Nothing So Constant as Change

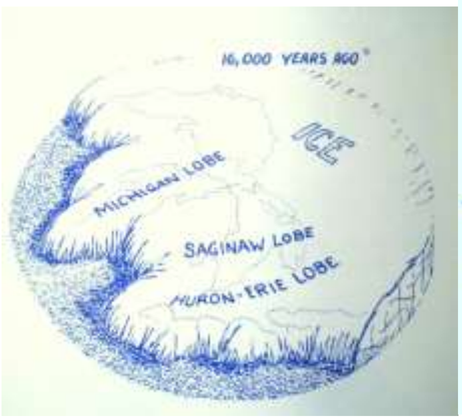
By Ron Schaper

Dynamic Environments

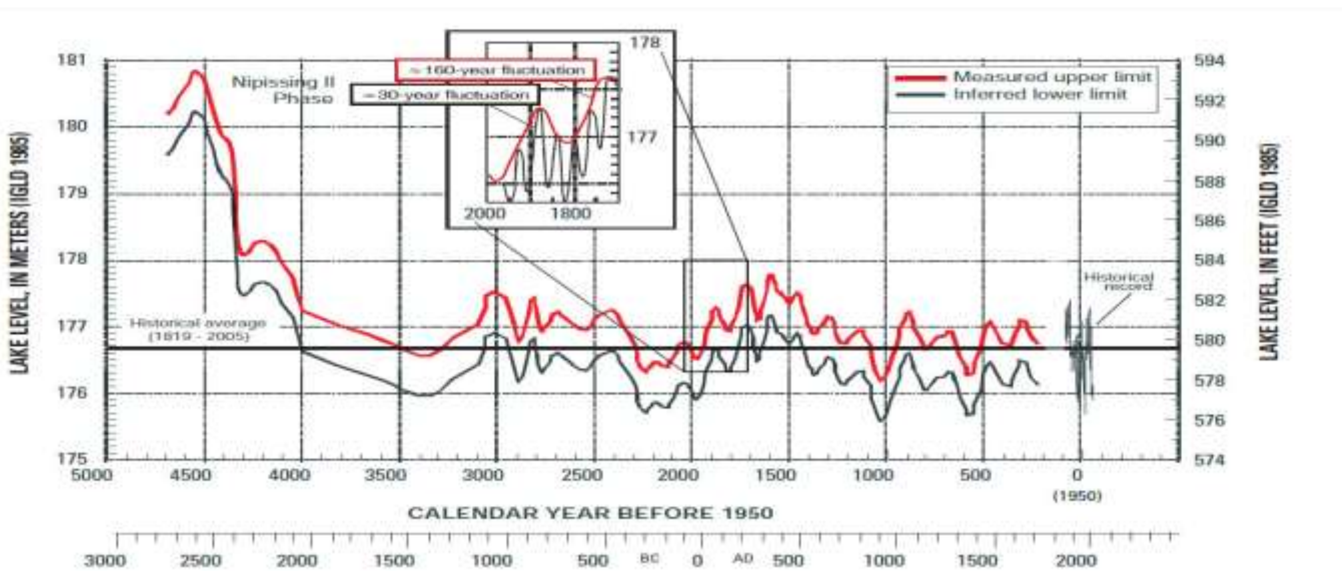
1) Lake Levels 2) Beach Size 3) Cliff Erosion 4) Beach and Cliff Plant Communities

1) Lake Levels (Michigan/Huron)

More than 20,000 years ago glaciers covered the Great Lakes area and were over a mile thick. Glaciers started to melt about 15,000 years ago, which formed the Great Lakes and deposited immense quantities of boulders, rocks, gravel, sand, and clay known as glacial till. This till (soil) was deposited in layers of gravel, sand, and clay in different combinations. As the glaciers continued their retreat the Lakes had a series of different levels. The present average Lake Michigan/Huron level is 579 feet above sea level. In the past the levels has been as high as 640 ft. 12,000 years ago and 605 ft. 11,000 yrs. ago as seen in the maps below. Since then there has been a series of different levels which have left marks on the landscape.



The graph below illustrates approximate Lake Levels over the last 5000 years. About 4,500 yrs. ago the level was about 593 ft. and in next 1000 years fell to a present average level of 579 ft. The last 3,500 yrs. the levels have fluctuated 4 ft. above the average of 579 ft. and 3 ft. below the average. <u>As the climate continues to change Lake Levels will continue to fluctuate.</u>



Since record keeping started over 120 years ago Lake Michigan/Huron has fluctuated 3 ft. above and 3 ft. below an average of 579 ft. as the two graphs below illustrate. <u>These Lake Level changes of the past 120 years are in the normal range for the last 3,500 years. This is what Lake Levels do. They erode the land containing them and their levels fluctuate with time which is caused by short and long term trends of climate.</u> Headlines tend to sensationalize high or low Lake Levels.

Lake levels face sudden decline

Over the years, the volume of water flowing into and out of the Great Lakes has been so closely matched that water levels have been remarkably stable. But there are signs that exquisite balance is out of whack. Between 1998 and 1999, levels for Lakes Michigan and Huron fell more than three feet and have not recovered.

Lake Michigan-Huron annual average lake level, in feet, 1918-2012

Sources: U.S. Army Corps of Engineers; National Oceanic and Atmospheric Administration

Journal Sentinel

Levels rise after 16-year low

Aside from one year of average measurements in 2008, water levels for Lake Michigan and Lake Huron have been well below long-term averages since 1998. After a record low year in 2013, the levels have bounced back to normal and are predicted to remain above average for the remainder of the summer.

Lake Michigan-Huron monthly average lake level, in feet

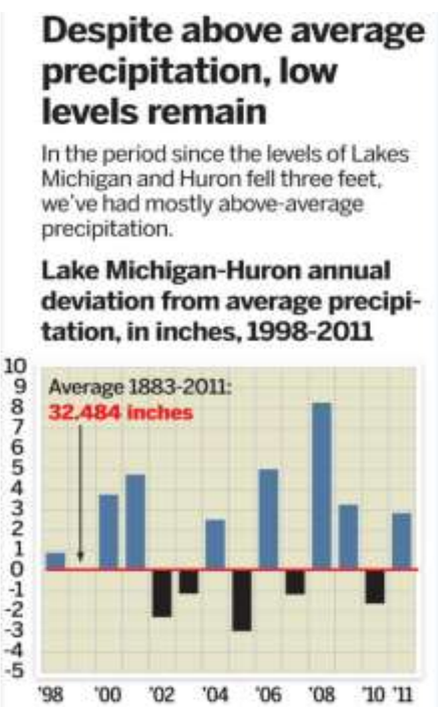
Factors of Lake Levels

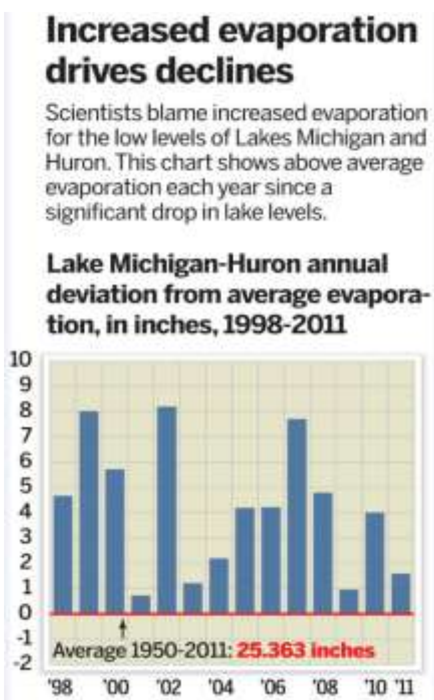
A) Drainage into Lakes **100% Precipitation (Seasonal average winter low Feb., summer high Aug.)**

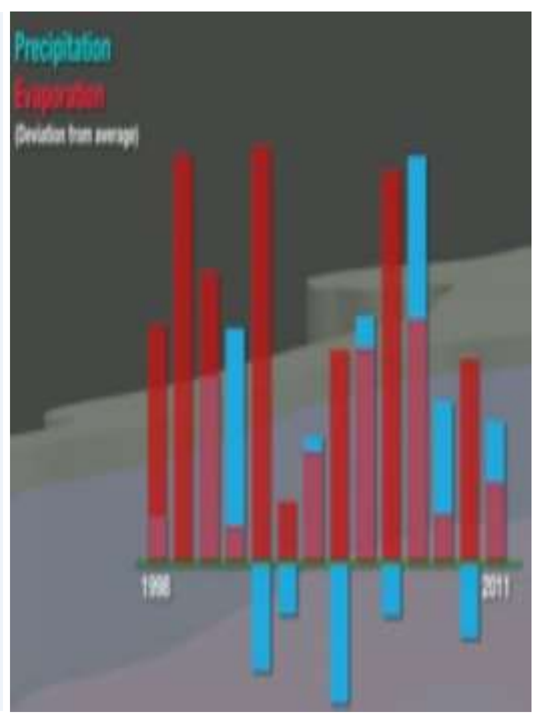
B) Drainage Out **68% of Water Loss + (Dredging St. Clair River extra 2ft. loss over 40 yrs.)**

C) Evaporation **32% of Water Loss (Amount of Ice coverage major factor)**

Combined Evaporation/Precipitation







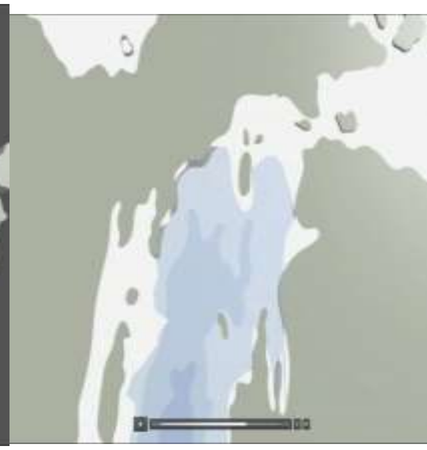
The graphs above demonstrate that above normal precipitation wasn't enough to keep Lake Levels up, because there was above normal evaporation.

Warmer winters cause less Ice coverage on Lakes and more Evaporation

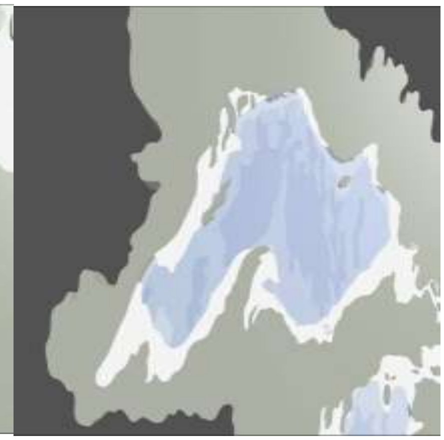
Cooler Period: Ice Coverage 1970-80's

Warmer Period: Less Ice Coverage 1998- 2013

Great Lakes Had more Ice coverage
Less Evaporation



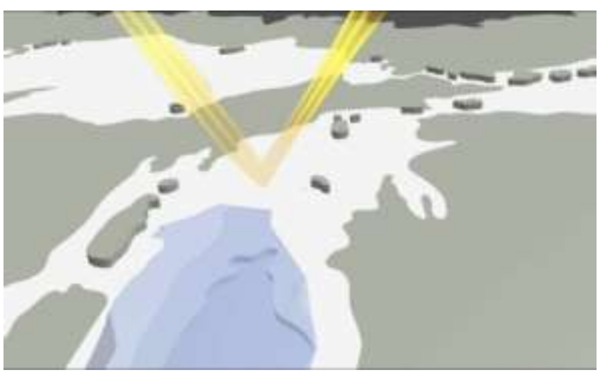
Lake Michigan
Lost 63% Ice coverage



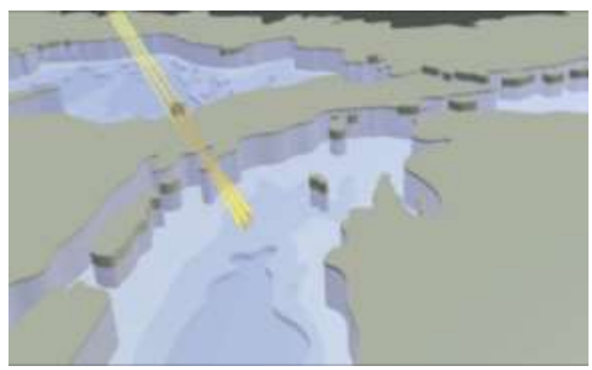
Lake Superior
Lost 76% Ice coverage

Increased Evaporation caused lower Lake Levels

Ice Reflects Sun's Heat Away



No Ice Lake Absorbs Sun's Heat

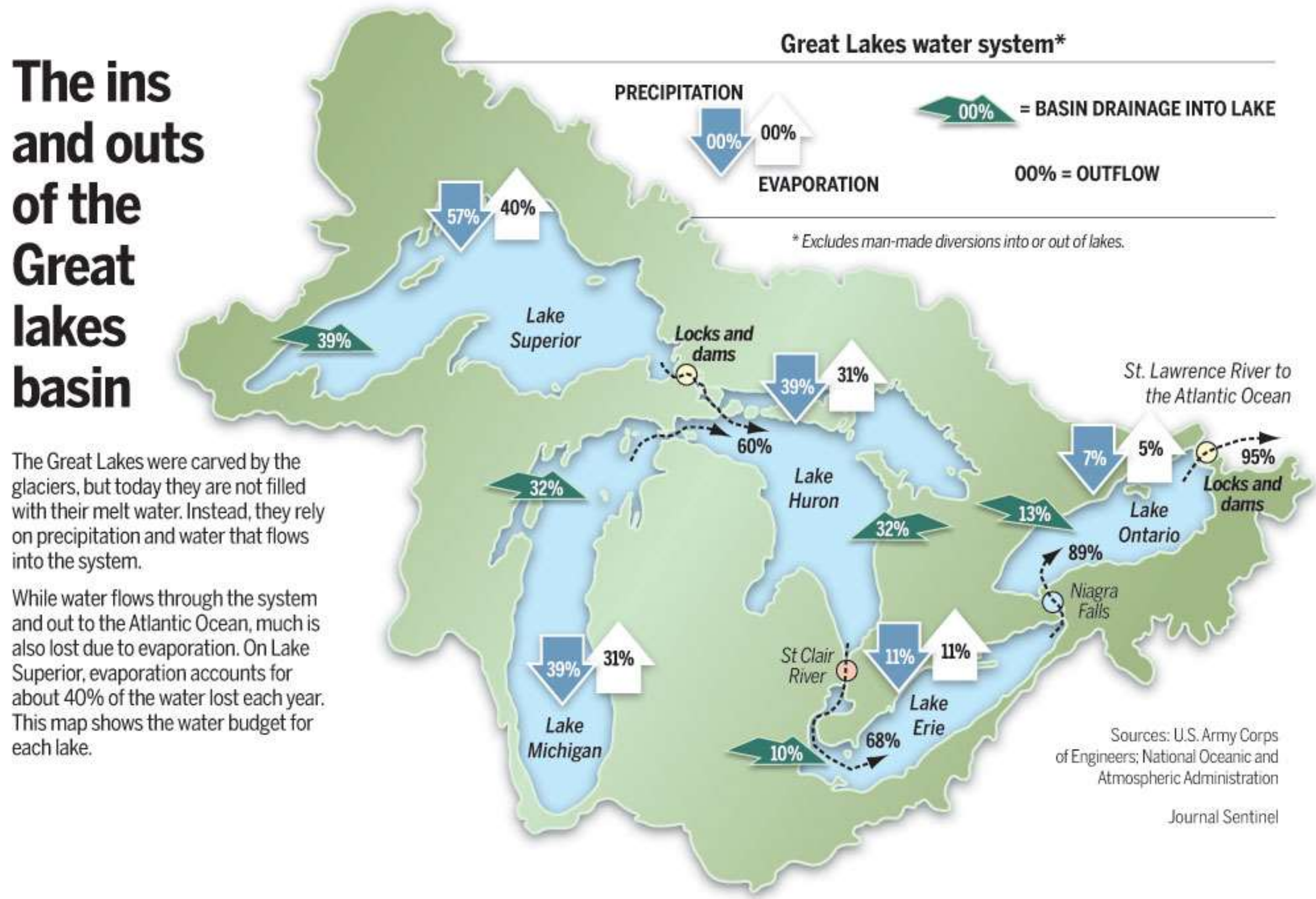


Summary

Warmer winters result in less ice coverage causing increased evaporation of Lakes. Less Ice coverage causes increased water temperatures, more evaporation and lower Lake Levels.

A major portion of evaporated water does not return to the drainage basin of the Great Lakes and is permanently lost to the Lakes.

Without ice coverage the long term trend of Lake Levels is likely to trend lower from the loss of increased evaporation. There will be cyclical interruptions of increasing Lake Levels from time to time.



2) Beach Size

A) Lake Level Decreases Beach Size Increases (Waves Deposit Materials)

B) Lake Level Increases Beach Size Decreases (Waves Erode Materials)

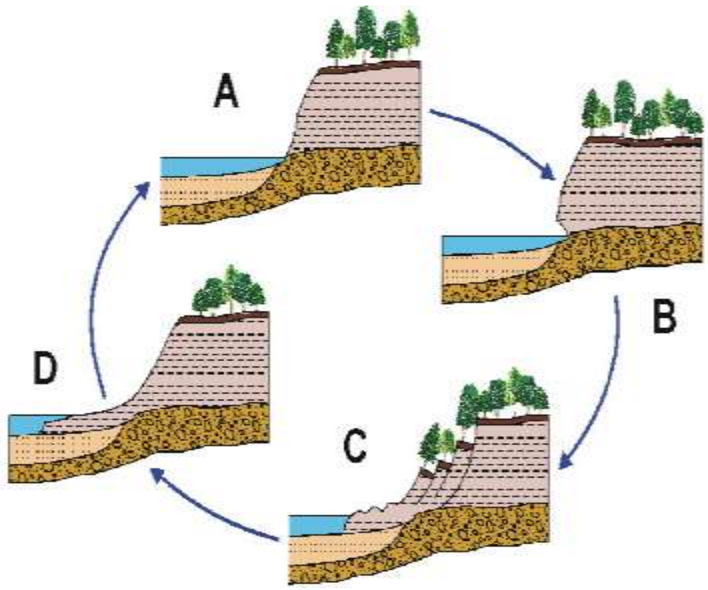
Major Factor: Cyclic Fluctuations of Lake Levels (Climatic fluctuations)

Minor Factors: Contour of Lake Bottom, Beach Material, Lake Currents, Storms, Wind & Wave Direction, Vegetation Coverage

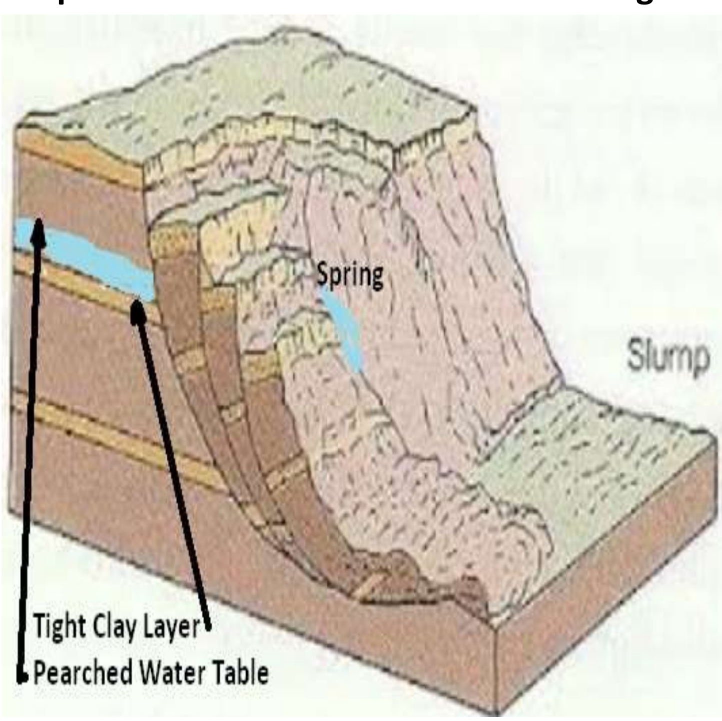
As Lake Levels fall the increase of the beach is not realized immediately. It takes time for waves to deposit material (sand) landward. Equilibrium is established between the Lake Level and the size of beach over a period of time. The reverse is also the case. When Lake Levels rise, it takes time for the waves to erode the beach until equilibrium is established.

3) Cliff Erosion

A) Lake is at Base of Cliff **Waves undercut and remove material causing instability and slumping. Process repeats when slumped cliff material is removed by waves.**



B) Slumping from Perched Water Table **In some areas glaciers deposited an impervious layer of clay near the surface which prevents water from percolating downward. On a cliff face a seep appears and saturates the soils of the cliff, and becomes a fluid- like consistency causing the cliff to slump. This type of erosion tends to happen in spring. During heavy precipitation events, soils of the cliff can become saturated and slumping will occur. Seeps create a wet environment for Phragmites to grow on damp cliffs.**



Problems Caused by Slumping due to Perched Water Table

Rip rap, large boulders, stones, vegetation, etc. will not prevent the process of slumping due to a perched water table. During periods of average to high Lake Levels the material that has slid down the cliff will probably be washed away. If slumped earth is prevented from being washed away by extensive amounts of rip rap at the base of a cliff, cliff erosion will continue by slumping from above because of a perched water table.

Stairways constructed will continually need rebuilding due to slumping if built where a perched water table exists.

4) Beach and Cliff Plant Communities

Beach Plants: **Lake cyclically rises and falls- vegetation changes with conditions.**
Cliff Plants: **Cliff erodes-vegetation slides down towards beach.**

Sources of Vegetation

A) Cliff Erosion: (Slumping) Vegetation slides down, top of cliff to lower cliff and beach.

B) Seeds in Animal Scat: (birds, mammals, etc.)

C) Air-Borne Seeds

D) Vegetation and Seeds wash ashore. Some beach vegetation migrates up onto cliff face.

E) Existing Seed Bank established from previous vegetation.

Dynamic Environments: Lake Levels, Beaches, and Cliffs are Constantly Changing

1) The beach environment is not permanent. The Lake Levels will continue to fluctuate as illustrated. Without ice coverage long term trend of Lake Levels is likely to be lower. There will be interruptions of increasing Lake Levels from time to time. (3ft. Increase of Lake Level in 18 months, 2013- 2014) Lake Level changes of the past 120 years are in the normal range for the last 3,500 years.

2) The beaches and cliffs will take care of themselves. Despite the fluctuations in Lake Levels, changes in beach sizes, the erosion of cliffs, there are diverse sources of vegetation for the beaches and cliffs to revegetate. The vagaries of Lake Levels, Cliff erosion, and Beach instability lead one to conclude, let nature heal itself.

Phragmites colonizes beaches mostly by air borne seeds and perhaps some plants washed ashore from other areas. It prefers a damp environment. It colonizes moist cliff areas by seeds and from plants on the beach which follow damp soil up the cliff. Damp soil is from a perched water table seep. Phragmites tends not to colonize on dry cliff areas or dry upper beach areas where other desirable beach grasses and vegetation grow. Availability of moisture limits its range. Phragmites forms extremely dense colonies which crowd out any desirable vegetation and prevent access. Elimination of Phragmites is achieved if all land owners cooperate by having it treated and are vigilant in the future. Any collateral damage of vegetation caused by chemical treatment of Phragmites will revegetate or heal in time.

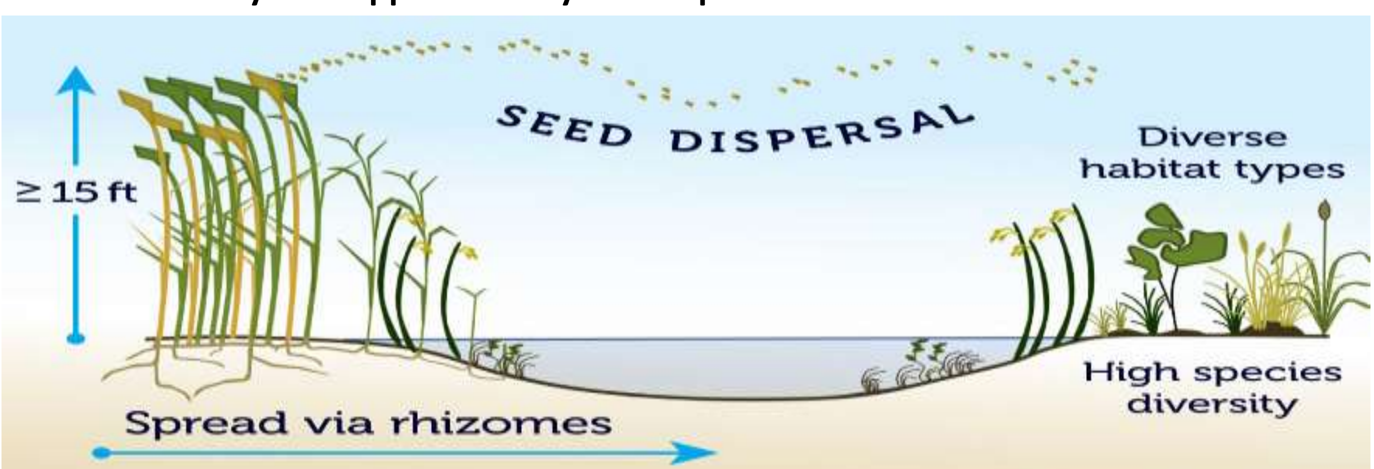
Ron Schaper 5/28/15

Phragmites (Extremely Invasive Public Enemy # 1)



Very thick colonies   Crowds out and kills other plants   Wildlife can't penetrate or eat

Extensive root system approximately 70% of plant is roots



Phragmites spreads primarily by rhizomes (grow over 50 ft. a year). Seeds are dispersed by animals and wind. Seeds land on desirable damp areas and sprout. It outcompetes and eliminates other native species. Killing Phragmites is accomplished by applying a herbicide like RoundUp in the fall when the plant is taking nutrients down to it's roots for next years growth. The herbicide then kills the roots. Applications at other times of the year are not as effective, because the herbicide doesn't get down to the roots to kill the whole plant.

Reed Canary Grass (very invasive)

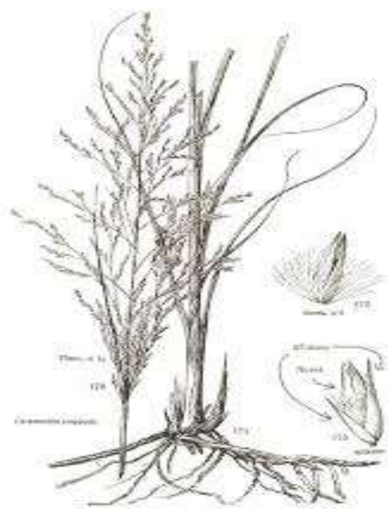
Native Plants of the Beach

American Beach Grass or Marrum Grass

Canada Wild Rye Grass

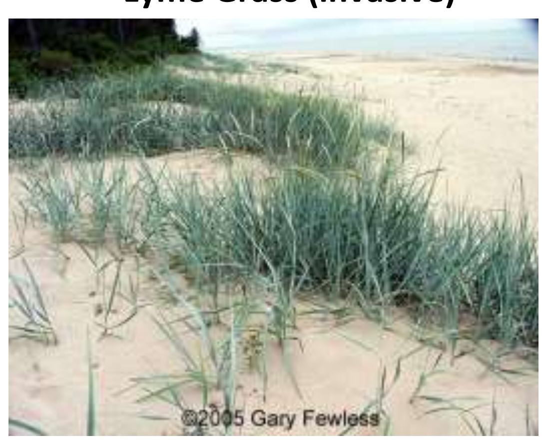
Little Bluestem

Sand Reed Grass



Switch Grass

Lyme Grass (invasive)



Beach Pea

Sedum

Rose

Grass of Parnassus

Bottle Gentian

Silverweed Cinquefoil

Evening Primrose

Blue Vervain

Swamp Milkweed

Joe Pye Weed

Harebell Campanula

Narrow-leaved/Hybrid Cattail (invasive)

Broadleaf Cattail

Sneezeweed

Composites (Daisey Family)