

Sorption of chlorpyrifos in vegetated agricultural drainage ditches

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Hypothesis

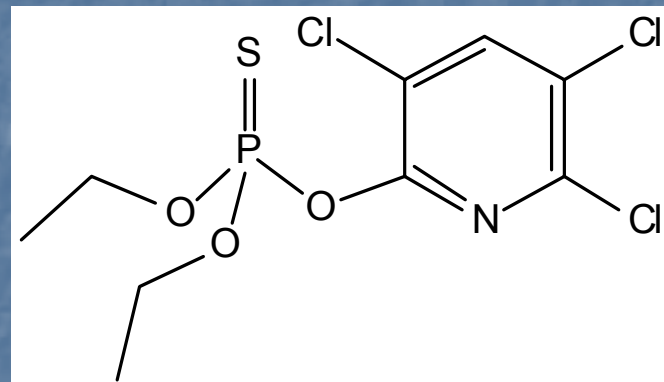
Plants are the predominate surfaces for sorption of chlorpyrifos in BMPs due to specific measurable physical and chemical characteristics.

Research objective

Quantify the partitioning of chlorpyrifos to soils and plants used in vegetated natural treatment systems in the San Joaquin Valley and explain observed differences

Pesticide Class	Organophosphate
Use Type	Insecticide
Trade Names	Dursban, Lorsban
Formula	$C_9H_{11}Cl_3NO_3PS$
CAS #	2921-88-2
Chemical Name	O,O-diethyl O-3,5,6-trichloro-2-pyridylphosphorothioate
Molecular Weight	350.588
Melting Point	41-44 °C
Boiling Point (°C at 1 atm)	200
Density	1.398 g/cm ³

	Min - Max (Mode)
Vapor Pressure (mPa at 25°C)	1.5-6.7 (2.5)
Henry's Law Constant (Pa m³/mol)	0.00406-7.903 (4.195)
Water Solubility (mg/L at 25 °C)	0.3-2.32 (0.3)
log K_{ow}	3.31-5.27 (4.96)





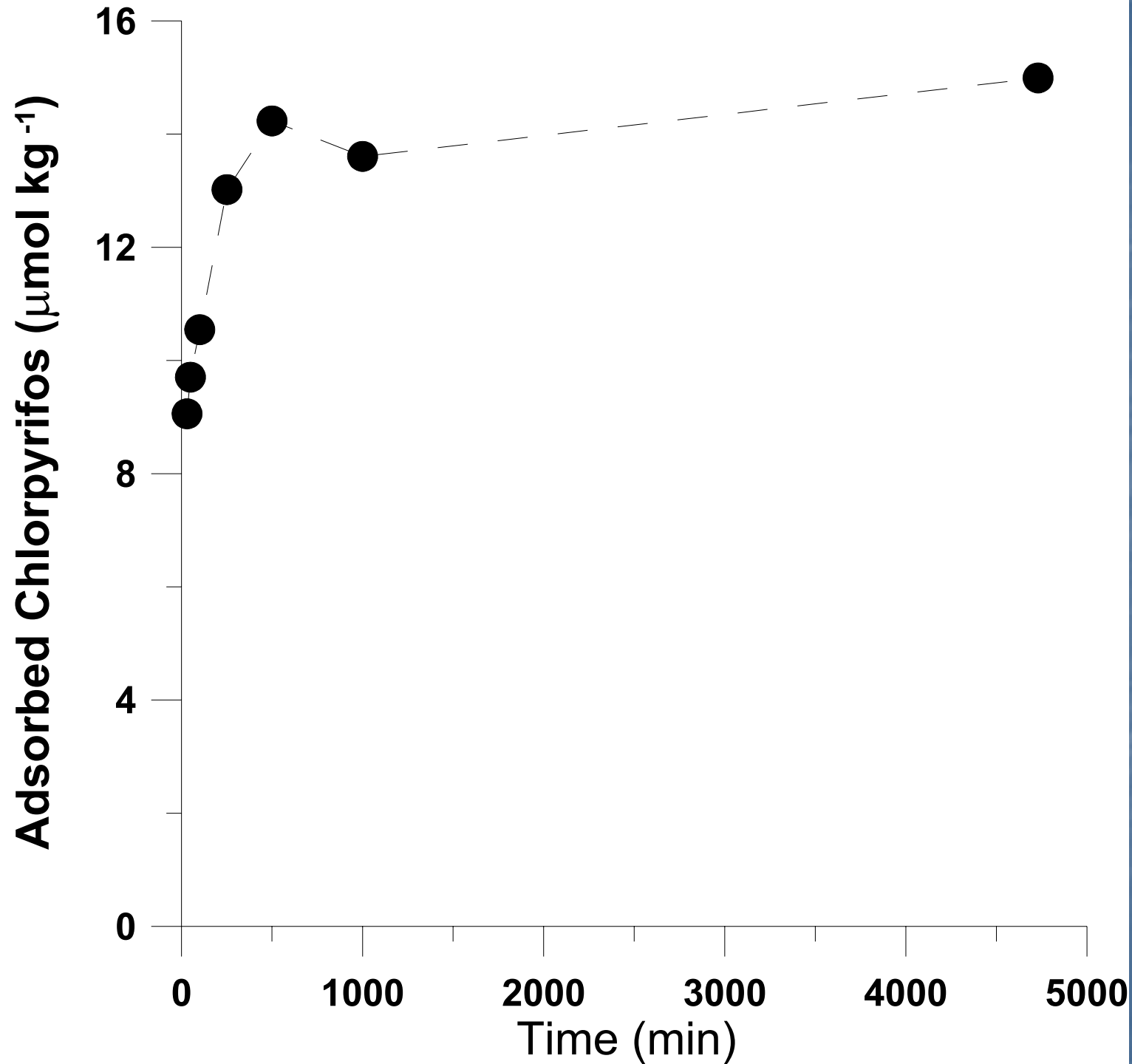
Ramona Lake

San Joaquin River

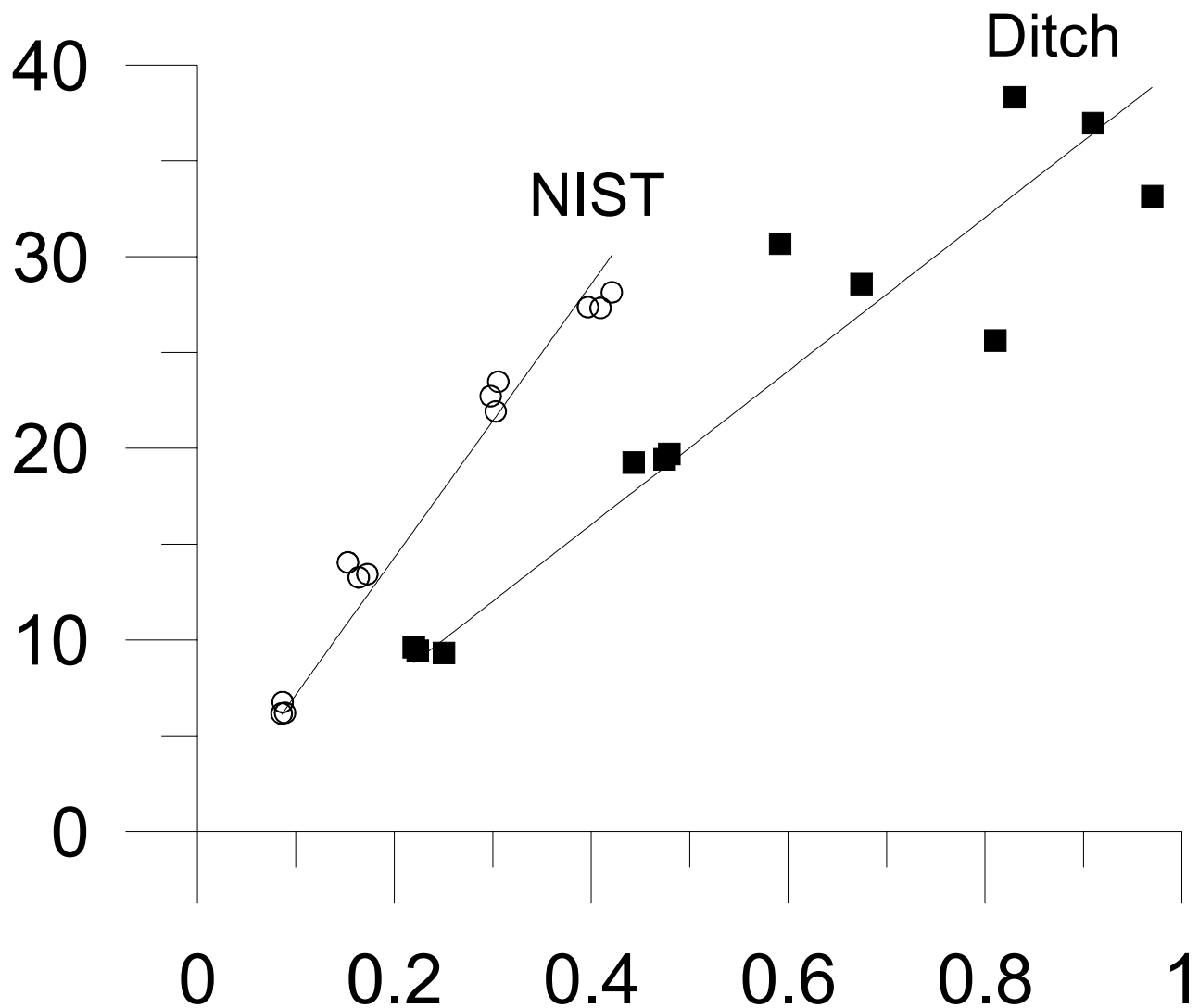
Ramona Drain



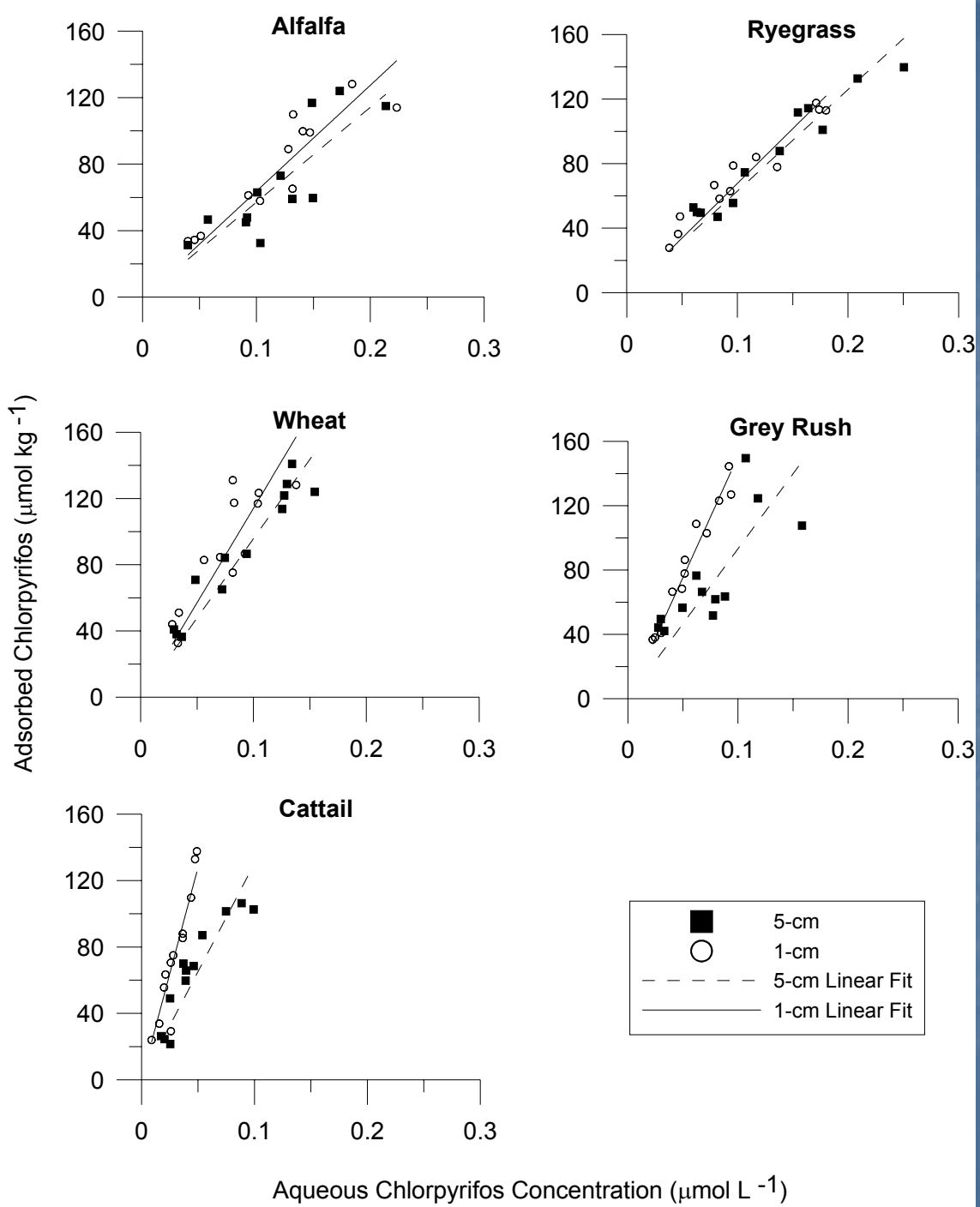
Adsorbate		Source
Cattail	<i>Typhus sp.</i>	<i>wetland</i>
California gray rush	<i>Juncus patens</i>	<i>wetland</i>
Ryegrass	<i>Lolium sp.</i>	<i>native</i>
Wheat	<i>Triticum aestivum</i>	<i>agricultural</i>
Alfalfa	<i>Medicago sativa</i>	<i>agricultural</i>
Composite Vegetated Ditch Soil		<i>agricultural</i>
NIST San Joaquin Standard Soil		<i>standard</i>



Adsorbed Chlorpyrifos ($\mu\text{mol}\cdot\text{kg}^{-1}$)



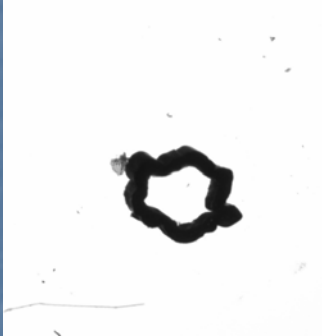
Aqueous Chlorpyrifos ($\text{mmol}\cdot\text{L}^{-1}$)



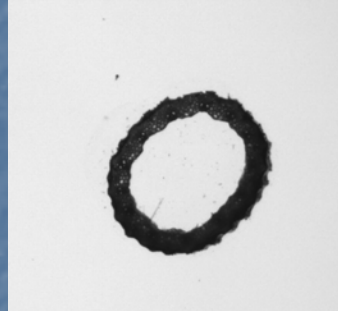
Adsorbate	Partitioning coefficients	
	K_d (L·kg ⁻¹)	K_{om} (L·kg ⁻¹)
Vegetated Ditch Soil	40.04	2819
San Joaquin Std Soil	71.44	5214

Adsorbate	Partitioning coefficients	
	5-cm K_d (L·kg ⁻¹)	1-cm K_d (L·kg ⁻¹)
Cattail	1303	2557
California gray rush	932.4	1507
Wheat	957.9	1141
Ryegrass	629.5	677.2
Alfalfa	571.1	637.1

Alfalfa



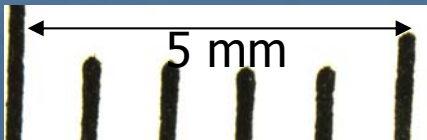
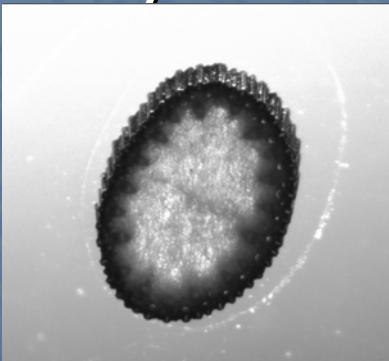
Ryegrass



Wheat

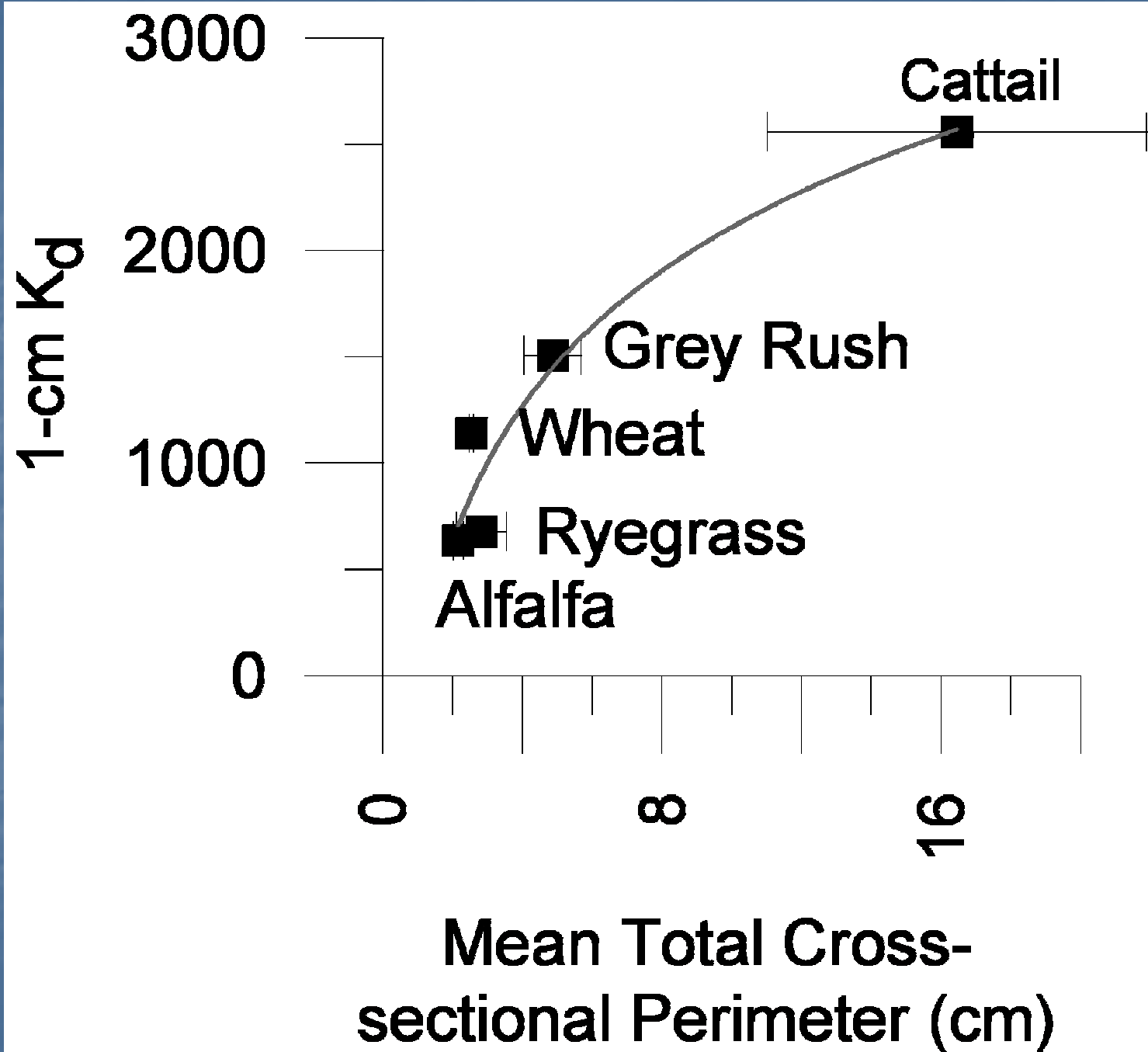


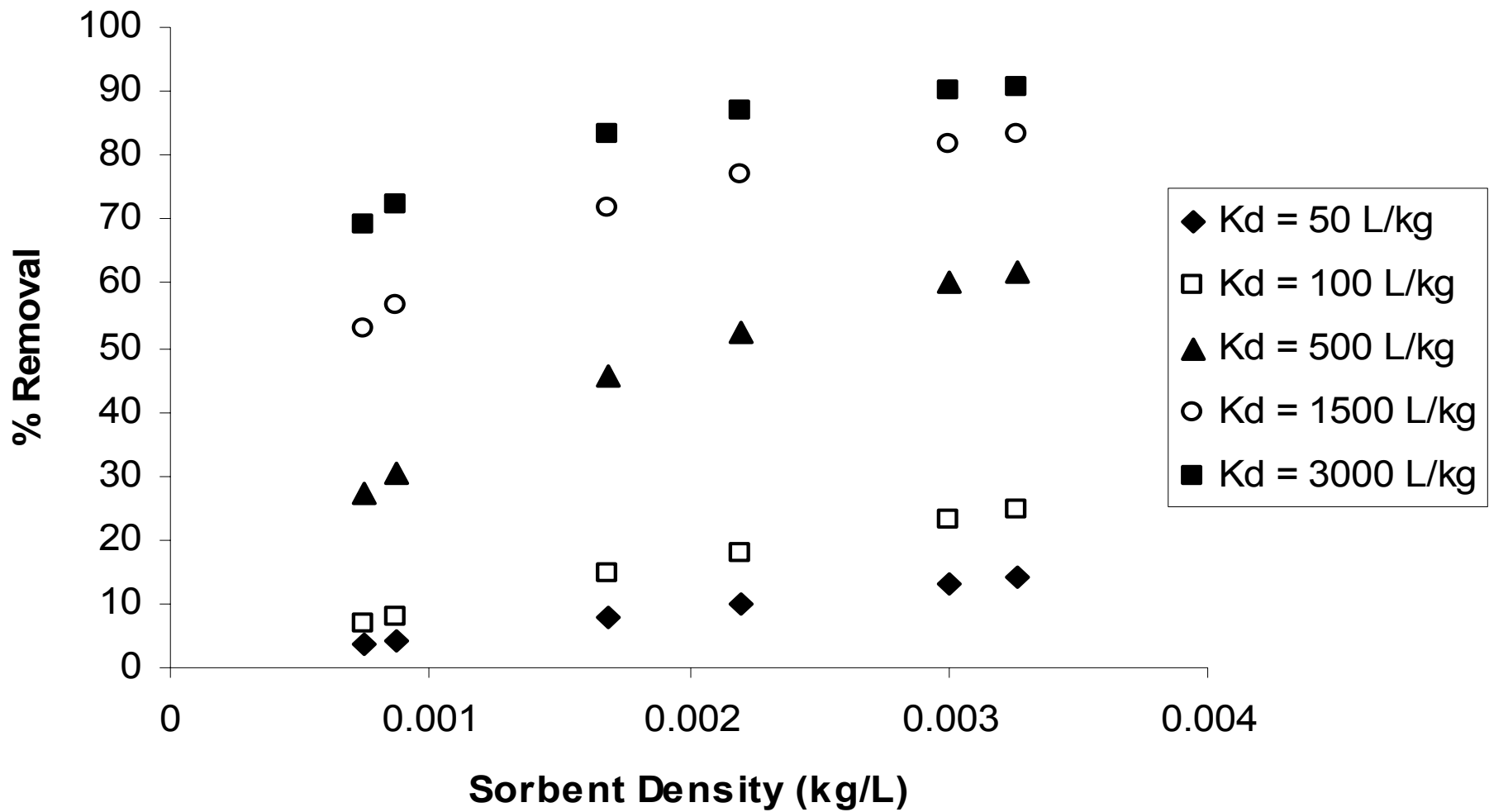
Grey Rush

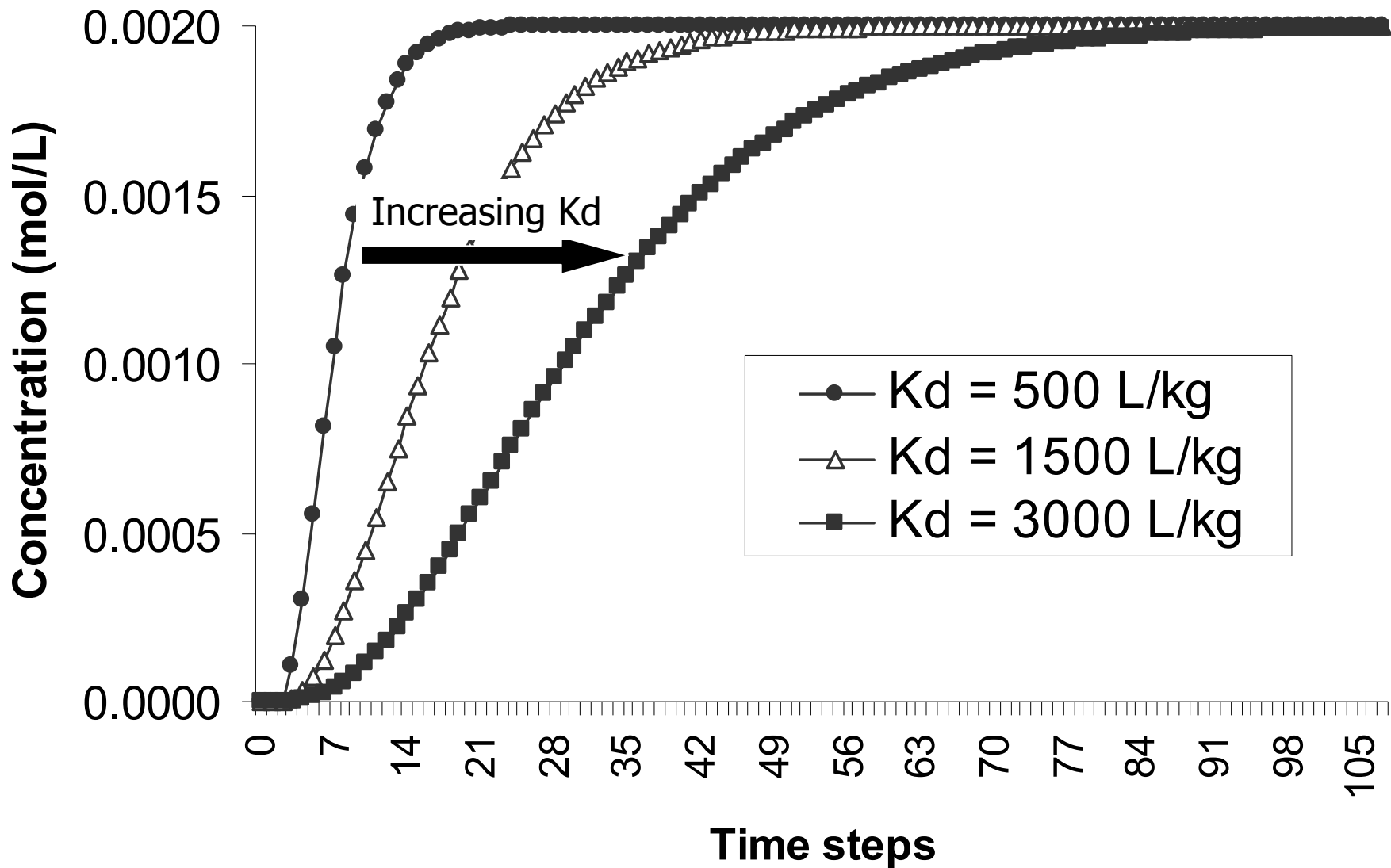


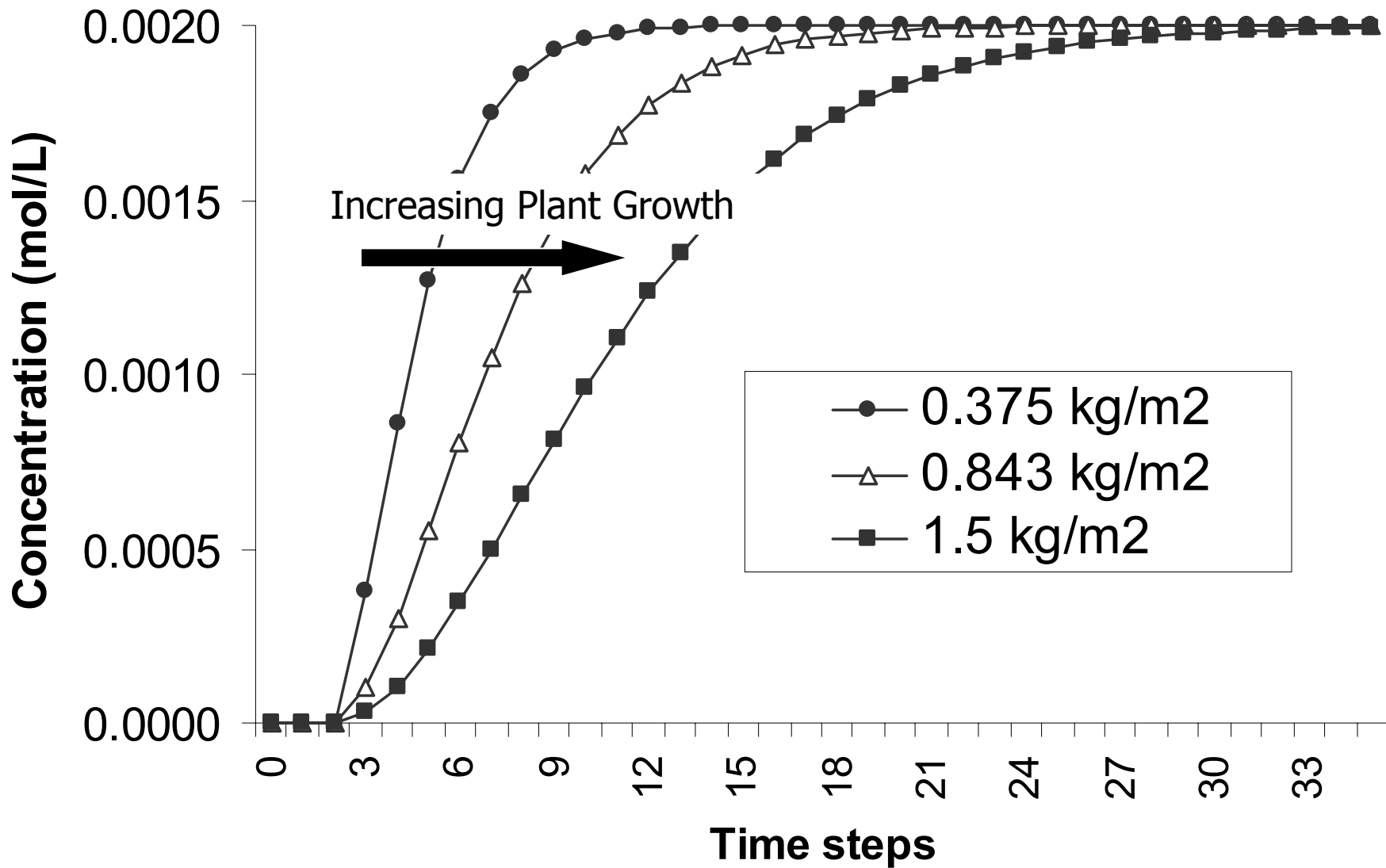
Cattail







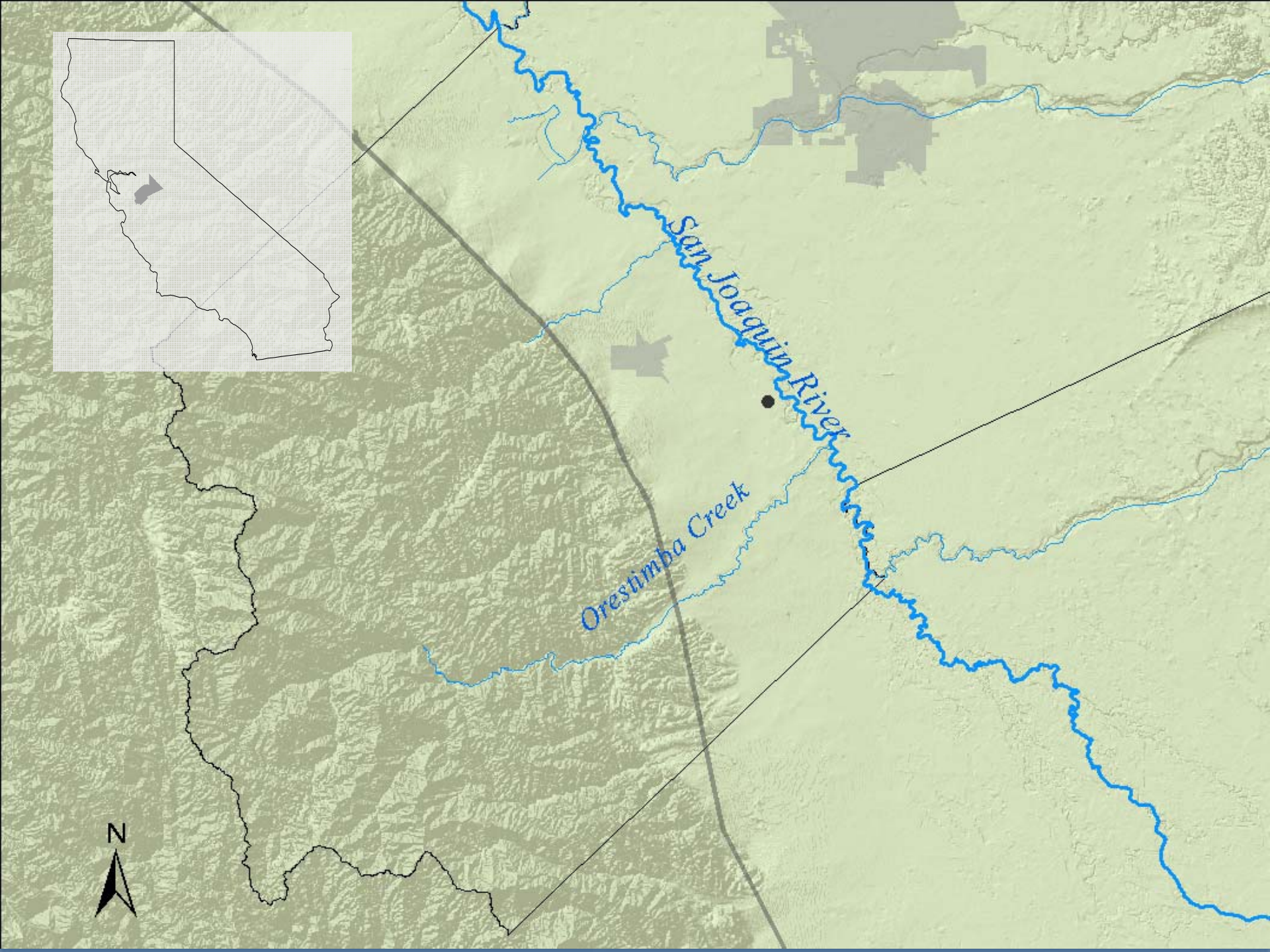




Goals

- Estimate plant growth densities
- Refine reactor models
- Quantify reactor non-idealities in the field
- Create and run watershed models





San Joaquin River

Orestimba Creek

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Orestimba Creek TSS:

15 – 580 mg/L

(mean: 150 mg/L)

On-field ditches:

300 – 9000 mg/L

Vegetated Ditch Soil

silty clay – clay loam

Bulk Density: 1.2 – 1.3 g/cm³

Plant Density (kg/ha)	Species	Wetland Depth (m)	Plant Density (g/L)	Reference
3750	Juncus, Scirpus	0.5	0.75	Deberry and Perry, 2004
4380	Lythrum	0.5	0.88	Emery and Perry, 1995
8433	Typha	0.5	1.69	Emery and Perry, 1995
11000	Typha	0.5	2.20	Horowitz, 1999
15000	Lythrum	0.5	3.00	Horowitz, 1999
16300	Typha	0.5	3.26	Koottatep and Polprasert, 1997

