Zoo's animals, visitors, and schedule. **—Darryl Windham, Horticulture Manager, Zoo Atlanta, Atlanta, Georgia**

As a metropolitan zoo with a finite footprint, one of the challenges we face at The Houston Zoo is trying to ever increase and improve our exhibitory without the ability to add to our acreage (55 acres/22 ha). This involves careful planning and in most cases, redesign and renovation of current areas. Whilst we always endeavour to plan and design new exhibitory around our existing mature trees, with our limited space this is sometimes just not possible.

In these instances, when it involves good specimen trees, transplanting over removal is always our preference. Transplanting enables us to both salvage trees and enhance other locations with the addition of those specimens; we have had much success with and continue to refine this process.

Another unique opportunity for the zoo horticulture team exists with the introduction and planning of new exhibits. Because of several factors such as required shade, viewing angles, animal enrichment and/or aesthetics, we may want to install a mature tree within the new exhibit.

We had just such an occasion in 2013 when the decision was made to move a large live oak (*Quercus virginiana*) from our notable collection of this species. With extreme care, the 60-foot (18 m) specimen was dug then rolled and craned to its new location 300 feet (91 m) away, creating an impressive feature within our new gorilla exhibit. The tree will have two years to re-establish before the animals are introduced in its vicinity prior to the exhibit opening in 2015. It is these types of challenge that make managing the landscape at a facility such as the Houston Zoo such a pleasure.—**Greg Liffen, Head of Horticulture, Houston Zoo, Houston Texas**

Let's Browse

Midwest utility ComEd struck up a unique partnership with Chicago Zoological Society's Brookfield Zoo three years ago, introducing the Browse Program. One of the first of its kind in the country, Browse has since provided fresh tree trimmings as food for the zoo's animals every summer. Each week during the summer months, ComEd makes two deliveries of 20-25 cubic yards (15-19 cubic meters) of browse per truckload.

The browse is from trees that are trimmed along power line corridors throughout the Chicago metropolitan area and is a great source of nutrition (with both gastrointestinal and dental benefits), as well as behavioral enrichment, for giraffes, gorillas, grizzly bears, kangaroos, rhinoceroses, camels, and other species. The zoo's nutritionist has provided ComEd with a list of approved plant and tree species, which includes sugar and silver maple, willow, grapevine, mulberry, box elder, honey locust, and alder.

According to the zoo, having access to a variety of plants and trees supports a more stimulating and changing environment for the animals by allowing them to continuously explore their exhibits. Prior to this program's existence, Brookfield Zoo was limited to finding browse on its own property, and it was often a scarce resource. Preventive pruning around aerial power lines is vital to ComEd's ability to provide reliable electric service and this program puts tree trimmings to good use while providing a valuable food source to living creatures in our community.