

Mediating the Conflict Between Outdoor Recreation and Nature
Conservation: *A Study of the Assiniboine Park Riparian Forest*

A practicum submitted to the Faculty of Graduate Studies
in partial fulfillment for the degree of
Master of Landscape Architecture

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**MEDIATING THE CONFLICT BETWEEN OUTDOOR RECREATION AND NATURE
CONSERVATION: A *STUDY OF THE ASSINIBOINE PARK RIPARIAN FOREST***

BY

Helen Fabbri

**A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University
of Manitoba in partial fulfillment of the requirements of the degree
of
Master of Landscape Architecture**

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"Landscape is neither nature nor culture but rather 'suspended' between the two."

Peter Jacobs (1991)

Abstract

Riparian forests play a valuable role in our urban environments including water quality protection, flood control, bank stabilization, erosion control, nutrient and pollutant filtration and water temperature regulation. In addition, they provide valuable habitat for urban wildlife and provide a natural setting for educational and recreational activities for urban dwellers. In spite of their importance, riparian forests represent a threatened and endangered habitat type in the City of Winnipeg.

Heavy recreational use is one of the major impacts affecting the Assiniboine Park riparian forest. The impacts of outdoor recreation at the Assiniboine Park riparian forest include trampling and loss of vegetative cover, tree damage, soil erosion, introduction of exotic vegetation, soil compaction, trail-pitting, litter, and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between different user groups, reduction in visitor learning, and visitor displacement.

The Assiniboine Park riparian forest is an especially attractive location for various recreational activities. The presence of water, diverse vegetation, varied topography in a relatively 'flat' land, moderated climate and wildlife enhance the recreational experience of the trail user. However, as recreational use of the Assiniboine Park riparian forest continues, the environmental and recreational quality of the resource will further diminish. There is a need for protecting and conserving this sensitive riparian system in addition to providing recreational opportunities for the public.

The proposed strategy for the design and management of the Assiniboine Park riparian forest was to widen and reconnect the riparian corridor/buffer by reclaiming large areas of land within the Assiniboine Park adjacent to and within the Assiniboine Park riparian forest. Design recommendations and guidelines for riparian buffers and corridors were explored resulting in the application of a three-zone urban riparian buffer system approach to the Assiniboine Park riparian forest. Each zone serves a different biological purpose and different recreational uses are allowed in each zone. In addition, two multiple-use trails were designed taking into consideration the activity-type and location of trails within the riparian zones.

The design and management of the Assiniboine Park riparian forest mediates between resource protection and recreation provision focusing on understanding the needs of the recreational users and the sensitivity of the environment.

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Introduction

Introduction

A riparian forest community is defined as the corridor of vegetation situated between aquatic and terrestrial environments that is periodically influenced by flooding (Bentrup & Hoag 1998; Wissmar & Beschta 1998). Riparian forests play a valuable role in water quality protection, flood control, bank stabilization, erosion control, nutrient and pollutant filtration and water temperature regulation. They also provide wildlife habitat, and recreational and educational benefits (Riley 1998).

In spite of their importance, riparian forests represent a threatened and endangered habitat type in North America (Knutson & Klass 1998). Historically, riparian forests were used extensively by humans because of their abundance of food plants and wild game, and as transportation routes. Over time, agricultural practices, timber harvesting, dam construction and urban development have adversely affected riparian habitat. As a result, the structure, composition and role of riparian forests have changed markedly leading to an increase in water pollution, flooding hazards, habitat fragmentation, a loss of wildlife habitat, and a reduction in urban nature for human use and enjoyment (Moffat 2002).

In Winnipeg, approximately 85% of riparian habitat has been negatively affected by urban development (C. Heming pers. comm. 2003). As such, there is a significant interest in protecting and conserving riparian forests along many of its creeks, streams and rivers from further disturbance or clearing. Private landowners, stewardship groups, non-profit organizations, civil, provincial and federal governments have begun to recognize the degradation of riparian ecosystems and the importance of protecting them.

In 1993, an inventory of natural heritage areas within the city of Winnipeg was carried out as a cooperative project between the Manitoba Naturalists Society, the Canadian Wildlife Service and the City of Winnipeg's Parks and Recreation Department. As a result, five native habitat types were identified and the information collected during the inventory provided an overview of the status of these native habitats. It became apparent from the inventory that, despite the amount of waterfront property within city limits, examples of good quality riparian habitat were rare (Cowan 1993).

In 1997, the Manitoba Naturalists Society, as part of the Urban Habitat Stewardship Project, and its natural areas inventory partners, began to examine the condition of riparian forests along Winnipeg's waterways. The study focused on identifying major impacts and establishing a baseline of information for various riparian forests across the City, including the Assiniboine Park riparian forest. Heavy recreational use was found to be one of the major impacts affecting the Assiniboine Park riparian forest (Fabbri & Jurkow 1997).

In 2004, the Assiniboine Park will be celebrating its hundredth year. Annually, the Assiniboine Park attracts hundreds of thousands of park-users (de Graaf 2000). Although the exact number of those that use the Assiniboine Park riparian forest each year has not been recorded, it can be said that it is well used, as there has been a marked decline in the quality of the forest environmentally and aesthetically, in part due to recreational activity.

Recreational use can cause adverse physical and biological impacts on riparian areas. The impacts of outdoor recreation at the Assiniboine Park riparian forest include trampling and loss of vegetative cover, tree damage, soil erosion, introduction of exotic vegetation, soil compaction, trail-pitting, litter, and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between different user groups, a reduction in visitor learning, and visitor displacement (Manning et al. 1996).

Riparian areas however, are especially attractive locations for various recreational activities (Welle & Baer 1997). The presence of water, diverse vegetation, varied topography in a relatively 'flat' land, moderated climate and abundant wildlife enhance the recreational experience of the trail user. The City of Winnipeg encourages the use of rivers and riparian areas stating in Plan Winnipeg's 2020 Vision on Managing Parks, Open Space, and Waterways in Section 5C-02 "*Promote the Use of Rivers and Riverbanks:*"

The City shall promote the use of its rivers and riverbanks by facilitating public access to rivers and riverbank lands and encouraging the use of Winnipeg's rivers for transportation and recreation through the provision of boat launches, docks, and other accessibility improvements (City of Winnipeg 2002).

Of the 240km of waterfront property within City limits, the City of Winnipeg owns about 45% (108km). Of that, only 35% (85km) are publicly accessible (Planning, Property & Development Department 2000). As recreational use of riparian areas increases, and the

abundance and quality of the resource decreases, the need for protecting and conserving remaining riparian forest in Winnipeg increases, for humans and wildlife alike.

The impacts of outdoor recreation on riparian forests in Winnipeg are to some extent recognized, however, nothing has been proposed thus far, to minimize this conflict.

This practicum intends to build on existing knowledge and research of the Assiniboine Park riparian forest gathered from the Fabbri & Jurkow (1997) study, focusing primarily on the issues of outdoor recreation and nature conservation. The objectives of this practicum are:

- 1) To review existing literature on the subject of riparian forests and outdoor recreation
- 2) To build on an existing baseline site analysis
- 3) To investigate the values and needs of trail-users
- 4) To develop a site program
- 5) To generate design proposals and recommendations for the Assiniboine Park riparian forest which aim to minimize the impacts of outdoor recreation on riparian areas, while considering the recreational experience of the trail user.

Chapter 1: *Riparian Forests*

Chapter 1

Riparian Forests

The term 'riparian' means 'affected by the river' (Malanson 1993) and as the name suggests, the composition and structure of riparian vegetation is determined by the frequency, magnitude, duration and seasonal timing of flooding as well as soil type (Bentrup & Hoag 1998).

1.1 Structure and Composition of Riparian Forests

Riparian forests are divided into three zones (Figure 1.1.1): the riverbank, floodplain and terrace as well as three layers: the upper canopy which is comprised of trees and large shrubs; the mid-canopy which is mainly comprised of shrubs; and the groundcover layer which is comprised of herbaceous annuals and perennials (Essenberg 1991; Bentrup & Hoag 1998).

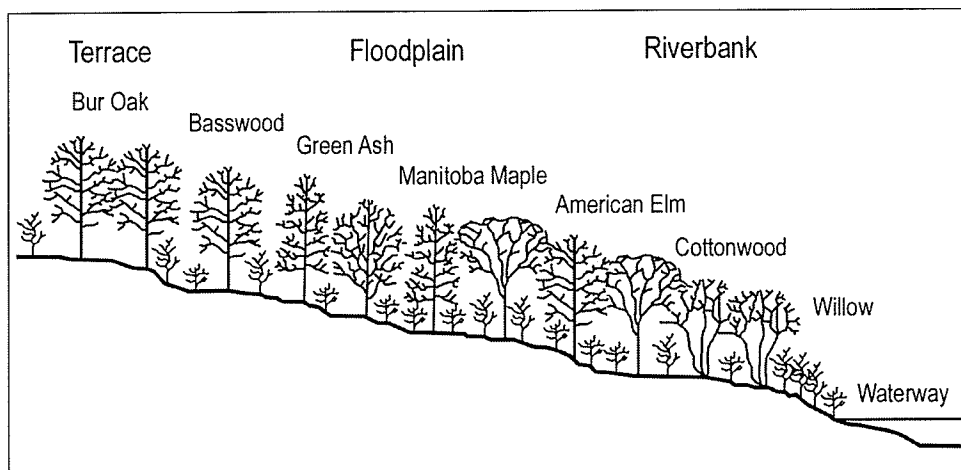


Figure 1.1.1: Profile of a typical riparian forest (Adapted from Canadian Forest Services, 1991).

Each riparian zone is associated with specific plant species that are adapted to the hydrology, soil type and microclimates characteristic of these areas (Daigle & Havinga 1996).

The riverbank is defined as the sloping area adjacent to the river (Essenberg 1991). In Manitoba, this riparian zone is dominated by tree species such as peach-leaved willow (*Salix amygdaloides*) and cottonwood (*Populus deltoides*) that can tolerate annual flooding and silt deposition. Shrub species such as beaked willow (*Salix bebbiana*) and sandbar willow (*Salix exigua*) also occupy this zone however few annual and perennial herbs are present.

The floodplain region is the relatively flat portion that lies above the riverbank and is subject to regular periods of inundation during flooding (Essenberg 1991). This zone usually contains the greatest variety of species and is inhabited by such tree species as Manitoba maple (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*) and American elm (*Ulmus americana*). The mid-canopy includes species such as red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*) and wild currant (*Ribes americanum*). Herbaceous perennials include Virginia creeper (*Parthenocissus quinquefolia*), false Solomon's seal (*Smilacina stellata*), moonseed (*Menispermum canadense*), carrion-flower (*Smilax herbacea*) and tall meadow-rue (*Thalictrum dasycarpum*).

The terrace is the highest elevated area above the floodplain region (Essenberg 1991). This riparian zone is not subject to periods of flooding and is dominated by bur oak (*Quercus macrocarpa*), which prefers drier habitats.

Appendix 1A shows a species list of common plant species found in riparian forest communities in Winnipeg.

1.2 Benefits of Riparian Forests

Riparian forests are valuable natural ecosystems that provide many important benefits including flood control, bank stabilization, erosion control, filtration of nutrients and pollutants, water temperature regulation, wildlife habitat, and recreational and educational benefits. These benefits are described in more detail below.

Flood control

An important benefit of riparian forests is its ability to reduce flooding hazards. Native vegetation absorbs floodwaters and reduces the velocity of flowing water (Hey & Philippi 1995). However, the potential for damage is dependent on the width of the riparian zone and the density of native riparian vegetation. When human activity causes the degradation of riparian forests, the flood storage capacity is compromised, aggravating the impacts from flooding (Bentrup & Hoag 1998).

Bank stabilization

Riparian vegetation plays a significant role in bank stabilization by anchoring the riverbank into place. The structure of riparian vegetation particularly along the riverbank is such that their deep root systems trap the soil and protects it from the eroding forces of the river (Cowan 1995). More specifically, plant roots provide stability by increasing the cohesion of the soil, through the binding action of the soil with the root network and by contribution of the tensile strength of the roots themselves. Lateral roots contribute most to binding because they occur in greater densities, whereas vertical roots provide most of the tensile strength (Tabacchi et al. 1998).

Erosion control and filtration of nutrients and pollutants

Riparian forests can reduce the impacts of non-point source pollution by trapping eroded sediments and pollutants from urban runoff and preventing them from entering the river system. The ability of the river or stream bank to filter sediments, nutrients and pollutants from urban runoff is dependent on the density and width of the vegetation corridor, the height and slope of the riverbank, and the volume and velocity of runoff. As a consequence of filtering, the system's water quality is improved (Cowan 1995).

Water temperature regulation

Riparian vegetation plays an essential role in regulating water temperature thereby contributing to the overall health of riparian systems. Riparian vegetation protects streams and rivers from summer and winter extremes that may be stressful or detrimental to aquatic life. Shade cast by riparian vegetation helps in maintaining cooler water temperatures in the summer, affecting the rate of nutrient cycling and dissolved oxygen levels. Cooler water temperatures hinder algal growth resulting in an increase in dissolved oxygen levels, further improving water quality (Bentrup & Hoag 1998).

Wildlife habitat/corridors

Riparian forests are among the most productive wildlife habitats. The diversity and productivity of these systems provides a rich diversity of habitat niches. This translates into a high variety of wildlife species in the riparian habitat (Bentrup & Hoag 1998). Losses and

degradation of habitat quality pose serious problems for wildlife, especially birds, which depend on these resources for survival (Knutson & Klass 1998). Riparian forests also serve as conduits or corridors for the movement of wildlife along the river and between diverse habitats (Forman & Godron 1986).

Recreational and educational benefits

Riparian areas are attractive locations for a variety of recreational activities such as canoeing, hiking, cycling, jogging and cross-country skiing. They also provide great opportunities for nature viewing, outdoor education and interpretation.

1.3 Impacts on Riparian Forests

Riparian forests are environmentally sensitive areas that are subject to a variety of impacts. Simply defined, environmentally sensitive areas are those that contain native vegetation and natural features and/or natural resources. They contain natural communities of plants and animals whose existence is determined by such factors as soil composition, hydrology, climate, solar conditions and site history. Environmentally sensitive areas are vulnerable in that further fragmentation, disturbance and development will negatively affect natural processes, composition, structure and function of these systems. Environmentally sensitive areas usually have one or more of the following conditions: 1) contain abundant native biodiversity and few exotics; 2) are of adequate size and cohesiveness to be biologically sustainable; 3) are a remaining example of a pre-permanent settlement natural community; 4) are considered rare; 5) contain sensitive geological and hydrological features; 6) contain or are adjacent to a wetland, river or stream and are critical in maintaining water quality, rare species habitat or flood control; and 7) contribute significantly to biological or hydro-geological functions such as wildlife habitat, air purification and erosion control (City of St. Cloud 2001).

Riparian forests in Winnipeg are subject to a variety of impacts that can have adverse effects. Some common causes of degradation include: urbanization/riverbank development, mowing, Dutch elm disease, exotic plant species, beavers and recreation.

Urbanization/Riverbank Development

Riparian forests have been significantly modified over time as a result of continuous urban development of riparian habitat (Moffat 2002). As a result, riparian forests are fragmented and remnant habitat is becoming further degraded. Figure 1.3.1 shows the extent of urbanization (developed riparian lots) along the Assiniboine River in Winnipeg. This figure can be compared with Figure 1.3.2, which shows the occurrence of parks along the Assiniboine River in Winnipeg. It is apparent that despite the number of parks and natural areas along the Assiniboine River, riparian habitat is significantly fragmented. Fragmentation reduces habitat for urban wildlife and interrupts valuable riparian corridors for use by both wildlife and humans (Moffat 2002). The City of Winnipeg recognizes the importance of riparian habitat and has included its protection, preservation and maintenance in *Plan Winnipeg's 2020 Vision on Managing Parks, Open Space and Waterways* in Section 5C-04 "Protect Environmentally Sensitive Lands." The policy states that:

The City shall protect environmentally sensitive lands that contain pockets of natural flora and fauna or that are susceptible to damage from flooding or erosion by:

- 1) Evaluating proposed developments that affect high-quality natural areas and encouraging the protection and preservation of such lands to the greatest extent possible;*
- 2) Developing a lands plan which designates natural areas that are environmentally sensitive and/or significant lands;*
- 3) Protecting floodplains and unstable riverbank slopes by identifying susceptible areas and employing protective and preventive measures, including the possible acquisition of such lands, to reduce the risk of property damage where appropriate; and*
- 4) Encouraging private landowner participation in support of riverbank management.*

The City of Winnipeg's Naturalist Services Branch is committed to following through Plan Winnipeg's mandate when carrying out all projects.



Figure 1.3.1: Urbanization along the Assiniboine River in Winnipeg.



Figure 1.3.2: Parks along the Assiniboine River in Winnipeg (highlighted area is Assiniboine Park).

The Branch is involved in all aspects of natural areas within the City, co-managing various projects and forming partnerships with several non-profit organizations and stewardship groups. They are responsible for exchanging resources and providing technical advice to the public, environmental stewardship groups, other City of Winnipeg departments and all levels of government regarding issues of natural areas, sensitive lands and urban wildlife. Recently, an *Eco-gift* program was introduced to the City whereby property owners of ecologically sensitive lands can donate their land in order to protect ecological heritage from ongoing development. In return, the donor receives tax benefits for protecting this land (Naturalist Services Branch 2001).

Commercial developers wishing to develop facilities in natural areas must be sympathetic to the environment in terms of building styles, extent of development, management and operation (Norton & Roper-Lindsay 1992). They must also recognize that not all proposals will be compatible with the nature conservation values of a site.

Riverfront property owners must also be aware of the importance of riparian areas and through education, may be encouraged to conduct small-scale restoration efforts in their own yards.

Mowing

Replacing valuable riparian vegetation with turf grass and mowing to the river's edge commonly occurs along many riverfront properties and was also formerly practised by the City of Winnipeg. Mowing to the river's edge causes banks to become more susceptible to erosion, decreases wildlife habitat, and reduces water quality. In 1999, the City of Winnipeg's Parks Division in concert with the City Naturalist's Office established a no-mow policy in order to protect and preserve the natural landscape of the city. The policy prohibits mowing on City-owned property along all rivers and streams. It involves establishing a no-mow riparian buffer zone from the river's edge to the top of the bank that will allow for the naturalization of native trees and shrubs. In addition, there is to be no mowing where oak trees are stressed and where there is evidence of tip die back due to soil compaction from machinery (Naturalist Services Branch 1999).

The re-established vegetation has environmental, aesthetic and financial benefits. Environmentally, the policy would help stabilize the banks, provide additional wildlife habitat

and corridors, and improve water quality. Aesthetically, users of these spaces would enjoy increased richness and diversity of both plant life and wildlife that would be attracted to these areas. Financially, the policy would prove a more efficient expenditure of city tax dollars.

It will now become necessary to educate riverfront property owners about the importance of creating no-mow buffer strips in order to protect their property and riparian forests as a whole.

Dutch Elm Disease

Dutch elm disease is another major impact on riparian forests also affecting elm trees in numerous city parks, boulevards and residential yards within the city of Winnipeg.

The disease is caused by the ascomycete fungus *Ceratocytis ulmi*, which interferes with the conduction mechanism of xylem vessels, the principal water-conducting tissue in vascular plants. In Manitoba, the native elm bark beetle *Hylurgopinus rufipes* is the major vector of the fungus. However, the European elm bark beetle *Scolytus multistriatus* is another vector, although uncommon. The adult beetles breed underneath the bark of stressed, dying or dead elm trees. If the brood tree is infected with Dutch elm disease, the brood and larval galleries become infested with the fungus as well. The newly emerged beetles containing the fungus pass the disease to healthy elm trees upon feeding (Essenberg 1991). The resulting effect is leaf yellowing, wilting and drop, eventually leading to tree mortality.

The disease was first observed in Winnipeg in 1975 along the Red River and at present, continues to spread across the city. Since its appearance, the City of Winnipeg's Forestry Branch initiated the Dutch Elm Disease Control Program whose mandate is to ensure the well-being, longevity and enhancement of the urban elm forest within the City of Winnipeg through undertaking and maintaining excellent, effective and on-going disease control and tree maintenance procedures. Since 1975, the annual loss rate of elms within the city has remained at or below 2%. Of concern, recent losses have increased to approximately 3% per year, however steps are being taken to address the situation (Forestry Branch 2000). Dutch Elm Disease control efforts are limited to prevention of spread, and require numerous strategies. Unfortunately, there is no effective cure and partial implementation of the control

strategies has proven unsuccessful. Effective results can only occur with an integrated control program, involving community efforts. Control methods include surveillance (detection), sanitation (removal/disposal), basal treatment (insect control), tree care (pruning), root-graft control and injection with fungicide (Forestry Branch 2000).

Exotic Plant Species

Exotic plant species are defined as 1) “natural” invaders, or species which have expanded their ranges without the aid of humankind; 2) indigenous agricultural species which have evolved in the region or have long associations with local culture; 3) exotic agricultural or human-dependent species which are recent introductions and were not developed in their present form in the region; or 4) exotic wildland species which are indigenous to another region and were introduced by human activity, either intentionally or accidentally (Bratton 1982).

Exotics vary in the type and degree of ecosystem impact. A successful exotic invader of natural areas can, however, influence any process or biological characteristic of a functioning ecosystem. This includes all trophic relationships (herbivore, detritivore or predator-prey), interspecific competition, primary and secondary succession, nutrient cycling, system productivity, diversity and stability. In addition there can be changes in biogeophysical processes, substrate deposition, soil formation and erosion, solar insolation, hydrologic balance and disturbance frequency (Bratton 1982; Harty 1986).

The success of an exotic species depends on its genetics, physiology, behaviour and ecology (Berger 1993). These species germinate, grow and flower rapidly under a wide range of climatic and soil conditions, and lack insect pests and pathogens that kept them in check in their native environments. Exotics are primarily perennial and they produce abundant seeds that are easily dispersed and remain viable for numerous years in the soil. A large number of exotics have a disagreeable odour or taste, or possess thorns or spines to deter herbivores.

Riparian habitats are one of the most susceptible ecosystems for invasion by exotic species because of their naturally occurring breaks in plant cover (Berger 1993).

In Winnipeg, the invasive exotic species, purple loosestrife (*Lythrum salicaria*) and European buckthorn (*Rhamnus cathartica*) are affecting riparian forests.

Purple Loosestrife

Purple loosestrife (Figure 1.3.3) is a woody perennial native to Europe and introduced into Canada in the 19th Century (Thompson 1991). It primarily invades moist habitats such as marshes, bogs, riverbanks, retention ponds and roadside ditches (Heidorn & Anderson 1991). Purple loosestrife is an aggressive, highly prolific plant that crowds out and quickly replaces native vegetation resulting in a homogenous environment providing little food, shelter or breeding habitat for wildlife.

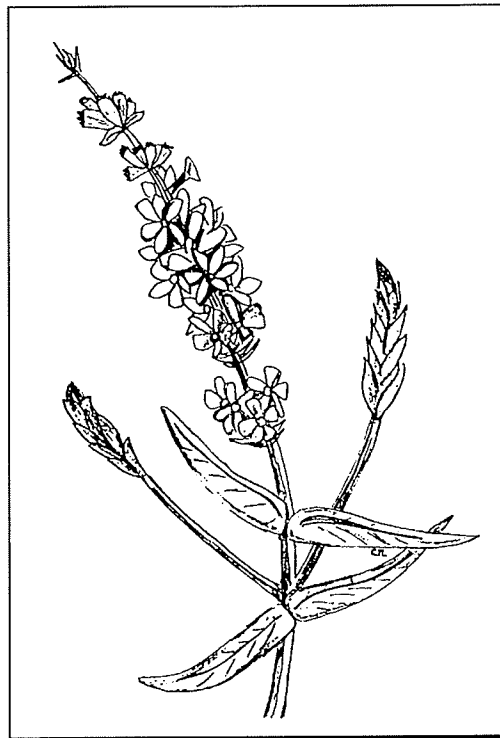


Figure 1.3.3: Purple loosestrife (*Lythrum salicaria*) (Manitoba Purple Loosestrife Project 1993).

Purple loosestrife has no natural enemies in North America and without an effective control strategy, the biodiversity of our riparian and wetland ecosystems will be threatened. Control methods include removing the plant in its entirety before the flower head begins to seed, then drying and burning. In July 2001, the City of Winnipeg began a purple loosestrife exchange program whereby homeowners could remove purple loosestrife plants present in their yards and gardens in exchange for a meadow blazingstar bulb (*Lyatrus ligulistylis*). Removing purple loosestrife can be a very laborious and costly method of control especially in high-density areas. Beginning in 1998, the leaf-eating beetle (*Gallerucella californiensis*) was introduced from Europe and released in selected sites throughout the province,

including Winnipeg, which contained purple loosestrife infestations and has proven to be the most successful control strategy against this exotic species. In May 2002, mass rearing of the leaf-eating beetles was initiated at the Birds Hill Provincial Park, Manitoba Rearing Station for release throughout the province (The Manitoba Purple Loosestrife Project 2002).

European Buckthorn

European buckthorn (Figure 1.3.4) is a deciduous shrub native to Europe, Asia and North Africa. It was introduced into the city of Winnipeg in the late 19th Century commonly planted in residential areas as an ornamental shrub or hedge. It is an extremely hardy plant capable of inhabiting a large range of terrestrial ecosystems. European buckthorn leafs out in early spring and does not lose its leaves until late autumn giving it a much longer growing season (Gourley & Howell 1984; Archibold et al. 1997). When combined with a rapid growth rate and prolific seed production it quickly chokes out and replaces native vegetation in all three forest strata (herbaceous, shrub and tree layers), especially in the upper terrace areas of Winnipeg's riparian forests along both the Red and Assiniboine Rivers.

There are many methods of controlling European buckthorn including hand pulling, girdling, cutting, herbiciding and burning (Heidorn 1991). Unfortunately, these methods are very labour intensive especially in areas where European buckthorn densities are high. However, it is necessary to control existing stands and prevent further spread. The Manitoba Naturalists Society and the City of Winnipeg's Naturalist Services Branch, with the support from the Coalition to Save the Elms, have recognized the significance of European buckthorn as an aggressive species invading Winnipeg's natural heritage and are in the process of developing a five-year control program that will control, or at least limit, the spread of European buckthorn across the city.

At present there are no known biological control methods for European buckthorn. It seems to be an intermediate host for oat rust (*Puccinia coronata*) but does not appear to be greatly affected by it. Some research is being conducted in Europe and Canada on host-specific European insects and fungal pathogens, however results are not yet available (Northern Prairie Wildlife Research Center 2001).

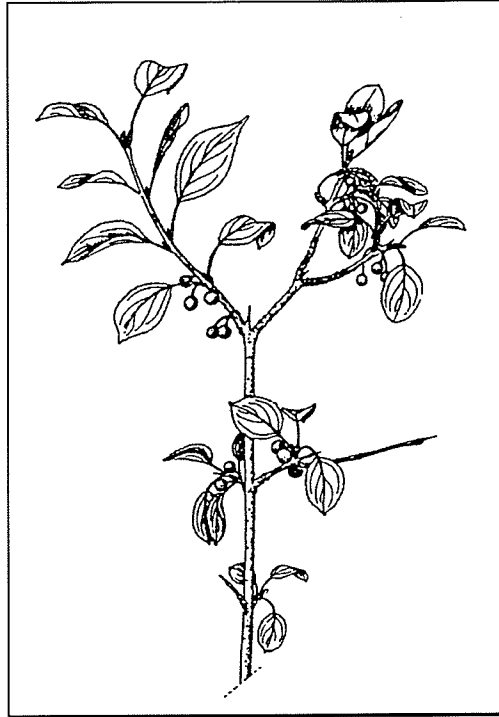


Figure 1.3.4: European buckthorn (*Rhamnus cathartica*) (Clare 1991).

Beavers

Beavers (*Castor canadensis*) that are present in an urban environment are responsible for significant impacts on waterways and riparian vegetation. Numerous hardwood trees from many of the city's riverbanks have been subject to beaver activity resulting in gaps where large trees once stood thus altering habitat for other wildlife, reducing the aesthetic and economic value for river-property owners, and the recreational value for recreationists. In addition, the sharply pointed stumps left over from beaver activity, pose a potential physical danger for site-users. The urban beaver population has increased significantly over the years, as there are no predators to keep them in check (Cowan 1995). Options for beaver management include tree-wrapping, live-trapping, trapping and flow devices. These methods are described below.

Tree-wrapping, consists of loosely wrapping stucco wire around the base of the tree creating a freestanding mesh cylinder to prevent beaver from accessing the tree. Another option includes live-trapping beaver for relocation outside city limits. Beaver relocation is a method used in areas where beaver populations are low however, it is less frequently used as the probability of individuals returning is high. Trapping or shooting beaver has caused great conflict over the years between wildlife management agencies, animal rights groups and

residents alike. In Manitoba, the number of beaver trapped by licensed trappers has recently declined due to low pelt prices resulting in a rise in beaver population. Manitoba Conservation in concert with the Association of Manitoba Municipalities and the Manitoba Trappers Association developed a winter subsidy program that provides monetary incentives to provincial trappers to encourage beaver-harvest in designated problem areas (Manitoba Conservation 2001). In this case, beavers are looked upon as problem wildlife where the best method of keeping population numbers down is trapping.

Conversely, the Fund for Animals Inc., an organization based in New Haven, Connecticut that specializes in solving beaver problems, believes that humans can work harmoniously with beavers to address issues of flooding. Instead of destroying beaver dams and trapping, which only has short-term effects, flow devices are designed to allow water to flow through a built dam preventing water from backing up and flooding (Fund for Animals Inc. 1999; Lisle 1999). This is essentially a win-win situation where the beaver can maintain its dam and the water level can be controlled. Similarly, the Zuni Fish and Wildlife Department in New Mexico has incorporated beavers as an important and innovative component in restoring riparian habitat (Albert & Trimble 2000). Beavers were reintroduced into degraded watersheds in order to benefit water quality, watershed health and riparian wildlife habitat. Dams built by beavers allowed sediment to drop out of suspension and raise the streambed. The spread of water over a wider area created larger pools of water allowing abundant riparian vegetation to develop thus encouraging more wildlife such as deer, elk, fish and amphibians.

Thus, good beaver management requires a complete understanding of the individual situation and the options available for reasonable, effective solutions.

Recreation

Recreational use of natural areas can cause adverse physical and biological impacts on the natural environment. Impacts include trampling and loss of vegetative cover, tree damage, compaction and erosion of organic litter and soil, introduction of exotic vegetation, harassment or displacement of wildlife, litter and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between incompatible visitor activities, reduction in visitor learning, and spatial, temporal, or total visitor displacement (Manning et al. 1996).

The City of Winnipeg encourages the use of rivers and riparian areas stating in *Plan Winnipeg's 2020 Vision on Managing Parks, Open Space, and Waterways* in Section 5C-02 "Promote the Use of Rivers and Riverbanks":

The City shall promote the use of its rivers and riverbanks by facilitating public access to rivers and riverbank lands and encouraging the use of Winnipeg's rivers for transportation and recreation through the provision of boat launches, docks, and other accessibility improvements (City of Winnipeg 2002).

Thus the conflict that exists between outdoor recreation and nature conservation will continue and will be amplified as the use of riparian forests is encouraged. The impacts of recreation on natural areas in Winnipeg are to some extent recognized and have been studied however, nothing has been proposed thus far to resolve this conflict. In 1997, the Manitoba Naturalists Society in concert with the City of Winnipeg's Naturalist Services Branch, the Canadian Wildlife Service, and the Critical Wildlife Habitat Program found that trampling associated with recreational activities played, and continues to play, a significant role in the degradation of the Assiniboine Park riparian forest (Fabbri & Jurkow 1997).

If the use of rivers and riparian forests is to be encouraged in Winnipeg, the effects of recreation on these sensitive ecosystems must be further studied and practical guidelines for its design and management should be discussed and implemented.

Chapter 2: *Outdoor Recreation*

Chapter 2

Outdoor Recreation

2.1 Leisure vs. Recreation

'Recreation' can have different meanings to many people. It is a term that is commonly used but seldom defined. Frequently, it is used interchangeably with the concept of 'leisure' or it has a more specific connotation which defines and distinguishes a distinctive behavioural area (Williams 1995). Zinser (1995) refers to leisure as a time concept and recreation as an activity concept. For the purposes of this study, the meanings of leisure and recreation are defined.

Conventionally, recreation is seen as a sub-area of leisure (Williams 1995). Leisure has been defined by many as the free or discretionary time available for people to use as they choose after meeting the biological requirements of existence and the subsistence requirements of work (Yukic 1970; Wall 1989; Zinser 1995). Zinser (1995) further defines four patterns in which leisure time occurs: 1) *daily leisure* – defined as the time after work or after school where only a few hours are available for recreation; 2) *weekly leisure* – refers to the weekend, where a larger block of time permits the use of recreational resources situated farther from the home; 3) *vacation leisure* – refers to a significant block of time in which one may travel to distant places for recreational pursuits; and 4) *retirement leisure* – allows an extended period of time for retirees to pursue recreational resources. Patmore (1983) uses the term 'leisure' in three distinct contexts: 1) it may be conceived in terms of time; leisure generally being that period of the day which remains after routine commitments to work, domestic chores and other obligations have been discharged; 2) it may be seen as an attitude of mind; for example, a reflection of an individual's perception of whether he or she is at 'leisure'; and 3) it may be associated with activity, and it is in this context that the concept of recreation emerges clearly.

The English word 'recreation' is derived from the Latin, '*recreate*', which means to create anew, to become refreshed (Jensen 1995). Recreation most often occurs during leisure time (Jensen 1995). Yukic (1970) defined recreation as an act or experience, selected by the individual during his [sic] leisure time, to meet a personal want or desire, primarily for his [sic] own satisfaction. Zinser (1995) defines it as any type of conscious enjoyment that occurs during leisure time. He distinguishes no sharp boundary between recreation and other activities and that the same activity may be work in some instances, and recreation in

others. The distinguishing characteristic is not the activity of recreation itself, but the attitude with which it is carried out. Patmore (1983) states that recreation is about an activity in which participants have chosen to engage. Recreational activities may serve a range of functions: they may be relaxing or energetic; they may foster social, cultural, intellectual or creative developments for individuals or groups; they may be recuperative; they may revitalize or re-create the participant, and usually they perform several of these functions at the same time.

2.2 Benefits of Outdoor Recreation

Outdoor recreation in North America is in great demand and appears to be rising in a society characterized by rapidly advancing technology, growing stress levels and time constraints. As a result, North Americans are placing a large emphasis on the leisure aspect of their everyday lives and on outdoor recreation as an essential leisure outlet (Pandolfi 1999).

Outdoor recreation can take place in many places and settings from one's own backyard, to small urban green spaces, to national parks. The main objectives and benefits of outdoor recreation, however, remain the same. Jensen (1995) lists five main objectives of outdoor recreation: 1) appreciation of nature; 2) personal satisfaction and enjoyment; 3) physiological fitness; 4) positive behavioural patterns; and 5) stewardship. He also describes the four distinct phases of the recreation experience: anticipation, planning, participation, and recollection. The *anticipation* phase occurs when an individual considers an activity and decides to pursue it. *Planning* involves aspects of education and preparation, for example, gathering equipment and supplies, preparing food and clothes, and making arrangements. The *participation* phase extends from the time of departure to the time of return. It includes the travel portion and the activity itself. Finally, the *recollection* phase involves thinking and telling about the experience through various media such as oral and/or written accounts, photographs, slides or videos.

Activities associated with recreation provide many benefits that include psychological, physiological, social/cultural, economic, environmental, educational and spiritual. Driver (1990) summarized the benefits attributed to leisure activities shown in Table 2.2.1.

Table 2.2.1: Types and categories of benefits associated with leisure activities

- I. Personal Benefits
 - A. Psychological
 - 1. Better mental health and health maintenance
 - Holistic sense of wellness
 - Stress management (prevention, meditation, and restoration)
 - Catharsis
 - 2. Personal development and growth
 - Self-confidence
 - Self-reliance
 - Self-competence
 - Self-assurance
 - Value clarification
 - Improved academic/cognitive performance
 - Independence/autonomy
 - Sense of control over one's life
 - Leadership
 - Aesthetic enhancement
 - Creativity enhancement
 - Spiritual growth
 - Adaptability
 - Cognitive efficiency
 - Problem solving
 - Nature learning
 - Cultural/historic awareness/learning/appreciation
 - Environmental awareness/understanding
 - Balanced competitiveness
 - Balanced living
 - Prevention of problems to at-risk youth
 - 3. Personal appreciation/satisfaction
 - Sense of freedom
 - Self-actualization
 - Exhilaration
 - Stimulation
 - Sense of adventure
 - Challenge
 - Nostalgia
 - Quality of life/life satisfaction
 - Creative expression
 - Aesthetic appreciation
 - Spirituality
 - Positive change in mood/emotion
 - B. Psycho-physiological
 - Cardiovascular benefits, prevention of strokes
 - Reduced or prevented hypertension
 - Reduced serum cholesterol and triglycerides
 - Improved control and prevention of diabetes

- Prevention of colon cancer
- Reduced spinal problems
- Decreased body fat/obesity/weight control
- Improved neuropsychological functioning
- Increased bone mass and strength
- Increased muscles strength and better connective tissue
- Respiratory benefits (increased lung capacity)
- Increased life expectancy
- Management of menstrual cycles
- Management of arthritis
- Improved immune system
- Reduced consumption of alcohol and tobacco

II. Social/Cultural Benefits

- Community satisfaction
- Pride in community/nation
- Cultural/historical awareness and appreciation
- Reduced social alienation
- Community/political involvement
- Ethnic identity
- Social bonding/cohesion/cooperation
- Conflict resolution/harmony
- Greater community involvement in environmental decision-making
- Social support
- Family bonding
- Reciprocity/sharing
- Social mobility
- Community integration
- Nurturance of others
- Understanding/tolerance of others
- Environmental awareness/sensitivity
- Enhance world view
- Socialization/acclimation
- Cultural identity
- Prevention of social problems by at-risk youth
- Developmental benefits of children

III. Economic Benefits

- Reduced health costs
- Increased productivity
- Less work absenteeism
- Reduced on-the-job accidents
- Decreased job turnover
- Local and regional economic growth
- Contributions to net national economic development

IV. Environmental Benefits

- Maintenance of physical facilities
- Stewardship
- Husbandry/improved relationship with natural world
- Understanding of human dependency on the natural world

Environmental protection

As the table shows, the benefits of recreation are broader and larger than one might have assumed. The benefits encompass almost all aspects of human behaviour and performance and can be realized in many different environments and settings from Central Park in New York to Mount Everest in Nepal and Tibet (Driver 1999).

2.3 Emergence of Outdoor Recreation in North America

In early North American settlement, open spaces were assigned for commons, pasture land, and training grounds for hunters (Ibbrahim & Cordes 1993). Commons were public grounds or village greens reproduced from the English (Jensen 1995). In New England, commons were characterized as plots owned by the community that had various functions including timber harvesting, livestock grazing, and political, social, commercial, and recreational activities (Ibbrahim & Cordes 1993; Jensen 1995). By the mid 18th Century, these open spaces were used for recreational activities and other amusements (Ibbrahim & Cordes 1993).

The need for local recreation was recognized and addressed in some North American urban environments. As North American cities were expanding rapidly and pollution levels were increasing, the need for open space was becoming increasingly important (Douglass 1999). In Canada, the establishment of municipal parks began with early settlements in New Brunswick, Nova Scotia, Quebec and Ontario. For example, in 1763, Halifax Commons was granted to the city and Montreal had its first public square in 1821 (Ibbrahim & Cordes 1993). In 1853, Frederick Law Olmsted and Calvert Vaux designed New York's Central Park where citizens could escape the poor conditions and tensions of city life through relaxation and exercise. Olmsted's vision was to create a public park,

'... large enough to contain a complete natural landscape, where boundaries are not obtrusive, where the city condition will not be unduly apparent, where one may stroll over hill and dale, across meadow and through woods, always amid natural surroundings, for hours without twice following the same routes; where one may come again and again without becoming familiar with all its interesting localities and natural features: where many thousands of visitors may be enjoying the scenery at the same time without crowding each other; where those who especially seek

seclusion may find parts so remote from the boundaries that even if city houses are not completely hidden they are reduced in the distant perspective of inconspicuous proportions as compared with the foliage of trees and other natural objects in the foreground; so remote that the roar of street traffic is less noticeable than the rustle of foliage stirred by the breeze or than the songs of birds.'

– Olmsted (de Graaf 2000)

This park set the precedent for major urban centres in North America to set aside open spaces for public recreation (Jensen 1995). In the late 19th Century in Canada, the importance of recreation in the citizens' everyday lifestyle, and the role that natural resources could play in the pursuits of outdoor activities gained importance. Provinces began enabling laws empowering their municipalities to build parks, set procedures for land acquisition, and establish standards for management of natural resources. Hamilton built its Gore Park in 1852 and Montreal established its Mount Royal Park in 1860 (Ibbrahim & Cordes 1993). In 1886, Stanley Park in Vancouver was designated as a public park (Tate 2001).

During the late 19th and early 20th centuries, fear of the destruction of natural resources due to population growth and expansion, resulted in the rise of a preservation movement which led, in turn, to the establishment, for the first time in human history, of natural areas allocated for the enjoyment of present and future generations (Ibbrahim & Cordes 1993). Many game preserves were established to protect and preserve popular game animals such as deer however, the concept of preservation reached its pinnacle in 1872 with the establishment of America's first national park. Yellowstone National Park in Wyoming, Idaho and Montana was established as a federal park because some farsighted individuals held out for its public ownership at a time when the land appeared to be valueless (Douglass 1999). The concept of federally designated national parks for the enjoyment of the public and the protection of natural resources is adopted by many nations today (Ibbrahim & Cordes 1993).

Expansion of outdoor recreational opportunities required the establishment of many agencies at the federal, state and local levels (Ibbrahim & Cordes 1993). This was in response to demands accelerated by:

- 1) The adoption of the Universal Declaration of Human Rights by the General Assembly of the United Nations in 1948 which states that *'every citizen has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay...and the right to freely participate in the cultural life of the community...'*
- 2) An increase in free time for almost every citizen in many countries regardless of social class and lifestyle;
- 3) An increase in disposable income allowing a greater percentage of money allocated for leisure activities (Jensen 1995);
- 4) The advent of industrialization and automation which allowed for greater free time;
- 5) An increase in urbanization with the resultant increase in the need for recreational outlets;
- 6) The provision of adequate means of transportation which takes the individual to the desired destination; and
- 7) Mobility with its social and psychological dimensions that drives one to seek recreational pursuits that correspond to a newly acquired status. For example, people seek higher pay, longer vacations, and the ability to afford an expensive recreational vehicle for both psychological and social reasons.

The relationship between outdoor recreational activities and open space is derived from a basic biological need to retain a connection with nature in sterile, urban environments, and a psychological need for contrast and change in one's surroundings and activities that most indoor environments do not provide. The desire to escape to natural open spaces is further enhanced when these needs are linked with routine indoor jobs and the artificial environments of most urban cities and suburbs (Gold 1997).

2.4 Trends in Outdoor Recreation in Canada

Canada is a country internationally renowned for its wildlife, forests, water, and protected areas. It contains 20 percent of the world's remaining natural areas and sustains a variety of nature-related activities that enhance the lives of millions of Canadians and foreign visitors. In 1996, Statistics Canada in concert with Environment Canada conducted the *Survey on the Importance of Nature to Canadians* that highlights the involvement of Canadians with nature through participation in various nature-related activities (Environment Canada 1997). The survey showed that 20 million Canadians (84.6 percent of the population) aged 15 years and over participated in one or more nature-related activities in Canada and participants dedicated 1.5 billion days of their leisure time and \$11.0 billion to these activities.

Nature-related activities include outdoor activities in natural areas, residential wildlife related activities, wildlife viewing, recreational fishing, hunting, and indirect nature-related activities. For the purposes of the study conducted by Statistics Canada and Environment Canada, a natural area was defined as forested areas, water bodies, wetlands, open fields and mountains. These nature-related activities mentioned above, are defined as:

Outdoor activities in natural areas – sightseeing in natural areas, photographing in natural areas, gathering nuts, berries, or firewood, picnicking, camping, swimming/beach activity, canoeing/kayaking/sailing, power boating, hiking/backpacking, climbing, horseback riding, cycling, off-road vehicle use, downhill skiing, cross-country skiing/snowshoeing, snowmobiling and relaxing in an outdoor setting.

Residential wildlife-related activities – activities that occur around the residence such as, watching, photographing, feeding or studying wildlife, and gardening.

Wildlife viewing – watching, photographing, feeding or studying wildlife for the purpose of enjoying wildlife and natural areas.

Recreational fishing – catching fish for non-commercial purposes.

Hunting – searching for, pursuing, stalking, trailing or lying in wait for game which may or may not be harvested.

Indirect nature-related activity – reading about nature, watching films or television programs about nature, purchasing art, crafts or posters of nature, visiting zoos, game farms, aquariums or natural history museums, joining or contributing to naturalist, conservation or sportsmen’s [sic] clubs and maintaining, restoring, or purchasing land for conservation purposes.

Figure 2.4.1 shows the number and percentage of Canadians participating in nature-related activities in Canada.

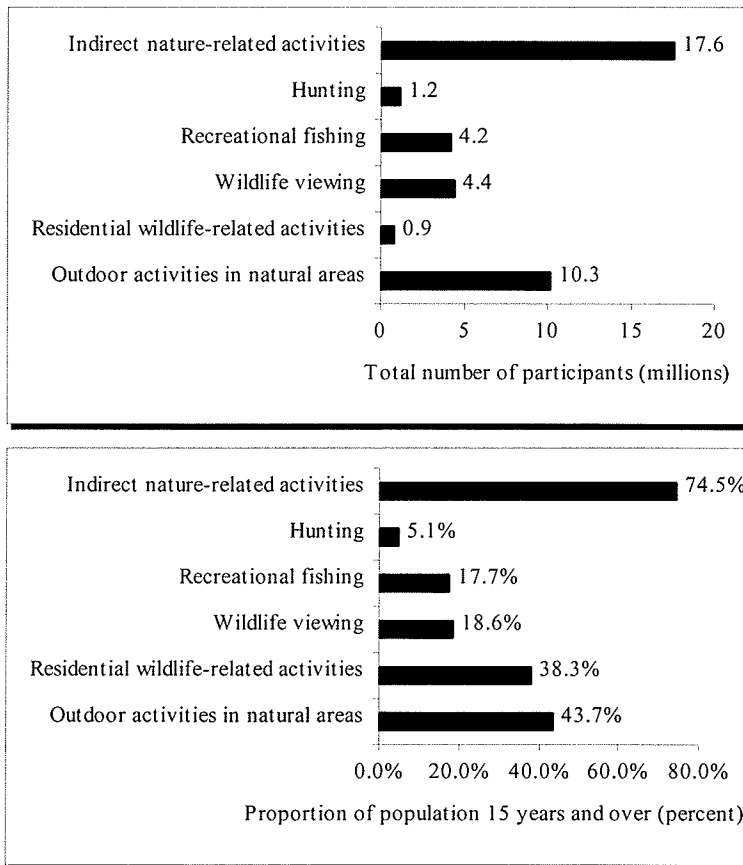


Figure 2.4.1: Number and percentage of Canadians participating in nature-related activities in Canada in 1996 (Environment Canada 1997).

The figure shows a high proportion of the population engaging in indirect nature-related activities (74.5%) followed by outdoor activities in natural areas (43.7 %) and residential wildlife-related activities (38.3%).

Figure 2.4.2 shows the percentage of Canadians participating in nature-related activities across Canada.

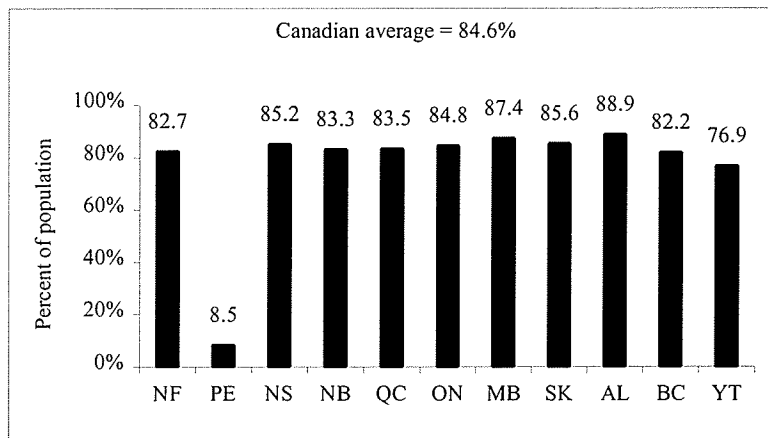


Figure 2.4.2: Percentage of Canadians participating in nature-related activities in 1996, by province or territory of residence (Environment Canada 1997).

Residents of Alberta, Manitoba, Saskatchewan, Nova Scotia, Prince Edward Island and Ontario had participation rates above the national average of 84.6 percent, with Alberta residents having the highest participation rate of 88.9 percent.

The proportion of residents participating in the various nature-related activities differs according to sex, age, urban-rural residence, education and personal income. Table 2.4.1 shows the profile of the Canadian population 15 years of age and over, in relation to the profiles of participants engaged in the various nature-related activities.

The table shows that the proportions of men and women that participated in outdoor activities in natural areas, in residential wildlife-related activities, and in wildlife viewing were similar while the proportion of men involved in recreational fishing and hunting practices was higher than that of women. In addition, the proportion of participants in nature-related activities between the ages of 15-19 and 65 years and over were considerably lower than those between the ages of 25-44. As well, the proportion of Canadians participating in nature-related activities was significantly higher with residents living in urban environments than those living in rural areas. Finally, there is a positive correlation between higher levels of both education and income, and participation in nature-related activities.

Table 2.4.1: Profile of Canadians participating in nature-related activities in 1996 (Environment Canada 1997).

	Outdoor activities in natural areas	Residential wildlife related activities	Wildlife viewing	Recreational fishing	Hunting	Population of Canada 15+
Total number of participants 15 years and over	10.3 million	9.0 million	4.4 million	4.2 million	1.2 million	23.6 million
Percent of participants						
Sex						
Male	50.5	47.5	49.3	66.3	8.5	49.1
Female	49.5	52.5	50.7	33.7	1.5	50.9
Age group						
15-19 years	9.8	6.6	7.8	9.4	6.7	8.4
20-24 years	10.1	6.3	8.8	9.3	8.4	8.4
25-34 years	25	18.5	23.8	23.5	21.9	19.9
35-44 years	25.6	23.3	25.9	26.8	27.3	21.4
45-54 years	15.4	18.7	17.2	16.2	19.2	16.4
55-64 years	7.6	12.2	8.9	0.8	10.2	10.8
65 years and over	6.5	14.4	7.6	6.8	6.3	14.6
Residence						
Urban	83	77.1	82.1	77.7	62.7	83
Rural	17	22.9	17.9	22.3	37.3	17
Education						
0-8 years	5.1	8.2	5.2	7.6	11	11.4
Some secondary	16.2	16.9	14.3	19.4	19.9	18.5
High school	17.3	18.1	17.2	18.5	17.7	18.5
Some post-secondary	11.2	9.9	11	10.5	8	9.9
Post-secondary certificate or diploma	27.4	26.7	27.8	29.1	32	24.6
University degree	22.8	20.2	24.5	14.9	11.3	17.1
Personal income						
No income	10.1	10.1	9.3	8.9	6.1	11.9
< \$5,000	10.4	9.3	9.5	9.4	6	9.9
\$5,000-\$9,999	9.6	11.1	10.2	8.7	7.8	12.2
\$10,000-\$19,999	16.6	19.6	17.3	16.2	15.5	20.4
\$20,000-\$29,999	16.5	15.9	16.4	17.1	20.3	16.5
\$30,000-\$39,999	13.4	12.1	13.4	14.5	16.4	11.3
\$40,000-\$49,999	9	8.3	9.1	9.5	11	7.1
>\$50,000	14.5	13.7	14.8	15.6	17	10.7

Focusing more specifically on outdoor activities in natural areas, Figure 2.4.3 shows the percentage of Canadians participating in outdoor activities in natural areas. Natural areas provided Canadians with opportunities for sightseeing (31.1%), picnicking (26.0%), swimming or beach activity (23.7%), camping (18.8%), photography (15.9%), and fruit and firewood gathering (11.0%). More active uses of natural areas included hiking or backpacking

(18.5%), canoeing or kayaking (9.9%), cycling in natural areas (8.6%), downhill skiing (4.7%), climbing (4.3%), cross-country skiing (3.5%) and horseback riding (1.6%).

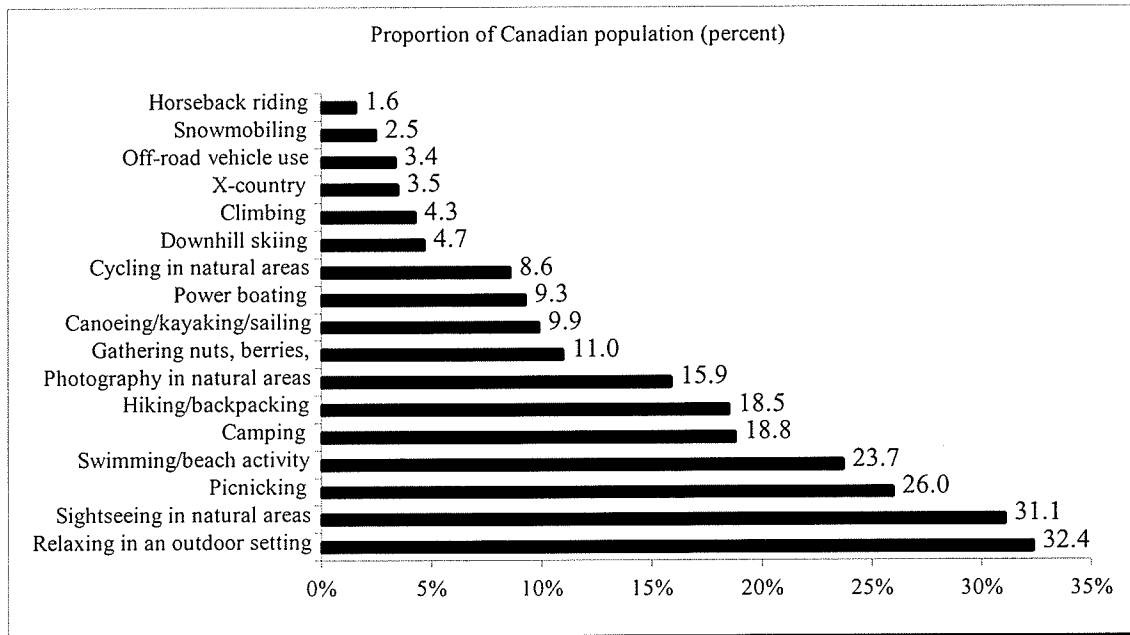


Figure 2.4.3: Percentage of Canadians participating in outdoor activities in natural areas in 1996 (Environment Canada 1997).

Participation rates of Canadians in outdoor activities in natural areas are shown in Figure 2.4.4. Residents of Alberta showed the highest rate (50.5%) above the national average (43.7%). Quebec and Prince Edward Island showed the lowest rates at 38.6% and 37.6%, respectively.

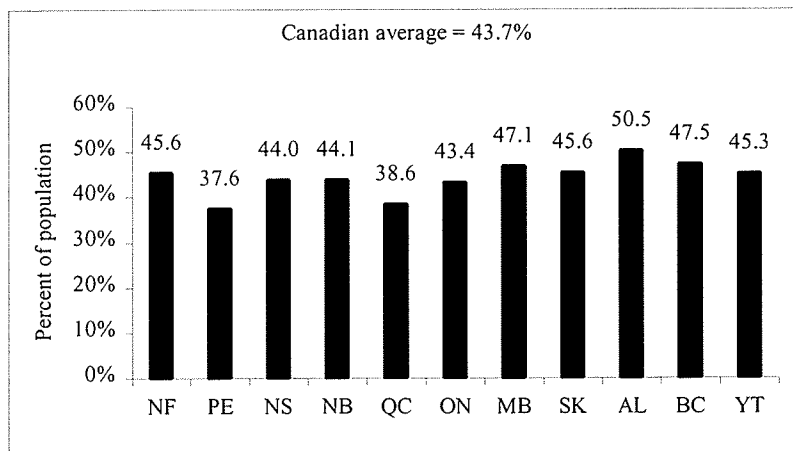


Figure 2.4.4: Percentage of Canadians participating in outdoor activities in natural areas in 1996, by province or territory of residence (Environment Canada 1997).

Of particular interest, other findings showed that Manitoba and Saskatchewan residents had the highest rates (73.6% each) of participation in outdoor activities in parks or other protected areas (Figure 2.4.5). Ontario, Quebec, Nova Scotia, Newfoundland, and the Yukon however, showed rates below the national average of 56.9 percent.

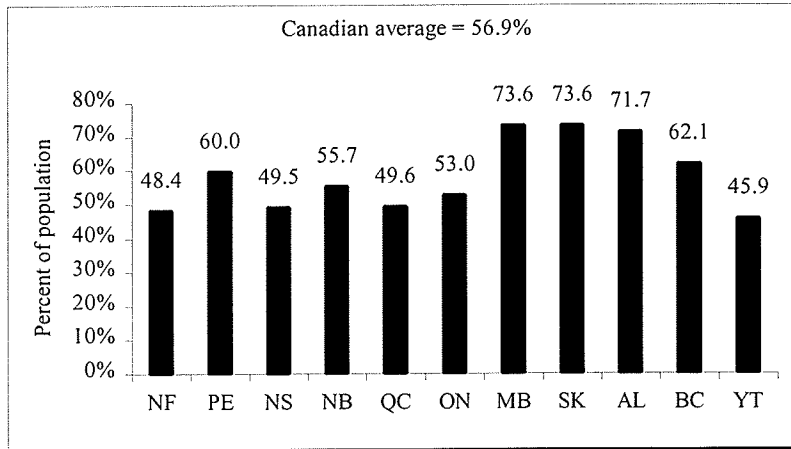


Figure 2.4.5: Percentage of participants in outdoor activities in natural areas in 1996 who visited parks or other protected areas, by province or territory of residence (Environment Canada 1997).

The *Survey on the Importance of Nature to Canadians* also addressed future changes to the current rates of participation in nature-related activities. The survey asked Canadians about their degree of interest in participating in nature-related activities, or whether they had interest in continuing to participate. Results showed that 74.0% of the Canadian population had either great or some interest in participating in outdoor activities such as hiking, riding, cycling, camping, skiing and snowshoeing in natural areas (Figure 2.4.6). If these results are compared to results from Figure 2.4.4, which shows the percentage of Canadians participating in outdoor activities in natural areas in 1996, we can see that the level of potential participation (74.0%) is over one and a half times higher than the rate of active participation in 1996 (43.7%). Thus, it is safe to assume that the rate of outdoor participation in recreational activities in Canada is likely to increase over time.

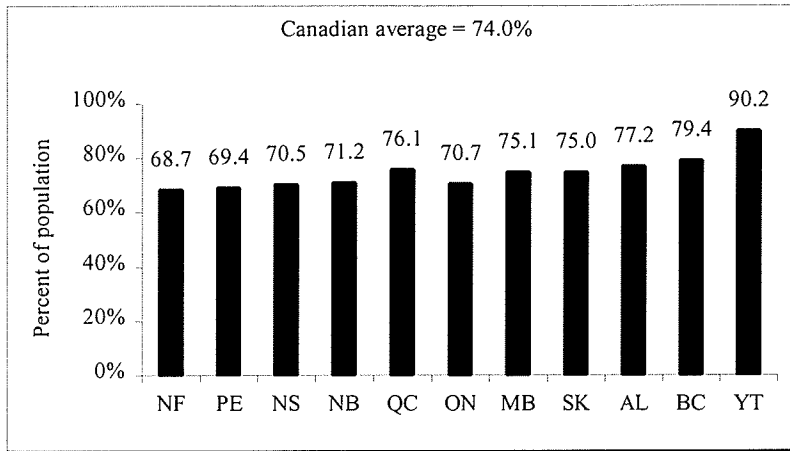


Figure 2.4.6: Percentage of Canadians expressing great or some interest in participating in outdoor activities in natural areas, by province or territory of residence (Environment Canada 1997).

Similar to what has occurred in the past and is occurring at present, future increase in outdoor recreation participation would be the result of demographic and socio-economic trends such as age, gender, culture, employment, leisure time, and technological advances (Wall 1989; Jensen 1995). This anticipated increase in outdoor recreational activities would have both positive and negative effects. The positive effects of recreation include personal benefits, social/cultural benefits, economic benefits and environmental benefits as set out in Table 2.2.1. The negative impacts of recreation are mainly of a social and environmental nature. Social impacts include conflicts between participants, conflicts between participants and non-recreationists/residents and impacts on local populations arising from infrastructure development. Social impacts are common in areas where tourism is high (Wall 1989). Environmentally, as the number of participants increase, overuse will exceed the ecological carrying capacity of a natural system and cause serious, often irreversible, damage (Burden & Randerson 1972). In addition, subsequent crowding and reduction in environmental quality will cause recreationists to venture more frequently and more extensively into more remote areas causing related impacts on soil, vegetation, wildlife and water. In addition, spatial expansion into remote regions is facilitated by technological innovations that will allow recreationists to readily venture into such areas (Wall 1989).

Chapter 3: *The Ecological and Social Impacts of Outdoor Recreation*

Chapter 3

The Ecological and Social Impacts of Outdoor Recreation

Activities associated with recreation result in the degradation of land, water and wildlife resources by simplifying plant communities, increasing animal mortality, displacing and disturbing wildlife, and distributing refuse (Boyle & Samson 1985).

Recreational impacts occur when there is an interaction between recreational use and environmentally sensitive areas. The degree of impact depends on 1) the characteristics of the environment, namely, the composition of the site and the vulnerability of its soils, vegetation, wildlife, water and topography; and 2) the characteristics of use of the environment, particularly, the amount of use, type of recreational activity, behaviour of recreationists, spatial distribution of use, and temporal distribution of use (Cole 1993).

The following section discusses and reviews existing literature on the effects of trampling associated with recreational activities on riparian soils, vegetation, wildlife and water, as well as the social impacts of outdoor recreation.

3.1 Effects of Outdoor Recreation on Soil

The vulnerability of soils to the impacts of recreational trampling varies depending on soil type, vegetation cover, topography and intensity of use (Weaver & Dale 1978). Impacted soils are typically found at picnic areas, campgrounds, low-standard roads, trails and off-roads (Douglass et al. 1999). Table 3.1.1 shows the relationship between soil characteristics and site vulnerability. Fine textured soils such as clay soils with high organic content and high soil moisture content, characteristic of riparian areas, are most vulnerable. On the other hand, loamy soils with moderate organic and soil moisture content are least vulnerable (Cole 1993).

Table 3.1.1: Relationships between soil characteristics and site vulnerability (Cole 1993).

Soil Property	Level of Vulnerability		
	Low	Medium	High
Texture	Medium (loam)	Coarse (sand)	Fine (clay)
Organic content	Moderate	Low	High
Soil moisture	Moderate	Low	High
Fertility	Moderate	High	Low
Soil depth	None	Deep	Shallow

The impacts of recreation on the air, water, dead organic matter and living organisms found in soil are unfavorable to all organisms that depend on this substrate for survival (Cole 1993). Figure 3.1.2 shows the three primary soil horizons. The uppermost layer of soil, the A-horizon, is the region of greatest physical, chemical and biological activity. It contains the greatest portion of the soil's organic matter, both living and dead, such as dead and decaying leaves and other plant parts, insects and decomposer organisms (Raven et al. 1992). The A-horizon plays an important role in the soil's biological activity and helps improve water quality by decreasing runoff and increasing water retention. It also contains the necessary nutrients required for plant growth and protects the more vulnerable mineral soil horizon below, from compaction and erosion (Cole 1993). This B-horizon is a region of deposition where iron oxide, clay particles, and small amounts of organic matter are carried from the top layer by percolating water. The B-horizon contains significantly less organic matter and is less weathered than the A-horizon (Raven et al. 1992). However, erosion of the mineral layer occurs once the vegetative cover and the organic layer is removed. Erosion processes are made worse by moderately steep to steeper slopes typical of riverbank zones. Once the soil-surface horizons are lost, long-term soil productivity decreases significantly (Douglass et al. 1999).

The principal effects of recreational trampling on soils are compaction, decreased macropore space, increased soil penetration resistance, increased soil density and a number of physical changes in the soil environment that inhibit seed germination (Kuss & Graefe 1985). When trampling affects the B-horizon, soil particles are compacted decreasing the amount of pore space resulting in reduced aeration and water content, making it difficult for plant roots to penetrate into the soil (Cole 1993). Crusts, which form on the surfaces of fine textured soils, inhibit seedling emergence and act as a seal against the entry of water, creating moisture stress in the soil surface (Jim 1987). Seedling mortality often results from desiccation and drought effects (Kuss & Graefe 1985).

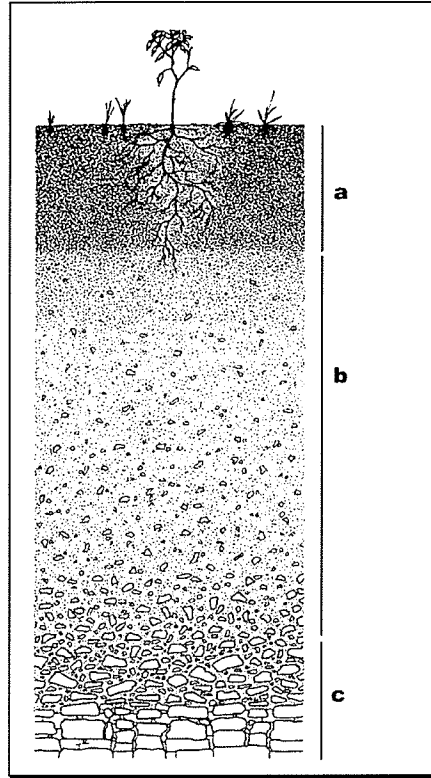


Figure 3.1.2: The three soil horizons in a typical soil (Raven et al. 1992)

Soil density changes influence root penetration, drainage properties, soil porosity and availability of soil nutrients (Liddle 1975). Changes in soil properties reflected by increased bulk density favour species with a greater tolerance to moisture and oxygen stresses as well as those morphologically adapted to gain establishment in highly compressed soils (de Gouvenain 1996). Thus, an increase in soil bulk density may cause the proliferation of one or more successful native and/or exotic species resulting in a change in community composition (Liddle 1975b).

Compacted soil will also affect the mobility of inorganic ions, and therefore their availability to plant roots (Burden & Randerson 1972). The resulting loss of vegetation cover and litter promotes higher soil surface temperatures and higher evaporation rates which lead to further restriction of soil air and moisture content (Kuss & Graefe 1985).

Figure 3.1.3 summarizes the effects of trampling on soil and vegetation.

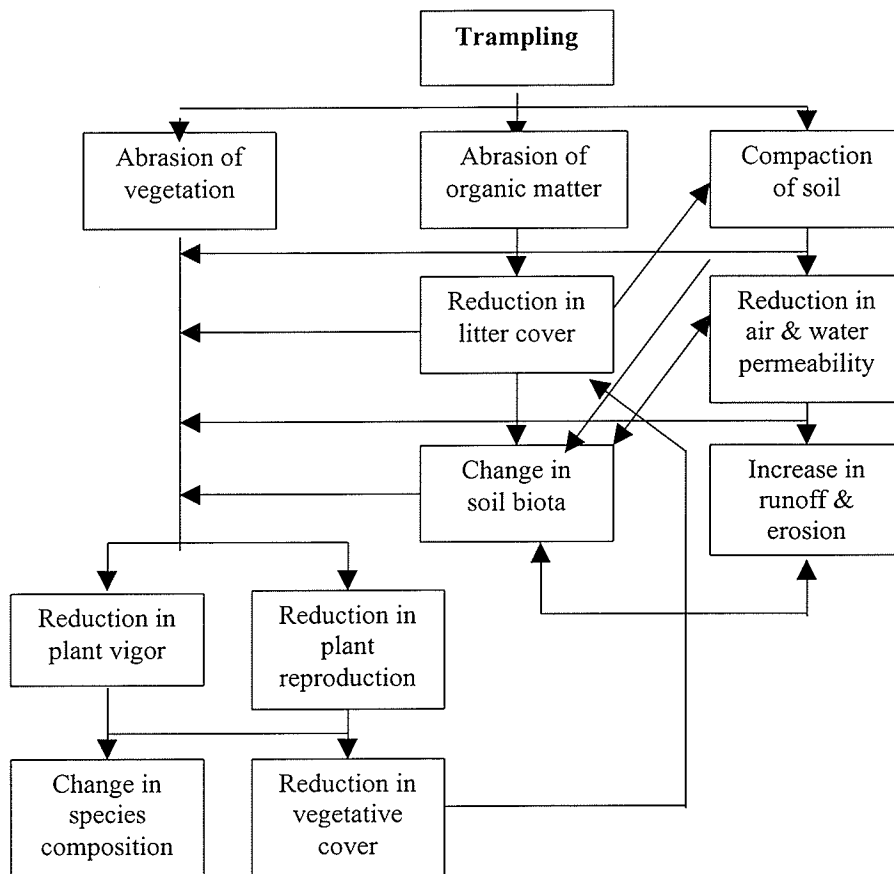


Figure 3.1.3: The effects of trampling on vegetation and soil (Cole 1993).

3.2 Effects of Outdoor Recreation on Vegetation

The impacts of recreation on vegetation are more evident than those on soils. Injury to plants caused by trampling may originate from below or aboveground damage (Dale & Weaver 1974). Belowground damage includes physical injury to root systems due to soil compaction and erosion effects exposing the roots (Douglass et al. 1999). Aboveground damage to fragile plant tissues includes bruising, crushing, tearing and uprooting. In areas of heavy recreation, trail networks fragment the forest leaving a large proportion of the surface stripped of vegetation (Cole 1993).

The ecological impacts of trampling on vegetation were best summarized by Liddle (1975). Two major effects can be observed: 1) the direct effects of mechanical forces which damage all or parts of the plant; and 2) the indirect effects of trampling on the physical and/or chemical characteristics of the soil, which in turn affect plant establishment, growth and reproduction. Bates (1935) suggested that the physical bruising of vegetation and puddling

caused by trampling has a greater effect on vegetation than the indirect effect of soil compaction. However, several researchers have discovered a causal relationship between marked changes in soil structure and vegetation degradation at trampled sites (Bhuju & Ohsawa 1998).

As diagnostic evidence of debilitation, symptoms of injured plants are similar to those expressed in response to disease and nutritional disorders (Kuss & Graefe 1985). Detrimental effects of trampling on vegetation include the disordered utilization of energy, injurious physiological processes and impaired vital functions of the injured plant (Kuss and Graefe 1985). Trampling damage to plants is often reflected by reduced vigour, significant reductions in height, loss of photosynthetic surfaces, flower and seed inhibition, defoliation, wilting, dieback and reduced biomass (Burden & Randerson 1972).

Some plant communities are more resistant to the direct effects of trampling than others, while some may be more resilient after direct impacts have ended (de Gouvenain 1996). This has been attributed to the fact that the resistance and resilience of different plant species to trampling varies depending on their morphology, anatomy, reproductive potential, and total biomass (Andraz & Ladislav 1998). Plants that are more vulnerable to the effects of trampling exhibit the following characteristics: 1) they grow to a moderate stature; 2) have an erect growth form; and 3) have woody, brittle, or delicate stems and leaves (Cole 1993; Cole & Landres 1995).

Characteristics that can make a plant more resistant to the effects of trampling include: 1) being either very small or very large; 2) growing either flat along the ground or in dense tufts; 3) having leaves and stems that are tough and/or flexible; 4) having growth points at or below the ground surface; 5) having a rapid growth rate; 6) producing numerous seeds; and 7) being an annual (Cole 1993; Cole & Landres 1995).

Recreational activities often play a role in introducing and encouraging weedy or exotic species, which often express these trampling-resistant characteristics (Douglass et al. 1999). Seeds or propagative tissue is easily dispersed along trails by humans through mud carried on footwear and bicycle tires, as well as the hooves, fur and feet of wildlife (Lanehart 1998). Once they are introduced into a disturbed area these weedy or exotic species thrive, favouring the environmental conditions present. They are resistant and/or resilient to the

impacts of trampling, and are likely to crowd out native vegetation, resulting in a decrease in the biodiversity of the site (Cole 1993).

3.3 Effects of Outdoor Recreation on Wildlife

With an ever-growing increase in outdoor recreation in natural areas, a lack of information about wildlife communities and their requirements and/or poor planning of recreational development could lead to considerable negative impacts on wildlife (Joslin & Youmans 1999). Boyle and Samson (1985) reviewed 166 articles that contained original data on the effects of non-consumptive outdoor recreation on wildlife and found that in 81% of the cases, effects were considered negative.

Human disturbance associated with recreational activities can impact wildlife in four main ways: exploitation, disturbance, habitat modification and pollution. *Exploitation* involves death of the animal via harvesting through hunting, trapping, fishing or collection. *Disturbance* involves activities such as photographing, bird watching, or hiking through an animal's territory. *Habitat modification* and *pollution* are indirect impacts. Vegetation, soil and water can be modified thus impacting the species that are dependent on these habitats. Animals may also be subject to pollutants, litter or food left behind by recreationists (Knight & Cole 1995).

Disturbance caused by recreational activities may trigger behavioural responses and/or physiological responses in wildlife (Douglass et al. 1999). The vulnerability of wildlife to these impacts depends on both the characteristics of the recreational disturbance and the characteristics of the affected wildlife. Characteristics of disturbance include type of activity, recreationist's behaviour, predictability, frequency and magnitude, timing and location. Characteristics of wildlife include type of animal, group size, and age and sex (Knight & Cole 1995b).

Wildlife may respond to these impacts in any of three ways: habituation, attraction or avoidance. These behavioural responses may be of short duration or longer term (Knight & Temple 1995).

Habituation: A waning of response to a repeated stimulus that is not associated with either a positive or negative reward. Conflicts with humans resulting from habituation may result in mortality such as vulnerability to hunters and poachers, vehicle collision, or management removal in response to constant property damage or nuisance.

Attraction: The strengthening of an animal's behaviour as a result of awards or reinforcement. Species are either in search for food they associate with humans such as garbage, pet food and bird feeders, or they approach humans for food in the case of squirrels, chipmunks, and some birds. This attraction of wildlife to humans can be dangerous to both wildlife and humans. In extreme cases, attraction can bring humans into contact with potentially dangerous animals resulting in the animal being killed or humans injured.

Avoidance: When human encounters are associated with pain or punishment shown in behavioural shifts in wildlife during recreational hunting season. Avoidance behaviour increases with an increasing number of negative encounters and can result in displacement and changes in distribution (Joslin & Youmans 1999).

Physiological responses to disturbance are difficult to observe and vary among species. These responses typically involve an elevated heart rate, increased blood flow to skeletal tissues, increased body temperature, elevated blood sugar levels, and reduced blood flow to the skin and digestive organs (Gabrielsen & Smith 1995). This active-defence response has a significantly large energy cost and can thus reduce vigour. However, an animal that is experiencing a deficient energy budget may express an opposite behavioural and physiological response to disturbance. This passive-defence response is characterized by the inhibition of activity, reduced blood flow to skeletal muscles, reduced blood flow to the digestive system, reduced heart and respiratory rate, and reduction in body temperature (Gabrielsen & Smith 1995).

Effects of disturbance can have detrimental effects to wildlife populations. If disturbance alters behaviours within a local population, it can result in distribution and habitat use changes, which may ultimately alter reproductive success and thus, the health and status of the population (Douglass et al. 1999). Several studies have shown that wildlife and humans can coexist together in most situations. However, there are two critical periods for many species of birds and mammals where human disturbance should be minimized or regulated

to prevent a reduction in the animal's reproductive success. These are the postnatal period in mammals and the breeding period in birds (Gabrielsen & Smith 1995).

3.4 Effects of Outdoor Recreation on Water

The majority of impacts of recreational activities on water occur indirectly through the disturbance of riparian soils and vegetation. Recreational use leads to a reduction in vegetative cover, loss of soil organic layers, and compaction of underlying mineral soils (Cole 1993). As a result, surface runoff increases and moves more rapidly because it has less resistance to flow compared to water percolating through soil (Douglass et al. 1999). This increase in surface runoff causes accelerated soil erosion and sediment deposition into the waterway, altering its physical structure and having adverse effects on aquatic life and habitat (Cole 1993; Douglass et al. 1999).

Compacted snow, as a result of winter recreational activities, melts rapidly and retains less water than non-compacted snow (Newmann & Merriam 1972). After heavy compaction, snow melting rates double, and the potential water-retaining capacity of compacted snow is significantly reduced. Consequently, during spring snowmelt, runoff increases significantly (Douglass et al. 1999).

3.5 Social Impacts of Outdoor Recreation

The social impacts of outdoor recreation include conflicts between participants, conflicts between participants and non-recreationists/residents and impacts on local populations arising from infrastructure development (Wall 1989). For the purposes of this study the impacts on the quality of visitor experience will be examined. Manning & Ballinger (1996) have found these impacts to include visitor crowding, conflicts between incompatible visitor activities, reduction in visitor learning, and spatial, temporal, or total visitor displacement.

Early outdoor recreation studies have shown that the quality of outdoor recreation experience diminishes as a result of increased use (Manning 1999). Crowding is often analyzed within social interference and stimulus overload theories (Baum & Paulis 1987). Social interference suggests that crowding occurs when the number of people present interferes with an individual's goals or desired activities. Stimulus overload is the result of an individual being overwhelmed by the presence of others. Studies have shown that perceived

crowding tends to be higher at more accessible locations and during peak use periods. On the other hand, perceived crowding is lower where management action is employed to reduce use (Shelby et al. 1989).

New behaviours, or coping mechanisms, evolve by individuals or groups of recreationists to deal with perceived crowding. Manning (1991) describes three main forms of coping behaviour: displacement, rationalization and product shift. Displacement is a behavioral coping mechanism that involves spatial displacement (intersite or intrasite) or temporal changes in use patterns. Rationalization is a cognitive coping mechanism involving rating one's recreation experience highly despite actual conditions in order to reduce internal conflict. Product shift is another cognitive coping mechanism whereby visitors experiencing higher use levels than expected or preferred, alter their definition of the recreational opportunity in correspondence with the conditions experienced.

It must be noted that use levels are not interpreted as crowding until it is perceived to interfere with an individual's values or objectives (Manning 1991). A number of factors have been found to influence crowding norms that include personal characteristics of visitors, characteristics of others encountered, and situational variables (i.e. location and environmental factors).

Other studies on outdoor recreation found conflicts between participants in alternative recreation activities. Conflict among recreationists is increasing as a consequence of technological innovations that contribute to the development of new recreational equipment and activities.

Conflict, for the most part, occurs among participants of differing recreational activities, especially between hikers and mountain bikers, and between canoeists and motor boaters (Manning 1999). Jacob and Schreyer (1980) defined conflict as goal interference attributed to another's behaviour resulting in dissatisfaction. They suggest that conflict is caused by four main factors that include activity style, resource specificity, mode of experience, and lifestyle tolerance. *Activity style* refers to the personal meanings assigned to an activity, which include intensity of participation, status as defined by equipment and expertise, and range of experience and definition of quality. *Resource specificity* refers to the significance attached to using a specific recreational resource for a given recreational experience

including, evaluation of resource quality, sense of possession, and status based on knowledge of a recreation area. *Mode of experience* refers to the extent to which the recreationist is focused or unfocused on the environment. Finally, *lifestyle tolerance* is the tendency to accept or reject lifestyles different from one's own.

Recreationists who are unable to cope with conflict stimuli experience diminished satisfaction and will ultimately be displaced. Conflict management is necessary in order to maintain the quality of recreation for those who are sensitive or intolerant of conflicting uses. Zoning of groups or recreational activities can be effective where goal interference is related to direct contact whereas, education is valuable where goal interference is indirect relating to differences in social values and attitudes (Manning 1999).

Chapter 4: *Riparian Buffers*

Chapter 4

Riparian Buffers

As discussed in Chapter 1, riparian buffers are valuable natural systems that provide many important benefits including flood control, bank stabilization, erosion control, filtration of nutrients and pollutants, water temperature regulation, wildlife habitat, and recreational and educational benefits. This chapter describes various guidelines and approaches to riparian buffer planning, design and implementation.

4.1 Functional Objectives

When designing riparian buffer strips or corridors, the primary objectives or functions of the buffer strip or corridor should be determined (Fisher & Fischenich 2000). Objectives may include: 1) water quality protection (pollutant removal, stream stabilization and temperature moderation); 2) riparian habitat (provision for aquatic and terrestrial wildlife); 3) flood control; and 4) recreational and educational opportunities (Berechtold et al. 1998). Land managers may choose to focus on one or all of the buffer strip functions.

4.2 Riparian Buffer Widths

Determining riparian buffer widths depends on the functional objectives one is interested in conserving (Berechtold et al. 1998). Criteria for determining proper buffer width dimensions for some functions are not well established and highly variable (Fisher & Fischenich 2000). Most existing criteria focuses on water quality protection however, it is only one of many functions performed by riparian buffers. There have been few approaches that mesh water quality width requirements with conservation values and recreational values (Fisher & Fischenich 2000). Generally speaking, the wider the buffer the better however, this is often not practical due to social, economic and political factors (Kipp & Callaway 2003).

Width recommendations for buffer strips can either be fixed or variable in nature (Fisher & Fischenich 2000). Fixed width buffer strips are usually based on a single function, for example, water quality protection. The advantage of fixed widths is that they are easier to enforce and administer by regulatory agencies. However, in certain situations, fixed widths may provide inadequate protection thus failing to address many of the riparian buffer functions (Castelle et al. 1994). Variable width buffer strips, on the other hand, are based on

multiple functions and may consider site-specific conditions by having widths adjusted according to adjacent land use, topography, hydrology, and wildlife considerations (Castelle et al. 1994). Table 4.2.1 shows a summary of recommended riparian buffer strip widths according to function.

Table 4.2.1: General Riparian Buffer Strip Width Guidelines (Fisher & Fischenich 2000)

Water Quality Protection

Buffers, especially dense grassy or herbaceous buffers on gradual slopes, intercept overland runoff, trap sediments, remove pollutants, and promote ground water recharge. For low to moderate slopes, most filtering occurs within the first 10 m, but greater widths are necessary for steeper slopes, buffers comprised of mainly shrubs and trees, where soils have low permeability, or where non-point source pollution (NPSP) loads are particularly high.

RW ¹ = 5 to 30 m

Riparian Habitat

Buffers, particularly diverse stands of shrubs and trees, provide food and shelter for a wide variety of riparian and aquatic wildlife.

RW = 30 to 500 m +

Stream Stabilization

Riparian vegetation moderates soil moisture conditions in stream banks, and roots provide tensile strength to the soil matrix, enhancing bank stability. Good erosion control may only require that the width of the bank be protected, unless there is active bank erosion, which will require a wider buffer. Excessive bank erosion may require additional bioengineering techniques.

RW = 10 to 20 m

Flood Attenuation

Riparian buffers promote floodplain storage due to backwater effects, they intercept overland flow and increase travel time, resulting in reduced flood peaks.

RW = 20 to 150 m

Detrital Input

Leaves, twigs and branches that fall from riparian forest canopies into the stream are an important source of nutrients and habitat.

RW = 3 to 10 m

¹Synopsis of recommended width (RW) values reported in the literature, a few wildlife species require much wider riparian corridors.

It is evident from the table that riparian buffer strip widths vary between functional objectives and vary within each function, depending on existing site conditions (topography, wildlife, and hydrology). However, in all cases, buffers wider than 10m should be promoted for optimizing a range of multiple objectives for water quality protection, stability, and habitat functions. Widths of 100m or more however, are usually needed to ensure values related to wildlife

habitat, and use as migration corridors (Fisher & Fischenich 2000). For recreational use within buffer strips, widths should be increased depending on the type of activity envisioned.

4.3 Riparian Buffer Lengths

According to Weller et al. (1998), long, continuous riparian buffer strips are encouraged rather than fragmented strips of greater width. In addition, unfragmented buffer strips are more effective at protecting water quality and for providing movement corridors for wildlife.

4.4 Riparian Buffer Zones

Several sources recommend a three-zone riparian buffer system approach in order to maximize the benefits of riparian buffers. (Bentrup & Hoag 1998; Berchtold et al. 1998; Connecticut River Joint Commission 2000; Fisher & Fischenich 2000). The most effective riparian buffers are comprised of three zones:

- *Streamside*: located from the high water line to the top of bank. This zone functions to protect the riverbank from erosion and provides habitat for both aquatic and terrestrial wildlife.
- *Middle Zone*: located inland from the top of bank. Width depends on the size of the existing site conditions (topography, wildlife, hydrology). This zone functions to protect water quality and provide wildlife habitat.
- *Outer Zone*: located upland from the middle zone, usually to the nearest permanent structure.

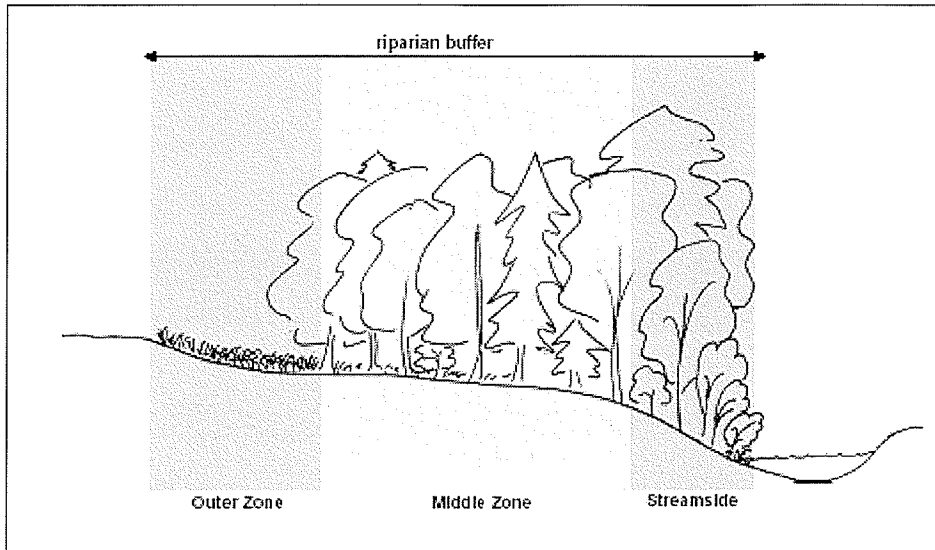


Figure 4.4.1: The three-zone riparian buffer system (Connecticut River Joint Commission 2000).

The description above can serve as a general guide to planning a riparian buffer, altered according to functional objectives and site conditions.

4.5 Urban Riparian Buffers

Riparian forests have been significantly modified over time as a result of continuous urban development of riparian habitat (Moffat 2002). Runoff from parking lots, roads, and lawns picks up heavy metals, toxins, litter, sediment, fertilizers, pesticides and other pollutants and carries them into streams. Removal of riverbank vegetation for land development and the use of riprap have reduced the ability of streams to cleanse themselves. Development has increased the amount of impervious surfaces such as roads, sidewalks, and parking lots increasing the risk of flooding (Connecticut River Joint Commission 2000).

Riparian buffers can counterbalance the negative effects of development, benefit public health, and bring beauty and enjoyment to a city. The three-zone riparian buffer system can be applied to urban areas as well. The most effective urban riparian buffers are those in which each zone serves a different purpose, and different uses are allowed in each zone (Bentrop & Hoag 1998; Berchtold et al. 1998; Connecticut River Joint Commission 2000; Fisher & Fischenich 2000). A general description of an urban riparian buffer is as follows:

- *Streamside*: located from the high water line to the top of bank and includes undisturbed forest along the riverbank. This zone functions to protect the riverbank from erosion, shade the stream, and provides habitat and food for terrestrial and aquatic organisms.
- *Middle Zone*: located inland from the top of bank. Width depends on the size of the existing site conditions (topography, wildlife, hydrology). This zone functions to protect water quality by removing pollutants from stormwater through filtering, denitrification, and plant uptake, and provides wildlife habitat. This zone is a strip of managed forest where some recreational uses such as pathways, may occur.
- *Outer Zone*: located upland from the middle zone, usually to the nearest permanent structure. The outer zone functions to help filter sediment from surface runoff. This zone is farthest from the stream and thus would allow for more uses.

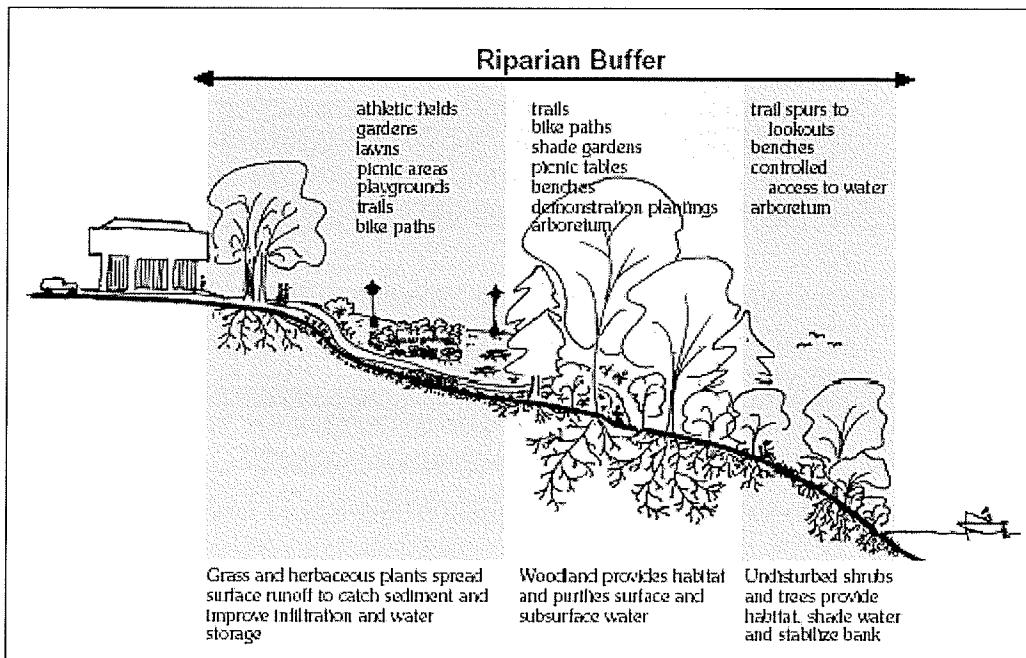


Figure 4.5.1: The three-zone urban riparian buffer system approach (Connecticut River Joint Commission 2000).

4.6 Planting Riparian Buffers

Revegetation

In order to reestablish or widen an existing riparian buffer, there are two main ways of establishing vegetation: natural revegetation or active revegetation. Natural revegetation involves creating a no-mow zone to allow pioneer species present in the area's seed bank to germinate and grow (Naturalist Services Branch 1999; Connecticut River Joint Commission 2000). Eventually, plants may be added and non-native plants can be removed. This method is less time-consuming and labour intensive and overall costs are reduced. Active revegetation involves establishing cuttings and/or nursery stock. This method allows for quicker results however, it is labour intensive and costly (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Plant Selection

In selecting appropriate vegetation for the riparian buffer, native plants that are well adapted to the environment will be the most successful (Fisher & Fischenich 2000). Native vegetation also requires less maintenance than non-native plants in addition, they are able to support native insects, birds, and wildlife (Connecticut River Joint Commission 2000). When selecting plants, it is recommended that a diversity of species be chosen to provide a more diverse habitat and visual appeal, as well as selecting age-diverse plants for a more 'natural' appearance (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Site Preparation & Planting

Prior to planting, invasive and aggressive species should be removed. Mechanical control is encouraged in riparian zones as chemicals can leach into the water system easily (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000). When planting, avoid the use of heavy machinery near the riverbank. Arrange plants in a random fashion rather than in straight lines for a more natural appearance. When planting cuttings or live posts, drive them deeply into the soil, allowing a foot or so to remain. For rooted plants, prune any large damaged roots before planting. Set plant in a hole 2-3 times wide but only as deep as the root ball. Fill in the hole gently but firmly with the original soil, watering to settle the soil. Plant understory species later, once the tree and shrub strata have been established, as most do not tolerate full sun. Water plants regularly during the establishment period. Mulching can be used to limit surface erosion, suppress competitive weeds, and retain soil moisture. Weed blankets can also be used beneath the mulch for extra protection. Fencing can be used to control grazing, mechanical equipment, recreationists and vandals. Chicken wire or stucco

wire can be used to prevent small mammals from girdling saplings, and beaver activity (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Maintenance

Maintenance activities include monitoring for stressed or failed plants, invasive species, weed competition, browsing, erosion, and debris accumulation. Leave vegetation undisturbed along the riverbank unless it presents itself as a hazard. For larger rivers, remove a large leaning tree only if it threatens to destroy part of the riverbank, if it falls. For smaller streams, leave such trees undisturbed as it provides fish habitat and cover, unless it threatens to cause flooding. Leave leaf litter and undergrowth undisturbed in the streamside zone and as much as possible in the middle zone (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

4.7 Recreation Planning

If recreational use is allowable in riparian buffer zones, keep recreationists on the trails and paths by establishing well-defined trails. Marker posts, boulders, signs, and fences should be used to direct traffic. Trails should run across a slope rather than down a slope to avoid creating runoff and erosion problems (Flink et al. 2001). A common mistake is to run a bike path adjacent to a river, which can result in an open 'swath', rather than a closed tree canopy. It is recommended instead to locate bike paths at a slight distance, with spurs to the river (Connecticut River Joint Commission 2000). Sensitive areas should be designated for low impact use rather than high impact use such as biking or horseback riding. Where vegetation is not fully established or rare, access should be restricted. In high traffic areas, trail surfaces should be firm however not impervious. Pet owners should be encouraged to avoid walking their pets in areas where droppings could wash into the river, and be reminded to pick up after their pets (Flink et al. 2001).

4.8 Managing Riparian Buffers

In order to manage riparian buffers, the Connecticut River Joint Commission (2001) suggests inspecting buffers regularly. Dumping, filling, and construction machinery should be excluded to protect damage to soils and vegetation. Cutting should occur only to trees that threaten to

pull the riverbank with them if they fall, but their root systems should be left to hold the bank in place. Tree snags should be removed from a stream channel only when it presents a flood hazard. Avoid raking leaves, clearing brush, and removing fallen logs to decrease runoff and to provide habitat for wildlife, particularly small mammals. If necessary, concentrate 'tidying up' efforts to highly visible areas. Exotic plant species should be identified and controlled as they can quickly spread and choke out native riparian plants. Public education focusing on the value and function of buffers should be adopted through signage, educational brochures, newsletters and field demonstrations to promote proper site-use and to prevent encroachment of development.

4.9 Costs and Benefits

The following describes the various costs and benefits involved in adding a riparian buffer in an urban setting (Connecticut River Joint Commission 2000):

Costs:

- Correction of compacted soil or other soil problems
- Plant material: Use cuttings or bare root plants from a native source; nursery stock are reliable but more expensive
- Mulch
- Labour in planting, pruning, sediment removal and maintenance
- Signage and fencing to guide public use, if appropriate
- Monitoring for signs of erosion and plant damage
- Cost of administering the buffer program
- Land acquisition, if applicable

Benefits:

- Reduced cost for mowing and maintaining
- Reduced cost for fertilizers, herbicides, fuel and equipment maintenance
- Avoided costs of engineering design, permits and bank stabilization
- Public land: recreation area and activities within buffer and waterfront access
- Flood protection
- Improved ambient air temperature and quality
- Visual screen and noise buffer
- Preserve important, valuable habitat
- Increased property value

The start-up costs of designing and implementing a riparian buffer may prove high initially however, the long-term benefits of riparian buffers greatly outweigh the initial costs.

Conclusion

This chapter revealed various guidelines and approaches to riparian buffer planning, design and implementation. Riparian buffers are among the best means for protecting rivers and streams and all that which lives within and adjacent to. In an urban environment, such a natural amenity is key to the quality of life of its citizens. Now, more than ever, riverfront lands are needed to protect the waterway from land-based pollution and to provide a place to recreate.

Chapter 5: *Design Precedents*

Chapter 5

Design Precedents

This chapter explores various projects where planning, design, or management strategies and recommendations have been proposed or implemented in order to minimize the ecological and/or social impacts of outdoor recreation in vulnerable landscapes.

The Wissahickon Riparian Restoration Trail Link – Philadelphia, Pennsylvania

The University of Pennsylvania's Morris Arboretum received a \$150,000 grant from the William Penn Foundation to coordinate and support a feasibility study, and to create a master plan for a multi-use path and riparian restoration along the Wissahickon Creek corridor between Fairmount Park in Philadelphia County and Fort Washington State Park in Montgomery County. Andropogon Associates Ltd., Cahill Associates, and Campbell Thomas & Co., were contracted by the Morris Arboretum for design, environmental consulting, and trail consulting services. In 1998, the feasibility study and master plan were completed.

The *Wissahickon Riparian Restoration and Trail Link Master Plan* is a set of conceptual and specific recommendations for the design and installation of a riparian restoration and trail link system.

“The vision of the Wissahickon Riparian Restoration and Trail Link project is to design a scheme for shared use in the project corridor that provides for recreation, education and enjoyment of the local community while preserving and enhancing the river corridor’s protective and nurturing role for plants and animals” (The *Wissahickon Riparian Restoration Trail Link Master Plan* 1998).

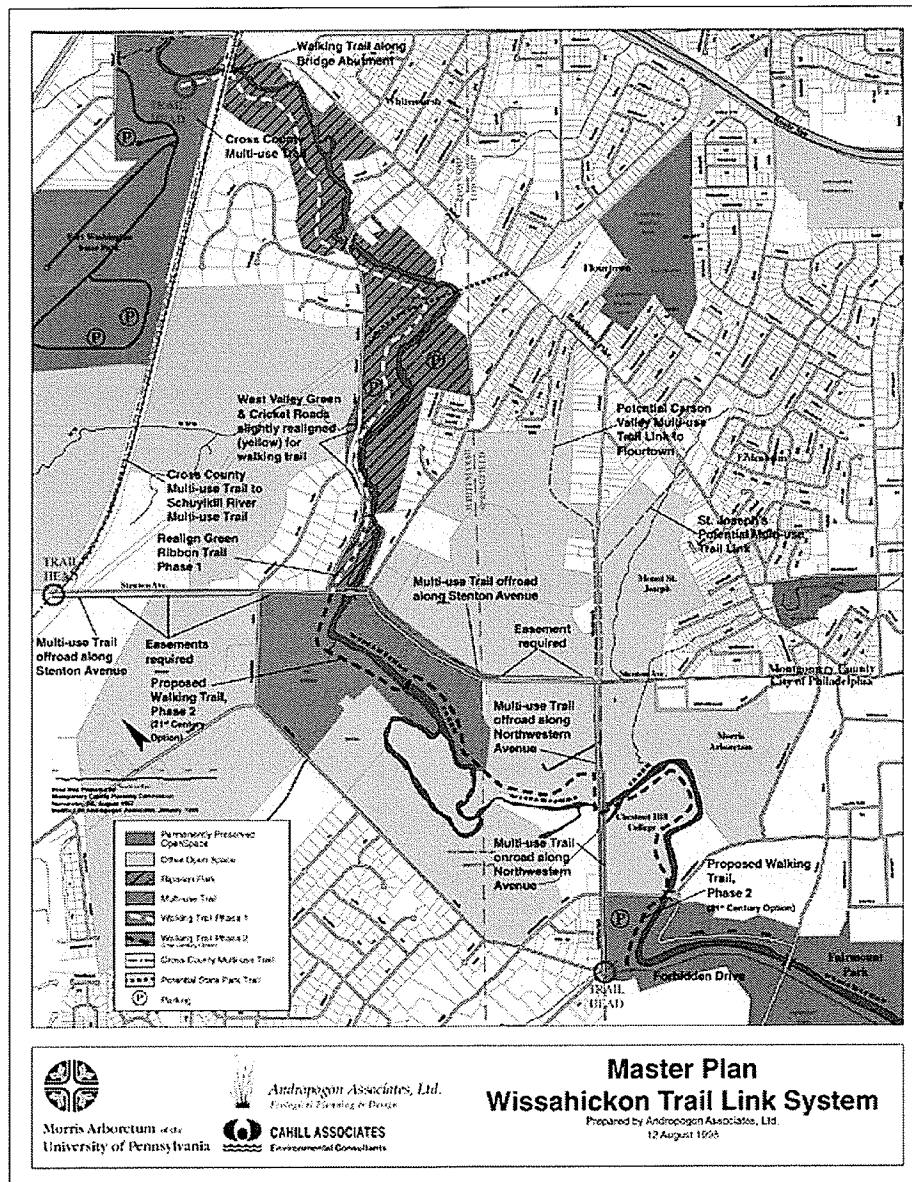
The Proposed Trail System

Three design guidelines for the trail system emerged from planning discussions:

- Provide for different types of user groups and prevent conflicts
- Provide a walking trail in natural areas that serves recreation needs that are consistent with the conservation of existing habitat
- Provide a wider hard-surfaced trail for recreational travelers and multiple uses outside of sensitive natural areas

These guidelines are based on the fact that different users have different needs and expectations, that no single trail or trail type can meet all recreational activities and their requirements successfully, and that the landscape is not suited to all potential users. The County and State lands adjacent to the Wissahickon Creek are viewed as irreplaceable and valuable habitat and of primary importance in sustaining water-related resources. Only recreational uses that are consistent with its value as a natural resource are deemed suitable.

The proposed trail system is composed of two trails: a *Multi-use Trail* along Northwestern and Stenton Avenues and a *Walking Trail* along the Wissahickon Creek. The conceptual design is customized to the unique conditions of the Wissahickon Creek riparian corridor.



The Walking Trail
The existing path along the Wissahickon Creek was too close to the water source in many locations and trail relocation was suggested in order to reduce negative impacts on stream bank stability. Bicycles were not permitted on the Walking Trail and were diverted to the Multi-use Trail. Where access to

Wissahickon Creek was desired, it was recommended that the soil surface be reinforced to handle excessive foot traffic without damage. Stepping stone trails, boardwalks over wet areas, fishing platforms, overlooks and rest areas were considered in order to allow opportunities for visitors to enjoy the water's edge. The following guidelines for the Walking Trail were developed:

- Limit use to pedestrians
- Relocate existing paths where damage has occurred
- Reinforce and manage streamside access
- Integrate environmental education, habitat restoration and recreation

The Multi-use Trail

The Multi-use Trail will provide connections with specific destinations and journeys incorporating a variety of experiences from share-the-road to off-road and will provide a scenic, cultural and pastoral journey. Trail surfaces for the Multi-use Trail include asphalt or porous asphalt paving designed to accommodate bicycles and meet the current guidelines for universal access for multi-purpose trails. The Multi-use Trail traverses the Wissahickon Creek twice allowing views of the Creek, however access is limited within the riparian corridor.

Blue Ridge Parkway – North Carolina

The Blue Ridge Parkway in North Carolina extends between Shenandoah National Park and the Great Smoky Mountains National Park, a distance of 469 miles. Construction began in 1935 and was completed 52 years later in 1987. The main intention of the Blue Ridge Parkway is to conserve, interpret, and exhibit the unique natural and cultural resources of the central and southern Appalachian Mountains, as well as provide for leisure motor travel through a variety of environments. The Parkway's varied topography and numerous vista points offer easy public access to spectacular views of the southern Appalachian rural landscapes and forested mountains. The Parkway's uninterrupted corridor facilitates the protection of a diverse range of flora and fauna including rare and endangered plant and animal species and areas designated as national natural landmarks (National Park Service 2003).

Craggy Pinnacle, a popular vista point along the Blue Ridge Parkway, offers spectacular views of the surrounding mountain range.

“Visitors hike a half-mile-long trail to the summit where they can enjoy panoramic vistas framed by numerous rock outcrops that encircle the peak. These outcrops enhance visitor experiences by offering extensive views, privacy, flat ledges for informal seating, and intriguing places to explore. They also harbour six rare or endangered species that account for nearly 90 percent of the vascular plant coverage on the rock outcrops” (Johnson 1989).

Visitor use of the area over the years, unchecked, has led to a network of informal trails converging, along with the official trail, toward the summit, where trampling of rare vegetation is problematic. The National Park Service conducted a preliminary inventory consisting of surveying visitor use and the distribution of rare plants. Results from the survey showed that frequency of visitor use was as high as 484 people per day during the height of the fall season and that as many as 50 % of those users arrived at the summit by unofficial trails. The vegetation survey showed that conditions ranged from areas relatively untouched to areas completely degraded where up to a foot of soil had been eroded, exposing bare rock (Johnson 1989b).

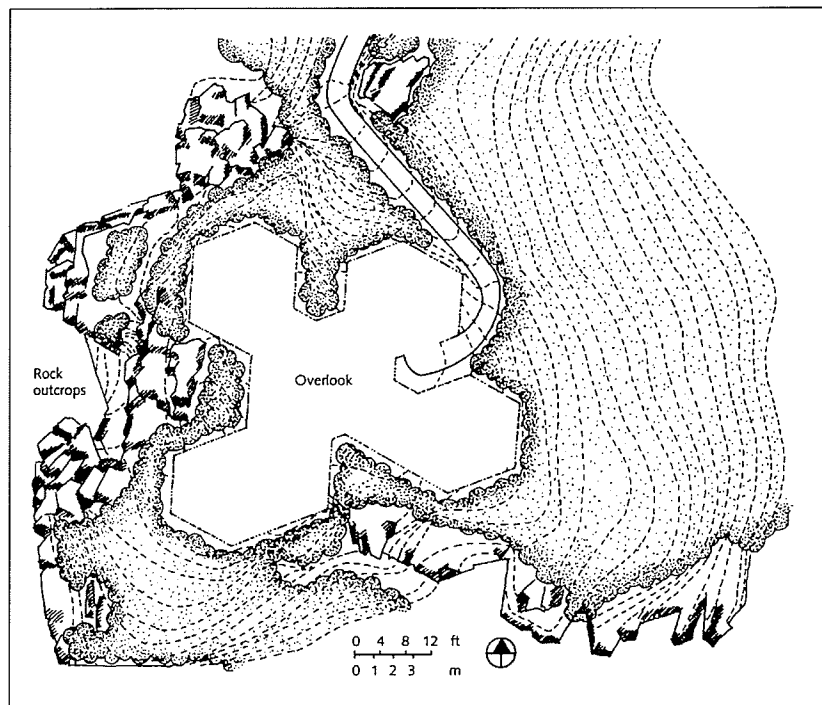
Preliminary efforts to close the informal trails with brush proved unsuccessful. Brush barriers were either destroyed or rendered ineffective. When signage, informing trail-users of the area’s fragile habitat were incorporated, barriers proved successful. Managers concluded that:

“The small interpretive signs were critical to keeping people on official trails, but that signs and brush barriers were still only a partial solution to the problem” (Johnson 1989c).

The design of an overlook platform for Craggy Pinnacle was determined to be necessary in order to concentrate use in a designated area, protect rare plants from trampling, and provide an attractive place for visitors to view the surroundings. Educational material, such as interpretive signage, was provided to inform visitors of the fragility of the site and to encourage visitors to stay within the designated areas (Johnson 1989). With visitor behaviour

under control, and the underlying cause of the problem solved, the final step involved reestablishing the damaged plant communities.

“Craggy Pinnacle offers a number of important lessons for greenway design and management. This example shows how site research and experimentation can be used effectively to identify and respond to the specific underlying problems facing the area. In this case, both visitor behaviour and environmental conditions were analyzed to help identify the root cause of the problems” (Cole 1993).



(Cole 1993)

Cole (1993) recommends using a combination of management strategies and actions when problem-solving. In the case of Craggy Pinnacle, a number of strategies were employed as part of the overall solution:

- Visitor use was concentrated in a smaller area
- Vulnerable sites were shielded from visitor use
- Sensitive areas were closed with barriers

- Education and interpretation were used to change or influence negative visitor behaviour
- Degraded areas were rehabilitated

Conclusion

In situations in which the ultimate goal is to provide recreational opportunities and to conserve natural resources, the key is to understand the recreational trail-users, their impacts, and the sensitivity of the resource at hand. The precedents outlined in this chapter provide useful recommendations and methods that can be drawn upon for the design and management of the Assiniboine Park riparian forest. These include:

- Providing for different types of user groups to prevent conflict
- Providing a walking, lower impact, trail in natural areas that allows for recreational activities that are consistent with the habitat conservation objectives of the site
- Providing another trail for higher impact recreational activities away from sensitive areas
- Using education and interpretation to encourage proper use and behaviour

Chapter 6: *Site Analysis*

Chapter 6

Site Inventory & Analysis

The Assiniboine River is a main tributary of the Red River (Baracos & Kingerski 1998). It flows southeast from its source in Saskatchewan towards Virden, Manitoba through to Portage la Prairie and into Winnipeg where it joins with the Red River. Winnipeg's Assiniboine Park is located west of the City centre on the south bank of the Assiniboine River. Park Boulevard borders Assiniboine Park on the east, and Corydon Avenue border it on the south. A pedestrian footbridge from Portage Avenue allows access from the north side.

6.1 Site Research

Site Location

The Assiniboine Park riparian forest is located within Assiniboine Park on the south bank of the Assiniboine River. It stretches along the Assiniboine River for approximately 2.3 km (Figure 6.1.1). The Assiniboine Park riparian forest is bordered by the Assiniboine River on one side and a paved bicycle path on the other. Beyond the bicycle path is the main thoroughfare, Assiniboine Park Drive, and the Assiniboine Park itself with its vast open recreational spaces and shade trees.

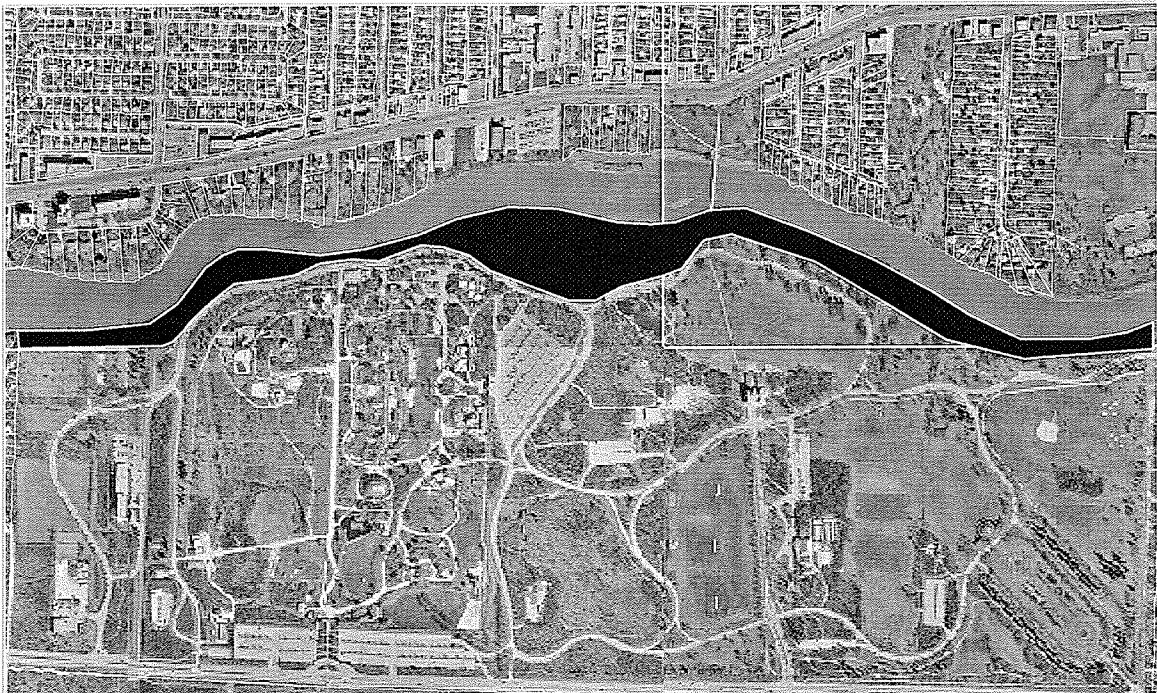


Figure 6.1.1: The Assiniboine Park riparian forest.

Geology

Bedrock formations underlying the Winnipeg region include rock types from the Mesozoic era to the Precambrian, with the dominant rock types of the Paleozoic era (Michalyna et al. 1975). Rocks of the Paleozoic era are mainly those of the Ordovician, Silurian and Devonian periods and are comprised of limestones and dolostones with small quantities of shales, sandstones and precipitates or evaporites. The rocks of the Mesozoic era include formations of the Jurassic and Cretaceous periods and are predominantly shales embedded with layers of sandstones, limestones and evaporites (Ehrlich et al. 1953).

The geology of the Assiniboine Park riparian forest area is attributed to the glacial history of the region. Approximately 12,000 years ago during the last retreat of the continental glacier, Lake Agassiz formed (Figure 6.1.2). It covered a significant portion of Manitoba and northwestern Ontario extending westward into Saskatchewan and southward into the northern United States (Krenz & Leitch 1993).

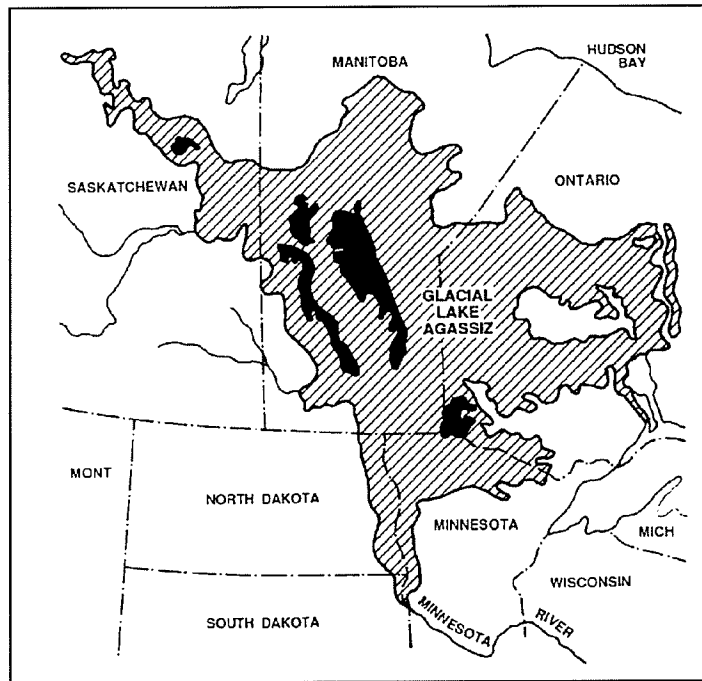


Figure 6.1.2: Glacial Lake Agassiz (Krenz & Leitch 1993).

From the time of glacial melting in the Pleistocene period, glacial drift or till, was modified by geological forces to produce diverse textural types of parent material (Ehrlich et al. 1953). Coarse fragments such as boulders, cobbles, gravel and stones were deposited along the

shoreline of the Lake Agassiz, whereas, finer sediments such as sand, silt and clay were transported and deposited on the lake bottom (Michalyna et al. 1975).

Winnipeg's glacial lake deposits vary in composition from predominantly clay to silty clay to predominantly silt (Baracos & Kingerski 1998). However, post-glacial river flooding, deposition and erosion, in conjunction with vegetation growth and human activity have consequently modified the surface of Lake Agassiz sediments within Winnipeg. Near-surface deposits are thus complex, and the highly plastic silty clay and clay in the upper zone of Lake Agassiz sediment have developed a "nuggety" structure from repeated shrinking and swelling activities associated with freezing and thawing. This upper zone has been defined as the Complex Zone Unit and typically extends 3m in depth. Below, homogenous glacial lake sediment extends to the till and has been called the Silty Clay Unit, which is approximately 9-12m in thickness. These two units, including another Complex Area along rivers and creeks, essentially underlie the entire city of Winnipeg (Baracos & Kingerski 1998).

Topography

The topography of the study area consists of the three zones typical of riparian forests: the riverbank, floodplain and terrace (Figure 1.1.1). During spring flooding, the rapid waters of the Assiniboine River erode and deposit sediment along its banks, constantly reshaping the land creating a system of river terraces (Briggs et al. 1993; Reilly 2000). The east side of the Assiniboine Park footbridge is characteristic of riverbank and floodplain zones. Elevation ranges from 217.5 m at the river's edge to 230.0 m at the forest's edge and paved bicycle path (Airquest Resource Surveys 1984). The average slope for the east side is 36.2% with a minimum slope of 18.9% closer to the footbridge and a maximum slope of 78.1% further east towards Park Boulevard. The west side of the Assiniboine Park footbridge is an area not prone to flooding and thus is characteristic of upland areas. Elevation ranges from 217.5 m at the river's edge to 232.0 m at the forest's edge and paved bicycle path (Airquest Resource Surveys 1984). The average slope is 47.3% with a maximum slope of 80.6% closer to the footbridge and a minimum slope of 19.6% approaching the western limits of the Assiniboine Park.

Soil

The soils of the Assiniboine Park riparian forest belong to the Riverdale Association. Riverdale soils are juvenile alluvial soils found on the terraces and floodplains along Winnipeg's rivers and their tributaries. These soils are recent alluvial deposits formed as a result of stream overflow. They are characterized by poor soil-horizon development composed of a thin leaf mat and layers of alluvial deposits varying in thickness and texture ranging from fine sandy loam to silty clay. Riverdale soils are a grayish brown colour in the upper portion of the profile, and slightly darker and sometimes iron-stained in the lower portion. These soils are highly fertile and can support dense deciduous forests comprised of elm, ash, aspen, cottonwood, basswood, Manitoba maple, and willow (Ehrlich et al. 1953).

St. Norbert Clays, which form part of the Red River Association of Blackearth Zone soils, are found primarily in the upland areas along the Assiniboine River. These soils are not regularly flooded and are moderately to highly fertile, supporting such species as oak, aspen, hazel, Saskatoon, and dogwood. St. Norbert Clays are well drained and better developed than Riverdale soils (Ehrlich et al. 1953).

The Riverdale soils of the Assiniboine Park riparian forest are subject to the impacts associated with heavy recreational use. Fabbri and Jurkow (1997) found a high percentage of bare ground in the floodplain region of the Assiniboine Park riparian forest, east side of the Assiniboine Park footbridge. Soils found along recreational trails in this area were 'cement-like' in character. Manning (1979) states that once trampling has removed leaf litter and organic matter, compaction of soils occurs. Compaction decreases soil porosity and thus decreases air and water permeability resulting in an increase in runoff and erosion (Lanehart 1998). During periods of spring flooding, the Assiniboine Park riparian trails become extremely wet and muddy (Fabbri & Jurkow 1997). Rutting and pitting occurs along these trails as a consequence of bicycle-tire treads eroding the wet surfaces of the clayey soils (Figures 6.1.3 and 6.1.4). When recreationists avoid these ruts and wet spots, further trampling of vegetation occurs and the trails become wider. In addition, users may create other temporary routes in order to avoid wet areas. As a result, an extensive network of braided trails or 'monkey trails' occurs throughout the riparian zone as observed at the Assiniboine Park riparian forest.