1982

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Published in TRANSACTIONS OF THE FORTY-SEVENTH NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE, ed. Kenneth Sabol (Washington, DC, 1982).

Project Applications of the Forest Service Rocky Mountain Region Wildlife and Fish Habitat Relationships System

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Wildlife and Fish Habitat Relationships (WFHR) is a Forest Service system for integrating wildlife and fish information and assessment data into interdisciplinary land and resource management. WFHR is a comprehensive organization of information in a format useful for managing wildlife through the management of their habitats. The WFHR System assists the Forest Service in meeting its goal of managing wildlife and fish habitats, both for species diversity as well as for individual species of management concern.

The Rocky Mountain WFHR System (USDA Forest Service 1981a) organizes information on 853 vertebrate animal species occurring on National Forest System lands in the five-state Rocky Mountain Region (Colorado, Kansas, Nebraska, South Dakota, and Wyoming). It provides an information base from which field inventories, assessments, and management plans can be developed. The system is usable on a District project, Forest, or Regional level. It is being coordinated with other Forest Service data inventory systems, as well as with other resource agencies' systems.

The System is based on a similar Forest Service Regional System in California (Hurley and Asrow 1980, Verner and Boss 1980). The data in the Rocky Mountain WFHR System were compiled by Forest Service wildlife and fisheries biologists throughout the Rocky Mountain Region. Overall coordination of the system was provided by the Forest Service Regional Office. Verification of the information compilation was made by wildlife professionals outside the Forest Service. The data have not been field validated.

The system can be used manually or with the Qwick Qwery (CACI 1975) data base management system.[1] The computerized system can be used two ways: for simple retrieval by specific data elements and to carry out analytical computations.

Retrieval by data elements can list species which might be present in given habitat conditions, and can be used to help determine indicator species or other species of special interest. The computational capability of the system can be used to evaluate the impacts of alternative vegetation modification proposals, to predict future impacts with and without modification, and to assist in determining when and what kinds of modifications need to be made in an area to meet given objectives.

[1]The use of a trade, firm, or corporation name does not constitute an official endorsement of or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

This paper will briefly outline the contents of the data base and will discuss two applications of the evolving system—an analysis of a timber sale, and an analysis of a mining project.

Contents of the Data Base

The Rocky Mountain WFHR System contains data in three formats: narratives, habitat relationships matrices, and status matrices. Narratives contain life history information as it relates to the habitat needs of each species. The following information is in each species narrative: Status (legal and management), distribution by habitat, reproduction, special habitat requirements, food habits, territory/home range, references, and other management information. The narrative information, although not computerized, is used manually to supplement the matrix information and to provide references.

The second format, habitat relationships matrices, differs for terrestrial species and aquatic species. Matrices for terrestrial species provide information on the use of 24 vegetation types (10 forested, 14 non-forested) and 10 special habitat needs (e.g., snags, talus slopes, etc.). The forested types are divided into five structural stages, based on growth characteristics of dominant plants: grass/forb, shrub/seedling, young, mature, and old growth. The young and mature stages of each vegetation type are further subdivided by three categories of canopy closure: less than 40 percent, 40 to 70 percent, and greater than 70 percent. Non-forested types include grasses, with one structural stage, and shrubs with both a grass/forb and a shrub stage.

Importance of each vegetation type and structural stage to a terrestrial species is related to the biological functions of reproduction, feeding, and resting (i.e., cover). Season of use is also included.

Within each cell of a matrix, a value is assigned for the species association with the particular vegetation type and structural stage for each biological function (Figure 1) (USDA Forest Service 1981a). This value, referred to as a habitat capability rating, is based on current literature and professional knowledge. The values range, in whole numbers, from 1 to 3. A habitat capability rating of 1 indicates the habitat is optimum (it contains all of the required elements, with none being limiting) for that biological function. A habitat capability rating of 2 is acceptable habitat for a particular biological function, but some elements might be limiting the population from reaching its optimum density. A habitat capability of 3 is marginal. In this case, the habitat might be used by the species, but there are some required elements that are missing or limited.

A final value, the habitat capability coefficient (HCC), is calculated for each vegetation type and structural stage (USDA Forest Service 1981b). The HCC is an aggregated, weighted value based on the habitat capability ratings for reproduction, feeding, and resting. These values can range from 0.00 to 1.00. The HCC, then, provides an overall subjective numerical rating of the value to a species of a vegetation type and structural stage, or of a special habitat need.

Habitat relationships matrices for aquatic species do not contain habitat capability ratings or coefficients, nor do they denote season of use. These matrices have a variety of aquatic habitat and micro-habitat elements; and use of an element is shown as "required for survival," "not required for survival," or "unknown."

Species Common Name	Biological Function[a]	Lodgepole Pine[b]								
		1	2	3A	3B	3C	4A	4B	4C	5
GRAY-HEADED JUNCO	B			2	2	3	1	2	3	1
	F	1	2	2	2	3	1	2	3	1
	R	2	2	2	2	3	1	2	3	1
	S[c]	▲	▲	▲	▲	▲	▲	▲	▲	▲
	HCC[d]	0.50	0.33	0.50	0.50	0.20	1.00	0.50	0.20	1.00

Figure 1. Habitat relationships matrix for the Gray-headed Junco (*Junco caniceps*) in lodgepole pine (*Pinus contorta*).

[a]Biological function: B = reproduction; F = feeding; R = resting (cover)
[b]Structural stages: 1 = grass/forb; 2 = shrub/seedling; 3A = young with <40% canopy closure; 3B = young with 40–70% canopy closure; 3C = young with >70% canopy closure; 4A = mature with <40% canopy closure; 4B = mature with 40–70% canopy closure; 4C = mature with >70% canopy closure; 5 = old growth
[c]Season of use (S) indicated by shading: summer / spring ⊠ fall / winter
[d]Habitat capability coefficient (HCC): 1 = optimum; 0.50 = intermediate; 0.20 = marginal

The final data format is status matrices. These matrices contain information on life form; Federal classification as threatened or endangered; State status as threatened or endangered; protected or unprotected nongame; and hunted, trapped, or fished. They also indicate species' occurrence (introduced or native) on each National Forest and National Grassland in the Rocky Mountain Region.

All of the information in the matrices has been computerized. The following two examples use computer analysis to different degrees, but both use the data base as the primary input for the analysis.

Project Applications

Application of the WFHR System to a Timber Sale

The purpose of this application of the WFHR System is to analyze the consequences to wildlife of various alternatives of proposed timber sales. Index formulation and application to timber sale planning are based on the work of Hurley (1978), and Barrett and Boss (1978). The analysis can be performed on an entire sale area, or on individual cut and uncut stands within a sale, depending on the resource inventory data available and the needs of the user or decision maker. The analysis can cover immediate effects on wildlife, and/or can assess the change over time in the capability of an area to support wildlife. All species of wildlife for which the particular forest type provides habitat can be analyzed, or the analysis can be applied only to selected species.

Information required for the analysis includes: acres of various forested types and structural stages prior to treatment, as well as those expected to result from each of the alternative treatments, and the habitat capability coefficient for each wildlife species in each vegetation type and structural stage.

The method used in analysis of alternative timber sale treatments assesses the impacts of vegetation change on all species, using the pre- and post-treatment structural stages of the forested types involved.

Some assumptions underlying this analysis include:

1. Vegetation types are relatively uniform over the sale area;
2. HCC represents the overall importance of a vegetation type to a species;
3. All habitat remains available to wildlife; none is "lost" to large roads or impoundments, etc.;
4. The sale is comprised primarily of single-storied stands (although the analysis can be applied in a limited manner to multi-storied stands);
5. Juxtaposition of acreages of the same vegetation type is not critical to a species' survival; and
6. Water for terrestrial species is adequately distributed throughout the unit.

Analysis of the effect of vegetation change is done in the following way:

1. A raw habitat capability index, pre-treatment ("RAW HCI, PRE"), is calculated for each species as the sum of the products of: HCCs of the given vegetation types and structural stages times the number of pre-treatment acres of each of those vegetation types and structural stages:

$$\text{RAW HCI}_{\text{pre}} = \sum_{i=1}^{j} \text{HCC}_i \times \text{Area}_{\text{pre}(i)}$$

(where i = distinct stands of the same vegetation type and structure)

2. A "RAW HCI, POST" is calculated in the same manner, using the projected number of post-treatment acres in each vegetation type and stage:

$$\text{RAW HCI}_{\text{post}} = \sum_{i=1}^{j} \text{HCC}_i \times \text{Area}_{\text{post}(i)}$$

3. An HCI is then calculated for both pre- and post-treatment by dividing the "RAW HCI" by the total number of acres in the sale area or in an individual stand, and then multiplying by 100:

$$\text{HCI, PRE} = (\text{RAW HCI}_{\text{pre}} \div \text{Total Area}) \times 100$$

$$\text{HCI, POST} = (\text{RAW HCI}_{\text{post}} \div \text{Total Area}) \times 100$$

4. The change in habitat capability indices is the difference between Post- and Pre-HCI:

$$\text{Change in HCI} = (\text{HCI, POST}) - (\text{HCI, PRE})$$

5. Steps 2, 3, and 4 are repeated for each alternative treatment.

This type of analysis was applied to the 2,000-acre (810-ha) Divide Timber Sale area on the Gunnison National Forest in Colorado. Two alternative treatments were proposed for the sale. Alternative 1, a partial cut, would remove 35 to 40 percent of total basal area by patch cuts of 1 to 5 acres (0.4 to 2.0 ha) each, and group tree selection of one-half to 1 acre (0.2 to 0.4 ha) each over the sale area. Alternative 2 proposed 40-acre (16.2-ha) clearcuts over 35 to 40 percent of the area containing mature trees with greater than 40 percent canopy closure. The acreages of the three forested types and structural stages prior to treatment and those projected from each alternative are displayed in Table 1.

The Rocky Mountain WFHR System allows the user to specify which wildlife species will be analyzed. In the Divide Timber Sale, the selection criteria were that the species occur, according to the status matrices, on the Grand Mesa, Uncompahgre, and Gunnison national forests (a single administrative unit) and use, according to the relationships matrices, any of the pre- or post-treatment vegetation types and structural stages on the sale area. Other combinations of criteria are also possible. Table 2 is a partial list resulting from the WFHR analysis on the Divide Timber Sale. The full report from this analysis listed 163 species that might use the area in its present or future condition.

The columns—habitat capability prior to treatment (''Habitat capabililty pre''), habitat capability with an alternative (''Habitat capability alt. X''), and the associated change in habitat capability (''Post-pre change in capability'')—indicate the relative changes in the overall value of the 2,000-acre (810-ha) area for meeting the reproduction, feeding, and cover requirements of each species. A positive ''change in capability'' implies the proposed changes would benefit the species; a

Table 1. Pre- and projected post-treatment acres by vegetation type and structural stage in the Divide Timber Sale, Gunnison National Forest, Colorado for partial cut and clearcut treatments.

Vegetation type	Structural stage	Canopy closure	Acres (pre)	Acres (post) Alt. 1 (partial cut)	Acres (post) Alt. 2 (clearcut)
Lodgepole pine	Grass/forb		0	0	391
	Young	<40%	10	10	10
		40–70%	56	56	56
		>70%	202	202	202
	Mature	<40%	60	285	60
		40–70%	643	563	418
		>70%	416	271	250
Spruce/fir	Grass/forb		0	0	176
	Young	40–70%	8	8	8
	Mature	<40%	87	115	87
		40–70%	102	235	66
		>70%	351	190	211
Aspen	Grass/forb		0	42	7
	Young	40–70%	45	18	45
	Mature	40–70%	20	5	13
Total acres			2,000	2,000	2,000

Table 2. Partial list of the wildlife analysis for the Divide Timber Sale. Alternative 1 was a partial cut; Alternative 2 was a clearcut. Figures might not add, due to rounding.

Common name	Habitat capability pre	Habitat capability Alt. 1	Post-pre change in capability	Habitat capability Alt. 2	Post-pre change in capability
Golden-mantled ground squirrel	6.00	18.00	12.00	20.00	14.00
Nuttall's cottontail	4.00	11.00	7.00	18.00	14.00
Pine marten	52.00	59.00	7.00	39.00	−13.00
Mule deer	25.00	31.00	5.00	29.00	4.00
Western jumping mouse	35.00	40.00	5.00	54.00	19.00
Prairie falcon	56.00	59.00	3.00	66.00	10.00
Northern pocket gopher	0.00	2.00	2.00	24.00	24.00
Mountain vole	2.00	3.00	1.00	6.00	5.00
Common elk	49.00	49.00	0.00	52.00	3.00
Red-tailed hawk	54.00	54.00	0.00	47.00	−8.00
Western toad	40.00	40.00	0.00	40.00	0.00
Common merganser	48.00	48.00	0.00	40.00	−9.00
Heather vole	62.00	62.00	0.00	62.00	0.00
Evening grosbeak	73.00	73.00	0.00	50.00	−24.00
Turkey vulture	82.00	82.00	0.00	78.00	−5.00
Tiger salamander	77.00	77.00	0.00	59.00	−18.00
Northern leopard frog	92.00	92.00	0.00	69.00	−23.00
Black bear	53.00	52.00	1.00	47.00	−6.00
Goshawk	74.00	71.00	−3.00	57.00	−16.00
Porcupine	66.00	60.00	−6.00	46.00	−20.00
Pine grosbeak	57.00	51.00	−6.00	37.00	−20.00
Bald eagle	47.00	39.00	−8.00	30.00	−16.00
Hammond's flycatcher	59.00	47.00	−12.00	47.00	−12.00

negative number implies adverse effects. For example, the turkey vulture (*Cathartes aura*) has a pre-treatment habitat capability index of 82.00 (out of a possible 100). Under Alternative 1, that capability would remain the same; under Alternative 2, the capability would be reduced.

Habitat capabiliity index (HCI) is not directly related to animal population densities. The post-pre change in capability represents an estimated change in the "ability of a land area to support a given species," rather than a direct change in numbers of individuals of that species. Thus, a 10-percent increase in HCI for a species under a given treatment does not mean the species' population will increase by 10 percent. It does, however, mean that the land should be slightly more capable of producing or maintaining that species than under the pre-treatment condition. The alternative that provides the greatest increase in the HCI would presumably benefit the species most.

Habitat capability indices for different species are not linearly related to one another. The change in HCI can be compared among species to identify those that will be most affected by a proposed activity. However, a change of −10 for one species is not necessarily twice as much as a change of −5 for a different species. It implies a greater adverse impact, but not necessarily one twice as great.

The analysis for the Divide Timber Sale (Table 2) shows that, for most raptors—particularly the goshawk (*Accipiter gentilis*)—the partial cut (Alternative 1) provides better habitat than the clearcut (Alternative 2). For most small mammals, the clearcut results in greater habitat capability. Amphibians and waterfowl, in general, are not benefitted by either alternative because of their dependence on aquatic and wetland conditions. Both alternatives show a negative impact on porcupines (*Erethizon dorsatum*). If a decline in porcupine population is a desired goal of the sale, the analysis shows that the clearcut should initially be more beneficial in achieving the goal than the partial cut.

The same analysis used to assess the effect of vegetation change can be used to assess the effect of proposed changes in special habitat needs created by specific treatment, such as snags or edge. The HCC for the special habitat need is used in place of that for vegetation type and structural stage. A quantification of the pre- and post-treatment special habitat condition, such as number of snags or linear feet of edge, is used. The quantification can be in any units, as long as post- and pre-treatment measurements are in the same units.

If applying the analysis to determine the effects of vegetation changes over time on wildlife species, estimates would have to be made on the structural stages of vegetation types for intervals throughout the given time span. This application is useful in determining when the next entry into a stand should be made in order to meet specific wildlife habitat objectives.

Application of the WFHR System to a Mining Project

This application of the WFHR System analyzes the general impacts of various alternatives of a proposed mining project on all wildlife species that might be present in the given area. Unlike the timber sale application, this analysis considers the impacts on wildlife of "acres lost," not acres converted from one structural stage or vegetation type to another.

The information required to perform the analysis includes: total HCC for each species in each vegetation type or special habitat need occurring in the project area; percentage of total project area occupied by each vegetation type or special habitat need; and number of acres of each vegetation type or special habitat need affected by each alternative.

The method used in the analysis of alternatives was to weight the final index by the number of species using the habitat of a certain HCC value and multiply by the scarcity of that habitat in relation to the total project area.

The methodology was developed specifically to analyze alternatives of the Mount Emmons Mining Project on the Gunnison National Forest in Colorado. During the initial stages of the Draft Environmental Impact Statement, a public issue surfaced that, in a broad context, impacts on all wildlife should be considered. The procedure was developed to respond to this issue. The following assumptions were made in developing the procedure (USDA Forest Service 1982):

1. All habitat has inherent value for wildlife, and changes in the relative quantities of various habitats can be compared.
2. Available data bases (WFHR) would be adequate to evaluate impacts of project alternatives on wildlife.
3. HCC represents the relative importance of a given habitat type to each species listed.
4. All species are analyzed without bias to social value.
5. Habitats that are in short supply have a relatively greater value than proportionately abundant habitats.
6. A "worst case" analysis is used which assumes that all disturbed areas will be unavailable for 30 to 50 years. In all probability, with reclamation, some habitats could be available for use by some wildlife species at a much earlier time.

Analysis of the impacts of alternatives is conducted as follows:

1. A list of species for the area is compiled from the WFHR System along with each species' total HCC for all structural stages of each vegetation type on the project area in which the animal occurs. The total HCC equals the sum of the HCCs of the structural stages of a vegetation type. The range of values of the total HCC could vary from 0 (not suitable) to 9 (optimum) for forested types (a maximum) value of 1.0 for each of 9 structural stages, and from 0 to 1.0 for non-forested and special habitat needs. Table 3 is a partial list of the species that might occur on the Mount Emmons Mining Project and their total HCCs.
2. A species influence factor (SIF) based on combined HCCs of the structural stages of each vegetation type, is an intermediate calculation that allows the derivation of an impact index value for each vegetation type. The SIF is calculated by taking each of the possible values of total HCC for a vegetation type occurring on the area and dividing by the maximum total HCC (as noted above) for that vegetation type. This is done to make the range of values of total HCC of forested types equivalent with the range for non-forested and special habitat needs. The total is multiplied by 100 and divided by the decimal value of the proportion of the study area on which the vegetation type occurred (P). A log transformation is applied to the equation to linearize the data:

$$\mathrm{SIF} = \mathrm{Log}_{10} \frac{(\text{Total HCC/Max. HCC}) \times 100}{P}$$

For example, Table 4 shows the calculations for sagebrush habitat on the

Table 3. Partial list of species that might occur on the Mount Emmons mining project area, Gunnison National Forest, Colorado. Total habitat capability coefficients are listed by vegetation type. Figures have been rounded.

	Total habitat capability coefficient by vegetation type								
			Mtn. meadow						
Common name	Alpine	Sagebrush shrubland	Wet	Dry	Riparian	Aspen	Lodgepole pine	Spruce/ fir	Douglas fir
Mountain chickadee	0.00	0.00	0.00	0.00	1.00	6.00	2.00	6.00	6.00
Prairie falcon	1.00	1.00	1.00	1.00	1.00	3.00	7.00	4.00	6.00
Goshawk	0.00	0.00	0.00	0.00	1.00	6.00	5.00	3.00	4.00
Ruby-crowned kinglet	0.00	0.00	0.00	0.00	1.00	2.00	6.00	6.00	4.00
Townsend's solitaire	1.00	1.00	0.00	0.00	0.00	4.00	4.00	6.00	7.00
Least chipmunk	0.00	1.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
Mule deer	0.00	1.00	0.00	0.00	1.00	9.00	4.00	3.00	6.00
Common elk	1.00	1.00	1.00	1.00	1.00	8.00	5.00	5.00	5.00
Pine marten	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00	1.00
Red squirrel	0.00	0.00	0.00	0.00	0.00	0.00	6.00	7.00	4.00

Table 4. Wildlife impact index calculations for sagebrush habitat on the Mount Emmons mining project. Sagebrush constitutes 36.03 percent of the surveyed area.

Total HCC	No. species[a]	SIF[b]	No. species × SIF
1.00	16	2.44	39.04
0.83	6	2.36	14.16
0.66	10	2.26	22.60
0.50	11	2.14	23.54
0.40	3	2.04	6.12
0.33	10	1.96	19.60
0.30	4	1.92	7.68
0.23	1	1.80	1.80
0.20	2	1.74	3.48
0.16	4	1.65	6.60
0.13	2	1.56	3.12
0.06	1	1.22	1.22
	70		149.96

Impact Index Value 149.96 ÷ 100 = 1.49

[a]No. species = number of species using this habitat and for which biologists have assigned a habitat capability coefficient as shown in the first column.

[b]Species Influence Factor (SIF) = $\mathrm{Log}_{10} \frac{(\text{Total HCC/Max. HCC}) \times 100}{P}$

where P = proportion of surveyed area with subject habitat (as a decimal), and
Max. HCC = Maximum total Habitat Capability Coefficient possible (9.0 for forested types, and 1.0 for non-forested types and special habitat needs).

Mount Emmons project. The total HCC for intermediate habitat is 0.50; the maximum HCC for sagebrush is 1.00; and the proportion of the study area containing sagebrush is 36.03 percent. Thus:

$$\mathrm{SIF} = \mathrm{Log}_{10} \frac{(0.50/1.00) \times 100}{.3603} = 2.14$$

3. An impact index value is determined by multiplying the SIF by the number of species of a given total HCC in that vegetation type. This provides a weighting of the SIFs by numbers of species and by HCCs.
4. The sum of the impact index values for each total HCC is divided by 100 to obtain a value that, when multiplied by the number of impacted acres, would be on the order of magnitude of the acres affected.

Once the impact index values are calculated for each vegetation type or special habitat need, the impacts of each alternative can be evaluated. Table 5 shows impact index values calculated for each of the nine vegetation types in the Mount Emmons project area.

Application of this technique to the Mount Emmons mining project was based on sample data from an area representative of the total project area. Vegetation types and proportions of project area covered by a specific type were derived from information gathered on the area.

Table 5. Wildlife impact index values for vegetation types occurring on the Mount Emmons mining project. Lodgepole pine results in a relatively high index value due primarily to the low proportion of its occurrence over the surveyed area.

Habitat	Index value
Rockland/talus	0.33
Sagebrush	1.49
Alpine	1.51
Dry mountain meadow	1.67
Wet mountain meadow	1.70
Spruce-fir woodland	1.78
Aspen woodland	2.11
Lodgepole pine	2.67
Riparian	3.61

The Mount Emmons Mining Project Draft Environmental Impact Statement (USDA Forest Service 1982) explored seven alternatives. The alternatives incorporated different combinations of mine and mill sites, ore haulage and worker access routes, production rates, land exchange, and mitigation measures. The impacts of each mine site, mill site, and ore haulage route, in terms of acres of vegetation type disturbed, were calculated. A "worst case" analysis of wildlife impacts from subsidence of Mount Emmons was also calculated. For each site or route, the acres of a specific vegetation type disturbed were multiplied by the appropriate index value (from Table 5) to give an index of wildlife impact for that vegetation type. The indices were then summed for all of the vegetation types on a mine site or haulage route. The general wildlife impact for a given alternative was determined by summing the impact indices for the combination of mill and mine sites and haulage routes that made up that alternative and adding the impact index of subsidence. The seven alternatives could then be compared as to their general impacts on wildlife.

Figure 2 shows the final aggregated wildlife impact indices for each proposed alternative of the Mount Emmons Mining Project. Higher impact indices represent greater adverse impacts. Alternatives 2, 3, and 4 would occur in the same general vegetation types. One reason for developing Alternative 7 was that it would occur in sagebrush habitat; and it was perceived that, in this vegetation type, impacts to wildlife would be minimized. What was not accounted for, however, was that the gentler terrain associated with Alternative 7 would require the use of more surface acres for the same volume of tailings than would the steeper terrain in Alternatives 2, 3, and 4. The analysis reflects the wildlife impacts resulting from the increased acres required.

There are several characteristics of this type of analysis. First, the focus is on wildlife species as the primary unit of importance, yet the process allows comparison of alternatives based on the degree of disturbance of habitat conditions. Second, all vertebrate species potentially occurring in the project area are considered equally without a bias toward economics, values, animal size, taxon, etc. The Mount Emmons application of this technique was the Forest Service response to

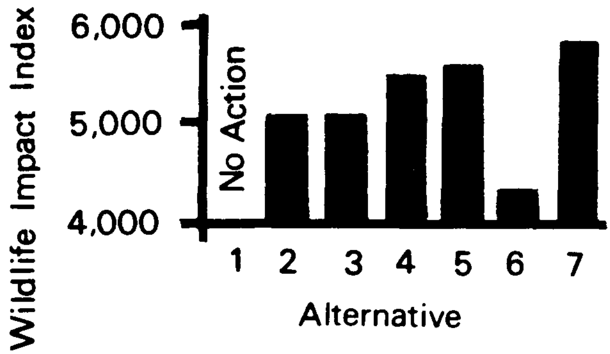

Figure 2. Aggregated wildlife impact indices for each proposed alternative of the Mount Emmons Mining Project (USDA Forest Service 1982:29). Higher index values represent greater adverse impacts.

a public issue that requested unbiased consideration of wildlife. The third characteristic of this analysis is that it takes into account the value of a vegetation type as species habitat, as well as the possible importance of relatively scarce vegetation types in limiting wildlife distribution. Fourth, the wildlife impact index values are specific in relation to the species considered and the local vegetation composition. Finally, this analysis considers the importance of each vegetation type to all species groups, rather than keying to species of special interest.

Interpretation of this analysis is limited by the same conditions as the timber sale analysis: the impact index value for each alternative is not directly related to animal population densities, and larger index numbers mean greater reduction in the capability of the habitat to support wildlife (but an index of 400 is not necessarily four times as great as an index of 100; nor will it necessarily mean a four times greater decrease in animal populations).

Discussion and Conclusions

The two applications of the Rocky Mountain WFHR System differ in several ways:

1. The mining application uses "acres lost," not acres converted to a different structural stage.
2. The final index value in the timber sale example is linked directly with one species. This allows evaluation of impacts on a single-species basis. The index value in the mining project example combines the impacts to individual species into one value for each alternative. This allows evaluation of impacts by alternatives.
3. The mining project analysis takes into consideration the scarcity of a vegetation type within the project area. The timber sale analysis could be modified to account for habitat scarcity within a sale area, but presently does not do so.
4. The mining project takes into account the value of vegetation types to different species, as well as the number of species that use a given vegetation type at a given capability rating.

Each application provides an analysis of project effects on wildlife, but uses the basic WFHR data in different ways. These analyses as well as the species narratives are intended to provide additional information for the decision maker. No single analysis will provide "the answer." Frequently, several levels (e.g., a project, or acres within a project) or types (e.g., assessment of effects on big game, or on endangered species) of analyses must be done to provide a more complete picture of potential effects on wildlife. The analyses presented in this paper are not meant to take the place of field knowledge. Field expertise is critical in the interpretation of the analysis and necessary in order to spot potentially important impacts of project proposals. Analyses using the Rocky Mountain WFHR System have a shortcoming in not being able to account for juxtaposition of vegetation types. Indirect or secondary impacts, particularly from a mining project, are also not included in these analyses; nor are impacts on fish populations. Again, this is where field knowledge is irreplaceable.

Currently in the Forest Service Rocky Mountain Region, use of the WFHR System via computer has not been extensive. The System is, however, being used creatively, and for a variety of purposes. While the applications presented in this paper are developmental, they are currently being used and evaluated. As needs arise, new types of applications of the system will be developed and old applications will be refined. As the basic information in the system is used, it will be validated and refined. Until the basic data in the system and the applications of that data are field validated, caution must be exercised in their use and interpretation. It is hoped that at some point in the future a link will be developed between values in the data base and habitat capability expressed in population numbers or percentage increase or decrease in populations.

In conclusion, the Rocky Mountain Region WFHR System contains a systematic organization of management and life history data on wildlife species on National Forest System lands in the Forest Service Rocky Mountain Region. Various levels of analysis can be performed with the System. Two uses of the System allow analysis of the effect of habitat modifications on a range of wildlife species or allow a resource manager to focus on the effect of habitat modifications on a specific group of species, such as big game or threatened or endangered species. While the Forest Service does not have a specific statutory mandate to analyze effects on all wildlife species, there is a multiple use mandate for management of the National Forest System for uses including wildlife, and the National Forest Management Act regulations (36 CFR 219, Subpart A) require that "fish and wildlife habitats will be managed to maintain viable populations of all existing native vertebrate species. . . ." It seems imperative, then, that techniques be used which will analyze projects and planning direction to determine consequences to all species of wildlife. In doing this type of analysis, it is possible that effects on a species not previously considered would be seen.

As Dr. Jack Ward Thomas said (Swanson 1981), "We can't wait 25 years for information on wildlife—forest management will keep moving on without it. Biologists must learn to come on with the information and skills they have and refine them as they go. It's better than waiting, and being too late." Application of the WFHR System to planning, projects, and in other ways is limited only by our own creativity.

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