Chapter 22
Destruction and Replanting of the Urban Forest of Sarajevo, Bosnia and Herzegovina

Igor Laćan and Joe R. McBride

Abstract Sarajevo, capital of Bosnia-Herzegovina, experienced severe damage during the 1991–1995 Yugoslav wars. During the 47-month-long Siege of Sarajevo from April 1992 to March 1996, the energy supplies to the city were cut off, and the besieged residents gradually cut down over three-quarters of all urban trees within the siege lines for use as firewood. In addition, some urban green spaces were converted into cemeteries, further reducing the number of urban trees. After the war, the city trees have gradually been replanted using primarily imported tree stock, as most of the local tree nurseries had been destroyed during the siege. This chapter presents the observations and measurements of trees which survived the war, as well as of the trees that have been planted after the war, made in Sarajevo in 2008, 13 years after the siege. We summarize the lessons learned from the Sarajevo experience, regarding both the patterns of damage and the effective strategies for replanting, which include the close relationship between the urban tree damage and the specifics of military operations, the importance of the initial planting stock, and the advantages of collaboration between academic researchers and urban forest managers in a large-scale replanting program.

Keywords Former Yugoslavia • Municipal arboriculture • Siege

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Authors Igor Laćan and Joe McBride describe the Bosnian conflict's toll on Sarjevo's urban and nearby forests. After the siege, the city parks department teamed up with university forest scientists to replant what they had lost.

Introduction

Wednesday, November 25, 1992

Dear Mimmy,

> The shooting really has died down. I can hear the whine of the electric saws. The winter and the power saws have condemned the old trees, shaded walks and parks that made Sarajevo so pretty.
>
> I was sad today. I couldn't bear the thought of the trees disappearing from my park. They've been condemned. God, all the things my park has had to go through! The children have left it, Nina forever, and now the linden, birch and plane trees are leaving it forever too. Sad. I couldn't watch, and I can't write any more.
>
> *Zlata's Diary* (Filipović 1994, pp. 104–105)

Destructive Events in Cities

Urban warfare has been a recurring phenomenon during the twentieth century (Machlis and Hanson 2008), often devastating all parts of a city, including urban trees. In Europe, what had been uncommon – the devastation of Louvain and Ypres in World War I (Strachan 2003) – became the norm in World War II, when the destruction of cities and their urban trees, parks and green spaces, reached its apogee. By 1945 many large cities in the Axis countries were nearly completely destroyed, either by aerial bombing (Dresden, Tokyo, Hiroshima and Nagasaki), ground warfare (Aachen), or a combination of the two (Berlin; Dear 1995; Starry 2003). Some large cities in Allied countries were in similar condition, burned down by incendiary bombs (Coventry), or reduced to rubble in a siege (Stalingrad). These cities were rebuilt and their urban forests replanted. Yet only limited systematic studies of the destruction and restoration of urban forests were undertaken (Morris 1997; Cheng and McBride 2006, Chap. 18, this volume), and today 50 years of growth obscures the devastation that had occurred.

Regrettably, there is a region where many cities and their urban forests experienced relatively recent war damage: the south-eastern European countries once comprising the Socialist Federal Republic of Yugoslavia ('former Yugoslavia'). During the early 1990s, former Yugoslavia collapsed in a series of wars, which included urban warfare, genocide, and mass expulsion of people ('ethnic cleansing'). The most infamous instance of urban warfare during the Yugoslav wars was the siege of Sarajevo, the 47 months during which the city was blockaded and bombarded by the Bosnian

Serb forces – effectively turning the city into a large red zone. Energy shortages caused by the siege forced Sarajevo residents to cut their urban trees for firewood, resulting in severe damage to the urban forest. Nevertheless, since the end of the conflict in 1995, the urban forest of Sarajevo has been thoroughly and successfully replanted. This act of replanting – which the Sarajevans started even during the siege, as an act of hope for the future of their city – now provides an excellent recent example of a post-disaster urban forest recovery.

This chapter examines the destruction of the urban and peri-urban forests of Sarajevo, the capital of Bosnia and Herzegovina (BiH), and the factors that shaped the replanting of the city, highlighting the lessons that can be learned from the Sarajevo replanting effort. We also present our observations and measurements (a proxy for tree age) of trees which survived the war and trees planted after the war, and summarize the conversations we had with Sarajevo's urban foresters during a visit to the city in May 2008.

Geography and History of Sarajevo

The city of Sarajevo occupies about 141 km^2 of the Sarajevo Basin, extending along the Miljacka River (20–30 m wide, non-navigable) for about 13 km in the E-W direction, and spreading out into the basin to about 3–4 km in the N-S direction. The city includes some level land along the river, but many of the residential areas are built in foothills of the adjacent mountains at an elevation between 511 and 900 m:

> …the truly dominant characteristic of the city was the ring of mountains surrounding it, placing the city in a bowl visible and vulnerable to anyone who occupied the rim of high ground on the outside edges. (King 2003, p. 241)

The continental climate of Sarajevo is moderated somewhat by the maritime influence of the Adriatic Sea, but this influence is attenuated by the mountains to the south of the city (Mt. Jahorina, Bjelašnica, and Trebević, all above 1,000 m elevation). Precipitation occurs year-round (yearly avg 825 mm), and snow predominates in winter. The average temperatures range from 1.3°C in January to 19.1°C in July, and the city enjoys an average of 1,830 sunshine-hours per year.

Although settled since prehistory (Munro 1895), Sarajevo first became a notable city during the Ottoman period (1453–1918). A provincial capital, the city was organized around units of *mahala* (neighborhood), each of which contained its own market, mosque, school, etc., connected by a *sokak* (street) or *čaršija* (street with storefronts). Although neither *sokak* nor *čaršija* were typically lined with trees, Sarajevo was already in the seventeenth century famed for its rich urban vegetation (Donia 2006). This consisted of many courtyard trees, either in private yards (often fruit trees) or the school/mosque courtyards. The most notable public trees were the tall poplars (*Populus spp.*), planted in mosque courtyards adjacent to minarets (Fig. 22.1). This minaret-and-poplar pairing endured, to great effect:

> the skies of Sarajevo must have appeared as pierced as eyelet lace, for in 1958 Sarajevo had many hundreds of mosques and poplars. (Bertram 1997, p. 2)

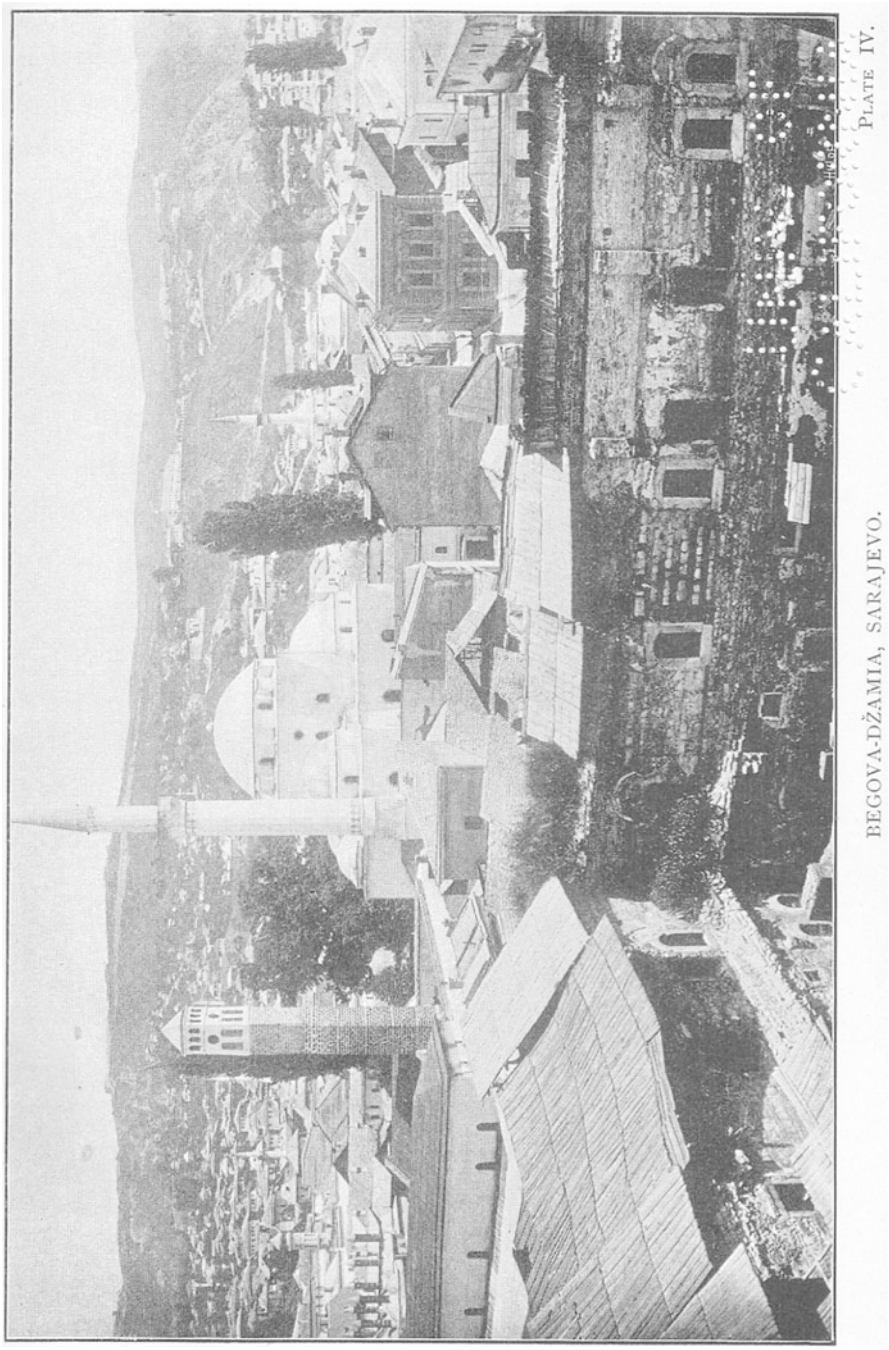

Fig. 22.1 Poplars and minarets in 1895 Sarajevo (From Munro 1895)

Fig. 22.2 Put za Vrelo Bosne (Bosnia Spring Promenade) in Ilidža park today. London planetrees and horsechestnuts

The second phase of city growth began with the Austro-Hungarian occupation in 1897, which introduced to Sarajevo new architectures and city plans. These included a new street grid, city parks, and tree-lined streets. A prominent example of the latter is 'Put za Vrelo Bosne' (the Bosnia Springs Promenade; Fig. 22.2) in the Ilidža suburb, double-lined with two rows of still-extant trees, London planes (*Platanus* × *acerifolia*) and horsechestnuts (*Aesculus hippocastaneum*).

The third phase in the expansion of Sarajevo occurred in the twentieth century as the population grew from 52,000 residents in 1910 to 430,000 in 1991. Urban trees were planted around newly constructed high-rise residential buildings and along broad boulevards that connected the new parts of town. Bejtić (1973) provides an approximate age distribution for the streets and squares of Sarajevo, and notes that Sarajevo was thus characterized strongly by its Ottoman past (with 50% of all streets and squares predating 1878), but had become in nearly equal measure a modern European city (with 33% of streets and squares built after 1945).

Sarajevo's Urban and Peri-Urban Forests Before 1991

Urban Forest (Before 1991)

The urban forest of the late twentieth century Sarajevo included plantings from three periods:

1. The pre-twentieth century plantings (Ottoman-period) was characterized by few public trees, but with many private yard trees, and also trees in the many small, partially wooded cemeteries integrated into the city itself which would later be converted into parks (see below).
2. The late nineteenth and early twentieth century plantings (Austro-Hungarian period), which included new tree-lined streets and promenades (e.g., the Miljacka River banks), and saw the construction of the first urban parks, some of which were created by converting the former cemeteries (e.g., Mali and Veliki parks).
3. The Yugoslav period plantings (1918–1991), which greatly expanded the urban forest to include street trees along the many new streets and city parks, and also plantings around the new multi-residential buildings.

The legacy of the latter two periods was visible in the samples we took during our visit to Sarajevo in May of 2008, and suggests the size of the city's pre-war urban trees. For example, the linden trees on Wilson's Promenade (Vilsonovo Šetalište, named after Woodrow Wilson), planted in 1905 (Beus 2009a) about 8 m apart, range from 30 to 69 cm in diameter at breast height (DBH), and average about 19 m in height, forming a closed canopy over the pedestrian walkway on the northern bank of the river Miljacka. Similarly, the large (75–120 cm DBH, 36 m high) London plane trees in the park adjacent to the President's Building are spaced 6–7 m apart, and form a continuous canopy along the park edge.

Individual trees, remnant of the pre-war period, that we observed along streets included a large tree of heaven (*Ailanthus altissima*) which was 100 cm in DBH (but was topped at 13 m); a 9 m tall common linden (*Tilia* × *europaea*), with trunk of 41 cm DBH but a crown spread of 6 m, very effective in shading the Marijindvor square; and a 28-m tall Lombardy poplar (*Populus nigra*), with a 125 cm DBH. Our sample also included one very large sycamore that possibly dated from the Ottoman period, having a remarkable DBH of 166 cm, and a height 36 m, located next to the old Ottoman-era quarter (Baščaršija).

Peri-Urban Forest (Before 1991)

Bosnia and Herzegovina is extensively forested, with approximately 43% of the total area covered by forest landscapes, and the forest products industry is an important part of the economy (Pintarić 1998). In this study we consider the forests surrounding Sarajevo that remained inside the siege lines, namely the mountains Hum and Žuč,

and the adjacent hillslopes. These were also largely covered in forests, comprising up to 90% conifers (*Picea abies*, *Pinus sylvestris*, *P. nigra*), but also containing some beech, oaks and hornbeam (*Fagus sylvatica*; *Quercus petraea*, and *Q. pubescens*; and *Carpinus betulus*, respectively). They were typically managed for water-source protection, and slope stabilization, as the local soils are prone to landslides.

The Siege of Sarajevo

The 47-month Siege of Sarajevo (April 1992 to March 1996) was the longest siege of a European city in the twentieth century (the WW II Siege of Leningrad lasted 29 months). In April 1992, after an unsuccessful attempt to take the city in a ground attack, Bosnian Serb fighters and the remnants of the former Yugoslav army encircled the city and positioned heavy artillery on the surrounding mountains (Silber and Little 1996). The attackers blockaded the roads out of Sarajevo and cut off the water and energy supplies, but would not make any additional attempts to overtake the city. The encircled area encompassed most of urban Sarajevo (except the Serb-held neighborhoods Ilidža, Grbavica, and Kolonija) and a few forested hills to the north, although the siege boundary extended almost into the city center in the Grbavica neighborhood.

Rather than attempt additional ground assaults, the Bosnian Serb forces began to shell the city, resulting in an average of 329 shell-impacts per day, for an estimated total of 2,600,000 shells (Donia 2006). The shelling, along with snipers, killed an estimated 11,000 Sarajevans, and wounded another 50,000. Among the siege victims were three professors of the Faculty of Forestry at the University of Sarajevo, and twelve employees of the Park-Sarajevo public company. Almost every building in the city was damaged (including the Forestry Faculty building and the Park-Sarajevo facilities), and some 35,000 structures were completely destroyed (Association des Architectes DAS-SABIH 1994). Damage to the public utilities and business infrastructure exceeded US $30 billion, while 100,000 jobs had been lost (Donia 2006). The city's tree nurseries, once the largest in Yugoslavia and operated by the municipal company Park-Sarajevo, were also destroyed. Two characteristics of the siege, which greatly influenced the damage to the urban forest of Sarajevo, were noted by King (2003, p. 273):

> …[the artillery shelling was] aimed at political or psychological targets rather than at any target that could help take the city. Sniper fire was random and designed to make life miserable for the citizenry, not to support an overall military assault as at Stalingrad [in WW II].

Despite the arrival of the UN peacekeepers in late 1992, the siege continued through 1993 and 1994. In the fall of 1995, after several well-publicized massacres and with the mounting evidence of genocide, NATO intervened by intensively bombing Bosnian Serb positions in September 1995. After the peace agreement at Dayton was signed in November 1995, Bosnian Serb forces gradually withdrew and the siege was declared lifted on February 29, 1996 (BBC 2008).

Table 22.1 Damage to the urban trees and green spaces in Sarajevo, 1992–1995

Component	Inventory in 1992	Destroyed in siege, 1992–1995	
		Total	Percent destroyed
Park lawns	1.59 km^2	1.23 km^2	77
Trees	**26,211**	**20,094**	**76**
Shrubs	185,748	111,542	60
Roses	11,193 m^2	5,772 m^2	51
Flowers	7,574 m^2	4,905 m^2	65
Hedges	12.6 km	2.1 km	17
Park benches	**1,711**	**1,706**	**99**
Park fences	**1.6 km**	**1.6 km**	**100**

From Park-Sarajevo (1996)
Combustible materials in bold

Effects on the Urban Forest

The urban trees of Sarajevo sustained heavy damage during the siege, both directly from military operations and indirectly from being harvested for firewood. Direct damage from artillery shells accounts for a minor part of the overall tree loss because artillery and sniper fire was directed at buildings and residents, and few ground operations and little aerial bombing took place. Nevertheless, Sarajevo arborists report commonly encountering shrapnel embedded in the wood, and a 2008 report on the condition of linden trees on Wilson's promenade lists 'damage from ordnance' on every tree evaluated (Dautbašić et al. 2008).

Firewood cutting was the primary form of damage to trees, as desperate Sarajevans resorted to colleting combustible materials for cooking and heating. After using up the wood products remaining in the city (e.g., shipping pallets, but also their own furniture and books; Cohen 1998), the residents first gathered urban wood debris, then 'harvested' wooden park furniture (e.g., benches; Table 22.1), and finally turned to cutting trees. In some areas, especially those sheltered from the direct view of artillery and snipers, the trees were removed very quickly: 'Not even a month had passed from the moment when the first tree was cut down, until the moment when not a single tree could be seen' (Prstojević 1994, p. 313).

After the trees had been cut, residents turned to digging up tree roots, severely damaging the planting pits in the process. In parks, additional damage was caused when former lawns were converted to vegetable gardens, where the besieged residents grew produce to augment their diet ('the average Sarajevan lost 30 pounds during the siege', Donia (2006)). Cohen (1998, p. 383) describes a Sarajevan who kept rabbits (for food), but had to '… cut back on the rabbits because it was hard to feed them. There was no more grass in Sarajevo. The land has all been cultivated or is covered in graves' (see Helphand, Chap. 17, this volume, for discussion of the importance of gardening in red zones).

The expansion of cemeteries – needed to bury the war victims within the siege lines – also contributed to the loss of Sarajevo's urban forest. Not only were the existing cemeteries rapidly enlarged (and thus lost their trees), but some city parks

were hastily converted into cemeteries, also losing their trees. Although these trees likely would have been cut for firewood, it is this land-use conversion of parks to cemeteries that may prove critical in the future, as it could preclude the restoration of urban trees in these formerly wooded areas.

Not all of Sarajevo's urban trees were cut, however. Although there was little systematic effort to protect trees in the face of energy shortages, some trees were protected as 'military assets' (either by the government or citizens) because they shielded streets, government buildings, or residences from direct view of the snipers. Additionally, because the siege line advanced nearly to city center, many trees were directly exposed to sniper fire and so could not be harvested.

In contrast, the trees located in Serb-held areas of Sarajevo (e.g., in Grbavica, or Ilidža) were not cut for firewood as energy was available to the residents there. However, some of those trees were damaged in fires set to buildings by the residents leaving their homes after the siege, when the Serb-held neighborhoods reverted to Bosnian government control.

Effects on Peri-Urban Forest

The effects on the peri-urban forests within the siege lines were similar to those on the city trees. Direct military damage occurred where front-line battles were fought, and also where trenches were dug and artillery emplacements constructed.

More importantly, firewood cutting was even more extensive (e.g., slopes of Mt. Hum) and tree roots were removed as well, leading to occasional landslides. In the words of urban forestry professor V. Beus: 'everything that could be cut down, was'. Much like in the city, the peri-urban tree cutting was constrained both by the military operations (artillery, snipers, and – importantly – landmines), and by some localized opposition to tree removal. Beus estimated (personal communication) that several hundred hectares of forest were cut during the siege.

Tree-Planting in Sarajevo During the War

Amazingly, despite the hardships experienced in besieged Sarajevo, plans were made (by Park-Sarajevo) during the siege for replanting the city. Although these plans could not be implemented at the time, Sarajevans recognized the importance of (re)planting at least a few trees as symbols of faith in the future of their city. This led to the transporting by the United Nations of a few Colorado blue spruce (*Picea pungens* 'glauca') from one of the Park-Sarajevo nurseries outside city. These were planted (by V. Beus and S. Hećo) adjacent to the President's Building, and are growing well today. Additionally, seeds of horsechestnut and gingko in storage within the city were planted at an abandoned army barracks by S. Hećo of Park-Sarajevo. Because of the proximity to the front lines and the potential danger from snipers and landmines, no replanting of the peri-urban forest took place during the siege.

Planting-After the War, and Urban Forest of Sarajevo Today

Urban Tree-Planting

The replanting plans, made during the war by Park-Sarajevo and the Faculty of Forestry, indicated that replanting would start on the larger boulevards and avenues, and would then extend into smaller streets. Twenty single-species 'allées' (*sensu* planted boulevards) were planned (Table 22.2). Some of these 20 species had not previously been common in Sarajevo (e.g., ginkgo, tuliptree), while others would simply be replacements for the lost trees (horsechestnut, linden).

However, despite the fact that the plans were in place, planting stock was unavailable, destroyed along with the city tree nurseries. After public officials informed the international audiences of the need for help (Bures 2001; Kurspahić 2008), several countries (e.g., Spain, Germany, France, Sweden, Croatia, Japan) contributed planting stock. In addition, funds to support tree-planting were raised by American Forests through their Global Releaf program. The first gift of trees came from Spain: 2000 London plane trees, a species well-adapted to the local climate and widely planted before the war. Japan, on the other hand, donated flowering cherries (*Prunus serrulata*), which had not been common in Sarajevo before the war, but appear to be growing well today. The received trees were for the most part 'bare root stock', which was 'healed-in' at the partially-rebuilt Park-Sarajevo nursery where it was maintained until planting. The majority of the donated trees were 1–3 m tall, although some were much larger (as tall as 4–5 m; Janjić 2002).

Planting took place under the direction of Park-Sarajevo and the Faculty of Forestry at the University of Sarajevo, and was seen as an opportunity to employ some of the thousands of unemployed people in the city. On occasion, community volunteers were organized to plant trees, but most of the planting was done by the Park-Sarajevo staff and the professors and students of the Faculty of Forestry. To enhance their establishment, the trees were watered for the first 2 years after planting using the municipal water trucks.

Table 22.2 Planned allées of Sarajevo, tree species

1. Linden allée (*Tilia cordata*[a])	2. Horsechestnut allée (*Aesculus* spp.)
3. Planetree allée (*Platanus* × *acerifolia*)	4. English oak allée (*Quercus robur*[a])
5. Cherry allée (*Prunus avium*[a])	6. Hornbeam allée (*Carpinus betulus*[a])
7. European ash allée (*Fraxinus excelsior*[a])	8. Narrow-leaved ash allée (*F. angustifolia*[a])
9. Tree-of-heaven allée (*Ailanthus altissima*)	10. Silver birch allée (*Betula pendula*[a])
11. Mountainash allée (*Sorbus torminalis*[a])	12. Sophora allée (*Sophora japonica*)
13. Tuliptree allée (*Liriodendron tulipifera*)	14. Sycamore maple allée (*Acer pseudoplatanus*[a])
15. Ginkgo allée (*Ginkgo biloba*)	16. Whitebeam allée (*Sorbus intermedia*)
17. Cherry plum allée (*Prunus cerasifera*[a])	18. Crabapple allée (*Malus purpurea*)
19. Kwanzan cherry allée (*Prunus serrulata*)	20. Sessile oak allée (*Quercus petraea*[a])

[a]Species native to BiH (Šilić 1983)

During our trip to Sarajevo in May 2008, we visited a sample of trees planted in the first few years following the war to record their present size and condition. These trees are typically 6–28 cm in DBH, and 2–14 m tall. All of the trees observed, with the exception of the winter-damaged oriental plane trees (next section), were in very good condition.

Tree-planting is continuing in Sarajevo. Although tree stock is being produced in the Park-Sarajevo nurseries today, much of it still is not large enough for planting, and larger-sized stock continues to be imported, especially from Hungary and Croatia. Unfortunately, some of the smaller planted stock is easily vandalized and saplings have occasionally been pulled from the ground and replanted in private yards.

Urban tree species composition in Sarajevo was comprehensively described by the late professor Nikola Janjić of the Forestry Faculty, University of Sarajevo (2002). In this, his sixth assessment of the cultivated vegetation in the city, Janjić reported a total 219 taxa of woody plants, including 71 trees: 24 conifer taxa (all cultivars) and 47 broadleaf taxa (species and cultivars, not distinguished). Janjić indicated that most of the trees originated from post-war plantings, although a few dated from the 1980s, and only very few remaining trees pre-dated 1980.

Janjić also noted the changing prevalence of tree taxa in Sarajevo, based on his 40 years of observation. Notably, the two species Janjić specifies as becoming 'most reduced in abundance' are poplars and the fruit trees (some *Malus*), both species that had been planted in Sarajevo's earliest urban forest (before the twentieth century). Conversely, the trees that Janjić indicated as 'very abundant, even overplanted' include many of the urban trees common in urban forests in the West (Norway maple, horsechestunt, black locust, Chinese elm, and London planetree).

Peri-Urban Replanting

Replanting of the peri-urban forest was organized by the municipal company Sarajevo-Forests, in cooperation with the Faculty of Forestry. Approximately 40% of the area from which trees were cut has been replanted. Hardwood species are preferred: oaks, maple, beech, hornbeam, and ash (*Quercus* spp., *Acer campestre*, *Fagus sylvatica*, *Carpinus betulus*, and *Fraxinus pennsylvanica*). However, because of continuing limited availability of hardwood seedlings, planting of conifers continues (mostly pines *Pinus nigra* and *P. sylvestris*; and Norway spruce *Picea abies*). The former designation of the peri-urban forests as parks and protected watersheds continues today. Nevertheless, some timber production is planned, and is currently being certified for sustainability by the Forest Stewardship Council (SGS Qualifor 2006).

Other portions of the deforested area are returning to forest cover through natural succession, mostly to non-timber species like birch, aspen and black locust (*Betula pendula*, *Populus tremula*, and *Robinia pseudoacacia*).Yet other deforested areas have been converted to cultivated land by refugees, who have migrated to Sarajevo

from other parts of BiH and taken over land at the margins of the city. These new residents have continued to occasionally clear for gardening some areas that either had been replanted or were returning to forest through natural succession.

One of the most interesting ideas in the peri-urban planting projects is the 'Ambassadors' allée' (Aleja Ambasadora), a section of a local road used as a pedestrian promenade leading to a popular recreation area. Starting in 2002, tree pits have been created along the roadway, and foreign ambassadors in Sarajevo invited to each plant a linden tree, with a plaque marking the ambassador's country and date of planting. A few dozen lindens have been successfully planted, but one difficulty has been the control of the surrounding (naturally regenerating) trees that are shading out the planted trees (Beus 2009b).

Lessons Learned

- *Urban tree damage is closely related to the specifics of warfare and military operations*. In red zone Sarajevo, tree cutting for firewood – not the military operations – was the primary cause of damage to the urban forest. The result was a strikingly uneven removal of urban trees from the city, so that some areas lost all their street and park trees, while other areas (some 'sniper alleys', Serb-held neighborhoods, etc.) appear today much like they did in 1991. This contrasts with the near complete and spatially uniform destruction of trees in the cities overrun or firebombed in WWII (e.g., Stalingrad, Tokyo, see Cheng and McBride, Chap. 18, this volume). Another specific problem in Sarajevo was the damage to soil surface from people removing tree stumps and from converting parks to gardens (compare to the situation in the ghetto gardens of WW II where sites vacant due to destroyed buildings were planted; Helphand 2006). Soil replacement and extensive re-grading of parks and green strips were often necessary before new trees could be planted.

Some lasting effects of the war on the urban forest are also related to the specific characteristics of the siege. For example, the greatly expanded cemeteries, where tree restoration is unlikely, resulted from the need to bury the siege victims when suburban cemeteries were out of reach. In the peri-urban forest, the land-use conversion to agriculture (by refugees) has also created areas where tree restoration is unlikely. Another lasting effect of the war, and a constraint both to reforestation and to forest management in general, is the presence of landmines. Although most of the peri-urban area has been de-mined (some suburbs only as recently as 2006), some wildland forests are still considered off-limits to foresters.

- *Tree removal was a last resort of people reduced to freezing to death*. As noted in *Zlata's Diary*, Sarajevans were very proud of their city trees prior to the siege, and damage to trees had been neither common nor tolerated. As an example of this, immediately following the initial attacks in April 1992 – unaware of what extended calamity awaited them – Park-Sarajevo employees and Forestry Faculty professors surveyed the tree damage caused by the first round of shelling, intent

Fig. 22.3 Tree on Austrijski Trg (Austrian Square) with a basal scar. During the siege, someone started to cut down this tree, but was interrupted by news cameras and, embarrassed, gave up. This situation was, we were told, somewhat common

on 'sending the bill' for the damages to the Bosnian Serb fighters. Similarly, Sarajevans even during the siege were quite aware that tree cutting was wrong: we were directed to several large trees with strange basal scars (Fig. 22.3). In what was a repeat occurrence, residents would begin to fell a tree, but then news cameras would appear (to document the wartime hardships) and the tree cutter(s), embarrassed, would abandon their effort.

- *Importance of appropriate planting stock (species, size) and of careful transport and handling of material*. Planting stock donations were welcome in Sarajevo after the war, because the local municipal nurseries had been completely destroyed. However, several problems arose with some planting stock that was initially contributed. A portion of saplings labeled as London plane tree were actually oriental plane tree (*Platanus orientalis*). These saplings were not adapted to the early winters of Sarajevo and suffered frost damage, although the trees still

survive along Zmaja od Bosne Avenue, exhibiting branch dieback and stunted growth. Other donated trees were over-mature (as tall as 4–5 m) and, having had their roots trimmed for transport, did not survive planting. In addition, some hornbeam planting stock, donated during the winter of 1996, had been transported in warm, covered trucks, and had broken bud during transport. Unfortunately, low temperatures in Sarajevo at the time the plants arrived resulted in the freezing death of these trees.

- *Importance of good initial plans (once planted, the trees acquire community support)*. In a sign that Sarajevans are again proud of their trees, Park-Sarajevo employees trying to remove the struggling oriental plane trees have met public disapproval, as the residents wish that these trees be retained both as a reminder of the support from European Union, and because they (again) are loath to see any tree removed (see Tidball, Chap. 4, this volume, for a discussion of the psychological importance of the stewardship and restoration of nature in red zones).
- *A remarkably productive cooperation of academic experts and municipal arborists in assessment, planning, and planting*. A partnership between the Forestry Faculty of the University of Sarajevo and the city's municipal arborists was an important contributing factor to the success of the replanting effort. This cooperation, begun with the wartime and post-war planting (e.g., by Hećo, and other Park-Sarajevo employees), continued during the post-war damage assessment and inventories (Janjić 2002) and continues today (e.g., the tree condition assessment by Dautbašić et al. 2008), and will result in an urban forest that is in many regards improved relative to the pre-war condition. For example, guided by the Forestry Faculty professors, the city accepted the donations of species that were previously not planted but are climatically appropriate, e.g., Chinese tallow tree *Triadica sebifera*, and several non-native whitebeam species (*Sorbus*), further increasing the overall tree diversity.
- *Rapid recovery of urban forest after the war with good plans and fast extensive replanting, resulting in multiple benefits*. Sarajevo is still being rebuilt 15 years after the war has ended. Although no longer ubiquitous, the damaged buildings remain (Fig. 22.4), and suggest the magnitude of the destruction that had been wrought by the siege. However, even a well-informed visitor to Sarajevo today is unlikely to accurately estimate the devastation the city's green spaces and urban forest had experienced. This is because the post-war replanting has been so thorough and tree growth so effective in re-creating Sarajevo's urban green canopy. It is only the uniformly small size and height of trees along most streets and in most parks – the streets and parks which themselves appear old – that suggest the recent origin of the trees, and hint at some destructive force that had obliterated the earlier tree population. This rapid restoration of the urban forest has multiple benefits, in addition to the economic and the ecological. The growing trees not only screen and diminish the physical damage in the city, but they also provide a sense of revival, growth, and potential – the qualities which reflect today's Sarajevo and its residents.

Fig. 22.4 Sarajevo today: the rebuilt and repaired (building, *left*), alternating with the still-common reminders of the war (*right*)

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References

Association des Architectes DAS-SABIH. (1994). *Urbicide – Sarajevo = Sarajevo, Une Ville Blessée*. Paris: Centre Georges Pompidou (in English and French).

BBC. (2008). *On this day – 29 February 1996: Siege of Sarajevo is lifted*. Retrieved November 11, 2008, from http://news.bbc.co.uk/onthisday/hi/dates/stories/february/29/newsid_4667000/4667292.stm

Bejtić, A. (1973). *Ulice i trgovi Sarajeva: Topografija, geneza i toponimija (Streets and Squares of Sarajevo: Topography, Genesys, and Toponymy)*. Sarajevo: Muzej Grada (in Bosnian).

Bertram, C. (1997). *Ottoman Sarajevo: The urban history of Sarajevo in the Ottoman period and into the period of the dual monarchy*. Retrieved July 30, 2008, from http://www.friends-partners.org/bosnia/cb1.html

Beus, V. (2009a). Stare aleje Sarajeva (Old allées of Sarajevo). *Fondeko Svijet, 28*, 32–33 (in Bosnian).

Beus, V. (2009b). Nove aleje Sarajeva (New allées of Sarajevo). *Fondeko Svijet, 29*, 50–51 (in Bosnian).

Bures, F. (2001). Turning gold into green. *American Forests, 107*(1), 44–48.

Cheng, S., & McBride, J. R. (2006). Restoration of the urban forests of Tokyo and Hiroshima following World War II. *Urban Forestry and Urban Greening, 5*, 155–168.

Cohen, R. (1998). *Hearts grown brutal: Sagas of Sarajevo*. New York: Random House.

Dautbašić, M., Treštić, T., & Višnjić, Č. (2008). *Program sanacije oštećenih stabala u 'Vilsonovom Šetalištu' (Restoration of damaged trees along 'Wilson's Promenade')*. Sarajevo: University of Sarajevo (in Bosnian).

Dear, I. C. B. (1995). *The Oxford guide to World War II*. Oxford: Oxford University Press.

Donia, R. J. (2006). *Sarajevo: A biography*. London: Hurst and Company.

Filipović, Z. (1994). *Zlata's diary: A child's life in Sarajevo*. New York: Viking.

Helphand, K. I. (2006). *Defiant gardens: Making gardens in wintertime*. San Antonio: Trinity University Press.

Janjić, N. (2002). Šesti prilog poznavanju nesamonikle dendroflore Sarajeva i okoline. *Sixth contribution to the knowledge of the cultivated woody plants of Sarajevo and surroundings*. Works of the Faculty of Forestry University of Sarajevo *32*(1), 53–97 (in Bosnian, with English summary).

King, C. S. (2003). The siege of Sarajevo, 1992–1995. In W. G. Robertson (Ed.), *Block by block: The challenges of urban operations* (pp. 235–290). Fort Leavenworth: U.S. Army Command and General Staff College Press.

KJKP Park-Sarajevo. (1996). *Štete na urbanom zelenilu Sarajeva (Evaluation of the war damage to urban greenery of Sarajevo)*. Sarajevo: Kanton Sarajevo (in Bosnian).

Kurspahić, K. (2008). Trees for Sarajevo after the war. *REC News – The Bulletin 8/1*. Retrieved November 11, 2008, from http://greenhorizon.rec.org/bulletin/Bull81/Sarajevo.html

Machlis, G. E., & Hanson, T. (2008). Warfare ecology. *BioScience, 58*(8), 729–736.

Morris, E. S. (1997). *British town planning and urban design: Principles and policies*. Harlow: Longman.

Munro, R. (1895). *Rambles and studies in Bosnia-Herzegovina and Dalmatia: With an account of the proceedings of the congress of archaeologists and anthropologists held in Sarajevo, August 1894*. Edinburgh: W. Blackwood.

Pintarić, K. (1998). Forestry and forest reserves in Bosnia and Herzegovina (Invited report). In J. Diaci (Ed.), *Virgin forests and forest reserves in central and East European Countries: History, present status and future development (Proceedings of the COST E4 meeting)* (pp. 1–15). Ljubljana: University of Ljubljana, Biotechnical Faculty.

Prstojević, M.(1994). S*arajevo, the wounded city*. Ljubljana: DAG Grafika.

SGS Qualifor. (2006). *Forest management certification report 9325-BA*. Retrieved November 11, 2008, from http://www.forestry.sgs.com/9325-ba_-_sar-s_gbosansko_ma2006-10_-_ad36a_gm_-_psummary.pdf

Silber, L., & Little, A. (1996). *Yugoslavia: Death of a nation*. New York: Penguin.

Šilić, Č. (1983). *Atlas Drveća i Grmlja (Tree and shrub atlas)*. Sarajevo: Svjetlost (in Bosnian).

Starry, D. A. (2003). Foreword. In W. G. Robertson (Ed.), *Block by block: The challenges of urban operations* (pp. vii–x). Fort Leavenworth: U.S. Army Command and General Staff College Press.

Strachan, H. (2003). *The First World War: A new illustrated history*. London: Simon & Schuster.