# Necromass Creation in an Amazon Forest: Examination of Undisturbed and Logged Forest Sites

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# Purpose

- Necromass, defined as dead wood or portions of dead trees, is a major component of the carbon cycle in tropical forests
- Forests of the Amazon region are undergoing drastic changes in land use
- Land use changes directly alter carbon cycling of the terrestrial systems, both in terms of storage and exchange with the atmosphere
- Necromass accounts for up to 20% of carbon stored in tropical forests and accounts for 14-19% of carbon fluxes annually


# Objectives

- Examined the creation of fallen necromass in a tropical forest over four and a half years through the use of repeated surveys
- Studied the dynamics in undisturbed forest (UF) and forests logged using reduced impact logging (RIL) techniques
- Quantified pools and fluxes of necromass and estimated the contribution of necromass to carbon dynamics at our study sites.

# Introduction – Challenges to CWD Studies

- Estimation of snag height in complex canopies with dense undergrowth
- Spatial variability
- Long residence time
- Difficulty estimating fallen wood in gaps
- Density and void space estimation difficult
- CWD rarely created
- Decay dependent on many factors

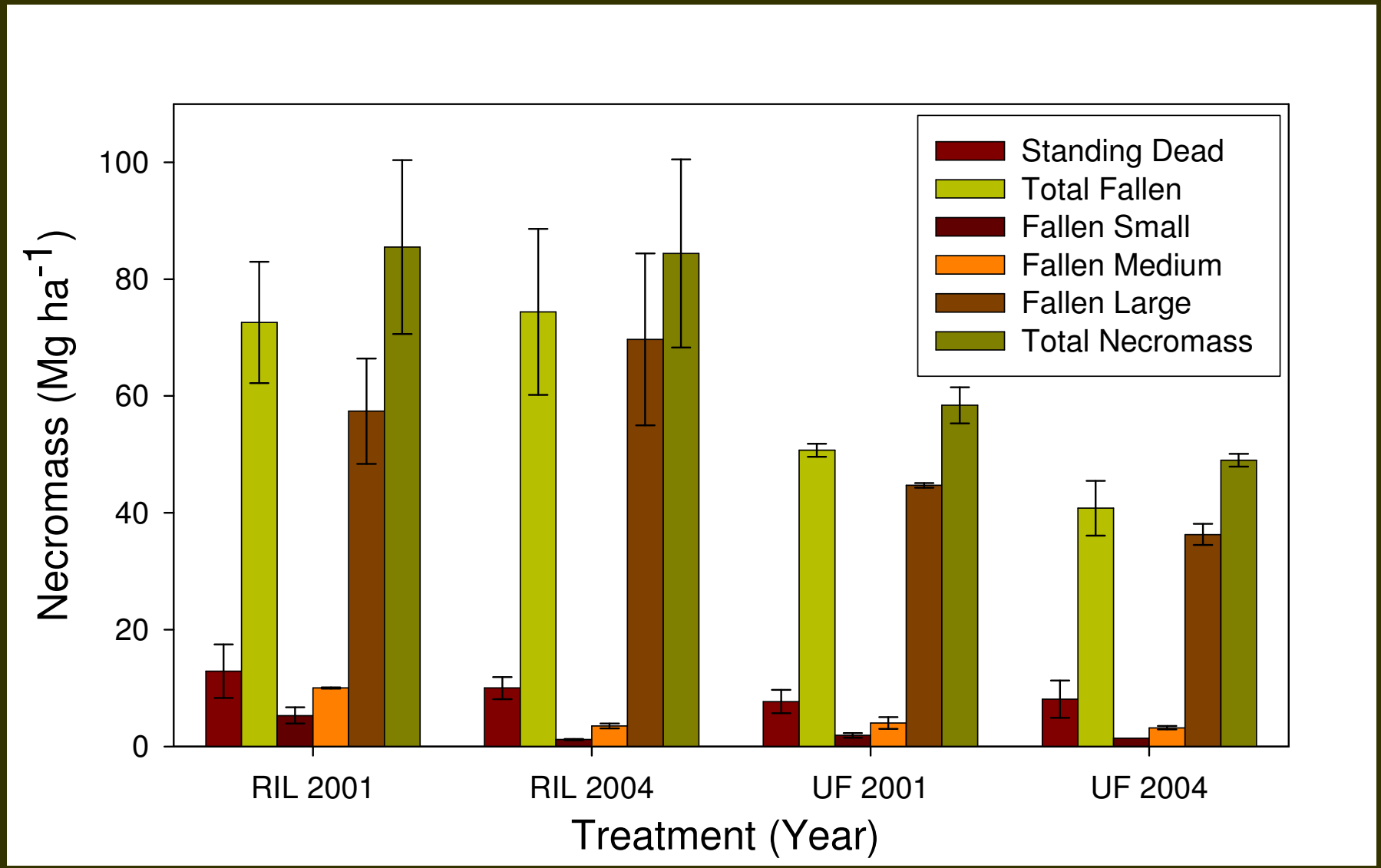
# Methods

- Line intersect sampling (LIS) – fallen CWD (23.3 km total)
- Strip plot sampling – standing CWD (22.3 ha total)
- Creation estimates of necromass – (LIS resampling) paint used to mark necromass so it was not recounted (11.3 km * 9 times = 101.7 km total)
- Nails placed in standing dead and a metal detector was used during the resurvey of standing stock

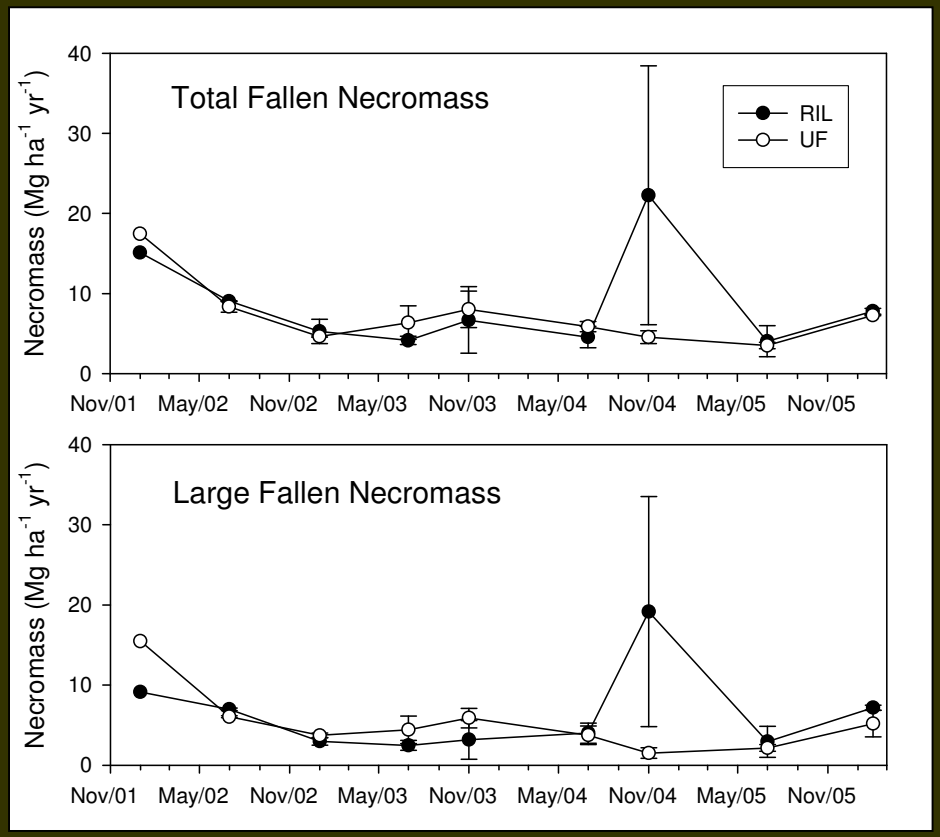
# Site Location

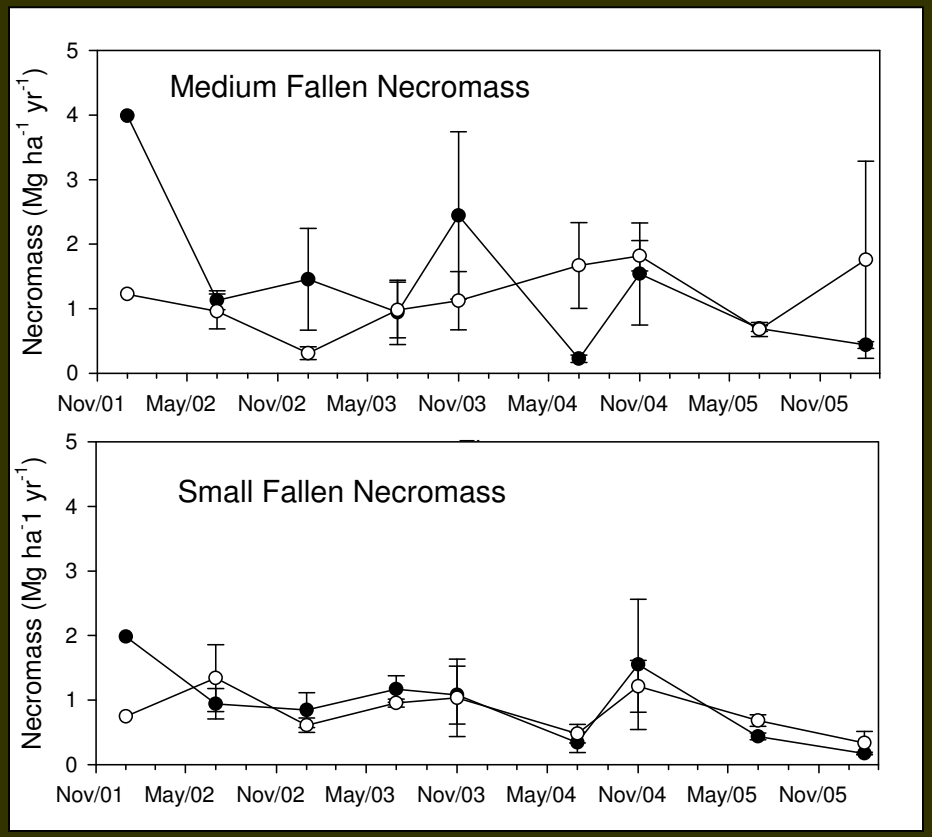

- Tapajos National Forest, Para, Brazil (3.08° S, 54.94° W)

Necromass Pools at Tapajos from two sample periods (2001 and 2004). Standing dead was measured in 2002.



# Necromass Creation over a 4.5 year period










Flux of newly fallen necromass shown for RIL (closed circles) and UF (open circles) treatments for nine sampling periods. The fluxes have been annualized for ease of comparison among variable time sampling periods. Error bars are standard errors of the mean.

## Creation of Necromass over a 4.5 year period at Tapajos National Forest, Para, Brazil

| Treatment | RIL | | | UF | | |
|---|---|---|---|---|---|---|
| Size Class | Mass ($Mg\ ha^{-1}\ y^{-1}$) | SE | Percent of Total | Mass ($Mg\ ha^{-1}\ y^{-1}$) | SE | Percent of Total |
| **Large** | 6.4 | (1.5) | 75% | 4.7 | (0.7) | 70% |
| **Small** | 0.9 | (0.0) | 10% | 0.8 | (0.2) | 12% |
| **Medium** | 1.3 | (0.3) | 15% | 1.2 | (0.1) | 18% |
| **Total Fallen** | 8.5 | (1.3) | 100% | 6.7 | (0.8) | 100% |

# Sources of Necromass for Creation and Pool Estimates

| Treatment | Source | Creation | | | Pool | | |
|---|---|---|---|---|---|---|---|
| | | Large | Medium | Small | Large | Medium | Small |
| RIL | Branch | 16% | 46% | 38% | 32% | 47% | 66% |
| | Other | 5% | 32% | 41% | 5% | 22% | 25% |
| | Trunk | 79% | 22% | 20% | 63% | 31% | 9% |
| UF | Branch | 35% | 57% | 53% | 23% | 49% | 71% |
| | Other | 8% | 22% | 39% | 3% | 29% | 25% |
| | Trunk | 57% | 21% | 8% | 74% | 22% | 4% |

## Simple Model – Assume Steady State

dM/dt = -kM +F

M=Mass (CWD Pool)

F = CWD Creation

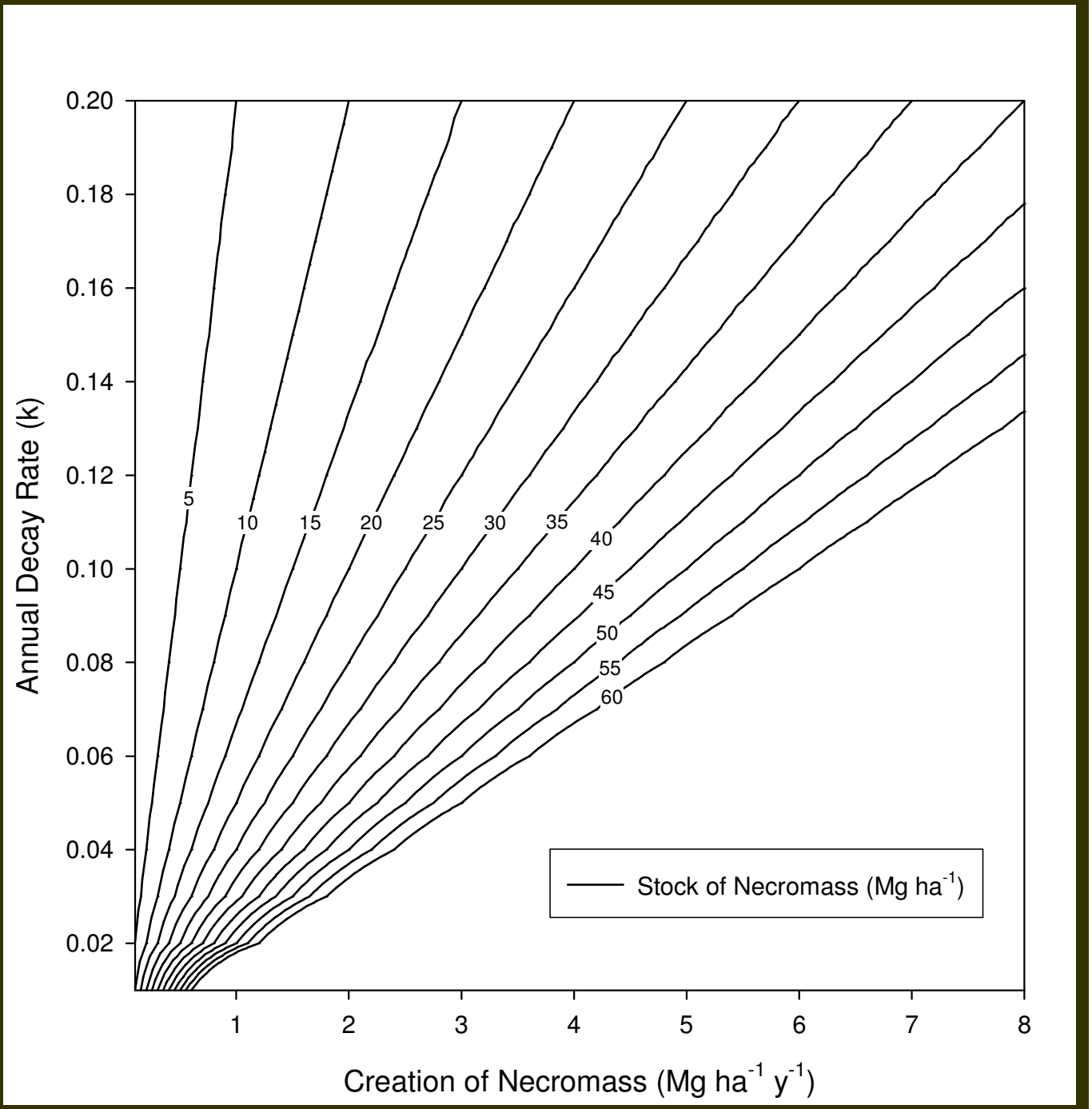
k = Decay Rate

dM/dt = 0 at Steady State

M/F = Residence Time

$$N = (k/c) + e^{-(kt)}$$

N = necromass stock
C = creation amount
k = decay rate
t = time (at steady state)



A simple model to estimate pools and fluxes of necromass in an undisturbed forest assuming steady state

**TOTAL**

| Site | Large | Medium | Small | Total |
|---|---|---|---|---|
| Creation of CWD (Mg $ha^{-1}$ $y^{-1}$) | 4.7 | 1.2 | 0.8 | 6.7 |
| Fallen CWD Pool (Mg $ha^{-1}$) | 45.8 | 4.0 | 1.9 | 51.7 |
| Estimated Decay Rate at Steady State ($y^{-1}$) | 0.10 | 0.30 | 0.42 | 0.13 |
| Residence Time (y) | 9.7 | 3.3 | 2.4 | 7.7 |
| Estimate Steady State Creation if k = .13 $y^{-1}$ ** | 6.0 | 0.5 | 0.2 | 6.7 |
| Estimate Steady State Creation if k = .17 $y^{-1}$ ** | 7.8 | 0.7 | 0.3 | 8.8 |

Examination of Standing Dead and estimation of time in pool and respiration in pool.

| **Necromass Component** | **UF** |
|---|---|
| Standing Dead Pool (Mg $ha^{-1}$) | 7.9 |
| Standing Dead New (Mg $ha^{-1}$ $y^{-1}$) | 1.9 |
| Rate of movement through Pool ($y^{-1}$) | 0.24 |
| Time in Pool (y) | 4.2 |
| Estimated Respiration while in Pool * (Mg $ha^{-1}$ $y^{-1}$) | 0.8 |

* using decay rate from large fallen necromass



# Conclusions

- Select logging in the form of RIL alters the stock of fallen necromass (1.5 X), but not the standing dead stock
- RIL also has no influence on creation dynamics in the few years following logging
- Creation and decay of necromass are approximately 12% of the total above ground respiration
- Necromass accounts for 14% of the total biomass in an undisturbed forest
- Smaller diameter necromass decays more quickly than larger necromass and account for 30% of the fallen necromass created
- Standing dead necromass accounts for up to 15% of the total necromass

# Acknowledgements

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