30 April 2008

To: Maine DOT Environmental (Duane, Charlie)
From: Dr. Karen Wilson, University of Southern Maine

General work plan for Sherman Marsh, Summer 2008

This document contains several sections. This first deals with the issue of *Phragmites* control and research on the marsh. The second outlines the basic monitoring work we propose for the marsh, which builds on work conducted in 2006 and 2007. Finally, I've included a budget and budget justification for the work.

***Phragmites* control and research in Sherman Marsh**

Phragmites control

Maine DOT has proposed to begin spraying the largest patches of *Phragmites* in Sherman Marsh (located in the southern tip of the eastern arm) in June 2008. My group has a few thoughts/concerns, the biggest of which is that we'd like to see the herbicide application be done by hand on individual stems and not by spraying. The reasons for this are:

1. in a quick review of the effectiveness of the herbicide Habitat we noticed that several West Coast sources mentioned that Habitat is particularly effective on *Spartina alterniflora* (on the West Coast, where that plant is actually invasive). Obviously accidental spraying of *Spartina alterniflora* that is still getting established in Sherman Marsh is something to be avoided at all costs.

2. Many of the *Phragmites* patches have other plant species mixed in that would be as vulnerable to spraying as the *Phragmites*. It's clearly suboptimal to leave big empty patches in the marsh, ready to be re-colonized by *Phragmites*; hand application *might* allow the other species to persist and fill that hole. This is a situation that is different from many *Phragmites* removal efforts where the *Phragmites* is well established and has eliminated other plant species.

3. Because of the still soft marsh peats, crews will have to work carefully to avoid damaging the marsh surface and other vegetation, and traditional mowing (usually done in the fall after herbicide application) would need to be done by hand (muds too soft for equipment, no access for equipment, and the likelihood that heavy equipment would do more harm than good). I know that in well-established *Phragmites* stands, usually there is a firm peat of *Phragmites* rhizomes and dead materials that probably do well with heavy equipment – not the case (yet!) in Sherman Marsh.

Other concerns include:

1. One of the long-term vegetation monitoring transects is located in the area of highest *Phragmites* concentration and we'd need to mark that out clearly.

2. Do you have plans to monitor the effectiveness of the spraying? We'd suggest building monitoring in to the other *Phragmites* work that might occur on the marsh (see below) to avoid the question of whether it was the spraying that did the trick, or the hydrology change that did the trick.

Phragmites research

It is hoped with the proposed (re)construction at the bridge site, increased tidal inundation will kill off some *Phragmites* stands by increasing salinity stress. At the same time, our work last fall, in collaboration with a *Phragmites* expert, has confirmed that several *Phragmites*-specific herbivorous insects are already established in Sherman Marsh *Phragmites* patches. These herbivores may function as additional stresses on the *Phragmites* plants, increasing their vulnerability to tidal inundation. Thus, we have two main research questions:

1) Does the change in hydrology planned for summer 2008 change the distribution and abundance of *Phragmites* in the marsh? This question would be approached in two ways:

1. At the marsh scale, map the location, area and perimeter of each *Phragmites* patch on the marsh (starting with work begun last fall).
2. Monitor *Phragmites* patches in several regions of the marsh for changes in biomass, stem density, area, perimeter, and abundance of other plant species. Environmental variables would include: Groundwater contribution (salinity)/inundation patterns using groundwater wells and data loggers (**in collaboration with Charlie**), Soil moisture, Soil salinity, Elevation (**in collaboration with Charlie**), and soil nutrients (N & P), and herbivore abundances.

2) Does the presence of herbivores contribute to *Phragmites* die-back over time, and what characteristics of *Phragmites* patches result in the highest densities of herbivores? Cutting edge research on *Phragmites* in other part of the US includes work on potential biological controls. Sherman Marsh has a confirmed population of *Lipara* sp.(shoot flies, family Dolichopodidae), who target *Phragmites* by laying eggs on leaves. The larvae then crawl to the apical meristem and burrow into the stem. The resulting damage (easily detectable as a gall and dead leaves in the fall) prevents the stem from continuing to grow and flower. Many questions still remain regarding this herbivore/host relationship, including ovipositing choice by the female adult, and how infestations might be an additional stress for *Phragmites* experiencing increased tidal inundation. Recent work has suggested that *Lipara* females may respond to patch characteristics such as stem density and size when choosing oviposition sites. We'd like to do a small scale manipulation where we manipulate the stem density, size and patch edges early in the summer and compare to herbivory rates later in the summer. This work would in no way spread *Phragmites* and should give us some insight into what types of patches are vulnerable to this herbivore.

Sherman Marsh General Monitoring Work Plan

The following plan assumes that the MDOT will provide the following equipment and, if applicable, assist in installing the equipment in the marsh. We will assist in choosing sites for the equipment, maintenance, and downloading data if applicable.

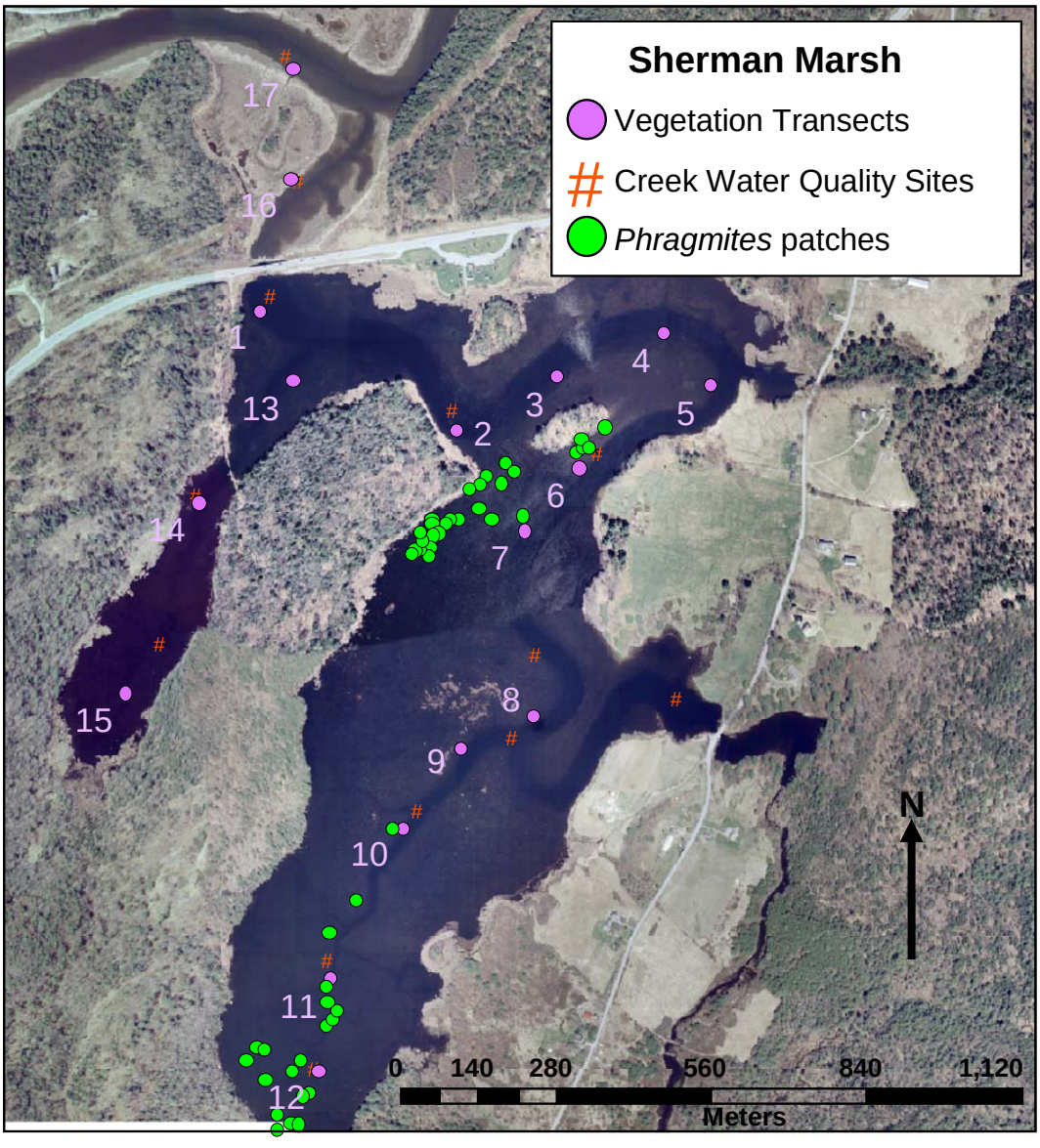
Equipment needed from the MDOT:

- Salinity/pressure/temperature data loggers & groundwater wells
- Means to measure elevation (e.g., Topcon HyperLite GPS with TDS Ranger data collector)
- Trimble GeoXH or similarly accurate GPS unit for mapping *Phragmites* patches.

Data needed from MDOT:

- Continuous tidal stage height (pressure loggers) in the tidal creeks.

Figure 1. Sherman Marsh monitoring sites and known *Phragmites* patches. Vegetation transects extend from the creek bank (shown) to the upland edge. Some creek water quality sites are dewatered at low tide (in 2007; Sites 11, 12, 15). *Phragmites* patches were observed in other areas of the marsh but were inaccessible at the time of the survey (interior of the marsh between transects 7 and 11). However, the mapped areas represent the highest concentrations of patches on the marsh.



Task	Protocol	Products
A. Vegetation monitoring (est time: 3 weeks in August; 2 weeks set up and specimen identification)	Vegetation monitoring will occur in August at 15 permanent vegetation transects (Figure 1) in Sherman Marsh, and 2 permanent transects in an adjacent "reference" marsh. Permanent plots ($1m^2$) are located at 1m, 3m, 5m, and every 15 m thereafter along the transect from the intertidal (*Spartina alterniflora* zone) to upland edge. Vegetation presence and percent cover will be measured using the point-intercept method, in which the 1 m^2 plot is gridded with 50 points, and each plant that touches a vertical "point" is considered present. Percent cover is then calculated as # points present * 2. This method accounts for layering of different species, so percent cover may add up to >100. Open water, bare mud and dead vegetation is also noted at each point. We will identify plants to species whenever possible.	Species composition presented as (1) distance from inlet, and (2) distance along transects, with an emphasis on indicator salt marsh plants. Species community composition presented in ordination format, showing similarities between plots. Voucher specimens will be housed at USM.
B. Soil pore water salinity (est time: 1-2 days per month)	Soil pore water salinity will be sampled in 2 – 3 permanent wells per transect once per month (June, July, August, September) using refractometers. Salinity wells will be cleared (and replaced if necessary) in June. *If MDOT is willing to purchase dataloggers for continuous salinity/conductivity measurements in wells on the marsh surface (recommended), we will assist with installation and be responsible for data retrieval.*	Plots of soil salinity vs. transect species richness or % salt marsh species.
C. Creek water quality (est time: 1-2 days per month; Total ~ 1 week)	Creek water will be sampled at 11-13 (two sites currently do not have water at low tide) permanent sample sites (Figure 1) for salinity, temperature and dissolved oxygen at half-meter intervals, once a month on an ebb tide and a rising tide. If possible, we will also sample, at least once in the summer, an ebb tide just before dawn to detect possible oxygen depletion. *If MDOT is willing to purchase dataloggers for continuous salinity/conductivity measurements in the creek (recommended), we will assist with installation and be responsible for data retrieval.*	Plots of salinity, temperature and dissolved oxygen arranged spatially on the site map. Comparison to previous year's results.
D. *Phragmites* monitoring How does *Phragmites* respond in changes in hydrology? (est. time: 1.5 weeks for mapping; 1 week for instrumentation and selection of reference plots for a subset of patches; 3 days per month (July, August, Sept) to re-sample environmental variables. Total ~ 4 weeks)	At the marsh scale, we will map the location, area, and perimeter of each *Phragmites* patch on the marsh using a Trimble GeoXH or similarly accurate GPS unit. **We assume that the GPS unit will be provided by MDOT for this task.** At a <u>subset of patches</u> representing areas of the marsh differing in expected tidal inundation, we will measure stem density and percent cover of other plant species (using the point-intercept method in 3 $1m^2$ plots – center, mid, edge). We will also measure environmental variables, including: continuous salinity/inundation patterns using groundwater wells and data loggers (**in collaboration with MDOT**), soil moisture, soil salinity (point samples in non-instrumented patches), elevation (**in collaboration with MDOT**) and soil nutrients (nitrate/nitrite and phosphate). Environmental variables will also be measured at a reference plot 10 m outside each *Phragmites* patch at similar elevations. Reference plots will be chosen by generating one or more random compass bearings and selecting the first plot that is located at a similar elevation. To monitor *Phragmites* response to Habitat and Rodeo herbicides on treated patches near in transects 2, 6-12, we will compare post-spray plant growth to nearby control patches. Specific patches to be	GIS map of *Phragmites* distribution and associated GIS layers. Analysis of relationships between *Phragmites* characteristics and environmental variables. Analysis of 1st year herbicide effectiveness, comparing the two herbicides and untreated control sites. **For this work MDOT will need to provide:** • **Salinity/pressure/temperature data loggers & groundwater wells** **Means to measure elevation within an inch accuracy (e.g., Topcon HyperLite GPS with TDS Ranger data collector)**

	treated will be identified by MDOT and USM. We will collect similar environmental variables in both treated and non-treated patches.	
E. *Phragmites* research Does the presence of herbivores contribute to *Phragmites* die-back over time? What characteristics of *Phragmites* patches result in the highest densities of herbivores? (Est. time: 2 wks manipulation set up; 2 weeks to monitor herbivores & environmental conditions; Total ~ 4 weeks)	We'll address *Phragmites*-herbivore interactions in two ways: 1. Monitor herbivore presence on a subset of *Phragmites* patches throughout the marsh (likely the same subset of patches monitored in Task D). Herbivores will be identified to species. We will collect information on herbivore density, and characteristics of the affected patch (stem diameter, stem density, distance to edge of patch, patch size, etc) as well as the associated environmental variables mentioned above. 2. Manipulate the stem density, size and configuration of patch edges early in the summer and compare to herbivory rates (i.e., herbivore density) later in the summer in a replicated experiment. We will collect information on these manipulated patches as above (#1).	Species list, spatial distribution and density estimates of *Phragmites* herbivores found on Sherman Marsh. Analysis of the relationship between herbivore density, *Phragmites* characteristics and environmental variables. Analysis of the relationship between manipulated patch characteristics and herbivore density.

Budget and budget justification

PERSONNEL	
PI – Wilson	5,398
One month's salary	
Employee Benefits @ 42.3%	2,283
Total Personnel	**7,681**
OTHER COSTS	
Student	5,280
Three months pay at $1760/mo	
Graduate Assistant	5,850
Three months pay at $1950/mo	
Consultants	2,000
Consultation for Phragmites and herbivores	
Printing	60
Printing costs for project reports	
Supplies & Materials	2,100
See below.	
Travel In-State (at $0.40/mile)	755
Portland to Sherman Marsh: 15 trips of 104 miles each	
Portland to Augusta: 2 trips of 116 miles each	
Total Other Costs	**16,045**
Total Direct Costs	23,726

Indirect Costs @ 49.5%	11,744
TOTAL COSTS	**$35,470**

Supplies and materials include a dedicated canoe that will be left in the marsh, supplies for nutrient analyses (syringes, filters, bottles), PVC and oak stakes for remarking transects and replacing lost salinity wells, hand-lenses, collection bags, calipers, loppers/clippers, safety glasses for *Phragmites* work, other expendables.