Performance and Behavior of Florpyrauxifen-benzyl Suppressing Hydrilla in a Small Eutrophic Lake in Florida

Prepared by J. Leary with B. Sperry J. Ferrell, D. Jones, M. Heilman and K. Gladding
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UF | IFAS Extension
UNIVERSITY of FLORIDA
CENTER FOR AQUATIC AND INVASIVE PLANTS

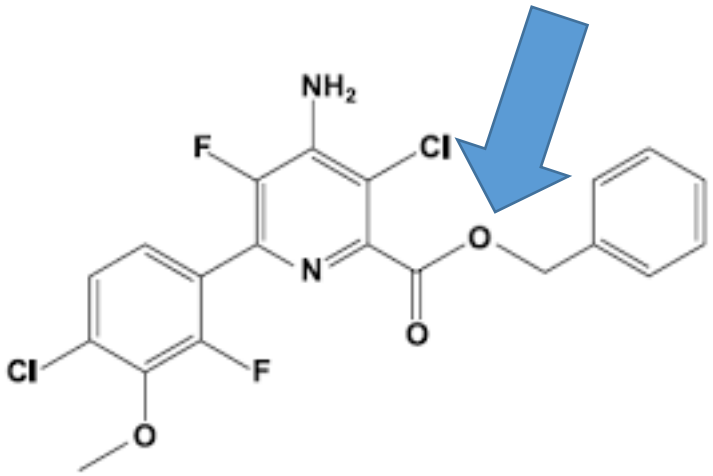
Hydrilla Management in FL

- Introduced to FL in the 1950s
- Whole-lake treatments w/ fluridone in the 1980s-90s
- Fluridone resistance identified in the mid-90s
- Current standard practice is over-reliant on Endothall
- Risk of Endothall resistance is very high
- Research priority to diversify management portfolio

https://en.wikipedia.org/wiki/Hydrilla#/media/File:Hydrilla_verticillata_collection_Lake SeminoleFL.jpg

Florpyrauxifen-benzyl

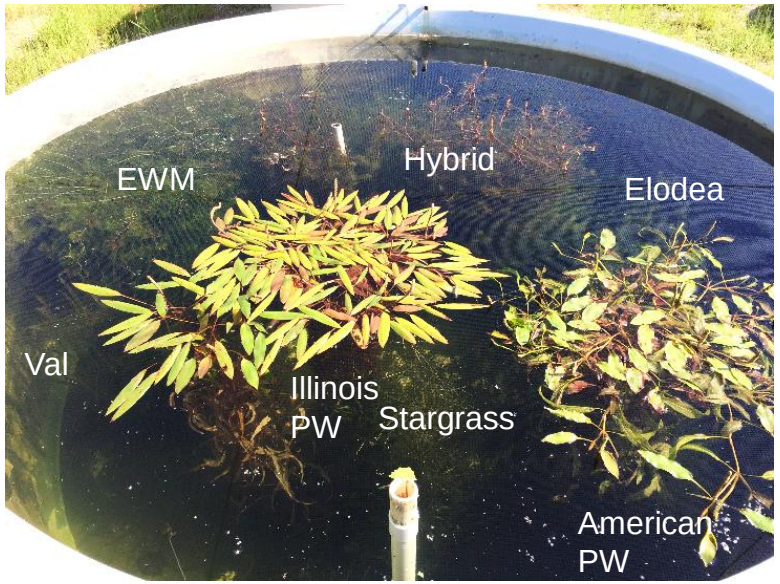
- Auxin chemistry
- Reduced Risk Classification
- Fate in Water
  - DT50 – pH-dependent (1-2 days at pH >9)
  - Photolysis is primary
- Low solubility (15 ppb), high K_{oc} and K_{ow} (lipophyllic)
- Low use rates
  - 19-48 ppb (2-5 pdu per acre-ft)



Florpyrauxifen-benzyl (FPB) de-esterifies into parent acid (FPA) through hydrolysis

Early Mesocosm Research

- Active at low concentrations (µg L^{-1}) and short exposure times 24-48 hrs
- Highly effective on *Myriophyllum* spp. (milfoils) and *Hydrilla verticillata*
- Sensitivity on other species: *Pontederia* sp., *Sagitarria* sp, all floating leaf plants
- Tolerances for selectivity with: *Potamagton* sp., *Typha* spp., *Scirpus* spp., *Vallisneria americana* and many other native grasses

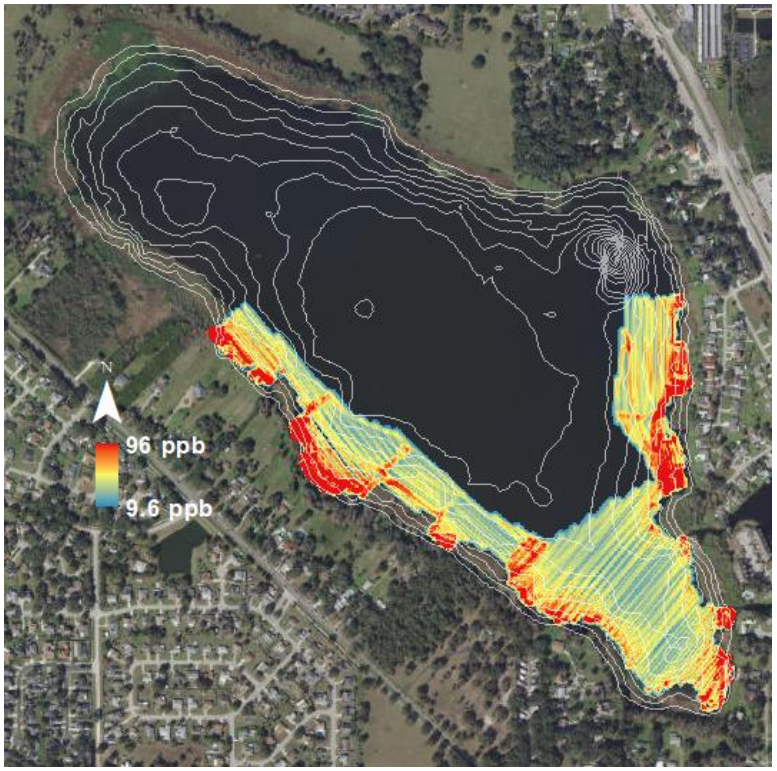


Netherland 2017

- *Netherland M. and R. Richardson. 2017. Evaluation of Sensitivity of Five Aquatic Plants to a Novel Arylpicolinate Herbicide Using an Organization for Economic Cooperation and Development Protocol. Weed Sci. 64(1):181-191.*
- *Richardson R., E. Haug, and M. Netherland. 2016. Response of seven aquatic plants to a new arylpicolinate herbicide. J. Aquat. Plant Manage. 54:26-32.*
- *Beets, J. and Netherland, M., 2018. Mesocosm response of crested floating heart, hydrilla, and two native emergent plants to florpyrauxifen-benzyl: A new arylpicolinate herbicide. Journal of Aquatic Plant Management, 56, pp.57-62.*
- *Beets, J., Heilman, M. and Netherland, M.D., 2019. Large-scale mesocosm evaluation of florpyrauxifen-benzyl, a novel arylpicolinate herbicide, on Eurasian and hybrid watermilfoil and seven native submersed plants. J. Aquat. Plant Manag, 57, pp.49-55.*

Herbicide Application

- ProcellaCOR SC registered Feb. 2018
- August 14, 2018
- Fish Lake is 228-acre elliptical basin; avg. depth ~5 ft.; a total vol. of ~400M gal.
- Treat 50-acre plot on south end 5 ft – avg. depth= ~250 acre-ft
- Target concentration – 48 ppb (5 pdu)
- 50 acres, 5 PDU acre-ft^{-1}
- Treated w/ 2 airboats; 20 ft swaths; 3.5 hours
- Southeast wind day of application and several days following



Evaluating the performance and behavior of FPB

Efficacy of suppressing hydrilla

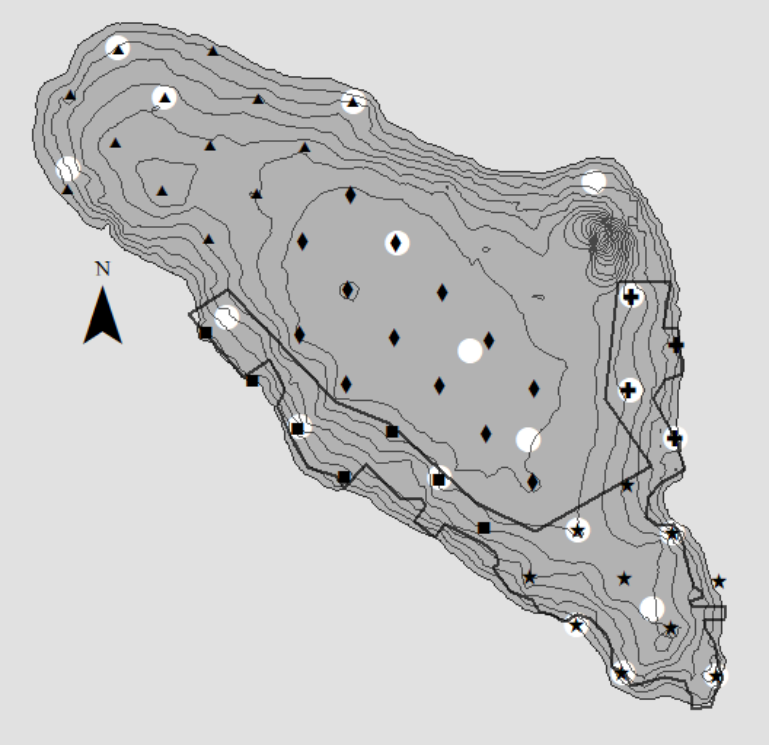
- Hydroacoustic and point-intercept surveys (monthly)

Herbicide dissipation

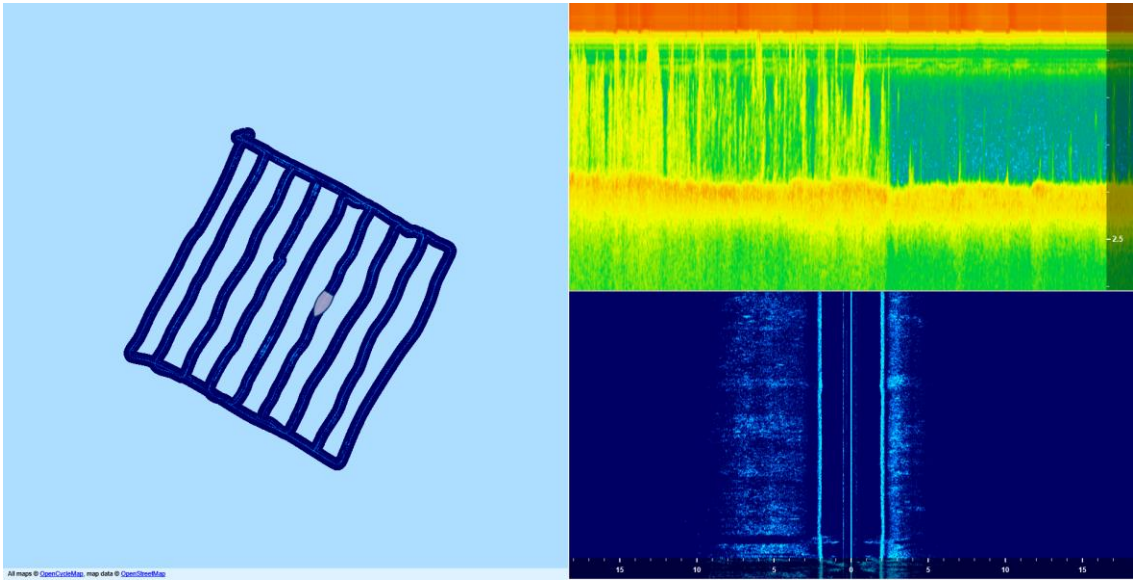
- Water grab sampling; analytical quantification of FB and FPA (daily out to 4 DAT; weekly out to 30 DAT)

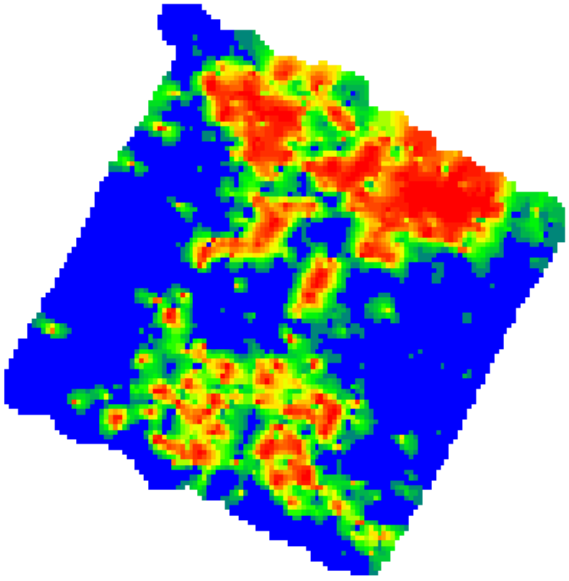
Non-target impacts

- point-intercept surveys (monthly)



Hydro-acoustic surveys





- Hydroacoustic data recorded with a Lowrance HDS7 Gen 2 logger integrated with WAAS GPS and transducer transmitting a 200-kHz signal in a 20° down scan at 10 to 15 pings s^{-1}.
- Scan log data files (.sl2) were submitted to BioBase® cloud-based data processing
- Post-processed in GIS to interpolate biovolume (BV) occupying the water column
- BV a proxy to SAV density

Hydrilla Suppression Efficacy

08/06/2018 (-7 DAT)

Treatment Plot
BV avg 0.64

Non-treated Area
BV avg 0.63

Hydrilla Suppression Efficacy

09/10/2018 (35 DAT)

Treatment Plot
BV avg 0.26

Non-treated Area
BV avg 0.44

Hydrilla Suppression Efficacy

10/09/2018 (64 DAT)

Treatment Plot
BV avg 0.12

Non-treated Area
BV avg 0.42

Hydrilla Suppression Efficacy

11/15/2018 (101 DAT)

Treatment Plot
BV avg 0.08

Non-treated Area
BV avg 0.51

Hydrilla Suppression Efficacy

12/17/2018 (133 DAT)

Treatment Plot
BV avg 0.04

Non-treated Area
BV avg 0.54

Hydrilla Suppression Efficacy

01/16/2019 (163 DAT)

Treatment Plot
BV avg 0.05

Non-treated Area
BV avg 0.55

Hydrilla Suppression Efficacy

02/22/2019 (200 DAT)

Treatment Plot
BV avg 0.14

Non-treated Area
BV avg 0.63

Hydrilla Suppression Efficacy

04/18/2018 (255 DAT)

Treatment Plot
BV avg 0.24

Non-treated Area
BV avg 0.71

Hydrilla Suppression Efficacy

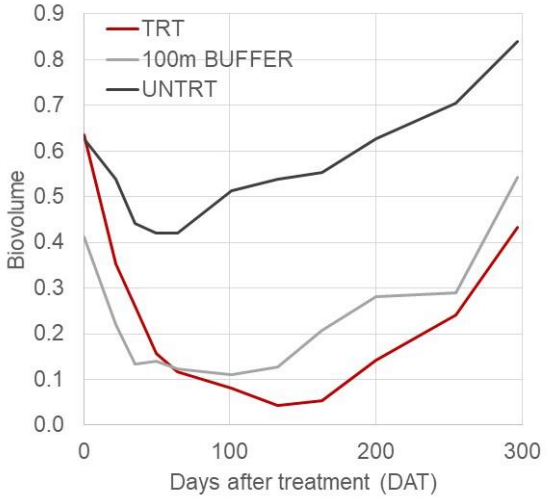
05/30/2019 (297 DAT)

Treatment Plot
BV avg 0.43

Non-treated Area
BV avg 0.84

Hydrilla Suppression Efficacy

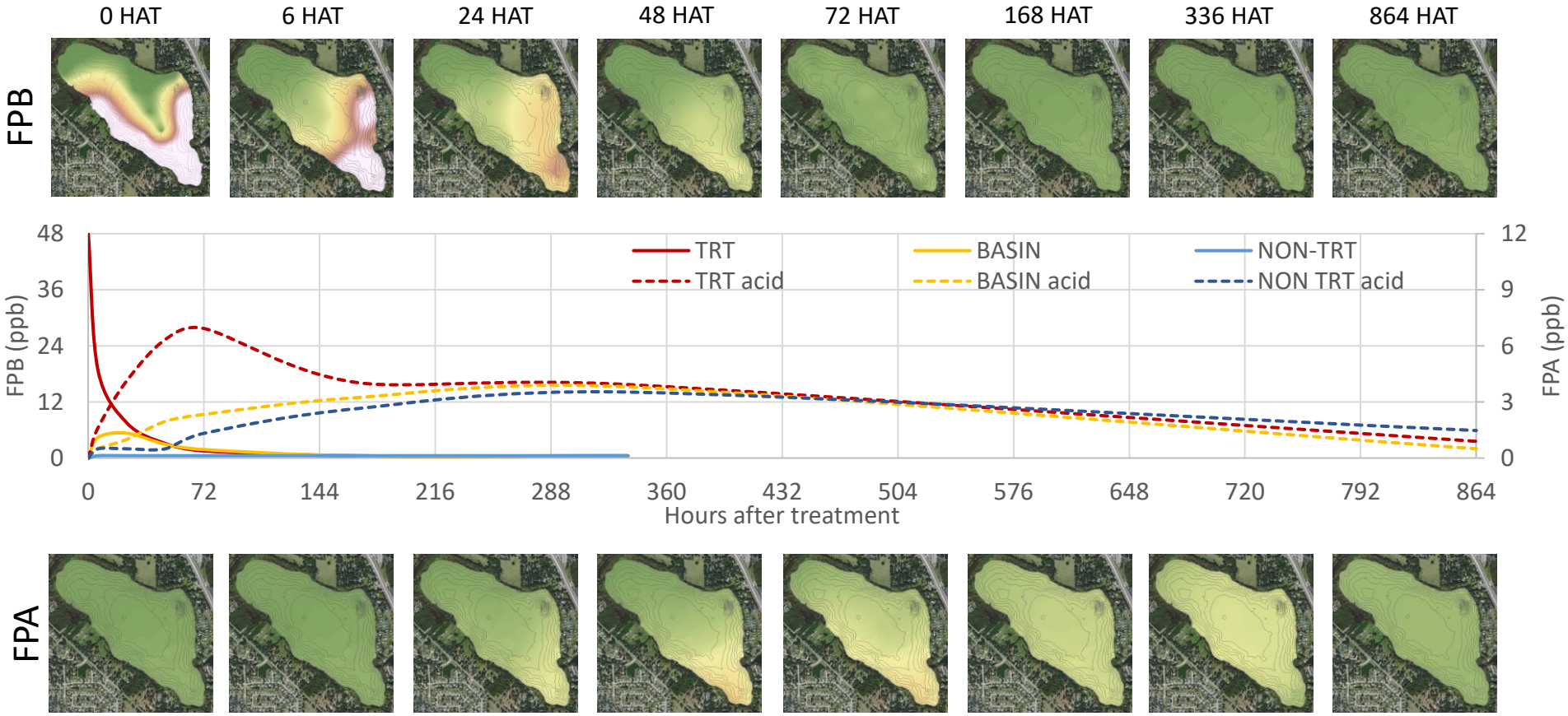
- The cooler temperatures during the winter months could have extended suppression
- 30% suppression was measured at ~300 DAT in treatment area
- Suppression measurable 100 m beyond treatment area
- Non-treated area increased 30%



Dissipation of FPB and FPA

- Water sampled at stations throughout the lake split between treated and non-treated sections (n=20)
- Samples collected at 6, 24, 48, 72 HAT and 1, 2 and 5 WAT
- Samples analyzed for conc. (ppb) of the herbicide parent ai and acid metabolite
- Conc. interpolated (an estimation between observed points w/ kriging technique) for spatial presentation of dissipation

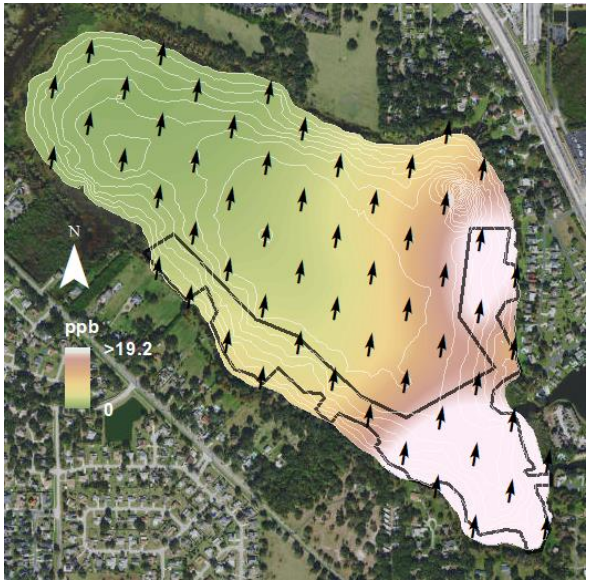
Dissipation of FPB and FPA



- FPB rapidly dissipated (adsorption, hydrolysis and diffusion)
- FPA biphasic w/ longer residency and higher mobile

Dissipation of FPB and FPA

6 HAT
winds 188° S at 2.6 m s^{-1}



24 HAT
winds 165° SSE at 1.7 m s^{-1}

48 HAT
winds 124° SE at 1.9 m s^{-1}

- Winds on day of treatment were S-SE pushing N-NW at 4-6 mph
- Lake fetch is the maximum length of open water wind can travel unobstructed
- Herbicide treatments were applied within 30 cm of the surface
- Fish Lake has a deep limnetic basin (>8 ft.) with a narrow concentric littoral zone

Dissipation of FPB and FPA

- Acid hydrolysis was rapid
- FPA >50% of detectable quantity 48 HAT [1]; FPA 100% of detectable quantity at 1 WAT
- Acid concentration is biphasic (increases then decreases) [2]
- Possibly ~50-70% of the ai adsorbed and/or taken up by hydrilla [3]
- FPA degradation is slower than FPB hydrolysis
- 18% of est. mass balance remaining at 5 WAT [4]
- FPA more mobile with time to detection corresponding to distance [5]

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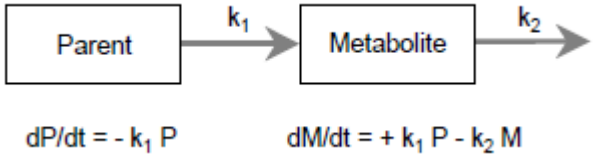
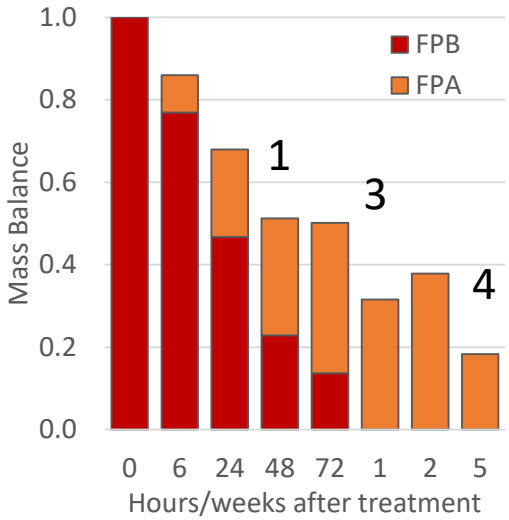
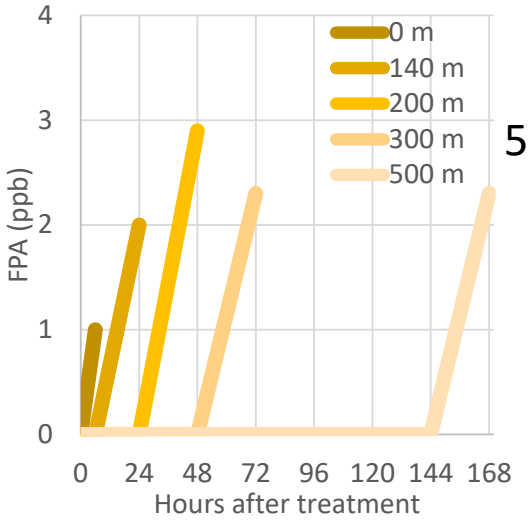
First-order kinetics reaction

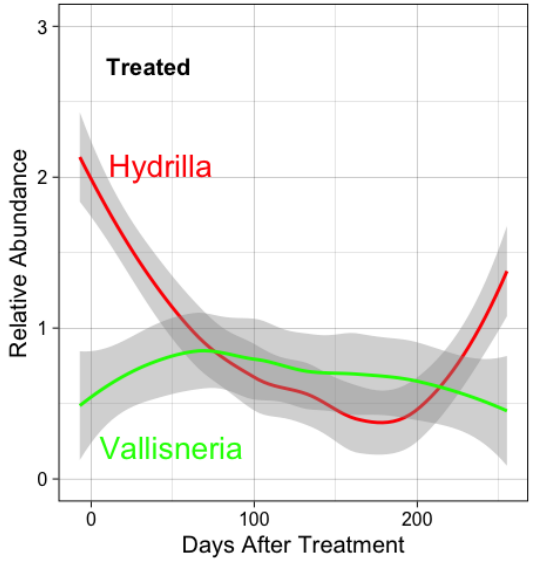




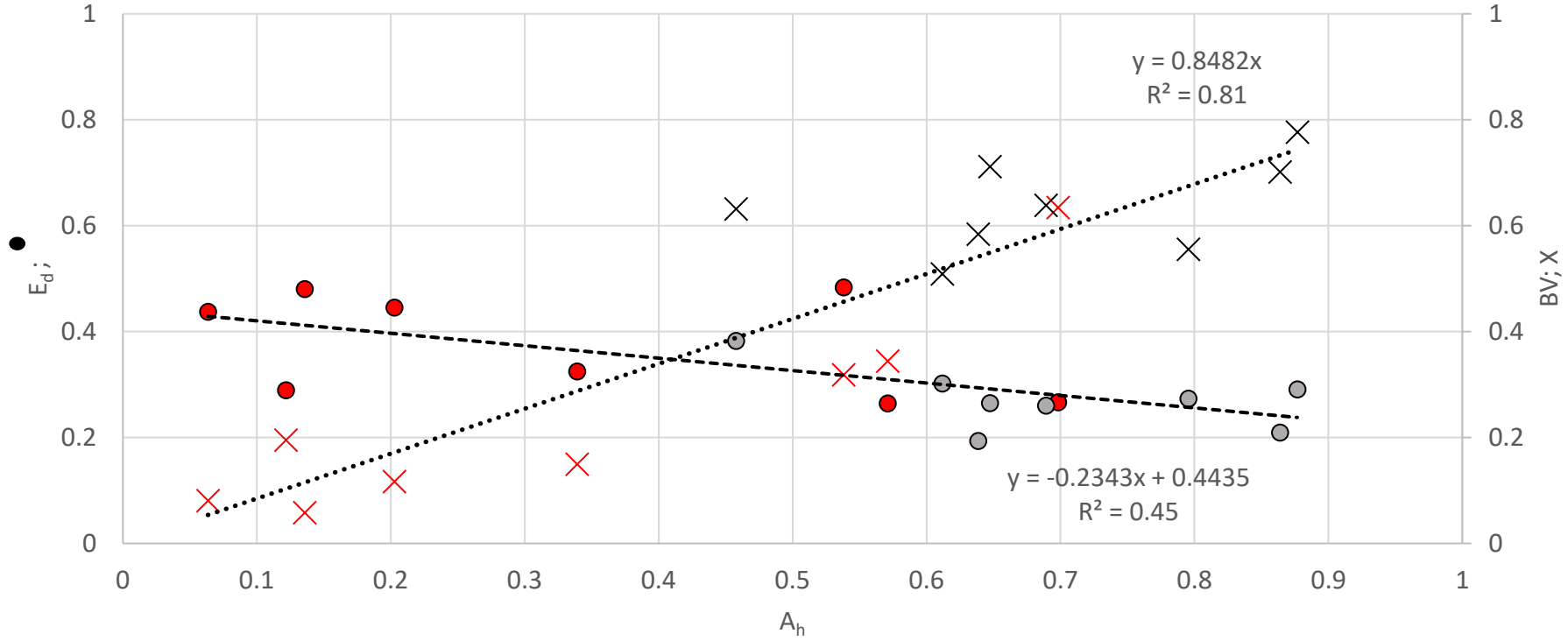


Non-target Impact

- Herbicidal symptoms detected outside of the treatment, throughout the lake
- Lotus and lily severely injured and will need further consideration if present
- *Nuphar* symptoms were apparent; No rhizomes floated; regrowth was observed in 3-4 MAT; no detectable change in frequency and abundance
- *Vallisneria* is tolerant to FPB/FPA and slightly responsive to hydrilla suppression



Non-target Impact



- Evenness (E_d; filled circles) and Biovolume (BV; Xs) plotted against the relative abundance of hydrilla (A_h)
- Mean values from dates -8 to 247 DAT (n = 8); treated (red) and non-treated (grey)
- BV dominated by hydrilla; Species diversity (evenness) increased with hydrilla reduction

Conclusions

- Hydrilla suppression extended to late spring (~300 DAT)
- *Vallisneria* exhibiting tolerance, *Nuphar* symptoms are acute but temporary
- Floating leaf species were acutely susceptible
- FPA is highly mobile with longer residency; reached equilibrium throughout the lake
- Observed non-target injury outside of treated area; no hydrilla suppression
- There are opportunities to enhance better selectivity with rate control and timing.

Questions?

This research was supporte in part by the Florida FWC Commission Invasive Plant Management Program…Thank you

For more information please feel free to reach out: *learyj@ufl.edu*