Moving Right Along: Effect of Flow on Microbial Processes in the Everglades STAs

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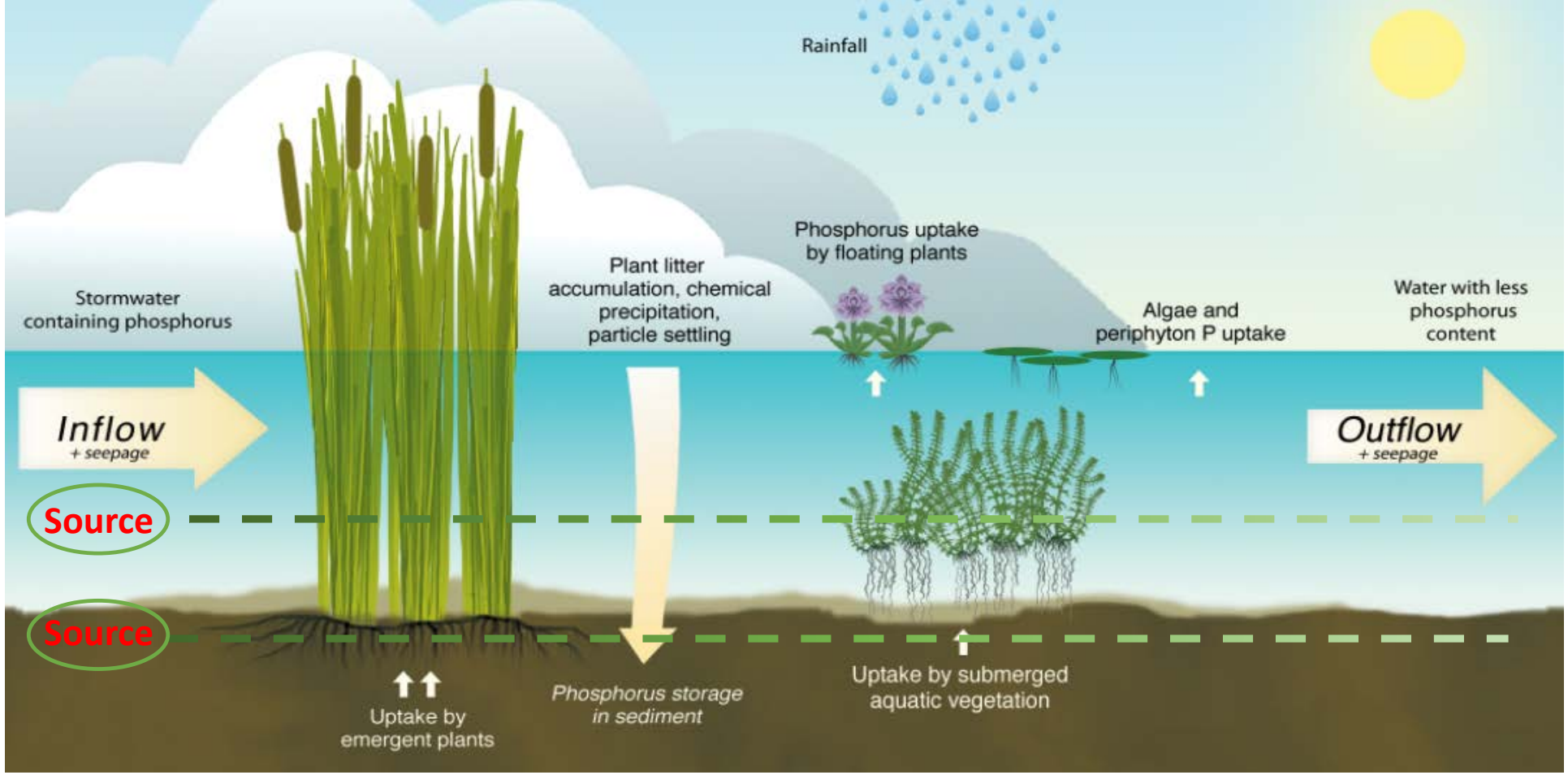
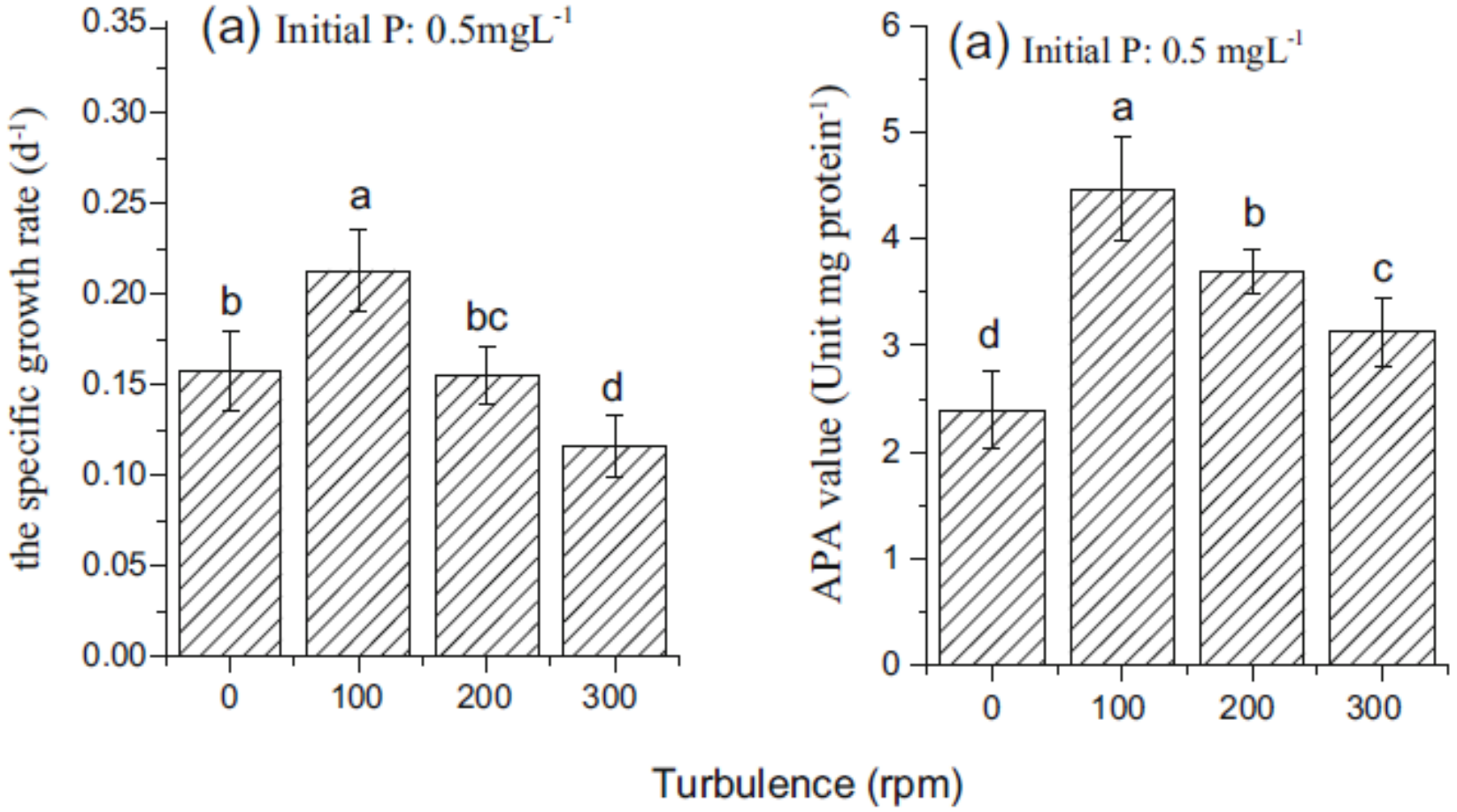


Flow:

- Generally viewed for sedimentation, threshhold for sediment stability
- ALSO…..
  - ❖Creates gradients, moves nutrients
  - ❖Changes water column (physicochemical, depth/light/redox)
    - Velocity (lentic vs lotic?)

Microcystis sp.



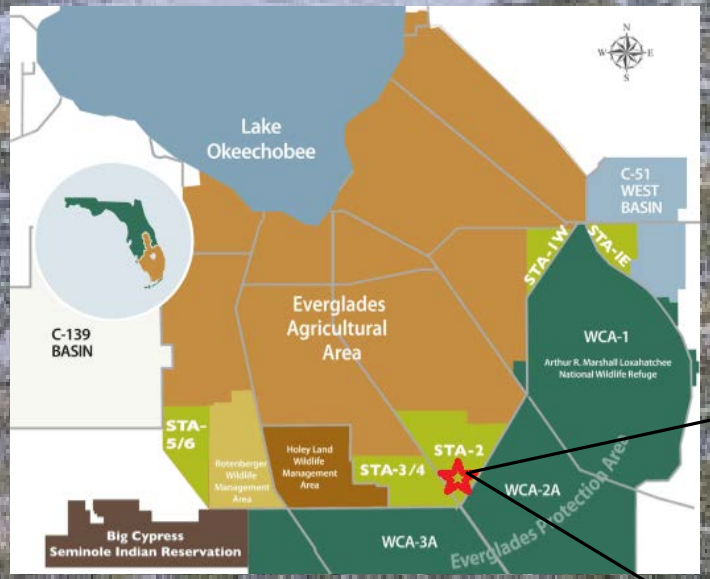
Zheng et al. (2017)

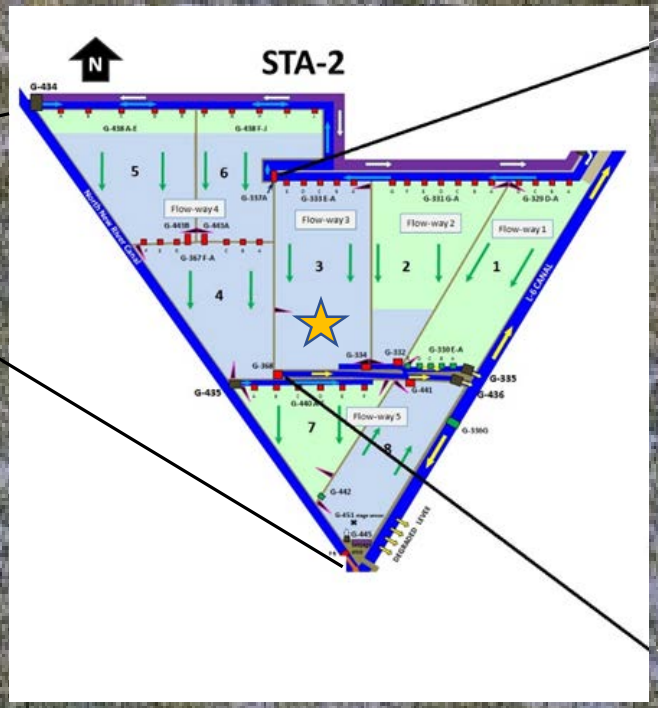
Study Goals

- **Objective 1**: To assess the effect of hydrologic flow on enzyme activities in detritus (floc) layer along transect sites (inflow, mid-flow, and outflow).
- **Objective 2**: Investigate the relationship of flow response to microbial biomass carbon (MBC) and microbial stoichiometric ratios.

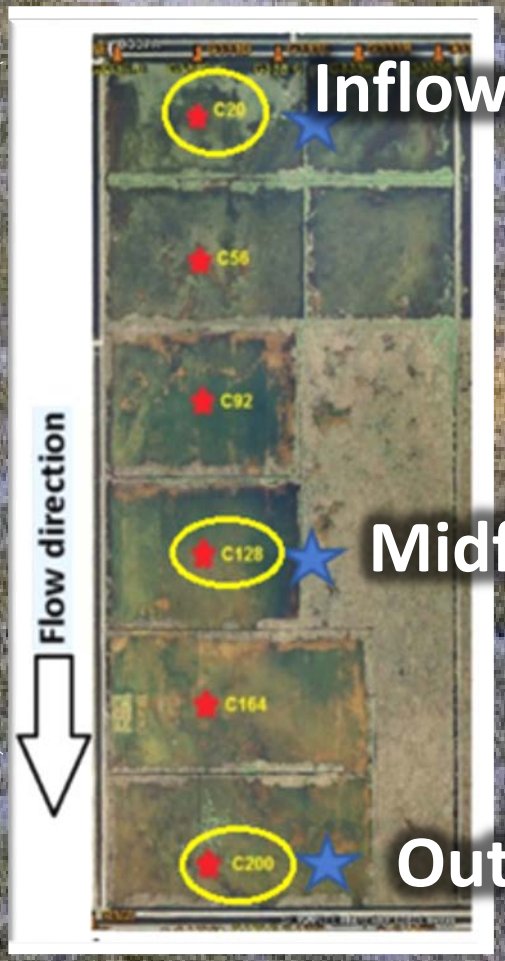
- **H_o**: There is no change in MBC or microbial ratios with flow conditions.
- **H_o**: There is no effect of flow on enzyme activity along the transect.

Study Site





STA-2 Flow way 3

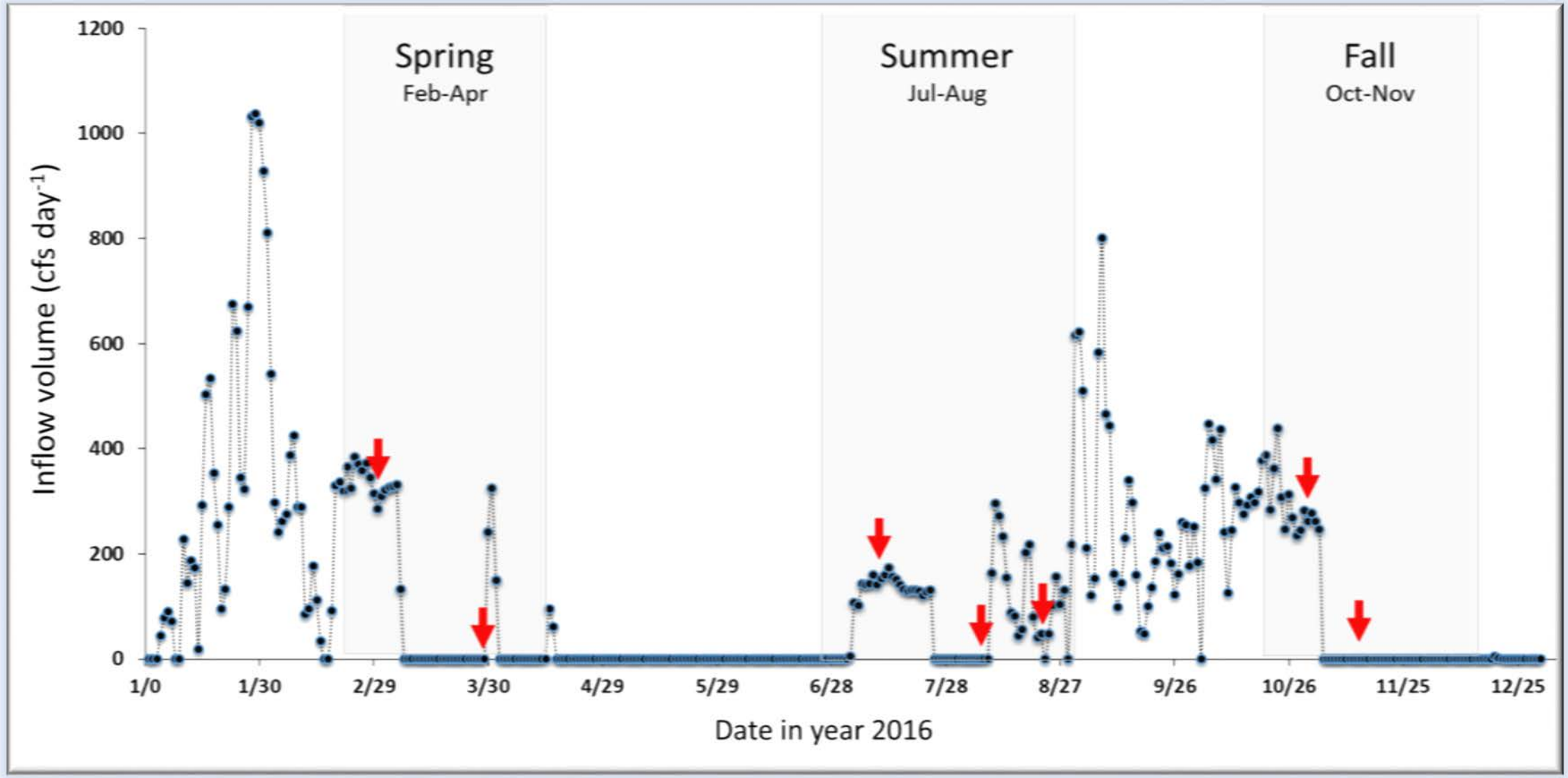


Inflow

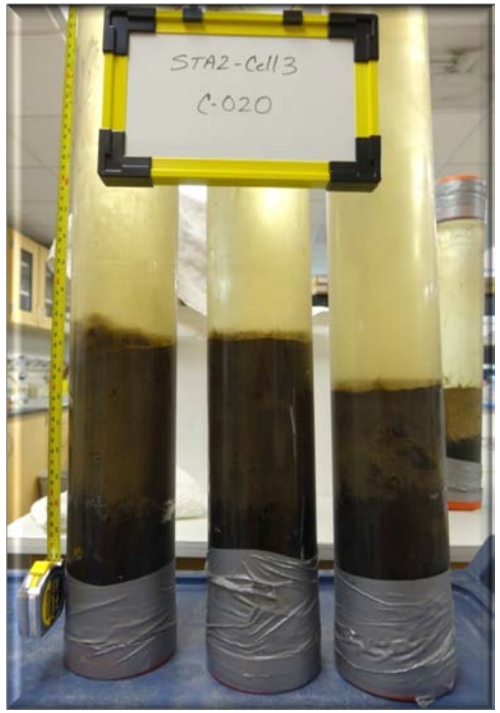
Midflow

Outflow

Flow Events

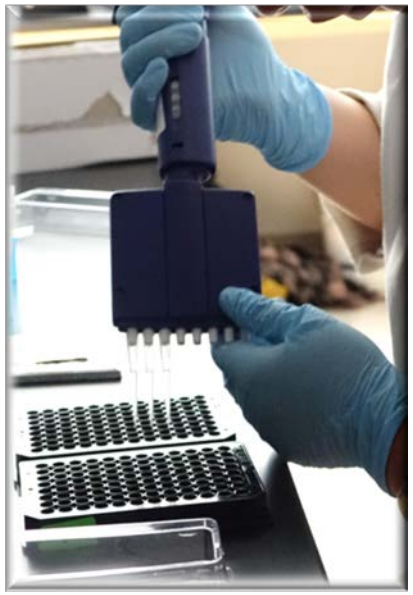

Spring
Feb-Apr
Summer
Jul-Aug
Fall
Oct-Nov
Inflow volume (cfs day-1)
1200
1000
800
600
400
200
0
1/0
1/30
2/29
3/30
4/29
5/29
6/28
7/28
8/27
9/26
10/26
11/25
12/25
Date in year 2016

Methods



MBC/N/P

Chloroform fumigation/Extraction

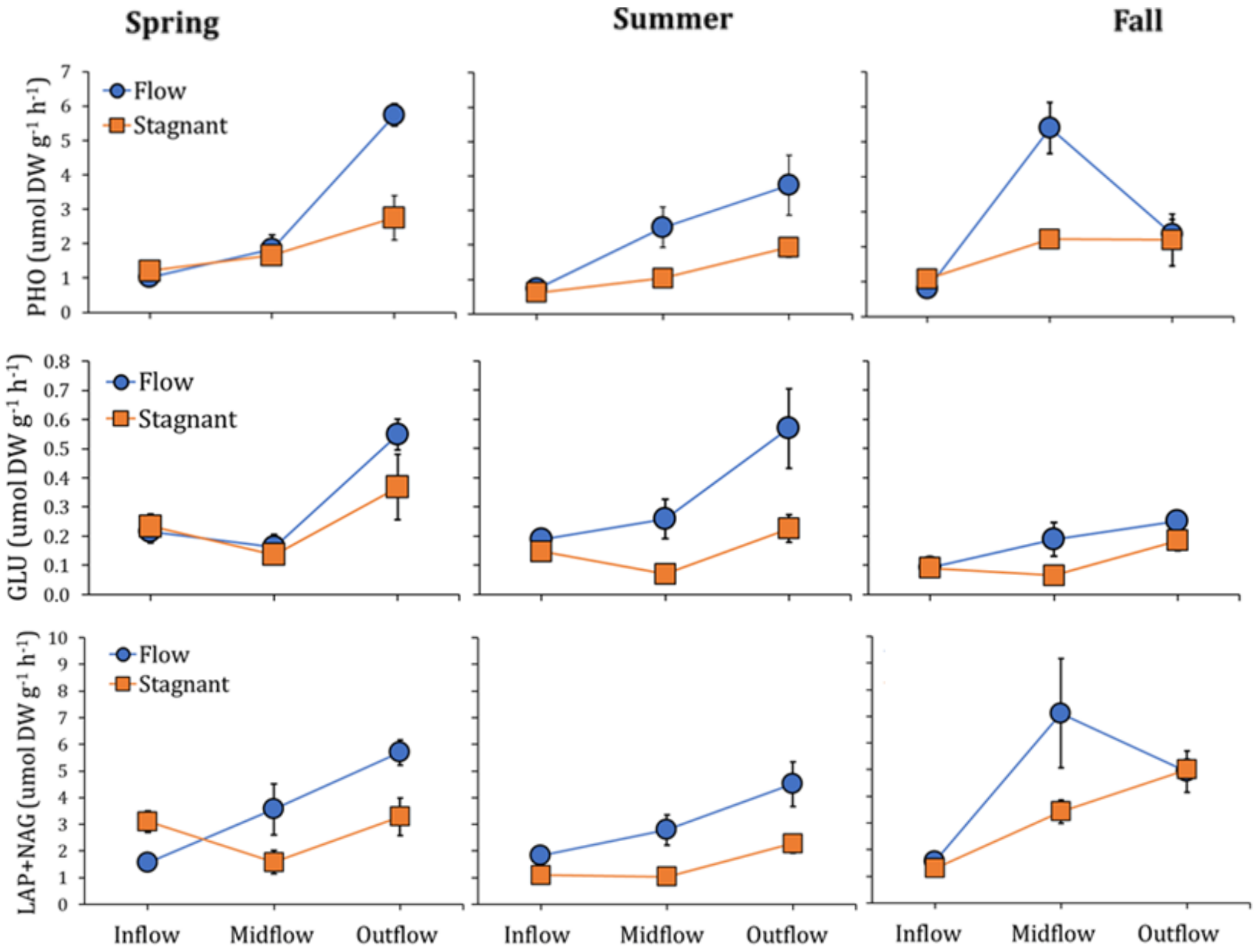


Enzymes

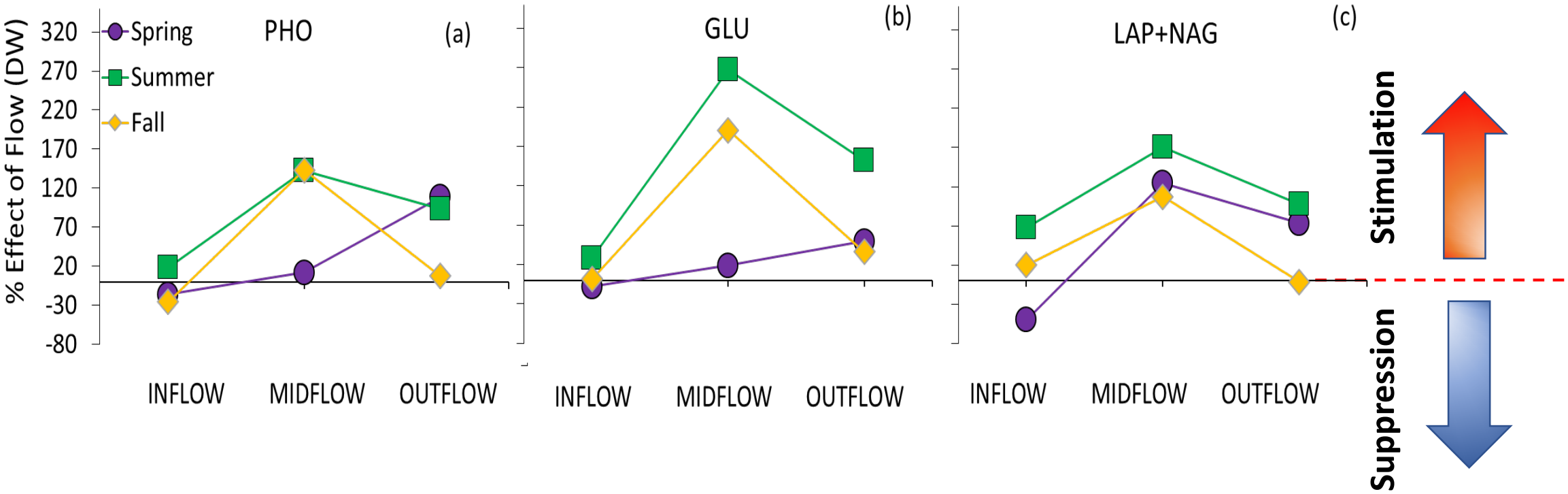
C: β-glucosidase (GLU)

N: Leucine aminopeptidase (LAP)/N-acetyl-glucosaminidase (NAG)

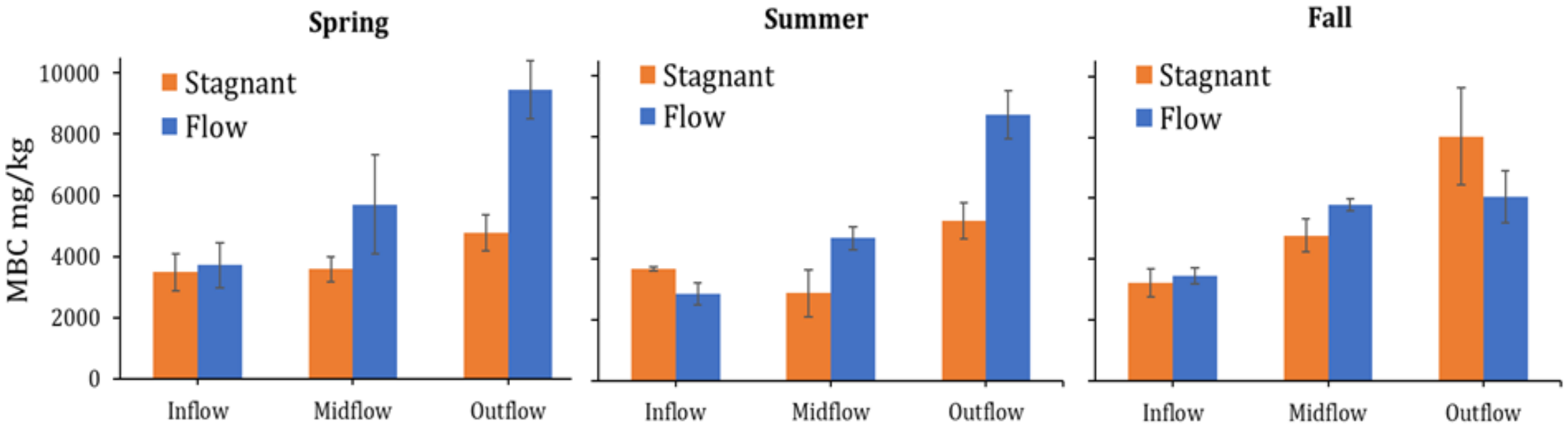
P: Alkaline phosphatase/ Diesterase (PHO)


Spring
Summer
Fall
Flow
Stagnant
PHO (umol DW g-1 h-1)
GLU (umol DW g-1 h-1)
LAP+NAG (umol DW g-1 h-1)
Inflow
Midflow
Outflow

Data Summary

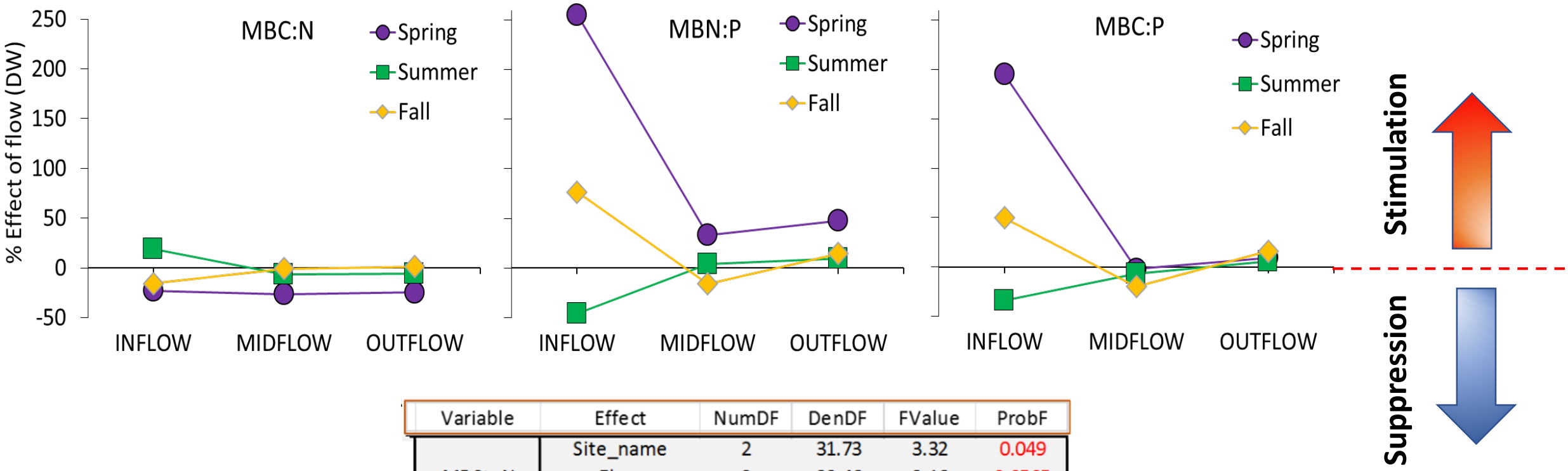


Flow Effect: Microbial Biomass Carbon (MBC)



Variable	Effect	NumDF	DenDF	FValue	ProbF
MBC	Site_name	2	34.33	42.75	<.0001
	Flow	2	50.94	3.92	0.0262
	Site_name*Flow	4	37.93	2.78	0.0406

Microbial Biomass Nutrient Ratios



Variable	Effect	NumDF	DenDF	FValue	ProbF
MBCtoN	Site_name	2	31.73	3.32	0.049
	Flow	2	30.46	3.16	0.0565
	Site_name*Flow	4	33.6	1.08	0.3835
MBCtoP	Site_name	2	31.4	0.82	0.4517
	Flow	2	28.99	0.88	0.4262
	Site_name*Flow	4	34.67	1.79	0.1536
MBNtoP	Site_name	2	30.83	1.54	0.2311
	Flow	2	27.94	3.34	0.0502
	Site_name*Flow	4	34.03	2.71	0.0463

		Spearman's	
Y	X	r-value	ρ-value
EEC_P	TP	-0.25	*<0.05*
	SRP	-0.06	0.56
	DOP	-0.06	0.59
	DOC	-0.23	*<0.05*
	DOC:TP	0.23	0.07
	DOC:SRP	-0.13	0.33
	TN:TP	0.22	0.07
	DIN:SRP	-0.24	0.09
EEC_N	TN	-0.004	0.97
	DIN	-0.16	0.24
	DOC	0.02	0.87
	DOC:DIN	0.18	0.19
	TN:TP	0.13	0.30
	DIN:SRP	-0.03	0.83
EEC_C	DOC	-0.13	0.27
	DOC:TP	-0.34	*<0.01*
	DOC:TN	-0.32	*<0.01*
	DOC:SRP	-0.13	0.32
	DOC:DIN	0.37	*<0.01*
$EEC_{C:P}$	DOC:TP	-0.41	*<0.01*
	DOC:SRP	-0.03	0.80
$EEC_{C:N}$	DOC:TN	-0.37	*<0.01*
	DOC:DIN	0.23	0.10
$EEC_{N:P}$	TN:TP	-0.05	0.67
	DIN:SRP	0.32	*<0.05*

Nutrient Changes

- Confusing Relationships
  - Weak relationships with P (PHO)
  - Negative correlations with DOC:nutrients (GLU)
  - Confusing relationships with DIN
- Problems
  - Likely different mechanisms along the gradient
  - Variation in inputs (flow sources)
  - Timing (antecedent conditions, steady state?)

Conclusions

- Flow stimulated microbes, especially at the mid-flow and outflow.
  - Increased MBC
  - Enhanced biomass specific enzyme activities
  - Enhanced nutrient limitation (P)?
- Mechanism?
  - Flow supplies substrates for microbes?
    - particulates, water column production, nitrogen
  - Flow removes P

Future Directions

- Elucidate cause
  - Physical changes
  - Water column and soil nutrient concentrations
  - Nutrient additions/bioassays
- Quantify the effect (low, moderate, and high rates).
  - Optimize microbial growth related to cell performance
- Compare with other vegetation types (emergents)

Thank you!

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