Nutrient spiking experiment using limnocorals in Willard Spur

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Objectives and methodology

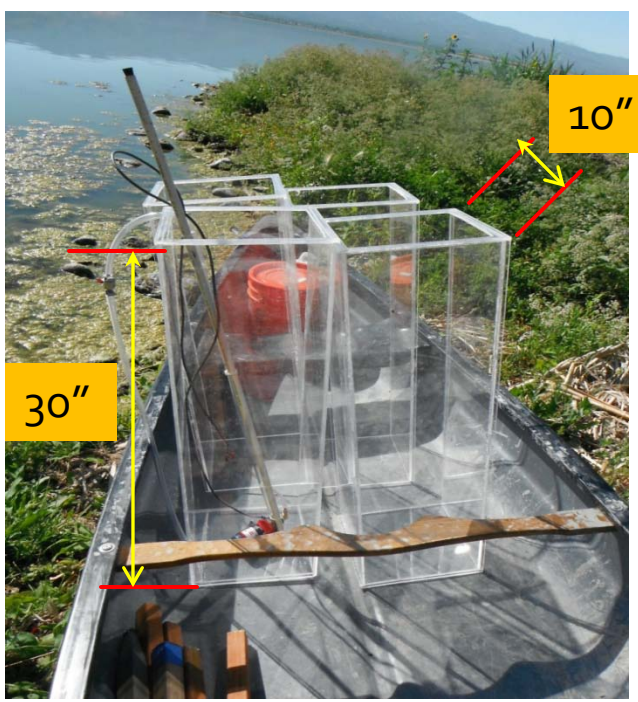
- The overall objective of this short study was to evaluate the response of the water column and sediments at one site in Willard Spur Wetlands when spiked with known concentrations of nitrogen and phosphorus.

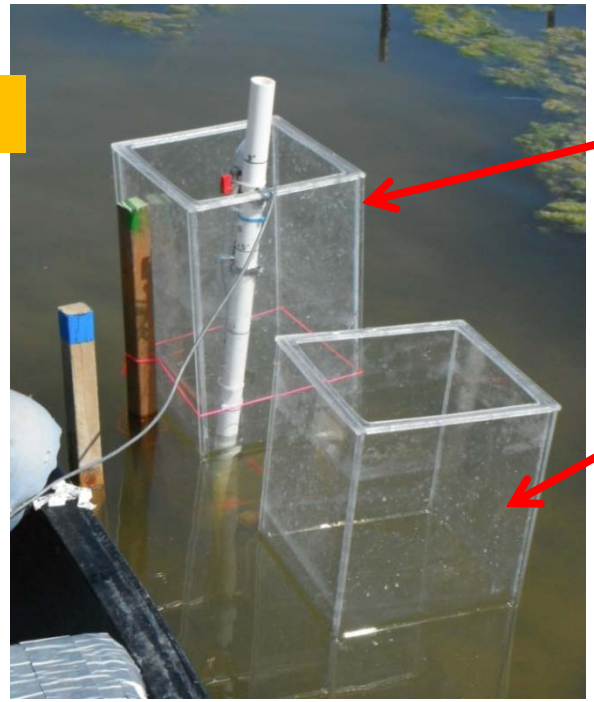
This overarching objective was accomplished by installing plexiglass square cross section chambers and spiking the contents of these chambers with known concentrations of nutrients.

the concentrations of major inorganic of nitrogen species and orthophosphate were monitored in the water column.

In-situ Nutrient Fluxes

- Measured using in-situ square chambers





Water column chamber- closed at the bottom

Sediment chamber- open at the bottom

A slow speed submersible pump was used to mix the water column to create well mixed conditions. Care was taken as not to disturb the sediments

Experimental Matrix

Type of chamber	Amendment	Target Concentration	Comment
Sed+WC	None	Background (Non spiked)	In duplicate
WC only	None	Background (Non spiked)	In duplicate
Sed+WC	(N+P)- low	0.1 mg P/l+0.5 mg-NH3-N/L+0.5 mg-NO3-N/L	In duplicate
WC only	(N+P)- low	0.1 mg P/l+0.5 mg-NH3-N/L+0.5 mg-NO3-N/L	In duplicate

Type of chamber	Amendment	Target Concentration	Comment
Sed+WC	None	Background (Non spiked)	In duplicate
WC only	None	Background (Non spiked)	In duplicate
Sed+WC	(N+P)- high	0.5 mg P/l+2.5 mg-NH3-N/L+2.5 mg-NO3-N/L	In duplicate
WC only	(N+P)- high	0.5 mg P/l+2.5 mg-NH3-N/L+2.5 mg-NO3-N/L	In duplicate

Flux calculation methodology

- Data obtained was normalized to 24 hour to get g/L/day.
- Data in terms of g/L/day was multiplied with water depth to obtain flux in terms of $g/m^2/day$.

- $Sed_{dark\text{-}flux} = (Sed_{dark\text{-}change} - WC_{dark\text{-}change})*depth$
- $Sed_{light\text{-}net} = (Sed_{light\text{-}change} - WC_{light\text{-}change})*depth$
- $Sed_{gross} = Sed_{light\text{-}net} - Sed_{dark\text{-}net}$

Data- Low spike-daytime

Light Conditions Low Spike

	AMB	WC-C1	WC-C2	WC-S1	WC-S2	SD-C1	SD-C2	SD-S1	SD-S2
NO2-N (mg/L/day)	-0.005	-0.006	0.008	0.010	0.000	0.000	0.000	0.000	-0.118
NO3-N (mg/L/day)	0.062	0.071	0.017	-0.088	0.003	0.015	0.022	-0.384	-0.387
NH4-N (mg/L/day)	-0.161	0.014	0.002	-0.296	-0.195	0.060	0.102	-0.414	-0.456
PO4-P (mg/L/day)	0.000	-0.041	-0.046	-0.033	-0.006	0.039	0.038	-0.075	-0.078

		NO3-N	NH4-N	PO4-P
WC-C	g/m3/day	0.044	0.008	-0.043
WC-S	g/m3/day	-0.043	-0.246	-0.019
Sed-C	g/m2/day	-0.011	0.031	0.035
Sed-S	g/m2/day	-0.148	-0.082	-0.025

Key Observations:

1. Negligible nitrite concentrations- either complete nitrification or denitrification
2. Ammonia was consumed in the water column spiked chambers without corresponding increases in nitrate (in fact decreased) or nitrite.
3. In sediment control chambers (unspiked), nitrate, ammonia and P were added.
4. In sediment spiked chambers, nitrate, ammonia and P were consumed.

Data- high spike-daytime

Light Conditions High Spike

	AMB	WC-C1	WC-C2	WC-S1	WC-S2	SD-C1	SD-C2	SD-S1	SD-S2
NO2-N (mg/L/day)	0.000	0.000	0.000	0.022	-0.211	0.000	-0.103	-0.107	-0.018
NO3-N (mg/L/day)	-0.030	0.006	-0.017	-0.429	-0.088	-0.079	-0.096	-1.926	-2.000
NH4-N (mg/L/day)	0.056	0.013	0.015	-0.992	-0.386	0.054	0.093	-2.188	-1.768
PO4-P (mg/L/day)	-0.006	-0.011	0.005	-0.134	0.012	-0.004	0.031	-0.676	-0.517

Low spike		NO3-N	NH4-N	PO4-P
WC-C	g/m3/day	0.044	0.008	-0.043
WC-S	g/m3/day	-0.043	-0.246	-0.019
Sed-C	g/m2/day	-0.011	0.031	0.035
Sed-S	g/m2/day	-0.148	-0.082	-0.025

High spike		NO3-N	NH4-N	PO4-P
WC-C	g/m3/day	-0.006	0.014	-0.003
WC-S	g/m3/day	-0.259	-0.689	-0.061
Sed-C	g/m2/day	-0.034	0.024	0.007
Sed-S	g/m2/day	-0.699	-0.528	-0.220

Key Observations:

1. Nitrite seemed disappearing in spiked water column control, sediment control and sediment spiked chambers
2. Ammonia and nitrate consumed in water column spiked and sediment spiked chambers.
3. Ammonia was added in water column and sediment control chambers.
4. P was consumed in sediment spiked chambers

Low spike-night time

Dark Conditions Low Spike

	AMB	WC-C1	WC-C2	WC-S1	WC-S2	SD-C1	SD-C2	SD-S1	SD-S2
NO2-N (mg/L/day)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NO3-N (mg/L/day)	-0.996	-0.013	-0.049	-0.047	-0.002	0.044	-0.016	-0.503	-0.402
NH4-N (mg/L/day)	0.030	-0.027	-0.003	-0.246	-0.156	0.143	0.213	0.260	0.149
PO4-P (mg/L/day)	0.027	-0.045	0.003	-0.053	-0.014	0.017	-0.073	-0.068	-0.068

		NO3-N	NH4-N	PO4-P
WC-C	g/m3/day	-0.031	-0.015	-0.021
WC-S	g/m3/day	-0.024	-0.201	-0.034
Sed-C	g/m2/day	0.019	0.083	-0.003
Sed-S	g/m2/day	-0.184	0.175	-0.015

Key Observations:

1. Surprisingly, the ambient conditions show nitrate depletion and in general, except for one of the sediment control chambers, nitrate fluxes were negative in all chambers. This trend was followed by P as well except under ambient conditions and one of the sediment control chambers.
2. Negative ammonia flux in water column and positive in sediment chambers

High spike- night time

Dark Conditions High Spike

	AMB	WC-C1	WC-C2	WC-S1	WC-S2	SD-C1	SD-C2	SD-S1	SD-S2
NO2-N (mg/L/day)	0.000	0.054	0.051	0.124	-0.222	0.051	-0.098	-0.009	0.000
NO3-N (mg/L/day)	0.010	-0.118	-0.025	-0.729	-0.215	0.042	0.018	-1.652	-1.768
NH4-N (mg/L/day)	-0.006	0.013	0.015	-2.123	-3.310	0.117	0.232	-0.048	-0.412
PO4-P (mg/L/day)	-0.032	0.003	0.010	-0.117	-0.082	-0.017	0.003	-0.019	-0.280

		NO3-N	NH4-N	PO4-P
WC-C	g/m3/day	-0.071	0.014	0.006
WC-S	g/m3/day	-0.472	-2.716	-0.100
Sed-C	g/m2/day	0.042	0.066	-0.005
Sed-S	g/m2/day	-0.508	1.020	-0.020

Key Observations:

1. Surprisingly, the ambient conditions show nitrate depletion and in general, except for one of the sediment control chambers, nitrate fluxes were negative in all chambers. This trend was followed by P as well except in water column control chambers.
2. Positive NH_3 flux in water column control, -ve in water column spiked, positive in sediment control and –ve in sediment spiked.

Mechanisms contributing to fate

Let us consider NH_3-N

Day time=Photo(-ve) + Nitri (-ve) + Decay(+ve) + Vola(-ve) + N-fix(+ve) + (others) = **Net flux$_{day}$**

Night time=Photo (no) + Nitri (-ve) + Decay(+ve) + Vola(-ve) + N-fix (no) + (others) = **Net flux$_{night}$**

Net flux$_{gross}$ = Net flux$_{day}$ - Net flux$_{night}$
= Photo(-ve) + N-fix(+ve)

Discussion/suggestions