Litter Decomposition in Created and Adjacent Forested Wetlands of the Coastal Plain of Virginia

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Decomposition in Wetlands

- Brinson (1977) found differences in decomposition in river / swamp / levee moisture gradient in NC
- Day (1982) found no difference in decomposition along moisture gradient in Great Dismal Swamp (cypress vs. mixed hardwood)
- Day (1982) found litter quality and type more significant than moisture gradient
- Atkinson and Cairns (2001) found slightly faster decomposition rates in 20-year old vs. 2-year old created wetlands

Objectives

- Primary objective: compare litter mass loss, changes in litter morphology, and associated macroinvertebrate communities at constructed / natural wetland pairs
- Secondary objectives:
  - compare above criteria along a moisture gradient in the created wetlands
  - assess the utility of examining invertebrate populations and litter morphology in conjunction with a traditional litterbag study of weight loss

Methods

- Litterbags - approx. 1100 nylon fabric bags
- Placed in wetlands December 1998, collected monthly through January 2000
- Mixed deciduous leaf litter or emergent marsh litter
- Fine and Coarse mesh to assess effects of macroinvertebrates (possible bag effect?)

Litterbag Processing

- After collection, litterbags were rinsed with distilled water, macroinvertebrates were collected, then dried at 60°C
- Dry weight was recorded
- Digital images of litter were taken
- After grinding samples, sub-samples were analyzed for C and N, and ashed

Physical Decomposition

- Digital image of forest litter spread on a known area
- Compared area loss, area:perimeter and weight:area ratios over time

37B CC 7/99 Reference Area

Macroinvertebrates

- Identified to order or family
- Compared overall and commonly collected invertebrate abundance and diversity
- Pooled and compared taxa which are typically detritivores

Tipulidae larvae (Crane Fly)

Macroinvertebrates

phylum	class	order	family	common name	nutrition (typically)
Annelida	Hirudinea			leeches	predator/parasite
	Oligochaeta			segmented worms	detritivores
Arthropoda	Arachnida	Araneae/Acarina		spiders/mites	predators
	Chilopoda			centipedes	predators
	Diplopoda			millipedes	detritivores
	Insecta	Coleoptera	Dytiscidae	predacious diving beetle	predators
			Hydrophilidae	water scavenger beetle	predator/scavenger
			other	beetles	predator/scavenger/herbivore/ few detritivores
		Collembola		springtails	detritivore/herbivore
		Diptera	Chironomidae	midges	detritivore (shredders, gatherers or filterers)
			Tipulidae	crane flies	detritivore (many shredders)
			other	flies	varies
		Hemiptera		true bugs	predator or herbivore-piercers
		Hymenoptera	Formicidae	ants	predator/scavenger
		Lepidoptera		butterflies and moths	herbivore (larvae)
		Trichoptera		caddisflies	predators/herbivores/detritivores (collector gatherers or filterers)
		other		insects	varies
	Malacostraca	Amphipoda		scuds	usually detritivores (some grazers, predators, scavengers)
		Decapoda	Cambaridae	crayfish	omnivores/scavengers
		Isopoda		sow bugs/woodlice	usually detritivores (some grazers, predators, scavengers)
Mollusca	Bivalvia			clams and mussels	detritivore/planktonivore (filter feeders)
	Gastropoda	Stylommatophora		slugs	herbivore - grazers
		other		snails	herbivore - grazers
Nematoda				nematodes	micro-predators/parasites

Ft. Lee Wetland

Charles City Wetland

Moisture Gradient

- **Ft. Lee**
  - upland (sat. soil in winter)
  - reference (0-5 cm standing H_2O in winter)
  - wet (0-5 cm standing H_2O in winter)
  - pond (permanently submerged, 10-30 cm H_2O)
- **Charles City**
  - reference (0-5 cm standing H_2O in winter)
  - wet (0-5 cm standing H_2O in winter)
  - pond (5-10 cm standing H_2O in winter, dry by mid-summer)

Upland (Ft. Lee)

- Drier saddle of land with no ponded water throughout year
- Supports white pine (*pinus strobus*), tall fescue (*Fescue arundinacea)*, sericea lespedeza (lespedeza cuneata) and other grasses
- Photos from 2/00
- Marsh litter collected on odd months

Reference (FL & CC)

- Fort Lee 2/00
- Riparian, mixed hardwoods

- Charles City 2/00
- Wet flat, mixed hardwoods

Wet (FL & CC)

- Fort Lee 2/00
- cattails, rushes, wool grass, willows

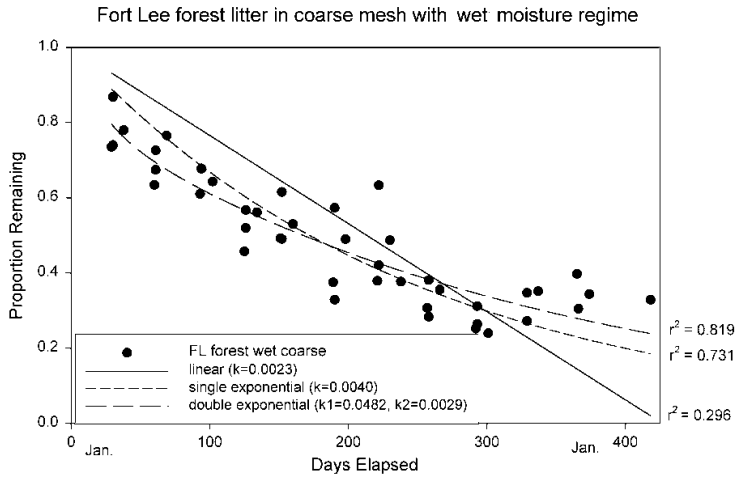
- Charles City 2/00
- grasses, sedges, reeds

Pond (FL & CC)

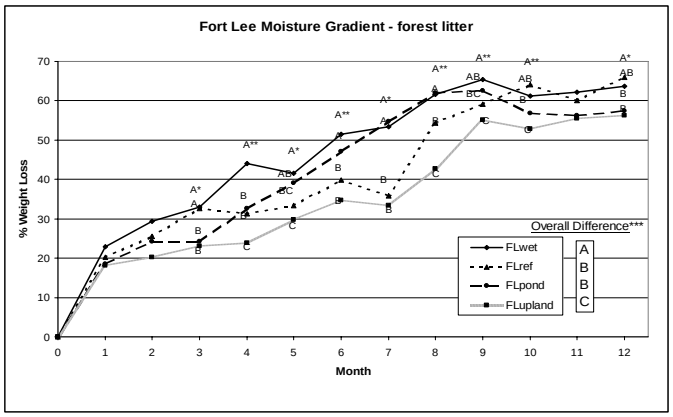
- Fort Lee 2/00
- permanent 10-30 cm water
- marsh litterbags collected on odd months

- Charles City 2/00
- temporary, ponded 10-15 cm in winter, dry by mid summer
- no marsh litterbags

Weight Loss Model - FL (forest litter, coarse mesh)

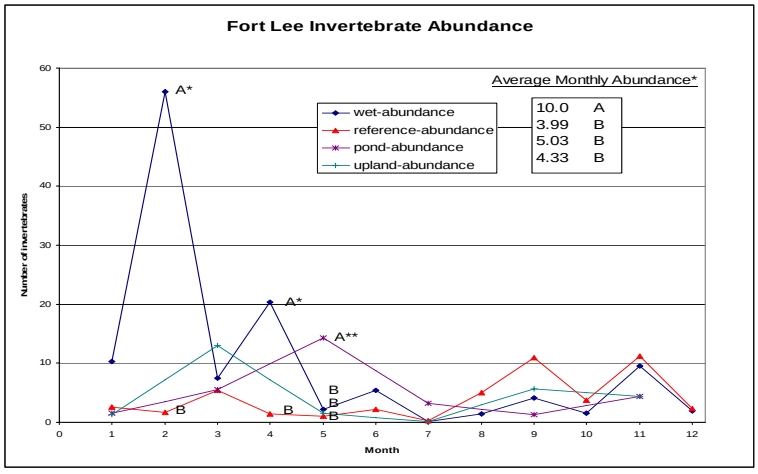


Weight Loss - FL forest litter



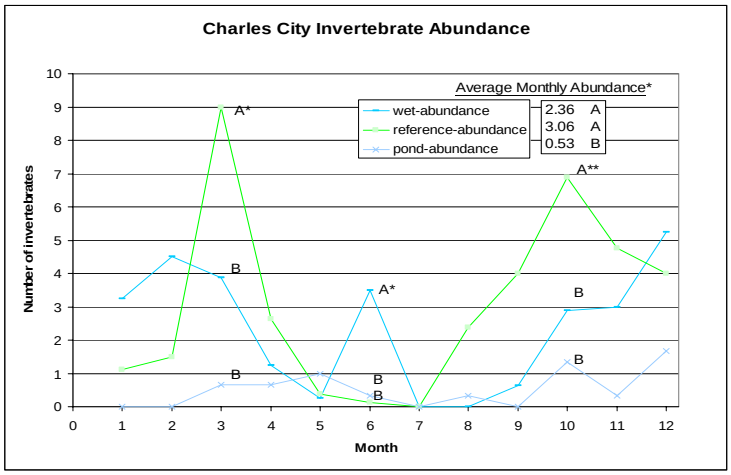
* Average values at a given date with the same letter are not significantly different (p=0.05).
** Average values at a given date with the same letter are not significantly different (p=0.10).
*** Overall moisture gradient treatment differences, regimes with the same letter are not significantly different (p=0.05).

FL Invertebrate Abundance



* Monthly and overall moisture gradient differences for 12 month period, regimes with the same letter are not significantly different (p=0.05), ** (p=0.10).

CC Invertebrate Abundance



* Monthly and overall moisture regime treatment differences, regimes with the same letter are not significantly different (p=0.05), ** (p=0.10).

Conclusions

- Litter in the created wetland lost litter area and weight more rapidly than in the adjacent forested wetland
- In the created wetlands, intermediate (wet) moisture regimes exhibited the fastest decomposition
- marsh litter decomposed more slowly than forest litter

Conclusions

- Rapid litter decomposition in FL created wetland appears to be associated with detritivore abundance
- CC detritivore abundance:
  natural wetland > created wetland
  - Another factor (temp., soil action, etc)
- Combined technique gave better insight into the process of litter decomposition and the role of macroinvertebrates

What Does it Mean?

- Faster rates of decomposition in created wetlands relative to “reference” wetlands
- 1) SOM may not accumulate long-term (supported by Cummings, 1999)
- 2) It is a positive result, the wetland function of decomposition recovers quickly?
- 3) It is difficult to compare very young and mature ecosystems to assess successful mitigation - “apples and oranges”