

Street Trees—A Misunderstood Common-Pool Resource

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Abstract:

Trees planted along streets have been identified as a desirable public resource due to the measurable ecosystem services they provide. In recent years, communities throughout the United States have sought better means to protect and promote street trees through stronger city tree ordinances, tree care manuals, greenspace plans and public outreach programs. Despite these efforts, significant confusion remains regarding the status of street trees. Ownership and management duties are often unidentified or misunderstood. Ordinances designed to protect street trees as a resource are often difficult to enforce, and monitoring is scarce. In this paper, we view how the confusion regarding street trees may qualify them to be classified as a common-pool resource—subject to tragic outcomes in the absence of proper management. We argue that sound management mechanisms are currently underdeveloped and provide recommendations for how protection could be better promoted.

Keywords: Urban forestry, street trees, tree ordinances, common-pool resources

1. Introduction

Urban deforestation represents a pressing problem across the United States. Recent findings suggest that over the past several decades, tree cover over many urban areas may be decreasing. For instance, tree cover in Washington, DC, has declined by half, and San Diego tree cover has fallen by one quarter. Forest cover over urban areas in Michigan, North Carolina, and Florida urban areas is just 27% of historical totals, while Chicago and Philadelphia have 16% of the tree cover that was once present (Cray 2007). The loss of forests in municipal areas has drawn parallels to the loss of rainforests in other parts of the world and has generated increased calls for better management of urban forest resources.¹

This paper examines one particularly important aspect of urban forests—street trees. Loosely defined as trees lining municipal streets, street trees form an integral part of urban forests. These trees provide a myriad of benefits, including the protection of local watersheds and improvement of storm water management, air pollution reduction, absorption of greenhouse gasses, provision of aesthetic beauty, and reduction in ambient air temperatures by providing shade on asphalt, concrete, and surrounding structures thereby improving energy efficiency for local buildings (see

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³ In making these observations, we in no way wish to assert that street trees and other aspects of the urban forest are uniformly in decline in every municipal setting. We are aware of municipal areas where this is not the case. We are simply pointing to general trends nationwide regarding pressures on street trees and urban forests generally.

generally McPherson et al. 1994). In addition to these ecosystem services, these trees have been further found to lower traffic speeds in residential neighborhoods resulting in safer driving and fewer serious auto accidents (Dumbaugh 2005). Street trees have also been associated with a variety of additional psychosocial benefits that result in reduced crime, higher occupancy and increased foot traffic in commercial areas, and higher property values and reduced turnover in residential areas (Wolf 2005a, 2005b; K. Miller 2007). Lastly, street trees also provide a natural habitat for birds, squirrels, and other urban wildlife.

In perceiving the various benefits of street trees, local communities and/or nongovernmental organizations have become increasingly interested in protecting, conserving, promoting, and even planting street trees. Since the 1970s, thousands of communities have drafted ordinances to protect urban forest resources including street trees. As noted above, despite this interest and attention, data suggests that street trees and other aspects of the urban forest still face threats.

As our title articulates, this paper aims to answer whether street trees are a misunderstood common-pool resource (CPR). The focus of this inquiry is to understand whether resource managers employ appropriate tools for the adequate management of an important urban resource. This general inquiry can be broken into two separate questions: (1) Do characteristics of street trees make them classifiable as CPRs? and (2) Do the street tree management tools encapsulate the nature of the resource sufficiently to effectively meet management goals?

To answer these questions, we provide conceptual definitions of CPRs and street trees. We review the available literature regarding street trees and view how street trees are treated by the public and in urban forestry practice and find compelling reasons to conceptualize street trees as CPRs. Specifically, we argue that street trees and the area they occupy are nonexcludable resources. Yet, they are subtractable in that the trees and the areas where they are planted are subject to a variety of competing uses. We further examine different types of management arrangements and conclude that the management tools may fall short of achieving successful long-term CPR management.

The paper proceeds as follows. In the next section, we define and provide some of the relevant literature regarding CPRs and street trees. In section 3, we examine why the benefits associated with street trees are often public goods, but that the trees themselves and the areas where they are planted are better classified as CPRs. In section 4, we examine common management tools for street trees, and in section 5, we present why those tools may be insufficient to effectively manage a CPR. In section 6, we provide conclusions and recommendations for future research.

2. CPRs and Street Trees

CPRs and street trees have each received a great deal of attention in natural resources, ecology, and policy circles. However, the terms have to date, not been associated with one another. An informal survey of researchers, federal and state urban forestry program coordinators, city foresters, and other urban forestry leaders in the United States has convinced us that the terms street trees and CPRs are not linked in the literature or within the practice of U.S. urban forestry. As a segue into how the concepts of CPRs and street trees may be related, this section provides general

definitions and a review of some of the pertinent literature dealing with each. We begin with CPRs and move on to a discussion of street trees.

2.1. CPRs—Defined and Management Tools Introduced

In defining CPRs, we borrow from Dietz et al. (2002, 18) who state, “a common-pool resource is a valued natural or human made resource or facility that is available to more than one person and subject to degradation as a result of overuse.” In essence, in a CPR setting, it is costly to exclude others from accessing the resource, but “one person’s use of the resource subtracts from what is available to others” (Dietz et al. 2002, 18). Thus, CPRs are characterized by two concepts: nonexcludability and rivalry in consumption.

Several potential problems flow from the nature of CPRs. The first is the potential propensity for overuse. Because individuals are able to gain access to a resource and individually benefit from its use, certain incentives are presented to resource users to appropriate the resources. This may end in tragic outcomes for all resource users as the underlying resource is destroyed through overuse. This outcome was famously described by Hardin (1968) in the context of an open access pasture that would surely be overused as self-interested herdsmen maximized personal gain to the detriment of the natural resource and at the expense of all other herdsmen. Decades of research have confirmed that overuse may indeed occur in CPR settings, and has been manifested through congestion, overharvesting, resource degradation, and even resource destruction (Dietz et al. 2002).

However, the tragic outcomes described by Hardin are by no means a foregone conclusion (Dietz et al. 2002). It is now well understood that “[w]ithout some form of coordination or organization to enable individuals to agree upon, monitor, and sanction patterns of appropriation by individuals from a CPR, the resource will be overused” (Ostrom and Walker 1997, 41). Individuals can and often do collaborate to form institutions whereby resources can be preserved over long time horizons (Ostrom 1990; Agrawal 2001; Baland and Platteau 2000).

This, however, brings up a second complication regarding CPRs. Facilitating coordination and organization is often difficult (Agrawal 2001). Individuals are subject to the “free rider” problem. Many are content to allow others to decide which institutions may be appropriate. Even when institutional choice is undertaken, deciding on which rules should be in place is often difficult, and monitoring and enforcing can be more difficult still (Gibson et al. 2005).

Three management approaches are commonly seen in CPR settings. Each of these is distinct from the open access regime described by Hardin. The management approaches include public property (where government controls access and allocation), private property (where access and allocation rights are held by private parties), and common property (where rules often propagated by local communities establish communal access and allocation rights) (Steins and Edwards 1999).

Regardless of the management approach used to protect CPRs, substantial research has attempted to decipher design principles common to successful CPR management. For the purposes of this paper, we will briefly discuss the design principles established by Ostrom (1990) after extensive investigation and comparison of CPR management. These include: (1) clearly defined boundaries regarding the rights

and duties associated with the resource; (2) congruence between appropriation and provision rules and local conditions; (3) collective-choice arrangements that allow local participation in changing the rules; (4) monitoring that occurs regularly and reliably; (5) graduated sanctions for violations of the rules; (6) conflict-resolution mechanisms; (7) minimal right to organize; and (8) nested arrangements to view provision, monitoring, enforcement, etc.

Finally, in discussing design principles, it is important to note the increasing awareness regarding the role of monitoring and sanctioning in successful CPR management. The existence of institutional structure may not be sufficient for management success. Rather, there must be active attention paid to monitoring and sanctioning of violators of whatever institutional arrangement exists. In support of this, for instance, Gibson et al. (2005) find that monitoring and sanctioning to be more important than other variables frequently associated with successful community forestry management. Similarly, Pagdee et al. (2006) find monitoring and sanctioning to be important attributes of successful community forestry management regimes. In sum, in the absence of effective monitoring and sanctioning, there may be de facto open access regardless of whatever institutional arrangement exists. We will return to these concepts in section 5 below to illustrate how many current management practices for street trees may fall short.

2.2. Street Trees

2.2.1. Street Trees and Tree Spaces Defined and Introduced

Street trees are frequently addressed as an integral part of urban forestry. Despite this, the definition of what is meant by “street tree” is frequently left unstated. Two popular U.S. textbooks for urban forestry (Kuser 2007; R. Miller 1997) discuss street trees, but neither gives a specific definition of what the term means. Most experts appear content that “street trees” is self-defining—trees that are in close proximity to streets (see, for example, Maco and McPherson 2003; Crankshaw 1996; Whitlow et al. 1992). Others have attempted to provide other more formal definitions. For instance, Bolund and Hunhammar (1999, 294) define street trees as “stand alone trees, often surrounded by pavement,” referring to the fact that street trees are frequently planted in the area within the sidewalk (such as a planter space surrounded by concrete), or between the sidewalk and the road. However, this definition may be unreasonably strict in that street trees often grow in areas where no sidewalk exists. Experts generally do not indicate how close a tree must be to the road to be considered a “street tree.” Municipalities often define street trees as those trees growing within the public right of way along public roads. Even this definition may lack clarity as will be seen below.

We offer no uniform solution to defining street tree, but operate on the common implied definition of trees located in close proximity to public streets. We further offer one additional concept. The areas where street trees normally grow will be referred to throughout the paper as “tree spaces” (others refer to these areas as tree lawns). As a simple rule of thumb, tree spaces line all streets in the municipal setting.

2.2.2 Origins of Street Trees

Street trees originate in a variety of ways. In historical context, tree-lined streets were

often a natural outcome as streets were cut through naturally wooded areas. Even for less forested areas, trees in close proximity to streets provide seeds through natural dispersion mechanism that germinated near the street. Natural processes leading to street trees, however, are usually the exception rather than the rule in the current context. Street trees are generally the product of intentional planting. Indeed, such trees have been found to represent a distinct population of trees within the urban forest having less species diversity than the surrounding urban tree populations (see, for example, Welch 1994). Private property owners, neighborhood associations (including homeowner associations), and local “tree” or city beautification groups frequently undertake street tree-planting activities to enhance the aesthetic beauty and property values of an area.

More frequently, street trees have been the result of government interest in city beautification. Government projects pushing for street trees can be dated as far back 1700s in the United States (Gerhold and Frank 2002). Such programs became more widespread by 1900. New York City, for instance, organized the Tenement Shade Tree Committee, whose duties included selection and planting of trees “in the streets” of New York, among other places (Smith 1903). Pittsburg, Pennsylvania, had introduced a Shade Tree Commission in 1910 to allow nature to flourish in the city through tree planting. This commission was replaced in 1914 with the Street Tree Division housed in the city Bureau of Parks specifically devoted to planting trees along the streets (Pittsburg City Planning 2008). Other programs developed throughout the United States in the first half of the twentieth century. Such programs began to diminish in the years after World War II. Renewed interest in such projects expanded greatly in the 1970s with the introduction of the Tree City USA program in 1976. Tree City USA, a collaborative effort between the National Arbor Day Foundation, the U.S. Department of Agriculture, and the National Association of State Foresters, is a recognition program for cities willing to undertake sound urban forestry programs. Myriad benefits can flow from being qualified as a Tree City, including the increased opportunity for receiving grants and other funding for local forestry activities. Since its creation in 1976, the program has grown from 42 participants to 3,210 in 2006. In order to qualify to be a Tree City, a municipality must meet a series of standards including the creation of an ordinance regarding tree care and protection. Such ordinances often dictate the procedures for planting street trees or protecting any street trees that may already be in existence. These activities are often undertaken by municipal parks and recreation departments or departments of urban forestry within the city infrastructure.

Finally, nongovernmental organizations (NGOs) have demonstrated increased interest in planting street trees. For example, in 1989, the nonprofit Greening of Detroit began with a mission to beautify Detroit, Michigan, through tree-planting activities. Since that time, the organization has planted thousands of trees in open spaces and along streets throughout the city (Greening of Detroit 2007) and are now charged with planting trees on public land and rights of way, in lieu of governmental entities. Similarly, Tree People, a nonprofit NGO operating in the Los Angeles, California, over the past 30 years has undertaken tree-planting activities throughout the Los Angeles area with a heavy emphasis on trees planted along streets (Tree People 2007). In 1993, the Alliance for Community Trees (ACT) was incorporated to bring together community

based urban forestry groups. The ACT mission is “to support grass roots, citizen based nonprofit organizations dedicated to urban and community tree planting, care, conservation, and education” (ACT 2007). ACT now includes over 100 organizations that have collectively planted over 7.8 million trees and engaged over 450,000 volunteers (ACT 2007).

3. Understanding Street Trees and Tree Spaces for Improved Management

Understanding the various benefits associated with street trees, there are valid reasons to seek sound management for this valuable resource. As institutions are crafted to manage street trees, it is vital to understand the nature of this resource. In this section, we argue that while the benefits of street trees are clearly public goods, street trees and tree spaces are best defined as CPRs.

3.1. Benefits of Street Trees are Often Public Goods

As briefly noted, researchers have found that street trees provide a variety of benefits. Many of the benefits can be classified as ecosystem services. Boyd and Banzhaf (2006, 8) define ecosystem services as, “components of nature, directly enjoyed, consumed, or used to yield human well-being.” Ecosystem services are classified by economists as public goods (Heal 2000; Ruhl et al. 2007)² and are generally seen as having the characteristics of nonexcludability and nonrivalry in consumption (see generally Weimer and Vining 2005). To illustrate the public good nature of the ecosystem services provided by street trees, take the example of the ecosystem service found in protection of local watersheds through improved storm water management. Trees have been found to help reduce storm water runoff (Konrad 2003). Trees planted along the street change runoff patterns through absorption and rainfall interception as leaves and branches temporarily store water that is more gradually dispersed on the ground below (Xiao and McPherson 2003). This process can mediate downpours and accompanying flooding. These protections benefit all individuals within the watershed. It would be extraordinarily difficult to exclude some members living in the watershed of the benefits created. Further, one’s benefit from the watershed protection does not subtract from another’s enjoyment of the benefit.³ These attributes of nonexcludability and nonrivalry in consumption can be seen as pure public goods.

Similarly, the benefits associated with cleaning the air of pollutants, the absorption of greenhouse gasses, the provision of aesthetic beauty, and the reduction in ambient air temperatures can all be seen as public goods. Even the psychosocial benefits associated with street trees such as safer traffic conditions, increased property values, more robust commercial districts, and more stable residential areas can be

² It should be noted that there may also be private ecosystem services such as the individual shade provided to a private home or yard or the increased property value offered to the individual residence located in proximity of the street tree. These benefits may be classified as private goods and may partially explain why individuals may be interested in planting street trees in the absence of further incentives.

³ Clearly, not all would be expected to benefit equally. Clearly those that rely on the watershed, such as downstream irrigators or those who would be flooded in the absence of the trees, may benefit more from their existence than others who are more loosely connected to or dependent on the watershed resource.

associated as public goods.⁴ The value of these services is not trivial. A recent study conducted by the New York City Parks Department found that the street trees of New York City provide annual benefits of more than 122 million dollars from absorbing airborne pollutants and increasing property valuation (Randall 2007).

3.2. Street Trees and Tree Spaces May be Appropriately Viewed as CPRs

Although the benefits associated with street trees can be considered a public good, the trees themselves and the spaces on which they reside are seemingly better defined as CPRs. We are not the first to assert that urban forest resources may be considered CPRs. Robert E. Loeb asserted urban forests may be subject to the tragedy of the commons in 1987. We assert that street trees may be best considered CPRs based on the specific attributes of the trees and tree spaces. We argue that due to the location of street trees and tree spaces, it is difficult to exclude access to the resource. However, unlike the public goods discussed above, use of and access to the street trees themselves can in fact be rivalrous. These points are discussed more fully below.

3.2.1. Difficult to Exclude

The location of street trees and tree spaces make them difficult to be considered an excludable resource. As noted above, trees and tree spaces are located near public rights of way. In many cases, they are contained within the public right of way. The public right of way can be characterized as having two components: (1) the constructed street and sidewalk and (2) other area within the legal right of way that does not contain pavement or other road surfacing. Public access to these areas is often guaranteed through easement or other legal means. When tree spaces reside in the public right of way, the public has open access to trees and tree spaces. While it is theoretically feasible to consider excluding individuals from the trees or tree spaces, it would generally be prohibitively costly to do so.

Similarly, even where the trees or tree spaces are located on private property (or are considered private property themselves), excluding others is difficult. Due to the open access nature of roads, most owners will not invest resources to exclude others from trees that are located on the border of the private property and public right of way. Although exclusion is more feasible through fencing and the posting of no trespassing signs than on the public right of way, it is still clearly costly to enforce exclusion. Moreover, little evidence exists that homeowners undertake the cost of exclusion to tree spaces or the street trees themselves. Fencing most often occurs nearer the home than in tree spaces.

3.2.2. Rivalry in Tree Spaces and Street Trees

Even though tree spaces and street trees are generally accessible, one individual's use of the resource likely reduces the availability of the resource for all others. It is important to note that in discussing how use of tree space and street trees may be rivalrous, we explicitly acknowledge that the uses contemplated for street tree

⁴ Although, in each of these psychosocial benefits, there are stronger spatial components to the associated benefits, those living in the closest proximity to these trees seem to benefit to the highest degree. Despite this, sound arguments may prevail that each of these benefits has overall positive benefits on the community at large.

resources are somewhat distinct from the rivalry contemplated in other forest settings. Whereas in the traditional forest, rivalry may result from competing use of timber or other forest products, these extractive uses do not adequately encapsulate the types of uses we perceive in street trees. Rather, rivalry in the context of street trees occurs due to competing uses of tree spaces and competing preferences regarding the street trees themselves. In this section, we discuss the competing uses of tree spaces and competing preferences regarding street trees themselves that we believe make them subject to rivalrous use. Specifically, we view a variety of competing uses and preferences that may crowd out, damage, or otherwise destroy tree spaces and street trees themselves.⁵

Perhaps the most straightforward of these competing uses can be seen in the context of tree spaces. There, rivalry in use is clear when competing uses for the area impact what can be done with the tree space. In that the area is accessible to all, it is very common for adjacent landowners and occupiers to transform tree spaces in fundamental ways. In urban areas, for instance, it is common for adjacent owners to pave or gravel areas near roadways to increase parking availability for residential or commercial users, regardless of ownership status of the underlying tree space. Similarly, it is common in commercial and industrial areas to extend sidewalks from the side of the building all the way to the road to increase pedestrian access. Furthermore, municipalities and homeowner associations frequently opt to expand existing roads. In so doing, existing tree spaces are paved over. Each of these activities results in the destruction of tree space and loss of net tree space area throughout the municipal setting.

Street trees themselves are likewise subject to rivalry in use. As noted, unlike free-standing forests, U.S. urban forests generally do not face extractive demand for timber or other forest resources. Extraction of street trees nonetheless occurs quite frequently due to competing incentives and public values that lead to the removal of street trees. As noted above, there may be competing uses of the tree space. Individuals may perceive higher benefits from the use of tree spaces for the construction of sidewalks, driveways, roads, or additional parking. To reach this end, any existing street trees must be removed.⁶

Similarly, due to their close proximity to streets, street trees frequently occupy the same area as a variety of public utilities. Whether above or below ground, these utility corridors may lead to destruction of the resource. In replacing underground sewer or gas lines, trees may be removed from the surface to facilitate construction. Above ground utilities such as power and communication lines also frequently come into

⁵ While we acknowledge that these rivalrous uses may be outside of the traditional views of forest uses, clearly competition for underlying land may impact the quality and size of any forest. Moreover, these pressures if not checked may lead to the destruction of the traditional forest CPR just as readily as overharvesting of timber or other forest products. For instance, the loss of the rain forest is as much a product of competing land uses—converting forest land to agricultural uses—as it is due to extracting timber or other forest uses.

⁶ Certainly all property arrangements may be subject to tradeoffs. It may at times be necessary to sacrifice some important resources to pursue another desirable goal (see generally Clark 1973). We simply note these pressures and several others to note that there are in fact numerous drivers leading to the destruction to street trees and tree spaces. Each of these pressures may have a cumulative impact on the underlying resources.

conflict with street trees. Trees are pruned or removed to provide clear access from pole to pole without the risk of line damage from tree limbs.

Additional incentives driving removal may occur due to practical considerations. Falling trees or limbs and branches may damage property. Further damage may result as root structures raise or break concrete on driveways or sidewalks. McPherson (2000) notes that a total of approximately 71 million dollars per year was spent resolving conflicts between street tree root structures and sidewalks, driveways, and roads in eighteen California cities.⁷ Even when damage does not occur, falling leaves, limbs, fruit, and nuts may create more yard and road maintenance requirements to clear debris. Additionally, street trees may adversely affect storefront visibility and access. In each of these cases, property owners and municipalities may have incentives to prune or remove trees to reduce foreseeable costs.

Property owners and municipalities alike often face incentives resulting from legal liability. Improperly maintained trees may create dangerous conditions. Numerous jurisdictions have found common law duty to maintain the trees in a safe manner and have held homeowners and municipalities liable for falling trees or tree limbs that injure passing pedestrians and motorists (Bloch 2000; Merullo and Valentine 1992). In a recent Nebraska case, for example, a jury awarded nearly 500,000 dollars in damages to a family whose thirteen-year-old son was crushed by a decayed tree that fell on the sidewalk where the boy was playing (*Holts v. City of Omaha* 2002).

Further liability may arise if trees block visibility of oncoming traffic at intersections or traffic signs (Bloch 2000). The U.S. District Court for the District of New York recently held that New York City could be held liable as a matter of law as having actual or constructive⁸ notice that a street sign was partially obstructed by trees (*Amacio v. Gaudicio* 2005). Thus, a municipality or individual could be held liable for not fixing a problem they should have known about, even if they did not actually know about the problem.

Additional liability may result from the trees damaging another's property. The Michigan Court of Appeals, for instance, recently heard a case where a neighborhood sought to form a class action suit against the city of Warren, Michigan, due to street trees that had damaged sewer lines leading to the individual houses (*Hill et al. v. City of Warren* 2007). Each of these liability issues may drive many risk adverse individuals, businesses, and municipal entities to remove the trees outright, even when there are ordinances that "protect" street trees.

Finally, even when street trees are not fully removed, they can be damaged in attempting to ameliorate any of the issues listed above. Overpruning is common. Despite trying to make the tree more manageable, the practice makes the trees vulnerable to storm damage, insect infestation, and may lead to tree mortality overtime.

Furthermore, competing public values may drive the removal of street trees. While street trees reduce traffic speed, they also reduce visibility and make it more difficult to spot pedestrians or other motorists entering the roadway. Also, if a motorist does leave the road, impact with a tree may increase injury to the motorist. In 2003, for

⁷ But see Sydnor et al. (2000), who argue that sidewalk problems often attributed to trees are frequently a result of poor soil conditions and other variables.

⁸ Constructive notice is a legal fiction referring to an item or event that an individual should have known about, even in circumstances when they did not know about the item or event.

instance, there were more than 8,500 fatalities in the United States from collisions with roadside obstacles such as trees (Dumbaugh 2005). Citing these concerns, many traffic engineers and municipal planners have long advocated clearing travel ways (Wolf and Bratton 2006). For instance, the American Association of State Highway and Transportation Officials state that “clear zones should be established or identified and forgiving roadsides established” (1997, 14). Forgiving roadsides refers to tree free areas along the side of the road. In addition to these safety concerns, it must be noted that street trees may be removed as simply a matter of taste. Surrounding owners and occupiers may not like the ways the trees look and take action accordingly. Some adjacent property owners, for instance, complain that the trees make them feel claustrophobic. They prefer the appearance and “feel” of more open areas.

Another frequent concern that leads to removal of street trees arises in the case of fruit bearing species such as the crab apple and the ginkgo biloba. There, individuals living in close proximity of the tree may not like the mess, or in the case of ginkgos, the smell, associated with the fruit of the female tree.

4. Street Tree Management

As noted above, CPRs in the absence of sound management tools can become overused. In this section, we examine three types of street tree management. These include, privatization/free market mechanisms, government management, and several types of collective management.

4.1 Types of Street Tree and Tree Space Management—Privatization/Free Market

In privatization, property rights are defined and market forces are generally allowed to dictate how individuals should treat street trees and tree spaces. Private actors often plant and/or manage trees in close proximity to streets for the increased aesthetic and property values on their own property. They may also undertake private management of street trees and the tree spaces located on the public rights of way adjacent to their property. This may often occur unintentionally if the property owner is unaware of the undeveloped portion of the public right of way.

Private planting and management of street trees located on the public right of way may also occur intentionally when the private actor perceives sufficient benefits (including aesthetic improvement, increased energy efficiency, or increased property value) from privately managing the tree in the public right of way. However, in this context, private actors often face certain disincentives. The private actor often lacks the actual ability to control how the street tree or tree space on the public right of way is treated by the local municipality and by other municipal residents. The private actor bears some risk in that the resource may be destroyed by the municipality without consulting or compensating the private actor. We are unaware of any case where a municipality and accompanying public has surrendered the public right of way to the private owner to increase the likelihood of sound management of tree spaces. Accordingly, private management may always face certain limitations in providing private individuals adequate incentives to appropriately manage street trees and tree spaces.

4.2 Government Management

Although government management of street trees and tree spaces in the United States has a long history, governmental management of the resource has grown in popularity since the mid-1970s. In this type of management, government officials establish rules regarding the treatment and use of street trees and tree spaces. Ordinances often place a local employee or governmental entity in charge of decision making processes for activities affecting street trees. Most often, this includes the creation of a permitting process, where private individuals are required to obtain a permit before taking any action regarding street trees or tree spaces—including planting trees, cutting trees, and major pruning.

Our review of governmental programs indicates wide variation in the approaches taken. Some municipalities claim ownership and management responsibility of all trees within the public right of way. For instance, the city of Beaverton, Oregon, claims ownership and performs maintenance responsibilities for certain trees lining major arterial, minor arterial, or major collector streets (City of Beaverton 2008).⁹ Similarly, the state of Maryland requires all municipalities within the state to take responsibility of street trees, although initial plantings can be the responsibility of individual owners (City of Frederick 2008).

Other ordinances seek to almost entirely shift tree ownership and management responsibility to abutting owners. The street tree ordinance governing the city of Lexington, Kentucky, for instance, indicates that abutting owners own the street trees on the public right of way and are responsible for their management. The city retains regulatory authority by requiring owners to obtain a permit to plant or prune any tree in the right of way, by requiring an approved list of trees that can be planted in the right of way, and by proscribing undesirable tree pruning activities, such as topping (City of Lexington 2007).

Still others assign street tree ownership to municipalities, but dictate management responsibilities to the individual citizens owning or occupying the abutting properties. The city of Spokane, Washington, for instance, defines street trees as part of the city infrastructure, but indicates that abutting property owners are responsible for:

1. protection of street tree health by obtaining all permits as required by this article for planting, removal or pruning of street trees. The property owners may perform minor pruning of street trees on their property without obtaining a permit;
2. care and maintenance of the tree [space] to ensure proper health of the trees;
3. removal and replacement of street trees that are topped or improperly pruned if the director determines that a street tree's health is severely degraded;
4. care and maintenance of trees on their property in such a way as to not cause a hazard to the public safety or to the health of public, landmark or street trees;
5. removal of trees located on their property that have been declared a public nuisance or hazard; and

⁹ It should be noted that for less major streets, the city of Beaverton's ordinance shifts maintenance responsibilities to adjacent property owners.

6. abutting property owners must exercise reasonable care in the use or condition of their property so as not to render the right of way unsafe for ordinary travel or to endanger persons or property of persons using the right of way. Abutting property conditions may include planting or allowing trees, shrubs, plants, or other natural or human-placed installations that affect the right of way directly or indirectly. Uses include a use with may cause or promote damage, unauthorized alteration or interference with the right of way, not by way of limitation. The abutting property includes the curtilage and areas in or near the right of way, whether or not actively used for public travel (City of Spokane Municipal Code, Section 12.02.908, 2007).

4.3 Collective or Community Management

Collective or community governance represents a third common alternative for management of street trees. In this category, management responsibilities are left to nongovernmental activities that occur by homeowners associations, neighborhood associations, or by community based nongovernmental organizations. In the case of homeowner and neighborhood associations, community managers select tree placement and management standards and may undertake tree planting, managing, and enforcement by association rules. For instance, the Southern Village Homeowners Association, which operates within a neighborhood of Chapel Hill, North Carolina, recently began a major project pruning and caring for street trees located within the community (Southern Village HOA 2007, 2008). Enforceable covenants, conditions, and restrictions are utilized in place of governmental ordinances to protect street trees and tree spaces. These arrangements often specify a tree plan and require tree plantings at the creation of the subdivision.

Nongovernmental organizations frequently undertake tree planning, planting, and in some cases pruning and other upkeep. Examples of such activities can be found in the activities of Greening of Detroit and Tree People listed above. In each of these instances, the NGO both plants and helps maintain trees. However, NGOs are often less equipped to function as monitors and enforcers in that they are in no position to establish enforceable community standards dealing with street trees and tree spaces.

5. Understanding the nature of the CPR—Potential Problems

With an understanding of the nature of the resource and the management approaches generally employed, it is now possible to provide an overview of some of the potential complications inherent in the management of street trees. It is not our intent to provide a comprehensive list of potential complications. Such an endeavor would be particularly difficult in light of the numerous and diverse approaches utilized to manage street trees. Rather, we wish to illustrate some of the potential problems inherent in most street tree management settings. To do this, we return to Ostrom's design principles listed above. Rather than touch on each of the principles listed, we wish to address two design principles frequently listed as very important to successful CPR management. These include: (1) clearly defined boundaries regarding the rights and duties associated with the resource and (2) monitoring (and enforcement) that occurs regularly and reliably. We focus on these items due to their overall importance in

successful CPR management and due to the fact that they are frequently violated in the context of street tree management.

5.1 Clearly Defined Boundaries and Duties

The boundaries regarding street trees are often poorly delineated. Part of this is definitional. As noted above, there is lack of general consensus in what is meant by street tree. A general definition of “trees by streets” likely does not provide sufficient clarity for effective resource management. Questions regarding how close to a street a tree must be in order to be considered a street tree are simply left unanswered. Municipalities have often tried to generate more clarity on this issue by defining street trees as those trees planted in the public right of way or adjacent public easement. However, this often does not resolve the issue. Public rights of way are often determined through a variety of processes. In some instances, rights of way are set by state law or city ordinance. In other cases, landowners deed land or grant easements to the city when building a new road. In a third manner, developers state a right of way width in establishing the plat map for a new subdivision. Often, the width of the right of way varies between each of these methods. Furthermore, the width of the right of way may vary within the same method of right of way creation. For instance, a city ordinance or plat process may require wider rights of way for roads that are envisioned as main transportation arteries for the city to avoid future condemnation when the roadway needs to be widened. This variation in right of way width leads to substantial confusion for adjacent property owners in determining which trees may be considered to reside on the public right of way.

Further confusion arises in the understanding of the duties associated with street trees. Duties are clearest in the context of private ownership, where a landowner may hold only a common-law duty to maintain the property in a safe condition. Governmental management may in fact cause some degree of additional confusion. Ordinances are often not well publicized or well understood. While the lack of knowledge of such ordinances does not absolve duty to abide by them (ignorance is not an excuse in the eyes of the law), it certainly may lead to underperformance of whichever duty is required by the law. This is especially apparent in cases where municipal ordinances establish city ownership of street trees, but attempt to shift the duty of care to adjacent property owners. There, adjacent owners may not understand that it is their responsibility to care for a resource owned by the municipality.

Finally, even in cases of collective resource management, there may be a lack of understanding of the duties associated with resource management. Many homeowners associations, neighborhood associations, and NGOs view their primary role as planting street trees. They do not view any duty to maintain the resource after established. This may lead to degradation of the resource.

5.2 Monitoring (and Enforcement)

Other problems may arise due to a lack of monitoring and enforcement. As stated above, the absence of effective monitoring and sanctioning often leads to a situation of de facto open access—which may result in tragic outcomes for the resource. Monitoring and enforcement in the context of street trees is often sparse. Government ordinances often establish a municipal official to act as monitor. These positions are

often underfunded. There are simply too many street trees to effectively ensure that others are not destroying the resource. One base metric to understand even a basic level of monitoring would include a street tree inventory—a count of the street trees known to exist. A study performed by Doherty et al. (2000) surveyed municipal “tree wardens” in 168 Massachusetts municipalities with populations over 10,000.¹⁰ The survey found that 72% of these municipalities had not conducted a tree inventory. An additional 5% responded that they did not know whether they had an inventory (or simply did not respond to the question) (Doherty et al. 2000). This study is representative of B. Fischer’s personal experience in Indiana urban forestry, where many communities have no comparative baseline for street tree numbers, placement, or condition within the community.

Considering enforcement brings additional complications. Elmendorf et al. (2003) note that while surveys often inquire whether municipalities have ordinances, little evidence illustrates whether those ordinances are indeed enforced. While we are confident that some ordinance enforcement does occur, little data exists regarding the frequency or severity of enforcement actions. For nongovernmental entities such as homeowners associations, however, we note that enforcement can be extremely costly. Enforcement may require civil legal action to recover damages or specific enforcement of the covenant condition code or restriction violated. This enforcement action may cost the association money that it does not have. Rather than perform a special assessment of association members, the association often prefers not to expend the resources required for enforcement. Other entities acting to protect street tree resources often have limited ability to enforce. NGOs have no ability to protect street trees through special enforcement or otherwise. They appear confined to plant and perform routine maintenance on street trees.

6. Conclusion and Need for Further Research

In this paper, we have argued that based on the nonexcludable, yet subtractable nature of street trees, they are best defined as CPRs. Understanding this may have implications for their successful, long term management. Principally, the mechanisms utilized to manage the resource must be reassessed. The extensive literature available on CPR management should be of great use to private individuals, municipal officials, and NGOs, who are interested in protecting and promoting the long-term growth and survival of street tree populations.

Perhaps the greatest insight gathered from the CPR setting is that sound management mechanisms are necessary for the survival of the resource. In the absence of these institutions, tragedy often ensues. In the street tree setting, focus must shift away from simply planting trees and the creation of “paper” management tools. Renewed emphasis must be placed on developing better street tree management programs. Further, renewed attention is necessary to define the street tree resource. While a one-size-fits-all approach is likely not appropriate, individuals, NGOs, and municipalities must work harder to identify how street trees should be defined in their

¹⁰ Tree wardens have been required under Massachusetts law for more than 100 years in all municipalities. Their duties include a broad mandate to care for shade trees located within 20 feet of the public right of way.

communities. After such a definition is established, effort should be made to perform and make public a street tree census that would indicate which trees are considered part of the street tree resource. Adjacent landowners should be apprised as to which trees are considered street trees and management mechanisms should be decided on. We do not recommend any type of management, be it private, governmental, or community, as superior to the other types of management available. We leave these decisions to individual communities. Rather, we recommend that decision makers become educated to the benefits and shortcomings of each type of street tree management. We further emphasize the importance of monitoring and enforcement in any private, public, or community management scheme.

6.1 Need for Further Research

More research is needed in order to better protect street tree resources. This includes information regarding resource management options. For instance, comparative studies that examine the effectiveness of private, governmental, and community management could help better illuminate the options available to local resource managers. Furthermore, additional research could help illuminate management within the context of each management type. For private management, additional research could identify the factors that lead private individuals to plant and maintain street trees. In regards to government management, more information is required regarding the level of monitoring and enforcement present under current street tree ordinances. A simple first step would identify whether municipalities have conducted a street tree census to understand the location and condition of trees governed by a given ordinance. Additional studies could examine the frequency of enforcement actions against ordinance violators and determine effective monitoring and enforcement practices. As for community management, additional information is needed in how community associations and NGOs can better manage street tree resources. This could help better identify the pitfalls of community management often seen in the need for the development of enforcement mechanisms. Finally, investigating the interactions and overlap when private, governmental and community based street tree management programs converge in the same setting would be useful to evaluate.

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