

2014

Resource Recovery Plan: *Bidens bidentoides*, A Rare Pennsylvania Plant

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Abstract

The purpose of this Resource Recovery Plan was to uncover information about a rare tidal marsh species in Pennsylvania, *Bidens bidentoides*. After compiling and determining its classification, description, ecology, conservation status, and historical populations, the plan shows what needs to be known and done about this species in terms of further research that should be conducted to prevent this species' extirpation.

In addition to compiling the plan that will be submitted to the Pennsylvania Department of Conservation and Natural Resources, three sites where *Bidens bidentoides* has been found in the past were visited to get a better understanding of its present populations. Also, the 120 specimens of *Bidens bidentoides* in the PH Herbarium at the Academy of Natural Sciences of Drexel University were imaged and databased. This historical population information will be made available to the public in the near future.

Disciplines

Botany

Comments

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Author: Chelsea Smith
The Eli Kirk Price Endowed Flora of Pennsylvania Intern

Date: April 2014

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INTRODUCTION

Assigning rarity to plants is a difficult task. The decision cannot be based just on numbers because there are other factors that influence the suspected longevity of a species. Not only does rarity have to be determined, but ranking of rarity does as well. Which species are in the most danger? There are committees of botanists who decide this for their local flora using a variety of guidelines and personal observations.

David DuMond created a general guide for determining whether a species is rare or not. To do this he developed a list of nine habitual traits. If a species fits one of these requirements and lives in a habitat that will be affected by the activities of man in the near future, its rare quota is filled. *Bidens bidentoides*, a native freshwater intertidal species, fulfills at least two of DuMond's requirements (DuMond 1973). This small plant, commonly known as the swamp or Delmarva beggartick, is found in a very specific habitat, the upper zone in three freshwater estuaries on the east coast of the U.S. According to local botanists, the numbers of *Bidens bidentoides* in its limited range, at least in Pennsylvania, has already decreased over the years due to increased usage of the Delaware River estuary system for industry.

Dr. Tim Block, the John J. Willaman Director of Botany at the Morris Arboretum received a grant to fund the compilation of Resource Recovery Plans for rare plant species in the state, which will be submitted to the Wild Resources Conservation Fund of the Pennsylvania Department of Conservation and Natural Resources. These plans include background information about the species, their habitat, and their distribution. Ultimately, these plans determine what needs to be known about the plant and what needs to be done in order to increase its numbers and survivability in its ecosystem. I have worked on one of these plans for the aforementioned *Bidens bidentoides*. The following is the majority of the plan, excluding a few sections that do not pertain specifically to *Bidens bidentoides* as a species or to its status in Pennsylvania. There is also some added information about what I did outside of the plan to enhance the accessibility of information for this little studied species.

CLASSIFICATION

The genus *Bidens*, in the Asteraceae family, includes 150-250 species, about 25 of which are native to North America (Fernald, 1950; Gleason and Cronquist 1991; Flora of North America Editorial Committee, e. 2006).

Bidens bidentoides (Nutt.) Britton is one of about 15 species of beggartick that have been documented in Pennsylvania (Rhoads and Klein 1993; Rhoads and Block 2007).

Nomenclatural History of *Bidens bidentoides*

In 1841, Thomas Nuttall described a new species based on a single specimen, *Diodonta bidentoides*, which was collected. He separated this genus from both *Coreopsis* and *Bidens*, two very similar genera, calling it an intermediate genus between the other two (Nuttall, 1841).

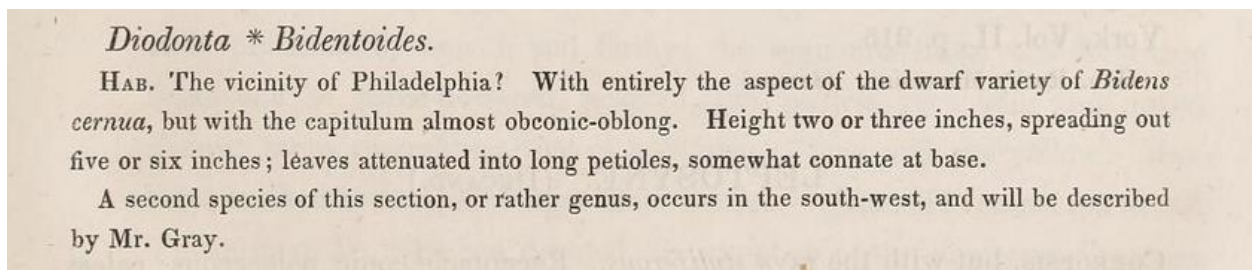


Figure 1: Original publication of *Diodonta bidentoides*

In 1842, John Torrey and Asa Gray described the same species as Nuttall, but called it *Coreopsis bidentoides*, mentioning that Nuttall's description was of one immature single plant of unknown origin (Torrey and Gray 1842).

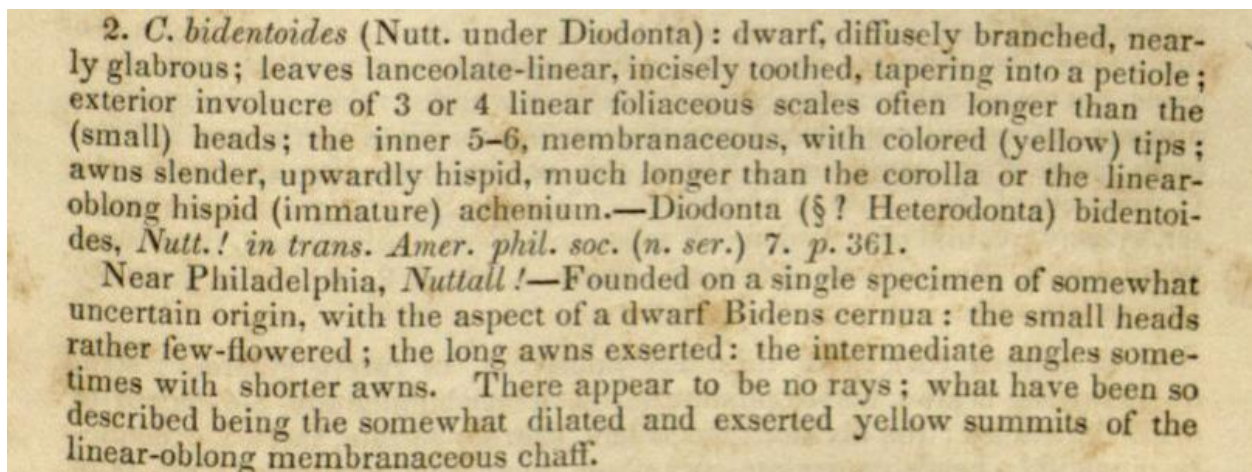


Figure 2: Original publication of *Coreopsis bidentoides*

This species was renamed again in 1893 by Nathaniel Lord Britton to *Bidens bidentoides*. Historically, the separation of the genera *Coreopsis* and *Bidens* centered on seed morphology; *Coreopsis* had winged achenes with antorsely barbed awns and *Bidens* had unwinged achenes with retrorsely barbed awns (Tadesse et al 1995). However, in the 1900s, the use of these morphological characteristics as sole identifiers was called into question. At the time, there were several species of *Coreopsis* known to have unwinged achenes when immature and therefore the use of this characteristic for identification purposes could only be applied when the plant was mature. The definitive separation of the direction in which the achene awns were barbed had also become troublesome when botanists began discovering North American plants identical to *Coreopsis* species, but with retrorsely barbed awns, and the opposite for *Bidens* (Sherff 1915, 1936, 1937). Britton indicated the inefficacy of utilizing barb direction as the sole identification feature when he moved six species of *Coreopsis* to *Bidens* in 1893, *Coreopsis bidentoides* being one of these, by using other morphological indicators (Britton 1893).

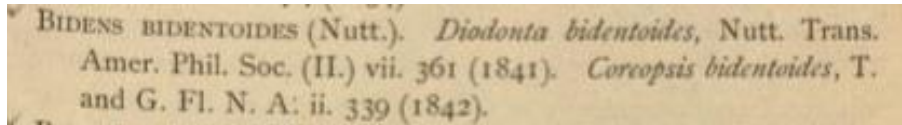


Figure 3: Original publication of *Bidens bidentoides*



In 1929, Sydney Fay Blake published a description of a new species that was almost identical to *Bidens bidentoides* except that its range was further south, in Maryland, and it presented shorter awns and pubescent corollas. He called it *Bidens mariana* (Blake 1929). A year later, Earl Sherff determined this species to instead be a variety, *Bidens bidentoides* var. *mariana* (Sherff 1930). The *Bidens bidentoides* found farther north was then also called a variety, *Bidens bidentoides* var. *bidentoides*, though this was unpublished. More recently, however, the species is typically not broken up into varieties.

Figure 4: Illustration for original publication of *Bidens mariana*

DESCRIPTION

Bidens bidentoides is an herbaceous annual that grows to be from 6 inches to 3 feet tall. The leaves are simple, oppositely arranged, lanceolate in shape with entire or serrate to denticulate margins. Flowers are usually in singly borne heads. The flower heads have calyx-like structure of 3-5 bracts or bractlets that are usually spreading, narrowly lanceolate, sometimes foliaceous, with margins entire. The involucre is narrowly campanulate to cylindric, with oblong phyllaries. There are no ray florets, however, there are 7-30 disk florets, 3-6 mm long with yellow corollas. The fruit is an achene-like cypsela that is red-brown, flattened, narrowly cuneate to linear, faces smooth or striated. There are two pappi that are erect to spreading with 2 antrorsely barbed awns (Strother and Weedon 2006; Rhoads and Block 2007)

Important distinguishing characteristics, specifically in Pennsylvania, include the lack of ray florets, simple lanceolate leaves with serrate to denticulate margins, and antrorsely barbed achene awns. These characteristics distinguish it from the other species of *Bidens* that grow in the same environment in Pennsylvania.

Figure 6: Simple, lanceolate leaves (Source: Rob Naczi)

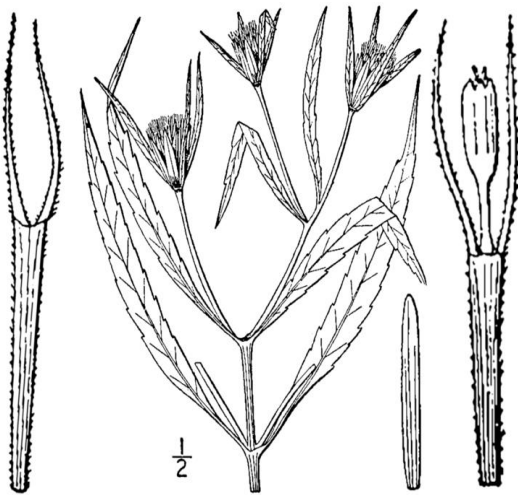


Figure 5: Botanical illustration of *Bidens bidentoides* (Source: Flora of the Northern United States, Canada and the British Possessions. 3 vols. Charles Scribner's Sons, New York. Vol. 3: 496.)

Figure 7: Lack of ray florets (Source: Rob Naczi)

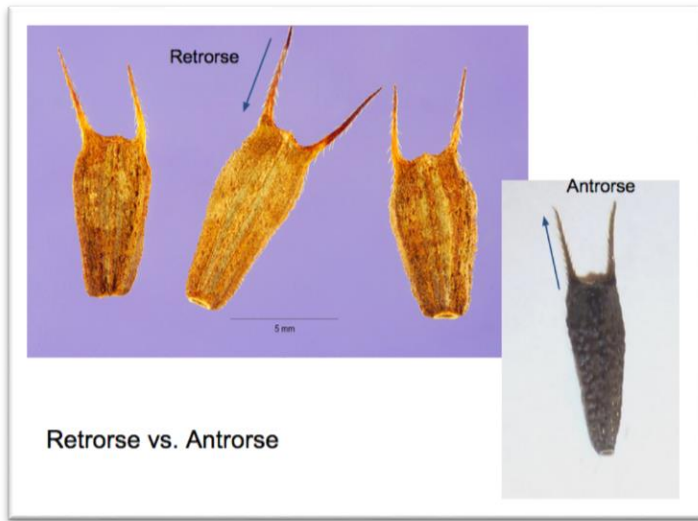


Figure 8: Achene barb direction

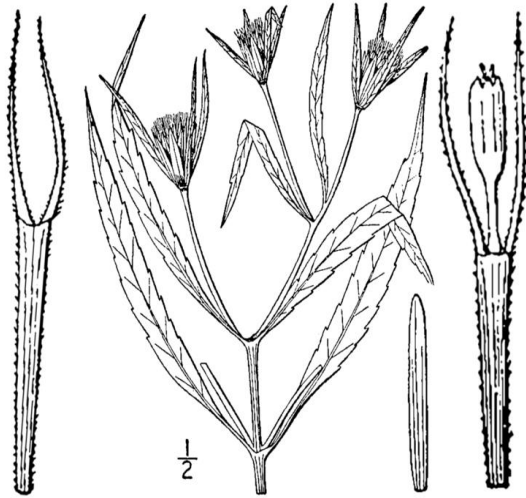
Phenology

Flowering occurs from late August to mid-October; fruits mature from late September to late October.

ECOLOGY

Range

Bidens bidentoides is found in counties in five states that have freshwater estuaries. Its northernmost reach is New York along the Hudson River, in Albany, Columbia, Dutchess, Greene, Rensselaer, and Ulster counties. The Delaware River estuary system is in three states. In Pennsylvania, *Bidens bidentoides* has been found in Philadelphia, Bucks, and Delaware Counties. In New Jersey, it has been found in Burlington, Camden, Cumberland, Mercer, Gloucester, Middlesex, and Salem counties. It is presumed to be extirpated in the last three counties. In Delaware it was found in New Castle County, though it is presumed to be extirpated there as well. At the most southern part of its region, it has been found along the Chesapeake in Maryland (Keller and Brown 1905; Benner 1932; Rhoads and Klein 1993; NatureServe 2013).



Retorse vs. Antrorse

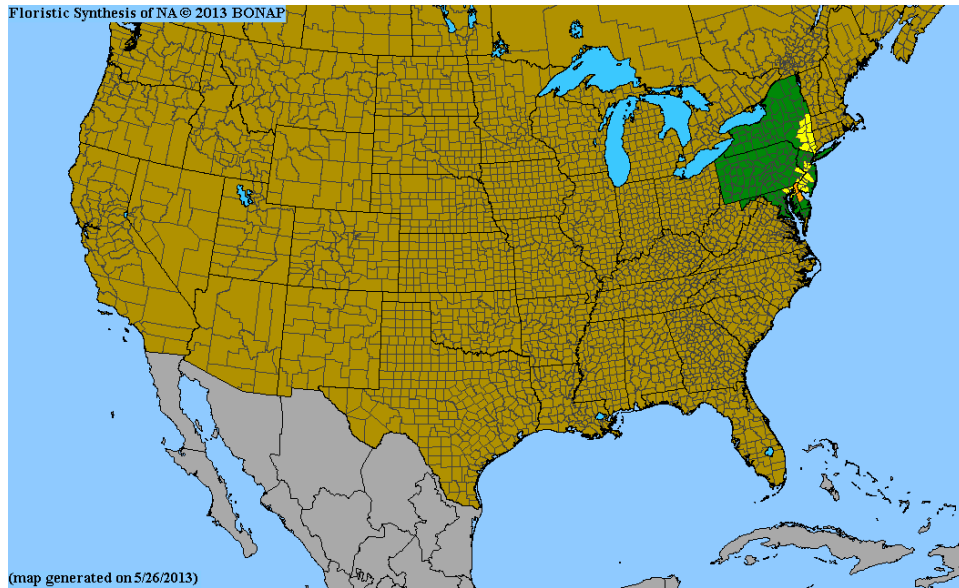


Figure 9: Range of *Bidens bidentoides*, in green

Habitat

The habitat for *Bidens bidentoides* is fairly restricted. It is a facultative wetland species that grows in freshwater intertidal marshes, mudflats, and shores. Often in the higher intertidal zone, it can be found growing among detritus or on decaying wood (Rhoads and Block 2007; PNHP Factsheet 2011).



Figure 10: Intertidal marsh in New York (Source: Robert Naczi)

CONSERVATION STATUS

Bidens bidentoides is classified as vulnerable at the global and national level (G3, S2). This global status was determined in 2005 and reviewed in 2009, but remained unchanged. It is ranked in every state in which it is found. It is ranked SH in Delaware (possible extirpated), S1 in Pennsylvania (critically imperiled), S2 in New Jersey (imperiled), and S3 (vulnerable) in both New York and Maryland (NatureServe 2013).

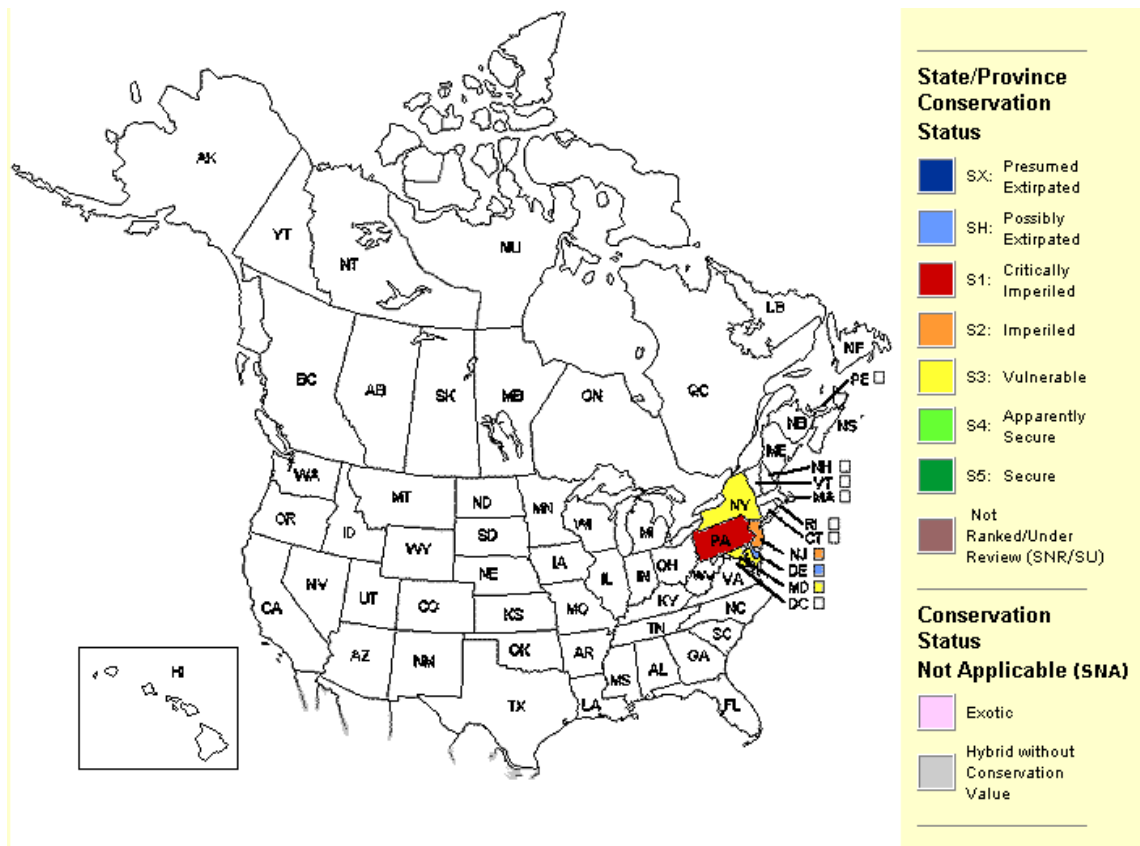


Figure 11: Conservation status of *Bidens bidentoides* (Source: NatureServe 2013)

HERBARIUM STUDIES

Herbaria are important for the study of plants in general. For this report, they are important for looking at historical and modern plant populations.

The two most likely herbaria to have specimens of *Bidens bidentoides* from Pennsylvania and the two that I had access to were the herbarium here at Morris Arboretum and the one at the Academy of Natural Sciences of Drexel University where I also work as part of my internship. There are 29 specimens of *Bidens bidentoides* here at the Arboretum herbarium, not including the specimens that were collected in the fall, and 50 at the Academy.

In addition to writing the plan, I curated, databased, and imaged the 120 specimens of

Bidens bidentoides at the Academy herbarium. Curation entailed general upkeep, such as replacing linen strips and sewing woodier specimens to the sheet. This ensures that they remain in good condition for many years to come. All the label information for each specimen was databased and then the specimen was scanned to create a high resolution image. This information will be made public in the near future and can be found through the PH Herbarium online database and JSTOR Plants. This is important because only an incredibly small percentage of specimens in the PH Herbarium's general collection have been databased and imaged and therefore the *Bidens bidentoides* information is special.

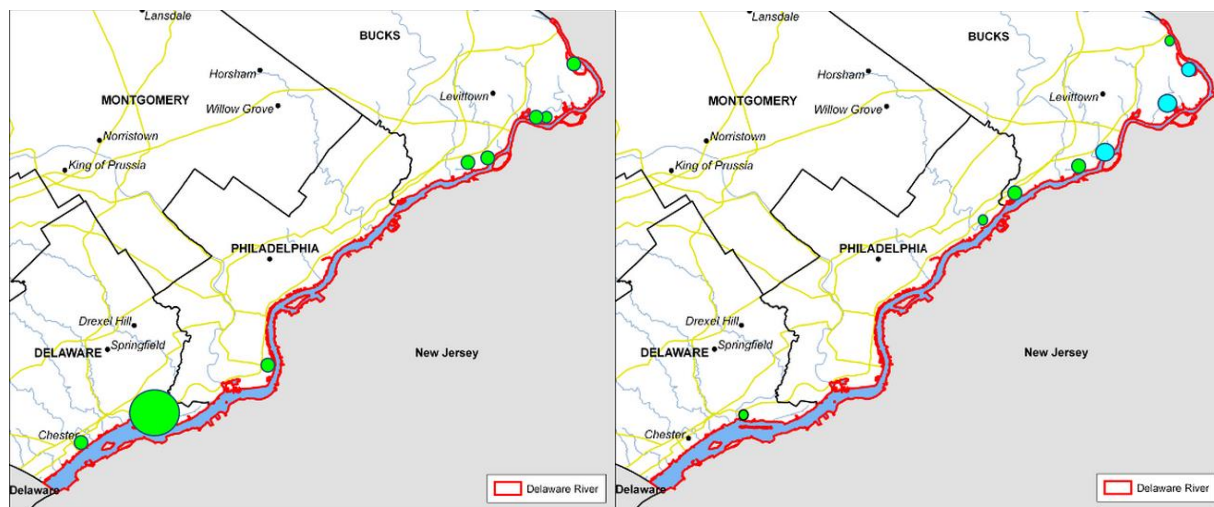


Figure 12: Locations and relative numbers of herbarium specimens collected pre-1950 (left) and post 1950 (right).

In order to connect recent population information to the collecting information from the herbarium specimens, I was able to visit three sites where *Bidens bidentoides* has been found previously. These are shown in blue in Figure 12. Based on personal observations over the years from eminent botanists like Dr. Ann Rhoads, Dr. Tim Block, and Dr. Ernie Schuyler, and comparisons to past collections, it is clear that *Bidens bidentoides* has declined in Pennsylvania.

CONCLUSIONS

There have been no studies on *Bidens bidentoides*, which needs to change in the future if we want to understand this species and prevent it from becoming extirpated. I think we need to understand its decline. It is threatened by dredging, filling, pollution, development, and competition from voracious invasives. Half of the plant species extirpated in Pennsylvania are gone because intense urbanization in the coastal plain region of the state has reduced this habitat to just a few isolated remnants. If the greatest threat to this species can be determined and decreased, then *Bidens bidentoides* would have a better chance at surviving.

The populations of *Bidens bidentoides* in Pennsylvania are almost nonexistent at the least and scattered at the most, therefore the gene pool in populations is small. Granted, plants handle inbreeding much better than animals and sometimes species that are naturally sparsely distributed have genetic systems that are adapted to the genetic drift. However, loss of variation

can reduce the ability of populations to adapt to changing environments and increase their susceptibility to pressures. It would definitely be interesting to look at the genetics of populations of *Bidens bidentoides* across its range to determine viability. If the species reproduces by incrossing, the small gene pool would not matter, but a lack of genetic variation could definitely reduce viability if the species turns out to be outcrossers.

Germination requirements are another aspect of reproduction that should be studied. This would help in potentially propagating *Bidens bidentoides* to be transplanted into the wild to boost population numbers and expand the gene pool. This could also aid in answering the question that I had about why this species is restricted to a tidal marsh environment while other *Bidens* that grow with it are also found along lakes. If the germination requirements are the same between these species, perhaps *Bidens bidentoides* could grow along lakes and just could not get there because its awns do not attach to moving animals like retrorsely barbed awns do.

It would also be beneficial to determine the presence of *Bidens bidentoides* in the seed bank and to do an inventory of the flora of the Delaware River estuary to truly see the decline and or fluctuations in all plant species in the tidal marsh.

ACKNOWLEDGEMENTS

I would like to thank Dr. Ann Rhoads, Dr. Tim Block, and Dr. Cindy Skema for introducing me to the world of botany, figuratively and quite literally, for they showed me the sites that were visited for this plan. I would also like to thank Dr. Ernie Schuyler for his input and in-depth knowledge of the Delaware Estuary.

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