Red Cedar Savanna:
A Disappearing Habitat at Point Pelee National Park

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Abstract

To assess the change in habitat of red cedar savanna (RCS) at Point Pelee over time, we compared geo-referenced historic air photos (1931, 1959, 1973, 1985 and 2000) using Geographic Information Systems (GIS). Red cedar savanna is a critical habitat for more than 25 % of the potential Species at Risk (SAR) of Point Pelee. It is an early successional community of mainly grasses and scattered trees that rely on frequent disturbance.

By analyzing historic air photos we have found that RCS has decreased in area by 37 % since 1931, with most of the change occurring between 1959 and 1973 due to natural forest succession. Large areas of RCS along the western shoreline of Point Pelee have developed into more shade tolerant hardwoods, mostly eastern hackberry (Celtis occidentalis). *This large drop in coastal red cedar savanna was somewhat offset by the increase of interior red cedar savanna created by the abandonment of agricultural and cottage sites during the 60s and 70s. Small declines in RCS habitat were due to shoreline erosion mostly occurring during the high water years of the 1970s. The west side of Point Pelee has been relatively stable since 1931, and has maintained a thin strip of RCS along the back beach area.*

We predict that the RCS habitat found in the interior of Point Pelee will likely disappear within the next 20 years without active management. The red cedar savanna along the shoreline will continue to persist, but is highly dependent on shoreline disturbance and the accretion of sand for its continued existence.

Introduction

Point Pelee is located in the extreme south of Canada and is considered a part of the Carolinean or Northern Hardwoods Forest Zone. The regional context of Point Pelee is shown in Figure 1. Point Pelee National Park protects 15 km^2 of marsh and forest as well as Middle Island 25 km to the south. Over 2/3^{rds} of Point Pelee is marsh, with the dry land forest, swamp forest, beach and red cedar savanna making up the remainder of the habitat types.

Kavanagh and McKay-Kuja (1992) (from Geomatics International Inc., 1994) described red cedar savanna (RCS) as a community where the principle arboreal species is red cedar *(Juniperus virginiana)*. The community is most widespread on dry sand substrate, usually on sand dunes where the associated tree species may include cottonwood *(Populus deltoides)*, hackberry *(Celtis occidentalis)*, and black oak *(Quercus velutina)*. It is an early successional habitat with sparse tree cover. Another name commonly associated with this type of habitat is sand prairie. The dominant grasses and herbs are characteristic of open prairie-like habitats such as little bluestem (*Andropogon scoparius)*, panic grass *(Dicanthelium acuminatum)*, and lyre-leaved rock cress *(Arabis lyrata)*.

Red cedar savanna in Point Pelee can be broken into two general habitat types (from Geomatics International Inc., 1994);

1) Coastal RCS: a thin area along the west and east beach of Point Pelee. Wind and wave action and the movement of sand create this habitat. High water levels and storm events can also destroy this habitat.

2) Old field RCS: found in the interior area of the park. This habitat type develops after cottage removal and farmland abandonment on sandy soils. Over time these areas are colonized by later successional species.

The red cedar savanna found at Point Pelee has been studied extensively due to its high numbers of endangered and rare species. In fact, of the 66 potential SAR (Species at Risk) found at Point Pelee at least 25% require savanna habitats (Table 1). SAR that require savanna habitat include: hop tree *(Ptelea trifoliata)* (SP-Special Concern), prickly pear cactus *(Opuntia humifusa)* (EN-Endangered), and prairie rose *(Rosa setigera)* (SP)(Table 1). As well many extirpated SAR species require savanna habitats including: blue racer *(Coluber constrictor)* (EN), hognose snake *(Heterodon platirhinos)* (SP), and eastern prairie fringed orchid *(Platanthera leucophaea)* (SP)(Table 1). This habitat also contains many provincially rare species such as green milkweed *(Asclepias viridiflora)*, wild potato vine *(Ipomoea pandurata)* and linear-leaved puccoon *(Lithospermum incisum)*.

RCS is a regionally rare habitat and is classified as extremely rare in Ontario (NHIC, 1996). Only small patches of RCS remain in Southwestern Ontario owing to habitat destruction due to pressures from human development. Protected areas of RCS are found on Pelee Island, Long Point Wildlife Refuge and Pinery Provincal Park. Park managers and biologists at Point Pelee recognize that the presence of red cedar savannah is vital to protecting and/or reintroducing many SAR and provincially rare species.

This project aims to quantify the amount of RCS found in the park since 1931 and determine how much has been lost to forest succession or shoreline erosion and

how much has been gained from old field abandonment or shoreline colonization.

Figure 1. A map of southwestern Ontario showing Point Pelee National Park.

Methods

The first task of this project was to create five air photo mosaics for each of the air photo sets from 1931, 1959, 1973LS(large scale), 1973SS(small scale), and 1985. Each air photo set was taken at a different scale, altitude, and focal length (Table 2).

All air photos sets were scanned at 400 dpi using a flatbed scanner and saved in .jpg format. Each photo was then imported into Orthoengine (PCI) and geo-referenced using the 2000 Point Pelee basemap. The accuracy of the 2000 air photo basemap is approximately 1 m and has a 12 cm pixel resolution. All air photographs, with the exception of the 1985 photo series, were flown in the late winter or early spring before leaf out; this made it easier to identify individual red cedar.

All red cedar savanna polygons were delineated in ArcView 3.2 ESRI. The criterion for selecting red cedar savanna was based on two factors: 1) the presence of scattered mature red cedar; or, 2) the presence of scattered immature red cedar with

Table 1. Species at risk that require savanna or early successional habitat.

Park Rank[1]	Common Name	Sceintific Name	COSEWIC Status
PRE	Eastern Prickly Pear Cactus	*Opuntia humifusa*	Endangered
PX	Blue Racer	*Coluber constrictor*	Endangered
PX	Northern Bobwhite	*Colinus virginianus*	Endangered
PX	Timber Rattlesnake	*Crotalus horridus*	Extirpated
PE?	Climbing Prairie Rose	*Rosa setigera*	Special Concern
PRE	Blue Ash	*Fraxinus quadrangulata*	Special Concern
PRE	Common Hop-tree	*Ptelea trifoliata*	Special Concern
PRE	Dwarf Hackberry	*Celtis tenuifolia*	Special Concern
PRE	Eastern Yellow-breasted Chat	*Icteria virens*	Special Concern
PRE	Five-lined Skink	*Eumeces fasciatus*	Special Concern
PRE	Monarch	*Danaus plexippus*	Special Concern
PX	Eastern Hognose Snake	*Heterodon platirhinos*	Special Concern
PX	Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Special Concern
PRE	Eastern Fox Snake	*Elaphe vulpina*	Threatened
PX	Black Rat Snake	*Elaphe obsoleta*	Threatened
PX	Eastern Massasauga Rattlesnake	*Sistrurus catenatus*	Threatened

PRE : Present; PX: Extirpated; PE: Probable

Table 2. Air photo series used to create park mosaics.

Name	Roll no.	No. of Photographs	Scale (Approx.)	Date Flown	Altitude (ft)	Focal Length (mm)
1993	A3272	50	1:10500	4/18/31	2070	152.7
1959	A16449	111	1:4300	4/4/59	2575	152.8
1973LS	A23123	32	1:9200	13/01/73	5370	152.7
1973SS	A23123	32	1:9200	13/01/73	2070	152.7
1985	B30305	7	1:30300	NA/85	8840	152.1
2000	ERCA	N/A	1:6250	4/1/00	N/A	N/A

open patches of sand and/or grass. All open areas with some red cedar present were included in the calculation, although it should be acknowledged that some of these areas may not be considered prime RCS. Areas that were completely closed in with red cedar, shrubs or trees were not mapped as RCS, although if an area contained small pockets of shrubs of rough-leaved dogwood (*Cornus drummondii*) and staghorn sumach *(Rhus typhina)* the whole area was considered RCS. Areas where large patches (>0.5 ha) of shrub cover occurred were not considered RCS. Photo interpretation was done on screen and with a stereoscope using the hard copies (stereo-pairs) of the original air photos. Historical accounts of the vegetation of Point Pelee (i.e., Dodge, 1914; Maycock, 1977; and Geomatics,1994) were used to help delineate RCS areas. The total change in area (in hectares) of RCS from year to year was calculated using ArcView with Xtools extension and graphed using MS Excel.

Results and Discussion

Using the historic airphotos a map of RCS habitat was created for each year (1931, 1959, 1973 and 2000). A map of the distribution of RCS for each year is shown for 1931 (A), 1959 (B), 1973 (C) and 2000 (D). From 1931 to 2000 RCS dropped 84.2 ha or a drop of 37 % (Table 3).

Between 1931 and 1959, a large area (106.4 ha) of RCS remained stable, with only small losses or gains to forest succession (Table 4). There was little loss of RCS to succession during this period since most of the RCS was immature and growing on the sand dunes of the west shore or in recently abandoned farmland near the tip.

During the next period from 1959 to 1973, a large portion (approximately 100 ha) of RSC habitat along the western dunes succeeded into eastern hackberry forest (Table 4)(Figure 2). Because of the shade intolerance of red cedar it quickly died under the shade of the hackberry. Presently parts of this area are now succeeding

into sugar maple *(Acer saccharum)* and ash *(Fraxinus)* forest as the eastern hackberry reaches its maximum life span of 100 years and begins to die.

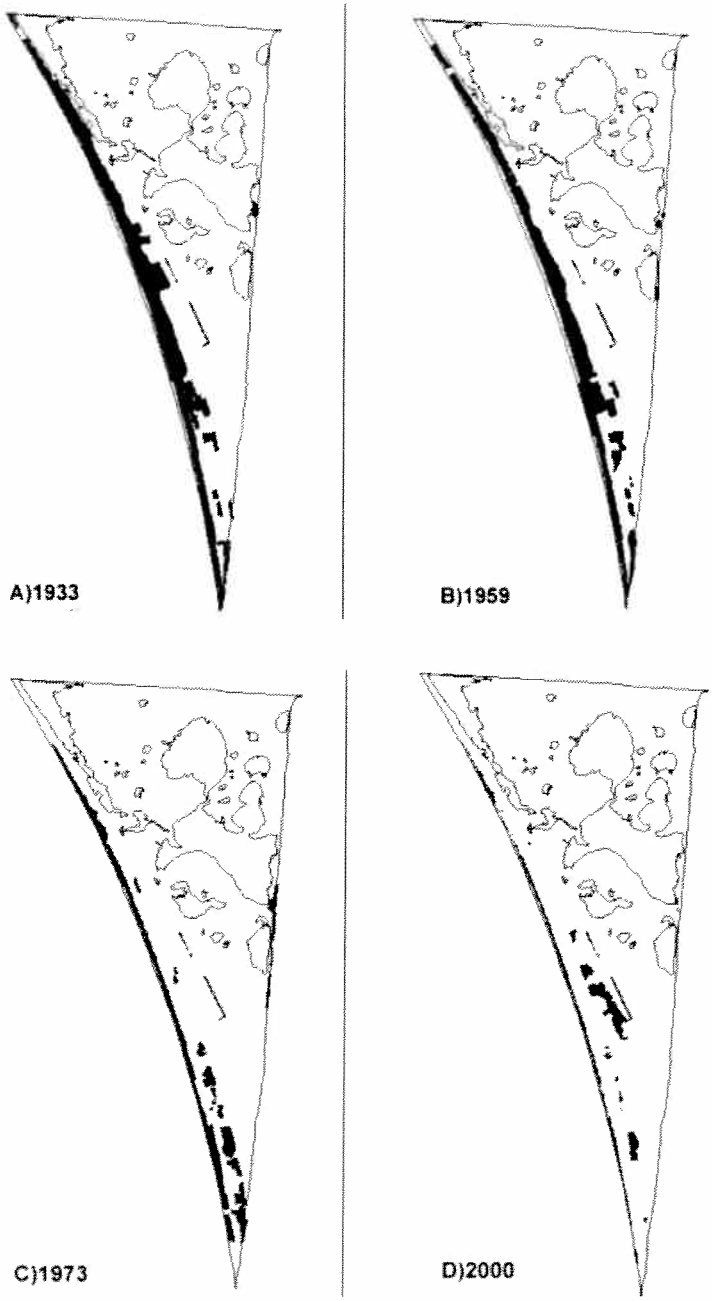
Table 3. Total change in RCS habitat at Point Pelee National Park since 1931.

Year	Total RCS	Period Change (ha)	Cumulative Change (ha)
1931	132.9	n/a	n/a
1959	130.1	-2.9	-2.9
1973	62.7	-67.4	-70.3
2000	48.8	-13.9	-84.2

Table 4. Origin of red cedar savanna habitat for three time periods (1931-1959), (1959-1973) and (1973-2000) and the overall origin (1931-2000).

Time Period	RCS created from Beach (ha)	RCS created from old field (ha)	Unchanged RCS (ha)	RCS Lost to Succession (ha)	RCS lost to Erosion (ha)
1931-1959	12.2	11.8	106.4	25.0	1.6
1959-1973	21.7	11.5	29.5	100.2	0.4
1973-2000	3.9	18.8	26.1	31.5	5.2
Total Change in RCS 1931-2000	**21.9**	**24.9**	**2.0**	**127.0**	**3.9**

Figure 2. The distribution of red cedar savannah (shown in black) at Point Pelee National Park a) 1931, b) 1959, c) 1973, and d) 2000.



Between 1973 and 2000 much of the abandoned farmland developed into the old field RCS that we see today. The disturbance caused by farming in very sandy soil created excellent habitat for RCS species. One such area is found north of Delaurier House, one of the sites where red cedar savanna was burned in 1998 (Falkenberg, 2000). The large amount of area naturalized during the 1970s offset some of the losses of RCS due to forest succession (Table 4)(Figure 2). However, the total red cedar savanna area in the park dropped by 14 ha during this period (Table 4).

High water levels during much of the 70s and 80s saw a drop in the coastal RCS along the east side of Point Pelee (Table 5)(Figure 2). The east beach savannah area had developed from bare sand present in the 1930s. By the late 1960s, the savanna area was open grassy area with scattered red cedar. This large amount of the RSC found on the east side of the tip was completely washed away between 1973-1978. By digitizing the shoreline for each air photo mosaic we see an overall decrease in the size of Point Pelee since 1931. In fact, the overall size has decreased from 1553.7 ha in 1931 to 1488.1 ha in 2000 (excluding Middle Island). That is an overall decrease in total park size of 65 ha or 4.4 % since 1931. Most of the decline is due to losses on the east side of Point Pelee with the west beach remaining relatively stable.

Table 5. The total change in the park size, beach area, and beach as % of the park. Negative values indicate a drop in land area (erosion). Positive values indicate an increase in area (accretion). The average water level of Lake Erie for the month the air photo was flown is also given.

Year	Total Park Area (ha)	Total Beach Area (ha)	Beach as % of Park	Change in Park Area from previous Year (ha)	Water Level (Ft.)
1931	1553.749	88.194	5.68	-	173.84
1959	1524.337	35.524	2.33	-29.4	173.96
1973	1506.66	19.265	1.28	-17.7	174.66
1985	1475.522	24.232	1.64	-31.1	174.73
2000	1488.11	41.097	2.76	12.6	173.98

In the future, park managers must decide whether savanna-type habitat should be actively maintained in the interior areas of the park. Test plots burned at DeLaurier and the Nature Preserve indicated that intensive management would be required to reach desired results (Falkenberg, 2000). The native seed bank in each of these areas is virtually non-existent and transplants would have to be used to re-introduce some RCS species (Falkenberg, 2000). Since the park is small and has a diversity of communities, it is important that the park set out clear vegetation management objectives for the future. Clearly enhancing red cedar savanna is beneficial for many existing SAR and possible SAR re-introductions such as the blue racer. A study looking into the potential re-introduction of the blue racer have concluded that too little savanna habitat presently exists to support its recovery (M'Closkey and Hecnar, 1997).

Conclusions

In conclusion, the historic mapping of RCS habitat has spatially documented a dramatic decline in RCS in the past 70 years. Large amounts of RCS have disappeared due to forest succession, and to a smaller extent, shoreline erosion. New RCS habitat has developed in recently abandoned farmland, and along the western shoreline. In the future, the old field RCS areas will likely disappear due to forest succession in the next 30 years. Since RCS is important for many rare and endangered species more work needs be done to record the floral composition of all of these areas. We recommend a detailed assessment of each RCS area by well-trained botanists to determine its health relative to other patches.

If park managers decided to restore large portions of Point Pelee to RCS, a large amount of time and money would be required. We recommend that a small test area near the Visitor Centre be used for red cedar savanna research and education purposes.

We also recommend a workshop with local experts to determine the vegetation management objectives of the park. Currently the only disturbance maintaining RCS in the park is shoreline disturbance. More research should be done to better understand whether shoreline disturbance alone could maintain a viable RCS community at Point Pelee, or whether active restoration techniques like burning should be employed. Since RCS is so closely tied to water levels, disruption in sand movement along the coast, caused by shoreline development, may be having a negative impact on the long-term survival of coastal RCS habitat.

Acknowledgements

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