Monitoring Recreational Use in the Eastern Lake Ontario Dune and Wetland Area

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INTRODUCTION

The Eastern Lake Ontario Dune and Wetland Area (ELODWA) is a 17-mile stretch of sand dunes and shoreline comprised of both public and private lands on the eastern coast of Lake Ontario in New York State (Figure 1). Visitors to the ELODWA include boaters who land or anchor their crafts at one of the four management areas, beach users who participate in activities such as swimming and birdwatching, and owners of nearby private properties.

The sand dunes in the ELODWA experience significant erosion, primarily caused by visitor foot traffic across the dunes that kills dune vegetation and enables coastal winds to erode sand. Because of the high impact of visitors on the health and stability of the sand dunes, recreational use data has been collected for public-use areas in the ELODWA from 1988 to 1990, and 1995 to 2002. Differences in the methodology used to collect the data as well as in the types of data collected exist between years. In order to identify important trends in visitor use and activities, and develop effective management strategies to protect this fragile coastal ecosystem, an analysis of existing data is needed. Establishing a data collection protocol for obtaining future recreational use data is necessary for collecting comparable data that can be used for future visitor management.
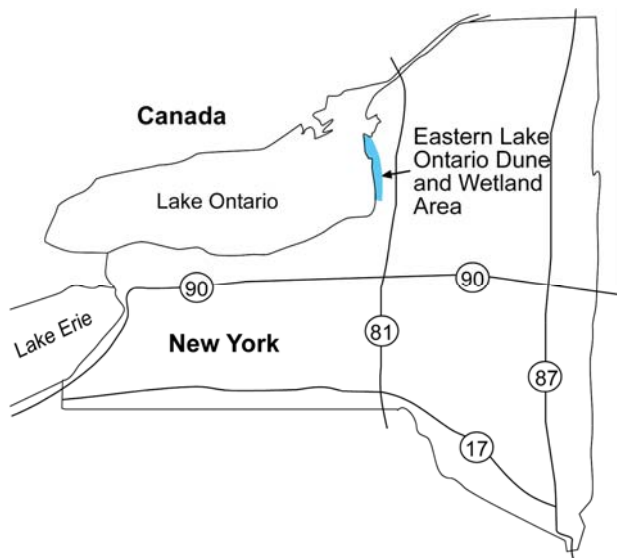

Figure 1. A map of New York State showing the Eastern Lake Ontario Dune and Wetland Area.

This report outlines a data collection protocol for the ELODWA. The focus of the study is on the shoreline/dune areas in the ELODWA and not on wetland or forest habitats. The tremendous impacts caused by visitor use on shoreline and dune sections of ELODWA make this focus necessary. In addition, only summertime and daytime use have been studied because of staffing limitations (i.e., dune stewards are on duty from 10 AM to 4:30 PM five days per week during the summer months).

The objectives of this study are as follows:
1. To identify existing relationships between recreational use and factors such as weather and day of the week (i.e., weekend day or weekday).
2. To estimate total visitor use of the ELODWA and use of each management area within the ELODWA.
3. To identify trends in use patterns for each of the management areas within the ELODWA and the ELODWA as a whole.
4. To identify trends in illegal activities or violations by visitors.
5. To establish a protocol (i.e., data collection sheets, sampling framework, database spread sheet) for collecting future recreational use data for the ELODWA.

METHODS

In May 2003, an assessment of visitor access points was conducted for each public area within the ELODWA (Figure 2). At the same time, existing data for 1988 to 1990 and 1995 to 2002 were entered into a statistical computer program by a graduate student at the State University of New York College of Environmental Science and Forestry. Because of differences in data collection methodologies between 1988 and 2002, data was assessed first for similarities and differences between years. Differences, such as the use of transects in some years and the use of observational counts of varying lengths of time in others, were noted. Inconsistencies were also identified between where data were collected in the ELODWA and the time of day during which data were collected (i.e., morning versus afternoon). Consistent visitor count methodologies were used from 2000 to 2002, enabling the development of a protocol that could be used to predict total visitor use in those years as well as in 2003. Differences in data collection methods used prior to 2000 made it impossible to use these data for trend analysis.

In May 2003, the decision was made to use an indirect count method. This method uses "spot counts" (i.e., counts of visitors made from a single location during a 5-minute time interval) to calculate total visitor counts. Regression analysis is used to identify the relationship between the
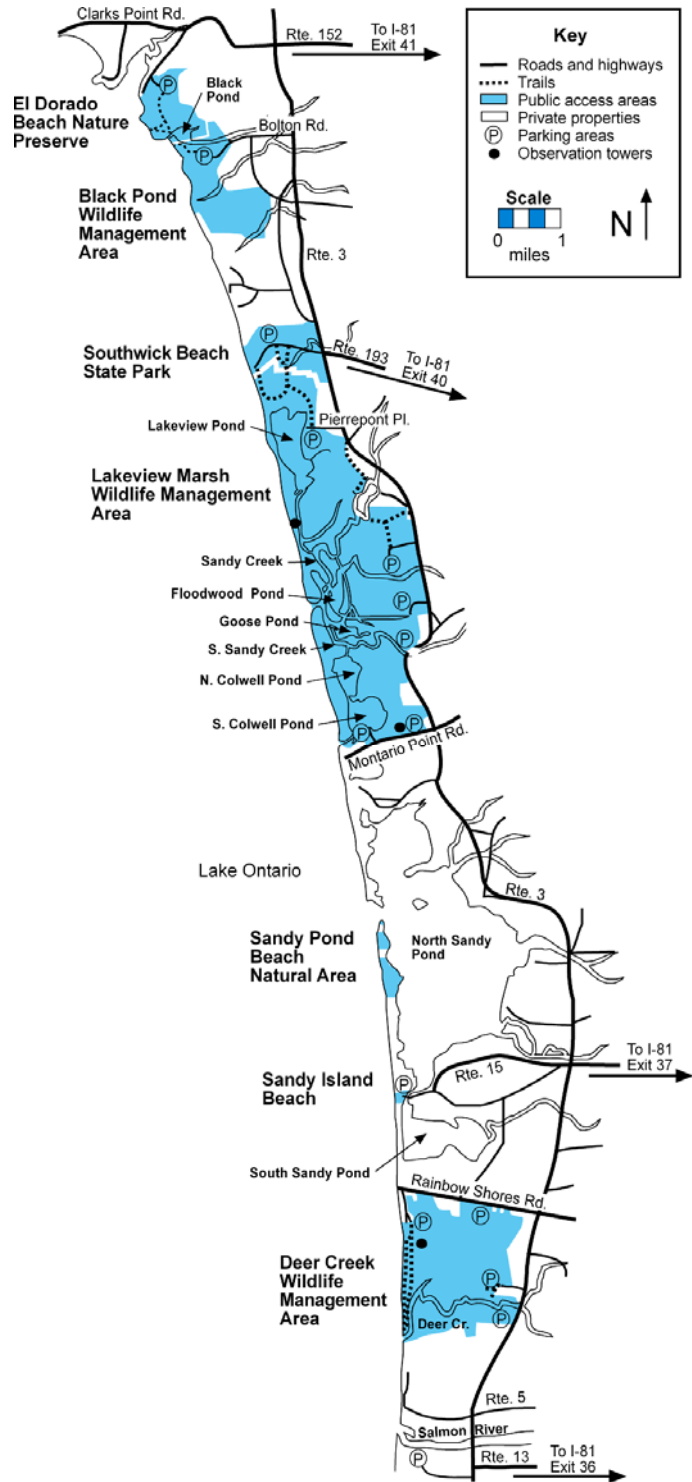

Figure 2. A map of the ELODWA and its public access areas.

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spot and total counts. The regression analysis produces an equation that spot count data is plugged into. The output of the equation is the estimated total count. The benefit of using this method is that spot count data collected in previous years could be used to estimate total visitor use for those years. However, in order to calculate the regression equations, *both* a total count and a spot count needed to be collected on randomly-chosen days in 2003. One weekend day and one weekday were chosen randomly for each week during the summer of 2003 as "full count/spot count" days. Because of the time that was needed to assess existing data and identify this protocol, full count days were not implemented until mid July 2003. This data collection process was repeated during the summer of 2004 in order to obtain data from Memorial Day through Labor Day.

In addition to the selection of sampling days, differences in visitor use throughout the ELODWA made it necessary to break down data collection by use "zones." Most use zones typically have one major access point such as a dune walkover or beach access from neighboring private properties, and one observation point at which data have been consistently collected since 2000. Additional zones not used in the 2003 data collection process were identified as important to include in 2004 data collection efforts.

In 2003, the exact observation point within most zones was identified using a GPS unit and, in most cases, marked with orange spray paint (where appropriate). Spray paint was also used to mark the ends of the area to be viewed from each observation point (i.e., 250 feet on both sides of the observation point). Spray paint was *not* used in those areas where it would be seen as an aesthetic intrusion to visitors (e.g., on the walkovers), but was utilized along string fencing and snow fencing where it was unobtrusive. The ends of some zones were permanently marked in 2004; others were marked in 2006 and 2007.

The breakdown of zones and their corresponding observation points by management area is as follows:

- o Sandy Pond Natural Area. Three zones as follows (see Figure 3):
  - SP1: southern end of area on Lake Ontario (observation point near dead tree and marked by GPS only).
  - SP2: middle of area including Sandy Pond side of spit (observation point at lakeside end of dune walkover).
  - SP3: northern end of spit including bird sanctuary and Sandy Pond side of spit (observation point at lakeside end of dune walkthrough).

- o Deer Creek Wildlife Management Area. Two zones as follows (see Figure 4):
  - DC1: southern end of area near Deer Creek outlet (observation point at outlet). (Note: In 2008, a third zone (DC3) was created within zone 1 due to the installation of a new walkover; this third zone is included in the results for zone 1 through 2009.)
  - DC2: northern end of area (observation point at lakeside end of walkover).
  - DC3: middle of area (observation point at lakeside end of newest walkover).

- o Black Pond Wildlife Management Area. One zone only (see Figure 5):
    - ▪ BP1: Northern end of Black Pond WMA to the southern end of Eldorado near the Black Pond outlet (observation point at lakeside end of walkover in Black Pond WMA).

- o Lakeview Wildlife Management Area. Three zones as follows (see Figure 6):
    - ▪ LV1: south end of Lakeview near outlet of South Colwell Pond. (Because of staffing and access limitations, data were not collected at LV1 from 2000 to 2003. It is recommended that the observation point be located on the northern side of the outlet.)
    - ▪ LV2: South and north sides of the Sandy Creek outlet. (This zone was identified as zone 2a from 2000 to 2003.) The observation point for zone 2 is located on the north side of the outlet. Visitor counts for the visible portion of the south side of the outlet are included in this zone.
    - ▪ LV3: Northern border of Lakeview south. (Because of staffing limitations, data were not collected at LV3 from 2000 to 2003. Data collection in this zone began in 2004.)

In addition to data collection in each zone, total visitor counts were collected at the entrance booths at Southwick Beach and Sandy Island Beach State Parks for 2000 to 2009.

From 2003 through 2009, spot count data were collected by Dune Stewards five days per week (i.e., those days on which they were scheduled to work), including those days during which full count data were collected. The stewards were instructed to count all visitors seen within 250 feet on each side of each observation point for a 5-minute length of time. Spot counts were collected between 11:00 am and noon, and between 3:00 and 4:00 pm each day. Prior to 2003, spot counts were collected either in the morning *or* in the afternoon, depending on the area. Beginning in July 2003, morning *and* afternoon spot counts were collected in order to determine if the best predictor of the total number of visitors is a single spot count or the double spot count.
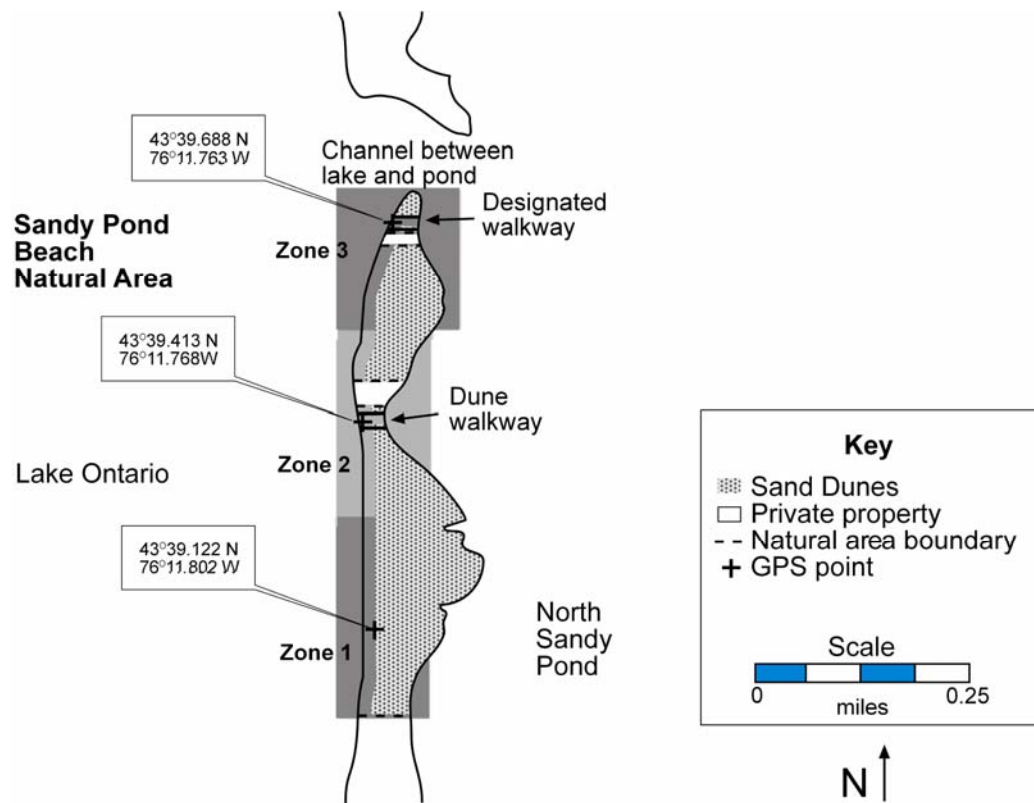
Figure 3. A map of the zones within the Sandy Pond Beach Natural Area.
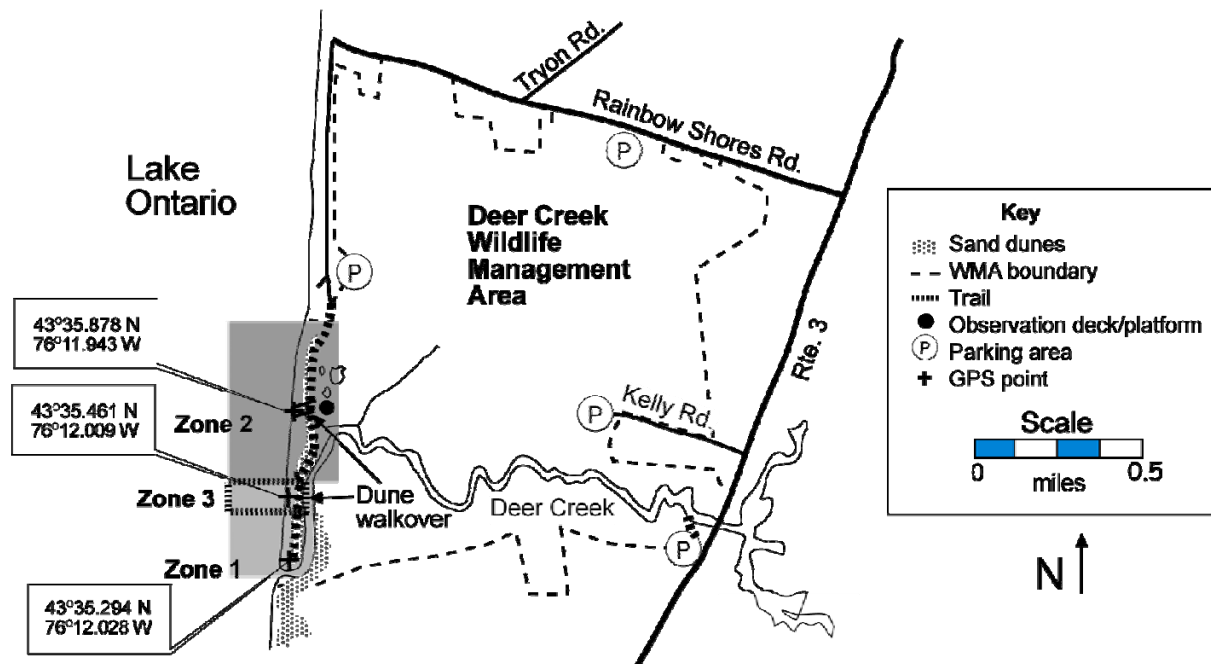

Figure 4. A map of the zones within the Deer Creek Wildlife Management Area.
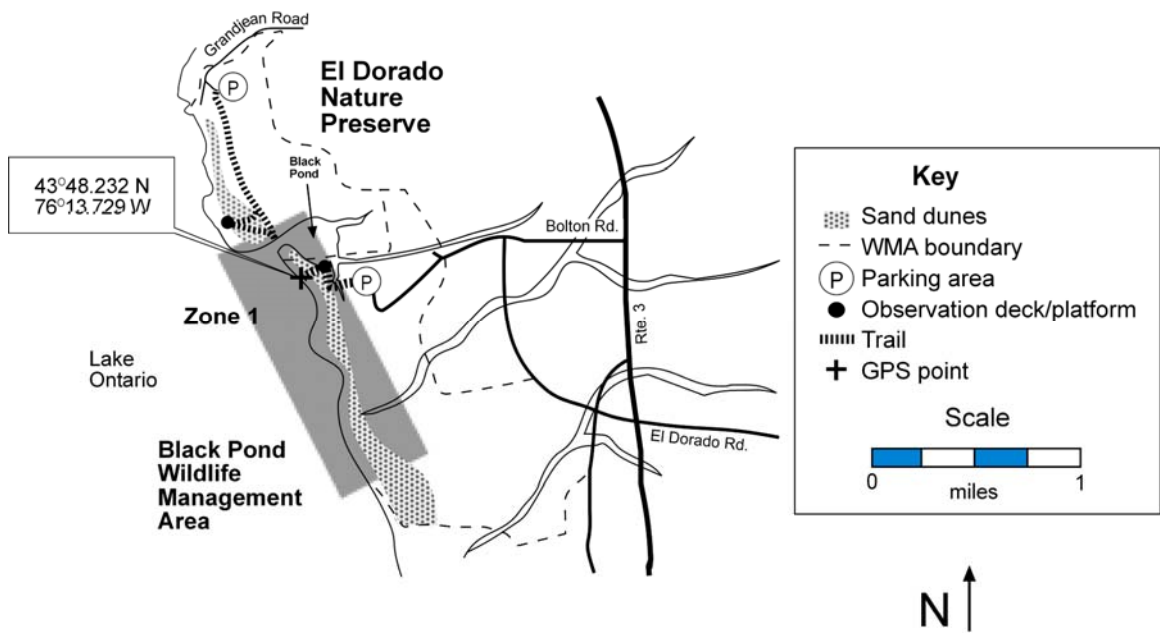
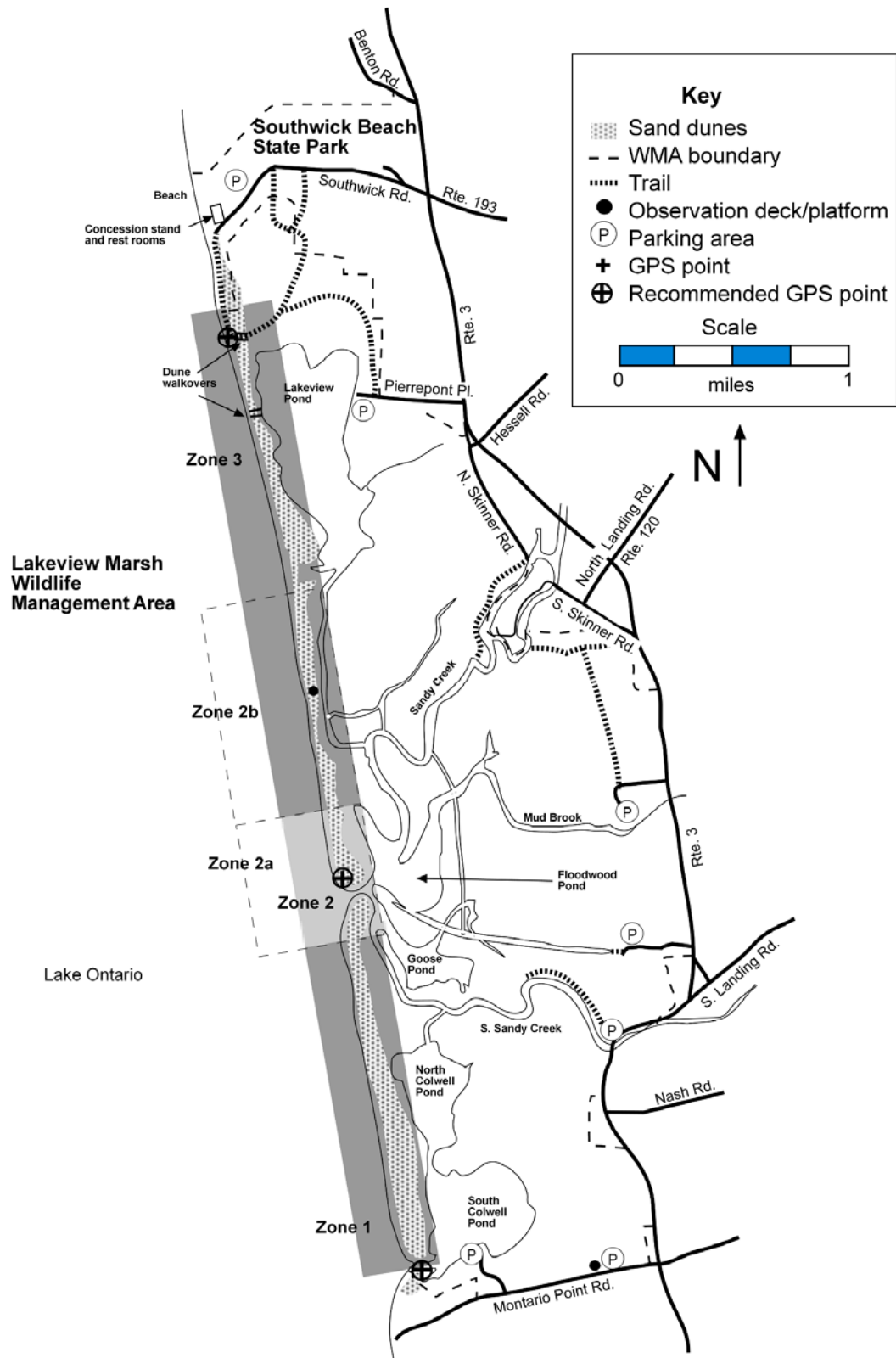**Figure 5.** A map of the zones within the Black Pond Wildlife Management Area.

Figure 6. A map of the zones within the Lakeview Wildlife Management Area.

Full count data were collected by Dune Stewards on randomly-selected weekend and weekday days in 2003, 2006, and 2007 between the hours of 11:00 am and 4:30 pm. Stewards counted all visitors who entered each public area, taking careful notes of visitors' appearances in order to prevent double counts. Spot counts were conducted on full count days as well.

As spot and full counts were tabulated, other data were collected as well. These data were identical to data collected in previous years and included:
1. cloud cover (overcast/rainy; partially cloudy; clear sky);
2. day of the week (i.e., weekday, weekend);
3. surf conditions (rough; moderate (choppy); calm);
4. air temperature (>80 degrees; 70-80; <70);
5. number of violations; and
6. visitor activities (collected during spot counts only).

Data from spot and full counts were tabulated in EXCEL and later converted to SPSS for each year. Maximum daily temperature and daily precipitation data for the Oswego East weather station were obtained from the National Oceanic and Atmospheric Administration for each day between the Friday of Memorial Day weekend and Labor Day, and were added to the SPSS spreadsheets. The numerical day of the year was included as well.

A regression analysis was used to identify the relationship between the weather and spot count data, and the total count data. This type of analysis produces an equation that can be used to calculate total counts in the future, simply by plugging in the weather and spot count data. "Total count" was identified as the dependent variable in the regression analysis, while spot count, day of the week, cloud cover, surf conditions, temperature, and precipitation were used as independent variables. Independent variables not found to be statistically significant ($p \leq 0.05$) were removed from the equations.

In order to estimate total counts for those days on which total count data were not collected, spot count data were plugged into the regression equations. Averages of these estimated total counts were then calculated separately for weekend days and weekdays. These averages were used as the estimated total counts on those days on which the Dune Stewards did not work (i.e., their days off).

Daily visitor use estimates were summed to obtain an estimate of total summertime and daytime visitor use. Regression equations calculated for 2003 were then used to estimate total daily visitor use in each zone within each public area for past years (i.e., 2000 to 2002). Equations calculated for 2004 were used to estimate total visitor use in 2004, 2005, and 2006. Equations calculated for 2007 were used in 2008 and 2009. Daily visitor use estimates were summed for these years to obtain an estimate of total summertime/daytime visitor use. Graphs were created to highlight trends in estimated visitor use. Correlations between daily visitor use data and number of observed violations in each zone were calculated.

RESULTS AND DISCUSSION

Regression Equations
The regression equations initially tested included all independent variables shown below. The initial regression formula used for each zone was:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$$

Where:
Y = Total number of visitors counted during full count
X_1 = Number of visitors counted during spot count
X_2 = Cloud cover (rainy/overcast = 1; partly cloudy = 2; full sun = 3)
X_3 = Day of the week (weekday = 1; weekend = 2)
X_4 = Surf conditions (strong = 1; moderate = 2; calm = 3)
X_5 = Maximum daily air temperature (^{o}F)
a = Intercept on the Y axis
b_1 to b_5 = Parameter estimates for each variable

The initial equations for 2003 were run using four different forms of the spot count data: one utilizing AM spot count data (i.e., data collected between 11 AM and noon), one PM spot count data (i.e., data collected between 3 and 4 pm), one the average of the two spot counts, and one the total of the two spot counts. The spot count data found to be most significant in determining the total count was the average spot count. Because of this, it is highly recommended that all data collection in the ELODWA in the future include both AM and PM spot counts so that an average spot count can be calculated. The average spot counts were used in the 2004 regression equations. Other variables were found to significantly influence total count as well (e.g., DAYWEEK, SUN, DAYYEAR).

The final regression equations calculated for 2003, 2004, and 2007 are below (Tables 1, 2, and 3). It is recommended that the equations for 2007 be used in 2008 and 2009 for estimating total visitor counts, and that new equations be calculated in 2010. The equations using the AM or PM spot counts were used to calculate estimates for 2000 to 2002 since only one spot count was collected daily in these years. (Note: The areas using an AM spot count in the past have a regression based on the AM spot counts in 2003, while those areas using a PM spot count in previous years have regression equations that use the 2003 PM spot count data.) In 2009, because of the addition of a third zone to the Deer Creek WMA due to the construction of a new dune walkover, the equation for Deer Creek zone 1 was used to estimate the visitation for zone 3 (zone 1 originally included zone 3).

The variables in each of the regression equations in Tables 1 and 2 are as follows:
- TOTCOUNT = total count of visitors in sample point zone on a specific day
- AVGSPOT = average of morning and afternoon spot counts for a specific day
- DAYWEEK = Day of the week (weekend = 2; weekday = 1)
- DAYYEAR = Numerical day of the year (i.e., 1 to 365)
- PMSPOT = afternoon spot count used

- AMSPOT = morning spot count used
- SUN = Sky conditions (1 = rain/overcast; 2 = partly cloudy; 3 = full sun)
- TEMPMAX = Daily maximum air temperature from Oswego weather station

Table 1. Equations used to calculate visitor estimates for 2000 to 2003.

Area	Zone	Regression equation	R^2	Significance of F
Sandy Pond Beach	SP1	TOTCOUNT = -11.775 + 3.954 (AMSPOT) + 22.630 (DAYWEEK)	0.841	0.025
	SP2	TOTCOUNT = -84.174 + 0.989 (AMSPOT) + 165.070 (DAYWEEK)	0.914	0.007
	SP3	TOTCOUNT = -37.5 + 3.315 (AMSPOT) + 63.815 (DAYWEEK)	0.883	0.040
Deer Creek	DC1	TOTCOUNT = 2.346 + 1.244 (PMSPOT) + 12.481 (DAYWEEK)	0.868	0.002
	DC2	TOTCOUNT = 0.869 + 1.326 (PMSPOT) + 6.150 (DAYWEEK)	0.904	0.001
Black Pond	BP1	TOTCOUNT = -101.121 + 2.098 (AMSPOT) + 60.717 (SUN)	0.755	0.030
Lakeview	LV1	Data not collected for this zone prior to 2004.		
	LV2a	Regression equation not significant.		
	LV2b	TOTCOUNT = -7.256 + 1.147 (AMSPOT) + 15.323 (DAYWEEK)	0.812	0.007
	LV3	Data not collected for this zone prior to 2004.		

Table 2. Equations from summer, 2004 (used for visitor estimates in 2004 through 2006).

Area	Zone	Regression equation	R^2	Significance of F
Sandy Pond Beach	SP1	TOTCOUNT = -115.234 + 2.495 (AVGSPOT) + 0.691 (DAYYEAR)	0.879	0.0001
	SP2	TOTCOUNT = 31.649 + 2.732 (AVGSPOT)	0.928	0.0001
	SP3	TOTCOUNT = -39.836 + 1.999 (AVGSPOT) + 56.947 (DAYWEEK)	0.894	0.0001
Deer Creek	DC1	TOTCOUNT = 7.323 + 4.115 (AVGSPOT)	0.930	0.0001
	DC2	TOTCOUNT = -80.795 + 2.348 (AVGSPOT) + 1.312 (TEMPMAX)	0.659	0.0001
Black Pond	BP1	TOTCOUNT = -154.33 + 3.732 (AVGSPOT) + 2.807 (TEMPMAX)	0.878	0.0001
Lakeview	LV1	TOTCOUNT = -17.496 + 5.245 (AVGSPOT) + 24.301 (DAYWEEK)	0.865	0.0001
	LV2 & 3[a]	TOTCOUNT = -21.06 + 1.465 (AVGSPOT) + 48.304 (DAYWEEK)	0.595	0.0001

[a] Full count data for zones 2 and 3 in Lakeview WMA were accidentally combined during data collection in 2004. Equations for these zones should be recalculated in 2007.

Table 3. Equations from summer, 2007, to be used for visitor estimates in 2007 through 2009.

Area	Zone	Regression equation	R^2	Significance of F
Sandy Pond Beach	SP1	TOTCOUNT = 3.426+ 3.715 (AVGSPOT)	0.984	0.0001
	SP2	TOTCOUNT = 20.897+ 2.631(AVGSPOT)	0.953	0.0001
	SP3	TOTCOUNT = 7.907+ 3.074 (AVGSPOT)	0.881	0.0001
Deer Creek	DC1	TOTCOUNT = -0.573+ 3.431 (AVGSPOT) + 8.625 (DAYWEEK)	0.808	0.0001
	DC2	TOTCOUNT = -34.739 + 5.649 (AVGSPOT) + 0.568 (TEMPMAX)	0.803	0.0001
Black Pond	BP1	TOTCOUNT = 5.169+ 2.266 (AVGSPOT) + 19.464 (DAYWEEK)	0.786	0.0001
Lakeview	LV1	TOTCOUNT = -31.125 + 4.911 (AVGSPOT) + 18.923 (SURF)	0.625	0.0001
	LV2	TOTCOUNT = 3.397+ 3.073 (AVGSPOT)	0.713	0.0001
	LV3	TOTCOUNT = 18.690+ 3.478 (AVGSPOT)	0.799	0.0001

While the regression equations for most areas are significant for 2003, problems occurred in data collection and analysis of this year that made the collection of full count data in the summer of 2004 necessary. Concerns over 2003 data include:

- Data were collected only from mid July through the end of August in 2003 because of the time needed to assess visitor access to the ELODWA and data from previous years, and to identify a suitable data collection protocol.

- For Lakeview, spot count data were not collected on the full count days in 2003. Because of this, observational data collected between 11 am and noon on full count days was used in place of AM spot count data; adequate data could not be identified to replace the missing PM spot count data. A significant regression formula using the AM counts was calculated for zone 2b in Lakeview; a significant formula could not be calculated for zone 2a. Because of this, spot count data for zone 2a were used to represent total daily use on spot count-only days, likely yielding a very conservative estimate of use in this zone.

- Data were not collected for zones 1 and 3 in Lakeview in 2003 because of staff and access limitations. The total estimated use of Lakeview in 2003 is likely to be much lower than that actually occurring in the area because of these problems. Results for Lakeview for 2000 to 2003 should be used only as an indication of trends in use, not as accurate estimates of use.

While the above concerns were corrected in 2004, one additional problem developed. Specifically, the total count data for Lakeview zones 2 and 3 were mistakenly combined by a Dune Steward in 2004 and 2005. Separate data for these zones was collected in subsequent years.

Finally, the Lakeview zone 3 estimate should be removed from the total ELODWA visitor use estimate because of an overlap in use between Southwick Beach State Park and Lakeview zone 3. This overlap in use between Lakeview zone 3 and Southwick Beach was eliminated in 2007, when data were collected separately for each of the three zones in Lakeview.

TRENDS IN VISITOR USE OF ELODWA

Visitor use in ELODWA

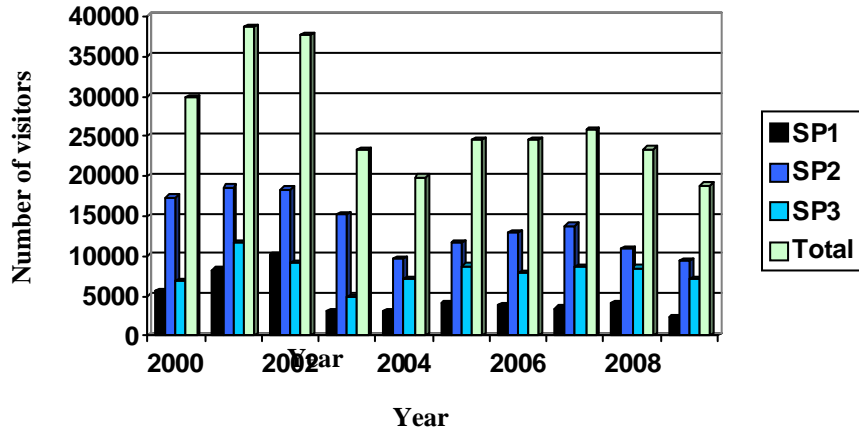Trends in visitor use are shown in Figures 7 to 13.

Figure 7. Estimated visitor use in the Sandy Pond Beach Natural Area, 2000-2009. Estimate are provided for each zone as well as the total area (summers only).
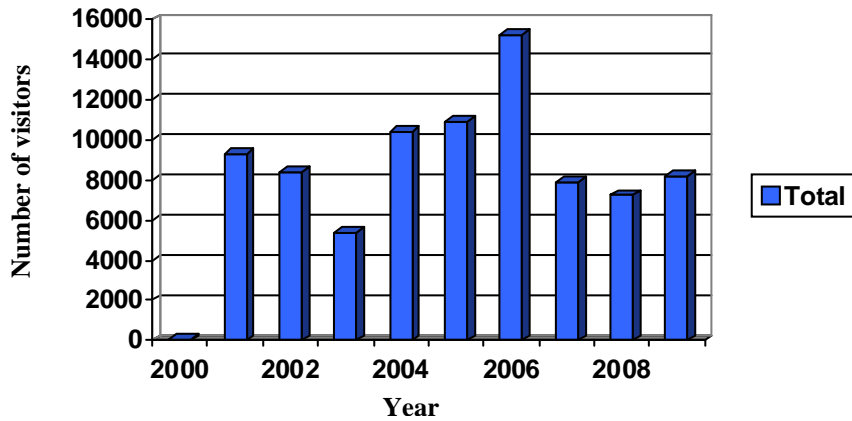

Figure 8. Estimated visitor use in the Black Pond Wildlife Management Area, 2000-2009 (summers only).
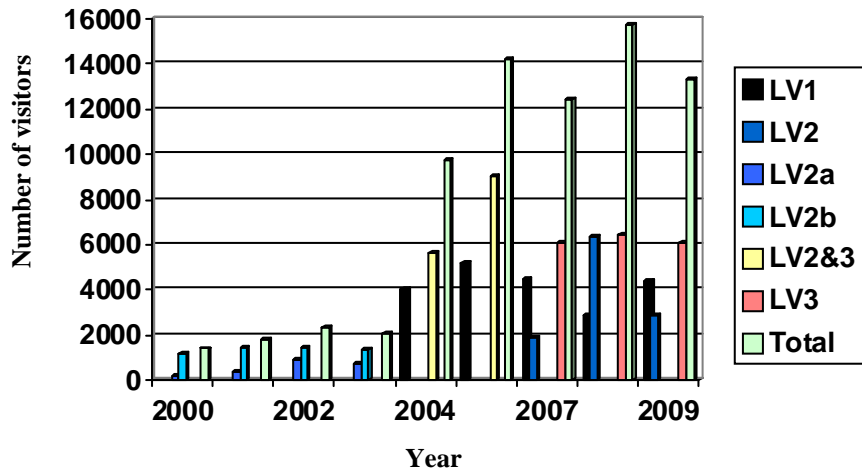

Figure 9. Estimated visitor use trends in the Lakeview Wildlife Management Area, 2000-2009 (summers only). Data were not collected for Lakeview in 2005. Data were collected for zones 2a and 2b only from 2000 to 2003.
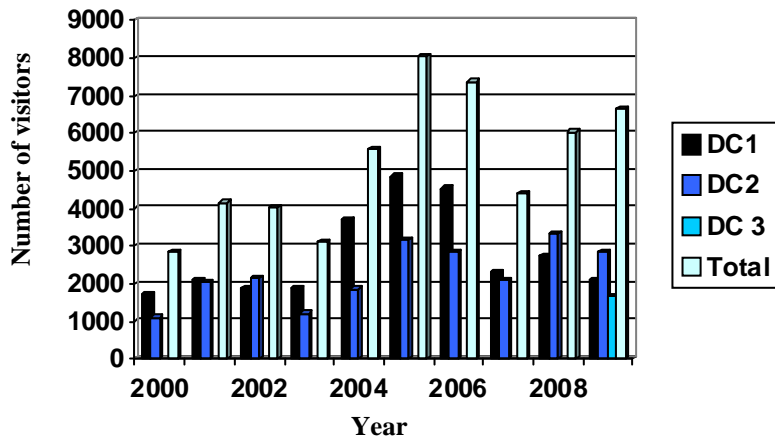
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Figure 10. Estimated visitor use in the Deer Creek Wildlife Management Area, 2000-2009 (summers only).
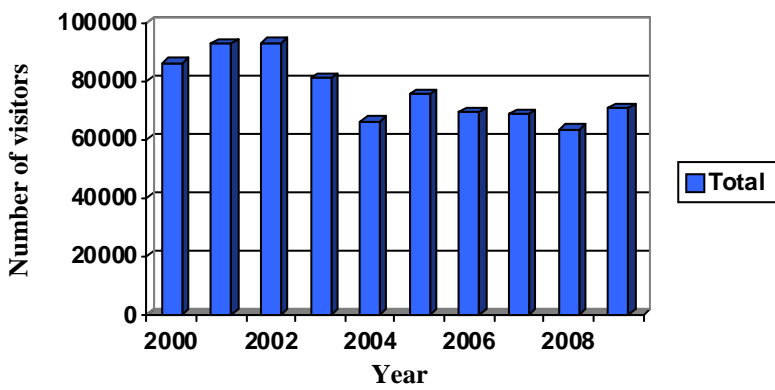

Figure 11. Estimated visitor use in Southwick Beach State Park, 2000-2009 (summers only).
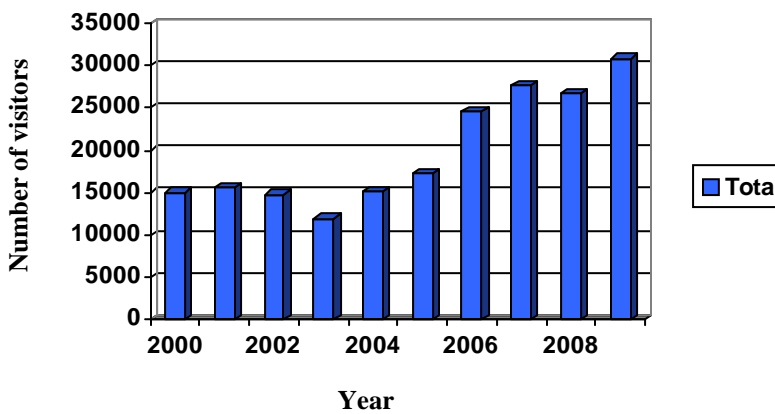

Figure 12. Estimated visitor use at Sandy Island Beach, 2000-2009 (summers only).
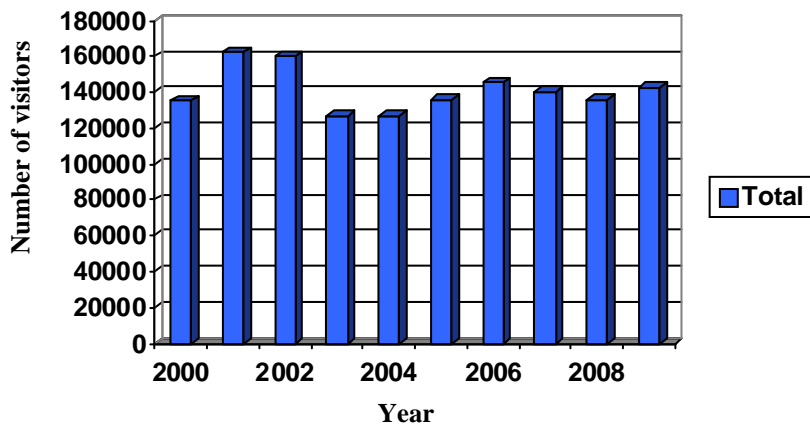
Figure 13. Total estimated visitor use in the ELODWA, 2000-2009 (summers only).

Overall, use of public areas in the ELODWA showed a decline in 2003 over previous years (Figure 13 and Table 4), followed by a steady increase from 2004 through 2006. Slight declines occurred in 2007 and 2008, followed by a slight increase in 2009. Comparisons between the 2000-2003 and 2004-2006 time periods for the ELODWA area are difficult to make because of the addition of two data collection zones (i.e., zones 1 and 3) in the Lakeview WMA in 2004.

The total ELODWA estimate for 2007 through 2009 does not include Lakeview zone 3 (this was intentionally removed from the total ELODWA estimate to eliminate overlap in use between zone 3 and Southwick Beach State Park). It was not possible to remove the zone 3 estimate from the total ELODWA estimate in 2004 since the zone 2 data were not collected separately from zone 3 data during this year. Likewise, zone 3 data were not removed from the 2006 ELODWA estimate since the 2006 Lakeview estimates were based on equations formulated with zones 2 and 3 combined (this is likely the cause of the increase in overall ELODWA visitation in 2006)

Areas receiving the highest use between 2000 and 2009 were Southwick Beach, Sandy Pond Beach Natural Area, and Sandy Island Beach. Visitor use at Black Pond showed a large increase between 2000 and 2001 because of the addition of a boardwalk access trail to the area in 2001. The estimates for Lakeview for 2000 through 2003 are likely much lower than the levels of actual use that occurred during these years because of the lack of data for zones 1 and 3 (collection of data for these zones began in 2004). Lakeview currently receives moderate levels of use on average, with high levels of use in zone 3. Unlike most of the other areas in the ELODWA, Deer Creek had an increase in use in 2008 and 2009, likely due to improved access in the area from the addition of a new dune walkover.

Table 4. Total visitor use estimates for management areas in the ELODWA.

Year	Black Pond	Lakeview[a]	Lakeview[b]	Southwick	Sandy Pond	Sandy Island	Deer Creek	Total ELODWA[c]
2000	64	1,393	NA	86,084	29,864	14,994	2,849	135,248
2001	9,325	1,790	NA	92,723	38,557	15,664	4,168	162,227
2002	8,378	2,363	NA	92,830	37,616	14,785	4,024	159,996
2003	5,415	2,061	NA	80,896	23,247	12,001	3,110	126,730
2004	10,385	NA	9,703	66,095	19,825	15,185	5,576	126,769
2005	10,882	NA	NA	75,394	24,491	17,297	8,040	136,104
2006	15,227	NA	14,197	69,133	24,552	24,604	7,375	145,484
2007	7,853	NA	12,385	68,463	25,855	27,612	4,405	140,500
2008	7,240	NA	15,732	63,598	23,354	26,672	6,038	136,194
2009	8,165	NA	13,345	70,657	18,874	30,830	6,636	142,427

[a]Estimates are for Lakeview zones 2a and 2b only from 2000 through 2003.
[b]Estimate is for Lakeview zones 1, 2, and 3 in 2004 and 2006 through 2009.
[c]Lakeview zone 3 estimate was removed from the total ELODWA use estimate from 2007 through 2009 to prevent overlap between zone 3 users and Southwick Beach users.

Violations in ELODWA

The total number of violations observed by Dune Stewards for each day were tallied throughout the summers of 2000 through 2009. Correlations between these numbers and total estimated visitor use per day were calculated, but were not statistically significant. In other words, a high number of violations were not necessarily experienced on days of high visitor use or in locations having high visitor use. However, when the average daily number of violations was examined for each individual public area (Figure 14), higher numbers of violations appear in some areas. For example, violations at Black Pond/Eldorado and Sandy Pond were the highest of the four areas studied in 2009. While Lakeview appears to have a relatively high average number of daily violations each year, the average violations per day have declined since 2006. Violations at Sandy Pond increased dramatically between 2006 and 2007 and decreased in 2008 and 2009; focusing educational efforts on this area may be needed.
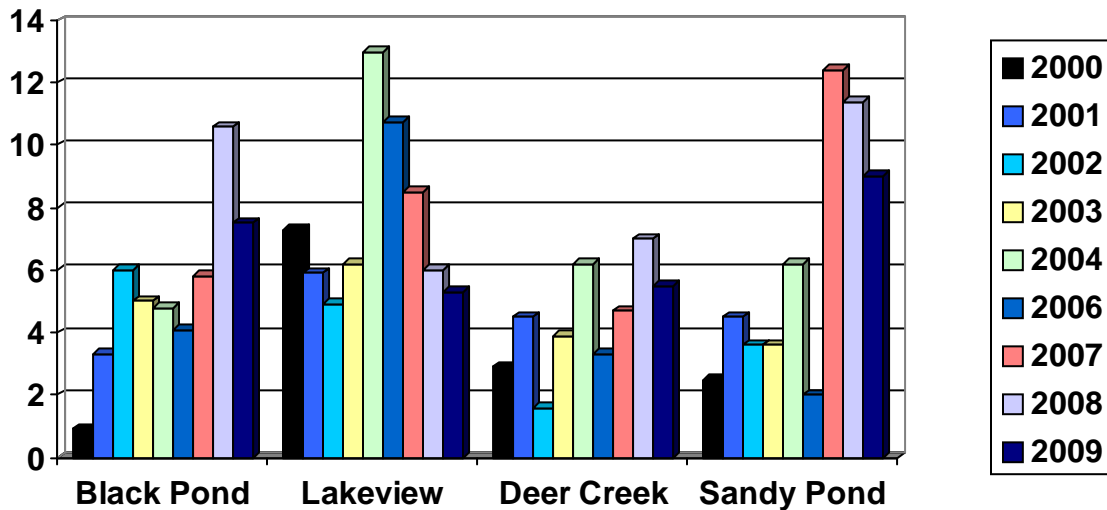

Figure 14. The average daily number of violations observed for Black Pond/Eldorado, Lakeview, Deer Creek, and Sandy Pond Beach for 2000 to 2009. Violations data were not collected in 2005.

RECOMMENDATIONS FOR A DATA COLLECTION PROTOCOL

The results of this study indicate that adequate estimates of total visitor activity can be obtained through the indirect count (i.e., regression equation) method. However, limited data collection in 2003 (i.e., full count data were collected from mid July to Labor Day only) made the collection of full count data in 2004 necessary in order to obtain the most accurate visitor use estimates. Significant regression equations were calculated in 2007 for all ELODWA zones because of improved data collection efforts, and similar collection methods should be utilized in 2010.

In addition, some changes in data collection are recommended as follows:
- Access patterns for zone 3 observed in 2003 indicate that nearly all visitors using this area enter from Southwick Beach State Park. It is important that researchers calculating future estimates for the entire ELODWA area remove zone 3 estimates in order to prevent double-counts of visitors using both zone 3 and Southwick Beach State Park.

- It is important that two dune stewards be positioned in Lakeview in order to collect data from all three zones (i.e., one steward for zone 1 and another steward for zones 2 and 3) and reduce the daily average number of violations. The large size of Lakeview WMA makes data collection and visitor education efforts difficult. One steward would be responsible for education efforts in the southern portion of Lakeview (i.e., from Montario Point north to the Sandy Creek outlet) and the other for efforts in the northern portion (i.e., zones 2 and 3). Collection of data for visitor use at the Sandy Creek Outlet will be done from the northern side of the outlet (see zone 2 in Figure 6).

- The unusually high average daily number of violations in Sandy Pond Beach in 2007, 2008, and 2009 suggests that additional educational efforts be implemented there. Data from 2007, 2008, and 2009 for Sandy Pond should be further examined to identify which violations in particular are occurring.

Randomly-selected full count dates for 2010, and revised data collection sheets are included in the appendices. Full counts of visitor use and recalculation of regression equations are recommended every three years after 2007 to maintain accuracy in total visitor count estimates and account for any changes in management of each area.

CONCLUSION

Data collection for the ELODWA indicates several interesting visitor use patterns. For example, trends indicate lower levels of use in the past three years in most management areas. Lower levels of use are likely to result in lower levels of visitor-caused impacts on the dunes. Second, there appears to be no correlation between the number of visitor violations and the number of visitors. Violations may be occurring in the evenings when Dune Stewards are not on duty and in locations where constant supervision is difficult (e.g., interior sections of Lakeview). Third, areas having high visitation are *not* more likely to have more violations than areas with low visitation. Violations appear to be more dependent on the ability of the Dune Steward program to provide education and supervision efforts across each area. Large areas such as Lakeview are difficult to adequately monitor and manage because of their size, and are thus likely to have a greater number of violations. Continual monitoring and education of visitors is needed throughout the ELODWA in order to ensure the continued protection of this fragile ecosystem and enjoyment of visitors.

ACKNOWLEDGMENTS

APPENDICES

Appendix A. Recommended full count days and years

Full count days in 2010
Sunday, May 30
Memorial Day-Monday, May 31
Thursday, June 3
Saturday, June 5
Friday, June 11
Sunday, June 13
Thursday, June 17
Saturday, June 19
Friday, June 25
Saturday, June 26
Thursday, July 1
Sunday, July 4
Friday, July 9
Saturday, July 10
Thursday, July 15
Saturday, July 17
Friday, July 23
Sunday, July 25
Thursday, July 29
Sunday, August 1
Friday, August 6
Saturday, August 7
Thursday, August 12
Sunday, August 15
Friday, August 20
Saturday, September 4
Labor Day-Monday, September 6

Years for future full counts:
Full counts should be collected every three years in order to update the regression
equations. Recommended years are as follows:
2010
2013
2016
2019
Etc…

Appendix B. Monitoring protocol instructions for Dune Stewards

1. Spot count only days.
Use the "spot count tally sheet" to collect data for the shoreline/dune area in each zone twice a day, on <u>all</u> days that you are working (<u>including</u> full count days (see below)).

- The AM spot count is collected between 11:00 AM and Noon.
- The PM spot count is collected between 3:00 and 4:00 PM

Stand at the designated GPS/observation point. Count all visitors, for each activity specified on the tally sheet, within a 250-foot radius of the observation point (this includes people in the water). Write in the number of visitors participating in each activity on the tally sheet.

Circle the following variables on the spot count data sheet for noon.
- Day of the week (weekday = 1; weekend = 2)
- Cloud cover (rainy/overcast = 1; partly cloudy = 2; full sun = 3)
- Surf conditions (rough = 1; moderate (choppy) = 2; calm = 3)

Repeat the count for all observation points in your area.

2. Full count and spot count days.
Use the "full count tally sheet" to count the total number of visitors for the shoreline/dune area in each zone throughout the day. Full count data are collected as follows:
1. At 11:00 AM, start at the observation point for your first zone. Conduct the spot count using the "spot count tally sheet."
2. Move from one end of the zone to the other, counting visitors as you go. Take notes on what visitors are wearing, the color of their towel, the color of their beach chair, etc...and/or map the location of visitors so that you do not double-count visitors throughout the day. Write the number of visitors counted on the "full count tally sheet."
3. Move to the observation point for your next zone. Conduct the spot count.
4. Move from one end of the zone to the other, counting visitors as you go.
5. Repeat steps 3 and 4 for any additional zones.
6. After all AM spot counts have been completed, take a lunch break. Start counting again at 1:00 PM.
7. At 1 PM, move back to the zone that you started with at 11 AM. Add to your data collection sheet any visitors that may have appeared in that zone since the first count in the morning. Be careful not to double-count visitors that you counted in the morning. Repeat for all zones until 3 PM.
8. At 3 PM, move to the observation point in your first zone and conduct a spot count. Walk through the entire zone and add any new visitors to your full count data sheet. Repeat for all zones.
8. Continue with the full counts until 4:30 PM.

3. Violations
Use the "Violations Tally Sheet" to collect data on the number of violations of each type that you observe for the entire day (i.e., 11 AM through 4:30 PM).

Appendices C, D, and E. Visitor Count and Violations Tally Sheets

Full Count Tally Sheet

Site:	Collect weather data at noon. Circle one for each of the following:		
Observation Point:	Surf:	3=calm	2=moderate	1=rough
Observer:	Sun:	3=full sun	2=partly cloudy	1=cloudy/rainy
Date:			

Time Period:	Count of New Visitors	Use this area for notes/diagrams as necessary to track visitors.
11:00-11:30		
11:30-12:00		
12:00-12:30		
12:30-1:00		
1:00-1:30		
1:30-2:00		
2:30-3:00		
3:00-3:30		
3:30-4:00		
4:00-4:30		

Spot Count Tally Sheet

Site:

Name of observer:

Date:

Collect weather data at noon. Circle one answer for each of the following:

Sun: (1) Cloudy/Rainy; (2) Partly cloudy; (3) Full sun

Surf: (1) Rough; (2) Choppy; (3) Calm

Day of week: (1) Weekday; (2) Weekend; (2) Holiday

AM SPOT COUNT (11 AM - 12 PM)

Activity	Obs. Point 1	Obs. Point 2	Obs. Point 3
Time:	Time:	Time:	Time:
# of People			
On Beach			
In Dunes			
Swimming			
Riding Bike			
Riding Horse			
Birdwatching			
# of Dogs			
On Leash			
Off Leash			
# of Vehicles			
Motor boats			
Canoes/Kayaks			
Personal watercraft			
Cars			
4-wheelers			

PM SPOT COUNT (3 PM - 4 PM)

Obs. Point 1	Obs. Point 2	Obs. Point 3
Time:	Time:	Time:

Violations Tally Sheet

Site: _____

Zone/Observation Point: _____

Date: _____

	# People in dunes	# People in bird areas	# Personal watercraft on shore in bird area	# Boats onshore in bird area	# People removing driftwood	# of structures	# of dogs off leash	# evidence of fires	# of camp sites	# of four-wheelers	# of cars	# people seen littering	# vandalism evidence	# of nudes	# of bikes or horses (specify)
Total																
														Grand Total		

Site: _____

Zone/Observation Point: _____

Date: _____

	# People in dunes	# People in bird areas	# Personal watercraft on shore in bird area	# Boats onshore in bird areas	# People removing driftwood	# of structures	# of dogs off leash	# evidence of fires	# of camp sites	# of four-wheelers	# of cars	# people seen littering	# vandalism evidence	# of nudes	# of bikes or horses (specify)
Total																
														Grand Total		

Appendix F. Visitor questionnaire.
Visitor Questionnaire

1. **Which area are you are visiting right now?** (Check one answer.)
    a. ❏ Deer Creek Wildlife Management Area d. ❏ Lakeview Marsh WMA
    b. ❏ Sandy Pond Beach Natural Area e. ❏ Southwick Beach State Park
    c. ❏ Eldorado Beach Preserve f. ❏ Black Pond WMA

2a. **Approximately how many times will you visit the ELODWA** *this summer* **(i.e., from Memorial Day through Labor Day)?** (Write in the number.) _____ times

2b. **Approximately how many times will you visit the ELODWA** *this year***?**
    (Write in the number.) _____ times

3. **Which seasons this year will you be visiting the ELODWA?** (Check all that apply.)
    a. ❏ Winter (January, February, March) c. ❏ Summer (July, August, Sept.)
    b. ❏ Spring (April, May, June) d. ❏ Fall (October, Nov., Dec.)

4. **Have you visited the Eastern Lake Ontario Dune Area in a** *previous year***?**
    ❏ Yes ❏ No

5. **Where are you from?** (Provide the city and state.) _____

6. **What time did you** *arrive* **here today?** _____ AM or PM (Circle one.)

7. **What time will you** *leave* **here today?** _____ AM or PM (Circle one.)

8. **Which of the following are you?** (Check one answer only.)
    a. ❏ A local resident c. ❏ A visitor passing through
    b. ❏ A visitor vacationing in this area d. ❏ Other, specify: _____

9. **Who are you here with?** (Check all that apply.)
    a. ❏ Friends d. ❏ Club or organization
    b. ❏ Family e. ❏ Other, specify: _____
    c. ❏ By myself

10. a. **How many people are in your group** *including yourself***?** (Provide number.)____
    b. **How many of them are in each of the following age categories?** (Write in number.)
    _____0 to 12 years _____13 to 19 yrs. _____20 to 59 yrs. _____60+ yrs.

11. **How did you** *first* **find out about this area?** (Check <u>one</u> answer only.)
    a. ❏ From living in the area (resident) d. ❏ From a web site
    b. ❏ From a friend or family member e. ❏ Other, specify:_____
    c. ❏ From a visitor guidebook

12. **What activities are you doing while in this area** *today***?** (Check all that apply <u>and</u> indicate the percentage of time that you spent on each activity *today*. NOTE: Percentages should total 100%.)

Activities	**Percentage of time spent on activity**
a. ❑ Walking or relaxing on the beach	_____%
b. ❑ Hiking on trails	_____%
c. ❑ Bird watching	_____%
d. ❑ Boating	_____%
e. ❑ Picnicking	_____%
f. ❑ Biking	_____%
g. ❑ Swimming	_____%
h. ❑ Fishing	_____%
i. ❑ Camping	_____%
j. ❑ Other, specify:_____	_____%
	TOTAL = 100%

13. a. **Have you seen the small signs posted along the beach?** ❑ Yes ❑ No (Go to #10.)

 b. **Have they encouraged you to stay out of the dunes?** ❑ Yes ❑ No

 c. **How do you feel about having the signs posted?** (Check <u>one</u> answer.)
 a. ❑ Good/Signs are needed b. ❑ Neutral c. ❑ I don't like them

14. What other types of educational materials did you use while visiting this area? (Check all that apply.)

 a. ❑ "Sand, wind, and water" guidebook d. ❑ Directory signs at parking areas

 b. ❑ Brochure for this area e. ❑ Other, specify:_____

 c. ❑ Educational signs along walkovers f. ❑ None

15. What types of facilities have you used while in the area? (Check all that apply.)

 a. ❑ Boat launches d. ❑ Campsites

 b. ❑ Trails e. ❑ Wooden dune walkovers

 c. ❑ Observation towers f. ❑ Other, specify:_____

16. Why is it important that beach grass and other plants grow on the sand dunes?

_____

17. Can you list two activities that people do that cause erosion of the sand dunes?

1._____

2._____

Thank you for taking the time to complete this survey!

Appendix G. Key to Data Entry

Notes:
- Use one computer file per management area.
- Use one spread sheet in each file for each observation point/zone.

Name of Variable:
Management areas:

EL   Eldorado Nature Preserve

BP   Black Pond WMA

SW   Southwick Beach State Park

LV   Lakeview Marsh WMA

DC   Deer Creek WMA

SP   Sandy Pond Beach Natural Area

SI   Sandy Island Beach

Data entry:

dayyear   Numerical day of the year (e.g., January 1 is "1" and December 31 is "365").

source   Source of estimate of total count (1 = full count; 2 = spot count/regression equation; 3 = average of spot count estimates).

year   Calendar year during which data were collected.

dayweek   Day of the week (1 = weekday; 2 = weekend or holiday).

point   Observation point for the use zone.

Spot counts of people:

ambeach/pmbeach   Number of beach users counted during the AM or PM spot counts.

amdunes/pmdunes   Number of visitors in the dunes during the AM or PM spot counts.

amswim/pmswim   Number of visitors swimming during the AM or PM spot counts.

ambike/pmbike   Number of visitors biking during the AM or PM spot counts.

amhorse/pmhorse   Number of visitors horseback riding during the AM or PM spot counts.

ambird/pmbird   Number of visitors birdwatching during the AM or PM spot counts.

amspot/pmspot   *Total* number of visitors counted during AM or PM spot count (NOTE: this column self-calculates when data is entered for other spot count observations).

Spot counts of dogs:

amdogon/pmdogon	Number of dogs *on* their leashes during the AM or PM spot counts.
amdogoff/pmdogoff	Number of dogs *off* their leashes during the AM or PM spot counts.
amdogs/pmdogs	*Total* number of dogs observed during the AM or PM spot counts (NOTE: this column self-calculates when data is entered for other spot count observations).

Spot counts of vehicles:

amboats/pmboats	Number of boats landed in the management area or observed/anchored near shore during the AM or PM spot counts.
amcars/pmcars	Number of cars observed on the beach during the AM or PM spot counts.
ampwater/pmpwater	Number of personal watercraft (e.g., jet skis) landed in the management area or observed near shore during the AM or PM spot counts.
am4wheel/pm4wheel	Number of four-wheelers or dirt bikes observed on the beach during the AM or PM spot counts.
amvehicl/pmvehicl	*Total* number of vehicles observed on the beach during the AM or PM spot counts (NOTE: this column self-calculates when data is entered for other spot count observations).

Weather data:

sun	Level of sunshine (1= cloudy/rainy; 2 = partly cloudy; 3 = full sun).
surf	Roughness of water (1 = rough; 2 = choppy; 3 = calm).
tempmax1	Maximum daily temperature as reported by the Oswego, NY weather station.
precip1	Total daily precipitation as reported by the Oswego, NY weather station.

Other data:

fulcount	Enter the total number of visitors counted on full count days ONLY (i.e., *source* = 1). Leave this column blank for all other days.
totcount	Do not enter any data into this column. The total count of visitors in the zone will be calculated as follows:

- If *source* = 1, than *totcount* = *fulcount*;

- If *source* = 2, than *totcount* = regression equation output;

- If *source* = 3, than *totcount* = average of regression equation outputs (calculated separately for *dayweek* = 1 and *dayweek* = 2).

violatn	Total daily number of violations observed in zone.