

# The R-Z Weight System (EOWEP) for FPA-PM

(An Abstract)

Douglas B. Rideout, Ph.D.  
and  
Pamela Sue Ziesler

June 21, 2004  
V 1.0

---

Fire Economics Laboratory  
Department of Forest, Rangeland, and Watershed Stewardship  
Colorado State University, Fort Collins, CO 80523

---

## Why Weights?

The original economic design for FPA (Rideout and Kirsch 2002) called for a system of non-monetized weights to guide resource allocation decisions. Previous and current fire management analysis systems use dollar values to weight the importance or value of different alternatives. FPA-PM is the first major system designed as a non-monetized application that conforms to the contemporary expectations that federal fire agencies use cost effectiveness analysis for program management planning. Cost effectiveness analysis requires a physical measure of effectiveness such as acres protected or acres improved. Because some acres are more important to protect than others, a weighting system is required to reflect this importance in the optimal deployment model (integer program - IP). Weights are applied at the FPU level because each FPU is composed of several administrative units that will share a common IP run and the resulting budget request and allocation.

## What is a Weight?

In initial attack, a weight defines how much more important it is to protect one kind of acre from wildfire than it is to protect another kind of acre (at a given intensity level and sensitivity period). For example, if it is twice as important to protect acres containing sensitive habitat than it is to protect acres of rangeland, then protecting acres of sensitive habitat would count twice as much toward the effectiveness calculation as would acres of rangeland. Thus, weights are *not* priorities or ranks. Instead, they empirically reflect relative importance. We have developed a weighting application for fire use using the metric “acres improved” to parallel our metric of “acres protected” in initial attack. Acres improved will be addressed in subsequent documentation and not in this abstract. The process for applying the weighing system will be addressed in a subsequent paper.

## The R-Z System (EOWEP) in FPA-PM

The system is best described in four parts.

### Defining Protection Attributes

Our system requires specification of a list of protection attributes that would make acres in the fire planning unit (FPU) important to protect. Protection attributes are identified and defined by interdisciplinary experts on the planning unit and could include values such as commercial

timber, sensitive habitat acres, WUI, or any other attribute(s) deemed important for protecting lands from wildland fire. Attributes may reflect planning goals or objectives. They may reflect fire planning goals and objectives. Each attribute has a defined unit of measure in acres. Each attribute needs to be commonly understood by each member of the planning team and documented. We suggest that teams develop a short paragraph for each attribute that documents the meaning of each attribute. Principles of attributes are defined in another paper.

#### Relative Value of Protection Attributes

Expert elicitation is used to evaluate each protection attribute relative to the other attributes by determining, for example, how important it is to protect an acre of sensitive habitat relative to an acre of WUI. The resulting relative values are known as implicit attribute prices (IAPs). It is crucial to realize that the weight elicitation process is key to the use of the FPA-PM system and accurate construction of weights relies upon an understanding of the economics involved. Before elicitation, the planning team must grasp the meaning of the comparisons and how these comparisons are used in the system. Developing this understanding requires time and effort by the planning team. No training is needed to perform this exercise, but a common understanding of the definitions of the protection attributes as identified by the planning team is required. Our focus is on developing an understanding of these definitions and the comparisons to be made so that the IAPs are meaningful and consistent. Completion of this step means that FPU planners will have developed an IAP for each attribute and that a “currency” can now be established in any of the attributes.

#### Acre Inventory of Protection Attributes

The planning team must now take their list of attributes and estimate how many acres of each attribute reside in each FMU. If an acre contains two protection attributes it is necessary to count it twice; once for each attribute. If an acre contains no protection attribute, the acre is not counted. An example of the acre inventory by FMU and attribute is listed in Table 1.

#### Computation of FMU weights

In an FMU, the acres for each protection attribute are multiplied by their IAP to yield the value of protecting that attribute in the FMU. These individual contributions to value are summed for each FMU to produce the Fire Protection Value (FPV) for the FMU. This FPV is divided by the number of acres in the FMU where fires could occur to provide a per acre weight for the FMU. This is the weight for the FMU that is applied to the integer program. This weight only has meaning when compared to the weight calculated for another FMU. For example, if the weight calculated for FMU 1 was 1.2 and the weight for FMU 2 was 0.8 then we would interpret this as saying that it is  $(1.2/0.8)$  1.5 times more important, or 50 percent more important, to protect acres in FMU 1. An empirical example, based on the Southern Sierra Prototype, is provided in the following table.

Protection Attribute	FMU			IAP
	FMU 12	FMU 13	FMU 14	
Wilderness	28,893	5,344	47,930	<b>0.200</b>
Sequoia Groves	0	1,099	0	<b>0.750</b>
WUI	41,949	41,683	61,766	<b>1.000</b>
Forest Structure	154	51,762	560	<b>0.400</b>
Commercial Timber	0	5,000	0	<b>0.600</b>
Natural Areas of SC		5,000	160	<b>0.570</b>
Social Areas of SC		10,000		<b>0.700</b>
Cultural Areas of SC		5,000		<b>0.750</b>
Rangeland	10,000	3,000		<b>0.300</b>
General Protection				<b>0.100</b>
<b>Fire Protection Value</b>	<b>50789</b>	<b>81781</b>	<b>71667</b>	
Total Acres in FMU	55501	74799	82167	
<b>Final FMU Weight</b>	<b>0.92</b>	<b>1.09</b>	<b>0.87</b>	

Table 1: Draft FMU Weight Calculation for Southern Sierra Prototype

This draft table shows the list of attributes in the first column followed by the number of acres of each attribute by FMU. The elicited IAPs are in the last column and their “currency” is acres of WUI; the highest IAP in this example. Computations are as described above.

## Discussion

The R-Z Expert Opinion Weight Elicitation Process (EOWEP) relies on establishing, documenting and evaluating the reasons why it is important to protect acres from wildfire. The strengths of this method are that when properly conducted it should be defensible and based on a sound application of economic theory. Eliciting the IAPs is the crux of the process and requires developing a clear understanding of attribute definitions and comparisons by the planning team. There are many implications that are not addressed in this abstract, but one that should be mentioned is the concept of the FPU family. In the sense that a family shares the family income, the FPU shares the cost analysis and budget allocation (even though it may be broken out by agency). The construct of the FPU requires that the integer program and the budget allocation be performed across the entire FPU. **Any weight system** would require an evaluation of each FMU relative to the other FMUs for initial attack. The method presented in this abstract makes the weighting process explicit, objective and, we think, defensible. Entities that cannot agree upon a common set of attributes and IAPs likely do not belong in the same FPU. This is the nature of the FPU “sharing” a budget analysis and integer program run, and it is not a function of the weighting system. An advantage of a credible weight system is that it can identify members of the FPU that cannot contribute as part of the family.

## Selected References

Champ, Patricia, A. et al., Editors, 2004. A Primer on Nonmarket Valuation. Kluwer Academic Publishers. Dordrecht, The Netherlands.

Osborne, David and Peter Plastrik. 2000. The Reinventor’s Fieldbook: Tools for transforming government. Jossey-Bass. San Francisco. 689pp.

Rideout, Douglas B. and Andrew G. Kirsch. 2002. The Economic Theory Guiding Fire Program Analysis System: Response to Questions Submitted by Howard Roose. Working Paper, Department of Forest Sciences, Colorado State University. Fort Collins, CO 28pp.

