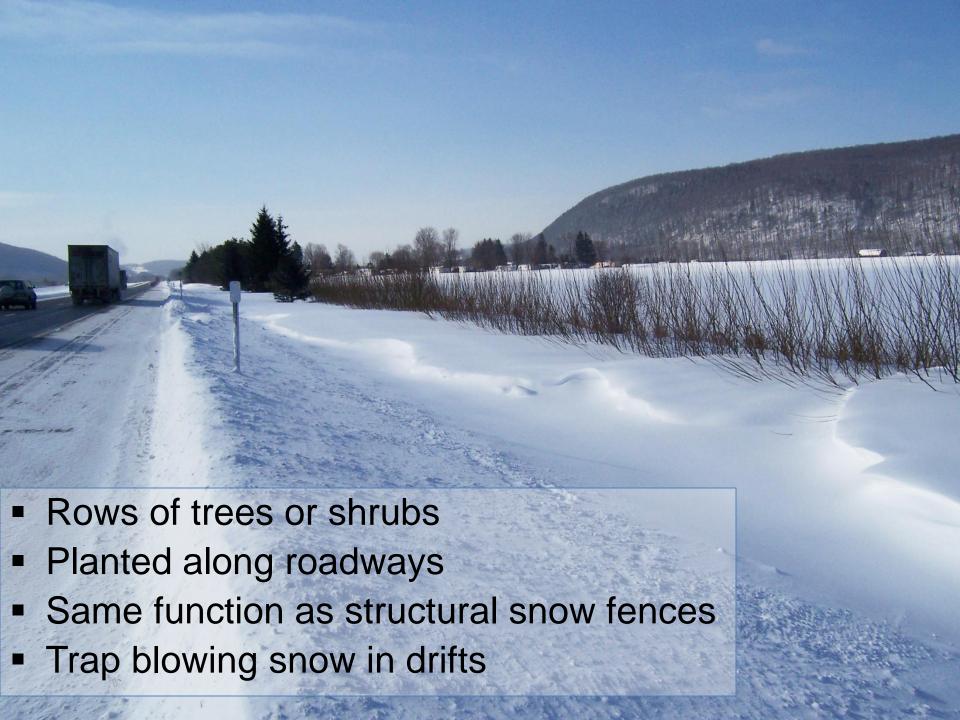
# Shrub Willow Living Snow Fences show potential for snow trapping and reduced drift length shortly after planting



Justin P. Heavey and Timothy A. Volk

State University of New York - College of Environmental Science and Forestry
Syracuse, NY

International Poplar Symposium VI – Vancouver, BC – July 2014



### Support

USDOT



NYSDOT



New York State Department of Transportation

"Developing and Implementing a Living Snow Fence Program for New York State"

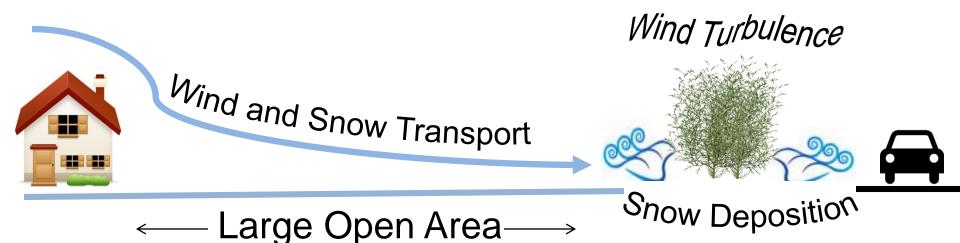
## **A Living Alternative**



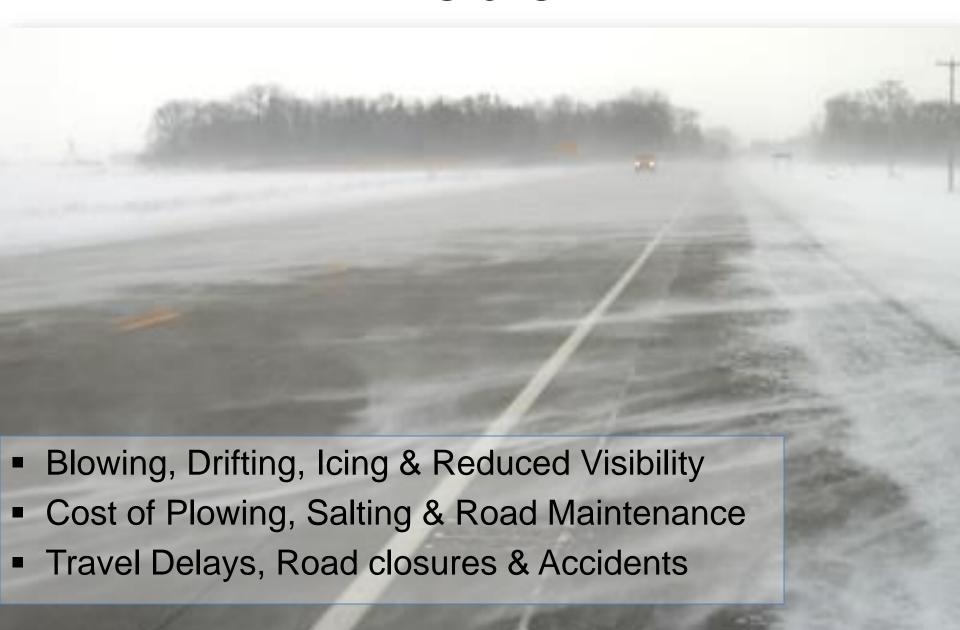


Structural Snow Fences	<u>Living</u> Snow Fences
Effective immediately	Some years after planting
Lifecycle 1 - 15 years	20 - 30 years or more
Capacity = Height and Porosity	Capacity = Height and Porosity
Constant over time	Changes as plants grow

#### **How Do Snow Fences Work?**



#### **Problem**



### **Opportunity**

#### **Reduce Cost of Snow Control**

- \$2.3 billion annually in the US
- \$300 million annually in New York State

#### **Improve Road Safety**

- Driving conditions
- Accidents rates
- Save lives

#### **Provide Additional Benefits**

- Travel time savings
- Environmental benefits
- Aesthetics
- Value-added products



#### Plant Growth & Drift Length

- Small plants
- Small snow storage capacity
- Fences fill to capacity
- Long drift length (35H)



<35H

- Same quantity of blowing snow...
- Larger plants
- More snow storage capacity
- Fences do not fill to capacity





### **Objectives**

#### 1. Measure...

- Fence Height
- Porosity
- Site and climate variables

#### 2. Model...

- Snow storage capacity of fences
- Snow transport (blowing snow at each site)
- Downwind drift length

### 18 Living Snow Fences

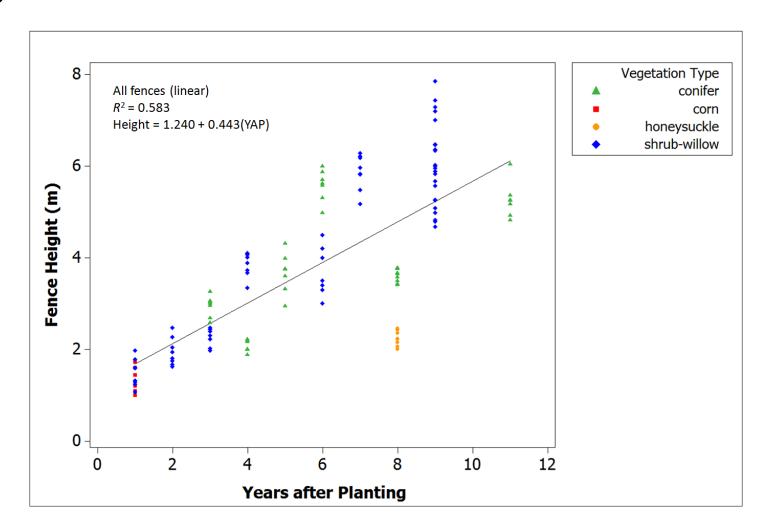
- 10 shrub willow
- 6 conifer
- 1 corn and honeysuckle
- 1 11 years after planting





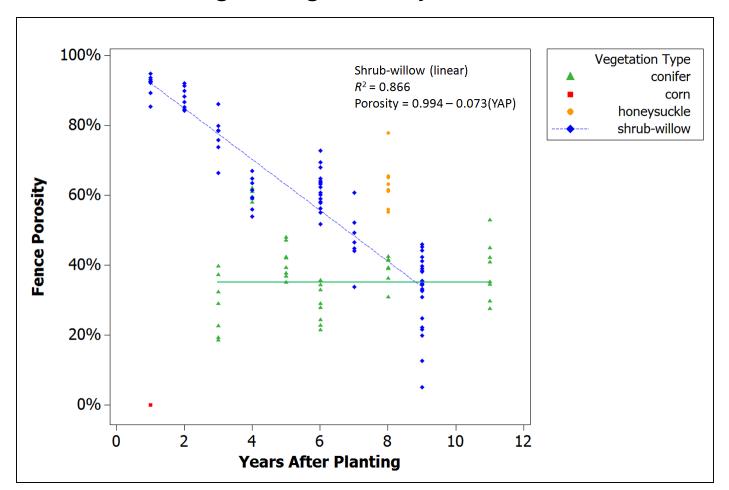
### **Height Over Time**

- 1 m 8 m increased linearly over time (P < 0.001)
- Height of conifer fences was similar to willow at various YAP



### **Porosity Over Time**

- 40% 60% ideal anything <80% sufficient
- Willow ranged from 90% to 10% effective 3 YAP
- Conifer did not change generally lower than willow



### Capacity versus Transport

Fence Capacity (Snow Storage Available)

Height and Porosity

**Snow Transport** (Blowing Snow in Avg. Year)

Fallen snow and % relocated by wind

**Units of t/m** (tons of snow per linear meter of fence)





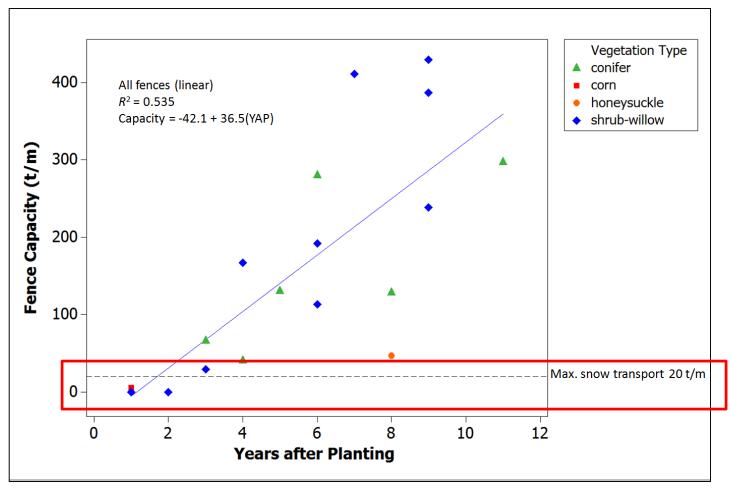
Snow Transport





### **Capacity Over Time**

- Increased linearly with fence height 1 400 t/m
- Max. Snow Transport = 20 t/m
- 3 -11 YAP...Capacity = 2x to 100x transport



### Drift Length and C/T Ratio

Drift length is a function of...

Snow storage capacity relative to annual snow transport

"Capacity/Transport Ratio" (X:1)

- As C/T increases, drift length decreases
- Drifts build up to height of fence before out towards road

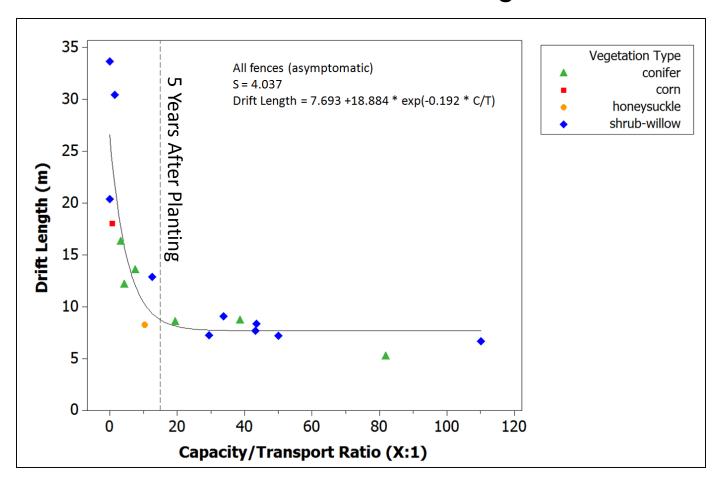


#### Drift Length and C/T Ratio (Time)

C/T ratio increases over time as fences grow

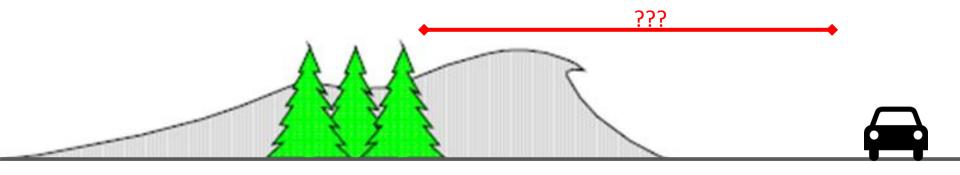
0 - 4 YAP: C/T 1:1 - 10:1 Drift length decreases rapidly

5 -11 YAP: C/T 10:1 -100:1 Drift length <10 m</li>



#### Required Setback Distance

- Distance between fence and road
- Chosen based on estimated drift length



- Estimated Drift Length: <10 m</p>
- Observed Setback Distances: 10 100 m

Published Recommendations: 30 - 180 m

### **Implications**

 Dynamics of LSF over time have not been well researched or publicized

Large C/T ratio = shorter drift lengths

 More potential sites where planting space is limited (common in northeast)

Need for improved design standards



#### **Shrub Willow Fences**

#### Ideal plant characteristics

- Numerous stems per plant (porosity)
- Rapid growth rate (capacity)
- Coppice ability, tolerance of high planting density

#### Relatively low costs...

- Other shrub species
- Large conifer trees
- Structural fences

#### **Numerous Applications**

- Windbreaks
- Noise & visual screens
- Buffers

#### Best practices well developed

SUNY ESF 2007 - 2013



#### Conclusion

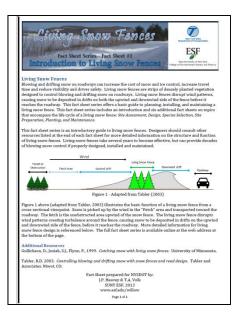
Shrub willows make highly effective LSF...

- Snow trapping just 3 years after planting
- Large storage capacity thereafter

Large capacity = shorter drift lengths...

- Reduced setback requirements
- More potential sites

This is leading to best practices and improved design standards that account for plant growth and snow trapping over time







- location where each plant will be installed. The recommended spacing for shrub willow fences is 24 inches between plants and 30 inches between rows. Rows should be offset so that there is one plant per foat along the double row (Figure 3). With proper maintenance, this planting pattern will grow into a dense snow fence with no gaps. Using two or more intermixed species per fence is recommended to create diversity in the planting. Refer to Fact Sheet #5 in this series for a diagram of the planting pattern described here.
- Insert cuttings by hand or lightly tap them into place with a rubber mallet. Plant the cutting unsers counting soy mans of ingirty tap them into puice with a runceer master. Flast the cutting of vertically, making sure the bods are pointing up (Figure 4). Flast the cutting to depth of 7 - 12" below the soil. Close the hole around each cutting by firming the soil at the base of the cutting with your hands or the head of your book. The planting window of entire willow Wer Vert State is late. April through early lune. Flastings done after this window will be prone to failure due to high temperatures and insufficient soil mistificates soil mistificates with the sundow will be prone to failure due to high temperatures and insufficient soil mistificates with the sundow will be prone to failure due to high temperatures and insufficient soil mistificates with the sundow will be prone to failure due to high temperatures and insufficient soil mistificates with the sundow will be prone to failure due to high temperature and insufficient soil mistificate soil mistificates with the sundow will be prone to failure due to high temperature and mistificates with the sundow will be prone to failure due to high temperature and mistificates with the sundow will be prone to failure due to high temperature and mistificates with the sundow will be prone to failure due to high temperature and mistificates with the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to failure due to high temperature and the sundow will be prone to



Figure 3 (left) – Willow cuttings installed through paper landscape fabric in a double row pattern Figure 4 (right) – Willow cuttings planted to the proper depth with the buds facing upwards Photos by SUNY ESS.

Page 4 of 5



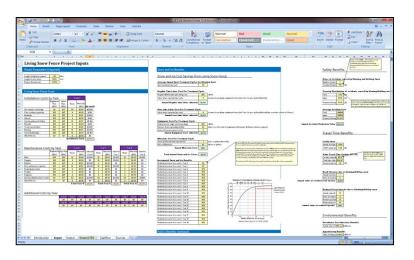
w fence can provide an optimal food source, especially if browsers are not discouraged in any wa smoot sense can provide stop better before bede can present any to recovers are not discouraged in any way, but the provide stop better bette



Figure 1- Maintaining 8+ feet wide mowed strips on either side of the fence, and regularly applying deer fence on Route 10 in Beerston, NY. Photo by SUNY ESF

As in Sainty, Sociation, unsurfacetion trees and patient from weather events of the interest. Which, takes of developing the storms, thunderstorms, mow deposition, freeze/thave; seekes, and other adverse weather conditions can diamage or hill living mow fences, especially when they are young. Monitor new installations for weather damage, especially after server weather events. Weather succurrollable and often unpredictable, they are some properties of the protected before severe weather and rehabilitated or quickly predictable, they are some first and rehabilitated or quickly predictable.

Page 2 of 4







#### www.esf.edu/willow/lsf

