Mechanisms and reversibility of effects of invasive cattail on native wetlands

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Introduction

• Most invasive plants negatively affect the native communities they invade.

• However, invasives can affect natives via different mechanisms and distinguishing among them is essential for understanding the dynamics of invasions and for directing management strategies.

• Two common mechanisms of invasive plant effect:
Direct competition
Alteration of the environment

• If invasives alter the environment, not only do restoration efforts need to remove the invader, but also these underlying environmental changes may need to be addressed before the system is again suitable for natives.

Questions:
1. By what mechanisms does invasive cattail (*Typha x glauca*) affect the ecosystem and plant communtiy?
2. Are these effects reversible?

Study System

Invasive hybrid cattail (*Typha x glauca*) in a Great Lakes coastal wetland

• *T. x glauca* produces monodominant stands with considerable litter accumulation

Hypothesis: *T. x glauca* litter alters the environment, and this alteration negatively affects native plants.

Methods

Addition experiment: Live *T. x glauca* and its litter were added in factorial design to an uninvaded part of the marsh.
Removal experiment: Live *T. x glauca* and its litter were removed in factorial design in the invaded part of the marsh.

Environmental properties and plant community measured over four years

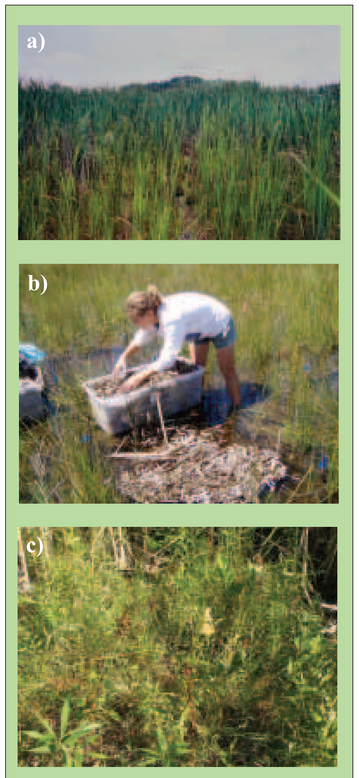

Fig. 1. a) Facing the area of *T. x glauca* monoculture in a coastal marsh on Lake Huron, MI. b) Adding litter in the addition experiment. c) Regrowth of natives after 3 years in the removal experiment.

Results

Addition Experiment:
Does live *T. x glauca* or its litter affect the environment and plant communtiy?

• Both live *T. x glauca* and its **litter** increased soil inorganic nitrogen pools
• Neither affected N mineralization in the long term
• Only **litter** decreased light

• Only **litter** reduced native plant diversity and abundance
• Marsh dominants (sedges and rushes) were negatively affected by litter addition, whereas grasses and forbs benefited from litter

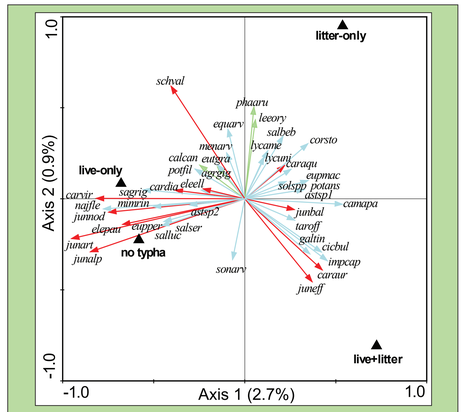

Fig. 3. RDA showing the effect of addition of live *T. x glauca* and its litter on species relative abundance. Native marsh dominans (sedges and rushes) are colored in red, grasses in green, and forbs in blue.

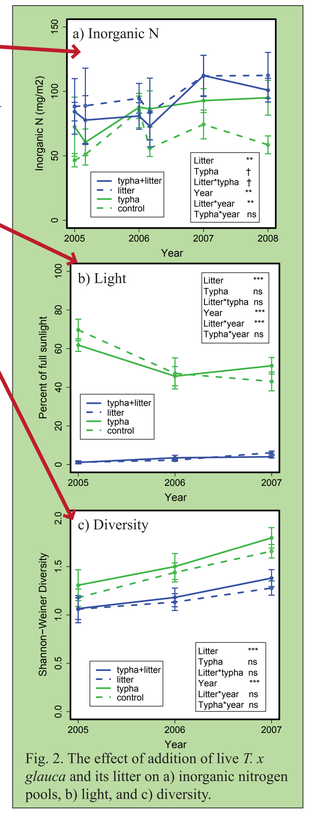

Fig. 2. The effect of addition of live *T. x glauca* and its litter on a) inorganic nitrogen pools, b) light, and c) diversity.

T. x glauca vs. native species responses to litter

• Most native marsh species were negatively affected by *T. x glauca* litter
• However, *T. x glauca* itself was not affected

→ This suggests that *T. x glauca* may produce a positive feedback: it creates an environment in which it performs well and native species decline

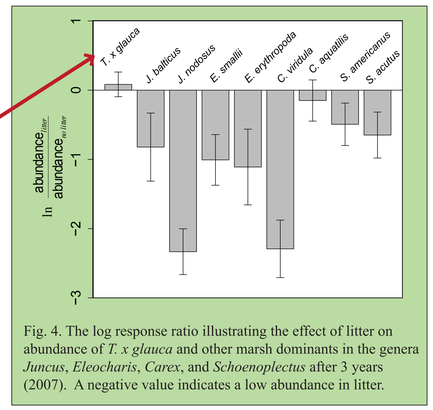

Fig. 4. The log response ratio illustrating the effect of litter on abundance of *T. x glauca* and other marsh dominants in the genera *Juncus*, *Eleocharis*, *Carex*, and *Schoenoplectus* after 3 years (2007). A negative value indicates a low abundance in litter.

Removal Experiment:
Does removal of live *T. x glauca* or its litter restore the environment and plant community?

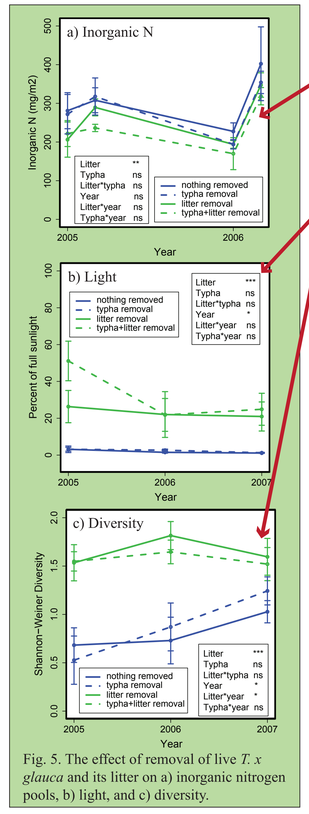

Fig. 5. The effect of removal of live *T. x glauca* and its litter on a) inorganic nitrogen pools, b) light, and c) diversity.

• **Removal of *T. x glauca* litter** caused a small decrease in soil inorganic nitrogen pools
• Neither affected N mineralization
• **Removal of litter** increased light

• **Removal of litter** increased native plant diversity and abundance
• However, it did not restore native marsh species, but rather recruited more terrestrial sedge meadow grasses and forbs

Table 1. A comparison of the 10 most abundant species in the native marsh and the 10 most abundant species in areas where live *T. x glauca* and its litter were removed after 3 years (2007). Native marsh species are in red, grasses in green, and forbs in blue.

		Native marsh plots	Litter and live *Typha* removal plots
Most abundant species	1	Juncus balticus	Calamagrostis canadensis
	2	Juncus nodosus	Carex bebbii
	3	Eleocharis smallii	Lycopus uniflorus
	4	Eleocharis erythropoda	Nasturtium officinale
	5	Eleocharis pauciflora	Solidago spp.
	6	Agrostis gigantea	Campanula aparinoides
	7	Juncus alpinus	Carex hystericina
	8	Carex viridula	Phalaris arundinacea
	9	Carex aquatilis	Impatiens capensis
	10	Shoenoplectus americanus	Lysimachia terrestris

Conclusions

• ***T. x glauca* affects native species through alteration of the environment (litter production), not direct competition.**
→ This is probably due to light reduction by the litter.

• **Most effects on the environment are also brought about by *T. x glauca*'s litter.**

• **Removal of live *T. x glauca* and its litter did not restore the native marsh communtiy, but rather recruited more terrestrial sedge meadow grasses and forbs.**
→ This is probably because the underlying environment was still altered, such as elevated nutrients and soil organic matter.

→ **When restoring marshes invaded by cattail, removal of litter and soil may be necessary to promote recruitment by sedges and rushes.**

Acknowledgements

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