Dredging of Drainage Ditches Can Increase Short-Term Contaminant Transport

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Introduction

Much of the glacial till area of the midwest is drained using drainage tiles and open ditches. These ditches are typically dredged every five to eight years. The effects of dredging on contaminant transport are largely unknown.

Objectives

To evaluate the impact of ditch dredging on in-stream nutrient and pesticide transport.

Figure 1. Photos of freshly dredged ditch and sediment collection of dredged sediments.

Methods

- Sediments collected immediately prior to and immediately after dredging
- Sediments placed in fluvarium
- Water for adsorption phase
  - ✓2.5mM $CaCl_2$, 0.55mM P (as K_2HPO_4)
  - ✓Continuous flow for 170 hours
- Water for desorption phase
  - ✓2.5mM $CaCl_2$, 0.00mM P
  - ✓Continuous flow for 24 hours

Figure 2. Photo showing fluvarium and cartoon depicting P uptake and release by sediment.

Results

Table 1. Particle size distribution and organic matter (OM) content of benthic sediments for pre-dredged and dredged sediments.

Treatment	Sand	Silt	Clay	OM
	%			
Pre-dredge	60.9	18.0	21.1	5.10
Dredged	82.0	3.1	14.9	1.98

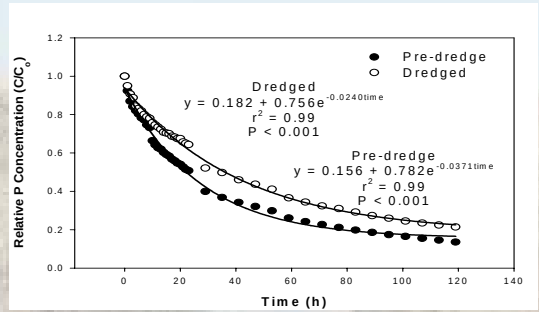

Figure 3. Relative P concentrations in fluvarium water for pre-dredge and dredged sediments.

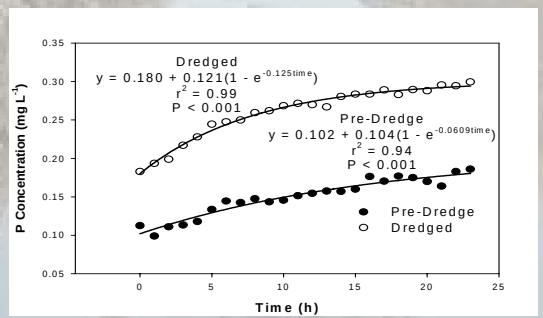

Figure 4. Mean P concentrations in fluvarium water during desorption experiment for pre-dredge and dredged sediments.

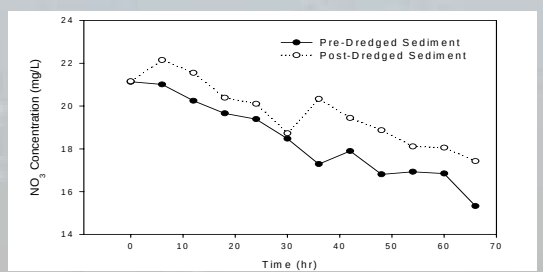

Figure 5. Nitrate concentrations with increasing time as affected by sediments collected before and after dredging.

Table 2. Mehlich 3 P, Al and Fe concentrations, P sorption ratio (PSR) and equilibrium P concentrations (EPC_0) for pre-dredge and dredged sediments during the adsorption and desorption experiments using stream simulations.

Treatment	P	Al	Fe	PSR	EPC_0
	mg kg^{-1}				mM
Adsorption					
Pre-dredge	121	313	2180	0.077	-0.0090
Dredged	82	90	1190	0.119	0.0261
Desorption					
Pre-dredge	151	475	2310	0.081	-0.0071
Dredged	118	125	1260	0.150	0.0048

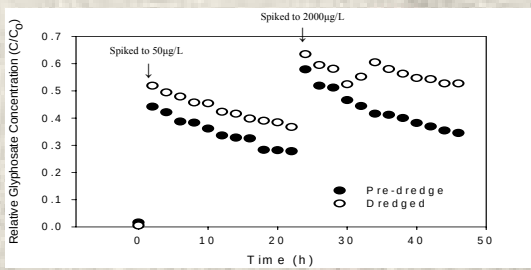

Figure 6. Relative Glyphosate concentration in simulated ditch water for the adsorbtion phase of experiment. An initial spike of 50µg/L occurred at Time 0 and a spike of 2000µg/L occurred at 24 hours.

Figure 7. Dredging spoils piled alongside a recently dredged ditch reduces direct runoff.

Conclusions

- Dredging reduced the ability of sediments to remove P, N and pesticides from the water column.
- Dredging released P, N and pesticides to 'clean' water more quickly than sediments taken prior to dredging.
- Dredging changed the physiochemical properties of sediments (EPC_0, P buffering capacity, and PSR) due to removal of fine particle size sediments and organic matter, and exposure of reduced Fe in sediments following dredging.
- Studies are ongoing to evaluate the time required for dredged ditches to recover, and characterize the physiochemical changes that occur in ditch sediments throughout the year.