Abstract
Invasive species are one of the largest threats to biodiversity today. They outcompete native plants, changing the suitability of the residing habitats for native animals and can even change nutrient and water cycles in invaded areas. The Asiatic sand sedge (Carex kobomugi) is an invasive plant that is expanding rapidly on coastal dunes throughout eastern North America. The goal of this project was to determine the effectiveness of a variety of different chemical control methods, both proven and experimental, during the spring, 2010 field season. Three herbicides, Plateau, Accord, and Sedgehammer were selected based on their ability to kill other sedges. The number of surviving plants was determined using stem counts compared with those seen in the replicate control plots. Both Rodeo and Plateau resulted in significant reductions in sedge survival relative to the control. Sedgehammer was most effective, killing significantly more plants than either Plateau or Accord (80% compared to 43% and 28% respectively). It is concluded that, while Plateau and Rodeo / Accord significantly reduce the survival of Carex kobomugi, due to its ability to kill the most plants in a single application, Sedgehammer may be the best herbicide for use in removing this species.

Introduction
Invasive species are one of the largest threats to biodiversity today. Dealing with the biological and ecological effects of these invasions is costing the US more than $120 billion dollars a year (Pimentel et al., 2005). Carex kobomugi, Asiatic Sand sedge is an invasive member of the sedge family that is spreading rapidly along the Northeastern US coastline. Carex kobomugi is thought to originally have reached the United States in solid ballast or packing material in the 1900s (Small, 1954). In the 1970s, Carex kobomugi was planted intentionally as a dune stabilizing plant in order to protect the coastline. At that time it was not known the ecological damage that it would cause. Carex kobomugi grows to about 0.3 meters in height (Wootton, 2007). Its leaves are yellow in color in summer and yellow or brown in fall and winter. In the Northeast US, Carex kobomugi grows in low dense clumps of extremely curly blades, and eventually spreads to cover vast areas, in which it often forms a monoculture. This is almost the opposite of the growth pattern in its native habitat which encompasses China, Japan, and Korea (Wootton, 2007). In its natural habitat Carex kobomugi grows in very dense clumps as well but is limited to small patches on coastal beaches. It spreads via seeds and rhizomes, a complicated root-like system which also allows it to stabilize the dunes (Lerner, 2008). As with most sedges plants in temperate climates, it has a period of intense growth in the spring and summer and dies back in the fall. This allows it to sprout again and continue the cycle the following spring. Overall, for lethality, Rodeo was the most effective at almost 90 percent mortality after one application. Sedgehammer, although it killed only 80 percent, is a promising alternative, especially due to the fact that it was very potent, even when other herbicides were negatively impacted, making it a more reliable option for the removal of Carex kobomugi.

Study Site and Method
- Location: Sandy Hook, NJ; North Beach (Figure 1)
- Secondary dunes dominated by Carex kobomugi
- Baseline established before spraying using stem counts in three 1m² quadrats per grid
- Living stems from each quadrat recorded on data sheets

- Herbicide sprayings conducted by National Park Service occurred in the Spring of 2010
- First trial:
  - Positive control - Rodeo (glyphosate salt): 0.5 gal per acre.
  - Plateau (imazapic): 4oz, 6oz, 8oz, 10oz, and 12oz per acre.
- Second trial:
  - Sedgehammer (halosulfuron-methyl): 0.9 grams per acre
  - Accord (glyphosate salt): 2 percent
  - Plateau (imazapic): 12oz per acre
- Stem counts conducted once a season after application using same method as baseline counts

Results (Continued)
During the second trial with Sedgehammer and Accord added to the treatment, the Accord herbicide killed 43 percent of Carex kobomugi plants in the test area (Figure 6). The Plateau killed 28 percent of the Carex kobomugi plants in the test region. The control group had a loss of 80 percent, is a promising alternative, especially due to the fact that it simply washes off the leaves into the porous sand. With a significant rain, the herbicide sprayings conducted by National Park Service occurred in the June 2003 Conference Proceedings. As the concentration of Plateau increased past 6 oz / acre, the percentage of plants killed decreased. Although there was no previous test for halosulfuron-methyl (Sedgehammer) in trial 1, it remained potent, even when other herbicides were negatively impacted, making it a more reliable option for the removal of Carex kobomugi. The trend that was seen in the first trial with Plateau is also noteworthy. As the concentration of Plateau increased past 6 oz / acre, the percent of plants killed decreased. Since there was no error in application, this result suggests that 6 oz / acre is the optimal application rate for this chemical.

Discussion
Overall, for lethality, Rodeo was the most effective at almost 90 percent mortality after one application. Sedgehammer, although it killed only 80 percent, is a promising alternative, especially due to the fact that it was very potent, even when other herbicides were negatively impacted, making it a more reliable option for the removal of Carex kobomugi. The trend that was seen in the first trial with Plateau is also noteworthy. As the concentration of Plateau increased past 6 oz / acre, the percent of plants killed decreased. Since there was no error in application, this result suggests that 6 oz / acre is the optimal application rate for this chemical.

Literature Cited