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Reply to:

Date: October 23, 1985

Subject: Species Habitat Relationships

To: Robert Radtke

Here's an early draft of the "Wildlife in Jack Pine" paper. I've intentionally left out the Appendix of wildlife species and abundances until I get some feedback on general approach. I'll also be adding a second appendix that covers species probably affected by management alternatives. Literature review will be added to the Introduction and Discussion. I'd appreciate any comments on the general approach. Clearly, the paper has more relevance to USFS Species Habitat Relationships than to KW management, but it does add some documentation of other species found in the same habitat, and those favored by burning.

Best wishes.

John

John R. Probst

WILDLIFE MANAGEMENT OF THE JACK PINE FOREST TYPE IN THE LAKE STATES

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INTRODUCTION

Recent legislation (RPA, NFMA) has mandated that the USDA Forest Service management of National Forests shall not adversely affect populations of vertebrate species, especially species that are endangered, threatened, rare economically important, or desirable in other ways. However, all stands cannot be managed to benefit all species, so difficult choices must be made between prescriptions that benefit the most species or the most desirable species. Thus, there is a need to develop habitat capability evaluation procedures that helps prioritize goals and evaluate wildlife tradeoffs.

A given region in the mid-latitudes of North America commonly holds 300-400 vertebrate species. Our knowledge of the habitat requirements of vertebrates varies enormously. At one extreme we know enough about some game species to predict approximate densities in different habitats. In contrast, there has been so little research on many non-game species that even their habitat distribution is poorly understood. Clearly, the wildlife tradeoffs among management options cannot be appreciated fully until there is adequate research accomplished for all vertebrate species. For the short term, there is a need to develop models that help prioritize goals, evaluate wildlife tradeoffs and identify research needs. Because of the large number of vertebrates, it is impossible to monitor the impact of management activities on all species. Consequently, NFMA of 1976 has directed the Forest Service to monitor populations of representative indicator species. As research information on almost all species accumulates, it may be possible to substitute direct habitat monitoring for monitoring of individual wildlife species.

We present a simple, multi-species model that divides wildlife into 4 importance classes, assigns an importance factor to each class, and further weights each species by one of four abundance categories. This permits comparisons of management alternatives by each importance class or all of them together. The weighting by importance categories and abundance class places less emphasis on species diversity per se at the stand level, and stresses the habitat values of rare or desirable species.

We chose the Jack Pine forest type in the Lake States as an example for three reasons: (1) There is a good mix of species in the different importance categories (an endangered species, a variety of rare or sensitive species and a variety of game, fur and "feature" species). (2) We have a reasonable familiarity with this forest type and there are several contrasting management options that are realistic alternatives for managers. (3) We have conducted wildlife research in the jack pine forest type for over six years, including vegetation measurements.

METHODS

We first grouped vertebrate species into four levels of importance below endangered for the purpose of ranking the overall value of various habitat conditions, and assigned each of them a logarithmic weighting factor: (1) threatened, sensitive or rare species, 8x; (2) game, furbearer or "featured" species, 4x; (3) other common vertebrates, 2x; (4) and ubiquitous/abundant species, 1x. (In actual practice, a land manager may only wish to consider one importance category or even only one species, such as an endangered species.) We also assigned each species a weighting factor for the estimated abundance class for each stand age and management option. The four abundance classes and factors were weighted as follows: abundant = 4, common = 3, uncommon = 2 and rare = 1.

Four stand age categories were defined to correspond to four general wildlife habitat conditions. The open situation was from 0-5 years after fire or harvest. Years 6-16 represented a shrubland-savanna with interspersed trees, thickets and openings. The third period (canopy closure) was from 17-30 years. Jack pine forests were classified as mature at stand ages greater than 30 years. We estimated the abundance class of each of 145 vertebrate species in each stand age category. The relative value of each stand age category to wildlife was estimated by multiplying the importance value of each species times the abundance class and summing the product of all species $WHV = \Sigma_i; A_i \times B_i$, where A = abundance class (1,2,3 or 4) and B = importance class (1,2,4, or 8) and i represents each species under consideration.

Four contrasting management options for regenerating jack pine were chosen as examples, two required the occurrence of fire and two did not. One of the regeneration methods uses fire in unharvested stands, as with a wildfire or non-commercial stand regeneration through prescribed fire. Trees are regenerated by serotinous seeding. Prescribed fire can also be used after commercial harvest if seed trees are left after harvest. Fill-in planting is often required for full stocking. The non-fire options include full tree harvest followed by planting, and a shelterwood option with two commercial harvests.

Most of the differences in wildlife habitat quality among jack pine stands are related to gross physiognomic characteristics associated with stand ages ranging from open fields to mature forests. However, the value of various stand ages can be modified by management alternatives, four of which are described above. The major habitat factors associated with the management options are: (1) snag density, (2) number of mature residual trees, (3) density of pine regeneration, (4) amount of hardwood regeneration, (5) amount of slash remaining from fire or harvest, and (6) changes in ground cover biomass and species composition.

The two alternatives that involve burning provide the most dead trees, which are killed by fire. Some snags are usually left after the first harvest in a shelterwood system and more appear as some of the residual trees die before the second harvest. In whole-tree harvesting, most dead and live trees would be removed, and little slash would be left in the habitat. In contrast, the two burning options would spare some live residuals either singly (seed tree burn) or in strips (wildfire or non-commercial prescribed burn). Three of the management alternatives leave abundant slash either from harvesting residue (seed tree and shelterwood) or subsequent windthrow (wildfire on shelterwood). Repeated burning should reduce the hardwood component of pine or pine-oak stands, and management options lacking fire should increase the prominence of oaks, aspen, and cherry. Because jack pine can produce abundant regeneration from serotinous seeding, the two burning options result in greater tree density, and vigorous hardwood sprout-growth as well. The biomass and species composition of ground vegetation in these xeric habitats is strongly influenced by the amount of shade from trees and saplings, so the three options that leave dense regeneration or numerous residuals result in a more diverse, lush ground cover that should be attractive to grazers and the prey base for carnivores.

In summary, the tree-length harvesting system should produce the wildfire habitat with the least complex structure--few to no snags, residuals or slash.

In addition, the poor, light ground cover should be undesirable to many species. However, the greater hardwood component in both the tree-length harvest and shelterwood options are important to many species not found in pure pine habitat. The two burning alternatives should produce similar stand conditions, but a tree harvest before fire leaves fewer snags and more scattered, residual live trees. The seed tree and burning option can result in a hot fire closer to the ground, so prescribed fire run through slash can be more destructive to ground cover than a canopy fire. In addition, a more xeric ground cover may develop with the seed tree option because of less shade, relative to fire in an uncut jack pine forest.

RESULTS

We assigned species to one of four importance classes based on the following criteria: rarity or abundance on the regional or national level, specificity or generality in habitat selection, economic importance as with game species, furbearers, species with broad public appeal, possible pest status, positive or negative effects on other beneficial or important vertebrate species. By these criteria species were rated higher if they were rare, important, lower in pest potential or beneficial to other species. Category A contained species that were endangered, threatened, or rare in most of the region (Kirtland's Warbler, Spruce Grouse, Loggerhead Shrike, Cooper's Hawk and Blanding's Turtle). In situations where endangered species may be mostly or entirely restricted to a single forest type, management should not be directed to lower level species if there is any risk of affecting the endangered species. This is the case with the Kirtland's Warbler in some jack pine stands in Lower Michigan. For the sake of example, we have lumped the Kirtland's Warbler with other A level species rather than create a fifth importance class. Category B holds a variety of wildlife that is valued by segments of society because of their aesthetic appeal, natural history interest or status as game species. This category also includes species that are decreasing in abundance regionally, that have restrictive habitat requirements or occur at low densities in all suitable habitat. Examples include white-tailed deer, black bear, badger, coyote, bobcat, sharp-tailed grouse, most raptors, many woodpeckers, Prairie Warbler, E. Bluebird and Lincoln's Sparrow. The third level of species importance includes all other common vertebrate species except those that are so widely distributed or abundant that they are of no management concern (i.e. Amer. Robin, Brown-headed Cowbird, Deer Mouse, Blue Jay).

Stand Age Classes

The number of species expected to occur in the four age classes was highest in the second age class, lowest in the youngest stand ages and intermediate in the two older stand age classes (Table 1). Wildlife Habitat Values were assigned to each age class of jackpine based on the sums of the individual species products of important class times and abundance class (WHV $= \mathcal{E}_i A_i \times B_i$). The relative scores and ranking of the habitats varied according to the number of importance levels included in the scoring both for all species or within separate vertebrate classes, especially birds (Table 2). The second stand age class was highest for WHV for any combination of importance levels (Table 2). The first age class had the largest change in rank order of WHV depending on the number of importance levels considered. Bird habitat values peaked in the second age class, but mammal habitat values increased with stand age. Our estimates of Herpt presence and abundance class showed little difference among stand age classes.

Habitat Factors

The probable number of species affected by six major habitat factors that could alter habitat suitability for terrestrial vertebrates are listed in Table 3. Tree density was the factor judged to have the most potential to adversely affect the most vertebrates, mostly because of the influence of premature stand closure on open-dwelling species. The two factors which would probably be most beneficial to mammals are the amount of broadleaf shrubs and trees, and the development of a relatively mesic, diverse ground vegetative cover. Slash was also rated of high importance to mammals, and was the most important factor for Herpts. Residual live trees were the most beneficial factor for bird species, and tree density and slash the least useful. The habitat factors ratings in Table 3 are only concerned with number of species affected, and do not account for the degree of habitat suitability alteration (estimated density change), nor do they consider species importance levels.

Management Options

A number of species at different importance levels are affected by combinations of the six habitat factors as determined by four management options (Table 4). The two alternatives involving fire have the most favorable balance between species with improved habitat versus species with degraded habitat. The tree-length harvesting option was estimated to have a negative effect on the most species. The impact of management options on the A and B species was less pronounced. The two fire alternatives would produce a slight benefit for A and B species collectively, but the shelterwood regeneration method would result in a large, negative imbalance for important species. The more important vertebrates that would be favored by the two burning options include species that require snags and residuals or are favored by denser pine regeneration. This group of species includes Kirtland's Warbler, Black-backed Woodpeckers, Spruce Grouse, E. Bluebird, Wild Turkey, White-tailed Deer, Loggerhead Shrike, Pileated Woodpecker and Red-headed Woodpecker. Species affected negatively by burning are marginal in habitats with a low proportion of broadleaf trees and shrubs. Examples are Prairie Warbler, Ruffled Grouse, Sharp-tailed Grouse, Gray Squirrel and Fox Squirrel. Other open dwelling species are reduced by the high tree density and early stand closure associated with fire in jack pine such as Upland Sandpiper, Harrier, Sharp-tailed Grouse and several sparrows.

The shelterwood option would create more suitable habitat for some species by increasing the proportion of oak relative to pine (Prairie Warbler, Squirrels, Ruffed Grouse), by leaving residual canopy (N. Oriole, some woodpeckers) or by leaving slash (several rodents and Herpts). This option would decrease species that were dependent on snags (Kestrel, Bluebird, Black-backed Woodpecker, Raccoon), pure pine stands (Kirtland's Warbler, Lincoln's Sparrow, Spruce Grouse) or very open canopy (Harrier, Sharp-tailed Grouse, Upland Sandpiper).

The tree-length harvest option should provide the poorest habitat for the most species. Those vertebrates that might have improved habitat under this management include those species mentioned above that are favored by mixed broadleaf woody growth, or very open habitat. The 54 species that would probably be adversely affected are those that require snags, residual overstory, relatively pure pine growth (Lincoln's Sparrow) or very dense regeneration (Kirtland's Warbler).

Discussion

The selection of four age classes that correspond to open ground, shrubland, closed canopy, and mature forest is applicable to most eastern pine forest types. The same age classes may also be suitable for many eastern broadleaf forests except that canopy closure may occur as early as six or seven years after harvest in forest types that have vigorous sprout-growth regeneration, and some mature structural characteristics may develop as early as 20 years of stand age. The jack pine forest type is atypical in having much less difference between the third and fourth age classes. Most other eastern forest types develop larger tree diameters, spreading tree crowns, larger snags, more fallen logs, and more litter and humus. Because of this similarity between mature and sapling jack pine stands, the wildlife communities in the two oldest age classes are much more similar than forest types which develop a more diverse wildlife assemblage in the mature stage.

The practice of placing wildlife species in importance classes is a useful modification of the concept of species diversity, because it places less emphasis on species that are common or widely distributed in favor of those that are rare or desirable. By weighting species by an importance class we are able to identify those habitats that benefit the more desirable species. This practice is difficult because it involves arbitrary value judgements, especially when classifying the higher two importance categories. However, the classification of wildlife into importance classes is quite flexible and should be adjusted for local situations or types of land ownership. Furthermore, the number of importance classes and the relative weight of each can be adjusted for individual management situations. For example, it may be advantageous to eliminate the lower importance classes from the tabulation of Wildife Habitat Values so that only those species in need of management are considered. This shifts emphasis on species diversity from the individual stand to the level of larger management units, states, or even regions. However, it would be unwise to totally ignore the common or ubiquitous species, because most vertebrates have some role in forest protection, nutrient cycling, or as prey for other wildlife species.

The individual species were also weighted by frequency of occurrence or abundance to de-emphasize species that use a given habitat only occasionally. This approach also stresses habitat improvements that can substantially increase wildlife populations, or cause the difference between presence or absence of a species (i.e., ~~songs~~ Snags). The four abundance classes suggested are gross enough that estimates can be made for most species with only superficial field work for verification.

The six habitat factors used in this analysis are by no means complete for a habitat evaluation of a species assemblage that comprises three vertebrate classes. However, the number of factors considered should be sufficient enough to have general applicability for an analysis of such broad scope. We were only able to estimate which species would be helped or harmed by such factors, and were unable to ascertain whether actual population changes would result from these habitat changes. Similarly, the effects of the four extreme management options chosen for the analyses would be difficult to quantify without further observation to determine species presence or absence.

Table 1. Number of Vertebrate Species in Four Stand Age Classes

	0-5 yrs.	6-16 yrs.	17-30 yrs.	> 30 yrs.
Birds	45	64	52	54
Mammals	30	33	38	38
Herpts	10	11	12	11
Total	85	108	102	103

Table 2. Wildlife Habitat Values of Four Stand Age Classes

	0-5 yrs.		6-16 yrs.		17-30 yrs.		> 30 yrs.	
	A+B	ABCD	A+B	ABCD	A+B	ABCD	A+B	ABCD
Birds	140	223	192	321	128	242	120	245
Mammals	88	150	96	166	104	179	120	193
Herpts	11	37	11	41	3	43	3	39
Total	239	410	299	528	235	464	243	477

Table 3. Probable Effect of Six Habitat Factors on Vertebrate Species

	Positive			Negative			Total
	Birds	Mammals	Herpts	Birds	Mammals	Herpts	
Snags	+41	+10	+ 1	- 2	0	0	+50
Residuals	+50	+12	0	- 1	0	0	+61
Slash	+12	+21	+12	- 3	- 1	0	+41
Tree Density	+12	+ 8	+ 2	-65	-23	- 6	-72
Broadleaf Component	+38	+25	+ 1	- 9	- 1	0	+54
Ground Cover	+21	+25	+13	- 4	0	0	+55

Table 4. Alteration of Habitat Values by Management Options

	Option 1 Burn	Option 2 Seed Tree, Presc. Fire	Option 3 Shelterwood	Option 4 Tree-length Harvest
No. Species +	+38	+36	+40	+19
No. Species -	-19	-19	-29	-54
A Species +	+ 3	+ 3	0	+ 1
A Species -	- 1	- 1	- 4	- 3
B Species +	+ 8	+ 9	+ 6	+ 6
B Species -	- 8	- 8	-11	- 8

WHV Age 1
WHV Age 2
WHV Age 3
WHV Age 4