100% INVENTORY METHODS FOR URBAN PARKS IN KHMELNITSKY, UKRAINE

By

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The project paper “100% Inventory Methods for Urban Parks in Khmelnitsky, Ukraine” is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN FORESTRY.

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Preface

Life in Ukraine as a Peace Corps Volunteer first began in the town of Kamyanets-Podilski. I was placed at the Podilski Tovtry National Nature Park. This placement was wrought with many serious problems. After eight months there, Peace Corps agreed I could not do my research there or in the area. Even working in the city could be detrimental to my safety.

After several months of waiting for a new site, I received a phone call from a fellow Peace Corps Volunteer in Khmelnitsky, a major city 2 hours north of me and my oblast center, the same as a state capital. The Volunteer's coordinator, Tetyana Pavlovna Dzyublyuk, had observed me giving a lesson plan demonstration on integrated pest management for K-12 children at a conference nine months earlier. Tetyana had been scheming for a way of stealing me from my current site since then because she needed inventories of the city's parks and squares completed. I thought this sounded like a good project to work on, so I granted permission for Tetyana Pavlovna to contact Peace Corps regarding my situation.

Following an additional month of preparations, I was moved to Khmelnitsky to work for the Khmelnitsky City Organization of the Ukrainian Society of Nature Protection. This organization is the city's Department of Ecology and Natural Resources' non-governmental organization (NGO) with Tetyana Pavlovna as the president. It was clear that I would be working with both organizations. The primary workload would be to help at the NGO where and when I could, to plan the tree plantings in three parks for Earth Day, and work on the park inventories. The inventories were not started for another four months because of adjustment to a new place and people, along with other little projects, which came up.

This new placement in Khmelnitsky provided me with the perfect site and job. I was able to combine my research and Peace Corps work into the ideal research project. I learned many new lessons and acquired many new friends throughout the time spent working and living in Khmelnitsky and Ukraine. This phase of my life began on a bad note and finished by giving me a dream job with incomparable experience.

Acknowledgements

I can never say how much Blair Orr, my advisor, means to me for not letting me quit when I wanted to, then telling me to quit when I could not, and in the end, making sure I knew it was all well worth it. I value all my committee members, Dana Richter, Linda Nagel, and Jim Mihelcic, have done for me. The emails, letters, and input on my paper are deeply appreciated.

In Ukraine, I was blessed with many friends and families. I thank each and every one of you much more than I ever let you know when I was there. I have to especially thank Victor and Svetlana Okonchuck and their families, who opened their homes and hearts to me, giving me support, guidance, and places of refuge during the insanity of Peace Corps life. Victor Okanchuck deserves an even bigger thank you for teaching me about Ukrainian forestry practices. I am eternally grateful to Tanya B. for all of the walks, talks, meals, and laughter. Words will not do justice to my fellow "Khmelnitsky Ladies", N. J. "Scotty" Scott and Linda DeGrave, and Tina Cintron. You three showed me the beauty of life and the graceful ways to overcome the hardships. Scotty, your assistance, drawings, and photographs for the inventories and management plans are invaluable. A standing ovation is given to Victor for patently answering all of my questions, translating all those meetings, and looking out for me. I wish the director, Tetyana Dzyublyuk, and the staff of the City of Khmelnitsky Department of Ecology and Nature Resources continued success in all of your endeavors. You are doing amazing things and I am honored that you let me be a part of it. A big thank you goes out to everyone at Peace Corps Ukraine. I would not be writing this paper if Oleg Smyichuk, Head Regional Manager, had not believed in me and supported me.

I would have never even made it to my Master's with out my friends and family here at home. Thank you to everyone who supported me before, during, and after this latest adventure, especially my parents and my brother and his family. Lastly, I thank Leah Engle for being the greatest of friends anyone could have. It is my turn, Leah, to pay for the phone bills and dinners.

Executive Summary

This paper presents methods for conducting 100% urban park inventories in Khmelnitsky, Ukraine and generalizes these methods to fit urban parks all over Ukraine. Figure ES 1 shows the main steps for conducting a 100% inventory in Khmelnitsky, Ukraine.

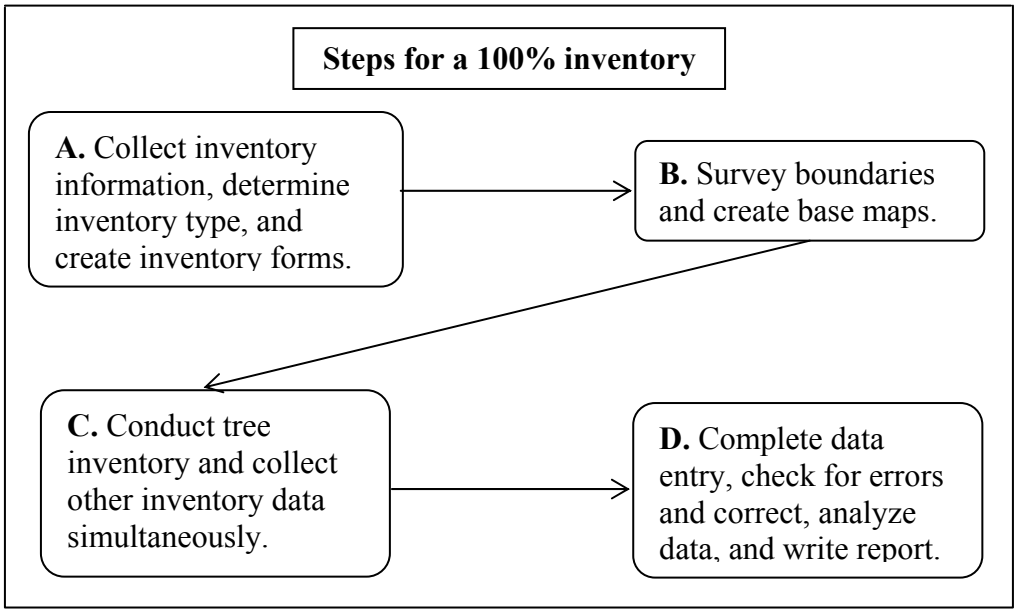


Figure ES 1 Flowchart of main steps for conducting a 100% inventory.

In step A, all relevant information for the inventory, such as inventory objectives, budget, personnel, deadlines, park documents and maps, is collected. The type of inventory and what is to be inventoried is decided upon after all of the collected information is assessed. The forms to record the inventory information can be made and copied. Inventory equipment is located. The officials who are requesting the inventory will need to be consulted throughout the inventory process.

Step B is the survey of the park's boundary. One must decide if the park is to be subdivided into sections for easier data collection. Any questionable boundary lines are discussed with the officials who requested the inventory and determined. The base maps are created.

Step C is the actual inventory. All tree information and any other requested information about the parks is gathered. All of this information is entered into the inventory forms and mapped.

Step D is to complete data entry into a computer, if used, and to check all maps and inventory forms for errors. The errors are corrected. The information is analyzed and the final copies of the maps and the final report are prepared.

The methods presented were developed through trial and error, based on national and local limitations. Several limitations were discovered. Information and trained urban foresters are hard to find and expensive. Volunteerism has bad connotations, so few people volunteer. GPS is generally not allowed or is not financially feasible. Legal versions of GIS programs are too costly for the average Ukrainian organization and Ukraine lacks trained personnel to run these programs. Basic forestry equipment is not readily available to the public. Ukraine has never had a national land survey performed, so no benchmarks or marked property lines are present.

These limitations dictated that the inventory methods had to be simple, adaptable, and easy to use by non-foresters. With Ukraine's economic and political growth, the limitations will disappear along with these methods and more technologically advanced urban forestry systems will be adopted. When this happens, the information gathered with these inventory methods can be used as the base line for future inventories.

Chapter 1 Introduction

The history of urban parks dates back to as early as 3000 B.C. in Egypt (Miller, 1997). Other early civilizations with urban parks were the Phoencians, Persians, Aegeans, Chinese, and the South American Indians (Grey and Deneke, 1992; Miller, 1997). These early urban greenspaces developed into four main types of greenspaces: private gardens, promenades, town squares, and parks (Grey and Deneke, 1992; Lawrence, 1995; Miller, 1997).

The beginnings of modern European parks can usually be traced back to royal hunting grounds, which were located on the urban fringe. Over the years, these parks were redesigned and wider social classes were allowed admittance. By the nineteenth century, city parks had achieved the designs known today and were open to all social classes (Lawrence, 1995).

The historical economic and political situations across Europe show corresponding increases and decreases in the number and quality of urban greenspaces with increased or decreased power and money of the ruling parties (Grey and Deneke, 1992; Miller, 1997). When economies and politics are stable, people have promoted urban greenspaces because these areas provide aesthetics to urban living, natural settings within municipalities, and play a role in social power struggles (Grey and Deneke, 1992; Lawrence, 1995).

Ukraine, as an Eastern European country, has many urban parks (Stebelsky, 2001). With the rejuvenation of Ukraine's economy and its political change to democracy, a renewed focus is being placed on urban parks. During the Soviet era of the

country, various organizations and departments within a municipality managed the city's parks. The new vision of city administration calls for one department to manage all of the municipality's parks. For this turnover to occur, the new departments must know what resources are being received and will be managed. The purpose of this paper is a description of how general methods for inventorying in Ukrainian cities were developed from field experience with urban park inventories in the City of Khmelnitsky.

Chapter two will present background information on the country, Ukraine, and urban parks within Ukraine and on the study site, the City of Khmelnitsky, and Khmelnitsky's parks. Chapter three describes the development and methods used for 100% inventories for Khmelnitsky's parks, along with a description of each park. Chapter four discusses the results and gives a general, but detailed, outline for conducting a 100% inventory for municipal parks. Chapter five concludes this research paper with recommendations on how to vary the inventory methods to fit other types of parks.

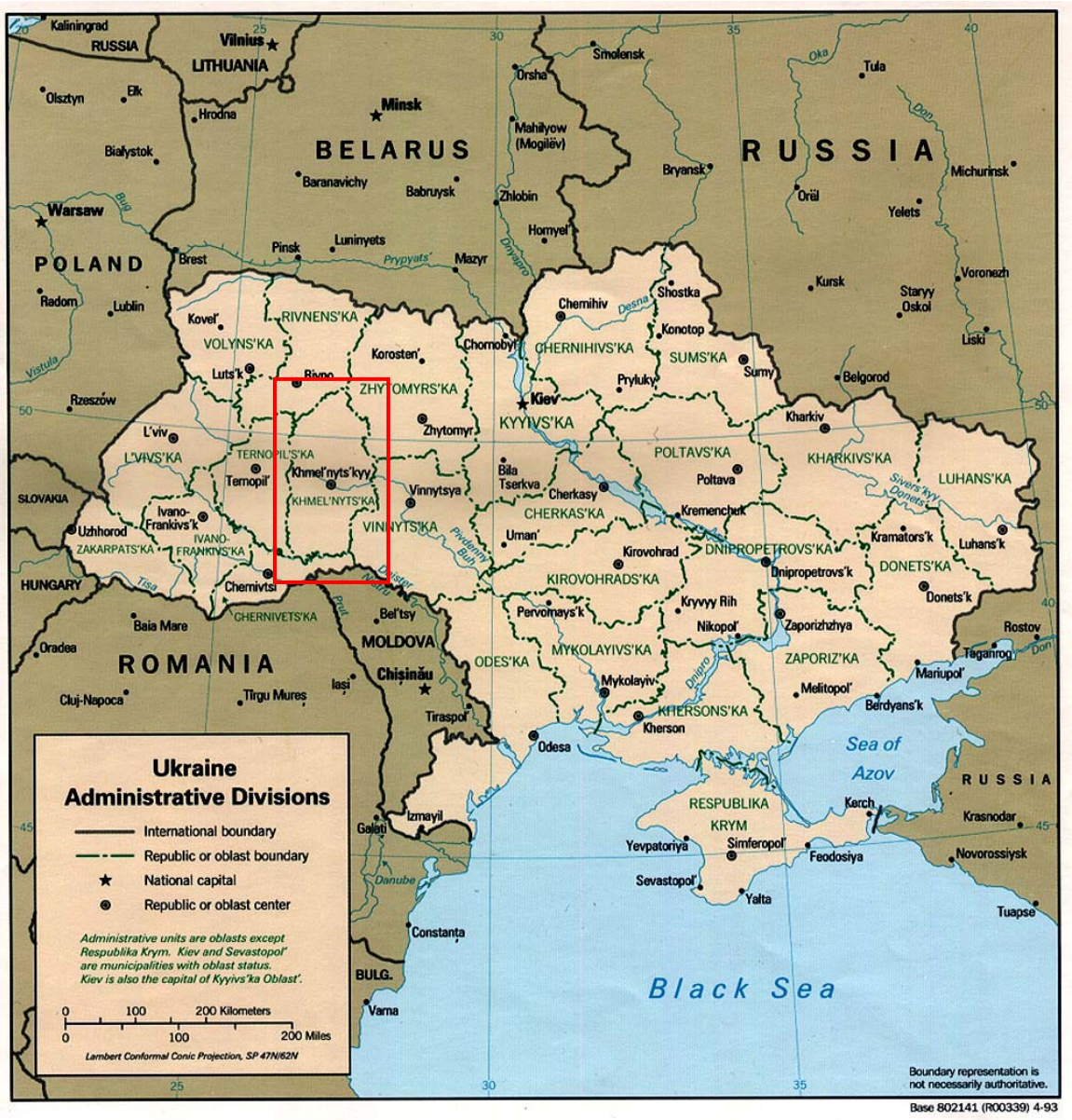
Chapter 2 Country and City Background Information

Ukraine Country Information

Background

A former Soviet Republic, Ukraine is located in Central Europe. It is bordered by Russia on the west, Belarus on the north, Poland, Slovak Republic, and Hungary on the east, and Romania, Moldova, the Black Sea, and the Sea of Azov on the south (Map 2.1). The Dniper and Dnister Rivers are the main waterways within the country with several secondary river systems. The capital of the country is Kyiv. Ukraine is divided into 24 oblasts (states) and the Autonomous Republic of Crimea. Each oblast has its own oblast center, which presides over the oblast's lower ranked divisions and in return, answers to Kyiv.

Ukraine's long history and association with the Soviet Union gives the illusion of a prospering country. In many ways, it is. However, Ukraine is undergoing economic and social changes, which are altering the country from an agricultural tradition to one of industrialization. One of the effects of this is the shift in population from the villages to urban centers. With the increase in urban populations, the need for city parks grows. These new and old parks need to be maintained. This maintenance requires trained personnel and urban forestry methods. If appropriate urban forestry methods were devised, then personnel would only need to have basic training and knowledge of forestry practices to be able to complete the necessary park maintenance. This paper discusses one of the urban forestry methods needed in Ukraine: urban park inventories.



Map 2.1: Bordering countries of Ukraine with main seas and rivers
(CIA, Perry-Castañeda Library Map Collection, 1993)**,**

showing Khmelnitsky Oblast and city in the red square, the location of the research site.

Ukrainian independence was declared on August 24, 1991 and the country was made a republic. Before 1991, Ukraine had a long history of being ruled by outsiders. The first Ukrainian period appeared approximately in the 9th century, known as Kyivan Rus. It was a principality. Feuding between the princes destroyed the regime's supremacy and the Mongols invaded. Mongolian rule lasted for over 200 years. The Poles and Lithuanians moved in and fought over the vast area after the Mongols left. The Cossacks, nomads of the steppe and defenders of Ukrainian independence, joined forces with the Russian tsars to overthrow the others in the 1600s. This patronage led to imperialism in Ukraine until 1917, when the throne fell to the Communists. Ukraine tried to remain independent, but failed and became the Ukrainian Soviet Socialist Republic in 1922 (Microsoft Encarta Online Encyclopedia, 2004). With the fall of the Soviet Union in 1991, Ukraine finally became independent. The different eras of Ukrainian history each left a mark on the cities and their parks.

The past also influences the ethnicity in the various areas of Ukraine. The west has more Poles and Hungarians, the east-Russians, and the south-Tatars and Romanians. Ukrainians make up 72.7% of the population. Russians are the next largest group at 22.1%. The other large groups are all less than 1% individually: Jewish, Byelorussian, Moldovan, Polish, Bulgarian, Hungarian, Romanian, and Georgian (Погурельська, 1998). The total population for the country is 47,732,079 (CIA World Factbook, 2004). The country's large population puts pressure on urban greenspaces, making it necessary to create new greenspaces and to increase maintenance.

The country's official language is Ukrainian. Nevertheless, Russian is more predominate in the country's eastern half and Ukrainian is spoken more in the western

half. It is not uncommon to run into Russian speakers in the eastern part that do not know Ukrainian, but the majority, country-wide, knows Russian to some degree, even though they may refuse to speak it. Professionals try to use Ukrainian, but some professions have not adapted the terminology from Russian to Ukrainian. Forestry is one of these professions, which uses a mixture of both languages with books rarely available in Ukrainian.

The literacy rate, defined as those who are age fifteen and over and can read and write, for Ukraine is 99.7% (CIA World Factbook, 2004). School is mandatory through eleventh grade (Educational Network Ukraine, 2001). Ukrainian forestry workers do not have to attend higher education in order to be employed. They can gain experience on the job.

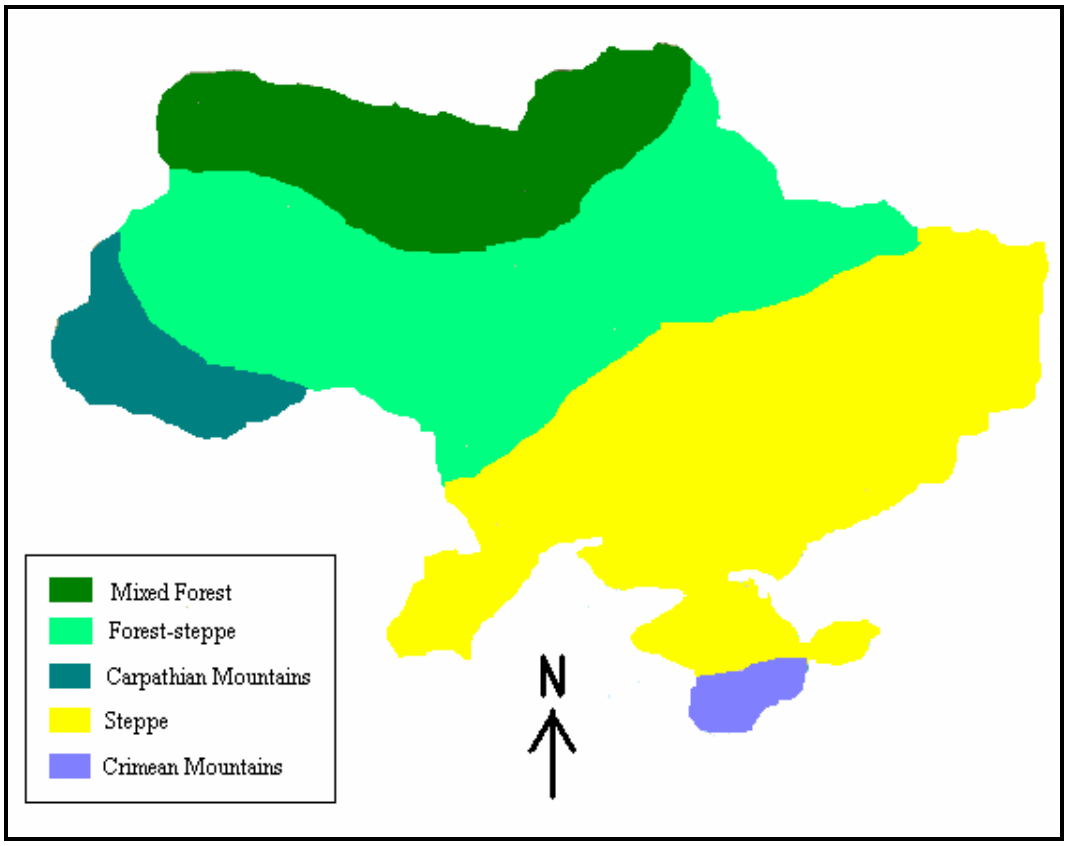
The economy of Ukraine was stable during the communist rule, but fell with the fall of the USSR and afterwards. In 2000, the economy accelerated and grew by 8.2% in 2003 (CIA World Factbook, 2004). This economic increase assisted with the renewed focus on urban parks.

Ukraine's industries are metal processing and machine building (42.9%), light industry (10.5%), food processing (9.2%), fuel industry (9.2%), metallurgy (6.8%), chemical and oil chemical (4.7%), forestry and wood and cellulose paper processing (4.2%), glass and china (1.0%), and other (9.3%) (Погурельська, 1998). Industry accounts for 32% of the work force and 44.8% of GDP (CIA World Factbook, 2004). The agricultural sector is broken down into tillage (79.5%), hayfields and pastures (17.9%), and other (2.6%). These percentages are for arable land only (Погурельська, 1998). The agricultural sector employs 24% of the work force and 18.8% of GDP (CIA

World Factbook, 2004). The service sector employs 44% of the work force and 36.4% of the GDP (CIA World Factbook, 2004). Ukrainian cities are growing in population as agriculture becomes less predominate while the industry and service sectors increase. The need for more and better maintained urban greenspaces is becoming an increasing concern. Organization of public services has declined; urban greenspace maintenance has also declined. Greenspaces located in urban centers have decreased since 1990 by 30% (Дзюблюк і Дранус, 2003).

The area of Ukraine is somewhat smaller than the state of Texas, at 603,700 km^2 (Погурельська, 1998; CIA World Factbook, 2004). Of this 603,700 km^2, 500,000 ha are located in cities and towns as greenspaces (Дзюблюк і Дранус, 2003).

There are five main geographic regions in the country (Map 2.2). The north houses the mixed forest. The Carpathian Mountains are in the west and the steppe covers the east and most of the south. The forest-steppe is located in the area between the mixed forest, Carpathian Mountains, and the steppe. The Crimean Mountains are on the Crimea Peninsula in the south (Buksha, 2004). The climate is temperate continental except for the Crimean Peninsula, which is Mediterranean. The average temperature in Kyiv for January is –6˚C and 20˚C in July (Microsoft Encarta Online Encyclopedia, 2004). Average annual precipitation for the country is 500 mm (Microsoft Encarta Online Encyclopedia, 2004). Both the temperature and the precipitation vary depending on the location within the country. These geographic and climatic differences add to the difficulty in creating a uniform urban parks program for Ukraine.



Map 2.2: Geographic regions of Ukraine (adapted from CIA, Perry-Castañeda Library Map Collection, 1993)**.**

Natural resources in Ukraine are abundant. Minerals include coal, oil, natural gas, iron ore, nickel, gold, titanium, manganese, uranium, sulfur, bauxite, mercury, graphite, magnesium, potash, kaolin, clay, salt, potassium, limestone, sand, chalk, marble, garnets, opals, and diamonds (Fedorick, 1997; Погурельська, 1998). Forest covers 9.6 million hectares (FAO Forestry: Ukraine Country Information, 2003). Twenty-five thousand species of plants grow in Ukraine with only 95 species used for medicinal purposes (Ministry of Ecology and Natural Resources of Ukraine, 1996; Погурельська, 1998). Ten to fifteen species of mushrooms are eaten in Ukraine, but ten thousand different species grow in the country (Погурельська, 1998). The birds, mammals, reptiles, amphibians, insects, and fresh and salt-water animals number approximately forty-five

thousand species (Ministry of Ecology and Natural Resources of Ukraine, 1994; Погурельська, 1998). Of the 45,000 species, 6600 are fresh-water species and 2400 are salt-water species (Погурельська, 1998). Five hundred forty-one flora species and three hundred eighty-two fauna species are listed in the Redbook of Ukraine (Ministry of Ecology and Natural Resources of Ukraine, 1994; Ministry of Ecology and Natural Resources of Ukraine, 1996). The Greenbook of Ukraine lists 126 endangered plant communities (Ministry of Environmental Protection and Nuclear Safety of Ukraine, 2000). The large numbers of threatened and endangered species and communities coupled with the amounts of natural resources increase the necessity of urban greenspaces. The economic and social aspects of metropolitan life are affected by the presence and condition of urban greenspaces (Дзюблюк і Дранус, 2003).

Parks

The first parks in Ukraine began appearing during Kyivan Rus as the nobility's hunting grounds or monastery gardens. In the early 1700s, private parks began to emerge in baroque or French styles. During the latter half of the 1700s and the beginning of the 1800s, many landscape parks evolved. Affluent landowners created these new parks. One of the first public parks was begun in 1877. Urban parks were established in the late 1800s and early 1900s. The urban parks did not have a large variety of plant species or cover large areas. Metropolises had many parks and greenspaces except for the Donbas area, the far east portion of Ukraine from Luhansk to Dniperpetrovsk to Donetsk (Map 2.1, p.4) before 1914 (Stebelsky, 2001).

During World War I, the parks experienced extensive damage. After the Soviets came to power, the parks were neglected until 1926 when a new law was passed to protect the natural legacy. Towards the end of the 1900s, the Soviets created different types of new parks and enlarged the old ones in urban areas (Stebelsky, 2001). Some were theme parks with children's rides and toys; others were for strolling through quiet woods or devoted to athletes' needs.

National parks were formed from the existing large parks and new national parks established as the urban population grew. National parks are state operated. Forest parks were set up around cities. These parks are large tracts of land set aside for recreational uses. Hydroparks were established for water activities, such as boating and swimming. Dendroparks were areas with large numbers of different species of trees and shrubs grown for research and tourism. Botanical gardens and zoological parks were begun and maintained by scientific organizations. Natural formations like waterfalls and rock formations were turned into natural monuments. Recreational and cultural parks are urban parks with various themes and are run by the municipalities (Stebelsky, 2001). The many different organizations involved in running the Ukrainian parks leads to inconsistent standards throughout the country.

When the Soviet Union fell, money was no longer available for maintenance of the parks. Now, with the economy growing, money is being redirected to the parks for improvements and upgrades of the old parks and creation of new ones (Figure 2.1) (Дзюблюк і Дранус, 2003).

Figure 2.1: Availability of maintenance funds: before and after, Dendropark, Kamyanets-Podilski, Ukraine.

Khmelnitsky City Information

Background

Khmelnitsky is located in Khmelnitsky Oblast, a 10-hour train ride southwest of Kyiv (Map 2.1, p. 4). Vinnistya, Zhytomyr, Riven, and Ternopol Oblasts and the Dnister River on the southern end form the oblast's borders. The Southern Bug River's headwaters are located in Khmelnitsky Oblast. This river is one of the secondary waterways of Ukraine (Kubijovyc, 2001). The oblast was formed on March 22, 1937. It is divided into twenty administrative rayons (counties). Thirteen cities are located in the oblast with six of them being under direct oblast control. The City of Khmelnitsky is one of these cities under oblast control. The oblast houses twenty-four city settlements (townships) and 1416 farm settlements; no equivalent exists for farm settlement in the

United States (Погурельська, 2002). Each of these municipalities is in charge of its own greenspaces. Coordination between the urban areas for greenspace planning is rare.

The City of Khmelnitsky began as a fort called Ploskuriv, first mentioned in history in the last part of the 1400s. The fort was destroyed by various wars. By 1649, the town had been rebuilt. In 1795, the area became a province and Ploskuriv was the administrative center. The town became Kamyanets-Podilski's rayon center (county seat) in 1941. Administrative duties were suspended while the Nazis' controlled the area until 1944, when the area was liberated by the Soviets. By 1950, the town was undergoing reconstruction. 1954 saw Ploskuriv renamed to Khmelnitsky, after the famous Ukrainian Cossack hetman, Bohdan Khmelnitsky. Today, the City of Khmelnitsky is a major railroad and trucking hub. The city houses a historical museum, an art museum, and three universities and academies. The fine arts are showcased in the philharmonic symphony, drama theaters, dance ensembles, and fine arts schools. The libraries are for regional scientists, children, oblast residences, and foreign language speakers. Khmelnitsky is home to Ukraine's first railroad mail sorting post office, which is located next to the main railroad station (Грищук, 1996). The world's largest bazaar is located in Khmelnitsky. With its regional importance, Khmelnitsky focuses on issues such as parks other cities cannot do yet (Дзюблюк і Дранус, 2003).

The ethnicity of Khmelnitsky is composed of 90.4% Ukrainians, 5.8% Russians, 2.4% Poles, 0.7% Jews, 0.3% Belorussians, and 0.4% Moldavians, Armenians, Gypsies and other nationalities (Грищук, 1996; Погурельська, 2002). A mixture of Russian and Ukrainian, called Sergik, is the spoken language of the city. Some people speak more Russian in their Sergik and others, Ukrainian. Throughout the oblast, Ukrainian Sergik is

more prevalent. My coordinator at the non-governmental organization spoke Russian with very little Ukrainian, while my coordinator at the Department of Ecology and Natural Resources spoke Ukrainian with little Russian. Language affects how work is done, since some professional terminology is better in one language than the other, especially when the terminology is for forestry.

The oblast population is 1,447,200. This is 2.9% of the population for the country. The City of Khmlenitsky is also a rayon center for the Khmelnitsky rayon, population 47,500. This number does not include the city's population because the city is controlled by the oblast, not the rayon. The rayon's rural population density is 30-40 people per square kilometer. The City of Khmelnitsky population is 261,600 (Погурельська, 2002). People come from all over the oblast, Ukraine, and Europe to visit the bazaar, the various administrative offices, and to live in the city, increasing park usage pressures.

The oblast economy is based on industry and agriculture. The oblast's main industries are: bakeries (43.9%), electricity production (28.3%), machine building and metal processing (14.1%), construction materials (7.2%), timber production and woodworks (1.4%), glass and china (1.2%), light industries (1.2%), metallurgy (0.7%), and chemicals (0.1) (Погурельська, 2002). The oblast has one nuclear power plant, one thermal energy plant, and two hydro energy plants (Погурельська, 2002). Khmelnitsky is the largest industrial center in the oblast and has chemical, machine, metal processing, and metallurgy factories, along with bakeries, construction materials plants, and light industries (Погурельська, 2002). The agricultural field is divided into 61.4% plant production and 38.6% animal production (Погурельська, 2002). Arable lands are tillage

(79.8%), hayfields (8.8%), pastures (8.8%) and gardens and orchards (2.6%) (Погурельська, 2002). The City of Khmelnitsky is located in the agricultural region with beef, dairy, and pork husbandry. The region also grows grain, sugar and regular beets, potatoes, thyme, and chicory. The city is the largest agricultural products processing center in the oblast. Its factories make sugar, bread, candy, alcohol, canned goods, meat, and dairy products (Погурельська, 2002). There are 727 agricultural business in the oblast and 557 farming cooperatives (Погурельська, 2002).

As the agricultural sector decreases, people are moving from the rural areas to the cities seeking employment in the growing industry sector. The increase in population and labor force is causing the construction business to also grow. Area around the city, once greenspace, is now being built over, increasing pressure on the city's parks (Дзюблюк і Дранус, 2003). This is a common phenomenon throughout Eastern Europe and the former Soviet Union, because these countries are economies in transition. The younger adults leave the villages for the cities and return to the villages for weekends and holidays. Usually, they assist with plantings, chores, and harvests. These younger adults earn money in the cities, with a portion of it given to older family members who remain in the village and increase their own standard of living with the remaining money. They build homes and businesses with this money, increasing the pressures on urban services while keeping a tenuous link to localized village economies. The younger adults have been raised in an agricultural society within the village. They retain the idea of people having gardens as an additional food source. The younger adults believe gardens are necessary for their livelihood, so they plant gardens where land is available. Their

gardens can be found within and outside the city limits, in city parks, along railroad tracks, and anywhere there is open land (Creed, 1998).

The area of Khmelnitsky Oblast is 20,600 km^2, representing 3.4% of the area of Ukraine, and is the size of Israel (Погурельська, 2002). The City of Khmelnitsky's area is 52 km^2 and 1958 hectares is greenspace (Погурельська, 2002; Дзюблюк і Дранус, 2003). The oblast sits on the slope of the Ukrainian Shield and the Raven Massif (Погурельська, 1998). There are ten principal soils in the oblast. The City of Khmelnitsky is located on three principal soils: dark gray and black earth opidzoleny (опідзолені), black earth with little humus, and swamps and peat lands (Погурельська, 2002). The soil of the city is extremely polluted. The foothills of the Carpathian Mountains characterize the geography of Khmelnitsky Oblast. The lowest point is 121 meters and the highest is 409 meters (Погурельська, 2002). Three thousand rivers and streams run through the oblast (Khmelnitsky Online, 2004). The City of Khmelnitsky is situated in the Southern Bug River valley. Khmelnitsky Oblast's climate is continental. The lowest recorded temperature for the city is –28°C and the highest is +37°C. In July, the average temperature ranges between +18.5°C and +19.0°C and the wind is from the northwest. In January, the temperature range is from –5.5°C and colder with the wind out of the southeast. The average precipitation is 600-650 mm per year with the most falling in July and the least in December (Погурельська, 2002). The soil, water, and climate in the city have been altered by the city's increase in industry and the amount of vehicular traffic (Scientific Practical Conference: No – Global Climate Change, 2002). Increased maintenance and new urban greenspaces will assist in alleviating the problems associated with the industrial and vehicular increases (Дзюблюк і Дранус, 2003).

Khmelnitsky Oblast's natural resources include minerals, flora, and fauna. The minerals are peat, graphite, phosphate, granite, sand, clays, limestone, chalk, gypsum, and kaolin (Погурельська, 2002). There are 231 native plant species in the oblast and 92 are in the Redbook of Ukraine (Погурельська, 2002). The plant community around the city is grassland steppe and agricultural grain fields (Погурельська, 2002). Thirty-three fauna are listed as rare and scenic (Погурельська, 2002). The total numbers for the oblast's fauna are unavailable. These natural resources need protection from the vehicular and construction activities happening in and around the oblast's urban centers. Protected greenspaces would assist in solving the problems while keeping the land open for public use (Grey and Deneke, 1992; McPherson, et al, 1995; McPherson, 2003; Дзюблюк і Дранус, 2003).

Parks

The City of Khmelnitsky has five parks. They provide many different functions, ranging from a dendrological park, an apple orchard, communal gardens, sports activities, amusement rides, a zoo, or a beach. The parks are considered safe places for people, are open 24 hours a day, and admission is free. The first park was designated in the 1920s and the newest one was added in 2001 (Аніськов, 1.08.03р.; Дзюблюк і Дранус, 2003). The parks were mainly created under Soviet times. They were well maintained until the collapse of the Soviet Union and the economic decline of the first ten years of independence. The City of Khmelnitsky's economy is growing now, so the city is interested in finding funding for the parks again. Khmelnitsky has invested in reconstruction of the apple orchard and the creation of two new parks (Дзюблюк і

Дранус, 2003). The city's residents use the parks daily for a number of activities, including exercise, relaxation, meetings, picnics, short cuts for commuting to work and home, wildlife and wildflower viewing, grazing livestock, gardening, and harvesting berries, mushrooms, and other non timber forest products (Figure 2.2). Despite all of these activities, the parks have not been inventoried (Дзюблюк і Дранус, 2003).

Figure 2.2: Lady grazing goats in a Khmelnitsky park.

Chapter 3 Methods

Need of Inventory

The need for inventories and management plans for the City of Khmelnitsky's parks and squares had been present during the two years prior to my arrival. The Department of Ecology and Natural Resources, created in 2000, had only completed cursory inventories for the squares. The Department of Ecology and Natural Resources' request was for information on how many mature trees were in the parks and squares, their health status, species, and location. Tetyana Pavlovna Dzyublyuk, the Department's director and my coordinator, asked to have information on the children's activities, garbage problems, future plantings, and anything else that pertains to the parks. She did not want just information on the trees. I had approximately eight months to complete the work. It was determined that only the five parks would be inventoried and have individual management plans written. The squares would not be part of the project.

The Department of Ecology and Natural Resources wants inventory information because the parks are currently administered through different city departments. The Department of Ecology and Natural Resources plays no part in the economic aspects of the parks' management. The city is interested in creating a Parks Department within the Department of Ecology and Natural Resources. When this happens, all of the management responsibilities will be handed over to this Parks Department. Part of the proposal requirements, to justify that a Parks Department is needed for budgetary purposes, calls for an inventory of each of the city's five parks. The Department of Ecology and Natural Resources has to determine the total number of trees in each park,

total number of each species, equipment needs and concerns, other natural resources issues, and additional information as necessary. The department must know what assets and responsibilities they are receiving. The actual tree maintenance will be handed over to community organizations.

Following Avery and Burkhart (1994) and based on this information, I decided that 100% inventories would be the best option. A 100% inventory is defined as "When all individual units of the population are observed…" or "Every tree of the desired species and size class may be measured, or the tally may consist of a 100 percent count of all stems…" (Avery and Burkhart, 1994).

In one hundred percent inventories, every tree in the designated area is surveyed and total estimates for the designated area are derived from all numbers. In sampling, only certain trees are surveyed and total estimates for the designated area are derived from the sampled numbers using statistical methods. One hundred percent inventories are more costly and time consuming than sampling. However, they more accurately reflect what is actually present in the designated area. Also, the exact size of the inventoried area does not need to be known for calculating total estimates. Trees must often be marked in 100% inventories so crews can track which trees have already been inventoried. In sampling, permanent plots or transects are marked, but individual trees are not (Avery and Burkhart, 1994). One hundred percent inventories fit the Department of Ecology and Natural Resources' objectives better than sampling.

This chapter discusses the methods behind the inventories. The discussion will begin with the limitations encountered followed by an account of each park's inventory. The first two parks are divided into four subsections: introduction to the park, park

boundary survey, tree inventory methods, and how the additional data was collected, with a conclusion. The last three parks have introductions with brief comments regarding the inventories. It is finished with a summary of the chapter.

Limitations of Inventory

In the United States, the urban forestry sector, while relatively new, has established practices and methods (Moll, 1995; Miller, 1997). Information is easily found on the subject and many cities have municipal forestry programs (Grey and Deneke, 1992; Bradely, 1995; Miller, 1997). Organizations perform an inventory of this type using GPS and GIS to map the features and track information (Figure 3.1). Inventory equipment exists in this country and is readily available to the general public. Trained personnel carry out established methods (Miller, 1997). Also, if large areas are being inventoried, crews know how to accomplish the task. In addition, land surveys are a part of the United States' history (United States Bureau of Land Management, 2004).

In Ukraine, urban forestry is a new profession. Information on urban forestry in Ukraine is difficult to locate. Universities in L'viv, Kyiv, and Kharkiv have urban forestry programs. Actual city forestry departments are few; one exists in L'viv and one Kyiv. If a city has a horticultural department, it may be responsible for the maintenance of the greenspaces. They, however, do not have the personnel for inventories.

Figure 3.1: Katrina Schnobrich with GPS unit conducting a tree and shrub inventory in Arlington National Cemetery, Washington, D.C.

Only the United States Agency for International Development (USAID) contractors under the strictest regulations and the Ukrainian military use GPS routinely. In addition, the average Ukrainian organization cannot afford survey grade GPS units. The local people know general locations, such as an ancient ruin's vicinity. However, the exact coordinates are unknown. Items like a ruin can be measured and mapped using surveying instruments, but only trained surveyors have access to this equipment and knowledge. The Department of Ecology and Natural Resources did not have access to these professionals. GIS is a new concept in Ukraine. The price of legal copies of the programs, the computers to run them, and the lack of trained personnel make GIS impractical. Illegal copies of ArcView are affordable and readily available in bazaars, but cannot be used for government purposes. Maps are usually hand drawn. Some exist in electronic format, but they tend to be more unreliable than the hand drawn ones.

Simple and effective inventory equipment (i.e. diameter tape, Biltmore stick) exists, but is not widely available to the general public. Inventory methods are established for the Forestry, the Ukrainian equivalent to the United States Forest Service, but the budding urban forestry sector does not have established methods. Work crews are not available because they work under the Forestry or the Protected Natural Funds of Ukraine, the equivalent agency to the United States National Park Service, and are not trained in urban forestry or inventory procedures. They are strictly used for forest maintenance and fire fighting, both urban and wildland. Recruiting volunteers is difficult because volunteerism is associated with the Soviet system of mandatory volunteerism, where people were forced to spend their free time assisting pre-determined organizations. Also, the idea that one would not do something for free discourages volunteering. Aesthetics is not enough of a reward to break this mindset. Within Ukrainian culture, people expect money or some other form of payment for any work performed.

Ukraine has never had a national land survey performed. Before Communism, the land belonged to the various nobles and elite who ruled over Ukraine. All of the lands were consolidated into state holding under the Soviets. Beginning in spring, 2003, USAID hired contractors to perform land surveys, starting with the rural areas. This program's objective is to have all of Ukraine surveyed with titles given to the landowners. This will create the private land base needed for financial investments.

These limitations made the inventories I conducted difficult. I had to devise a method for the actual fieldwork and how to record the data in a fashion fitting with existing systems and useful to the average Ukrainian city departmental employees (Figure 3.2).

Figure 3.2: Writing inventory information with paper and pencil, Ivan Franko Park, Ukraine.

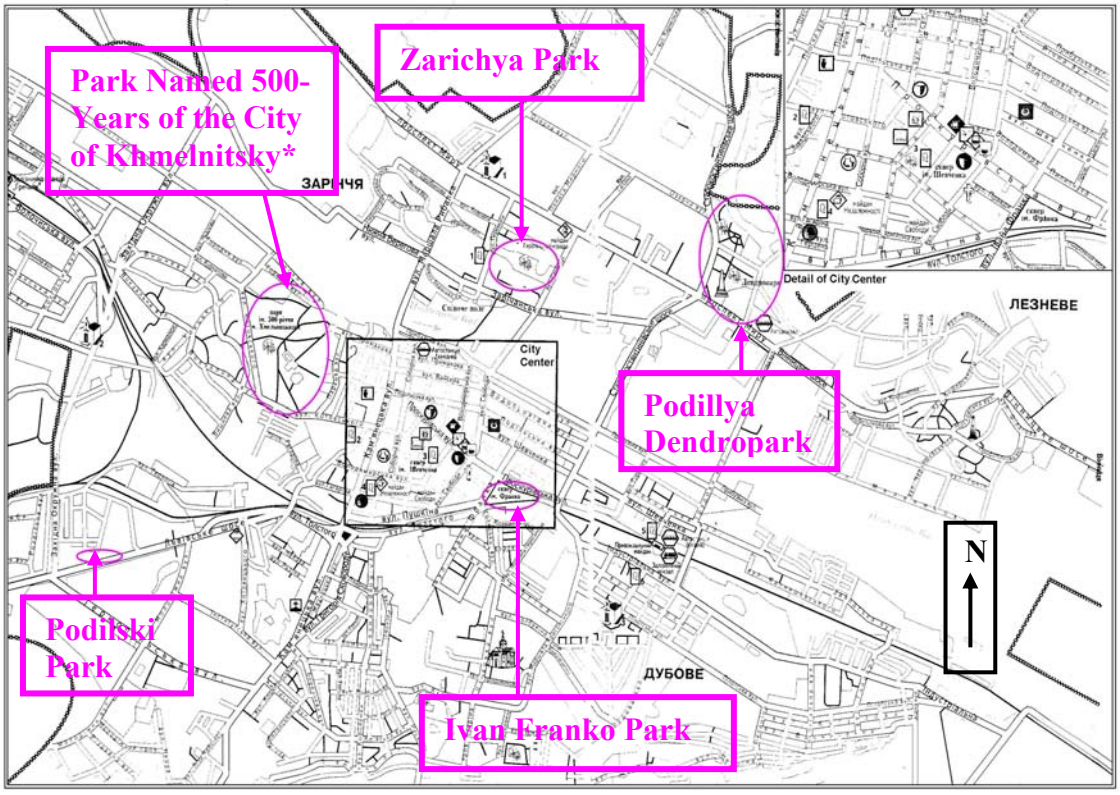
I did not have access to a survey quality GPS unit, which would be required given the desired accuracy of the inventory. I could have obtained a lower caliber GPS unit, but the regulations would have made it impossible for me to use it in Khmelnitsky. The United States Ambassador and Ukrainian Ministers had to approve the acquisition of a GPS unit. Then, every time it is used, a list of authorities has to be notified and consent given. None of the authorizations would have been granted for the City of Khmelnitsky because it is home to the country's Border Guard Academy, the largest Ukrainian military base, and a key Ukrainian Air Force missile base.

The next problem with using GPS was the availability of a computer with a GIS program. Rumor said the city's Cartography Department had one, but the follow-ups never produced any more information. This GIS possibility was the only one in the city. The Department of Ecology and Natural Resources did not have the money to buy a

computer, legal software, or obtain GIS training. Therefore, I needed a cartographer to map the inventory information, so the fellow Peace Corps Volunteer at my site, a professional architect, was appointed as cartographer. I explained to her what was needed and she produced the maps without supervision or guidance. The cartographer created the inventory and management plan maps by using existing departmental maps, copiers, scanners, tracing paper, several different computer programs.

All of this information is summed up in Map 3.1, Map 3.2, and Map 3.3. One can see the differences in the maps. All are from departmental files. The base city map in Map 3.1 was not generated by hand; for this paper, I overlaid the circles and park names using the computer. The cartographer scanned it in, modified it, and used it in a park management plan. Map 3.2 is hand drawn. The base of this map was traced from another map, also hand drawn. Department personnel made the base map for Map 3.3 on a computer from a hand drawn field map, which had unreliable boundaries and building locations. Map 3.3 has the only known original source. Of the three maps, the city map is the most dependable, but still has errors. All base maps had to be adapted before they could be used. The final copies of all maps will be sent to a Ukrainian professional cartographer, who will craft them to Ukrainian map standards.

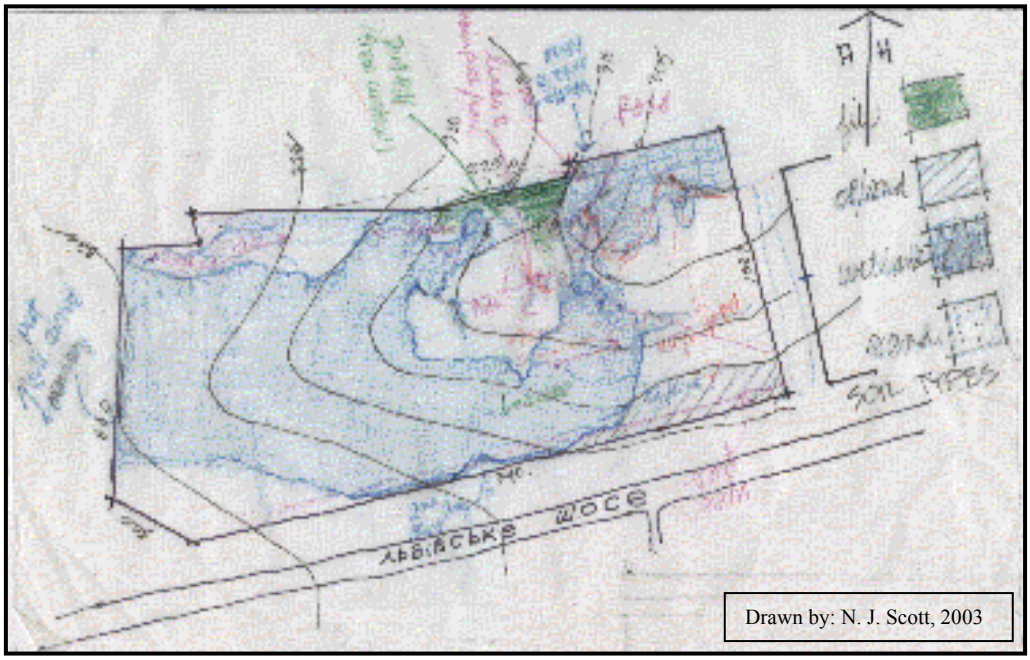
The drawbacks to this mapping method are: the maps are not easily updated; the map-making process is slow and cumbersome; a professional Ukrainian cartographer is needed; and the updating process will be longer and therefore more costly. The two main advantages to this process are it fits with the current traditional way of Ukrainian mapping techniques (hand drawn versus electronic), and an inexperienced person can draw the base maps, decreasing mapping costs.



Map 3.1: Locations of Khmelnitsky City Parks (adapted from Filius, 2004)**.**

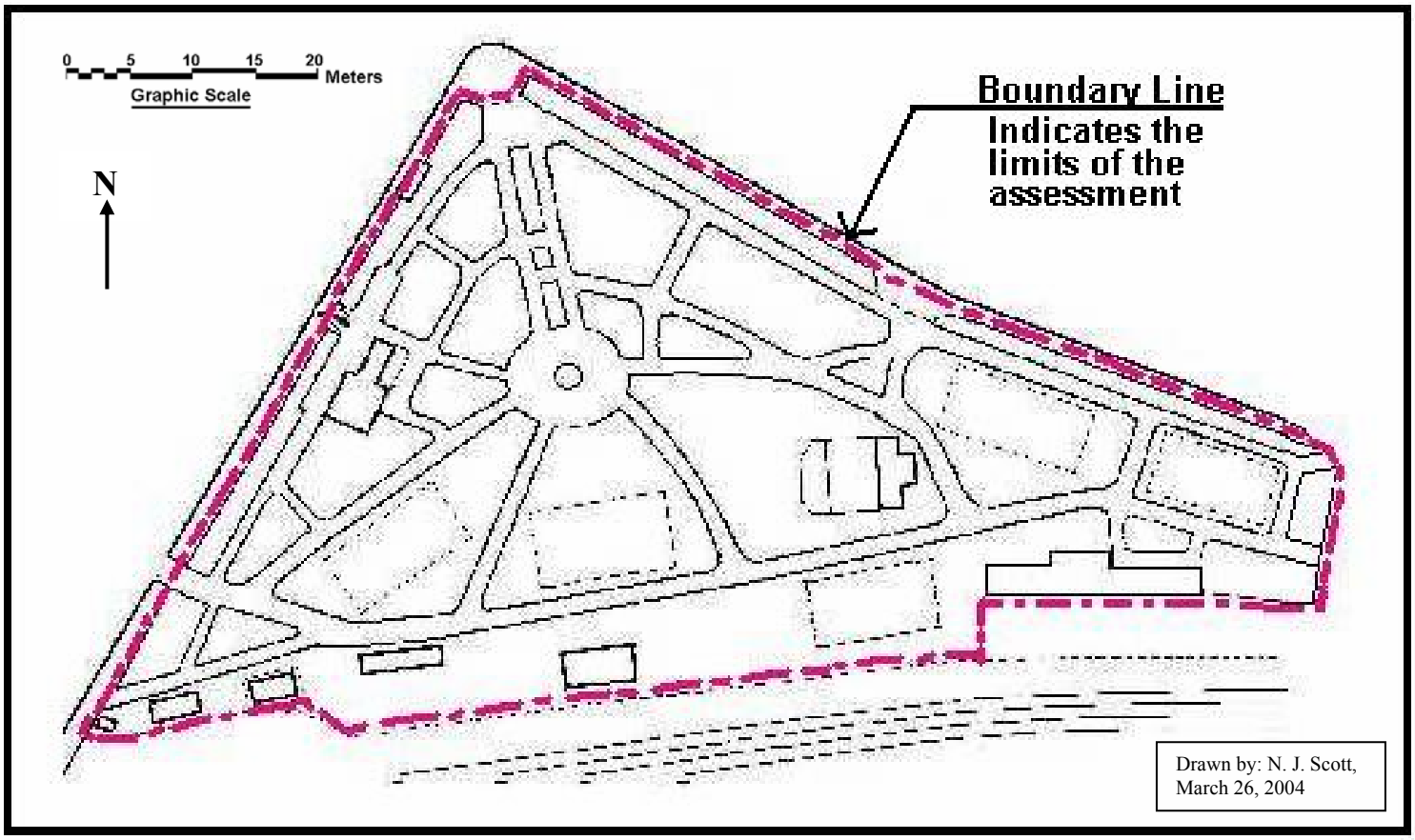
Base map was not hand drawn.

***Park Named 500-Years of the City of Khmelnitsky is named to commemorate the five hundredth anniversary of the city.**



Map 3.2: Field copy of soil/hydrological/topographical map for Podilski Park.

Base map was traced from hand drawn map.



Map 3.3: Boundary map for Ivan Franko Park (Filius, 2004)**.**

Base map was copied and modified from a computer drawn map.

Personnel to assist with the inventories were hard to locate. The only consistent help was the cartographer. On occasion I requested assistance from other departmental personnel, who helped when possible. I did have limited aid from two other Peace Corps Volunteers and a local American expatriate. Limited personnel are the reason why the Department had not conducted an inventory earlier. They had no personnel on staff trained in or possessing limited knowledge of forestry practices, so no one knew inventory methods. The main portion of the inventory project was to create methods for conducting the inventories. Before my arrival, the Department did not have an employee who could devise these methods. With the methods that were developed over the course of the inventories, the department will be able to have someone with limited forestry knowledge perform the inventories.

Land surveys played a larger role in the methods formation than first expected. Established park boundaries were assumed, until actual fieldwork showed that they did not exist in places and were not always detectable. Many park boundaries were undetectable, because it was not clear whose land was whose with no discernable boundary lines between them. On several occasions, boundaries were based on the presence of trees. If trees grew in the questionable area, then the area was included in the inventory. If trees were absent, then the area was left out of the inventory. If the area was located next to a private establishment, then a wide corridor was placed between the area inventoried and the private holding.

Appropriate methods were formed, beginning with the parks to be inventoried. The parks were: Podilski Park, Ivan Franko Park, Park Named 500-Years of the City of Khmelnitsky, Zarichya Park, and Podillya Denropark. These parks are located

throughout the city and all have different characteristics (Map 3.1, p. 25). Map 3.1 was adapted from the original for city and park orientation purposes.

Based on the size, layout, and number of trees of each park, the order in which the parks would be inventoried was established. Podilski Park was the second smallest park with the fewest mature trees, so it was inventoried first, followed by Ivan Franko Park, Park Named 500-Years of the City of Khmelnitsky, Zarichya Park, and Podillya Dendropark.

The inventory methods developed over time as my coordinator realized what exactly she wanted and as I determined improved ways to do it. For example, initially, Tetyana Pavlovna wanted the mature trees measured at 22 cm above the ground. After some discussion on the methods of measuring trees and the definition of "mature" tree, we agreed to measure trees at diameter at breast height (dbh), 1.3 meters above the ground, and mature would be any tree equal to and over 10.16 cm dbh. These measurements were based on standard measurement practices (Avery and Burkhart, 1994; Filius, 2000).

Podilski Park Inventory

Introduction

In 1998, the Khmelnitsky City Council created Podilski Park for the residents of the city's southwest district (Дзюблюк і Дранус, 2003). Podilski Park is six hectares and primarily vegetable and flower gardens with fruit and religious trees scattered throughout (Figures 3.3, 3.4, and 3.5). Religious trees, such as linden and rowan, are planted in

yards and gardens for their spiritual affiliations. The park was originally under the city's Department of Life and Communal Farming. One of the areas this department is in charge of is monitoring and distributing garden plots to the city's residents. Prior to 1998, the park was communal gardens.

Podilski Park is located in the top portion of a watershed. Next to the park's west end are a gas station and a site for a church. The south border is L'viv Highway. The east end adjoins a walled-in parking lot. To the north is residential housing.

Figure 3.3: Gardens during the summer in Podilski Park, west end of park.

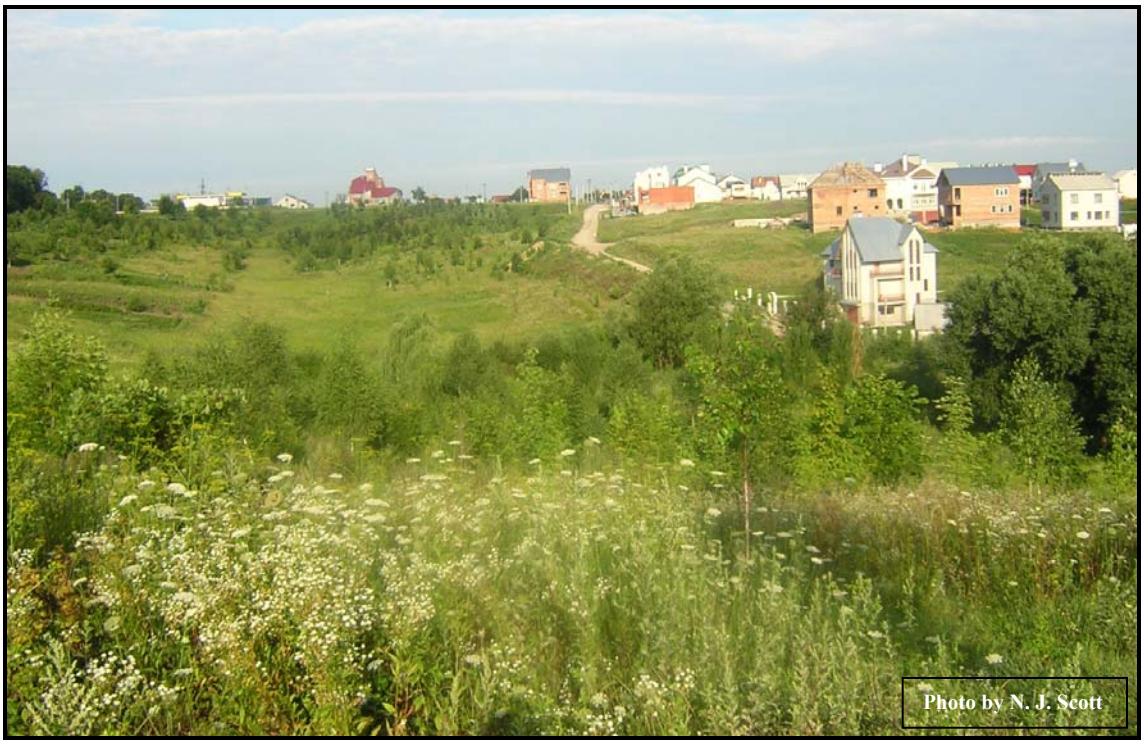


Figure 3.4: Podilski Park in summer with gardens, view from east end of park.

Figure 3.5: Same view as Figure 3.5, in the fall.

Throughout the course of Podilski Park's inventory, I encountered many flaws in the methods I had used. These problems were solved and new ideas emerged as to how the other parks could be inventoried. Working together, Tetyana Pavlovna and I changed the requirements of the information needed as results were presented, which changed the methodology used. The methods changed the most for this park, simply because it was the first park inventoried with untried methods. The park was inventoried four times. The first time was the initial inventory. The second inventory corrected information from the first one. The third used new methods to gain newly requested information. The fourth inventory accounted for another change in requested information and adjusted techniques. In the end, the last inventory was postponed because of vandalism and rain.

The following is an account of the methods, problems, and modifications of Podilski Park's inventory. It will begin with a discussion of the park boundaries. The second section contains the actual tree inventory methods. The final section includes general inventory information collection and the repeated inventories with a conclusion.

Boundary Survey

As the first park to be inventoried, Podilski Park maps were located and copied. Ukrainian maps do not normally have a date on them, so it is unknown when the Podilski Park maps were made or updated. As a result, all maps were utilized to create the inventory maps used in the field and to find the park's boundaries.

The park was located (Map 3.1, p. 25); the initial overview of the park was conducted, the overall physical aspect of the park recorded, and a plan of action developed. The cartographer and I agreed that it would be easiest to map and keep track

of where the trees are if the park was divided into sections. The sections were enlarged on a copier. The tree locations could be placed right on the map in the appropriate position. Accuracy for the mapped tree locations had to be within one meter.

Podilski Park was divided into four sections, each section roughly one quarter of the park. The boundaries of Podilski Park were confirmed with Tetyana Pavlovna, since the map boundaries did not correspond with those in the field. At this point, I created the "Tree Tally Sheet" (Appendix A) and the "Inventory Cover Sheet" (Appendix B) for sectional data collection. The final version of these sheets evolved during the initial inventory of Podilski Park. These sheets can be used for any of the parks and easily updated for changing inventory goals. These sheets were used in the Ivan Franko Park inventory as well. The sheets are available in electronic form and can be photocopied as needed for fieldwork. They are also user friendly and easy to store. The sheets can be stored in folders by park and section.

The easiest boundary to locate was the east line, so the southeast corner of the park was located by pacing south and then west from the wall of the neighboring parking lot to the corner. The position of this boundary line is uncertain because the wall was measured and compared to the length on the map. There was a two-foot difference between them, so the other boundaries may be even farther off. In addition, it was impossible to locate the west boundary and only the middle and east portions of the north and south lines could be located. These lines are unknown because there are no noticeable natural features on the map or in the field (Figure 3.6). In addition, a new house was located where there should have been parkland and no church existed where there should have been a church. Also, it was unknown how the two feet of error on the

Figure 3.6: Questionable west boundary of Podilski Park from neighboring gas station. Immature fruit and religious trees in the park.

east boundary would affect the west boundary. Since the maps did not clearly show where the line was between park and gas station property, and departmental personnel did not know for sure, the far west section was assumed to go to the last line of planted saplings (Figure 3.6, p. 33).

From the southeast corner of the park, lines were walked north and south with trees inventoried and mapped. There were no mature trees in the far west section of the park, so the questionable boundary lines did not become an issue.

Tree Inventory

Before the inventory could be started, equipment had to be located. This caused much delay in beginning the fieldwork. I spent two months devising various methods for inexpensive and easily locatable equipment. I also found other methods and equipment as the inventory progressed. As the inventory evolved, it became obvious that each park would require basic methods to be individually adapted, because of the differing characteristics.

For Podilski Park's tree inventory, the following steps were used. The tree was first given an identification number. To denote trees that had trunks that split below dbh, a lower case letter was added to the number. For example, a tree with no split trunk or a split above dbh is given a number, 1-1. The first number denotes which section the tree is located in and the second, the actual tree number. Then, if a tree had two or more splits below dbh, the numbers would be: 1-1, 1-1a, 1-1b, etc.

Each tree was identified using Press (1996), Coombes (2000), and Кремер (2002). The circumference at breast height was measured with a standard metric measuring tape and later converted to dbh.

The health conditions of each tree were recorded, management recommendations given, and comments recorded. The tree health conditions were based on Project Learning Tree (1998 and 2001) (Table 3.1 and Ukrainian version in Appendix G). The tree maintenance recommendations were designed as the trees were inventoried and listed in a table (Table 3.2 and Ukrainian version in Appendix G). There was one duplicate recommendation line, number 14, which was not caught until the end of the Ivan Franko Park inventory, so it has been left blank for a future recommendation. This information was recorded on the "Tree Tally Sheet".

A table of scientific and English common names was kept. At the end of the inventory, a species number was assigned to each species (Table 3.3). The species number was provided at the request of Tetyana Pavlovna for future Department of Ecology and Natural Resources mapping purposes (Appendix C).

The language the inventories and management plans were written in became a problem. The inventory materials were in English. No one at the Department of Ecology and Natural Resources spoke English. The translator did not know forestry terminology; unless a Ukrainian forester learns English or a Ukrainian translator works closely with an English speaking forester, Ukrainian translators do not know forestry terminology. In addition, my Ukrainian and Russian were not good enough to write everything in either language. The Department of Ecology and Natural Resources will find a person to translate the materials into Ukrainian.

Table 3.1: Number for each health condition with brief description of condition (adapted from Project Learning Tree, 1998 and 2001)**.**

Tree Health Conditions List		
#	**Description**	**Criteria**
1	Healthy	No signs of damage, infestation, or infection.
2	Minor Infestation	Tree is growing healthy with some sign of insects.
3	Minor Infection	Tree is growing healthy with some sign of fungi.
4	Infestation	Tree has signs that insects are harming it.
5	Infected	Tree has signs that fungi are harming it.
6	Dying	Tree shows signs of death.
7	Snag	Tree is dead and standing.
8	Leaf Wilt	The leaves are wilting.
9	Discolored Leaves	The leaves have abnormal color.
10	Deformed Leaves	The leaves are not shaped, as they should be.
11	Leaf Insects/Holed Leaves	Leaves have holes from insects or insects eating them.
12	Bark Beetles/ Holes in Bark	Bark has holes from insects.
13	Spotted/Bumpy Leaves	Leaves have spots or bumps on them.
14	Canker	Tree has canker(s).
15	Trunk Split	The crotch of the trunk is split.
16	Wind Damage	Tree has been damaged by wind.
17	Windthrow	Tree has been blown down by wind.
18	Snow Damage	Tree has been bent by snow load.
19	Snow Breakage	Tree has been broken off due to snow load.
20	Fire Damage	Tree has fire scars.
21	Frost Fissure	Tree has fissure from frost on trunk.
22	Lightning Damage	Tree has lightning scar.
23	Defaced	Humans have damaged the tree.
24	Wildlife Home	Tree has an animal home in it.
25	Pruned Improperly	Cuts are not at proper angle/in wrong place, bark torn from cuts, branches are not cut all the way through and are ripped off.
26	Trunk Rot	The trunk has evidence of heartwood infection.
27	Secondary Borers	Holes in exposed heartwood.
28	Mistletoe	Mistletoe is growing on tree.
29	Burl	Tree has lumpy trunk.
30	Exposed Dead Wood	Gray colored wood not covered by bark or dead branches.
31	Conk	Mushroom growing on side of tree.
32	Ants/Termites	Frass piles on and around tree with insects on/in tree.
33	Tent Caterpillars	Tents on leaves and branches from caterpillars.
34	Wild Grapes	Wild grapes choking tree.
35	Gall	Bumps on branches.
36	Obstruction	Specify what is obstructing the growth of the tree.
37	Wildlife Activity Signs	Tree has signs of wildlife activity.
38	Root Rot	Roots have evidence of infection.
39	Girdled	Bark has been or tried to be removed from around trunk of tree.
40	Branch Rot	Branch shows evidence of infection.
41	Witch's Broom	Branches misshapen like a witch's broom.
42	Dead Leader	The leader of the tree is dead.
43	Open Wound	Tree has an unhealed wound.
44	Exposed Roots	The roots are not covered with soil.
45	Buried by Fill	The base of the tree is buried by fill.
46	Branch Split	The branch has a split in the crotch.
47	Topped Tree	The crown of the tree has been cut off.
48	Gall at Base	There is a gall at the base of the trunk.

For the maps and basic information to be of use immediately, English common names could not be used. Many Ukrainians call all oaks, oak (дуб) and all maples, maple (клен). They do not distinguish between the various species of a genus, like Norway maple, *Acer platanoides* L., and field maple, *Acer campestre* L., and may not even know the tree's basic common name. Another problem with using common names is the names were in Russian initially and when the country's official language was changed to Ukrainian, just the spelling changed, but the two words sound alike. Some of the tree names have not been changed into Ukrainian, so the Russian spelling is still being used.

Table 3.2: Numbers for each recommendation with description (Filius, 2004)**.**

Tree Management Recommendations List	
#	**Recommendation**
1	No management necessary.
2	Prune damaged area.
3	Spray insecticide.
4	Spray fungicide.
5	Plant replacement tree.
6	Harvest.
7	Leave for wildlife value.
8	Discontinue pruning.
9	Discontinue digging of the ground around the tree.
10	Relocate the path/tree.
11	Stake tree.
12	Remove item(s) from tree.
13	Do not wound the bark.
14	
15	Do not grow climbing plants on trees.
16	Plant shade tolerant replacement tree.
17	Do not cement up the wounds.
18	Prune exposed dead wood.
19	Take care when mowing around tree.
20	Plant bushes.
21	Erect guardrail around tree.
22	Let seedlings grow.
23	Plant hedge-appropriate plants.
24	Take more care with pruning.
25	Harvest if necessary.

Table 3.3: Scientific and common names are listed with corresponding species number.

Tree Species Numbers and Scientific/Common Names		
Species #	**Scientific Name**	**English Common Name**
0		Dead
1		Unknown
2	*Acer campestre* L.	Field maple
3	*Acer negundo* L.	Box elder
4	*Acer platanoides* L.	Norway maple
5	*Acer pseuoplatanus* L.	Sycamore
6	*Aesculus hippocastanum* L.	Horse chestnut
7	*Betula pendula* Roth	Silver birch
8	*Betula* spp.	Birch
9	*Carpinus betulus* L.	Hornbeam
10	*Crataegus* spp.	Hawthorn
11	*Euonymus europaeus* Jacq.	Spindle tree
12	*Fagus sylvatica* L.	Common beech
13	*Fraxinus excelsior* L.	Common ash
14	*Fraxinus ornus* L.	Manna ash
15	*Juglans regia* L.	Walnut
16	*Malus* spp.	Apple
17	*Picea* spp.	Spruce
18	*Pinus nigra* Arnold	Austrian pine
19	*Populus nigra* L.	Black poplar
20	*Populus nigra* v. Italica	Lombardy Poplar
21	*Populus tremula* L.	Aspen
22	*Prunus* spp.	Plum, apricot, cherry
23	*Quercus robur* L.	English oak
24	*Quercus* spp.	Oak
25	*Robinia pseudoacacia* L.	Black locust
26	*Salix* spp.	Willow, Weeping willow
27	*Thuja occidentalis* L.	White cedar
28	*Tilia cordata* Miller	Small-leaf linden
29	*Tilia tomentosa* Moench.	Silver linden
30	*Ulmus carpinifolia* Gleditsch	Smooth-leaf elm
31	*Ulmus laevis* Pallas	European white elm

Identification books use the scientific name and the common name in the language of the country where the book was printed. Ukrainian publishing companies have not printed many identification books since the fall of the Soviet Union. Therefore, few books are available in Ukrainian. Scientific names are used in Russian and Ukrainian identification books as in Table 3.3. I have included the academically accepted common names in Ukrainian or Russian in Appendix C.

The inventory had to be repeated because mislabeled and missing trees on the map and missing data on the tally and cover sheets for each section were discovered. The errors were found by comparing the tree tally sheets with the map. Trees listed on the tally sheets were not on the map and trees drawn on the map were not on the tally sheet. Two trees were drawn in the wrong sections or numbered incorrectly. Information was not filled in on the tree tally sheets and on the cover sheets. With the cartographer's inexperience in working on such a large scale and the new methods for the inventory, items were either misunderstood or overlooked during the fieldwork. A complete data set was later collected.

Other Inventory Data

Soil, groundcover, land use, wildlife, general comments were included in the information as well. This information was collected by observation, soil sampling, and talking with park users and administrators. The information was recorded on the "Inventory Cover Sheet".

A soil texture classification scheme was modified from Project Learning Tree (1998 and 2001) and Project WET (2000) (Table 3.4 and Ukrainian versioun in Appendix G). The soil was tested in each section using Table 3.4 guidelines. If the soil appeared to change color or texture from the first location tested, then the soil was retested at the new location. The soils were mapped, noting the changes in color and soil texture (Map 3.2, p. 25). The park boundary and topographic lines on Map 3.2 were not modified because there was no way to check the accuracy.

Table 3.4: Criteria for soil texture (adapted from Project Learning Tree, 1998 and 2001; Project WET, 2000)**.**

Soil Test Chart		
Soil Texture	**Soil Squeezed Dry/Dry Color**	**Soil Squeezed Moist/Moist Color**
Sand	Falls apart	Molds, but falls apart when touched
Sandy Loam	Molds, but falls apart	Molds, can with stand careful handling
Loam	Molds, can be carefully handled	Molds, can be handled
Silt Loam	Molds, can be handled	Molds, will not ooze, look broken
Clay Loam	Forms hard lumps	Will ooze and break easily
Sandy Clay	Light gray	Bluish/greenish gray
Sandy Loamy Clay	Gray	Black

No soil maps for the area were available. A soil testing system had to be devised which used simple or no equipment with immediate results. The names of the soils needed to be general since specific names and types are not available. Table 3.4 seemed to be the most appropriate way to test the soil. The testing methods can give poor readings because the results are subjected to user's bias for touch and sight, weather conditions, and soil moisture content. The types of soil listed are inclusive enough to include the actual soil texture (United States Soil Conservation Service, 1962).

The hydrology portion of the mapping was based on the presence of wetlands, wetland plant species, waterways, and topography (Map 3.2, p. 25). Wetland cover typing books were not available for Khmelnitsky region. The easiest way to determine if wetlands were present or not was to see if water sources were present and then look for wetland plant species. Flowing springs were located and horsetail reeds were observed growing in the park (Figure 3.7). The mapping method deemed most accurate was to follow the leading edge of *Equisetum palustre* L., another horsetail reed, a marsh grass, and *Stachys palustris* L. as wetlands indicator species and map the line walked. These species were identified using Гуленкова и Сергеева (2001). The unknown western boundary caused a problem with the mapping because we did not know if the wetland

Figure 3.7: Horsetail reeds in vegetable garden, Podilski Park.

boundary was inside or outside of the park's boundary. It was assumed to go beyond the west line.

This type of mapping has some difficulties. First, the edge effect of a plant's habitat will give inaccurate readings for exact line location. Second, there may be areas in the wetland zone, which are not wetlands but are mapped as such. Conversely, there may be wetland zones outside of the area not mapped. If different types of wetlands exist in one area, they may not be mapped separately, providing erroneous results.

The map's topography lines were provided from a departmental map (Map 3.2, p. 25). The topography of the park provided information on the past and future possible land uses. Since Podilski Park is the top portion of a creek bed, springs and wetlands may be present. Both were located in the park. Severe human impact on the trees growing on the hillsides in the park was also present (Figure 3.8).

Figure 3.8: Birch tree with evidence of human impact at base of trunk, Podilski Park.

The soil topographic hydrological map will be used to determine general tree planting recommendations. The accuracy levels in the testing methods were acceptable for the accuracy requested by Tetyana Pavlovna.

Podilski Park groundcover consisted of vegetable plants, flowers, and weed plant species. In some areas, paths and gardening activities replaced natural groundcover (Figure 3.9).

The gardens were the primary land use within the park. A park neighbor dug a pond where the creek bed exits the park and built a picnic shelter with a grill. He introduced different fish species to the pond. The springs supply water to the pond. The neighbor has plans of adding more picnic shelters to the area and building a women's fitness center on the park's premises. All of this was done without city authorization or

Figure 3.9: Brown areas in Podilski Park lack groundcover.

knowledge. In the bushes at the east end of the park, a homeless person's hiding spot was discovered. It was noted the place was being routinely used.

Garbage in Podilski Park was significant. Around the springs, fire pits were built and household and human refuse was left (Figure 3.10). Construction fill was dumped on

Figure 3.10: Household refuse and human feces, Podilski Park.

the north line and construction trash was buried or left on the surface (Figure 3.11). Gardening garbage was left in piles around the gardens (Figure 3.12). Throughout the park, various types of garbage were found. Household trash and human and animal feces occurred more in Podilski Park than the other parks surveyed.

Figure 3.11: Construction rubbish in Podilski Park.

Figure 3.12: Garbage from gardening, Podilski Park. Colorado potato beetles in old water bottles.

Tetyana Pavlovna requested the preliminary results of the inventory for publication, so a summary was written. She was not pleased with the results, because she thought that the 2469 trees that have been planted over the past two years would have been on the inventory (Дзюблюк і Дранус, 2003). After a lengthy discussion regarding Ukrainian standards and what information the department can and cannot use, I was told that all trees, no matter what size had be inventoried. In the meantime, I had discovered a classification system for tree health (Table 3.5 and Ukrainian version in Appendix G), which I adapted from Miller (1997).

Table 3.5: Classification scheme for the various sizes of trees and their health conditions (adapted from Miller, 1997)**.**

Tree Health Rating Class List		
Class	**Tree Type**	**Description**
1.0	Sapling	Not established, but will live.
1.5	Sapling	Not established, has problems, needs treatment.
2.0	Sapling	Established, will live.
2.5	Sapling	Established, has problems, needs treatment.
3.0	Mature Tree	Will live.
3.5	Mature Tree	Has problems, needs treatment.
4.0	Mature Tree	Has problems, will die within 20 years, may treat.
4.5	Mature Tree	Near death, no treatment necessary.
5.0	Mature Tree	Dead or nearly dead, remove for safety.
5.5	Mature Tree	Dead, wildlife habitat, leave.
6.0	Sapling	Dead or nearly dead, remove.

The inventory was repeated and every tree, seedling to mature, was inventoried and mapped by estimating the distance from one tree to the next. For instance, the distance from tree A to tree B was estimated and then the distance estimated from tree B to tree C. After approximately 150 square feet, the map was inaccurate and illegible. Tetyana Pavlovna and I decided this was not the best approach for what was wanted or needed. We then agreed on only inventorying trees that were 1.5 meters or taller and rating the health of the trees with specific problems listed for mature trees only.

Using this health rating system, the trees now had to be divided into saplings and mature trees. Saplings are defined as ≥ 1.5 meters tall and ≤ 9.9 cm dbh. Mature trees are ≥ 10.0 cm dbh. In the field notes, anything under 9.9 cm dbh was not given a dbh measurement according to Tetyana Pavlovna's directions (Table 3.6). After all of the conditions had been recorded for the tree, a health class was assigned.

Table 3.6: Sample spreadsheet for Ivan Franko Park, Section 16.

Tree #	Species #	Species Name	DBH (in)	DBH (cm)	Class	Condition(s)					Comments	Recommendation(s)				
						A	B	C	D	E		A	B	C	D	E
16-1	27	*Thuja occidentalis*	4	10	3,0											
16-2	27	*Thuja occidentalis*	0	0	2,0											
16-3	27	*Thuja occidentalis*	0	0	2,0											
16-4	27	*Thuja occidentalis*	0	0	2,0	26										
16-4a	27	*Thuja occidentalis*	5	13	3,0											
16-5	27	*Thuja occidentalis*	0	0	2,0											
16-6	27	*Thuja occidentalis*	0	0	2,0											
16-7	27	*Thuja occidentalis*	0	0	2,0											
16-8	27	*Thuja occidentalis*	0	0	2,5							8				
16-9	27	*Thuja occidentalis*	7	18	3,0											
16-10	27	*Thuja occidentalis*	5	13	3,0											
16-11	27	*Thuja occidentalis*	5	13	3,0											
16-12	16	*Malus* spp.	0	0	2,0											
16-13	4	*Acer platanoides*	0	0	2,5							1				
16-14	4	*Acer platanoides*	0	0	2,5							1				
16-15	4	*Acer platanoides*	0	0	2,5							1				
16-16	4	*Acer platanoides*	0	0	2,0											
16-17	4	*Acer platanoides*	0	0	2,5							1	22			
16-18	13	*Fraxinus excelsior*	30	76	3,0											
16-19	13	*Fraxinus excelsior*	30	76	3,5	12	15	23	31	38		5				
16-20	4	*Acer platanoides*	16	41	3,5	21	26	29	30			5				
16-21	19	*Populus nigra*	31	79	3,5	28						5				
16-22	6	*Aesculus hippocastanum*	29	74	3,5	14	26	30				5	18			
16-23	4	*Acer platanoides*	26	66	3,5	26						5				
		Average	7,8	19,9	2,7											

Since many more trees now had to be mapped, marking the actual location of each tree on the map had become impractical; graphing was accomplished by using standard graph paper with a scale of 1 inch = 10 feet. Each tree was paced from the previous tree using a set of north-south paces and east-west paces (Figure 3.13). This added a minimum of five minutes to the inventory time for every tree, but proved to be more accurate than estimating distances.

The number of trees now being inventoried highlighted the concern of limited personnel, causing another problem with the inventory method. Tracking which trees had and had not been inventoried became impossible. Since permanent and very visible marking methods were not allowed, a different method for marking trees had to be devised. Marking ribbon was allowed, however it would have to be removed from every tree at the end of every day. It was too time consuming and still did not solve the initial problem. A chalk box used in construction for snapping chalk lines proved most effective. It is semi-permanent and left an unobtrusive mark on the bark, which stayed on the tree through a severe rainstorm, but would wash off over time. A chalk box requires no special skill to use. The boxes and chalk are cheap and available at building supply stores and bazaars. The drawbacks are large containers of chalk and different colors are not available. A donation from an American construction company supplied the department with two large containers of orange chalk, enough for all five inventories. Blue is available in country. Just blue could be used, if the boundary trees are marked twice, once with a slash for inventoried and once with an "x" for boundary tree. The trouble with this system is from a distance, the marks are not visible, so lining up sections would be problematic. The small bottles of chalk are acceptable; they will just have to be

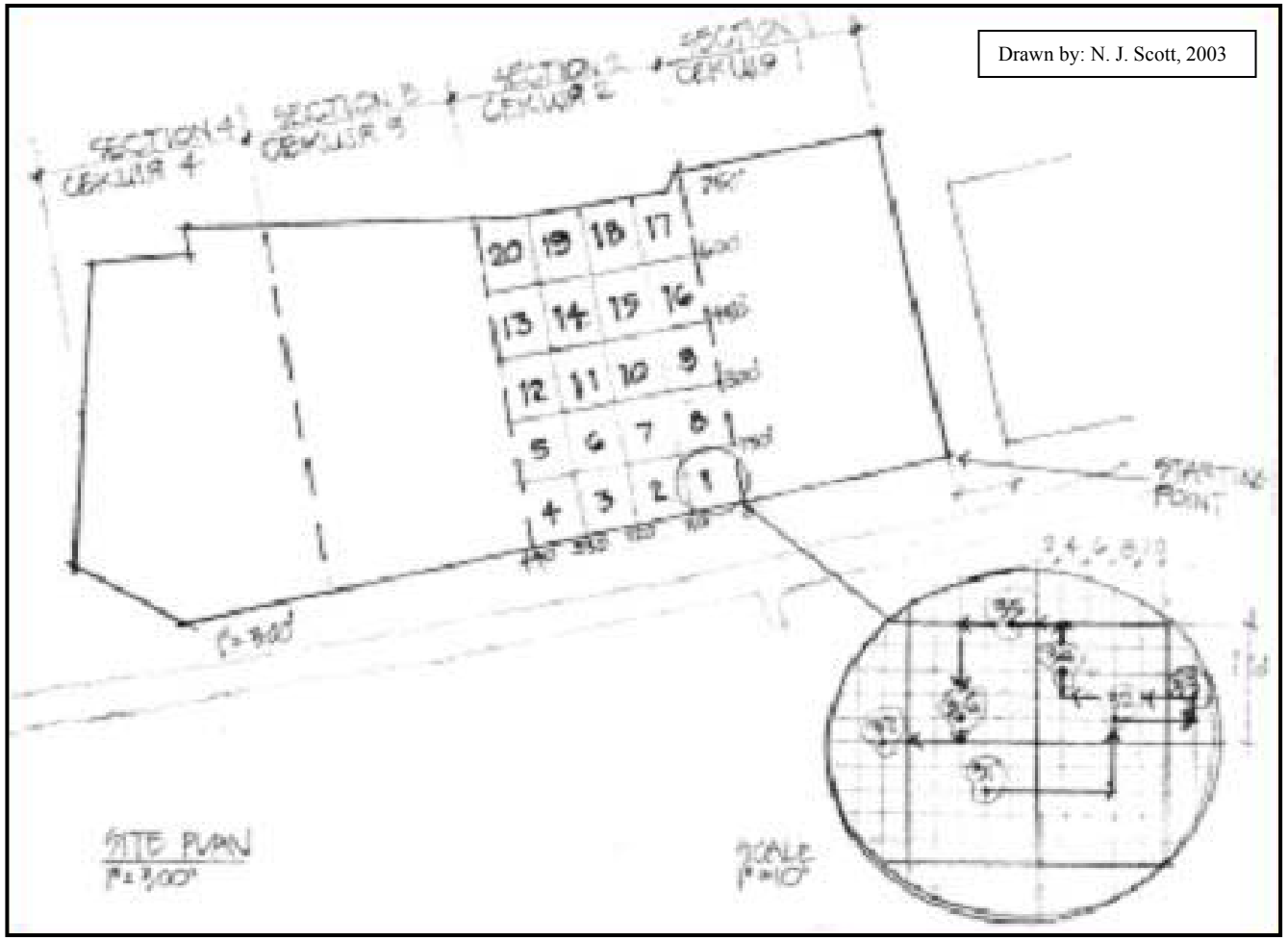


Figure 3.13: Podilski Park with section divisions and Section 2 subdivisions.

In circle are actual trees with identification numbers and pacing route.

purchased more often. Using one color would also be beneficial because only one box would have to be purchased. Approval was granted to leave up marking ribbon on certain trees that marked each section line and each division (based on the size of a sheet of graph paper) within the section (Figure 3.13, p. 48). The sections were marked with flagging, and each tree was paced off.

Upon return to Podilski Park after two weeks, the section ribbons had been removed and the fall rains had arrived. From then on, at night, vandals removed the ribbons tied up during the day. The park's vegetable and flower gardens had been harvested and tilled by this time, so it was practically impossible for accurate pacing in the deep mud. We determined it would be best to wait until the earth froze for accurate pacing and an inconspicuous color of spray paint could be used on the ground to paint in the section lines.

When the graphed trees were traced onto a map of Podilski Park, they were 100 feet short of the north boundary line. In the field, we measured the east boundary with a tape measure and pacing, discovering the actual line is smaller than the map's length. This helped to solve the mystery of why the trees were so far from the north boundary. However, it did not account for the original two feet of error noted at the beginning of the boundary survey. The error could be even larger.

The inventory for Podilski Park lasted 29 days, including all research, location and acquisition of equipment, and fieldwork. There was still two to three more months of fieldwork left when the fall rains came. The original predicted amount of time to complete the inventory was one week. As new information was gained, new ways of gathering needed information had to be devised based on what equipment or methods

could be found locally. With all needed information and equipment assembled, and without encountering delays, weather changes, and vandalism, the Podilski Park inventory could be completed in two months

Podilski Park's first inventory was completed in three days. With the addition of all trees inventoried, the fieldwork would have taken several months to complete. After the discussion on exactly which trees to inventory, fieldwork went faster than the previous time, but still took multiple days for one section. The final requests for the inventory added more work to the project, resulting in slower fieldwork. This added time to the over-all inventory. The benefit of inventorying Podilski Park several times was that I could try different methods to see what worked. Those methods would be adapted to fit the other parks.

Ivan Franko Park Inventory

Introduction

The area of Ivan Franko Park was first mentioned in the historical records of Khmelnitsky, formerly Proskurov, in the middle of the 1800s. The park was originally a slough used for duck hunting by the local nobility. At the beginning of the 1900s, the backwater was cleaned and turned into the city beach. In the 1920s, the area was drained and Ivan Franko Park was created (Аніськов, 1.08.03р.).

According to the city records, the park houses five sports fields, a chess school, and a summer theater (Figures 3.14 and 3.15). The park's environmental accountability was handed over to the Department of Ecology and Natural Resources in 2000. On June 14, 2002, the city began renovation of the park's theater into a family café, playground,

Figure 3.14: A basketball court, Ivan Franko Park.

Figure 3.15: Picnic tables, outdoor café, and antique bazaar, Ivan Franko Park.

and outdoor stage (Figure 3.16). On August 1, 2003, the Khmelnitsky City Council, Department of Family and Youth Affairs, the park's governance, made a petition to have

Figure 3.16: Construction on new café and theater, Ivan Franko Park.

the park status changed from garden and park art to a park monument. This status change was to increase protection of the park and the effective use of its resources (Аніськов, 1.08.03p.).

Ivan Franko Park is located in the city center (Map 3.1, p. 25). The west boundary is Ivana Franka Street. The north line is Proskurivska Street. East of the park boundary is a building and a fence. The railroad yard is located on the south border.

This park inventory was more cohesive with fewer mistakes than Podilski Park. We did not have to repeat any part of the inventory. Corrections did have to be made, but they were caught before the next field day and were corrected during the day's activities. Comparing the maps and tally sheets for mislabeled and missing trees discovered errors. The tally and cover sheets were also read through to determine if the information collected was complete. Doing an inventory check at the end of each day saved time, because I could begin with the mistakes the next day and continue on where we had left

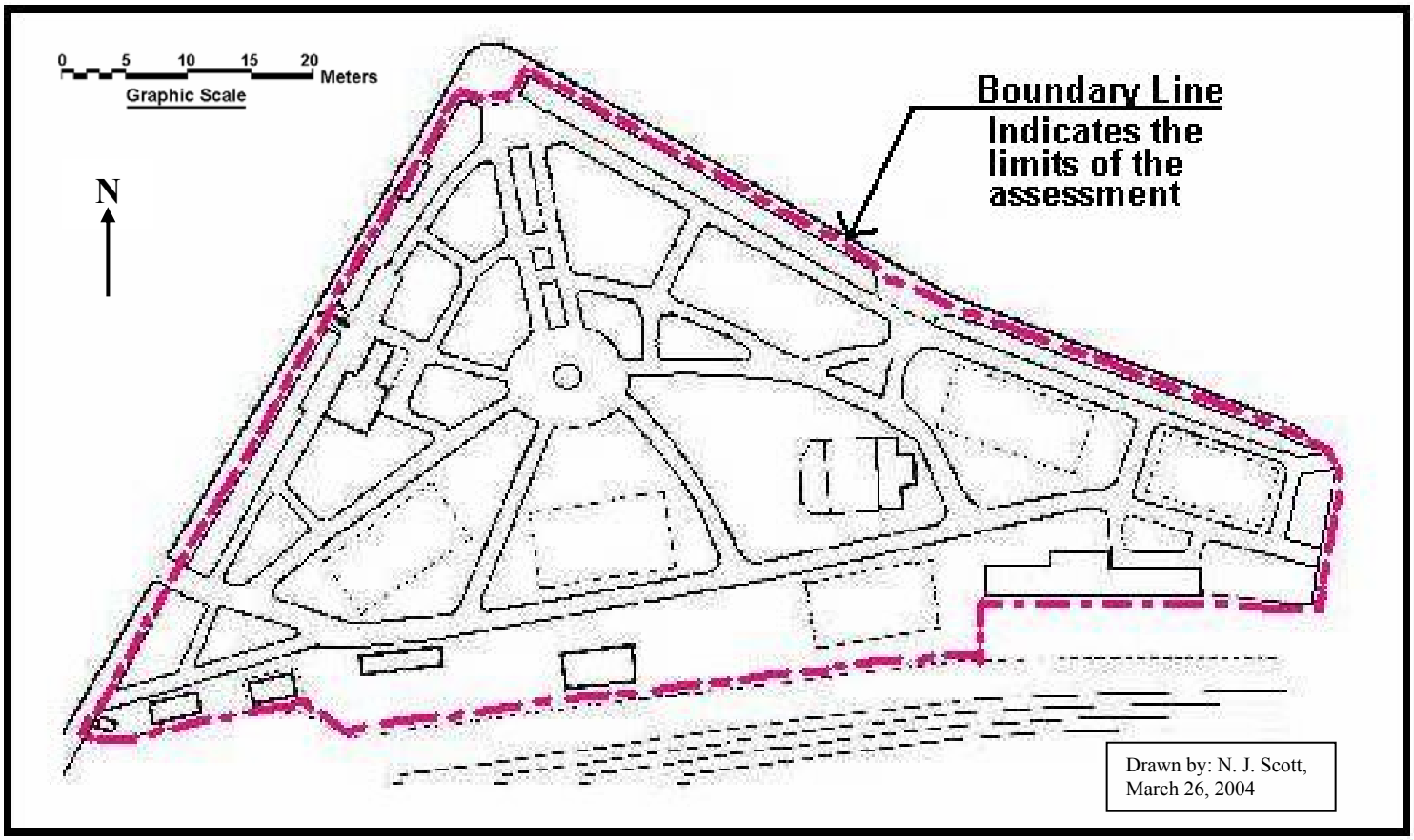
off after the corrections were made. Also, the errors were still fresh in my mind, so I did not have to go over items more than once. For example, with Podilski Park, when I went to the field to check the errors, enough time had elapsed between when the data had been collected and checked that I had forgotten what the problem was. This inventory was faster because the parameters of the inventory had been set with Podilski Park's inventory, so we did not have to spend time defining them.

The following is a discussion of the Ivan Franko Park inventory methods. The first part discusses the boundary survey. The second section goes over the tree inventory and the last segment talks about the other inventory data and the analysis.

Boundary Survey

Ivan Franko Park was started after the first inventory at Podilski Park. The maps and documents for it were copied. The park was well established, so there was no problem in locating it. The preliminary overview was completed and a plan of action decided.

The boundaries were agreed upon and were easier to find because more detailed maps were available and the park is located in the city center, versus Podilski Park's, a field next to a new suburb. The south line is a bit questionable because it is an open field bordering the railroad yard. The south line was agreed to be the top edge of the ridge of fill from the railroad yard to an adjoining building and fence (Map 3.4). No trees were in the area between where the boundary line was run and the railroad tracks. The north and west lines were determined to be the 2-foot wall surrounding the park on these two sides.



Map 3.4: Boundary lines for Ivan Franko Park inventory (Filius, 2004)**.**

South line follows top of ridge (dashed line) to building and fence.

A different city department managed the trees outside of this wall.

The original base map for Map 3.4 was field checked. Buildings that existed on the map were not in the actual park or in different locations, and the boundary lines included partial buildings, roads, and railroad tracks. Map 3.4 was modified slightly by adding and removing items in the park and the boundary lines were adjusted to run along walls, the hilltop or edges of buildings.

Ivan Franko Park would also be divided into sections, only they would be smaller than Podilski Park's, so the trees could be drawn in on each section map. In addition, there was very little regeneration. The majority of the trees were mature and spaced relatively far apart (Figure 3.17). The sections were based on the existing paths. Only Section 5 had to be subdivided because it could not be enlarged to the same scale as the other sections and fit on one piece of paper. It was divided using a straight line from a path along a fence and building wall to the south boundary (Map 3.5). Section maps

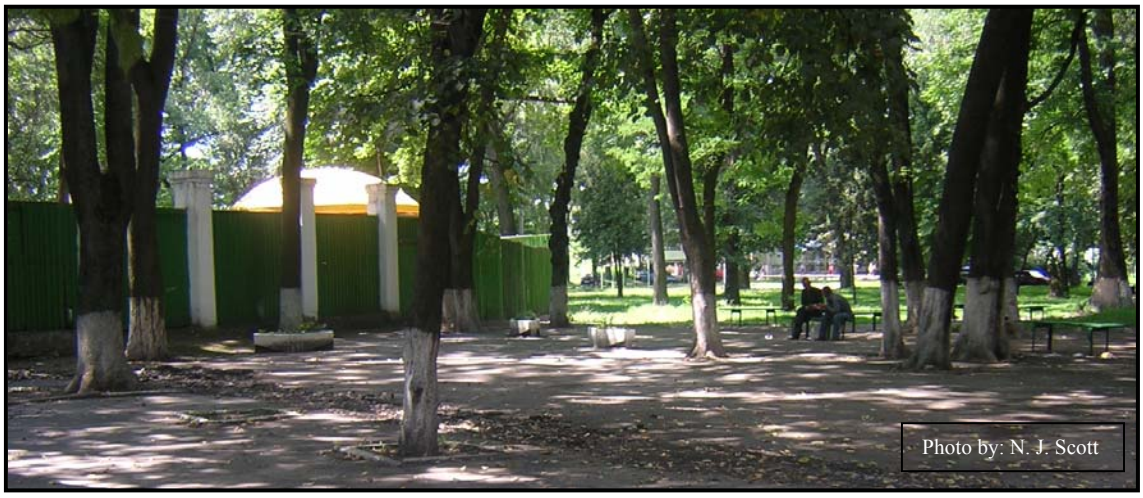
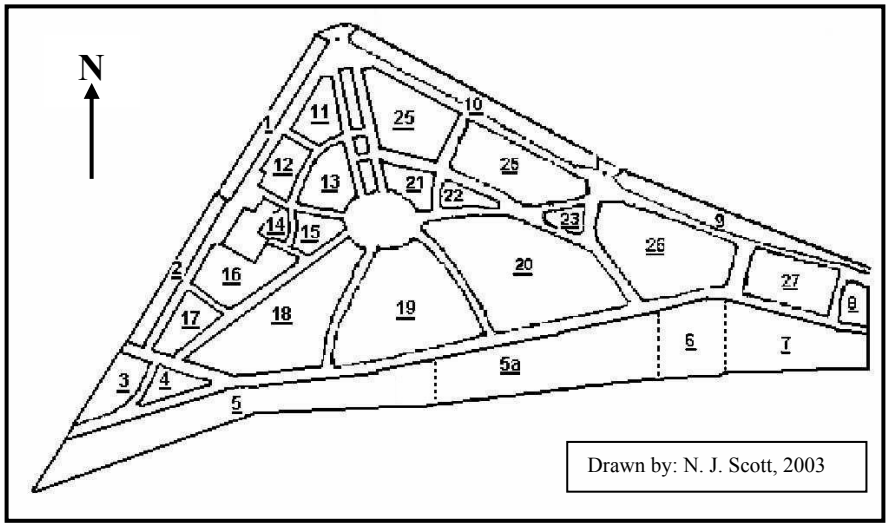


Figure 3.17: Tree spacing in Ivan Franko Park.



Map 3.5: Ivan Franko Park sectional map
(adapted from Filius, 2004)**.**

were created and general tree locations were placed on the maps to see if this was a feasible way of mapping them.

Tree Inventory

The tree inventory was completed using the same basic methods as Podilski Park. The tree was given an identification number, species identified, dbh measured, health conditions recorded, health class assigned, and recommendations logged. By the time the actual inventory was begun, a logger's tape in inches had arrived from the United States. The logger's tape was used exclusively on this park inventory. The dbh in inches was later converted to dbh in centimeters during the data entry process.

The main difference between this inventory and Podilski Park's was the trees were not paced off and marked. The trees were widely spaced and the park contained enough permanent landmarks so that the trees could be accurately mapped without

having to pace each one off or mark them. This saved over five minutes of inventory time per tree.

Ivan Franko Park inventory was accomplished with the data checked daily, so any mistakes could be corrected during the next field day. One of the data checks discovered approximately ten trees missing or not lining up in Section 5. Section 5 trees were mapped again.

Over the course of the inventory, I adjusted the terminology for canker and burl. I knew the difference between the two, but I could not remember what the word was for canker, so I called both burls. When I remembered the word for canker, I began distinguishing between a burl and a canker in the health conditions. I also shifted how I classified health conditions. For example, I began calling trees with a dead branch or a little burl on them as healthy and slowly I had shifted to unhealthy. Consequently, I pinpointed exactly what constituted healthy and unhealthy for cankers, burls, and dead branches (Table 3.7). Table 3.7 was used in conjunction with the other health conditions to select the final health classification for the tree.

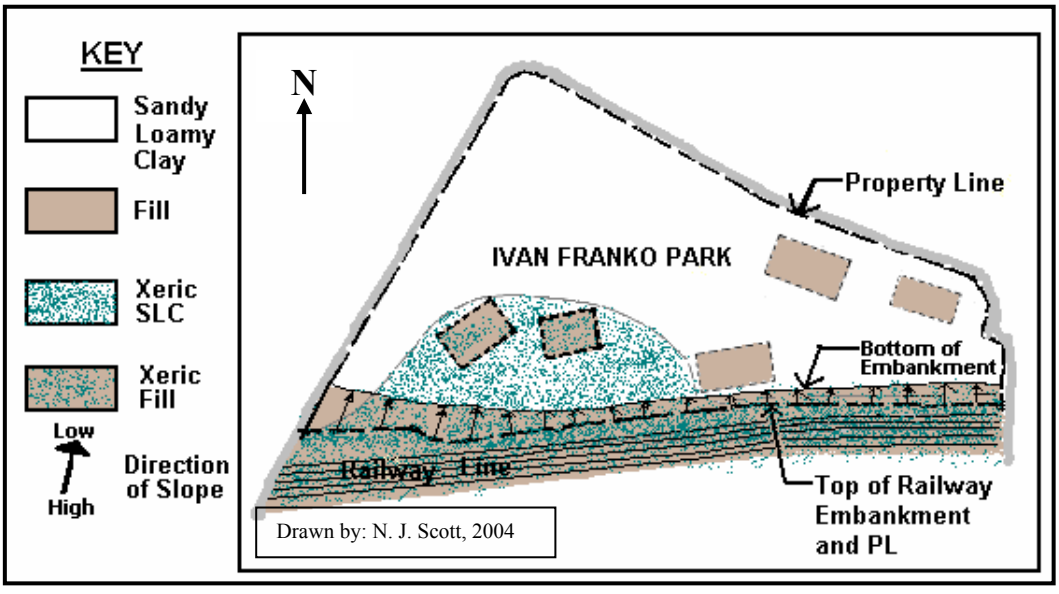
Table 3.7: Classifications for trees that have cankers, burls, and dead branches.

Classification of Cankers, Burls, and Dead Branches	
Problem	**Health Classification**
A few dead minor branches	Healthy
A few dead major branches	Unhealthy, but not serious
More than a couple of dead major branches	Unhealthy, may or may not be serious
A few small burls or cankers without problems	Healthy
Large burls or cankers with problems	Unhealthy, may or may not be serious
A mix of the above healthy	Unhealthy, but not serious
A mix of the above unhealthy	Unhealthy, serious

Other Inventory Data

Soil, hydrological, topological, and other general information was collected in the same manner as Podilski Park. Park visitors were less open with ideas for the park than the ones in Podilski Park. This is possibly because of the park's long history in the city, so they saw the management of it as less likely to change.

Soil information was collected using the same methods as Podilski Park. Ivan Franko Park has more of a uniform soil than Podilski Park (Map 3.6). The hydrology of Ivan Franko Park is mesic to xeric depending on the canopy cover (Map 3.6). No wetlands were observed in the park and no wetlands indicator species were located. The park's topography was flat with the exception of where the railroad yard fill formed an embankment along the south line (Map 3.6). The embankment line was copied from a departmental map and verified in the field.



Map 3.6: Ivan Franko Park soil/hydrological/topographical map (Filius, 2004)**.**

The park's groundcover consisted of turf grass and weeds. The park is mown regularly. Seedlings are present in low quantities and are also mown over. Some areas have no groundcover because they are either a sports field or adjacent to a field with heavy foot and vehicular traffic resulting in compacted soils and no plant growth.

Ivan Franko Park's land uses vary throughout the park. There are outdoor cafes, sports fields, outdoor fitness equipment, benches, picnic area, public toilets, utility buildings, a school's fitness rooms and sauna building, buried gas lines, electrical poles, and buried cables. The park is mainly used for sports activities, walking, and exercising. People also enjoy picnicking in the park. An antiques bazaar is held every weekend and twice a year a food festival is held in the park (Figure 3.18).

Figure 3.18: Land uses in the parks.
Khmelnitsky Days Food Festival, Ivan Franko Park.

Garbage was present in Ivan Franko Park (Figure 3.19). It was not as bad as in Podilski Park. Trash baskets are located in the park, although more are needed. Human feces was also less noticeable. Dog excrement was quite abundant throughout the park.

Figure 3.19: Garbage around a bench, Ivan Franko Park.

Birds such as ravens, chickadees, pigeons were the only wildlife observed in the park. Woodpecker activity on trees and one nesting cavity was present. It might be home to a squirrel, but no signs were noticed.

Other general information observed and recorded included the condition of the sports equipment, fields, and buildings in the park. I also recorded tree infestations or infections.

The field data was entered into the tree tally spreadsheets (Appendix D and also on the enclosed CD) and cover sheet template (Appendix E and also on the enclosed CD) that had been created. The data entry took place at the end of the inventory.

The spreadsheets were proofread against the field notes. The most numerous mistakes encountered were typographical errors. The second type of error discovered was from reading errors, which caused tree information to be duplicated or overlooked. Once the errors were located in the spreadsheets, the rough copies of the maps and the spreadsheets were taken back out to the field and corrected. Final copies of the maps were prepared and the data analyzed.

The data was analyzed for dbh classification for all park trees, dbh classification for each species in the park, dbh classification for each species per section and an overall dbh classification for each section, number of each health condition and recommendation per section, total number of conditions and recommendations by section, occurrences of each health condition for the whole park, total number of each tree species per section and overall for park, and average dbh and health classification per section. Once all data was analyzed, the management plan was written (Appendix F). The maps were needed in electronic form for inclusion in the management plan, so the hand drawn maps were scanned into the computer and electronically manipulated.

This inventory took nine days to complete. The size and location of the park, along with tree spacing and size was an advantage to being able to complete the inventory in a short timeframe. The trial and error of Podilski Park also assisted with speeding up the process. The inventory could have been done in less than a week if it had been the only project underway.

The speed and accuracy with which Ivan Franko Park's inventory was completed shows the validity of the methods developed over the course of Podilski Park's inventory. The methods for Ivan Franko Park did not have to be substantially modified for the

inventory. The knowledge of what was required before the inventory, and the set up of the park, with few saplings and a uniform soil hydrological topographical layout, also made the park's inventory easier.

Remaining Parks

Park Named 500-Years of the City of Khmelnitsky

Park Named 500-Years of the City of Khmelnitsky was founded in 1947-1948. The first name of the park was Komsomolsky Park named after the Komsomol (Young Communist League) members who first worked on the park. The name underwent several changes before the present one, commemorating the 500th anniversary of the city.

The park was built on the floodplain of the Polska and Southern Bug Rivers by "people's construction" (Дзюблюк і Дранус, 2003), or mandatory volunteerism by the city's residents (Map 3.1, p. 25). Trees from different areas of Ukraine were planted first. The dance floor, pavilions, children's car city, and amusement park rides were added later (Figure 3.20). The park covers 55.27 hectares (Дзюблюк і Дранус, 2003).

Two of the park's boundaries were rivers. One other is a street and the fourth is private property. The private property caused problems with boundary line locations. This was resolved by exaggerating the boundary line's location in favor of private property.

While Ivan Franko Park data and maps were being worked on, the material for Park Named 500-Years of the City of Khmelnitsky was located and the division into sections began. First, the park was divided by using the existing paths and canals. In the

Figure 3.20: Rides in Park Named 500-Years of the City of Khmelnitsky from the Ferris wheel.

field, the large sections were further subdivided into smaller sections using permanent landmarks within and around the park. The inventory was not completed.

Zarichya Park

Zarichya Park is an old apple orchard (Map 3.1, p. 25). It became a park in 2001. The park's area is 4.342 hectares (Дзюблюк і Дранус, 2003). The property lines are questionable on all four sides. There is a creek that has been destroyed to allow more room for communal gardens. This park was formerly under the direction of the city's Department of Life and Communal Farming. Communal gardens are still present in the park (Figure 3.21). This park was not inventoried.

Figure 3.21: Gardens and apple trees in Zarichya Park.

Podillya Dendropark

Podillya Dendropark was founded in 1964 to commemorate 50 years of Soviet rule. The trees in the park come from all over Ukraine and Moldova. The park contains many different paths, different tree plantations, a creek with wetlands, and the Monument to Glory, a war memorial (Figure 3.22 and Figure 3.23). The park is 35 hectares (Дзюблюк і Дранус, 2003). The east boundary of Podillya Dendropark is questionable because it borders farm fields and woodlots. The other three boundaries are roads or have fences along them. This inventory also was not begun.

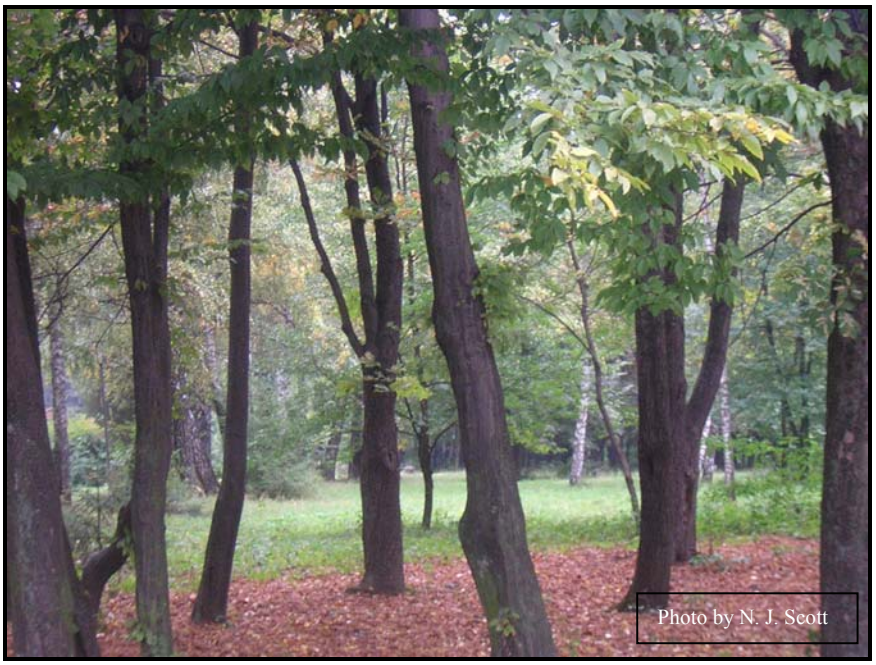


Figure 3.22: Tree plantation with clearing, Podillya Dendropark.

Figure 3.23: Birch stand in Podillya Dendropark.

Summary

The inventory request for the City of Khmelnitsky's five parks from the Department of Ecology and Natural Resources began with determining appropriate methods to conduct the inventories based on local factors. Many of these factors are countrywide and therefore, the methods developed can be used in cities other than Khmelnitsky. The other portion of the project was to implement the methods in actual inventories. The methods were tried and tested several times in the field and modified as needed. This assured the methods would work under different circumstances. Chapter 4 will discuss the results of the inventory methods with analysis of the methods used and how urban foresters in Ukraine can modify these methods to fit the parks that do not have inventories.

Chapter 4 Results and Discussion

Introduction

The results desired from an inventory will dictate the type of inventory needed and methods used. Furthermore, the chosen inventory methods will need to be carefully planned (Avery and Burkhart, 1994). If established urban forestry inventory methods exist for different inventory types, then choosing the inventory type and methods is less problematic than having to create the methods for a given inventory type. The methods chosen will have to fit the limitations where the inventory will be performed (Grey and Deneke, 1992; Avery and Burkhart, 1994; Miller, 1997).

Many different items are needed for a successful inventory. In Ukraine, urban parks require a different inventory approach then what is used traditionally in other parts of the world. The reasons for differing approaches are numerous and each reason affects the how and why of the inventory methods.

Typically, the type of inventory needed for urban parks is a 100% inventory. With the Soviet organizational structure of different city departments managing different parks based on the parks' characteristics, uniform management objectives were not issued or created for all of a city's parks. Therefore, each park was managed differently, creating different circumstances. The fall of communism and the rise of free-market economics have brought about the need for Ukrainian governmental structures to adapt Western models. One of these models that Ukrainians are seeing as important are city parks departments. For these new parks departments to succeed, they must know how each park was managed previously, what is located within the park and where, and the

conditions of the items in the park. The best way to accomplish the gathering of this information is through 100% inventories (Grey and Deneke, 1992; Avery and Burkhart, 1994; Miller, 1997).

What actually determines which type of inventory to be conducted are the objectives an organization has for the inventory. These goals will vary depending on the intensity and type of park management. The first step in an inventory is to determine what the exact objectives are for the inventory. Talking with departmental personnel can discover the inventory goals. Officials may want everything inventoried or only the trees inventoried. Some may want locations of items and others, no locations. What needs to be inventoried will also be discovered with the inventory objectives. Some cities will want all squares, street trees, parks, and public gardens inventoried. Others may want only parks inventoried. The type of inventory can be established when this information is clear. For initial Ukrainian urban park inventories, 100% inventories are acceptable and preferred. Choosing the methods for an inventory is the next step in the inventory process.

Personnel

One of the main factors to take into consideration for any inventory is the personnel. Who will perform the inventory, how many people, and what are the qualifications of the personnel need to be answered.

For 100% inventories in Ukraine, three person crews are optimal. One person inventories the trees and handles the equipment (inventory person), one person records the tree and general park information (the recorder), and one person maps the information

(the cartographer). Either of the last two people can assist the inventory person with additional tasks.

Three people decrease the amount of error encountered versus using either larger or smaller numbered crews. Each person has their own job and responsibilities, increasing the level of attention to detail. Each person can be more focused on what they are doing, improving results and expending less energy on what is happening around them. If larger crews are used, then people tend to stand around without a task to do, decreasing attention and increasing mistakes. Smaller crews tend to have too many tasks to accomplish, so omissions and errors increase.

With three people, inventory speed increases, over the speed of smaller crews. Three people can handle all equipment and tasks without extra time needed for switching equipment and tasks. More than three people impair the efficiency of the operation. People have too much time between processes, leading to wasted time.

The inventory can be accomplished with just one or two people crews. However, additional time will be needed for the field portions of the inventory and to correct the increase in mistakes.

An experienced, professional forester is not required for standard inventory methods. The inventory methods can be used as long as the person doing the inventory has a basic knowledge of forestry (i.e., can identify trees, knows how to measure dbh, and read a map). They can use the methods provided and perform 100% inventories. City ecology departments will be able to find people with natural resources backgrounds, who, with an interest in forestry, can meet with local State Forestry foresters to learn how to measure dbh. With locally available identification books, they can identify the trees, and

natural resources people already know how to read maps. The cost for these people is less than the cost of a trained forester, urban or traditional.

Recruiting volunteers is not an option, but city ecology departments may be able to receive assistance from local university biology department students. If the ecology departments can arrange to train the students to measure dbh and identify trees, then the cities may be able to organize internships with the universities and have an on-going urban parks' forestry program. Ukrainian students receive stipends from the universities during their internships, so the ecology departments' costs would be minimal.

An experienced cartographer is also not needed to draw the field maps. A person with basic map reading skills can sketch the maps. If needed, a professional can be hired to create high quality maps from the field maps. If professional quality maps are not required, then recopied field maps are acceptable.

Equipment and Office Supplies

Another factor to consider is inventory equipment. Equipment, locally available, can be substituted for standard forestry instruments. The equipment needed for a 100% inventory in Ukraine is: a standard 100 meter tape measure, a chalk box, and a bottle of chalk or spray paint. The office supplies include an appropriate number of copies of the "Tree Tally Sheet" and "Inventory Cover Sheet", one copy each of soil texture, tree health conditions, tree classification, and tree recommendations tables, a field book for field notes, copies of park base maps and sectional maps, colored and regular pencils, and one or two clipboards or other hard surface to write on.

In parks where the tree density makes marking necessary, marking the trees with a chalk box is the ideal method. The section lines will have to be periodically remarked until all of the surrounding sections are finished. This will not take much time to do, because the chalk will already be on the trees, so people can snap lines as they walk the necessary section lines. The section lines can be set right before the section is worked on and the next section's lines marked from the previous section's lines. Therefore, only the current section's lines will be needed to set the next section's lines, reducing time spent remarking all of the park's section lines.

A computer or photocopier may not be available for use, so all of the information can be kept in bound notebooks. Keeping field information in a bound notebook is a standard practice all over the world. In many countries, a field book is a legal document because people cannot tamper with the bound notebook by removing or adding sheets of paper (Wolf and Brinker, 1989). In Ukraine, bound notebooks are inexpensive, but photocopying is expensive if the organization does not own their own copier. The organization can do all of the copying of the forms by hand. As the forms are copied by hand, the organization can adapt them to fit their needs and only the number of copies needed for a certain inventory has to be made at one time. Current Ukrainian tradition is to use bound notebooks to record information and the tables are drawn onto each individual page, so the extra time of handwriting all of the inventory information is acceptable.

The scientific and English names table with species numbers is necessary for obvious reasons. Species numbers are used for data analysis and professional mapping purposes. Ukrainian landscape maps have tree symbols drawn on them instead of dots

for the location of each tree. These symbols are outlines of what an open grown tree of a certain species would look like. Since drawing each individual tree on a map is impractical, a different method for denoting tree locations is used. It is impossible to draw the tree symbols small enough and clearly enough on a manageable sized field map, hence the dot and tree identification number system.

A professional cartographer will determine the correct tree symbol for each species from the corresponding species number to draw the right symbol on the map according to each park's sectional field maps and spreadsheets.

The shapes and relative dimensions of the parks are kept when creating the base maps. Thus, the questionable property lines can be set exactly after a national land survey is concluded. The accuracy of these maps has to be high enough to meet the inventory requirements and to allow somebody who has not worked on the inventory to be able to locate each tree in the field. The grid system and measuring distances between trees will increase tree location accuracy. After the land survey is completed, minimal adjustments for corrections will need to be made to the inventory maps and information.

When mapped tree locations have to be within one meter of actual field location, parks need to be divided into sections. Section divisions are based on the number of trees in the park. If only mature trees are needed and the park has few, then the park may not need to be divided into sections. If many trees are to be mapped, then the park will need to be divided. The size of the sections will depend on the number of trees per section, the size of the park, and stable objects within the park.

Boundary Survey

The lack of a land survey is not limited to just Ukraine. Many other developing countries also have not had land surveys completed (Brower, 2000; Ploetz, 2000). The difficulty of Ukrainian park boundary surveys will depend on the land uses adjoining the park. Without stable objects bordering the park, a land survey, and accurate maps, the exact boundaries cannot be located.

At least one stable object should be located in each park as a reference point for determining the boundary and sections. All of the lines can be measured from this reference point. When a land survey is completed, the difference between the land survey and the inventory boundaries can be determined and the inventory area can either be enlarged or made smaller. If no stable object is located in the park, then one outside of the park can be used to determine the boundary lines. The same process of comparing a completed land survey against the inventory boundaries can be made and the appropriate adjustments implemented.

Establishment of a wide buffer around private property and adjusting the questionable lines based on the presence of trees may leave out some trees while including others not on park property. When a completed land survey occurs, trees can be easily added and deleted from the inventory as necessary. The addition and deletion of trees can be accomplished with little effort because the park tree locations are known from the inventory map.

When a land survey is completed, the park's section lines can remain as originally mapped. The questionable lines and areas can be added or removed from the appropriate section and the inventory information adjusted.

Tree Inventory

Each park's inventory is begun at a stable reference point, for example a fence or monument located within or on the boundary of the park. If enough stable reference points are in the park and there is a small number of trees, the trees do not have to be paced or measured off; these can be aligned with the stable reference points instead. Aligning trees with stable reference points creates accurate maps and is similar to the use of a plane table (Integrated Publishing, 1998; Denny, 2000).

The dbh is measured using a tape measure. If a person does not know how to measure dbh, they can meet with a local traditional forester, who can teach them how to measure dbh.

Other Inventory Data

Looking for wetland areas during the park overview is ideal for determining if wetlands may or may not be present in the park. If wetlands are present, then they will be examined further. Questionable boundary lines may cause problems with definite wetland areas. When unknown property line locations interfere with wetlands mapping, the wetlands should be extended past the line. When a legal boundary survey is completed, the wetland areas can be appropriately adjusted.

Groundcover inventory does not have to be intensive. A cursory observation of each section will suffice. If more detail is required, Russian identification books are available in Ukraine.

The inventory crew should talk with park visitors regarding what the crew is doing and why. They should also ask for the visitor's opinions about the park. This is a good way of collecting information and public opinion. The crew does not have to poll all the visitors, but only those who approach the crew.

Steps of a Standard 100% Inventory

This section contains an ordered list to conduct a 100% inventory for an urban park in Ukraine. There are five sections to the inventory, the pre-inventory work, boundary survey and map creation, the tree inventory, collection of other inventory data, and post-inventory.

A. Pre-Inventory (office)

1. Questions to be answered:
    a. What parks are to be inventoried?
    b. What information is wanted from the inventory? For example: tree dbh, health status, management recommendations, land uses, groundcover, wildlife, or other information.
    c. What are the specific requests for the inventory? For example: tree location accuracy, which trees to inventory, where new trees need to be planted, or other specific requests.
    d. What are the limitations for the inventory? For example: no permanent markings, time frame, number of personnel available for assistance, or other limitations.

2. Determine the type of inventory. Usually 100% is preferred.
3. Research and collect all available information on each of the targeted parks.
4. Determine the inventory methods.
    a. What methods are appropriate for the inventory type?
    b. How many people are needed to conduct the inventory?
    c. What equipment is necessary?
    d. How much chalk or spray paint is needed?
    e. How many photocopies, notebooks, maps, pieces of graphing paper, or notebooks are needed?
5. Locate funds or donations to cover inventory costs.
6. Locate and contract, if needed, all inventory personnel.
7. Locate and purchase needed equipment.
8. List the parks in order by which they will be inventoried. Order can be based on size, location, personnel and material needs, priority, or other criteria.
9. Determine what will be on the base map, features such as paths, roads, or buildings.
10. Modify and copy the paper “Tree Tally Sheet”.
11. Modify and copy enough tree tally computer spreadsheets for each park and section.
12. Modify and copy the paper “Inventory Cover Sheet”.
13. Update the cover sheet computer template.

B. Boundary Survey and Map Creation (office and field)

1. Collect all maps for the park to be inventoried. (Office)
2. On one map, mark all boundaries that do not line up with each other. (Office)
3. Double-check the boundaries on the map with a knowledgeable official. (Office)
4. Conduct a park overview at this time. (Field)
    a. Record the over-all physical aspects of the park.
    b. Create a basic tree species table.
5. Obtain the measurement between at least one stable reference or known point in the park and a corner or boundary line. (Field)
6. Check boundaries by measuring and pacing. (Field)
7. Determine where the temporary boundary will be for questionable lines. (Field)
8. Mark questionable lines on map and write in field notes a description of the line for future reference. (Field)
9. Determine the feasibility of drawing all of the park's trees on a map, which fits on a standard size piece of paper. (Field)
    a. If feasible, create base map with all desired characteristics. (Office)
    b. If not feasible, decide on sections and subsections, as needed. (Field or Office)
    c. Create base map with sections, subsections, and all desired characteristics. (Office)
10. Mark boundary lines and section lines. (Field)
    a. After a section is completed, the lines, which will not be used by any other sections, do not have to be marked again.

b. After a section is completed, remark boundary and sections lines, which will be used again for another section.

C. Tree Inventory (field)

1. Locate first tree of park or section from a stable reference point by pacing, measuring, or with reference points.
    a. For every tree afterward, locate the new tree from the previous tree or from reference points.
    b. Draw dot on the sectional map or graph on graph paper.
2. Assign the tree an identification number.
    a. If the tree is split below dbh, assign appropriate number and letter(s) and write on tally sheet.
    b. Write identification number on the map.
3. Identify tree and record.
4. Measure dbh.
    a. If dbh is over 10.0 cm, then record dbh.
    b. If dbh is less than 10.0 cm, do not record dbh.
5. Record health condition(s) and add new conditions to the table as needed.
6. Record a health class.
7. Record management recommendations and add new recommendations to the table as needed.
8. Record comments as needed.
9. Mark tree if need be.

10. Repeat steps one through nine for every tree in the park.

D. Other Data (field and office)

1. The soil hydrology topographic information can be mapped either on a field day when inventory information is not being collected or it can be mapped while inventory information is being collected.
2. Soil testing and mapping (Field):
    a. Test soil texture for each section.
    b. Test soil texture where changes occur within a section.
    c. Map the soil at every test site.
    d. Connect appropriate lines to form areas of like soil.
3. Hydrology mapping (Field):
    a. Identify wetlands and water sources by following the leading edge of wetlands plant species indicators or edges of watercourses.
    b. Map them by drawing the edge of the indicator species on the soils map.
4. Topographic mapping (Field):
    a. If park topographic maps are available, then a cursory field check is suitable.
    b. If park topographic maps are not available, then map the topography by drawing the basic features on the soils and hydrology map.
5. Talk with park visitors throughout the inventory to uncover new information about the park. (Field)
6. Record the groundcover type throughout each section. (Field)

7. Record land uses for each section and throughout the park. (Field)
8. Record special concerns, such as garbage, severe erosion, safety hazards, for each section. (Field)
9. Note any questionable items, such as land uses, trees, boundaries, for each section and the park. (Field)
10. Record observed wildlife signs and activity for each section and the park. (Field)
11. Record the condition(s) of park structures, paths and roads, and utilities for each section and the park. (Field)
12. Fill out an "Inventory Cover Sheet" every day for each section where fieldwork has occurred. (Field)
13. Take care of equipment at the end of each field day. (Office)
14. Check the field notes and sheets with the maps for errors at the end of every day in the field. (Office)
15. Correct any errors from the previous field day at the beginning of the next field day. (Field)

E. Post-Inventory (field and office)

1. Enter tree inventory information into the tree tally spreadsheets. (Office)
2. Enter the general park information into the cover sheet template. (Office)
3. Proofread the spreadsheets and templates. (Office)
4. Prepare and proofread rough drafts of the maps. (Office)
5. Check the rough copies of the maps, spreadsheets, and templates. (Field)
6. Store all inventory equipment and archive all field notes. (Office)

7. Prepare final copies of all maps. (Office)
8. Analyze inventory data. (Office)
9. Write report or management plan. (Office)

Summary

The methods designed for 100% inventories were based on local and national needs. The methods accounted for the limitations encountered and the requests of the Department of Ecology and Natural Resources. These methods evolved over a long period of time with much trial and error. Since the people using the methods will have little financial support or forestry training, the methods utilize readily available equipment, pre-made lists, and knowledge sources locally available. A critical problem within the methods that had to be overcome was the lack of marked property boundaries. The methods of the inventory are flexible enough to allow for changes in the boundaries, maps, and inventory information when a legal Ukrainian land survey is completed. The following chapter will summarize the inventory project and give recommendations for 100% inventories of the remaining Khmelnitsky city parks.

Chapter 5 Recommendations and Conclusion

Summary of Research

The history of Ukrainian urban parks is long. The management of these parks has changed through the years, depending on the economic and political situation of the country. Many parks were created during the Soviet times and fell into neglect with the fall of the Soviet Union and subsequent economic crisis. With the rejuvenation of the economy and the rise of democracy, Ukrainians are becoming interested, once more, in their urban parks.

This rise in interest of urban parks prompted the initial request of having an inventory conducted for the City of Khmelnitsky's five urban parks. What appeared to be a straightforward request turned into an in-depth project. The methods were changed as the limitations of the country's history, city officials' requests, and inventory equipment became apparent. The main limitations were financial support, minimal personnel for work crews, and lack of land surveys.

Traditional inventory methods were modified to fit the limitations and new methods adopted. A key process was developing a boundary survey method which allows the exact lines to be set after a legal land survey is completed. Boundaries and distances were measured from a stable reference point within the park and a buffer created around adjoining private property. Once legal boundaries are set, urban forestry information derived from these methods can be easily adjusted to fit legal boundaries. Dividing the park into sections and subsections, measuring each tree from the previous tree, and graphing the distance on graph paper gave accurately mapped tree locations.

The trees were evaluated using standard forestry criteria with the health conditions and management recommendations being incorporated into tables for future use. The health classification system was modified from current United States urban forestry methods (Miller, 1997). Keeping track of which trees had been inventoried and which trees had not been inventoried proved to be a problem until marking the trees with a chalk box was discovered. The modified soil texture chart worked well to meet the inventory objectives. Following the leading edge of a wetland plant species as an indicator achieved the results necessary for the inventory goals. Topographic maps were important when researching the park and writing the management plans. Drawing a topographic map without elaborate equipment was adequate for the inventory. Recording tree information on the "Tree Tally Sheet" and "Inventory Cover Sheet" assisted with keeping the tasks in the same order, so items were not overlooked or forgotten.

By using minimal, familiar equipment and methods for non-forestry professionals, the inventory procedures can be replicated throughout Ukraine by municipalities which do not have large financial bases or trained, forestry personnel. These methods can be easily adapted to fit each urban park's needs.

Modified Inventory Methods for Remaining Parks

The remaining Khmelnitsky parks will use the standard 100% inventory methods. However, they will be slightly modified to accommodate the different characteristics of each park. Each section below will describe the modifications required for each remaining Khmelnitsky park.

Park Named 500-Years of the City of Khmelnitsky

Park Named 500-Years of the City of Khmelnitsky was broken down into subsections using stable reference points within and outside the park. The size of the park and the number of trees in it cause some of the subsections to be further subdivided. This can be accomplished by marking the lines of a subsection (Figure 5.1). Next, squares 15 m x 15 m are imposed over the subsection starting at the bottom of the subsection. Using a tape measure, 15 meters above the bottom line is measured on one of the sides of the subsection and a line is marked straight across to the other side of the subsection. Another line is measured 15 meters above that line and so on until the

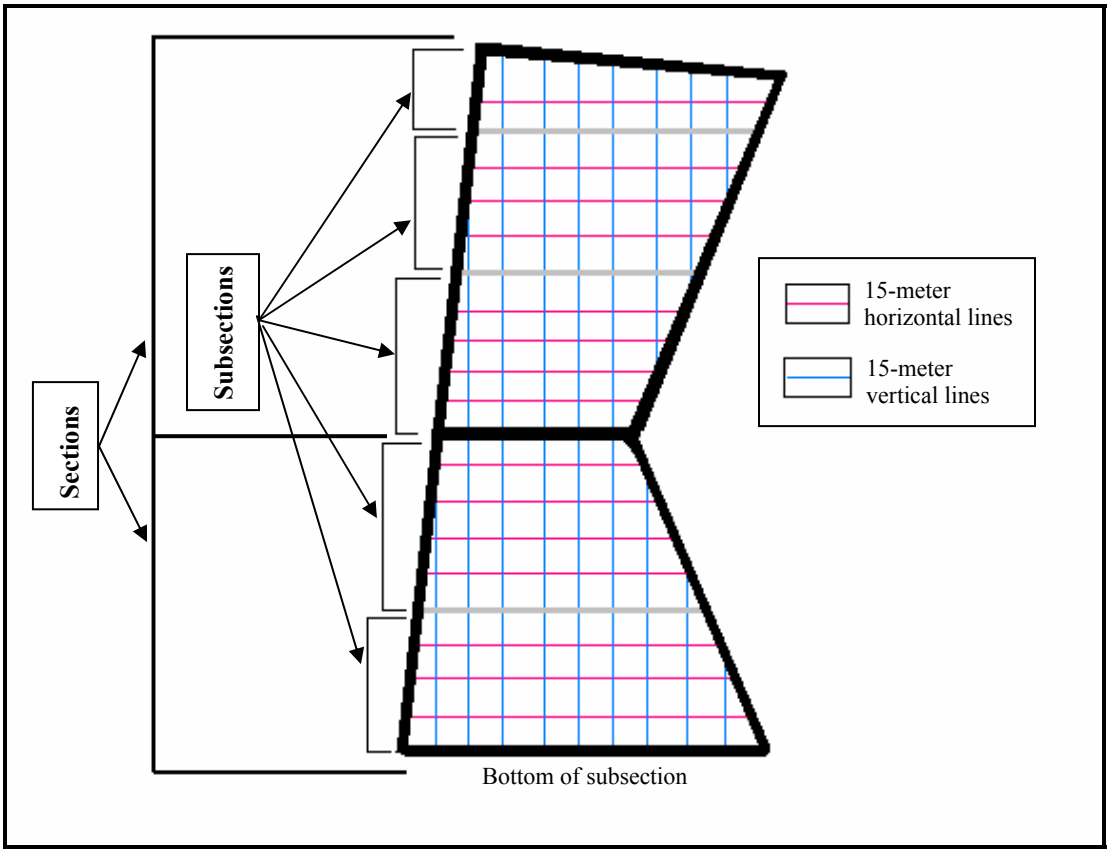


Figure 5.1: Example of two sections divided into subsections with 15 x 15 meter divisions of the subsections.

subsection is divided horizontally. The subsection is divided vertically using the same method. Each division of the subsections will fit on a sheet of graph paper and trees can be measured and graphed. The rest of the inventory will proceed as the general steps indicate.

Zarichya Park

Zarichya Park's inventory will deviate from the standard methods in a similar way as Park Named 500-Years of the City of Khmelnitsky. The difference between the two is Zarichya Park only has one apparent partial boundary and two paths running through it, whereas Park Named 500-Years of the City of Khmelnitsky has many locatable boundaries and stable reference points. The grid system used for Park Named 500-Years of the City of Khmelnitsky can be superimposed over all of Zarichya Park basing it off of the two paths where they meet in the center of the park. Since this park has some open areas that will interfere with marking division lines, spray paint must be used to mark division lines. The rest of the inventory will follow the standard procedures.

Podillya Dendropark

Podillya Dendropark will follow Park Named 500-Years of the City of Khmelnitsky's grid system with a variation. By making the squares smaller, 6 x 6 meters, the grid system is modified. The park has many bushes and trees growing close together. To be able to graph the trees and bushes, the grid will have to be smaller. The rest of the inventory will follow the standard procedures.

Conclusion

Many different ways of conducting urban park inventories exist. Most are more technologically advanced then the methods in this paper. Many park inventories use aerial photos, satellite images, and other remote sensing methods to collect general information about the park. GPS, personal digital assistants, data recorders, and total stations record in the field inventory data. Computers are used to store the inventory information in databases. The information is mapped using GIS programs and analyzed with special urban forestry software (Miller, 1997; USDA Forest Service Northeast Center for Urban & Community Forestry, 2002; Bloniarz, et al, 2003). Other methods used are plotting trees on maps by compass and pacing or plane table and grid systems. Data collected from these methods is either electronically recorded and stored or just electronically stored. How the data is stored on a computer is determined by the methods used. The information is manipulated using various software packages (Miller, 1997). The methods presented in this paper are similar to these methods by measuring distances between trees (compass and pacing), basing tree locations off of stable reference points (plane table), and using grids in subsections (grid system). A main difference between these methods and the others was all data was recorded by hand and entered into a spreadsheet for storage. No database was created and the information was not analyzed with urban forestry programs. The maps also will not be available on GIS. These methods also give ways of storing and organizing data without the aid of a computer.

Standard inventories begin with a boundary survey and the area to be inventoried is determined. The inventories in this paper could not be based on boundary lines, because no official lines existed. Other inventories also have accurate maps available or

accurate maps can be made with the technology available to the organization. Accurate maps are not available, so discrepancies between maps and field conditions had to be taken into account manually by estimation because the organization did not have the funds to purchase or access to technology. Trees are also marked using aluminum identification tags. These tags are not available in Ukraine and are considered permanent markings (Miller, 1997). The differences in methods will gradually become less distinct as Ukraine progress towards a developed nation.

Ukraine is experiencing an exciting time in its history. Many old traditions are being revived and new ones created. With this renewal, Ukrainians can be more concerned about their environment. The improvement of the country's economic situation is encouraging the people to actively improve their living conditions. This desire of a richer life is shown in cities were parks departments are developing and citizens are taking a leading role in urban parks' management. The 100% inventory methods presented in this paper can assist these new parks departments and active city residents to manage their lands. The continued economic and political growth of the country will ensure these inventory methods become obsolete with the adoption of more technologically advanced urban forestry systems. Given the present situation of Ukraine, growth and advancement is inevitable.

Literature Cited

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Аніськов, С. до В.В. Андреєву, 1.08.03р. № 268/01-13.

Avery, Thomas Eugene and Harold E. Burkhart, 1994. Forest measurements, 4th edition. McGraw Hill, Boston, Massachusetts, pp. 408.

Bloniarz, David V., Barbara L. Deutsch, Jill R. Mahon, and Greg Ina, September 17, 2003. Handheld technologies for urban forestry – Inventories, GIS & more. http://www.umass.edu/urbantree. Last viewed on January 4, 2005.

Bradely, Gordon A., ed., 1995. Urban Forest landscapes: Integrating multidisciplinary perspectives. University of Washington Press, Seattle, Washington, pp. 224.

Brower, Andrew M., 2000. Honduras: An ethnographic study of El Armando National Wildlife Refuge and Guayape, Olancho. M.S. Thesis, Michigan Technological University, Houghton, Michigan, pp. 95.

Buksha, Igor, 2004. Presentation on forestry sector of Ukraine in transition to market economy. UNECE/FAO, Sixth Meeting of ToS, Warsaw, Poland.

CIA, Perry-Castañeda Library Map Collection, 1993. Administrative map of Ukraine. http://www.lib.utexas.edu/maps/europe/ukraine_adm93.jpg. Last viewed on October 22, 2004.

CIA World Factbook, 2004. Ukraine. http://cia.gov/cia/publications/factbook/geos/up.html. Last viewed on October 7, 2004.

Creed, Gerald W., 1998. Domesticating revolution: From socialist reform to ambivalent transition in a Bulgarian village. The Pennsylvania State University Press, University Park, Pennsylvania, pp. 304.

Coombes, Allen J. 2000. Trees. Dorling Kindersley, London, pp. 320.

Denny, Milton, PLS, 2000. Plane table mapping in Point of Beginning. http://www.pobonline.com/CDA/ArticleInformation/features/BNP__Features__Item/0,2338,9496,00.html. Last viewed on November 16, 2004.

Дзюблюк, Т. і Р. Дранус, 2003. Міський екологічний бюлетень № 4 «Заповідні території та зелені зони м. Хмельницького». Відділ екології та раціонального природокористування міськвиконкому, Хмельницький, Україна, pp. 40.

Educational Network Ukraine, 2001. Ukraine's system of basic education. http://www.ednu.kiev.ua/index_e.htm Last viewed on November 1, 2004.
FAO Forestry: Ukraine Country Information, 2003. Forest and the forestry sector. http://www.fao.org/forestry/site/23747/en/ukr. Last viewed on October 20, 2004.

Fedorick, Darwin, 1997. Ukraine statistical facts. http://www.rjstours.shawbiz.ca/facts.htm. Last viewed on October 19, 2004.

Filius, Kara, 2004. Ivan Franko Park: Resource assessment and management recommendations. Khmelnitsky, Ukraine. http://peacecorps.mtu.edu/parks/plan.pdf.

Grey, W. Gene and Frederick J. Deneke, 1992. Urban Forestry, 2nd edition. Krieger Publishing Company, Malabar, Florida, pp. 299.

Грищук, Броніслав, 1996. Хмельниччина. Фірма «POLYGRAF», Пряшів, Словаччина, pp. 172.

Гуленкова, М.А. и М.Н. Сергеева, 2001. Атлас родной природы: Растения болот. Издательство «Эгмонт Россия», Москва, Россия, pp. 63.

Integrated Publishing, 1998. Engineering: Chapter 9: Plane-table topography and map projection. http://www.tpub.com/content/engineering/14070/css/14070_175.htm. Last viewed on November 16, 2004.

Khmelnitsky Online, Last viewed on October 25, 2004. History and geography. http://online.km.ua/cgi-bin/online?city,04.

Кремер, Бруно П., 2002. Деревья: Местные и завезенные виды европы. Издательство «Астрель», Москва, Россия, pp. 287.

Kubijovyc, V., 2001. Encyclopedia of Ukraine: Boh River. http://encyclopediaofukraine.com/pages/B/O/BohRiver.htm. Last viewed on October 14, 2004.

Lawrence, Henry W., 1995. Changing forms and persistent values: Historical perspectives on the urban forest. Urban forest landscapes: Integrating multidisciplinary perspectives, Gordon A. Bradely, ed. University of Washington Press, Seattle, Washington, pp. 17-40.

McPherson, E. Gregory, Rowan A. Rowntree, and J. Alan Wagar, 1995. Energy-efficient landscapes. Urban forest landscapes: Integrating multidisciplinary perspectives, Gordon A. Bradely, ed. University of Washington Press, Seattle, Washington, pp. 150-160.

McPherson, E. Gregory, 2003. Urban forestry: The final frontier? Journal of Forestry, 101 (3): 20-25.

Microsoft Encarta Online Encyclopedia, 2004. Ukraine. http://encarta.msn.com. Last viewed on October 7, 2004.

Miller, Robert W., 1997. Urban forestry: Planning and managing urban greenspaces, 2nd edition. Prentice Hall, Upper Saddle River, New Jersey, pp. 502.

Ministry of Ecology and Natural Resources of Ukraine, 1994. Fauna Redbook of Ukraine. http://mail.menr.gov.ua/publ/redbook/redbook.php. Last viewed on October 20, 2004.

Ministry of Ecology and Natural Resources of Ukraine, 1996. Flora Redbook of Ukraine. http://mail.menr.gov.ua/publ/redbook/redbook.php. Last viewed on October 20, 2004.

Ministry of Environmental Protection and Nuclear Safety of Ukraine, 2000. National report on conservation of biological diversity in Ukraine. http://www.grida.no/enrin/biodiv/biodiv/national/ukraine/l_ind/index.htm. Last viewed on October 20, 2004.

Moll, Gary, 1995. Energy-efficient landscapes. Urban forest landscapes: Integrating multidisciplinary perspectives, Gordon A. Bradely, ed. University of Washington Press, Seattle, Washington, pp. 12-16.

Ploetz, JeffreyD., 2000. Implementation and effectiveness of a Traveling nature display for environmental education in Central Balkan National Park, Bulgaria. M.S. Thesis, Michigan Technological University, Houghton, Michigan, pp. 107.

Press, Bob, 1996. Trees of Britain and Ireland. HarperCollins Publishers, London, pp. 191.

Погурельська, Т., 1998. Україна географічний атлас. МП "Мапа ЛТД", Київ, Укаїна, pp. 31.

Погурельська, Т., 2002. Хмельницька область географічний атлас. ТОВ "Видавництво Мапа", Київ, Укаїна, pp. 19.

Project Learning Tree, 1998. The changing forest: Forest ecology. American Forest Foundation, Washington, DC, pp. 136.

Project Learning Tree, 2001. Environmental education Pre K-8 activity guide. American Forest Foundation, Washington, DC, pp. 402.

Project WET, 2000. K-12 curriculum & activity guide. Project WET, Bozeman, Montana, pp. 516.

Reed, David, 2000. FW5700-Graduate field forestry class. Michigan Technological University, Houghton, Michigan.

Scientific Practical Conference: No – Global Climate Change, 2002. Khmelnitsky Oblast Department of Ecology and Natural Resources, Khmelnitsky, Ukraine.

Stebelsky, I., 2001. Encyclopedia of Ukraine: Park. http://encyclopediaofukraine.com/pages/p/a/park.htm. Last viewed on October 14, 2004.

United States Bureau of Land Management, Last viewed on October 25, 2004. General land office records. http://www.glorecords.blm.gov/Visitors/PublicLands.asp.

United States Soil Conservation Service, October 1962. Soil Survey Manual, United States Department of Agriculture Handbook No. 18. Washington, D.C., pp.503.

USDA Forest Service Northeast Center for Urban & Community Forestry, July 2002. Community tree inventory: Data collection. http://www.umass.edu/urbantree. Last viewed on January 4, 2005.

Wolf, Paul R. and Russell C. Brinker, 1989. Elementary surveying, 8th edition. Harper & Row, Publishers, New York, pp. 696.

Appendix A

Appendix A is also found in electronic format on the enclosed CD.

Appendix A

Tree Tally Sheet

Department of Ecology and Natural Resources, City of Khmelnitsky

Park: **Section:** **Date:**

Tree #	Species	DBH (cm)	Class	Condition(s)	Comments	Recommendation(s)

Appendix B

Appendix B is also found in electronic format on the enclosed CD.

Appendix B

Inventory Cover Sheet

Department of Ecology and Natural Resources, City of Khmelnitsky

PARK NAME:	DATE:
SECTION:	
WORKER NAME(S):	
Soil Type(s):	
Land Use(s):	
Groundcover:	
Understory:	
Overstory:	
Insect Infestation:	
Fungi Infection:	
Wildlife:	
General Comments:	

Appendix C

Appendix C is also found in electronic format on the enclosed CD.

Appendix C: Table of scientific, English, and Russian or Ukrainian common names

Tree Species Numbers and Scientific/Common Names			
Species #	**Scientific Name**	**English Common Name**	**Russian* Common Name**
0		Dead	Зів'яло**
1		Unknown	Невідомо**
2	*Acer campestre* L.	Field maple	Клен полевой
3	*Acer negundo* L.	Box elder	Клен ясенелистый
4	*Acer platanoides* L.	Norway maple	Клен остролистый
5	*Acer pseuoplatanus* L.	Sycamore	Клен ложноплатановый
6	*Aesculus hippocastanum* L.	Horse chestnut	Каштан конский обыкновенный
7	*Betula pendula* Roth	Silver birch	Береза бородавчатая
8	*Betula* spp.	Birch	Береза
9	*Carpinus betulus* L.	Hornbeam	Граб обыкновенный
10	*Crataegus* spp.	Hawthorn	?
11	*Euonymus europaeus* Jacq.	Spindle tree	?
12	*Fagus sylvatica* L.	Common beech	Бук лесной
13	*Fraxinus excelsior* L.	Common ash	Ясень обыкновенный
14	*Fraxinus ornus* L.	Manna ash	Ясень
15	*Juglans regia* L.	Walnut	Орех грецкий
16	*Malus* spp.	Apple	Яблуко
17	*Picea* spp.	Spruce	Ель
18	*Pinus nigra* Arnold	Austrian pine	Сосна черная
19	*Populus nigra* L.	Black poplar	Тороль черный
20	*Populus nigra* v. Italica	Lombardy Poplar	Тороль ?
21	*Populus tremula* L.	Aspen	Осина
22	*Prunus* spp.	Plum, apricot, cherry	Слива, абрикос, вишня
23	*Quercus robur* L.	English oak	Дуб черешчатый
24	*Quercus* spp.	Oak	Дуб
25	*Robinia pseudoacacia* L.	Black locust	Робиния лжеакация
26	*Salix* spp.	Willow, Weeping willow	?
27	*Thuja occidentalis* L.	White cedar	Туя западная
28	*Tilia cordata* Miller	Small-leaf linden	Липа Мелколистная
29	*Tilia tomentosa* Moench.	Silver linden	Липа войлочная
30	*Ulmus carpinifolia* Gleditsch	Smooth-leaf elm	Вяз граболистный
31	*Ulmus laevis* Pallas	European white elm	Вяз гладкий

*Russian is used here because only a book on conifers was found in Ukrainian at the time of research.

** These words are in Ukrainian.

Appendix D

Appendix D is also found in electronic format on the enclosed CD.

Appendix D: Blank tree tally spreadsheet sample. The Excel sample on the CD contains the formatting and complete spreadsheet.

Tree #	Species #	Species Name	DBH (cm)	Class	Condition(s)					Comments	Recommendation(s)				
					A	B	C	D	E		A	B	C	D	E
		Average													

Appendix E

Appendix E is also found in electronic format on the enclosed CD.

Appendix E: Cover sheet template*

Inventory Cover Sheet

Department of Ecology and Natural Resources, City of Khmelnitsky

PARK NAME:	**DATE:**
SECTION:	
WORKER NAME(S):	
Soil Type(s):	
Land Use(s):	
Groundcover:	
Understory:	
Overstory:	
Insect Infestation:	
Fungi Infection:	
Wildlife:	
General Comments:	

*To use this template, it will need to be copied into a separate file. To lock the template for use, go to the View menu, click Toolbars, and click Forms. In the Forms toolbar, click the Lock icon. The template is now ready to use. When ready to save, use Save As… out of the File menu and rename the file. Use the Save As… command every time the form is used. The Word sample on the CD is locked and ready to use.

Appendix F

See the enclosed CD for Appendix F: Ivan Franko Park Resource Assessment and Management Recommendations.

Appendix G

Appendix G is also found in electronic format on the enclosed CD.

Таблиця 3.1

Перепік станів здоров'я дерева		
#	**Опис**	**Критерій оцінки**
1	Здорове (дерево)	Немає ознак пошкодження, зараження паразитами, чи інфекції
2	Незнчне ураження паразитами	Дерево росте здоровим з деякими ознаками комах
3	Незначне ураження інфекцією	Дерево росте здоровим з деякими ознаками грибків
4	Ураження паразитами	Дерево має ознаки що свідчать про ураження комахами (паразитами)
5	Заражене інфекцією	Дерево має ознаки що свідчать про ураження грибком
6	Вмираюче дерево	Дерево має ознаки мертвого дерева
7	Поломане з якихось причин дерево	Дерево мертве і стоїть
8	Зів'яле листя	Зів'яле листя на дереві
9	Знекольороване листя	Листя має ненормальний колір
10	Деформоване листя	Форма листя не така, як повина бути
11	Комахи на листях/листя з дірками	Листя має дірки зпричинені комахами або комахи їдять листя
12	Жуки що їдять кору/дірки в корі	Кора має дірки зпричинені комахами
13	Листя в п'ятнах або опухле	Листя має п'ятна або пухлини на собі
14	Рак (злоякісна пухлина)	Дерево має рак (злоякісну пухлину)
15	Розщеплений стовбур (надвое)	Вершина стовбура розщеплена
16	Пошкодження вітром	Дерево було пошкоджене вітром
17	Повалене вітром. поламане	Дерево було повалене/зланане вітром
18	Уражене снігом	Дерево що прогнулося під вагою снігу
19	Поламане снігом	Дерево що поламалося під вагою снігу
20	Пошкоджене вогнем	Дерево що має шрами. сліди вогню
21	Тріснуло через мороз	Дерево має тріщини від морозу на стовбурі
22	Враженя блискавкою	Дерево має слід від блискавки
23	Пошкоджене людиною або зпорчене	Людина пошкодила дерево
24	Дерево є домівкою дикої тварини	В дереві живе дика тварина
25	Нерпавильно обрізане	Обрізи/Порізи зроблені під неправильнин кутом чи в невірному місці, кора зірвана з надрізів і гілки обрізані не всюди і є зламані
26	Гнилий стовбур	Стовбур має очевидні ознаки того, що сердцевина є заражена інфецісю
27	Ушкоджене хробаками-сверлильниками	Дерево має дірки у відкритій сердцевині
28	Омела	На дереві росте омела
29	Наплив/вузли на дереві	Дерево має хвилястий стовбур
30	Відкрите/оголене мертве дерево	Gray colored wood not covered by bark or dead branches.
31	Уражене грибком (форма носа)	Гриб що росте на боці дерева
32	Мурахи/терміти	Велика кількість екскрементів на дереві та поряд з деревом;

		комахи на дереві та в середині
33	Гусінь	Сліди гусіні на листях та гілках
34	Дикий виноград	Дикий виноград що вється на дереві (закутує його - дослівно)
35	Галл (чорнилький горішок)	«Шишки» на гілках
36	Перешкода/загорода росту дерева	Зазначити що перешкоджає/запобігає росту дерева
37	Ознаки дикого життя на дереві	Дерево має ознаки дикого життя
38	Коріневий гній (гній корнів дерева)	Корні дерева очевидно уражені інфекцією (інфіковані)
39	Кільцевання (обрізання кори у вигляді кільця)	Кора видалена або були спроби видалення корм навколо стовбура дерева
40	Гній на гілках дерева	Гілки дерева мають очевидні ознаки інфекції
41	«Мітла відьми»	Гілки ростуть невпорядковано, як мітла відьми
42	Мертвий головний росток	Головний росток дерева є мертвим
43	Відкрита рана/ушкодження на дереві	Дерево має рану/ушкодження, що не загоюється
44	Відкриті корені	Корені дерева не вкриті землею
45	Вкрите навалом грунта дерево	Основа дерева засипана грунтом (насыпь (рос.))
46	Дерево з розщолленою гілкою (біля основи/початку гілки)	Дерево має розсічену гілку
47	Дерево без верхівки	Корона дерева була відрізана
48	Галл біля основи дерева	Біля основи стовбура є знайденим галл (чорнильний горішок)

Таблиця 3.2

Перелік рекомендацій для догляду за деревами	
#	Рекомендація
1	Догляд непотрібний
2	Пошкоджене при обрізанні дерево
3	Потрібне розпилювання інсекитициду
4	Потрібне розпилювання антифунгіцидного препарату\протигрибкового препарату
5	Дерево повино були посадженим поред з цим деревом
6	Дерево повино бути зрізаним
7	Залишити через цінність для дикого природного життя
8	Припинити обрізання дерева
9	Припинити обкопування/прополювння землі навкого дерева
10	Пересадити дерево/змінити стежку (шлях)
11	Підтримати/підв'язати дерево
12	Видалити об'єкт з дерева
13	Не віддирати кору
14	
15	Не вирощувати рослини що в'ються на деревах
16	Посадити дерево що може рости в затінку\з ним
17	Не цементувати/закривати рану на дереві
18	Обрізати відкрите/оголене мертве дерево
19	Бути уважним при косінні/підстриганні трави біля дерева
20	Посадити кущі
21	Встановити направляючу балку біля дерева
22	Дозволити розсаді/саженцем росли бідя дерева
23	Посадити рослини/кущі що відокремлюють дерево від стежок/доріжок
24	Бути більш уважним при обрізакні дерева
25	Зрізати дерево, коли це необхідно

Таблиця 3.4

Критерії для опису текстури грунту		
Тир грунту	**Висушений та зтиснений грунт/колір сухого грунту**	**Зтиснений вологий грунт/колір вологого грунту**
Пісок	Розпадається на частини	Приймає певну форму але розпадається при дотику
Піщаний/пісочний суглинок	Може приймати форму, але розпадається	Приймає форму, зберігає її при уважному користнуванні
Суглинок	Приймає певну форму при уважному обходженні	Приймає форму, можна обробляти
Суглинок з мулом (ил (рос.))	Приймає форму, можна обробляти	Приймає форму, не розтікається, виглядає зламаним
Глина	Формує тверді комки/згустки	Буде розтікатись та легко ломатись
Глина з піском (піщанна глина)	Світло-сіра	Синьо/Зелено-сіра
Піщанний суглинок та глина	Сіра	Чорна

Таблиця 3.5

Класифікаційна схема різних розмірів дерев та їхнього стану здоров'я		
Клас	**Тип дерева**	**Опис стану здоров'я**
1.0	Молоде дерево	Не встановлено, але буде жити
1.5	Молоде дерево	Не встановлено, має проблеми, потрібне лікування
2.0	Молоде дерево	Встановлено, буде жити
2.5	Молоде дерево	Встановлено, що має проблеми, потрібне лікування
3.0	Доросле дерево	Буде жити
3.5	Доросле дерево	Має проблеми, потрібне лікування
4.0	Доросле дерево	Має проблеми, помре за 20 років, можна вилікувати
4.5	Доросле дерево	Майже мертве, лікування не потрібне
5.0	Доросле дерево	Мертве, зрубати для безпеки
5.5	Доросле дерево	Мертве, заселене тваринами, залишити
6.0	Молоде дерево	Мертве, майже мертве, зрубати

Додаток А

<u>Перечёт деревьев (рос.)</u>

Відділ з питань екології та раціонального природокористування, м. Хмельницького

Парк:			**Секція:**		**Дата:**	
№ Дерева	**К-ть дерев**	**Діаметр дерева на висоті 130 см**	**Класс**	**Умова**	**Коментар**	**Рекомендації**

Додаток Б

Інвенторизація парка

Відділ з питань екології та раціонального природокористування, м. Хмельницького

Назва парку: Дата:
Секція:
Ім'я робітника:
Тип грунту:
Вживання території:
Покриття землі:
Нижній ярус:
Верхній ярус:
Зараження комахами:
Зараження грибком:
Дике життя:
Загальні коментарі:

Додаток В: Приклад варіанта комп’ютера

Перечёт деревьев (рос.)

№ дерева	К-ть Дерев	Назва Дерева	Діаметр дерева на висоті 130 см	Класс	Умова					Коментар	Рекомендації				
					А	Б	В	Г	Д		А	Б	В	Г	Д
		Середнє													

Додаток Г: Варіанта комп’ютера

Інвенторизація парка

Відділ з питань екології та раціонального природокористування, м. Хмельницького

Назва парку:	**Дата:**
Секція:	
Ім'я робітнка:	
Тип грунту**:**	
Вживання території**:**	
Покриття землі**:**	
Нижній ярус**:**	
Верхній ярус**:**	
Зараження комахами**:**	
Зараження грибком**:**	
Дике життя**:**	
Загальні коментарі**:**	