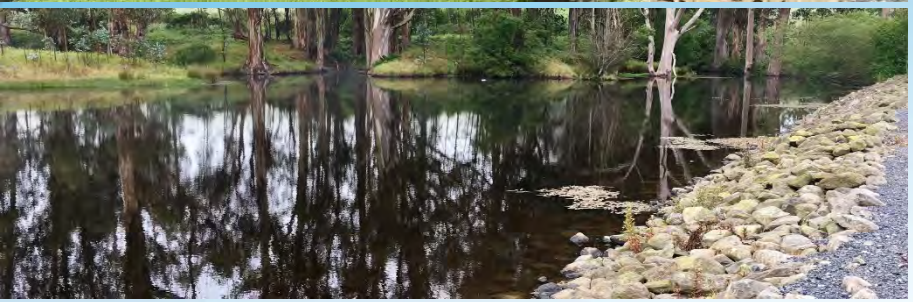

ProcellaCOR™
Aquatic Herbicide

Game-changing technology for aquatic plant management

Mark A. Heilman, Ph.D.
Senior Aquatic Technology Leader
SePRO

April 25, 2018

SePRO

Thanks to many partners!

UF IFAS
UNIVERSITY of FLORIDA

NC STATE
UNIVERSITY

UNIVERSITY of
WASHINGTON

Colorado
State
University

LSU

MONTANA
STATE UNIVERSITY

UCDAVIS
UNIVERSITY OF CALIFORNIA

NEW HAMPSHIRE
DEPARTMENT OF
Environmental
Services

DEPARTMENT OF
ECOLOGY
State of Washington

DEQ
MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

FLORIDA FISH AND WILDLIFE
CONSERVATION COMMISSION

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
sfwmd.gov

USDA

SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES
DNR

CONNECTICUT
DEPARTMENT
OF AGRICULTURE

NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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Overview

ProcellaCOR™

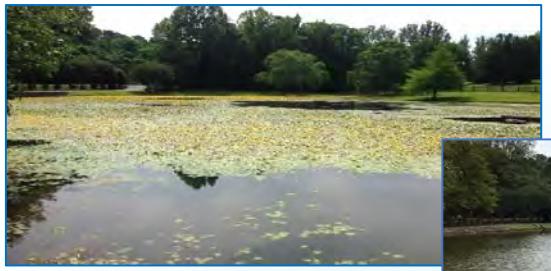
- Introduction to the technology
- Stewardship and label highlights
- Collaborative studies and field development on major invasive aquatic plants
- ERDC-APCRP partnership and next steps (Getsinger)


SPECIMEN LABEL

ProcellaCOR SC

Keep Out of Reach of Children

CAUTION



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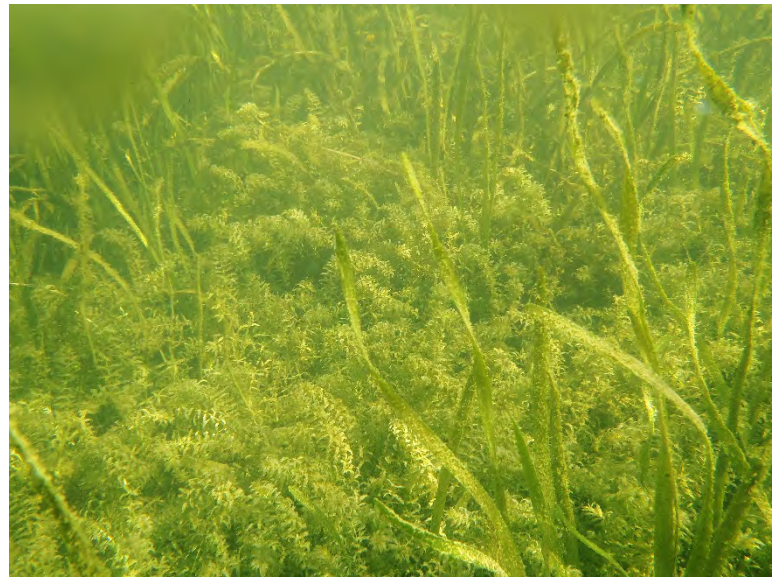
ProcellaCOR™ a.i., florpyrauxifen-benzyl

- **EPA label approved late February.**
- **The first herbicide active to have aquatic use with initial registration in over 30 years.**
- **High selective, systemic activity** on multiple major US weeds
- **EPA Reduced Risk Classification – 100X or greater reduction in use rates** versus older herbicides and **excellent environmental profile**
  - In-water applications with short in-water exposure
  - Foliar applications to floating and emergent aquatic weeds



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USEPA Reduced Risk Program

- *'Expedites the review and regulatory decision-making process of conventional pesticides that pose less risk to human health and the environment than existing conventional alternatives.'*

- *'The goal of this program is to quickly register commercially viable alternatives to riskier conventional pesticides…'*

Advantages of Reduced Risk Pesticides

- Low impact on human health.
- Lower toxicity to non-target organisms (birds, fish, plants).
- Low potential for groundwater contamination.
- Low use rates.
- Low pest resistance potential.
- Compatibility with Integrated Pest Management (IPM) practices.

https://www.epa.gov/pesticide-registration/conventional-reduced-risk-pesticide-program

USEPA Reduced Risk Approval

USEPA Human Health Risk Assessment

(https://www.regulations.gov/docket?D=EPA-HQ-OPP-2016-0560)

- **No adverse effects** were observed in the submitted toxicological studies **regardless of the route of exposure**.
  - **No drinking water or recreational use restrictions**
  - **Minimal personal protective equipment (PPE) for handlers and applicators**

- **'May provide a better alternative to older chemistries** that require higher levels of risk mitigation practices in order to reduce exposure.'

- **Eligible for full exemption from the requirement of crop tolerances**
  - Exemption request has been made to EPA RD

USEPA Reduced Risk Approval

ProcellaCOR™

- **<u>EPA Ecological Risk Assessment</u>**
  - **No risk concerns for non-target wildlife**
  - No toxicity to fish, birds, bees, reptiles, amphibians, and mammals

- Supplemental studies with university cooperators have documented **no adverse effects to key US sensitive wildlife species**
  - **Juvenile Chinook salmon** (*Oncorhynchus tshawytscha*)
    - Univ. of Washington with Kurt Getsinger (ERDC-APCRP) (in prep)
  - **Freshwater mussel** (rep. species - *Lampsilis siliquoidea*)
    - NC State University (in prep)

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Physical Properties and Fate

- **Rapid dissipation**
  - Photolysis (primary) with 1 – 2 day half-life
    - Secondary processes
      - hydrolysis at high pH (9+) and water temperatures (25C+) can form low quantities (10-30%) of less active acid form
      - Additional microbial degradation in water and sediment

- **High Koc and low volatility**
  - Rapid weed uptake resulting in short exposure requirements with in-water spot/partial treatment
    - NC State University research – Dr. Erika Haug and Dr. Rob Richardson
      PhD Dissertation (publications in prep)
      (https://repository.lib.ncsu.edu/bitstream/handle/1840.20/35124/etd.pdf?sequence=1&isAllowed=y)
  - Limited drift potential due to low volatility if foliar applied

Stewardship & Label highlights

ProcellaCOR™

- **Formal SePRO certification required before use.**
  - Over 400 managers nationally have been certified to date
- **Caution signal word** with **minimal PPE** for handlers/applicators
- **No potable use restrictions**
- **No swimming or fishing restrictions**
- **Irrigation**
  - **Non-agricultural**
    - Turf – No restrictions
    - Landscape & garden – analytical, precautionary waiting periods (typically <14 days), or confirmation of vegetation tolerance
  - **Agricultural**
    - Analytical confirmation of dissipation from management area
    - Tolerance exemption expected by 2019
- **2 liquid formulations initially**
  - SC in the southern tier US (TX to NC)
  - EC in northern tier US (NM to VA)
- **Prescription Dose Unit™ (PDU)** rate system

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Prescription Dose Unit (PDU™)

- Stewardship system to improve treatment prescription calculation and dosing similar to medicinal prescriptions/directions.
  - simplifies calculation and reduces risk for error
  - incorporated into the product container (net contents, fill level) for efficiency and precision measurement.
- An amount of ProcellaCOR needed to treat:
  - 1 acre foot of water for in-water applications or
  - 1 surface acre for foliar applications.
- Typical ProcellaCOR rates will be simple 1 – 5 PDU.

ProcellaCOR™ Use Sites

For management of freshwater aquatic vegetation in slow-moving/quiescent waters

- Ponds
- Lakes
- Reservoirs
- Marshes
- Wetlands
- Bayous

- Drainage Ditches
- Non-Irrigation Canals
- Including
  - Shorelines
  - Riparian Areas
  - Or Adjacent sites to these sites
- Also for management in slow-moving/ quiescent areas of rivers
  - coves, oxbows or similar sites

Aquatic Plants Controlled

In-Water Application

	Submersed Vascular Aquatic Plants Controlled: In-Water Application	
	Baby Tears	*Micranthemum spp.*
	Bacopa	*Bacopa spp.*
	Coontail	*Ceratophyllum demersum*
*	Hydrilla	*Hydrilla verticillata*
*	Hygrophila	*Hygrophila polysperma*
*	Limnophila	*Limnophila sessiliflora*
*	Parrotfeather	*Myriophyllum aquaticum*
*	Rotala	*Rotala spp.*
	Spikerush, slender or creeping	*Eleocharis baldwinii*
*	Water chestnut	*Trapa spp.*
*	Watermilfoil, Eurasian	*Myriophyllum spicatum*
*	Watermilfoil, Hybrid Eurasian	*Myriophyllum spicatum X M.* spp.
	Watermilfoil, Variable	*Myriophyllum heterophyllum*

* Invasive

Aquatic Plants Controlled

ProcellaCOR™

Foliar or In-Water Application to Floating or Emergent Weeds

*	Floating	Mosquito fern	*Azolla spp.*
*	Floating	Water hyacinth	*Eichhornia crassipes*
*	Emersed	Alligatorweed	*Alternanthera philoxeroides*
	Emersed	American lotus	*Nelumbo lutea*
*	Emersed	Floating heart	*Nymphoides spp.*
*	Emersed	Parrotfeather (emersed)	*Myriophyllum aquaticum*
	Emersed	Water pennywort	*Hydrocotyle umbellata*
*	Emersed	Water primrose	*Ludwigia spp.*
	Emersed	Watershield	*Brasenia schreberi*

* Invasive

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Collaborative research on control of major US aquatic invasive aquatic plants

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US collaborative mesocosm and early field development

- **Hydrilla** (*Hydrilla verticillata*)(Beets and Netherland 2018)
- **Floating hearts** (*Nymphoides cristata* and others)(Beets and Netherland 2018)
- **Invasive watermilfoils** (Netherland and Richardson 2016, Richardson et al. 2016, Beets et al 2018 in prep, Heilman & Smagula in prep)
  - Eurasian (*Myriophyllum spicatum)*
  - hybrid Eurasian (*M. spicatum* X *M. sibiricum*)
  - parrotfeather (*M. aquaticum*)
  - variable watermilfoil (*M. heterophyllum*)
- **Water hyacinth** (*Eichhornia crassipes*) (Mudge et al. in prep)
- **Water primrose** (*Ludwigia spp.*) (Enloe and Laurer 2017)

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Univ of FL Mesocosm Study Overview
Hydrilla and Crested Floating Heart (Beets and Netherland 2018)

- Tested Aquatic Plants
  - *Hydrilla verticillata* (dioecious hydrilla)
  - *Nymphoides cristata* (crested floating heart)
  - *Native plants Sagittaria lancifolia* (duck potato) and *Pontedaria cordata* (pickerelweed)

UF Trial: PRE and 16 Days Post

TX Study Overview

- <u>Tested Aquatic Plant</u>
  - *Hydrilla verticillata* (hydrilla)
- Hydrilla was grown 7 weeks prior to treatment Aug 4
  - ~90F or 32 C during study
- Multiple in-water rates and flow scenarios
  - 6h or 24h DT50 or static

Untreated

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TX mesocosm study of dioecious hydrilla

Photos @ 1 month post

Left: Untreated hydrilla

Right: Hydrilla treated with a 24-hour exposure

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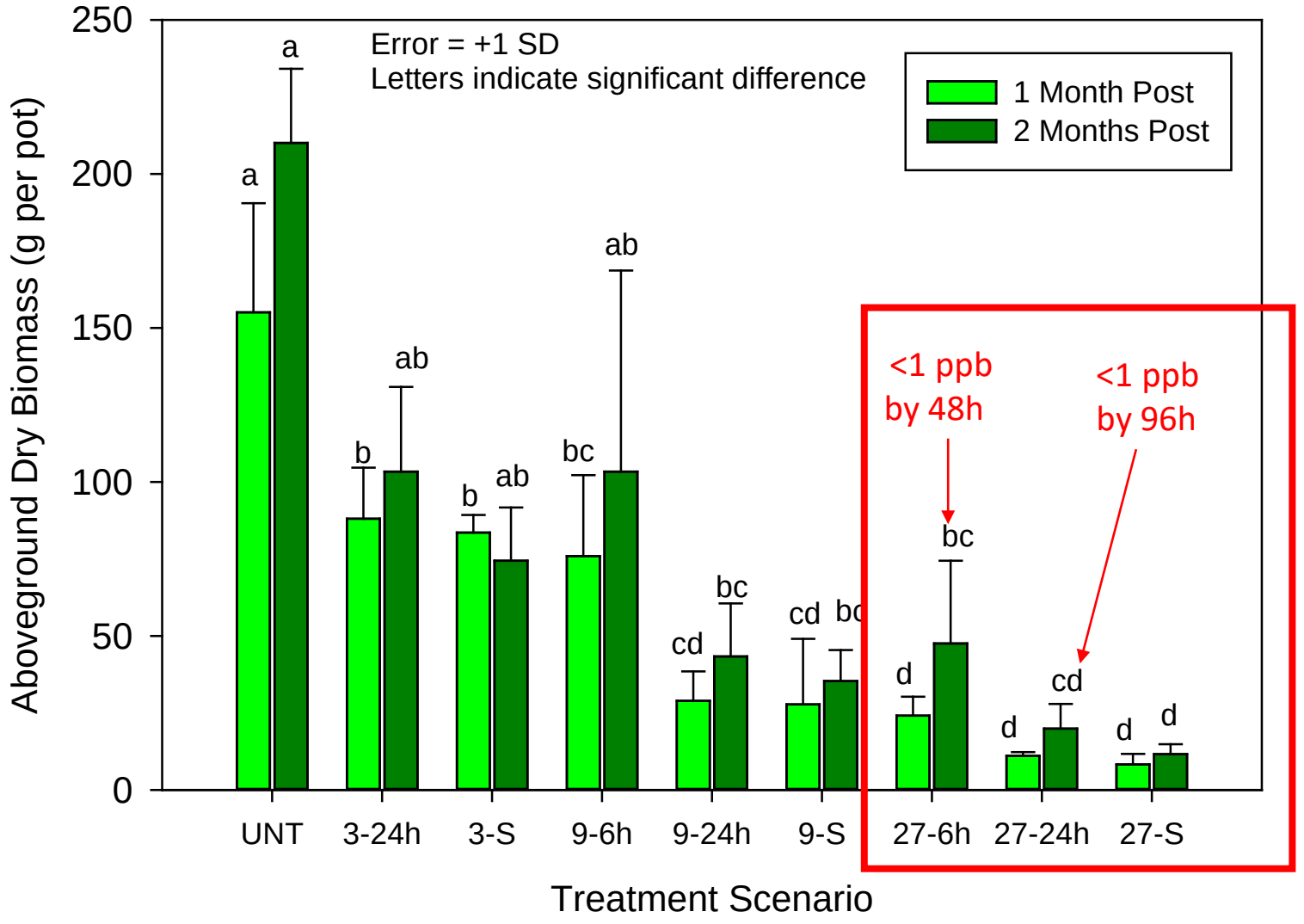
TX Mesocosm Trial
Aboveground Hydrilla Biomass: 1 and 2 MAT



Monoecious hydrilla…
Similar CET behavior

Selective:
Tapegrass and pondweeds are tolerant

Untreated (left) and treated (right) hydrilla ponds in TX at 4 months post

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Yellow Floating Heart NC 2017

- Very dense infestation discovered in 2016 and targeted for eradication by NCDACS with NCSU and NCDEQ support
- 1A acre treated, 3.5 ft avg depth
- Treated June 13

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June 13, 2017 – Yellow floating heart on day of treatment

June 30, 2017 – Highly injured yellow floating heart @ 17 DAT

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July 27, 2017 – Remnant dying YFH @ 44 DAT


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July 27, 2017 – Remnant dying YFH @ 44 DAT

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September 26, 2017 – 100% YFH Control @ 105 DAT

Laboratory and Mesocosm Evaluation of Growth and Herbicide Response in Eurasian and Four Accessions of Hybrid Watermilfoil

Jens Beets* and Michael D. Netherland
University of Florida- CAIP
Western Aquatic Plant Management Society
March 28, 2018

UF IFAS
UNIVERSITY of FLORIDA

TX Mesocosm Study #1 Overview
Selective milfoil control

- Tested Aquatic Plants
  - *Myriophyllum spicatum* (Eurasian watermilfoil)
  - *M. spicatum X M. sibiricum* (Hybrid EWM)
    - Highly 2,4-D tolerant - Hayden Lake, Idaho
  - *Vallisneria americana* (tapegrass)
    - ‘southern’ & ‘northern’ biotypes
  - *Potamogeton illinoensis* (Illinois pondweed)
  - *Potamogeton nodosus* (American pondweed)
  - *Elodea canadensis* (Canadian or common waterweed)
  - *Heteranthera dubia* (water stargrass)
- Growth Period – 7 months
  - Planted September 17, 2015
    - 1 gal pots with local topsoil and Osmocote
  - Study initiated April 12, 2016

Experimental Design

- CET Scenarios
  - Untreated Control
  - 3 test rates with 6 hr, and 24 hr ½ lives via flow-through or static
  - Treated April 12, 2016
  - Biomass harvests at 1 and 2 months post
- General Water Quality
  - Early pH = 8 – 8.5
  - Average water temperature through 1st month = 21.8 C (16.6 – 26.7)
    - 71F (62 – 80F)
- Analytical monitoring of water concentrations confirmed anticipated dissipation scenarios

Selective Milfoil Control @ 1 MAT

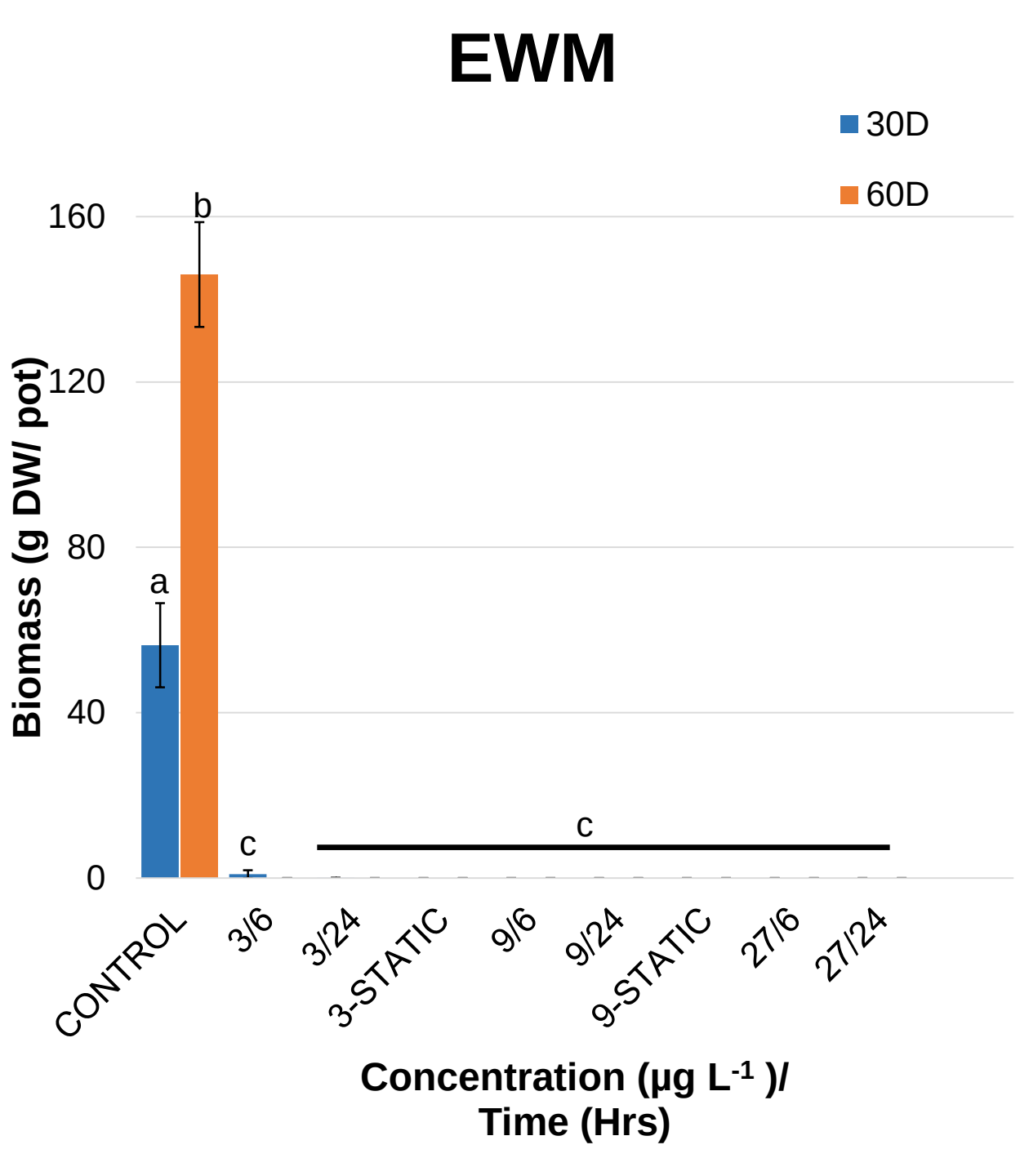
Untreated

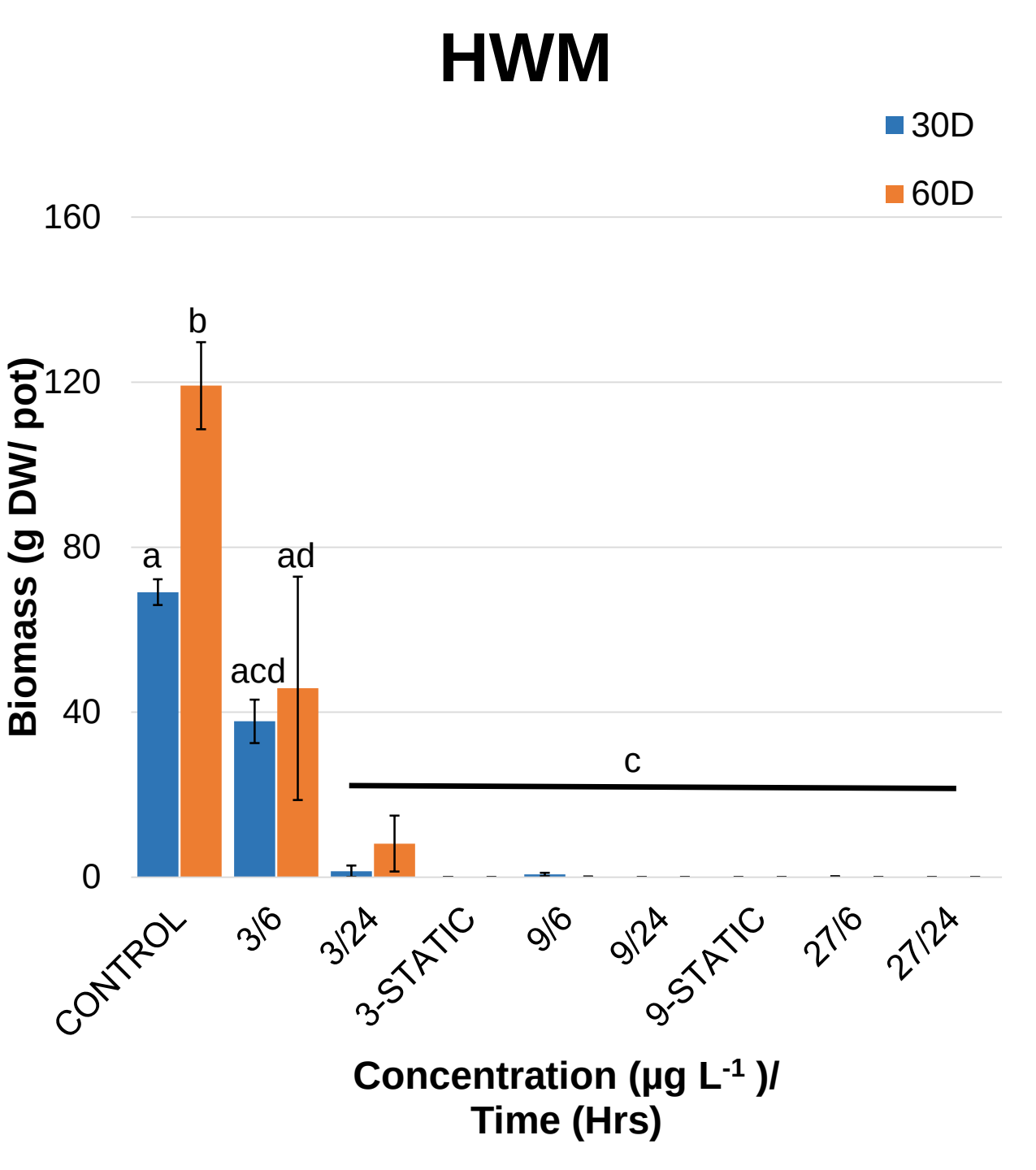
4 weeks with ProcellaCOR intermediate rate post 6h ½ life

Selective Milfoil Control @ 2 MAT

Selective Milfoil Control @ 2 MAT

4.7 PDU (9 ppb)
24 h turnover


EWM
30D
60D
160
120
80
40
0
Biomass (g DW/ pot)
a
b
c
c
CONTROL
3/6
3/24
3-STATIC
9/6
9/24
9-STATIC
27/6
27/24
Concentration (µg L-1)/
Time (Hrs)


HWM
30D
60D
160
120
80
40
0
Biomass (g DW/ pot)
a
b
acd
c
CONTROL
3/6
3/24
3-STATIC
9/6
9/24
9-STATIC
27/6
27/24
Concentration (µg L-1)/
Time (Hrs)

General Conclusions

- HWM showed greater tolerance to 2,4-D, triclopyr, and ProcellaCOR.
- ProcellaCOR highly active on EWM and HWM
- Selected native species show ProcellaCOR selectivity
- ProcellaCOR can effectively manage all watermilfoils with appropriate rate and CET scenarios

Variable Watermilfoil New Hampshire 2016

- Cooperative effort with New Hampshire DES and USACE New England District and ERDC APCRP
- 1-acre partial-site application to invasive variable watermilfoil at the Hopkinton-Everett Flood Control Area
- Special permit from NH Department of Agriculture in consultation with EPA
- Full control of affected water use per experimental testing requirements
- Treated August 8 with 5 PDU ProcellaCOR

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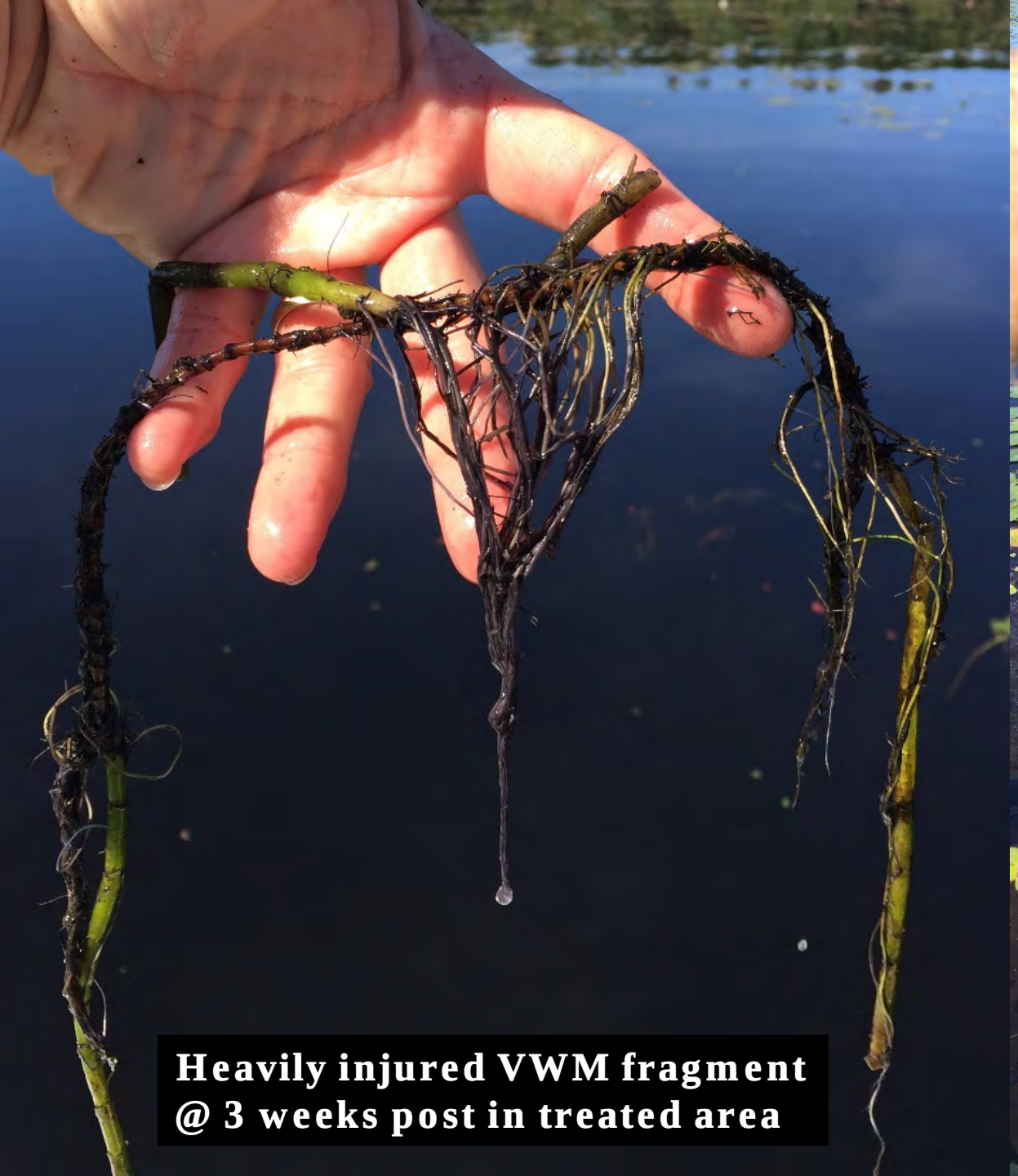
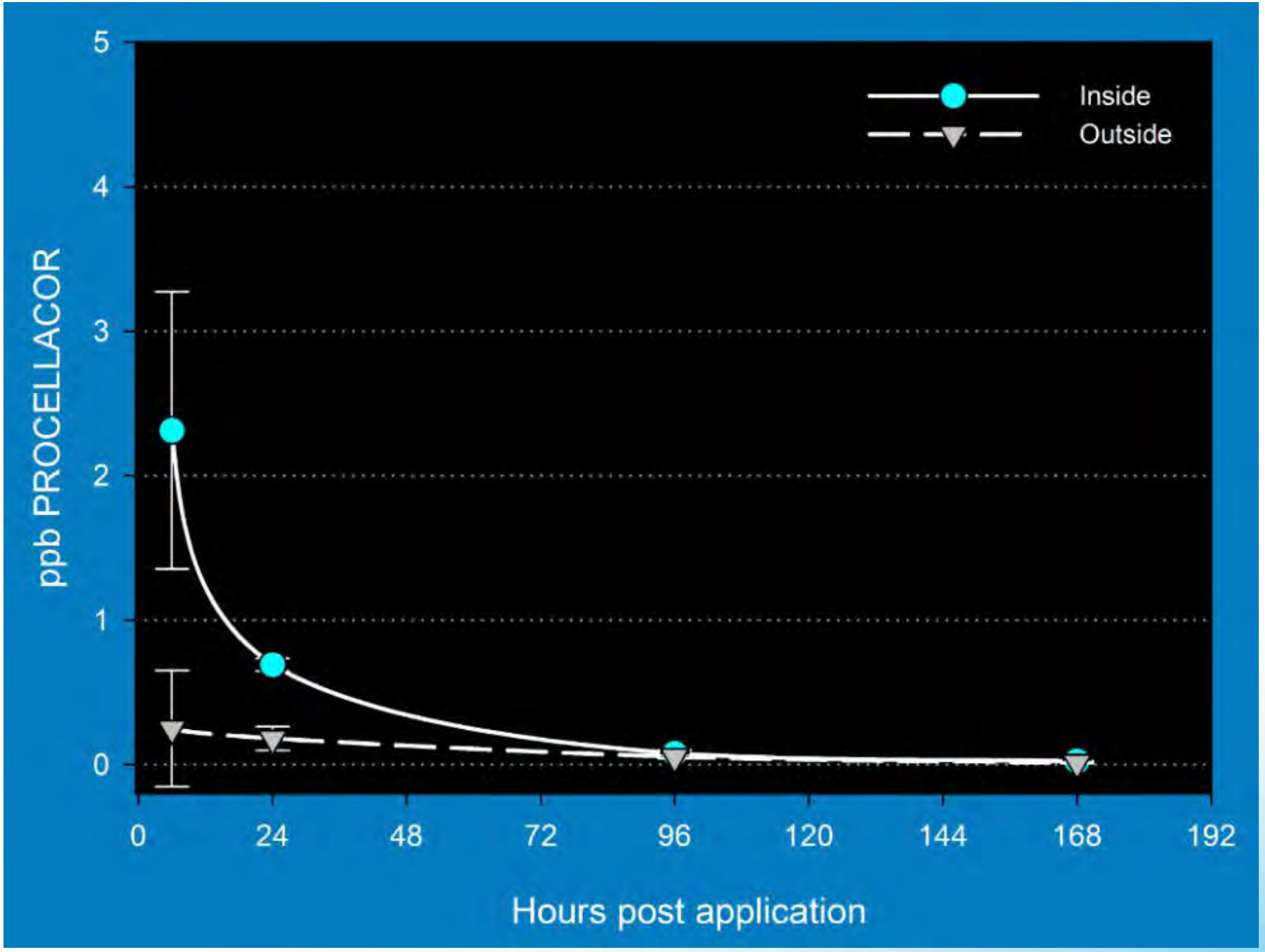
Dense topped-out VWM
in selected 1-acre zone in July 2016



Heavily injured VWM fragment
@ 3 weeks post in treated area

VWM 20 yards outside treated area


ProcellaCOR concentrations below 1 ppb within 24 hours
Selective VWM control
@ 6 weeks post treatment



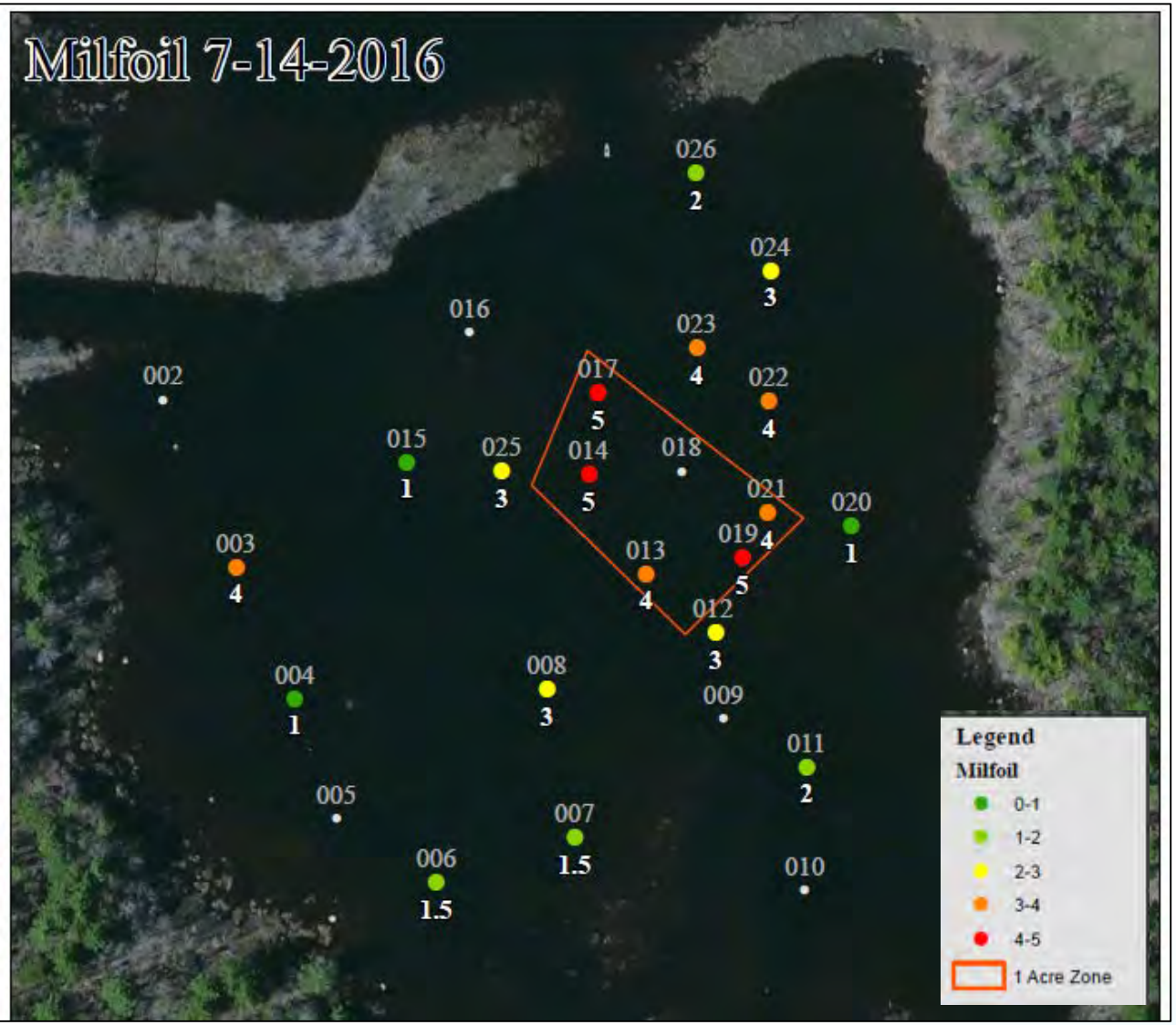
ProcellaCOR Hopkinton dissipation monitoring

Analysis via LCMS

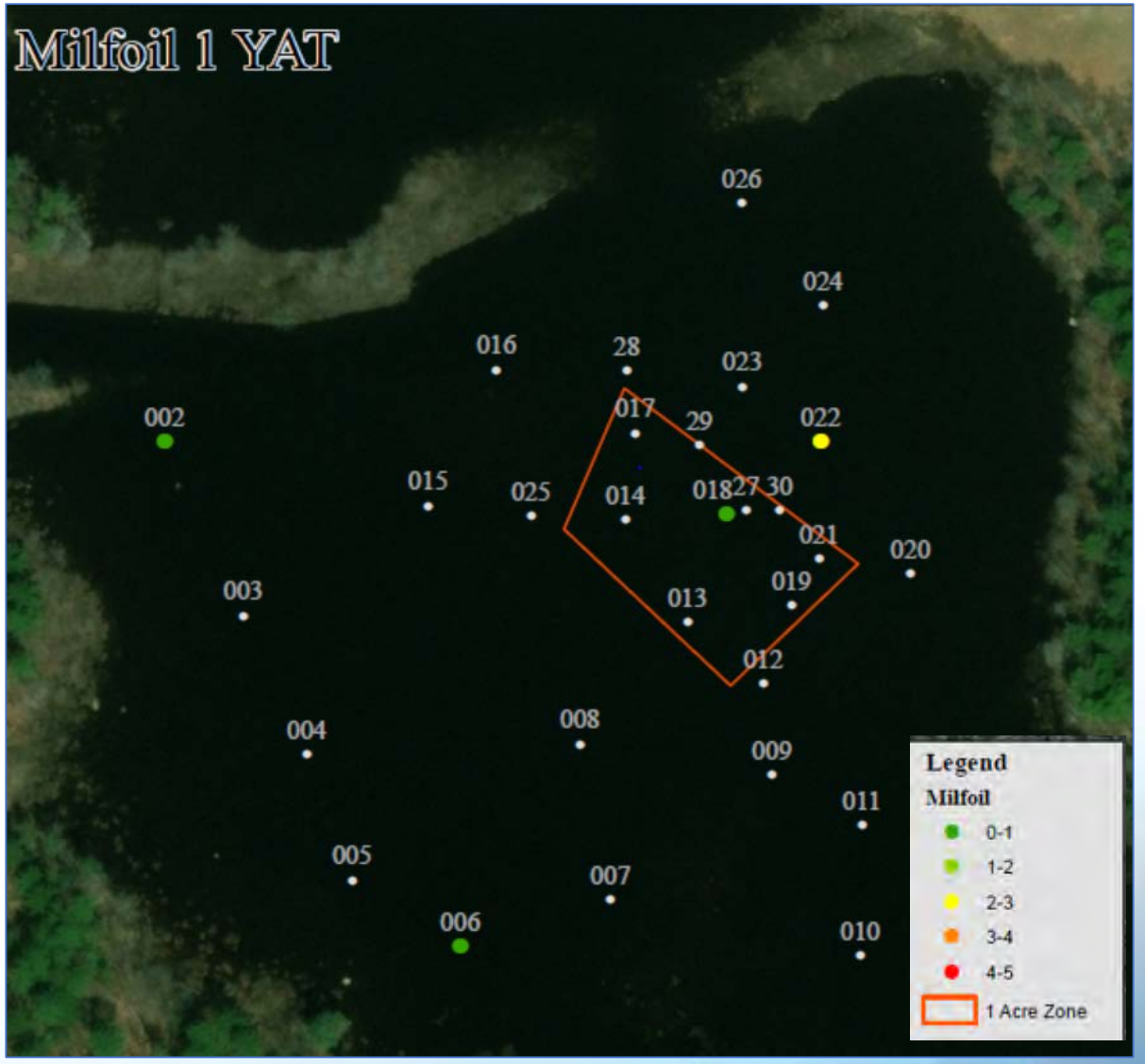
3 sites inside 1-A area

3 sites between 200-300 ft outside

Pre-Treatment



1 year post treatment (4 total finds in rake survey)



1 YAT – Additional healthy VWM patches were noted outside treatment area, just not collected on formal rake throws.

	Pre-Treatment	1 year post treatment
	PRE FOO	POST FOO
M. heterophyllum	76%	13%
Nymphaea odorata	62%	73%
Utricularia vulgaris	52%	77%
Potamogeton robbinsii	41%	67%
Utricularia radiata	34%	17%
Utricularia intermedia	34%	30%
Potamogeton natans	17%	30%
Nuphar variegata	7%	7%
Najas guadalupensis	7%	3%
Utricularia purpurea	3%	3%
Utricularia gibba	3%	3%
Eleocharis sp.	3%	13%
Braesenia schreberi	3%	20%
Potamogeton epihydrus	3%	3%
	29 sites	30 sites

2016 VWM in plot

8 of 9 stations - all dense

2017 VWM in plot

1 of 9 stations – trace

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Google Earth
Sept 26, 2015


SePRO / NHDES UAV
July 10, 2017

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Water hyacinth

(Foliar ProcellaCOR
@ 0.025 lb ai / acre)

Cooperative study with ERDC-APCRP (Dr. Chris Mudge)

LSU

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Invasive Water Primrose

- Enloe and Lauer 2017. Uruguay waterprimrose control with herbicides. JAPM 55:71-75

1 – 2 PDU SC
(0.025 – 0.05 lb ai / A or
30-60 g ai / ha)

TABLE 1. COMPARISON OF URUGUAY WATERPRIMROSE PERCENTAGE OF INJURY 10 AND 35 D AFTER TREATMENT (DAT) FOR EXPERIMENT-TREATMENT COMBINATIONS.

		Experiment 1		Experiment 2	
	Rate	10 DAT	35 DAT	10 DAT	35 DAT
Aminopyralid	0.11	47 ab	98 a	40 bcd	99 a
	0.22	58 a	98 a	68 ab	100 a
Glyphosate	4.2	28 b	78 b	18 de	62 b
Glyphosate + flumioxazin	4.2 + 0.14	48 ab	93 ab	77 a	95 a
Glyphosate + 2,4-D	4.2 + 4.3	53 ab	98 a	75 a	99 a
Imazamox	0.28	23 b	73 b	12 e	21 c
Imazamox + flumioxazin	0.28 + 0.14	40 ab	87 ab	82 a	93 a
ProcellaCOR™	1.35	48 ab	80 b	23 cd	100 a
	2.7	52 ab	77 b	22 cd	92 a

[1]Means followed by the same letter within a column are not significantly different at $P = 0.05$ using Tukey's adjustment for multiplicity.

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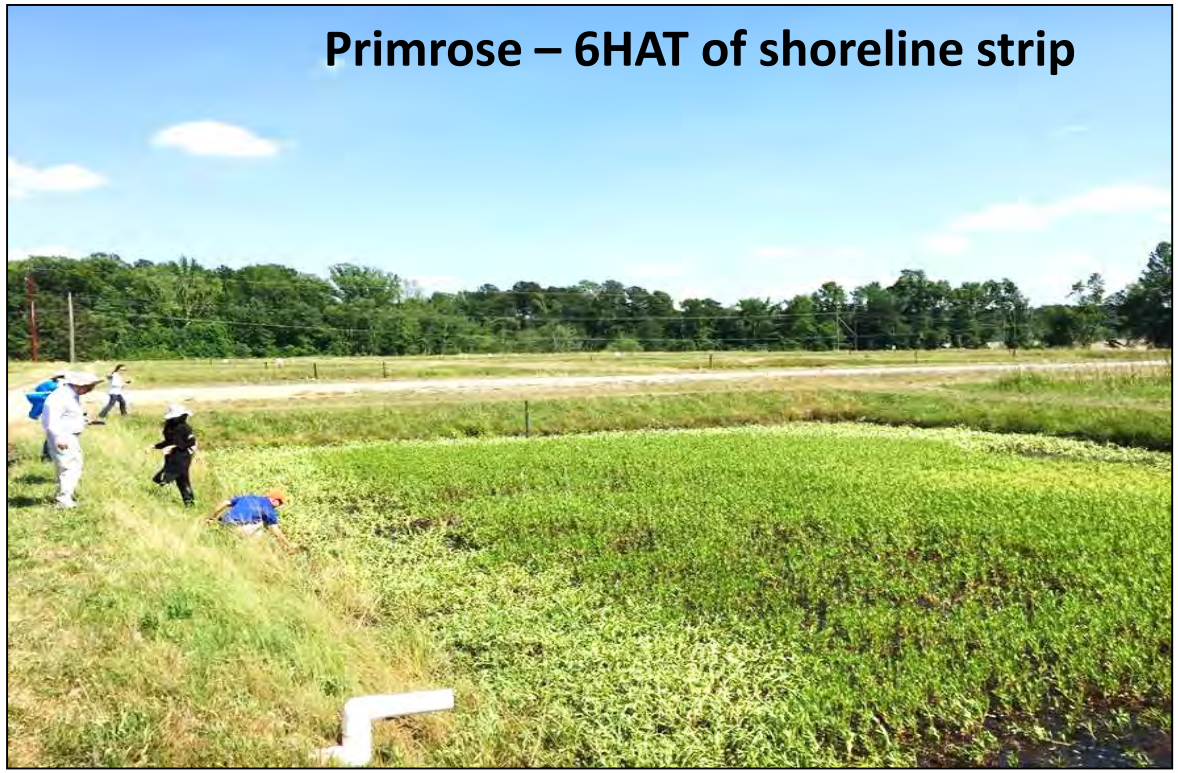
Invasive water primrose pond demonstration (NC) – 60 g ai/ha (10 PDU EC / acre)



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Conclusions

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- **Novel, reduced-risk, low-rate herbicide active is fully registered as a result of collaborative partnership.**
- **Mesocosm evaluations and field evaluations confirm high selective activity on several major US weeds.**
- **Continued partnership including documentation of field outcomes will be critical.**

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ERDC Collaboration on ProcellaCOR

- Research and Development
- Registration Activities

-- Dr. Kurt Getsinger, ERDC - APCRP

Thank you!

Questions?

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