

SUMMER ASSESSMENT OF ASPECTS OF THE ECOLOGY OF
WHITE-TAILED DEER IN POINT
PELEE NATIONAL PARK

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By

Dr. John B. Theberge
Faculty of Environmental Studies,
University of Waterloo,
Waterloo, Ontario.

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ABSTRACT

The deer herd at Point Pelee National Park appears to be small (6⁺ 50%, as estimated on 75% of the dry land of the Park), and stable, the latter conclusion based on re-calculating erroneously analyzed data collected by Henry in 1972. The technique used in both cases -- pellet group analysis, estimates low but likely consistently so. All habitats analyzed were used approximately in proportion to their size. Deer do not appear to be emigrating permanently from the Park, and fawns per doe are much lower than expected.

Deer numbers are below the carrying capacity of the range. Most browsing is on the most abundant species of woody plants in the Park, and in no cases were the percent of stems browsed on 100 square foot plots greater than 33 percent. Hackberry forests support more browsing in total and percent area than other habitat types, indicating that older forests do not lose most of their attractiveness to deer as in the northern hardwoods. No plant species in the Park is in jeopardy because of deer browsing, and succession appears to be little affected.

From the foregoing is the conclusion that a reproductive rate lower than normal for white-tailed deer is holding the herd below the carrying capacity (in terms of food availability) of the range.

The analysis of the significance of abandoned land to deer suggests that as succession proceeds, deer browse can be expected to improve only slightly. While quality of deer browse is better on abandoned land than in adjacent forests, this is partly counteracted by more quantity in the adjacent forests in most (but not all) cases. However, since food availability is now in excess of that needed by the present herd, more food that may grow on abandoned land can be expected to have an only minimal effect on increasing the size of the herd.

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TERMS OF CONTRACT

Project requirements were:

- (1) census the deer population in the Park and determine sex and fawn/adult ratio;
- (2) determine the seasonal distribution patterns (spring-summer-fall) and limits of range of the deer within the Park;
- (3) investigate and report on the daily movements of deer with particular emphasis on the movements of deer into and out of the Park;
- (4) assess the effects of the deer herd on the vegetation in its present range in the Park, and attempt to determine the range changes or range requirements for the future;
- (5) prepare maps at a scale of 1 inch equals 400 feet to clearly illustrate deer movements, distribution and limits of range to correlate with the written data, within the Park;
- (6) assess and report on the effects of visitor use of the Park on distribution and habits of the deer;
- (7) submit an original and two copies of the final report containing:
 - (a) all data collected (in map, chart, and/or table form);
 - (b) photographs or other illustrative material needed to properly report on the work;
 - (c) an interpretation and discussion of findings, with recommendations as to future management practices of the herd.

INTRODUCTION

The terms of the contract can be subdivided into three major topics, dealt with successively in this report in three major parts:

PART A Deer numbers, Distribution and Demographic Data;

PART B Assessment of Food Habits on Forested Range for Deer;

PART C Assessment of Probable Successional Changes of Cleared Land and their Significance to Deer.

This study assesses the present balance between deer and their habitat at Point Pelee National Park, and reflects on possible future changes in this balance. It follows one completed in 1972 by B.A.M. Henry at the University of Western Ontario, which also attempted to assess numbers of deer, movements, and food habits. Our report reflects on the adequacy of the previous data, and adds to food habit information with quantified data hitherto not collected. It points indirectly in another direction to answer the question of what limits deer numbers in the Park.

Deer numbers have apparently varied in the past. Historically deer were undoubtedly part of the peninsula's fauna, since they lived throughout southern Ontario. Between 1830 and 1880 the population was thought to have declined because of "the increasing intensity and scale of human activity". (Nelson and Battin, 1974, P.45). Wigle (1973) summarized the more recent history of deer numbers commenting that numbers were so low in the 1920's that residents introduced additional deer. Cutting and burning of underbrush during the early decades of the twentieth century by cottagers and park residents (Nelson and Battin, 1974, P. 19) may have mitigated against deer, but by 1940 the herd was thought to be approximately 50 animals (Wigle, 1973). Since then, periodic estimates and observations of residents and the results of deer removals in the mid 1950's (to supposedly protect adjacent farmland), placed deer numbers between 20 and 25 up to the late 1960's, and 15 to 20 up until winter 1974, the subject period of this study.

Vegetation on Point Pelee has changed greatly since the early 1800's when

white man first settled there. While early botanists described forests as Carolinian (Maycock, 1972, P. 78), cultivation and farming have so altered natural succession that the present vegetation must be viewed as the result of the dual forces of nature and man. This complicates any extrapolation of past plant communities into a prediction of the future, and makes such an assessment almost wholly dependent on present evidence alone.

Why have deer numbers not increase? Since 1957, deer have been protected in the Park. Accidental or illegal mortality has been low, estimated at two deer per year between 1967 and 1973. Coyotes are the only possible predator, likely not significant to adult deer. A variety of successional stages exist in the Park's vegetation. The answer to the low deer numbers is not clear. Will deer increase as farmland bought by Parks Canada in recent years in the Park, begin to grow deer food? Is the natural perpetuation of Carolinian forests elements, one of Pelee's attractions and unique contributions to Canada's national park system, in jeopardy from the present deer browsing, as is believed at Rondeau, a sister peninsula? These are the broad questions addressed in this study.

ACKNOWLEDGEMENTS

Field data for this report were collected under my supervision by undergraduate students Susan Heffernan, (from May 1 to September 1, 1974), and Andrew Gordon (from May 1 to July 1), and the success of this collection is due to their efforts. Preliminary analysis of parts of the field data presented in Parts A and B and the preparation of maps were done by Sue Heffernan in conjunction with partial requirements of a fourth year undergraduate paper at the University of Waterloo.

I would like to express my appreciation to park personnel at Point Pelee: Superintendents F. Camp and D. Harris. Both the warden, staff and park naturalists were both interested and helpful in many ways: Don Wigle, Ray Knight, Rick Hollingsworth, Jim Fulman, Cliff Drysdale, Don Ross and the seasonal naturalists. From Cornwall, Dr. B. Lief helped with the original contract, and with equipment. Larry Lamb of the University of Waterloo helped with plant identification.

PART A DEER NUMBERS, DISTRIBUTION, AND DEMOGRAPHIC DATA

INTRODUCTION

How many deer are there in Pelee Park? Are they distributed unevenly? Do they move out of the Park in the summer? What is the sex and fawn/adult ratio?

PART A addresses these questions.

METHODS

A census of the 1973-74 winter's deer population was conducted by the "pellet group technique". This technique, widely used to determine deer numbers, involves counting pellet groups on the basis of samples stratified as to habitat, and based on three assumptions. These assumptions are: 1) defecation rate for deer is 13 pellet groups per 24 hours, 2) the winter period during which pellets accumulate can be accurately estimated as a date when leaf fall terminated to the

! point of the time during which the pellet census is being conducted, 3) all pellet groups on transects are found and counted, and no pellet groups disintegrate during this period. (A pellet group was more than 5 pellets in close proximity.)

In our case, the period of accumulation was taken as 164 days, being from December 1 until May 14 inclusive. The following equation transforms data on pellet groups to numbers of deer:

$$\text{No. of deer} = \frac{(\# \text{ pellet groups per acre})}{(\text{defecation rate})} \times \frac{\text{total no. of acres}}{\text{accumulation period}}$$

Thirty-two transects were run, most 100 meters long and two feet wide. Their locations were, as nearly as possible, duplicates of those run previously

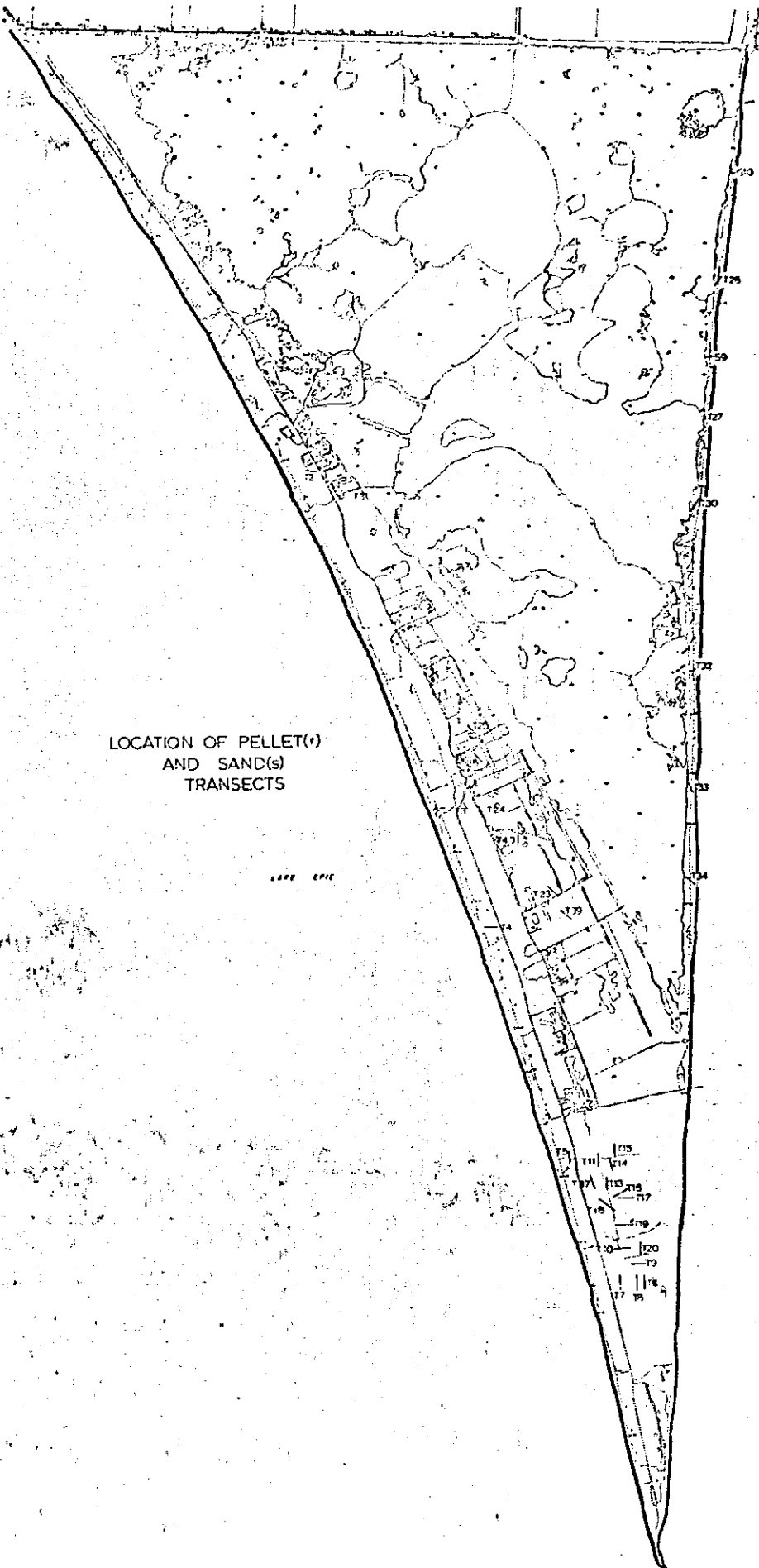
by Henry (1972), but his map of transect locations was quite inaccurate. Transects were shorter than 100 meters only when constrained by habitat type (all individual transects were chosen to be representative of only one habitat type).

In addition, we ran 7 transects chosen on edges between habitats to test the use of "edge" by deer.

The transects are listed in Appendix I, and their location shown on Map 1.

In this study, since deer distribution was perceived as uneven, data plugged into the formula were stratified by habitat type. Four habitat types were sampled: Hackberry forest, Abandoned farmland, Red cedar A, Red cedar B, using categories suggested previously and described by Henry. These made up 75.1% of the Park, exclusive of the marsh. Not assessed were: Wet forest, Shrub, Herbaceous strand. In marsh and wet forest, pellets would have disintegrated; shrub habitat was initially thought to be prohibitably small; herbaceous strand was too small and inseparable from beach. By careful planimetry, the size of each habitat type was determined (these varied from Henry's estimates). Then the mean numbers of pellet groups per 50 meter transect were calculated separately for each of the four habitat types and weighted as to the extent of that habitat, by multiplying each of these figures by the percent that each habitat represented of the total of the four habitats. Mean number of pellet groups per 50 meters was used instead of 100 meters (a full transect), because some transects were shorter, as mentioned. The sum of the weighted mean number of pellet groups per 50 meter transect for each habitat was converted to pellet groups per acre, and used in the formula.

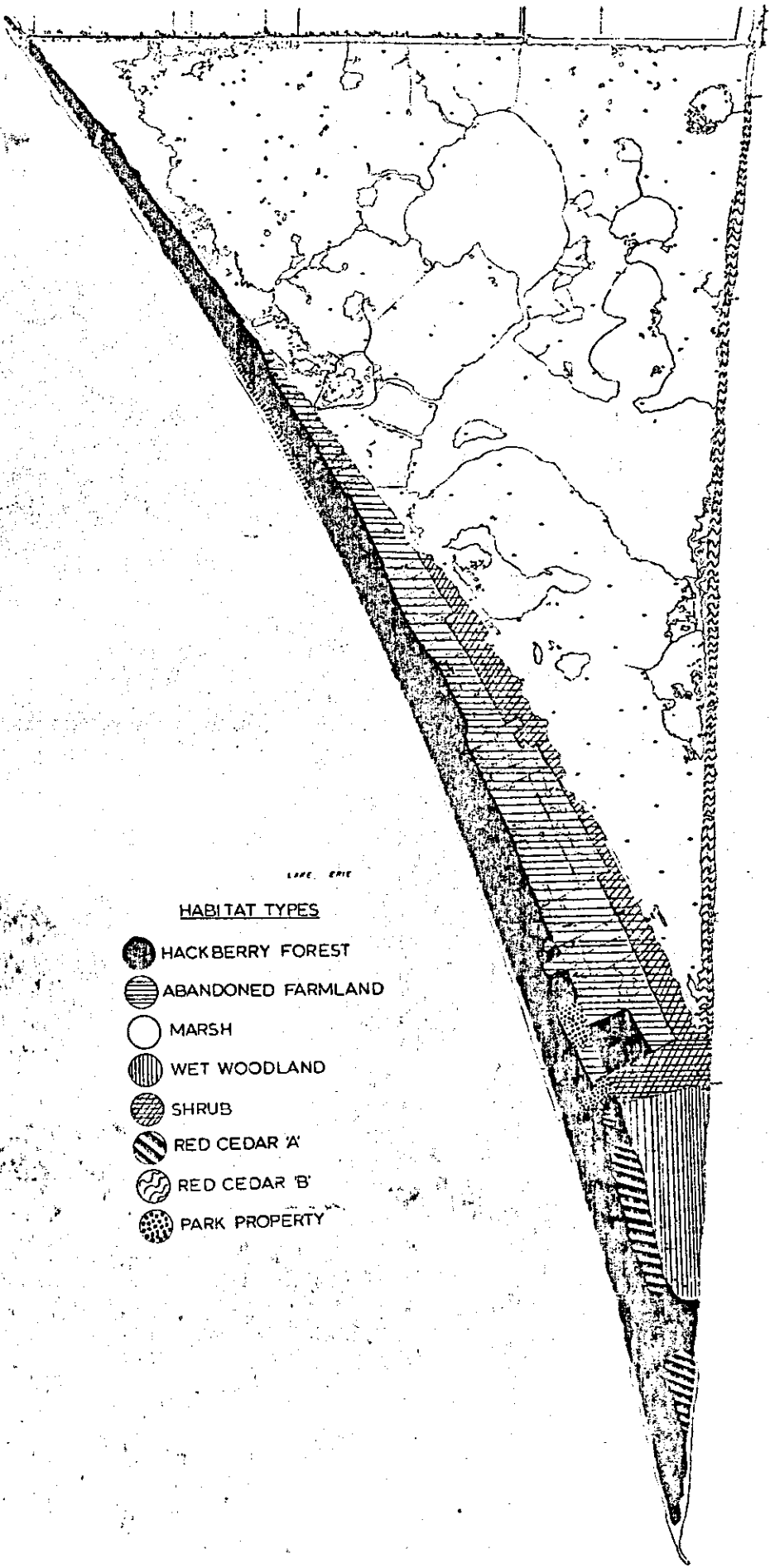
This stratification by habitat type is essential when distribution of deer is uneven; otherwise a disproportionate amount of sampling in any one habitat will result in a biased score. Henry did not recognize this, which completely



LOCATION OF PELLET(s)
AND SAND(s)
TRANSECTS

LAKE ERIE

- || 25
- || 24
- || 23
- || 22
- || 21
- || 20
- || 19
- || 18
- || 17
- || 16
- || 15
- || 14
- || 13
- || 12
- || 11
- || 10
- || 9
- || 8
- || 7
- || 6
- || 5
- || 4
- || 3
- || 2
- || 1



LAKE ERIE

HABITAT TYPES

- HACKBERRY FOREST
- ▨ ABANDONED FARMLAND
- MARSH
- ▤ WET WOODLAND
- ▧ SHRUB
- ▩ RED CEDAR 'A'
- RED CEDAR 'B'
- PARK PROPERTY

validates his census. We re-calculated numbers of deer from his data after stratifying the data, and results are presented.

To place a measure of confidence on our census data, we calculated confidence limits, using the sum of the sum of deviations from the mean number of pellet groups in each habitat type, and plugging this into the standard equation.

The extent to which deer were unevenly distributed in the Park during the previous winter was calculated by a Chi-square test, based on the assumption that all habitats were expected to be used proportionately to their size.

An attempt to determine movements in summer was made by setting out and periodically checking eleven sand transects. Each transect was four feet wide and they averaged 95 feet in length. They were established where Henry had established his in 1971. Every 8 to 10 days all deer tracks found on them were counted, and the transects raked. Nine of the eleven transects were run throughout June and then abandoned as unsuccessful due to a combination of factors: human tracks or rain (it rained 18 days out of 30 in June) obliterating deer tracks; unsuitable surfaces of gravel or herbaceous cover. The remaining two transects were maintained until the end of August, and were located on the north-east beach so as to assess any movement of deer out of the Park.

Data on movements also came from observations of deer made on early morning or late evening searches conducted three times each month, or during the course of other work, plus observations made by the public and reported on a form provided at the Interpretive Center. These observations were also the source of demographic information.

RESULTS

Deer Numbers and Winter Distribution. The number of deer in the sampled portion of Pelee Park (75.1% of land, exclusive of marsh) in the winter of 1973-74 as

etermined by pellet groups analysis was $6 \pm 50\%$. In other words, at the 95% confidence level, the population that used the area sampled lay between 3 and 9. Table 1 displays the data which were used to calculate for each habitat type the weighted mean number of pellet groups per 50 meter transect", which was one necessary component in the estimation of deer numbers.

Table 1. Manipulation of observed deer pellet groups into weighted mean number of pellet groups in each habitat type.

Habitat	% of total habitat studied	Number of transects ¹	Total pellet groups	Total of pellet groups per 50 meter transect ²	Mean no. pellet groups per 50 meter transect ³	Weighted mean no. pellet groups per 50 meter transect ⁴
Hackberry Forest	52	6	5	2.5	0.42	0.22
Abandoned Farmland	33	6	3	1.5	0.25	0.08
Red Cedar A	5	14	17	9.3	0.66	0.03
Red Cedar B	9	6	1	1.0	0.17	0.02
					TOTAL =	0.35

¹ Transect lengths were variable, as explained in text.

² See Appendix I for details.

³ Column five divided by column three.

⁴ Column six times column 1 divided by 100.

The sum of "weighted mean number of pellet groups per 50 meter transect", which was 0.35, represents a mean score for 100 square meters (since each transect was 2

eters wide). This was converted to a score per acre (14.2) and used in the equation described under methods:

$$\frac{\frac{(14.2) 846}{(13)}}{164} = 5.7 \text{ deer.}$$

The total acreage of the four habitats, 846 acres, was made up of 445 acres hackberry forest, 279 acres abandoned farmland, 44 acres Red Cedar A, 78 acres Red Cedar B. (The sizes of habitats not included in this analysis were: 2564 acres marsh, 101 acres wet woodland; 116 acres shrub, 54 acres beach, and 20 acres park buildings.) As mentioned, acreages of each habitat differed from those used by Henry, and are believed to be more accurate.

This estimate of deer numbers in 75 percent of the park exclusive of marsh is likely low, for reasons that will be discussed. The number, however, is reasonably consistent with a re-calculation of data collected in May 1971, by Henry. This re-calculation involved: a) stratifying the sample by habitat type and weighting in proportion to that habitat type, and b) using our calculations of the sizes of habitat types. When this was done, Henry's data yielded an estimate of 5.3 deer rather than 18 deer. The data used in this re-calculation are shown in Table 2. From the calculated weighted number of pellet groups per acre (14.8), the number of deer (5.3) in 83.5 percent of the park was derived from the formula as follows:

$$\frac{\frac{(14.8) 962}{13}}{200} = 5.3$$

Henry was also in error in using an accumulation period of 200 days, since that ran from December 1 to June 20 and thus included all his period of running pellet groups transects. Rather he should have included only half that time, a logical (ie., half the period of running transect

essity. Since dates of sampling do not appear in his thesis, the correct accumulation period could not be determined, but if it were 164 days as was ours, Henry's deer estimate would have been 6.4 deer in 83.5 percent of the park. Confidence limits could not be placed on Henry's data because his thesis did not display all the relevant data. The high degree of confidence he did put on his erroneous estimate of numbers is likely also a miscalculation, as his total area in transects was only slightly larger than ours, and only a greatly larger sample size would have resulted in narrower confidence limits.

Table 2. Re-calculation of 1971 pellet group analysis (Henry, 1972) to stratify the observed data by habitat type.

Habitat ¹	% of total habitat studied	Transect area (square meters)	No. of pellet groups	No. of pellet groups per acre	Weighted number pellet groups per acre
Hackberry Forest	46	924	0	0	0
Abandoned Farmland	29	1000	8	32.4	9.4
Red Cedar A	5	2833	63	89.0	4.5
Red Cedar B	8	1078	3	10.9	.9
Shrub	12	200	0	0	0
TOTAL =					14.8

¹ Wet forest, which Henry included, was excluded in this re-calculation because size of area could not be determined, as water level varies between years.

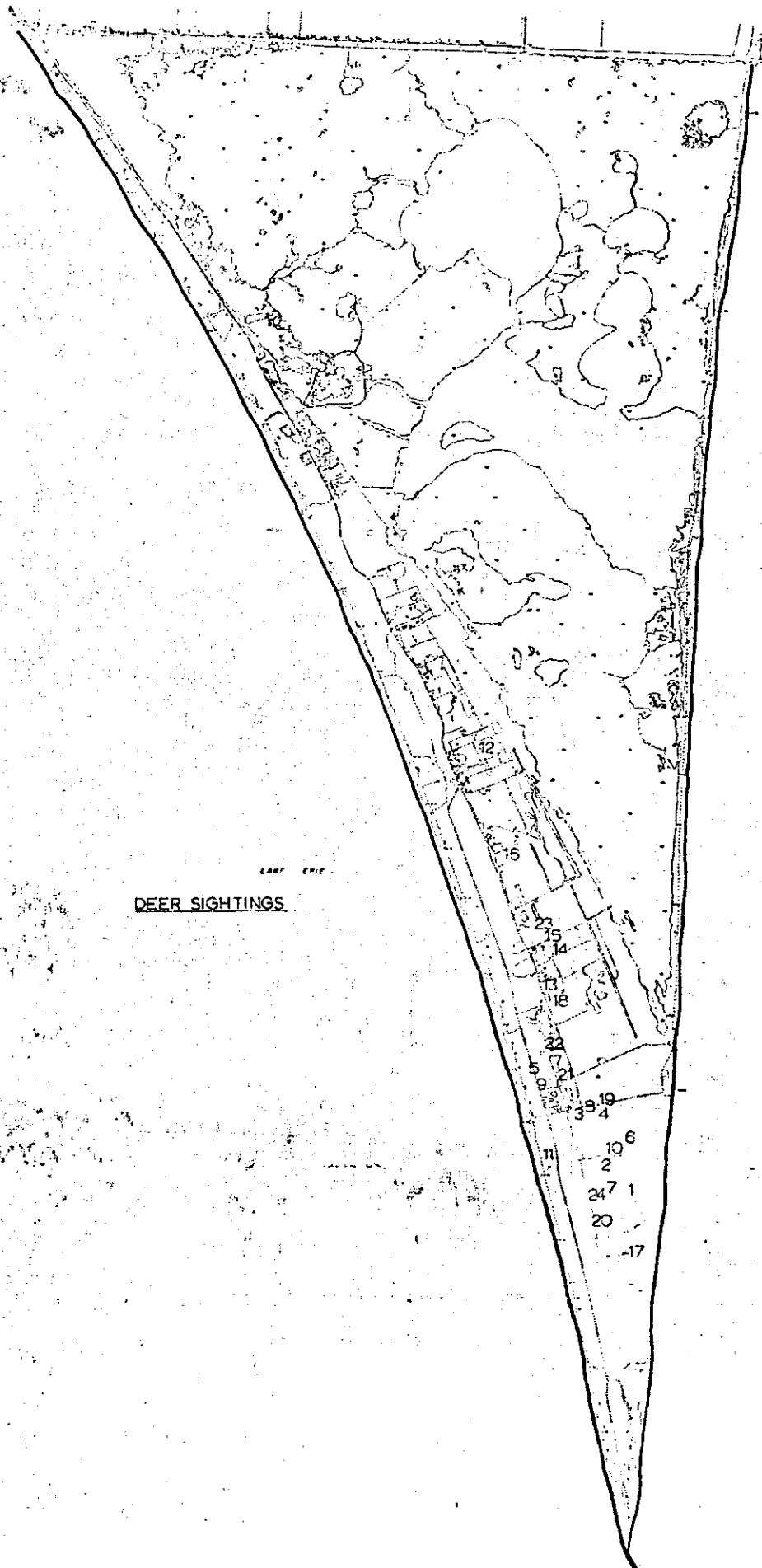
The four habitats analyzed in our study were used proportionately to their relative sizes. A Chi-square test of non-random distribution showed no significance at the 0.05 confidence level. The data used in this analysis are displayed

in Table 3. While Table 3 shows some uneven use, such as more use of Red Cedar A than expected (the largest contributor to the total Chi-square value), and less use of Red Cedar B habitat, the total is not significant.

Table 3. Deer distribution data tested by Chi-square for non-randomness. (Expected values were calculated as total pellet groups in all acres times ratio of the specific sample area of each habitat to the total sample area.)

<u>Habitat Type</u>	<u>Area Sampled (square meters)</u>	<u>Observed Pellet groups</u>	<u>Expected Pellet groups</u>	<u>X² Value</u>
Hackberry Forest	1200	5	5.6	0.06
Abandoned Farmland	1060	3	4.9	0.73
Red Cedar A	2520	17	11.7	2.40
Red Cedar B	820	1	3.8	2.05
			TOTAL X ² =	5.24
			0.05 probability level =	7.82
			(D. of F. = 3)	

Summer Distribution. Twenty-four sightings of deer were made, totalling 41 animals. These sightings indicated that deer used the red cedar A habitat in May, July and August, and the abandoned farmland in late July and all of August. Tracks indicated that the wet woodland and shrub were used throughout the summer, with occasional use of red cedar B and hackberry forest. However, movements, or changes in distribution over the summer could not be accurately determined from the small number of sightings, and the non-systematic observations of tracks.



LARF EPIC
DEER SIGHTINGS

11
2
247 1
20
17

In addition to our sightings, 81 sightings were made by the public. Most were within a mile of the Interpretive Center. Since this is the area of heaviest public use of the Park, these sightings are of limited value in determining the summer distribution or movements of deer.

The two sand transects on the north-east beach indicated some possibility that deer may have occasionally moved out of (or into) the Park. Between early June and late July, a total of 45 tracks (individual hoof marks) were noted on the two transects. On June 25, tracks were observed going right into the water at the north end of the beach, and returning. To exit from the Park this summer via the north-east beach would have required wading.

Demographic Information. Of the 41 deer we observed, 14 were does, 10 were bucks and 17 were unidentified. This sex ratio is not significantly different from 50:50 at the 0.05 probability level. Of the bucks, 3 were spikehorns, 2 had 4 point antlers, one had 5 points and one six points.

The 81 sightings made by the public were not of value in determining sex ratio, as most people indicated uncertainly regarding sex of the deer observed.

Two sightings of a fawn (perhaps the same animal) were made by park naturalists in late May and early June on roads near the Interpretive Center.

DISCUSSION

The deer census based on pellet groups provided a lower estimate compared with a winter drive census conducted on February 4, 1974. In that drive, 35 deer were counted. Either the pellet group census was too low or the winter census too high. Examining the first possibility, the pellet group census covered 75% of the "dry-land" area of the Park. Winter deer use of wet woodland (most of the remaining 25%) was subjectively studied in the browse analysis conducted in June. No disproportionate amount of browsing was found, indicating no "yarding up" here.

Extrapolating the census results to include the whole dry-land of the park still yields only 8 deer (or a range from 4 to 12.).

The red cedar B habitat lies adjacent to the East beach, and hence may have flooded during high late winter water levels. Only one pellet group was found here, a lower than expected finding (Table 3). However, red cedar B only makes up 8 percent of the dry-land of the Park, so an adjustment for lost pellets here would, at the most add only one deer.

Pellet groups may have been missed, and in an assessment of "Some sources of errors in using pellet-group counts for censusing deer", Van Etten and Bennett found significant differences between the abilities of two biologists to find pellets. However, their paper also identifies bias that would tend to overestimate deer numbers, namely slow disintegration of some pellet groups over a number of years, in New Jersey. Transects in the present study were run slowly, resulting in confidence that all pellet groups were found.

The possibility that deer used edges between habitat types and hence were missed was checked with 7 deliberately selected "edge transects". No pellet groups were found, eliminating this source of error.

Our results were almost identical to the corrected results of Henry, so in effect, a duplication of the technique with different personnel came up with similar results.

In short, while a bias towards low results with the pellet group census may have been present, we could not identify one.

The winter deer drive was also believed reasonably accurate by personnel in charge. However, all deer were counted as they doubled back through the line of drivers, making the straightness of the line critical to avoiding duplicate counting. In a report on the drive, D. Wigle (1974) commented that in the last mile "the people involved were becoming tired and stragglers were falling behind".

Probably deer numbers rest somewhere between the two estimates. This is

similar to the long-term general average believed to be between 10 and 20 (Wigle, 1973) and indicates no recent large increase in numbers. A density of 10 to 20 deer in 1137 acres (5 to 10 deer per acre) is low for an un hunted population with little or no predation and no necessity to yard because of excessive snow depths.

Our finding that the four habitats studied were used proportionately to their size was different from Henry's results. He identified a very heavy use of red cedar A habitat as evidenced by pellet groups and some of his winter observations.

Deer appear to use all of the park (except marsh) during the summer, even the area south of the Interpretive Center used heavily by people. From this however cannot be concluded that people are having no adverse effect on deer. Heaviest naturalist use of the park coincides with the fawning period in late May and early June. Perhaps people exert adverse stress on does at this critical time, but at present there is no evidence.

Our observations of possible movement of a few deer across the north-east boundary of the Park adds to speculation of the significance of emigration to the population, rather than solves it. In 1970 a deer was known to move out, and was shot by a cottager. In 1973 two deer were observed to walk to the north-east boundary and then return. However, if many deer moved out of the park permanently, one would expect the population to exhibit characteristics of exploitation, notably increased fawn production. The Ontario average reproductive rate is 1.5 fawns per doe (Cummings and Walden, 1970). At Rondeau, where removal of deer has occurred in the last two years, the average number of fawns per doe is about 1.3 (Burton and Pratt, 1973). That none of the ten does observed at Pelee had fawns indicates both that emigration is not significant, and more importantly, that a limitation to production may be the stabilizing influence on the population. If production is limiting this contrasts markedly with the situation at Rondeau where with average production, mortality must be a significant factor in dampening the potential numbers that could be reached (Lincoln, 1974). At Rondeau, deer are believed

be in a dynamic equilibrium (not necessarily static) with their environment (Cruickshank, 1974), at a density of approximately 50 deer per square mile (200 deer in 4 square miles of forest habitat), much denser than at Pelee. Therein lies an intriguing ecological problem - what is the cause of apparent reduced reproductive success of deer at Pelee that appears to be holding the deer population down?

SUMMARY AND CONCLUSIONS

1. The deer population at Point Pelee, based on pellet groups, in the winter of 1973 - 74 on 75 percent of the "dry land" area of the Park was $6 \pm 50\%$. This estimate is believed to be somewhat low, for reasons given.
2. A re-calculation of data collected in 1971 by Henry using the same technique, but correcting for his statistical error showed a population of 5 deer in 83 percent of the dry land of the Park. Indications are that the herd is small and relatively stable.
3. The four habitats studied (hackberry forest, red cedar A, red cedar B, abandoned land) were used in proportion to their relative sizes.
4. Sand transects indicated some movement of deer across the park boundary at the north-east beach.
5. Sex ratios are even. Fawns are fewer than expected (10 observations were made of does with no fawns, no does with fawns).
6. Low fawn production may be the reason for stability in the population. If high mortality of adults, or emigration were important, fawn production would be expected to be greater.

PART B ASSESSMENT OF FOOD HABITS ON FORESTED RANGE FOR DEER.

INTRODUCTION

What effects are deer having on the vegetation of Point Pelee National Park?

What plant species are they utilizing and why?

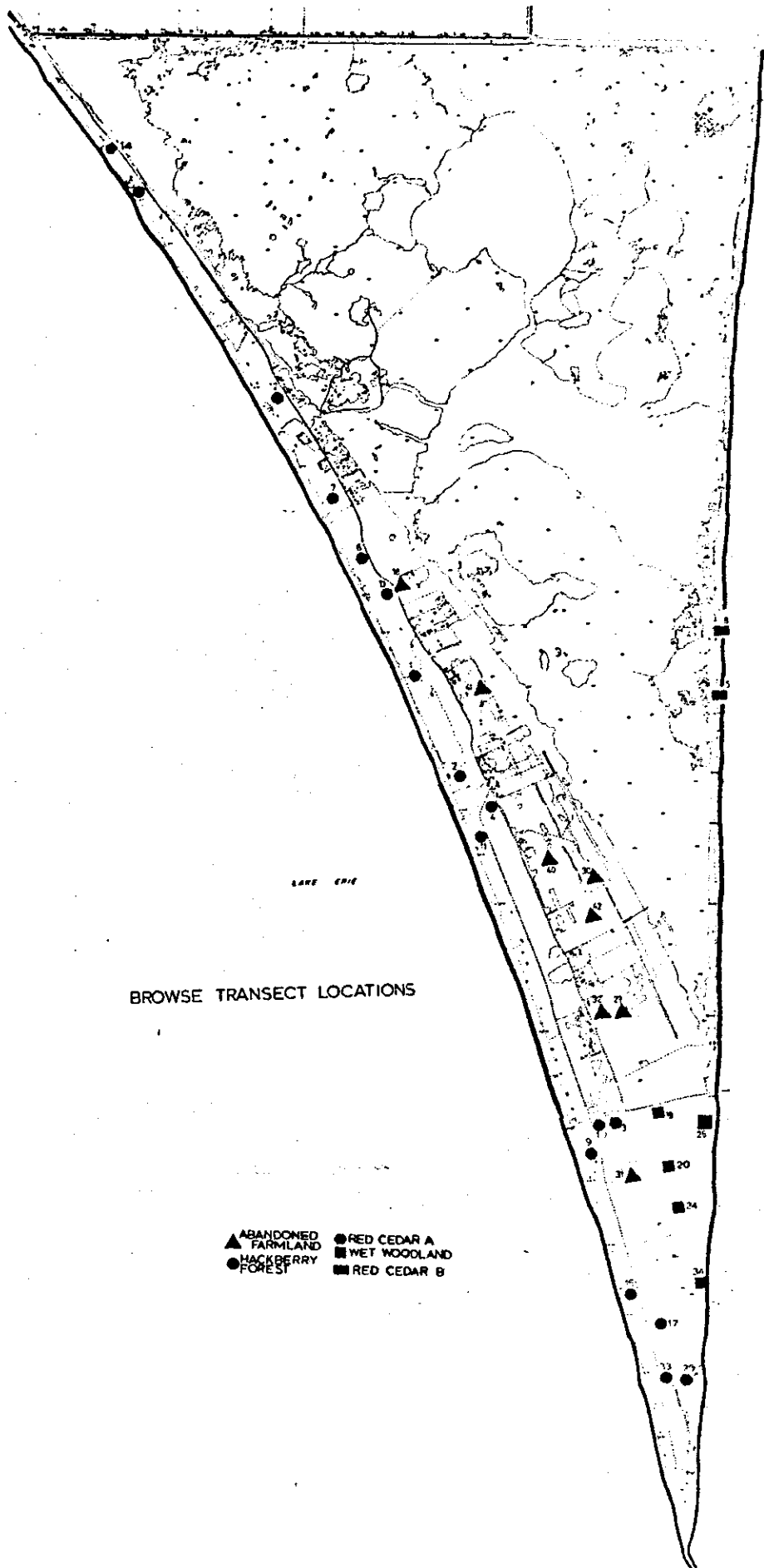
Do browse levels indicate that food supply is a limiting factor to growth of the deer herd?

Concentrating on the above questions, we sought to survey and understand the interrelationships between deer and vegetation in Point Pelee. We were concerned primarily with winter browse levels, since Henry (1972) had concluded that "over-browsing of winter food plants lowered the carrying capacity of the winter range". The winter browse period represents the time of heaviest browse utilization or roughly the period between November 1st and May 1st. We also examined the availability of vines and herbaceous vegetation.

METHODS

The availability of deer food and degree of utilization were determined by measuring vegetation on 32 transects during June and early August. A single transect was established in most of the 29 vegetation zones identified and mapped by Maycock (1971) (See Nelson and Batten, 1974, Fig. 9), except in the wet woodland where the location of Maycock's zones could not be determined. Corresponding with the habitat types referred to in PART A, as originally defined by Henry (1972), 15 transects occurred in the hackberry forest habitat, seven in abandoned farmland, five in wet woodland, three in red cedar A, and two in red cedar B. By using Maycock's subdivisions of habitat types, we were sure of including the variation in vegetation within each habitat type.

Each transect within a vegetation zone was located by subjectively finding a



LAKE ERIE

BROWSE TRANSECT LOCATIONS

- ▲ ABANDONED FARMLAND
- RED CEDAR A
- HACKBERRY FOREST
- WET WOODLAND
- RED CEDAR B

representative area in the vegetative zone, and then picking numbers from a hat to determine a compass bearing for the transect. Each transect consisted of eight plots, (total of 256 plots) each 25 feet long and 4 feet wide, located consecutively

along a tape stretched out on the ground. Data collected for each plot included:

1) relative percentage of woody, herbaceous and vine growth (eg. 20% woody, 80% herbaceous, 0% vine); 2) the five most abundant plant species of each group --

woody, herbaceous, vine, listed in ranked order of abundance; 3) the amount of

browse observed on woody species:

very slight	(under 5% of stems)
slight	(6 to 33% of stems)
medium	(34 to 66% of stems)
high	(67 to 100% of stems)

A "stem" was defined as single growth arising from the ground, from one strand of a species such as Ribes, to the trunk of a tree.

Procedures adopted in analyzing the data from the 256 plots included the following:

1. Utilization of each species of woody vegetation was determined by adding the number of plots on which it was browsed (regardless of the extent browsed). To the extent that the location of transects reflected fairly the proportional availability of browse species, this gives a true reflection of the relative amounts of various species eaten by deer. The extent of browsing on plots was not considered, as it never exceeded "very slight" or "slight" (see above) of the stems available even when few stems were present. In other words, regardless of amounts of any species on transects, browsing was uniformly light.
2. Availability of browse species was determined by calculating "prominence values" for each species. This is an index, obtained by multiplying the density of a species by the square root of its percent frequency of occurrence on plots. Here, density was determined by assigning a value of 5 to the species if it was the most abundant on any one plot, 4 if it stood second, 3, 2, and 1 for third,

fourth and fifth. A total density for a species was the sum of its scores on individual plots. Percent frequency of occurrence, the second value needed in calculating prominence values, was simply the percent of plots on which the species was listed as one of the top five.

The value of using prominence values for determining availability is that it generates one figure that takes into account two parameters: density and frequency of occurrence (the later is a measure of how widely distributed the species is). The technique suggests that density is the more important of the two parameters in regards to how prominent or common a species is, because frequency is made less important by being square-rooted. This technique has been used widely in botanical investigations (Stringer and La Roi, 1970; Douglas, 1972; Theberge, 1974). It has not previously been applied in describing the availability of deer browse. However, it is logically more valid than the usual method of simply using the number of plots the species occurs on as a measurement, because it includes a measurement for density on each plot.

3. Palatability of various species of woody vegetation was determined by first calculating a total browse score, as follows: the various levels of browse on individual plots were given numerical scores -- very slight (25% of stems browsed) = 0.16; slight (6 to 33% of stems browsed) = 1.30; medium (34 to 66%) = 3.0; high (67 to 100%) = 5.0. These numerical values were based on proportional values to the mid-point of each class, with 1% equally a value of 0.063 (The choice of value for 1% was made arbitrarily, and chosen to allow at least two of the categories to have round numbers for their scores instead of decimal values). Computation was made from the mid-point of each class since observations could fall anywhere within the range of the class and therefore the mid-point is most representative.

For each species a total browse score was the sum of all the individual browse scores on plots. To convert this to palatability, it was then divided by the number of plots on which the species occurred.

Palatability, then was independent of availability, since it really was a mean level of browse on plots where the species occurred, and on these plots the species' rating was independent of abundance (eg. a species could score as "highly browsed" even if only a few stems were present, since the score was based on the extent of use relative to amount present).

4. The availability of herbaceous vegetation and vines was determined by calculating the percentage of plots on which each species occurred. Prominence values were not used because that precision of analysis was considered unwarranted since very little data exist on utilization or palatability of these groups to allow interpretation of the significance of availability. Any grazing, or browsing of vines noted during the study were recorded.

RESULTS

Of a total of 31 species (or in some cases genera) of woody plants (except vines) found on transects, 18 (58%) were browsed by deer (Table 4.). Gooseberry spp. and hackberry were the most heavily used, on the basis of total number of plots browsed, followed by cherry spp., staghorn sumac, dogwood spp., raspberry spp. and red cedar. (For scientific names, see Appendix II). These seven species made up 87% of the total occurrences of browsing on the plots by deer. Staghorn sumac, ranking fourth, may have ranked lower than it should because utilization of seed heads in fall or winter was difficult to determine due to their normal disintegration by the following summer. Observations made in January, 1975, indicated that almost all of the preceding summer's seed heads that were growing within reach of deer had been browsed.

The hackberry forest habitat supported by far the most feeding by deer, followed by close to equal amounts for wet woodland, abandoned farmland and red cedar A, determined from subdividing the total browse score by habitat type. (Table 5.) In Table 5, no species were included that were found on less than four plots.

The comparison of total use between habitat types made in Table 5 is as acc-

Table 4. Availability and utilization of woody plants (non-vine) by deer at Point Pelee National Park.

Species	Availability (total prominence value ¹)		Utilization	
	No. of plots where found	Total prominence value ₁	No. of plots where browsed	% of plots where occurring where browsed
Hackberry	90	2740	55	61
Gooseberry spp.	74	2585	55	74
Cherry spp.	73	2340	36	49
Dogwood spp.	49	1542	18	37
Raspberry	37	807	16	43
Staghorn Sumac	29	789	19	66
Red cedar	16	339	9	56
Hop tree	12	214	6	50
Sugar Maple	7	156	1	14
Apple	5	152	5	100
White Pine	—*	134		
Fragrant Sumac	7	117	5	71
Rose	5	115	2	40
Silver Maple	4	95	3	75
Basswood	—	79		
Ash spp.	—	72		
Oak spp.	6	71	2	33
Black Walnut	—	68		
Elderberry	5	64	1	20
Hop Hornbeam	—	56		

Table 5. Utilization of browse¹ in various habitat types by deer at Point Pelee National Park.

Species	Utilization (No. of plots with browse) ² per habitat type					Total Utilization
	Hackberry Forest	Red Cedar A	Red Cedar B	Abandoned Farmland	Wet Woodland	
Hackberry	38	2		4	11	55
Gooseberry spp.	42	2		3	8	55
Cherry spp.	29	1		2	4	36
Staghorn Sumac	2	8	1	8		19
Dogwood spp.	1	4	3	2	8	18
Raspberry spp.	8	3		4	1	16
Red Cedar	2	2	1	4		9
Hop Tree	6					6
Fragrant Sumac	1	4				5
Apple				5		5
Silver Maple					2	2
Rose spp.					2	2
Oak spp.	2					2
Sugar Maple	1					1
Elderberry	1					1
Total Use	133	26	5	32	36	232

¹ No species is listing that occurred (not necessarily browsed) on less than four plots.

² Total number of plots was 256, with 120 in hackberry forest, 24 in red cedar A, 16 in red cedar B, 56 in abandoned farmland and 40 in wet woodland.

urate as the proportion of plots examined in each habitat was proportional to the relative size of habitats. Forty-seven percent of the plots were examined in the hackberry forest, 17% in the wet woodland, 9% in red cedar A, 6% in red cedar B, and 22% in abandoned land. Comparative percents of actual acreage, from Part A are: 47, 10, 5, 8 and 30 percent respectively. These percents do not exactly match because variability within habitat types had to be examined (done by using Maycock's subdivisions, as described). The comparison in Table 5, therefore must be seen as a general indicator that habitat types were used partially in proportion to their sizes, with hackberry, the largest, used the most, wet woodland and red cedar A used slightly disproportionately heavily (they received a greater percent of the total browsing than their percent of total area), and red cedar B and abandoned farmland used slightly less.

The greater use of hackberry forest than other habitat types was due not only to its greater size, but also greater amount of browse use per plot. When total utilization for each habitat type (Table 5) was converted to mean utilization for habitat type (by dividing by the number of plots), hackberry forest received a score of 108, wet woodland 90, red cedar A 65, abandoned farmland 57, and red cedar B 31. This list is as expected, with the three habitat types browsed disproportionately heavily related to size receiving more browsing per transect than the other three habitat types.

The relative availability of woody plants is shown in Table 4. Hackberry ranked first, in prominence value, followed in order by, gooseberry spp., cherry spp., dogwood spp., raspberry spp., and staghorn sumac.

Regarding the impact of deer on woody vegetation, Table 4 lists the percents of plots where each species was browsed out of plots where it occurred (omitting species that were found on less than four plots). Some species were browsed commonly when found (apple 100%, silver maple 75%, gooseberry spp. 74%, staghorn sumac 66% -- the latter species may have been browsed more, as mentioned previously). While this may indicate a significant impact of browsing on these species,

such is not the case for two reasons. First, data were based on stems, not twigs, so even if only one twig was browsed, this was recorded as a browsed stem. Secondly, in no cases (plots or species) where browse was recorded, did browsing exceed the "slight" category (which was less than 33% of available stems). This latter fact is a compelling reason to conclude that deer are having an insignificant impact on any browse species in the Park.

Utilization of browse by deer correlated with availability (prominence values) with a high level of confidence ($t:01$) as determined by calculation a correlation coefficient ($r=0.97$). The figures used in this test came from Table 4, including only species that deer browse.

The calculation of palatability of browsed woody species showed that fragrant sumac was selected most by deer when it was available, followed in order by silver maple, red cedar, gooseberry spp., apple, staghorn sumac and hop tree (Table 6). No species were included in Table 6 that occurred on less than four plots.

No correlation was found between utilization (Table 4) and palatability.

The occurrence of vines on vegetation plots is shown in Table 7, along with information on use of vines by deer, the latter a summation of our observation plus those of Henry (1972) at Point Pelee. While the extent of use by deer of virginia creeper, the most common vine on plots, is not well known (found browsed only once), deer seem to use grape, the second very common vine. Browsing on vines was hard to identify because of their lack of terminal twigs, and reliable data can only come from observation of deer actually feeding, of which we had little.

The occurrence of herbaceous vegetation on plots is shown in Table 8, along with information on use by deer, as for vines. Herb robert occurred most frequently (47% of plots), followed closely by grasses (40%).

In total, 29 species of herbaceous plants were identified, of which 11 have the record of use by deer. Seven of the top 14 species are used to some unknown extent, including the top two (herb robert and grasses).

An examination of herbaceous vegetation by habitat type revealed that herb

Table 6. Palatability of woody plants browsed by deer in Point Pelee National Park.

Species	No. of plots occurrence (A)	Total browse score (B)	Palatability (B/A)
Fragrant sumac	7	9.9	1.4
Silver maple	4	4.5	1.1
Red cedar	16	17.0	1.1
Gooseberry	74	69.7	0.9
Apple	5	4.2	0.8
Staghorn sumac	29	16.0	0.6
Hop tree	12	7.2	0.6
Cherry	73	37.0	0.5
Hackberry	90	38.4	0.4
Raspberry	37	14.5	0.4
Rose	5	1.5	0.3
Dogwood spp.	49	11.8	0.2
Oak spp.	6	1.5	0.2
Elderberry	5	0.2	0.03
Sugar maple	7	0.2	0.02

Table 7. Occurrence, and utilization of vines by deer at Point Pelee National Park.

Species	Percent occurrence	Utilization	
		1974	Henry ¹
Virginia creeper	24	+	
Wild grape	23	+(2) ²	+(17)
Poison ivy	11		
Climbing nightshade	7	+	
Wild potato vine	5	+	+(30)
Field bindweed	3		+
Canada moonseed	3		
Bittersweet	2		

¹Henry (1972) -- observations made at Point Pelee.

²Numbers in brackets refer to the number of times deer observed feeding on the species.

robert grew on 88% of plots in hackberry forest, 21% in red cedar A with lower values for the other habitat types. Grasses however, were found on 86% of plots in abandoned farmland, 79% in red cedar A and only 14% in hackberry forest. Other herbaceous species that deer graze showed habitat preferences; jewelweed, 72% in wet woodland; goldenrod, 30% in abandoned farmland; milkweed, 20% in abandoned farmland. Major herbaceous species that deer use are therefore spread among habitat types, even mature hackberry forest. All other species occurred in less than 10% of plots in any habitat type.

Without knowing the extent of use of herbaceous plants by deer, however,

Table 8. Occurrence and utilization of herbaceous plants by deer.

Species	Percent occurrence	Utilization		
		1974	Henry ¹	Bartlett ²
Herb robert	47	+	+(2) ³	
Grasses	40	+	+(6)	
Sweet cicely	26			
Canada avens	24			+
Cleavers	21			
Starry Solomon's seal	16			
Jewelweed	13	+	+(4)	+
Violet	11			+
Aster	11			
Stinging nettle	9			
Chickweed	9			
Goldenrod	8	+		+
Milkweed	6	+		+
True Solomon's seal	4			
White Sweet clover	4			
Appendaged waterleaf	4	+(2)		
Catbrier	3	+		+
Bouncing bet	3			
Motherwort	3			
False Solomon's seal	2	+		
	2			

these data on herbaceous vegetation are of limited value in interpreting range quality. They stand for possible later value when more may be known about deer grazing at Pelee.

DISCUSSION

The major finding from this analysis of present vegetation-deer relationships at Point Pelee is that many more deer could be supported -- the deer herd is below the carrying capacity of the Park as defined by food abundance. This is in direct contrast to the conclusion drawn by Henry (1972) that "overbrowsing of winter food plants lowered the carrying capacity of the winter range". Henry appeared to arrive at his conclusion intuitively, as he conducted no analysis of browse conditions. His main evidence was that deer increased their ranges in the Park in winter, and in some studies elsewhere, the conclusion was drawn that such was the result of food scarcity -- "poor quality of the winter range (at Pelee) compared to summer range requires the deer to undertake greater movements in winter to meet habitat requirements". This is a tenuous basis for his major conclusion, as one could conceive of many other explanations for greater movements in winter: climate, less human occupation of some areas, and especially social behaviour. Compounding the lack of a firm data-base for Henry's conclusion about the poor quality of the winter range is his erroneous impressions of deer food habits. He refers to red cedar as "overbrowsed" in the red cedar A habitat (P. 43). While almost all red cedars were re-shaped by browsing in their lower sections, twigs were not decimated-- in fact a great deal of browse is left. As well, he listed gooseberry as a very-insignificant deer food, whereas our work indicates it is one of the two most used species. The other top utilized species, hackberry, was not even recognized as a deer food by Henry.

In contrast with Henry, our study showed deer use spread over 18 species of woody plants (non-vine), with seven species making up 87% of the use. On no plots was browsing of these species over 33% of available stems. These seven species,

Besides being the most used by deer, are also the most common in the Park. In
these two of these species, sumac, dogwoods, form dense stands. The seven species
dominate in various different habitat types, arguing for a relatively constant
quality of browse throughout the Park. On top of the seven, one of the two common-
est vines is used by deer -- grape -- and in places is very dense. Apparently
deer are not confined by snow in winter, and lack of confinement was verified in
Part A from the distribution of pellet groups; hence the whole range is available
to deer.

Besides these data, another way of establishing that the quantity of deer food
in winter is more than sufficient is on the basis of pounds of food required for
deer. Allen (1954) reviewing data on deer food, quotes that in Pennsylvania about
two pounds of browse are required daily per 100 pounds of body weight of deer in
the winter. Calculating on the high side, if the mean weight of deer is 180 lbs.
(true of bucks in Algonquin Park), then each deer needs 3.6 lbs. per day. If the
herd at Pelee was even as high as 30 animals, from November 1 to May 1 it would
require 12,580 lbs. of browse. On 1053 acres (all but marsh, beach, and park build-
ings), each acre would have to provide 12 lbs. of browse. There is little doubt
that the seven key species produce more than that; a Pennsylvania hardwood in the
7 year brush stage produced more than 200 lbs. of potential deer browse per acre.
In contrast, very poor 35 year old hardwood in Pennsylvania still produced 25 pounds
per acre, twice that needed at Pelee. At Pelee, perhaps in contrast the Pennsylvania
(certainly in contrast to northern hardwoods), the older forest maintain quality for
deer, with species such as gooseberry, hackberry and raspberry. In addition, vines
and herbaceous plants provide food.

Yet another way of interpreting our data as indicating plentiful winter browse
is slightly more tenuous but worth considering. In "Deer of North America", Taylor
stated, "a comparatively small group of plants were heavily used and a large number
used only slightly or not at all. This undoubtedly reflects both the wealth of
food species and the comparatively low deer population". In our study, we also

found a large number of species not used, and even those that received maximum use were only slightly browsed.

We concluded that no woody species was subjected to overbrowsing, despite finding a high percent of browse on stems of a few species (apple, silver maple, gooseberry, staghorn sumac). This was in part because each stem (trunk of a tree) has many twigs available to deer, and never were these severely cropped. Sumac was the only possible exception, with almost all seed heads at deer height eaten (on the basis of observations in January, 1975). Sumac, however, is not in jeopardy from browsing. It is unisexual (the male and female on separate trees) and once established reproduces primarily asexually by root-sprouting. Destruction of the seed heads is therefore of little consequence.

Our methods of collecting data introduced some inaccuracies, but not sufficient to change our conclusions. The analysis was based on stems, not twigs, the latter reflecting better what you might find in deer rumen's (stems of different species differ in numbers of twigs). We used stems in order to analyze more plots (counting twigs is very slow). With many stems of key species unbrowsed, it follows that if the analysis were based on twigs, results would have been similar, at least to the extent of indicating no over-use.

In retrospect, we should have sub-divided abandoned land into older than 1964 and younger than 1969 (there were these two groupings of ages available). We were not aware of this possibility until we began the field work for Part C, which was last. Had we subdivided abandoned land we would have been able to more accurately assess its use by deer relative to other habitats.

Deer utilize herbaceous vegetation in some unknown amount. Table 8 detailed what is known from Pelee and Rondeau Parks. In summer deer eat herbeceous vegetation, normally the leaves and parts of petioles. Bartlett (1958) remarked that "greatest use (of herbaceous vegetation) occurred in August and September in

Rondeau". For winter, Bartlett presented data on only tall scouring rush: "It
make up a considerable portion of the herbaceous material utilized during this
period (17 out of 51 stomachs in January)". Tall scouring rush forms extensive
"stands" in places such as some wet abandoned farmland and wet forest in the south-
ern part of Pelee Park. At Pelee, Henry listed two herbaceous plants as important
in winter: horsetail (backed by no data) and herb robert (found in the one deer
stomach examined). Bartlett after reviewing the literature, observed that in
southern latitudes, deer are largely grazers in winter, and in the north, exclusive-
ly browsers, with Rondeau intermediate in terms of climate. Such would also be
true of Pelee, indicating a diet probably made up of some woody and some herbaceous
plants in winter.

SUMMARY AND CONCLUSIONS

1. The deer herd at Point Pelee is well below the carrying capacity of its range
in terms of food quantity. Key facts that support this are:
 - (a) the browse species used are the most common woody species in the park
(there is a direct correlation between availability and use);
 - (b) no species on any of the 256 plots examined had more than 33% of stems
present with browse on any twigs;
 - (c) deer feed in the various habitats available to them in roughly the same
proportion as the sizes of these habitats, and therefore are not confined
in winter;
 - (d) the normal situation of deer browse decreasing markedly in mature forests
is less evident at Pelee, with the two most used species (hackberry and
gooseberry spp.), and the greatest amount of browsing per plot occurring
in the relatively mature hackberry forest;
 - (e) deer have available and use vines and herbaceous vegetation as well as
woody browse species.
2. Deer browsed 18 out of 31 species (or genera) of woody plants found on plots

throughout the Park. Of these, seven species made up 87% of total browse (gooseberry spp., hackberry, cherry spp., staghorn sumac, dogwood spp., raspberry spp., and red cedar).

3. Palatability of woody species did not correlate with use. Most palatable species, in order were: fragrant sumac, silver maple, red cedar, gooseberry spp., apple, staghorn sumac, etc.
4. Grape, is common in places and a supplemental deer food, along with other vines of lesser consequence.
5. Herbaceous species are used by deer to an unknown extent. Herb robert, growing in older woods is probably an important species (it stays "green" most of the winter). On abandoned land, species diversity of herbs reduces with age, but likely palatable species such as goldenrod and milkweed give way to grasses, which may also be used. Jewelweed is common in wet woodlands, another herb used by deer.

PART C ASSESSMENT OF PROBABLE SUCCESSIONAL CHANGES OF CLEARED LAND AND THEIR SIGNIFICANCE TO DEER.

INTRODUCTION

In conformity with an objective of reducing the impact of man and his historic alterations of Point Pelee, Parks Canada has taken over approximately 154 acres of farmland within the park since 1963. As well, small cottage lots have been obtained, totalling another 14 acres. All this land is in various stages of vegetational succession, and as such, will theoretically alter the carrying capacity of the Park for deer. The objective of Part C is to predict the impact of successional change on the future deer herd.

Succession is complicated at Point Pelee because of past modification by man, a variety of seres, and the fact that the Park is in an ecotone between the St. Lawrence Lowland hardwood forests and the southern Carolinian forests. Maycock (1971) has attempted to set out successional seres. His study, however did not encompass the abandoned land.

The following botanical descriptions are the first made of the abandoned land. They are made not in a general descriptive way, but related to the designated objective. On each parcel of abandoned farmland, future vegetation is predicted by comparing the center of the field with that adjacent to the forest, and with the adjacent forest itself. The significance of each area to deer is determined by relating vegetation to observations of palatability and utilization of various vegetation described in Part B.

METHODS

From maps, aerial photographs, and park files, a list of abandoned land (farm and cottage) and when abandoned was compiled, and map drawn up. In the field, transects were laid out and run during July and August, on each parcel of abandoned farmland. At least two transects were run on each parcel, starting 100 feet inside the forest edge and extending straight across to 100 feet inside the forest

on the opposite side. Transect locations were picked far enough out from the lateral sides of the parcel so as to represent the full gamut of vegetational change unaffected by succession from these lateral sides. Judgement was used in placing transects to be sure the transects represented the vegetation fairly.

Every 50 feet along each transect was a sample point. Trees (including saplings) and shrubs were sampled separately by the point center quarter method¹ (Smith, 1966); herbaceous vegetation and vines were both sampled separately by listing in order the four most abundant (in terms of total cover) on plots by . Data were compiled on standard sheets.

On cottage lots, the most abundant species were listed separately in order for woody vegetation, herbaceous vegetation and vines, together with general descriptions. These areas were analyzed separately from abandoned farmland.

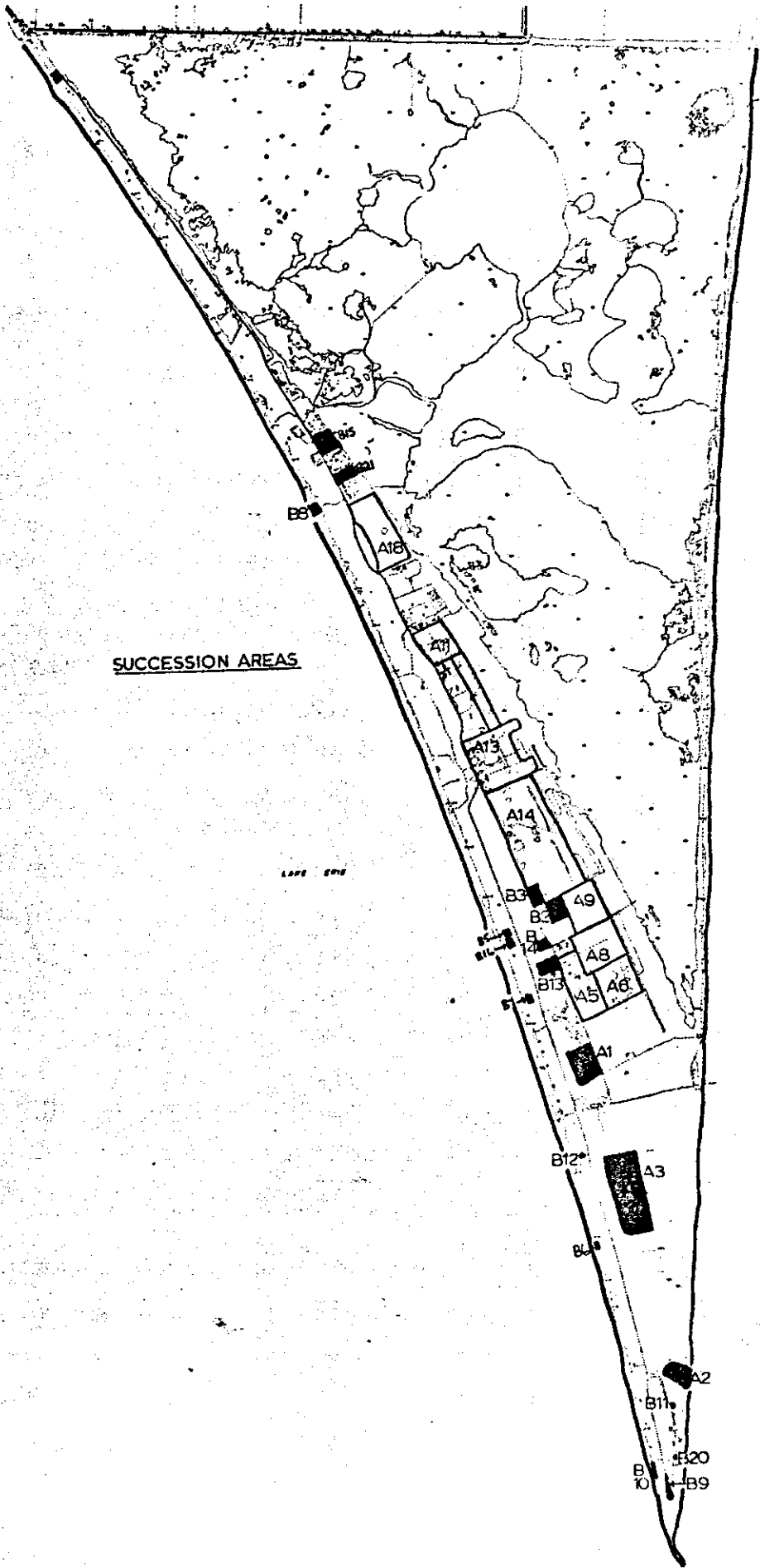
In the analysis of each parcel of abandoned farmland, the significance of woody vegetation for deer was determined on sub-sections of each plot by summing the relative density of each species times its palatability value as determined in Part B and listed in Table 6. Relative density, determined by the point center quarter method, was calculated as:

$$\frac{\text{number of times an individual species was tallied as closest}}{\text{total number of individuals of all species}} \times 100$$

This resulted in an index of the quality of deer food, of value in comparing areas.

Parcels of abandoned land which were bounded by forests representing totally different seres were subdivided into two separate parcels at their mid point or wherever the ultimate point of differentiation was judged to be (normally a function of wet or dry soils), and analyzed separately.

¹The point center quarter method of analyzing forest composition requires the observer, who is standing at a sampling point, to mentally divide the area around him into four plots, each encompassing 90° of a circle. For each plot, he lists the nearest tree or sapling and its distance. In our study, the normal procedure was altered because of the open land as follows: trees greater than 50 feet away were listed as 50 feet. Thus, mean distances calculated from the data are indices for comparisons rather than constituting actual measurements.



SUCCESION AREAS

LAKE Erie

B10
B9

B11

A2

B1

B12

A3

A1

B13

A5

A6

A8

B2

B3

A9

A13

A14

A18

B5

RESULTS

Rate of tree re-stocking. The approximate stage of succession of each parcel of abandoned farmland can be typified by its percent of re-stocking by trees (Table 9). In Table 9, the mean distance between trees in the adjacent forest, is compared with that in the first 50 percent of the distance towards the center of the field, and in the last 50 percent to the center of the field. While percent re-stocking of trees does not completely reflect stage of succession, it does give a valid impression of the degree of difference between the field undergoing succession and the adjacent forest, particularly when the former is in early secondary succession (later, stocking rate may equal or even exceed that expected in the "climax" community).

Table 9 demonstrates great variability in the re-stocking of various fields. In four instances, trees on adjacent areas are sparser than on abandoned land (Field A9 west and east, field A6 west and east). The reason for this is that,

after about 10 years, a great abundance of small saplings of species such as Staghorn sumac or dogwood commonly take over.

Another "anomaly" is in De Laurier's field west and east, abandoned only last year, restocked already at 59 and 77 percent of adjacent forests. This is a result of our technique of scoring trees at a maximum of 50 feet away when they were, in these cases, almost always much farther away.

Considering the remaining 12 of the 18 parcels, a general observation can be made that fields abandoned in 1963 are restocked roughly five times as much as those abandoned in 1969 or more recently. On an average, in 6 - 8 years, restocking can be expected to go from about 10 percent of that in adjacent forests, to at least 50 percent. This generalization, however, is only very approximate because of the great variability between fields.

This variability, both between and within fields thwarts any attempt at more specific conclusions about speed of restocking. As an example of within-field variation is a comparison of mean distances between trees near the edge of the field

Table 9. Density of trees on parcel of abandoned farmland, Point Pelee National Park.

Area	Size (acres)	When Abandoned	Adjacent forest Mean distance between trees	Abandoned land, mean distance between trees.		Percent restocked ¹
				0-50% of distance to center	50-100% of distance to center	
Ander's Orchard B West Side	7	1963	7.6	9.4	15.8	57.
Ander's Orchard B East Side		1963	5.0	8.4	18.0	39.
White Poplar Region	6	1969	2.4	9.7	20.0	17.
Langell's Orchard West Side	19	1938	3.8	6.6	6.7	57.
Langell's Orchard East Side		1938	2.0	2.9	6.3	43.
De Laurier's Field West Side	21	1973-74	22.9	32.5	46.1	59.
De Laurier's Field East Side		1973-74	30.2	37.6	42.7	77.
Ander's Orchard C West Side		1963	5.6	16.3	25.5	29.

(from edge to 50% of distance to center) and the center (50 to 100% of distance center) (Table 9.). Most succession can be expected to proceed from the edge towards the center. In two fields of similar age, the one in which the density of trees in the center is similar to the edge is therefore succeeding fastest. Of seven fields which have a dry (west) and wet side (east, bordering on a canal or other water), three showed slower succession on the dry than wet side (De Laurier's field, Ander's orchard C, and Field A9). The reverse was true in the four other fields (Langell's orchard, Ander's orchard B, Fields A14 and A6).

Browse quality. Table 10 shows the results of the calculations of indices of browse quality of tree species (based on the sum of relative densities of each palatable species times their individual palatability value) on a field by field basis. Figures are calculated by adding the scores obtained for the edge and center halves of each field.

The length of time since abandonment does not correlate with the indices of browse quality shown in Table 10. While the highest score was obtained from the oldest field (1938); the next highest score came from a field abandoned only in 1970.

Figure 1 displays indices of quality for fields subdivided into edge half and center half, along with an index of quality for the forests adjacent to each field.

The following observations can be made from Figure 1:

1. Of the 18 fields, 10 had higher browse quality scores in the field than in adjacent vegetation, six showed the reverse, and for two a comparison was not possible. This means that in most cases, species composition was more favourable for deer on the abandoned land.
2. Of the 18 fields, ten had higher browse quality scores in the center half of the field than the edge half, seven showed the reverse, and a comparison was not possible for one.

Concerning the first observation, the reason why in six cases the browse quality score was higher adjacent to the field apparently cannot be generalized. Four

Index of Browse Quality

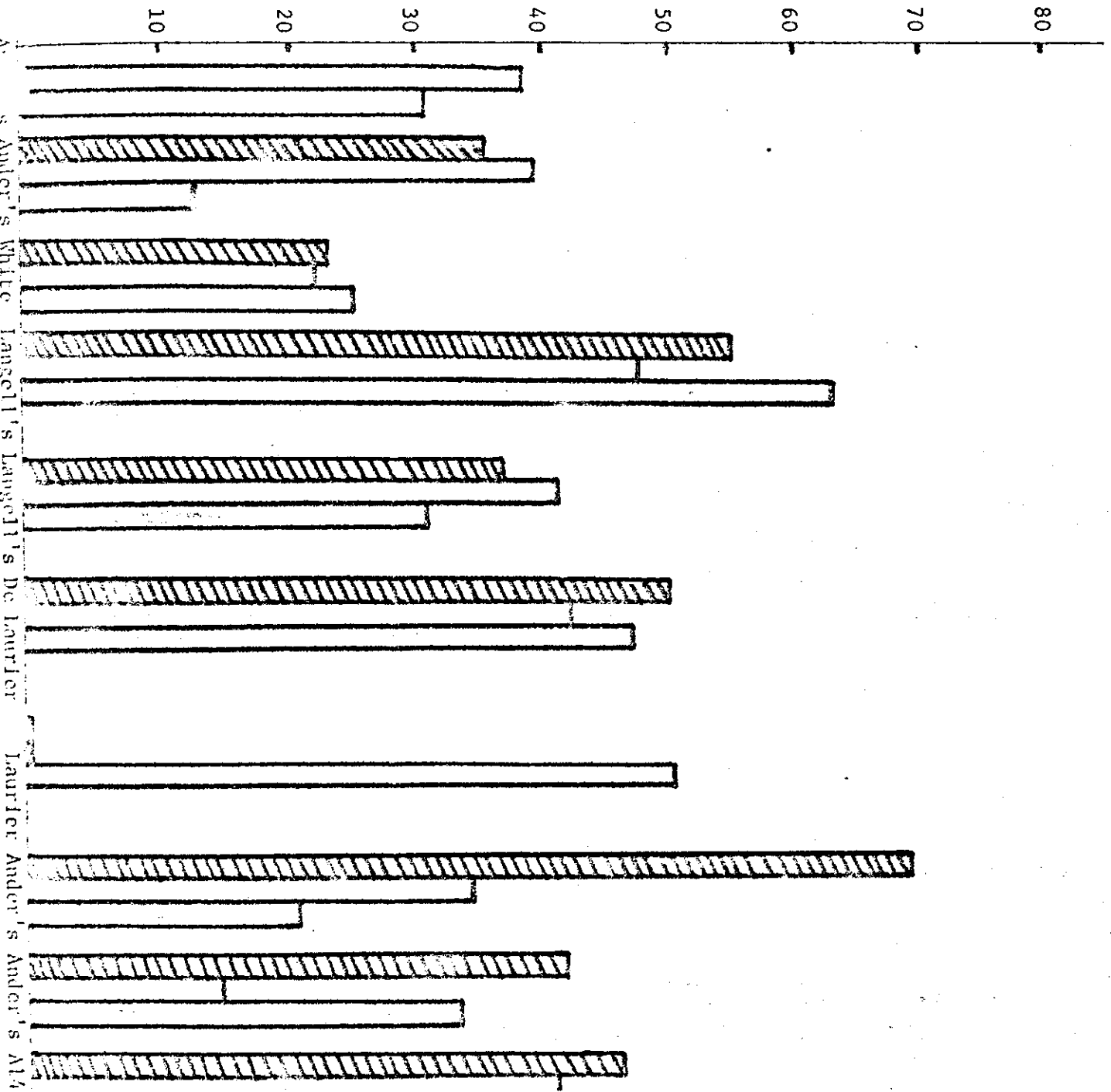


Figure 1. Indices of Browse quality on abandoned farmland, Point Pelee National P

le 10. Indices of browse quality of abandoned fields.

<u>Field</u>	<u>Index</u>	<u>Field</u>	<u>Index</u>
Langell's West	111.0	Field A6 West	64.6
Hackberry Picnic Area	107.2	Field A5	63.9
Field A9 West	104.6	Anger's B West	54.6
De Laurier West	89.2	Ander's C West	53.7
Field A14 West	84.9	De Laurier East	49.2
Field A6 East	72.7	Ander's C East	48.2
Langell's East	72.0	White Poplar	45.8
Field A9 East	69.2	Tilden's Fields	44.2
Ander's B East	68.9	Field A14 East	43.2

were abandoned in 1963 and two in 1973. Since other fields of the same ages showed the reverse, it is not possible to explain why some fields had better browse adjacent than on them on the basis of age. Nor is it possible by identifying a different type of habitat type on the adjacent land, which varied. Rather, individual subtleties of the sites such as soil characteristics, seed sources, etc. must be responsible.

Concerning the second observation that ten fields had a higher browse quality score in the center half than edge half, age again does not provide a sufficient explanation, as the extremes of abandonment in 1938 and 1973 are represented in this group. Again, individual subtleties of the sites must be involved.

Ribes (gooseberry) and Rhus (raspberry) were considered shrubs and analyzed separately. Ribes was found only once on abandoned land, near the edge of Field A6. In adjacent forest, it occurred only 7 times (in seven segments out of all employed

in the point-center quarter method, as used for trees). Ribes had a high palatability rating of 0.94 (Part B). Since Ribes is primarily a shade or forest edge species, it appeared to add more to deer food availability on the non-abandoned land.

Rhus occurred on seven of the 18 parcels of abandoned land, in 38 segments out of a possible 448 segments on those 18 parcels (8.4%). Adjacent to these parcels, it occurred on 14 out of 44 segments (31.8%), demonstrating that this genus, too, was more prevalent in adjacent forests than on the abandoned land. In addition, it occurred adjacent to two other parcels of abandoned land (Langell's Orchard and Hackberry Picnic Area) in 7 out of 52 segments (13.4%) where it was not found on the abandoned land itself. Rhus had a relatively low palatability score of 0.39 (Part B).

Both species of shrubs, therefore, contribute more to food availability on land adjacent to abandoned land, rather than on the abandoned land itself.

Vines were compared for frequency of occurrence on plots set out on the same transects used to estimate trees and shrubs. Table 11, lists species and percent occurrences of vines on land abandoned in 1963 or before, land abandoned in 1969 or more recently, and in adjacent forests. In each plot, up to four species were listed if they occurred. Therefore a total possible score for the occurrence of vines was the total number of occurrences divided by four times the number of plots times 100. Table 11 shows that the adjacent land supports more vine growth (13.8% of possible total score) than either recently abandoned land (4.1%) or older abandoned land (4.8%), with the latter two similar. Interpretation of these data is made difficult by knowing little about browse preferences for vines. This will be discussed later.

Herbaceous vegetation. The same plots used for describing the presence of vines were used to analyze herbaceous vegetation (see Methods). All species were listed on the field tally sheets, and described as percent occurrences on land

Table 11. Occurrence of vines on abandoned land and that adjacent to it.

Species	Fields abandoned 1963 or earlier		Fields abandoned 1969 or more recently		Adjacent forest land	
	Number of occurrences	% occurrences	Number of occurrences	% occurrences	Number occurrences	% occurrences
Pe	47	28.5	9	8.6	14	16.1
son Ivy	48	29.0	7	6.7	16	18.4
ginia eper	7	4.2			7	8.0
ld Bind- d	5	3.0			5	5.7
d Potato e	3	1.8			1	1.1
ada-Moon- d	1	0.6				
en Night- ade			1	0.9		
ttersweet					1	1.1
ound Nut					4	4.6
<hr/>						
Total Percent possible ore ¹	31 (on 165 plots)	4.8	17 (on 104 plots)	4.1	48 (87 plots)	13.8

Total possible score is number of occurrences divided by four times the number of plots.
(See text)

abandoned in 1963 or before, 1969 or more recently, and in the adjacent forests. Table 12 displays the results. Species diversity (total number of species is almost identical for fields abandoned 1969 or more recently (32 species) and, all the adjacent land (33 species); species diversity was lower (24) for the older fields.

Cottage lots. A total of 14.0 acres were enclosed by 17 abandoned small cottage lots of a mean size of 0.8 acres. These were scattered in the Park (see Map). Their names and year of abandonment are listed in Appendix III.

In the analyses of the value of these lots in producing deer food, they were all pooled. No transects were run, but rather estimates made of the five commonest trees and shrubs, vines and herbs. For trees and shrubs, a total index of browse palatability was determined as for abandoned farmlands.

Table 13 shows the results, subdivided into a score when cover from woody vegetation fell between one and 33 percent, and between 34 and 100%. The two indices of browse palatability are similar to those shown in Figure 1, for abandoned farmland. The two indices are also similar to each other, agreeing with the previous observation that density of trees on abandoned land does not correlate with browse palatability.

Vines were found only eight times, and were of little significance. Four of these were grape.

Herbaceous vegetation included 27 species with the same general relative species density as on larger areas. (Details are unwarranted because of the probable minimal significance of the small total area to deer.)

DISCUSSION

Concerning browse from trees, the analysis showed that in most cases abandoned land was less densely stocked with trees than adjacent forests (Table 9). However, in most cases, the index of browse palatability was higher on the fields than adjacent forests (Figure 1). The method of calculating indices of browse palatability (described previously), results in the indices being independent of

Table 12. Continued.

Species	Fields abandoned 1963 or earlier		Fields abandoned 1969 or more recently		Adjacent forest land	
	Number of occurrences ¹	% occurrences	Number of occurrences ²	% occurrences	Number of occurrences ³	% occurrences
's thumb			1	1.0		
ess spurge			1	1.9		
ow loostrife			1	1.0		
traws						
vers					2	2.2
e avens and da avens					4	4.7
robert					2	2.2
ax sp. and rier sp.					2	2.2
erwort					2	2.2
ail					3	3.2
y alyssum					1	1.1
scouring					1	1.1
er sp.					2	2.2
et spp.					1	1.1

total number of plots = 165

total number of plots = 104

total number of plots = 86

Table 12. Herbaceous vegetation found on abandoned farmland and that adjacent to it.

Species	Fields abandoned 1963 or earlier		Fields abandoned 1969 or more recently		Adjacent forest land	
	Number of occurrences ¹	% occurrences	Number of occurrences ²	% occurrences	Number of occurrences ³	% occurrences
Species	117	70.3	58	55.7	52	60.4
Denrod	54	32.7	55	52.9	34	39.5
Blackweed	50	30.3	17	16.3	8	9.3
White sweet ver	18	10.9	7	6.7	5	5.8
Red straw- ry	22	13.3	7	6.7	4	4.7
Flowering beet	11	6.7	7	6.7	10	11.5
Red carrot	10	6.1			1	1.1
Yellow sweet ver	6	3.6				
Common Rag- ged	2	1.2	1	1.0	1	1.1
in	4	2.4	3	2.9	1	1.1
sp.	1	0.6				
Polygonum sp.	1	0.6	2	1.9		
Paragus	8	4.8	28	26.9		
Black trefoil	1	0.6	3	2.9		
Barry Solomon's leaf	1	0.6			1	1.1
White bellflower	1	0.6	1	1.0	2	2.2
Curled dock	2	1.2	3	2.9	1	1.1

Table 13. Indices of browse palatability for pooled cottage lots.

Species	Woody cover 1 - 33%	Woody cover 34 - 100%
	Index of browse palatability	Index of browse palatability
Dogwood	0.1	2.2
Staghorn sumac	9.8	10.0
Red cedar	3.8	19.2
Hackberry	7.7	3.9
Raspberry	5.6	
Hop tree	2.2	
Prunus	5.5	4.6
Apple		7.6
Total	35.5	47.5

absolute density. Hence density of trees and the index of palatability are unrelated variables. That being true, a generalization can be drawn that while species composition on abandoned land is most favourable to deer compared with adjacent forests, the adjacent forests more often than not have more total trees and hence an opportunity to grow as much browse. This suggests that browse availability of palatable species may remain fairly constant throughout succession. Helping to support this is the observation that cases did occur where the reverse of the above generalizations were true: some older fields had tree densities greater than adjacent forests, and occasionally the index of browse palatability was greatest in the adjacent forests. These reverse exceptions argue against any clear-cut trend that as succession proceeds, browse availability will improve or decrease. However, this conclusion needs to be adjusted by the subjective obser-

vation that older fields will support more deer than newly abandoned fields. As these younger fields mature, deer browse on abandoned land in total will increase somewhat. The quantitative results presented here suggest this may not be as great as one might expect, because of the capacity of Pelee's forests to support deer. (Part B).

From Part B, however, comes the conclusion that deer are already below the carrying capacity for the Park. The future effect of succession on the deer herd may be viewed as of little consequence. Something besides food quantity is holding numbers down.

Concerning vines, grape, one of the the most common species in abandoned land and adjacent land, is palatable for deer. (The other, poison ivy is not.) In total, more occurrences of vines were recorded on the adjacent rather than abandoned land. As abandoned land gets older, it can be expected to support more vines.

The analysis of the herbaceous vegetation on the abandoned farmland showed there was less species diversity on old (1963 or before) than young (1969 or more recent) fields. This may be due to the dominance of Graminae, on old fields (70% of plots) compared with young fields (56%). In older fields, only three species exceeded 15% occurrence (Graminae, goldenrod and milkweed), whereas in young fields, six species exceeded 15% occurrence (Graminae, goldenrod, milkweed, asparagus, prickly lettuce and purple vetch). Perhaps as grasses become better and better established, they out compete some of the original pioneer species. Species diversity increases again in adjacent forests, likely a function of summing the floral variety of a lot of different plant communities.

As in Part B, the data on herbaceous vegetation stand for future use if and when more is known about grazing by deer.

SUMMARY AND CONCLUSIONS

1. Variability was observed in the rate of re-stocking of trees on abandoned

farmland.

Allowing for 1., areas that were abandoned in 1963 or earlier were stocked about five times as much as areas abandoned in 1969 or more recently.

3. Most fields were stocked with trees at a lower rate than adjacent land (but not all).
4. A comparison of rate of succession on fields with a wet side and a dry side showed no consistent pattern.
5. Fields listed for their indices of browse palatability (quality) showed no consistent relationship with age since abandonment (index of browse palatability is a function of relative species composition of trees times their individual palatability scores). A three-fold variation was found in scores for different fields.
6. Most fields scored higher in browse palatability than adjacent forests. Where the reverse was true, subtleties of the individual sites were deemed to be the reason.
7. Fields scored approximately equally in their browse palatability scores when the "edge half" was compared with the "center half", some showing differences one way and others the reverse, indicating that quality did not improve substantially during the ranges of succession displayed.
8. A major conclusion drawn from contrasting conclusion 3 with 6, is that quantity woody vegetation (greater on adjacent land) and quality (better on abandoned land) may counteract any trend for deer browse to improve other than slightly during succession. Helping support this conclusion is the observation that the reverses of generalizations made on quantity (conclusion 3) and quality (conclusion 7) did occur sometimes.
9. Two genera of shrubs, Ribes and Rhus, both palatable for deer, were found more on adjacent forests than on abandoned farmland.
10. Vines were found more on adjacent forests than abandoned farmland. However, grape, a browse species, is one of the two most common vines found on abandoned

land.

Species diversity of herbaceous plants is least for old fields, probably the result of competition by grasses which dominate. Data stand for future value when more is known about grazing in deer.

APPENDIX I. A list of transects, their lengths, and pellet groups found.

<u>Habitat</u>	<u>Transect No.</u>	<u>Length (meters)</u>	<u>No. of Pellet Groups</u>	<u>Pellet Groups per 50 Meters</u>
Hackberry	T1	100	0	0
"	T2	"	0	0
"	T3	"	1	0.5
"	T4	"	0	0
"	T5	"	2	1.0
"	T37	"	2	1.0
Red Cedar A	T6	95	4	2.1
"	T7	"	2	1.1
"	T8	100	0	0
"	T9	"	0	0
"	T10	80	0	0
"	T11	90	1	0.6
"	T13	85	2	1.2
"	T14	95	3	1.6
"	T15	100	2	1.0
"	T16	85	2	1.2
"	T17	"	1	0.6
"	T18	90	0	0
"	T19	"	0	0
"	T20	60	0	0
andoned Farmland	T24	100	1	0.5
"	T25	"	1	0.5
"	T26	"	1	0.5
"	T31	50	0	0
"	T39	100	0	0
"	T40	80	0	0
Red Cedar B	T27	100	0	0
"	T28	50	1	1.0
"	T30	100	0	0
"	T32	55	0	0
"	T33	"	0	0
"	T34	50	0	0
Edge	W48	100	0	0
"	W50	"	0	0
"	W52	"	0	0
"	W53	"	0	0
"	W43	"	0	0
"	W45	60	0	0
"	W47	100	0	0

APPENDIX II. Common and scientific names of all plants identified on transects as part of this study.

<u>Common name</u>	<u>Scientific name</u>
Appendaged water leaf	Hydrophyllum appendiculatum
Apple	Pyrus malus
Ash spp.	Fraxinus spp.
Asparagus	Asparagus asparagus
Aster	Aster spp.
Basswood	Tilia americana
Bittersweet	Celastrus scandens
Black locust	Robinia pseudo-acacia
Black medic	Medicago lupulina
Black walnut	Juglans nigra
Blue vervain	Verbena hastata
Boneset	Eupatorium perfoliatum
Bouncing bet	Saponari officinalis
Burdock	Arctium lappa
Buttonbush	Cephalanthus occidentalis
Canada avens	Geum canadense
Canada moonseed	Menispermum canadense
Canada thistle	Cirsium arvense
Catbrier	Smilax sp.
Cherry spp.	Prunus spp.
Chickweed	Stellaria media
Cleavers	Galium aparine
Climbing nightshade	Solanum dulcamara
Common cattail	Typha latifolia
Common ragweed	Ambrosia artemisiifolia
Curled dock	Rumex crispus
Cypress spurge	Euphorbia cyparissias
Dogwood spp.	Cornus spp.
Eastern cottonwood	Populus deltoides
Elderberry	Sambucus pubens
Evening primrose	Oenothera biennis
False Solomon's Seal	Smilacina racemosa
Field bindweed	Convolvulus arvensis

<u>Common name</u>	<u>Scientific name</u>
Field horsetail	<i>Equisetum arvense</i>
Flowering spurge	<i>Euphorbia corollata</i>
Fragrant Sumac	<i>Rhus aromatica</i>
Coatsbeard	<i>Tragopogon pratensis</i>
Goldenrod spp.	<i>Solidago</i> spp.
Gooseberry	<i>Ribes</i> spp.
Grasses	Gramineae
Great lobelia	<i>Lobelia siphilitica</i>
Ground juniper	<i>Juniperus communis</i>
Groundnut	<i>Apios americana</i>
Hackberry	<i>Celtis occidentalis</i>
Hedgenettle	<i>Stachys tenuifolia</i>
Herb robert	<i>Geranium robertianum</i>
Hoary alyssum	<i>Bertorea incana</i>
Hop tree	<i>Ptelea trifoliata</i>
Jewelweed	<i>Impatiens capensis</i>
Lady's Thumb	<i>Polygonum persicaria</i>
Lambs Quarters	<i>Chenopodium album</i>
Lilac	<i>Syringa</i> sp.
Manitoba maple	<i>Acer negundo</i>
May apple	<i>Podophyllum peltatum</i>
Milkweed	<i>Asclepias syriaca</i>
Mint sp.	fam. Labiatae
Motherwort	<i>Leonurus cardiaca</i>
Mulberry	<i>Morus rubra</i>
Mullein	<i>Verbascum thapsus</i>
Oak spp.	<i>Quercus</i> spp.
Peppergrass	<i>Lepidium campestre</i>
Plantain	<i>Plantago major</i>
Poison Ivy	<i>Rhus radicans</i>
Prickly lettuce	<i>Lactuca</i> sp.
Prickly pear cactus	<i>Opuntia humifusa</i>
Purple giant hyssop	<i>Agastache scrophulariaefolia</i>
Purple vetch	<i>Vicia americana</i>
Raspberry	<i>Rubus</i> spp.
Redbud	<i>Cercis canadensis</i>
Red cedar	<i>Juniperus virginiana</i>

<u>Common name</u>	<u>Scientific name</u>
Rose	Rosa spp.
Sassafras	Sassafras albidum
Silver maple	Acer saccharinum
Slippery elm	Ulmus rubra
Smartweed	Polygonum sp.
Staghorn sumac	Rhus typhina
Starry Solomon's Seal	Smilacina stellata
Stinging nettle	Urtica procera
Sugar maple	Acer saccharum
Sweet cicely	Osmorhiza longistylis
Tall bellflower	Campanula americana
Tall scouringrush	Equisetum hyemale
Tall wormwood	Artemisia caudata
Tick trefoil	Desmodium sp.
Tree of heaven	Ailanthus altissima
True Solomon's Seal	Polygonatum pubescens
Violet	Viola sp.
Virginia creeper	Parthenocissus quinquefolia
White clover	Trifolium repens
White pine	Pinus strobus
White sweet clover	Melilotus alba
Wild bergamot	Monarda fistulosa
Wild carrot	Daucus carota
Wild grape vine	Vitis riparia
Wild lettuce	Lactuca sp.
Wild potato vine	Impmoea pandurata
Wild strawberry	Fragaria virginiana
Willow spp.	Salix spp.
Yarrow	Achillea millefolium
Yellow loosestrife	Lysimachia terrestris
Yellow sweet clover	Melilotus officinalis

APPENDIX III. Abandoned small cottage lots in Point Pelee National Park.

<u>No.</u>	<u>Name</u>	<u>Year Abandoned</u>
B2	Superintendent's Backyard	1963
B3	West Cemetery	1963
B5	Marsh Hawk	1974
B6	Old incinerator	1969
B7	Red Oak	1974
B8	Krause's Fishery	1972
B9	Abandoned Circle Road	1971
B10	West Point Beach	1970
B11	Comfort Station	1973
B12	Red Cedar	1971
B13	Lot 9	1968
B14	Lot 21	1961
B15	R & G Fisheries	1972
B16	Little Raccoon	1974
B17	North Houses	1968
B20	Comfort Station	1973
B21	Johnson's Campground	1971

Habitat Types Used in this Study (see prints in back envelope)



Hackberry Forest



Wet Woodland





Shrub

4



Herbaceous Strand

5



Browsed Apple Tree



Staghorn Sumac



Lamb's Quarters Grazed by Deer

8



Wild Grape

9



White Poplar Region

10



De Laurier's Field

11



Field A14

12



Old Hackberry Picnic Area

13



Abandoned Cottage Lots

14



Abandoned Cottage Lot
(Note Deer)

15

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