

THE NEW YORK BOTANICAL GARDEN

January 29, 2016

Dr. Dennis J. Suszkowski  
Science Director  
Hudson River Foundation  
17 Battery Place, Suite 915  
New York, New York 10004

Re: 003/14E (Naczi)

Dear Dr. Suszkowski:

On behalf of The New York Botanical Garden, I am pleased to submit the enclosed final report to the Hudson River Foundation on *Conservation of Intertidal Vascular Plants of the Hudson River Estuary*. The Foundation's grant of \$15,000 has enabled Robert Naczi, Ph.D., Arthur J. Cronquist Curator of North American Botany at the Garden, along with project collaborators, to continue preparing conservation assessments for these vulnerable plants as well as spearhead efforts for protecting them along with their wetland habitat.

This work has included providing information, recommendations, and training to New York State Department of Environmental Conservation's personnel who are conducting conservation and restoration programs for the Hudson River Estuary; and training and providing professional development for students and early-career scientists focused on careers in conservation. In addition, Dr. Naczi educated the wider public about conservation of the native plants of the Hudson River Estuary through presentations and symposia.

If you have any questions about this report, please do not hesitate to contact me at 718.817.8622, or [bthiers@nybg.org](mailto:bthiers@nybg.org), or Dr. Naczi at 718.817.8087, or [rnaczi@nybg.org](mailto:rnaczi@nybg.org). Thank you again for the Hudson River Foundation's support of this project, which is making a major contribution to environmental protection in the Hudson River Estuary.

Sincerely,

A handwritten signature in black ink, which appears to read "Barbara M. Thiers".

Barbara M. Thiers, Ph.D.  
Patricia K. Holmgren Director of the Herbarium  
and Vice President for Science Administration

BMT/scc

Enclosures

c: Dr. Robert Naczi

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Bronx, New York 10458-5126

Tel 718.817.8700 • Fax 718.220.6504 • [www.nybg.org](http://www.nybg.org)

***CONSERVATION OF INTERTIDAL VASCULAR PLANTS OF THE  
HUDSON RIVER ESTUARY***

**Technical Report of 2015-16 Activities Funded by the  
Hudson River Foundation**

**HRF Grant #003/14E**

**Robert F. C. Naczi, Ph.D., Principal Investigator  
Arthur J. Cronquist Curator of North American Botany  
New York Botanical Garden  
2900 Southern Boulevard  
Bronx, New York 10458-5126  
rnaczi@nybg.org**

**January 29, 2016**

**THE NEW YORK BOTANICAL GARDEN**

**MAUREEN K. CHILTON, CHAIRMAN**

**GREGORY LONG, CEO AND THE WILLIAM C. STEERE SR. PRESIDENT**

**JANUARY 2016**

## THE NEW YORK BOTANICAL GARDEN

### *Conservation of Intertidal Vascular Plants of the Hudson River Estuary*

#### ABSTRACT

The New York Botanical Garden (NYBG) is pleased to submit this final report on *Conservation of Intertidal Vascular plants of the Hudson River Estuary*. The accomplishments of this project were made possible by a grant of \$15,000 from the Hudson River Foundation. The project was led by Principal Investigator Robert Naczi, Ph.D., Arthur J. Cronquist Curator of North American Botany at NYBG.

Intertidal zones of the Hudson River estuary constitute habitats that host rare vascular plant species of conservation concern. These species are restricted or nearly restricted to intertidal habitats, and several grow only in the northeastern U.S.A. Grave threats challenge the survival of these species, including pollution and invasive species. Because of the narrow ecologic and geographic specificity of intertidal-restricted plant species, one would expect them to be the most sensitive of all plants in the Hudson River Estuary, and thus the best botanical indicators of environmental health. Thus, intertidal plants of the Hudson River constitute a top priority in conservation.

The focus of this project is a group of 32 species of vascular plants restricted or nearly restricted to intertidal zones of the Hudson River. During this project, Dr. Naczi worked with a college student to produce GIS-based maps and analyses of the intertidal species. These maps are helping to identify and assess extent of changes in distributions and frequency of populations of intertidal species through time.

Dr. Naczi conducted a small amount of field work, which led to important findings for rare intertidal plants, including one significant discovery—the second-largest known population in Hudson River Estuary of globally rare *Bidens eatonii* (Asteraceae); and one important rediscovery—a population of *Iva frutescens* (Asteraceae).

Dr. Naczi participated in training staff from the New York State-Department of Environmental Conservation (NYS-DEC), assisting NYS-DEC staff with restoration efforts in the Hudson River Estuary, and sharing information on intertidal plant occurrences. The college student who assisted with GIS mapping and analyses gained useful experience that helped her in her quest to begin a career using GIS to apply to real-world conservation challenges and urban planning. To disseminate the findings of this project, Dr. Naczi delivered five public oral presentations to 690 people.

## INTRODUCTION

The southern portion of New York's Hudson River encompasses a major estuary that extends 150 miles from the Federal Dam at Troy to the river's mouth in New York City. This estuary provides habitat for a particular group of vascular plant species. From a conservation perspective, the most important of these plants are those species that are restricted or nearly restricted to intertidal habitats—those zones that fall between low and high tides, and thus are alternately submerged and exposed twice each day. Besides occupying the very restricted habitats of intertidal zones, these plants tend to be specific to freshwater, brackish, or saltwater zones. Furthermore, with 15 plant species globally restricted to estuaries of the Northeast, this region merits consideration as a center of endemism for the northeastern United States, and thus should be a priority for conservation. Moreover, because of the narrow ecologic and geographic specificity of intertidal-restricted plant species, one would expect them to be the most sensitive of all plants in the Hudson River estuary, and thus the best botanical indicators of environmental health.

Some of the ecosystem services provided by these native plants include cleaning water by absorbing pollutants, abating the effects of flooding and storm surges, providing food and shelter for wildlife, and sustaining pollinators. Intertidal plants are by nature rare because their habitats are limited in extent. Additionally, they are important because most of these species occur only in eastern North America, with several restricted to the Northeast. Not surprisingly, intertidal plants are vulnerable to extinction, with habitat destruction and pollution obvious threats to their continued survival.

## SUMMARY OF ACTIVITIES AND ACCOMPLISHMENTS

With gratitude for financial support from Hudson River Foundation, the PI is pleased to report on work accomplished during 2015 and early 2016 on the conservation of intertidal vascular plants of the Hudson River Estuary. Below are brief descriptions of activities and their outcomes related to this project.

### **Conservation Assessments**

The focus of this project is a group of 32 species of vascular plants restricted or nearly restricted to intertidal zones of the Hudson River. Highlights of work to produce conservation assessments for these species are as follows.

- The project team georeferenced many historic occurrences for intertidal plants in the Hudson River Estuary, as documented by herbarium specimens, which, during an earlier phase of this project, the PI studied, but had not yet georeferenced. Now that the PI has determined latitude and longitudes for these occurrences, they are available for use in GIS mapping and analyses.
- The project employed a college student experienced in GIS (geographic information systems), Ms. Lidia Henderson, to produce GIS maps of historic and current occurrences of intertidal vascular plants and conduct analyses of patterns of distribution, and patterns of change through time in these distributions.

- Examples of GIS maps show a relatively common species, *Amaranthus cannabinus* (Figure 1), and a species that is quite rare in the Hudson River Estuary, *Bolboschoenus novae-angliae* (Figure 2).
- An example of a GIS-based analysis is a series of violin plots of species population frequencies and locations (by latitude) of intertidal plant species (Figure 3).
- Currently, the PI is writing conservation assessments. The GIS work informs these assessments and enhances their value. The maps and violin plots are useful for showing changes in distributions of species through time, and where species continue to survive. For example, *Bolboschoenus novae-angliae* has disappeared from several populations in the southern portion of its historic range, though it continues to survive farther north (Figure 2).

### Field Work

Field work was a minor component of this project, but did provide an opportunity for training and sharing information with NYS-DEC staff, and exploration of two key sites for intertidal plants.

The following is a summary of the field work and its outcomes.

- June 22, 2015–Piermont Marsh, Rockland County: The project team worked with NYS-DEC staff (as described below in Information Dissemination, Training, and Outreach section); explored for *Carex hormathodes* (Cyperaceae), a species of interest to NYS-DEC staff historically known from Piermont Marsh, but not observed by the project team in 2015, despite much search.
- September 22, 2015–Piermont Marsh, Rockland County: The project team discovered three significant remnants of native plant occurrences that can serve as cores for restoration of native vegetation; rediscovered a population of *Iva frutescens* (Asteraceae), an intertidal plant very rare in the Hudson River Estuary that was last observed at Piermont Marsh in 1936; collected and prepared 19 specimens of intertidal plants to document their presence at Piermont, and deposited these specimens in the NYBG's William and Lynda Steere Herbarium.
- October 6, 2015–Haverstraw, Rockland County: The project team discovered second-largest known population in the Hudson River Estuary of globally rare *Bidens eatonii* (Asteraceae), a species completely limited to intertidal habitats in northeastern North America; collected and prepared 10 specimens of intertidal plants to document their presence at Haverstraw, and deposited these specimens in the Steere Herbarium.

### Information Dissemination, Training Activities, and other Outreach

- The college student who assisted with the GIS mapping and analyses, Ms. Lidia Henderson, gained valuable experience in using GIS that helped her attain her goal of starting a career using GIS to address conservation challenges and urban planning.

- The PI supplied information to NYS-DEC on historic and extant occurrences of intertidal plant species at Piermont Marsh, Rockland County, in order to assist with restoration of this key site (largest tidal salt marsh in the Hudson River Estuary) that is severely infested by invasive plant *Phragmites australis*, February 2015.
- The PI assisted NYS-DEC with drafting restoration plan for Piermont Marsh, March–August 2015.
- Supplied information on rare intertidal plant occurrences to Mr. Erik Kiviat, Executive Director of not-for-profit conservation organization Hudsonia, in order to help him with his study of impacts of invasive plants on native estuarine plants, May 2015.
- Led NYS-DEC staff (four people) on a field trip at Piermont Marsh in order to show them populations of rare intertidal plant species; to train them in identifying intertidal plant species; and to search for extant occurrences of one intertidal plant species that has not been seen in the Hudson River Estuary in decades that was of special interest to DEC— (*Carex hormathodes*, Cyperaceae)—on June 22, 2015.
- Led NYS-DEC staff (two people) on a field trip at Piermont Marsh in order to show them populations of rare intertidal plant species; to train them in identifying intertidal plant species; to search for remaining high-quality habitat; and to plan action for management of invasive plants on September 22, 2015.
- Supplied information to NYS-DEC on rare plant occurrences in and along tidal portions of Croton River at its mouth on Hudson River, Westchester County, New York, in order to assist with DEC efforts to manage a serious infestation of the aquatic invasive plant *Hydrilla verticillata* on January 22, 2016.
- Delivered the following public presentations, each of which included significant coverage of the project’s research on Hudson River intertidal plants and acknowledged Hudson River Foundation for funding support. Total number of attendees for these lectures was 690.
  - January 14, 2015. “Conserving the Plants of Northeastern North America,” Briefings from the Field: Highlights from the North American Plants Program, The New York Botanical Garden, Bronx, New York. Video: <https://www.youtube.com/watch?v=3iE4uWrqB2M>, 27:00–45:00. 125 attendees.
  - July 27, 2015. “New Floristic Manual for Northeastern United States and Adjacent Canada: Status report and emerging patterns.” Botany 2015 meetings, American Society of Plant Taxonomists, Edmonton, Alberta, Canada. 65 attendees.
  - September 18, 2015. “Floristic Change in the Northeast,” Native Plants Summit, The New York Botanical Garden, Bronx, New York. Video: <https://www.youtube.com/watch?v=EBim7kg7pEo>, 11:25–38:30. 450 attendees.

- October 16, 2015. “New Floristic Manual for Northeastern United States and Adjacent Canada: Status report and emerging patterns,” Science Seminar Series, The New York Botanical Garden, Bronx, New York. 35 attendees.
- November 13, 2015. “New Floristic Manual for Northeastern United States and Adjacent Canada: Status report and emerging patterns,” Columbia University Field Botany and Plant Systematics Class, class visit to The New York Botanical Garden, Bronx, New York. 18 attendees.

### CONCLUSION

The generosity of the Hudson River Foundation to *Conservation of Intertidal Vascular Plants of the Hudson River Estuary* has enabled Dr. Robert Naczi to make a tremendous contribution to the discovery of the grave threat to the survival of these vulnerable plants as well as to spearheading efforts to conserve them. This work included preparing conservation assessments of Hudson River intertidal plants; providing information, recommendations, and training to New York State Department of Environmental Conservation’s personnel who are conducting conservation and restoration programs for the Hudson River Estuary; and training and providing professional development for students and early career scientists focused on careers in conservation. In addition, Dr. Naczi educated the wider public about conservation of the native plants of the Hudson River Estuary through presentations and symposia. Everyone here is deeply grateful for the support of the Hudson River Foundation for this important research and conservation initiative for the Hudson River Estuary and for your longstanding commitment to NYBG’s work to promote environmental awareness, protection, and sustainability.

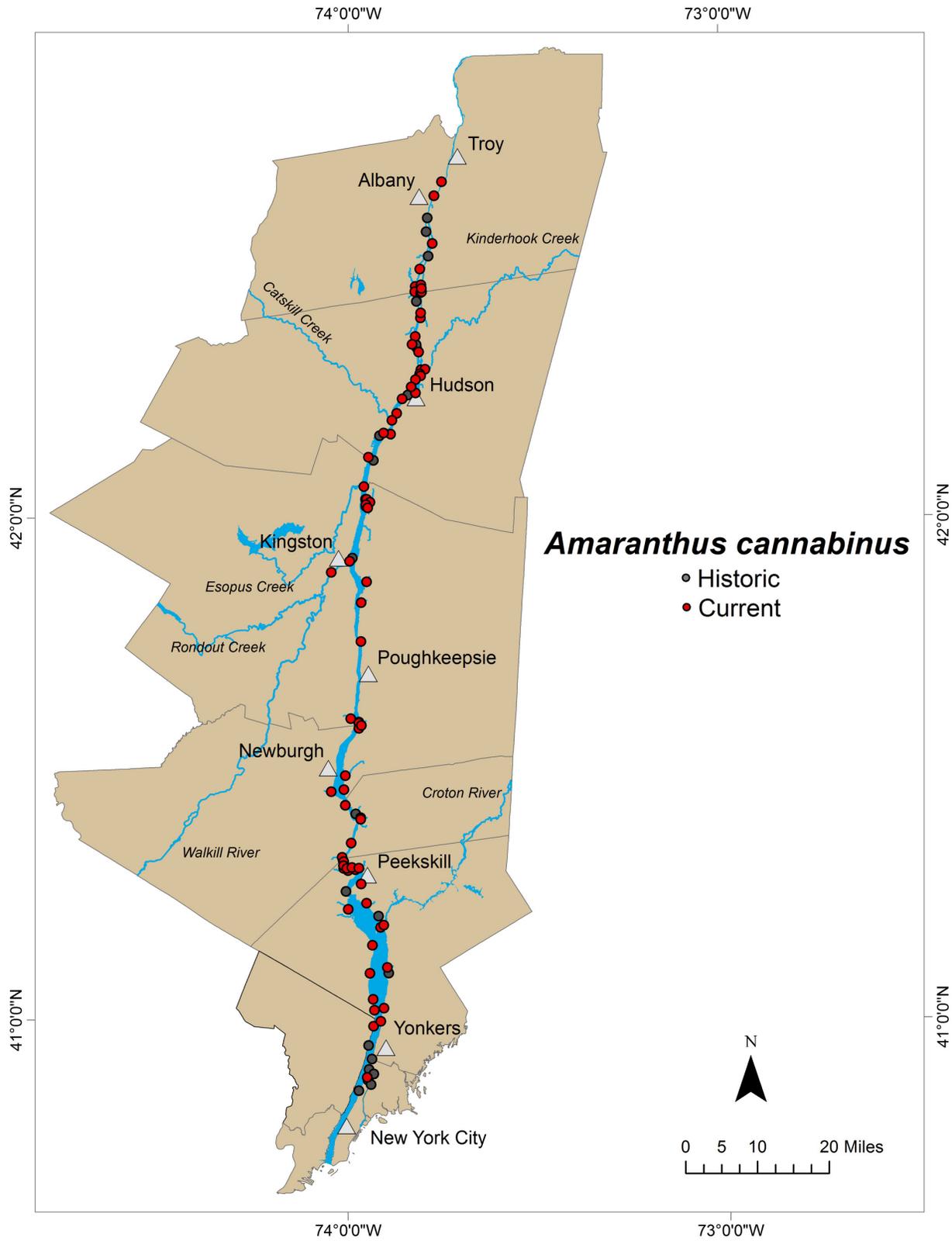


Figure 1. Historic and current distribution of *Amaranthus cannabinus* (Amaranthaceae) in Hudson River Estuary. Map by L. Henderson.

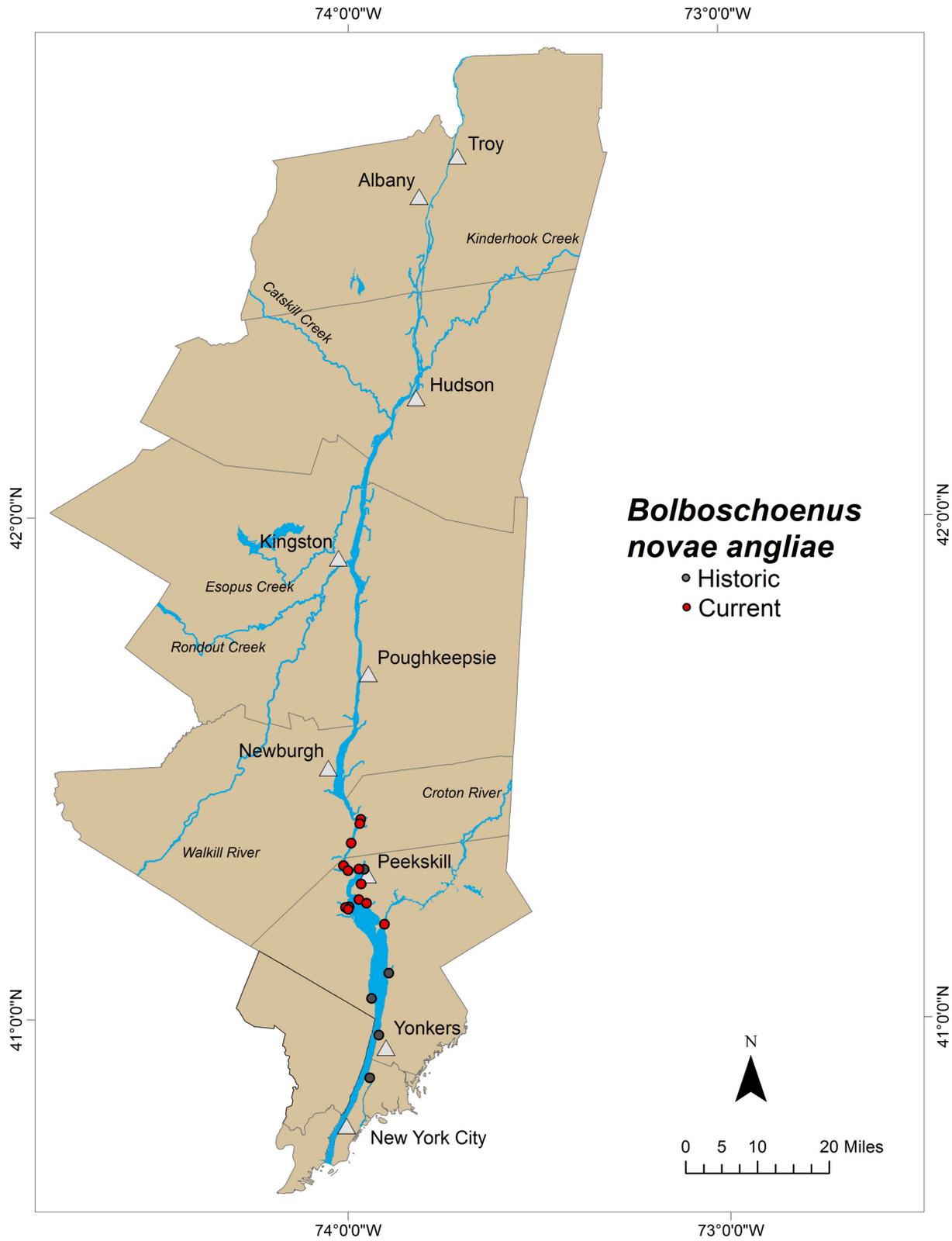


Figure 2. Historic and current distribution of *Bolboschoenus novae-angliae* (Cyperaceae) in Hudson River Estuary. Map by L. Henderson.



Figure 3. Violin plots of frequency and latitude of historic populations (red polygons) and current populations (teal polygons) of several intertidal vascular plant species in the Hudson River Estuary. Plot by L. Henderson.

**EXPENSE REPORT/ADVANCE REQUEST**

**Hudson River Foundation**

STATEMENT OF EXPENSES -- FROI 1/27/2016

HRF GRANT NO. 003/14E (Naczi) RECIPIENT NO. \_\_\_\_\_

PRINCIPAL INVESTIGATOR: Robert F. C. Naczi, Ph.D.

RECIPIENT ORGANIZATION: The New York Botanical Garden

REPORT NO.: 1

DATE: 27-Jan-16

REPORT:

INTERIM \_\_\_\_\_ FINAL X (CHECK ONE)

CATEGORY OF EXPENSE	PREVIOUS EXPENDITURES			EXPENDITURES FOR THIS REPORT		
	HRF SHARE (A)	COST SHARING (B)	TOTAL (C)	HRF SHARE (D)	COST SHARING (E)	TOTAL (F)
<b>DIRECT COSTS</b>						
<b>LABOR</b>						
1) Robert Naczi, Ph.D., PI	4,500.00	4,500.00	9,000.00			
2) Elizabeth Kiernan (GIS Analysis)				1,388.00		
-						
-						
-						
-						
<b>A. TOTAL LABOR COSTS</b>						
<b>B. FRINGE BENEFITS</b>	1,922.00	1,922.00	3,844.00	521.00		
<b>C. NON-EXPENDABLE EQUIPMENT</b>						
<b>D. EXPENDABLE EQUIPMENT</b>						
<b>E. EQUIPMENT RENTAL</b>						
<b>F. BOAT USE</b>						
<b>G. COMPUTER SERVICES</b>						
<b>H. CONSULTANT SERVICES</b>	630.00	0.00	630.00	1748		
<b>I. TRAVEL</b>	1,084.00	1,813.00	2,897.00	568		
<b>J. PUBLICATION COSTS</b>	0.00	0.00	0.00	0.00		
<b>K. TOTAL OFFICE SUPPORT</b>	139.00	0.00	139.00			
(SUPPLIES, PHONE, POSTAGE, ETC.)						
<b>L. MISCELLANEOUS</b>		155.00	155.00			
-						
<b>M. TOTAL DIRECT COSTS</b>	8,275.00	8,390.00	16,665.00	4,225.00	0.00	4,225.00
<b>N. INDIRECT COSTS</b>	1,655.00	1,678.00	3,333.00	845.00	0.00	845.00
<b>O. SUBCONTRACTS</b>						
<b>P. TOTAL COSTS</b>	9,930.00	10,068.00	19,998.00	5,070.00	0.00	5,070.00
<b>Q. SHARING PERCENTAGE</b>	50.00%	50.00%	100%	100%	0%	100%

I hereby certify, to the best of our knowledge and belief, the above properly summarizes the grant expenditures and are supported by adequate documentation.

*AnneMarie Blancato*  
SIGNATURE

AnneMarie Blancato

TYPED NAME

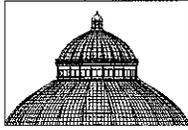
Chief Financial Officer

*2/1/16*  
DATE

**EXPENDITURE SUMMARY**

R. PREVIOUS EXPENDITURES - HRF SHARE (from line P(A))	9930
S. THIS REPORT - HRF SHARE (from line P (D))	5070
T. TOTAL EXPENDITURES TO DATE - HRF SHARE (lines R + S)	15000
U. TOTAL GRANT AMOUNT - HRF SHARE	15,000
V. % TOTAL EXPENDITURES TO DATE - HRF SHARE (line T / line U)	100%
W. AMOUNT OF PAYMENT NOW REQUESTED	2250

FOR HRF USE ONLY:



THE NEW YORK BOTANICAL GARDEN

January 29, 2016

Dr. Dennis J. Suszkowski  
Science Director  
Hudson River Foundation  
17 Battery Place, Suite 915  
New York, New York 10004

Re: 003/14E (Naczi)

Dear Dr. Suszkowski:

On behalf of The New York Botanical Garden and in regards to the project entitled *Conservation of Intertidal Vascular Plants of the Hudson River*, I am confirming with this notarized letter that the final expense report is accurate and that the grant was managed in accordance with standard accounting procedures.

If you have any questions about the expense report, please do not hesitate to contact me at 718.817.8671 or [ablancato@nybg.org](mailto:ablancato@nybg.org). Best regards.

Sincerely,

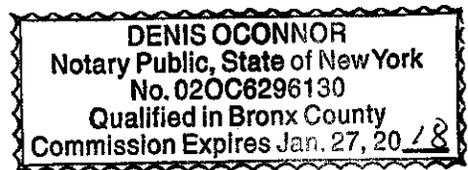
AnneMarie Blancato  
Chief Financial Officer

c: Robert Naczi, Ph.D., Curator of North American Botany  
Stephan Chenault, Director of Science Development

STATE OF NY  
COUNTY OF BRONX

SWORN TO ME THIS 29<sup>th</sup> DAY OF  
JANUARY, 2016

Den O'Connor



Bronx, New York 10458-5126

Tel 718.817.8700 • Fax 718.220.6504 • [www.nybg.org](http://www.nybg.org)