Summary Report

Population Status of the Milfoil Weevil and its Possible Impact on Eurasian Watermilfoil in Conesus Lake One Year After Weevil Augmentation

Submitted to

The Conesus Lake Association and EnviroScience Inc.

by

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SUMMARY

- On July 20, 2005 approximately six thousand eggs and larvae of the milfoil weevil *Euhrychiopsis lecontei* were released into an experimental site in Conesus Lake, just south of Wilkins Cove along the east-northeast shore. The goal of this project was to augment the small numbers of weevils already in the lake and establish a population that might control the growth of the invasive Eurasian watermilfoil, *Myriophyllum spicatum*.

- By July 2006 the milfoil weevil population had reached an estimated size of more than twenty-three thousand individuals and dispersed southward from the stocking site approximately 400 m. The average density of the larval/adult population was 0.05 individuals per milfoil stem. This is well below the two or more individuals per stem associated with damage to milfoil populations in other lakes.

- Major declines in milfoil occurred had occurred within the range of the weevil population by July 2006. However, several lines of evidence argue against weevils having a primary role in those declines. The evidence includes a low weevil population density, limited signs of weevil damage to plants, and collapses of milfoil beds in areas where weevils have not been detected.

- It remains to be seen whether the weevil population can continue to expand and significantly damage milfoil beds in Conesus Lake. Further monitoring of the stocking site must be conducted to resolve these questions. On the other hand, there are other areas in Conesus Lake that will likely provide suitable habitat for weevil population growth, and where additional augmentations may be productive.

INTRODUCTION

The herbivorous beetle *Euhrychiopsis lecontei,* known as the milfoil weevil, negatively affects the growth of the Eurasian watermilfoil (*Myriophyllum spicatum*), a submersed macrophyte that is predominant in lakes throughout temperate North America, including New York. Larvae of the milfoil weevil feed on the tender leaves of the plant's growing tip, thus slowing plant growth. They also burrow into the stem of the milfoil plant, disrupting nutrient and gas distribution in the vascular system and often causing the collapse of the plant canopy. There is solid evidence that dense populations of weevils can cause extensive damage to milfoil beds (Sheldon and Creed 1995, Newman, 1996, Newman and Biesboer, 2000). However, in some lakes with large populations of weevils there appears to be surprisingly little impact on the milfoil (e.g. Waneta and Lamoka Lakes according to Belinksy, Johnson and Hairston, 2001). Attempts to augment weevil populations to control watermilfoil have not always been successful. In cases where it has been successful, the watermilfoil population has recovered by the next year, leading residents to seek alternative methods of milfoil control (Belinksy, Johnson and Hairston, 2001).

Conesus Lake, the westernmost of the Finger Lakes of New York, is home to a very small population of *E. lecontei* (Myers and Bosch, unpublished data; R.L. Johnson, personal communication) despite the fact that the preferred food source for weevils, Eurasian milfoil, is the predominant macrophyte species in the lake (Bosch et al. 1999). The limited success of weevils in Conesus Lake may be due to high densities of sunfish, an important weevil predator (Sutter and Newman, 1997), and/or a lack of natural shoreline that adult weevils require as over-wintering sites.

On July 20, 2005, an experimental stocking of six thousand weevil eggs and larvae was undertaken at a single location along the east-northest region of Conesus Lake, below Wilkins Creek (see Figure 1). The fate of the weevil and milfoil populations in the vicinity of the stocked area was evaluated by means of population surveys conducted in 2005 and 2006. In this report we describe the results of these surveys and provide evidence that indicates the weevil augmentation in Conesus Lake was moderately successful.

MATERIALS AND METHODS

Three primary locations were sampled during this study (Figure 1). One area, referred to as Palermo Shores, served as the experimental stocking site. It was selected because of the abundant local milfoil biomass and ample natural shoreline that could serve as over-wintering habitat for the adult weevils. An area to the north (South Wilkins Cove) and another to the south (South Palermo; called East Lake road in interim report) of Palermo Shores served as reference habitats in which weevils were not stocked.

On July 20 of 2005, approximately six thousand weevil eggs and larvae were introduced into Palermo Shores by an EnviroScience Inc. field team, with assistance from our research group and members of the Conesus Lake Association. Fragments of milfoil plants that had been colonized by weevil eggs and larvae at the EnviroScience Inc. culture facility were added to the experimental bed by tying the stems individually to healthy milfoil stems selected randomly to cover most of the stocking area.

Three surveys of the weevil populations and the plant community were conducted during this study. A pre-stocking survey was completed on July 19-20, 2005, and two post-stocking surveys were completed during the weeks of Sept. 10, 2005 and July 10-18, 2006. All our procedures minimally followed procedures established by EnviroScience for their weevil stocking studies (*www.enviroscienceinc.com*)

Surveys of weevil density

To determine weevil density, ten apical meristems (~ top 0.33 m of the plant) were collected from each of three transects running perpendicular to the shoreline at each site (n= 30 per site). The apical meristems were placed in sealed plastic bags and brought to the laboratory where they were examined individually at 10-40x magnification under a stereo-microscope for weevil adults, larvae, eggs, and any signs of weevil damage.

Surveys of the plant community

Following is a brief description of the measurements taken in the study of the plant community.

- Percent dominance and canopy height: two 30 m transects set parallel to the shoreline about ten feet apart in the more dense areas of the macrophyte beds over a depth of 1-1.5 m. For each transect the number of milfoil plants among ten plants found in the area was recorded at meter intervals (n=30 per transect). Additionally, the height of the macrophyte canopy in reference to the water surface was determined at five meters intervals along these transects (n=7 per transect).

- Species composition and biomass: at each site S.C.U.B.A. divers collected three benthic quadrat samples (0.5 m per side, 0.25 m^2 area). The samples were taken at random within the transect areas. All plants within the quadrat were removed by cutting the stems above the sediment. Samples were analyzed in the laboratory for species composition and dry weight biomass. The values reported are the above-sediment dry biomass.

- Abundance of milfoil plants: divers counted the number of milfoil stems per quadrat at each site (sample ranged from 5-6).

Estimate of Weevil Population

Surveys conducted in late July showed that weevils were present within the Palermo Shores-South Palermo region but not to the north or south. We saw this as an opportunity to estimate the weevil population size in our study sites. To accomplish this we measured the surface area of the milfoil bed between the two extremes of the weevil distribution by tracking the perimeter of the bed using a Trimble GPS. Pathfinder mapping software was used to estimate the surface area. The total number of weevils (larvae and adults combined) in the area was estimated using the following relationships:

$$(\text{Avg \# weevils/apical meristems}) * (\text{Avg \# stems}/m^2) = \text{Avg \# weevils}/m^2$$

$$(\text{Avg \# weevils}/m^2) * (\text{total } m^2 \text{ of weevil range}) = \text{Estimated weevil population}$$

RESULTS AND DISCUSSION

Millfoil Weevil Population in Conesus Lake

Stocking of weevil eggs and larvae into Conesus Lake by EnviroScience in July 2005 has resulted in the establishment of a population estimated to be more than twenty three thousand larvae and adults along the northeast shoreline starting at Palermo Shores and extending 400 m southward over an area of approximately 7,400 m^2 of milfoil (about 1.83 acres). Weevils were not detected in this region prior to stocking. A post-stocking survey in September 2005 yielded one larva among the ninety apical meristems examined, indicating that the population was small or that adults had already migrated to the shoreline for their over-wintering period. A few cases of possible weevil damage to milfoil plants were detected in September (n=3 in 30 apical meristems at stocking site).

By July 2006, weevil larvae and/or adults were found at Palermo Shores (n=3 in 60 apical meristems), 400 m to the south at South Palermo (n= 2 in 30 apical meristems), and at one of two areas that we surveyed between these two end points (n=1 in 30 apical meristems; see Table 1 for the complete data set). We did not find weevils north of Palermo Shores (in South Wilkins Cove), or immediately to the south of the South Palermo site. Weevil abundance was 0-2 animals per 30 apical meristems (average 0.033, n = 180 meristems), well below the two or more individuals per stem associated with damage to milfoil populations in other lakes. Only four of the 180 meristems examined microscopically showed damage characteristically caused by weevils.

Condition of the Macrophyte Community

Our analysis of the plant community included measurements of milfoil canopy height, milfoil dominance, total macrophyte and milfoil dry biomass, and number of milfoil plants per square meter. We also inspected plants for evidence of weevil-related damage.

For the sake of clarity the results of our plant community survey are reported for 2005 first and the changes from 2005 to 2006 are reported after.

July-Sept. 2005 trends

Figure 2 A-C shows the height of the milfoil canopy in July and September 2005. There were minor decreases in canopy height at South Wilkins Cove and Palermo, but because weevils were not found at South Wilkins Cove in September and the canopy height at the South Palermo site was unchanged, we concluded that these small canopy differences were not attributable to weevil damage.

Figure 3 A-C shows the percent dominance (or % cover) of milfoil along 30 m transects for all three sites as determined by a swimmer from the surface. From July to September of 2005 milfoil dominance either remained the same or increased, an indication of increased canopy formation. This is consistent with our observation that the weevil population was very small and that very few milfoil plants were damaged during the first three months after stocking.

Figure 4 A-C shows changes of macrophyte biomass, reported as dry weight of total plant biomass and dry weight of milfoil biomass per square meter. The biomass increased by nearly thirty percent or more at all three sites from July to September of 2005. The highest increase was seen at the Palermo Shores site.

Figure 5 A-C shows the average number of milfoil stems for each site. The trends indicate a decrease in stem number at South Wilkins Cove from July to September of 2005, but this decrease was not statistically significant. Stem numbers increased at both Palermo Shores and the South Palermo site by similar proportions.

Overall, the 2005 data provide no indication of a significant impact of the weevils on the macrophyte community. This is not altogether unexpected. Only eggs and larvae were stocked at the site and there should be a time delay before adults become established and contribute to a vigorous population growth.

Changes from 2005 – 2006

Preliminary observations in late June and during the first week of July 2006 revealed that the milfoil bed between Palermo Shores and South Palermo was very sparse. To the north and south of this area milfoil populations formed a canopy that was visible from the surface. To what extent this pattern can be attributed to the effect of the small weevil population in the area remains uncertain, as we discuss below.

Canopy height (Figure 2), percent dominance of milfoil (Figure 3), milfoil biomass, total macrophyte biomass (Figure 4), and number of milfoil stems (Figure 5) all were dramatically lower in 2006 compared to 2005. This was true for Palermo Shores as well as South Palermo. However, we found a similar pattern in Wilkins Cove, yet no weevils or signs of weevil damage were found in that site. This observation, and the low frequency of damaged plants in our surveys of weevil habitats can be taken as indications that factors other than weevil herbivory were responsible for the 2006 milfoil declines. Indeed, milfoil beds throughout Conesus Lake experienced large-scale collapses in 2006 due to a combination of strong wind-induced currents, and a heavy burden of zebra mussels and metaphyton on plants. Therefore, we cannot conclusively attribute the declines of milfoil in the weevil habitat to weevil herbivory.

Other observations made by our study group provide some support for at least a partial role of weevils in the decline of milfoil populations in our study sites. For example, when we first examined our three study sites in early July in preparation for sampling, there was a moderately-dense milfoil canopy in South Wilkins Cove, but the Palermo and South Palermo populations were very sparse and did not form a canopy. By the time we sampled the Wilkins Cove site in late July the milfoil population there had collapsed and there were many dead or unhealthy plants on the bottom. Our counts of stem number and biomass at South Wilkins may have been very low due to the difficulty in sampling the collapsed bed. In contrast, there were no signs of a massive collapse and die-off in the sparse milfoil population of Palermo Shores and South Palermo.

CONCLUSIONS

The small-scale stocking of six thousand eggs and larvae of the milfoil weevil (*Euhrychiopsis lecontei)* into Conesus Lake in July 2005 has resulted in the establishment of a small but significant population estimated to be upwards of twenty-three thousand weevils, having an average density of 0.033 per milfoil apical meristem distributed within an area of 1.83 acres of milfoil habitat.

Within the area inhabited by weevils there were dramatic reductions in milfoil canopy height, dominance, biomass, and density in 2006 compared to 2005. However, several lines of evidence, including a low weevil population density, limited signs of weevil damage to plants, and bed collapses in areas without weevils, argue against weevils having a primary role in these milfoil declines.

Whether the weevil population that developed from the 2005 stocking will continue to expand and significantly damage the milfoil beds in Conesus Lake remains to be seen. Further monitoring of the stocked site must be conducted to resolve these questions. On the other hand, there are other areas in Conesus Lake that will likely provide suitable habitat for weevil population growth, and additional trial augmentations may be productive.

ACKNOWLEDGEMENTS

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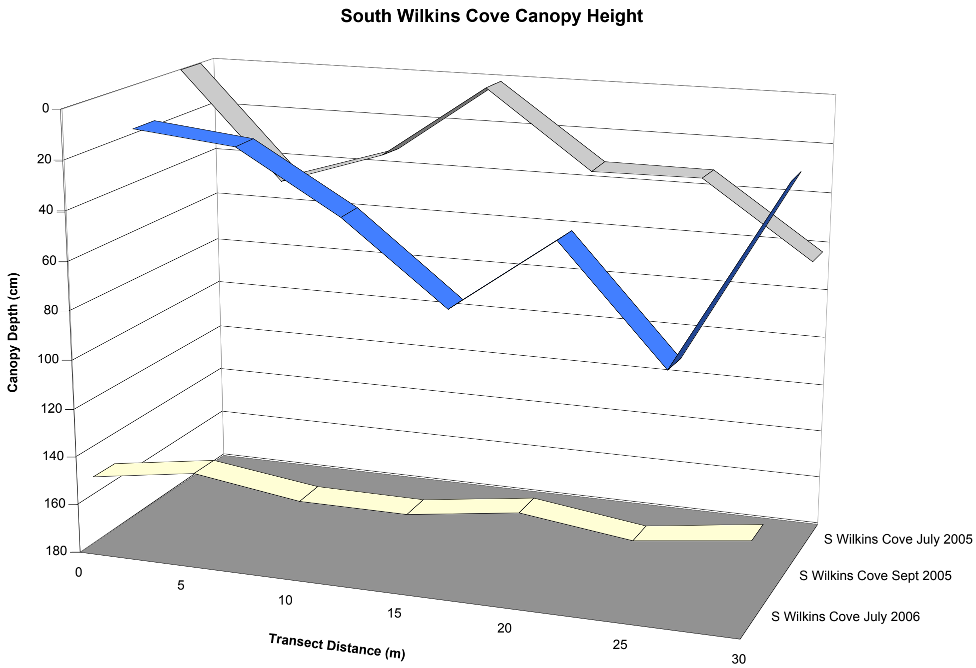
Table 1.

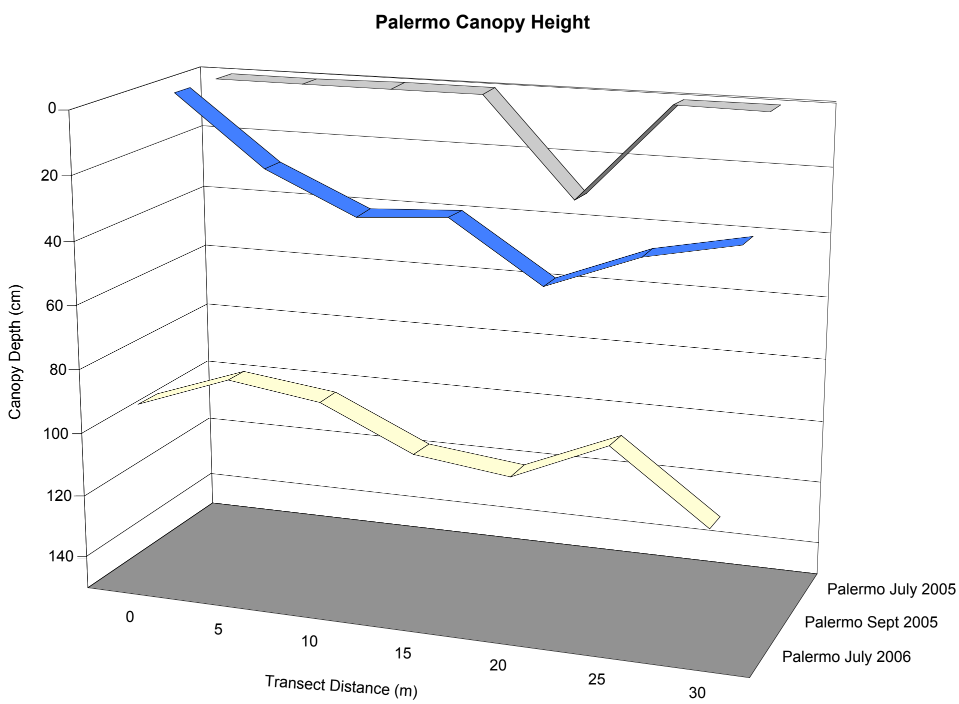
Numbers of weevil adults and larvae collected in Conesus Lake in two surveys centered around a site where eggs and larvae were introduced in July, 2005			
Date	Location	# of Larvae/ 30 Stems	# of Adults/ 30 Stems
Sept. 2005	S. Wilkins	0	0
	Palermo	1	0
	S. Palermo	0	0
July 2006	S. Wilkins	0	0
	Palermo	1	2
	4198 E. Lake Rd	1	0
	4237 E. Lake Rd	0	0
	S. Palermo	2	0
	4266 E. Lake Rd	0	0

Figure 1. Terra Server image showing sites where population studies of weevils and Eurasian watermilfoil were conducted in 2005 and 2006. Weevils were stocked along Palermo Shores, which is currently the northern limit of weevil distribution. South Palermo represents the southern limit. Macrophyte surveys wee conducted at South Wilkins Cove, Palermo Shores and South Palermo. Surveys for weevils were conducted at all the stations shown.

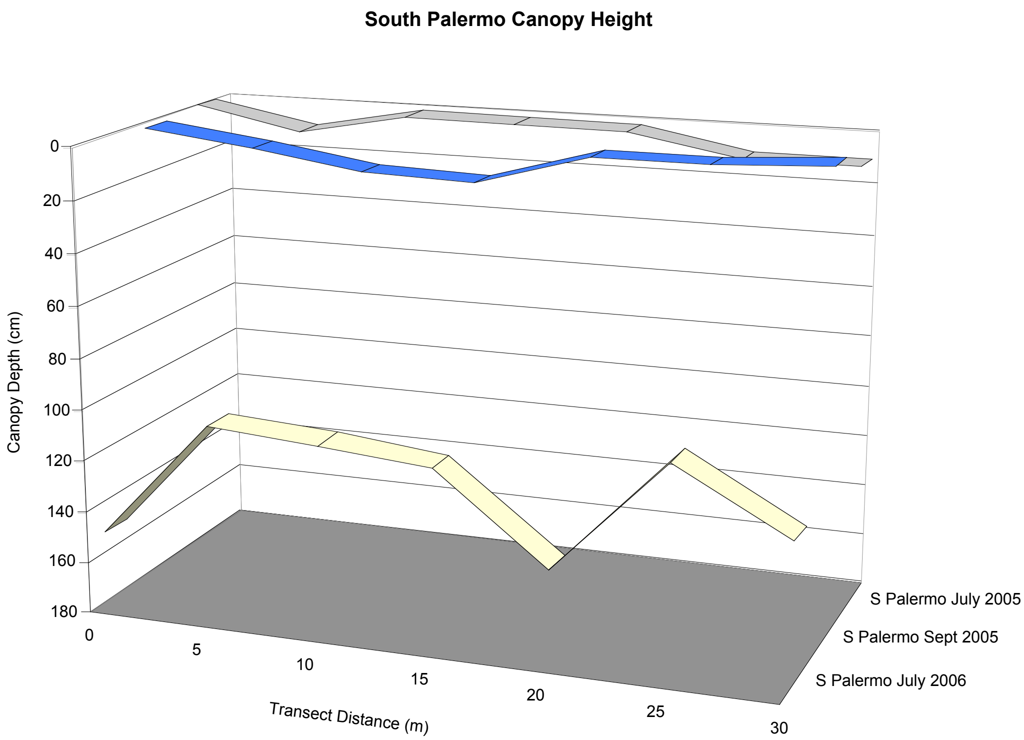
Figure 2: Height of milfoil canopy indicated by the distance in centimeters from the water surface along a 30 m transect. The lines represent the top of the canopy as viewed from the surface..



a) South Wilkins Cove

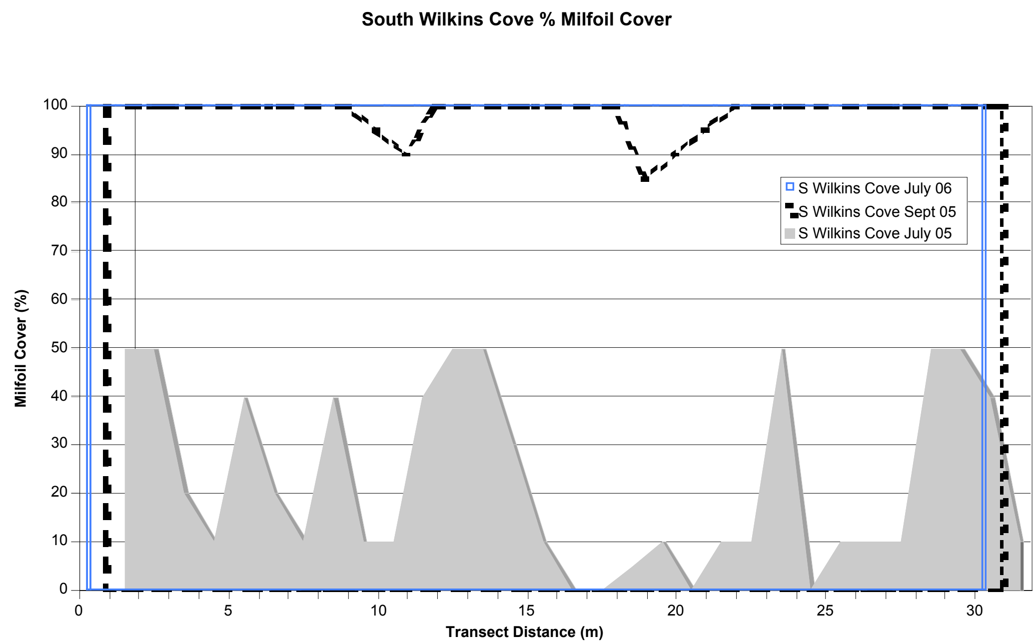


b) Palermo Shores

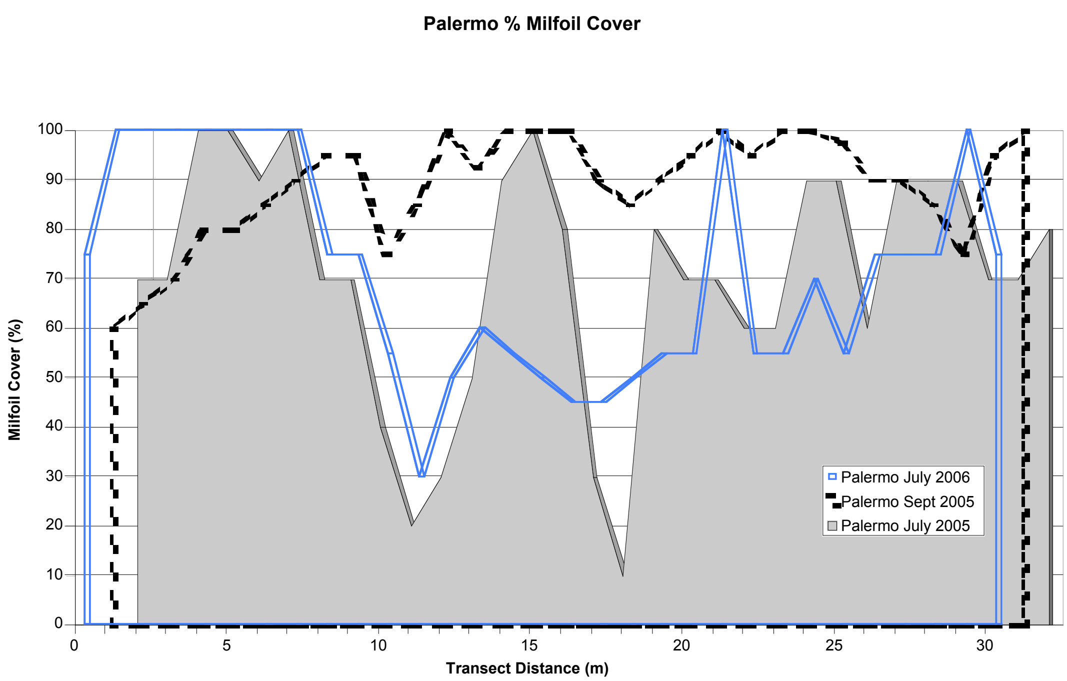


c) South Palermo

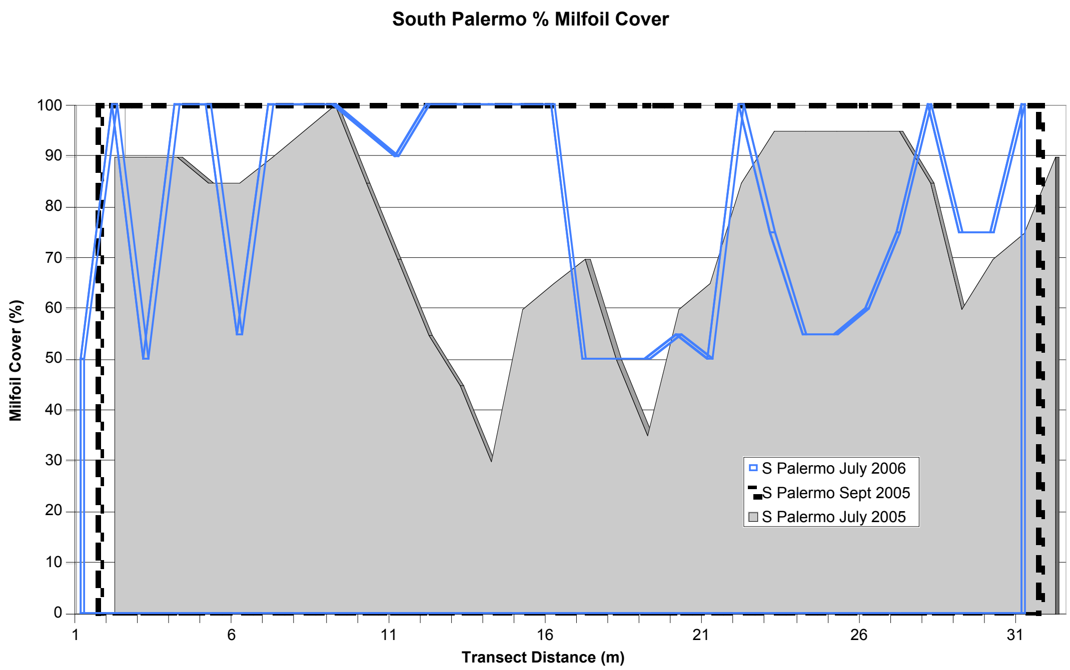
Figure 3: Percent dominance of Milfoil cover along a thirty meter transect for July & September 2005, and July 2006.



a) South Wilkins Cove



b) Palermo Shores



c) South Palermo

Figure 4: Average dry weight Milfoil biomass as compared to total dry weight biomass per square meter at South Wilkins Cove, Palermo Shores, and South Palermo for July & September 2005 and July 2006.

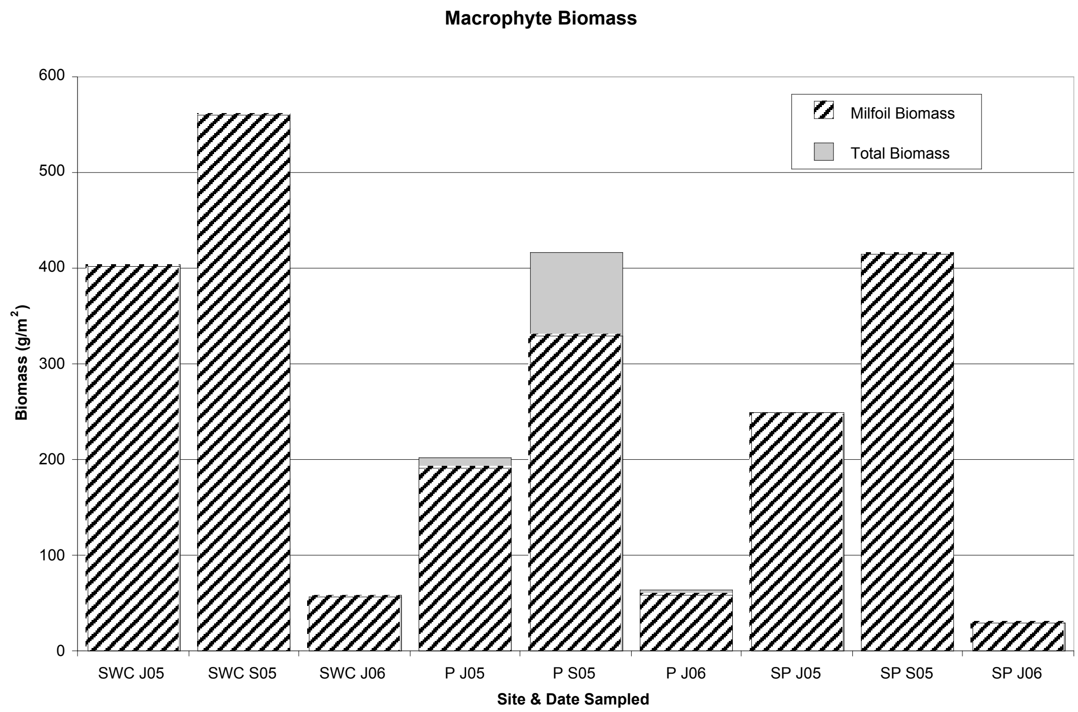


Figure 5: Average number of Milfoil Plant stems found per square meter at each site.