Estimating the Cost of Gypsy Moth Sex in the City

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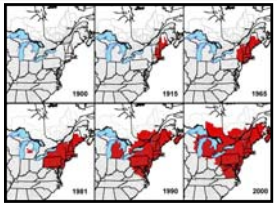
Objective

Establish a model framework and methodology for estimating total costs and losses associated with gypsy moth (GM), *Lymantria dispar* (L.), infestation in urban and suburban areas.

Introduction

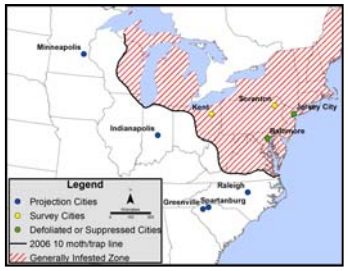
- Area infested by GM has steadily expanded since its introduction into North America (Tobin et al. 2007).
- The rate of expansion can be slowed down by public programs (Sharov & Liebhold 1998).
- Postponing impacts in urban and suburban areas are a major justification for such programs (Leuschner et al. 1996).



We aim to model the economic impact of GM in urban areas:
(1) Establish an organizing framework
(2) Identify appropriate methods
(3) Obtain parameters from literature and secondary data
(4) Estimate key costs and losses for case study cities
(5) Determine key drivers of GM impact

Steps (1) and (2) are presented here.

Study areas

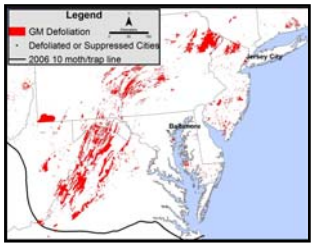


Case study cities:
- ***Baltimore***
- ***Jersey City***

Selected for:
- GM outbreaks
- urban forest data

Urban forest data:
- Urban FIA street tree inventory data for Maryland (Cumming et al. 2006)
- FIA "non-forest" inventory for 5-counties near Baltimore (Riemann 2003)
- Urban Forest Effects (UFORE) Model output (Nowak & Crane 2000)

Gypsy moth data:
- Outbreak data from aerial detection surveys
- Management data from Cooperative Suppression Programs (Gypsy Moth Digest)



Model framework

Gypsy Moth outbreak (conditioned by suppression)

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Physical impacts (nuisance, defoliation, mortality)

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Loss in value of urban trees
Loss in quality of life due to nuisance
Cost of clean-up, removal & replacement

GM Outbreak Scenarios:
- Reflect range of GM population densities and public suppression effort
- % Mortality = % trees that die above background mortality
- % Defoliation = % trees with > 30% crown defoliation
- Susceptible/Resistant species defined according to Liebhold et al. 1995.

Outbreak level	Year	Defoliation		Mortality	
		Susceptible species	Resistant species	Susceptible species	Resistant species
High	1	90%	25%	0%	0%
	2	90%	50%	25%	5%
	3	50%	10%	25%	5%
Low	1	50%	0%	0%	0%
	2	90%	20%	10%	0%
	3	0%	0%	10%	0%

Consequences of GM outbreak: costs and losses

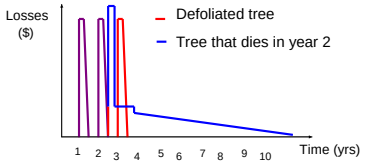
Costs: out of pocket expenses for mitigating the effects (e.g. private spraying, tree removal and replacement, medical).

Losses: reduction in monetary or non-monetary values (e.g. aesthetics, energy savings, and air quality benefits from trees).

GM effect	Impact
Defoliation	energy use, air quality, aesthetics
Mortality	tree removal & replacement costs
	energy use, air quality, aesthetics - (until tree fully replaced)
Nuisance	clean up, aesthetics, health impacts

Additional: recreation losses in urban parks and green spaces

Timeframe of losses due to defoliation, mortality and nuisance



References

Cumming et al. (2006) USDA Forest Service NA-FR-01-06; **Jakus (1992)** NCSU PhD thesis; **Leuschner et al. (1996)** So. J. Appl. For. 20:65; **Liebhold et al. (1995)** USDA Forest Service GTR NE-211; **Nowak et al. (2001)** J. Econ. Entomol. 94:116; **Nowak & Crane (2002)** J. Arboriculture 28:4; **Riemann (2003)** USDA Forest Service GTR NE-312; **Sharov & Liebhold (1998)** Ecol. Appl. 8:833; **Tobin et al. (2007)** J. Biogeogr. 34:305.

Methodology

Physical impacts of GM outbreak scenarios

- Estimate number of trees defoliated and killed based on species distribution in urban areas

Losses and costs associated with urban trees vary by:
- Land use (residential, commercial, park)
- Tree tenure: public vs. private
- Tree size (DBH class)

Approaches:

1. Costs: average rates and costs of
- Private GM suppression
- Tree removal and replacement
- Medical treatment for GM rash ~ cost of nuisance

2. Losses:

- Accounting
  Value of a tree = compensatory value (Nowak et al. 2001)
  V = Basic replacement cost × (BA lost/BA replaced)×S×C×L
  where S = adjustment based on spp. preferences
  C = adjustment based on tree condition
  L = adjustment based on tree location (land-use)
- "Black box": **UFORE**, **STRATUM**, and/or **CITYgreen** models that value urban trees and their environmental benefits (e.g. carbon sequestration, energy savings, pollution removal)
- Hedonics: estimates the contribution of environmental factors to real estate prices.
  Literature: value of trees ~6% of property sale value (annualized value = sale value/interest rate)

3. Contingent Valuation: directly elicits willingness to pay (WTP) in a hypothetical market via surveys
- Captures both **Costs** and **Losses** plus quality of life impacts
- The best estimates of annual WTP per household in outbreak areas are:
  1) $273 - $323 for a 25% reduction in defoliation,
  2) $332 - $400 for a 65% reduction in defoliation, in 1991 dollars (Jakus 1992)

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