The Invasion and Spread of the Emergent Wetland Plant *Phragmites australis* into a Lake Erie Coastal Wetland

Robert S. Whyte[1], David M. Klarer[2], and Robert Shields[3]
[1]California University of Pennsylvania, Department of Biological & Environmental Science
[2]Ohio Department of Natural Resources, Division of Wildlife
[3]University of Akron, Department of Curricular and Instructional Studies

INTRODUCTION

The Old Woman Creek National Estuarine Research Reserve (OWC-NERR) and State Nature Preserve represents one of the few remaining undeveloped coastal wetland systems along the southern shore of Lake Erie. Coastal wetlands once prevalent in Lake Erie's Western Basin have disappeared largely through the combined effects of natural shoreline disturbance and development of the surrounding watershed. Disturbance to these biologically productive and diverse systems threatens existing plant diversity and may contribute to an overall loss of wetland biological diversity. One contributing factor to the loss of Great Lakes wetland biological diversity may be the increased presence of invasive plants such as *Phragmites australis*, an aggressive invader that displaces the native vegetation. Few studies have been done in the Great Lakes documenting or quantifying changes in plant species composition and community structure in response to *Phragmites* expansion. Better information is needed to evaluate the impact of invasives such as *Phragmites* to determine if its presence and spread in Great Lake's systems is an ecological threat. Large-scale vegetation control programs are being implemented, yet our knowledge of overall system impacts and community dynamics resulting from an increased presence of *Phragmites* and other invasives is limited. Such studies will allow wetland and natural resource managers to better understand vegetation dynamics of *Phragmites* and subsequently enable managers to implement appropriate management strategies.

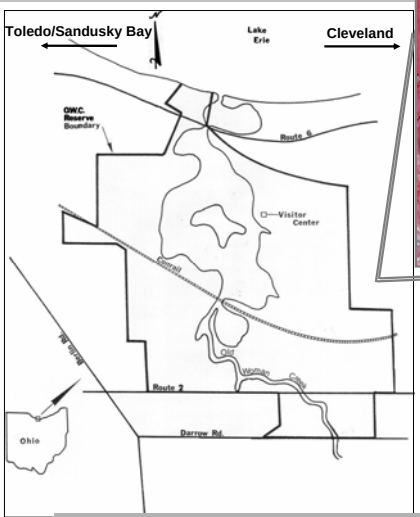
This ongoing study documents a shift in wetland vegetation distribution and community structure in response to water level fluctuations. The preliminary information presented here is particularly relevant as Lake Erie water levels return to their approximate long-term mean after an extended period of high water levels and OWC wetland species composition shifts in response to lower water levels. This ongoing research effort will also provide a foundation for additional work investigating the impact of *Phragmites* on community structure of the wetland plants and the overall community dynamics of the wetland.

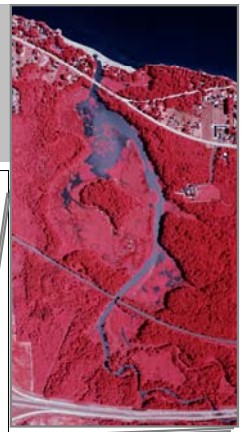
STUDY SITE - METHODS

The present day Old Woman Creek estuary is characterized by a drowned river mouth and sand barrier-beach separating the wetland from Lake Erie. Water depths in OWC average less than 50 cm but can increase to more than 1 m in response to storm events and Lake Erie storm surges. Its geographic location is reflected in the floristic composition of the wetland plant communities, which contain species with a broad geographical affinity. The southern species *Nelumbo lutea* (American water lotus) is historically the dominant macrophyte in OWC. Fluctuating water levels directly affect the macrophyte species composition.

Methods:

- Aerial Photography
  2003-2005: 1"=1000' and 1"=200', B&W, Color IR
  1993: 1"=1000' B&W
  1999-2000: maps constructed from Trexel-Kroll (2002) original maps and available aerial photographs
- Ground Surveys
  2003-2005
- GIS
  digitizing vegetation boundaries





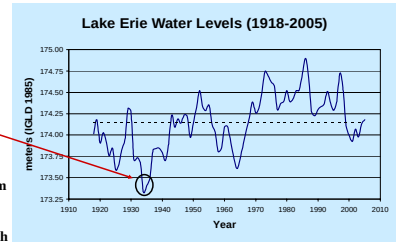
The OWC-NERR, a 56 hectare site and draining a watershed of 69 km², lies directly east of Sandusky Bay and the mouth of the Huron River, near the southern-most point in the Great Lakes, 41 degrees 22'N, 82 degrees 31'W.

OWC-NERR color infra-red image from August, 2005 (above right).

RESULTS

Vegetation Dynamics - Documenting Change:

Aerial photographs of OWC from as early as 1937 provide a record of plant coverage and community types. Emergent vegetation dominates the wetland in low water years such as 1937. In the 1970s, following an extended period of low water levels, the wetland shifted from a predominantly emergent community dominated by *Typha latifolia, Peltandra virginica* and *Polygonum amphibium* to an open water community dominated by the floating-leaved plant *Nelumbo. lutea*. *Nelumbo* expanded from a few beds covering less than 10 percent of the estuary (1970s) to extensive beds with an areal cover of about 36 percent in mid 1990s.



Water levels in Lake Erie have recently declined and are now closer to the long-term mean. Fluctuations in levels play an important role in coastal wetland plant community dynamics. (Dashed line on graph is long-term mean.)

Phragmites Distribution & Abundance:

Phragmites was first observed in OWC in the mid-1980s in the area of the barrier-beach and has subsequently been identified as the invasive-introduced type (European) (Saltonstall 2002). Since 1993, *Phragmites* has expanded from a few small stands to several expansive stands (all > 1ha).

Vegetation maps (1993, 2000, 2004 and 2005) show the change from a *Nelumbo* dominant, open water system to an emergent plant community dominated by *Phragmites* in response to low water. Other emergents characterized by the Emergent-Mix includes *Typha angustifolia, Sagittaria latifolia, Sparganium eurycarpum, Polygonum* spp., several grasses, *Scripus* spp., and *Carex* spp. Transect data (shown in far right panel), was used to aid in aerial photo interpretation and the digitizing of vegetation boundaries.

Old Woman Creek 1993

Change in vegetation type expressed as percent of total wetland area, 1993, 1999-2000, 2003-05.

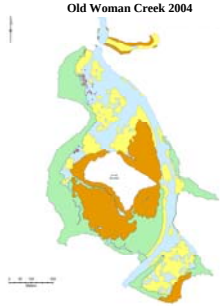
Vegetation Type	1993	1999	2000	2003	2004	2005
Phragmites	0.75	0.03	2.8	3.0*	24.2	21.6
Nelumbo (floating-leaved)	33	32.9	24	26	20.5	23
Emergent-Mix	0.84	5.3	42.7	49.4	28.9	29.8
Open Water	60.6	61.87	30.4	21.4	26.5	24.9

*In 2003, *Phragmites* abundance increased although it remained a minor portion of the Emergent-Mix vegetation type.

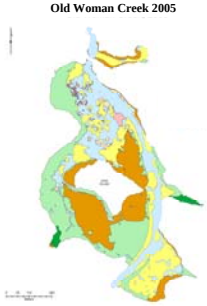
Phragmites | Emergent Mix | Nelumbo | Submersed | Phalaris (emergent) | Open Water

Old Woman Creek 2000

Old Woman Creek 2004



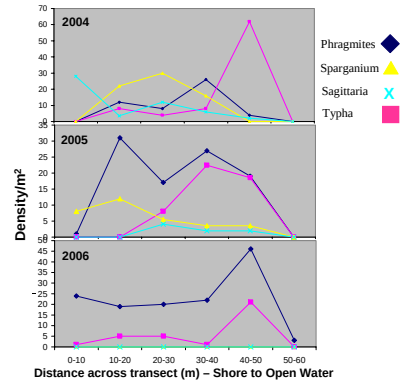
Old Woman Creek 2005



Lotus Lilies, a painting by Charles Curran in 1888; courtesy of the Terra Museum of American Art (reproduced from the Old Woman Creek Site Profile, 2004)

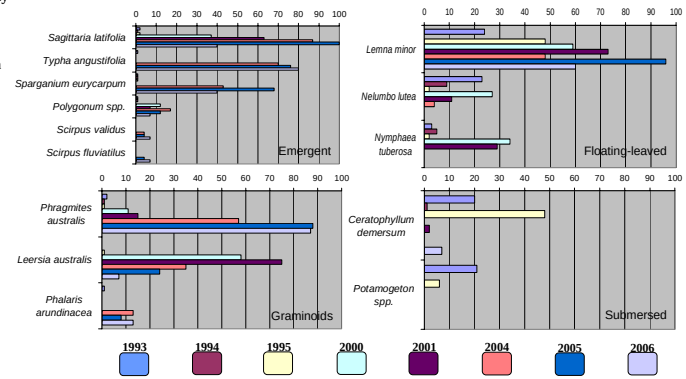
Beginning in 1999 exposed mudflats provided habitat for the growth and expansion of *Phragmites*. Advancing *Phragmites* rhizomes in 2003 are shown below spreading on recently exposed sediment; area was previously dominated by *Nelumbo* (flowering American water lotus). Photograph below shows the same area as illustrated in the 1888 painting (above).

Change in *Phragmites* Density Over Time (2004-2006)



From 2000 to present (low water years) *Phragmites* has spread and significantly increased its abundance and density in the wetland. Plot data from established transects (2004-2006, above; 1993-95, 2000-01, 2004-06, below) show this increase in *Phragmites* and decline in other emergent species over time.

Observed Species Frequencies: 1993-1995, 2000-2001, 2004-2006



SUMMARY, CONCLUSIONS & FUTURE RESEARCH

Great Lakes coastal wetlands such as Old Woman Creek are very dynamic systems, the result of fluctuating water levels in the Great Lakes. This is observed directly in the shifting species composition and structure of the plant communities in the wetland. The dynamic nature of the wetland tends to promote large monotypic beds which are influenced by water depth and soil moisture.

- In 1999 water levels declined to levels similar to those of the 1960s driving the plant community structure from one largely composed of the floating-leaved *Nelumbo* to an emergent community. Total plant cover rose from less than 40% in 1993 to 75% in 2005.
- *Prior to 1999, Phragmites* was restricted to several low relief shoreline areas. *Phragmites* distribution in OWC increased beginning in 2000 with lowered water levels. This expansion has likely been exacerbated due to the presence of a non-native *Phragmites* strain identified in OWC.
- A few "pre-*Phragmites* invasion" emergent stands remain intact indicating that established native beds may be able to resist the initial expansion of *Phragmites*.
- It remains unclear from current Great Lakes studies and the results of this study to what extent *Phragmites* represents an ecological threat to these coastal wetlands. We suspect, however, that during this period of lower Lake levels, *Phragmites* will continue to expand.
- A *Phragmites* control program is now underway in the wetland; however, for the control program to be effective better scientific information on *Phragmites* and its ecological impacts is needed to make informed management decisions.
- *Phragmites* expansion will continue to be monitored in OWC. Work is ongoing to determine changes in plant species composition, community structure, and the relationship of the plants to the aquatic animals.

References

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