Discussion

This section is designed to guide the workshop through meaningful discussions about the feasibility of restoring Dyke Marsh. Through this section, we hope to provide thought stimulating questions that you may think about and comment on at the workshop.

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DISCUSSION

What we know, don’t know and may need to know

The previous chapters summarize the historical and present-day physical, chemical and biological conditions at Dyke Marsh Preserve (DMP), as well as put the decision-making process and potential restoration activities at DMP into the context of other restoration projects conducted in the region. Dr. Joy Zedler, in her book *Handbook for Restoring Tidal Wetlands* summarizes crucial historical and current information about a restoration site that needs to be gathered before a restoration commences. Her advice is used here to evaluate what pertinent information for restoration is known about Dyke Marsh, and what information we still may need to know (Table 29).

The information gathered for DMP is extensive and thorough (Table 29) and should allow, at the very least, a preliminary evaluation of whether, and to what level, restoration of DMP is feasible. Of course, unanswered questions and concerns are numerous (see “Primary Concerns” following this section) and more information is always needed to decrease the uncertainties associated with predicting the outcome of a restoration. For example, to maintain the stability and health of existing and restored marshes at DMP, the long-term effects of urbanization and air quality on the physical, chemical and biological characteristics of DMP need to be fully understood. In this case and others, best guesses based on expert opinion (see case study section), may be desirable. Some incomplete information may be collected most efficiently after a restoration decision has been made to ensure the most current data is available. Such information includes a new bathymetric survey and identifying suitable dredge characteristics.

The only historical information that is incomplete (Table 29) is data related to the composition of DMP sediments that can be collected using soil cores. Soil core information can identify any large sediment deposition events, which are related to changes in environmental conditions. Such changes in environmental conditions at DMP include diking of the marsh in the early 1800s, urbanization around DMP (Figure 4) and changes in land-use throughout the Potomac watershed (Figure 3). These land-use changes lead to changes in the sediment load and dynamics (Paul and Meyer 54)
2001) in the Potomac and its tributaries with consequences on sediment accretion and erosion (Allan 2004) at DMP.

The current site information could also be enhanced with some additional information. Elevations of the marsh surface were taken in 1992 using GPS, but with unknown accuracy (see Recent Studies section). Elevations can easily change within the complex system of a tidal marsh; sediments may have significantly shifted since 1992 due to storms, tidal fluctuations, and sediment accretion or erosion. We sampled marsh elevations of 129 points using Topcon GPS equipment during the summer of 2004 (Figure 14). If restoration is advised, a more extensive topographical survey should take place to ensure that the marsh surface is restored to ecologically relevant elevations.

Hydrologic models of the system have been developed in the past (see hydrology discussion in the Recent Studies section, pg. 22), but more current hydrologic data may be helpful to understand hydrologic dynamics in and around the marsh that include tidal flows, freshwater inputs and storms. A model predicting hydrologic flow post-restoration would also be useful in deciding the number and/or size of tidal guts developed during restoration. A predictive model could also incorporate predicting the effects of sea level rise on the hydrology of the system and potential consequences on marsh vegetation and stability.

If restoration of DMP is feasible and advisable, a new bathymetric survey will be required prior to restoration so that definitive amounts of dredge fill can be calculated. Water quality factors such as sedimentation and turbidity have yet to be defined specifically for Dyke Marsh (Figure 30). It is important to understand if these factors are increasing or decreasing in response to the continued development of the watershed.

The physical and chemical (organics and metals) properties of potential fill will need to be assessed in order to match particle size (for settling and stability of the substrate as well as suitability for establishment of appropriate marsh plants) and quality (as good as or better than current DMP sediments in concentration of materials toxic to plants and wildlife) to DMP restoration goals. Examples of these important physical and chemical properties to analyze include dredge material consolidation rates, texture, organic matter, Total Kjeldahl Nitrogen (TKN), metal concentrations, nutrient retention.
capabilities, and drainage characteristics. Potential dredge material will also need to be
tested for the presence of a seed bank and possible invasive species. Some soil
properties of the existing marsh are known (texture and organic matter), except for TKN.
Knowledge of these soil characteristics (known and unknown) will be helpful in
understanding the dredge material characteristics needed to restore specific areas in
the existing marsh.

Lastly, a remote sensing image of DMP and its surrounding area may be useful
in current studies, restoration planning and in post-restoration monitoring efforts for
comparison. The most recent imagery in-hand is a digital orthophoto of the area from
1994, although a few 1:6000 color IR flights were flown over the DMP area in 2003 and
2004, but the images have not been formally accepted yet (Shawn Carter, personal
communication, National Park Service, September 2004). A remotely sensed image
may contribute additional information on the vegetative patterns at Dyke Marsh, and/or
could be compared to images from other regional tidal freshwater marshes to better
understand vegetation dynamics.
Figure 30. Total dissolved solids (mg/L) in the tidal freshwater reach of the Potomac River from 1985 to August 2004 (Chesapeake Bay Program Water Quality Data, http://www.chesapeakebay.net/data/, accessed September 2004).

LITERATURE CITED


Table 29 was created by combining tables 2.1 and 6.6 from the *Handbook for Restoring Tidal Wetlands* (Zedler 2001). The table displays categories of information that are helpful to understand about a proposed restoration site before restoration begins, how those categories of information can be applied to the planning process, and what information is currently known about Dyke Marsh. The (*) signifies site characteristics that are recommended for sampling pre-restoration because they provide important reference information for post-monitoring. Information currently available for DMP is represented by “√”, and unknown by “X”.

**Table 29. Information to know pre-restoration.**

<table>
<thead>
<tr>
<th>Background Information</th>
<th>Application</th>
<th>Dyke Marsh</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Past/historical reference information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journals, books, herbarium records, oral histories</td>
<td>Flora, fauna, and geology of site prior to development, important structures and processes</td>
<td>√</td>
</tr>
<tr>
<td>Maps and elevations</td>
<td>Determine historical extent of marsh, channel morphology, land use</td>
<td></td>
</tr>
<tr>
<td>Meteorological data and streamflow records</td>
<td>Determine past levels of variation for rainfall</td>
<td>√</td>
</tr>
<tr>
<td>Aerial and historical photographs</td>
<td>Outline history of changes to marsh, channel morphology, land use</td>
<td>√</td>
</tr>
<tr>
<td>Land use and town planning records</td>
<td>Outline past use of marsh and surrounding areas</td>
<td>√</td>
</tr>
<tr>
<td>Soil cores</td>
<td>Abrupt changes to soil profile in sediment characteristics indicate large sediment deposition event, dumping activities, changes in environmental conditions</td>
<td>some</td>
</tr>
<tr>
<td><strong>Current site characteristics (existing Dyke Marsh)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topography* and hydrology</td>
<td>Indicate extent of tidal influence, patterns of tidal flow, creek density, drainage</td>
<td>some</td>
</tr>
<tr>
<td>Water quality</td>
<td>Indicate variation in quality</td>
<td>some</td>
</tr>
<tr>
<td>Soil properties* (texture, organic matter, TKN)</td>
<td>Indicate needs for soil amendment (e.g., nutrients, organic matter)</td>
<td>√ (texture, OM) X (TKN)</td>
</tr>
<tr>
<td>Sediment characteristics (dredge material)</td>
<td>Predict nutrient retention, drainage characteristics, toxins, heavy metals</td>
<td>X</td>
</tr>
<tr>
<td>Vegetation cover and composition*</td>
<td>Indicate pool of local wetland species and rank abundance, potential colonists, exotic species problems</td>
<td>√</td>
</tr>
<tr>
<td>Animal usage</td>
<td>Indicate potential colonists, permissible levels of disruption to site during construction</td>
<td>√</td>
</tr>
<tr>
<td>Remote sensing image of area</td>
<td>Provide measures of aerial coverage of water, vegetation, habitat areas as model for restoration site</td>
<td>orthophoto</td>
</tr>
</tbody>
</table>
Primary Concerns

Several concerns have been identified regarding the long-term persistence and health of the existing marsh and any restored areas. These concerns need to be addressed before making a decision on whether or not to restore DMP.

A. Shoreline Erosion
Erosion has been observed at several places in the marsh by managers and members of the public, suggesting that shoreline erosion is an obvious phenomenon throughout the marsh (Figure 31). However, studies on shoreline erosion at DMP so far have been inconclusive owing to problems encountered when evaluating changes in shoreline from aerial photographs taken at different, and unknown, times in the tidal cycle. Therefore, shoreline erosion can only be demonstrated to be a problem in Dyke Marsh at this time using anecdotal observations. A scientifically defensible demonstration of shoreline erosion would have to include long-term observations in shoreline elevation and extent using a) high-precision surveying equipment, as used in the recent elevation survey (see pg. 21) and b) permanent stations along the shoreline and inland that monitor changes in sediment accretion and erosion.

Besides concerns about the rate and extent of shoreline erosion at DMP, we do not have a full understanding of the processes causing shoreline erosion. Along with major storm events, some hypotheses for how erosion may be occurring include wave action from boats and hydrologic effects from the deep holes left behind after dredging (see Bathymetry section pgs. 22-23). The islands off of the mainland and the small channels that motorboats cannot speed through may protect some of the marsh from waves caused by boats. In areas where the marsh is not protected, the shoreline is gently sloped in places, with areas of SAV and mudflats, rising into sandy/mucky areas of debris, rising into emergent marsh. Further investigations of shoreline erosion would be helpful in deciding if it should be a primary concern for the marsh and whether restoration efforts need to be prioritized to prevent further erosion in specific areas.

Figure 31. Shoreline erosion occurring at DMP in 2003.
Therefore, the questions that need to be addressed by experts using newly collected scientific information or best guesses are:

- Is shoreline erosion occurring and at what rate?
- What current or potential processes may be contributing to shoreline erosion and can they be ranked from most severe to least severe?
- If shoreline erosion is occurring, can we decrease or halt it by taking specific restoration measures?
  - Would changing the bottom contour of previously dredged areas and filling in the deep holes attenuate wave action and thereby halt shoreline erosion?
  - Would decreasing boat traffic in certain areas decrease shoreline erosion?
  - Would strategically placed restoration areas attenuate wave energy?
B. Engineered Marsh Soils
The richness of the soils that currently exist in Dyke Marsh are suggested to be one of the reasons the vegetation communities are as viable and long-lasting as they are (personal communication, Dan Sealy NPS, 2004). It is of great concern to any restoration project that the dredge material used to restore a site is suitable to the goals of the project. Some of the case study projects (see “Case Study” chapter) involved creating new habitat through the placement of dredge materials, and several ideas can be learned from them. Having a detailed plan of where the material will go and how it will be contained was key among the case studies. Completing small-scale trials ahead of time with containment structures may also be helpful. For example, managers of Kenilworth Marsh wished they had studied containment methods more in depth before restoration took place (pg. 42).

Characteristics of the dredge material used for restoration are of concern. Much of the soils currently in Dyke Marsh in the top 5cm are very organic and rich in fine silt and clay particles (pgs. 17-19) that may not be available from dredge materials, and if they are available, they may not provide the desired outcome for the restoration. Sandy soils may be needed instead of fine particles to allow for quicker drainage. The Kenilworth Marsh case study found that knowledge of interactions between sediment [dredge material] contaminants and marsh biota would have been helpful before restoration occurred (pg. 42). The Poplar Island case study also used dredge material and found that better data on dredge material consolidation rates would have been beneficial before restoration began (pg. 44).

Therefore, the questions that need to be addressed by participants at the workshop are:

- What do we know about containment structures in high-energy systems such as the Potomac River to ensure that dredge material and created marsh areas will stay in place?
- Are toxins and nutrients released from dredge material a major concern?
  - Can toxins released during a restoration effort be detrimental to the existing fauna and flora?
  - Can toxins released during a restoration effort have detrimental effects further down the watershed?
- How do we place dredge material to function in the specific ways we want (to be similar to the current soils characteristics and allow for drainage)?
  - Can the soil profile in the existing marsh be adequately mimicked using dredge materials, or how close can one realistically get?
  - How feasible would it be to use sandy materials and let nature “do the rest” through sedimentation processes? How long would such a process take for the sediment profile to be comparable to the existing marsh?
C. Sea Level Rise

Sea level rise is projected to impact coastal wetlands (e.g., Orson et al. 1985, Douglas 1991, Morris et al. 2002). Predictions for New England, North Carolina and Louisiana are that wetlands will deteriorate and disappear, mostly because sediment inputs are inadequate (Chmura et al. 1992, Moorehead and Brinson 1995, Donnelly and Bertness 2001). In contrast, in the San Francisco Bay and the Chesapeake Bay predictions are that sediment loads may be sufficient for wetlands to keep pace with sea level rise (e.g., Griffin and Rabenhorst 1989, Patrick and Delaune 1990). A notable exception in the Chesapeake Bay is the Blackwater National Wildlife Refuge (Stevenson and Kearney 1996), which has rapidly lost tidal wetlands area.

Tide gages around the Chesapeake Bay show that relative sea level rise is rising twice as fast as the average global rate of 1.8mm per year (Douglas 1991) (Figure 32). The reason for this fast rate in the Chesapeake Bay is hypothesized to be a combination of rising water levels of the ocean and land subsidence caused by groundwater extraction in the region. Sea level rise in the Chesapeake Bay is likely to cause shoreline erosion and marshland pond development (Orson et al. 1985), where pond development may lead to further erosion of a marsh by increasing sediment loss from the interior of the marsh.

Therefore, the questions that need to be addressed by participants at the workshop are:

- How will sea level rise affect the persistence of the existing marsh?
  - Will sediment loads of the Potomac be sufficient to keep pace with sea level rise?
  - Will sea level rise lead to further shoreline erosion?
  - Will ponds develop in the interior of the existing marsh?
  - Will increased salinity be a concern that may change the ecology of the marsh?

- How do we address sea level rise in restoration of DMP?

Figure 32. The tide gauge records shown above were selected to provide global coverage, avoid tectonic plate boundaries and have a long history. The Baltimore tide gauge, is emphasized in red; note the noticeably faster rise compared to the other tide gauges. (Figure provided by Bruce Douglas (NODC) and John Lilibridge (GL), Accessed September 2004, http://www.ngs.noaa.gov/GRD/GPS/Projects/CB/SEALEVEL/sealevel.html).
D. Northeastern Storms
Strong and infrequent storms from the northeast may have an impact on Dyke Marsh because they can produce extreme amounts of energy and wave action (Figure 33). Because of the energetic wave action on the marsh, a concrete barrier or sill may be needed to protect restoration of Dyke Marsh. Looking at past local restoration projects on the Anacostia River (see “Case Study” chapter), the strong energy from northeastern storms were not factors for those projects because of their location. The Poplar Island case study (pg. 44) designed wave barriers during the restoration project that may be helpful in informing restoration alternatives for Dyke Marsh.

Therefore, the questions that need to be addressed by participants at the workshop are:
- Could excessive wave energy from northeasterly storms result in movement of newly restored marsh areas and contours that decreases the likelihood of a stable marsh establishing?
- How much movement of contours or marsh areas can be tolerated?
- What engineering approaches are known to maximize the stability of a created marsh and are they feasible approaches to use for the high-energy system of Dyke Marsh?

Figure 33. Damaged boardwalk in DMP due to Hurricane Isabel (2003).
E. Urbanization Effects

The effects from the highly populated urbanized area around Dyke Marsh are an ever-present concern. One concern from urbanization involves the increased amount of impervious surfaces in the watershed, which prevents water from soaking into the ground and creates increased runoff that picks up nutrients and toxins on the way to the river (Blankenship 2004). It is well known that impervious surfaces increase the surge of water to the river after storms, specifically in places where hardened shorelines have replaced original vegetated (marsh) shorelines (Garbisch and Garbisch 1994).

The way that urbanization affects the amount of sedimentation and turbidity in the marsh is also of concern. Historically, marsh sediments originated from Hunting Creek (NPS 1977), but in recent years during construction of the George Washington Memorial Parkway, the stream outlet to Hunting Creek was significantly narrowed to build a stone bridge (personal communication, Dan Sealy NPS, 2004). Hunting Creek was further impacted by the construction of the Woodrow Wilson Bridge, which resulted in the placement of fill in the embayment of the Creek (personal communication, Dan Sealy NPS, 2004). More recent, a mitigation fill cell was placed at the mouth of Hunting Creek offshore of what are now Porto Vecchio condominiums (personal communication, Dan Sealy NPS, 2004). All of these urbanization effects can collectively change the source of sediments and nutrients in Dyke Marsh.

Today's marsh ecosystems are subjected to a variety of stressors that did not exist 100 years ago. These stressors exist due to impacts of development, urbanization, increased human population, increased road density, etc. Stressors associated with urbanization that are likely to have an impact on the Dyke Marsh ecosystem include:

1. hydrologic changes caused by regional (e.g., impervious surfaces of Washington DC, Alexandria, and throughout the Potomac Watershed) and local (e.g., changes to Hunting Creek, effects of the Haul Road in Dyke Marsh);
2. pollution (e.g., increased turbidity and nutrient concentrations, oil spills) (Figures 34-36);
3. recreation (e.g., fishing, hiking, biking, boating, birding) (Figure 37);
4. research and management activities;
5. park infrastructures (e.g., Belle Haven marina, George Washington Memorial Parkway); and
6. changing air quality (e.g., ozone, nitrogen deposition) throughout the region.

The fact that these stressors did not exist 100 years ago and are major factors in the ecosystem today should be taken into consideration when discussing restoration of the marsh.

Therefore, the questions that need to be addressed by participants at the workshop are:

- Are any of the listed stressors a major threat to the long-term health and stability of the existing marsh and to the success of a restoration effort? If so, can these stressors be managed in a way such that the long-term health and persistence of the existing marsh and any restored portions are achievable goals?
- Has the hydrology changed enough to affect the ecology of Dyke Marsh?
- Do the changes in Hunting Creek hinder or help restoration efforts?
• How does sediment replenish itself in the marsh?
• How does the current construction on I-495 (i.e. the Wilson Bridge) affect Dyke Marsh?
• How does shoreline hardening affect the extent of how much we can restore, and does this need to be addressed before restoration begins?

Figure 34. Construction of the Wilson Bridge, 2004.

Figure 35. Oil in tidal gut in DMP, 2004.

Figure 36. Garbage washed up in DMP from the Potomac River, 2004.

Figure 37. Belle Haven Marina, adjacent to the north of DMP, 2004.
F. Invasive Species

Once major concern is that development of new marsh surfaces may encourage the spread of invasive species because such surfaces allow species to establish that can rapidly colonize new areas. Some good colonizers are non-native species, although a variety of native species can rapidly colonize new or disturbed marsh surfaces as well. The current vegetation surveyed in 2003 and 2004 (pgs. 25-28), show that two small patches of *Phragmites australis* exist in the marsh. One patch has been chemically controlled by the NPS and has decreased in size (Figure 38). *Lythrum salicaria* has been known to be another invasive species. Very small patches of *Lythrum* have been observed on the edges of the islands and the marsh, yet no *Lythrum* has been observed in the interior of the emergent marsh. An important fact is that although *Phragmites* and *Lythrum* have been seen in or around DMP, neither of these species have had seeds germinate in the 2003 and 2004 seed bank studies (pgs 30-35). Even more interesting is the fact that an entire transect of the 2003 and 2004 seed bank studies traversed an entire patch of *Phragmites* that was being controlled by NPS and still no *Phragmites* seeds were sampled in the seed bank. Other wetland restoration projects from around the region (see “Case Study” chapter) have had similar concerns and found that constructing the correct elevations during restoration (Anacostia River pgs. 42-43) and close monitoring of the vegetation after planting and during establishment (Cape Cod National Seashore pgs. 46-47) were key.

Therefore, a key question that needs to be addressed by participants at the workshop are:

- How can restoration of the marsh promote the spread of native species while decreasing the establishment and survival of non-native species?

![Figure 38. This photo shows a small patch of *Phragmites australis* that is being controlled in DMP, the *Typha* sp. border is in the background depicting the border of the patch, and in the foreground is standing dead and new growth *P. australis*.](image-url)
G. Herbivory
The herbivory by geese, mammals, carp, and turtles is hypothesized to be an important factor in the revegetation of restored marshes in the region and elsewhere (McKnight and Hepp 1995; Taylor and Grace 1995; Evers et al. 1998; Connors and Kiviat 2000); thus, a discussion of herbivory needs to be included in establishing feasibility of restoration at Dyke Marsh.

Through the Friends of Dyke Marsh 2003 Breeding Bird Survey, we know that Canada geese are confirmed breeders at DMP. A 1993 National Park Service field checklist of birds in Dyke Marsh (updated in 2000), listed the Canada goose as a resident of the area year-round (Appendix F). We can learn more about this concern by looking at past restoration projects in the region (see “Case Study” chapter). Kenilworth Marsh located in Washington D.C. along the Anacostia River was restored in the early 1990s. Within a few weeks after planting the restored area, Canada geese consumed much of the planted marsh area, specifically the *Sagittaria latifolia* and *Pontederia cordata* tubers, and *Schoenoplectus pungens* (Stevenson et al. 1995; personal communication, Andy Baldwin, University of Maryland College Park, 2004). However, geese did not graze the *Peltandra virginica*, *Juncus effusus*, and *Schoenoplectus tabernaemontani* (personal communication, Andy Baldwin, 2004). Managers dealt with this problem by constructing goose-exclusion fences, a method developed by Ed Garbisch of Environmental Concern in St. Michaels, MD. Managers at Kenilworth found these simple fences, consisting of wooden stakes and string, to be highly effective in protecting the newly planted areas from geese and other waterfowl (Bowers 1995). This year, 2004, the vegetation at Kenilworth and its associated fringe marshes appear to be vigorously growing back in spite of the geese (personal communication, Dan Sealy NPS, 2004). One hypothesis explaining the changes in goose impacts on a developing marsh is that the seed bank in placed dredge material may take several years to develop, after which the marsh is resistant to goose herbivory.

Some individuals are concerned that muskrats and nutria may impact the revegetation of restored areas of DMP. A 28-year old study of mammals in DMP and the surrounding areas indicated that muskrats were present and nutria were not (Appendix G). After extensive research and communication with other nearby marsh preserves, current activities of muskrats are unknown and to the best of our knowledge, nutria are not present in the area.

Therefore, the questions that need to be addressed by participants at the workshop are:
- Will herbivory by geese, mammals, carp, and/or turtles impact the revegetation of restored portions of the marsh? If so, what management approaches need to be taken to minimize the impact?
- How resistant is Dyke Marsh to goose herbivory?
  - Will restoration attract more geese to Dyke Marsh and lead to greater impacts on the existing marsh?
H. Fish and Wildlife Habitat

Some parties have expressed a concern for destroying or providing sturgeon habitat when restoring DMP. In recent U.S. FWS fish surveys, short-nose sturgeon (*Acipenser brevirostrum*) was not recorded in Dyke Marsh (see Fish section pg. 36). Past surveys from 1994 lists *Acipenser brevirostrum* as "apparently extirpated", and *Acipenser oxyrhynchus* as "very rare" (Appendix D). A 3-year study by the USGS and USFWS was recently initiated to survey the Potomac River for reproducing populations of short-nose sturgeon. Experts currently do not know if short-nose sturgeon exist in the Potomac River anymore. Sturgeon prefers cobble bottom substrate for habitat, and the substrates of DMP do not fit that description. Therefore, current information suggests that restoration at DMP will not impact sturgeon because they have not been sampled in the area and the habitat does not currently exist at DMP.

Marsh wren (*Cistothorus palustris*) habitat is also of concern. Spencer (2000) claims that Dyke Marsh provides the only suitable habitat for a breeding marsh wren population in the upper tidal zone of the Potomac River (pg. 37), therefore, it is important to consider their habitat and how it may be affected when designing restoration alternatives.

Habitat for the king rail (*Rallus elegans*) and Virginia rail (*Rallus limicola*) is also of concern. These two species prefer to be in fresh to brackish water marsh habitats containing a variety of cattails, rushes, and sedges. The king rail was found extensively in the 1980s near the Patuxent River in Maryland (Robbins and Blom 1996), was observed as a possible breeder in Dyke Marsh in 1985 (Van Alstine et al. 1992), and was known to be of general and resident occurrence in Fairfax County, Virginia in 2003 (VA DGIF 2004). Reasons the king rail may not be common at Dyke Marsh may include: they are adversely affected by human disturbances; the species prefer early succession stages; they prefer undisturbed and undeveloped areas; and sediments, pollution, and water quality need to be under control (VA DGIF 2004). The Virginia rail is adversely affected by development, dredging, industrial chemicals and agricultural practices (VA DGIF 2004).

The least bittern (*Ixobrychus exilis*), a rare bird species in Virginia, has been observed breeding very near to Dyke Marsh in Huntley Meadows County Park (Van Alstine et al. 1992). In June and August of 1991, least bittern were found in Dyke Marsh near Hog Island Gut. Visiting the same location twice during the nesting season may be evidence for breeding (Van Alstine et al. 1992). Habitat preferable to least bittern includes very dense and tall marsh vegetation (*Typha* sp., sedges, and grasses) (VA DGIF 2004).

Therefore, the questions that need to be addressed by participants at the workshop are:

- Will restoration efforts drive fish and wildlife species away through disturbance?
- When would be the preferred time to complete restoration to not adversely affect species of concern?
- Should a goal of the restoration be to encourage short-nosed sturgeon to locate to the marsh?
• How can current fish and bird species and communities be protected in a restoration effort?
• Should restoration focus on encouraging rails to return to the marsh?
• Will we have more nesting pairs of marsh wrens after restoration?

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Blankenship, K. 2004. It’s a hard road ahead for meeting new sprawl goal: states will try to control growth of impervious surfaces. Bay Journal 14(5). Alliance for the Chesapeake Bay.


Different reasons for restoration and end goals

Before we go on to discuss the fundamental questions involved in the decision to restore DMP, we should think about the different reasons groups may have for restoring the marsh. Tied into those reasons to restore are what end goals each group is interested in achieving through a restoration. There are always several reasons to restore an area, and many times a restoration project can fulfill many reasons and goals with one design. Some reasons to restore DMP include:

1. To reduce / halt erosion of marsh edges.
2. To increase size of emergent marsh without harming existing marsh.
3. To restore healthy submersed aquatic plant beds.
4. To restore area to pre-dredging size (Figure 4).
5. To protect the marsh from sea level rise and stressors associated with development of the watershed.
6. To create habitat (cobbley bottom substrate) for short-nose sturgeon.
7. To increase or maintain breeding habitat (dense Typha stands) for marsh wren.
8. To increase or maintain habitat (tall, dense, Typha stands) for least bittern.
9. To create habitat (dense cattails, rushes and sedges) to encourage rail species to return.
10. To enhance diversity of emergent marsh.
Fundamental Questions

A positive restoration effort requires that consensus can be established among partners and stakeholders in the restoration process. To establish a consensus on whether to move forward with restoration, several fundamental questions need to be addressed by all involved groups to rigorously evaluate whether restoration of Dyke Marsh Preserve (DMP) is feasible (Figure 39). We will first start by discussing the need for restoration (1). If a need exists, we will discuss the potential negative consequences of restoration on the existing marsh (2). If negative impacts can be avoided or can be reconciled, we will briefly discuss essential information, materials and financial support for moving forward with a restoration (3, 4). Our final goal will be to document levels of support from all groups involved and evaluate whether the levels of support are sufficient to deem the restoration feasible (5).
Figure 39. Decision tree to establish feasibility of restoring Dyke Marsh Preserve.
Fundamental Questions to be addressed to make a decision on whether or not to restore Dyke Marsh Preserve

1) Does a need exist for restoring Dyke Marsh Preserve?  Yes  No

Specific study questions:
   a) Do federal mandates exist for restoring the marsh?
      i) What are minimum levels for restoration to fulfill federal mandates?
   b) Is the current marsh undergoing significant change that may threaten the long-term existence and stability of the marsh?
      i) Are shorelines eroding?
      ii) Are invasive species or herbivory currently destabilizing the marsh?

If a need exists, different end goals of restoration need to be discussed and agreed upon that specifically respond to the need. Hence, further study questions are:
   c) What is the ecological value of restoration?
   d) Which attributes appear to be restorable?
      i) What extent of restoration is necessary to make the effort worthwhile?
      ii) Which end goals of restoration have highest priority?

2) Considering different end goals and scenarios of restoration, would the existing marsh at Dyke Marsh Preserve be negatively affected by restoration?  Yes  No

Specific study questions
   a) How could composition of vegetation change?  Non-natives increase?
   b) How could species of concern be impacted, such as marsh wren, least bittern, and sturgeon?
   c) How could herbivory become a problem?
   d) How will water quality be altered?
   e) How could shoreline erosion increase?
   f) What are the greatest risks to the existing marsh?
   g) What are the greatest risks to the ecosystem immediately surrounding the marsh and down-stream from the marsh?
3) Do we understand the marsh ecosystem at Dyke Marsh well enough to complete a restoration project without harming the current marsh?  Yes  No

If no, what other information is needed and is this information crucial to obtain before restoration commences?

4) Will suitable dredge material be available?  Yes  No  If yes, when?

5) Will funding be available to fully complete the restoration, post-restoration monitoring, and control of exotic species?  Yes  No

6) Given the answers to the aforementioned questions, will all involved parties support a restoration effort at Dyke Marsh?  Yes  No  Maybe

7) If maybe (6), what changes to the restoration process would need to be included in a recommendation for you to support DMP restoration?
Scenarios

Several different scenarios could be considered if the decision is made to go ahead with restoration. Some scenarios may respond to different primary concerns and/or fundamental questions than others. Four general scenarios are easily identified, but many more detailed options should be discussed.

Whole marsh restoration
The whole marsh restoration scenario represents the idea of restoring the entire emergent marsh area. This could include filling all dredged areas, repairing eroded shorelines, and creating an emergent marsh area the size of DMP before it was ever dredged. An important idea to consider with this scenario is, what time in history the marsh should be restored to, e.g. pre-dredging, pre-diking. This scenario would be the most extensive, and costly.

Partial marsh restoration
The partial marsh restoration scenario represents the idea of restoring specific areas of the marsh, such as the deep holes around the edges of the marsh that were dredged in the past (see Figure 15). If this scenario is selected, more thought would need to go into the amount of area to restore, and the effects that may occur as a result of filling those holes. This scenario, along with the whole marsh restoration, would have to incorporate the U.S. Army Corps of Engineers to assist with supplying dredge material and filling the holes.

Shoreline erosion control
The shoreline erosion control scenario represents the idea of restoring specific areas of the marsh that have been severely eroded or may become severely eroded in the future. Further investigations into shoreline erosion and the causes of it at DMP would need to take place before making specific recommendations on where and how to restore.

Staged restoration
The staged restoration scenario represents the idea of restoring the marsh in stages through time. This could essentially include the entire marsh, eroded shorelines, filling deep holes, etc., but differs from the whole marsh restoration scenario in respect to the time frame. If this scenario is chosen, many decisions would need to be made regarding the amount of marsh to be restored and a timeline for restoration of all areas chosen.