Assessment of Vegetation Along Peconic River Post Remediation

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Abstract

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The Peconic River running through the property of Brookhaven National Laboratory is the focus of a remediation process to eliminate contaminated sediments inadvertently created by the laboratories past practices. An assessment of planted vegetation from April 2002 is being conducted to monitor how reintroduced vegetation has thrived. The methods used to assess the vegetation's progress includes 1) identifying native and invasive plant species, 2) mapping various plant species with a Thales Navigational Mobile Mapper GPS unit and 3) comparing present results with the original revegetation planted in April 2002. The data collected will be used to determine how different species adjust after the remediation process has occurred.

INTRODUCTION

The Peconic River running through the property of Brookhaven National Laboratory (BNL) is the focus of a remediation process to eliminate contaminated sediments created by the Laboratories past practices. Brookhaven National Laboratory supported by the Department of Energy (DOE) in March 2002 began the remediation process. The Brookhaven National Laboratory's Sewage Treatment Plant became a route for contaminated sediments to inadvertently pollute the river from waste disposal practices. Sediments such as Polychlorinated biphenyls, pesticides, radionuclides and elevated concentrations of metals were found in the section of the river that spanned between the Sewage Treatment Plant and various offsite depositional areas [1]

Pilot studies were performed on site to evaluate the success of remediation in the wetland habitat. After review, DOE, Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) agreed that conducting pilot studies would help assess the potential success of select technologies to remediate and restore the Peconic River habitat. One section of the Peconic River used as a pilot study was Area D, which runs along the eastern boundary of the laboratory crossing into residential properties, as seen in figure 1 (area of study shown in red). Area D was chosen for the study due to the areas' accessibility for equipment from North St., the public could easily view it, and the site is on the Laboratories' property [2].

United States Fish & Wildlife Service National Wetlands Inventory classified Area Ds' five acres of pre-remediation wetland resources as Palustrine Scrub-Scrub Broad Leaved Deciduous/Emergent Seasonally Flooded and/or Saturated (PSS1/EME) wetlands. The sites biodiversity included *Carex sp.* (sedge species), *Vaccinium* *corymbosum* (high bush blueberry*)*, *Clethera alnifolia* (sweet pepperbush), *Juncus effuses* (soft rush), *Sparaganium americanum* (American Burreed), and *Phalaris arundinacea* (Reed Canary Grass)[1]

A dense population of the invasive Reed Canary Grass inhabited a major portion of Area D. Reed Canary Grass is an invasive species, introduced from Europe and Asia. Reed Canary Grass is an aggressive species that reproduces by seed or creeping rhizomes. Growth peaks occur from mid June to August with a second growth peak in the fall. The grass can grow on dry soils in upland habitats but does best fertile, moist organic soils in full sun. The species prefers disturbed areas such as ditching of wetlands, stream channelization and sedimentation. Once established, reed canary grass dominates an area by building up a tremendous seed bank that will erupt, germinate and recolonize treated sites. Reed Canary Grass has a history of establishing a wetland area and reducing biodiversity in a twelve-year time period [3].

In March 2002, 740 cubic yards of contaminated sediments were excavated from transect regions two through six. Sediment was removed twelve to twenty-four inches below land surface and another six to twelve inches from the channel area [1]. Standard construction equipment and a small wide track, long arm excavator was used to remove sediments. Waste management involved waste characterization based on the criteria for disposal at either an approved sub-title D landfill or a low level radioactive mixed waste facility [2].

The wetlands restorations involved many critical stages to help facilitate the area towards recovery. After the completion of sediment removal an excavator was used to carve out an open water channel. A substrate material was used to contour the topography and also to replace the removed sediment. Approximately 821 cubic yards of topsoil replacement was spread over the restoration area. All areas from which sediment was removed (including ten feet beyond the area of disturbance) a native grass mixture of fifty percent winter rye (*Secale cereale*) and fifty percent switch grass (*Panicum virgatum*) was hand sown. Approximately forty-five pounds of seed was planted in the area. Erosion control was established through the use of coconut fiber soil erosion control blankets. Six-foot wide coconut blankets were used to cover the entire wetlands area [2].

Native vegetation species were planted to complement the wetlands habitat. Planting locations of species were selected based on species habitat preference (hydrology and topography). Species were installed in a two-foot alternating pattern over the entire marsh. The two-foot spacing pattern was chosen because it was thought to help prevent the recolonization of invasive species. High marsh areas consisted of *Carex stricta* (tussock sedge), *Carex crinita* (fringed sedge), and *Carex lurida* (shallow sedge). The low marsh areas consisted of soft rush and American burreed [1].

The half-acre section of Area D that spans from the stream gauging station to the BNL property boundary was divided into transects labeled two through six. The transects contained three one meter squared monitoring plots to represent the overall percentage of each species in the wetland area. . The transects provided a standardized sample for the monitoring of each microhabitat in the wetlands area because they took cross-sections of the river. Transect two is directly downstream from the stream gauging station increasing up to transect six which lies downstream of the wetland [5]. The monitoring frequency of these areas was to be monthly from April 2002 to October 2002, with semi annual evaluations occuring for the first two years. Annual monitoring would occur thereafter for a period of five years [1].

METHODS AND MATERIALS

A Thales Navigation Mobile Mapper GPS unit with Wide Area Augmentation System and post processing capabilities was used delineate polygons and points in the restored area. Large abundances of plants were mapped as polygons. Single plants were entered as separate points in the GPS. An initial river boundary was logged into the system under the line option to get the parameters for mapping. The river boundary is a representation of where the forest and high marsh merge. The most abundant species in the area of study were mapped first in the polygon setting proceeding down to single plants with no similar species adjacent to them, which were mapped as points. Mapping was performed when ideal satellite and PDOP numbers were available. The goal of successful mapping was to have the highest number of satellites combined with the lowest number for the PDOP. The minimum number of satellites that could enable accurate mapping was five. The highest number PDOP allowable for mapping was eight.

At the end of each survey, vegetation data was uploaded into the computer and exported into the GIS software program where it would begin to form a body within the initial river border (Figure 2). Once entered in the GIS software the data was post-processed to further enhance accuracy. The GPS/GIS had a 2-3 meter error margin that must be accounted for when interpreting the resulting data.

Other materials used to help compare the present vegetation status with the previously planted vegetation were a digital camera (see photographs 1,2, and 3) and planting maps. Flagging tape was used to help identify the boundaries of each polygon.

The digital camera also helped with the identification of unknown species. A field guide was constructed to easily identify each species present in the wetland. A two way radio and cellular phone were used for communication and emergencies.

RESULTS

Table 1 displays the area of points and polygons in feet squared, the total maximum area in feet squared and the percentage of vegetation by area for each species. Points were assumed to be less than one meter squared. Points were calculated by multiplying each point by 10.7639 to convert from meters squared to feet squared. The GIS software automatically calculated the area of polygons because the polygons have eccentric and non-linear shapes. To receive the data for the total maximum area in feet squared the sum of the area of points was added to the sum of the area of polygons. The total maximum area of each species was divided by the total area of vegetation covered to receive a percentage of vegetation for each species.

The species found to be present in the area of study were *Clethra alnifolia, Eleocharis acicularis* (Needle Spike Rush), *Juncus effusus, Moss, Nyssa sylvatica* (Black tupelo), *Osmunda cinnamonea*(Cinnamon fern), *Plalaris aruninacea, Quercus bicolor*, (Swamp White Oak), *Scirpus cyperinus* (Wool Grass), *Smilax, Sparaganium americanum, Typha latifolia* (Common Cattail), and *Vaccinium corymbosum.*

Table 1 presents a significant percentage difference between *Phalaris arundinacea* (Reed Canary Grass) and all other vegetation species present in the area surveyed. The total area of vegetation covered was 11,231 square feet. Of the 11,231 feet squared, 79.8 percent was Reed Canary Grass. The second largest vegetation population in the area was *Juncus effusus*, which was 13.7 percent. The species percentages began to drop dramatically to 3.0 for the American burreed. The ten other species identified in the area of study were found to be less than one percent each.

DISCUSSION AND CONCLUSION

The restoration project objective was to obtain 80-85 percent survivability among planted vegetation species [4]. Six months later, in October of 2002 the success of the wetland restoration was determined by having achieved a 98 percent survival rate of planted wetland species [2]. Based on the current calculations, survivability for planted species is 21 percent. Many of these plants looked stressed and stifled due to the invasive grass that inhabits the area. There were no preliminary percentages noted for each species planted in the area, which makes it difficult to compare with the data presented in Table 1. It is assumed that once restored, the project area had no Reed Canary Grass present (see photo 1). As seen in Figure 1, the Reed Canary Grass dominates the area of excavation by 79 percent (see photo 2). It is unclear how this invasive species was introduced into the wetland habitat, but it requires more management than initially anticipated.

ACKNOWLEDGEMENTS

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REFERENCES

[1] Roux Associates, Inc. “Six Month Wetlands Monitoring Report” October30, 2002.

[2] Environmental Management Directorate, Brookhaven National Laboratory. Completion Report, Operable Unit V Peconic River, “Sediment Removal and Wetland Restoration Study” December 31, 2002.

[3] Wisconsin Department of Natural Resources “Reed Canary Grass” February 04, 2004.

[4] Roux Associates, Inc. Attachment D, Operable Unit V, “Wetland Removal and Reconstruction Pilot Study Revegetation Plan” March 6, 2002.

[5] L.Appel, G.Ricciotti Brookhaven National Laboratory “Assessment of Wetland Areas Along Peconic River Proposed for Remediation” July 25, 2002

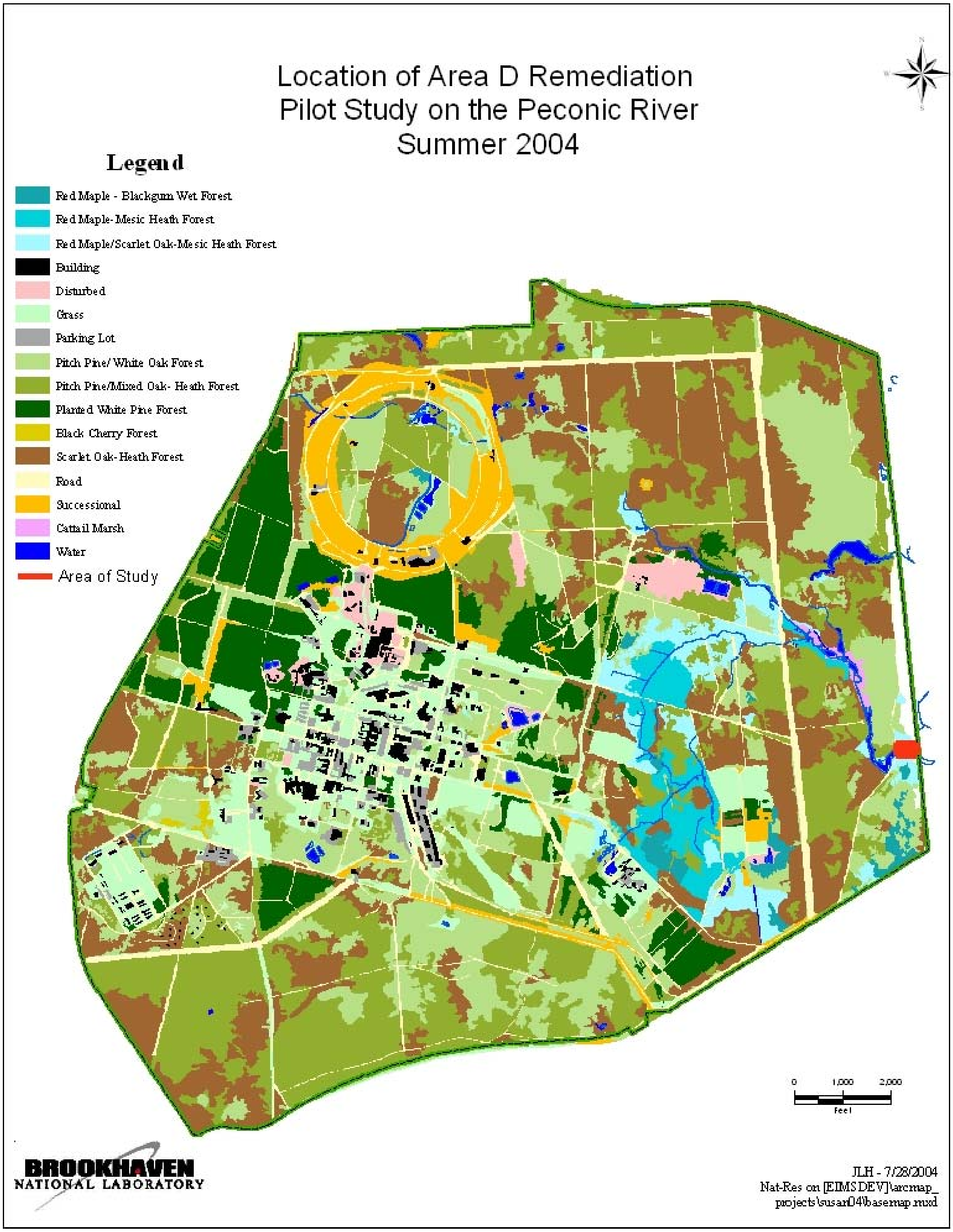
Photograph 1

Photograph 2

Photograph 3

Species	Area of Points in Feet ^{2}	Area of polygons in Feet ^{2}	Total Maximum Area in Feet ^{2}	Pecentage of Vegetation by area
Clethra alnifolia	43.06		43.06	0.383
Eleocharis acicularis	53.82		53.82	0.479
Juncus effusus	656.60	887.11	1543.71	13.744
Moss	10.76		10.76	0.096
Nyssa sylvatici	32.29		32.29	0.288
Osmunda cinnamonea	32.29		32.29	0.288
Phalaris arundinacea	161.46	8805.31	8966.76	79.834
Quercus bicolor	10.76		10.76	0.096
Scirpus cyperinus	32.29		32.29	0.288
Smilax	43.06		43.06	0.383
Sparaganium americonum	226.04	118.57	344.61	3.068
Typha latifolia	32.29		32.29	0.288
Vaccinium corymbosum	86.11		86.11	0.767
Total area of vegetation covered = 11231.82 feet ^{2}				

Table 1



Location of Area D Remediation
Pilot Study on the Peconic River
Summer 2004
Legend
Red Maple - Blackgum Wet Forest
Red Maple-Mesic Heath Forest
Red Maple/Scarlet Oak-Mesic Heath Forest
Building
Disturbed
Grass
Parking Lot
Pitch Pine/ White Oak Forest
Pitch Pine/Mixed Oak- Heath Forest
Planted White Pine Forest
Black Cherry Forest
Scarlet Oak-Heath Forest
Road
Successional
Cattail Marsh
Water
Area of Study
0
1,000
2,000
Feet
BROOKHAVEN
NATIONAL LABORATORY
JLH - 7/28/2004
Nat-Res on [EIMS DEV]\arcmap_
projects\susan04\basemap.mxd

Figure 1

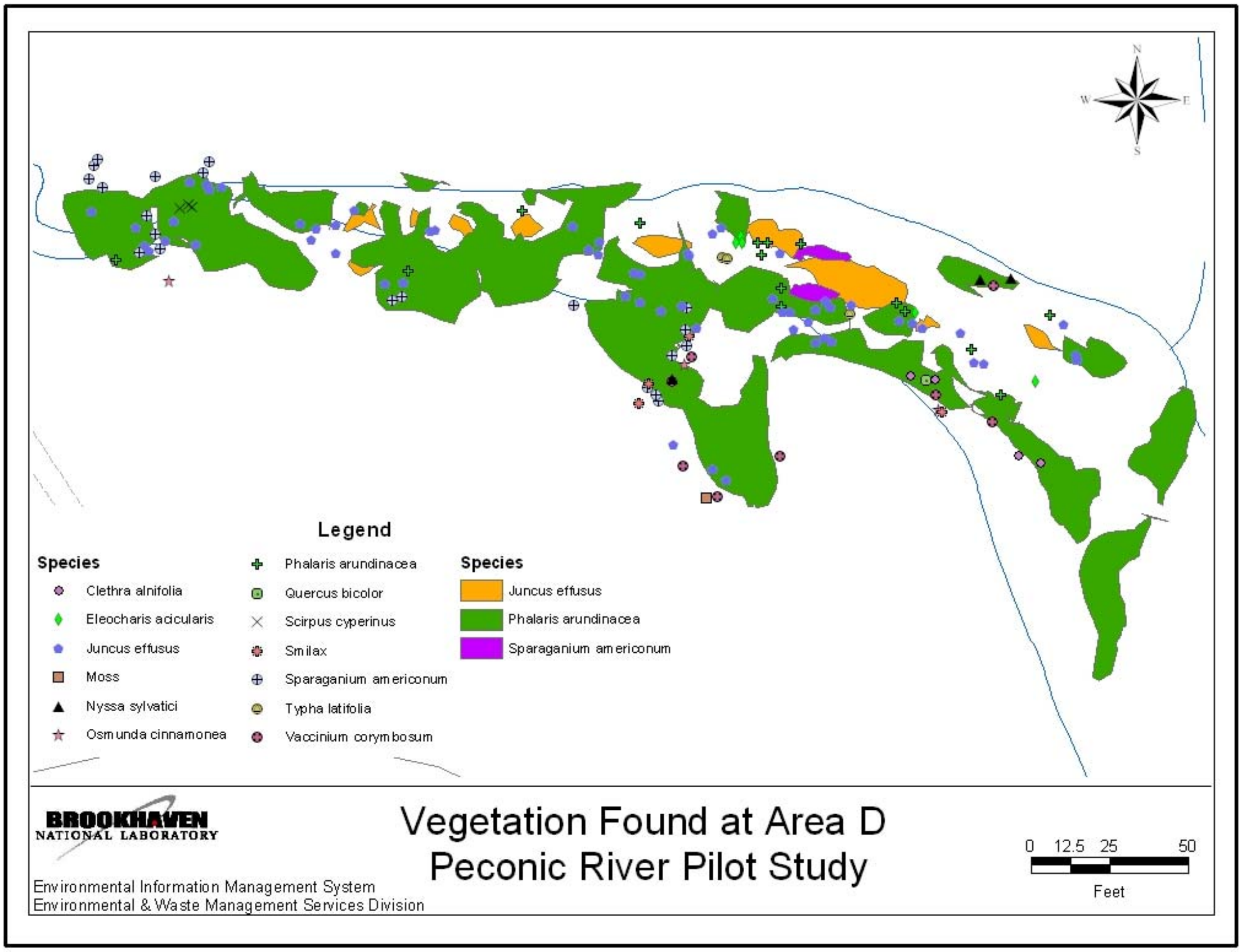

Legend
Species
Clethra alnifolia
Eleocharis acicularis
Juncus effusus
Moss
Nyssa sylvatici
Osmunda cinnamonea
Phalaris arundinacea
Quercus bicolor
Scirpus cyperinus
Smilax
Sparaganium americonum
Typha latifolia
Vaccinium corymbosum
Species
Juncus effusus
Phalaris arundinacea
Sparaganium americonum
BROOKHAVEN NATIONAL LABORATORY
Vegetation Found at Area D
Peconic River Pilot Study
Environmental Information Management System
Environmental & Waste Management Services Division
0 12.5 25 50
Feet

Figure 2