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PRELIMINARY ASSESSMENT OF SHORT-ROTATION (70-120 YEAR) TIMBER MANAGEMENT EFFECTS ON FOREST COVER TYPE COMPOSITION AND GRIZZLY BEAR

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INTRODUCTION

Grizzly bear occupy all available cover types. However, some cover types are preferred or even critical to the bears. Management of cover types can therefore influence grizzly bear well-being or survival. If grizzly bear are to persist in certain areas, management agencies must understand the consequences of their actions, including those affecting cover type composition.

Fires, insects, and timber harvest are the primary managed factors changing or maintaining cover type composition. The primary agent of change addressed in this assessment is timber harvest. Short rotation (70-120 year) timber management, in particular, is being employed in and planned for an increasing portion of grizzly bear range in the Yellowstone area. In some areas profound changes in cover type composition will likely result. This paper addresses, therefore, the probable effects of short rotation timber management on grizzly bear.

DEFINITIONS AND DESCRIPTIONS

Cover Type Code	Description
ASP	Aspen forms predominant or entire forest overstory
DF	Mixed-age stand of predominantly Douglas-fir
DF1	Sapling to mature stand of even-aged Douglas-fir
LPO	Regenerating stand of predominantly seedling to sapling lodgepole pine
LP1	Usually dense, closed canopy, pole-size to mature, even-aged lodgepole pine stand
LP2	Closed canopy, mature, more or less even-aged lodgepole pine stand
LP3	Usually moderately open to moderately dense, uneven-aged lodgepole pine stands, where lodgepole pine is persistent seral or climax species
LP4	Overmature, moderately open lodgepole pine overstory with spruce and fir well represented in sapling to pole or mature categories
SF1	Sapling to pole-sized stand of typically dense, more or less even-aged spruce and fir
SF	Mature to overmature spruce and fir stand, characteristically uneven-aged
WB1	Sapling to pole-sized stand of predominantly whitebark pine
WB	Mature to overmature, characteristically uneven-aged, stand with greater than 50% of the overstory composed of whitebark pine
NF	Nonforest cover type, including lithic, mesic and wet nonforest areas
LP2/NF	Either a mosaic of LP2 and NF cover types or an open mature lodgepole pine stand over characteristically lush graminoid-forb vegetation
DF/NF	Open stand of uneven-aged Douglas-fir
WB/NF	Open stand of characteristically uneven-aged whitebark pine
DF3	Mature to overmature Douglas-fir with spruce and fir well represented in sapling to pole or mature categories

Variables	Definition
PF:	Preference; $\ln (1 + \frac{OBS_x}{EXP_x})$, where OBS is the proportion of all feedsites (or daybeds) found in cover type X and EXP is the proportion of cover type X available (proportionate use versus proportionate availability); values range from .10 to 3.35.
EMP. IV:	Empirical importance value; PF x USE_x, where USE_x is the proportion of all feedsites (or daybeds) found in cover type X; values range from .0005 to 1.000.
P-ACT:	Proportion of radio relocations in cover type X at which no sign of feeding was found; in part indicates proportion of time bears were not feeding in cover type X; more appropriately used as an index; values range from .00 to .50.
FVS:	Food value score; Σ_X(DIET-ITEM I.V.)$_i$ x (FEEDING ACTIVITY PROPORTION)$_i$, where (DIET-ITEM I.V.)$_i$ is the importance value of diet item i and (FEEDING ACTIVITY I.V.)$_i$ is the proportion of feeding activity i in cover type X. Diet item i is the food item obtained by feeding activity i; for example, whitebark pine nuts (DIET-ITEM I.V. = .58) are obtained by digging in squirrel middens (feeding activity PIAL). Values range from .010 to .665.
DER. IV:	Derived importance value; (FVS_x x H_x) ÷ .621; FVS_x (food value score) is derived by the summation of weighted feeding activities known to occur in cover type X. H_x is the diversity index for feeding activity in cover type X. The value, .621, standardizes DER. IV to a maximum value of 1.0; calculated values range from .08 to .78.

Feeding Activity Code	Description
UNG	Feeding on ungulates, primarily elk; both carrion and kills
GOPH	Digging for voles or pocket gophers and their caches
CAMB	Stripping bark from conifers and eating cambium/ licking sap
PIAL	Digging in squirrel middens primarily for whitebark pine cones
LOCO	Digging for biscuitroot (*Lomatium* spp.) roots
PEGA	Digging for yampa *(Perideridia gairdneri)* roots

Feeding Activity Code (cont'd)	Description
CISC	Grazing thistle *(Cirsium scariosum)*
MUSH	Grazing mushrooms
SHCA	Eating Sheperdia *(Sheperdia canadensis)* berries
CLLA	Grazing and digging spring-beauty *(Claytonia lanceolata)*
ANT-LOGS	Digging in decomposing logs for ants
ANT-HILLS	Digging in anthills
FISH	Fishing for cutthroat trout
GRM	Grazing graminoids
WRMS	Digging for earthworms
EQAR	Grazing horsetail (primarily *Equisetum arvense*)
POTA	Digging for *Potamogeton* spp. roots
TAOF	Grazing dandelion (*Taraxacum* spp.)
EPAN	Grazing fireweed (primarily *Epilobium angustifolium* and *E. glandulosum)*
TRFL	Grazing and digging clover (*Trifolium* spp.)
STRW	Eating strawberries (*Fragaria* spp.)
VAGL	Eating huckleberries *(Vaccinium globulare)*
VASC	Eating whortleberries *(V. scoparium)*

RESULTS

Table 1 lists the occurrence of feeding activities by cover type. Table values are the proportion of feedsites in a given cover type at which a specific feeding activity occurred. Food value scores (FVS) and diversity index (H) for feeding activity are also listed by cover type. Importance values for diet items associated with each feeding activity are listed above feeding activity codes. The diet item importance values are used as weights in a weighting function by which food value scores are calculated for each cover type. (See variables definitions on page 3.)

Diet item importance values, ranging in value from .01 to .96, have been calculated for each prominent grizzly bear diet food item. Importance values integrate numeric evaluations of diet item preference, reliability, and scat volume as well as the energetic efficiency of associated feeding activity. Diet item importance values allow weighting of feeding activities according to the importance of the food extracted.

Sapling to mature, typically even-aged stands of Douglas-fir and lodgepole pine (DF1, LP0, LP1, LP2, LP2/NF) derive a substantial portion of their importance from ungulate (elk) feeding. Most often this feeding occurs in the spring coincident with elk winter range. Typically mature to over-mature spruce-fir and whitebark pine stands (SF, WB, WB/NF) derive substantial importance from feeding on whitebark pine nuts in middens. Almost all forest cover types are associated with digging in logs for ants.

Tables 2 and 3 list cover types and corresponding numeric evaluations of importance (PF, EMP. IV, P-ACT, DER. IV). Variable E is the number of numeric evaluations substantiating the importance of corresponding cover types. Values of E ranging from 3 to 4 reliably indicate the high importance of corresponding cover types. An average value of E is also calculated for groups of cover types either likely to be propagated or reduced by short rotation management.

ty proportions, food value score and feeding activity diversity index by cover type.

Feeding Activity															Food value score	Diversity index (H)
(.01) CAMB	.58 PIAL	.08 LOCO	.26 PEGA	.16 CISC	(.01) MUSH	(.20) SHCA	.37 CLLA	.13 ANT LOGS	.13 ANT HILLS	.01 FISH	.96 GRM	(.01) WRMS	.29 EQAR	(.26) POTA		
.08								.42	.33						.187	1.233
								.28							.406	.600
								.89					.11		.148	.346
.09	.04							.54	.18						.190	1.262
												(1.00)			(.01)	(0)
								(.50)							(.325)	(.693)
.08					.08	.15	.08	.38							.230	1.596
.12					.07	.05		.38	.11			.04			.196	1.668
.31								.31	.06			.06			.182	1.410
	.08	.08			.08		.03	.33	.11						.236	1.653
							(.50)				(.50)				(.665)	(.693)
.12	.28							.38	.02						.314	1.372
							(1.00)								(.370)	(0)
						(.20)		(.80)							(.144)	(.500)
.15	.54							.29	.01				.02		.386	1.250
								(1.00)							(.130)	(0)
	(1.00)														(.580)	(0)
	.87							.13							.522	.386
	(.50)	(.50)													(.330)	(.693)
.004		.10	.19	.06			.02	.01	.12	.03	.09	.01	.004	.04	.292	2.126

Table 2. Assessment of probable short-rotation timber management effects on grizzly bear feeding values or opportunities.

	Successional status index	E*	Cover type	PF	EMP. IV	P-ACT	DER. IV	
Early	1	0	LP0	(.19)	(.002)	(.33)	(Low)	Mid elev
		3	ASP	(2.40)	(.12)	(.25)	(.37)	Low elev
	2	0	WB1	(.20)	(.001)	(.00)	(Low)	High elev
		-	SF1	-	-	(.17)	(.12)	High elev moist
		2	LP1	(.25)	(.01)	(.24)	(.59)	Mid elev
		2	DF1	(3.35)	(.09)	(.22)	(.39)	Low elev
	3	2	LP2	(.42)	(.13)	(.37)	(.52)	Mid elev
		2	LP2/NF	(2.87)	(.24)	(.41)	(.41)	Mid elev riparian (moist)
	4	2	LP4	(.34)	(.06)	(.29)	(.69)	Mid-high elev
		-	DF3	-	-	(.47)	(.08)	Low elev
	4.5	0	WB/NF	(.10)	(.001)	(.50)	(Low)	High elev
		3	LP3	(.65)	(.10)	(.26)	(.63)	Mid elev dry
Late		2	DF	(1.00)	(.11)	(.40)	(.39)	Low elev
↓		0	DF/NF	(.10)	(.0005)	(.50)	(Low)	Low-mid elev dry
(Climax)	5	1	WB	(.36)	(.04)	(.22)	(.32)	High elev
		4	SF	(1.51)	(.56)	(.26)	(.78)	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LP0 - 0
LP1 - 2
LP2 - 2
SF1 - 0
DF1 - 2

Average importance score (E): 1.2

Cover types likely to be reduced or eliminated by short-rotation management:

LP4 - 2
DF3 - 0
LP3 - 3
DF - 2
SF - 4
(WB) - (1)

Average importance score (E): 2.2 (2.0)

*Number of criteria (0-4) establishing importance of each cover type.

Table 3. Assessment of probable short-rotation timber management effects on grizzly bear daybed value or opportunities; 1977-78 daybed data.

	Successional status code	E*	CT	PF	EMP. IV	
Early	1	0	LPO	.34	.01	Mid elev
		2	ASP	2.40	.13	Low elev
	2	1	WB1	1.10	.06	High elev
		-	SF1	-	-	High elev moist
		0	LP1	.28	.02	Mid elev
		0	DF1	-	-	Low elev
	3	2	LP2	.68	.52	Mid elev
		2	LP2/NF	2.40	.13	Mid elev riparian (moist)
	4	1	LP4	.46	.15	Mid-high elev
		-	DF3	-	-	Low elev
	4.5	0	WB/NF	.41	.03	High elev dry
Late		0	LP3	.40	.04	Mid elev dry
		2	DF	.95	.20	Low elev
		0	DF/NF	-	-	Low-mid elev dry
Climax	5	1	WB	.59	.17	High elev
		2	SF	1.69	1.00	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LPO	0)	Average importance score: .50
LP1	0)	
LP2	2)	Criteria "score" (0-2)
SF1	-)	
DF1	0)	

Cover types likely to be reduced or eliminated by short-rotation management:

LP4	1	
DF3	-	
LP3	0	Average importance score: 1.25 (1.20)
DF	2	
SF	2	
(WB)	1	

*Number of criteria (0-2) by which C.T. is "important."

DISCUSSION

These results are substantive although not final. Several feeding activities not discernible by feed-site analysis are not accounted for by the derived importance values. Later analysis will account for these more elusive feeding activities; derived importance values will likely not change significantly, however.

The use of several criteria (two for daybed cover-type use and four for feeding activity cover type use) lends weight to the assessment of cover type importance to grizzly bear. Actual importance is a probable function of feeding and cover opportunity as well as intangibles such as learned or habitual behavior not readily attributable to site characteristics other than location. Therefore, "importance" is only estimated by this assessment.

Data from the entire grizzly bear range in and around Yellowstone Park was used. The nature of cover type use appears to be more or less consistent throughout grizzly bear range. Availability of cover types differs, however. Consequently, in any one area, grizzly bear may eat more ants, for example, in one cover type than another based strictly on availability.

Use of the Douglas-fir (DF and DF1) and probably aspen (ASP) cover types very likely reflects the availability of winter-killed or weakened ungulates (primarily elk) (Table 1). Therefore, the "importance" of these cover types may be a substantial function of coincidence with elk winter range.

Tables 2 and 3 results show that the reduction of overmature and mixed-age stands over a broad area in favor of early successional, even-aged immature stands would very likely be detrimental to grizzly bear. Average importance score (E) for early successional cover types (LP0, LP1, DF, SF1, LP2) is less than for late successional or climax cover types (LP3, LP4, DF, SF, WB). On the other hand, the assessment does not indicate elimination or reduction of early successional cover types would benefit grizzly bear either. Rather, grizzly bear utilize almost all cover types, with a preference towards late successional types. Maintenance of area-wide stand diversity approximating natural conditions, including late successional and climax stands, is a management objective suggested by this assessment.

Effects of access and cover type juxtaposition are factors not covered by this assessment. Both factors are influenced by short rotation timber management and likely have critical influence on grizzly bear well-being and survival.