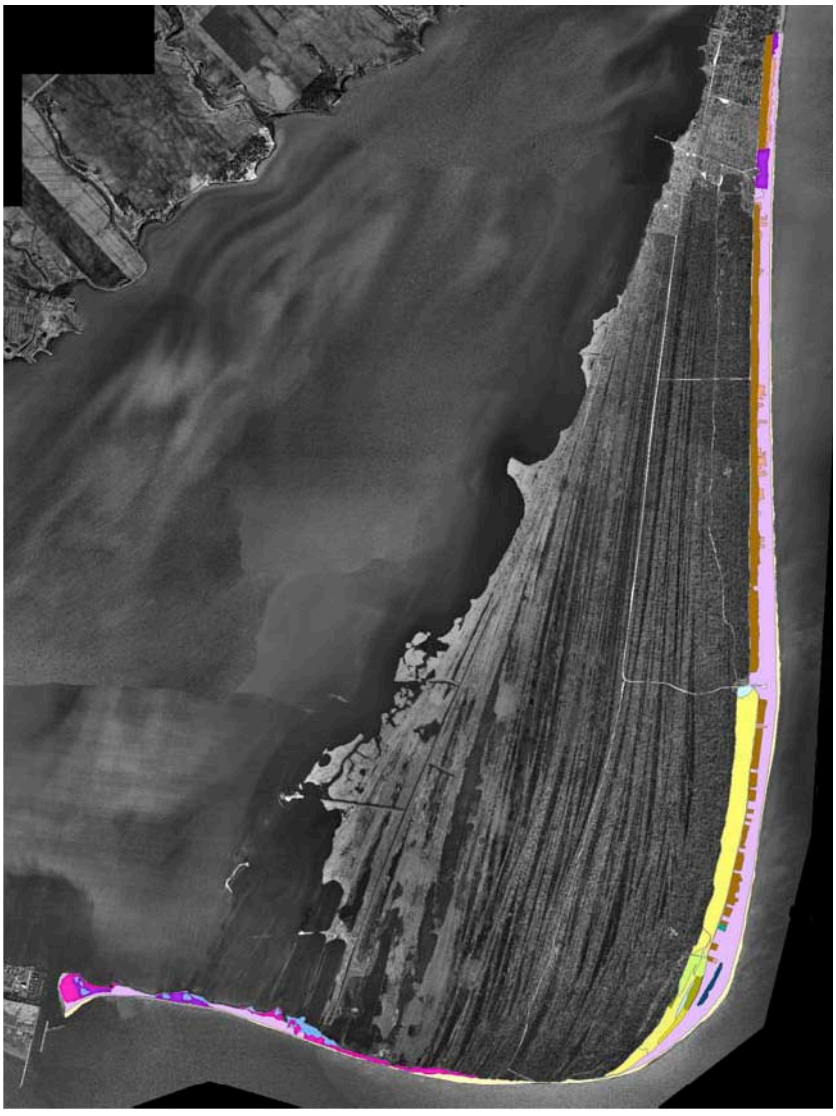
Coastal Vegetation and Dune Disturbance Change Analysis for Rondeau Provincial Park, 1955-2006



Ontario

Ministry of Natural Resources and Forestry

Parks and Protected Areas Policy Section

July 2012

Webpage title: Analysis to the changes of Rondeau Provincial Park's coastal vegetation and dune disturbance

Webpage description: This report covers a Ministry of Natural Resources and Forestry study on the changes to coastal vegetation and dune disturbance in Rondeau Provincial Park between 1955 to 2006.

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Table of Contents

Executive Summary

Through the interpretation of aerial photographs taken over the last half century it is possible to chart the disturbance of ecologically sensitive sand dunes in Rondeau Provincial Park through time. The impacts of public and private recreational use of fragile sand dunes can be quantified and compared. Over the 51 year study, the beach/dune area increased by 57.9 hectares due to the natural process of sand being deposited on the beach and blown inland. The amount of area disturbed by human activity decreased by almost 50% over that same time period, with a significant drop associated with the cessation of bulldozing activities in dunes between 1985 and 2006. Sand dunes can recover over time if disturbances are removed. The largest source of disturbance to sand dunes in Rondeau Provincial Park is private cottages.

Background

Rondeau Provincial Park is located 40 kilometres southeast of the city of Chatham, along the north shore of Lake Erie. Rondeau Provincial Park is classified as a Natural Environment park in recognition of its provincially significant landforms and associated flora and fauna and outstanding recreational landscapes (MNR 1991). Natural Environment class parks are managed to protect outstanding recreational landscapes and representative and provincially significant elements of Ontario's natural and cultural heritage (PPCRA 2006).

The park contains a diversity of ecosystem types including marsh and aquatic communities, thicket swamps, savannah and woodland communities, transitional and interior forest and beach and dune communities. The amount of remaining wetlands in south-western Ontario is very low, estimated at less than 5% in the Municipality of Chatham-Kent (Reid *et al*. 1996 in MNR 2001), contributing to the importance of the wetlands in Rondeau. The transitional and interior forest area of the park forms one of the largest blocks of Carolinian forest left in Canada and is thus of provincial and national significance.

The most important recreational landscapes in the park are the coastal beach and dune communities along the south and east boundaries of the park. The coastal areas are

rich in natural heritage values and contain a number of provincially rare vegetation communities and habitat for a number of provincially and federally listed species at risk. The mosaic of unique vegetation and habitat for threatened and endangered species extends along the coast for much of the roughly 8 kilometre length of the park. This area receives considerable recreational pressure from cottage leaseholders and park visitors seeking to access and enjoy the recreational opportunities the beach affords.

As of the writing of this report, there are 285 cottage leaseholds in Rondeau Provincial Park, the majority of which are located on the east side of the park along Lakeshore Road, roughly 100 metres inland from the shoreline. The cottages begin at the north-east end of the park, extending approximately 7 of the 8 km length of the park's east side. Cottage leaseholds were first introduced during the 1890's until about 1950. Existing cottages are permitted in the park as per a lease agreement consistent with Provincial Park regulation and policy, but are scheduled to expire in 2017. The government of Ontario is currently reviewing its policy position. Rondeau also receives approximately 70,000 camper nights and 164,000 visitors per year (based on a five year average calculated using annual publications of Ontario Parks Statistics 2005-2009), demonstrating the high degree of annual visitor pressure to the park. The long-term impacts of pedestrian traffic from individual cottage leaseholds, public access points, campsites, and day-use areas across the dunes to the beach are suspected to have resulted in damage to sensitive dune vegetation and species at risk habitat.

The Provincial Parks and Conservation Reserves Act states maintenance of ecological integrity shall be the first priority in guiding all aspects of park planning and management, and restoration of ecological integrity shall be considered. This study aims to examine the changes in vegetation communities and evaluate dune disturbance due to recreational use over time. The study is an historic analysis of vegetation and dune disturbance change based on an assessment of historic aerial photography spanning a 51-year period covering four air photo series including 1955, 1972, 1985, and 2006. The quantification of changes in vegetation cover and dune disturbance is intended to examine spatial and temporal change to vegetation communities within coastal areas. The identification of trends will help inform future management of the dune vegetation and species at risk habitat, serving to contribute to the maintenance and potential restoration of the ecological integrity of the park.

Introduction

Objectives

The objectives of the historic vegetation analysis and dune disturbance mapping are to:

- measure the extent of change in coastal vegetation during the period of 1955 – 2006;
- measure historic and current dune disturbance along the east beach;
- provide a baseline for which the extent of future change over time to the dunes can be monitored.

Study Area

Rondeau Provincial Park is centred at 42° 17’ N latitude and 81° 52’ W longitude, at an approximate elevation of 176 metres (m) above sea level (a.s.l.). The location of the park situated in southern Ontario is illustrated in Figure 1.

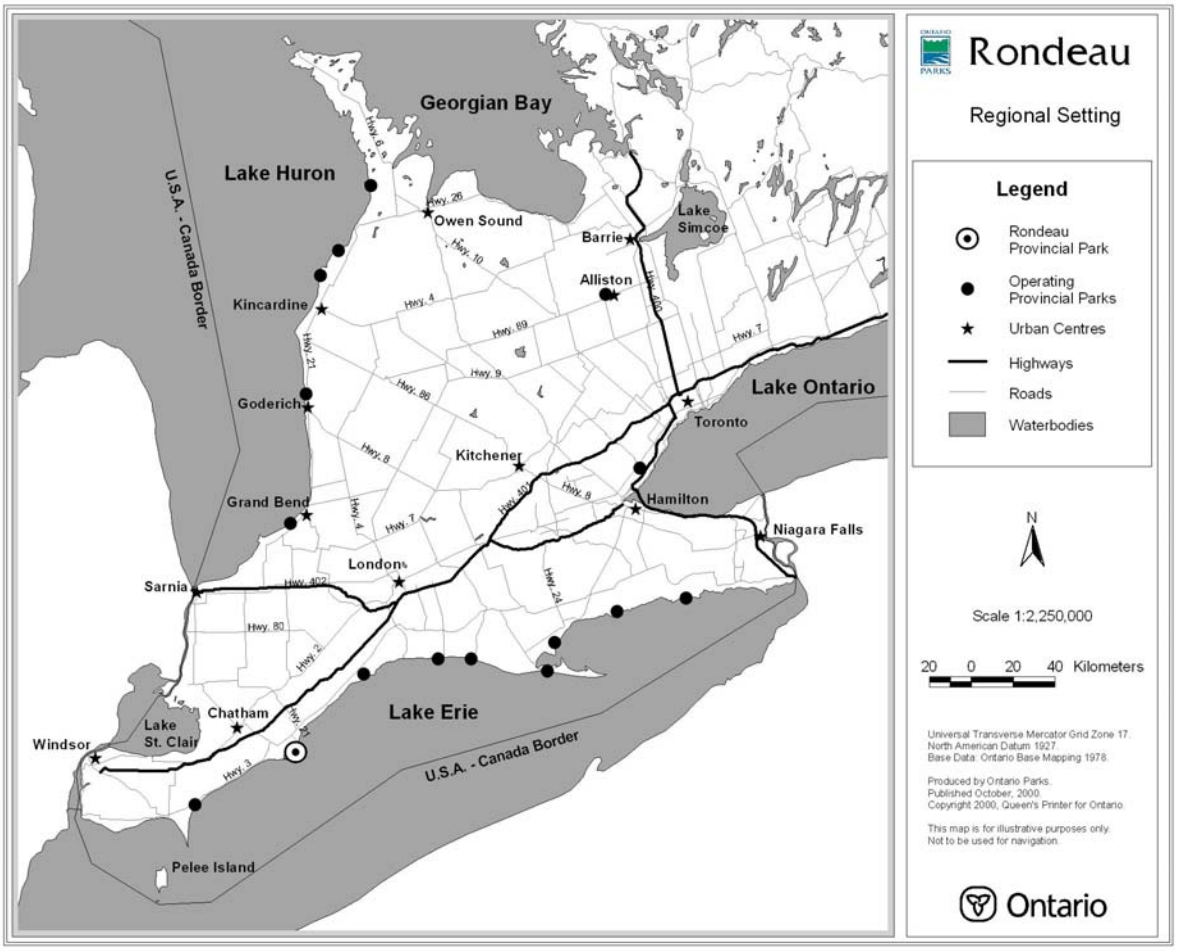


Figure 1. Location of Rondeau Provincial Park in southern Ontario (from Dobbyn and Pasma, in prep).

Figure 2 illustrates the study area within Rondeau Provincial Park. Vegetation communities subject to classification and mapping generally included areas east of Lakeshore Road, and from the Visitor's Centre, areas south and east of South Point Trail including the south shore to the tip of the peninsula. Areas subject to the disturbance mapping were limited to the coastal sand dunes on the east beach, inland from the mapped shoreline extending only to the boundary of any leased land.

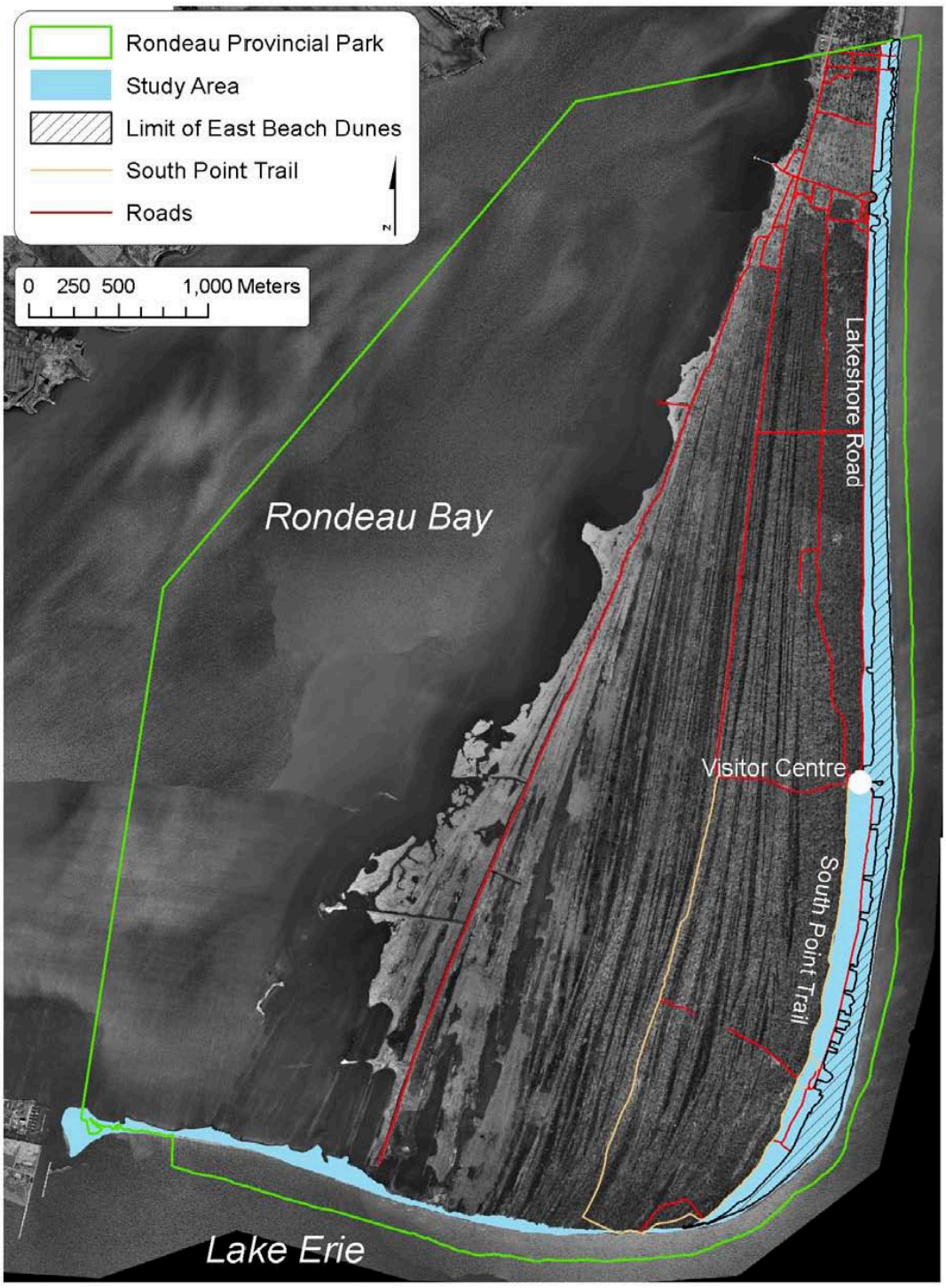


Figure 2. Location of study area within Rondeau Provincial Park

Limitations

Some areas of vegetation could not be accurately classified because portions of the land cover were obscured by shadow, introducing a small degree of error into the vegetation classification. In addition, several irregular notches that appear along the shoreline in the 1955, 1972 and 1985 imagery are artefacts of the rectification process and not real, resulting in some minor inconsistencies in shoreline arrangement and therefore mapping.

The disturbance analysis lacked the ability to assess vertical changes within the dunes and only evaluated horizontal changes over time. While effort was made to determine the origin of individual mapped disturbances, a certain degree of observer interpretation was required to establish whether the origin was from a public access point or from a cottage (private leaseholder). As well, it was very difficult to know how far public access related impacts extended beyond public access points, so to be consistent, areas directly in front of cottages were considered cottage access points, and public access areas lacking cottages nearby were mapped and analysed as such. Disturbances not clearly linked to a public or cottage access point were not included.

Image resolution was not consistent through years limiting the ability to digitize below 1:1,500 for the earlier series, particularly the 1955 image. As well, interpretation of the shoreline was influenced by water levels at the time the images were taken. Unusually high or low water levels have the potential to skew overall area calculations for a given year. Flight dates could not be found for the 1955 or 1972 images, limiting the ability to compare water levels published by the Canadian Hydrographic Service (DFO 2011) which has monitoring gauges located at Erieau (42.266667º N 81.916667º W), on a peninsula on the south shore of Rondeau Bay, directly opposite the park. Nonetheless, water levels for July 17-18, 1985 and May 8, 2006 are 174.86 and 174.86 a.s.l. respectively, and the average for the months of May to September for 1972 (roughly corresponding to leaf out conditions of when the image was taken) are 174.61. No water level information is available for 1955. With this in mind, it appears water levels are very similar at least for 1972, 1985, and 2006.

Methods

Orthorectification

Table 1 shows the imagery year, type, scale, source and flight dates used for the current study. Digital ortho-imagery at 30 cm resolution was available for 2006, meanwhile black and white scanned aerial photography was available for the years 1985, 1972, and 1955. Flight dates were unavailable for the 1955 and 1972 series, and no source could be found for the 1985 series.

Table 1. Ortho-imagery flight dates, scale and source used in the study.

Year	Type	Scale	Source	Date Flown
1955	B&W	1:10,000	MNR	Unknown
1972	B&W	1:10,000	MNR	Unknown
1985	B&W	1:10,000	MNR	July 17-18
2006	Colour	30 cm	First Base Solutions	May 8

Orthorectification and georeferencing of the scanned 1955, 1972 and 1985 historic imagery were completed using PCI Geomatic in NAD 1983 UTM Zone 17N. The spatial resolutions were 1m (1955), 70 cm (1972) and 30 cm (1985).

Historic Vegetation Mapping

Vegetation polygons were created within a file geodatabase in NAD 1983 UTM Zone 17N at a scale of 1:1000. Polygons were digitized in a Geographic Information System (GIS) using heads-up visual interpretation of monoscopic imagery from a monitor using the editing capability of ArcMap. Each air photo series was interpreted to the vegetation type level according to the Provincial Ecological Land Classification (ELC) Catalogue Version 8 (Lee 2004), to be consistent with the terminology and standards used for the 2003 vegetation mapping outlined in Dobbyn and Pasma (in prep). Each polygon was assigned to a vegetation type and measured by area (m^2). The inferred shoreline was the wet/dry interface visible as a change in hue or tone, reflecting the high water mark. Once ecosite mapping was completed for each air photo (1955, 1972, 1985, and 2006),

area calculations for each vegetation type were made in the GIS. The total hectares of each vegetation type were compared to determine the trends and change over time and space using calculations generated in the GIS.

Dune Disturbance Mapping

For this analysis, dune areas included Little Bluestem – Switchgrass – Beachgrass, Willow Shrub Sand Dune, Cottonwood Treed Sand Dune and Mixed Anthropogenic Treed Sand Dune vegetation community types. Polygons to capture dune disturbance were mapped in the same GIS environment as the vegetation mapping and digitized at a scale ranging from 1:1,000 - 1:1,500. Mapped disturbance polygons were only those areas showing a high level of reflectance indicating denuded vegetation and exposed mineral soil and included only those areas that were clearly emanating from specific manicured / built areas or access points. Previous and subsequent air photos series, and park management documents were used to verify access points and disturbances where information was available. Areas of disturbance were mapped by tracing the outer perimeter of the disturbed area. These disturbance polygons were then overlain on the vegetation mapping and the area of the disturbance was subtracted from the larger vegetation type area to determine the net area of habitat loss due to disturbance by dune vegetation type for each air photo series.

Each disturbance polygon was also assigned a category according to access type of either “public” or “cottage” (i.e. leaseholder) access according to the methodology discussed in Section 2.3. Classification favoured “public” access as only those disturbance with a clear linear linkage to a cottage leasehold were labelled “cottage” access.

Results

Coastal Vegetation Change

Table 2 shows changes in vegetation types by area (ha) and as a percentage over the 51 year period. Most noticeably, there has been a marked increase in Little Bluestem – Switchgrass – Beachgrass Open Graminoid Sand Dune, from 46 hectares in 1955 to 80 hectares by 2006, a 74 percent increase. Also of particular note, the area of Mixed Anthropogenic Treed Sand Dune more than doubled over the 51 years from 1.8

hectares in 1955 to 4.8 by 2006. Meanwhile, the area of Sea Rocket Sand Open Shoreline has fluctuated over the 51 year period. Otherwise, the overall area of remaining natural habitat and constructed areas has remained relatively constant. On the other hand, the actual size of the study area has increased from 158.6 hectares to 216.5, with the most obvious changes occurring along the east beach, where sand has been accruing, while losses have been observed to the beach along the south shore.

Table 2. Vegetation type coverage by area (ha) in the study area at Rondeau Provincial Park for the years 1955, 1972, 1985, 2006.

Vegetation Type	1955	1972	1985	2006
Sea Rocket Sand Open Shoreline Type	20.5	16.6	15.6	21.4
Little Bluestem - Switchgrass - Beachgrass Open Graminoid Sand Dune Type	46.2	54.5	49.6	79.6
Willow Shrub Sand Dune Type	0	2.4	1	7.7
Cottonwood Treed Sand Dune Type	1.1	4.4	8	6
Mixed Anthropogenic Treed Sand Dune Type	1.8	4.9	4.8	4.8
Canada Blue Grass Graminoid Meadow Type	0	0	0.2	0.3
Native Deciduous Regeneration Thicket Type	0	0	0	0.1
Fresh - Moist Big Bluestem Deciduous Savannah Type	3.2	4.7	5	4.9
Dry Black Oak - Pine Tallgrass Savannah Type	1.8	0.5	1	1
Dry Black Oak - White Oak Tallgrass Woodland Type	26.9	27.1	27.6	27.1
Dry White Pine - Oak Tallgrass Mixed Woodland Type	0.7	1.1	1.1	1.4
Dry - Fresh Black Oak Deciduous Forest Type	2.6	2.9	2.9	3
Fresh - Moist Sugar Maple - Hardwood Deciduous Forest Type	0.2	0.2	0.2	0.2
Recreational Open Space	0	0.8	0.9	0.6
Cart Track	7.7	7.6	7.3	7.3
Paved Road	11.9	11.9	11.9	11.9
Low Density Residential	31.4	31.9	31.4	32.5
Institutional	1.2	1.2	0.8	0.8
Canada Blue-joint Graminoid Mineral Meadow Marsh Type	0	0	0.7	0.7

Vegetation Type	1955	1972	1985	2006
Common Reed Graminoid Mineral Meadow Marsh Type	0	0	0	4.1
Rush Graminoid Mineral Meadow Marsh Type	1.7	1	1	1.2
Shallow Marsh Pond Type	0	0.6	1	0
Pond	0	0.1	0.2	0
Total size of Study Area	**158.6**	**174.3**	**172.1**	**216.5**

Table 3. Vegetation type coverage by percentages in the study area at Rondeau Provincial Park for the years 1955, 1972, 1985, 2006.

Vegetation Type	1955	1972	1985	2006
Sea Rocket Sand Open Shoreline Type	12.9	9.5	9	9.9
Little Bluestem - Switchgrass - Beachgrass Open Graminoid Sand Dune Type	29.1	31.3	28.9	36.8
Willow Shrub Sand Dune Type	0	1.4	0.6	3.6
Cottonwood Treed Sand Dune Type	0.7	2.5	4.7	2.8
Mixed Anthroprogenic Treed Sand Dune Type	1.1	2.8	2.8	2.2
Canada Blue Grass Graminoid Meadow Type	0	0	0.1	0.1
Native Deciduous Regeneration Thicket Type	0	0	0	0.1
Fresh - Moist Big Bluestem Deciduous Savannah Type	2	2.7	2.9	2.3
Dry Black Oak - Pine Tallgrass Savannah Type	1.1	0.3	0.6	0.5
Dry Black Oak - White Oak Tallgrass Woodland Type	17	15.5	16.1	12.5
Dry White Pine - Oak Tallgrass Mixed Woodland Type	0.4	0.6	0.6	0.7
Dry - Fresh Black Oak Deciduous Forest Type	1.6	1.6	1.7	1.4
Fresh - Moist Sugar Maple - Hardwood Deciduous Forest Type	0.1	0.1	0.1	0.1
Recreational Open Space	0	0.5	0.5	0.3
Cart Track	4.8	4.3	4.2	3.4
Paved Road	7.5	6.8	6.9	5.5
Low Density Residential	19.8	18.3	18.3	15
Institutional	0.8	0.7	0.5	0.4
Canada Blue-joint Graminoid Mineral Meadow Marsh Type	0	0	0.4	0.3

Vegetation Type	1955	1972	1985	2006
Common Reed Graminoid Mineral Meadow Marsh Type	0	0	0	1.9
Rush Graminoid Mineral Meadow Marsh Type	1.1	0.6	0.6	0.6
Shallow Marsh Pond Type	0	0.3	0.6	0
Pond	0	0.1	0.1	0

Figure 3 shows the percentages of change in vegetation community classes over the 51 year period. The dune community class (which includes the Little Bluestem – Switchgrass – Beachgrass Open Sand Dune, Willow Shrub Sand Dune, Cottonwood Treed Sand Dune and Mixed Anthropogenic Treed Sand Dune) showed the largest change, increasing from 31 percent of the entire study area in 1955 to 45 percent by 2006. This is likely largely due to the natural process of sand deposition. The shoreline community class comprising of the Sea Rocket Sand Open Shoreline Type has declined slightly over the 51 years, from 13 percent down to 10 percent. The total area of marsh saw an increase from just over than one percent of the study area in 1955, up to nearly 3 percent by 2006. The constructed type representing residential areas and other anthropogenic features in the study area, declined from 30 percent to 25 percent in 2006. Otherwise, the vegetation community classes have remained relatively constant over the 51-year period.

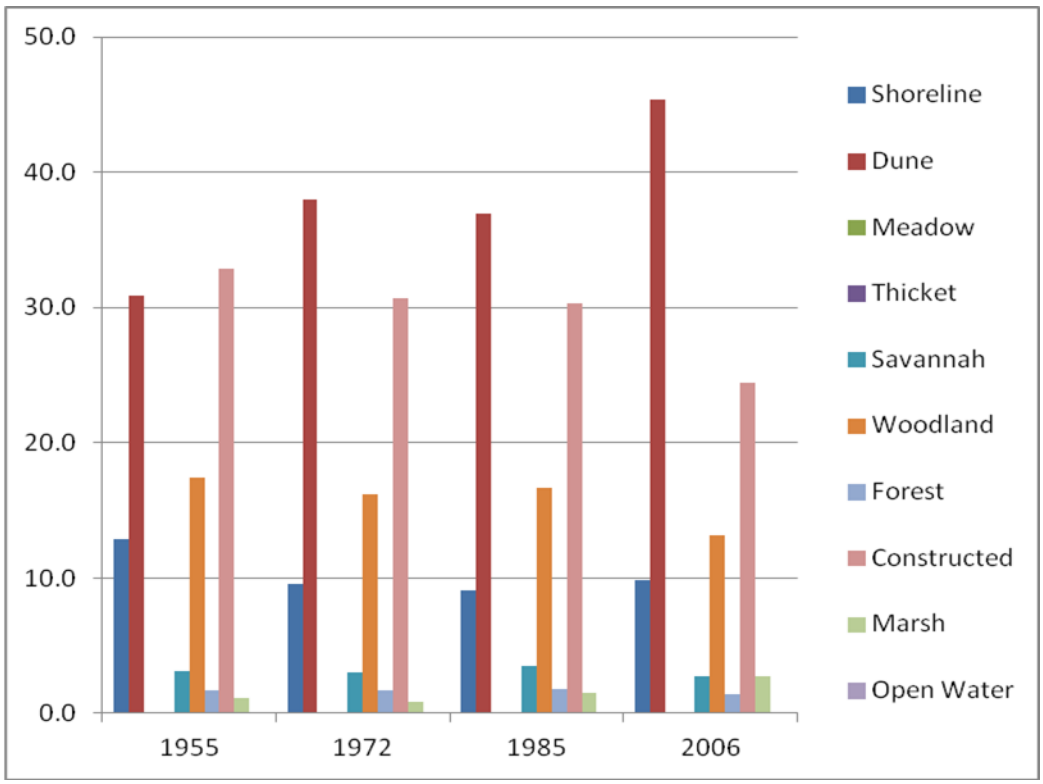
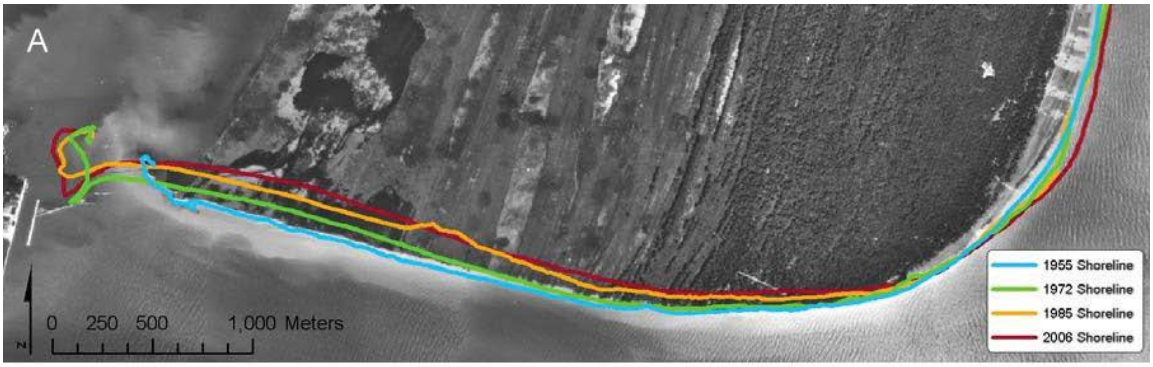
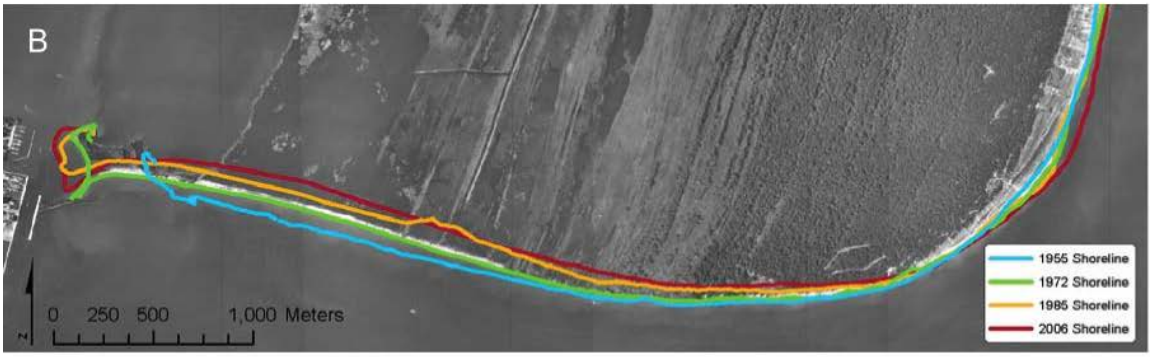


Figure 3. Percentages of community classes within the study area for Rondeau Provincial Park, 1955, 1972, 1985, 2006.

Figure 4 shows the northward migration of the south beach over the 51-year study period at Rondeau. Between 1955 and 1972, the shoreline retreated 81m north; between 1972 and 1985 it retreated 74m; and from 1985 to 2006 it retreated 60m. On average, it appears the shoreline has moved roughly 4.2m a year over the 51-year period. These results reinforce some of the earlier interpretations regarding rates of erosion along the south beach at Rondeau. Crysler and Lathem (1975) utilized aerial photographs to measure erosion along the south beach between 1942 and 1972 and concluded the south beach had retreated approximately 200m, or an average of almost 7m per year.


A
0 250 500 1,000 Meters
1955 Shoreline
1972 Shoreline
1985 Shoreline
2006 Shoreline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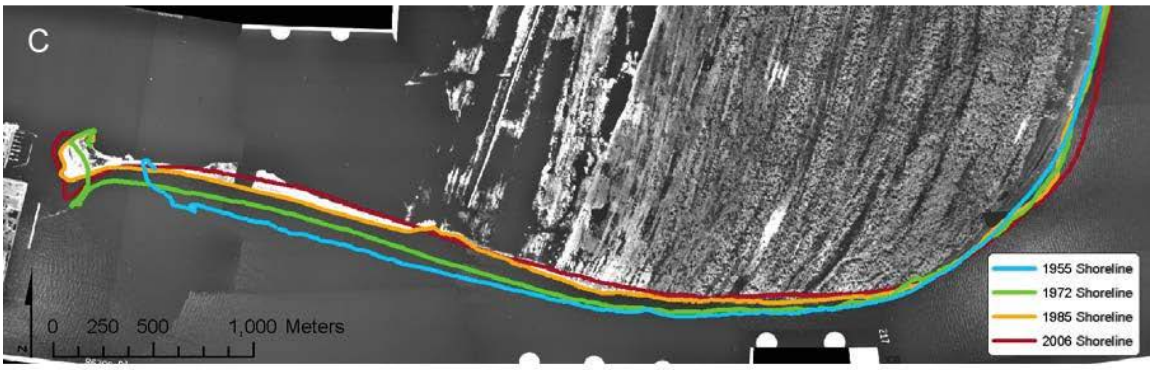
1985 Shoreline
2006 Shoreline


C
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1955 Shoreline
1972 Shoreline
1985 Shoreline
2006 Shoreline

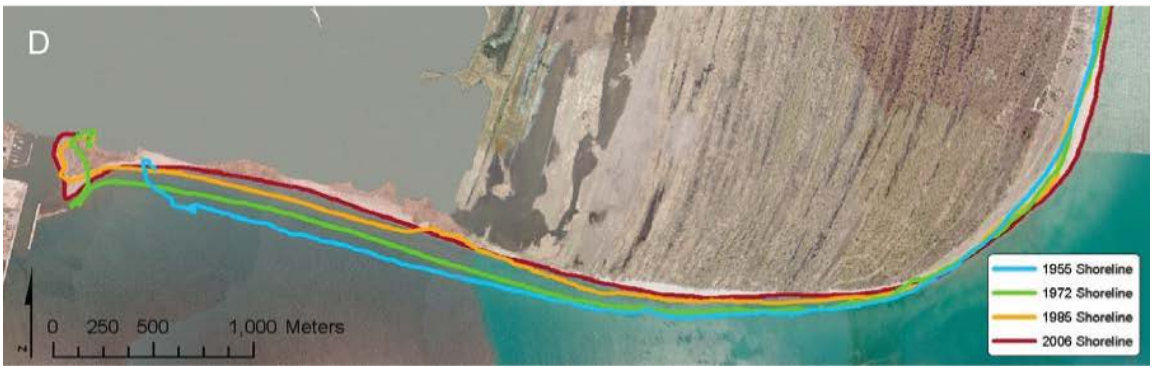
D
0 250 500 1,000 Meters
1955 Shoreline
1972 Shoreline
1985 Shoreline
2006 Shoreline

Figure 4. Shoreline change along the south beach at Rondeau Provincial Park, 1955-2006. A 1955; B 1972; C 1985; D 2006.

Coastal Disturbance Change

Table 3 lists the area of disturbance from within the dunes and as a percentage of the total dune area for each air photo series. Based on the analysis, the absolute area of disturbance grew from just under 13 hectares in 1955 up to 14.8 in 1972, then decreased to just over 7 hectares by 1985, and remained relatively unchanged in 2006. The proportion of the disturbed areas relative to the total area of the dunes, has decreased successively each year from just under 26 percent in 1955, to a minor reduction of 2 percent by 1972, then reduced by roughly half by 1985 to 11.9 percent, and finally to 7.7 percent by 2006.

Table 4. Area of disturbance within the dunes and as a percentage of the total within the study area at Rondeau Provincial Park for the years 1955, 1972, 1985, and 2006.

Year	Disturbance Area (ha)	Total Dune Area (ha)	Percentage of total
1955	12.8	49	26.1
1972	14.9	66.2	22.5
1985	7.3	63.5	11.5
2006	7.6	98.1	7.7

In Figure 5, the disturbance area is plotted alongside the total area of the dune habitat for each air photo series, along with the calculated area of remaining undisturbed dune habitat.

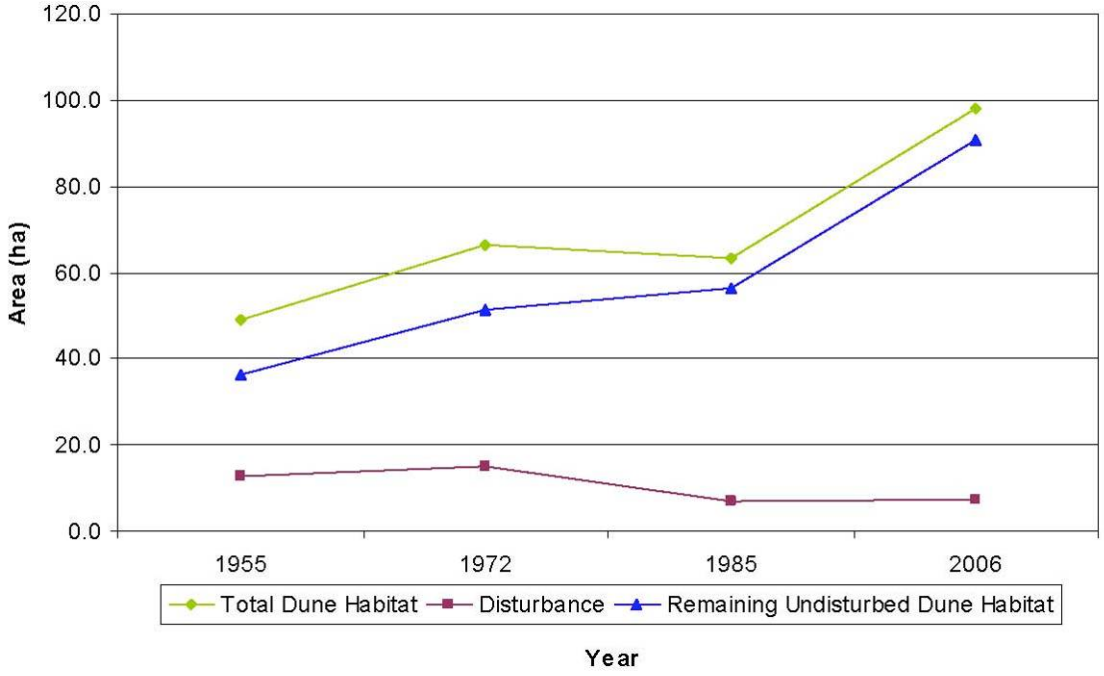

Figure 5. Total area of sand dune habitat, area of disturbance, and remaining undisturbed dune habitat by area (ha) at Rondeau Provincial Park for the years 1955, 1972, 1985, and 2006.

The second component of the disturbance analysis evaluated the number of individual disturbance polygons emanating from cottage (leaseholder) access points versus public access points. As shown in Figure 6, the number of individual cottage access points has fluctuated through time with the biggest increase of up to 249 access points using the 2006 imagery up from 189 access points in 1985. The number of public access points rose dramatically in 1972 to a total of 62 access points due largely to a host of additional access points evident along the south-eastern beach. By 1985 there was a subsequent major decline in access points in the same area. By 2006 the number had increased again to 33 public access points.

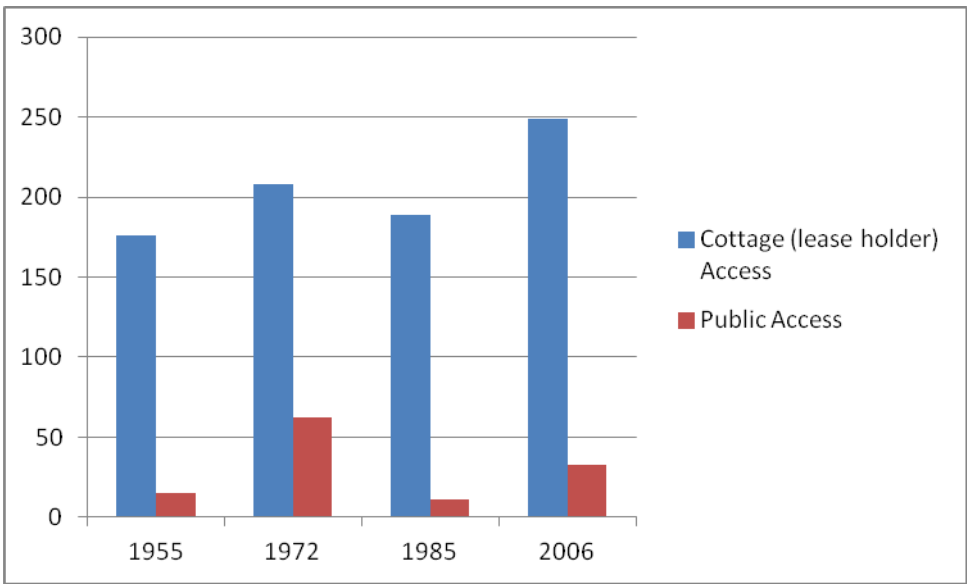

Figure 6. Number of cottage (leaseholder) access points vs. public access points on the east side of Rondeau Provincial Park for the years 1955, 1972, 1985, and 2006.

In Figure 7, the total area (in hectares) of disturbance attributed to public access points has demonstrated a similar trend to the total number including a large increase in the total disturbed area in 2006 up to 1.4 hectares. The total disturbed area due to cottage access points has shown a decrease through time, most markedly between 1972 and 1985 with a drop in nearly 50% of the total disturbed area. 2006 imagery showed a total disturbed area due to cottage access points of 6.2 hectares.

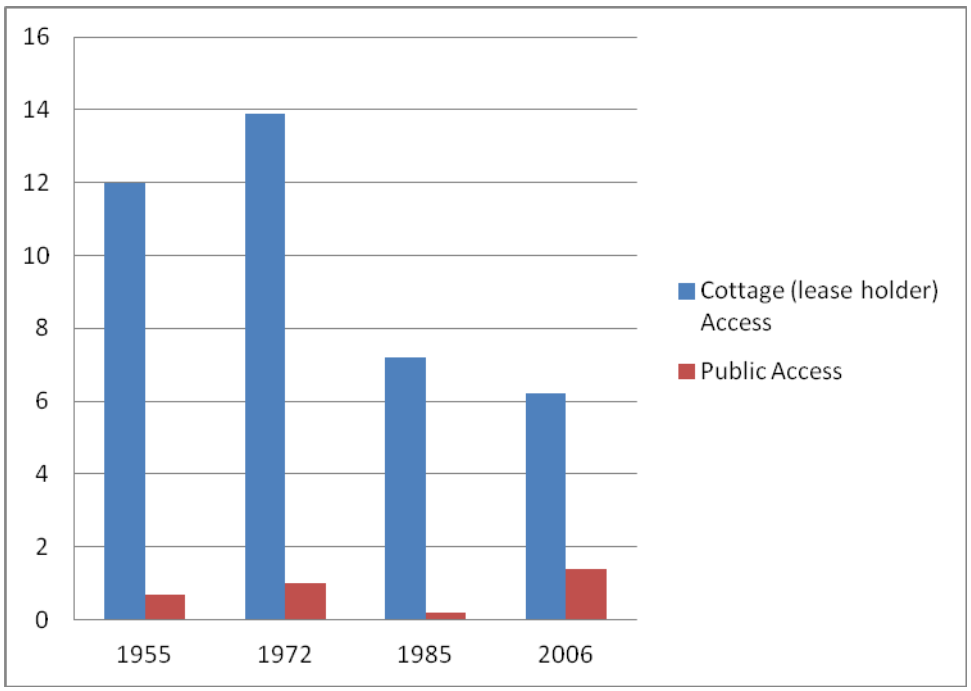

Figure 7. Total area of disturbance (hectares) due to cottage (leaseholder) access points and public access points on the east side of Rondeau Provincial Park for the years 1955, 1972, 1985, and 2006.

Figures 8 and 9 reveal the disturbance mapping for the study area for each air photo series along the east beach, with Figure 8 showing the northern half of the park and Figure 9 showing the southern half. The mapping also shows the location and spatial extent of cottage access points (shown in red) and public access points (shown in yellow). The disturbance mapping illustrates a general trend from fewer, larger areas of disturbances to more areas of smaller, linear disturbances through time. Over the course of the 51 years, the polygons develop into more narrow and increasingly longer shapes, as the east beach migrates eastward. For example, large areas of mapped disturbance in the Figure 8 (A,B) midway along the beach south of the visitor centre evident in 1955 and 1972 are diminished by 1985 and very narrow and more numerous by 2006. The distribution of disturbances among years does not appear to have changed by much, although there appears to be fewer large gaps between mapped disturbances in 2006 (Figure 7 and 8D) with the increasing number of individual trails scattered evenly along the east beach, whereas in previous years there are areas with wide gaps between some polygons.

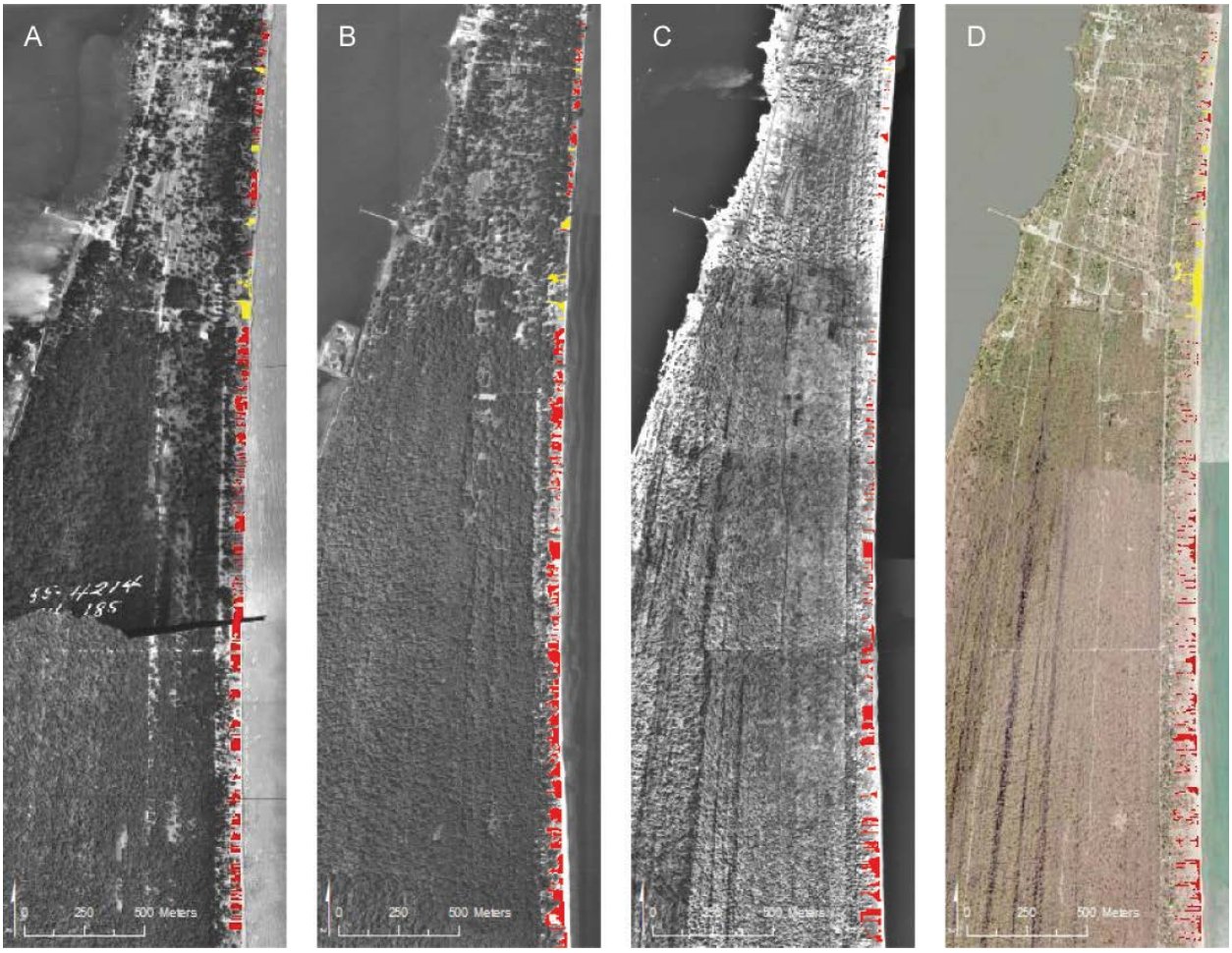

Figure 8. Mapped areas of disturbance in the dunes, northeast section of Rondeau Provincial Park, 1955-2006. A 1955; B 1972; C 1985; D 2006.

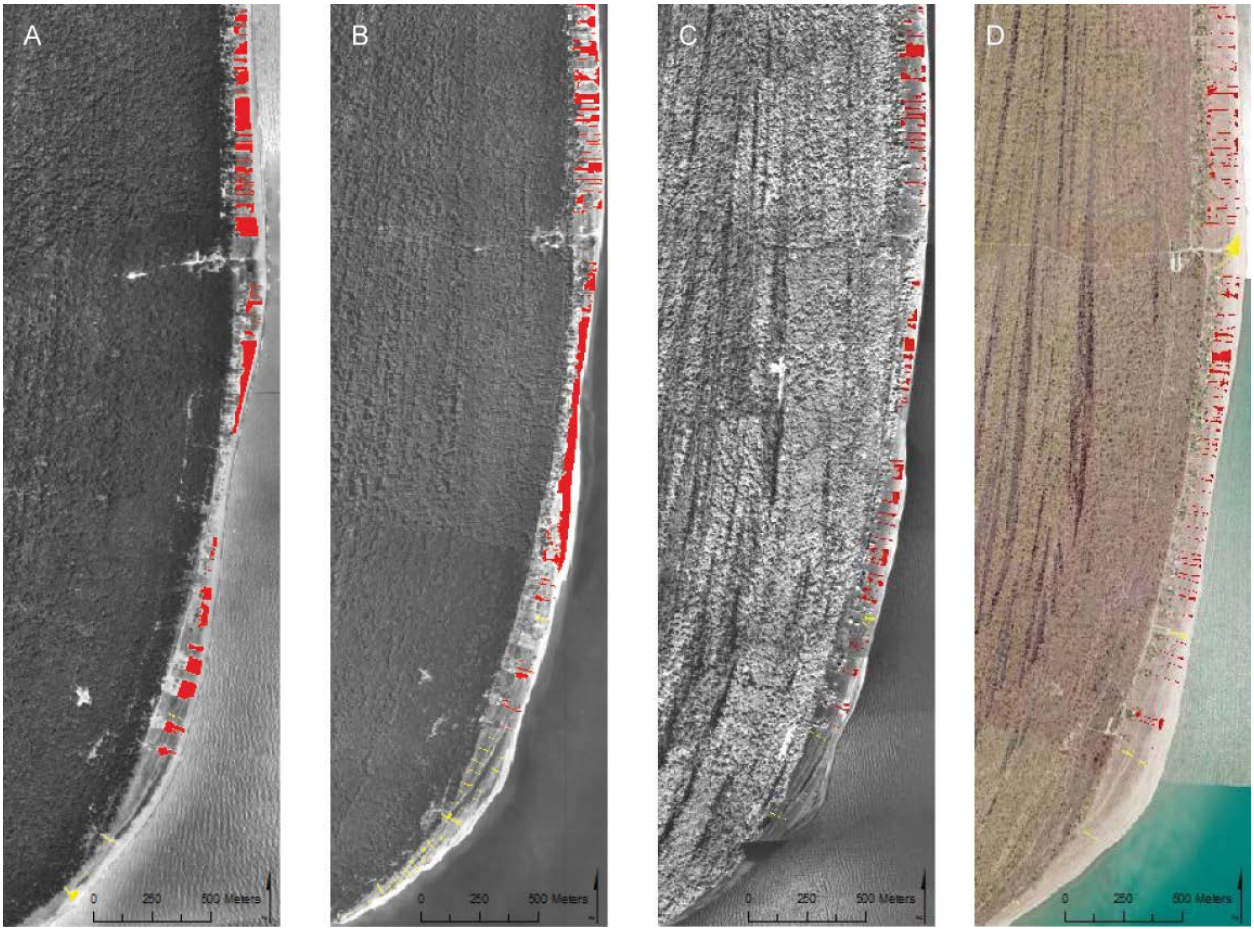

Figure 9. Mapped areas of disturbance in the dunes, southeast section of Rondeau Provincial Park, 1955-2006. A 1955; B 1972; C 1985; D 2006.

Discussion

Coastal Vegetation Change

The results of the vegetation change analysis reinforce several previous interpretations about the coastal areas of Rondeau Provincial Park. Crysler and Lathem (1974) concluded there was sufficient sediment available east of Rondeau to nourish the east and southeast beach area. The current study showed a 36.5 percent increase in vegetation communities associated with coastal dunes over 51 years indicating that deposition of sediment, and thus beach growth, is continuing to occur on the east beach. Next, Crysler and Lathem concluded there was insufficient sediment feeding the

south beach and this study indicates it is receding at a rate of at least 4.2 metres per year. As well, Crysler and Lathem concluded that certain land use practices including altering the dune topography and vegetation through bulldozing must be altered to allow natural forces to develop and stabilize the dunes. This study showed that the most significant increases in dune vegetation in terms of aerial extent were between 1985 and 2006 with gains of 63 percent, at which time bulldozing activities on the shoreline and dunes had generally ceased and some restoration activities occurred (Coates and Associates 1977). As the development of dunes is also closely related to water levels, the increase in dune vegetation is likely a combination of altered management practices and natural processes occurring.

The vegetation change analysis also resulted in the classification of a new vegetation type from within the park along the east beach in the dunes, termed Mixed Anthropogenic Treed Sand Dune. As Dobbyn and Pasma (2012) point out, trees are likely to have been planted at Rondeau beginning before the establishment of the park in 1894 until present day. Many of the trees planted have been alien and invasive species such as Black Locust (*Robinia pseudo-acacia*), White Mulberry (*Morus alba*), Tree-of-heaven (*Ailanthus altissima*), Manitoba Maple (*Acer negundo*), Norway Maple (*Acer platanoides*), European White Poplar (*Populus alba*), Scots Pine (*Pinus sylvestris*) and to a lesser extent, Catalpa (*Catalpa bignonioides*) and were often planted on cottage leasehold properties. Since the majority of these properties are adjacent to the dunes along the east beach, many of these invasive species have spread to the dunes forming varying compositions of exotic species, sometime intermixed with native species. The vegetation change analysis has shown an increase in this vegetation type from 1.8 hectares in 1955 to 4.9 by 1972. Since then it has stabilized and decreased slightly. This may be in part due to recent efforts by park managers to eradicate some of these species from the dunes using a number of techniques to reduce their frequency and abundance (Dobbyn pers. comm.).

Coastal Disturbance Change

The large areas of mapped disturbances evident on Figures 8(A,B) and 9(A,B) for 1955 and 1972 are suspected to be attributed to certain land use practices in use at the time in the park. Alteration and destruction of dune profiles through bulldozing along the east beach to create clear views of the lake for cottagers and to remove excess sand accumulated after storm events was at one time common practice in the park despite

recommendations to terminate this activity (Crysler and Lathem 1974, Warren 1974).This may explain the lack of smaller, linear trails during this same time period since large areas of the dunes would have been denuded of vegetation, limiting the ability to detect trail networks from air photos. By 1985, this type of management had more or less ceased with the development of the park preliminary master plan (Coates and Associates 1977). The cessation of bulldozing and restoration efforts are reflected in the reduced size of mapped disturbances in Figures 8 (C,D) and 9 (C,D) for 1985 and 2006. As these larger areas recovered, more direct and narrow trail networks are visible emanating from individual cottage lots and public access points to access the beach.

The increase in public access points represented by linear trails along the southeast beach evident on the 1972 air photo series in Figure 9B can be attributable to a large campground that was developed there and in operation from 1958 to 1975 (Dobbyn and Pasma, 2012). Campground users would have walked from the campground through the dunes to access the beach creating a series of unauthorized trails emanating from individual campsites. These trails were not present on the 1955 air photo series before campground development, and are largely absent by 1985 (Figure 9C), and 2006 (Figure 9D).

Conclusions

Coastal vegetation and dune disturbance mapping and trends have been completed for 4 series of aerial photography spanning 51 years at Rondeau Provincial Park. Based on this analysis, it appears that although the park is experiencing erosion rates along the south shore upwards of 4 metres per year, the east beach is accruing sand, resulting in a net expansion of coastal dune habitat. The total area of dune has grown from 158.6 hectares in 1955 to 216.5 by 2006. Coastal dune vegetation experiencing the largest growth appears to be the Little Bluestem – Switchgrass – Beachgrass vegetation type, which almost doubled in size during the 51 year study period from 46 to 80 hectares. Although the relative proportion of Mixed Anthropogenic Treed Sand Dune vegetation type declined between 1985 and 2006, the absolute area of this vegetation type has stayed constant at around five ha. This vegetation type contains many alien invasive tree species that could compromise the integrity of the natural vegetation types if left unmanaged in the future.

In terms of dune disturbance, it appears that the total area of disturbance has decreased over the 51 years from a high of 14.8 (ha) in 1972 down to 7.3 ha by 2006. However, the number of access points and individual disturbance polygons has increased from 113 to 178 over the same time period. Although it is encouraging that the total area of disturbance has declined, the increase in number of access points may be cause for concern due to the potential impacts of fragmentation on recovering vegetation communities.

The proportion of disturbed dune area resulting from cottage leasehold access versus public access has declined from 95% of all disturbed area (12ha) in 1955 to 82% in 2006 (6ha) and over a 50% decline in total area during that time period. This study indicates that changes in management approaches, enhanced stewardship, and improved adherence to leasehold conditions have resulted in significant recovery of the dune ecosystems. However, dune disturbance attributed to access by individuals at 285 cottage leaseholds still results in a significantly disproportionate amount of disturbance when compared to the disturbance caused by 70,000 camper nights and 164,000 annual public visitors to the park.

Disturbance and vegetation change at Rondeau Provincial Park from 1951-2006 show that large areas denuded of vegetation associated with human activity can rebound over time if disturbances cease and sand deposition continues. Left to recover, the dunes have been reverting back to a natural state. However, given the current prevalence of invasive species more active restoration may be necessary to adequately restore ecological integrity of these sites.

Recommendations

There are a number of recommendations arising from the completion of the current study that are worth mentioning. Firstly, it would be highly beneficial to verify the current condition and extent of dune disturbances through ground-truthing the mapped areas of disturbance identified in this study solely through interpretation aerial imagery. Once baseline conditions are confirmed, future monitoring of dune disturbance trends could be more accurately mapped and compared over time as new ortho-imagery becomes

available. Consideration should also be given to assessing the vertical changes in dune crestline / toe position over time as this study could only measure horizontal change.

References

Coates and Associates Ltd. 1977. Preliminary Master Plan for Rondeau Provincial Park (First Draft). Ontario. Government of Ontario, Ministry of Natural Resources (unpublished report).

Crysler and Lathem. 1974. Rondeau Provincial Park Shoreline Erosion Study Phase 2. Government of Ontario, Ministry of Natural Resources, Toronto. Prepared by Crysler and Lathem Consulting Engineers.

DFO (Department of Fisheries and Oceans Canada). 2011. Station Inventory Data, Station 12250. Site accessed April 12, 2011.

Dobbyn, S., pers. comm. 2011. Conversation with S. Brinker. March 2011. Ecologist, Central Zone, Ontario Parks

Dobbyn, S. and L. Pasma. 2012. A life science inventory and evaluation of Rondeau Provincial Park. Ontario Parks, Southwest Zone.

Lee, H.T. 2004. Provincial ELC Catalogue Version 8. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch (unpublished manucscript).

Warren, W.D. 1974. The Geology and Geomorphology of Rondeau Provincial Park, Kent County, Ontario. Government of Ontario, Ministry of Natural Resources (unpublished report).