

**An Assessment of Cutting and Salting
Control Methods on Small *Myrica* Shrubs
at Cape Hatteras National Seashore**

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Abstract

Bayberries, *Myrica* spp., at Cape Hatteras National Seashore have become a management concern where they invade marsh edges, roadsides and open areas with high visitor use. This experiment examined the effectiveness of cutting and salting, applied individually and in combination, for control of small (50cm) *Myrica* invading highway margins. First treatments were applied in late May and early June of 1986 and repeated in mid-June 1987. By August 1987, both cut-only and salt-only treatments had 100% survivorship, as determined by the number of sprouts. In plots treated with both salt and cutting, survivorship declined with salt concentration. At 10 ‰ NaCl an average of 48% of the stems had resprouted, at 20 ‰ 15.7% had resprouted and at 30 ‰ 9.8% had resprouted. Differences in survivorship were statistically significant in both 1986 and 1987 at the 95% confidence level. The height of the sprouts also declined slightly, but the differences were not statistically significant. Suggestions are presented for further research and/or possible management strategies using the cutting and salting technique.

Introduction

Cape Hatteras National Seashore has a long history of human impact. Two construction programs completed with the concurrence of the National Park Service have led to major changes in the plant communities presently found on these islands. The first was the construction of artificial dune lines. Beginning in 1934, with the activities of the North Carolina Beach Erosion Control Project, work crews from the Civilian Conservation Corps, and other agencies used sand fences and plantings of American beach grass, *Ammophila breviligulata*, to create a stable dune line (Firth 1987). These dunes were neglected during World War II, but repair work, initiated in 1954, attempted to extend a dune line 2.5 to 3.0 meters in height along the entire Atlantic beach of the Cape. After the Ash Wednesday Storm, in 1962, the Park Service again repaired the artificial dunes (Firth 1987). These artificial and immobile dunes protect the areas to the west from the full impact of salt spray, winds and ocean overwash. The shrub communities have responded to reduction of natural disturbance by invading inter-dune meadows immediately adjacent to the artificial dune line and the ocean beach (Schroder et al 1976).

The second major project was the construction of N.C. State Highway 12 in 1958-59. The building of the road caused some areas to increase in elevation (the road shoulders and adjacent strips) while at the same time causing some areas to decrease in elevation (the "borrow" ponds and roadside ditches).

Bayberry, (*Myrica* spp.- primarily *Myrica cerifera*, but also *Myrica pensylvanica* and *Myrica heterophylla*) have become established in many areas that have both the protection of the dunes and the improved drainage afforded by ditch systems. "Driving between hedgerows" is a phrase often used to describe the sections of Highway 12 bordered with a high (>2m) *Myrica* thicket. Medium (1-2m) and small (<1m) *Myrica* bands are also found scattered along the road shoulder throughout the Seashore.

National Park Service policy avoids the use of chemical pesticides when possible. Cutting of the road shoulders using mowers and bush-hogs is the only current form of shrub control. The N.C. State Highway Department cuts the road shoulders approximately 4-5 times during the late spring, summer and early fall of each year. *Myrica* established on the edge of the road ditch has been growing out from under the path of the bush-hog. -

Treatments of cutting and salting of *Myrica* and other invasive shrubs present the following potential advantages to park management: 1) they avoid use of chemical herbicides such as Roundup and Garlon, 2) they mimic natural events (salt concentrations of 10, 20 and 30 parts per thousand [‰] imitate salt water overwash), and 3) they can be applied by available park crews.

Procedures

A band of consistent height (50 cm) roadside *Myrica* just south of Salvo campground was divided into 16 ten meter strips, each separated by approximately 1-2 meters. The width of these *Myrica* strips was one meter. Eight treatments were randomly assigned with two replicates each among the 16 strips (Figure 1).

Cutting was accomplished using a swing blade and scythe. Salt was sprinkled onto the soil surface at a weight per unit area calculated to create the concentration desired in the soil solution. (Calculations were based on the amount of water necessary to occupy the interstitial space in the upper 14 cm of soil in shrub areas. Ten ‰ was estimated as 241.2 grams of NaCl per meter square of surface if washed into the soil with fresh rain water.) The salt used was coarse grain "solar" salt (obtained by evaporation of ocean water), and included compounds other than NaCl commonly found in seawater.

The first round of treatments was performed in late May and early June of 1986, after presampling. Survivorship (as percent resprouting) and height (cm) were sampled for all strips in late August, 1986. Each strip was divided into five 2x1 meter rectangles for sampling. One half, lengthwise, of all strips were inadvertently cut by the N.C. State Highway Department twice in September, 1986. Survivorship and height were again sampled in early June of 1987. Treatments were repeated in mid June and a final sample obtained in late August, 1987. One of the cut-only strips was lost due to incorrect application of the treatments.

Results

Summaries of the data used in the following calculations are given in Tables 1, 2, 3, 4, and 5. Based on previous studies in which *Myrica* consistently showed 100% survivorship when subjected to cut-only treatment, the values for the missing cut-only replicate were assumed to be 100% (Furbish et al 1987). No such assumption is made for the average height of the missing cut-only replicate. Both cut-only and salt-only treatments had 100% survivorship (Table 1). In plots treated with both salt and cutting, survivorship declined with salt concentration. By Aug. 27, 1987, at 10 ‰ an average of 48% of the stems had resprouted, at 20 ‰ 15.7% had resprouted and at 30 ‰ 9.8% had resprouted (Table 3). Differences in survivorship were statistically significant in both 1986 and 1987 at the 95% confidence level (Tables 9 and 10). The height of the sprouts also declined slightly, but the differences were not statistically significant. The average height for a cut and salted plot, at the end of the study was 18.5 cm at 10 ‰, was 19.5 cm at 20 ‰ and was 14.5 cm at 30 ‰ (Table 2, Table 11).

Survivorship data at the August 20, 1987 sampling are further summarized in Table 6. These data were used in an ANOVA (Table 7) to investigate differences between the cutting vs. salting treatments, as well as the interaction between cutting and salting, at a 95% confidence level. The results of this test indicate cutting, salting and the interaction of cutting and salting each have a significant effect on survivorship. Further examination of the ANOVA table and the data summary table (Table 1) shows that the total salt treatment effect is found in the interaction of cutting and salting. Therefore, all cut/salt treatments are examined in more detail to clarify the interaction.

A second ANOVA (Table 8) based upon the data in Table 3 tested the hypothesis that significant differences existed between cutting in combination with the three salt concentrations and cutting combined with no salt application, at the 95% confidence level. Results indicate that differences in survivorship do exist between these four treatments. The differences are explored using multiple-t confidence intervals at 95% confidence (Table 8). The confidence intervals show significant differences between all treatments except between the cut/20 ‰ salt and the cut/30 ‰ salt.

Conclusions

The present practice of bush-hogging several times during the growing season is losing its effectiveness as a control measure. As the *Myrica* shrubs grow out from under the path of the bush-hog, they will become increasingly conspicuous. The possibility of vista blockage will increase through time.

The small *Myrica* has demonstrated its ability to recover and even expand under a regime of multiple cutting treatments. The first analysis of survivorship (Table 7) demonstrated the advantage of cut treatments combined with salt treatments. However, this analysis did not elucidate the relative effectiveness of the different levels of salt applied in conjunction with cutting. For all levels of salt application, the combination of cutting and salting was significantly more effective in suppressing sprouts than a cut only treatment.

The post-treatment samples (Tables 8 and 10) yielded conflicting results for survivorship response. After one treatment, there was no significant difference between the 10 ‰ and 20 ‰ salt levels. Yet, after two applications of the treatments, there was no significant difference between the 20 ‰ and 30 ‰ salt levels. Further, all salt application levels demonstrated a difference in response after a single treatment and a recovery period of one year (Table 9). Finally, salt did not significantly reduce sprout height.

Given these results, interpretation cannot be conclusive. Since management attempts maximum control for minimum costs, the cut/salt 10 ‰ treatment is probably the best choice. However, continuation of this experiment may clarify the effectiveness of the various cut/salt treatments. Also, the response of small *Myrica* when subject to two applications of cut/salt treatments per year, one early in the summer and one late in the summer, might be examined for the possibility of even greater control.

In summary, and cut/salt treatment is found to be a more effective control than cut only or salt only treatments. The change in shrub response to cut/salt treatments at increasing concentrations of salt is not clear, although greater levels of salt application in combination with cutting decrease sprout survivorship. Further experimentation may clarify this relationship. Presently, the most cost efficient choice for control of small *Myrica* on roadsides beyond bush-hog reach is cutting in combinations with salt application at 10 ‰.

References

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Figure 1. Random Treatment Assignment (plots numbered 1 - 16)

	Cut	Not Cut
Salt 10 ‰	8, 15	2, 12
Salt 20 ‰	4, 10	5, 9
Salt 30 ‰	6, 7	3, 16
No Salt	1, 13	11, 14

Table 1. Survivorship Data Summary, 8-20-87.- (percent resprouting)

replicate	Cut		Not Cut	
	1	2	1	2
Salt	80	25	100	100
10 ‰	90	20	100	100
	75	20	100	100
	80	50	100	100
	20	20	100	100
Salt	20	5	100	100
20 ‰	40	5	100	100
	10	10	100	100
	10	12	100	100
	25	20	100	100
Salt	3	5	100	100
30 ‰	10	2	100	100
	10	15	100	100
	15	20	100	100
	8	10	100	100
No Salt	100	(100)	100	100
	100	(100)	100	100
	100	(100)	100	100
	100	(100)	100	100
	100	(100)*	100	100

*This replicate inferred from response in previous study.

Table 2. Average Height of Resprouts, 8-20-87. (centimeters)

	Cut and 10 °/00	Cut and 20 °/00	Cut and 30 °/00	
	20	20	15	
	15	50	20	
	20	25	20	
	25	20	10	
	20	20	10	
	15	10	10	
	20	10	15	
	15	15	15	
	20	10	15	
	15	15	15	
sample size	10	10	10	(30 total)
sample mean	18.5	19.5	14.5	(17.5 overall)

Table 3. Survivorship of Cut/Salt Treatments, 8-20-87.
(percent resprouting)

	Cut and 10 ‰/00	Cut and 20 ‰/00	Cut and 30 ‰/00	Cut Only
	80	20	3	100
	90	40	10	100
	75	10	10	100
	80	10	10	100
	20	25	8	100
	25	5	5	(100)
	20	5	2	(100)
	20	10	15	(100)
	50	12	20	(100)
	20	20	10	(100) *
sample size	10	10	10	10 (40 total)
sample mean	48	15.7	9.8	100 (43.375 overall)

*This replicate inferred from response in previous study.

Table 4. Survivorship of Cut/Salt Treatments, 6-4-87.
(percent resprouting).

	Cut and 10 ‰/00	Cut and 20 ‰/00	Cut and 30 ‰/00	Cut Only
	100	50	20	100
	75	50	20	100
	40	30	25	100
	45	50	25	100
	50	50	10	100
	40	10	25	(100)
	50	30	20	(100)
	50	50	20	(100)
	75	50	20	(100)
	75	50	20	(100) *
sample size	10	10	10	10 (40 total)
sample mean	63	42	21.5	100 (56.625 overall)

*This replicate inferred from response in previous study.

Table 5. Survivorship of Cut/Salt Treatments, 8-27-86.
(present resprouting).

	Cut and 10 ‰/00	Cut and 20 ‰/00	Cut and 30 ‰/00	Cut Only
	25	20	25	100
	10	30	25	100
	10	10	25	100
	25	25	25	100
	40	25	10	100
	20	10	10	(100)
	30	25	10	(100)
	20	30	10	(100)
	50	40	10	(100)
	50	50	10	(100) *
sample size	10	10	10	10 (40 total)
sample mean	28	26.5	16	100 (42.625 overall)

*This replicate inferred from response in previous study.

Table 6. Summary of Survivorship Data, 8-20-87.
(percent resprouting).

		Cut	Not Cut	Mean Across Row
Salt 10 ‰/00	rep 1	69	100	
	rep 2	27	100	
	mean	48	100	74
Salt 20 ‰/00	rep 1	21	100	
	rep 2	10.4	100	
	mean	15.7	100	57.85
Salt 30 ‰/00	rep 1	9.2	100	
	rep 2	10.4	100	
	mean	9.8	100	54.9
No Salt	rep 1	100	100	
	rep 2	(100) *	100	
	mean	100	100	100
Mean Down Column		43.375	100	71.6875

*This replicate inferred from response in previous study.

Table 7. ANOVA, Survivorship Data, 8-20-87
(data from Table 6) 95% Confidence

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Cut Treatments	12,825.562	1	12,825.562	109.2816
Salt Treatments	5,120.9675	3	1,706.9892	14.5458
Interaction Between Cut and Salt	5,120.9674	3	1,706.9892	14.54588
Residual (Error)	938.9	8	117.3625	
Total	24,006.397	15		

at 95% confidence, $F(1,8) = 5.3177$
 $F(3,8) = 4.0662$

Table 8. ANOVA and Multiple-t Confidence intervals for Cut/Salt Treatments Only, Survivorship Data, 8-20-87. (data from Table 3) 95% Confidence

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatments	51,209.675	3	17,069.892	64.308853
Error	9,555.700	36	265.43611	
Total	60,765.375	39		

at 95% confidence, $F(3,30) = 2.9223$

Treatments difference
 (mean 1 - mean 2) = between means $\pm$ boundary

Cut/No Salt & Cut/10 °/00 Salt	(100 - 48)	52.0	5.066
Cut/No Salt & Cut/20 °/00 Salt	(100 - 15.7)	84.3	5.066
Cut/No Salt & Cut/30 °/00	(100 - 9.8)	90.2	5.066
Cut/10 °/00 Salt & Cut/20 °/00 Salt	(48 - 15.7)	32.3	5.066
Cut/10 °/00 Salt & Cut/30 °/00 Salt	(48 - 9.8)	38.2	5.066
Cut/20 °/00 Salt & Cut/30 °/00 Salt	(15.7 - 9.8)	5.9	5.066

Table 9. ANOVA and Multiple-t Confidence intervals for Cut/Salt Treatments Only, Survivorship Data, 6-4-87. (data from Table 4) 95% Confidence

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatments	33,696.875	3	11,232.292	73.22092
Error	5,522.5	36	153.40277	
Total	39,219.375	39		

at 95% confidence, $F(3,30) = 2.9223$

Treatments	difference (mean 1 - mean 2) = between means $\pm$ boundary		
Cut/No Salt & Cut/10 °/00 Salt	(100 - 63)	37.0	3.851
Cut/No Salt & Cut/20 °/00 Salt	(100 - 42)	58.0	3.851
Cut/No Salt & Cut/30 °/00	(100 - 21.5)	78.5	3.851
Cut/10 °/00 Salt & Cut/20 °/00 Salt	(63 - 42)	21.0	3.851
Cut/10 °/00 Salt & Cut/30 °/00 Salt	(63 - 21.5)	41.5	3.851
Cut/20 °/00 Salt & Cut/30 °/00 Salt	(42 - 20.5)	20.5	3.851

Table 10. ANOVA and Multiple-t Confidence intervals for Cut/Salt Treatments Only, Survivorship Data, 8-27-87. (data from Table 5) 95% Confidence

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatments	44,746.875	3	14,915.625	141.21301
Error	3,802.5	36	105.625	
Total	48,549.375	39		

at 95% confidence, $F(3,30) = 2.9223$

Treatments difference
 (mean 1 - mean 2) = between means $\pm$ boundary

Cut/No Salt & Cut/10 %/00 Salt	(100 - 28)	72.0	3.196
Cut/No Salt & Cut/20 %/00 Salt	(100 - 26.5)	73.5	3.196
Cut/No Salt & Cut/30 %/00 Salt	(100 - 16)	84.0	3.196
Cut/10 %/00 Salt & Cut/20 %/00 Salt	(28 - 26.5)	1.5	3.196
Cut/10 %/00 Salt & Cut/30 %/00 Salt	(28 - 16.5)	11.5	3.196
Cut/20 %/00 Salt & Cut/30 %/00 Salt	(10.5 - 16.5)	10.5	3.196

Table 11. ANOVA for Cut/Salt Treatments Only. (excluding Cut/No Salt Treatment), Height Data, 8-20-87. (data from Table 2) 95% Confidence.

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatments	140	2	70	1.2621035
Error	1,497.5	27	55.462962	
Total	1,637.5	29		

at 95% confidence, $F(3,30) = 3.0984$