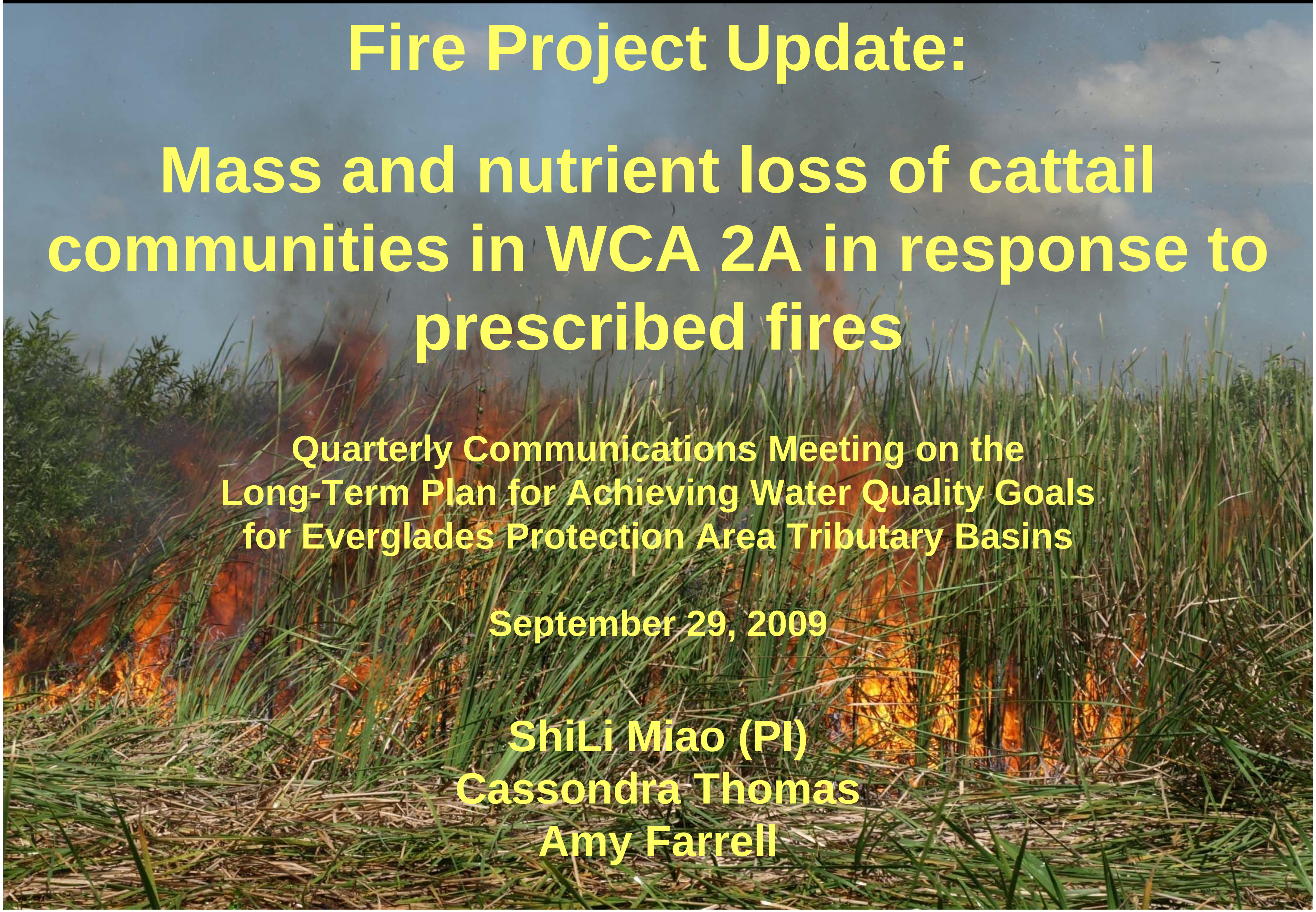


Fire Project Update:

Mass and nutrient loss of cattail communities in WCA 2A in response to prescribed fires

Quarterly Communications Meeting on the
Long-Term Plan for Achieving Water Quality Goals
for Everglades Protection Area Tributary Basins

September 29, 2009

ShiLi Miao (PI)
Cassondra Thomas
Amy Farrell

Management objective

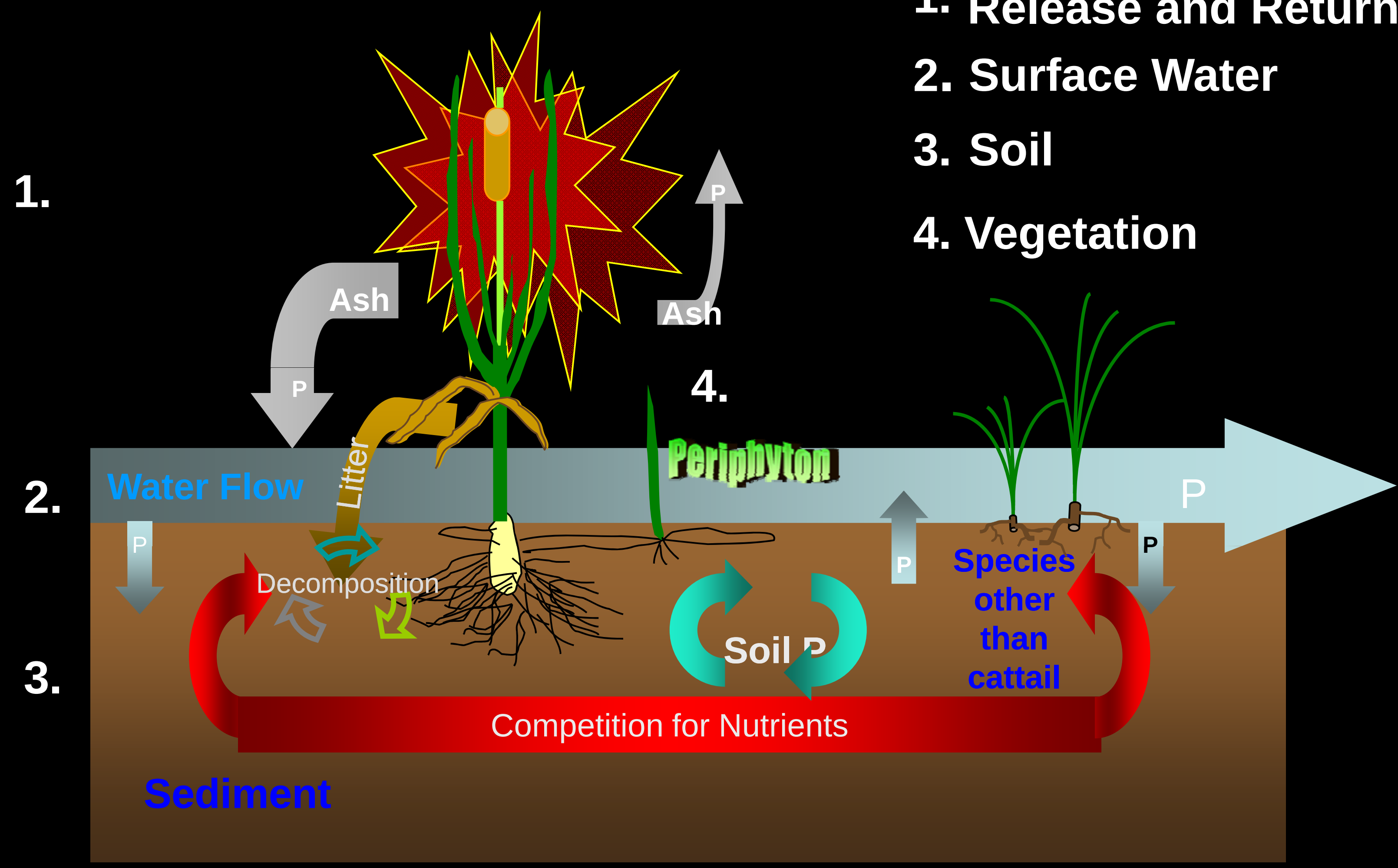
Assess whether multiple surface fires accelerate the recovery of the nutrient-enriched areas now dominated by cattails in WCA 2A

Research objectives

- **Determine ecological effects of multiple surface fires on critical wetland ecosystem structure, function, and processes in nutrient-enriched areas**
- **Examine natural recovery pattern in WCA 2A**

Conceptual model for Fire Project

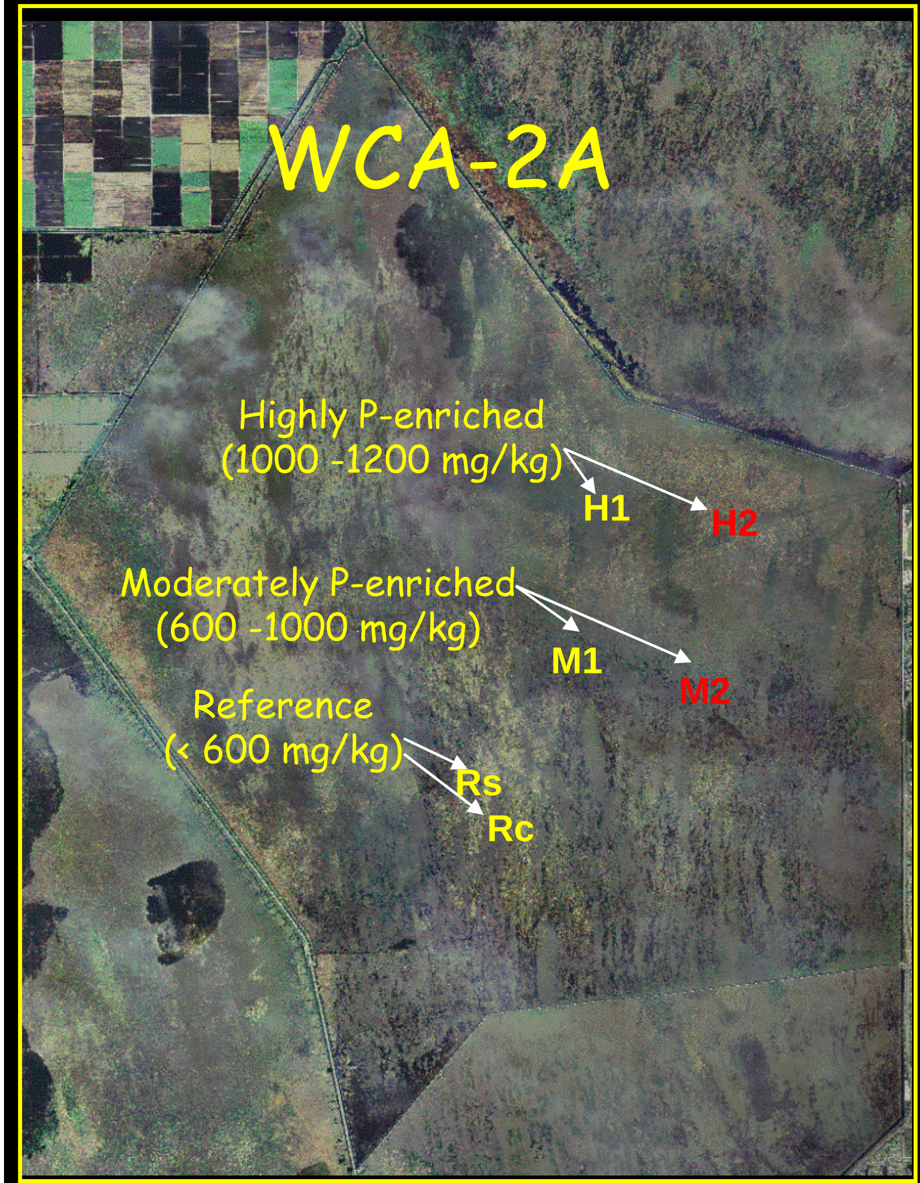
1. Release and Return
2. Surface Water
3. Soil
4. Vegetation



Objectives

- Quantify mass and nutrient loss and return
- Examine factors that affect mass and nutrient loss and return
- Assess ash chemistry and its impacts on water quality

Fire Project Design



Date	Type	Water Depth (cm)
Highly enriched		
July 2006	**Prescribed**	**10**
July 2008	**Prescribed**	**43**
Moderately enriched		
February 2006	**Wildfire**	**19**
August 2008	**Prescribed**	**32**

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Fire Implementation

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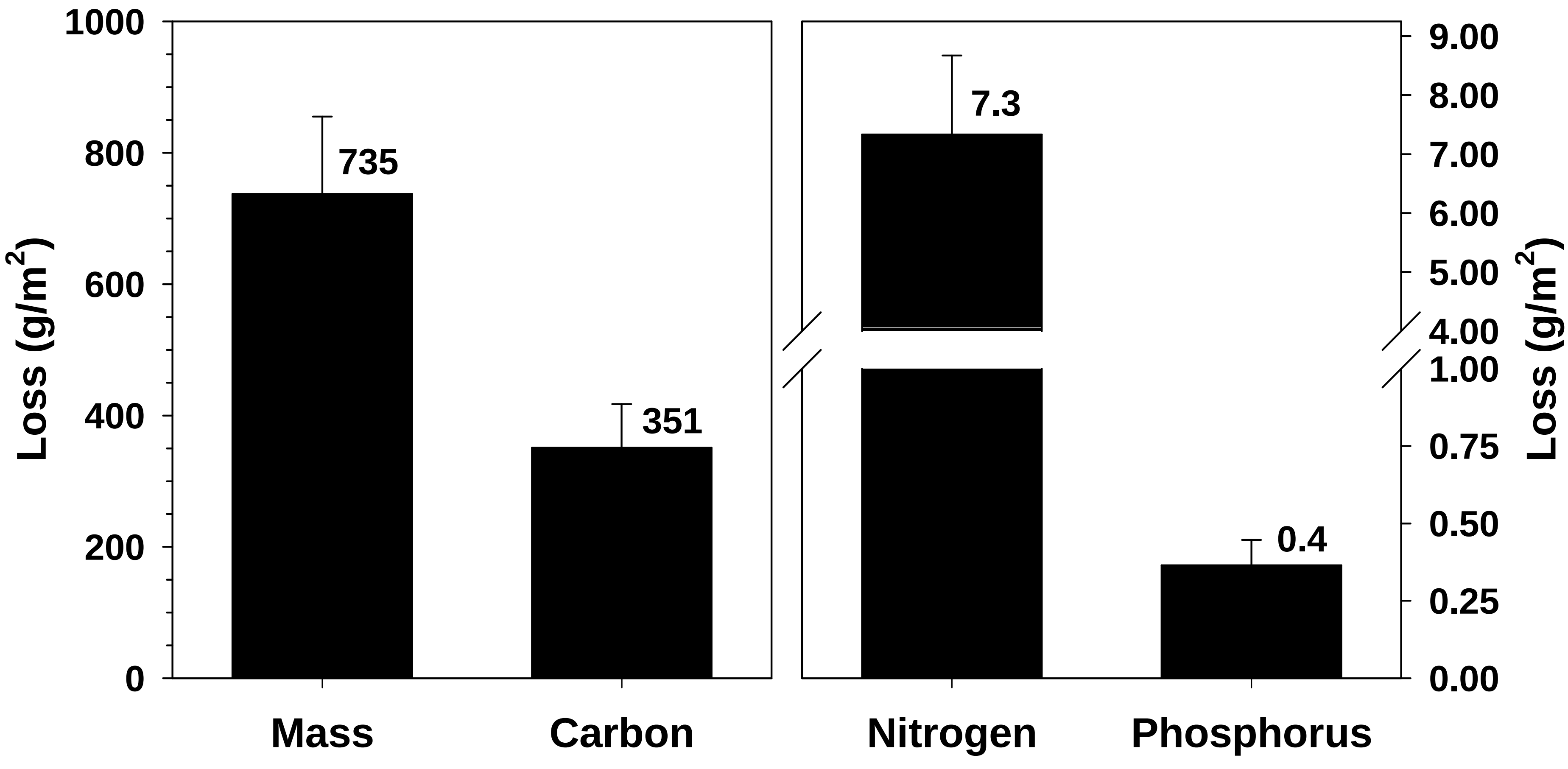
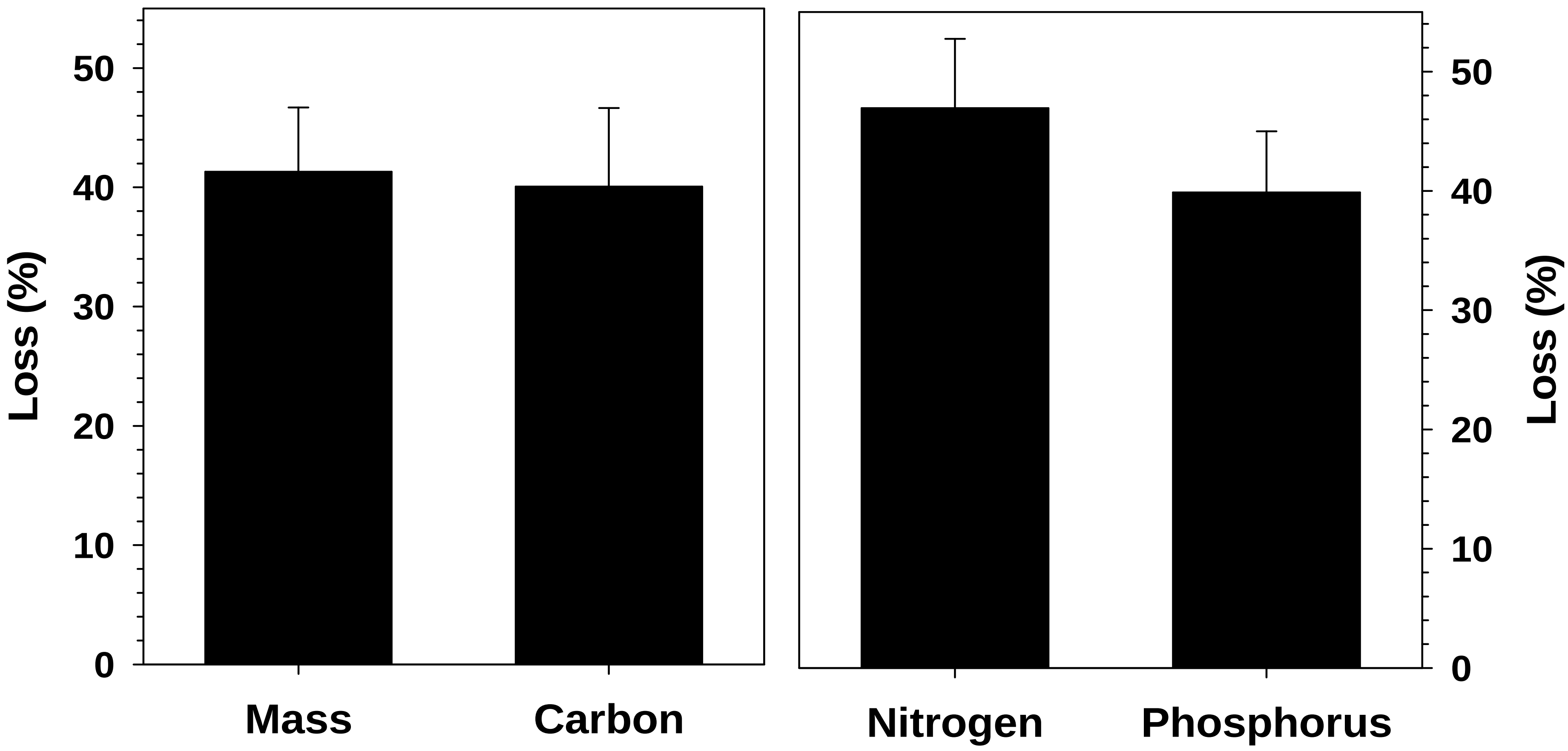
Average Biomass and Nutrient Loss

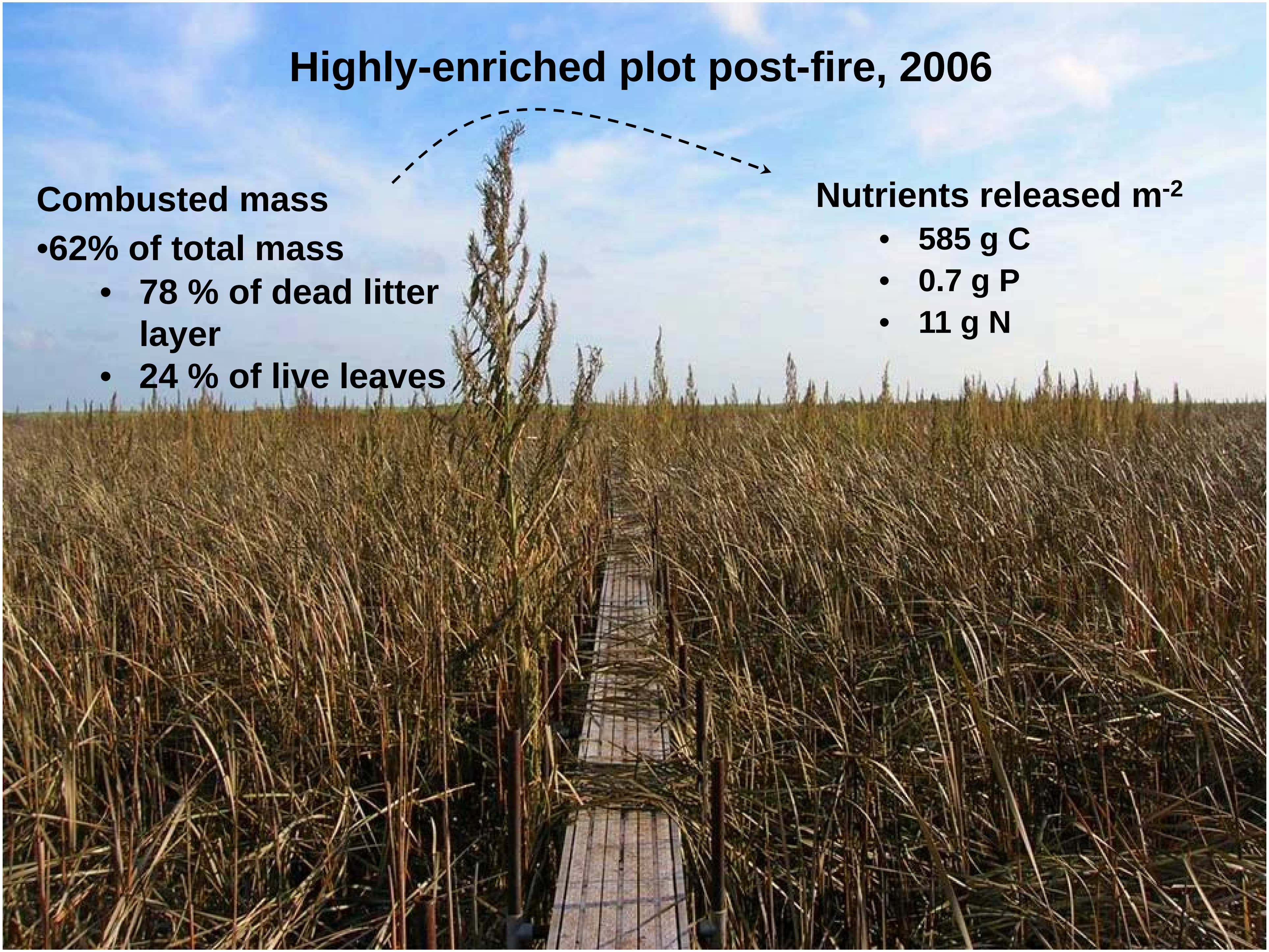


Average Biomass and Nutrient

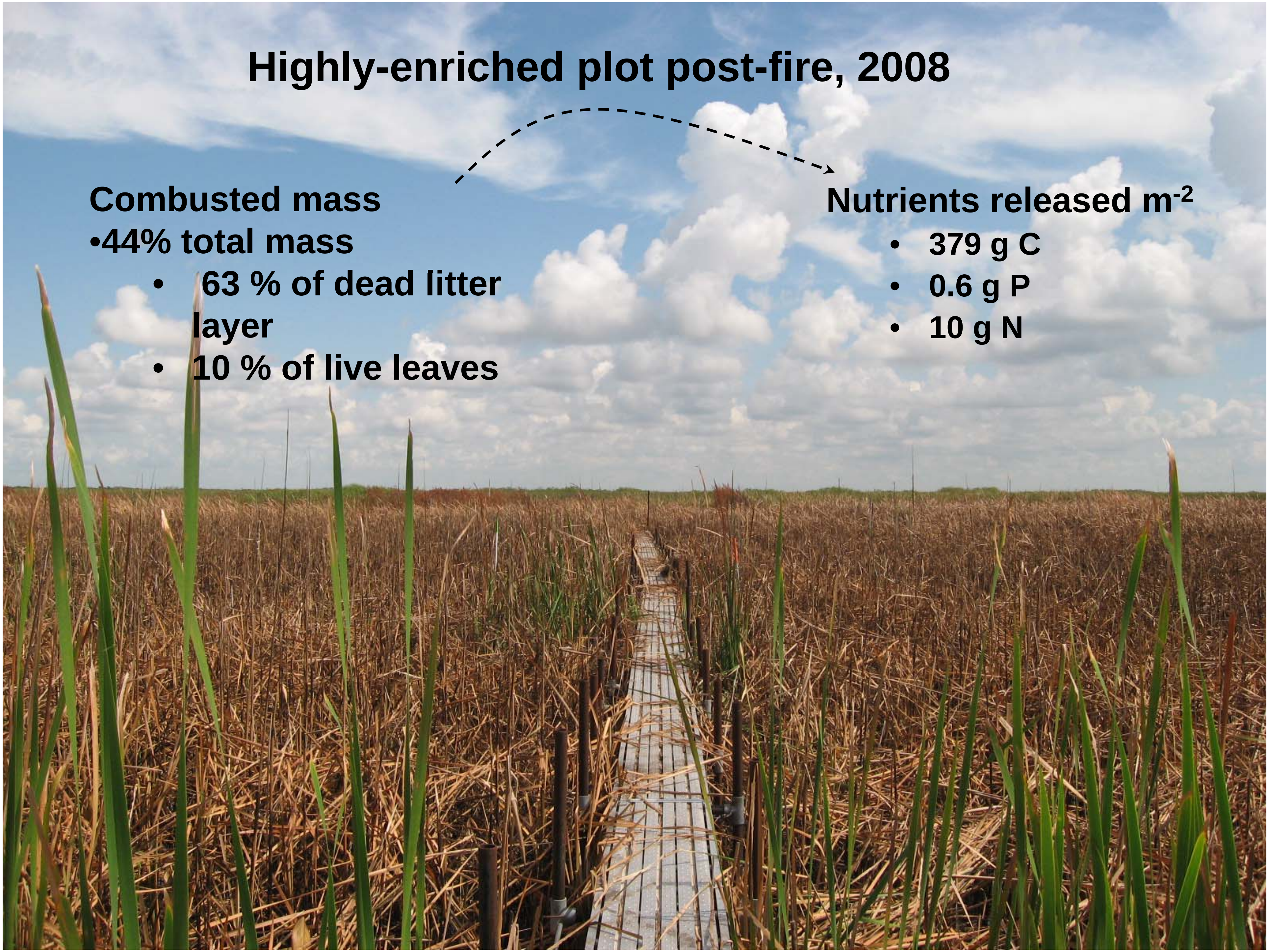


Biomass & Nutrient Loss at Different Habitat & Burns

Habitat	Fire #	Nutrient loss (%)			
		Mass	Carbon	Nitrogen	P
Highly-enriched	1	62	62	62	50
	2	44	43	58	49
Moderately-enriched	1	49	62	63	41
	2	28	25	28	30


Highly-enriched plot post-fire, 2006
Combusted mass
•62% of total mass
• 78 % of dead litter layer
• 24 % of live leaves
Nutrients released m^{-2}
• 585 g C
• 0.7 g P
• 11 g N

Highly-enriched plot post-fire, 2008



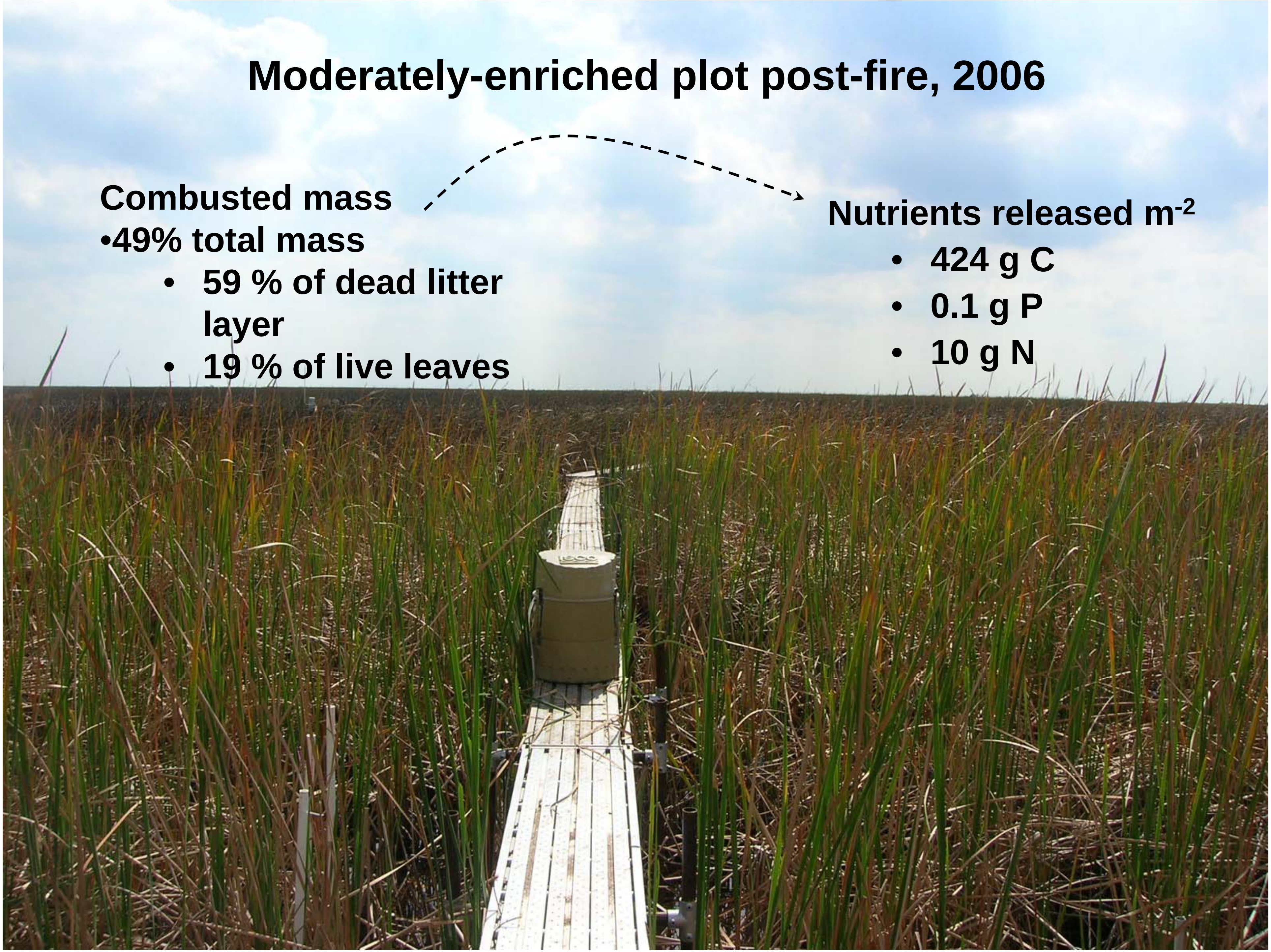
Combusted mass

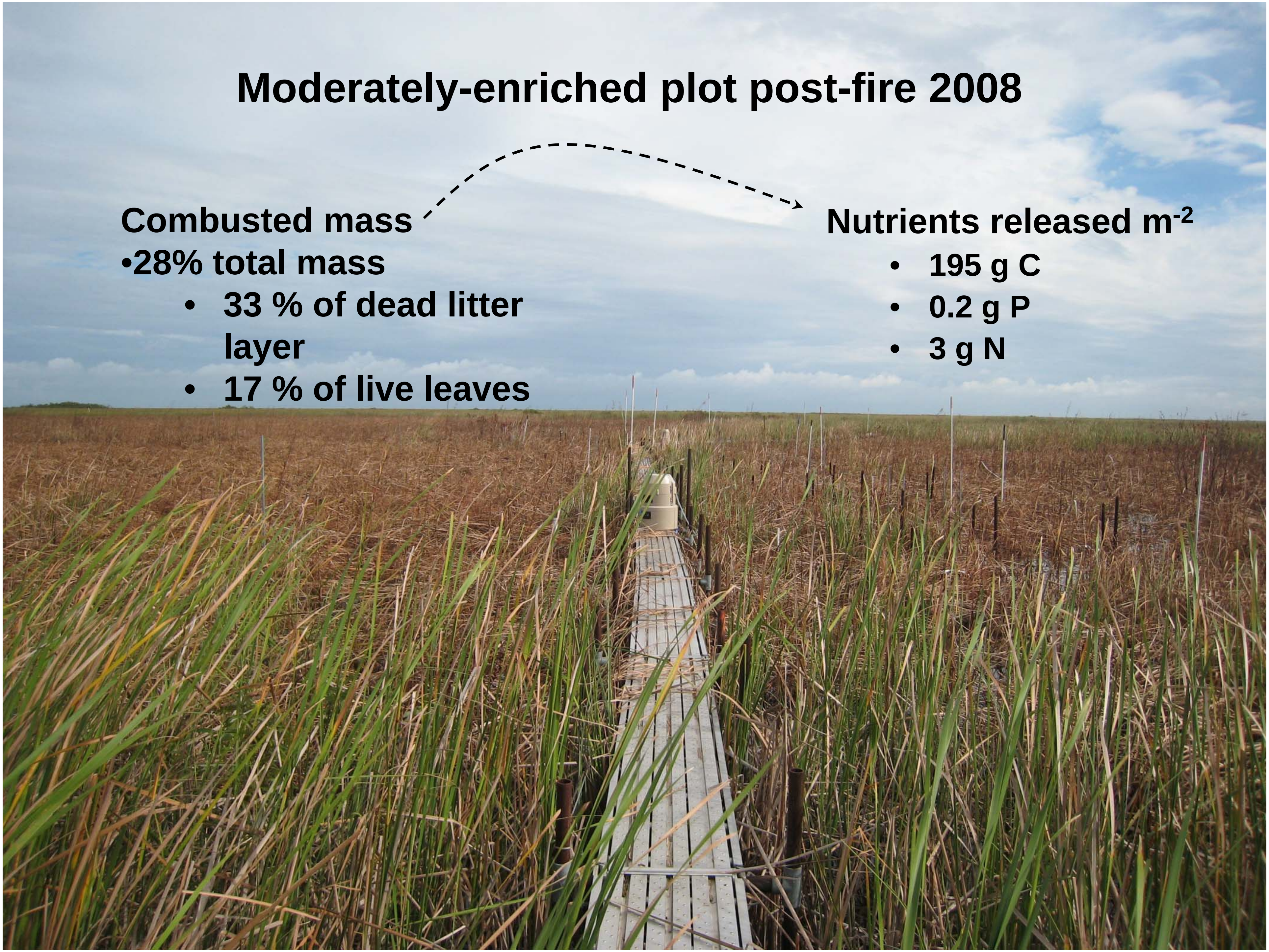
•**44% total mass**

- **63 % of dead litter layer**
- **10 % of live leaves**

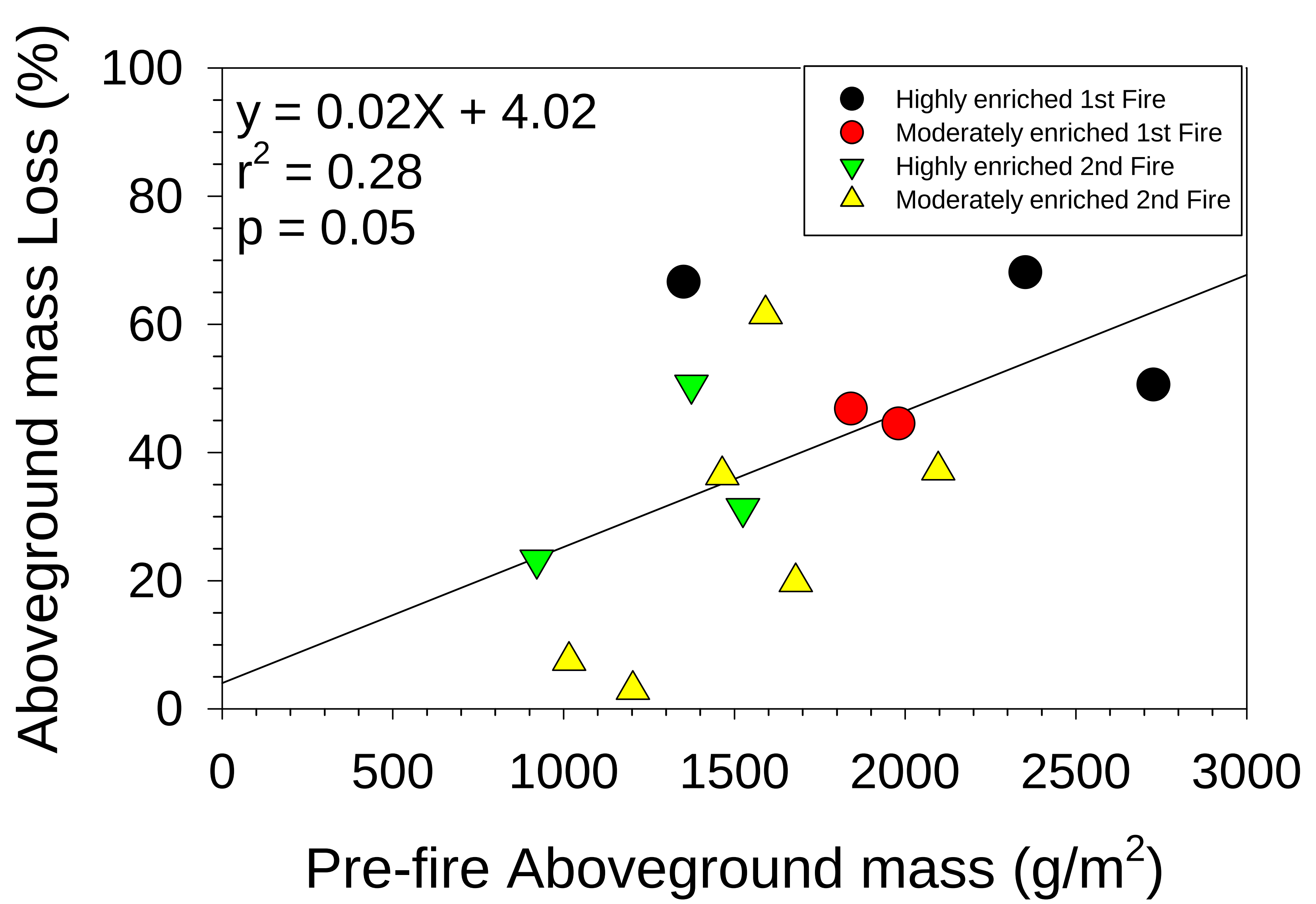
Nutrients released m^{-2}

- **379 g C**
- **0.6 g P**
- **10 g N**


Moderately-enriched plot post-fire, 2006
Combusted mass
•49% total mass
• 59 % of dead litter layer
• 19 % of live leaves
Nutrients released m^{-2}
• 424 g C
• 0.1 g P
• 10 g N


Moderately-enriched plot post-fire 2008
Combusted mass
•28% total mass
• 33 % of dead litter layer
• 17 % of live leaves
Nutrients released m^{-2}
• 195 g C
• 0.2 g P
• 3 g N

Mass Loss and Pre-Fire Mass



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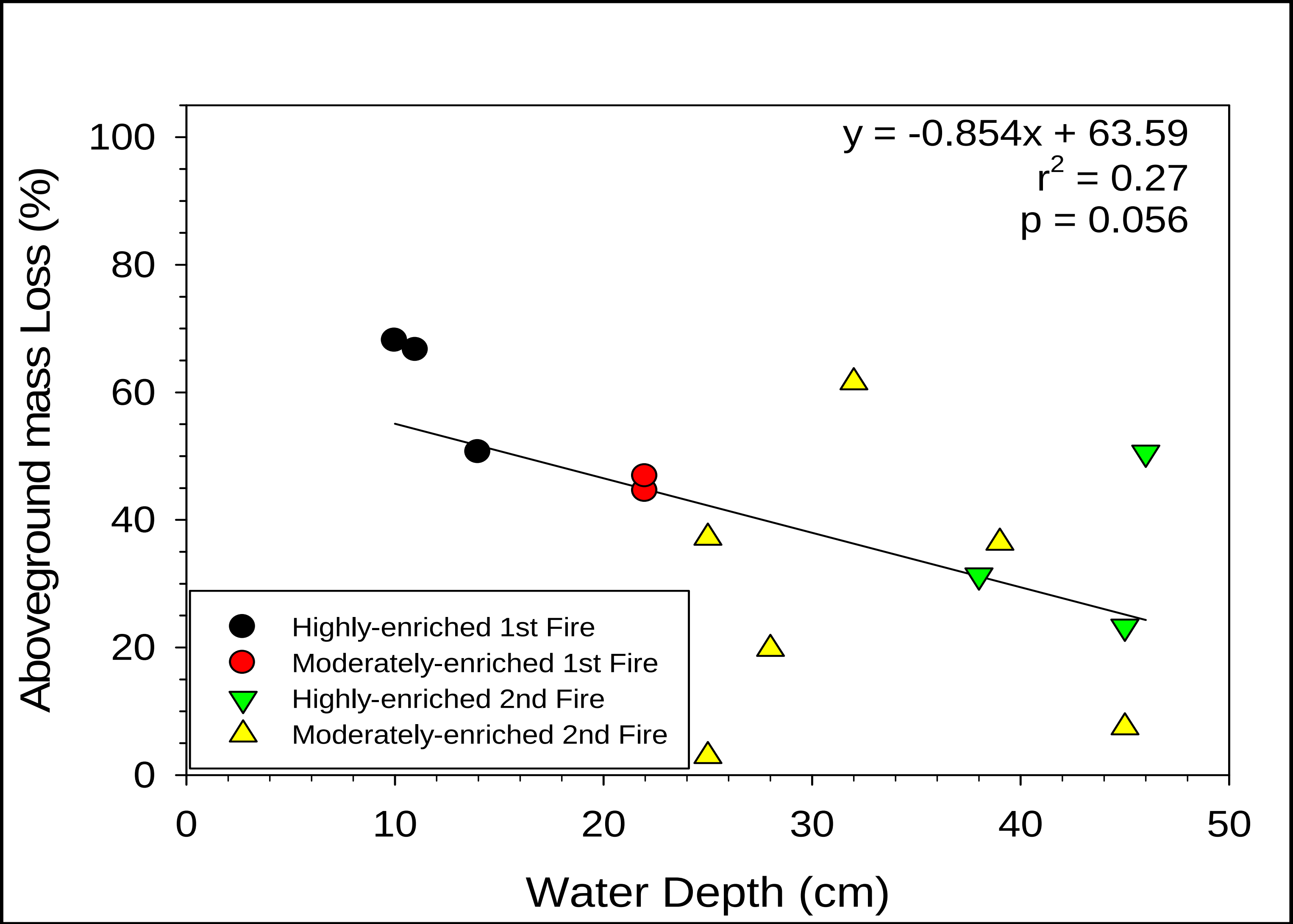
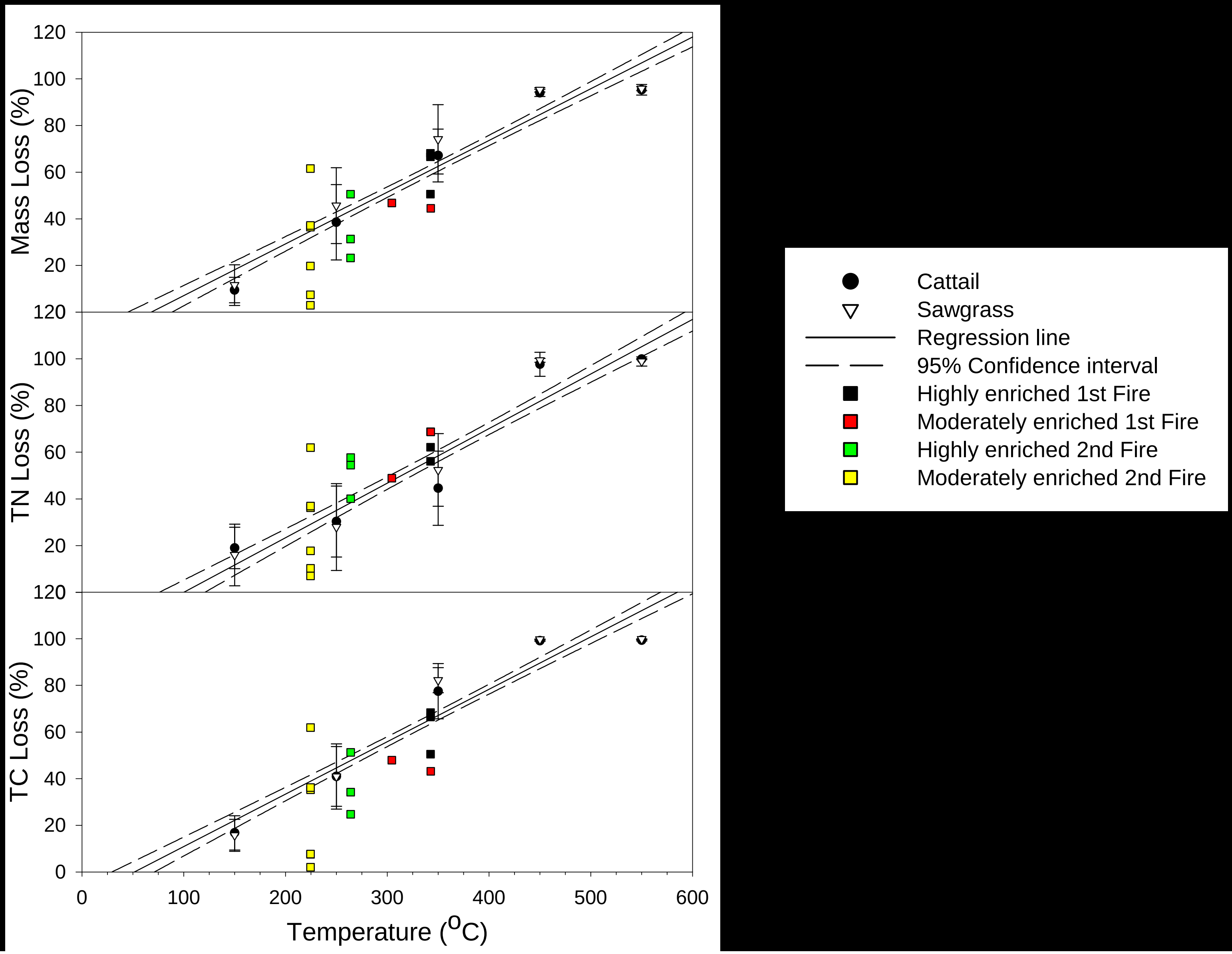
Mass Loss and Water Depth



Mass Loss and Temperature



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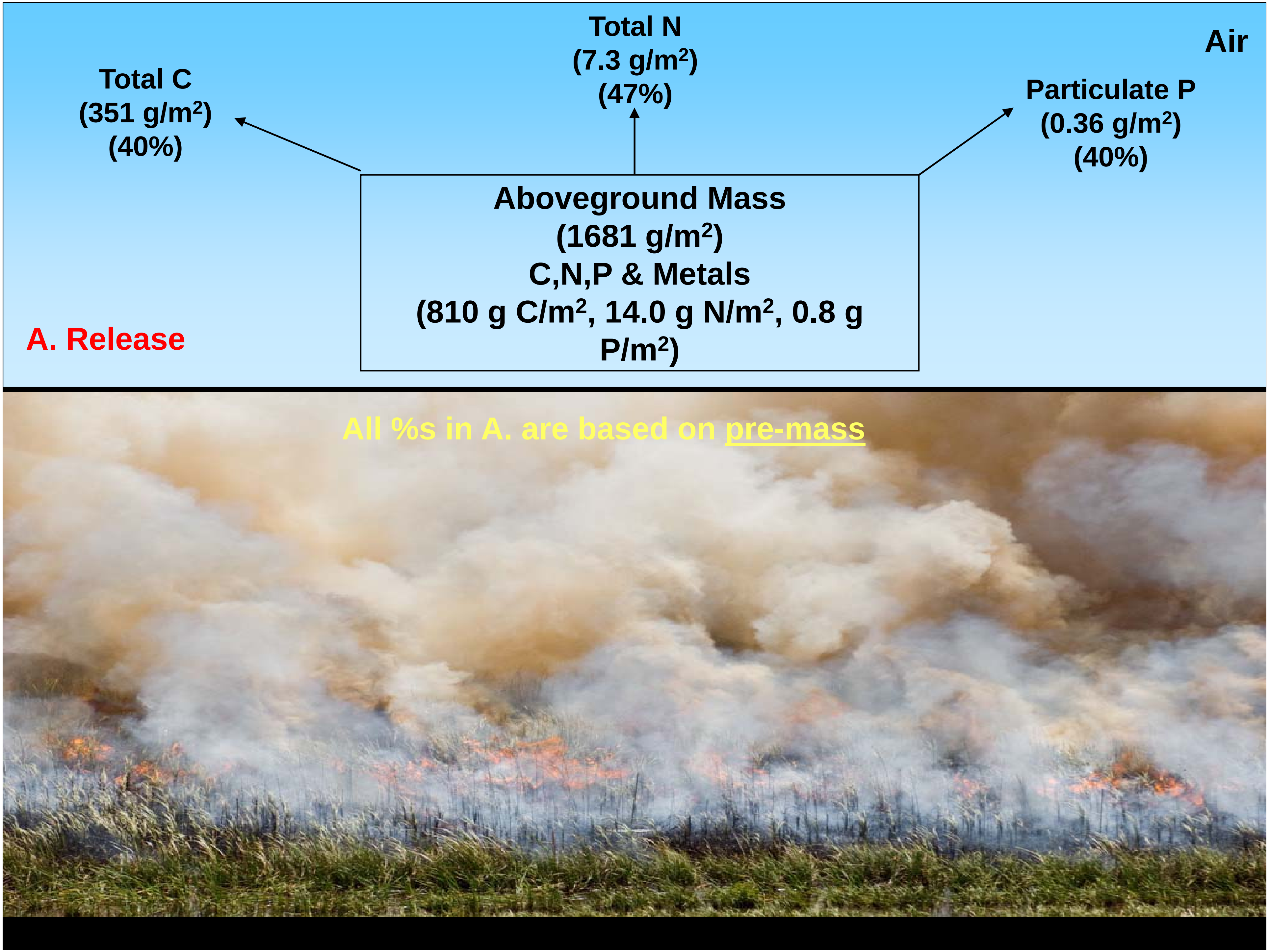
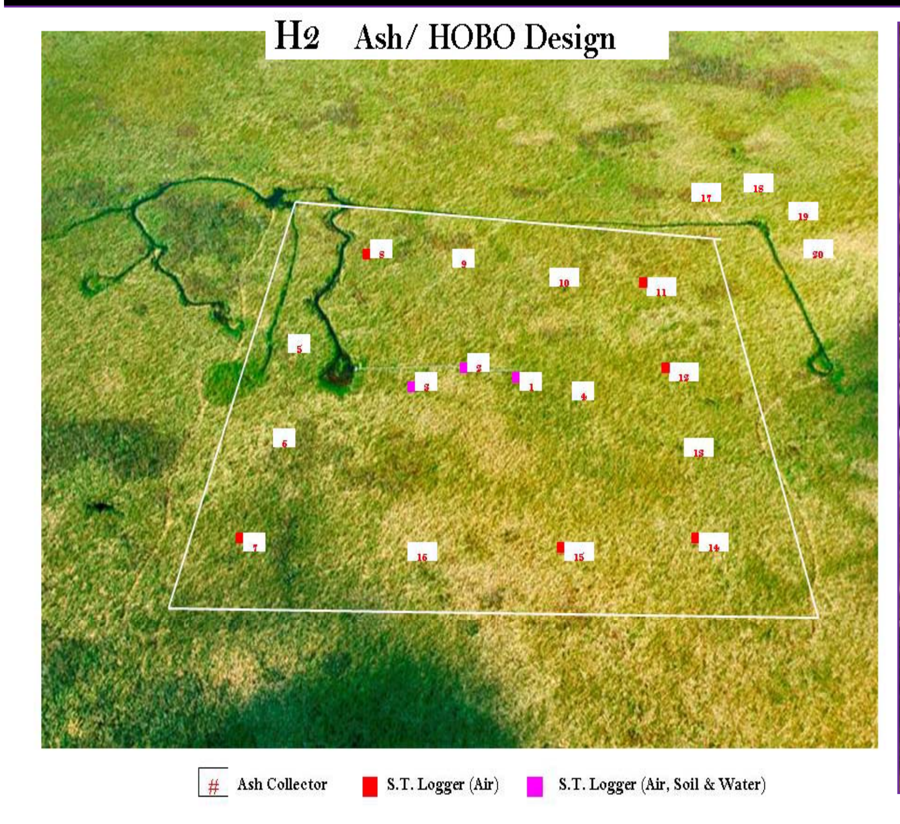
Mass Loss and Species

Cattail | **Sawgrass**


Air
Total C
(351 g/m²)
(40%)
Total N
(7.3 g/m²)
(47%)
Particulate P
(0.36 g/m²)
(40%)
Aboveground Mass
(1681 g/m²)
C,N,P & Metals
(810 g C/m², 14.0 g N/m², 0.8 g P/m²)
A. Release
All %s in A. are based on pre-mass

Ash Collection Design



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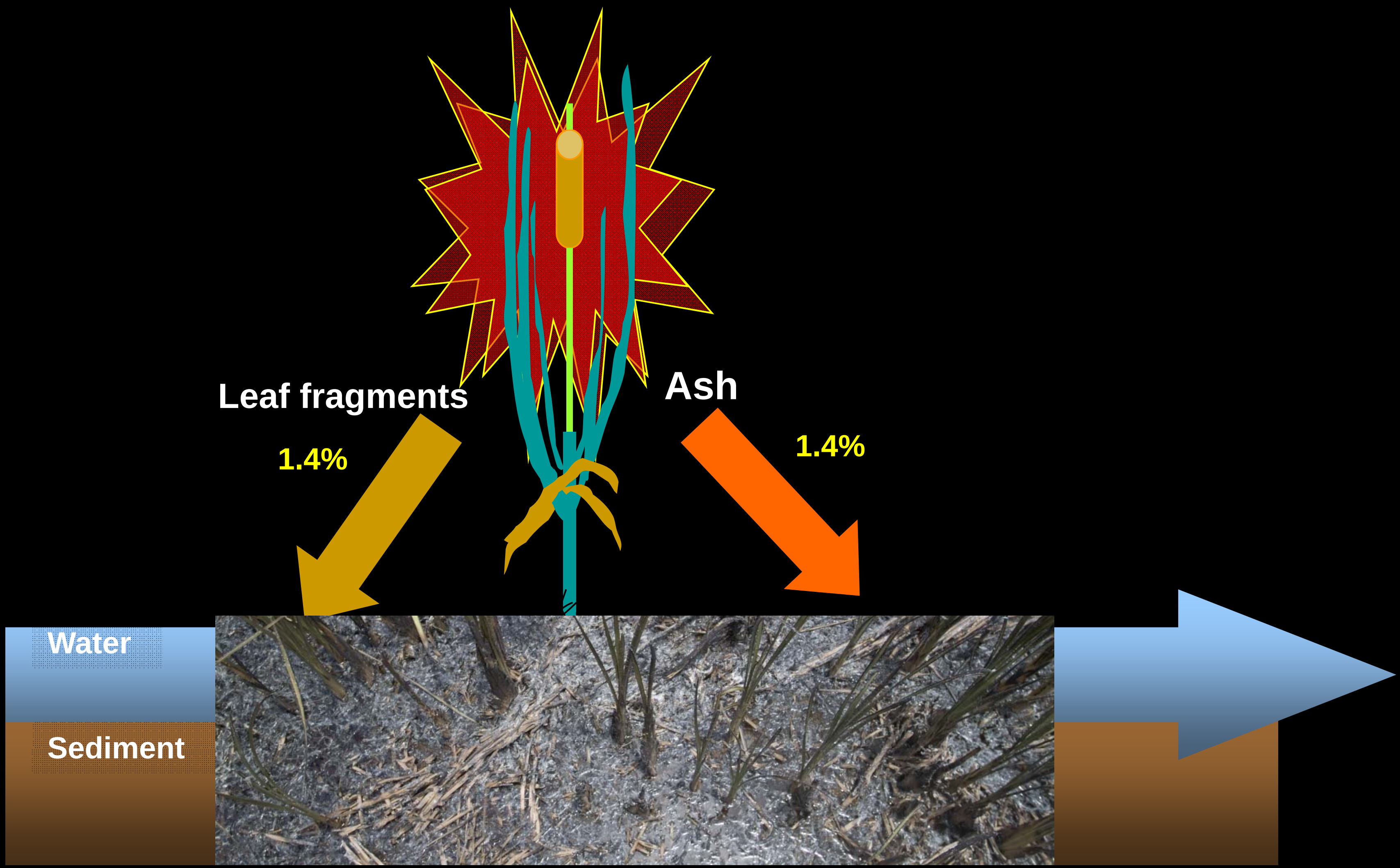
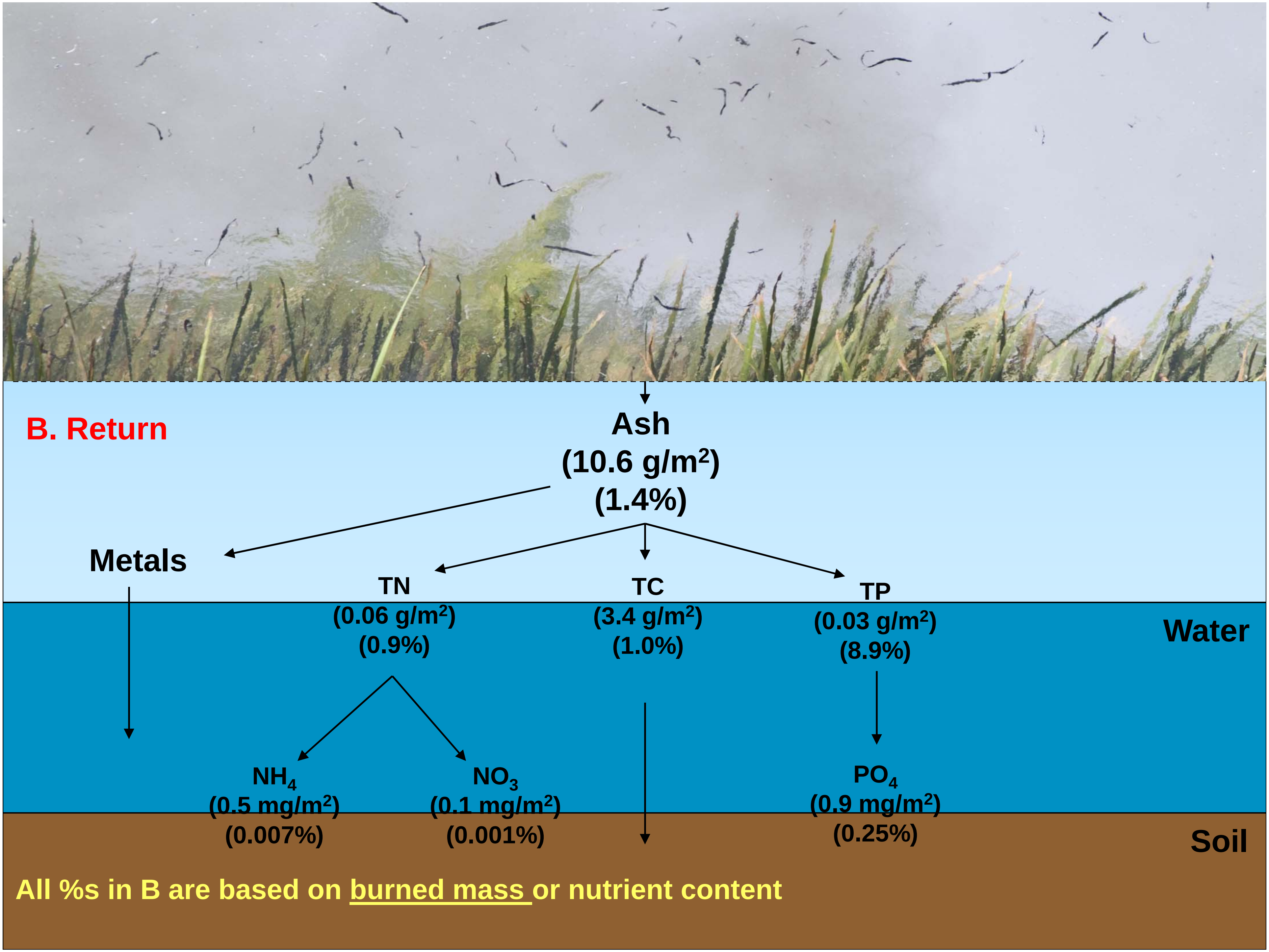
Nutrient Return to the System



Ash Return to the System

Ash return	% pre-fire	% burned
Mass	0.6	1.4
Ash TN	0.5	0.9
Ash TC	0.4	1.0
Ash TP	4.0	8.9


B. Return
Ash
(10.6 g/m²)
(1.4%)
Metals
TN
(0.06 g/m²)
(0.9%)
TC
(3.4 g/m²)
(1.0%)
TP
(0.03 g/m²)
(8.9%)
Water
NH4
(0.5 mg/m²)
(0.007%)
NO3
(0.1 mg/m²)
(0.001%)
PO4
(0.9 mg/m²)
(0.25%)
Soil
All %s in B are based on burned mass or nutrient content

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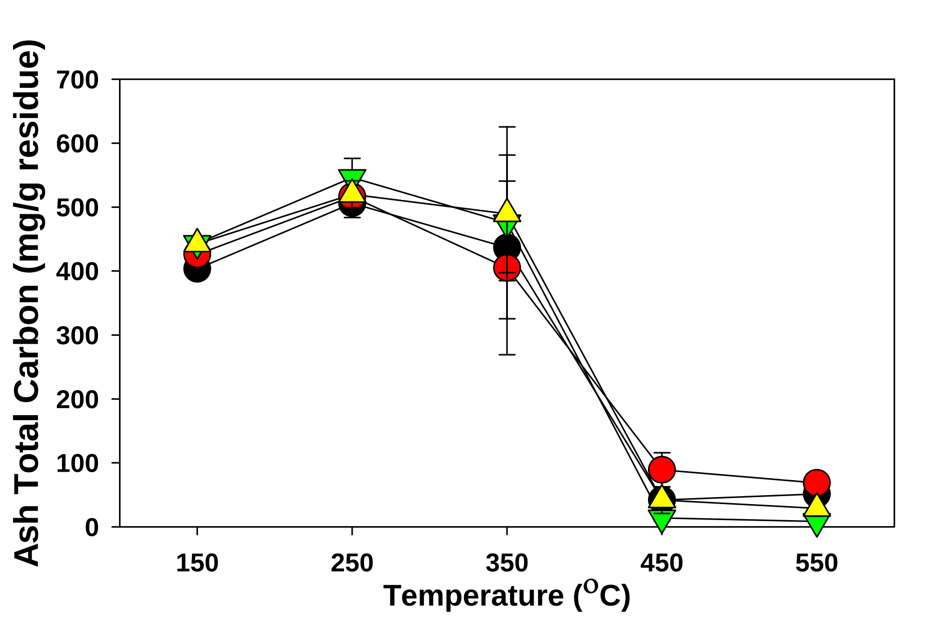
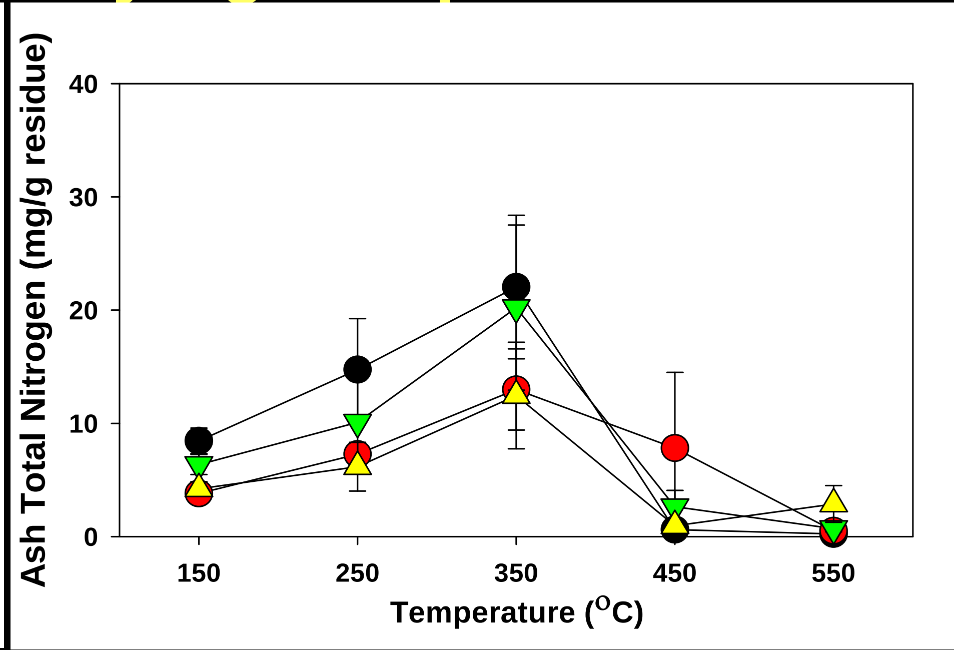
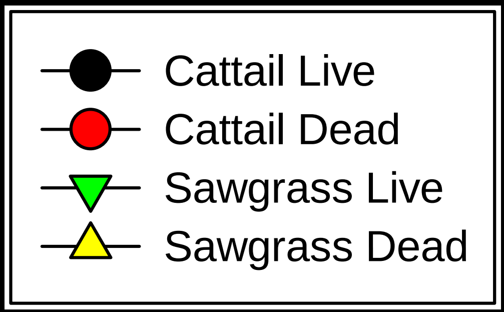
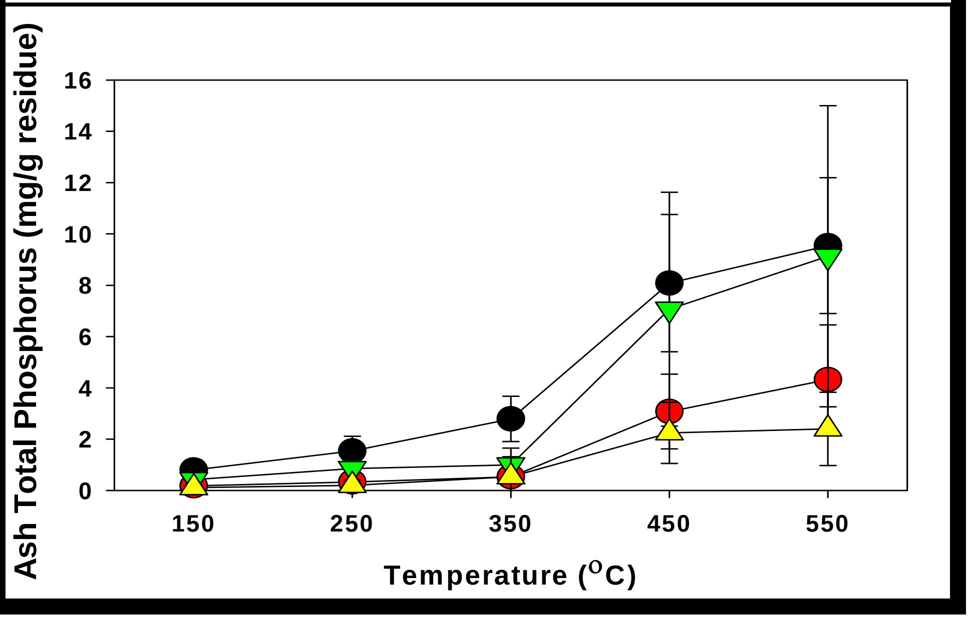
Ash Chemistry with Varying Temperature

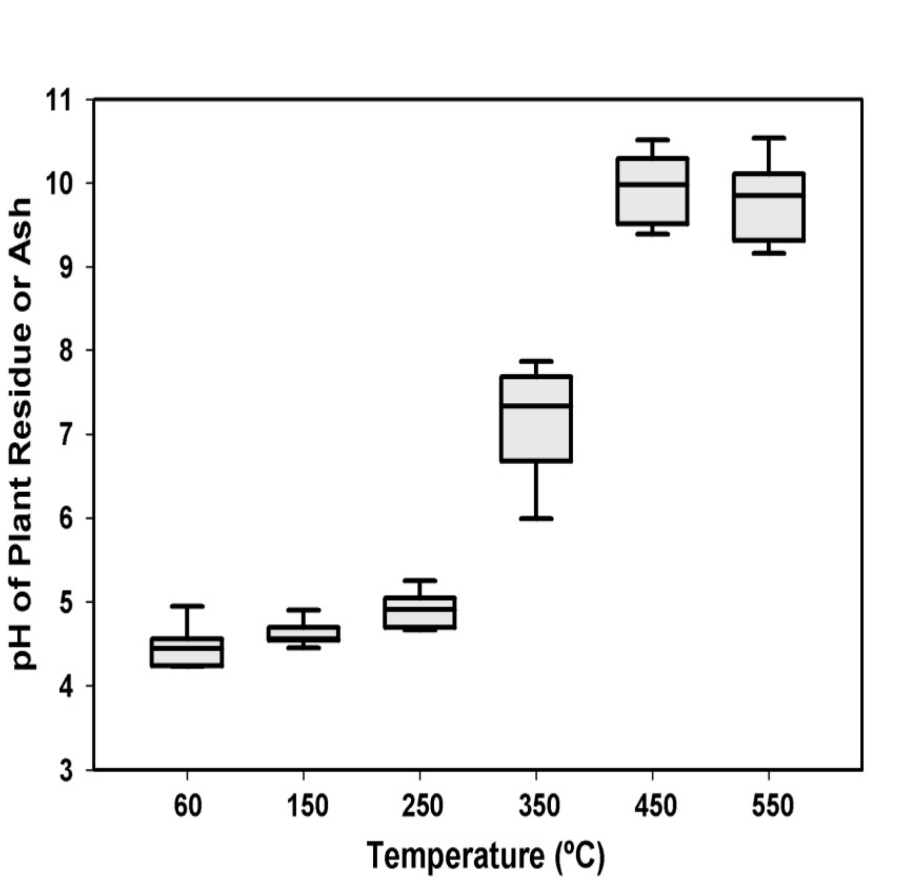


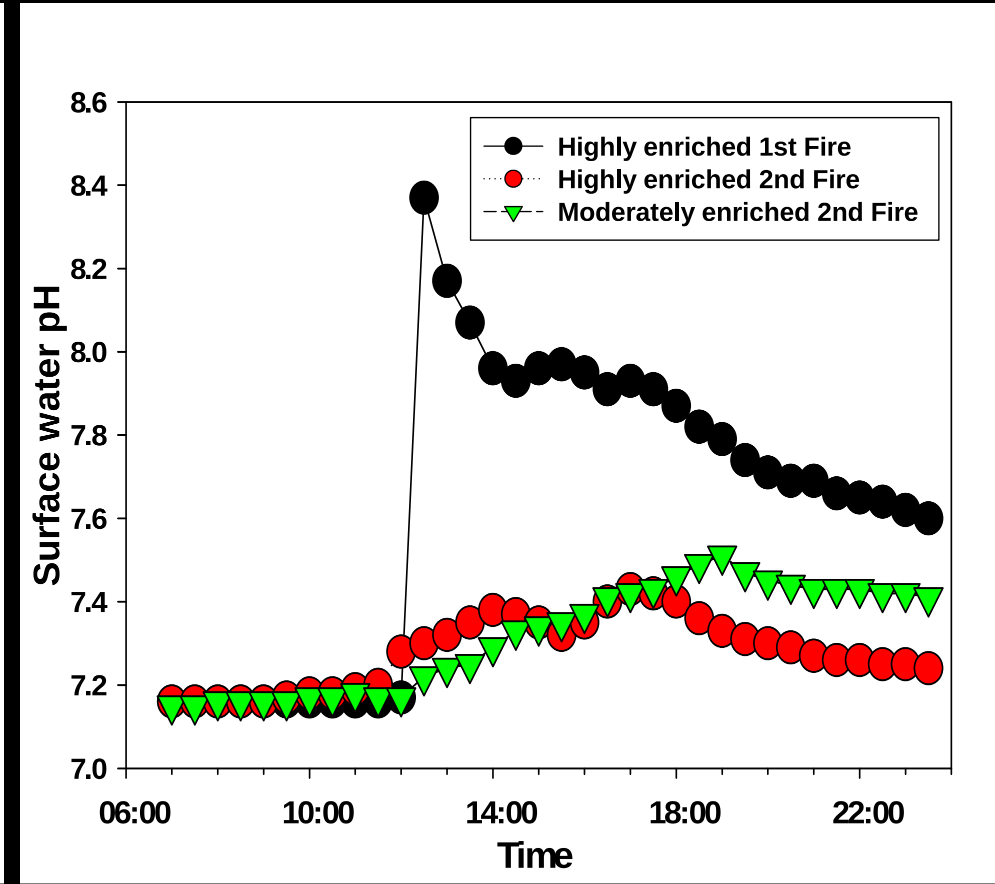




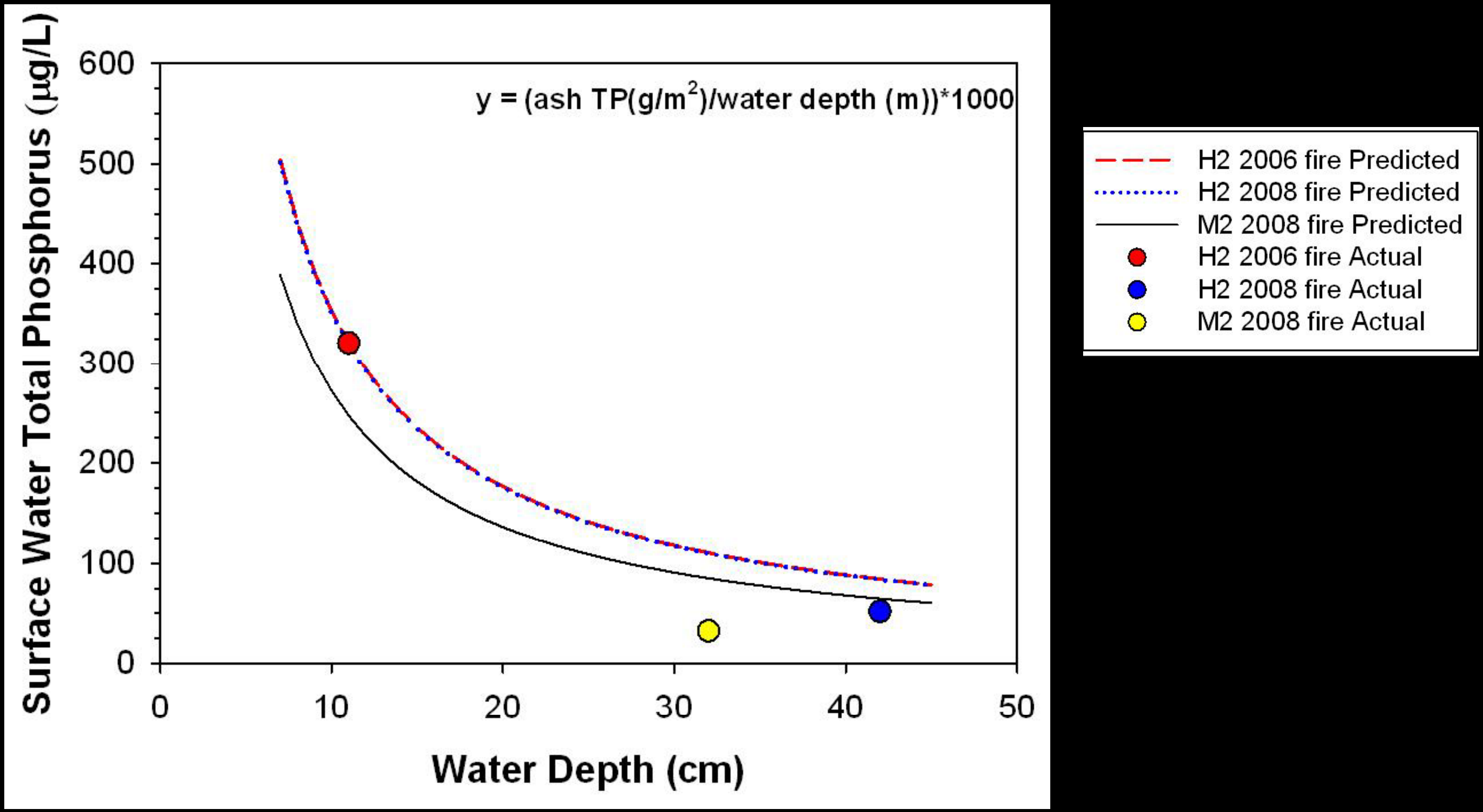


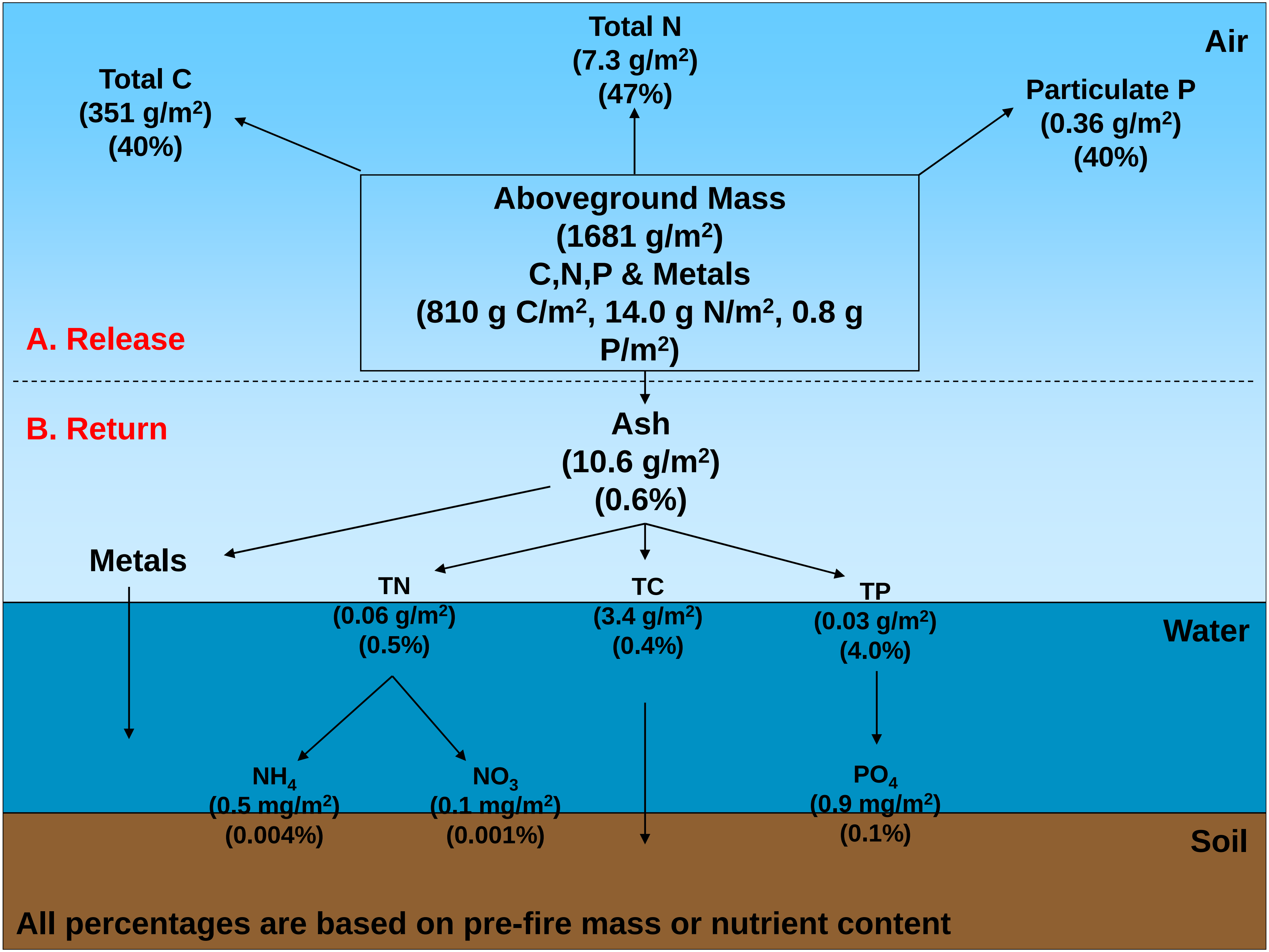
Surface Water pH Response to Ash Addition





Ash Deposition and Water Depth on SWTP

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A. Release
B. Return
Ash
(10.6 g/m2)
(0.6%)
Metals
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NH4
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NO3
(0.1 mg/m2)
(0.001%)
PO4
(0.9 mg/m2)
(0.1%)
Soil
All percentages are based on pre-fire mass or nutrient content

Major Conclusions

- Prescribed fires were an effective way to quickly remove nutrients, as approximately 1% of N and C and < 8% of P of burned nutrients was returned as ash.
- Pre-fire mass and water depth at the time of fire were the main factors determining mass and nutrient loss.
- Water depth and fire temperature both directly (release) and indirectly (ash effect on water quality) affected ecosystem nutrient concentration.

Management Implications

- Two years were required for fuel loads to return for repeated fire but more time may be required for additional fires.

- As more N was released and less returned in ash than P, repeated fires can lead to a more N-limited system, and therefore care must be taken when considering prescribed fires in N-limited systems.

Management Implications

- Water depth is a key management consideration with levels between 10 and 40 cm resulting in successful surface fires.
  - The lower end is good for maximizing nutrient loss
  - The upper end is good for minimizing water quality changes.

- High water levels also reduce fire temperature, creating ash with lower pH, TP and soluble P concentrations.

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Dan Salembier

Project Publications

- Miao and Carstenn 2006. A new direction for large-scale experimental design and analysis. Frontiers in Ecology and the Environment 5: 227.

- Miao et al. 2008. Allometric relationships of field population of two clonal species with contrasting life histories, *Cladium jamaicense* and *Typha domingensis*. Aquatic Botany 88: 1-9.

- Gu et al. 2008. Effects of a prescribed fire on dissolved inorganic carbon dynamics in a nutrient-enriched Everglades wetland. Fundamental and Applied Limnology 171:263-272.

- Miao and Zou, 2009. Seasonal variation in seed bank composition and its interaction with nutrient enrichment in Everglades wetlands. Aquatic Botany 90:157-164.

- Qian et al. 2009. Effects of burn temperature on ash nutrient forms and availability from cattail and sawgrass in the Florida Everglades. J. Environ. Qual. 38: 1-15.

- Qian et al. 2009. Estimation of postfire nutrient loss in the Florida Everglades. J. Environ. Qual. 38: 1812-1820.

- Thomas et al. 2009. Environmental factors affecting temporal and spatial patterns of soil redox potential in Florida Everglades wetlands. Wetlands 29:1133-1145.

- Miao et al. 2009. Real World Ecology: Large-scale and Long-Term Studies and Methods. Springer

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