

BEACHES AND SAND DUNES IN
GRAND BEACH PROVINCIAL PARK,
MANITOBA: DEVELOPMENT OF
MANAGEMENT GUIDELINES TO
ENSURE LONG-TERM ECOLOGICAL
SUSTAINABILITY

by

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ABSTRACT

The purpose of this study was to develop management guidelines to ensure long term ecological sustainability of the beach and sand dune area of Grand Beach Provincial Park. A qualitative approach was taken including interviews of individuals who use Grand Beach. A literature review was completed describing the history of use at Grand Beach Provincial Park, ecological processes specific to the park, and management guidelines in other jurisdictions in Canada with similar natural features. Aerial imagery provided a temporal look at intensely used areas in the park.

Recommendations include: 1) completion of a biophysical study of the park including an inventory of flora and fauna species 2) development of a monitoring plan incorporating the natural environment with the human dimension of the park 3) engagement of park visitors through signage, education and awareness, and 4) engage the scientific community to form partnerships for further research studies in the park.

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CHAPTER ONE: INTRODUCTION

1.1 Preamble

Manitoba Conservation developed the Management Plan for Grand Beach Provincial Park (Manitoba Conservation 2002). The plan identifies the need to “document the natural processes that maintain and replenish the beach and sand dunes at Grand Beach” as well as the need to develop an approach to the management of the beaches and sand dunes.

This research explored the ecological processes that led to the creation of the beaches and sand dunes, assessed the ecological change over the past 50 years while linking human use and impact of that change, and surveyed the biota of these habitats to ensure long-term ecological sustainability.

1.2 Background

Recreational use in Grand Beach Provincial Park is popular in Manitoba and has been steadily rising. The park serves a wide range of park users including local cottage owners (there are 517 cottages within the park boundaries (Manitoba Conservation, 2002)), beach users,



Photo 1: Recreational use on Grand Beach (A. Demski 2007)

surrounding landowners, and the larger urban and rural communities. The usability by and access of the public to the park are important public agenda items in Manitoba, and maintaining the quality of ecological elements is vital. The beach and sand dune complex are areas of intense recreational use during the summer months. It is important to the local and surrounding communities to know if the beaches and dunes are being adversely affected, and if so, how they can be managed in a more sustainable fashion.

Freshwater beach and dune systems – including Grand Beach Provincial Park - represent only a small fraction of Manitoba's natural landscape; however these sites often attract large numbers of people for recreation, particularly in the summer months. Any given freshwater beach and dune system is extremely sensitive to many kinds of impacts. Several studies have concluded that this type of landscape is highly susceptible to recreational uses, and the ability of a small area to accommodate a large number of people is limited (Kutiel and others 1999). Sand dune areas are also extremely susceptible to wind erosion and vegetation damage. Once the vegetation is disturbed, generally by human causes, the sand dunes are then exposed to a higher level of wind erosion (Peach 2004).

Dune movement in a sand dune system may be continuous. However, vegetation and other obstacles, either natural or human-made, may slow or impede them. The beach and associated sand dune system is fragile. Several processes interact with a beach and sand dune environment: wind processes, hydrological processes, vegetation, wildlife and sand supply. These factors may alter dune growth or destroy them altogether (Davies 1980).

Many beach ecosystems have been altered based on human needs. Sometimes the alteration of the landscape is intentional where the environment is considered less desirable. At times the change is unintentional, as excessive use of the beach environment creates disturbances in the sand accumulation and natural vegetation in the dunes are trampled (Pye 1990). Areas considered to have excessive human traffic should have proper management strategies to preserve the landscape as much as possible. The education of beach visitors about the

sensitivity of the beach and sand dune environment may also help alleviate some of the potential stress being put on the landscape.

1.3 Study Area and Significance

The study area is located in the western edge of Grand Beach Provincial Park in Manitoba, approximately 90 minutes north of the provincial capital of Winnipeg (Figure 1). The park itself is approximately 25 km² in area with a three km stretch of white-sand beach. The sand dunes consist of very finely textured sand (silicon dioxide and other minerals) and are constantly shifting in the park. They can reach as high as 12 metres. The beach is divided into two areas, the West Beach and East Beach. The West Beach has more recreational use and development attracting thousands of visitors every summer. The East Beach is much quieter and less developed. Behind both of the beaches is a lagoon- a sheltered environment utilized for several water recreational sports. Grand Beach Provincial Park is classified as a natural park, a classification which preserves portions of a natural region, while at the same time accommodating various recreational activities and resource uses (Manitoba Conservation 2002).

Most of the beach ecosystems in Manitoba have yet to be studied or analyzed. It is difficult to determine if the sand dunes in Grand Beach Provincial Park are changing in a positive or negative fashion, or if they can be considered a stable environment.

The dunes and beaches at this park have as



Photo 2: Sand dunes on the East Beach (A. Demski 2007)

many as 50,000 visitors each year, mainly during the summer months, which may cause major stress to the system. However, the effects of this high seasonal use have not been determined at this time. Within the Grand Beach Management Plan, Manitoba Conservation has recognized that this environment needs to be carefully monitored and maintained. Implementation of the park management plan involves a study of the natural processes in the park, with an emphasis on the dune and beach system. Although the current management plan is relevant to this study, the main emphasis of this thesis research is to put the beaches and sand dunes of the park above any other management initiatives.

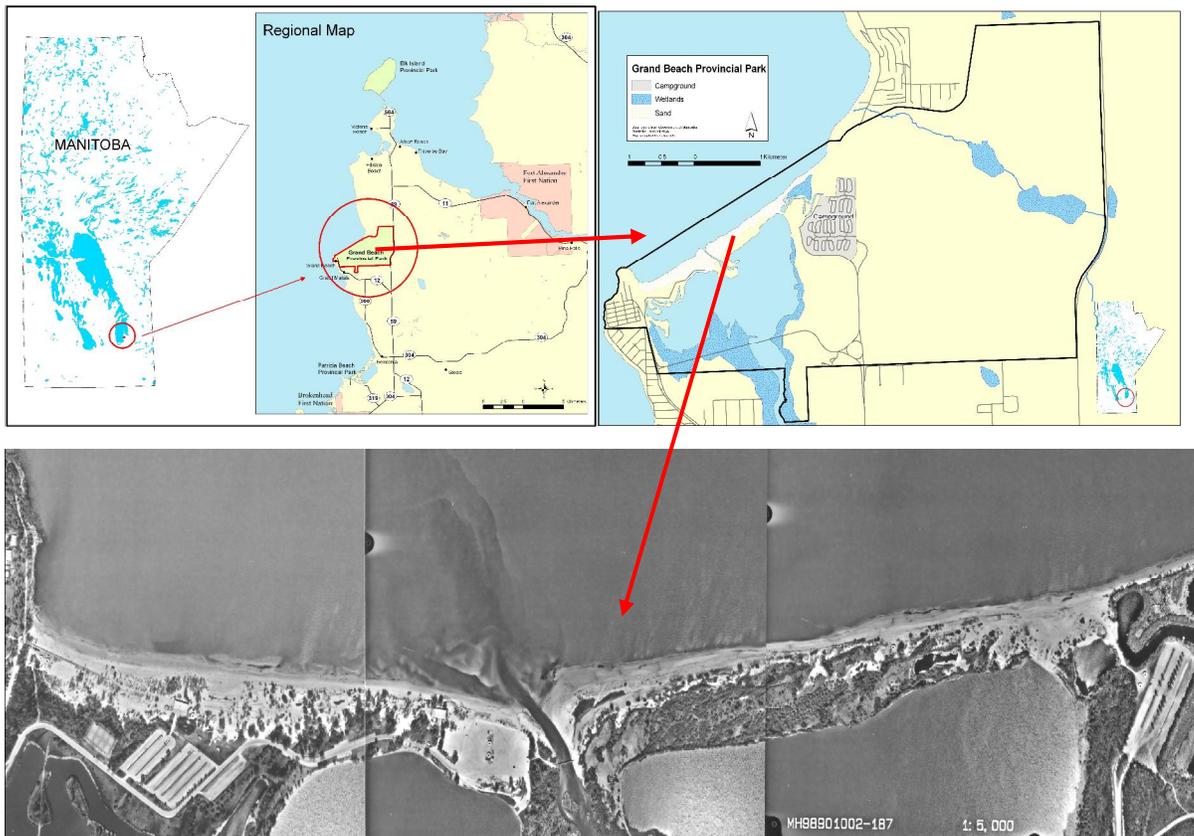


Figure 1: Grand Beach Provincial Park (Data layers & Aerial Photo from Government of Manitoba 2007)

1.4 Problem Statement

The Parks and Natural Areas Branch of Manitoba Conservation is responsible for Grand Beach Provincial Park and has developed a Grand Beach Provincial Park Management Plan. Within the Management Plan there is a recognized need to document the natural processes related to the beaches and sand dunes and to establish guidelines for recreational use that will ensure long term ecological sustainability. Questions that need to be answered are:

- i. What are the geological processes that led to the development of the beaches and sand dunes?
- ii. What are the physical ecological processes that occur over time and what are the rates of change of these processes over time?
- iii. To what extent has human use of the area contributed to ecological change over time?
- iv. What actions can be taken that will facilitate greater ecological sustainability of the beaches and sand dunes?

1.5 Purpose Statement

The purpose of this research was to develop management guidelines directed at long term ecological sustainability of the beaches and sand dunes in Grand Beach Provincial Park. This process in turn produced an understanding of the needs of visitors and local cottagers and how they use the beaches and sand dunes, provided a broad background of ecological processes, and led to an analysis of how the park is used via aerial photography.

1.6 Research Objectives

In order to generate management guidelines for the beaches and sand dunes in Grand Beach Provincial Park, the objectives of this study are:

1. To prepare an overview of the literature regarding processes associated with the ecological equilibrium and change with beaches and sand dunes in a Canadian lake setting.
2. To provide spatial analysis of past and current human use of the beaches and sand dunes at Grand Beach Provincial Park.
3. To evaluate park user perspectives regarding the long-term sustainability and biological integrity of the beaches and sand dunes in Grand Beach Provincial Park.

1.7 Research Design and Methods

The research design was based on a qualitative methods approach in order to achieve the above objectives. Data collection methods included: (1) semi-structured interviews involving individuals who use Grand Beach Provincial Park; these individuals consist of both cottagers and general park users; (2) a literature review designed to provide a background of the various ecological processes in the provincial park; and (3) aerial photograph interpretation focusing on areas that are intensely used by humans who visit the beach and dune area.

These methods will assist the researcher to develop guidelines and recommendations to ensure the ecological sustainability of the beaches and sand dunes of Grand Beach Provincial Park.

1.8 Thesis Organization

This thesis is organized into six chapters. Following an introductory chapter, Chapter Two reviews the relevant literature related to beaches and sand dunes from a management perspective, as well as a review of the geomorphological processes that operate in a beach environment. Chapter Three examines the methods used to fulfill the research objectives, while Chapter Four analyzes the data collected. Chapter Five discusses the previous chapters' methods and analyses. The thesis then concludes with Chapter Six which summarizes the project, derives conclusions, and provides recommendations for the future sustainability of the beaches and sand dunes in Grand Beach Provincial Park.

CHAPTER TWO: HUMAN USE, ECOLOGICAL PROCESSES AND ENVIRONMENTAL CHANGE AT GRAND BEACH PROVINCIAL PARK

2.1 Introduction

Chapter Two examined three main components related to the research project: the history of human use at Grand Beach Provincial Park, ecological processes specific to the park, and the environmental change associated with a beach environment on a northern lake and how those changes may be measured. This chapter also investigated other jurisdictions with similar beach and sand dune qualities along with their respective management guidelines. Conclusions regarding the current gaps in the literature associated with this project will follow.

2.2 A Brief History of the Use of Grand Beach

The first documented European sighting of the Grand Beach area was made by La Verendrye in the early 1700s. Although other explorers had visited Manitoba, La Verendrye was the first to establish trading posts around Lake Winnipeg; others carried on along the Saskatchewan River in the northern part of the lake. La Verendrye's sons travelled along the Winnipeg River and reached Lake Winnipeg in the 1730s. They went south to the Red River where they first discovered the Grand Beach area. In 1734 one of La Verendrye's oldest sons named the beach area "Grand Marais", which is "big marsh" in French (Eastern Manitoba Tourism Association 2007). They saw the area from the water while travelling to other trading posts, it is unknown whether they actually stopped in the Grand Beach region. Today Grand Marais is the name of the community just outside the park's west entrance.

There is no record of Aboriginal settlement directly associated to the Grand Beach area. Most settlements were at the mouths of rivers entering Lake Winnipeg. However, there was a large Métis community with a local fishery, and they mainly caught whitefish in the Grand Marais area in the mid 1800's (Tough 2000). Along with the Métis community was a group of homesteaders that settled behind the beach area (Lemoine & Barnfather 1978). Access into the beach area during this time was by boat or by rough trails, which generally flooded every year. It was not until the early 1900s that the recreation potential for the Grand Beach area was realized.



Photo 3: Catching the train at Grand Beach Station
(Photograph courtesy of the Canada Science and Technology, Ottawa)

The Canadian National Railway bought large portions of land in the early 1900's including the Grand Beach area. It was the first railway company to build tracks to Grand Beach, and the first resort in the area in 1916. Eventually "there were as many as 15 trains a day..., and even more reasons to attract

them: sun, sand, surf, boardwalks, roller coasters, and some of the finest dance halls in western Canada", as many as 40,000 people per day would ride the train to Grand Beach (Great Canadian Lakes 2007). By the 1930s permanent cottage communities were being built in the area. Until the 1950s there were several permanent features along the beach: a boardwalk, carousel, concession stands and Western Canada's largest dance hall. Now a full recreational area, local Aboriginals and Métis provided fish and berries to cottagers and visitors (Lemoine & Barnfather 1978).

By 1959, the Canadian National Railway decided to sell the land to the Manitoba provincial government (Grand Beach Cottage Owners Association 2007). Trains stopped travelling to Grand Beach, as the area became accessible by automobile. The park was established in 1961 (Manitoba Conservation 2002). Today more than 50,000 people visit to the beach during the summer months.

2.3 Provincial Parks Legislation in Manitoba

The first legislation for provincial parks in Manitoba was the *Provincial Park Lands Act*, passed in 1960. Its primary purpose was to help protect certain areas of the province and to provide recreational opportunities. A revision of this Act led to the new *Provincial Parks Act*, passed in 1993. Once the new Act was in place, the creation of a provincial park system plan was required. The purpose of the system plan was to identify the park boundary, classification and land use categories for each provincial park in Manitoba (Manitoba Environment 1995). The system plan did not, however, deal with individual park land issues; the management plan for each individual park held that responsibility, as described in section 11 of the *Provincial Parks Act* (Government of Manitoba 1993).

All provincial parks in Manitoba are classified using park classifications outlined in section 7(2) of the *Provincial Parks Act* (Government of Manitoba 1993). Park classifications identify the main purpose of a provincial park, be it to conserve natural lands, preserve natural and human heritage values, and provide outdoor recreation and education or a combination of these. Grand Beach Provincial Park, for example, is considered to be a natural park, with its main purpose to “both preserve areas of a natural region and to accommodate a diversity of recreational opportunities and resource uses...” (Manitoba Conservation 2002; Government

of Manitoba 1993). Other types of classifications allow for protection of wilderness areas (wilderness park classification), recreational opportunities (recreation park classification), and land preservation for historical purposes (heritage park classification) (Government of Manitoba 1993).

The *Provincial Parks Act* also requires that parks be categorized according to the main purpose of areas within the park, as outlined in the System Plan for Provincial Parks. Land use categories “identify areas in provincial parks that are protected from resource use, areas that will be available for resource use and areas to be managed for recreation and heritage values” (Government of Manitoba 1996). Each provincial park may have more than one land use category. Grand Beach Provincial Park has two land use categories: backcountry and recreational development (Figure 2). Within a backcountry land-use category, land is protected from logging, mining and hydro generation, and the entire area is generally

undisturbed and away from intensive recreational use. On the other hand, the main purpose of a recreational development land use category is to accommodate recreational development which

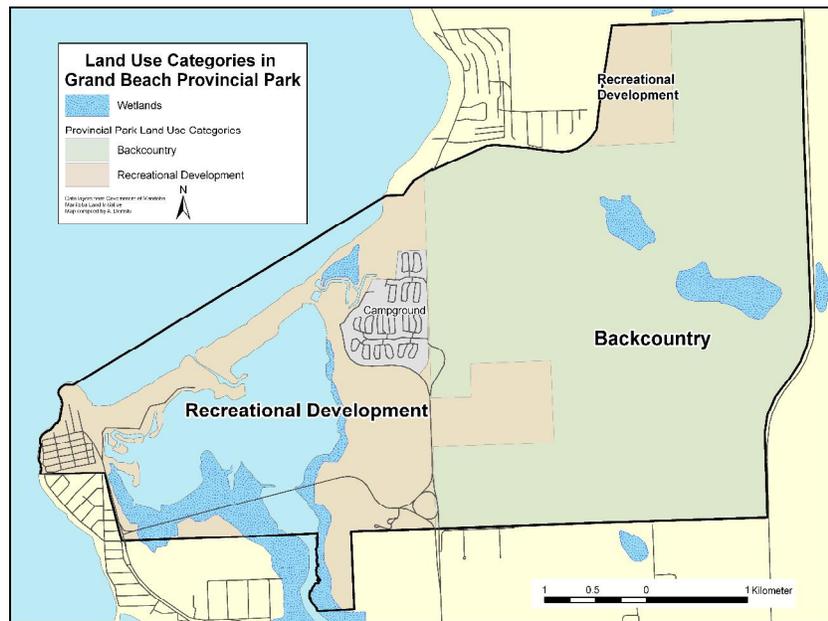


Figure 2: Land use categories in Grand Beach Provincial Park (Data layers from the Government of Manitoba 2007)

may include swimming, camping, cottages, roads and other human-based activities within the park (Manitoba Conservation 2002).

2.3.1 Grand Beach Provincial Park Management Plan

The Provincial Parks Act includes a requirement for the creation of a management plan for each provincial park. Within a management plan, zones and land use categories established in the provincial park will be described, along with a description of the park's natural recreational and human heritage values. Specific issues within each park are addressed, including resource protection, development, and recreational use (Government of Manitoba 1993). The process of developing a management plan will vary from park to park; however, public consultation is generally included in the early planning stages of the management plan. The consultation phase generally provides opportunities for the public to identify and address park issues, and is followed by the review of a draft management plan (Manitoba Conservation 2008). Once the draft is publicly reviewed necessary revisions are made, then approved for distribution. The Grand Beach Provincial Park Management Plan was finalized in 2002.

Grand Beach Provincial Park is one of seven provincial parks in Manitoba that have completed and approved management plans. The Grand Beach plan is divided into three sections: a background section, park management guidelines, and the implementation of those guidelines. The background section describes the natural features of the park, the recreational activities within the park, and the purpose of the park according to the land use categories found in the *Provincial Parks Act* (Manitoba Conservation 2002).

The guidelines portion of the management plan focuses on “specific issues identified during the management planning process” (Manitoba Conservation 2002). The issues identified in the plan include natural features, cultural resources and recreation. The natural features addressed are the natural landscape, beach and sand dunes, and the endangered wildlife including the Piping Plover. For each issue identified in the management plan there is a specific intent. For example, within the management plan, the intent for the beaches and sand dunes is “to preserve the beach and active sand-dune formations in the park by identifying and safeguarding the natural processes that maintain the beach/dune/lagoon environment”.

To make certain the intent is carried through, guidelines follow to ensure the various features in the park are preserved as best as possible. The main guideline for the beaches and sand dunes is to perform a study that will “document the natural processes that maintain and replenish the beach and sand dunes at Grand Beach” (Manitoba Conservation 2002). Until the report is completed, no new structures would be built, and every measure possible would be taken to protect the beaches and sand dunes.

The implementation section of the management plan explains how each of the guidelines can be fulfilled. Implementation is dependent on the operational work plan and budget of the park (Manitoba Conservation 2002). The following chapters will reference the Grand Beach Management Plan in more detail.

2.4 Ecological Processes Specific to Grand Beach Provincial Park

2.4.1 Geological Setting

The region of Grand Beach Provincial Park consists of Upper Ordovician (in the Paleozoic Era) rock structures that run along the southern exposed edge of the Precambrian Shield. It is located in the Western Canada Sedimentary Basin (Government of Manitoba 2007). Due to glaciation and inter-glaciation events in this area, there is no exposed bedrock found in the park. It was eroded away and buried during the glacial periods and ultimately supplied the surficial material found in the area today (Todd and others 1997).

The sand in Grand Beach Provincial Park and the surrounding area was formed and deposited by glacial, wind and wave actions during the last post-glacial period 14,000 – 10,000 years ago. When the Laurentide ice sheet began to recede northwards, an extensive ridge of sand and gravel was deposited by an ice advance from the northeast, which is aligned in a north-south fashion. Today this ridge can be found just west of Highway 59 and behind the lagoon area. When the ice sheet receded completely, it left behind glacial till “unsorted and unstratified material carried and laid down by glacial ice” (Trenhaile 2004). This glacial till was deposited in the area that is now the East and West beaches of Grand Beach Provincial Park.

Once the Laurentide ice sheet receded northwards, it fed the large Glacial Lake Agassiz that began to form to the south, approximately 11,700 years ago (Trenhaile 2004). The glacial till deposited by this ice sheet was then modified by the large lake. Throughout the history of Glacial Lake Agassiz, there were sudden and dramatic drops in the lake levels, creating higher lands, or beaches. The East and West beaches in Grand Beach Provincial Park were

originally created in this fashion (Parks Branch 1976). Lake Winnipeg is a remnant of Glacial Lake Agassiz, left behind approximately 8,000 years ago. The beach material today is finely textured sand which was deposited along the beaches of Lake Agassiz. W.F. Baird & Associates (2000) concluded that Grand Beach has one of the largest sand deposits in Manitoba “where volumes of sand are of the order of 5000 cubic feet per foot of shoreline” (460 cubic meters per metre), which would be an approximate depth at the shoreline of 3-4.5 meters.

The surficial geology within the park consists of various deposits from the changes to Lake Agassiz (Figure 3). The lagoon area consists of former Lake Agassiz shoreline sediments including sand and gravel deposits up to 2 meters thick (Government of Manitoba 2007). Toward the center of the park are glaciofluvial sediments, consisting of finer sand, clay, silt and small gravel (Government of Manitoba 2007). Other deposits include glaciolacustrine sediments, consisting also of sand and gravel. However, these deposits are much thicker, up to 20 meters thick in some areas of the park. These deposits were formed by waves around the shorelines of Lake Agassiz (Government of Manitoba 2007).

Along the eastern portion of the park boundary are organic deposits, which are generally wetland areas consisting of peat up to 5 meters thick (Government of Manitoba 2007).

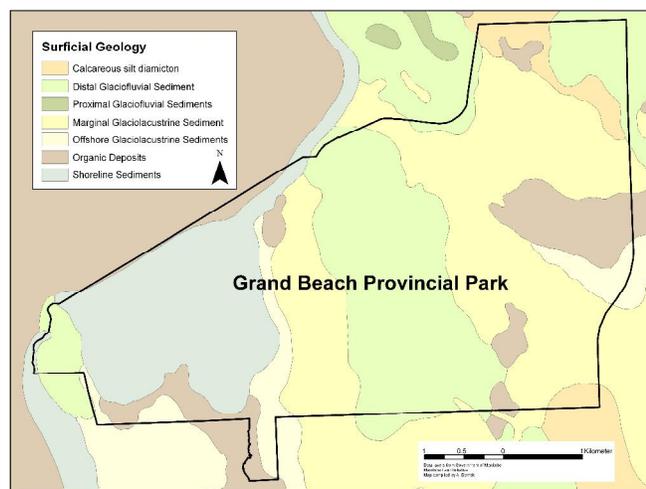


Figure 3: Surficial geological deposits in Grand Beach Provincial Park (Data layers from the Government of Manitoba 2007)

2.4.2 Sand Supply and Sand Transport

There have been several hypotheses about how the sand is supplied to the beach and sand dunes in the park. Generally speaking, storm waves bring sand from the lake bottom onto the beach, where the sand dries just above the normal shoreline. It is then carried and moved by the wind into the sand dune area behind the beach (Teller 2006; Goldsmith 1985).

Figure 4 shows how wind and water push the sand into the sand dune area of a beach. There are several factors involved in the formation of sand dunes, the two main ones being sand supply and wind. Other factors include vegetation and water-level fluctuations (Albert 2006). There must first be a large quantity of sand available as previously mentioned, there is an immense supply of sand in the Grand Beach area. Sand that is blown from a beach onto a sand dune is typically fine-grained. Since wind can transport smaller grains more easily than larger grains. The wind must be sufficiently strong to move the sand from the water level to the dune formation behind the shoreline (Davies 1980).

Longshore drift (or Littoral Drift), refers to the movement of sediment, or sand in the case of Grand Beach, in the littoral zone, the area closest to shore, in a parallel direction to the shore. There are several factors involved including wave height and duration, the angle of the wave as it approaches the shore, the size of the sand grains, sand supply and the shape of the shoreline (Cooper & Pilkey 2004).

The landward limit of the wave action depends on the strength of the wave, for example, during a storm event; waves will reach further up the beach compared to a calm day. When a wave approaches the shore, it is generally at an angle. The wave carries the sand in the same

direction it is moving, when the wave retreats, the sand then moves directly down the beach towards the water in the same direction of the beach slope (Easterbrook 1999). The result is the sand moving several centimeters along the beach with each wave. These small repetitious movements' results in the constant lateral shifting of sand along the shoreline. The stronger the wave action, the more movement will occur, waves that reach further onto shore during a storm event moves the sand further up the beach.

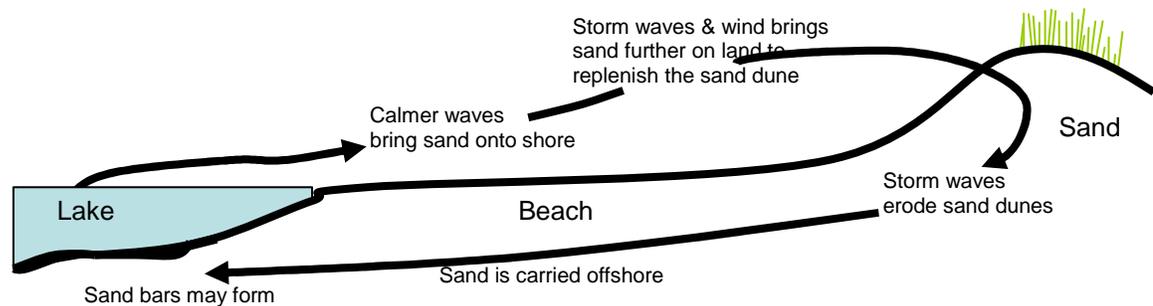


Figure 4: The Dune Cycle (Adapted from Peach 2004)

Water on the surface of a lake such as Lake Winnipeg will move in the direction of the wind, which is generally a northerly wind. The waves generated by strong northern winds are pushed into the southern portions of Lake Winnipeg, including Grand Beach. Water levels will temporarily increase above the still water levels, a phenomenon called wind set-up (Manitoba Conservation 2002; Manitoba Hydro 1991); this term can be used interchangeably with storm surge (W.F. Baird & Associates 2000). The wind and wave action generated push the sand from the beach area into the sand dunes behind the beaches. Wind set-up on Lake Winnipeg is generally higher in the fall months (Manitoba Hydro 1991). The wind rose shown in Figure 5 shows the accumulation of wind from October 2008 to June 2010. The strongest winds come from the north-northwest throughout the year, with the exception of the fall months of September and October when the dominant winds are coming from the

south-southwest. Wind speeds are uniform throughout the year, with a slight increase during the months of September to November (Wind Finder 2010). Wind-generated waves are the most important for sand transport along a shoreline such as Grand Beach.

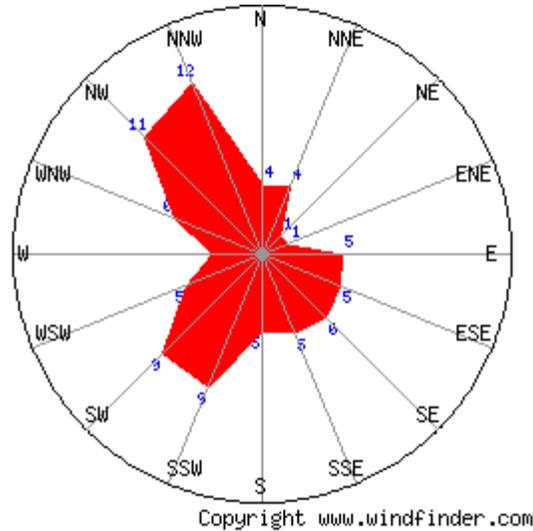


Figure 5: Wind Rose – Victoria Beach (Wind Finder 2010)

2.4.3 Dune Formation

Sand is moved from the beach after it has been pushed by wind and wave action from the water. After it has dried, it is carried further away from the shoreline. Dune formation can be

complex: there must be enough wind to push the sand into the proper position, but if winds are too strong, dunes can be



Photo 4: Blowout as seen on the West Beach (A. Demski 2007)

destroyed (Photo 2). If winds are not strong enough, the sand will not move to form a dune (Trenhaile 2004). The process of dune formation is cyclic in nature and considered to be a dynamic environment.

Generally, sand-dune formation occurs when the prevailing winds are the strongest, which in the case of Grand Beach is the fall season. Once ideal wind speeds are reached, sand is transported inland where it is “trapped” by vegetation, other objects, or weakening wind power. Once the sand has been trapped and begins to accumulate, dunes will start to form (Trenhaile 2004; Albert 2006).

Albert (2006) gives an adequate representation of the beach and dune area in Grand Beach Provincial Park (Figure 6). The beach gives way to the sand dune area, which is where the dune and beach meet, and is generally parallel to the shoreline. This area has a gentle windward slope and a steeper leeward slope (Hardaway and others 2001). Small grasses trap the sand and cause it to accumulate. Trees and shrubs find this environment too extreme to establish themselves effectively, but some larger species may exist on the leeward side of the foredunes (Albert 2006; Davies 1980). The movement of sand can be constant and dynamic in this foredune area (Hardaway and others 2001; Albert 2006; Davies 1980; Trenhaile 2004). The sand dunes along Grand Beach are considered to be in the foredune area. This is also the area where dune blowouts are likely to occur. This occurs when vegetation is removed and the sand becomes vulnerable to wind action. It can take years for a blowout area to recover and be re-vegetated.

Behind the foredune is a trough (Figure 6) which is common in many coastal dune areas, including the east side of Grand Beach. Other names for this area are interdunal wetlands and interdunal swales (Albert 2006). These areas will have fluctuating water levels related to weather events and lake levels. During a hot summer, this area would be virtually dry, whereas in the spring or wetter summers, standing water would exist.

Behind the sand dune area is a trough area (Figure 6). In the case of Grand Beach, a large lagoon lies behind the sand dune area, making it a barrier beach. The opening to the lagoon area separates the East and West beaches, and the beach and dunes protect the lagoon area from the wind and wave action of Lake Winnipeg.

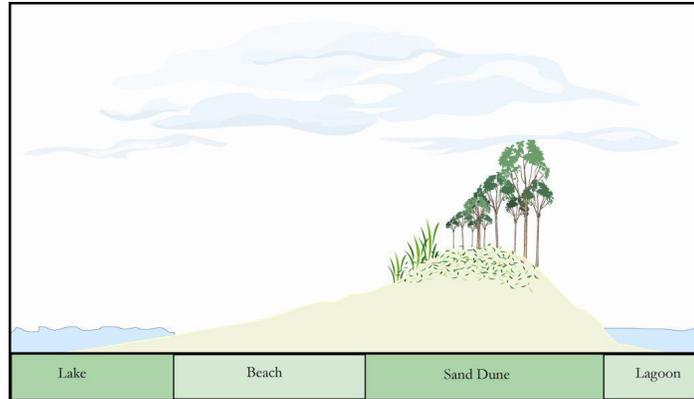


Figure 6: Beach Zones (Adapted from Albert 2006)

There is significant literature about beach and sand dune environments, with the main focus on coastal-based systems (Bird 2000; Davies 1980; Martinez, Psuty 2004; Nordstrom, Psuty & Carter 1990; Nordstrom 2000). Dune environments are defined in the same way for salt-water and fresh-water environments, but actual processes may vary. For example, beaches that are generated through tidal processes are mainly in salt-water coastal environments only.

2.4.4 Seasonal Influences on Sand Dunes

Similar to sand dunes found along the shores of the Great Lakes, the sand dunes found in Grand Beach Provincial Park are not altered by coastal influences. They are altered by seasonal changes in temperature, wind and precipitation which influence how sand is deposited and transported, as well as by the types of vegetation that are able to grow in the dunes (Davidson-Arnott and Law 1990)

Studies have been done in the past along the shores of the Great Lakes, where there are similar climate features to Grand Beach Provincial Park including hot humid summers and cold winters with precipitation occurring throughout all four seasons (Hansen and others 2009). Moisture is generally the highest in the spring and fall months (Ensign and others 2006). Two study sites along Lake Michigan showed sand deposition occurring the most throughout the winter months when winds were the strongest (Hansen and Others 2009). Vegetation and ice held the sand together throughout the winter. When the weather warms the tops of the sand dunes are heavy with sand accumulation and water, the sand then slumps down to the lower slopes of the sand dunes. Similar observations have been made in the winter months at Grand Beach. Snow and ice accumulate on the dunes in turn covering dune vegetation, generally in areas where the sand is more flat, leaving the slopes exposed.

2.4.5 Water Regime and Lake Winnipeg Water Regulation

Lake Winnipeg is the eleventh largest freshwater lake in the world (W.F. Baird & Associates 2000, Manitoba Hydro 1991). Compared to other lakes of this size, it is shallow with an average depth of 12 metres and a maximum depth of 36 metres located in the northern basin (Manitoba Water Stewardship 2005b). With strong northerly winds and a shallow basin, Lake Winnipeg water levels can fluctuate regularly and sometimes dramatically. “Since the earliest records were kept, inhabitants around the lake have been wrestling with the fluctuations in water levels and the patterns of erosion and have protected their shorelines with varying degrees of success” (Manitoba Hydro 1991). Today Lake Winnipeg is used as a large reservoir for generating hydroelectricity.

In 1966 Manitoba Hydro decided to use Lake Winnipeg as a natural reservoir while developing hydroelectric power from the Nelson River at the northern portion of the lake (Manitoba Hydro 1991). When the generating stations were completed in 1976, they regulated the level of the lake between 711 (216.7m) and 715 (217.9m) feet above sea level. Prior to this regulation, lake levels fluctuated between 710 (216.4m) and 718 (218.8m) feet above sea level, mainly from the natural variations of seasonal changes, precipitation and evaporation (W.F. Baird & Associates 2000). Figure 7 shows how after regulation, the lake has remained within the regulation levels, with several months exceeding 715 feet (217.9m). The maximum water level prior to regulation reached 720.07 feet (219.5m) in 1974, whereas the lowest occurred in 1940 at a level of 709.62 feet (216.3m) (Veldman 1969; Manitoba Hydro 1991). With hydro regulation on the lake, these extreme values have been eliminated.

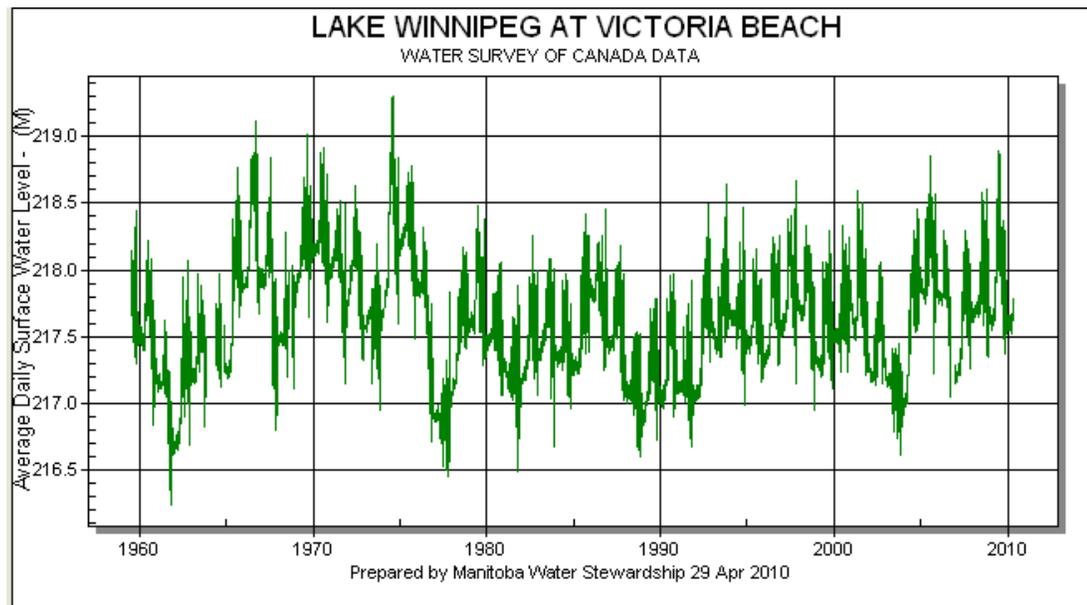


Figure 7: Water levels on Lake Winnipeg, 1959-2000 (Environment Canada, 2009)

Short-term increases in lake levels are primarily due to the strong winds coming from a particular direction over the course of hours. When this happens, lake levels will rise

dramatically where the wind is the strongest; this also brings sand from the bottom of the lake onto the beach (W.F. Baird and Associates 2000; Veldman 1969; Manitoba Hydro 1991). These values may exceed the Manitoba Hydro regulation levels, but the higher levels are temporary, and once the wind velocity drops, the lake levels goes back to the regulation levels between 711 (216.7m) and 715 feet (217.9m). Also, these short-term increases do not occur at all shorelines around Lake Winnipeg. Therefore, when measuring lake levels, the wind must be taken into account and then factored in to make an accurate lake level measurement.

With regulation on the lake, the occurrence of extreme high and low lake levels has decreased. In terms of sand supply and lake regulation, it is not known if there has been an impact, positive or negative, on the beaches and sand dunes at Grand Beach Provincial Park.

2.4.6 Ecological Equilibrium

The beach and sand dune environment is considered to be a dynamic one (Nordstrom 2000; Bird 2000; Albert 2006; W.F. Baird and Associates 2000). It is an environment that is always changing due to the ecological processes surrounding it. Lake levels, wind and vegetation all have a significant part in sand dune generation and stabilization. If any of these processes change dramatically, the beach and sand dune area in Grand Beach Provincial Park will also change. Teller (2006) has suggested that Grand Beach is in balance, mainly due to very little change to the channel that feeds the lagoon behind the beach. There has been little documentation on how beaches and sand dunes can reach a state of equilibrium, suggesting it may be difficult to determine if a dynamic environment is in a state of balance. Sand dune blowouts are considered to be a natural phenomenon where most become inactive and

revegetate without management intervention (Bate & Ferguson 1996). A blowout is defined as a “saucer-, cup-, or trough-shaped depression or hollow formed by wind erosion on a pre-existing sand deposit” (Hesp 2002, p.255). Several factors must be taken into account when it comes to blowout formation. Blowouts are initiated by the removal of vegetation on the sand dune, whether it is human induced or a naturally occurring event. Natural events can include changes in climate, increased wind erosion and natural changes to dune vegetation (Hesp 2002).

When vegetation is not recovered, dune blowouts can increase in area, ultimately causing a shift in the beach and sand dune dynamic. Human impacts may cause an increase in the blowout dynamics of a beach; however, blowouts are a natural process on shorelines around the world (Hesp 2002, Bate and Ferguson 1996)

2.5 Biological Features in Grand Beach Provincial Park

In 1976 the Parks Branch of the Manitoba Government released a master plan for outdoor recreation in Grand Beach Provincial Park. Within this document was an extensive description of the flora and fauna of the park. Much of this section is derived from that document.

2.5.1 Vegetation

Vegetation plays a significant role in the formation of sand dunes. Plants trap the sand that is moving from the beach area, and vegetation growing in this area must be able to grow up through the sand while it is being buried. Grasses and willows grow in an area of the beaches and sand dunes where it is much drier and exposed to sand movement and higher winds

(Photos 5 and 6) (Parks Branch 1976). These grasses and willows have fairly deep roots and are considered to be unique in their growth patterns. New growth is established through the sand, while the roots help to stabilize the sand (Albert 2006). Wind and sand transport is the highest in the foredune area. Vegetation in this area has evolved to become more tolerant to “sand blasting” than vegetation further inland (Yura and Ogura, 2006).

Within Grand Beach Provincial Park, there is a considerable amount of vegetation ranging in size from sedges, grasses and ferns on the lake(windward) side of the sand dunes, to willow shrubs from the edge of the lake side to the highest points of the dunes, to large trees such as poplars, birch and various types of pines on the backside (leeward) of the dunes (Parks Branch 1976).



Photo 5: Beach Grasses (A. Demski)



Photo 6: Beach Willows (A. Demski)

The Manitoba Conservation Data Center stores plant and animal information in a species and plant community database (<http://www.gov.mb.ca/conservation/cdc/>). Each species in the database has a standardized global and provincial rank, ranging from very rare to abundant and secure. Some plants found in Grand Beach are listed on the Manitoba Conservation Data Center and are considered rare in the area, with the threat of extirpation. These species include: Hooker’s Orchid, Tessellated Rattlesnake Plantain and Houghton’s

Umbrella-sedge, all of which are flowering plants that prefer well drained, upland, shaded areas either near or within Jack Pine areas. The Umbrella Sedge has been known to live on sand dunes along lake shores, and along the lakeshore. Hooker's Orchids can also live near the water's edge.

Uncommon low lying shrubs such as the Dwarf Bilberry, New Jersey Tea, Fox Sedge and the False Heather have also been found in the Grand Beach area and have been documented in the Manitoba Conservation Data Center. Each of these shrubs prefers sandy sites, including the False Heather being found directly on sandy beaches. The Fox Sedge has also been found in seasonally wetter areas similar to the marshy area behind the East Beach.

The Outdoor Recreation Master Plan for Grand Beach Provincial Park (Parks Branch 1976) provides a list of 153 genera and 59 families of the plant kingdom which are thought to occur in Grand Beach Provincial Park.

However, the list has not been verified by a ground survey and may be incomplete. Of the 8 plant species listed in the Manitoba Conservation Data Center, only 5 are noted in the Outdoor Recreation Master Plan for Grand Beach Provincial Park.



Photo 7: Larger vegetation behind the sand dunes, West Beach (A. Demski)

2.5.2 Animals

With the varying landscapes throughout Grand Beach Provincial Park, there is a wide variety of animal species present.

During site visits (by the researcher) in the spring, summer and fall, several species of birds were recognized. Terns, Gulls and other shorebirds can be seen on both the East and West beaches as well as in the lagoon area. American White Pelicans generally are seen along the shoreline of Lake Winnipeg. Canada Geese and Mallard ducks are common in the lagoon as well as the grassy areas behind the sand dunes. Other ducks and Snow Geese and song birds are common to these areas. A Great Blue Heron was observed by the researcher in the channel area in September 2006 (Photo 8).



Photo 8: Great Blue Heron in the channel (A. Demski)

Other notable bird species in the Grand Beach area include the American Avocet and the Osprey. The American Avocet have similar nesting and feeding preferences as the Piping Plover, however, the Avocet prefer not to nest as close to human traffic (Bob Jones, 2011). The fish-eating Osprey have had artificial nesting sites set up at Grand Beach in the past, it is questionable as to when they were last seen at Grand Beach, even though they are not as affected by human interaction as the American Avocet, and their preferred habitat is the Lagoon area over the beach and dune area of Grand Beach (Bob Jones, 2011). Most of the

shorebirds in the Grand Beach area choose the beach area for feeding opposed to nesting due to the large amount of people on the beaches during the summer, therefore, most of the nesting sites are found on islands or marshy areas with less human traffic (Bob Jones, 2011).

Various amphibians and fish are also located in Grand Beach Provincial Park including the Hairy Necked Tiger Beetle, an at-risk species in Manitoba that has only been sighted few times in the past several years by other scientists. The larvae and adults live in burrows in the sand and are easily destroyed by foot and vehicle traffic. Zoologist Dr. Bob Wrigley recently discovered the Hairy Necked Tiger Beetle on the lagoon side of the West Beach. Other notable species include the amphibian Blue Spotted Salamander, a delicate species found at the West Beach. The Manitoba Conservation Data Center has recognized the Blue Spotted Salamander species as uncommon throughout their habitat range.

There are numerous mammals found in every corner of the park, and some have been observed by cottagers and beach visitors. Chapter Four will provide a description of sightings of animals seen in the park by the 30 individuals interviewed for this research. The Outdoor Recreation Master Plan for Grand Beach Provincial Park (Parks Branch 1976) provides a list of animals that are thought to inhabit Grand Beach Provincial Park. However, the list has not been verified by a ground survey and may be incomplete. There may be several key species that could assist future monitoring and conservation tactics of the beaches and sand dunes. An updated survey would be beneficial to Grand Beach Provincial Park, but it is beyond the scope of this study.



Photo 10: Snow Geese in the picnic area (A. Demski)



Photo 9: Small animals can be seen throughout the park (A. Demski)

Appendix 4 lists mammals thought to be located in Grand Beach Provincial Park. This list has been provided by Dr. Robert Wrigley of the Assiniboine Park Zoo.

2.5.2.1. *The Piping Plover (Charadrius melodus)*

The Piping Plover is an endangered species listed under the Manitoba *Endangered Species Act* (Government of Manitoba 1990) as well as the federal *Species at Risk Act*. It is a small shorebird that prefers beaches with coarse to rocky sand and has been known to nest in several areas of the beach and sand dunes (and parking lots) in Grand Beach, one of only several breeding sites in the province. The preferred habitat in Grand Beach occurs in areas that are intensely used by beach visitors, thus creating a major disturbance for the nesting of the birds. Due to the decline in their numbers and nests, the Manitoba Piping Plover Recovery Program was established to help protect the existing population as well as to assist in identifying and protecting nest areas. Some protective measures include fencing off nesting sites



Photo 11: The Piping Plover (A. Demski)

and protecting the actual nest and eggs from predators. Manitoba Conservation also provides park interpretation for educating visitors to the park (Miller 2006).

2.6 Ecological Sustainability

With rapid change to the global environment, threats to ecological and environmental sustainability become more predominant. The term “ecological sustainability” is still fairly new; however, “sustainable development” caught the world’s attention with the release of the Brundland report - “*Our Common Future*” - in 1987. Sustainable development as defined in *Our Common Future* is “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987). Sustainable development, however, is more associated with the human perspective, whether it is human alteration of a natural landscape or the inhabitation of nature (Callicott & Mumford 1997).

Ecological sustainability is more focused on conservation of the biological factors of an ecosystem that has been exploited by humans (Callicott & Mumford 1997). The approach of ecological sustainability is directed at maintaining the normal ecological processes within an ecosystem. From a planning and management perspective, ecological sustainability describes limits or a carrying capacity of the environment on any scale. Humans need to respect the limits of the environment and provide limitations and goals for such environments. These goals and limitations are derived from managers of the land as well as legislators who create the policy and law for regulating the environment (Carlman 2005).

2.6.1 Natural Resource Management

Part of effective natural resource management is to take scientific information such as the status and conditions of various abiotic and biotic components of the ecosystem (Andreasen and others 2001) and develop effective policies and management strategies to keep the natural features sustainable for wildlife and future recreational users of the park. Two components of natural resource management include ecosystem management and ecological integrity.

2.6.2 Ecosystem Management

There are three different management approaches that natural resource managers use: coarse-filter (preservation of entire communities of plants, animals and other biota), fine-filter (protection of certain species and elements), and ecosystem management (Carignan & Villard 2002). Ecosystem management is a combination of the coarse-filter and fine-filter strategies (Hunter and others 1998; Kessler 1994; McKenney and others 1994; Wilcove 1994; Lambeck 1997; Noss and others 1997). One definition of ecosystem management is as follows:

“Management driven by explicit goals, executed by policies, protocols, and practices, and made sustainable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function” (Christensen and others 1996).

The main point researchers have tried to make is that ecosystem management must have science and research as well as an understanding of how humans can work together with nature (Brunner & Clark 1997; Grumbine 1994). After examining a large amount of

literature, various themes became apparent when looking at ecosystem management implementation. One theme that was constantly mentioned was ecological integrity.

2.6.3 Ecological Integrity

Ecological integrity is a term used within ecosystem management to determine if the goals of management and sustainability have been successful (Carignan & Villard 2002). It is not only concerned with the aesthetic value a natural area has for humans, but also with the actual condition of the ecosystem and the species within it (Andreasen and others 2001). One of the most frequently used definitions of ecological integrity is:

“The capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition comparable to that of the natural habitat of the region (Karr & Dudley 1981).”

Karr and Dudley also described how a system with ecological integrity can survive many forms of degradation. It has become a challenge in many different types of natural areas as to how to measure ecological integrity, as well as monitor it through time, measure the results and describe everything to the managers, policy makers and the public. There are three main characteristics the literature has associated with ecological integrity: 1) sustainability, 2) naturalness, and 3) stability (Andreasen and others 2001). The first characteristic, sustainability, generally focuses on maintaining all of the components within an ecosystem so they can continue to be a source for human consumption and use in the future. The second characteristic, naturalness, has a mixed definition. Some researchers feel a natural area is one that has remained unchanged since the arrival of Europeans to North America (Bonnicksen & Stone 1985). However, most natural areas today have changed due to human contact, and are still thought to have a higher ecological integrity than other

human habitats (Andreasen and others 2001). The last characteristic of stability refers to areas that have high ecological integrity should also have a significant amount of stability or resistance to environmental change.

Essentially, when defining ecological integrity, all knowledge of a specific ecosystem should be compiled, as well as the human concerns and preferences being noted (Kay 1993). Kay described ecological integrity as being clearly defined for a particular ecosystem where humans play a significant role within that ecosystem. There is no one predetermined way of measuring ecological integrity but a common method in any ecosystem is to select various indicators within the natural environment.

2.7 Best Practices of Ecological Processes Involving Beaches and Sand Dunes in Canada

This section reviewed management guidelines and best practices from other areas in Canada with similar ecological processes to Grand Beach.

2.7.1 Devonshire Beach, Alberta

Devonshire Beach is located along the southeast shore of Slave Lake in Lesser Slave Lake Provincial Park, northwest of Edmonton. To date, Alberta Community Development (2005) has drafted a management plan for the park, which includes a 5-kilometre stretch of beach and a beach ridge parallel to it. Like Grand Beach, Devonshire Beach lies adjacent to a large shallow lake (maximum depth of 21 metres) with a significant sand supply coming from the lake bottom (Smith 1987; Bradley 1980). Devonshire Beach is located on the eastern side of

the lake with strong winds coming from the west. Once the sand dries, it is pushed beyond the beach into the beach ridge.

Devonshire Beach has undergone a significance and disturbance study, as well as a vegetation inventory and rare plant survey prior to the development of the proposed management plan. Proposed management guidelines include long-term preservation of the natural features by allowing the beach ridge to change through natural processes, protection of rare plant species while managing invasive species, and increasing the public understanding of the natural and cultural features of the park through interpretation and education. A monitoring program has been proposed to examine the sand movement on the beach, how people access the beach, and how sand retention methods can be used.

Devonshire Beach and Grand Beach have very similar natural features within a provincial park setting. It would be beneficial to monitor the progress of Devonshire Beach Plan to determine if its management practices are useful, and how some of the techniques could be applied to Grand Beach Provincial Park.

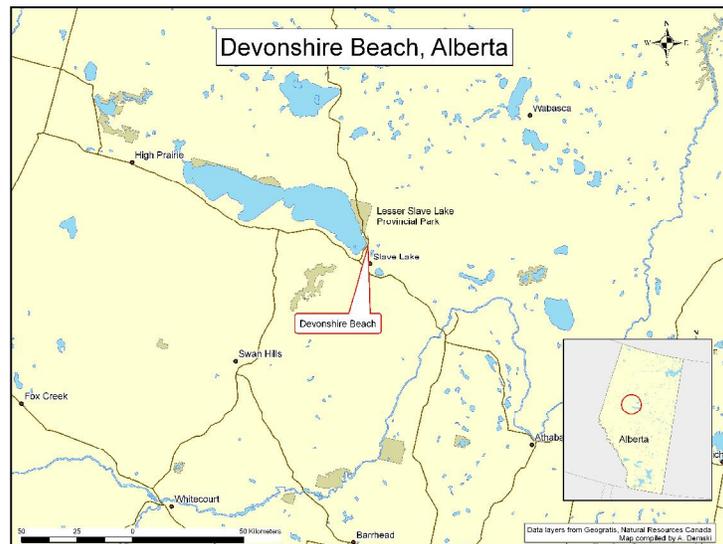


Figure 8: Devonshire Beach, Alberta (Data layers from: Department of Natural Resources (a-d))

2.7.2 Sauble Beach, Ontario

Sauble Beach is one of numerous long beaches and sand dunes on Lake Huron. A management plan for Sauble Beach was initiated by a local community group, The Friends of Sauble Beach. They had contacted the Lake Huron Centre for Coastal Conservation for support, and in turn they prepared the Sauble Beach Management Plan. The plan is:

“...intended as a guidance document to assist the Friends of Sauble Beach, the Town of South Bruce Peninsula and the broader community of Sauble Beach to implement an effective dune conservation, environmental education and restoration program that works with the tourism and recreation needs of the community”
(Peach 2004).

The sand supply and dune formation is similar to those at Grand Beach Provincial Park, where sand is supplied from the lake via wind processes. However, one key difference between Sauble Beach and Grand Beach is the proximity of human settlement to the beaches. Directly behind the dunes on Sauble Beach is a busy road and community area. This human interaction has caused stress and disturbance to the beach and sand dune area. The Friends of Sauble Beach wanted a plan that would help minimize the impact on the beach and dune system.

Within the Sauble Beach Management Plan (Peach 2004) are “best management practices”, comprised of four main objectives.

1. *Education*: Beach signage, education and awareness of the beach and dune ecosystem, interpretative tours of the dunes and dune ecology. The focus of these techniques would be toward locals and tourists who visit the area.

2. *Managed access*: Currently at Sauble Beach, there are many pathways through the dunes in order to access the beach. By having permanent walkways strategically placed

through the dunes, the beach would become more accessible and there would be fewer makeshift walkways through the dunes. The idea is to control access to the beach, not restrict it.

3. *Restoration:* Loss of vegetation can cause sand dunes to become unstable and more susceptible to blowouts, making re-vegetation difficult. In such an event, proper restoration techniques can be applied. These techniques include planting beach grasses that are native to the area and using sand fencing.

4. *Management issues:* There are several management issues park officials have to deal with on a regular basis, and how they are managed can have a profound effect on the overall health of the beach and dune system. Beach raking can accelerate beach erosion and possible permanent damage to the beach and dune system, and can remove habitat for life forms. With regard to sand disposal, when sand is blown onto the road through wind action, it cannot be returned to the beach area for fear of pollution from being on the road. Proper sand fencing between the dunes and road can impede this process. Other issues include endangered species recovery, climate change and dune vandalism.

At the conclusion of the Sauble Beach Management Plan is a summary containing each management practice and who would be best suited to lead the implementation. The local community, the Lake Huron Centre for Coastal Conservation, and the Friends of Sauble Beach are the three key players in providing successful beach and dune ecology management at Sauble Beach.



Figure 9: Sauble Beach Ontario (Data layers from: Department of Natural Resources (a-d))

2.7.3 Pinery Provincial Park, Ontario

The Pinery Provincial Park is located on the eastern shoreline of Lake Huron in Ontario. The park has very striking features including an oak savanna forest and a 10-kilometre stretch of freshwater beach with sand dunes. The sand dunes in Pinery have been studied extensively since the 1980s, resulting in a significant amount of knowledge of the beach and dune system (Bowles & Maun 1982; Byrne 1997; Maun & Perumal 1999; Baldwin & Maun 1983; Dech, Maun & Pazner 2005). The Pinery Provincial Park Management Plan was established in 1985, with a resource management strategy to follow in 1988. Within the park management plan (Ministry of Natural Resources 1986):

“The goal of Pinery Provincial Park is to protect an extensive, provincially significant, freshwater dune system with associated representative floral, faunal and cultural features and to provide high quality educational and recreational experiences.”

The management plan also discussed the need for proper resource management strategies being implemented to ensure the ecological needs of the park are met. The Pinery Management Strategy (Crabe and others 1988) explains what is required to ensure the goal of the management plan is met.

Currently there are several projects regarding the beaches and sand dunes in Pinery Provincial Park, specifically by Wilfred Laurier University and the University of Western Ontario. Most of the research findings for the beaches and sand dunes are from peer-reviewed journals and conference proceedings. In terms of sand dune management practices, the management plan has implemented the construction of boardwalks to minimize trampling of vegetation, and park officials continue to monitor the beach and dune area for potential impacts and to decide how to minimize those impacts in the future. Information about Pinery Provincial Park can be obtained through a substantial literature review which is beyond the scope of this project.

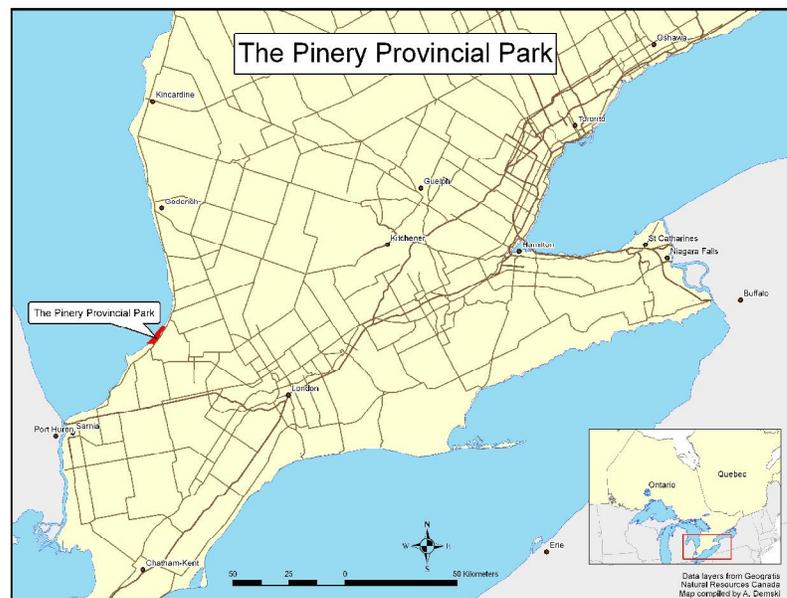


Figure 10: The Pinery Provincial Park, Ontario
(Data layers from: Department of Natural Resources (a-d))

2.7.4 Presqu'ile Provincial Park, Ontario

Presqu'ile Provincial Park is located on the north shore of Lake Ontario. The park has a distinct landform called a tombolo, which is a long stretch of beach that joins the mainland to an island. This area is of high value, and several hundred thousand people enjoy the beach each year (Ontario Parks 2008). The Presqu'ile Provincial Park Management Plan (Usher 2000) describes the tombolo area as being “highly diverse for such a narrow strip of land, consisting of a sand beach on Popham Bay, two ridges of dunes, a seasonally wet meadow between the dune ridges, and finger-like points curving into Presqu'ile Bay Marsh.” The tombolo area is zoned as a nature reserve which “includes significant earth and life science features which require management distinct from that in adjacent zones, as well as a protective buffer with an absolute minimum of development” (Usher 2000). The beach areas other than the ones on the tombolo are designated natural environment zones that include human recreation and habitat for migrating shorebirds (Usher 2000).

The Presqu'ile Provincial Park Management Plan was released in 2000. Similar to the formation of the Grand Beach Provincial Park Management Plan, extensive public consultation took place during the planning process. During this time the public indicated they regarded the beach and dune area of the park as a highly significant area for humans and migratory birds. In 2008 the Presqu'ile Beach and Dune Resource Management Plan was released for review. The goal of this plan is separate from the park's management plan. It is “to provide quality beach recreational opportunities and habitat for migrating and resident birds, and educate park users on the values of the beach and dune system” (Ontario Parks 2008).

The park has had various research activities involving the beaches and sand dunes in order to understand the processes in more detail in order that better management practices could be established. The results are an adaptive management approach for beach and dune management policies which involves initial planning, implementation of the plan, and analysis and monitoring. Modifications to the management plan and policies would then be based on solid data analysis, which in turn would improve resource management in the park (Ontario Parks 2008). Proposed policies within the beach and dune resource management plan focus on regular beach maintenance, restoration methods for beaches and dunes, control of invasive species, the enhancement of habitat for shorebirds, education, recreational activities, and monitoring and research (Ontario Parks 2008). Implementation of the proposed policies would depend on available funds and the plan would be reviewed every ten years.



Figure 11: Presqu'ile Provincial Park (Data layers from: Department of Natural Resources (a-d))

2.8 Chapter Summary

The researcher was looking for several forms of literature associated with beaches and sand dunes including peer-reviewed journal articles, government reports from other jurisdictions including consulting reports, historical text, and research documents. Much of the literature reviewed was published in the late 20th century and early 21st century.

After a reviewing the literature there appear to be noteworthy gaps related to ecological processes at Grand Beach Provincial Park specifically. Any literature directly associated with Grand Beach Provincial Park is out of date; there have been projects on other beach areas surrounding Lake Winnipeg, but Grand Beach has not been the main focus of any of these studies with the exception of the 1976 Outdoor Recreation Master Plan for Grand Beach.

This document also speculated about the flora and fauna in the park, but studies were inconclusive.

Much of the literature cited has come from research in different jurisdictions and contains substantial information as to how a beach and dune area such as Grand Beach Provincial Park can be effectively managed and monitored on a short-term and long-term basis. The various research methods shown in this chapter from other jurisdictions can be applied to the management of the beaches and sand dunes in Grand Beach Provincial Park. The studies performed at Devonshire Beach, Alberta, reveal a similar environment to Grand Beach Provincial Park along with it being a provincially-run park. Devonshire has completed the necessary background research to derive management guidelines which will impact the environment in a positive fashion. Sauble Beach has shown how positive public involvement can help the beach environment through education and outreach. Finally, Pinery and

Presqu'île Provincial Parks have many university-based research and government initiatives as well as educational outreach. For the purpose of this project, literature on these jurisdictions will provide substantial knowledge and guidance to produce management guidelines and monitoring strategies specifically for Grand Beach Provincial Park.

CHAPTER THREE: METHODS

3.1 Introduction

The purpose of this research was to develop management guidelines directed at long-term ecological sustainability of the beaches and sand dunes in the Park, and also to gain an understanding of the needs of visitors and local cottagers and how they use the park, as well as obtaining a better understanding of the ecological processes occurring in the park. In order to fulfill the objectives of this research, the method of data collection is considered to be qualitative in design. This may in turn lead to better management strategies in Grand Beach Provincial Park.

Creswell (2003) describes qualitative research as relying on text and image data. General qualitative characteristics include various methods of data collection (generally non-numeric), a discussion of data collection and analysis within the research project, and the tools used for data collection. This chapter describes the qualitative methods used, along with a brief description of data analysis and the validity of the findings (Creswell 2003; Bazeley 2007).

Qualitative research is used in many areas of study that are concerned with human environments and experiences in order to address a wide range of issues (Winchester 2005). Essentially the goal of qualitative data analysis is to transform the data into findings; however, there are no guidelines as to how this transformation occurs. Transforming large amounts of data, reducing it into something meaningful for the researcher, and effectively communicating the findings are complex and very much a challenge to the researcher (Patton 2002).

Denzin and Lincoln (2003), Winchester (2005) and Trochim (2008) describe qualitative research as having three categories of qualitative data: 1) oral research such as interviews, 2) direct observation, and 3) textual information involving written documents. The research for this thesis involves all three types of qualitative data.

The methods used in this research were qualitative and applied to fulfill the objectives outlined in Chapter One. The methods include: 1) a review of the literature, 2) semi-structured interviews with cottage owners and non-cottage owners who use Grand Beach Provincial Park, and 3) a review of aerial photographs from an observational standpoint. These methods provide a better understanding of the Grand Beach landscape and those persons who use the landscape, and in turn have fulfilled the research objectives of this study.

3.2 Data Collection

3.2.1 Semi-structured Interviews

Surveys have been conducted with park users in the past by Manitoba Conservation, however none provided information that is specific to this research. For example, the most recent survey was a campground survey. Some of the demographic data may provide insight as to what type of camper uses the beach area; however, most of the data collected was irrelevant as it focused more on the use of the campground, not the beach area. When the Grand Beach Provincial Management Plan was in the planning stages, public consultations were part of the process. Again part of the data can provide some relevant information about the activities people engage in while at the beach area, but more information was

needed to provide an accurate depiction of the knowledge beach users had regarding ecological processes.

Semi-structured interviews were conducted as part of the qualitative data collection for this research. Dunn (2007) described the semi-structured interview process as generating an interview guide, but the interviewer would not be restricted to asking questions within that guide. The researcher could ask other questions outside the preset interview questions, but it is up to the researcher to keep the interview focused on the research topics. This was an effective method of data collection because it was a low-cost way to gain valuable information about the experiences and behaviors Grand Beach visitors have had. The purpose of conducting interviews for this research is to know how visitors and local cottagers use the beach and sand dune area throughout the seasons.

Table 1: Demographics of 30 Interview Participants

	Cottage Owners		Non-Cottage Owners	
		Number of Interviewees		Number of Interviewees
The interviews focused on two types of visitors: individuals who come to Grand Beach for the day or camp for the weekend, and individuals who own a cottage in Grand Beach Provincial Park. Thirty individuals participated in the interview process;	<i>Gender</i>		<i>Gender</i>	
	Male	6	Male	10
	Female	4	Female	10
	<i>Age</i>		<i>Age</i>	
	Under 20	0	Under 20	5
	21-30	0	21-30	3
	31-40	0	31-40	7
	41-50	1	41-50	3
	51-60	8	51-60	2
	60+	1	60+	0
	<i>Overall impression of Grand Beach Provincial Park</i>		<i>Overall impression of Grand Beach Provincial Park</i>	
	Positive	6	Positive	9
	Neutral	3	Neutral	6
	Negative	1	Negative	5

this number was selected in order for the research to be completed on time. The actual

process of individual interviews was time-consuming as not all interviews were done in one venue. Cottage owners were interviewed in Grand Beach, while the others were interviewed at the University of Manitoba or at the interviewees' homes in Winnipeg. Some participants were initially reluctant to participate; however, once they entered into the interview process, they were very open and honest with their responses. It was important to interview both cottagers and non cottagers, since cottagers spend more time in the area and own property in the park, whereas non cottagers are only in the park for a short time.

There were several ways in which the interviewees were recruited. For Grand Beach cottage owners, the researcher contacted the Grand Beach Cottage Owners Association president to discuss the willingness of other cottage owners to participate. This generated a snowball effect where some cottage owners interviewed passed on the names of other cottage owners. To recruit younger adult visitors, a brief presentation of the research was made to random university classes at the University of Manitoba. This too created a snowball effect where students willingly provided the researcher with other younger Grand Beach visitors. Finally, a third method was generated to recruit persons older than 30 years of age. Posters and emails were sent out to a variety of businesses as well as persons the researcher had met while doing research at Grand Beach.

The interviews were done in person during the spring, summer and fall of 2008. Prior to the start of each interview, a consent form was reviewed and signed by the interviewee and researcher. The researcher also provided a brief overview of the research project, and emphasized that the interviewee could withdraw from the interview at any time. Each interview lasted from 30-90 minutes, depending on what the individual had to say to each

response. A list of questions was prepared (Appendix Two): some questions were simple one-word responses, but most questions allowed for the interviewee to speak freely, which initiated further discussion. At the end of the interview the interviewee could add any further comments that may have not been discussed during the formal part of the interview.

The interview consisted of questions based on three areas: ecological, social and economic.

The interview was divided into four categories:

1. *General statistical information:* this section asked about age, income, gender, and other questions that helped to describe the individuals without providing their name and address to ensure anonymity.
2. *Social component:* this section asked questions on how the visitor used the beach, i.e., what activities did they participate in while at Grand Beach Provincial Park and how many people were with them.
3. *Economic Component:* this section looked at the spending habits of the interviewee; for example, did they use any establishments within the Grand Beach area, including the concessions directly on the beach.
4. *Ecological component:* this section asked questions based on ecological components found within Grand Beach Provincial Park. This was an important section for this research, as it discussed the various natural processes and habitats within the park, and how the visitor perceived them.

3.2.2 Literature Review

In qualitative research, a literature review is generally presented at the beginning of the research study in order to provide direction for the research questions, as well as to share the results of other studies relevant to the present research study (Creswell 2003). The literature presented in Chapter Two reviewed the relevant topics on beaches and sand dunes on large lakes, the ecological sustainability of these areas, and the review of other jurisdictional management practices. The literature review also presented a historical perspective on human use of the beach and dune area and a brief overview of the natural species, both plant and animal. This literature review consisted of:

- peer reviewed journal articles, government documents, and books associated with beach and sand dune ecology, management guidelines, and ecological sustainability;
- websites of other jurisdictions displaying best management practices;
- various reports written by the Government of Manitoba and Manitoba Hydro, as well as previous studies already done in the area;
- conference proceedings related to beach and sand dune ecology.

The literature review concluded that there were gaps in the literature associated with the Grand Beach area. Much has been documented regarding the beach and dune processes elsewhere in Canada; however, most literature does not have a direct focus on Grand Beach Provincial Park.

3.2.3 Aerial Photography Collection and Observation

Table 2: Aerial Imagery Acquired

Aerial photographs of Grand Beach Provincial Park were acquired for the following years: 1958, 1968, 1970, 1971, 1983, 1993 and 1998. All photos were digital files from Manitoba Conservation and the National Air Photo Library of Canada; scales vary for each year (Table 2). Photos from 1998 are Digital Orthorectified Imagery which have been corrected for errors and have a high level of accuracy.

Year	Scale
1958	~1:15,000
1968	~1:12,000
1970	~1:10,000
1971	~1:15,000
1993	1:5,000
1998	1:5,000

Each set of photos were visually observed, paying close attention to where persons use Grand Beach Provincial Park the most. The 1998 set were brought to each interview to enable to locate their favourite and least favourite spots were on the beach, and which parking lots they generally used when coming to the park. Aerial imagery was collected from 1983. However, the photos lacked proper resolution and clarity to be adequately used in this thesis. Therefore they were not used. Although much can be done with aerial photography, advanced analysis is beyond the scope of this research study.

3.3 Data Analysis

3.3.1 Qualitative Data Analysis Using NVivo

Once the interviews were completed, they were transcribed into a format suitable for analysis using NVivo software for further coding and content analysis. Qualitative data analysis begins with a content analysis process, where main themes are identified from the semi-structured interviews. Each of these themes was coded to see how frequently they

showed up in each interview. Coding the data provides a more numeric (quantitative) value to a qualitative response.

Weitzman (2003) described NVivo as being a code-based theory-building software program for qualitative analysis. Although the program does not produce an actual theory, it provides the user with the tools necessary to derive a theory from the data collected and analyzed. NVivo can also be considered a code and retrieve software program, where it assists the researcher by separating text into segments, attaching codes to those segments of text, then finding and displaying all text segments with a given code or a combination of them (Patton 2002; Weitzman 2003). Data can be analyzed with the help of computer software such as NVivo to minimize the amount of manual labour involved in analyzing semi-structured interviews.

Once all the interviews were entered into NVivo, the data were coded. First, all the interviews were coded according to those owning a cottage or not owning one. These formed tree nodes, where one tree node was a cottage owner and the other being a non-cottage owner. Within each tree node, each question asked during the interview represented a “branch” within the node. This provided a basic comparison of responses between a cottager and non-cottager. Other “free nodes” were generated based on a particular question. For example, it was determined through the creation of a free node that 11 of the 30 participants interviewed were concerned with the water quality in Lake Winnipeg. This was further broken down based on whether the participant was a cottager or non-cottager.

3.3.2 The Constant Comparative Method and Content Analysis

The constant comparative method uses the basics of any analysis: comparing and contrasting the data (Boeijs 2002). It is a type of qualitative data analysis that is part of the grounded theory approach. The grounded theory approach simply means allowing the data to speak for itself instead of trying to put the data into an existing framework (Welsh 2002). Coding is a technique used in the constant comparative method, as comparison through coding provides a meaningful interpretation of the interview data. Tesch (1990) described the grounded theory analysis as the “main intellectual tool for comparison” during analysis. Tesch also described tasks as forming categories, assigning segments, summarizing each category content, and ultimately finding similarities and discovering patterns.

3.3.3 Aerial Observation

In order to supplement the findings within the semi-structured interviews, a subsequent look at the aerial photographs of Grand Beach Provincial Park will assist park management in creating more efficient guidelines.

3.4 Reliability of Qualitative Data

Generally with quantitative data, when using the same tests and the same instruments, the analysis results will be the same each time, creating reliable and accurate data. Marshall and Rossman (1999) describe the strength of the qualitative study resting with the validity of the research. For qualitative data to be considered valid and reliable, it must be done accurately, honestly, and collected in a true fashion. The use of content analysis also strengthens the researcher’s findings, as it is clear to the reader and information can therefore be checked (Marshall & Rossman 1999). The researcher of this study is confident in the findings within

the semi-structured interviews, as well as how the data was analyzed, coded and compared, and if repeated, similar results would be produced.

3.5 Chapter Summary

Combing various types of qualitative data can increase the strength of the research project.

Three forms of data were collected and analyzed: a literature review, semi-structured interviews and aerial photograph interpretation, all of which contributed to the research objectives. The next chapter discusses the results of the analysis.

CHAPTER FOUR: DATA ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents the findings and analysis from the data collection described in Chapter Three. One objective of the research was to provide an overview of the literature regarding processes associated with the ecological equilibrium and change with beaches and sand dunes in a Canadian lake setting; Section 4.2 will highlight some of these findings. In order to provide a spatial analysis of past and current human use of the beaches and sand dunes at Grand Beach Provincial Park, Section 4.3 describes the results of the semi-structured interviews between the researcher and cottagers of Grand Beach Provincial Park, as well as non-cottagers who use the park. Section 4.4 analyzed aerial photographs to distinguish visible changes in the park landscape over the past fifty years. The chapter concludes with a more in-depth analysis of the Grand Beach Provincial Park Management Plan as to how the plan relates to the biophysical processes together with the topics and issues which arose from the interviews.

4.2 Biophysical Processes in Grand Beach Provincial Park

Substantial literature has been generated for beaches and sand dunes; however, the literature has gaps which include a lack of data collection and documentation directly associated with Grand Beach Provincial Park. Currently there is a substantial amount of data for the entirety of Lake Winnipeg, but it falls short in a direct context of Grand Beach. When compared to other jurisdictions with similar features, there is insufficient data for Grand Beach Provincial Park to draw direct conclusions for management decisions.

4.3 Perceptions of a Beach Visitor

A total of 30 individuals were interviewed: ten people owned a cottage at Grand Beach Provincial Park and 20 people did not. All of the data analysis has been done according to these two groups for better comparison of the results.

4.3.1 Social Aspects

The interviews began by discussing social aspects, including general visitor information as well as normal activities individuals would partake in while at the park. When participants were asked who they usually visit the park with, 70% of cottagers and 60% of non-cottagers visit the beach and dune area with their family, while 63% of all interviewed use the beach and dune area with their family members (Figure 12). Thirty percent of cottagers and 35% of non-cottagers enjoy the beach and dune area with their friends. Only one participant, a non-cottager, (5%) responded that they go to the beach area with both their family and friends, all of whom were non-cottagers.

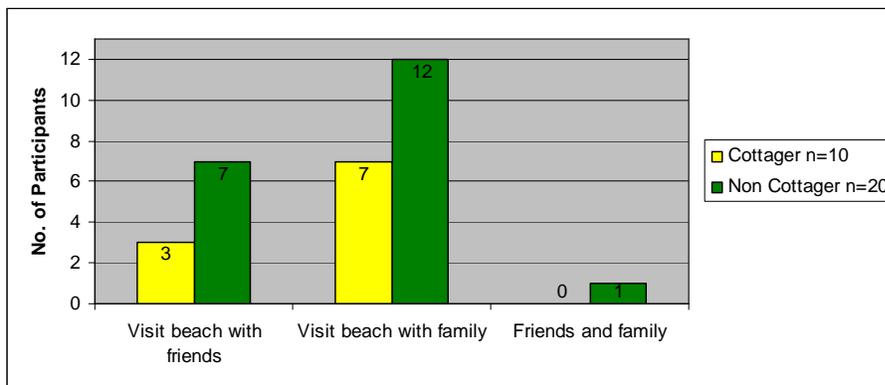


Figure 12: Participants visiting the park with others

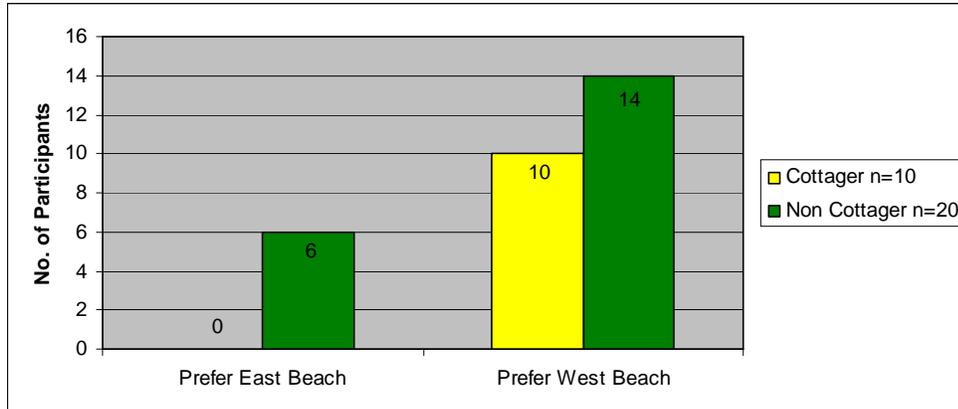


Figure 13: Beach preference

It is important to know when people use Grand Beach Provincial Park. Some non-cottagers used the park during the spring, summer and fall, but 80% only used the park in the summer. Some participants commented they would like to use the facilities more prior to the May long weekend and after the Labour Day weekend when the weather is hot. However, most of the facilities on and off the beach are closed at those times. Fifty percent of all cottagers are in the park during all four seasons. Some use the park for snowmobiling while others use it for rest and relaxation outside the summer season. Fifty percent of cottagers, however, do not use the park in the winter mainly due to their cottages not being winterized.

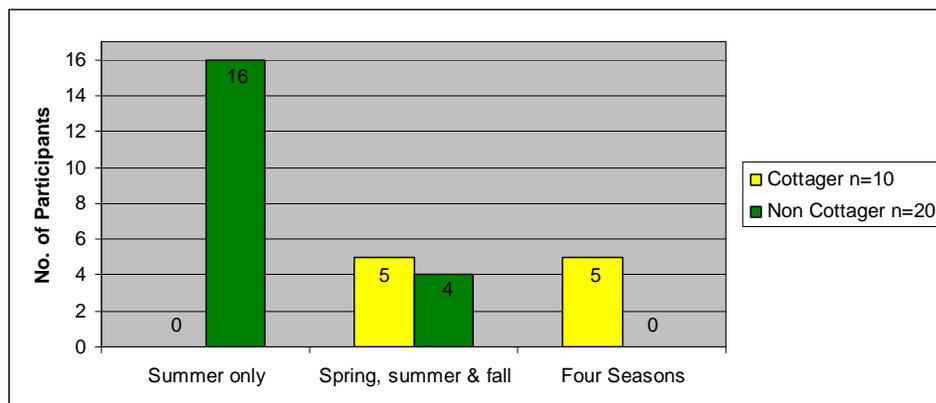


Figure 14: Seasonal preference

Weather can greatly impact the number of visitors to Grand Beach Provincial Park. When participants were asked if weather affected their decision to visit Grand Beach, 70% of all non-cottagers stated they do not go to the beach if the sun was not out. The other 30% of non-cottagers did not mind if the sun was not out as they alter their activities. Instead of sun tanning, some go hiking or biking. Seventy percent of cottagers, however, were only somewhat affected by the weather. If the weather was not fair enough for sun tanning or other activities on the beach, cottagers engage in activities within their or another person's cabin. Visiting with friends is a common activity for cottagers when the weather is not fair. Generally, weather does play a role in all cottager and non-cottager activities, as 100% of all 30 participants were affected by the weather.

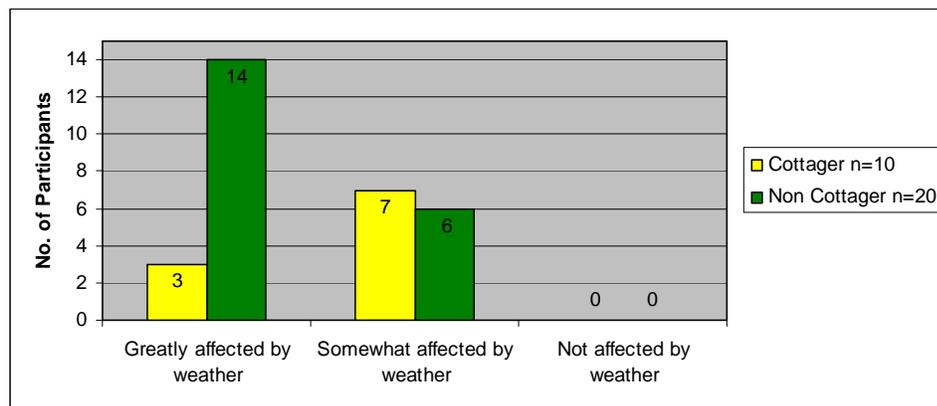


Figure 15: Weather preference

The last question in the social aspect category asked about the activities they engage in while at the park. Cottagers generally choose more activities related to the community, while non-cottagers prefer the beach atmosphere, engaging in outdoor recreation activities such as swimming, playing games in the sand, and walking along the beach.

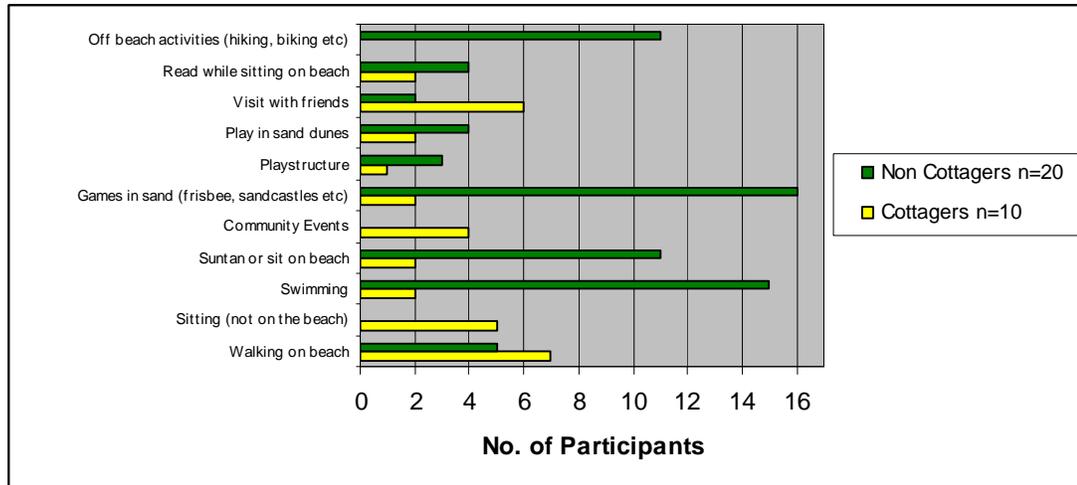


Figure 16: Preferred activities by interview participants

4.3.2 Economic Aspects

A very brief section of the semi-structured interviews discussed typical economic activities of each participant. Seventy percent of all non-cottagers use the concession stands along the West Beach, whether getting a drink or ice cream, or buying their entire meals (usually lunch). Ninety percent of all cottagers actively support the economic growth of the local communities of Grand Beach and Grand Marais by frequently using the local restaurants, grocery store, gas station and other small shops. Two out of ten cottagers, however, expressed their disappointment with the local gas station in Grand Marais, stating that it was not open during the off-season. Most non-cottagers do prefer to use the venues at or near the beach.

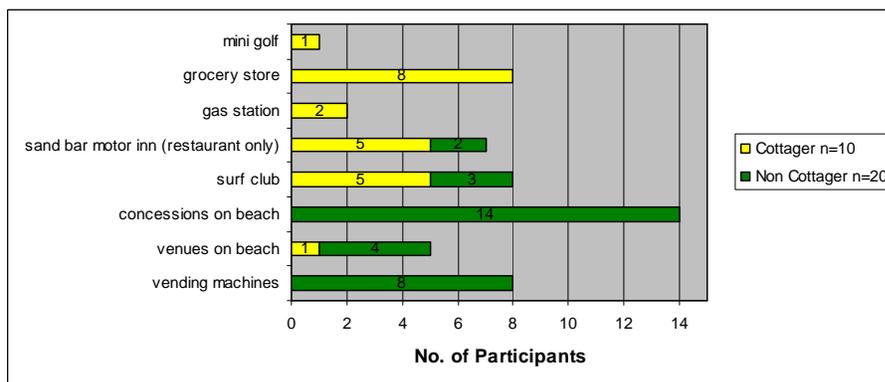


Figure 17: Economic activities of interview participants

4.3.3 Ecological Aspects

The final portion of the interviews discussed various natural processes and habitats within the park, and how the park visitor perceives them. The section begins with how participants access the beach and dune area. All cottagers (100%) responded that they used an area that is designated for foot traffic, such as walking through a parking lot, or using the boardwalk on the most western side of the West Beach. Thirty percent of non-cottagers choose the easiest possible route from the various parking lots in the park to the beach area, including walking through the makeshift pathways through the sand dunes. Some commented their children and grandchildren like to play in the dunes while walking through them, such as sliding down the dunes. The other 70% of non-cottagers prefer the structured pathways, some commenting on how difficult it is to walk through the dunes with all their belongings. However, these individuals also suggested there are not enough structured walkways from the parking lots to the beach area.

“When you have children and stuff that comes with children, it can be difficult to get to the beach through one walkway that is far away.”

The next portion of the interview discussed how much a beach visitor actually knew about the various natural processes occurring in the park, and if they would respect those processes if explanatory signs were posted. Eight out of the ten cottagers interviewed said they would read signs about the dune processes, with three out of those eight suggesting particular locations that might be a good location for such a sign. All three said the boardwalk and channel areas would be good places.

“...if it is on the boardwalk or by the channel. Maybe it would change the behavior if there were a better understanding.”

The two cottagers who said they would not read about the processes by way of signage commented:

“There are too many signs in the park - I would pick up pamphlets and read them.”

Of the non-cottagers, 18 of the 20 interviewed said they would read signs, while the other two would not. Their responses were similar to the cottagers:

“I would read the signs, but others may not though. The best place to put them along the pathway and boardwalk or by the concessions.”

Between the cottagers and non-cottagers, 20 of the 30 individuals interviewed would be influenced by posted signs regarding the ecology of the beaches and dunes in Grand Beach Provincial Park. Some of the comments from non-cottagers regarding posted signs follow:

“I think people would be more aware of their surroundings and be more cautious.”

“I think a lot of people would not though, half of the group that I go with would not pay attention.”

“I think it is good to learn about the local environment. It would be good to have them along the walkway.”

Table 3: Signage and participants’ perspectives

	Cottagers	Non-Cottagers
	n=10	n=20
I would read signs about sand dune processes	5	11
I would read signs if they were posted in a particular area	3	7
I would not read signs about sand dune processes	2	2
I would be influenced by posted signs regarding the ecology of the beaches and sand dunes	8	20

It is important to know how many individuals who use the beaches and sand dunes of Grand Beach Provincial Park understand why it is important for beach grasses and other plants to grow on the sand dunes. One hundred percent of all participants responded in a very similar fashion, stating it is important for the grasses and vegetation to exist in order to hold the sand in place at the dunes and preventing it from blowing away. Below are some cottager’s replies.

“Vegetation keeps the sand from blowing away.”

“Keep the sand from blowing around, provides a home for little critters on the beach.”

“Holds the sand.”

Non-cottagers had similar comments.

“To prevent erosion.”

To keep the sand from blowing away.

“I guess to hold the sand in place - to keep it in the dunes.”

As mentioned in Chapter Two, the Piping Plover is an endangered migratory bird that has nested in areas within the beaches and sand dunes at Grand Beach Provincial Park. All participants were asked if they knew about the Piping Plover at Grand Beach. Eighty percent of cottagers interviewed are aware of the protective measures being taken to protect the nests of the Piping Plover, of this 80%, 20% thought the program was a little overdone.

“It has been overdone - move 10,000 people for one bird, it's OK, but way too big of a deal for the results. They are in other areas and there is all this effort and no results.

Only 25% of non-cottagers are aware of the Piping Plover nests on the beach. Half of the cottagers

Table 4: Piping plover information	Cottagers	Non-Cottagers
	n=10	n=20
I am aware of Piping Plovers in the park	8	5
I am not aware of Piping Plovers in the park	2	15
Never heard of the Piping Plover	0	3
Program is not producing enough results for the effort	2	
Would respect the habitat	2	6
I am concerned	1	3
No response	5	8

did not have a response regarding the habitat, while 40% of non-cottagers did not respond.

The participants who were concerned about their habitat (both cottager and non-cottager), stated they would respect the areas sectioned off for the birds and avoid the area all together.

Table 5: Animals at Grand Beach

Following the discussion about piping plovers, the interview switched to other animals that are seen in the park by visitors. Most participants saw smaller animals near the beach area, while the larger animals were seen on hiking trails and in the cottage area. Participants were asked about all animals seen; Table 5 shows the responses. All participants noted seagulls seen on the beach. Squirrels, chipmunks, and gophers/prairie dogs

Wildlife seen in Grand Beach Provincial Park	Cottagers	Non-Cottagers
Small migratory birds	10	2
Geese	10	1
Foxes	6	
Bears	3	
Skunks	3	
Coyotes	3	
Owls	1	
Gophers/Ground Squirrels	3	5
Deer	3	4
Raccoons	1	
Beavers	1	
Squirrels/Chipmunks	7	4
Seagulls	10	20
Fish		1

were seen near the beach area generally behind the dune area. Bears, raccoons, skunks, foxes, owls and deer were mainly seen by cottagers in the cottage area.

Table 6: Threats vocalized by interview participants

Participants were asked, “When you sit on the beach, do you notice any possible threats or negative impacts to the beaches and dunes?” Again participants were allowed to express more than one response, and every

Threats to beach area	Cottagers	Non-Cottagers
Garbage in sand	4	7
Seagulls	1	3
Pathways	1	1
Wind erosion	2	0
Too many people	6	9
Water level changes	2	0
Water quality	2	9
Snowmobiling in winter	1	0

participant responded. Half of all respondents identified too many people on the beach at one time as a threat. Thirty-seven percent of all respondents noticed garbage in the sand, varying in size from cigarette butts to plastic bags to leftover food. Table 6 shows the threats expressed by cottagers and non-cottagers.

“I see people as a threat, there are trails going through the dunes. Sun tanning oils in the water.”

“The people and their garbage, and overall carelessness of the natural environment - but it is also not regularly patrolled, so no one is being told how to act on the beach. The water quality is not that great.”

To continue the discussion of possible threats to the beach area, participants were then asked about the threat of *E.coli* and how it impacted their activities while at the beach. Eighty percent of all non-cottagers were affected by *E. coli*, some stating they wash their bodies off more after they swim. If they know the threat is high, they may still go to the beach, but will alter their activities and swim less. Very few (10%) decide to not go to Grand Beach when the risk is higher than normal. Sixty percent of all cottagers have made the decision not to swim at all in the lake. Four cottagers noted the presence of algae on the beach in the summertime. Some cottagers have concerns over the water quality. However, only a few noted that it could have an impact on the cottage industry in Grand Beach.

“It has to be visible - posted numbers seem to fluctuate so base it more on the algae blooms. I am concerned about the water quality, but it won’t affect the use of the cottage.”

“I would go to the beach but wouldn’t go swimming. If the government does not take action, cottage areas will become more affected.”

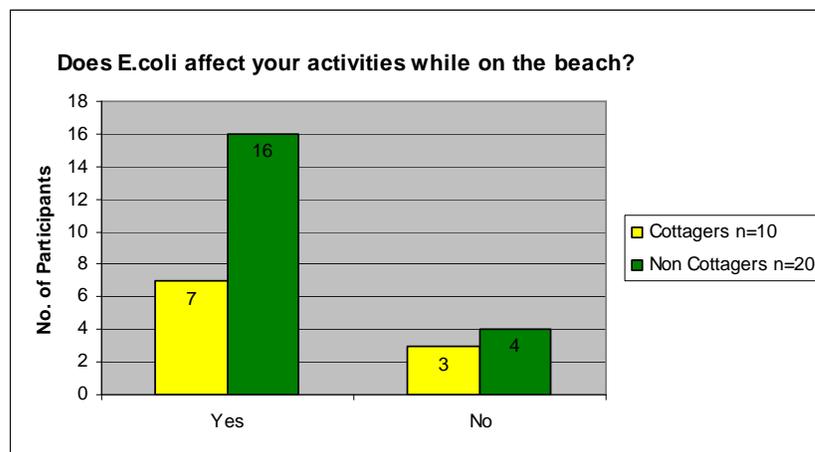


Figure 18: Interview participants’ perspectives on *E. coli*

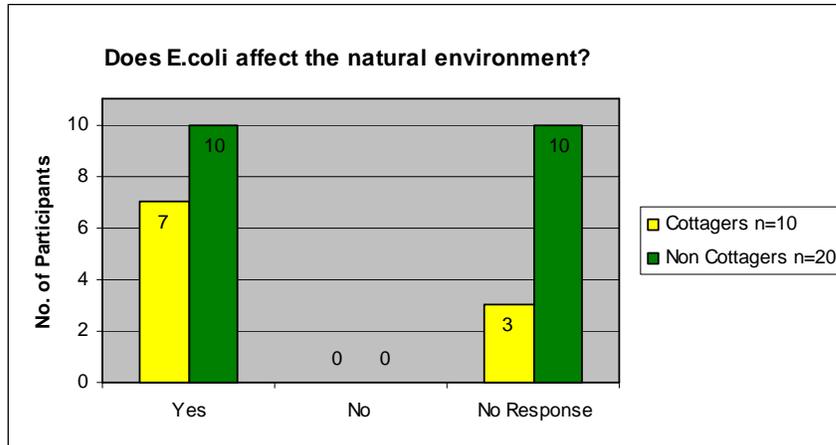


Figure 19: Interview participants’ perspectives on *E. coli*

Overall impressions of Grand Beach Provincial Park varied. All participants were asked what their impressions were of the park, and more specifically of the beach and sand dune area. Most cottagers like its close proximity to Winnipeg, and are generally happy with the

Table 7: Overall impression of Grand Beach

	Cottagers	Non-Cottagers
Short drive from city	7	2
Family close by	1	0
Not enough government intervention	1	1
Like it the way it is	5	2
Well managed	0	1
Nice sand	0	7
Concern of water quality	0	6
Appears dated and needs structural improvements	1	2
More park patrol intervention	2	1
Becoming very busy	0	4
Needs more educational outreach	1	1
Make park more family oriented	0	1

way the park is run, with some minor improvements recommended. Non-cottagers note the nice sand on the beach, but realize the beach is becoming busier and the change in the water quality is a concern. Some prefer to go the park during the week in the summer months to avoid the larger weekend crowds.

“I love the sand dunes, but I am concerned with the quality of the water.”

“It seems alright, maybe a lot more people than there should be. The water seems to be getting worse, but I don’t know if Grand Beach would be affected by it.”

“I like how close it is to Winnipeg, and I like that it is on such a large lake, the sand is really nice and there is so much of it.”

“It is okay during the week when there aren’t so many people there.”

One cottager commented on the decline of the quality of the park:

“It is going to crap - the provincial government does not do enough to maintain the park, let alone improve it. They are losing ground every year, lack of maintenance, washrooms are old and gross.”

Table 8: Preferred improvements recognized by participants

Participants were then asked what park officials could do to improve their visit to the park. The responses from this question generated a lot of dialogue between the interviewer and participant.	What could be done to improve your experience at Grand Beach Provincial Park	Cottagers	Non-Cottagers
	Satisfied the way it is	1	2
	More animal-proof garbage receptacles/improved garbage handling	5	3
	Maintain green spaces	1	0
	Improve maintenance of structures within park	4	5
	More staff off-season (before May long weekend and Labour Day weekend)	4	2
	Restrict sizes of cottages being rebuilt	4	0
	More beach supervision	4	2
	Enforce curfew	3	2
	Regulate number of people on West Beach	0	3
	More interpretation/education	1	5
	Clean garbage off beach more often	2	5
	Decrease environmental footprint	0	1
	Create recycling facilities	6	6
	More washrooms	0	1
	Create more walkways from parking lots	0	2
	Create kids programs	0	3
	Splash pad	0	1
	New play structure (no steel)	0	2

Cottager comments included:

“They are doing their best to accommodate different groups. I am concerned with the garbage - get steel cages. Get a recycling grant. The park staff needs to take further initiatives. Keep green spaces green. I have a positive outlook. The money brought into the park should stay in the park. Reallocate money to maintain the facilities.”

“In the fall after Labour Day weekend, it shuts down and there is no staff here, but if there is a nice weekend, there will be 20,000 people here and no park people. There should be retention of some sort of services. There needs to be a resident park officer that lives in the park. Put the gate money back into the park. Need recycling facilities; currently there are none, and scheduled for July, there will be a new program for handling garbage. Park businesses should be more environmentally friendly, less garbage and more recycling containers, etc.”

“The surf club has a lot of party goers and the area gets rather loud at night. The size of cottages that are now being built are getting too big - some have 2-3 stories - giving their neighbours too much shade and less natural looking space.”

Non-cottager comments were:

“I think they could clean up the beach, the maintenance is not that great. There is a lot of burnt wood in the dunes that should be cleaned up.”

“More accessibility to the West Beach, clean up the beach better.”

“Preserve the park a little more for future generations. If the activities impact the natural environment there needs to be better regulations and research.”

“Get a spray park for kids to go in, make it more kid/family friendly with different activities. There are a lot of neat places in the park; there could be better information about it.”

“Regulate the amount of people on the West Beach - it is very dirty and too hectic.”

The semi-structured interviews ended by asking the participants if they had anything else they wanted to add. It was an open-ended question and individuals could now say anything they wanted regarding Grand Beach Provincial Park. Only seven of the 30 persons interviewed made brief comments. Two cottage owners and one non-cottage owner said they used to come to Grand Beach as a child. They describe it as being different.

“I used to come as a child by train and the beach has changed. It was very different. The sand dunes seemed to have shrunk - there are more trees and scrub it seems like. Kids used to wander everywhere and no one ever worried about it.”

“I used to come as a child - there seemed to be more beaches and more wildlife.”

“I used to come as a child by train with my parents; it is a very different atmosphere - less family friendly.”

The other four individuals who made additional comments voiced their concerns over the quality of the water, and one cottage owner noticed other changes.

“The beach has become very commercial; the channel was always deep and fast, surrounded by bush and could not be accessed by the beach. I feel the channel is filling in with sand. There are a lot of sandbars in the lagoon.”

One non-cottage owner noted:

“Increase the park patrol. Regulate the development of the area and the land use in the park. Enforcement of regulations, garbage, waste management.”

4.3.4 Spatial Distribution of Interview Participants

Participants were given an aerial image of the entire park area when asked what areas did they consider to be more desirable and did they prefer the East Beach or the West Beach.

The researcher decided to compile these responses into a visual format, showing the exact places where cottagers and non-cottagers prefer to be while at Grand Beach. The following image is the results from these questions.



There is a general cluster of cottagers and non-cottagers towards the westernmost portion of the West Beach. Preference was given to this particular area for the cottagers because it is the closest to the cottage area. Although some cottagers commented how nice the East Beach is, they still prefer to be at the West Beach because it was closer, and they choose to walk to the beach area instead of driving. Six of the 14 non-cottagers who prefer the West Beach also prefer the concession and washroom area toward the middle of the West Beach. Behind this beach area is the largest parking lot in the park. Only one of the non-cottagers preferred to be near the channel and the easternmost concession area of the West Beach, as it is a quieter area but still near all the amenities.

Six of the non-cottagers have a preference for the East Beach, their main reasons being that it is much quieter and generally has fewer people. Although the walk from the East Beach parking lot to the beach area is longer and there are no modern facilities on the beach, they still prefer to enjoy the East Beach.

4.4 Human Use of Grand Beach and the Piping Plover

Recall that the Piping Plover is a small migratory bird that prefers a pebble/rocky beach area to nest. The Piping Plover is an endangered bird, and there are monitoring programs in place at Grand Beach Provincial Park to ensure its successful breeding. The following is the same map showing the preferred areas of the participants, along with data showing the approximate areas of the preferred piping plover nesting sites.

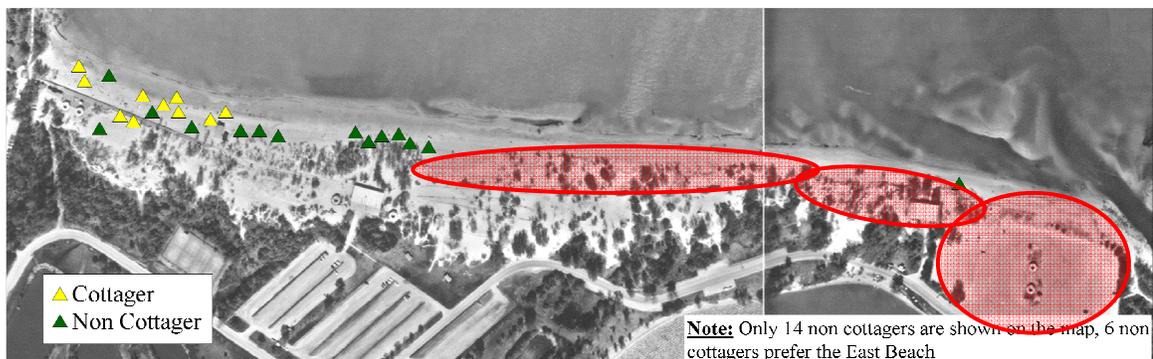


Figure 21: Piping plover distribution (areas highlighted in red) (Government of Manitoba 2007)

4.5 Aerial Photography Analysis

Aerial photography can be a useful tool for a visual analysis of a particular area (large or small) over a long period of time. Aerial photographs were obtained for the Grand Beach Provincial Park area dating back to 1948. The photos of 1948 and 1958 cover the entire beach and dune area, together with areas outside the present-day park boundaries. Although

they are useful for overall interpretation, they will not be used for smaller area analysis as they lack proper resolution.

As indicated through the semi-structured interviews, 24 of the 30 interviewed preferred the West Beach area and for the purpose of this research, visual analysis of the aerial photographs will focus on the West Beach.

4.5.1 The West Beach

The following image shows the entire West Beach together with the three main areas to be analyzed: the boardwalk, the Mid -West Beach concession and picnic area, and the east concession. The Mid-West Beach area is broken into two sections: the area around the concession, and the picnic area between the concession and parking lot.



Figure 22: The West Beach (Government of Manitoba 2007)

4.5.2 The Boardwalk Area

The boardwalk area of the West Beach is one of the most popular areas. As mentioned in the previous section, 17 of the 30 individuals interviewed prefer the beach area near the boardwalk. There are small kiosks that sell a variety of merchandise, concession stands, washrooms and change rooms. There is also a large parking lot adjacent to the area, and a green space. In the 1958 images, the present parking lot is where the train stopped to drop

off people. These photographs also show a large dance hall on the most westerly portion of the beach. The 1968, 1971 and 1998 photos show a more permanent boardwalk made of either wood or concrete. Behind the boardwalk, vegetation is noticeably becoming more dominant in the more recent images; the 1998 photos, for example, show a very visible line of vegetation encroaching on the dunes and beach. These images also show a beach patrol structure toward the eastern portion of the boardwalk.

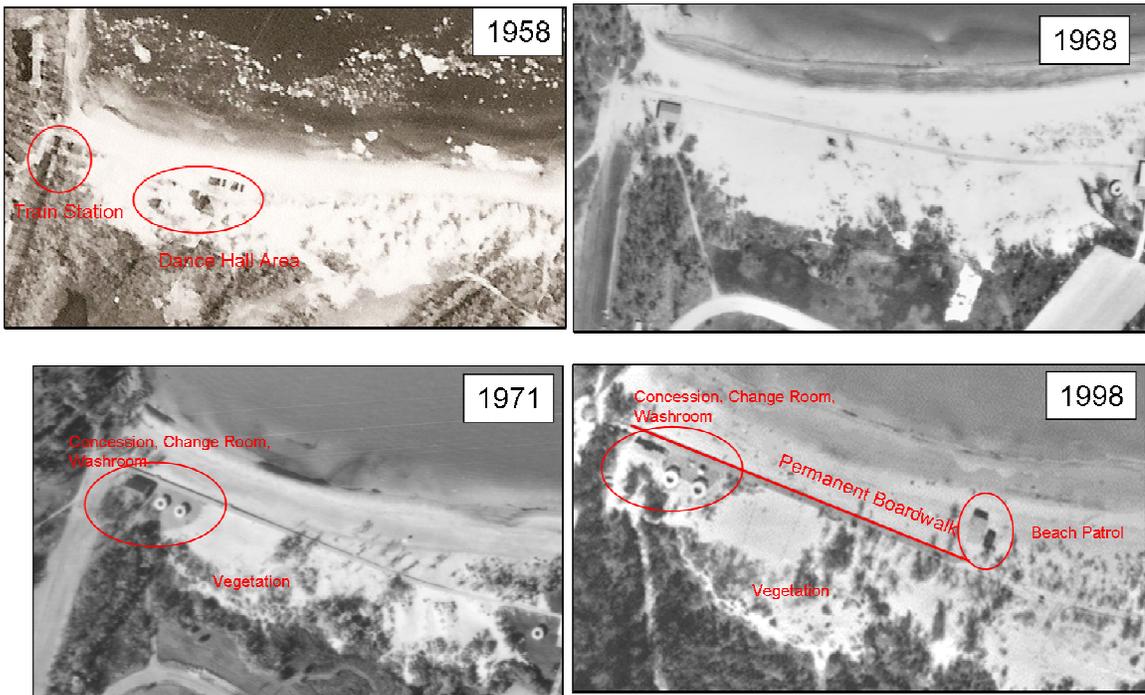


Figure 23: The boardwalk (National Air Photo Library (1958 image), all others Government of Manitoba 2007)

4.5.3 Concession Area – Mid-West Beach

Toward the eastern portion of the boardwalk is a concession area. Behind it is the largest parking lot in the entire park. Near the concessions is a play structure for children and washrooms. The photos prior to 1968 do not show any of these features, and are therefore not used for this portion of the analysis. The area became a provincial park in 1961 and the structures were erected after the park was established, including the large parking lot behind

the concession area. In the 1968 and 1971 photos there appears to be much less vegetation surrounding the concessions. The 1968 image shows more grass behind the beach and dune area, while the 1971 image shows grass growing around the concession area as well as larger vegetation (such as trees and shrubs) on the dunes. The 1998 image shows more vegetation dotted along the sand dunes, and less grass in the beach and dune area, leaving grass near the parking lot.

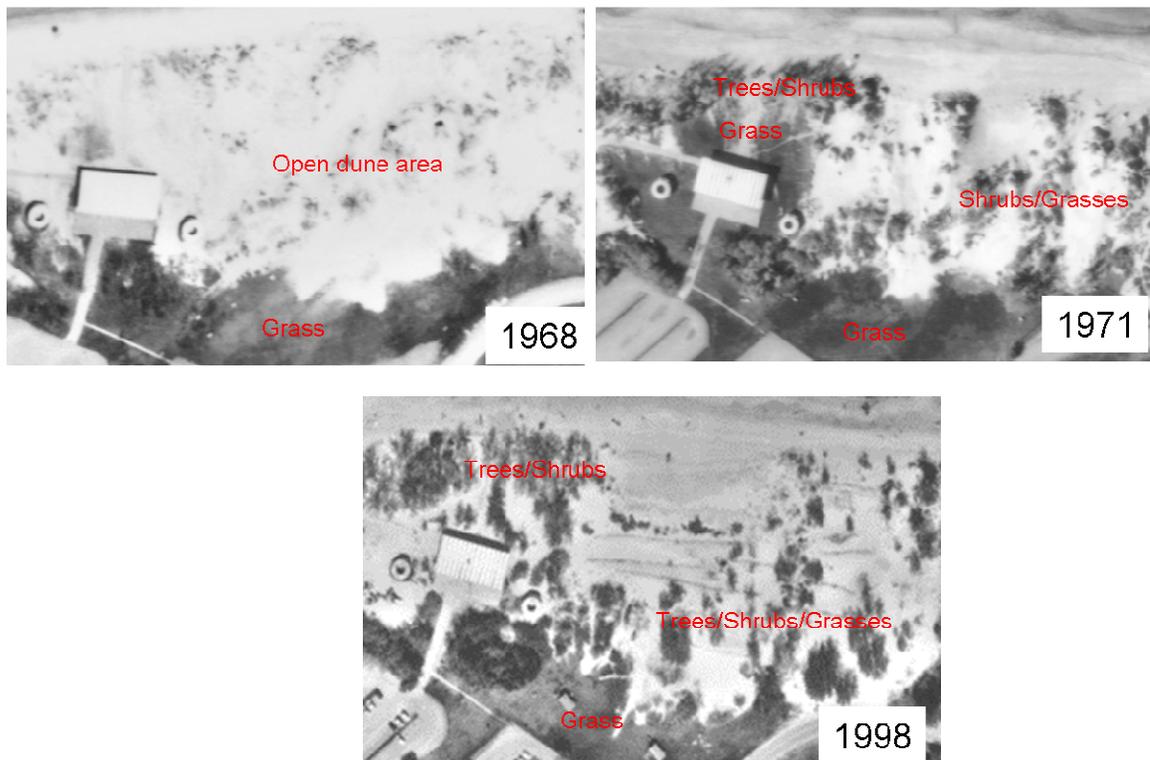


Figure 24: Concession area – mid west beach (Government of Manitoba 2007)

4.5.4 Picnic Area – Mid-West Beach

Between the concession area of the Mid-West Beach and the parking lot is a picnic area. The photos do not show picnic shelters in 1968 and 1971. However, permanent structures are shown in the 1993 and 1998 images. During site visits between 2005 and 2007, the researcher noticed several pathways generated by humans in the sand dunes in this area, and

observed visitors using the pathways. The 1968 and 1971 photos do not show these pathways; it is not until the 1993 photos that the pathways become more visible near the picnic area.

Vegetation has changed on every image, with 1968 showing the least amount of vegetation on the sand dunes. There is a significant change in vegetation on the sand dunes between the 1968 and the 1971 images, with 1971 showing much more vegetation.

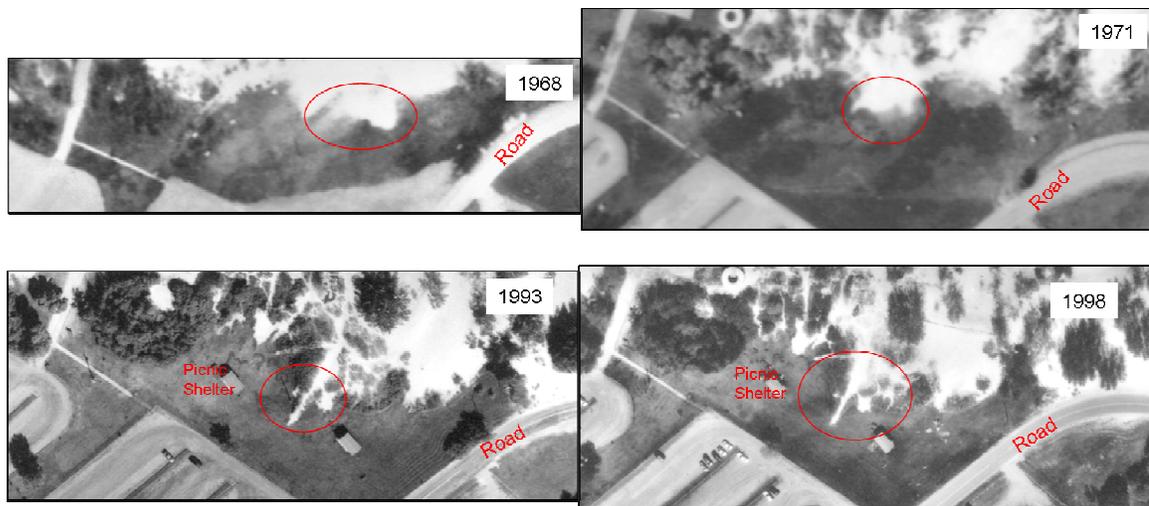


Figure 25: Picnic area (Government of Manitoba 2007)

4.5.5 East Parking Lot – West Beach

The easternmost parking lot for the West Beach is located closest to the channel area. All the photos observed show change rooms located directly on the beach in 1968, but then are located in the middle of the parking lot in the 1971, 1993 and 1998 photos. Ground observations made by the researcher in 2006 and 2007 have shown that the change rooms are no longer located on the beach or parking lot area. In the bottom right-hand corner of the 1993 and 1998 images there is a boat launch area which provides access to the lagoon area behind the West Beach. Located slightly behind the concession area is a volleyball court

that still exists today. This area has undergone significant vegetation changes. The 1968 photo shows almost no vegetation in this area, while the 1971 images show slightly more vegetation. The 1998 image shows the most vegetation. Between 1993 and 1998, the vegetation was cleared to provide room for the volleyball court shown in the 1998 image. Ground observations in 2006 and 2007 by the researcher can verify that the volleyball court still exists.

The east parking lot provides access to the channel that separates the East and West beaches. The 1993 and 1998 images both show a pathway from the parking lot to the channel area, whereas the 1968 and 1971 images do not show this.

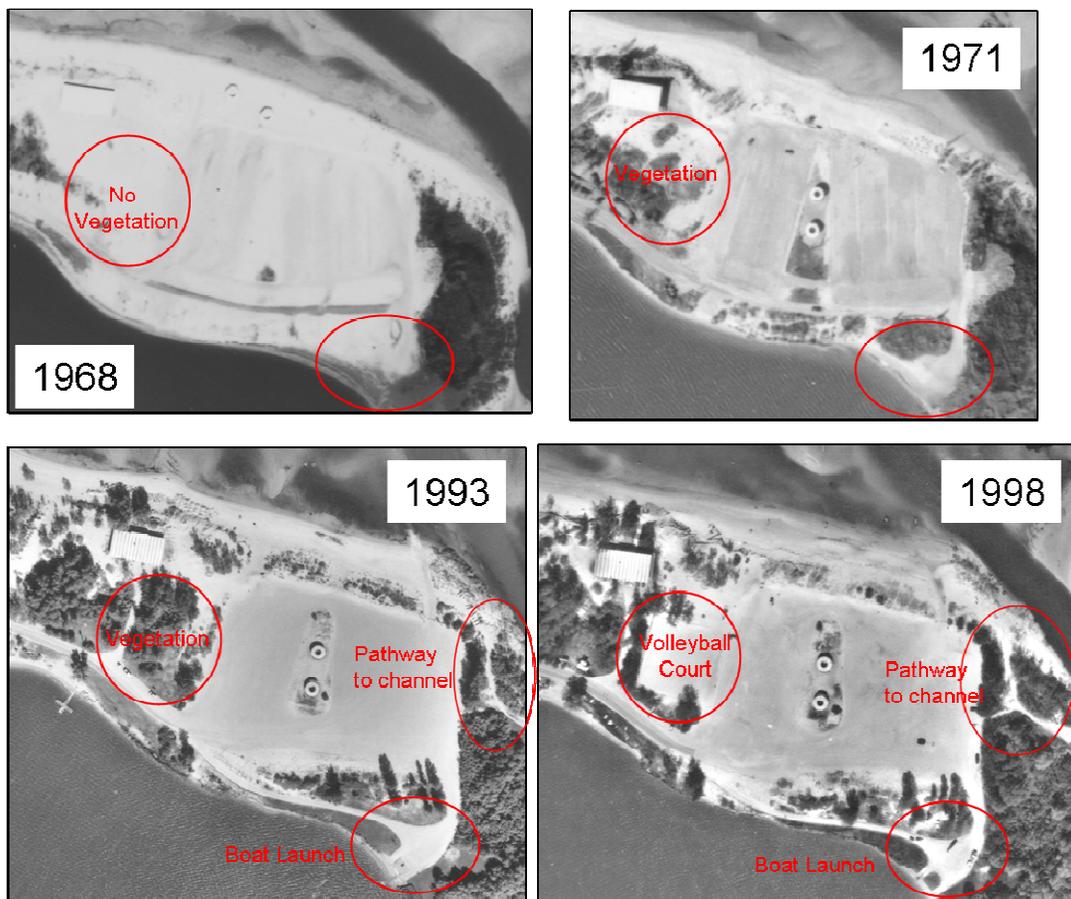


Figure 26: East parking lot – West beach (Government of Manitoba 2007)

All of the photos indicate significant changes to the Grand Beach landscape. Analysis has shown this is a natural occurrence with changes to vegetation, as well as human-induced changes by vegetation trampling creating pathways and development for recreational activities.

4.6 Guidelines for Sustainability – An Analysis of the Grand Beach Management Plan

The Grand Beach Provincial Park Management Plan was completed and approved in 2002. In Section 2 - Park Management Guidelines - the plan accurately describes the natural processes, and states the intent to preserve the beach and dune formations. These guidelines include the need for an in-depth review and documentation of the natural processes within the beach and dune area. Until this review is completed, the plan indicates that no new structures will be built. As of the writing of this thesis, the review and documentation has yet to begin. However, based on the findings in this research, new management guidelines can be presented.

As per the management plan, erosion control techniques may be introduced, including the planting of vegetation native to the area. Tree and vegetation debris collected along the beach area and snow fences may be used to prevent a blowout area. Some of these techniques have already been introduced along the beach area.

The management plan also discusses the preservation of the nesting sites for the endangered Piping Plover. Preferred nesting sites for the birds are generally blowout areas, or areas which are predominantly rockier and more pebble-like, instead of the finer sand deposits. To

date, there has been substantial protection of the nesting sites in the spring and summer (see Chapter Two for more information on protective measures).

Section Three of the management plan discusses the actual implementation, describing it as an on-going need basis. Beach and sand dune monitoring is one of the recommended priorities for the park. Other high priority projects including the revamping of the concession areas and developing a visitor centre were discussed in previous sections in the plan.

The recreational activities within the park are not adequately noted, and thus they may not be managed effectively, leading to possible threats to the beaches and sand dunes. Most other management plans reviewed in the literature review describe the various human activities in some detail.

The plan does not discuss when it will be reviewed for possible revisions to the implementation strategies. There is also no indication of a review under the *Provincial Parks Act*.

When comparing the Grand Beach Provincial Park Management Plan to similar documents from other jurisdictions, it is similar in terms of content. When comparing it to the Pinery Provincial Park Management Plan in Ontario, similar issues arose and were documented in a similar fashion. The Pinery plan, however, gives more detail about the various human activities in the park compared to the Grand Beach plan.

4.7 Chapter Summary

The qualitative methods used and the data analysis that resulted have been summarized in this chapter. The responses from the semi-structured interviews highlighted the experiences and opinions that cottagers and non-cottagers have at Grand Beach Provincial Park. Aerial photographs were also qualitatively analyzed, looking at the spatial distribution of park visitors, piping plover habitat, and changes to the landscape in the latter half of the 20th century. A review of the management plan and an overview of the literature has provided insight into the various ecological processes within the park as well as current management guidelines.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

The previous chapter showed the results of the qualitative data analysis methods used in this research. Chapter Five will provide further discussion of the issues that emerged from those methods and how they can enhance management guidelines for Grand Beach Provincial Park.

There is always some sensitivity to all natural environments and the beach and dune environment is no different. Researchers have determined that some beach and dune environments are sensitive to change. However it cannot be concluded that Grand Beach is a sensitive environment due to the lack of research in the area. From the aerial photographs, there are noticeable changes to the beach and dune area. However, this does not mean they have changed in a negative fashion; it simply means there is a visible difference. Research is needed to determine the implications of this visible change on the long-term ecological sustainability of the beach and sand dunes.

5.2 Past and Current Human Use of Grand Beach Provincial Park

5.2.1 The Days of the Train

The literature has shown humans have been using the beach intensively throughout the 20th and 21st centuries. Prior to the area becoming a provincial park, Grand Beach was serviced by the railway, with a train station located very close to the West Beach. It can be concluded that since train service began at Grand Beach in the early 1900s, there has been intense human use of the West Beach. The East Beach seems to have remained little used; the area

would have been difficult to get to in the early train travelling days, as there were no roads leading to the area. The channel that separates the East and West beaches has complex currents, making it very dangerous to swim through, thus making the West Beach more desirable for visitors to the area in the earlier days. When the area became a park in 1961, human use continued, but people traveled by car instead of train. However, intense use of the West Beach continued even though the East Beach became more accessible. Even today, fewer facilities exist on the East Beach because park officials wanted to maintain a quieter, more family oriented atmosphere (Hummelt 2009).

Aerial imagery was not available for the Grand Beach area until 1948. These earlier images show a very large beach that was more open with less vegetation, and permanent structures dotting the westernmost area of the West Beach. It is not known how these structures impacted the ecological change of the beach area, if they had any impact at all. Some persons interviewed for this research had come to the park by train in the past; they commented on how the beach seemed to be bigger and wider. This may be the case, as the aerial imagery shows much less vegetation on the beach and sand dune area, creating the illusion that the beach is bigger. Vegetation covers much of the sand dunes in Grand Beach today, making them less accessible, and possibly making a person believe they have shrunk. It may never be known if this is actually the case, as there have not been any previous studies done at Grand Beach involving sand data collection.

5.2.2 Current Use of Grand Beach

Although the method of transportation has changed, the use of Grand Beach still remains the same - the beach area for recreation. Grand Beach has a significant cottage population.

The Grand Beach Management Plan (Manitoba Conservation 2002) describes the area as having 517 cottages in “the park’s most intensely developed area”. The research has involved cottagers from this development and non-cottagers to obtain a glimpse of the current use of Grand Beach and gain an understanding of people’s needs, as well as how they use the park facilities. Chapter Four showed the results of the semi-structured interviews for cottagers and non-cottagers; this section will discuss the similarities and differences of their responses.

When comparing cottager responses to non-cottager responses, some of the responses vary greatly, while others are very similar. Cottagers are generally in the park for a longer period of time throughout the year, whereas the non-cottagers mostly visit in summer. However, when non-cottagers use the beach, they are often there much longer than the cottagers. The average cottager spends one to three hours at the beach, whereas non-cottager spends at least four hours per visit. Although cottagers are in the park boundaries longer (a weekend, for example), they spend less time at the actual beach area than non-cottagers. The cumulative amount of time spent at the beach by a cottager, however, may be equivalent to a non-cottager coming to the beach a few times during the summer season.

The economic activities vary between the cottager and non-cottager groups. Cottagers have expressed their desire to support the local economy, which involves using the various amenities found in the town of Grand Marais outside the west park gate. Non-cottagers prefer the convenience of the concession stands found along the West Beach, or they bring their own food and snacks. Most non-cottagers, once at the beach, will stay there for the duration of their stay. Some non-cottagers noted they may use the amenities outside the park

on their way home, getting an ice cream cone or a light meal. These economic patterns are very different and should be addressed in future research studies of Grand Beach.

When discussing ecological processes in the park, cottagers' and non-cottagers' responses aligned in some instances. It was interesting to note that all 30 persons interviewed seemed to know the reason why grass grew on the beaches and sand dunes. The Dune Book (Rogers & Nash 2003) describes how important vegetation is on a sand dune, as it will trap blowing sand to form sand dunes and stabilize them. The participants all had a response that would coincide with this description. The research would thus conclude that many of the people who visit the beach know the importance of vegetation on a sand dune.

The spatial distribution of beach users is similar to the historical use of Grand Beach, with modern facilities found on the West Beach. Visitors are becoming more aware of their natural environment and demand greater conservation and education of these areas. The following section discusses some of the issues raised during the interview process.

5.3 Emerging Issues

Prior to the area becoming a provincial park in 1961, there were no specific regulations set for the beach. The benefits of becoming a provincial park include protection and management. The land-use categories help to protect particular areas. The beach and dune area in the park are within the recreational land use category which has the least amount of protective measures, however recreational development and public education are encouraged.

The participant interviews have shown there are several emerging issues associated with Grand Beach. This next section discusses each issue in more detail and how it relates to the management guidelines found in the Grand Beach Provincial Park Management Plan.

5.3.1 Algae, *E. coli* and Water Quality

Within the interviews for this research, water quality and the threat of *E. coli* were discussed. None among cottagers and only 30% of non cottagers have a growing concern for the change in the water quality of Lake Winnipeg, and have altered their beach activities because of the decrease in water quality. Since the 1980s several beaches surrounding Lake Winnipeg have been carefully monitored for *E. coli*. Only a few beaches have had high *E. coli* levels and had to post signs of the possible danger to humans. However, in summer of 2005, 12 of the 17 beaches around Lake Winnipeg tested positive for *E. coli*. The normal range of *E. coli* bacteria is 200 *E. coli*/100 mL, but several of these beaches saw counts more than double the norm (Manitoba Water Stewardship 2005a). Manitoba Water Stewardship have samples taken daily between June and September at Grand Beach, which is more than the recommended number by Health Canada. This in turn leads to more days of exceedences in guidelines, but paints a more accurate picture than other locations that may report less exceedences (Wendy Ralley, Personal Communication). The beach advisories that were erected were only minor advisories, meaning swimmers would probably not get sick but nevertheless should take precautions. Precautions included rinsing after coming out of the water, washing hands before eating and not swimming with open cuts (Manitoba Water Stewardship 2005a).

The Outdoor Recreation Master Plan for Grand Beach Provincial Park noted the decline in water quality on Lake Winnipeg stating: “The accumulation of industrial wastes and the subsequent chemical pollution (especially Mercury) caused Lake Winnipeg to be closed to Commercial Fishing for the summers of 1970 and 1971”. It also cites the continuance of industrial wastes and organic solids being deposited into Lake Winnipeg waters. Water quality issues on Lake Winnipeg continue today.

Williamson and others (2004) concluded that the main source of E coli around Lake Winnipeg was not from human or agricultural causes, but from the gulls and terns flying overhead at the local beaches. When beach visitors leave the area, the birds move in to feed in the area, leaving large amounts of fecal material in the beach zone closest to the shoreline. E coli levels can also rise when winds bring waves up onto the dry sandy shore, moving fecal material into the shallow bathing water. E coli levels gradually decrease in deeper waters over 6 feet (Wendy Ralley, Personal Communication). One recommendation was to not feed them, as well as keeping the recreational area free of garbage, which is a popular meal for the birds. When the wet portion of the beach is raked, this can move the fecal material around and cause an increase in e coli (Wendy Ralley, Personal Communication). Many participants interviewed noticed a significant amount of garbage left in the sand by visitors. The researcher also made similar observations and also noticed many children feeding the gulls, or the gulls going into the open garbage cans to feed. One hundred percent of participants interviewed noticed the gulls on the beach feeding off of garbage and items washed ashore. However, only four of the 30 persons interviewed saw gulls as a threat to the beach and sand dune area. The documentation describing the bacteria research is not well known. It is a

government released technical report, and most beach visitors are not aware of the correlation between *E. coli* and the gull population.

Algae and algal blooms can make the lake unappealing, as well as decreasing its safety for swimmers and boaters. Blue green algae is one of the most toxic algae, and is common during the summer months on Lake Winnipeg (Wendy Ralley, Personal Communication). Blue green algae require warm temperatures, nutrients and sunlight in shallow waters, all of which are common along the shallow shores of Lake Winnipeg, including the Grand Beach area. Not only are humans impacted by blue green algae, pets and cattle have been known to become seriously ill from drinking water containing the algae, and have even resulted in animal deaths. Blue green algae is also toxic to filter feeders such as clams and fish. Because the blooms are unattractive, odorous and toxic, they can hinder or prevent recreational use altogether. One method that has been used in other jurisdictions for managing algal blooms is through the use of copper sulphate. Copper sulphate is added to the area of the lake where algae is found and the chemical effectively destroys the algae, allowing humans to once again enjoy and use the lakeshore. However, too much copper sulphate is often added, causing many other organisms to die off along with the algae. This in turn contributes to oxygen depletion while also releasing phosphorus from the lake sediment, creating a larger phosphorus supply which will encourage algae growth (COSEWIC 2002).

Although Grand Beach Provincial Park can benefit from some of the research studies, they have not directly focused on the area. Grand Beach has a rare landform feature along the shores of Lake Winnipeg and although there are other beaches in the south basin of the lake, very few or none have the large amount of sand supply to produce the sand dunes found

within the provincial park. To increase the quality of the water in Lake Winnipeg is beyond the scope of this research, and water quality is currently not considered in the Grand Beach Provincial Park Management Plan. Participants in the interview process make several comments regarding their concern over the decreased water quality in Lake Winnipeg, and their activities have been altered - either by not using the lake for recreational activities or avoiding the beach altogether. Management guidelines associated with quality should be included in the current plan for the park. An increase in interdepartmental communication between the Parks Branch and Manitoba Water Stewardship can aid in this issue and the role it plays in beach areas.

5.3.2 Garbage and Recycling

Interview participants noticed there is not a significant recycling program in the park. With most non-cottagers using the concession facilities for food and drink or bringing their own, empty pop bottles and cans have nowhere to go except in the garbage. Most individuals practice recycling in their homes. Thus when they come to a provincially-run park, they expect the same type of facilities to be available to them, such as a recycling bin beside the garbage cans. Within the cottage area, there are no recycling facilities and very limited garbage service. Most cottagers and non-cottagers interviewed would use a recycling facility if it were available.

As mentioned in the previous section, garbage has become a concern in the park. With *E. coli* associated with the number of gulls on the beach, more attention should be paid to the proper handling of garbage. Garbage bins in the park are open on the top, allowing gulls to feed freely. Although it may be more costly to have a garbage and recycling program in the

park, it may be more appealing to beach visitors if recycling were available which could decrease the amount of garbage on the beach. However, garbage cans that are covered as well as more bins throughout the park may be suitable solutions for keeping animals away from the garbage.

5.3.3 Signage

It has been discussed with interview participants how signage is interpreted at Grand Beach Provincial Park. Four of the 30 participants told the researcher they would not stop and take the time to read signage about the natural processes in the park. However, most responded in a more positive manner, explaining they would take the time to review signage about natural processes. Some participants suggested areas where they felt the signs would be most effective.

Signage is important for the park visitor to gain a better understanding of the natural environment. When placed correctly and displaying aesthetically pleasing graphics, signage can provide self-serve interpretation, where visitors become more aware of the various processes occurring within the park, and learn to respect them, in turn creating a more educated visitor. Peach (2004) discusses how signage may be the only form of environmental education for the dunes and why their conservation is so important in Sauble Beach. The Sauble Beach Management Plan also describes several different types of appropriate signage for hazards, education and interpretation. Placement, visibility and wording recommendations are also provided. These factors have a significant impact on the visitor. If a sign is not worded correctly, or has a negative message, the visitor will not choose to read

further signage. Providing a more positive message on a sign encourages reading, awareness and education.

Much of the existing signage in Grand Beach Provincial Park describes several hazards, generally found directly on the beach (Photo 12). Although the signs in the park do provide awareness, they do not encourage the park visitor to gain appreciation of the park's unique environment. There is a small number of signs that describe the natural processes throughout the park. However, there are very few at the beach entry points and on the beach. The beach and dune area of Grand Beach falls under the Recreational Development land use category of the *Provincial Parks Act*, which promotes educational awareness and the promotion of the park (Manitoba Conservation 2002). A low-cost way of promoting environmental awareness of the beach and dune processes is through strategically placed interpretive signs along higher traffic walkways to the beach area. Participants in the interviews have said the best suited areas for interpretive signage is along the boardwalk, and the walkway from the parking lot and concession at the Mid-West Beach area.



Photo 12: Signage near the channel – West Beach (A. Demski 2007)

5.3.4 At-Risk Species and Beach Visitors

Chapter Four showed the spatial distribution of the endangered Piping Plover and human use of the beach. Most beach users prefer the West Beach area closest to the boardwalk, and the Piping Plover's preferred habitat is further east on the West Beach. However, there are times when these areas overlap, exposing the sensitive nesting areas to human activity. It is stated in the Grand Beach Management Plan that beach maintenance and park operations will be amended to reduce the disturbance to the nesting sites. However, the management plan does not provide direct guidelines for human activity on the beach associated with Plover nesting areas. Under the *Provincial Parks Act* (Government of Manitoba 1993) and the *Endangered Species Act* (Government of Manitoba 1990) there is no mention of these unique areas.

The purpose of the *Endangered Species Act* is to ensure the protection and survival of endangered species in the province. It also states in Section 10 (1) that no person shall destroy, disturb or interfere with the habitat of an endangered species. The key areas for Piping Plover nesting in Grand Beach Provincial Park are located in a recreational land use category, which has been designated to accommodate more intense recreation, in turn causing a disruption of habitat. Miller (2006) has recommended that recreational activities be restricted at all active nesting sites in Grand Beach Provincial Park. Within a recreational land use category in a provincial park this recommendation however may not be feasible, as the purpose of these areas is for recreational use.

The *Endangered Species Act* ensures the protection of endangered species and habitat is not disturbed. However, the *Provincial Parks Act* designates the recreational land use category as having the highest level of recreational activity in a provincial park. Areas such as these can make adequate habitat protection difficult. Miller (2006) has also made a recommendation based on the high recreational activity on the West Beach of Grand Beach that special status be given to these areas to protect the habitat where endangered species are known to nest.

The other at risk species, the Hairy Necked Tiger Beetle, relies on the beach and dune habitat with very little human traffic. Their habitat needs should be further researched to ensure their breeding success in Grand Beach Provincial Park.

5.3.5 Human Impact on Sand Dunes

An impact that humans can impose on the beach and sand dune system can initiate a negative chain reaction, beginning with walking on unstructured pathways through the dunes. This causes the removal of vegetation on the dunes. Once the vegetation is removed, the sand on the dunes is exposed to wind erosion, further pedestrian traffic, and possibly a sand dune blow out, causing a loss of sand and vegetation in the beach and sand dune system (Peach 2004).

Access to the West Beach in Grand Beach Provincial Park requires individuals to walk from the parking lots to the beach area. There are several large parking lots on the opposite side of the sand dunes, which requires people to cross the dune area to get to the beach. In some areas, people have a tendency to find the shortest route possible, which generally results in makeshift pathways through the vegetation on the sand dunes (Photo 13).



Photo 13: Unstructured paths through the sand dunes (A. Demski 2007)

In Chapter Four, the aerial photographic analysis showed significant changes to high traffic areas from these large parking lots, and pathways were very evident. This appears to be an obvious trend, and by not preventing all park visitors from going through the dunes, the unique ecological area of the beach and sand dunes will not be protected. Other parks have noticed similar issues. “Dune Cones” are described as being a form of erosion pattern based on pedestrian traffic through dune areas (Peach 2004). To prevent this from occurring, pedestrian traffic to the beach should be re-routed through areas that are less susceptible to erosion. In some areas this may not be possible, and a smaller area may be compromised in order to preserve a larger area.

There are currently no guidelines in place to monitor these pathways to determine if they are causing a negative impact. Other parks have limited the number of pathways through dune areas by creating permanent wooden pass-overs, or portable cordwalks through the sand dunes. This allows park visitors to still enjoy the sand dune area in a more structured fashion, thereby eliminating makeshift pathways

5.3.6 The Management Plan and the *Provincial Parks Act*

Under Section 5 of the *Provincial Parks Act*, one of the purposes of the provincial park system includes conserving ecosystems and maintaining biodiversity. Within the Act, however, there is no official definition of biodiversity. DeLong (1996) did an extensive literature review and identified 85 different definitions of biodiversity. The term may have a different meaning to different people and different government departments. It would be important to know how the *Provincial Parks Act* defines biodiversity and how it is maintained in provincial parks.

5.4 **Proposed Management Guidelines in Grand Beach Provincial Park**

The previous chapters have discussed existing management practices and guidelines in Grand Beach Provincial Park. During the management planning process, several park issues were identified and then documented in the management plan, including specific guidelines for each issue. As time progresses, new issues emerge and the Grand Beach management plan must adapt to provide the protective measures the beach and dune area requires. In Grand Beach Provincial Park there are several park values that conflict with each other including dune processes, recreational beach use and habitat for birds including the Piping Plover. This section will propose new management guidelines that will assist Grand Beach in adapting to changing issues.

Proposed Management Guideline #1: Adopt an adaptive management process

The adaptive management process may prove to be beneficial in Grand Beach Provincial Park. Sabine and others (2004) described adaptive management as “an approach that includes scientific methodologies in the design, implementation and evaluation of management strategies.” It is an excellent tool for evaluating and integrating issues associated

with natural resource management as it is generally cyclical in nature, where the whole process may be repeated over time (Sabine and others 2004). In order for adaptive management to be deemed successful, management has to remain flexible and be willing to change its management practices wherever necessary. Adaptive management involves both social values and science in order to create a more sustainable management method of natural systems (Haney & Power 1996). By taking an adaptive-management approach, each of the management strategies and guidelines are continuously monitored and evaluated, ensuring the long-term sustainability of the park environment.

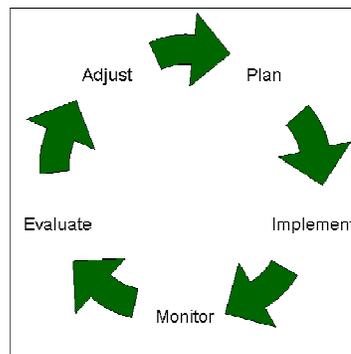


Figure 27: Adaptive management process
(Adapted from Ontario Parks, 2008)

Proposed Management Guideline #2: Manage access to the beach area

Uncontrolled access to the West Beach has resulted in several disturbances throughout the sand dune area including the creation of unstructured pathways from the various parking lots. The literature review showed that vegetation disturbances on the sand dunes can lead to a loss of sand and blowouts are generally the results. Existing routes to the beach and sand dune area need to be monitored, and negative impacts need to be phased out. The completion of a disturbance study will derive proper solutions for controlled access and sand dune preservation. For areas in the sand dunes where pathways are permitted, guidelines

should be established to ensure the long term sustainability of the various sand dune habitats.

Proposed Management Guideline #3: Outline short and long-term monitoring needs

The Grand Beach Management Plan has recognized the need for beach and sand dune monitoring in its implementation plan. This will require additional research and should be done in consultation with scientists and stakeholders in a variety of disciplines, with adequate funding to successfully monitor the ecology of the beach and sand dunes in Grand Beach. Therefore priority areas within the park can be determined with a suitable time frame laid out, ensuring the various environmental needs of the park are being met and coinciding with park user needs.

Proposed Management Guideline #4: Encourage public engagement in park management

One way to initiate change in a park setting is to encourage public participation in park management. Some of the needs that were addressed in this research include: better signage, education and awareness, water quality, and suitable garbage and recycling facilities. It would be beneficial for Manitoba Conservation to establish visitors' needs within Grand Beach Provincial Park (and other parks) and adapt its management strategies based on visitor need.

Proposed Management Guideline #5: Facilitate partnerships and scientific research opportunities

Other jurisdictions have found success by forming scientific partnerships and creating educational outreach. The partnership between volunteer stewards and scientific researchers

creates a balance between scientific knowledge and basic recreational needs of beach visitors. Partnerships such as this allow for many agencies to share costs and knowledge, in turn creating a more enjoyable beach experience. Manitoba Conservation should take the lead by promoting research in Grand Beach Provincial Park related to the ecological processes associated with the beach and sand dunes. Lake level control, water quality and change in vegetation over time on the sand dunes are all issues that have emerged from this research. Manitoba Conservation has an opportunity to offer these scientific opportunities in Grand Beach Provincial Park as they relate to the overall health of the beach and sand dunes.

Management practices and monitoring strategies that are developed need to consider all aspects of the parks use, that is, all flora, fauna and human use needs to be taken into account. Enlisting the assistance from experts, learning from other jurisdictions, testing and adapting techniques all will ensure the long-term sustainability of Grand Beach Provincial Park.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The Grand Beach Provincial Park Management Plan (Manitoba Conservation 2002) identifies the need to “document the natural processes that maintain and replenish the beach and sand dunes at Grand Beach”, as well as develop management guidelines for the recreational use of the beaches and sand dunes.

The purpose of this research was to define management guidelines for the ecological sustainability of the beaches and sand dunes in Grand Beach Provincial Park. This research consisted of an examination of literature and an assessment of the spatial distribution of the past and current use of the beaches and sand dunes, and is underpinned by a survey of people’s use of the beach that includes both cottagers and non-cottagers.

6.1.1 Semi-structured Interviews

Thirty persons participated in the survey, which included cottage owners and non-cottage owners. The largest concerns that both groups had were the quality of the water and the number of people on the beach on any given weekend. Although most respondents knew why it was important for beach grasses to grow on the sand, the respondents were not concerned with the health of the beach and sand dune area.

Both cottage owners and non-cottagers were concerned about garbage and recycling. Cottagers were more concerned about the volume of garbage within the cottage area, while non-cottagers noticed garbage more on the beach.

Algae problems have been occurring for decades on beaches in the Lake Winnipeg South Basin. However, water quality has only been a recent issue, which is beginning to have an impact on how persons visiting Grand Beach engage in daily activities. Parents are beginning to be more aware of the issues and will either not go to the beach at all, or will be more aware of the activities of their children such as making them thoroughly wash themselves after contact with the lake. Although cottage owners still appreciate the fact that Grand Beach is close to the city, they too are changing their activity patterns and swimming less in Lake Winnipeg. If water quality of Lake Winnipeg continues to decline, and the number of people who use it for recreation declines, the economic impacts to the Grand Beach area may become more negative causing local businesses to close, and permanently altering the cottage landscape.

6.1.2 Aerial Photograph Interpretation

Aerial imagery provided spatial and temporal analysis of Grand Beach Provincial Park. The earliest photo set collected is from 1948, with the most recent images being from 1998. Part of a qualitative data collection includes visual interpretation of images and although a simple interpretation of the photos was done for this research, it provided a past and current view of the park, including the period when the area was not a provincial park. Some changes were very visible, including a very noticeable change in vegetation on the back portion of the West Beach. The vegetation in this area appears to be encroaching onto the beach and sand dune area.

6.1.3 Literature Review

A literature review was completed that described the history of human use at Grand Beach Provincial Park, ecological processes specific to the park, and the various management guidelines associated with other jurisdictions in Canada with similar natural features.

Reviewing the relevant literature has shown that there is a significant gap in research aimed directly at Grand Beach Provincial Park. In order to provide sound management guidelines, background knowledge of previous research and ecological aspects need to be known.

6.2 Conclusions

Changes in the beaches and sand dunes in Grand Beach Provincial Park are a function of long-term ecological processes and equilibrium change. Human activities can impact vegetation distribution, wildlife nesting habitats and sand supply on the beach and sand dune area. From this research, further management strategies have been developed for the beaches and sand dunes in Grand Beach Provincial Park that are directed at long term ecological sustainability.

Conclusions drawn from this research are as follows:

1. Ecological processes associated with the beaches sand dunes at Grand Beach Provincial Park are not well understood. The literature reviewed for this research described ecological processes and methods used in other beach and sand dune environments, not Grand Beach. The literature shows a significant gap in the management and research regarding Grand Beach. Therefore, the processes within the Provincial Park have yet to be properly documented. Spatial analyses of the beaches and sand dunes have shown a

change in distribution of vegetation. However, it has not been determined why this is occurring, and if it has a positive or negative impact on the beaches and sand dunes.

The beach and sand dune environment is not static and is always changing. The process of sand being pushed into the dune area during a storm or high winds is not well understood in this area. However, once the sand reaches the dune area, it adds to the already complex ecosystem consisting of small grasses, shrubs, birds and animals. The literature review has shown that the natural processes including plants animals and the beach ecosystem specific to Grand Beach Provincial Park have yet to be documented.

2. Ecological sustainability is directed at maintaining the normal ecological processes within an ecosystem along with the limits, or carrying capacity, of the environment at varying scales. Literature from other jurisdictions has shown how humans are learning to respect the natural beach and sand dune environment by limiting certain activities that can have a negative impact on the beach and dune environment. Analysis using aerial imagery of Grand Beach Provincial Park has shown an increase in vegetation on the sand dunes over time, an increase in human-made pathways through the sand dunes to access the beach area, and development for recreational activities. In Grand Beach Provincial Park, there have been changes to the environmental conditions over time including the quality of water in Lake Winnipeg, changes to weather patterns and lake levels, as well as a change in the sand dunes and overall nature aspect. It can be concluded that Grand Beach Provincial Park has yet to determine the ecological limits of change as related to long-term ecological sustainability of the beaches and sand dunes.

3. Visitors are receptive to change; they want the best possible experience while at the park, including more education and environmentally sound park operations. Park visitors interviewed for this research feel that more can be done to protect the park, through enhanced education, environmental protection and awareness. Many visitors are not aware they are sharing the beach with an endangered species, the Piping Plover, which may negatively impact the Plover population. Much effort has been put into the recovery of the Plover population; however, steps should be taken to ensure sufficient education to the public.

4. Current management practices have yet to adapt to the changing environment in Grand Beach Provincial Park. The public has expressed concern regarding the change in water quality, which has resulted in changes to the visitors' experiences. Park management can adapt to these changes to ensure that ecological needs are being met. The Grand Beach Provincial Park Management Plan states that there will not be any more construction on the beach until further research has been completed, a positive sign that Manitoba Conservation is responsive to the unique environment and is willing to take possible protective measures. The management guidelines proposed in this research will only enhance the visitor experience to the beach and dune area of Grand Beach Provincial Park, in turn maintaining an ecologically sustainable environment.

5. The use of aerial photographs has proven to be highly beneficial for detecting changes in the beach and dune landscape. Reviewing aerial imagery, it can be concluded that there are changes occurring. However it is unknown whether these changes have a positive or negative impact and why they are occurring.

6.3 Recommendations

Based on the previous conclusions, recommendations can be proposed.

1. Recreational use of the beaches and sand dunes in Grand Beach Provincial Park should be managed to reflect the changing environment. Grand Beach Provincial Park could benefit from other management practices already engaged in other provincial parks in Canada with similar natural features including the adaptive management process.
2. The scientific knowledge of the biodiversity and ecology of the beaches and sand dunes in Grand Beach Provincial Park should be increased. This will lead to better management within the park. A more in-depth biophysical of the beaches and sand dunes, including inventory of flora and fauna species is recommended within Grand Beach Provincial Park. Without a thorough understanding, the ecological needs of the park will not be met.
3. In Chapter Five, management guidelines were established for the beach and dune area of Grand Beach Provincial Park. Manitoba Conservation should develop a plan to implement these guidelines. A beach and dune management plan specific to the park will directly focus on the small and unique environment and will ensure the human impacts will not negatively affect the beaches and sand dunes in the Park.
4. A monitoring plan should be developed that incorporates the natural environment with the human dimension of the park. This recommendation would be contingent on the

completion of a biophysical study of the park. Mapping and monitoring every 5 years through the adaptive management process would prove to be beneficial.

5. Manitoba Conservation should engage park visitors through signage, education and awareness of the natural environment and ecology in Grand Beach Provincial Park. The more park visitors know of their surroundings, more effort will be made to protect and maintain the beaches and sand dunes.
6. The scientific community should be encouraged to form partnerships for further research studies in the park including:
 - a. GIS and Mapping Study: GIS, remote sensing and mapping technology would be an advantage to monitor change of the beach and sand dune ecology and further understand the dynamics of beach visitors. The provincial government has established GIS initiatives; this project would be a low cost project and would provide a spatial aspect to the management of the beaches and sand dunes.
 - b. Biodiversity Inventory: Within the park is a federal/provincial program for the endangered Piping Plover. Partnerships between the federal and provincial governments as well as the scientific experts at the university level can lead to a more thorough understanding of the biota found in the beach and sand dune area of Grand Beach Provincial Park. Involving Non Governmental Organizations as well as community groups would only enhance the inventory process.

- c. Social Aspects of Park Visitors: Several university–based projects are directed at the recreational value a park has for their visitors. Grand Beach Provincial Park can benefit from such studies to further engage park visitors while enhancing their experience.

- 7. Already within Grand Beach Provincial Park is the Grand Beach Cottage Association. These individuals have a vested interest in the ecological success of the park. However, many others have an interest in the conservation of the beach and sand dune ecosystem, and establishing a community organization can bring dedicated volunteers to the beach and dune area that want to see the area flourish in its natural state. This kind of initiative would use the Grand Beach Management Plan and this research to guide their conservation efforts. The Provincial Government may not always have Grand Beach Provincial Park at the top of their list for funding. Community organizations dedicated to the beach and sand dunes in Grand Beach Provincial Park can raise funds, accept donations, and volunteer time to ensure that the ecological integrity of Grand Beach Provincial Park is maintained.

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APPENDIX ONE:
JOINT-FACULTY RESEARCH ETHICS
BOARD APPROVAL CERTIFICATE

APPENDIX TWO:
CONSENT FORM TO PARTICIPATE IN
RESEARCH

Consent Form

Research Project Title: **Beaches and Sand Dunes in Grand Beach Provincial Park, Manitoba: Development of Management Guidelines and Monitoring Strategies to Ensure Long Term Ecological Sustainability**

Researcher: **Allyson Demski – Natural Resources Institute
University of Manitoba**

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to examine various management issues surrounding Grand Beach Provincial Park. Part of this research will look at the physical processes that occur within the park, and the other part of this research will look at how visitors to the park perceive these physical processes. Visitor assessment within the park is an integral part of this research project, by filling out this questionnaire; you are providing very important information to the research team to assess and analyze how visitors like yourself experience Grand Beach Provincial Park.

Following this consent form is a questionnaire that should take no more than 30 minutes to complete. It will ask for some personal information that will be used for statistical analysis only. However, your name, address, phone number will not be put into this survey to allow confidentiality. However I will ask you very easy to answer questions about your visits to Grand Beach Provincial Park. There is no risk to you to answer these questions, and no recording devices will be used in communication with the research team. **Answers will be handwritten by the principal researcher, a tape recording device will be used to ensure the accuracy of the participants responses. You may withdrawal from the questionnaire anytime without penalty or explanation; this is strictly a voluntary procedure.**

The information that will be collected from you will be kept confidential. The persons that will have access to the collected information will be the principal researcher (Allyson Demski) and the supervisor (Professor Thomas Henley). Your name or any other personal information will not be collected; however, you will be asked your age, gender and the city you live in, addresses will not be collected.

Once the data is collected, compiled and analyzed, it will be available to review by contacting the principal researcher through phone or email in the spring of 2008. **All the data that will be collected will be stored in a secure cabinet in the principal researcher's office. Any entries made electronically will be on a separate USB memory drive that will be used solely for this project. All recorded material will be destroyed five years after the project has been completed.**

Currently, there is no monetary compensation being offered to participants. The principal researcher gratefully acknowledges your volunteer participation in this process.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Principal Researcher: Allyson Demski
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The Joint Faculty Research Ethics Board has approved this research. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

Participant's Signature

Date

Researcher and/or Delegate's Signature

Date

APPENDIX THREE:
INTERVIEW SCHEDULE

Interview Questionnaire

Introductory Remarks to be addressed to the participant

Thank you for meeting me today.

As I have previously mentioned, the purpose of your participation in this questionnaire is for my master's thesis research at the Natural Resources Institute at the University of Manitoba. Your participation today will provide qualitative information for my research, which will assist in fulfilling my thesis objectives.

The format of this interview will be as follows:

Before we begin the formal part – we will review and sign the consent form – giving myself permission from you to ask you the questions that follow.

I will ask a series of questions, some of the questions will have options which your answer will fit into. Other questions will be open ended, that is, you can speak freely and answer the best to your knowledge.

Once the formal questions are completed, you are more than welcome to ask any questions you may have, as well as provide any additional comments you wish regarding this research.

During the entire interview – there will be photos and maps available to you to use as reference – there will also be some questions asked where you will look at the map to assist in your response

You may also choose to withdraw from the interview at any time.

Are there any questions before we begin?

Introductory Questions

Researcher: *“This section will provide some basic demographic information. That is, WHO is visiting the park?”*

1. Male or female? (because this is a face to face interview, this question will not be asked directly)
2. Where are you from? (City & Province)
 - a. If you are from Winnipeg, which end of the city do you reside in?
North, East, South or West?
3. What is your age?

4. What your approximate average household income?
5. What is your highest form of education?
6. If you have a cottage in the area, which cottage community?
 - a. Do you drive or walk to the beach area from your cottage?
 - b. Please use the maps provided to identify the location of the cottage
7. When you visit Grand Beach Provincial Park, do you use a day pass, or do you have a seasonal park pass?

Social Aspects

Researcher: *The following questions are general visitor information, that is, what your normal activities would be on any given visit to Grand Beach.*

1. On an average visit to Grand Beach, how many people are in your group including yourself? _____
2. How many of them are in each of the following age categories
 - a. 0-12 _____
 - b. 13-19 _____
 - c. 20-29 _____
 - d. 30-59 _____
 - e. 60+ _____
3. On an average visit to GBPP, who do you visit the park with?
4. Do you prefer the East Beach or the West Beach? Why?
5. What activities to you partake in while there?
 - a. Using the maps and photos provided – please indicate where you would partake in the activities
6. On an average visit to GBPP, how many hours would you spend at Grand Beach? _____ (# hours)
7. On average, what time of day do you primarily visit Grand Beach (check one that best applies)

- a. Before noon
 - b. Noon-4pm
 - c. After 4pm
 - d. All or most of the day
8. How does the weather affect your decisions to visit Grand Beach?
(choose one)
- a. Does affect it
 - b. Somewhat affect it
 - c. Greatly affects it
9. What seasons do you visit the park?
10. What activities do you do while at the park during each season you are there?

Economic Aspects

Researcher: *The next set of questions will deal with what type of economic activities that you do while at the park.*

1. What are some of the venues within the park that you go to on an average visit?
 - o Including:
 - Restaurants, gas stations, gift shops, convenience stores, concession stands, and any other that may apply.
 - Approximately how much money would you spend at each?
 - Please indicate on the map where those facilities are
2. On an average trip to Grand Beach, how much money do you usually spend?
 - o This should include the amount of money spent on gas to drive to the park.

Ecological/Environmental Aspects

Researcher: *“The following questions are based on the ecological environment of Grand Beach”*

1. How do you access the beach?
 - a. Structured walkways
 - b. Make shift pathways through the dunes
 - c. Other (please specify)

2. Do you feel there is enough access to the beaches from the parking lots?
 - a. Using the maps provided – please indicate which park gate you go through and which parking lot you normally park at
 - b. Is there an area that you would prefer to park in but cannot because it is too busy? If so please indicate using the map/photos provided

3. If there were signage about sand and dune processes, would you take the time to read them?

4. Why would you think is it important that beach grass and other plants grow on the sand dunes?

5. If signs were posted about these processes, would they influence how you use the beach and dune area at Grand Beach?

6. Are you aware of the protection of the piping plovers in the park?
Researcher to respond if asked “what is a piping plover”: Piping plovers are small birds that like to nest in rockier beach areas - there is a photo on the computer screen of a piping plover

7. What do you know about piping plovers, and are you concerned about their habitat?

8. What is your overall impression regarding the state of nature in the park?
 - a. Do you see wildlife when you visit the park? If so, what kind of wildlife
 - o Include everything, from insects to mammals

9. When you sit on the beach, do you notice any possible threats or negative impacts to the beaches and dunes?

10. Does the threat of E.coli affect your activities at the beach?
 - a. Do you think E. coli has an impact on the ecological activities in the beach and dune area? That is, do you think it affects the natural environment?

11. What is your overall impression of Grand Beach Provincial Park?

12. Please refer to the maps and aerial images and indicate if there are areas of the park that you feel are more desirable and areas that are less desirable – why do you feel that way?

13. Have you been to other beaches in Manitoba?
 - a. If so, how does Grand Beach compare in terms of the status of the natural beach environment?

14. What can Grand Beach Provincial Park officials do to improve your overall experience at the park?

15. Do you have any other questions or comments regarding what was discussed today?

Researcher: *Thank you for taking the time to talk with me today, your responses are very valuable to my research.*

APPENDIX FOUR:
ANIMALS IN GRAND BEACH
PROVINCIAL PARK

Mammals of Grand Beach Provincial Park

Pygmy Shrew	Muskrat
Masked Shrew	Meadow Vole
Arctic Shrew	Southern Red-backed Vole
Water Shrew	House Mouse (introduced)
Short-tailed Shrew	Brown Rat (introduced)
Human	Meadow Jumping Mouse
Little Brown Bat	Black Bear
Long-eared Bat	Grizzly (extirpated)
Red Bat	Raccoon
Hoary Bat	Grey Wolf (extirpated)
Silver Bat	Coyote
Snowshoe Hare	Red Fox
White-tailed Jack Rabbit	Cougar (rare)
Eastern Cottontail	Canadian Lynx
Woodchuck	Bobcat
Thirteen-lined Ground Squirrel	Ermine
Richardson's Ground Squirrel	Least Weasel
Fox Squirrel (rare, recent immigrant)	Mink
Grey Squirrel	River Otter (extirpated)
Red Squirrel	Striped Skunk
Northern Flying Squirrel	American Badger
Eastern Chipmunk	Mule Deer (extirpated)
Least Chipmunk	White-tailed Deer
Northern Pocket Gopher	Moose (extirpated)
Canadian Beaver	American Elk (extirpated)
Deer Mouse	American Bison (extirpated)