PROXIES FOR RESOURCES

Proxies for water, wood, and wildlife resources are derived from earlier studies on the effects of thinning post-harvest Emory oak coppice to accelerate the growth and increase the volume of the sprouts (Bennett 1988; Touchan and Ffolliott 1999; Farah et al. 2003). These studies have also provided a basis to evaluate the effects of coppice thinning on the water budget (Shipek et al. 2002, 2003) and structural diversities important to wildlife habitats (Sharman and Ffolliott 1992). The treatments evaluated in these studies were thinnings of post-harvest Emory oak sprouts to retain one, two, or three of the most dominant and vigorous stems in the clumps; unthinned clumps of sprouts were used as controls.

Water

Ffolliott (2000) has quantified water loss through transpiration by thinned Emory oak coppice, which is likely the largest component of the water budget. Water that is lost to transpiration is not available to produce runoff, recharge groundwater aquifers, or aid the growth of other plants. The transpiration rate is key to selecting a coppice thinning treatment that minimizes water loss on a site; it was therefore selected as the proxy for the water resources in formulating the preliminary decision matrix. On a daily basis, average transportation rates for Emory oak rootstocks ranged from lowest to highest in thinned clumps of one, two, and three sprouts, respectively (Shipek et al. 2002, 2003). The unthinned rootstocks transpired the highest amount of water from a site.

Wood

Growth rate and volume of Emory oak coppice comprise the proxy for the wood resources in the decision matrix. When the main management objective focuses on utilizing Emory oak coppice for fuelwood in the future and a decision is made to thin the coppice resulting from earlier harvesting, thinning to retain one residual sprout is recommended (Bennett 1988; Touchan and Ffolliott 1999; Farah et al. 2003). Growth and volume are concentrated in the single stem, so that stem will attain a desired volume for fuelwood in a shorter time. However, the age of the coppice at the time of thinning also affects the growth of the sprouts. Resprouting is likely if the sprouts are thinned too soon, which reduces the effectiveness of the thinning treatment. When thinning is delayed too long, growth can be lost to competition and mortality. There is no significant difference in the growth and volume of post-harvest Emory oak coppice when clumps are thinned to either two or three sprouts. Growth and volume are comparatively minimal in the absence of thinning, and, as a consequence, this is the least preferred of the management options.

Wildlife

Structural diversity expressed in terms of the abundance of foliage in the vertical layers of the crowns is the proxy for the wildlife resources. When sustaining the structural diversity for wildlife habitats is the management objective, a decision not to thin Emory oak coppice is the most preferred of the management options considered in this paper (Sharman and Ffolliott 1992). Harvesting tends to remove taller trees, which provide a greater number of habitat niches for non-game bird species (Balda 1969; Block et al. 1992) and other wildlife than shorter trees. Furthermore, thinning of the coppice resulting from earlier harvesting activities eliminates much of the remaining structural diversity by removing many of the intermediate trees. Thinning, therefore, might not be prescribed so that a minimum level of biomass is retained in the harvested woodland. Ordering of the management options to sustain the structural diversity of Emory oak coppice from most preferred to least preferred is no thinning, thinning to

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three residual sprouts, and thinning to either one or two sprouts.

**PRELIMINARY DECISION MATRIX**

Incorporating the proxies for the water, wood, and wildlife resources into a preliminary decision matrix for selecting management actions in stands of post-harvest Emory oak coppice results in Table 1. Although other management options are likely, those displayed in this table are derived from earlier research and are therefore the basis for solving the decision-making problem described below.

Problems arise when the integration of natural resources management goals or objectives are complex and involve different management disciplines. As a consequence, a manager can be faced with a decision-making task of obtaining a fair and equitable solution to the problems of integrated management. The decision-making process in this case is generally viewed in terms of the sequential steps of problem recognition, specification of strategies, specification of the decision criterion or criteria, and selection of the optimum management strategy. To illustrate this decision-making process to optimize management of the Emory oak coppice for water, wood, and wildlife values, we will assume that minimizing water loss while optimizing fuelwood production and structural diversity is the management problem confronted. The strategies available for solving this problem are centered on thinning the coppice to one, two, or three of the dominant sprouts or not thinning at all but retaining the coppice as it evolves naturally following fuelwood harvesting. The decision criterion in this example is optimization of the water, wood, and wildlife benefits of a selected management practice. Methods available to solve this problem include the use of a simplistic approach or more rigorous approaches.

**Simplistic Approach**

The simplistic approach to solving the problem requires a knowledge of the "values" that the stakeholders have placed on the resources. There are two cases to consider in applying this approach to problem solving. In the first case, all of the natural resources of interest have equal value to the stakeholders, whereas in the second case the stakeholders have placed preferential (unequal) values on the resources. Stakeholders representing water interests, for example, would place higher values on water than wood or wildlife, and so forth. The stakeholders with political advantages

<table>
<thead>
<tr>
<th>Criteria</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>No Thinning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Wood</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Wildlife</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Ranking: 4 = most preferred; 1 = least preferred.

The decision outcome is based on the assumption that all resources are weighed equally. When the management objective is minimizing water losses to transpiration and optimizing fuelwood production and structural diversity, thinning the Emory oak coppice evolving from earlier fuelwood harvesting to one residual sprout is the best compromise. Water loss to the transpiration process is minimized and the growth and yield of the residual sprout is maximized by thinning the clumps to one residual sprout. However, structural diversity is reduced relative to the options. Although changes in structural diversity inevitably result from harvesting fuelwood and imposing subsequent thinning treatments, a need for non-game bird habitat niches might still be met at an acceptable level with this management prescription.
SUMMARY

A decision matrix such as that presented in this paper is useful to managers attempting to implement ecosystem-based, multiple-use management practices in the Emory oak woodlands of the southwestern United States. However, further refinement that includes incorporating other natural resources (such as forage for livestock or recreational opportunities) into the decision matrix is necessary before truly holistic and environmentally sound land stewardship of these fragile ecosystems becomes possible.

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REFERENCES CITED


