

Introduction

Maine State Parks are in their 77th year, providing public access to a variety of scenic views, picnicking opportunities, freshwater and saltwater swimming, hiking, camping and a variety of other activities.¹ These opportunities allow individuals to experience relatively undeveloped nature and can protect habitat for a variety of wildlife. On the other hand, concentrating large amounts of people in these natural areas can lead to degradation, and should be monitored closely and managed to the greatest ability.

In 2010, Reid State Park, in Georgetown, Maine was the most visited Maine State Park for day use, with 181,149 visitors.² The Park offers swimming opportunities in the surf and a lagoon, as well as multiple picnicking sites and walking trails. The high number of visitors potentially have a significant impact on the area. I aimed to estimate where that impact is concentrated using a GIS model. I also considered impact on water quality by comparing water quality results from several testing sites with modeled impact.

Methods

Using ArcMap10 I downloaded the 2011 Maine Orthophotos and conserved lands layer from the Maine Office of GIS.³ I digitized the park boundary and features that seemed to indicate high user presence, including infrastructure. All data were projected in NAD1983 UTM19N.

I could not find research indicating the level of impact of similar features in conserved lands so I created two models of visitor impact to reflect uncertainty in the parameters chosen. One model assumed "low impact" and the other assumed "high impact" from visitors. See Table 1.

	LOW		HIGH			LOW		HIGH	
	Old Values	New Values	Old Values	New Values		Old Values	New Values	Old Values	New Values
Private Roads	0-7	6	8		East Bath	0-7	3	8	
	7-15	2	6			7-15	1	6	
	15-50	1	2			15-50	0	2	
	50-65	0	1			50-5000	0	0	
Public Roads	65-5000	0	0		Mile Beach	0-7	5	9	
	0-7	6	9			7-15	2	6	
	7-15	2	7			15-30	1	3	
	15-35	1	4			30-5000	0	0	
Head Lot	35-65	0	1		Half Mile Beach	0-7	4	8	
	65-5000	0	0			7-15	2	6	
	0-7	5	8			15-30	1	2	
	7-15	2	6			30-5000	0	0	
Point Lot	15-45	1	2		East Beach	0-7	3	7	
	45-5000	0	0			7-15	2	5	
	0-7	5	8			15-30	1	2	
	7-15	3	6			30-5000	0	0	
East Lot	15-35	1	2		Lagoon	0-7	5	8	
	35-5000	0	0			7-15	2	6	
	0-7	4	7			15-35	1	2	
	7-15	1	3			35-5000	0	0	
Shop Lot	15-30	0	1		Lifeguard Stands	0-7	5	8	
	30-5000	0	0			7-15	2	5	
	0-7	3	5			15-30	0	3	
	7-25	1	2			30-5000	0	0	
Head Bath	25-50	0	1		Walking Paths	0-7	2	6	
	50-3000	0	0			7-15	1	3	
	0-7	4	7			15-5000	0	0	
	7-15	2	3			0-10	3	5	
Point Bath	15-50	1	1		Shop	10-35	2	3	
	50-5000	0	0			35-50	1	1	
	0-7	4	8			50-5000	0	0	
	7-15	2	6			0-10	2	5	

Table 1: Features and parameters used, low and high models.

Low Impact Model



High Impact Model



Figure 1: Visual representation of low and high impact models.

Methods (continued)

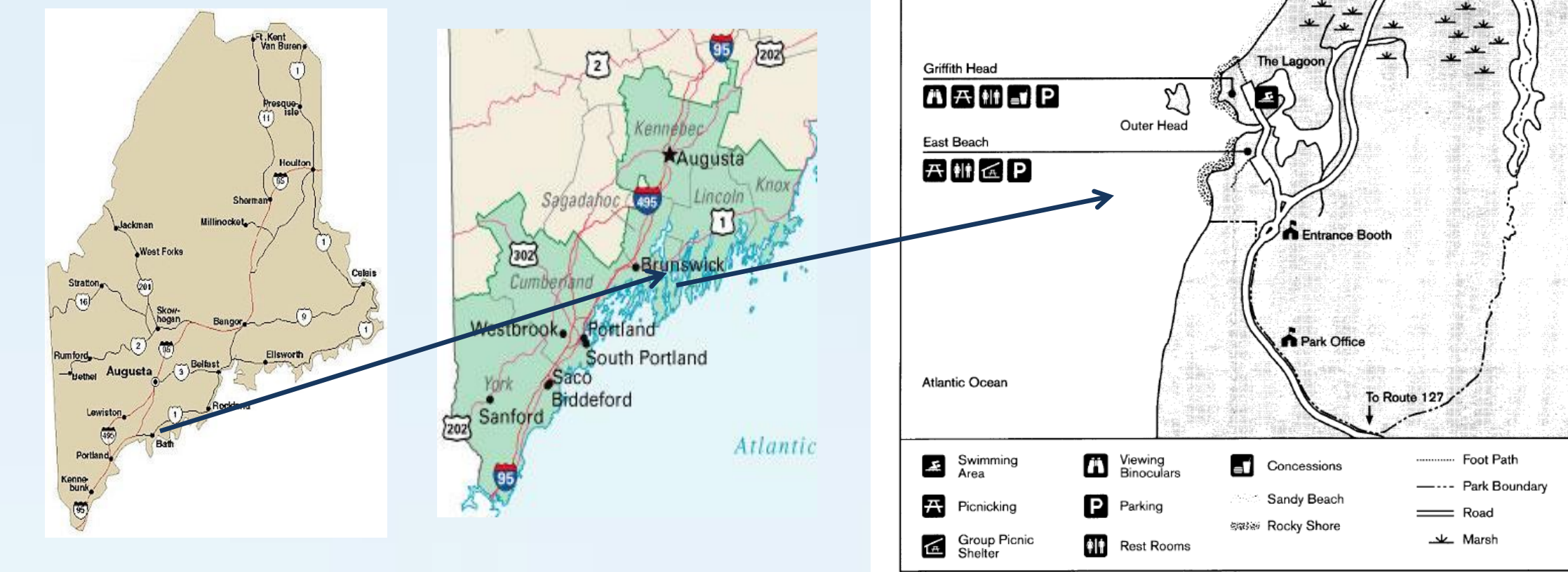
For each model, the vector layers of park features were converted to raster and then transformed using the Euclidean Distance tool in order to normalize the cell distances. The Euclidean distances were reclassified to describe the level of impact anticipated from that feature. Impacts were given a 0 (no impact) to 10 (highest impact) value. For all features there was an anticipated gradual lowering of impact with increasing distance. Using a weighted sum, a new layer was created for each model from the reclassified features. Finally, the number of pixels effected were found and converted to area for comparison.

To create a layer showing the average water quality I used the water quality monitoring results from the Maine Healthy Beaches Program, which has been monitoring Reid State Park since 2003.⁴ The program uses the bacteria *Enterococci* as an indicator.

I then used the Extract Multi-Values to Points tool to append the cell value at each monitoring site to the attribute table of the water monitoring site layer. This was then exported to Excel and a regression line was fit.

Acknowledgments

Many thanks to the Maine Healthy Beaches Program for the use of their data, as well as Manny Gimond, GIS & Quantitative Analysis Specialist, and Phillip Nyhus, Associate Professor of Environmental Studies, for their expert advice and assistance.



Impact Level	Low Model		High Model	
	Area (m ²) Effected	% Effected	Area (m ²) Effected	% Effected
0 - 1	2591012	86.13%	2251517	74.84%
1.1 - 4	210272	6.99%	411694	13.69%
4.1 - 7	190199	6.32%	203252	6.76%
7.1 - 11	15266	0.51%	128995	4.29%
11.1 - 22.0	696	0.02%	12859	0.43%

Table 2: Area effected at each level of impact.

Results

Noticeable impact within the park (defined as a modeled value above 1) ranged from 13% - 25%. See Figure 1 for visual comparison, see Table 2 for values.

The regression line between average water quality and low impact values showed a very weak negative correlation while the regression line with high impact values showed a moderately strong positive correlation. These results were not tested for statistical significance. See Figure 2.

Discussion

The Maine Healthy Beaches program considers wildlife the greatest water quality factor for Reid, with the possible exception of the lagoon (which receives many swimmers in relatively standing water). The results of my modeling are consistent with this view, as high impact had to be assumed before any correlation was seen.

Testing on East Beach ceased in 2010 because of consistently low results and low swimming activity, resulting in smaller sample sizes.

There are additional walking trails through the northeast section of the park that could not be located to digitize. Because they are missing from both models this will not effect the comparison, both models would have proportionally higher impact were the trails included.

The values assigned in the models are not supported by any studies. Impact studies would have to be done to refine the models before they could be considered reliable.

Literature Cited

- "Maine State Park Visitors Top 2.6 Million, the Highest in 21 Years." *www.maine.gov*. Department of Conservation, 5 Jan. 2011. Web. 4 Apr. 2012.
- "Welcome to the Maine Bureau of Parks & Lands." *Maine Bureau of Parks and Lands*. Department of Conservation. Web. 04 Apr. 2012. <<http://www.maine.gov/doc/parks/>>.
- "Maine Office of GIS Data Catalog." *Maine Office of GIS*. Department of Administrative and Financial Services. Web. 04 Apr. 2012. <<http://maine.gov/megis/catalog/>>.
- Lindberg, Keri. Maine Healthy Beaches Program Reid State Park Data. Unpublished.

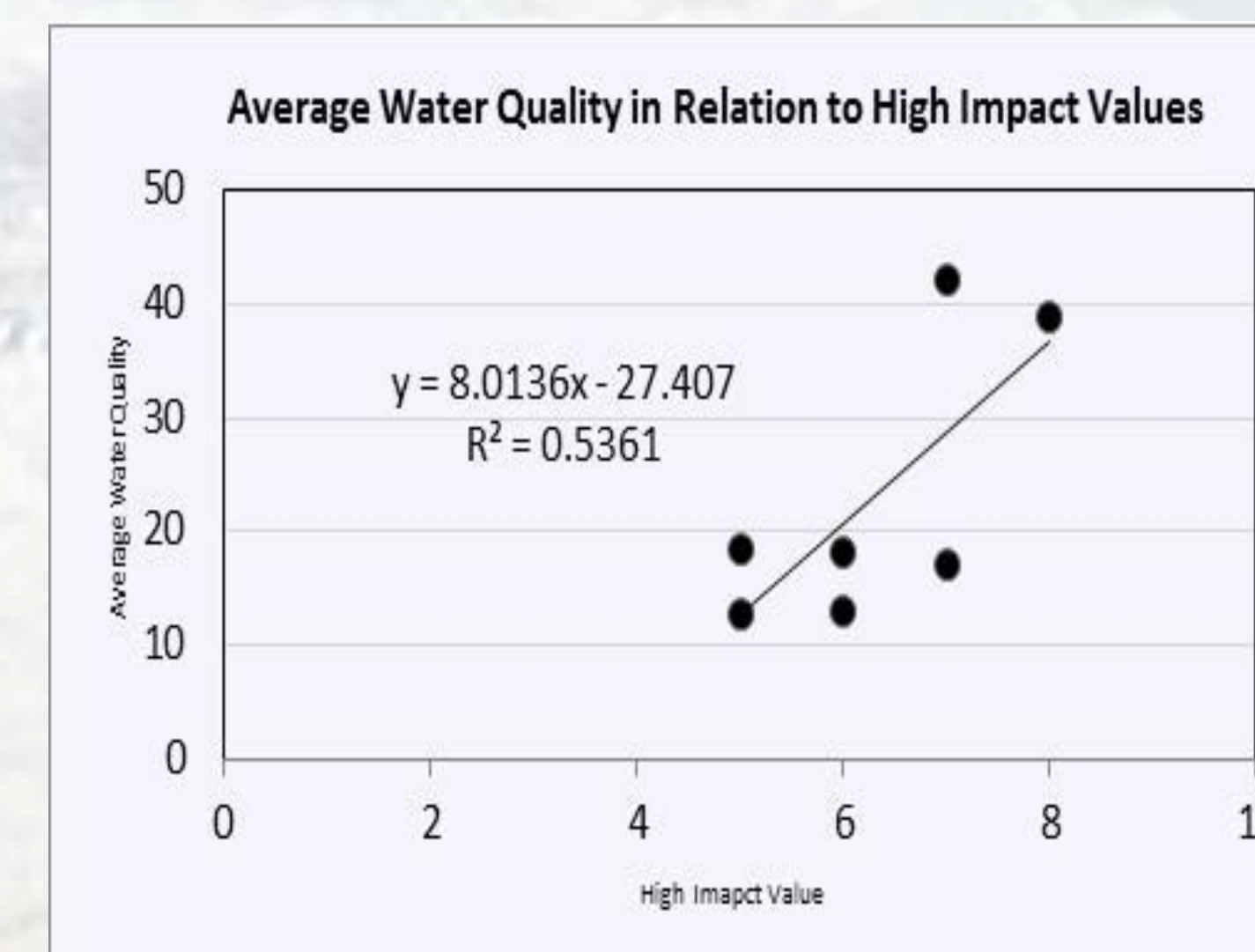
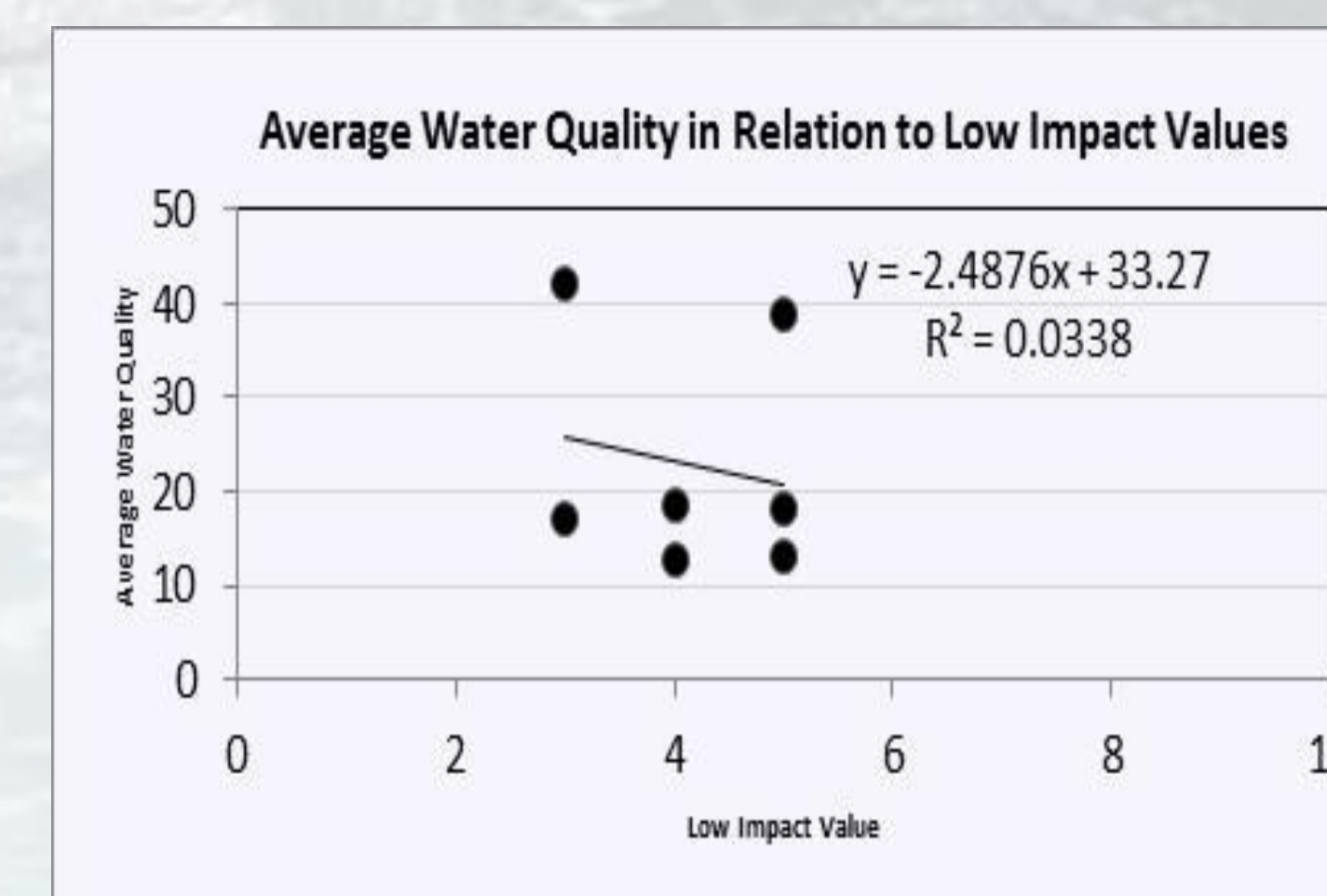


Figure 2: Average water quality dependent on impact value, with fitted regression lines.