Frequency of Vegetated Points

In analysis including all four zones there was a slight decrease in vegetated points from 1989/90 to 2005 and then a slight increase in 2009. When zone 4 was excluded from analysis there was an increase in vegetated points each subsequent year. There was a trend between all years of an increase in the number of points vegetated in zones 1 and 2 and a decrease in vegetation in zones 3 and 4 (Figure 5, Table 5). In 1989/90 and 2005 the rankings of zones vegetated from most to least were 2, 3, 1, 4. In 2009 this ranking changed to 2, 1, 3, 4.

Table 5. Percent of quadrats containing vegetation in each zone and with all zones combined as illustrated in Figure 5.

	0-1.5ft Zone 1	1.5-5ft Zone 2	5-10ft Zone 3	10-20ft Zone 4	Overall
1989/90	28.1%	51.9%	43.9%	0.0%	31.0%
2005	36.5%	55.3%	40.3%	20.6%	39.0%
2009	57.1%	62.0%	37.7%	9.9%	43.0%

Total Acreage Vegetated

Visual estimations of plant bed sizes totaled 495.5 (7.9%) acres over the entire water system, 162.9 (45.7%) acres in Moon Bay, 47.8 (11.9%) acres in Little Lake and 152.5 (13.2%) acres in the Chippewa River north of the main basin (Table 6). Shoreline vegetation occurred on 39.3 miles (70.1%) of the entire shoreline.

Table 6. Percent of total lake area containing vegetation in 2009.

	Acres Vegetated	Total Acreage	% Vegetated
Total Lake	495.5	6300	7.9%
Moon Bay	162.9	356.8	45.7%
Little Lake	47.8	400.9	11.9%
Upper Chippewa	152.2	1153.4	13.2%

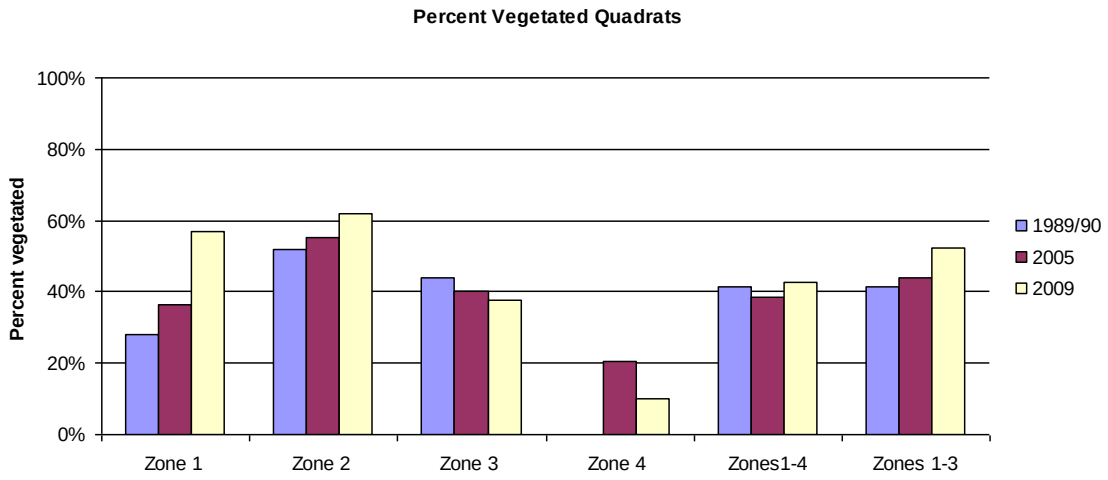


Figure 5. Percent of quadrats containing vegetation in each zone and with all zones combined.

Species Present

There were a total of 31 species present in 1989/90, 33 in 2005 and 32 in 2009. There were 22 species located on transects in 1989/90, 31 in 2005 and 32 in 2009. There was a decrease in the number of species of submergent plants and an increase in the number of species of floating leaf plants, sensitive and exotic species in the later studies (Figure 6).

One species of special concern *Potamogeton vaseyi* was found only in the 2005 study. Two invasive species *Potamogeton crispus* and *Myriophyllum spicatum* were found in the 2005 and 2009 studies. Both of these plants showed increases in frequency and density in the 2009 study. Two sensitive species *Ranunculus longisrostris* and *Potamogeton amplifolius* were new to the 2009 study.

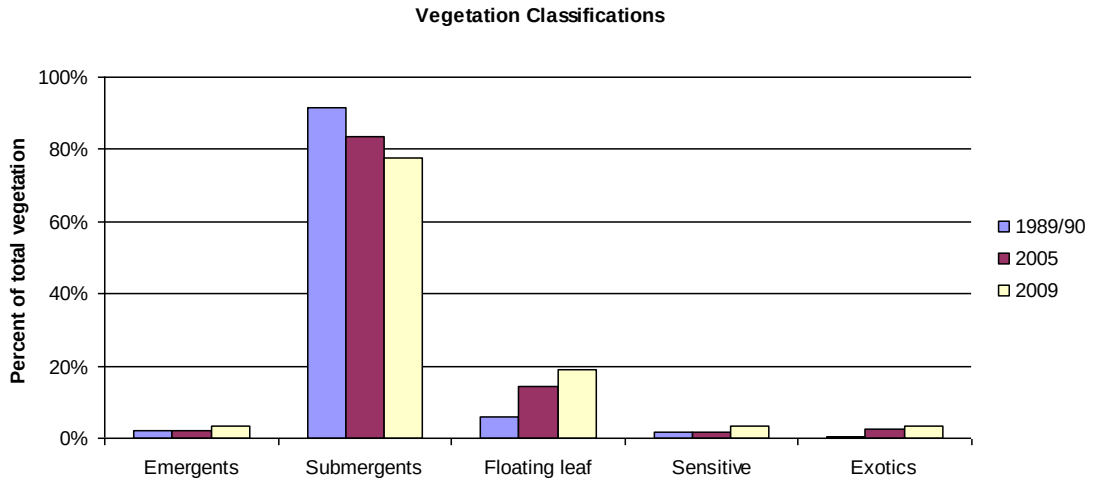
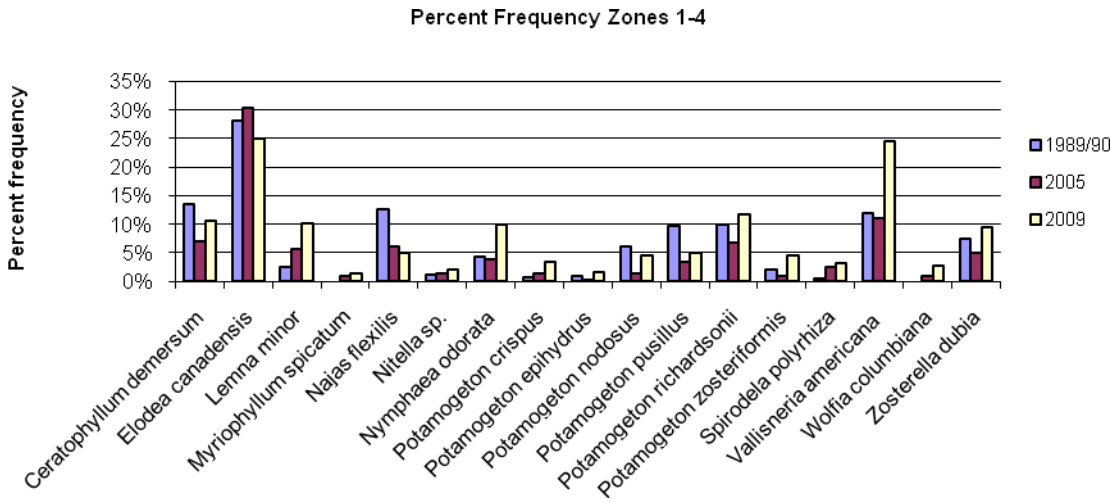


Figure 6. Percent of total plant frequencies in each classification. Results are presented for zones 1-4 only as there was no difference in the results of zones 1-3.

Appendix A contains tables showing the percent frequency, percent frequency when present, density when present and dominance values of all plants that occurred during any year. The following figures show these data for the most prevalent plants.

Frequency

Elodea canadensis was the most frequently encountered plant in all three studies when zone four was included in the analysis. *Vallisneria americana* increased dramatically in 2009 and was the most frequently encountered plant in 2009 when zone four was excluded from the analysis. *Nymphaea odorata* and *Lemna minor* also increased in 2009 (Figure 7). *Najas flexilis* decreased in 2005 and 2009. Many other plants decreased in 2005 and then increased in 2009 or vice versa.



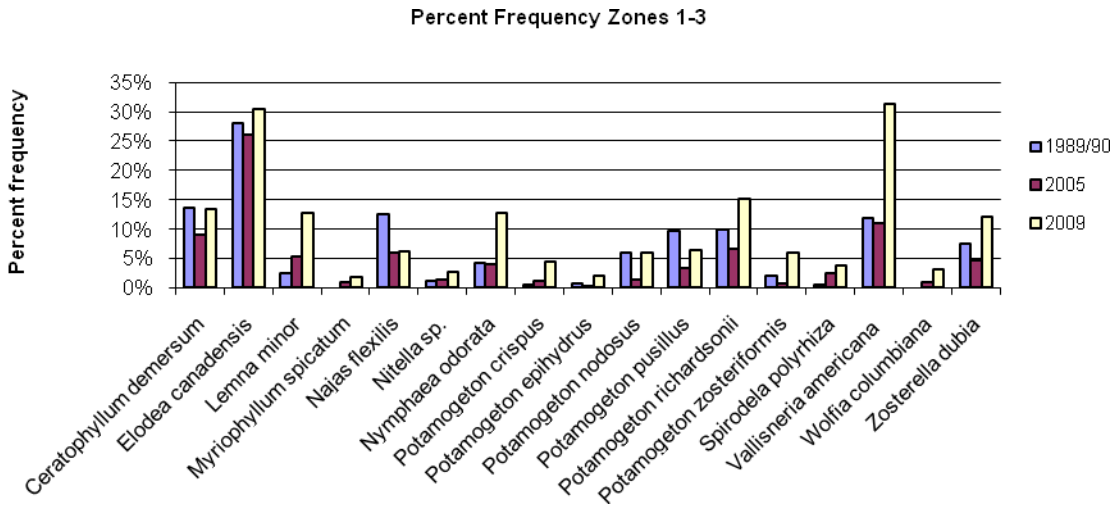
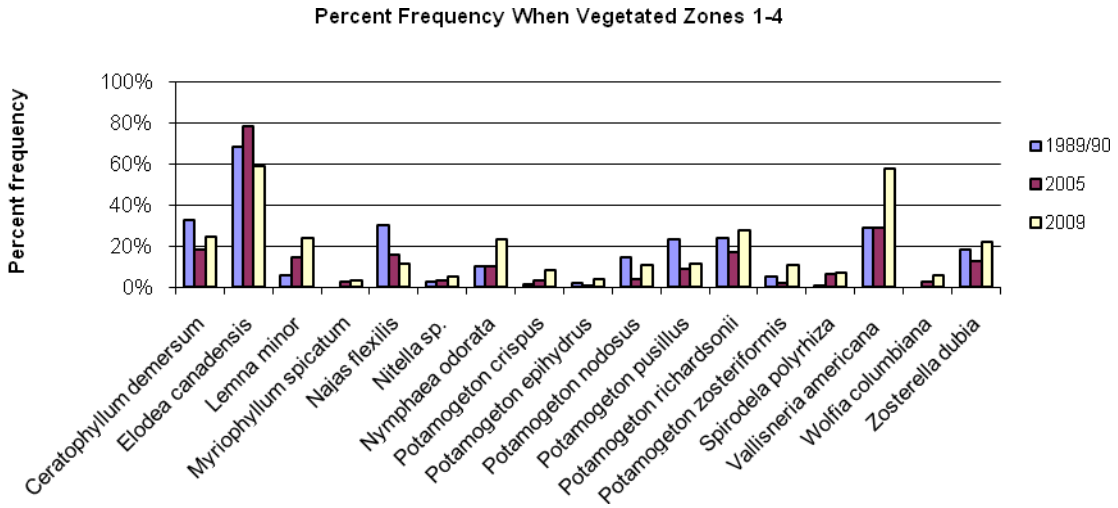


Figure 7. Percent of quadrats containing the most prevalent species.

Frequency When Vegetated

Elodea canadensis and *Vallisneria americana* were the most frequently encountered plants at quadrats that contained vegetation. *Lemna minor*, *Nymphaea odorata* and *Vallisneria americana* showed consistent increases in frequency across the studies while *Najas flexilis* consistently decreased when vegetation was present (Figure 8).



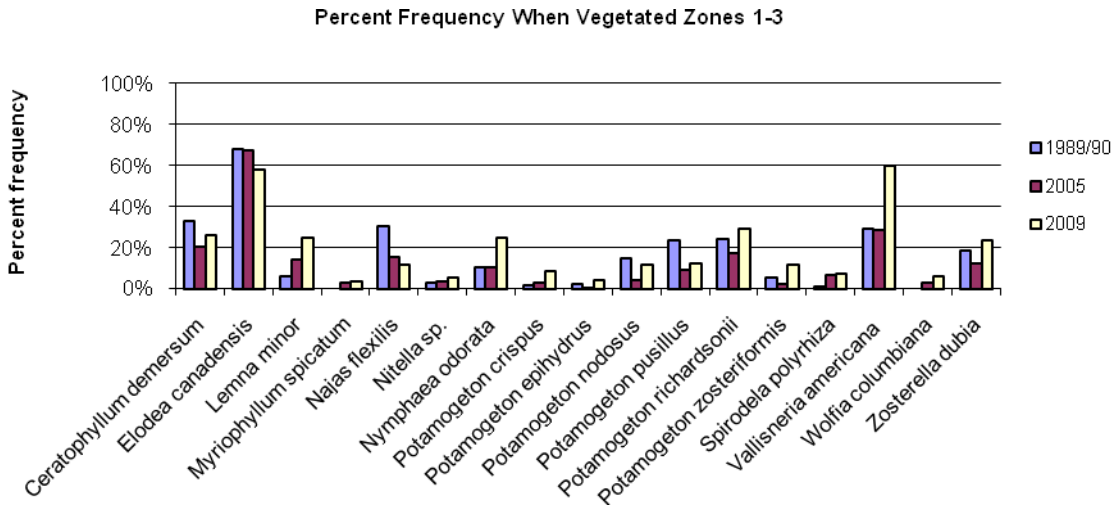
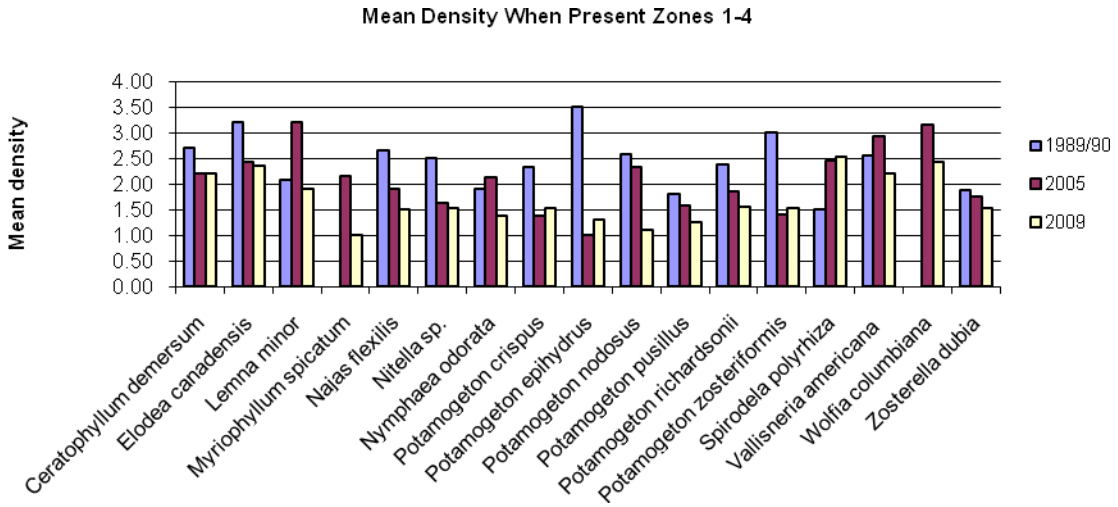


Figure 8. Percent of vegetated quadrats containing the most prevalent species.

Mean Density When Present

A trend of decreased densities of most plants continued through 2005 to 2009. *Elodea canadensis*, *Ceratophyllum demersum* and floating-leaf species *Lemna minor*, *Spirodela polyrhiza* and *Wolffia columbiana* had the highest densities in 2009 when they were present while *Potamogeton* species had the lowest densities (Figure 9).



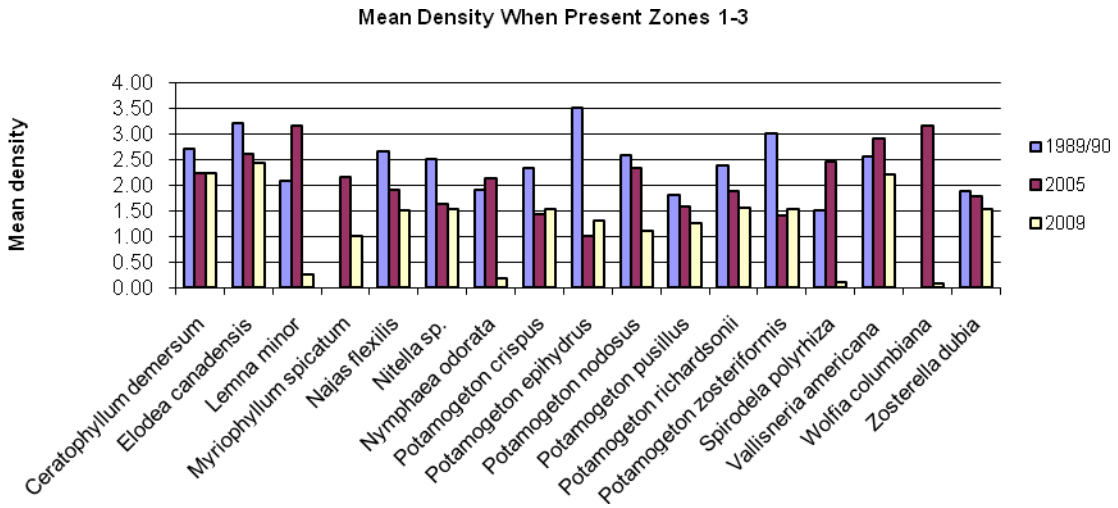


Figure 9. Mean densities of prevalent species when they were present.

Dominance Values

Elodea canandensis had the highest dominance value in all three years. *Vallisneria americana* and *Ceratophyllum demersum* had the next highest values. *Vallisneria americana* and floating-leaf species showed consistent increases over the three years. *Najas flexilis* and *Potamogeton pusillis* decreased consistently (Figure 10 and 11).

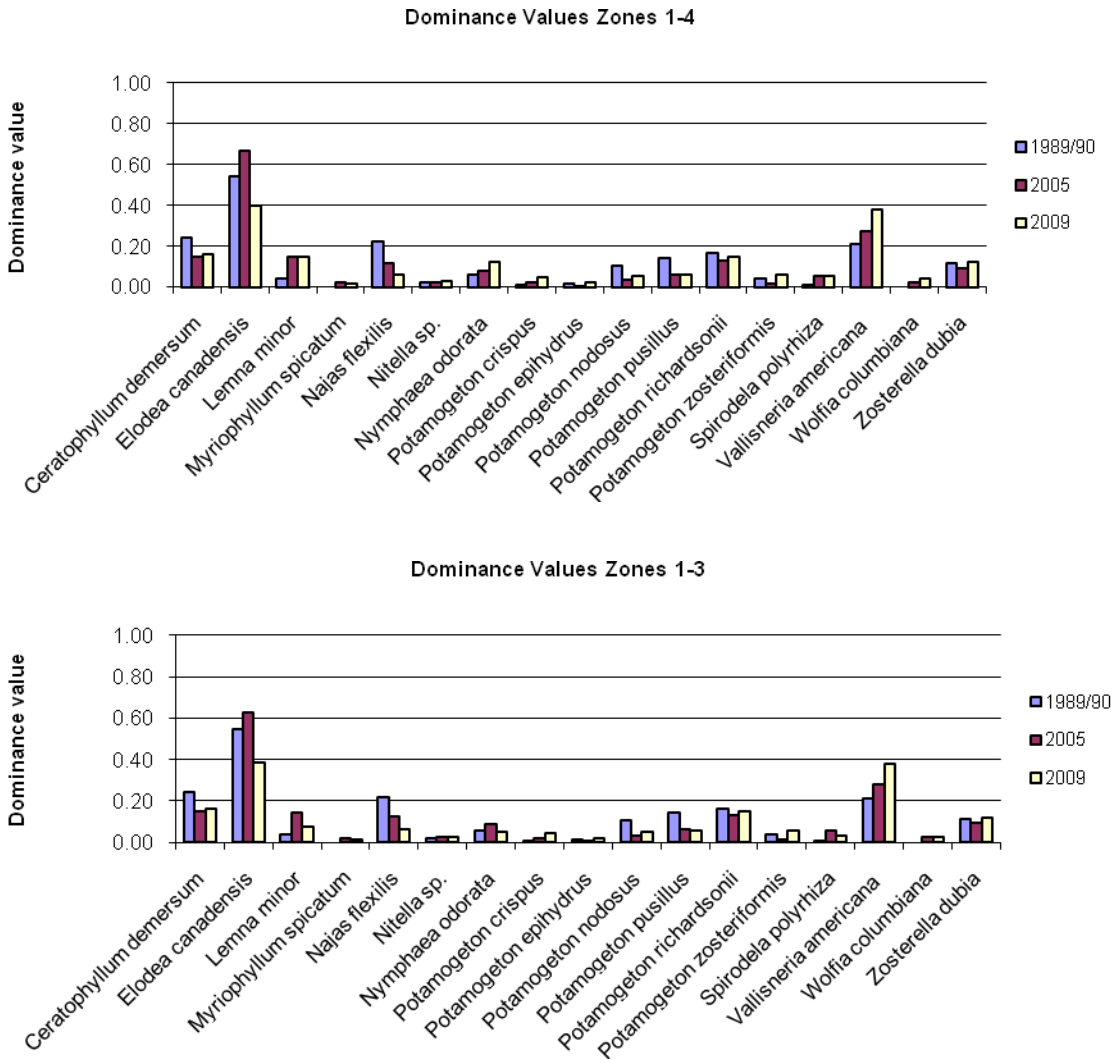


Figure 10. Dominance values (relative frequency * relative density) for prevalent species.

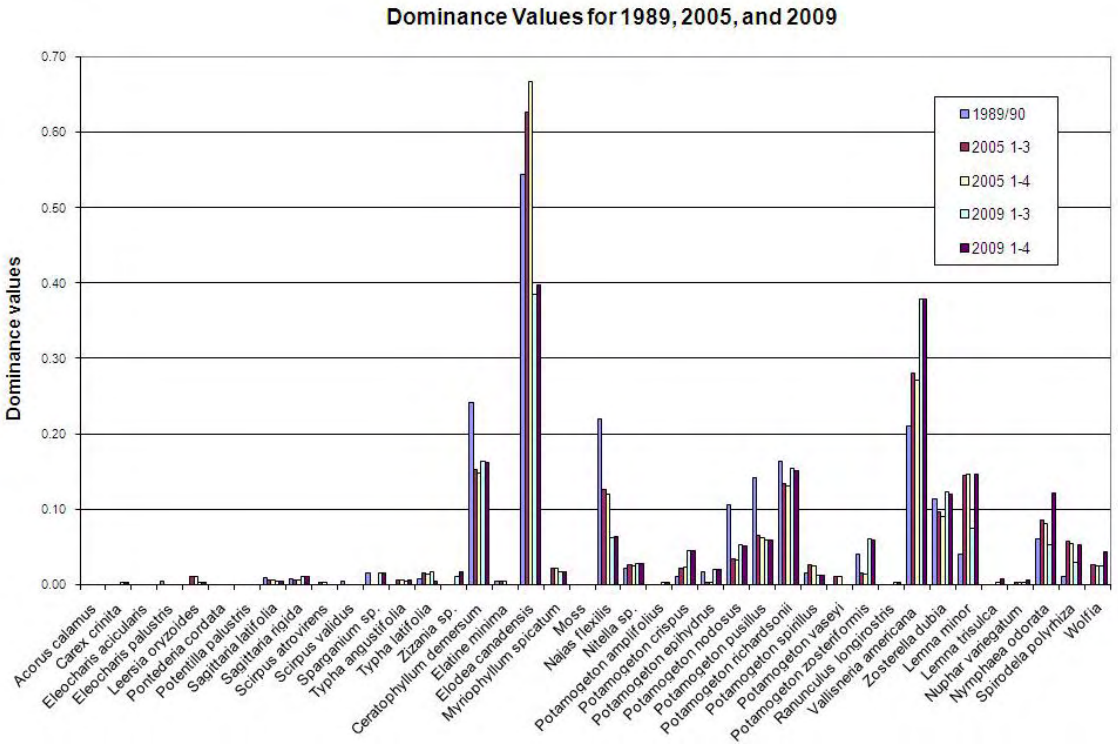


Figure 11. Dominance values (relative frequency * relative density) for all species.