Assessing Various Community Tree and Forest Values With Inventories

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Determining the value of any object or function is a question for the marketplace filled with willing buyers and sellers. This ephemeral value of the marketplace is in sharp contrast with perceived values only apparent when comparisons are made by eliminating objects, or over inflating expectations of their future worth. This is the plight of the community natural resource manager, caught between a marketplace and perceived norms of environmental values. The solution remains the same regardless of the problem in that there must be accepted methods for reaching "objective" values. Inventories of objects, attributes and values are critical to the success of community natural resource programs.

Definitions

Before beginning in earnest to assess the values of the community forest, several definitions and concepts must be recognized. The first is "evaluation," which means to judge, determine, or appraise the worth, value, quantity, and quality of the community forest and its individual trees. "Inventory" means to create and produce an itemized list or catalog of evalued characteristics. Evaluation and inventory are attempts to determine the quality and quantity of community forest values and physical attributes. If we are to evaluate and inventory community forests, where do we begin? The first step is to determine what should be measured. The number of trees, tree sizes, energy audits, wildlife populations, water quality, water use, liability risk exposure, management effectiveness, dollar values, and a host of other things could appear on inventory sheets. For cost-effective management, it is critical to determine what questions you want answered and then collect only that information needed to reach that answer.

Measurement Components

Next we must identify measurement components. Measurement components include how often inventories will be made. Inventories can be continuous or periodic. Continuous inventories are driven off of work orders and daily reports. Continuous inventories provide a dynamically updated report base at all times. Periodic or batch inventories occur at given intervals and represent a snapshot in time. The next measurement component in inventories is how attributes will be measured. The two primary types of measurement are direct measures and remote measures. Direct measures are approaching the tree and measuring its various attributes. Remote measures vary in scale, but all measure tree attributes at some distance. Remote measures could include a windshield survey, ground photography, or aerial photography (vertical and oblique). Areal photos are not used enough in community forestry, especially low level shots. Remote measures do require a number of direct sub-samples or ground-truth plots to assure accuracy. The final measurement component to understand is how much of the resource is going to be measured. Most community forest inventories use complete 100% samples where every tree, area, or management unit is examined. Partial inventories can help break up expenses into several years while all trees are measured once in a rotation of years. Sampled inventories have great value but intimidate managers because of the statistical requirements. If you need to know forest attributes, and individual tree locations are not critical, the most cost-effective way to generate high-quality inventory data may be by sampling (5-25% of area).

Inventory Design Concepts

With measurement components considered, inventory design and potential application procedures

can begin. Only collect what you need and understand how it will be measured and analyzed. Any charts, tables, and graphs can be drawn-up ahead of time with all the labels present. You should know this information ahead of time in order to collect the proper information. All that remains after the inventory is filling in the numbers. The danger in community forest inventories is paying to collect too much information that has marginal, at best, impact of future management. The expected products you should receive from an evaluation and inventory process are: a description of each management or inventory unit; a summarized listing of attributes composed to quickly help people understand or visualize needed management activities; statistics to suggest objective criteria for judging accomplishments and for formulating the initiation and continuation of management activities; and, interpretations and recommendations of how this inventory information fits into already functioning community forest management plans and how this inventory could shape future management activities. Inventories are an essential piece of a good urban forest management plan that can be used to seek larger budgets, attain better management efficiency, and have greater public relations impact. For the community natural resource manager, reasons for a strong evaluation and inventory system are many. Principle reasons include improving management decision making, assisting with effective resource maintenance and appreciation in value, minimizing liability risks, and assisting with public education and relations (defense of the program). It is tough to know where you are going (goal) if you do not know where you are and how things are changing (inventory), or how to get there (a management plan).

Administrative Planning

There are three major parts of a good evaluation and inventory process: administrative planning, technical planning, and technical development. The first of these, administrative planning, formulates the needs, goals and objectives for the inventory and the management framework. This planning process concerns defining goals and setting clear objectives. This process includes six steps that force the manager to confront political and administrative resolve to value resources and their proper management. Without this resolve, resource management is a sham and will lead to resource value declines. Step 1 in the administrative management process is the initial assessment of decision maker's and stake holder's perceptions and expectations -- in other words, paradigm review. This is a vital communication step that is often left out of resource management programs and can end-up destroying or disabling management processes. Step 2 in administrative planning is developing goals. A goal is the place you want to end up. Review other programs and listen carefully to interested people for descriptions of expectations and perceptions in step 1 and translate these into goal statements. Goals do not state how things will be accomplished but do provide a basis for examining cost / benefit analysis. Goals deal with economic considerations and establish a limit on costs. Step 3 in administrative planning is developing objectives to reach the goals set in step 2. Objectives define how a goal will be reached and how long it will take to get there. Constraints that should be included in objective development are labor availability, space, time, knowledge, and how the corresponding goal's economic constraint will be prioritized among associated objectives. Step 4 in administrative planning is the inventory and critical assessment. Careful consideration must be given to how an inventory will be designed and how data generated will be analyzed. Here the constraints that must be considered are ecological, biological, and physical components of the resource, their values, and appropriate measures. Step 5 in administrative planning is a part of total quality management and biology-first design. Because constraints have been identified in each of the proceeding steps, a planning document can be synthesized that provides maximization of individual, social, and biological / ecological values. In the past social good has been prioritized most highly and the biology / ecology has suffered. In a resource planning document, biology of the trees and system ecology must be of the highest priority or the values generated will decline and be exhausted over time. Every other constraint has emphasized social values, a community natural resource manager should, at least

initially, prepare to emphasize the resource and its sustainable production of values. The final Step 6 in administrative planning are conflict opportunities. This feedback is critical to the future of good resource management. As concerns arise, determine the step where the problem is concentrated. If people need more information only, go back to step 4 and modify. If there is conflict with an objective go back to step 3. Conflicts with goals require retirement to step 2. And conflict with paradigms requires a reexamination of the whole process at step 1. Clearly, the intensity of the conflicts will increase the farther back up the steps you travel. You can see why Step 1 is so vital to successfully facilitating evaluation and inventory.

Technical Planning

The second of three major parts of an evaluation and inventory process is technical planning. For many community natural resource managers, this is the step where technical expertise can be most effectively used. Technical planning involves the evaluation and inventory design, the data handling and manipulation, and the financing of the project. The administrative planning part should have laid a strong foundation for this part. Once a decision has been made to move forward, technical planning can commence. The adage of inventories in this step is "data is money and money is data" -- do not waste money on unneeded data.

Technical Development

The third major part of the evaluation and inventory process is technical development. Technical development includes the data collection, analysis, and use, and evaluation of the process. Many communities hire outside specialists to complete portions of these tasks. The final process evaluation cannot be emphasized enough. Evaluation of the process will help positively modify management plans, goals, objectives and can influence paradigm shifts.

Planning!

To summarize, it is not an accident that two of the three major parts of evaluation and inventory include the word "planning" in their title. Planning is essential. Goals and objectives show where you want to go, and a framework on how to get there. Management plans provide the details of how to reach goals following set objectives. The inventory and evaluation process establishes where you are managerially, and where the resources and generated values are from a quality and quantity standpoint. Well-designed inventories can also suggest trends and inherent changes that are occurring in the resource base. The inventory and evaluation planning process is critical to getting what you want, getting what you need, eliminating what you do not need, and ensuring usability and compatibility. Planning is for professional resource managers while simply counting trees is for technicians. Many managers confuse their roles and duties. You should earn your money (and title) by doing the planning and training. Use well-trained crews or private consultants to measure. Your ultimate purpose should be to design, complete, and maintain an evaluation and inventory system with help from private consultants. Of all the things to measure, and the various values to determine, which are important? What assessment tools should be used in an evaluation and inventory process? There are many assessment tools and a select few will be examined here. But first, we must assure strong observational discipline and skills. These skills come with experience and practice, as well as touching a lot of trees in various states.

Observational Discipline

Observations of a tree, forest, or other entity require a specific thought process and a systematic approach. Evaluating trees and resources begin with conceptualizing the tree and site under the social and ecological context in which it exists. This process requires you to know internal tree reactions and symptoms of external stress, as well as social and cultural constraints on management. You should be able to

develop a story about a tree's life and prognosis for the future by an examination. The idea of developing a story and telling people is a great learning experience and essential for good evaluation. Observations should be based upon the scientific method. The scientific method cannot determine precise cause and effects, but can eliminate most possibilities. Scientific method eliminates from consideration that which is not occurring. In diagnosis for example, this method may not be able to prove what damaged a tree but can eliminate many things that can damage trees. Observe tree/site responses and then generate a story of how these effects could possibly exist based upon your further observations. Remember that as you evaluate trees and other resources there will be responses or changes to observe. How an object differs from some established norm can determine quality and quantity values (either negative or positive values). Be comprehensive in your observations because what you do not see will devalue inventories, resources, and management plans. When evaluating a tree or other resource, use a three level observational approach. Level 1 is where you look at the tree and environment in a broad sense before you approach the tree or as you approach the tree. Level 2 is an up-close examination for specific qualities and quantities, looking for unique values and departures from established norms. Final level 3 is where you refocus your observations as you step back from the tree and develop a holistic "story" of how the resources and associated values are generated and how management can influence (and has influenced) productivity and sustainability.

Assessment Items

You will need to develop a management form for recording observations. The form should help you visualize assessment processes and documentation. You should carefully develop your personal form for assessment of community forest resources to assure it will record precisely the information you need. The remainder of this publication will deal briefly with a number of assessment items available for your inventory process. I will assume you can already count individual trees, measure sizes, determine species, and estimate general health through an inventory process.

Ownership

One of the first assessments legally required is the determination of ownership. Trees are considered to be permanently attached to the land, and so belong to the landowner. Animals and other resources that are not necessarily attached to the land are considered to belong to society and come under regulatory constraints. Here we will concentrate on trees. If a tree is completely on one property owner's land, it belongs to that property owner. If the tree sits on the legal property line or is treated as sitting on the property line, then the tree is a borderline tree and subject to joint responsibilities. One joint-owner cannot injury or treat the tree without the other owner's acceptance. Questions of ingrowth into a boundary line and extension of tree parts over adjoining ownership are critical to answer for management planning. Trees that are nuisances or a threat to public travel, access, and safety must be identified and their owner notified in case of treatments or condemnation proceedings.

Risk Assessment and Hazard Identification

The next assessment is for determining the amount of risk associated with a resource or a tree. Risk assessment and hazard identification are primary requirements of most evaluation and inventory processes. A tree is a hazard when confirmed as having a major structural fault that could lead to catastrophic loss and could injury or damage property or human targets. Major structural faults include large vertical cracks, decayed areas or columns, included bark areas, forks, dead wood/branches, hollows, significant leans, openings to the inner portions, and mechanically damaged areas, to name a few. The extent of damage, complexity of fault interactions, and future consequences of faults to tree life is a professional judgement. Minor faults (correctable faults requiring care) include things such as pavement

buckles, surface roots, small dead wood, tree litter, animal/insect activities, entrapment, face-level branches, and destruction of surrounding property. Examine the tree in order of where faults are most likely to be accentuated. Start at the tree base and move outward and upward to build a good tree. Stop the risk assessment when, in the presence of a target, the tree has major structural problems that will lead to catastrophic failure. As a rule-of-thumb, one complex set of major structural faults or three simple major structural faults that are socially, economically, or biologically impossible to repair or adjust, should initiate tree removal. Risk assessment targets are people and property. Anywhere people would walk, drive, stand, lay, run, recreate, etc. could be a target area. Sidewalks, streets, parking lots, ball fields, golf courses and parks are all prime target areas. Property targets are most often damaged by trees include cars, fences, buildings, roofs, pavement, yards, and gardens. Personal injury targets and property targets are usually interrelated. Minimize risk to all personal injury targets. Be sure to identify hazards for immediate removal.

Storm Damage Potential

Another aspect of an evaluation and inventory assessment process is generating expectations of storm damage and trying to minimize risks. Storm damage assessment is a speciality area of risk management. There are six general forms of storm damage (listed in order of decreasing severity): blow-over, stem failure, crown twist, root failure, branch failure, lightning. Each type of damage is the result of a complex and interactive mixture of tree structure, tree reactivity to change, and climatic conditions. Evaluation and inventory are needed for two reasons. The first is that most communities leave too many damaged trees standing after a storm and all the equipment has left the site. These trees continue to require yearly care and will eventually require removal. Remove potentially hazardous trees the first time. The second reason for evaluation and inventory of storm damage potential is for civil safety. Civil defense activities require hospital, fire department, and police travel lanes and access routes to remain passable. Planning for storm damage and correcting potential problems is important, especially along primary travel routes. In addition, utility corridors require special assessments.

Dollar Value Appraisals

Once liability risks have been identified and inventoried, monetary values should be derived to assist in management activities. The standard form of a tree appraisal, where trees are too large for simple replacement value calculations, is the trunk formula method of the Council of Tree and Landscape Appraisers. This formula is commonly called the ISA formula (eighth edition). There are many ways of attaching a dollar value to a tree. This specific formula can be used in inventories where species, size, condition and location factors are determined. This appraisal process first develops a marketplace value for units of size and then develops a maximum total value an ideal tree could be worth. Additional steps take demerits for species, condition class, and general and specific location factors. Call 910-789-4747 for order information on the Tree Appraisal Manual (eighth edition).

Utility Interactions

Trees do have intrinsic values, but many values come from their surroundings. Trees that interfere with safety, access, and vision are nuisances and can represent negative values in a landscape. Tree interactions with above-ground and below-ground utilities can be life degrading and/or threatening. Old, unused utility corridors can also be problems. For expected future cultural problems, poisoning, and planting space requirements, utilities on a site or around a tree must be identified. Underground lines incorrectly installed (as far as trees are concerned) will be candidates for damage by root growth. Utility corridor trees involve additional management inputs and require proper assessment.

Ecological Dollar Appraisal

There many means and measures for examining tree and community forest resource values. The computer programs called "QUANTI-TREE" and "MUNI-TREE" produced by Davey Resource Group, Kent, OH (1-800-445-TREE) can help you determine many different values and understand municipal forest management practices. Any of the community forest values suggested or quantified in these programs could be collected by inventory and used in developing management plans. One method of determining an ecological value for a tree is the F&R formula (from Franks and Reeves. 1988. A formula for assessing the ecological value of trees. Journal of Arboriculture 14(10):255-259.) This formula helps determine the ecological contribution a tree makes to the environment in dollars. It works by generating a score from each of 3 factors: local factors (soil erosion, nutrient cycling, water percolation, animal usage, habitat diversity, canopy and neighbors), distant factors (flood prevention, siltation, and animal visitors), and standing life span expectation. The scores are converted into three equally weighted coefficients that are used to reduce a total value produced from cross-sectional area value determinations.

Futuring Concerns

Another evaluation and inventory approach is trying to determine future encroachment problems and impacts of societal land use changes. This process of assessment requires futuring and brainstorming potential problems that are not currently apparent. For example, what management actions will be needed as new subdivisions expand, future road widening occurs, hot pockets and canyon effects occur, and new (or old) pest problems reach critical levels. This type of management input should be completed by skilled, experienced tree professionals familiar with political and technical aspects of tree and community forest maintenance. This process can help in setting goals and objectives and provide managerial notice of future problems. Using outside managers can help you gain a new perspective.

Needed Management Activities

Part of assessment is determining what needs to be done. Consolidation of this information can show what management activities are needed, their prioritization, and help in seeking budget assistance. An assessment should identify what is needed currently and what will be needed in the future for resource care and maintenance. Tree professional should complete this type of assessment and scale needed activities into appropriate time spans, such as immediate need for treatment, treatment within the season, or longer term expectations of treatment needs.

Management Costs

One of the most valuable but least likely to be collected values in community forests are management cost values. By correctly designing work-orders, time sheets, and contracts a manager can help keep track of real time and costs of a management program. Some of the costs to collect would be the daily / seasonal costs of taking care of a tree, a running total of costs over the life of a tree for care and maintenance, immediate treatment costs per event, and costs over other time frames and cost accounting methods. Cost-effective management implies you know what the costs are, not just an annual budget total.

Site Water Use Potential

Water is a precious resource that is becoming more of a focal point for resource managers as time passes. In some locations water use values can help set watering restriction and can assist in setting watering priorities for landscapes. Over normal summertime temperatures, for approximately every 18oF (10oC) increase in temperature, water use doubles in the landscape. Water use is both a biological and physical process. Impervious, hard surfaces produce a lot of heat loading in a landscape forcing surround-

ing trees to use their available water to dissipate radiated and advected heat. Shade management principles must be used, as in some xeriscape programs, to track evaporation, precipitation, and temperature while assessing potential tree interactions with water use on-site. This assessment can generate a relative water use value for specific landscape areas.

Interference (Competition and Allelopathy)

Trees need to collect resources to survive and thrive. Other plants require the same resources. Sites with too many plant systems for available resources will continually have some plants in decline. Assessing interference levels can help in controlling planting and other management activities on a site. Interference is the combination of competition (95%) and allelopathy (5%). Light resources (lack of or excess) tend to be central to many physiological problems. One layer of leaves effectively blocks light for approximately 60 effective leaf diameters below. Depending upon the species involved and their shade tolerance, many sites may be over-planted, containing too many leaf layers. As a rule-of-thumb -- do not exceed four to five main leaf layers in a community forest situation. Excessive root stacking is also a serious problem in community landscape sites and needs to be identified.

Critical Site History

As a community natural resource manager, you need to know site history for cost-effectiveness and biological success. Historic, socially significant, unusual, rare, or protected (statute) trees require managerial notice and modification of normal management programs to avoid damage. Past biological/ ecological, cultural, soils, and social history of the site is important to understand before inserting another management regime over the site. The site and tree must be put into biological and societal context to avoid compounding problems, creating new problems, or failing to react to current or new problems. Site history can get you if you don't watch out!

Work Orders and Associated Problems

Assessment should translate well into work orders for care and maintenance activities. Work orders can be attached to inventory and evaluation sheets, as can comment cards, to provide a managerial history of recent events. A unique and permanent tree number or site address can be used to track problems over the years, and with the turnover of managers and staff.

Conclusions

In conclusion, assessments of community trees and forests through inventories are more than just counting trees. An inventory is a complex process that leads to a better quality of life for the tree, the tree owner, and the tree manager. Assessment through inventories is essential for keeping records of your responsibilities (trees / other resources). These types of records can keep you out of trouble and help enlist support. Evaluating trees is a lifelong challenge requiring (demanding!) time to actually notice the trees in spite of the forest, and any social / political fog.

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