Overview of the Aquatic Invasive Plant Research Program at Mississippi State University

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Gulf and South Atlantic Regional Panel

Aquatic Invasive Species

Jackson, MS

MISSISSIPPI STATE UNIVERSITY™

GEOSYSTEMS RESEARCH INSTITUTE

Background

MS Waterbodies

- MS has highest density of small waterbodies (ponds) in MidSouth (1.3/km^2)
- MS has highest number of ponds (~160K)
- 5 large flood control reservoirs
  - Arkabutla, Sardis, Enid, Grenada, & Ross Barnett
  - Ross Barnett doubles as a drinking water reservoir
- TTW reservoirs
- Pat Harrison and MDWFP waterbodies

Ponds (0.5 – 40 ha or 1.25 to 98 ac) in the midsouth. %-land area is pond area / state area. %-total pond area is state pond area / total US pond area. (Revised from Fleming and Stubbs Mississippi State University and printed in Willis and Neal 2012)

State	# of Ponds	Pond Area (ha)	State Area (ha)	Pond Density (ponds/km^2)	% Land Area	% Total Pond Area
AL	74,474	50,151	13,394,500	0.56	0.37 %	1.66 %
AR	127,714	63,255	13,704,600	0.93	0.46 %	2.09 %
GA	123,161	132,896	15,185,100	0.81	0.88 %	4.39 %
LA	132,823	119,885	11,871,600	1.12	1.01 %	3.96 %
MS	160,237	77,719	12,333,400	1.30	0.63 %	2.57 %
TN	78,408	27,448	10,901,800	0.72	0.25 %	0.91 %
TOTAL	696,817	471,354	77,391,000	0.90	0.61 %	15.58 %

Background

MSU Program

- Lots of opportunities for research in MS & surrounding states (also national focus)

- 2 classes of projects at MSU
  - Laboratory/mesocosm
  - Field

- Focus areas of Turnage Lab
  - Aquatic/Wetland Plant Biology and Ecology
  - Aquatic/Wetland Nuisance (Invasive) Plant Control
  - UAS operations (Plant detection and monitoring protocols)


Photo credit: G. Turnage

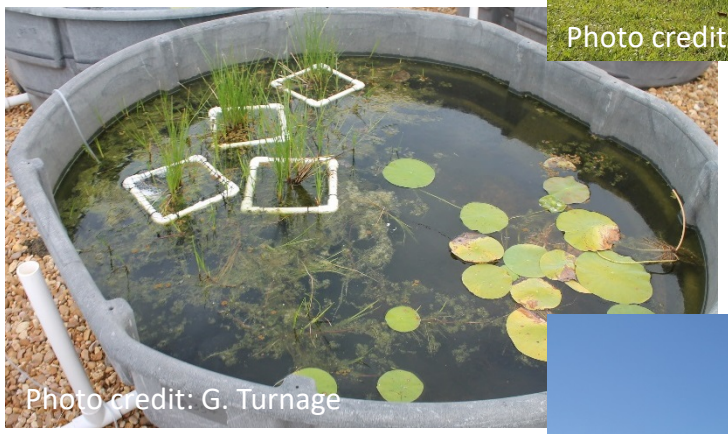


Photo credit: G. Turnage


Photo credit: G. Turnage

Research

MSU Program (Lab/Mesocosm)

- 2 Facilities at MSU dedicated to Aquatic/Wetland plant research
  - Boats, trucks, GPS units, etc. part of program as well
- Aquatic Plant Research Facility at the R.R. Foil Plant Research Center (Northfarm)
  - Mesocosms used to conduct trials
- Greenhouse facility
  - Aquaria used to conduct trials

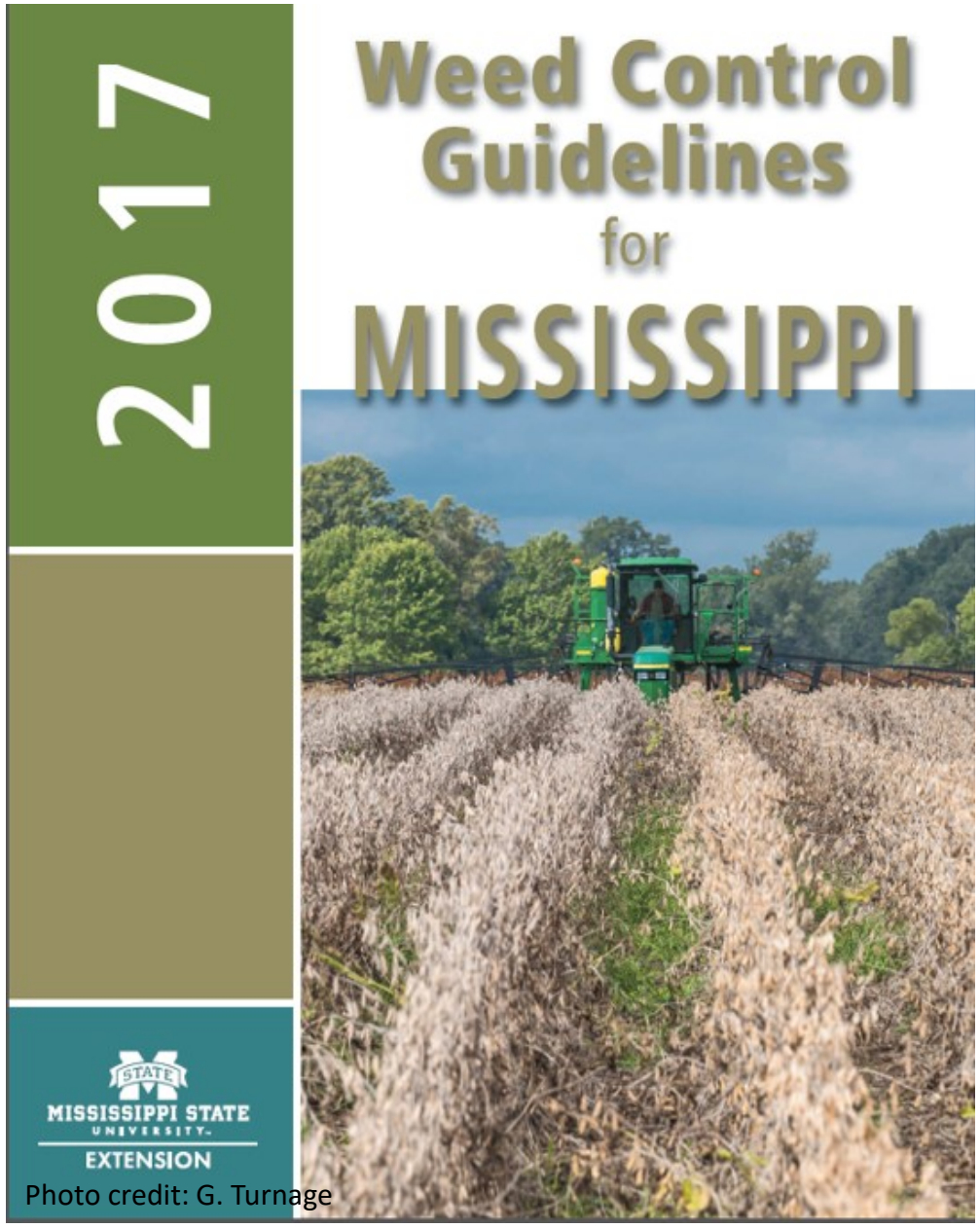

Photo credit: G. Turnage


Photo credit: G. Turnage

Outreach & Education

MSU Program

- Most projects have an extension or outreach component (proprietary work is exception)
- Weed control guidelines
- Technical reports
- Professional presentations
- Poster presentations
- Workshops



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Overview

MSU Program

- APRF – mesocosms used. Meso – medium or intermediate; Cosm – World.
  - Hundreds of mesocosms in use at APRF
  - Various sizes – 1,500 gal, 650 gal, 300 gal, 100 gal, 80 gal, 20 gal, 2 gal

- Allows us to grow plants in simulated natural conditions for study while altering some aspect of each study in a controlled manner
  - Water depth, herbicide rate, etc.

- Plants still subject to natural temperature, photoperiod, and precipitation events

MSU Aquatic Plant Research Facility (APRF)

- Multiple experiments running at any given time (2 dozen species – at least)
- 14 in 2017 – some ongoing
- 3 life history
  - Plants and algae
- 9 control trials
  - Vascular plants
- 2 UAS trials

MSU APRF

- Life history example
- Curlyleaf pondweed (*Potamogeton crispus*) in Southeastern US
- Different phenology from populations in northern US
  - Northern – winter annual (Woolf and Madsen 2003)
  - Southern perennial – no sensescence (Turnage et al. 2018)
- Phenology can affect timing, type, and application method of control measures

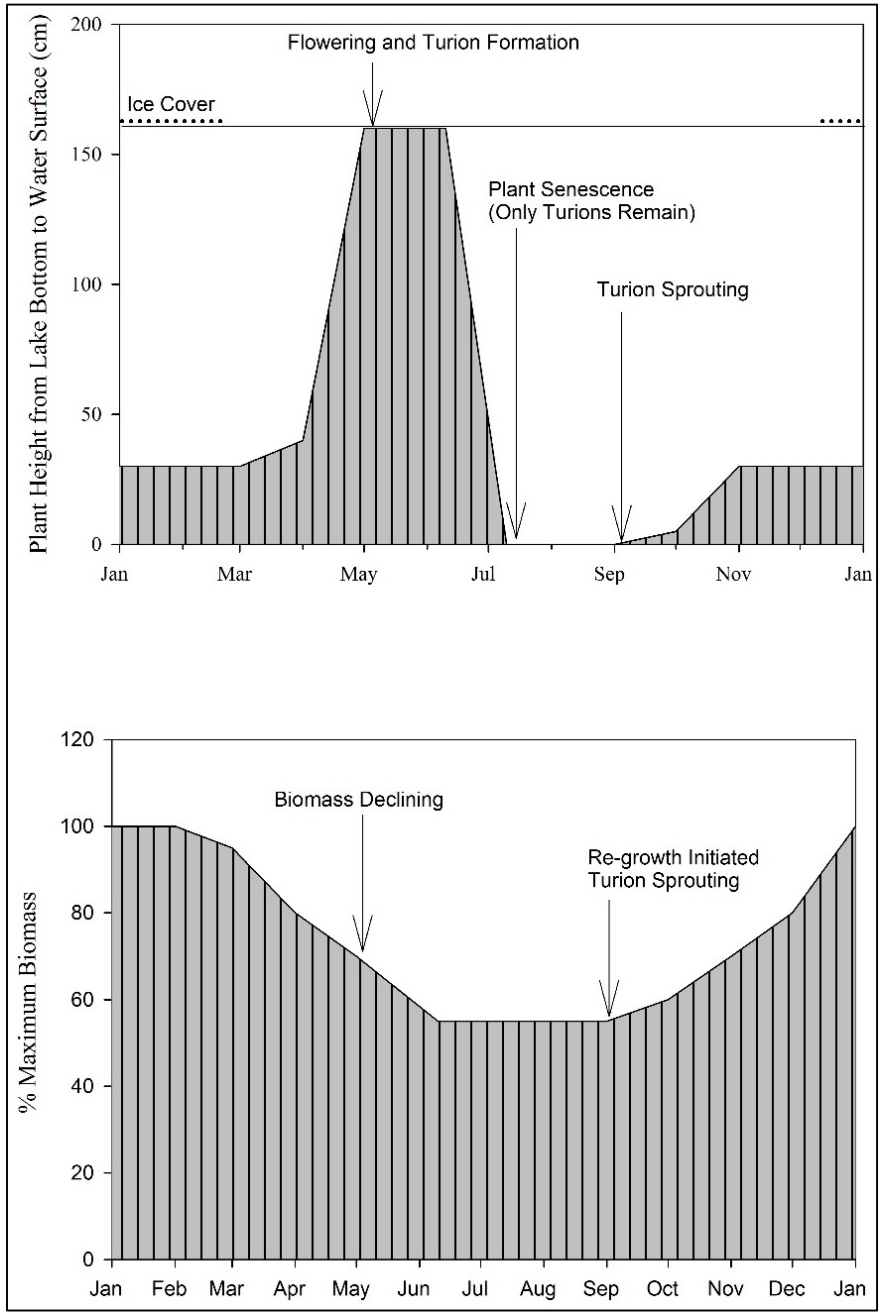


Image credit: Turnage et al. 2018

MSU APRF

- Control trial example 1
- Cuban bulrush (*Oxycaryum cubense*) - ongoing
- Problematic in many southeastern states
- Utilizes floating objects as initial colonization habitat then can form free floating mat (tussock)
- Many herbicides work short term, long term results summer 2018

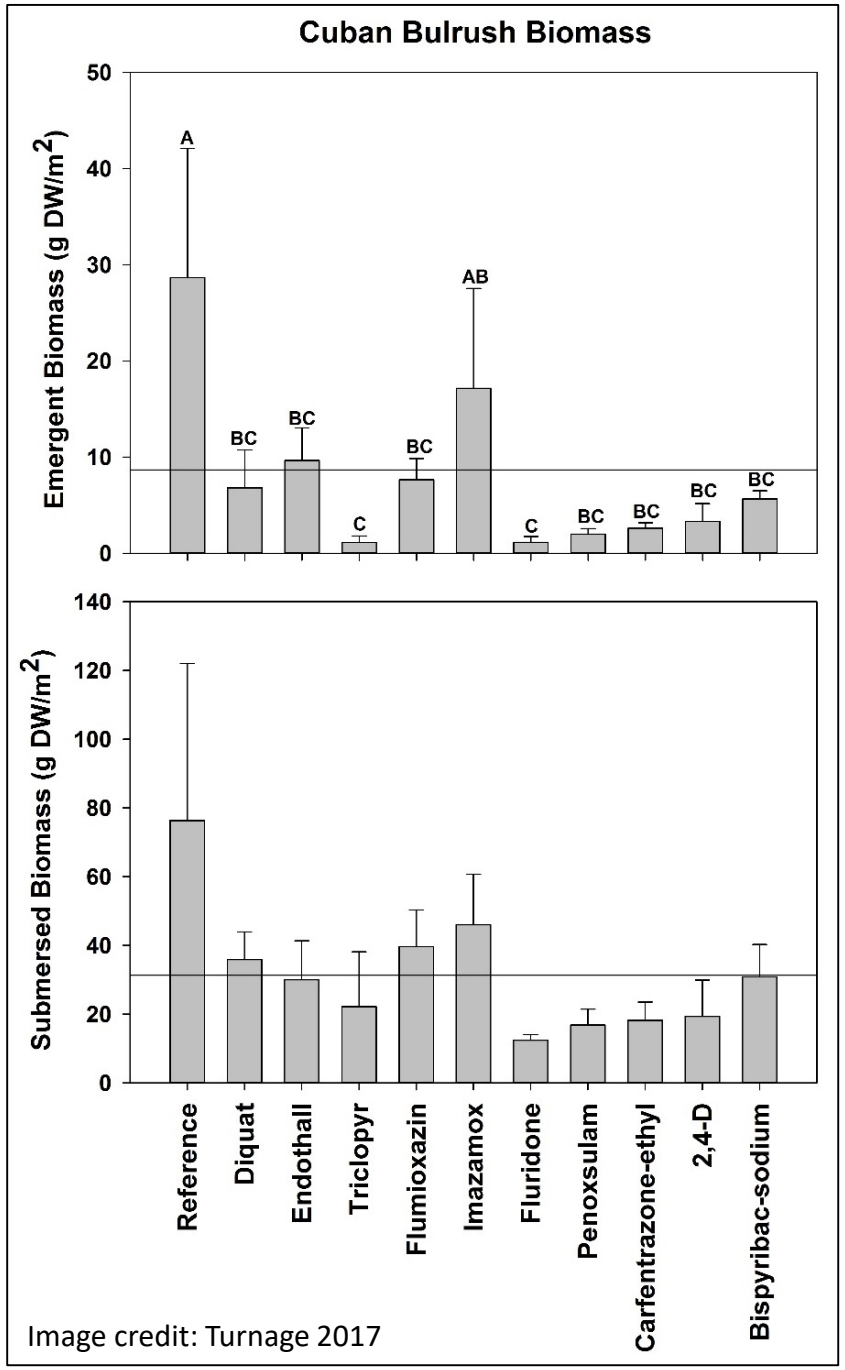
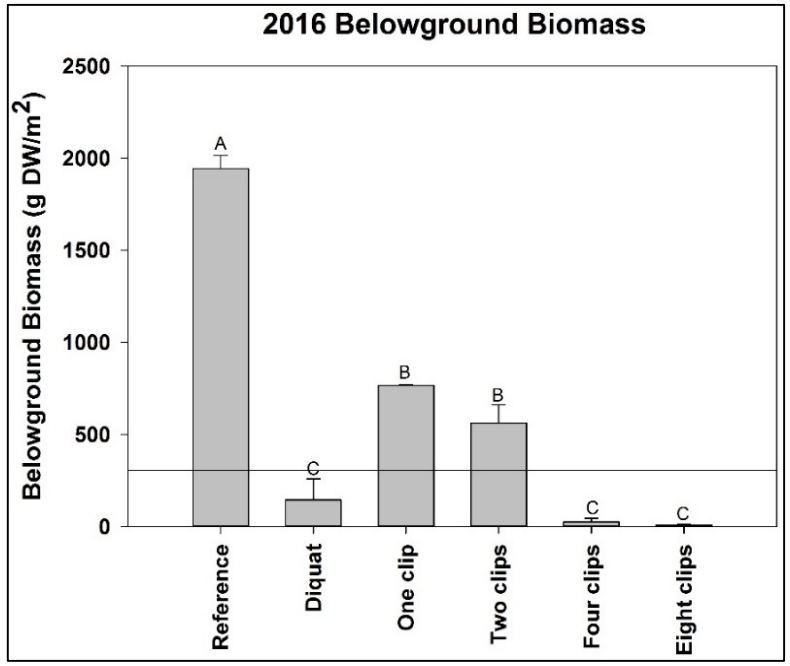
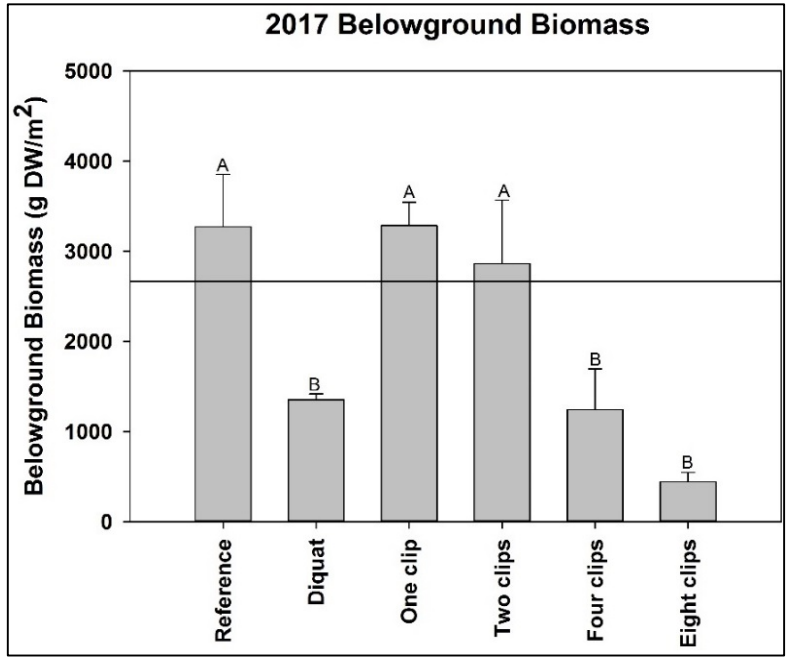


Image credit: Turnage 2017

MSU APRF

- Control trial example 2
- Flowering rush (*Butomus umbellatus*)
- Problematic in many northern US states
- Can grow in moist soil, emergent in shallow waters, or completely submersed
- Herbicides work but non-chemical control methods needed for some areas with T & E species
  - Mowing/clipping investigated





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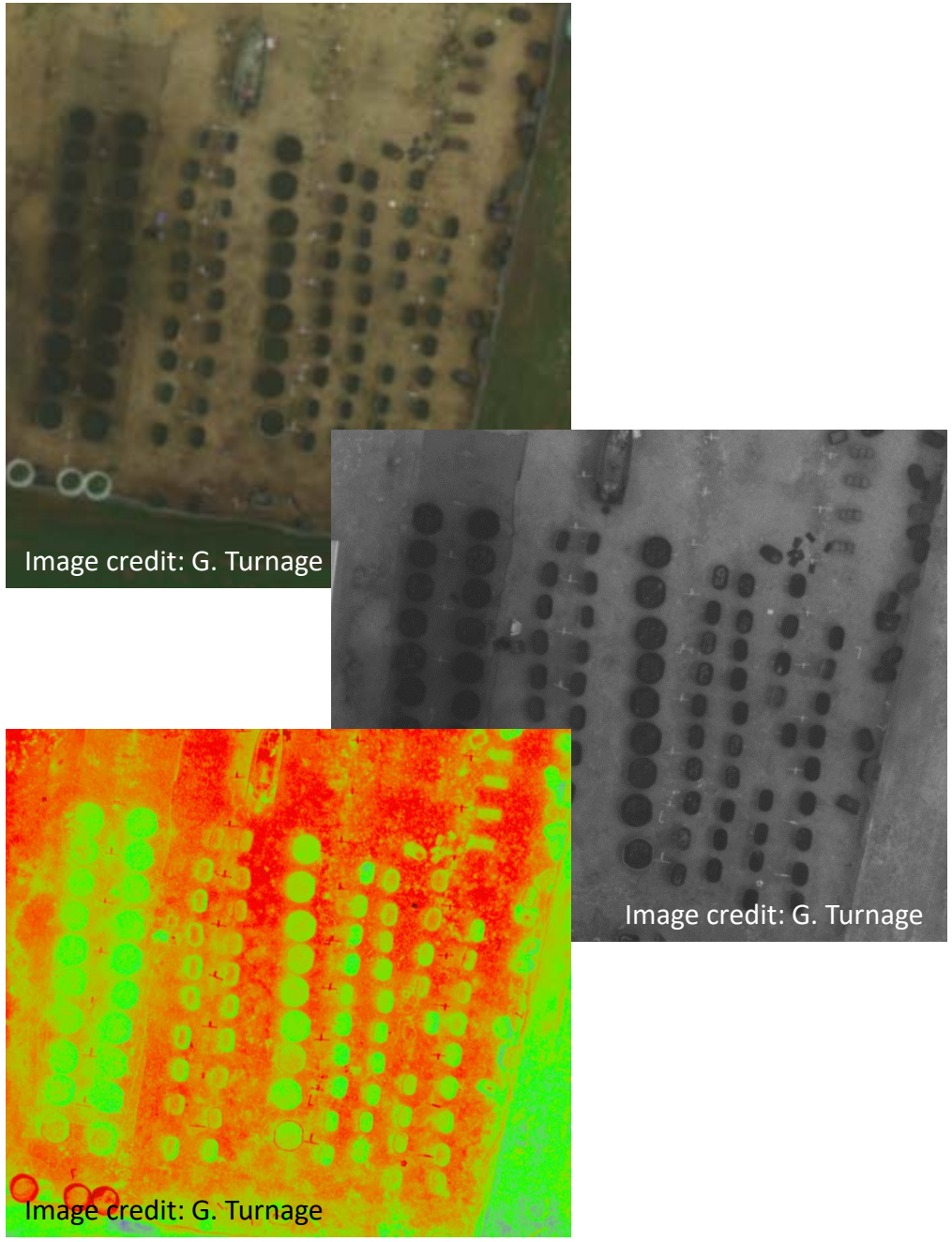
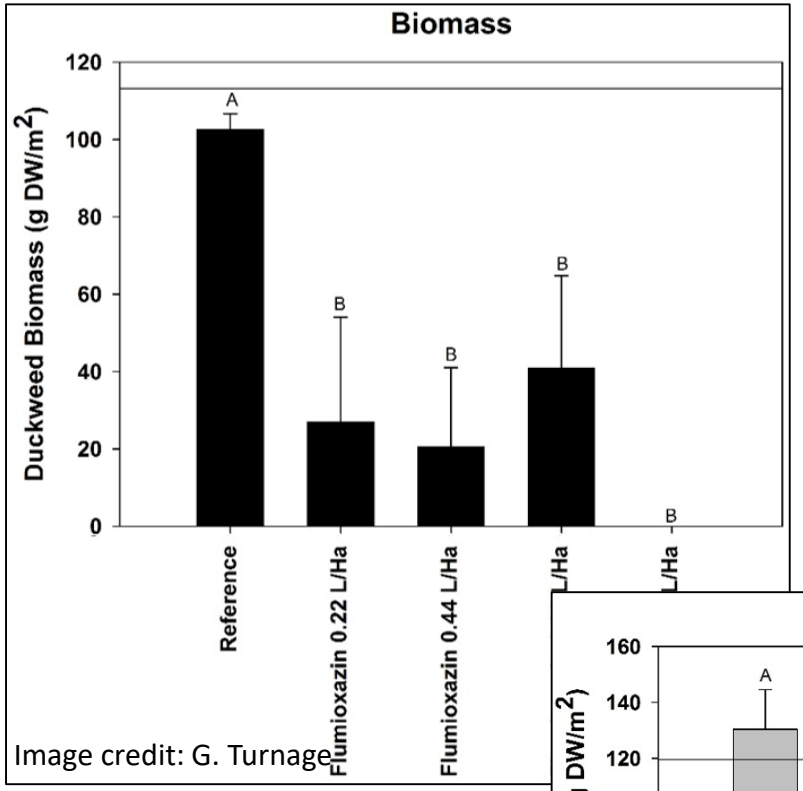
MSU APRF

- UAS trial example
- Flowering rush and hardstem bulrush (*Schoenoplectus acutus*) utilize same habitat
- Hard to reach habitat in some cases
- Can imagery from UAS be used to differentiate two species?
  - Possibly
- Ongoing



MSU APRF

- Control trials (usually)
- Allows us to control more environmental factors than a mesocosm approach
  - Water depth, precipitation, photoperiod, &/or water temperature can be controlled
- Allows for off season trials (i.e., winter)
- Aquaria used in place of mesocosms
  - 10 gal
- 2 trials in 2017



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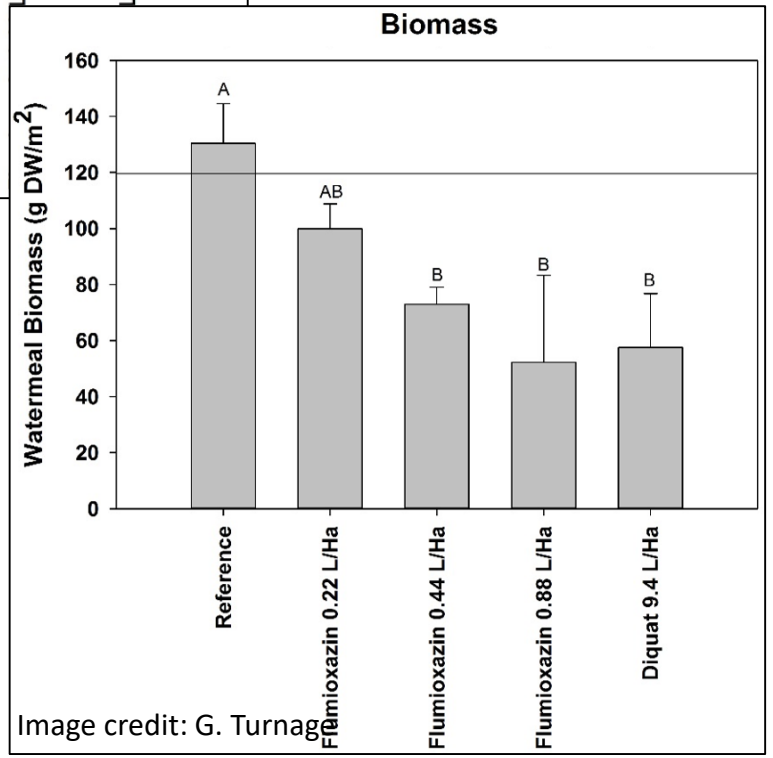

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MSU APRF

MSU Program – APRF & Greenhouse

- These facilities allow us to run small pilot projects prior to large field trials

- Phenology – negates the need to travel to the field as often

- Control - Allows us to screen multiple control options at one time
  - Saves money (i.e., drops of herbicide vs. gallons)

- UAS – Allows us to determine issues that may arise with flight protocols/plans prior to field ops
  - Flight altitude


Photo credit: G. Turnage


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MSU Field Projects

MSU Program – Field projects

- Same focus as APRF but at a larger scale
  - Some of these are stand alone projects while others are follow up to APRF projects
- Aquatic/Wetland Plant Biology and Ecology
- Aquatic/Wetland Nuisance (Invasive) Plant Control
  - Extension work with land owners (pond calls)
- UAS operations (Plant detection and monitoring protocols)

Photo credit: G. Turnage

MSU Field Projects

- Biology & Ecology
- Example - Survey of MS waterbodies in 2017
- 42 waterbodies surveyed, 105 aquatic plant species observed, 15 non-native
- Survey used to prioritize species for control efforts in MS
- First large scale (statewide) survey

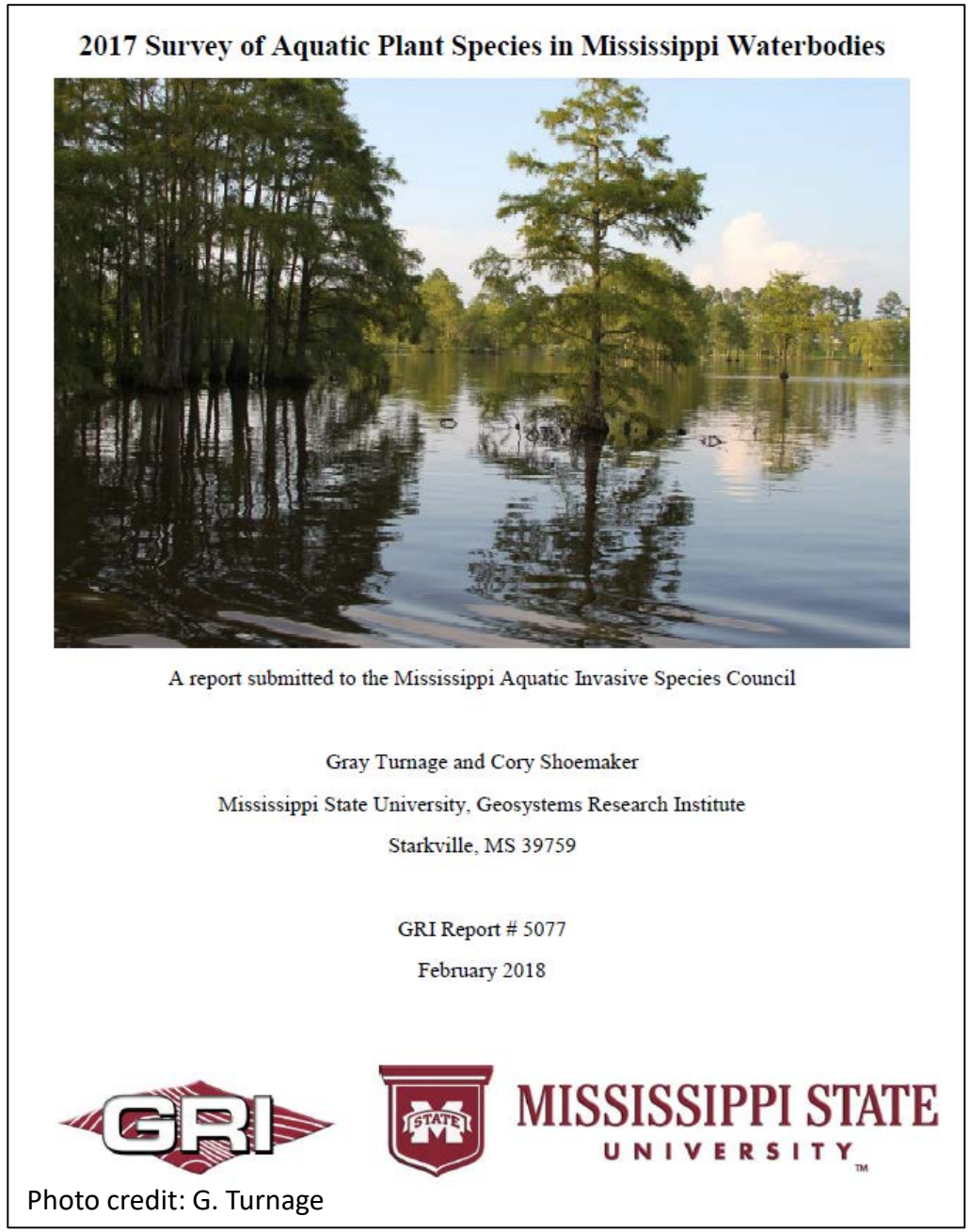


Photo credit: G. Turnage

MSU Field Projects

- Nuisance Plant Control
- Example 1 – Pickwick Lake, follow up to APRF trial
  - Turnage et al. 2015
- Hydrilla control
- MSU partnered with private applicators and chemical companies to investigate the use of a copper product for control of hydrilla
- Found a use for chelated copper as a stand alone hydrilla control option

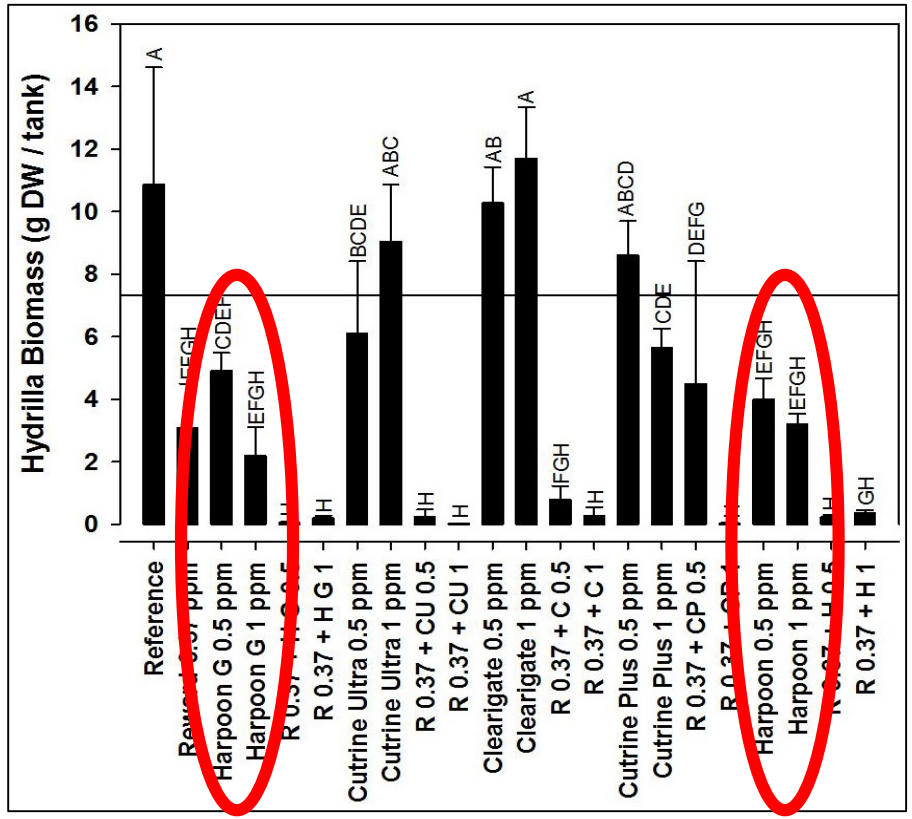


Image credit: Turnage et al. 2015

MSU Field Projects

- Nuisance Plant Control

- Example 2 – Detroit Lakes, MN; in conjunction with multiple APRF trials
  - Madsen et al. 2016
  - Turnage et al. 2018

- Flowering rush control

- MSU partnered with natural resource managers to investigate control options and develop an adaptive management plan

Madsen, J. D., B. Sartain, G. Turnage, and M. Marko. 2016. Management of Flowering Rush in the Detroit Lakes, Minnesota. Journal of Aquatic Plant Management 54: 61-67.

Turnage, G., R. M. Wersal, and J. D. Madsen. 2017. Evaluating the Efficacy of Granular Copper and Triclopyr Alone and in Combination for Control of Flowering Rush. Journal of Aquatic Plant Management 55: 120 – 122.

Turnage, G., B. Alcott, and T. Guetter. 2018. Adaptive Management of Flowering Rush Using the Contact Herbicide Diquat in Detroit Lakes, Minnesota 2016 – Final Report. GRI Report # 5076. Mississippi State University: Geosystems Research Institute. 57 pp.

MSU Field Projects

- UAS Operations

- Example 1 – *Phragmites australis*
  - Samiappan et al. 2017a
  - Samiappan et al. 2017b

- Mapped *Phragmites australis* in a coastal wetland

- Able to differentiate Phragmites from other wetland species with high degree of accuracy via multiple methods of aerial image analysis

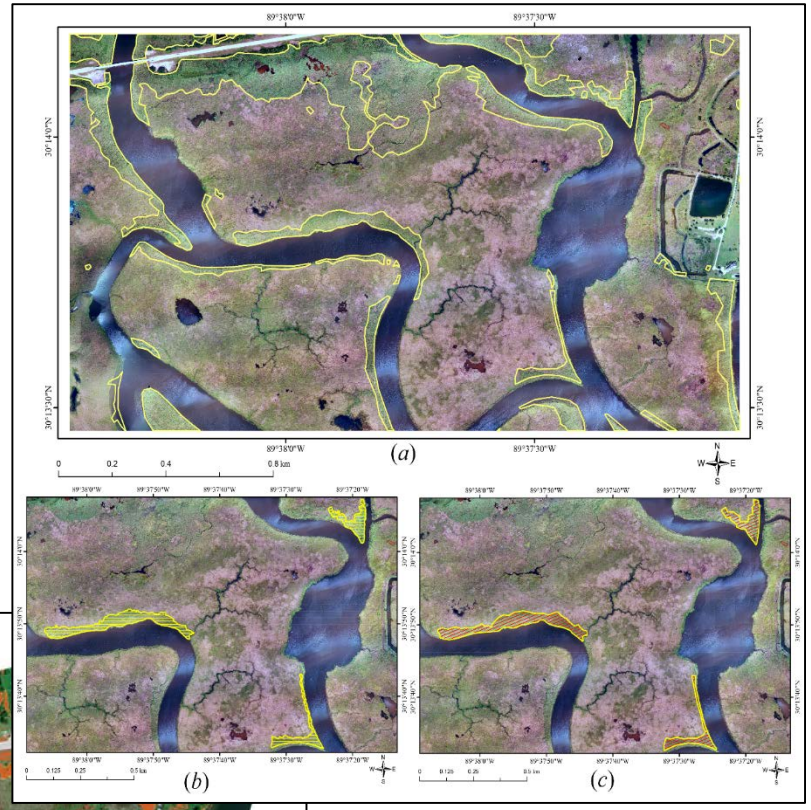


Image credit: Samiappan et al. 2017a

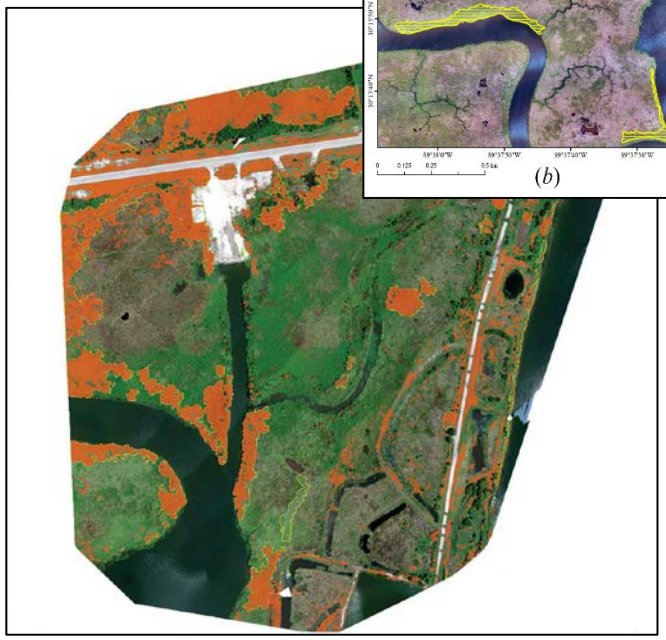
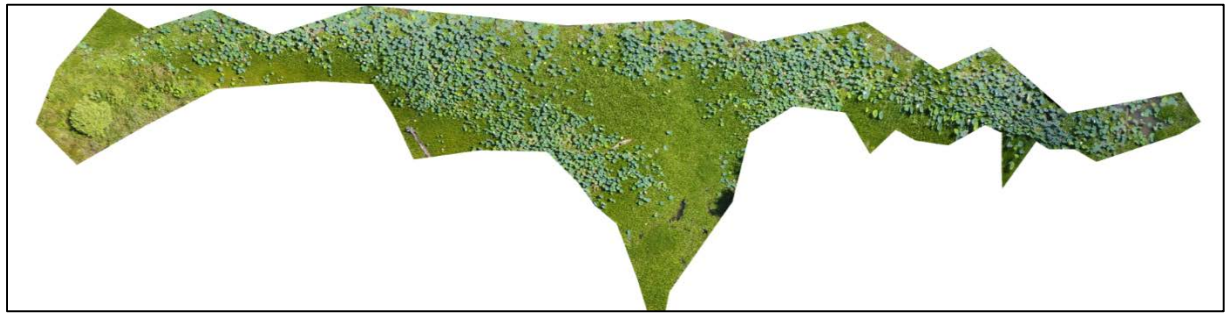


Image credit: Samiappan et al. 2017b

MSU Field Projects

- UAS Operations

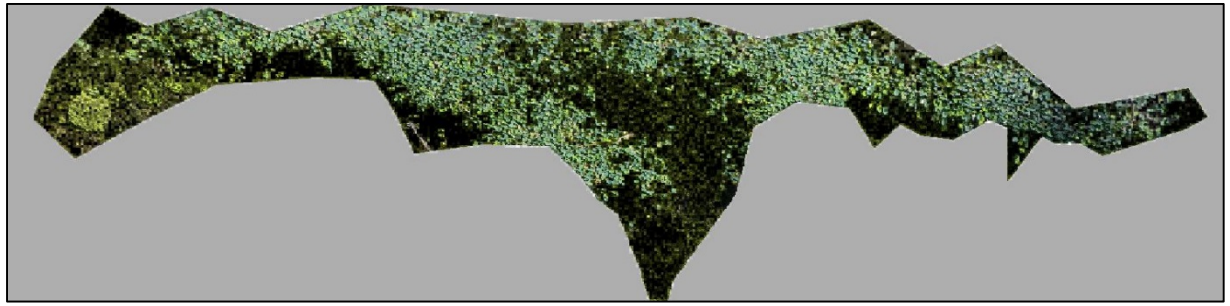
- Example 2 – Water hyacinth vs. American lotus
  - TTW
  - McCraine et al. 2018



Original Trial Mosaic

- Mapped intermixed stand of the two species

- Image analysis conducted with high degree of accuracy



10 x 10 Pixel Sample Size = 0.69 ft^2

MSU Field Projects

- UAS Operations

- Example 2 – Water hyacinth vs. American lotus
  - TTW
  - McCraine et al. 2018

- Mapped intermixed stand of the two species

- Image analysis conducted with high degree of accuracy

- Re-evaluated analysis technique to decrease analysis time while maintaining accuracy

	Sample Size		
	10x10	**25x25**	**50x50**
Overall Accuracy	81.60%	81.66%	76.80%
Kappa Statistic	0.63	0.63	0.58
Computation time (Min:Sec) for 0.45 Acres	16:02	2:19	00:46

Conclusion

- Problems aren't going away
  - Ex) Water hyacinth present in US since 1800's

- Focus is to solve problems related to aquatic/wetland ecology from a scientifically sound standpoint using as many options as are available
  - New use patterns/protocols for old tools
  - Innovative tools and use protocols (UAS)

- Research and Extension/Outreach/Education components of most projects
  - Some proprietary work

Photo credit: J. Madsen

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Questions?

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