UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Main Mall Tree Inventory

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Section 1: Executive Summary

For my capstone project, I conducted a tree inventory of the red oaks (*Quercus rubra*) on Main Mall. In total, I inventoried the red oaks from Agronomy Road to Agricultural Road (Figure 1). I am also working for UBC SEEDS who is interested in acquiring data from multiple tree inventories on campus. An updated campus tree inventory can help managers better understand the condition of UBC's urban forest assets and ultimately, help with the development of an urban forest management plan. The Main Mall was a high priority area to be inventoried since it is frequently used and an iconic part of the core campus environment. The parameters I had collected were GPS coordinates, DBH, crown height, tree height, tree tag ID, crown width, percentage of green groundcover, and probability of failure. These parameters were decided based on UBC's Tree Inventory Handbook. This handbook was another SEEDS project developed by other undergraduates who conducted a tree inventory at UBC's Stadium Neighbourhood. To collect GPS Coordinates, I used the Avenza Maps application on an android device. Crown and tree height were accurately measured using the Nikon Laser Rangefinder. The D-tape was used for finding DBH at approximately 1.3m from the base of the tree. Recorded figures for each tree's crown width are an average taken from the crown measured from north to south and east to west orientation. Crown width was measured with a tape measure initially. Once I gained the concept for sensible figures for width and found out my pacing measurements, pacing was done to find crown width. Percentage of green groundcover and probability of failure was based off of visual assessments.

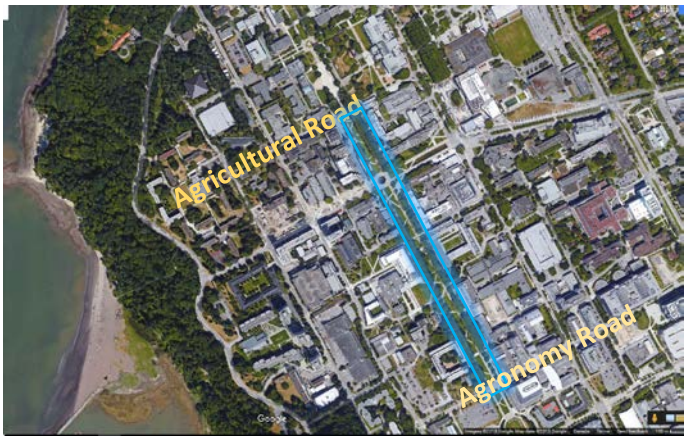

Figure 1: The part of Main Mall that was completed for the current inventory as indicated by the blue rectangle. Map derived from Google Maps.

Section 2: Findings from the Inventory

As a highly trafficked and multipurpose area, the great amount of compaction on Main Mall would impact the health of the red oaks. Although there was a range of conditions in terms of health for the inventoried trees, majority of the trees had good vitality. Despite the fact that all the trees were located along Main Mall, trees located in certain areas are growing under specific environmental conditions, which is likely to be reflected in the way tree grows. For instance, trees that are located at intersections are likely to be growing on compacted soil and are more vulnerable to mechanical damage due to high pedestrian traffic. Trees that are located southeast from the Martha Piper Plaza, except for those beside the Neville Scarfe Building (SCRF), are bordered by a concrete pathway on one side. The trees in front of the SCRF and northwest of the Martha Piper Plaza are bordered by concrete pathways on two sides. These trees have also shown more signs of tree failure, which may be attributed to unample soil volumes. Trees that are growing in limited soil volumes, such as by the Chemistry Building (CHEM) or by SCRF are more water stressed because their rate of uptake by roots is less than the rate of water lost from foliage (Lilly et al., 2010). With increasing average temperatures due to climate change, the water management of trees should be incorporated into current discussion between planners and architects. Later in the report, I will discuss the indicators of the probability of failure.

In total, 89 trees were measured over the span of four days. The tallest tree measured was 37.6m. Its tag number is 5888 and it is located by the CHEM. The shortest tree measured is 6.8m tall, by the Biological Sciences Building (BIOL). The average tree height is 20.8m. There is a large discrepancy between the tallest and shortest tree and a wide range in height values because as trees die out, they are replaced with new oaks. The highest crown ratio is 96.8% while the lowest is 37.8%. The tree with the highest crown ratio is also the tallest inventoried tree. The crown width of this tree is about 18m. Average crown ratio is 85.8%. The tree with the greatest DBH of 126.1mm is by the Earth and Ocean Sciences Building (EOS) and has a height of 25m. The tree with the lowest DBH of 9.1mm is also the

shortest inventoried tree. Average DBH for all trees calculated is 67.1mm. Crown width for each tree was estimated by pacing from north to south and east to west. The average of these two measurements is recorded as crown width. The tree with the widest crown width of 25m also had relatively great height and DBH. Similar to many other trees, the crown of this tree spreads wide enough to have contact with neighbouring light posts. Thus, utility pruning may be needed to taken into action soon. The tree with the shortest average crown width of 2.5m is also the shortest measured tree and has the smallest DBH.

Table 1: Statistics for Inventoried Trees.

	Tree Height (m)	Crown Ratio (%)	DBH (mm)	Crown Width (m)
Average	20.8	85.8	67.1	13.3
Greatest	37.6	96.8	126.1	25
Least	6.8	37.8	9.1	2.5

Figure 2: Indication of inventoried red oaks with outstanding statistics. The numbers of the trees are from their ID tags, except for one tree with no tag (listed as "Untitled Placemark"). Map derived from Google Earth.

The Probability of Failure

The probability of failure rating system was derived from UBC's Tree Inventory Handbook (Bellis et al., 2017). This is adopted from both the US Forest Service Urban Tree Risk Management and the International Society of Arboriculture Tree Health and Risk Assessment.

Table 2: Rating of Probability of Failure derived from the UBC Tree Inventory Handbook (Bellis et al., 2017).

Probability of Failure Rating	
1	Decay <25%, minor architectural problem
2	Decay 25-40%, single crack, minor root damage
3	Decay 25-40%, multiple cracks, moderate root damage
4	Decay 25-40%, dead wood, large cracks
5	Decay >40%, dead wood, severe damage

For rating the probability of failure, most trees (37%) were assigned a rating of 1, meaning they only exhibited minor architectural problems. Only 3 trees (3%) were given a rating of 5 as they seem to be severely damaged. When a tree matches any of the description ratings from table 2, they would be assigned the highest matched rating. The percentage of decay helps to define the rating of probability of failure. University arboriculturalist, Collin Varner, says that it is difficult to visually determine the amount of decay and that most common decay fungus, turkey tail (*Trametes versicolor*), is usually only visible high into the crown. Other potential indicators of decay are cracks, wounds, bulges, carpenter ants, fruiting bodies, and small cavities (Lilly et al., 2010).

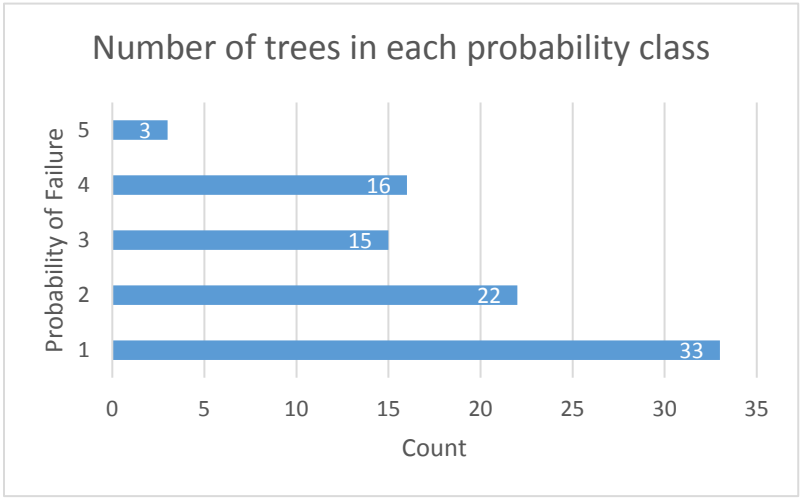

Figure 3: Number of trees in each probability class.

Examples of Each Probability of Failure Rating

If the only defect spotted on a tree were broken branches and water sprouts or there was no architectural issue identified, they were assigned a rating of 1. Although these trees are low priority in terms of arboricultural attention, their broken branches could potentially hit a target as well as clue into the tree's resistance to winds.

Trees with a rating of 2 may have only one crack spotted or/and some root damage. If there are no signs of root damage but compaction is high, it is assumed that there will be some damage to roots.

Once moderate root damage and/or multiple cracks are spotted, the tree will be assigned a rating of 3. Examples would be cracks from mechanical damage, cracked bark of roots, and girdling. Many cracks observed are assumed to result from mechanical damage as they are located low on the tree.

Trees with a rating of 4 would have eye catching cracks and dead wood. I identified dead wood by spotting cankers and fruiting bodies. Large cracks provide entrances for insects and diseases that can rot wood and produce cankers, eventually disrupting the tree's ability to transport materials internally (Lilly et al., 2010).

Trees with severe cracks would be given the highest rating. The three trees that had the highest probability of failure had multiple signs of failure that stood out in severity from the rest. If a cavity becomes sufficiently large that it diminishes the tree's strength, the ISA handbook suggests removing or pruning the tree so that the weakened area carries less weight.

Additional interesting observations that were not necessarily considered in rating the probability of failure includes graffiti, staples, nails, dog feces, plastic wrap caught in crowns, established holly and ferns on the crotch of the tree, rubbing branches, crowns of individual trees being too close to light posts and nearby trees, chauffeur beetle invading the surrounding lawn, and unidentified stains.

Here are a list of trees that may require professional attention in the near future based on a general visual assessment:

Table 3: Trees that currently require professional examination by an arborist.

Tree Tag ID	GPS Coordinates	Issue
n/a	49.26545, -123.25379	Woody mushrooms on ground
5920	49.26502, -123.25332	Black and white fruiting body at base
5415	49.26117, -123.24981	Turkey tail fungus
5416	49.26138, -123.24996	Tag needs replacement

5608	49.26315, -123.25122	Unsure if dead or alive
n/a	49.26578, -123.25407	White sap and fruiting body
n/a	49.26096, -123.24946	Unknown fungus on branch
5547	49.26183, -123.25008	Unknown gall structure, insect signs
5548	49.26193, -123.25021	Overhanging broken branches
5545	49.26154, -123.25026	Utility pruning, tag needs replacement
5616	49.26297, -123.25154	Turkey tail
n/a	49.26236, -123.25096	Fungus spotted?
5915	49.26516, -123.25296	Unknown red orange stain
5916	49.26559, -123.25308	Unknown red orange stain
5564	49.26183, -123.25077	Tag needs replacement
7781(?)	49.26364, -123.25208	Original tag missing

Section 3: Proposed Recommendations

Pruning

In order to reduce the probability of failure, pruning dead or broken branches is a method recommended by Lilly et al. (2010). Pruning should be prioritized for trees with broken branches hanging over walkways or for trees with large broken branches. Newly planted younger trees should also be given attention in regards to how they develop sound structure. Pruning for good structure for young trees can help decrease chance of failure in the future. Pruning for these trees entails having a single straight leader and removing dead or broken branches. The types of pruning that will most likely be needed are crown cleaning for broken branches and perhaps thinning to improve air movement throughout the crown (Lilly et al., 2010). Crown reduction will be needed soon especially for trees by the HR Macmillan Building (MCML) as well as neighbouring trees with touching crowns (Lilly et al., 2010). Utility pruning would be done periodically to prevent crowns from damaging lamp posts. Although pruning can be accomplished any time, Lilly et al. (2010) recommend pruning between late winter and early spring rather than after initial growth flush since that may reduce tree growth.

Water Management

Currently, there is construction at the BIOL, which is located at the busy intersection of Main Mall and University Boulevard. This is a frequently used area where bike and pedestrian traffic is high

Figure 4: This tree is located at a busy intersection and by construction. Photo taken by Jane Ho on March 27, 2018.

(figure 4). Therefore, the oaks located here are currently under a lot of stress. The two oaks that are closest to BIOL at the major intersection are assumed to be younger than most of the oaks on Main Mall based on their size. Since these trees are younger, they require frequent irrigation, especially within the root ball (Lilly et al., 2010). According to Lilly et al. (2010), one of the most important treatments following construction damage is maintaining adequate drainage and water supply to the root zone. Furthermore, they suggest that a "slow soaking of the entire root zone" is ideal for watering (Lilly et al., p.225, 2010). It is important to avoid watering directly or near the tree trunk and shallow watering should not be done to avoid shallow rooting (Lilly et al., 2010). Construction and maintenance operations can also cause water flow to be filled with pollutants and chemicals. Treatment of water is a consideration to be taken but one that is costly (Lilly et al., 2010). In addition, some tree defects that were noticed during inventory were girdling roots, cankers, and trunk injury. These defects disrupt the tree's vascular system (Lilly et al., 2010).

It was noticed that the soil near the SCRF and the Martha Piper Plaza was extremely muddy and wet. Professional assessment of this area is needed to evaluate drainage conditions. If drainage is a problem here, an option would be to change grade or trench to improve surface drainage (Lilly et al., 2010). Where water drainage is known to be slow, standing water can be avoided by slowing irrigation rates so that it is slower than infiltration rates (Lilly et al., 2010). As mentioned earlier, high compaction along the Mall is a big factor for poor drainage conditions. To reduce compaction, aeration is a solution that can be done by multiple methods, which I will talk about in the following section.

Aeration

Soil aeration has multiple benefits like improving root growth, water uptake, and improving soil compaction (Lilly et al., 2010). One way to aerate the soil would be via radial trenching that extends to

the dripline (Lilly et al., 2010). Then the trenches should be back filled with granular material such as coarse sand (Croy, 2018). Radial trenching can be done by using an air excavator, which helps improve soil conditions and cause less root injury (Lilly et al., 2010). Other ways to aerate would be using a walk behind core aerator or by low cost, labour intensive hand punches core aerators (Croy, 2018). In combination with aerating the soil, fertilizing may be considered.

Fertilization

If fertilization is desired and there is sufficient funding, Croy (2018) suggests drilling holes 5-10cm deep, 30-90cm apart, and filling them with slow release granular fertilizer. This puts the fertilizer under the grass roots and in the vicinity of feeder roots of the oaks so that I can be captured and taken up (Croy, 2018). Croy (2018) adds that the high bulk density of soil helps with decompaction and soil aeration too. A cheaper method of fertilizing would be to use a hand spreader (Croy, 2018). If fertilizer is to be applied, it should be done in mid to late April since oaks break bud in April in Vancouver and active growth happens though May and June (Croy, 2018). This ensures the fertilizer is dissolved in soil water by the time buds break and active growth takes place (Croy, 2018). As for trees that are currently affected by construction or will be in the future, Lilly et al. (2010) does not recommend fertilizing these trees the first year after construction damage because “root damage may inhibit uptake of water and minerals” (p.226). They also stress to avoid over fertilizing and to only fertilize based on soil and foliar analyses (Lilly et al., 2010).

Mulching

Organic mulch releases essential elements to the soil as it decomposes so supplemental fertilization may not be necessary (Lilly et al., 2010). Mulching has multiple advantages such as regulating temperature, suppressing weeds, conserving water, improving aeration, enhancing soil biodiversity, preventing mechanical damage, decompacting soils, and improving water infiltration. Croy (2018) says a preferred method would be to add a quality mulch compost mix that will help reduce soil

bulk density. The mulch layer should be 5-10cm thick and extend outwards rather than piling up. (Lilly et al., 2010). A trade off with applying mulch is that it may impact the aesthetics of the Main Mall and create habitats for small animals that can injure the tree. The difference in appearance after mulching would be most obvious near the SCRF and CHEM because the oaks here are in between two paved walkways that are less than 5m apart. Since there are animals that move quickly across campus and there are special events that occasionally occur on Main Mall, a little bit of messiness can be expected from mulching.

Figure 5: Many trees had cracks that may result from mechanical damage or vandalism. Photo taken by Jane Ho on March 27, 2018.

Mechanical Damage

A number of trees had cracks that are most likely to have resulted from mechanical damage. Young and newly planted oaks should be protected from this kind of damage as it can affect future growth conditions. Installing a temporary metal tree guard around the trunk would be a solution. Tree guards can also discourage vandalism and feeding by some animals (Lilly et al., 2010).

Tree Support Systems

Figure 6: Large codominant stems were often spotted for the trees on Main Mall. Photo taken by Jane Ho on March 25, 2018.

A number of oaks lacked a central leader and codominant stems were a trait obvious for some trees (figure 6). Oaks are more susceptible to codominant stems (Andra, 2018). Codominant stems indicate a weakened part of the tree. If the conditions ignored major concerns are branch tear out and insect infiltration (Andra, 2018). Further, Andra (2018) adds that untreated codominant stems will eventually push themselves against each other until the weaker side splits off from the trunk. The installation of static cabling systems can help to support these trees or bracing can be done in combination with cabling (Lilly et al., 2010).

Fungus and Pathogens

Figure 7: Trametes versicolor fruiting body. Photo taken by Jane Ho on March 25, 2018.

During inventory, there were signs of root pathogens, cankers and fungi spotted. Identification of species is referenced from online resources. A university arborist reported that there was turkey tail fungus on the oaks but signs would be most evident high up in the crown. I had also spotted the fruiting body on a tree near the BIOL (figure 7). They are able to colonize plants stressed by water shortage, sunburn, damage, or wounding (Hickman et al., 2011). It is a common decay for hardwoods and invades the cambium layer of trees to accelerate a tree's demise (Lee, 2013). There was a lack of information online about the management of turkey tail but research shows that the fungus has great cultural value. Glaeser and Smith (2010) advises sanitation pruning to remove infected branches and to prevent spread.

Figure 8: Fruiting body of fungus believed to be Armillaria. Photo taken by Jane Ho on March 25, 2018.

For one to two trees, tan coloured mushrooms in clusters were seen in the rooting zone (figure 8). It is assumed that the observed fungus is Armillaria root disease (*Armillaria spp.)*; however, further examination of the tree is needed to confirm the fungus species. Symptoms of Armillaria root rot include reduced height, chlorosis, chronosequence, resinosis, rapid tree death for saplings, and production of stress crop (Hamelin, 2017). One management strategy would be reducing the inoculum by stumping. This effective method dries out the roots and the fungus. The downside of this method is that it is quite costly.

body that was spotted on a few occasions. Photo taken by Jane Ho on March 18, 2018.

There is one type of canker observed that may be the Nectria (*Nectria spp.)* canker. The oval layered appearance of the canker is a characteristic of Nectria species. The canker invades the tree while it is dormant and as the tree attempts to seal off the fungus, a canker scar forms (Burke, 2017). Another sign of the fungus

are red orange fruiting bodies (Burke, 2017). Although I did see red orange stains, they did not look like fruiting bodies. For young oaks, the canker can girdle, kill or increase susceptibility to winds (Arbor Consulting, 2003). Control of this canker can be done by minimizing pruning during wet weather, avoiding pruning wounds, removing cankered branches, and sterilizing pruning tools before pruning uninfected trees (Arbor Consulting, 2003).

Finally, there is one type of basal rot that I could not identify. It is a black potato shaped fruiting body that has a smaller white irregular shaped fruiting body attached (figure 9). Since I have mostly spotted this fungus at the base of trunks, I assume that it is a basal rot. Attention needs to be directed to these infected trees since basal rots can cause trees the fail at the base, which is dangerous (Lilly et al., 2010).

Girdling

A few trees have demonstrated girdling roots (figure 10). Girdling can be dealt with by removing the portion of the root that is in contact with the stem (Lilly et al., 2010). If girdling is severe enough to impact the structural stability of the tree, it may have to be removed (Lilly et al., 2010). Ultimately, Lilly et al., (2010) says the most efficient way to deal with girdling roots is to prevent them from occurring. This can be done through loosening up the roots during planting and making sure the soil is not too packed when a tree is being planted.

Figure 10: Girdling roots. Photo taken by Jane Ho on March 27, 2018.

One of the most important factors in guaranteeing the success in the health of the oaks would be having proper communication between UBC Campus and Community Planning, arborists, contractors, and urban foresters. Having good understanding of the main goals, protocols, and policies that relate to the project is key to the sound management of trees. Clear communication between the

different actors can help prevent accidents and damage to the university's urban forest assets, which saves a lot of resources in the long run.

Section 4: Reflective Conclusion

Although completing this inventory is a simplified version of what professional arborists do for clients, I had a taste of what doing a full inventory would be like. Thinking back to the technical aspects of urban forestry that we were taught in field camp, I feel that doing the entire inventory step by step alone made me understand how to use the tools and what each procedure means more fully. Writing up the recommendations section made me realize that urban foresters can excel and get a fuller perspective of a project if they participate in both the technical and analytical elements. Initially I thought this project would be straightforward and simple but in the process of completing the inventory, I reflected on many thoughts. It was very interesting to me how being in the shoes of a "pseudo" arborist actually feels different from what I had expected based off of listening about what the job entails in lecture. If I were to redo the inventory, I would create a separate checklist for signs of failure instead of writing each observation out. I also wished that I would have consulted experts in the field of pathology prior to inventorying the first tree.

References

Andra, T. (2018, February 16). Codominant Stems. Retrieved April 13, 2018, from http://www.timmystrees.com/codominant-stems/

Arbor Consulting. (2003). Nectria Canker. Retrieved April 13, 2018, from http://www.sicktree.com/pubs/oakpests/p52.html

Bellis, E., Ikeda, T., Naveau, A., & Miao, A. (2017, September 29). *UBC Vancouver Campus Tree Inventory Handbook* (Rep.). Retrieved April 12, 2018, from The University of British Columbia website: https://sustain.ubc.ca/sites/sustain.ubc.ca/files/UBC Vancouver Campus Tree Inventory Handbook_3.pdf

Burke, J. *Cankers* [PDF document]. Retrieved from Lecture Notes Online Web site: http://frst307.sites.olt.ubc.ca/files/2017/10/Lecture-14-Cankers.pdf

Croy, O. (2018). *Tree Identification, Soil Science and Tree Nutrition* [Lab Assignment Report]. The University of British Columbia, Vancouver

Glaeser, J. A., & Smith, K. T. (2010). Decay fungi of oaks and associated hardwoods for western arborists. *Western Arborist,* 32-46. doi:10.3897/bdj.4.e7720.figure2f

Hamelin, R. *Root Diseases* [PDF document]. Retrieved from Lecture Notes Online Web site: http://frst307.sites.olt.ubc.ca/files/2017/09/Root_diseases.pdf

Hickman, G. W., Perry, E. J., & Davis, R. M. (2011, June). Wood Decay Fungi in Landscape Trees. *Pest Notes*, *74109*, 4. Retrieved April 13, 2018, from http://ipm.ucanr.edu/PDF/PESTNOTES/pnwooddecay.pdf

Lee, Victoria. (n.d.). Turkey Tail Fungus on an Oak Tree Stump. Home Guides | SF Gate. Retrieved from http://homeguides.sfgate.com/turkey-tail-fungus-oak-tree-stump-73418.html

Lilly, Sharon J., and Peggy Currid. *Arborists' Certification Study Guide*. International Society of Arboriculture, 2010