Sampling Submersed Aquatic Plant Biomass: Fresh vs. Dry Weight

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INTRODUCTION

Many times, aquatic resource managers and stakeholders are tasked with monitoring aquatic plant vegetation after management activities have occurred. This can be done many ways, but one of the most common methods is the collection and statistical analysis of plant biomass for a given species. Biomass is a useful metric as it encompasses the productive output of individual species over a given time frame, thus changes in biomass can help resource managers determine the effectiveness of different management activities over time.

However, there are different ways to measure plant weight. Fresh weight (or wet weight) is comprised of the weight of the plant material and all water incorporated in the plant's tissues. Dry weight is plant material that has been dried to remove the water content until biomass weight no longer changes with continued drying. Water weight percentage of plants may differ among growth forms (submersed vs. emergent) or populations and could potentially lead to difficulty interpreting the results of management activities on plant species with different growth forms. Fresh weight is often used when data collection is time sensitive or logistical issues are present (no access to plant dryers). However, the water fraction within plant tissues may yield different results than an analysis of dry biomass.

The purpose of this work was to assess the fresh and dry biomass components of the submersed aquatic invasive plant species monoecious hydrilla (*Hydrilla verticillata* [monoecious] (L.f.) Royle) in order to determine the utility of each biomass quantification method for hydrilla assessment.

MATERIALS AND METHODS

This study was conducted in four 378-L (100 gal) outdoor mesocosms from Summer 2016 to Fall 2019. Mesocosms were filled with pond water in the summer of 2016. Monoecious hydrilla turions were planted (5 per pot) in June in 3.8 L (1.1 gal) pots filled with a 75:25 mixture of sand and top soil amended with 2 g/L of sediment of a slow release fertilizer to stimulate plant growth. Twelve pots were placed in each mesocosm.

Three pots per mesocosm were harvested in the fall of each year. Harvest consisted of removing all hydrilla biomass from a pot and separating into aboveground (AG) biomass, root/rhizome biomass, and subterranean turion biomass. Plant material was left to "drip dry" on paper towels for 10 minutes then fresh weight of biomass was measured and recorded and then placed in labeled paper bags and dried in a forced air oven at 70C for 5 days. After drying, dry biomass weight was measured and recorded. Weights of roots/rhizome (RR) and turion (TUR) samples were summed to calculate total belowground biomass (BG). The dry weight percentage of fresh weight for each plant metric (AG, BG, RR, and TUR) was calculated as %-FW = (W_{DRY} / W_{FRESH}) * 100, where W_{DRY} is dry weight and W_{FRESH} is the fresh weight for each plant metric.

A one way analysis of variance was conducted to determine if there were differences in biomass or dry weight percentages for each year. If differences existed, a Fishers Least

Significant Difference test was conducted to further separate treatment means. All statistical tests were conducted at the alpha = 0.05 significance level.

RESULTS AND DISCUSSION

Biomass – AG fresh and dry biomass did not differ among years ($p>0.05$). BG fresh weight did not differ, but dry biomass was different among years ($p<0.0001$). BG dry biomass was similar in 2016 (223 g DW/m^2) and 2019 (209 g DW/m^2) but was higher in 2017 and 2018 (425 g DW/m^2); peak biomass (823 g DW/m^2) occurred in 2017 ($p<0.0001$; Figure 1). RR fresh and dry biomass did not differ among years ($p>0.05$). TUR fresh and dry biomass differed among years ($p<0.0001$ for both). TUR fresh biomass was similar in 2016 (301 g DW/m^2) and 2019 (360 g DW/m^2) but was higher in 2017 and 2018 (634 g DW/m^2); peak biomass (1302 g DW/m^2) occurred in 2017 ($p<0.0001$). TUR dry biomass was similar in 2016 (105 g DW/m^2) and 2019 (145 g DW/m^2) but was higher in 2017 and 2018 (258 g DW/m^2); peak biomass (544 g DW/m^2) occurred in 2017 ($p<0.0001$; Figure 2).

Percent – Dry weight percentages for AG, BG, RR, and TUR did not differ among years ($p>0.05$ for all; Figures 3 and 4) suggesting that the dry weight component of hydrilla fresh weight is constant within each biomass component.

The fresh and dry weight of AG hydrilla did not differ among years (Figure 1) and the water fraction within tissue was constant across time (6.2%; Figure 3). Hydrilla BG fresh weight did not differ among years while dry weight did (Figure 1) suggesting that hydrilla management decisions based solely on interpretations of changes in fresh weight may not achieve the desired results. The water fraction within BG hydrilla tissue was constant across years (20.4%; Figure 3).

The TUR and RR components of hydrilla BG did not have similar patterns. Hydrilla RR fresh and dry biomass did not differ over time and the water fraction within RR biomass was constant across years (10.1%; Figure 4). In contrast, hydrilla TUR fresh and dry biomass differed over time (Figure 1) while the water fraction within TUR biomass stayed constant over time (39.6%; Figure 4).

CONCLUSIONS

- The water fraction of monoecious hydrilla tissue types appears to be constant over time.
- However, the confounding results in analysis of hydrilla fresh and dry biomass components suggests that fresh weight is not a good surrogate for dry weight when using biomass as a tool to assess management activities.

TABLES AND FIGURES

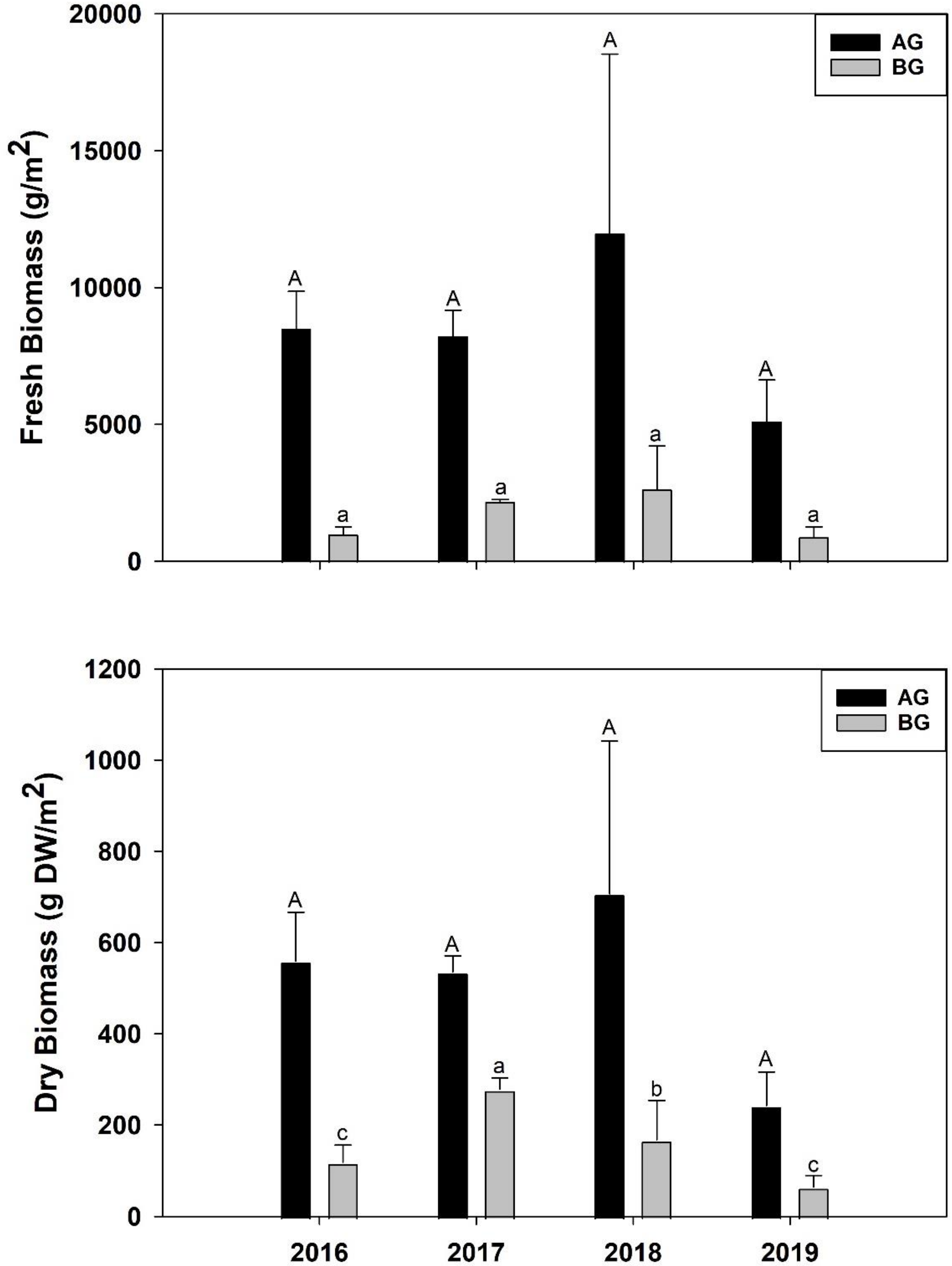

Figure 1. Fresh (top panel) and dry biomass (bottom panel) of aboveground (AG) and belowground biomass (BG); separate analyses were conducted for fresh and dry biomass; error bars are one standard error of the mean; bars sharing the same letter are not different at the alpha = 0.05 significance level.

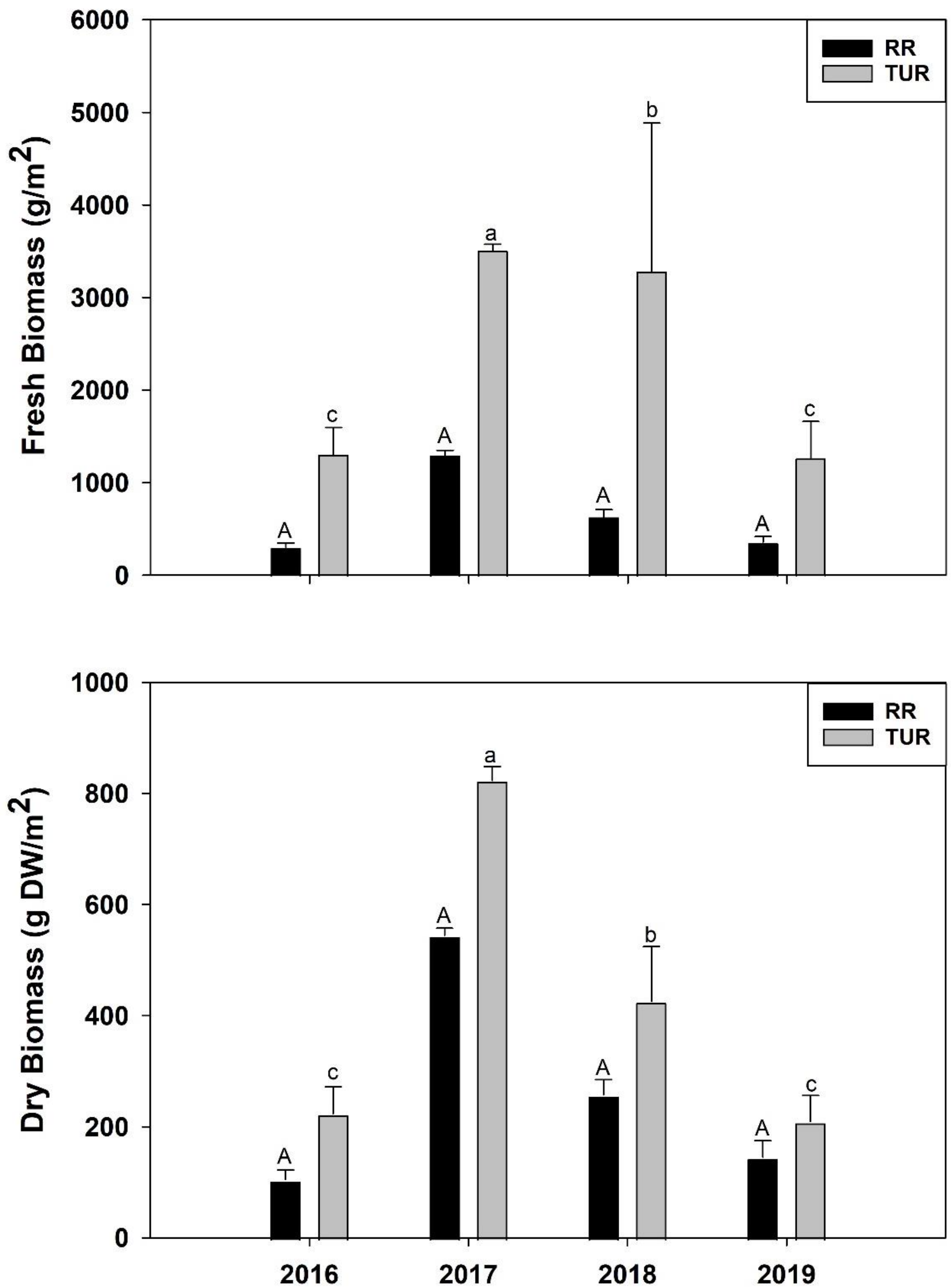

Figure 2. Fresh (top panel) and dry biomass (bottom panel) of root/rhizome (RR) and turion biomass (TUR); separate analyses were conducted for fresh and dry biomass; error bars are one standard error of the mean; bars sharing the same letter are not different at the alpha = 0.05 significance level.

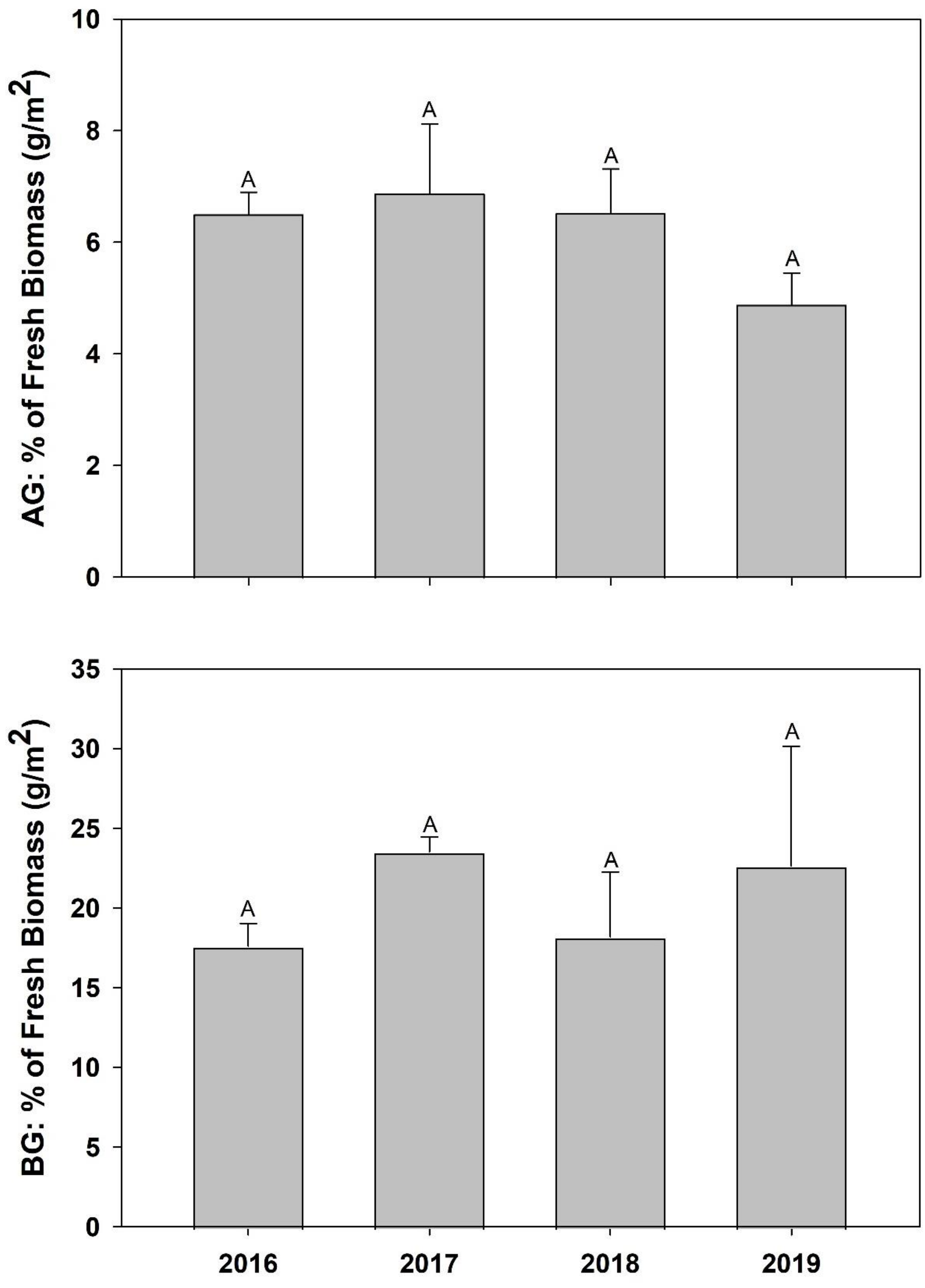

Figure 3. Dry weight percentages of AG (top panel) and BG biomass (bottom panel); error bars are one standard error of the mean; bars sharing the same letter are not different at the alpha = 0.05 significance level.

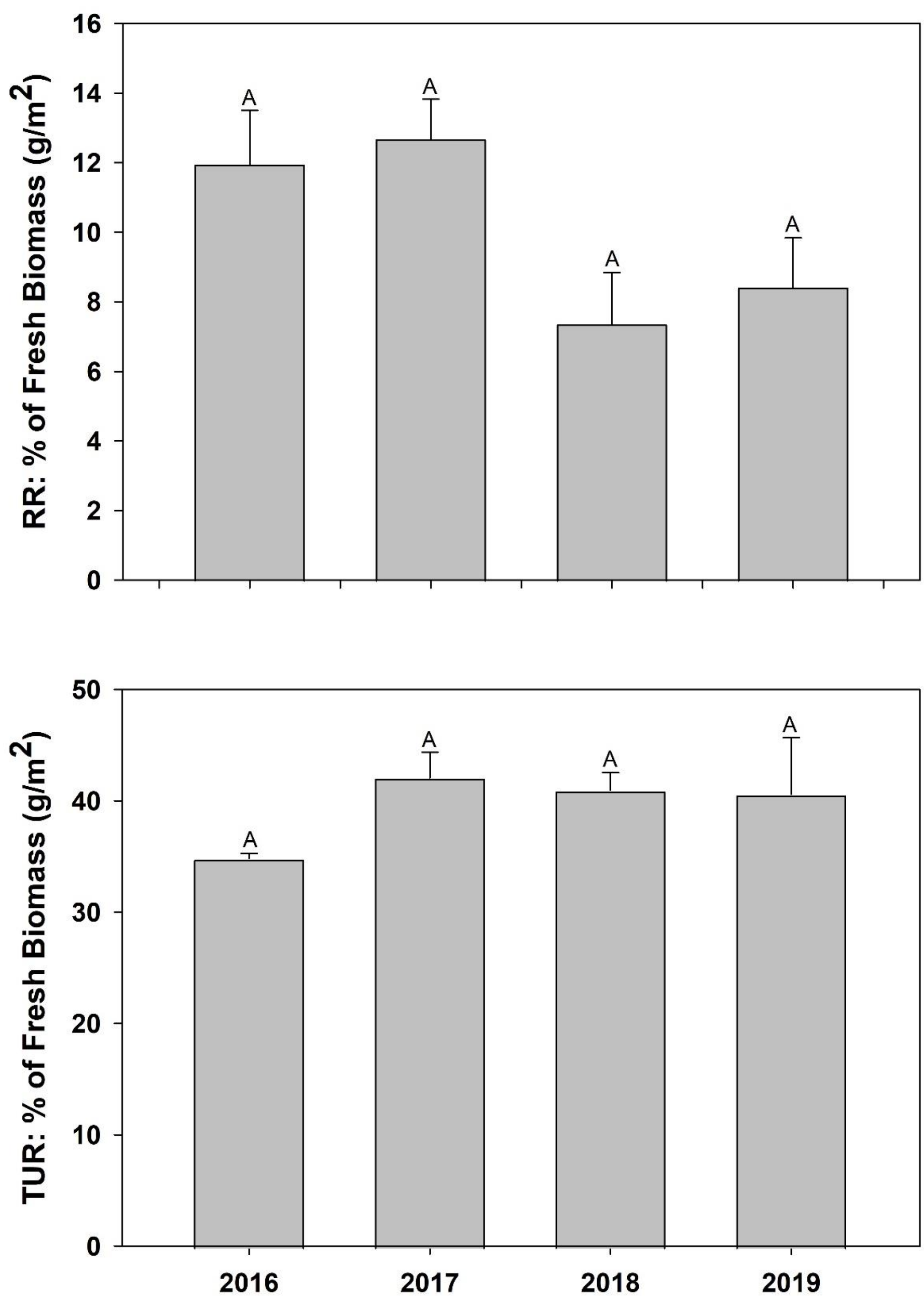

Figure 4. Dry weight percentages of RR (top panel) and TUR biomass (bottom panel); error bars are one standard error of the mean; bars sharing the same letter are not different at the alpha = 0.05 significance level.