2016 Experiment: Objectives

- Methodological objectives:
  1) Test plumbing and flow systems, measurement procedures, equipment, etc.
  2) Check for abiotic gradients that may require block designs
  3) Characterize diversity, succession & water chemistry of ponds and reservoir, and compare with Lake Hertel
  4) Estimate variance required for power calculations for 2017 experiment

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  4) Estimate variance required for power calculations for 2017 experiment
- Ecological questions:
  1) Impacts of multiple, locally-relevant stressors on pond communities. Test stressor doses.
  2) Rapid adaptation to multiple stressors?

2016 Experiment: Field team

Vincent Fugère (postdoc)

Marie-Pier Hébert, M.Sc. (Research Assistant)

Tara Jagadeesh (UG assistant)

Alex Arkilanian (UG assistant)

Invaluable help from Gault Nature Reserve:

David Maneli (Conservation and Academic Activities Administrator)

Marc-André Langlois (Property Manager)

Charles Normandin (Building Technologist)

2016 Experiment: Tentative design and timeline

Objective 1: impacts of multiple, locally-relevant stressors on pond communities. Test stressor doses.

3 stressors, all possible combinations (7) + control = 8 treatments. 8 doses per treatment. Regression-type design.

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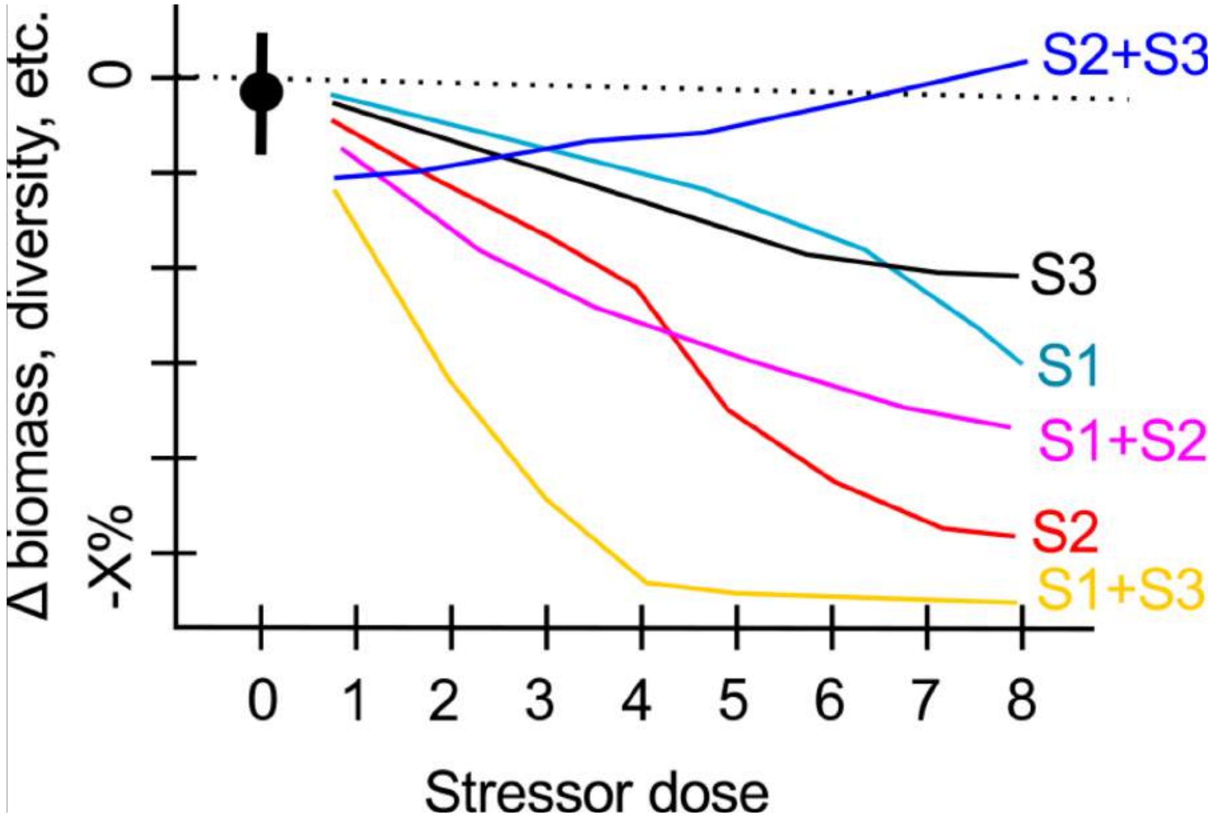

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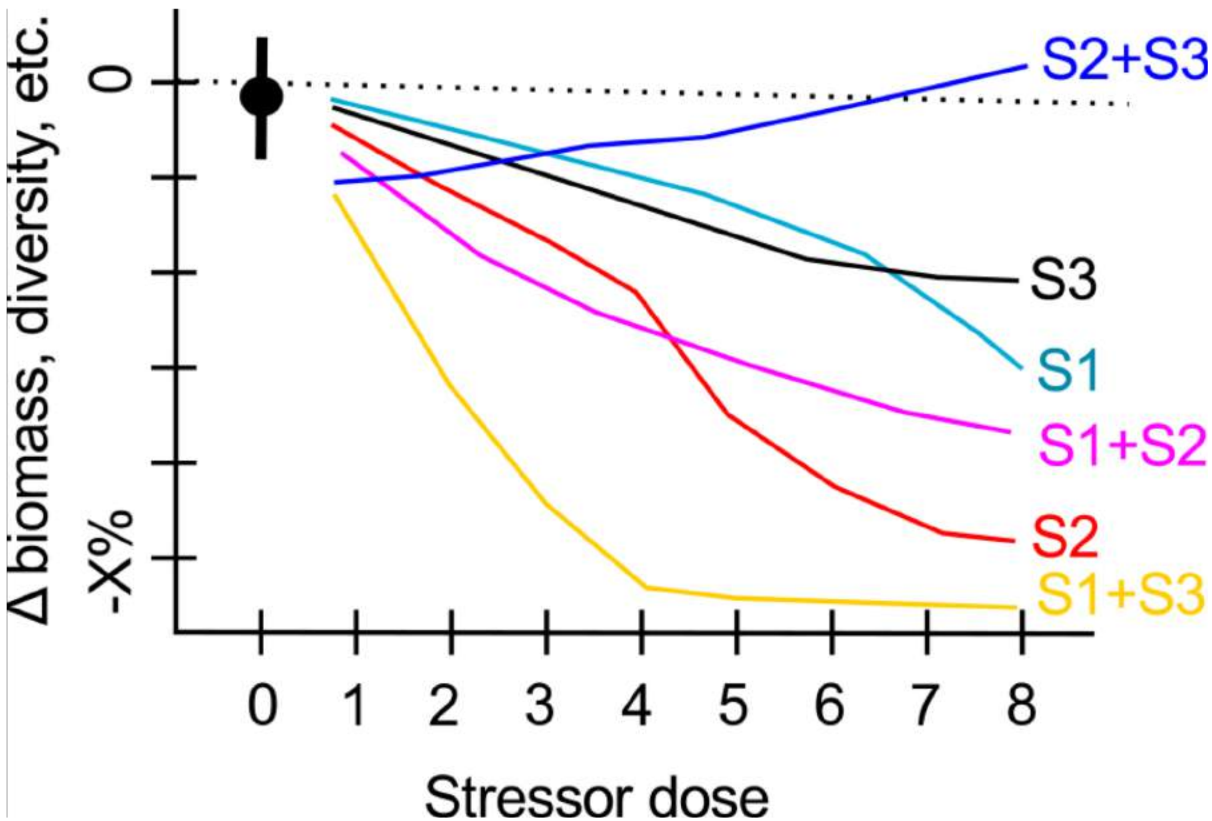
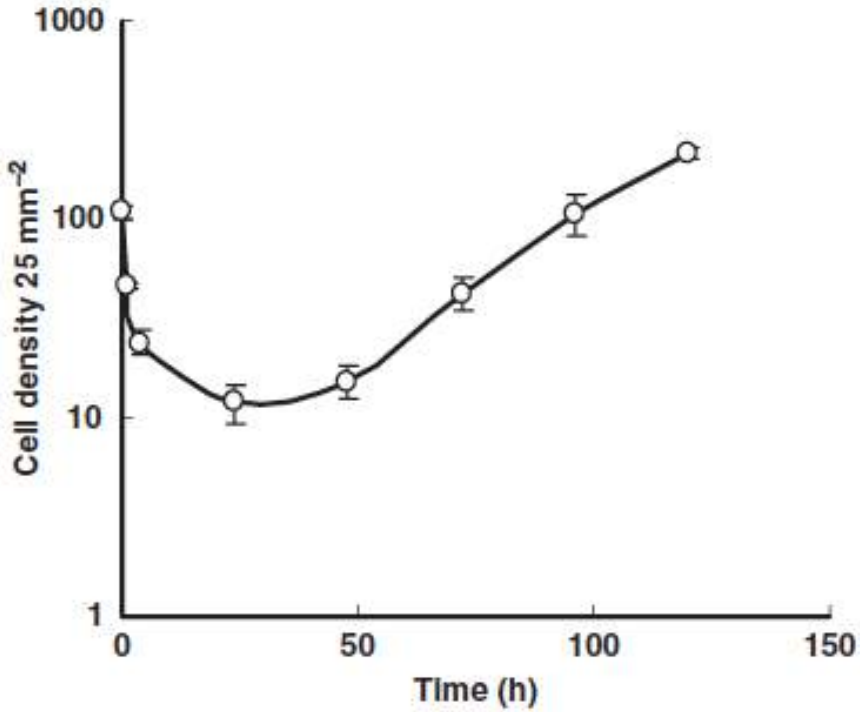


- Stressor interactions (synergies, ES, etc.)
- Many potential response variables from time series & community matrices

2016 Experiment: Tentative design and timeline

Objective 2: test for possibility of rapid adaptation to stressors

- Recovery of biomass/abundance over time in stressed ponds? Taxa replacement vs. Δ abundance of taxa present before and after disturbance.



Bell & Gonzalez 2009

2016 Experiment: Tentative design and timeline

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1 month pre-stressor	2 months exposure + potential recovery	transplant

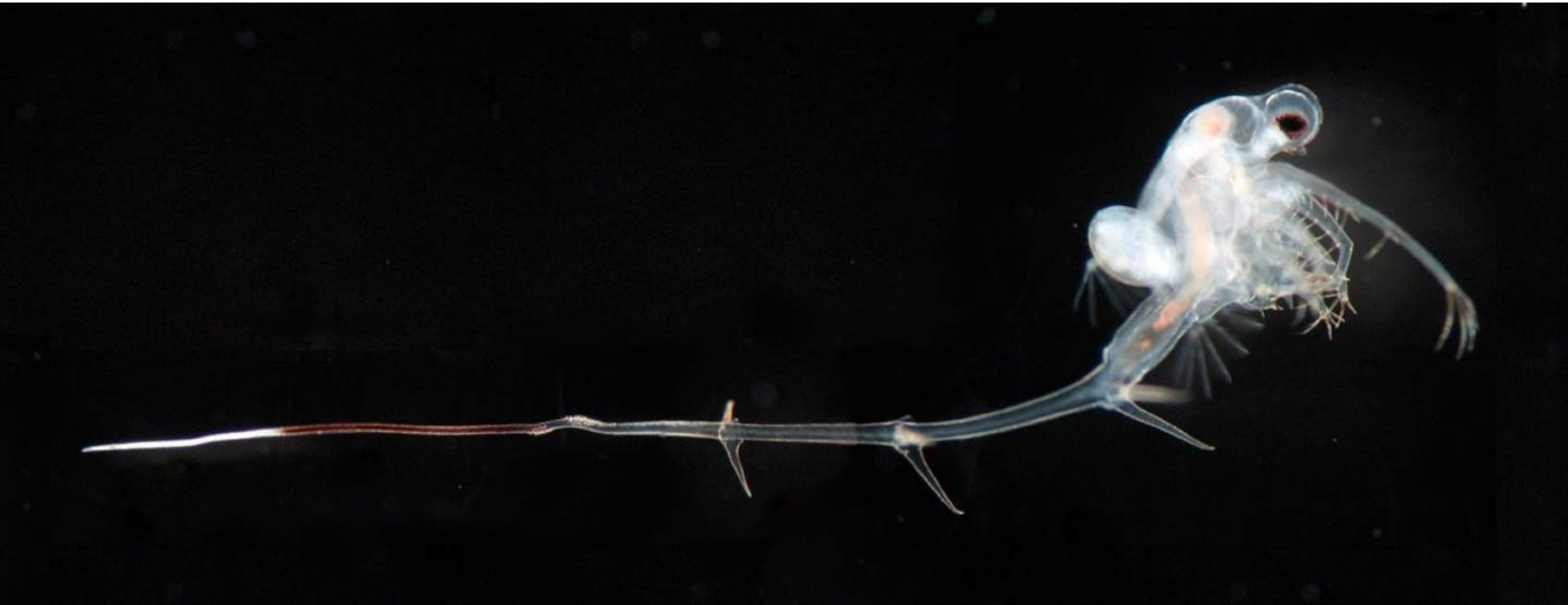
Weekly or biweekly measurement: Zooplankton community composition, ecosystem metabolism

2-3 times a week: water chem., biomass of phytoplankton (fluoroprobe) and zooplankton (oven-dried samples sorted into size classes with sieves)

Monitor population growth with same assay

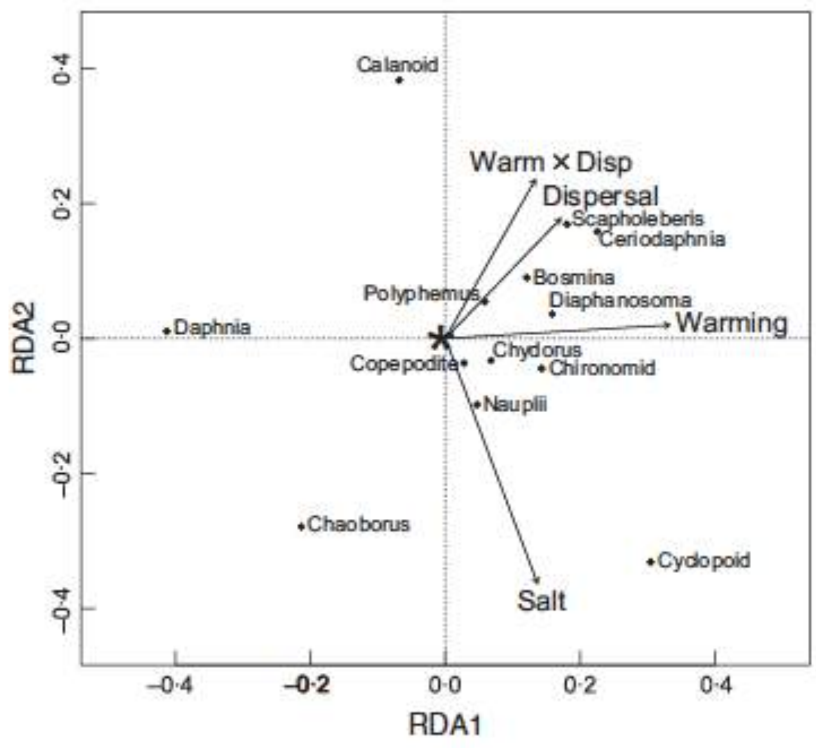
2016 Experiment: Possible stressors

Common stressors: Nutrient enrichment, warming, browning (DOC). Acidification. Increased UV. Species invasion (e.g. *Bythotrephes*).



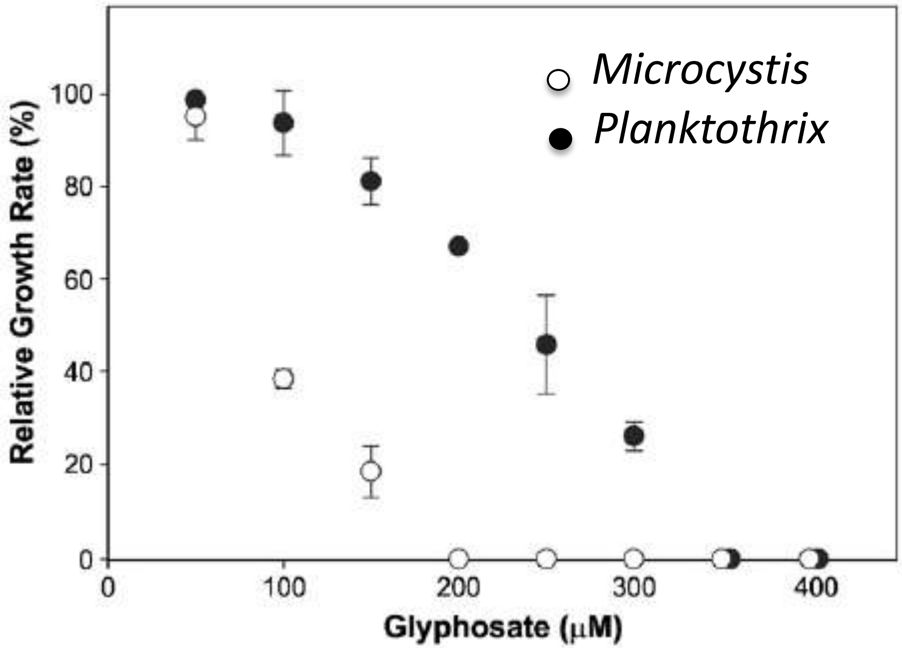
2016 Experiment: Possible stressors

1) Salt (NaCl): Increasing concentrations of chloride and sodium in many Canadian lakes due to road salt (Palmer & Yan 2013). Same stressor as in original evolutionary rescue experiments (Bell & Gonzalez 2009). Cheap, lot of background info. Moderate effects on planktonic communities in mesocosms (Thompson et al. 2012).



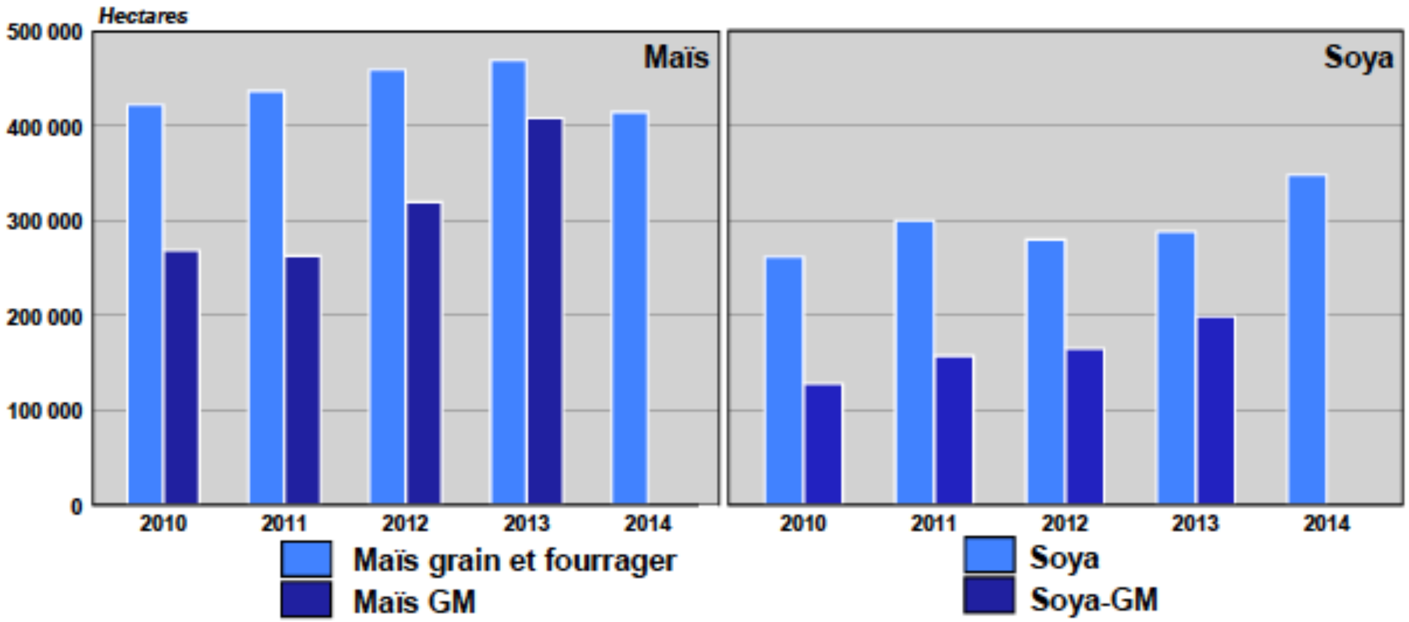
2016 Experiment: Possible stressors

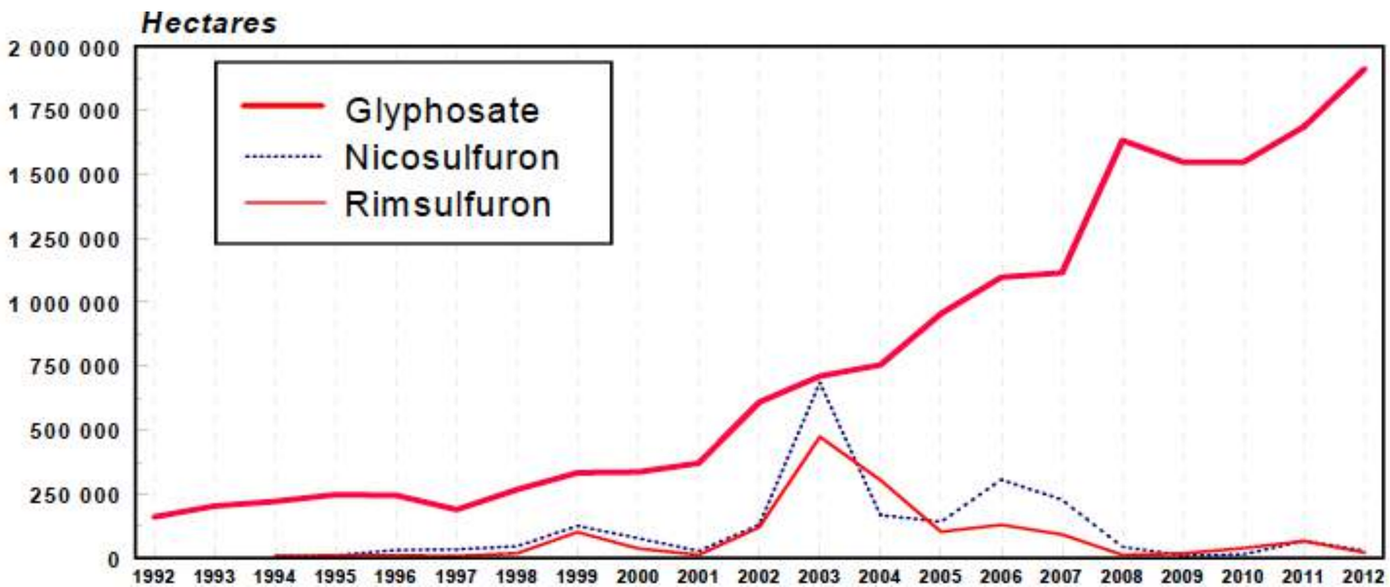
1) Salt (NaCl)
2) Herbicide glyphosate (aka "Roundup"): Most widely-used herbicide in the world. Broad-spectrum herbicide. Inhibits a plant enzyme involved in amino acid synthesis. Used in conjunction with GM, glyphosate-resistant maize and soy (Monsanto's "Roundup-ready" crops).



Saxton et al. 2011

Glyphosate (herbicide, GM soy & maize)

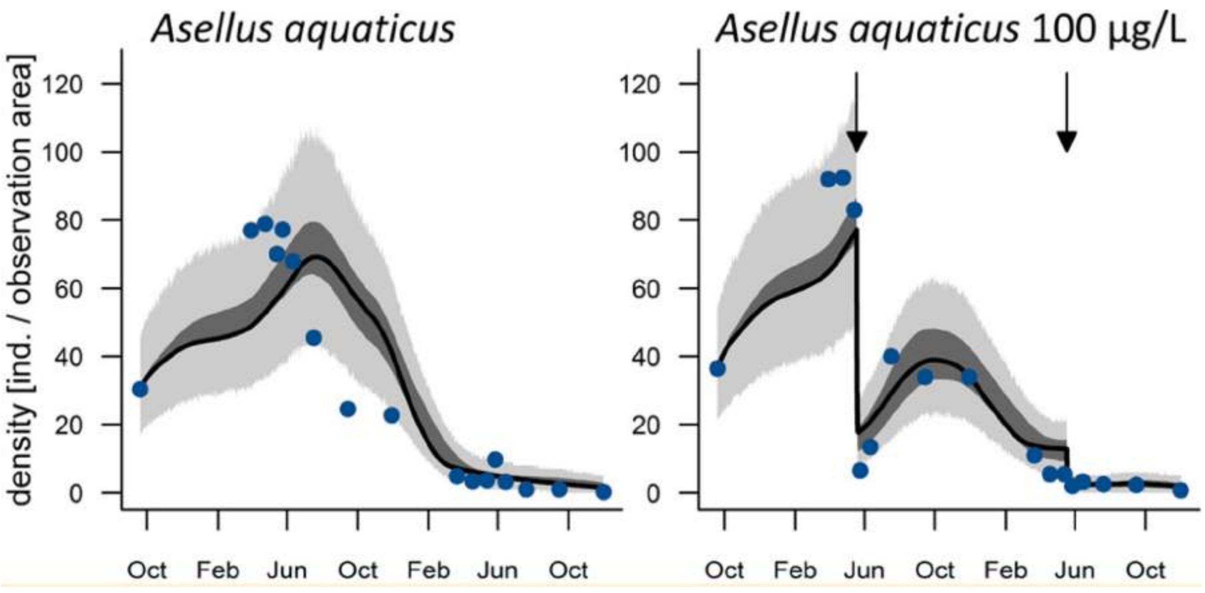




Source: MDDELCC (2014)

2016 Experiment: Possible stressors

1) Salt (NaCl)
2) Glyphosate (aka "Roundup")
3) Neonicotinoid insecticides: Neuro-active insecticides chemically similar to nicotine. Blocks nicotinic acetylcholine receptors, which are very abundant in the central nervous system of insects. Cause paralysis. Neonicotinoid Imidacloprid (Bayer) is the most widely used insecticide in the world.



Kattwinkel et al 2016

Neonicotinoid insecticides

Tableau 2 Fréquence moyenne de détection des pesticides dans les quatre rivières du réseau de base de 2011 à 2014 (%)

	2011	2012	2013	2014
Insecticides				
Clothianidine	NA	96,5	93,1	97,4
Thiaméthoxame	NA	NA	NA	98,3
Chlorantraniliprole	NA	NA	46,6	50
Diméthoate	8	6,7	6	8,6
Diazinon	2,6	-	0,9	-
Carbaryl	1,7	3,3	5,2	6,8
Chlorpyrifos	0,8	6,7	9,5	7,7
1-Naphtol	0,8	-	0,8	0,8
Carbofuran	0,8	-	-	-
Malathion	0,8	-	5	2,5
Perméthrine	-	0,8	-	-
λ-Cyhalothrine	-	-	-	1,7

« Le changement le plus notable est sans contredit la détection fréquente des insecticides de la famille des néonicotinoïdes, notamment la clothianidine et le thiaméthoxame. Ajoutée à l'omniprésence des herbicides et des multiples pesticides présents en même temps dans l'eau, la détection des insecticides néonicotinoïdes n'est pas sans conséquence sur les espèces aquatiques. »

Source:
MDDELCC (2014)

Pesticides?

Pros/cons of using pesticides:

Advantages

- Unambiguous stressors (unlike nutrients, DOC)
- Highly relevant
- Selective food web knock-outs?

Disadvantages

- Hard/costly to measure
- Health/environmental hazard
- Little background info