The Influence of Beached Harmful Algal Blooms on Terrestrial Arthropods on the Shore of Lake Erie

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Introduction

Scientists worldwide demonstrated links between aquatic and terrestrial systems, such as primary material inputs from oceans that supported food chains on islands (Polis & Hurd 1996). Similar subsidizing trends occur in systems adjacent to fresh water (Bartels, *et al.* 2013), however many freshwater systems increasingly experience toxic cyanobacterial blooms (Sukenik, *et al.* 2015).

Research Question

Do the nutritional benefits of aquatic inputs outweigh the toxic risks associated with harmful algal blooms?

Methodology

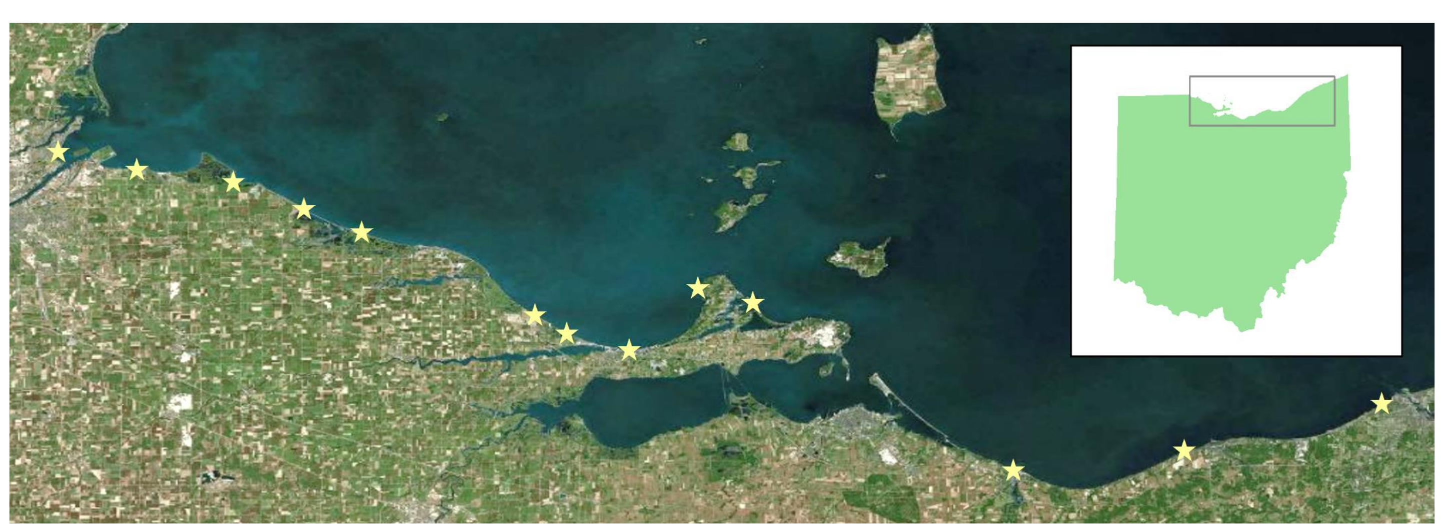

Fig 1. The 13 sampling locations along Lake Erie's southern shore spanned 140 km from Toledo to Lorain in Ohio, USA. We took observations, samples, and covariate data (beached material, 100x100m land cover, water microcystin concentration, and water chlorophyll a content) during three surveys: late July (baseline), early September (peak harmful algal bloom (NOAA 10 Nov. 2015)), and late September.

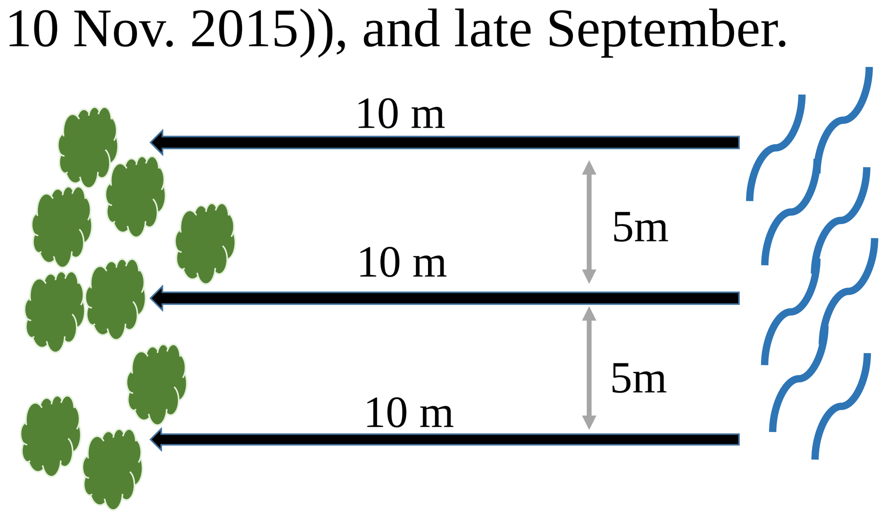

Fig 2. At each site, we identified living arthropods encountered on one walk of three 10 m transects spaced 5m apart.

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Results

Response Variable	Survey	Test	Distribution	Environmental Factor	X2	F	Degrees of Freedom	P	Direction of Relationship
Arthropod Richness	3	Chisq	Quasipoisson	PC1	1.73		1,11	0.16	-
	3	Chisq	Quasipoisson	**Water Microcystin**	3.07		1,10	**0.06**	+
	3	Chisq	Quasipoisson	Chlorophyll A	1.15		1,9	0.26	-
	3	Chisq	Quasipoisson	Microcystin*Chlorophyll A	0.25		1,8	0.60	
Shannon's Diversity	2	F	Normal	PC2A1		0.42	1,11	0.54	-
	2	F	Normal	Water Microcystin		0.75	1,10	0.41	+
	2	F	Normal	**Beached Material**		4.53	1,9	**0.07**	+
	2	F	Normal	Microcystin*Beached Material		0.04	1,8	0.84	
Community Structure	3	Adonis		PC2			1	0.16	
	3	Adonis		**Water Microcystin**			1	**0.06**	
	3	Adonis		Chlorophyll A			1	0.58	
	3	Adonis		Microcystin*Chlorophyll A			1	0.78	

Table 1. This table shows the factors of the significant models (α=0.1). There were no significant factors associated with total arthropod abundance in survey 2 nor 3.

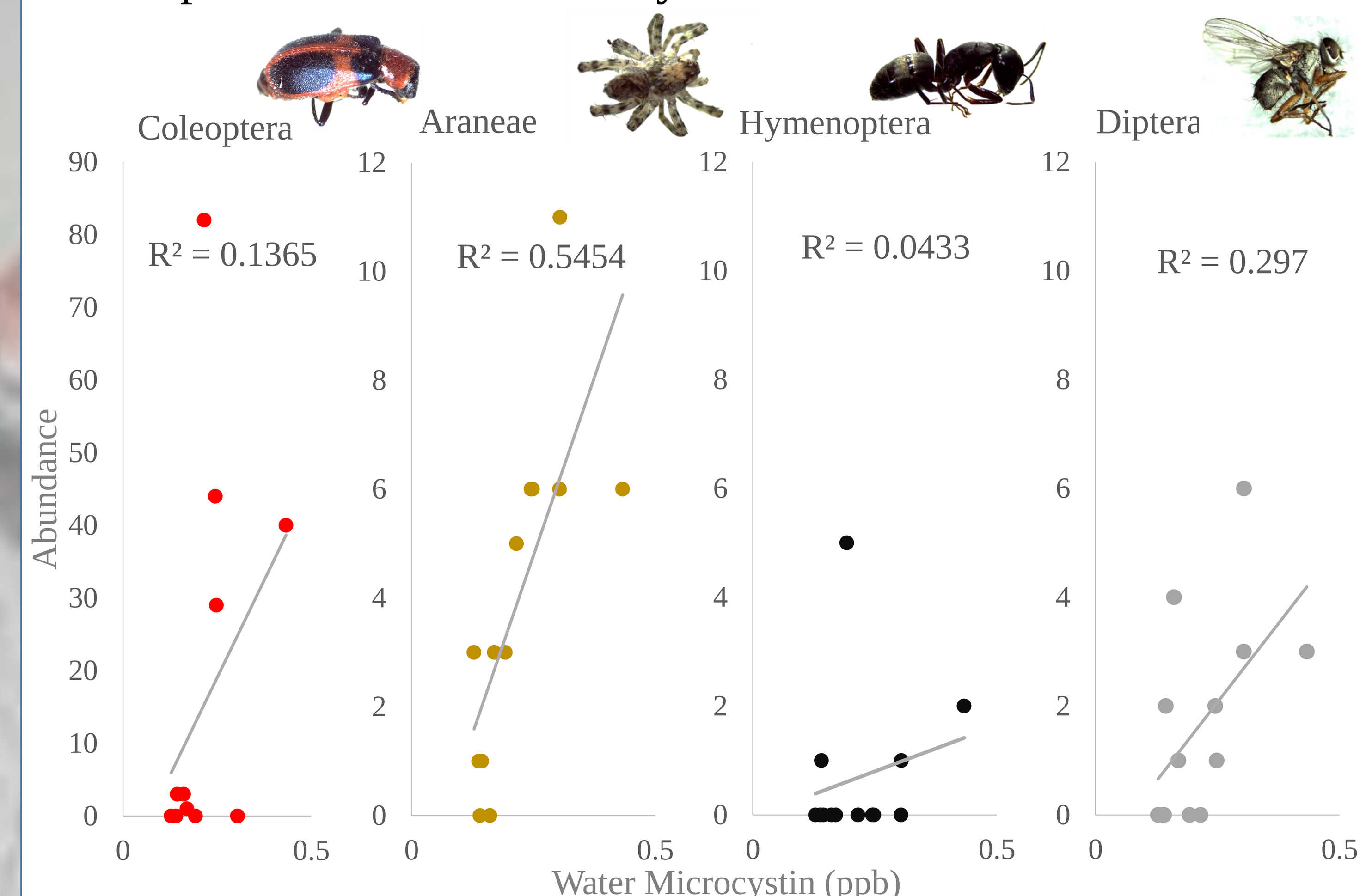

Fig 3. These figures show the arthropod abundance in orders that contributed most to the variation associated with the significant community structure results in relationship to the water microcystin (ppb) levels during survey 3. All of these orders display positive relationships with microcystin, but Araneae and Diptera have the strongest positive relationship.

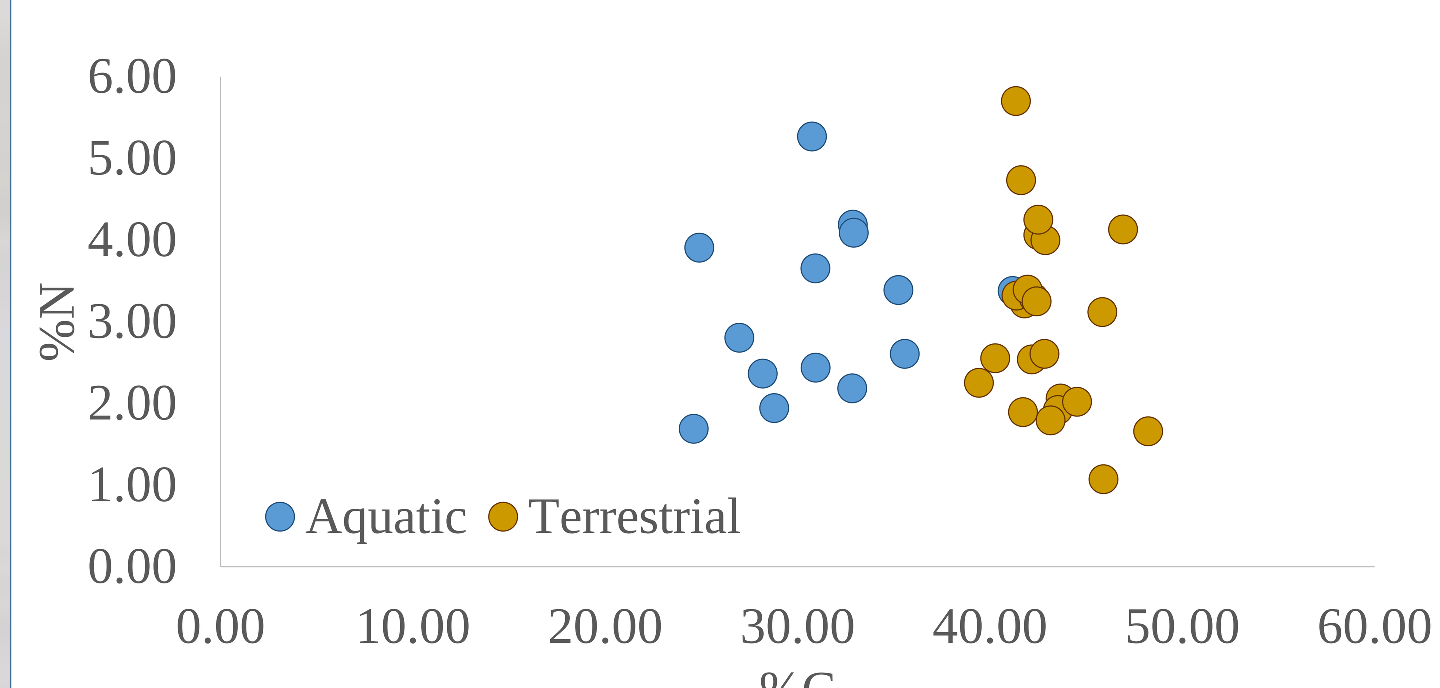

Fig 4. This figure shows percent carbon vs nitrogen of terrestrial primary material (leaves, grasses) and aquatic primary inputs (algae, seawrack, cyanobacteria). Terrestrial material had more carbon than aquatic material. Arthropods could fill their nitrogen needs without eating as much carbon if they eat more aquatic material than terrestrial material.

Discussion

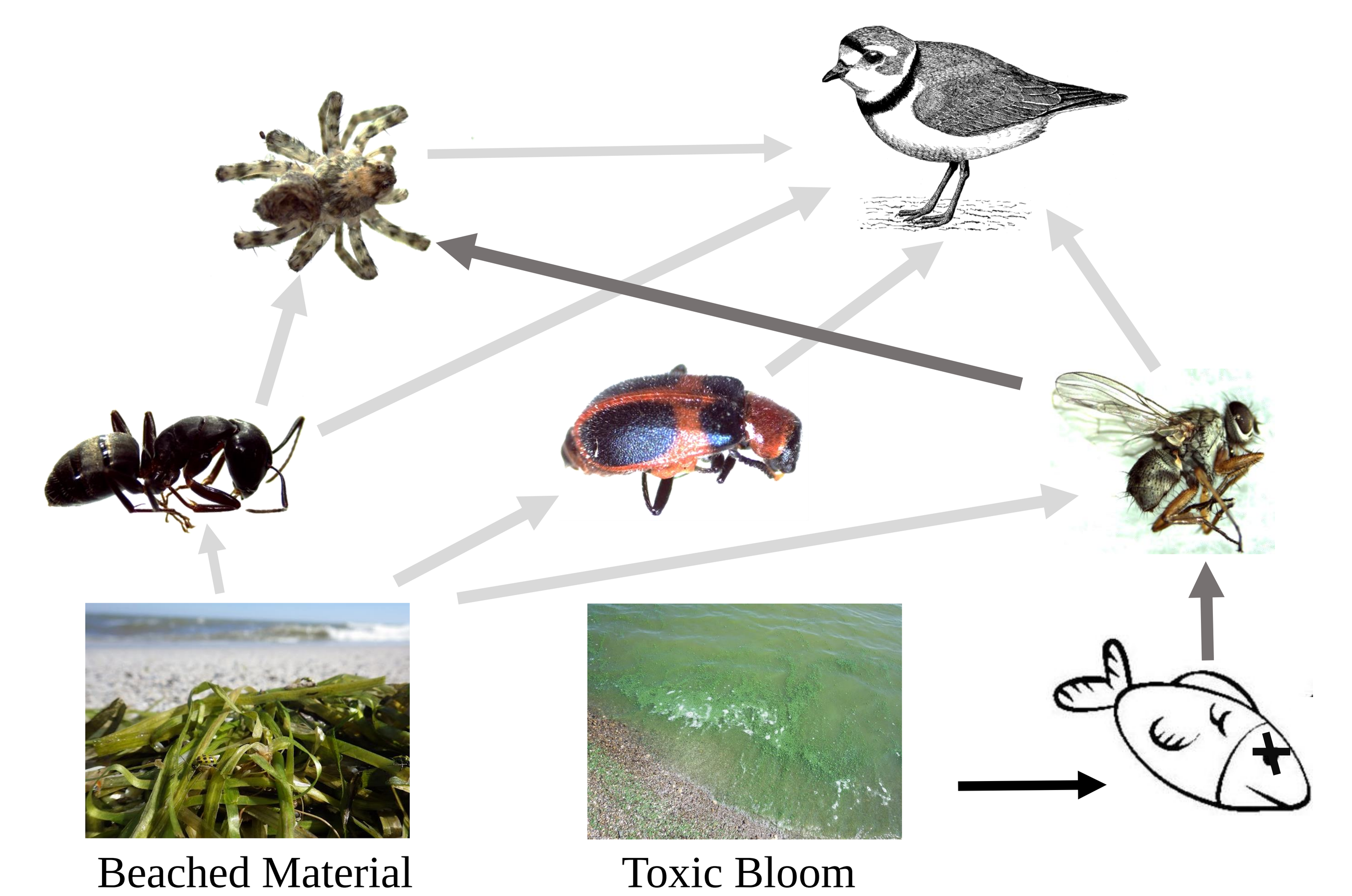

Fig 5. Represented by this food web, we propose that the toxic blooms are indirectly adding food to the otherwise unproductive beaches by killing aquatic life that support the scavengers living near the shore, which supports predators (represented in darker arrows). Light gray arrows indicate probable but weaker interactions such as arthropods utilizing beached material.

Conclusions

Toxicity does not appear to deter arthropods from the shore, but aquatic inputs may have diversifying effects.

Acknowledgements

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Northwest Ohio Chapter

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