Money and Ash Tree Management: Prioritizing Decisions in the Face of EAB

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As emerald ash borer (EAB, *Agrilus planipennis*) has spread across the U.S. and Canada, practitioners are faced with difficult questions. Should we do nothing except remove ash trees (*Fraxinus* spp.) after they die? Is it better to preemptively remove ash trees in anticipation that they will die? Can treatment to retain ash trees become an important part with EAB management? Is tree replacement part of the management approach? Should we preemptively plant trees before ash trees die? Should we just get rid of all urban trees since they cost money to plant, maintain, and remove? Answers to these questions should address what is the most economically efficient solution. Quantifying the benefits *and* costs is an important part. The difference between these is the net benefit. If you see limited or no value in urban trees, then the answer is easy: get rid of the trees. The science says this not the case, because the functional value of urban tree populations typically exceed the life cycle cost of managing the asset. Unlike roads, utilities, and vehicles that depreciate in value, the urban forest value appreciates over time. While a building body of literature is providing valuable insight into EAB management, it's up to the practitioner to apply management in the right place, at the appropriate time, and for a dedicated purpose. The following steps highlight some important factors for EAB management.

Step #1: Inventory

Keeping an account of the existing resource has long been an accepted practice in capital asset management. Having an inventory of your ash resource is an important step to addressing EAB management costs and loss of the benefits derived from these trees. Recognizing community constituents is important as well. Urban foresters manage people as much as they manage trees, and citizen involvement is a key component of the decision-making process. Urban forest projects are more effective if the community is integrated into the planning process, and "repositioning" the urban forest in the minds of city leaders and residents can be an effective approach for garnering budgetary support. An inventory of community resident perceptions and desires of the urban forest is crucial to developing an EAB response that best fits the community. Formal social science approaches or using a community tree board are methods to inventory a community's desires. An assessment of available equipment and human resources is also important to see if the needed response can be met through internal resources or if external or both are needed.

Step #2: Assign Priority

A successful EAB management decision rests not on any single variable, but on the complete needs and desires of the community. Is the lowest cost option desired, or is the conservation of the greatest number of trees over time the goal? Is the size of future forest stock most important, or do community members want to get the most "canopy for the currency"? Management decisions will change with the goals of the community, so it is important to define these goals before delving into the numbers routine. The following are important considerations when assigning priority to an EAB management plan:

Risk & Liability: Priority should be given to the health, safety, and welfare of the general public. Tree risk assessment and storm response models are management approaches that can be adapted to an EAB response. Decreasing the number of dead or dying trees due to EAB can effectively reduce risks. Consider removing ash trees in poor condition first and maintain those with the greatest functional or compensatory value. Risk prioritization improves safety and reduces urban forest liabilities. Playing off an analogy to medical triage, "remove the worst first."

MANGEMENT ALTERNATIVE ANALYSIS

Goals & Objectives	Management Alternatives: Control	Management Alternatives: Treatment	Management Alternatives: Removal	Management Alternatives: Remove & Replant	No EAB
Mean Net Per Tree Value	$963	$946	$211	$233	$988
Net Per Tree Value at Year 20	$882	$896	$0	$232	$931
Net Total Tree Value at Year 20	$25,915	$525,154	$0	$164,901	$621,836
Mean Net Per Tree Value Lost	$1,329	$1,333	$324	$1,293	$1,301
Total Trees Lost After 20 Years	971	414	1,000	1,290	332
Mean Annual Tree Diameter (DBH)	12.0	13.6	2.5	6.1	13.7
Mean Number of Trees Lost Per Year	46	20	48	61	16
Trees Retained at Year 20	29	586	0	710	668
Mean Per Year Maintenance Cost	$14,175	$22,843	$6,435	$13,037	$23,437
Total Maintenance Cost	$297,685	$479,698	$135,142	$273,770	$492,179
Mean Per Year Removal Cost	$12,121	$4,849	$14,274	$15,426	$3,968
Total Removal Cost	$254,547	$101,830	$299,748	$323,943	$83,337
Mean Per Year Planting Cost	$0	$0	$0	$12,035	$0
Total Planting Cost	$0	$0	$0	$252,742	$0
Mean Per Year Treatment Cost	$0	$32,632	$0	$0	$0
Total Treatment Cost	$0	$685,282	$0	$0	$0
Total Management Cost	$552,232	$1,266,810	$434,889	$850,455	$575,516
Mean Per Year Total Management Cost	$26,297	$60,324	$20,709	$40,498	$27,406
Mean Per Tree Annual Management Cost	$63	$72	$21	$40	$33

Management Alternatives	Retained Tree Analysis		Lost Tree Analysis		Benefit/Cost
	Mean Net Value	Relative Ratio	Mean Net Value	Relative Ratio	
Control	$395,337	1.00	$61,411	1.00	0.76
Treatment	$749,793	1.90	$26,297	2.34	0.64
Preemptive Removal	$123,502	0.31	$64,757	0.95	0.33
Remove & Replant	$202,431	0.51	$79,467	0.77	0.29
No EAB	$813,048	2.06	$20,589	2.98	1.46

Legend
- Most Desirable Outcome
- Least Desirable Outcome

Figure 1. Comparison of four emerald ash borer management alternatives without EAB using methods of VanNatta et al. (2012) for a 1,000 ash tree population. (Retained Tree Analysis: Relative ratio = Management alternative / Control option; Lost Tree Analysis: Relative ratio = Control option / Management alternative; management options include treatment, preemptive removal over five years, preemptive removal and replanting over five years, and no EAB; Table 1 presents modeling assumptions.)

Cost Considerations: Economic decision-making models are an important component of the planning system. Community finance managers use economic criteria daily, and EAB management becomes more defensible by considering such. For example, what is the opportunity cost associated with an EAB management decision? Does spreading costs over time lead to easier efficiency with financing the cost of EAB? Can EAB management projects be coordinated between city departments or among communities in an area? Whether one likes it or not, EAB will cost society money, and reducing management costs and maintaining net urban forest value are important goals.

Citizen Coverage: Determining who receives community benefits has significant equity implications. Treatment to retain ash in areas with existing tree canopy deficiencies is an idea to consider. Citizen involvement plays an important role forging equitable urban forestry decisions. Finding common ground is central to the development of equitable goals and objectives.

Political Feasibility: While politics should not be the only consideration when assigning priorities, these realities must certainly come into play. Education, collaboration, and outreach are important components of engaging politically significant stakeholders. Moving forward with EAB management plans without a clear education, collaboration, or outreach plan can result in political bad will.

Established Standards: Conditional or functional performance standards can be established internally (comparing past with current output) or externally (between municipalities, agencies, or third parties). For instance, will the selected alternative change existing or proposed standards? Is the stated action in agreement with an area's comprehensive community plan?

Forest Structure: Whether or not one chooses to manage EAB, costs will be incurred and the urban forest structure will be impacted. The community must envision what the desired forest structure will be both today and years down the road. For instance, by not replacing a removed ash tree, one incurs no direct tree replacement costs, but also forgoes any future benefits. If this is a shared community goal, then it is the right one. In contrast, a newly planted tree will provide little immediate benefit, but over time (e.g., one to two decades) will produce net benefits. By considering the long-term implications of management decisions on forest structure, the most efficient, effective, *and* equitable outcomes can be achieved.

Step #3: Selecting the Preferred Alternative

Urban forest sustainability is an iterative, innovative process and must be performed not only at the municipal level, but on a block-by-block,

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person-to-person basis. Current research demonstrates that treatment of ash for EAB is an economically viable option. However, relying solely on numbers is a dangerous proposition. Likewise, relying too heavily on any one management option can result in an inefficient, ineffective, and inequitable situation. The use of EAB economic decision-making models for evaluating numerous alternatives at the same time is a valuable and worthwhile activity. When used in conjunction with a community visioning process, the application of such a system can prove both economical and beneficial to community well-being.

Planning for the emerald ash borer is dynamic and involves many variables to consider. An EAB management simulator (EAB Plans) developed at the University of Wisconsin – Stevens Point provides an economic method to analytically compare alternatives (Figure 1). The model allows urban forest managers to use their specific data to evaluate their ash tree population, simulate tree growth and mortality, add management cost data, and make decisions based on their unique goals and assumptions (Table 1).

Decision-making for EAB management options should be based on community goals and objectives. If your goal is to spend the least amount of money, then the preemptive removal of all ash trees is the least costly option. However, this is the worst option if your goal is to maximize net urban forest value (benefits – costs). Preemptive removal provides approximately one-third of the net value of the urban forest over 20 years compared to removing ash trees after they die (doing nothing). Conservation of ash through treatment, in contrast, provides the greatest net urban forest value, approximately 1.9 times the value as doing nothing using the input variables in Table 1. Preemptive ash removal followed by tree planting is intermediate between preemptive removal only and treatment of ash trees. These results may differ from other resource structure and assumptions.

Because urban forests do not generate much real revenue (i.e., wood products, food sources), managers must frame their decisions on a "triple bottom line" approach of social, ecological, and economic factors. The economic value of the urban forest is quantifiable through ecologic services and societal improvement (e.g., human health, recuperative environments). The integration of these three components necessitate that practitioners make efficient, effective, and equitable urban forestry decisions. Effective is defined as completing the task at hand. Efficient is used to evaluate the cost of completing the job per unit effort. Equitability evaluates if people are equally treated or if they are better or worse off than others.

Step #4: Evaluation

In any planning process, a solution today may not appropriately meet tomorrow's needs and goals. By continually appraising conditions, balancing priorities, and reevaluating the most appropriate, time-sensitive alternative, managers can evolve with changing circumstances and plan for the most environmentally, economically, and socially sustainable results. The science and management approaches to EAB are evolving, and ideally, result in easier decision making. Managers faced with EAB decisions need to determine community goals and plan accordingly if they change. Economics and resource dynamics are equally important aspects of managing EAB. Taking the time to develop a comprehensive management plan will make the difficult decisions easier.

Table 1. Model assumptions inputs used in EAB-PLANS (emerald ash borer planning simulator) for the resulting output presented in Figure 1.

Variables	Unit	Value
Starting diameter	Inches	10
Starting population	Number	1000
Preemptive years	Number	5
Tree growth rate	Inches/year	0.4
Maintenance cost	$ (USD)/DBH	3.5
Removal cost	$ (USD)/DBH	31.90
Treatment cost	$ (USD)/DBH	10
Treatment (Tx) interval	Years between Tx	2
Expected Tx success	Percent	99%
Natural survival	Percent	98%
Control survival (EAB)	Percent	80%
Replacement size	Inches cal.	2
Replacement cost	$ (USD)	100
Installation cost	$ (USD)	200
Unit tree cost	$/sq. in.	31.83
Species	Percent	0.70
Condition	Percent	0.75
Location	Percent	0.70
Interest rate + 1	Percent	1.06

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