NC STATE UNIVERSITY

Hydrilla verticillata Phenology and Growth in Lotic Systems of North Carolina

Jens Beets[1] , Erika Haug[2], Tyler Harris[2], Benjamin Sperry[3] and Robert J. Richardson[2]
[1]North Carolina State University, Department of Fisheries, Wildlife and Conservation Biology; Raleigh NC, jbeets@ncsu.edu
[2]North Carolina State University, Department of Crop & Soil Sciences; Raleigh NC
[3]US Army Corps of Engineers, University of Florida – Center for Aquatic and Invasive Plants, Gainesville, UF

Introduction

Hydrilla (*Hydrilla verticillata* L.f. Royle) is a submersed, rooted aquatic macrophyte native to Asia. Since its documented introduction in the 1950s, hydrilla has rapidly infested water bodies across the United States. Hydrilla invasions have become increasingly problematic in lotic (flowing) systems such as the Erie Canal, Cape Fear River, Ohio River, and Lake Panasoffkee River. These systems pose unique challenges to management due to water flow, presence of desirable species, rocky substrate, and limited access. Hydrilla infestations can impact power generation, present a flood risk, impede boating activities, and negatively impact biodiversity including threatened and endangered species. Anecdotal reports indicate the potential for differences in phenology and morphology of hydrilla growing in flowing systems, which may impact propagule spread and establishment. Phenology and morphology differences would impact potential management efforts, creating a need to understand any potential differences. We hypothesized that notable differences may occur in timing of sprouting, aboveground biomass formation and tuber density between the systems.

Objectives

Determine phenological and biological differences between hydrilla in flowing and quiescent systems.

Methods

Phenology

Fortnightly field surveys were conducted at each field site (Figure 1). Visual observations were made within 100m of the temperature loggers placed at each site. Plant health, life cycle and any major phenological events were recorded. Tubers were collected from each field site from an area totaling one square meter to bring back for in lab verification of life stage and record tuber characteristics.

Aboveground Biomass

Beginning in June 2021 aboveground biomass was monitored by quarterly harvests. Four 0.5 m^2 quadrats were placed at each site and biomass was clipped at soil level. Biomass was washed and dried for analysis. A Student t-test was performed comparing lentic and lotic systems

Tuber Density

Sampling was performed in December 2021 and December 2022 after biomass had died off. Tuber cores were unable to be used for sampling due to hard substrate and three quadrats were placed at each site, digging 20-30 cm within the quadrat to obtain tuber density estimates.

Results

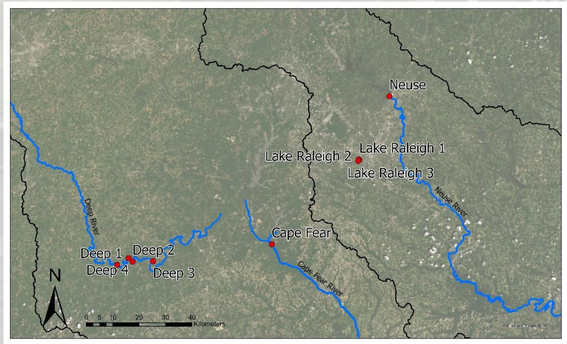

Figure 1. Lentic and Lotic field sites

Figure 2. Biomass collected from Neuse river and Lake Raleigh sites.

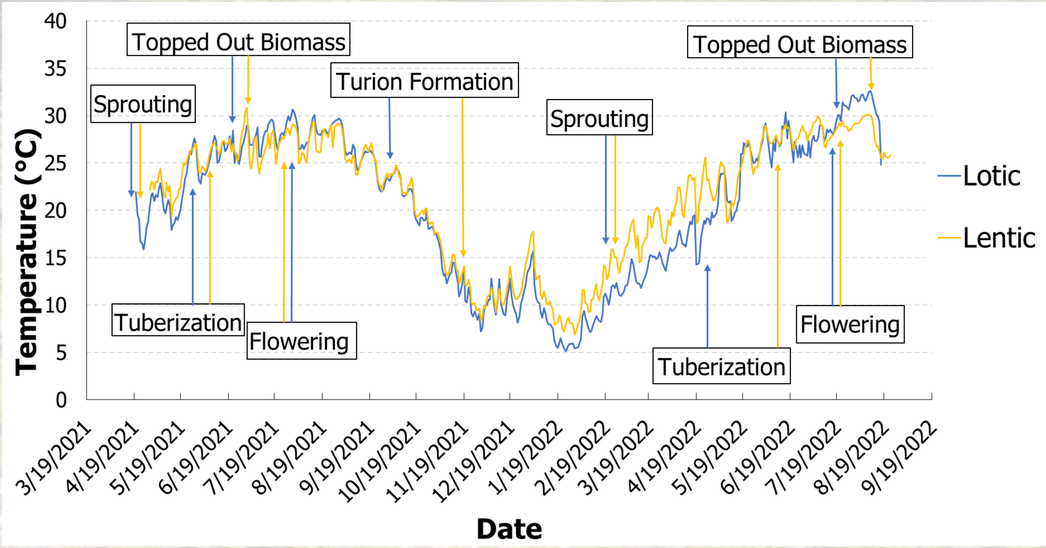

Figure 3. Average temperature at each date across lentic and lotic sites. Major phenological events are indicated by arrows.

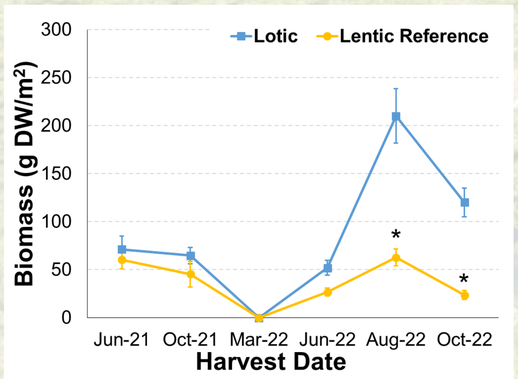

Figure 4. Mean aboveground biomass (±SE) at each date. Points with an asterisk are significantly different between lotic and lentic systems

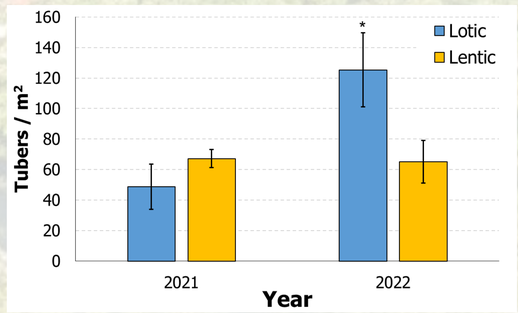

Figure 5. Mean tuber density (±SE) at each year. Bars with an asterisk are significantly different between each year

Conclusions

- Apparent phenological differences between flowing and non-flowing reference sites
  - Water depth and flow likely major abiotic factors
- Tuber and turion production occurs earlier in lotic systems
- Sprouting and flowering occurs at similar times
- Mat formation on rivers is dependent on flow
  - Slower to form in higher flow areas
- Flood events wash out standing hydrilla biomass
  - Limited re-sprouting dependent on time of year
  - Plants growing in rapids appear more resilient to washout
- Biomass production similar or greater (70-80%) in lotic systems at similar depths
- Tuber density not significantly different between lotic and lentic systems
  - Density increased 61% in 2022 in lotic systems
  - Density may not differ due to flooding and tubers traveling downstream
  - Current tuber density methods may not be accurate in rocky substrate

Implications

Hydrilla is present and spreading in lotic systems of North Carolina. Several competitive adaptations present in hydrilla such as fragmentation and tuber production are well suited to promote spread in lotic systems. These hydrilla infestations can alter water flow dynamics and pose a potential flood risk to surrounding areas. Continuing to monitor and developing new methodologies and technologies to monitor and manage hydrilla in lotic systems is necessary. Developing novel management strategies for hydrilla in lotic systems is a desirable next step.

References

Johansson ME, Nilsson C. 1993. Hydrochory, population dynamics and distribution of the clonal aquatic plant Ranunculus lingua. Journal of Ecology, 81-91.

Langeland KA. 1996. Hydrilla verticillata (LF) Royle (Hydrocharitaceae)," the perfect aquatic weed". Castanea. 293-304.

Madsen TV, Sand-Jensen KAJ. 1991. Photosynthetic carbon assimilation in aquatic macrophytes. Aquatic Botany. 41(1-3): 5-40.

Madsen JD, Smith DH. 1999. Vegetative spread of dioecious Hydrilla colonies in experimental ponds. Journal of Aquatic Plant Management, 37, 25-29.
Riis T, Sand-Jensen KAJ. 2006. Dispersal of plant fragments in small streams. Freshwater biology, 51(2): 274-286.

Thum RA, Lennon JT. 2010. Comparative ecological niche models predict the invasive spread of variable-leaf milfoil (Myriophyllum heterophyllum) and its potential impact on closely related native species. Biological invasions, 12(1), 133.

Zhang C, Boyle KJ 2010. The effect of an aquatic invasive species (Eurasian watermilfoil) on lakefront property values. Ecological Economics, 70(2), 394-404.

Acknowledgements

We would like to thank the US Army Corps of Engineers ERDC for funding, NCSU for providing facilities, and the rest of the Richardson lab for technical support.

AQUATIC PLANT MANAGEMENT